Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 0

Item No		Quantity	Rate	Amount

SECTION ONE : PRELIMINARIES

PRELIMINARIES

BILL NO. 1

PRELIMINARY AND GENERAL

NOTES

(i)The agreement is to be the General Conditions of Contract for Works of Civil Engineering Construction (2010) (Second Edition) , published by the S. A. Institution Of Civil Engineering.

(ii)The Preliminaries are to be the Construction and management requirements for works contracts - Part 1: General engineering and construction works (SANS 1921-1: 2004 Edition 1) prepared by Standards South Africa and shall be deemed to be incorporated herein.

(iii) Tenderers are referred to the above mentioned documents for the full intent and meaning of each clause thereof (hereinafter referred to by heading and clause number only) for which such allowance must be made as may be considered necessary.

(iv) Where standard clauses or alternatives are not entirely applicable to this contract such modifications, corrections or supplements as will apply are given under each relevant clause heading.

(v) Where any item is not relevant to this specific contract such item is marked N/A (signifying "not applicable").

(vi) Adjustment of the preliminaries: each item priced, is to be allocated to one or more of the three categories, where "F" denotes a fixed amount (amount not to be varied), "V" denotes an amount variable in proportion to value and "T" denotes an amount in proportion to time.

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	(vii)Time (T) related Preliminaries will only be adjusted for omissions or additions, issued by the Employer, or delays caused by the Employer, for which variation and extension of time has been granted. See Contract Data.				
	SECTION A: GENERAL CONDITIONS OF CONTRACT				
1	A1 General (clause 1)				
	F:..... V:..... T:.....	Item			
2	A2 Basis of Contract (clause 2)				
	F:..... V:..... T:.....	Item			
3	A3 Engineer (clause 3)				
	F:..... V:..... T:.....	Item			
4	A4 Contractor's General Obligation (clause 4)				
	F:..... V:..... T:.....	Item			
5	A5 Time and Related Matters (Clause)-As referred to in the contract Data Under Special Condition of Contract . The contract period shall be deemed to include all non - Working Days, Special Non-Working Days and the year end Builders Annual Industry Holiday Periods.				
	F:..... V:..... T:.....	Item			
6	A6 Payment and Related Matters (clause 6)				
	F:..... V:..... T:.....	Item			
7	A7 Quality and Related Matters (clause 7)				
	F:..... V:..... T:.....	Item			
8	A8 Risk and Related Matters (clause 8)				
	F:..... V:..... T:.....	Item			
9	A9 Termination of Contract (clause 9)				
	F:..... V:..... T:.....	Item			
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10	A10 Claims and Disputes (clause 10)				
	F:..... V:..... T:.....	Item			
	SECTION B: SANS 1921-1:2004 (Edition 1): CONSTRUCTION AND MANAGEMENT REQUIREMENTS FOR WORKS CONTRACTS: PART 1				
	Refer to the SCOPE OF WORK for detail requirements:				
11	B1 Scope				
	F:..... V:..... T:.....	Item			
12	B2 Normative references				
	F:..... V:..... T:.....	Item			
13	B3 Definitions				
	F:..... V:..... T:.....	Item			
14	B4 Requirements for construction and management				
	F:..... V:..... T:.....	Item			
15	B4.1 General				
	F:..... V:..... T:.....	Item			
16	B4.2 Responsibilities for design and construction				
	F:..... V:..... T:.....	Item			
17	B4.3 Planning, programme and method statements				
	F:..... V:..... T:.....	Item			
18	B4.4 Quality assurance				
	F:..... V:..... T:.....	Item			
19	B4.5 Setting out				
	F:..... V:..... T:.....	Item			
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20	B4.6 Management and disposal of water				
	F:..... V:..... T:.....	Item			
21	B4.7 Blasting				
	F:..... V:..... T:.....	Item			
22	B4.8 Works adjacent to services and structures				
	F:..... V:..... T:.....	Item			
23	B4.9 Management of the Works and site				
	F:..... V:..... T:.....	Item			
24	B4.10 Earthworks				
	F:..... V:..... T:.....	Item			
25	B4.11 Testing				
	F:..... V:..... T:.....	Item			
26	B4.12 Materials, samples and fabrication drawings				
	F:..... V:..... T:.....	Item			
27	B4.13 Equipment				
	F:..... V:..... T:.....	Item			
28	B4.14 Site establishment				
	F:..... V:..... T:.....	Item			
29	B4.15 Survey control				
	F:..... V:..... T:.....	Item			
30	B4.16 Temporary works				
	F:..... V:..... T:.....	Item			
31	B4.17 Existing services				
	F:..... V:..... T:.....	Item			
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32	B4.18 Health and safety				
	F:..... V:..... T:.....	Item			
33	B4.19 Environmental requirements				
	F:..... V:..... T:.....	Item			
34	B4.20 Alterations, additions, extensions and modifications to existing works				
	F:..... V:..... T:.....	Item			
35	B4.21 Inspection of adjoining structures, services, buildings and property				
	F:..... V:..... T:.....	Item			
36	B4.22 Attendance on nominated and selected subcontractors				
	F:..... V:..... T:.....	Item			
	SECTION C: SCOPE OF WORKS IN ACCORDANCE WITH SANS 10403				
	'(The reference to Clauses refer to Table B.1 of SANS 1921-1:2004)				
37	C1 Certification by recognised bodies - CLAUSE 4.4				
	F:..... V:..... T:.....	Item			
38	C2 Agreement certificates - CLAUSE 4.5				
	F:..... V:..... T:.....	Item			
39	C3 Other services and facilities - CLAUSE 4.8				
	F:..... V:..... T:.....	Item			
40	C4 Recording of weather - CLAUSE 5.2				
	F:..... V:..... T:.....	Item			
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41	C5 Management meetings - CLAUSE 5.3				
	F:..... V:..... T:.....	Item			
42	C6 Daily records CLAUSE 5.6				
	F:..... V:..... T:.....	Item			
43	C7 Bond and guarantees - CLAUSE 5.7				
	F:..... V:..... T:.....	Item			
44	C8 Permits - CLAUSE 5.9				
	F:..... V:..... T:.....	Item			
45	C9 Proof of compliance with the law - CLAUSE 5.10				
	F:..... V:..... T:.....	Item			
	SECTION D: SPECIFICATION DATA ASSOCIATED WITH SANS 1921-1:2004 (Table A.1)				
46	D1 Requirements for drawings, information and calculations for which the contractor is responsible CLAUSE 4.1.7				
	F:..... V:..... T:.....	Item			
47	D2 The responsibility strategy assigned to the contractor for the works CLAUSE 4.2.1				
	F:..... V:..... T:.....	Item			
48	D3 The planning, programme and method statements - CLAUSE 4.3				
	F:..... V:..... T:.....	Item			
49	D4 Samples of materials, workmanship and finishes - CLAUSE 4.12.1				
	F:..... V:..... T:.....	Item			
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50	D5 Fabrication drawings that the contractor is to provide and deliver to the employer - CLAUSE 4.12.2				
	F:..... V:..... T:.....	Item			
51	D6 Office for the foreman CLAUSE 4.14.3				
	F:..... V:..... T:.....	Item			
52	D7 Telephone - CLAUSE 4.14.3				
	F:..... V:..... T:.....	Item			
53	D8 Office for inspector of works - CLAUSE 4.14.3				
	F:..... V:..... T:.....	Item			
54	D9 Telephone in office for inspector of works - CLAUSE 4.14.3				
	F:..... V:..... T:.....	Item			
55	D10 Sheds - CLAUSE 4.14.3				
	F:..... V:..... T:.....	Item			
56	D11 Provision and erection of signboards - CLAUSE 4.14.6				
	F:..... V:..... T:.....	Item			
57	D12 Termination, diversion or maintenance of existing services - CLAUSE4.17.1				
	F:..... V:..... T:.....	Item			
58	D13 Services which are known to exist - CLAUSE 4.17.3				
	F:..... V:..... T:.....	Item			
59	D14 Detection apparatus - CLAUSE 4.17.4				
	F:..... V:..... T:.....	Item			
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60	D15 Additional health and safety requirements - CLAUSE 4.18 F:..... V:..... T:.....	Item		
	SECTION E: SPECIFIC PRELIMINARIES *Section E contains Specific Preliminary items which apply to this contract except where "N/A" (Not Applicable) appears against the item.*			
61	**E1 PROPRIETARY BRANDED PRODUCTS** The contractor shall take delivery of, handle, store, use apply and/or fix all proprietary branded products in strict accordance with the manufacturers' instruction after consultation with the manufacturer's authorised representative. F:..... V:..... T:.....	Item		
62	**E2 OVERTIME** Should overtime be required to be worked for any reason whatsoever, the costs of such overtime are to be borne by the Contractor unless the Engineer/Principal Agent has specifically authorised in writing, prior to the execution thereof, that costs for such overtime are to be borne by the Employer. F:..... V:..... T:.....	Item		
63	**E3 AS BUILT DRAWINGS** The position of construction breaks and the extent of individual concrete pours are to be recorded by the Contractor on the Structural Engineer's drawings and are to be submitted to the Engineer/Principal Agent and the Structural Engineer for their records. F:..... V:..... T:.....	Item		
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64	**E4 SITE INSTRUCTIONS** Site Instructions issued on site are to be recorded in triplicate in a Site Instruction book which is to be maintained on site by the Contractor. F:..... V:..... T:.....	Item		
65	**E5 LABOUR RECORD** At the end of each week the Contractor shall provide the Engineer/Principal Agent with a written record, in schedule form, reflecting the number and description of tradesmen and labourers employed by him and all sub-contractors on the works each day. F:..... V:..... T:..... *Note: In the event that the contractor fails to satisfy the requirements of this specification, the Employer (Msunduzi Museum) may apply any of the sanctions provided in the contract. Sanctions may include the application of a financial penalty of .04% of the Contract Sum per calendar day of which the required report has not been submitted*	Item		
66	**E6 PLANT RECORD** At the end of each week the Contractor shall provide the Engineer/Principal Agent with a written record, in schedule form, reflecting the number, type and capacity of all plant, excluding hand tools, currently used on the works. F:..... V:..... T:.....	Item		
67	**E7 NON CESSION OF MONIES** The Contractor shall not cede nor assign his rights or claims to any monies due or to become due under this contract .F:..... V:..... T:.....	Item		
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68	**E8 SECTIONAL COMPLETION** When it is required that the contract be executed in sections or portions, the tenderer shall allow for all costs in this regard as no claim for additional costs will be entertained F:..... V:..... T:.....	Item		
69	**E9 LOCAL LABOUR** It is a general requirement of this contract that persons normally resident in the locality of the works (Local Labour) be given preference for employment on the contract. Provided, however, that should adequate and appropriate Labour not be available within the locality, others may be employed subject to satisfactory proof being provided that every reasonable endeavour has been made to employ Local Labour. The Contractor shall identify the local community leaders with the purpose of negotiating with them regarding the utilization of Local Labour in the construction process. In this regard, the Contractor shall furthermore give preference, wherever possible to the employment of single heads of households, women and youth. The Contractor shall, in general, maximize the involvement of the local community. F:..... V:..... T:.....	Item		
70	**E10 IMPORT PERMITS AND DUTIES** The responsibility for obtaining the necessary import permits shall rest with the successful Tenderer. No foreign exchange will be arranged or provided by the Administration. Tenderer's are to allow in their tenders and pay the ordinary levy imposed on imported items in terms of item 196.10 of Part 8 of Schedule No. 1 of the Customs and Excise Act, 1964 with effect from 1 October 1989. F:..... V:..... T:.....	Item		
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71	**E11 CONTRACT PRICE ADJUSTMENT PROVISIONS (CPAP)** Notwithstanding anything to the contrary contained in the GCC for Construction Works 2010 2nd Edition, this Contract shall only when the Construction Period exceeds 6 months and the Contract sum exceeds R1,000,000,00 be subject to the Contract Price Adjustment Provisions Indices Application Manual for use with P0151 indices (CPAP) (Revised 1 January 2013) as published by Statistics South Africa. Tenderers are advised that with reference to Clause 3.4.6 of the Contract Price Adjustment Provisions (CPAP) Indices Applications Manual, the Msunduzi Museum ***will not accept the submission by Tenderers of lists of additional items.*** Where this contract is a Lump Sum contract, the contract will be subject to Contract Price Adjustment Provisions (CPAP) only where the contract period equals or exceeds 6 calendar months. The applicable work group shall be WG 180 for domestic buildings or WG 181 for commercial and industrial buildings. F:..... V:..... T:.....	Item			
	E12 LABOUR CONDITIONS AND SPECIFICATIONS **12.1 EMPLOYMENT TARGETS**				
72	12.1 Employment Targets The contractor needs to provide a realistic estimate on the number of jobs that the project has the potential to create throughout the project duration as the project will be implemented using labour intensive construction methods on elements where it is economical and feasible for this construction methods. No of jobs to be created = ……. [Contractor to fill in an estimated number] F:..... V:..... T:.....	Item			
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73	E12.1 b Employment requirements Tenderer's are advised that this contract will be aimed at reducing unemployment Tenderer's must allow for any costs for the employment of unskilled labour as per the requirements. 1. 60% of unskilled labour to be women 2. 55% of unskilled labour to be youth aged between 18 and 35 years 3. 2% of unskilled labour to be people living with disability 4.100% Unskilled labour utilised must reside within the boundaries of the Municipality Ward where this contract is executed , with preference to the local community closest or at the walking distance to the contract site. Wherever possible local skilled tradesman are to be employed on this contract with the view to maximize utilization of local resources F:..... V:..... T:.....		Item		
74	E12.1 c Labour rate and payment intervals The contractor should ensure that labour rate paid to unskilled local labour is commensurate to the daily task. When determining the rate, consideration should be given to that Labour beneficiaries are most bread winners in their families, as the program intends alleviating poverty. There should also be consideration that the labour rate promotes creation of expanded number of jobs created and person days of work. Contractors should make endeavours to ensure that the labourers, particularly unskilled are remunerated on fortnight basis and prior notification be made should there be a shortfall on their wages. The labour rate for local unskilled shall also be determined in consideration of the location of the project , i.e. for projects implemented in urbanized municipalities will not be the same as that for rural municipalities. F:..... V:..... T:.....		Item		
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	12.2 LABOUR INTENSIVE CONSTRUCTION METHOD				
75	E12.2 a Labour Intensive Construction (LIC) method On site there must be a person(s) having competency in managing and implementing LIC methods. * Foreman @NQF Level 4 the unit standard on implementing LIC methods on site Site Agent / Managers @ NQF Level 5 the unit standard on manage Labour -intensive skills programme both must be CETA accredited. F:..... V:..... T:.....	Item			
76	E12.2 b Labour Intensive Construction Method Site Agent/ Managers @ NQF level 5 the Unit Standard on Manage Labour-Intensive Skills Programme both must be a CETA accredited Those parts of the contract to be constructed using Labour Intensive methods will be marked in the BoQ with letter LI (indicating Labour Intensive) against every item so designated. Such works will only be constructed using method so indicated. F:..... V:..... T:.....	Item			
	E12.3 RECORD KEEPING				
77	12.3.1 Every employer must keep in the project site office the following minutes of site progress minutes; contractors 's monthly site progress reports; authenticity of data in the Labour Beneficiary form submitted with payment certificates. Copies of submitted beneficiary data forms should also be kept in the site office F:..... V:..... T:.....	Item			
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78	12.3.2 The Employer must keep this record for a period of at least three (3) years after the completion of the project in his/hers office as the project site office would have been relocated. This should be safely kept for job creation, data verification and periodical audits on projects may be conducted one or two quarters of submitting captured data. F:..... V:..... T:.....	Item			
79	**E12.4 LABOUR REPORTING AS PER LABOUR DATA FORM** At the end of each month as part of site progress report and to be attached to every contractors progress payment certificate; the contractor shall provide the Principal Agent and with a written record, which will be reflecting, beneficiaries surnames; ID Number and job description of labour employed by main contractor and sub-contractors on site. At the end of each month the Contractor must submit the following documents to be attached to the progress payment certificate: 1. Labour monthly data collection form 2. Worker monthly payment upload 3. Worker monthly proof of payment i.e. 3.1. Acknowledgement of receipt of payment or 3.2. Payslips 3.3 bank statement highlighting the workers paid 4. Worker monthly training form 5. Monthly attendance register 6. Certified copies of ID's (once off) 7. ID size photos (once off) 8. Proof of UIF 9. Proof of COIDA F:..... V:..... T:	Item			
	E12.5 LABOUR PROMOTION				
80	**12.5.1 Labour Apparel** Contractor and Sub-contractors labourers shall be provided personal protective equipment (PPE) F:..... V:..... T:.....	Item			
81	**E12.6 COMMUNITY LIAISON OFFICER (CLO)**				
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UTILISATION OF A COMMUNITY LIAISON OFFICER

In addition to the requirements of clause E9, contained in this document; the contractor shall allow for and pay any and all costs necessary for the engagement of the services of a Community Liaison Officer (CLO) for the full duration of this Contract.

In the interest of providing a sound service to both the community and the contractor, a CLO may only manage one project at a given time.

A CLO will be identified by the Local structures of the Ward Areas and appointed following fair and transparent process, to be conducted in the presence of Local structures and the contractor representative, in order to assist the contractor in the procurement of local labour, etc. required for this project. The contractor is to liaise with the CLO and afford him any assistance needed in insuring sound working relations with the local community.

Key Responsibilities of the CLO are envisaged to include and not necessary be limited to:

1. Assisting local leadership in conducting skills and resources audit which facilitates sourcing labour from within the ward or targeted areas for employment, required by the contractor.

2. Assisting in sourcing labour-only domestic sub-contractors and the procurement of materials from local resources, as required by the contractor.

3. Assisting the contractor by identifying areas of potential conflict and/ or threats to the project or to stakeholders in the project and recommend appropriate action to the contractor.

4. Assisting the contractor and stakeholders in the project in the resolution of any conflict that may arise.

5. Establishing and ensuring the sufficient and open communication channels between the contractor and the work force are maintained.

6. Establish and ensuring that efficient and open communication channels between the contractor and the community are maintained.

7. Identify and reporting to the contractor regarding

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	issues where communication between stakeholders is necessary, recommended courses of action and facilitate such communication. 8. Assisting the contractor and the work force in the establishment of grievance procedures and necessary recommendation to the contractor regarding the grievances and solution thereto. 9. Attending to site meetings and project implementation meetings as required by the contractor and prepare periodic reports as may be required by the contractor from time to time. 10. Attending to such other duties which are consistent with the functions of a CLO, as may be required by the contractor from time to time. Tenderers are to price twice the rate of unskilled local labour rate against this item for any and all costs arising out of compliance with the foregoing and in the event of a tenderer failing to price against this item or making inadequate financial provision against this item for compliance as aforesaid, then no claim for cost and additional costs incurred will be entertained by the Museum. F:..... V:..... T:.....	Item			
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82	**E12.7 SKILLS DEVELOPMENT ON SITE** The Contractor in conforming that its beneficiaries need to be capacitated with skills that will render them employable in the future. It is then the responsibility of the contractor that mandatory life skills are provided to 100% of work force on site and on the job training to labourers from whom the potential for further development has been identified. The latter is not mandatory to all as it covers technical skills. The contractor should also make provisions for the possibility that there might be local youth that will need to be placed on the project with an intention to be provided with support towards improving their level of competency and productivity. The contractor shall also provide all necessary on the job training to targeted labour to enable such labour to master and advance on techniques required to undertake the work in accordance with requirements of the contract in a manner that does not compromise workers health and safety. F:..... V:..... T:.....	Item			
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83	**E12.8 LABOUR ONLY SUB-CONTRACTING FOR LOCAL EMERGING ENTERPRISES** **AFRICAN EQUITY OWNERSHIP** a) The tenderer is to allow for 5% of the total value undertaken by priority population group. This percentage excludes the cost of employing local unskilled labour. The allocation of this percentage from the project, the screening of people, the selection of skills, will be for the contractor to adjudicate. b) The priority population group consists of women, youth and disabled people. c) The contractor is to give first option for prospective PPG's from the surrounding areas of the project. Should there be insufficient suitable people fitting the criteria of PPG's, the contractor may hire people from further afield. This is to be done only after consultation with the Museum Co-ordinator and the community liaison officer (CLO). d) A mentor is to be employed by the contractor in consultation with the Museum for the purposes of quality control and liaison between the contractor and the selected PPG's on site. The mentor will be responsible for and acceptance level of quality workmanship and that such work carried out by the PPG's is executed within the time frames stipulated. Insofar possible, the contractor is encouraged to expand the PPG's skills knowledge and performance levels. F:..... V:..... T:.....		Item		
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	TENDERER'S TO NOTE CONDITIONS				
	a) The contractor to be entered into between the contractor and the PPG's will be a LABOUR ONLY sub-contractor.				
	b) The contractor will be responsible for ensuring that all materials for use by the PPG's in the works are to be on site timeously . The contractor shall liaise with the mentor and PPG's to determine the nature and extent of materials required and the time necessary.				
	c) The contractor shall be responsible for the overall programming of the works and he is to allow for monitoring the PPG's programme and progress.				
	d) In conjunction with the mentor, he is to allow for the supervision and mentoring (where necessary) of the PPG to ensure quality and adherence to standard building practice.				
	e) The contractor is to allow for extra storage facilities on site for the PPG's tools and equipment.				
	f) Basic tools shall be provided by the PPG's and where these are not available ; the contractor will supply him with the necessary tools and equipment and deduct the costs there of from the interim claims made by the PPG's				
	g) Work requiring specialized tools will be provided free of charged by the contractor with the provision that these be returned upon completion of the work.				
84	**CO-ORDINATION**				
	The contractor is to co-ordinate the work of all the PPG's , sub-contractors and nominated sub-contractors appointed direct by the Employer in such a manner and at all times as will suit the building programme and he is to allow adequate access, for the PPG's , where required, to carry out their work in an efficient manner as no claims for extras in this connection will be entertained.				
	F:..... V:..... T:.....	Item			
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85	**ATTENDANCE** The contractor may allow for attendance upon the PPG's concerned to execute the work . The contractor is to allow the PPG's the use of any scaffolding belonging to him while it remains so erected on the site. Where scaffolding is necessary for the use by any PPG and the contractor has not erected any for his own use or has removed same after his own use, the contractor shall supply sufficient scaffolding to the PPG to be erected and dismantled by the PPG and returned to the the contractor. This attendance upon PPG's to execute the work is to include for the scaffolding provisions as aforesaid and , in addition , is to include for co-operating to the fullest extent with all the parties, attending on off-loading materials , providing suitable storage for tools and materials used by the PPG;s , use of general facilities such as latrines , etc. supply and costs of power, lighting, water and the like. F:..... V:..... T:.....		Item		
86	**E12.9 CONTRACT FOR LABOUR** It is compulsory that shortly after the contractor and or sub-contractors has appointed local labour, the employment contract should be signed by both parties , prior to commencement with works on site. The employment contract forms part of the ministerial determination or from the the regional officials. Each contract will be lapse at the end of each financial year therefore requiring the contractor to do a renewal of each contract should the need of employment still exist for that particular labourer. F:..... V:..... T:.....		Item		
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87	**E12.10 LOCAL LABOUR SCOPE OF WORK** **Note:** Contractors are to price any item on the Bill of Quantities having below, bearing in mind that they are regarded as main sources of job creation, whether sub contracted or undertaken by the main contractor. Elements on the scope of work where application of Labou Intensive Construction methods as will indicated with lette (LI) are regarded feasible are as follows; i) Excavating trenches for foundations and any other civil works with the depth not more than 1.5 m ii) All masonry works which include concrete mixing on site brickwork; plastering; screed works; jointing; etc. iii) Painting, Plumbing, Ironmongery; roof cladding; glazing tilling; carpentry; flooring; waterproofing; etc. F:..... V:..... T:.....	Item			
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Note:

It is general requirements of this contract that persons normally resident in the ward of the works (local labour) be given preference for employment on the contract.Provided , however, that should adequate and appropriate labour not be available within the ward, others may be employed subject to satisfactory proof being provided that every reasonable endeavour has been made to employ local labour local labour (local labour sub-contractor (s), skilled , semi-skilled and unskilled). The contractor shall in consultation with the local community leaders with the purpose of negotiating with them regarding the utilization of local resources in the construction process. In this regard, the contractor shall furthermore give preference, wherever possible to the employment of single heads of households , women and youth as well as families declared as most indigent by war on poverty program profiling process. The contractor should aim in general , to maximise the involvement of the local community , however workers from other communities should not exceed 20% of all persons working on the project , where local employees possess skills at level of competency that meet contractors requirements.

Payment for the labour-intensive component of the works

Payment for works identified in the Scope of Work as being labour-intensive shall only be made in accordance with the provisions of the Contract if the works are constructed strictly in accordance with the provisions of the Scope ofWork. Any non-payment for such works shall not relieve theContractor in any way from his obligations either in contract or in delict.

Linkage of payment for labour-intensive component of works to submission of project data

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	The Contractor's payment invoices shall be accompanied by labour information for the corresponding period in a format specified by the employer. If the contractor chooses to delay submitting payment invoices, labour returns shall still be submitted as per frequency and time frame stipulated by the Employer. The contractor's invoices shall not be paid until all pending labour information has been submitted.				
88	Applicable labour laws The current Ministerial Determination Expanded Public Works Programmes, issued in terms of the Basic Conditions of Employment Act of 1997 by the Minister of Labour in Government Notice , shall apply to works described in the scope of work as being labour-intensive and which are undertaken by unskilled or semi-skilled workers. F:..... V:..... T:.....	Item			
	E13. HIV/AIDS AWARENESS E13 Tenderers are to price against the following items for compliance with the SPECIFICATION FOR HIV/AIDS AWARENESS bound into this document (The clauses referred to are those of the Specification for HIV/AIDS)				
89	E13.1 Provide and maintain a condom dispenser in terms of Clause 5.1a) F:..... V:..... T:.....	Item			
90	E13.2 Provide and maintain HIV/AIDS awareness posters terms of Clause 5.1b) F:..... V:..... T:.....	Item			
91	E13.3 HIV /Aids Awareness Programme on Site for not less than 90% of workers inclusive of all direct and indirect costs; Engage a qualified service provider as described in the scope of works to conduct an HIV Awareness Programme in terms of Clause 5.2.1a) F:..... V:..... T:.....	Item			
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	Section No. 1 SECTION ONE : PRELIMINARIES Bill No. 1 PRELIMINARIES				

92	E13.4 Arrange for workers to attend the HIV Awareness Programme in terms of Clause 5.2.1b) F:..... V:..... T:.....	Item			
93	**E13.5 REPORTING** Prepare and attach to claims for payment a brief report in terms of Clause 5.3 (see also HIV/STI Compliance Report included with this document). F:..... V:..... T:.....	Item			
	Note: In the event that the contractor fails to satisfy the requirements of this specification, the employer (Msunduzi Museum) may apply any of the sanctions provided for in the contract. Sanctions may include the application of a financial penalty of .04% of the Contract Sum per calendar day of which the required reports has not been submitted.				
94	**E14 OCCUPATIONAL HEALTH AND SAFETY ACT NO. 85 OF 1993** Tenderers are to allow for costs in providing a project specific ' Construction Phase Safety, Health and Environmental Plan' in accordance with "Section 2 - Specification Data associated with SANS 1921-1:2004" clause C4.18 in "Part C3 - Scope of Work" F:..... V:..... T:.....	Item			
95	**E15 NOTICE BOARD, SITE OFFICE, ETC.** Bidders are to allow for the provision and removal of a project notice board and a site office in accordance with the Principal Agent's requirements. F:..... V:..... T:.....	Item			
	Carried to Collection			R	

Section No. 1
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Bill No. 1
PRELIMINARIES

96	**E16 IMPORTED MATERIALS AND EQUIPMENT** Where imported items are listed in the tender documents, the tenderer shall provide all information called for, failing which the price of any such item, material or equipment shall be excluded from currency fluctuations. (Refer to T2.14 - Schedule of Imported Materials and Equipment. F:..... V:..... T:.....	Item		
97	**E17 CONTRACT DOCUMENTS** The drawings issues with these Bid documents do not comprise the complete set but serves as a guide only for Biding purposes and for indicating the scope of works to enable the Bidder to acquaint him with the nature and extent of the works and the manner in which they are to be executed. Should any part of the drawings not be clearly legible to the Bidder he shall, before submitting his Bid, obtain clarification in writing from the principal agent. F:..... V:..... T:.....	Item		
98	**E18 GENERAL PREAMBLES** The Document Preambles will be the “ASAQS Model Preambles for Trades – 2008” and is obtainable from the various sources and shall be read in conjunction with the Bills of Quantities and be referred to for the full descriptions of work to be done and materials to be used. F:..... V:..... T:.....	Item		
99	**E19 TRADE NAMES** Wherever a Trade Name for any product has been described in the Bills of Quantities the Bidder's attention is drawn to the fact that any other product of equal quality may be used subject to the written approval of the Principal Agent being obtained prior to the closing date for submission of Bids. F:..... V:..... T:.....	Item		
	Carried to Collection		R	

Section No. 1
SECTION ONE : PRELIMINARIES
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PRELIMINARIES

100	**E20 EXISTING PREMISES OCCUPIED** Refer to Scope of Works Part C3 of this Bid Document for information on the occupation of existing buildings. F:..... V:..... T:.....	Item			
101	**E21 INACCURATE AND DEFECTIVE WORK EXECUTED UNDER PREVIOUS CONTRACT** The contractor shall, after taking possession of the site and before commencing the work, check all levels, liners, profiles and the like and satisfy himself as to the dimensional accuracy of all work executed under the previous contract which may affect his work. Should any inaccurate or defective work be found, the contractor shall immediately notify the principal agent in writing requesting his instructions with regard thereto and afford every facility to those rectifying such inaccurate or defective work. F:..... V:..... T:.....	Item			
102	**E22 VIEWING THE SITE IN SECURITY AREAS** If the site is situated in a security area and the Bidder must arrange with the Authorities to obtain permission to enter the site for Bidding purposes. F:..... V:..... T:.....	Item			
103	**E23 COMMENCEMENT OF WORKS IN SECURITY AREAS** If the works falls within a security area, the contractor must arrange with the Authorities and give the necessary notices before commencement of the works. Should the contractor fail to make such arrangements, admission to the site may be refused and any additional costs will be for the contractor's account. F:..... V:..... T:.....	Item			
	Carried to Collection			R	

Section No. 1
SECTION ONE : PRELIMINARIES
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104	**E24 ENTRANCE PERMITS TO SECURITY AREAS** If the works fall within a security area, the contractor shall obtain entrance permits for his personnel and workmen entering the area and shall comply with all regulations and instructions which may be issued from time to time regarding the protection of persons and property under control of the Authority. F:..... V:..... T:.....	Item		
105	**E25 SECURITY CHECK OF PERSONNEL** The principal agent may require the contractor to have his personnel and workmen, or a certain number of them, security classified. In the event of the principal agent requesting the removal of a person or persons from the works for security reasons, the contractor shall do so forthwith and shall thereafter ensure that such person or persons are denied access to the works and the site and/or to any document or information relating to the works. F:..... V:..... T:.....	Item		
106	**E26 PROHIBITION ON TAKING PHOTOGRAPHS** In terms of article 119 of the Defence Act, 44 of 1957, it is prohibited to sketch or to take photographs of any military site or installation or any building or civil works thereon or to be in possession of a camera or other apparatus used for taking photographs, except when authorised thereto by or on behalf of the Minister. The same prohibition is also applicable to all Correctional Institutions in terms of article 44.1(e) of the Correctional Services Act 8 of 1959. F:..... V:..... T:.....	Item		
	Carried to Collection		R	

Section No. 1
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107	**E27 MANAGEMENT OF WATER** Management of Water for Construction purposes must be obtained from alternative water sources (i.e. supply other than water that is produced and distributed by a regulated water service authority from a licenced water treatment works for human consumption), eg dams, rivers, boreholes, springs, rainwater harvesting, recycled sewerage water,etc. The alternative water source shall not be of an inferior quality / standard than that required for construction purposes. The client reserves the right through his agents to test such supplies or request certificates confirming the grade and nature of the water supply. Relevant knowledge of the respective area will be an advantage. F:..... V:..... T:.....	Item		
108	**E28. PROVISION FOR SCAFFOLD** Provision for scaffold or lift equipment to height of 15m as and when required for the duration of the work completion. F:..... V:..... T:.....	Item		
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Section No. 1

SECTION ONE : PRELIMINARIES

Bill No. 1

PRELIMINARIES

COLLECTION

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PRELIMINARIES

Section No. 1

SECTION ONE : PRELIMINARIES

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PRELIMINARIES

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Item No		Unit	Quantity	Rate	Amount

SECTION TWO: BUILDING WORKS

BILL NO. 1

ALTERATIONS (WORK GROUP 102)

Tenderers are referred to the relevant clauses in the separate document: ASAQS Model Preambles for trades (2008 edition) and the ASAQS supplementary preambles which are incorporated in this Bill of Quantities.

SUPPLEMENTARY PREAMBLES

View site

Before submitting his tender the contractor shall visit the site and satisfy himself as to the nature and extent of the work to be done and the value of the materials contained in the buildings or portions of the buildings to be demolished. No claim for any variations of the contract sum in respect of the nature and extent of the work or of inferior or damaged materials will be entertained

General

The contractor shall carry out the whole of the works with as little mess and noise as possible and with a minimum of disturbance to adjoining premises. He shall provide proper protection and provide, erect and remove when directed, any temporary tarpaulins that may be necessary during the progress of the works, all to the satisfaction of the principal agent

Water supply pipes and other piping that may be encountered and found necessary to disconnect or cut, shall be effectually stopped off or grubbed up and removed, and any new connections that may be necessary shall be made with proper fittings, to the satisfaction of the principal agent

Prices for taking out of doors, windows, etc shall include for removal of all beads, architraves, ironmongery, etc

Carried to Collection R

Section No. 2
SECTION TWO: BUILDING WORKS
Bill No. 1
ALTERATIONS

Prices for taking out and removing doors and frames shall include for removing door stops, cabin hooks, etc and making good floor and wall finishes to match existing

With regard to building up of openings in existing walls, cement screeds and pavings, granolithic, tops of walls, etc, shall be levelled and prepared for raising of brickwork

Making good of finishes shall include making good of the brick and concrete surfaces onto which the new finishes are applied, where necessary

The contractor will be required to take all dimensions affecting the existing buildings on the site and he will be held solely responsible for the accuracy of all such dimensions where used in the manufacture of new items (doors, windows, fittings, etc)

Electric wires, pipes, etc

Special care is to be taken not to interfere unnecessarily with any electric light, power or telephone wires and fittings that may be met with and notice is to be given to the
Representative/Agent when any disconnections or removal of wires, etc. are necessary and the contractor is to afford every facility to the Electricians carrying out this work

Any water supply pipes or other piping that may be met with and found necessary to disconnect or cut, are to be effectively stopped off and any new connections that may be necessary are to be made with proper fittings and to the satisfaction of the Representative/Agent, to whom due notice must be given of any alterations to the existing services

Protection

In taking down and removing existing work the utmost care is to be observed to avoid any structural or other damage to the remaining portions of the buildings

Carried to Collection R

Section No. 2
SECTION TWO: BUILDING WORKS
Bill No. 1
ALTERATIONS

	The contractor must also protect all work not removed such as walls, floors, doors, windows or other joinery, loose and fixed fittings and electrical appliances, etc., from damage during the progress of the work and provide all necessary materials for so doing The contractor will be held solely responsible for any damage to persons or property and for the safety of the structure throughout the whole of this contract and must make good at his own expense any damage that may occur					
	Tenders The Submission of a tender will imply that the Contractor has physically visited the site and fully understands the content and scope of the work described in this bill and no claims in this respect will be afterwards entertained.					
	TEMPORARY BARRIERS, SCREENS, ETC					
	Temporary barriers, screens, etc including removal					
1	Temporary barriers, screen, etc including removal	m	100			
2	Dust screen 3500mm high between floor and ceiling formed of suitable timber framing with 375 micron polyethylene sheeting stapled on including cornices, ends,etc	m	20			
	REMOVAL OF EXISTING WORK					
	Taking out and removing roofs, floors, panelling, ceilings, partitions, etc					
3	Remove existing ceilings and replacing with new to match existing	m2	90			
	MAKING GOOD OF FINISHES ETC					
	Making Good Ceiling					
4	Ceilings in Patches	m2	10			
	Carried to Collection			R		

	Making good of wall finishes where damaged to match existing				
5	Patch work to wall finishes including paint to match existing	m2	20		
	Carried to Collection			R	

Section No. 2
SECTION TWO: BUILDING WORKS
Bill No. 1
ALTERATIONS

Section No. 2

SECTION TWO: BUILDING WORKS

Bill No. 1

ALTERATIONS

COLLECTION

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Item No		Quantity	Rate	Amount

SECTION TWO : BUILDING WORKS

BILL NO. 2

PAINTWORK (WORKGROUP 152)

Tenderers are referred to the relevant clauses in the separate document: ASAQS Model Preambles for trades (2008 edition) and the ASAQS supplementary preambles which are incorporated in this Bill of Quantities.

Note : Where trade names and catalogue numbers are given, it shall be taken to mean to be followed by the words "equal or other approved".

SUPPLEMENTARY PREAMBLES

PAINT SPECIFICATIONS

All painting shall be done in accordance with the specifications unless otherwise described

COLOURS

Unless otherwise described all paintwork shall be deemed to have to colour value in excess of 7 on the Munsell system in accordance with SANS 1091

PAINT TO STRUCTURAL STEEL WORK

Primer- apply premix of Plascotuff 3000 (PEC 3004 Grey/PEH 3) to structural steelwork by airless spray, conventional spray, roller or brush to a miniumum DFT of 100-150 micrometres.

Intermediate and final coat-apply premix of Plascon Plascothane 9000 series (PRU 9001 white/PRU 9002 black PRT 90015 Pastel/PRT 90025 deep/PRT 90035 Transprent base/PRH 9 Hardner) to structural steelwork by airless spray, conventional spray, roller or brush to a minimum DFT of 40-75 micrometres.

PREPARATORY WORK TO EXISTING WORK

Previously painted plastered surfaces

Carried to Collection R

	Surfaces shall be thoroughly washed down and allowed to dry completely before any paint is applied. Blistered or peeling paint shall be completely removed and cracks shall be opened, filled with suitable filler and finished smooth.				
	Previously painted metal surfaces				
	Surfaces shall be thoroughly rubbed and cleaned down. Blistered or peeling paint shall be completely removed down to bare metal.				
	Previously painted wood surfaces				
	Surfaces shall be thoroughly cleaned down. Blistered or peeling paint shall be completely removed and cracks and crevices shall be primed, filled with suitable filler and finished smooth.				
	PAINTWORK TO PREVIOUSLY PAINTED WORK				
	ON FLOATED PLASTER				
	Professional Superior Low Sheen (smooth finish - water based superior low sheen acrylic, durable, washable) one coat primer and two coats topcoat				
1	On plastered walls internally	m2	50		
	ON WOOD				
	One coat wood primer, one coat Dulux universal or equally approved universal undercoat and two coats super universal enamel paint				
2	Doors	m2	10		
3	Windows	m2	10		
	PAINTWORK ETC TO NEW WORK				
	ON PLASTERBOARD				
	Carried to Collection			R	

	Professional Superior Low Sheen (smooth finish - water based superior low sheen acrylic, durable, washable) one coat primer and two coats topcoat				
4	On ceilings and cornices	m2	90		
	ON METAL				
	One coat primer and two coats Dulux PearlGlo water base tinted or equally approved				
5	On Metal Roof Sheeting	m2	45		
	Carried to Collection			R	

Section No. 2

SECTION TWO: BUILDING WORKS

Bill No. 2

PAINTWORK

COLLECTION

	Page No		Amount
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Item No		Quantity	Rate	Amount
	SECTION TWO : BUILDING WORKS			
	BILL NO. 3			
	PROVISIONAL SUMS			
	Tenderers are referred to the relevant clauses in the separate document: ASAQS Model Preambles for trades (2008 edition) and the ASAQS supplementary preambles which are incorporated in this Bill of Quantities.			
	Where possible abbreviated descriptions have been used in the following bills and except where otherwise described all preambles and full descriptions of the items appearing in the preceding bills are to apply equally to these bills.			
	Note : Where trade names and catalogue numbers are given, it shall be taken to mean to be followed by the words "equal or other approved".			
	ROOF REHABILITATION			
1	Allow the provisional amount of R5,000,000.00 (Five Million Rand) for the Roof rehabilitation	Item		5,000,000.00
2	Add Profit	%		
3	Add Attendance	%		
	BUILDING WORKS			
4	Allow the provisional amount for the amount of R100,000.00 (One Hundred Thousand Rand) for Ancillary Building Works	Item		100,000.00
5	Add Profit	%		
6	Add Attendance	%		
	Carried to Collection		R	

	GENERATOR ROOM			
7	Allow the provisional amount of R200,000.00 (Two Hundred Thousand Rand) for the Generator room	Item		200,000.00
8	Add Profit	%		
9	Add Attendance	%		
	Carried to Collection		R	

Section No. 2

SECTION TWO: BUILDING WORKS

Bill No. 3

PROVISIONAL SUM

COLLECTION

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SECTION TWO: BUILDING WORKS

SECTION SUMMARY - SECTION TWO: BUILDING WORKS

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Section No. 2
SECTION TWO: BUILDING WORKS

Item No		Quantity	Rate	Amount
	SECTION THREE: ELECTRICAL INSTALLATION			
	PRELIMINARY AND GENERAL			
	BILL NO.1			
	Allow for the costs which the contractor may incur in terms of any or all of the description in these documents and drawings which are not specifically covered in the bill of quantities. Submit full details.			
	Fixed Charge Items			
1	Formal contract	Item		
2	Sureties	Item		
3	Checking of existing services and relocation of such services as indicated by the Electrical Engineer	Item		
4	Insurance of works etc. and damage to persons and property	Item		
5	Third party insurance	Item		
6	Workmans compensation	Item		
7	Initial supply of plant, material and labour and services required by contractor	Item		
8	Contractors camp site/ store yard	Item		
9	Allow for the following additional items which the tenderer requires to be priced separately	Item		
10	a)	Item		
11	b)	Item		
12	c)	Item		
13	Marking up as built drawings and issuing to Engineer	Item		
	Carried to Collection		R	

	Time Related Items				
14	Contractors superintendence	Item			
15	Setting out	Item			
16	Watching and lighting	Item			
17	Care of works, damage to persons and property	Item			
18	Attendance on work done by sub-contractor and nominated sub-contractors	Item			
19	Facilities for other contractors	Item			
20	Provision of plant, material and labour	Item			
21	Clearance of site during contract and on completion	Item			
22	Allow for the following additional items which the tenderer requires to be priced separately	Item			
23	a)	Item			
24	b)	Item			
25	c)	Item			
26	Provision for scaffolding or lifting equipment to height of 15m as an when required for the duration of the works completion	Item			
	Carried to Collection			R	

Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 1
PRELIMINARY AND GENERAL

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 1

PRELIMINARY AND GENERAL

COLLECTION

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Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 1
PRELIMINARY AND GENERAL

Item No		Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION			
	BILL NO. 2			
	DISTRIBUTION BOARDS			
	DISTRIBUTION BOARDS			
	MAIN Distribution Board and Metering Panel With Generator ATS 400V 20kA (Essential / Non-Essential)			
	IP68 20kA Floor Standing DB with bottom with 500mm base plinth extensible DB side and front panels to be removable **4 Pole surge arrester class 1** **Metering section to the latest standard by Msunduzi Municipality built into main panel for future upgrade for 630A supply** **800/5 Current Transformers (CT) x 3** **1 x 3 Phase electronic smart meter to Msunduzi Municipality specification** **630A Automatic transfer switch built into main panel** **1 x 630A 3 Phase (4 pole) switch disconnector 20kA** **1 x 630A 20kA circuit breaker** **1 x 350A 20kA circuit breaker** **1 x 63A 1 Phase 30mA earth leakage unit** **2 x 15A single pole Circuit breaker 10kA** **2 x 20A single pole circuit breaker 10kA** **1 x 7.5KW Connector Metasol or equivalent** **1 x 250A 3 phase (3 pole) slow curve circuit breaker 10kA (Block M HVAC DB)** **1 x 300A 3 Phase (4 pole) Circuit breaker 10kA (Block M main DB)** **13 x 40A (2 pole) Circuit breaker 5kA (various buildings)** **1 x 100A 3 Phase (4 Pole) Circuit breaker 5kA (Block B Church)** **1 x 100A 3 Phase (4 Pole) Circuit breaker 5kA (Block H Church)** **1 x 63A 3 Phase (4 Pole) Circuit breaker 5kA** **1 x 80A 3 Phase (4 Pole) Circuit breaker 5kA**			
	Carried to Collection		R	

1	Supply	No	1		
2	Install	No	1		
3	Refurbishment to all existing Distribution Boards within Block M (Provisional Amount)		Item		45,000.00
	Electrical Supply Upgrade				
4	Upgrade existing 200kVA to 400kVA with the Msunduzi Municipality (Provisional Allowance)		Item		965,000.00
	Carried to Collection			R	

Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 2
DISTRIBUTION BOARDS

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 2

DISTRIBUTION BOARDS

COLLECTION

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Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 2
DISTRIBUTION BOARDS

Item No			Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION				
	CABLES				
	BILL NO. 3				
	CABLES				
	6mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
1	Supply	m	200		
2	Install	m	200		
	6mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
3	Supply	No	4		
4	Install	No	4		
	6mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
5	Supply	No	1		
6	Install	No	1		
	10mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
7	Supply	m	150		
8	Install	m	150		
	10mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
9	Supply	No	4		
10	Install	No	4		
	Carried to Collection			R	

	10mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
11	Supply	No	2		
12	Install	No	2		
	16mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
13	Supply	m	500		
14	Install	m	500		
	16mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
15	Supply	No	20		
16	Install	No	20		
	16mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
17	Supply	No	4		
18	Install	No	4		
	25mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
19	Supply	m	300		
20	Install	m	300		
	25mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
21	Supply	No	12		
22	Install	No	12		
	25mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
23	Supply	No	2		
24	Install	No	2		
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	35mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
25	Supply	m	100		
26	Install	m	100		
	35mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
27	Supply	No	4		
28	Install	No	4		
	35mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
29	Supply	No	1		
30	Install	No	1		
	50mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
31	Supply	m	300		
32	Install	m	300		
	50mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
33	Supply	No	4		
34	Install	No	4		
	50mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
35	Supply	No	2		
36	Install	No	2		
	70mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
37	Supply	m	150		
38	Install	m	150		
	Carried to Collection			R	

	70mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
39	Supply	No	4		
40	Install	No	4		
	70mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
41	Supply	No	2		
42	Install	No	2		
	95mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor				
43	Supply	m	200		
44	Install	m	200		
	95mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Termination Kit				
45	Supply	No	8		
46	Install	No	8		
	95mm2 x 4core PVC insulated PVC bedded SWA PVC sheathed Copper Conductor Cable Joint				
47	Supply	No	2		
48	Install	No	2		
	2.5mm2 x 7core PVC insulated Control cable for Generator				
49	Supply	m	50		
50	Install	m	50		
	2.5mm2 x 7core PVC insulated Control cable terminations for Generator and ATS				
51	Supply	No	4		
52	Install	No	4		
	Carried to Collection			R	

Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 3
CABLES

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 3

CABLES

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Item No			Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION				
	CONDUIT AND WIRING				
	BILL NO. 4				
	CONDUIT AND WIRING				
	32mm PVC Sleeve				
1	Supply	m	200		
2	Install	m	200		
	20mm PVC Conduit				
3	Supply	m	5,100		
4	Install	m	5,100		
	25mm PVC Conduit				
5	Supply	m	6,400		
6	Install	m	6,400		
	40mm PVC trunking				
7	Supply	m	200		
8	Install	m	200		
	25mm diameter Galvanised surface mount conduit				
9	Supply	m	200		
10	Install	m	200		
	4mm PVC Wire				
11	Supply	m	3,100		
	Carried to Collection			R	

12	Install	m	3,100		
	2,5mm PVC Wire				
13	Supply	m	16,000		
14	Install	m	16,000		
	1,5mm PVC Wire				
15	Supply	m	12,000		
16	Install	m	12,000		
	2c x 2.5 mm2 + Earth Surfix				
17	Supply	m	300		
18	Install	m	300		
	2c x 4 mm2 + Earth Surfix				
19	Supply	m	300		
20	Install	m	300		
	2 Channel 3 Compartment Power Skirting (PVC, incl bends, joiners, end caps, divider and tee's)				
21	Supply	m	500		
22	Install	m	500		
	50mm PVC Sleeve				
23	Supply	m	450		
24	Install	m	450		
	110mm PVC Sleeve				
25	Supply	m	600		
26	Install	m	600		
	Carried to Collection			R	

	101mm mild steel mesh wire tray including suspension chain, rods bends joints and all accessories				
27	Supply	m	200		
28	Install	m	200		
	P2000 Trunking 1.6mm Thickness, including bends and supports, hangers, PVC cover and all accessories				
29	Supply	m	250		
30	Install	m	250		
	Carried to Collection			R	

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 4

CONDUIT & WIRING

COLLECTION

	Page No		Amount
Total Brought Forward from Page No.	55		
	56		
	57		
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Item No			Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION				
	SMALL POWER AND FIXED APPLIANCES				
	BILL NO. 5				
	SMALL POWER AND FIXED APPLIANCES				
	100 X 100 Galv Flush Box				
1	Supply	No	250		
2	Install	No	250		
	100 x 50 Galv Flush Box				
3	Supply	No	125		
4	Install	No	125		
	100 x 100 PVC blank cover plate				
5	Supply	No	50		
6	Install	No	50		
	20mm PVC Round Box				
7	Supply	No	450		
8	Install	No	450		
	1 Lever 1 Way Switch & Cover				
9	Supply	No	50		
10	Install	No	50		
	2 Lever 1 Way Switch & Cover				
11	Supply	No	20		
	Carried to Collection			R	

12	Install	No	20		
	1 Lever 2 Way Switch & Cover				
13	Supply	No	20		
14	Install	No	20		
	1 Lever Dimmable Rotary Switch				
15	Supply	No	15		
16	Install	No	15		
	16 Amp Single S.S.O (in power skirting) + SANS 164-2 Plug				
17	Supply	No	150		
18	Install	No	150		
	16 Amp Dedicated Single S.S.O (Power Skirting Mount)				
19	Supply	No	50		
20	Install	No	50		
	16 Amp Single S.S.O recessed wall mount including Box and Covers + SANS 164-2 Plug				
21	Supply	No	150		
22	Install	No	150		
	16 Amp Single S.S.O surface wall mount In IP65 York Box Lockable + SANS 164-2 Plug				
23	Supply	No	15		
24	Install	No	15		
	16 Amp Double S.S.O surface wall mount + SANS 164-2 Plug				
25	Supply	No	20		
	Carried to Collection			R	

26	Install	No	20		
	5 amp unswitched socket outlet for light fitting box and cover				
27	Supply	No	600		
28	Install	No	600		
	Data point/communications cover on power skirting				
29	Supply	No	60		
30	Install	No	60		
	ISOLATORS				
	230V / 400V isolator complete with PVC cover plate and all fixings.				
	20 Amp, SP, surface isolator IP66				
31	Supply	No	35		
32	Install	No	35		
	40 Amp, TP, surface isolator IP66				
33	Supply	No	25		
34	Install	No	25		
	10 Amp, SP, surface isolator				
35	Supply	No	25		
36	Install	No	25		
	63A 4 Pole Isolator				
37	Supply	No	12		
38	Install	No	12		
	Carried to Collection			R	

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 5

SMALL POWER & FIXED APPLIANCES

COLLECTION

	Page No		**Amount**
Total Brought Forward from Page No.	59		
	60		
	61		
Carried Forward to Summary of Section No. 3		R	

Item No			Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION				
	LIGHTING SYSTEM				
	BILL NO. 6				
	LIGHT FITTINGS				
	Backlit LED panel 48w (PAN/BLP/123/004 or similar to engineers Approval)				
1	Supply	No	105		
2	Install	No	105		
	60W IP65 Integrated LED Vapour Proof (MB-IVP-60W or similar to engineers Approval)				
3	Supply	No	35		
4	Install	No	35		
	12W LED Down lighter COB (MB-DL04-C-12W or similar to engineers approval)				
5	Supply	No	80		
6	Install	No	80		
	30W LED Down lighter COB (MB-DL06-C-30W or similar to engineers Approval)				
7	Supply	No	50		
8	Install	No	50		
	Suspended / Surface Mount Office Linear 48w Non dimmable 4000K (ARD-SK6065-015 or similar to engineers approval)				
9	Supply	No	40		
10	Install	No	40		
	Carried to Collection			R	

	12w 24 Deg Magnetic track Linear fitting 1500mm (MCX-ZD12 or similar to engineers approval)				
11	Supply	No	150		
12	Install	No	150		
	Magnetic Track Ultra thin 48w (35mm Width and 10mm Height clip in track)				
13	Supply	No	250		
14	Install	No	250		
	200w Embedded power supply				
15	Supply	No	10		
16	Install	No	10		
	100w Imbedded power supply				
17	Supply	No	25		
18	Install	No	25		
	Track Connectors				
19	Supply	No	60		
20	Install	No	60		
	96W 1200mm Circular Pendant				
21	Supply	No	8		
22	Install	No	8		
	50W LED Floodlight				
23	Supply	No	20		
24	Install	No	20		
	Carried to Collection			R	

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 6

LIGHTING SYSTEM

COLLECTION

	Page No		Amount
Total Brought Forward from Page No.	63		
	64		
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Item No			Quantity	Rate	Amount
	SECTION THREE : ELECTRICAL INSTALLATION				
	GENERAL				
	BILL NO. 7				
	GENERAL				
1	Test & issue Certificate of Compliance	No	10		
2	Label existing and new socket outlets, switches, isolators and light switches to correspond to correct DB circuit	Item			
	Earthing and bonding of complete installation				
3	Supply	Item			
4	Install	Item			
5	As Built Drawings	No	1		
6	Lightning protection on Building Structures (Provisional Amount)	Item			40,000.00
	300 x 300 Junction Boxes Telkom and IT				
7	Supply	No	1		
8	Install	No	1		
9	Isolate, Make safe, dismantle environmentally dispose of existing light fittings, switch socket outlets, light switches circuit breakers and DB,s provide certificate of disposal.	Item			85,000.00
	Chasing and making good (as per design specifications)				
10	Supply	m	500		
	Carried to Collection			R	

11	Install	m	500			
12	Liaison with Municipality regarding connections and supply upgrade		Item			
13	Maintenance, Testing and Repairs to existing Fire Detection and EVAC system Upgrade Provisional Allowance		Item			135,000.00
	800x800x1000 Electrical Manhole complete with concrete base, double skin brickwork and cast iron cover and frame (medium duty)					
14	Supply	No	10			
15	Install	No	10			
16	**500x500 Telkom Manhole as construction and material with steel cover plate**	No	5			
17	**Trenching and backfilling 600 x 600mm in all surface including importation of bedding**	m	500			
	8m Wooden pole for perimeter lighting					
18	Supply	No	25			
19	Install	No	25			
	Install 300mm wide orange danger tape					
20	Supply	m	500			
21	Install	m	500			
22	**Provisional Allowance General Building Works for Main Supply**		Item			150,000.00
	Supply and Install Fully Containerised 220kVA Generator with Deep Sea Controller 350A Circuit Breaker to feed ATS on Main DB and Synod Building (Volvo, Perkins, Cumins, Cat engines with Stamford Alternator or similar to engineers Approval)					
23	Supply	No	1			
	Carried to Collection				R	

Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION
Bill No. 7
GENERAL

24	Install	No	1		
	Supply and install fully containerised 220kva generator with deep sea conroller 350A circuit breaker to feed ATS on main DB Synod building (volvo , perkins , cummis, cat engines with stamford alternator or similar to enginees approval)				
25	Supply	No	1		
26	Install	No	1		
27	Provisional Allowance for testing and maintenance of existing access control system	Item			20,000.00
	Double conversion -5kva UPS complete with UPS DB and 20 mins Battery Autonomy				
28	Supply	No	1		
29	Install	No	1		
	Carried to Collection			R	

Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

Bill No. 7

GENERAL

COLLECTION

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Section No. 3

SECTION THREE: ELECTRICAL INSTALLATION

SECTION SUMMARY - SECTION THREE: ELECTRICAL INSTALLATION

Carried to Final Summary R

Section No. 3
SECTION THREE: ELECTRICAL INSTALLATION

Item No		Quantity	Rate	Amount
	SECTION FOUR: MECHANICAL INSTALLATION			
	BILL NO. 1			
	HVAC INSTALLATION			
	Miscellaneous			
	The costs for the following items shall not be included in the cost rates for work listed in the rest of the BOQ			
1	HVAC Contractors P&G's, including compliance to OSHA, site establishment and removal, exit medicals, site supervision and management	Item		
2	Decommission and remove existing HVAC systems and handover equipment to client, unless otherwise instructed. To include all air-conditioning and ventilation systems: Units, ductwork, pipework, air terminals, etc.	Item		
3	Workshop drawings as specified. Drawings to be done on CAD, as no hand drawn mark - ups will be accepted.	Item		
4	Builders work drawings as specified. Drawings will be done on CAD, as no hand drawn mark-ups will be accepted.	Item		
5	As built drawings as specified. Drawings to be done on CAD, as no hand drawn mark-ups will be accepted	Item		
6	Four sets of hard copy O&M manuals C/W USB's (including certificates issued on completion such as electrical compliance, etc. Warranties, guarantees, maintenance schedule, etc.). USB's are to contain the entirety of the O&M Manuals in digital form, neatly organised.	Item		
7	Specialist commissioning and testing of the entire HVAC system by supplier, including reports, etc. Contractor must notify the Engineer of commissioning so that they can be present.	Item		
	Carried to Collection		R	

8	Additional commissioning and testing of the entire HVAC system pertaining to internal air balancing, reports, etc. Contractor must notify the Engineer of commissioning so that they can be present.		Item		
9	Labelling of all HVAC equipment. Labelling to include equipment naming, area serving, manufacturer details, year installed and design set points (where applicable)		Item		
10	Maintenance and guarantee of the complete installation for a period of 12 months from date of completion and handover.		Item		
11	Certificates to be issued on completion of the project in addition to detailed testing as specified - electrical compliances, etc.		Item		
12	Provisional sum - builder's work (Add R125 000.00)		Item		125,000.00
13	Allow for profit.		%		
14	Allow for attendance.		%		
15	Provisional sum - design and construct structural supports, plinths and structural openings for HVAC systems (Add R250 000.00)		Item		250,000.00
16	Allow for profit.		%		
17	Allow for attendance.		%		
18	Budgetary allowance - unforeseen items		Item		125,000.00
19	Other items not included in the foregoing and required by the Contractor. Full detailed schedule to be attached.	No	1		
	All cost rates for the below are to be priced as fully supplied and installed.				
	"LG" AIR-CONDITIONING EQUIPMENT				
	Carried to Collection			R	

	"LG Multi V5" outdoor unit c/w anti-vibrational mounts, weatherproof electrical isolator, insulated condensate drainage to nearest drain point, and all electrical & communications wiring. Condenser with factory corrosion resistant coating on coils, casings, base, fan assembly and PCBs. Fully labelled.				
20	ODU-1 - Heat Pump - 28 kW - ARUM100LTE5	No	1		
21	ODU-2 - Heat Pump - 33.6 kW - ARUM120LTE5	No	2		
22	ODU-3 - Heat Pump - 44.8 kW - ARUM160LTE5	No	1		
23	ODU-4 - Heat Pump - 56 kW - ARUM200LTE5	No	3		
24	ODU-5 - Heat Recovery - 56 kW - ARUM200LTE5	No	1		
	"LG Multi V5" indoor unit, P-traps, anti-vibrational dampers, mountings, electrical wiring and communication wiring to condenser unit. Fully labelled.				
25	IDU-1 - Mid-wall - 2.2 kW - ARNU07GSJN4	No	2		
26	IDU-2 - Mid-wall - 2.8 kW - ARNU09GSJN4	No	1		
27	IDU-3 - Mid-wall - 4.5 kW - ARNU15GSJN4	No	1		
28	IDU-4 - Mid-wall - 5.6 kW - ARNU18GSKN4	No	1		
29	IDU-5 - Mid-wall - 7.1 kW - ARNU24GSKN4	No	5		
30	IDU-6 - Mid-wall - 10.4 kW - ARNU36GSVA4	No	5		
31	IDU-7 - 4-way ceiling cassette - 2.2 kW - ARNU07GTRC4, c/w front panel (PT-QCHW0)	No	2		
32	IDU-8 - 4-way ceiling cassette - 2.8 kW - ARNU09GTRC4, c/w front panel (PT-QCHW0)	No	2		
33	IDU-9 - 4-way ceiling cassette - 4.5 kW - ARNU15GTQC4, c/w front panel (PT-QCHW0)	No	3		
34	IDU-10 - 4-way ceiling cassette - 5.6 kW - ARNU18GTQC4, c/w front panel (PT-QCHW0)	No	1		
	Carried to Collection			R	

35	IDU-11 - Fresh Air Intake (Ducted) - 28 kW - ARNU96GB8Z4, c/w drain pump (standard)	No	4		
	"LG" Split units, c/w indoor unit, outdoor unit, hard-wired controller, anti-vibrational mounts, weatherproof electrical isolators, insulated condensate drainage to nearest drain point, and all electrical & communications wiring. Outdoor unit with factory corrosion resistant coating on coils, casings, base, fan assembly and PCBs. Fully labelled.				
36	SU-1 - Mid-wall - 6.45 kW - M24AKH	No	1		
37	SU-1 - Mid-wall - 6.45 kW - M24AKH	No	1		
	Piping accessories				
38	Y-branch - ARBLN01621	No	4		
39	Y-branch - ARBLN03321	No	3		
40	Y-branch - ARBLN07121	No	2		
41	Header branch - ARCNN21	No	1		
42	HRU-01 - 6 branch heat recovery unit - PRHR063A	No	1		
43	HRU-02 - 8 branch heat recovery unit - PRHR083A	No	1		
44	EV-1 - Expansion valve kit - 56.3 kW - PRLK096A0	No	1		
45	EEV-2 - Expansion valve kit - 112.5 kW - PRLK396A0	No	1		
	Electrical accessories				
46	C1 - "LG Standard III" Wired Remote Controller, c/w connection & wiring to relevant indoor unit - PREMTB100	No	29		
47	Group control kit - PZCWRCG3	No	8		
	Carried to Collection			R	

Section No. 4
SECTION FOUR: MECHANICAL INSTALLATION
Bill No. 1
HVAC INSTALLATION

48	C2 "LG AC Smart 5" touch based centralised controller to control and monitor all air-conditioning units, c/w connection to all air-conditioning units (VRF, split and AHU), all required wiring, cards, set-up of the controller with scheduling, electronic accessories etc. for a complete, operational installation. - PACS5A000	No	1		
49	AHU communications kit (return air) - PAHCMR000	No	2		
	25mm "Armaflex" insulated refrigeration copper pipework c/w fittings & labelling run in cable trays (allowed elsewhere)				
50	Ø 6.35 mm	m	238		
51	Ø 9.52 mm	m	137		
52	Ø 12.7 mm	m	275		
53	Ø 15.88 mm	m	174		
54	Ø 19.05 mm	m	47		
55	Ø 22.2 mm	m	35		
56	Ø 28.58 mm	m	143		
	uPVC Drain Pipe Insulated with Armaflex c/w Supports, Brackets & Fittings. Laid to 1:80 fall & connected to nearest drain stack with traps by HVAC Contractor.				
57	Ø 25 mm	m	130		
58	Ø 50 mm	m	75		
	Cable Trays				
59	300mm wide standard cable trays (internal of building), c/w fixings & supports	m	110		
60	600mm wide standard cable trays (internal of building), c/w fixings & supports	m	30		
61	300mm wide enclosed, protective cable enclosure (external of building), c/w, painting, fixings & supports	m	60		
	Carried to Collection			R	

Section No. 4
SECTION FOUR: MECHANICAL INSTALLATION
Bill No. 1
HVAC INSTALLATION

62	600mm wide enclosed, protective cable enclosure (external of building), c/w, painting, fixings & supports	m	15		
63	75x100mm PVC trunking (exposed areas internal of building), c/w, painting, fixings & supports	m	80		
	Miscellaneous extras				
64	Bluchem treatment on ODU-01	No	1		
65	Bluchem treatment on ODU-02	No	2		
66	Bluchem treatment on ODU-03	No	1		
67	Bluchem treatment on ODU-04	No	3		
68	Bluchem treatment on ODU-05	No	1		
69	Bluchem treatment on SU-1 outdoor unit	No	1		
70	Bluchem treatment on SU-2 outdoor unit	No	1		
71	Lockable, galvanised security cage on SU-1 outdoor unit	No	1		
72	Lockable, galvanised security cage on SU-2 outdoor unit	No	1		
73	Additional R410 refrigeration charge	kg	56		
	AIR HANDLING UNITS				
	Carried to Collection			R	

	Air handling unit, c/w double skin construction, Chromadek-faced panels, base frame, adjustable levelling feet, anti-vibrational dampers, access doors, EC/VSD fan(s), electrical panel & fan control with dirty filter LEDs and status LEDs, cu/al coil with s/s casing, reverse cycle capable coil arrangement, drift inhibitor, s/s drip tray, primary filtration banks & mountings, mixing box, fresh air louvre and damper, return air spigot with damper, supply air spigot, internal lighting, gauges (minihelic/magnehelic), dirty filter alarms, trapped & insulated condensate drain to nearest drain point, connection to AHU kit (wiring & piping), electrical and electronic wiring, all required sensors and all consumables and material required for a complete installation.				
74	AHU-1 - vertical type - 56.2kW, 3320l/s & 250Pa ESP	No	1		
75	AHU-2 - horizontal type - 61.6kW, 3000l/s & 250Pa ESP	No	1		
76	Extra over for Bluchem treatment on AHU-1 coil(s)	No	1		
77	Extra over for Bluchem treatment on AHU-2 coil(s)	m	1		
	VENTILATION EQUIPMENT				
	"Systemair" inline duct fan c/w timer, speed controller (stepless), wiring, flanges, flexible collars, fixings, supports, anti-vibrational mountings, etc.				
78	SF-1 - Supply, 90-145l/s @ 200Pa - Prio Silent XP 150 EC	No	3		
79	SF-2 - Supply, 885l/s @ 200Pa - Prio 315 EC	m	1		
	"Xpelair" wall/window/ceiling mounted extract fan, c/w timer, controls, wiring, fixings, etc.				
80	EF-1 - ceiling mounted - 333 l/s - PX9	No	4		
81	EF-2 - window mounted - 145 l/s - GX9C	No	3		
82	EF-3 - window mounted - 171 l/s - GX9	No	6		
83	EF-4 - window mounted - 303 l/s - GX12	No	1		
	Carried to Collection			R	

	DUCTWORK				
	Galvanised sheet metal ductwork c/w neoprene rubber gaskets, area of bends and transformations, vanes, hangers, clamps, supports, etc. - insulated with 15 mm Compriflex/Thermaflex, vapour sealed, etc.				
84	0.8 mm rectangular	m2	343		
85	Ø250 mm circular	m	28		
86	Ø400 mm circular	m	11		
87	Ø560 mm circular	m	5		
	Flexible ducting - wire reinforced, insulated with fiberglass, internally and externally lined with foil face and inclusive of Q-bands, duct spigots and duct tape				
88	Ø250 mm circular	m	8		
89	Ø560 mm circular	m	10		
	Galvanised sheet metal ductwork (uninsulated), complete with hangers, supports, clamps etc. Inclusive of area over fittings (bends, transformations, etc.)				
90	0.8 mm rectangular	m2	124		
91	Ø200 mm circular	m	2		
92	Ø250 mm circular	m	2		
93	300 mm circular	m	2		
	Flexible ducting - wire reinforced, un-insulated and inclusive of Q-bands, duct spigots & duct tape				
94	Ø200 mm circular	m	6		
95	Ø250 mm circular	m	1		
96	Ø300 mm circular	m	2		
	Carried to Collection			R	

	AIR-SIDE EQUIPMENT				
	"Trox AT" double deflection grille c/w plenum & O.B.D.				
97	SG-1 - supply air - 200x200mm	No	3		
98	SG-2 - supply air - 300x250mm	No	2		
99	SG-2 - supply air - 300x250mm	No	2		
100	SG-4 - supply air - 550x250mm	No	3		
101	SG-5 - supply air - 850x250mm	No	7		
	"Trox DUK-4-E1-4" jet diffuser c/w external electric actuator, controls and wiring.				
102	JD-1 - ceiling mounted - Ø400mm	No	8		
	"Trox" disc valve				
103	SD-1 - supply air, type "Z-LVS" - Ø200mm	No	8		
	Double sided aluminium transfer grille c/w acoustic insulating material between grille faces				
104	TG-1 - 500x1000mm	No	2		
	"Trox" return air grille, c/w O.B.D., filter, hinged frame & plenum				
105	RAFF-1 - 1200x600mm	No	1		
	"Trox AWR" aluminium weather louvre, c/w insect screen				
106	WL-1 - 200x550mm	No	1		
107	WL-2 - 250x250mm	No	2		
108	WL-3 - 1000x1000mm	No	6		
	Remove, clean and re-install existing air-side equipment				
109	ESG-1 - existing supply air grille - 450x250mm	No	12		
	Carried to Collection			R	

110	ERG-1 - existing return air grille - 700x700mm	No	6		
111	ERG-2 - existing return air grille - 500x1000mm	No	2		
112	ELD-1 - existing louvre door c/w repainting - 3000x1500mm	No	1		
	Washable primary filter c/w sliding frame				
113	FF-1 - 200x550mm	No	1		
114	FF-2 - 250x250mm	No	2		
115	FF-3 - 1000x1000mm	No	4		
	"Systemair LDC" circular sound attenuator				
116	ATT-1 - Ø315x900L mm	No	2		
	"TROX XS" rectangular sound attenuator				
117	ATT-2 - 300x450x500L mm	No	4		
118	ATT-3 - 600x600x1500L mm	No	1		
119	ATT-4 - 700x700x1500L mm	No	1		
120	ATT-5 - 1000x400x1500L mm	No	1		
	Balancing damper				
121	BD-1 - rectangular - 250x350mm	No	1		
122	BD-2 - rectangular - 300x250mm	No	3		
123	BD-3 - rectangular - 350x350mm	No	1		
124	BD-4 - rectangular - 400x400mm	No	1		
125	BD-5 - rectangular - 500x350mm	No	1		
126	BD-6 - rectangular - 1000x400mm	No	1		
127	BD-7 - rectangular - 1000x1000mm	No	1		
	Carried to Collection			R	

Section No. 4

SECTION FOUR: MECHANICAL INSTALLATION

Bill No. 1

HVAC INSTALLATION

COLLECTION

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Item No		Quantity	Rate	Amount
	SECTION FOUR: MECHANICAL INSTALLATION			
	BILL NO. 2			
	LIFT INSTALLATION			
	Tenderers are referred to the relevant clauses in the separate document: ASAQS Model Preambles for trades (2008 edition) and the ASAQS supplementary preambles which are incorporated in this Bill of Quantities.			
	Note: The brand of units are to conform to engineer's approval			
	PRELIMINARY AND GENERAL			
	Note: All items shall be priced for whatever cost may be considered necessary for Preliminary and General items to carry out the Electrical Installation in full, as detailed in the drawings, Specifications and Schedules, which shall include, but shall not be limited, to the following:			
	Miscellaneous			
1	Lift Contractor's P&G's, including compliance to OSHA, site establishment and removal, exit medicals, site supervision and management	Item		
2	Workshop, builder's work and as-built drawings as specified. Drawings to be done CAD, as no hand drawn mark-ups will be accepted.	Item		
3	Four sets of hard copy O&M Manuals C/W USB's (incl. certificates issued on completion such as electrical compliances, DOL annexures, warranties, guarantees, maintenance schedule, etc.) USB's are to contain the entirety of the O&M Manuals in digital form, neatly organised.	Item		
4	Cost of signage, hoarding, barricades, scaffolding, protection for 1-Off lifts.	Item		
	Carried to Collection		R	

5	Certificate to be issued on completion of the project in addition to detailed testing as specified - electrical compliances, etc.	Item			
6	Budgetary allowance - unforeseen items (add R75 000).	Item			75,000.00
7	Other items not included in the foregoing and required by the Contractor. Fully detailed schedule to be attached.	Item			
	LIFT				
	Total Design, Manufacture, Supply & Install - c/w Items Specified in Technical Specification (Lift, Glass & Steel Structure)				
8	1a Complete Manufacturing Cost & Equipment (incl. ESO – Energy Saving Operation as Specified)	Item			
9	1b Transportation to Site & Rigging as Specified	Item			
10	1c Builder's Work	Item			
11	Supply and Install Battery Back-up (A.R.D)	Item			
12	Independent Lift Inspector's Approval before Lift Handover	Item			
13	12 Months Free Maintenance	Item			
	Carried to Collection			R	

Section No. 4

SECTION FOUR: MECHANICAL INSTALLATION

Bill No. 2

LIFT INSTALLATION

COLLECTION

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Section No. 4

SECTION FOUR: MECHANICAL INSTALLATION

SECTION SUMMARY - SECTION FOUR: MECHANICAL INSTALLATION

Bill No		Page No		Amount
1	HVAC INSTALLATION	81		
2	LIFT INSTALLATION	84		

THE TENDERER IS TO STATE THE FOREIGN EXCHANGE RATE AND DATE AT WHICH THIS TENDER WAS PRICED.	
Foreign Currency	**Date**
1 US Dollar =	
1 Euro =	
Other:	

Completed by (Name):

Signature:

On Behalf of (Company):

Date:

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Section No. 4
SECTION FOUR: MECHANICAL INSTALLATION

FINAL SUMMARY

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Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 1

The Association of South African Quantity Surveyors
Die Vereniging van Suid-Afrikaanse Bourekenaars

MODEL PREAMBLES FOR TRADES 2008

forming part of
the bills of quantities

Project: _____

_____

_____

Contract Reference Number: _____

Effective date November 2008

ISBN 978-0-620-1663-4

EXPLANATORY NOTES AND INSTRUCTIONS ON THE USE OF THESE MODEL PREAMBLES

1. The document

1.1 This document is published by and is available from the Association of South African Quantity Surveyors, P.O. Box 3527, Halfway House, 1685. Telephone (011) 315 4140. E-mail: administration@asaqs.co.za

1.2 The contents of this document are intended to cover workmanship and materials encountered in a significant majority of projects. If a material is not encountered in a significant majority of projects, its preamble will in all likelihood not be included in this document

1.3 By its very nature, this document is a "Model" document and one that is designed to act as a basis upon which to build. It is anticipated that it will be supplemented by a "Supplementary Preambles" document included in the text of the bills of quantities that will include, *inter alia*, the following:

1.3.1 supplementary clauses of a general nature that practitioners may deem necessary to cover their own individual requirements,

1.3.2 additional clauses pertaining to specific materials incorporated in a project and not covered by the Model Preambles,

1.3.3 amendments to anything contained in the Model Preambles. A clause has been incorporated in the "General" section of the document stipulating that anything contained in the "Supplementary Preambles" which is at variance to that which is contained in the Model Preambles, will take precedence over the Model Preambles and apply to the works in hand

1.4 It is intended that this document will be used by reference only in the text of the bills of quantities and will NOT be bound or reproduced therein

2. The basic philosophy

2.1 Wherever possible, reference has been made throughout the preambles to South African National Standards (SANS) to describe materials and methods respectively. It is therefore incumbent on the users of these preambles to have ready access to the relevant Specifications and Codes. Where such Specifications or Codes do not exist, suitable preambles have been compiled

2.2 These preambles have been designed to assist in abbreviating descriptions in the text of the bills of quantities and practitioners are encouraged to make use of this facility. e.g. The description of a stormwater catchpit would read:

"Brick stormwater catchpit size internally 600 x 400 x 1 200mm deep to invert fitted with and including a 450 x 300mm x 59kg cast iron grating and frame"

2.3 Wherever alternatives exist in respect of materials or workmanship, specific choices have been made in these preambles. Should users require different choices to specific items, these should be referred to in the Supplementary Preambles as outlined in clause 1.3

3. Additional notes in the use of these Model Preambles

3.1 **Concrete, Formwork and Reinforcement**

The Project Specification embodied in these preambles was compiled in collaboration with the Authors of SANS 1200G, which forms the basis for the Concrete, Formwork and Reinforcement model preambles

Users of these preambles are advised to submit a copy of the Model Preambles to the Engineers involved in a project for their scrutiny. Any amplifications, amendments, etc required by individual Engineers would then be incorporated in the Supplementary Preambles referred to in item 1.3

3.2 **Roof Coverings**

The roof coverings included in these Model Preambles are limited in their content and therefore any roofing material not included in these Preambles will need to have its full preamble included in the Supplementary Preambles

3.3 **Structural Steelwork**

The comments made under item 3.1 apply equally to Structural Steelwork

Note that the protective treatment of the structural steel covers only the treatment up to and including the primer (and patching after erection). The finishing coats of paint must be fully described and included either in the "Structural Steelwork" or in the "Paintwork" trade, as the practitioner wishes

MODEL PREAMBLES FOR TRADES

CONTENTS

A. GENERAL

A.1 APPLICATION OF CLAUSES

These Model Preambles for Trades, and any Supplementary Preambles, shall be read in conjunction with and shall form part of the descriptions of items in the bills of quantities

Where descriptions or Supplementary Preambles in the bills of quantities differ from these Model Preambles for Trades, the descriptions or Supplementary Preambles in the bills of quantities shall take precedence. Where supplementary preambles differ from descriptions in the bills of quantities, the descriptions in the bills of quantities shall take precedence

Except where otherwise stated, all preambles contained in any individual Trade Preamble shall apply equally to any work of a similar nature in all other trades

A.2 ABBREVIATIONS

The following abbreviations shall apply:

AASHTO	–	American Association of State Highway and Transportation Officials
AISI	–	American Institute of Steel Industries
BS	–	British Standard
CKS	–	Coordinating Specifications issued by the Central Coordinating Committee under the auspices of the South African Bureau of Standards
CSIR	–	Council for Scientific and Industrial Research
SANS	–	South African National Standards and the number following shall refer to the relevant specification or code of practice as the case may be

A.3 MATERIALS AND WORKMANSHIP

Materials and workmanship shall be the best of their respective kinds. Only new and undamaged materials shall be used in the Works. Materials to be permanently installed into the works shall not be used for any temporary purposes on site. Work shall be to the approval of the Principal Agent and shall be executed in accordance with the relevant manufacturer's written recommendations and instructions where applicable

A.4 PROPRIETARY PRODUCTS

For the purposes of submission of tenders, rates for items described in the bills of quantities by trade names, catalogue references, etc shall be for the particular type and manufacture specified

The approval of the Principal Agent shall be obtained prior to any substitution and where products or materials etc other than those specified are used, adjustments in the rates will be made if necessary

A.5 ASSEMBLING

Rates for manufactured items shall include assembling complete and handing over in proper working order

A.6 REFERENCES IN DESCRIPTIONS

Any references given in brackets at the end of certain descriptions shall refer to the relevant references on the drawings or schedules

A.7 WATER

Water shall be clean and free from injurious amounts of acids, alkalis, organic matter and other substances and shall be suitable for its intended use

A.8 APPLICATION OF THE NATIONAL BUILDING REGULATIONS

All work shall be executed in accordance with the requirements of SANS 10400

A.9 ACCURACY IN BUILDINGS

The dimensional and positional accuracy of the buildings and their component parts shall comply with Grade II requirements of SANS 10155 unless otherwise stated

A.10 REFERENCES TO OTHER DOCUMENTS

References in these "Model Preambles for Trades" to other documents, including SANS, CKS and BS, shall pertain to the latest edition thereof including all amendments thereto at the date for submission of the tender

B. ALTERATIONS

B.1 ALTERATIONS

In taking down and removing existing work the utmost care shall be observed to prevent any structural or other damage to remaining portions of the building. The Contractor shall ensure the stability of all structures during alteration work

Special care shall be exercised during the progress of the work to ensure that any electrical installations, water supply pipes, telephone and other services which may be encountered are not interfered with and notice shall be given to the Principal Agent if any disconnection or alterations become necessary

The Contractor shall take all precautions necessary to prevent any nuisance from dust whilst carrying out the work

B.2 MATERIALS FROM THE ALTERATIONS, CREDIT, ETC

Materials recovered from the alterations (except where described as to be re-used or to be handed over to the Employer) will become the property of the Contractor, who may allow credit in respect thereof where provided for in the bills of quantities. Such materials shall not be re-used in new work without written permission from the Principal Agent

Materials described as “removed” shall be removed from the site immediately.

Materials described as “handed over to the Employer” shall be carefully dismantled where necessary, neatly stored under cover on the site where directed and protected from damage, until required

Materials described as “set aside for re-use” shall be carefully dismantled where necessary, cleaned, neatly stored under cover and protected from damage until required for re-use. Any damage caused to such materials during removal, storage or refixing shall be made good at the Contractor’s expense

B.3 DISPOSAL OF DEBRIS ETC

The Contractor shall be responsible for the removal from the site of all materials, debris and rubbish resulting from the alterations

B.4 MAKING GOOD DAMAGED WORK

The Contractor shall make good in all trades to existing work where damaged or disturbed through the alterations with all necessary new materials to match the existing

B.5 FORMING NEW OPENINGS OR ALTERING OPENINGS IN EXISTING WALLS

Where new openings are formed or openings altered in existing walls, the wall above the opening shall be broken out and a new brick, in situ concrete or prestressed concrete lintel inserted, complete with all necessary reinforcement, formwork, turning piece, etc, the jambs and portions of openings as described shall be built up with new brickwork or blockwork properly toothed and bonded to existing, cavities of hollow walls shall be closed where necessary and finishes shall be made good all round and into reveals

B.6 BUILDING UP OPENINGS

Where existing openings are given in number as built up, the existing surfaces all round shall be prepared as necessary, brickwork or blockwork properly toothed and bonded to existing, wedged up to underside of existing lintel and finishes shall be made good on both sides

C. EARTHWORKS

C.1 DEMOLITIONS

C.1.1 Nature and extent

Descriptions of demolitions give a rough guide only as to the scope of the work. Tenderers are therefore advised to visit the site before submitting a tender and to acquaint themselves with the nature and extent of the work to be done and the value of recoverable materials which are not to be re-used or handed over to the Employer. Unless otherwise stated, loose furniture, kitchen and other equipment, apparatus, machinery, etc shall remain the property of the Employer and the removal thereof does not fall within the scope of this Contract

The Contractor shall completely demolish the buildings etc in a careful, skilful, practical and safe manner down to 150mm below ground level

Demolitions shall include breaking up and removing:

all floors and surface beds;

all external screen walls, steps, ramps, aprons, surface water channels, rainwater sumps, gulleys, etc attached to the building to be demolished;

all services, manholes, etc in ground to a point not less than 1m beyond the perimeter of the building including plugging off ends of all remaining pipes, drains, etc, filling in holes where necessary and ramming and levelling to ground level

Where only a portion of a building is to be demolished, it shall be done without damage to the remaining portion of the building. Any such damage shall be made good by the Contractor at his own expense

C.1.2 Notices etc

The Contractor shall, before commencing work, obtain all necessary authorisation for carrying out the work, by whatever means including the use of pneumatic equipment or blasting, give all necessary notices and pay all charges and fees in connection therewith. He shall also comply with all regulations pertaining to rodent extermination and he shall obtain the requisite Rodent Extermination Clearance Certificate and pay all necessary fees. All receipts and certificates shall be left in the safekeeping of the Principal Agent. All the abovementioned charges and fees shall be paid by the Contractor and included in his prices

The Contractor shall give ample notice to the Principal Agent and Local Authorities regarding any disconnections necessary prior to the removal or interruption of electrical or telephone cables, water and sanitary services etc

C.1.3 Loss

After the handing over of the site to the Contractor, the full risk of any loss or damage to buildings to be demolished shall be the responsibility of the Contractor and he shall take such precautions as he deems necessary against such loss or damage

C.1.4 Materials from the demolitions, credit, etc

Materials recovered from the demolitions will become the property of the Contractor, who may allow credit in respect thereof where provided for in the bills of quantities. Such materials shall not be re-used in any new work without written permission from the Principal Agent

C.1.5 Disposal of debris etc

The Contractor shall be responsible for the removal from the site of all materials, rubble, debris and rubbish resulting from the demolitions

C.2 SOIL INSECTICIDES

The application of soil insecticides shall be carried out in accordance with “The application of soil insecticides for the protection of buildings” - SANS 10124

C.3 FILLING ETC

C.3.1 **Filling generally**

Filling over site shall be spread, levelled, watered and consolidated in layers not exceeding 300mm

Filling under floors and backfilling to excavations shall be suitable inert material, free from clay, vegetable matter, large stones, etc, having a maximum plasticity index of 10, spread, levelled and compacted to a density of at least 90% Mod. AASHTO

C.3.2 **Hardcore**

Hardcore shall be broken stone or other approved hard material graded from 25mm to 75mm with the finer material on top and shall be spread, levelled and consolidated

C.4 EXCAVATIONS

C.4.1 **Classification of excavated material**

“Hard rock” shall mean granite, quartzitic sandstone or other rock of similar hardness, the removal of which requires drilling, wedging and splitting or the use of explosives

“Soft rock” shall mean hard material the removal of which warrants the use of pneumatic tools and includes hard shale, ferricite, compact ouklip and material of similar hardness

“Earth” shall mean all ground other than that classified as “hard rock” or “soft rock” and shall include made-up ground and any loose stones or pieces of concrete not exceeding 0,03m^3 in volume

D. CONCRETE, FORMWORK AND REINFORCEMENT

D.1 SPECIFICATION FOR CONCRETE WORK GENERALLY

All in situ concrete work (plain and reinforced) shall comply with SANS 1200G supplemented by the following Project Specification. Where SANS 1200G and the Project Specification are in conflict, the Project Specification shall take precedence

Wherever the term "Engineer" appears in SANS 1200G or in the following Project Specification this shall be deemed to mean the Principal Agent's representative responsible for this section of the Works

PROJECT SPECIFICATION

The following amplifications, additions and amendments to SANS 1200G shall constitute the Project Specification. Clause numbers refer to either the existing clauses in SANS 1200G or to new clauses, which are related to the existing clauses

1. **SCOPE**
This clause is amended to include:

1.1 This specification does not cover the methods by which the finished structure is to be measured for the purpose of payment and the "Standard System of Measuring Building Work" shall apply

2. **INTERPRETATIONS**

2.1 **SUPPORTING SPECIFICATIONS**
Clause 2.1(b) shall not apply

2.2 **APPLICATION**
This clause shall not apply

4. **PLANT**

4.5 FORMWORK

4.5.2 **Finish**
Unless otherwise stated the quality of all formwork shall be such that the finished surface of the concrete is "Rough" in terms of clause 5.2.1(a)

5. **CONSTRUCTON**

5.2 FORMWORK

5.2.1 **Classification of Finishes**

(a) **Rough**. No treatment of the surface of the concrete will be required after the striking of the formwork. The finish of the concrete need not be more accurate than Degree of Accuracy III

(b) **Smooth**. Imperfections such as small fins, bulges, irregularities, surface honeycombing and surface discolorations shall be made good and repaired by approved methods. The finish of the concrete shall be accurate to Degree of Accuracy II

(c) **Special**

(i) **Smooth and fair**

This class of finish requires the highest standard of concrete work, formwork, accuracy and technique

Concrete placed in any one structure to give this finish shall be made from cement and aggregates from the same source. The grading of the aggregate shall be kept constant

Formwork shall be metal, wrot timber or other approved material in new condition designed and constructed to suit the particular job in hand and with shutter bolts and joints between panels in a regular pattern approved by the Principal Agent. Joints between panels shall be watertight, but the use of sealing tape which will mark the concrete shall not be permitted

Designated joints shall be in the position and of the details shown upon the working drawings. Should the Contractor wish to incorporate further construction joints or amend the position of those shown to suit his own requirements or technique, this may be allowed provided that all design considerations are met, that the prior approval of the Engineer is obtained and that any extra costs are borne by the Contractor

In the case of horizontal construction joints, the top edge of the concrete on the smooth and fair finished side shall be struck true and level with a trowel

Special care shall be taken to ensure that forms are clean and free of all pieces of tying wire, nails and other debris at the time of concreting

The standard of finish shall be such that upon removal of the formwork, no further treatment, other than treatment of bolt holes if required, shall be found necessary to provide a straight, smooth and uniform finish of good quality and consistent colour and texture, free of all honeycombing etc. Any defect shall be made good by either removing and replacing the defective concrete or, in certain instances only, by patching

5.5 CONCRETE

5.5.1.6 **Prescribed mix concrete**

Where prescribed mix concrete is specified the proportions of constituents, the maximum size of coarse aggregate and the estimated minimum compressive strength shall be as specified in the following table:

Class of Concrete	Estimated minimum compressive strength in MPa at 28 days	Maximum nominal size of coarse aggregate in mm	Proportions of Constituents		
			Cement (Parts)	Fine aggregate (Parts)	Coarse aggregate (Parts)
A	7	37,5	1	4	8
B	15	19	1	3	5
C	20	19	1	2,5	3,5

Cement shall comply with SANS 50917-1 of strength 32,5N or higher

Should cement and aggregates be mixed by volume, the contents of a 50kg sack of cement shall be taken to be 0,033m^3

Notwithstanding the requirements contained in SANS 1200G, the Principal Agent may permit certain items of non-structural concrete to be mixed by hand

If the concrete is mixed by hand, it shall first be mixed in a dry state on a clean non-absorbent surface until it is of uniform colour and consistency. Just enough water shall then be added to permit mixing and working, at which stage the concrete shall continue to be mixed until it is of uniform colour and consistency

5.5.1.7 **Strength concrete**

Where strength concrete is specified it shall be designated by its specified strength followed by the size of stone used in its manufacture, eg 30 MPa/19mm

The water/cement ratio shall be as Table 5 of clause 5.5.1.5 for moderate exposure conditions

5.5.1.8 "**No-Fines" concrete**

"No-fines" concrete shall consist of one part cement to eight parts aggregate graded from minimum 6mm to maximum 13mm size

The quantity of water used shall be just sufficient to form a smooth grout which shall completely coat every particle of aggregate and also to ensure that the grout is just wet enough to form a small fillet at each point of contact between the stones. “No-fines” concrete mixed with excessive water, which results in a thin grout, which drops off the aggregate, will be rejected

“No-fines” concrete shall be placed in its final position within 20 minutes of mixing and shall be placed in continuous horizontal layers. Concrete shall be spade worked sufficiently to ensure that it fills the forms but vibrating, tamping or ramming will not be permitted

5.5.3.2 **Ready-mixed concrete**

The use of ready-mixed concrete and the acceptability of test results from a central concrete production facility shall be subject to the written approval of the Engineer

6. **TOLERANCES**

Degree of Accuracy II shall apply for all work unless otherwise stated

7. **TESTS**

7.1 FACILITIES AND FREQUENCY OF SAMPLING

7.1.2 **Frequency of sampling**

7.1.2.5 The frequency of sampling shall be as directed by the Engineer, but not less than one set of cubes from every 50m³ cast

8. **MEASUREMENT AND PAYMENT**

This clause shall not apply

D.2 AGGREGATES OF LOW DENSITY

Aggregates of low density shall comply with SANS 794

D.3 HOLLOW BLOCKS, PREFABRICATED BLOCK BEAMS AND PLANKS, ETC

Blocks, block beams, planks, etc shall be fixed and supported in such a manner that no movement can take place before or during the casting of concrete. No broken components shall be used

D.4 SUPERVISION

A competent and experienced foreman shall superintend personally the whole of the concrete construction and pay special attention to:

(a) The quality, testing and mixing of materials,
(b) The placing and compaction of concrete,
(c) The construction and removal of formwork and
(d) The sizes and position of reinforcement

The Contractor shall obtain the permission of the Principal Agent before commencing concreting of foundations or reinforced structure

No inspection, approval, authorisation to proceed, comment or instructions following from such an inspection, or failure of the Principal Agent to comment on any particular aspect of the work, shall be deemed to relieve the Contractor in any way from his obligation to ensure through his own supervision that the work is constructed in every way in accordance with the Drawings, Specification and Conditions of Contract, nor relieve him from his obligations to make good any fault or defect, nor shall it be deemed that there is any obligation on the Principal Agent to inspect all or any part of the Works or that such inspection is necessarily complete in every respect

D.5 GENERAL

Concrete

Rates for concrete work shall include all “construction joints” other than “designated joints” as defined in SANS 1200G clause 2.4.3 which are measured separately, and for the design of strength concrete mixes and all testing of concrete and materials other than compressive strength testing of concrete samples taken from concrete being placed in the Works. The Contractor shall only be entitled to payment for those samples and compressive strength tests called for by the Engineer and which pass the test requirements

Surface beds cast in panels shall be cast in panels approximately 9m^2

Formwork

Formwork to slabs and beams shall be cambered where required
Rates for formwork to soffits shall include propping not exceeding 3,5m high unless otherwise described. Formwork to walls and columns is not exceeding 3,5m high above bearing level unless otherwise described

Reinforcement

Standard welded steel fabric reinforcement shall be as included in Table 1 of SANS 1024 and shall have 300mm wide laps.

The mass of binding wire is not included in the mass of the reinforcement and the cost thereof shall be included in the rates for the reinforcement

E. PRECAST CONCRETE

E.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Precast concrete paving slabs SANS 541

Cement, water, aggregates and reinforcement shall be as described under D. CONCRETE, FORMWORK AND REINFORCEMENT

E.2 CONCRETE

Concrete shall be as described under D. CONCRETE, FORMWORK AND REINFORCEMENT and unless otherwise stated shall be prescribed mix concrete Class C but with coarse aggregate of an appropriate size

E.3 MOULDS

Before each casting, moulds shall be coated with a suitable release agent which will not in any way discolour the surface of the finished product or impair its strength. Where items are described as “finished smooth from the mould” or as “precast terrazzo”, moulds shall be made to a high degree of accuracy and shall be such as to leave even and smooth surfaces

E.4 FINISHES TO BLOCKS

Where described as “precast terrazzo”, such surfaces shall have a facing of terrazzo described under O. PLASTERING. The facing shall be poured into the moulds in a wet state (not dry pressed) and thoroughly worked up against finished faces to ensure that it finishes smooth from the mould

Projections shall be rubbed off and faces shall be of even colour and free from blemishes, cracks and other imperfections. Salient angles shall be arris rounded

E.5 CASTING ETC

Items shall be suitably cured, shall not be handled whilst still green and shall not be built in within 21 days of casting

E.6 REINFORCEMENT

Unspecified reinforcement required for manufacturing, handling and erection purposes and for reinforcing projecting and other unwieldy portions of blocks shall be provided by the Contractor at his discretion

E.7 BEDDING, JOINTING AND POINTING

Blocks shall be bedded and jointed solidly in Class I mortar as described under F. MASONRY and shall be pointed with slightly keyed joints

Blocks finished with “precast terrazzo” shall have joints raked out and pointed with slightly keyed joints in tinted waterproofed mortar composed of one part cement and three parts sand to match terrazzo facing

E.8 GENERAL

Precast concrete work shall include reinforcement required for manufacturing, handling and erection purposes, steel rod or wire hooks and/or mortices for lewis bolts required for handling and transporting, any necessary temporary propping and strutting and bedding, jointing and pointing

F. MASONRY

F.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Burnt clay masonry units	SANS 227
Limes for use in building	SANS 523 {Slaked (hydrated) limes}
Aggregates from natural sources – fine aggregates for plaster and mortar	SANS 1090
Concrete masonry units	SANS 1215
Prestressed concrete lintels	SANS 1504
Burnt clay paving units	SANS 1575
Metal ties for cavity walls	SANS 28
Common cement	SANS 50197-1 (Class 32,5N)
Masonry cement	SANS 50413-1 (Class 22,5X)
Concrete masonry construction	SANS 10145
The structural use of masonry	SANS 10164-1
Masonry walling	SANS 10249
Concrete floors	SANS 10109-1&2

F.2 SAND

Sand shall be washed where necessary and screened through a 2,4mm mesh sieve

F.3 BURNT CLAY BRICKS

Burnt clay bricks shall be of nominal size 222 x 106 x 73mm unless otherwise stated

Common bricks shall be General Purpose bricks

Extra hard burnt bricks shall be General Purpose (Special) bricks

Facing bricks shall exhibit a liability to efflorescence not in excess of “Slight” and water absorption when tested in conformity with the requirements of SANS 227 shall not exceed 14%

Particular care shall be taken to preserve arrisses and faces of facing and paving bricks during transit and handling

F.4 CONCRETE BRICKS

Concrete bricks shall have a nominal compressive strength of 8 MPa

F.5 QUARRY TILES ETC

Quarry, cement and similar tiles shall be of approved manufacture, even in shape and size, free from cracks, twists or blemishes and uniform in colour

F.6 WIRE TIES

Wire ties shall be of galvanized steel of the single wire type for solid walls and either the “Butterfly” or Modified PWD type for hollow walls. Ties shall be of sufficient length to allow not less than 75mm of each end to be built into brickwork or embedded in concrete

F.7 BRICKWORK REINFORCEMENT

Brickwork reinforcement shall be manufactured from hard drawn steel wire conforming to BS 785 and shall consist of two 2,8mm diameter main wires with 2,5mm diameter cross wires at 300mm centres welded at intersections

Brickwork reinforcement shall be lapped not less than 300mm at end joints and for a length equal to the width of the widest reinforcement at intersections

F.8 MORTAR

Mortar shall comply with the following table:

1	2	3	4
Mortar Class	Minimum compresive strength MPa	Cement:sand (common cement)	Cement:sand (masonry cement)
I	10	1:4 or 50kg to 130 litres	1:3 or 50kg to 100 litres
II	5	1:6 or 50kg to 200 litres	1:5 or 50kg to 170 litres
III	1,5	1:9 or 50kg to 300 litres	1:6 or 50kg to 200 litres

Mortar shall be Class II unless otherwise specified

Mortar plasticizers may only be used with the approval of the Principal Agent

The materials shall be mixed dry until of uniform colour, water added and the mixture turned over until the ingredients are thoroughly incorporated

Mortar shall be produced in such quantities as can be used before commencement of set and no mortar that has set shall be used

F.9 COMPO MORTAR

Compo mortar shall be Class III mortar in accordance with clause F.8 but with a lime content of 80 litres

The lime and sand shall be mixed dry until of uniform colour, water added and the mixture turned over until the ingredients are thoroughly incorporated. Immediately before use, the cement shall be mixed in and the requisite amount of water added. Compo mortar shall be produced in such quantities as can be used before commencement of set and no compo mortar that has set shall be used

F.10 BRICKWORK

Wherever practicable, brickwork shall be built in stretcher bond. Unless legitimately required to form bond, no false headers shall be used. English bond shall only be used where specifically so indicated or where stretcher bond is not practicable

Brickwork, unless otherwise described, shall be built in Class II mortar

Bricks shall be laid on a solid bed of mortar and all joints shall be grouted up solid

The brickwork shall be carried up in a uniform manner, no part being raised more than 1,2m above adjoining work

Where necessary, bricks shall be wetted before being laid and the course of bricks last laid shall be well wetted before laying a fresh course upon it

Walls in thicknesses of more than one skin shall have at least five wire ties per square metre. Linings to concrete, unless otherwise specified, shall be tied to the concrete with at least five wire ties per square metre

Hollow walls, unless otherwise specified, shall be built of two half brick skins with cavity between, tied together with at least five wire ties per square metre. The cavities shall be kept free of all rubbish, mortar droppings and projecting mortar. Mortar joints to brickwork shall be not less than 8mm or more than 12mm thick

F.11 BLOCKWORK

Unless otherwise described, all blockwork shall be built in stretcher bond. Whole blocks shall be used except where bats or closers are required to form bond. Blockwork, unless otherwise described, shall be built in Class II mortar

Solid blocks shall be laid on a solid bed of mortar and all joints shall be grouted up solid

Hollow blocks shall be laid in shell bedding, ie only the inner and outer shells of the blocks shall be covered with mortar. Vertical joints shall be similarly formed

The blockwork shall be carried up in a uniform manner, no part being raised more than 1,2m above adjoining work

Clay blocks shall be wetted before being laid and the course of blocks last laid shall be well wetted before laying a fresh course upon it

F.12 CENTRES AND TURNING PIECES

Centres and turning pieces to soffits of arches and lintels shall be left in position for not less than 14 days

F.13 FACE BRICKWORK

Face brickwork shall be built in stretcher bond, unless otherwise specified, to a true and fair face. Perpends shall be vertically aligned

Facing bricks shall be mixed to ensure that the proper blending of bricks within the colour range of each facing brick being used is obtained

F.14 PAVINGS, SILLS, COPINGS, ETC

Clay bricks and tiles shall be wetted before fixing and shall be solidly bedded and jointed in Class I mortar and pointed with slightly keyed joints

G. WATERPROOFING

G.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Bituminous damp-proof courses	SANS 248 (Type FV)
Polyolefin film for damp- and waterproofing in buildings (walls, sills, etc)	SANS 952 (Type B)
Polyolefin film for damp- and waterproofing in buildings (floors and basements)	SANS 952 (Type C)
Mastic asphalt for roofing	SANS 297
Mastic asphalt for damp-proof courses and tanking	SANS 298
Bituminous roofing felt	SANS 92 (Type 60)
Polyolefin film for damp- and waterproofing in buildings (flat roofs)	SANS 952 (Type A)
Chloroprene rubber sheet (for waterproofing)	SANS 580
Sealing compounds for the building industry, two-component, polysulphide base	SANS 110 (Type 2 - Gun Grade)
Sealing compounds for the building and construction industry, two- component, polyurethane base	SANS 1077
The waterproofing of buildings (including damp-proofing and vapour barrier installation)	SANS 10021

G.2 WATERPROOFING TO ROOFS, BASEMENTS, ETC

Waterproofing to roofs, basements, etc shall be carried out by workmen who are experienced in this type of work

G.3 DAMP-PROOF COURSE TO WALLS

All joints in damp-proof course to walls shall be lapped a minimum of 150mm except at junctions and corners where the lap shall equal the full thickness of the wall

H. ROOF COVERINGS ETC

H.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Concrete roofing tiles	SANS 542
Clay roofing tiles	SANS 632
Sawn softwood timber battens	SANS 1783-4
Fibre-cement sheets (flat and profiled)	SANS 685
Aluminium alloy corrugated and troughed sheets	SANS 903
Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities	SANS 3575
Continuous hot-dip zinc-coated carbon steel sheet of structural quality	SANS 4998
Polyolefin film for damp- and waterproofing in buildings	SANS 952
Metal roofing tiles	SANS 1022
Glass-reinforced polyester (GRP) laminated sheets (profiled or flat)	SANS 1150
Fasteners for roof and wall coverings in the form of sheeting	SANS 1273
Materials for thermal insulation of buildings	SANS 1381-1&4
Expanded polystyrene thermal insulation boards	SANS 1508
Fixing of concrete interlocking roofing tiles	SANS 10062
Roof and side cladding	SANS 10237
Sheet zinc	BS 849
Sheet lead	BS 1178
Sheet aluminium	BS 1470
Sheet copper	BS 2870

H.2 GALVANIZED STEEL PROFILED SHEETS ETC

Galvanized steel profiled sheets, ridge and hip coverings, etc shall be coated with a minimum of 275 g zinc per m^2 and shall be free of white rust

H.3 GALVANIZED SHEET IRON

Galvanized sheet iron shall be rolled steel sheet coated on both sides with a minimum of 275 g of zinc per m^2 and shall be free from white rust

H.4 NAILING AND SCREWING

Where nailing and screwing is required:

- galvanized iron nails and screws shall be used for galvanized sheet iron and sheet zinc
- copper or copper alloy nails and screws for sheet copper and sheet lead
- aluminium alloy or stainless steel nails and screws for sheet aluminium

H.5 LAPS

Sheet metal flashings shall have minimum 100mm laps and linings to valleys, secret gutters, etc minimum 225mm laps

H.6 GENERAL

Rates for profiled sheet roofing and rolled edges, ridge and hip coverings, flashing pieces, etc of metal, fibre-cement, plastic, etc shall include fixing accessories

I. CARPENTRY AND JOINERY

I.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Sawn softwood timber : General requirements	SANS 1783-1
Sawn softwood timber : Stress-graded structural timber and timber for frame wall construction	SANS 1783-2
Sawn softwood timber : Brandering and battens	SANS 1783-4
Softwood flooring boards	SANS 629
Hardwood furniture timber	SANS 1099
Hardwood block and strip flooring	SANS 281
Wooden ceiling and panelling boards	SANS 1039
Laminated timber (glulam)	SANS 1460
Gypsum plasterboard	SANS 266
Fibreboard products	SANS 540
Wood-wool panels (cement bonded)	SANS 637
Fibre-cement sheets (flat and profiled)	SANS 685
Fibre-cement boards	SANS 803
Plywood and composite board	SANS 929
Wooden ceiling and panelling boards	SANS 1039
Particle boards	SANS 50312-1to7
Decorative laminates	SANS 4586
Wooden doors	SANS 545
Fire doors	SANS 1253
Materials for thermal insulation of buildings	SANS 1381-1,2,4&6
Expanded polystyrene thermal insulation boards	SANS 1508
Mild steel nails	SANS 820
Metal screws for wood	SANS 1171
Wood-preserving creosote	SANS 539

Softwood shall bear the relevant SABS mark and shall be ordered in the sizes in which it will be used as no scantlings of marked timber will be allowed. Should SABS marked timber be unavailable, the Principal Agent's prior permission shall be obtained before using unmarked timber

I.2 HARDWOODS

All hardwoods shall be specially selected, well seasoned, free from sapwood and well kiln dried. Meranti shall be Red or Medium Brown Meranti, even in grain and colour, selected from "Standard and Better" quality from Malaysia

I.3 INFECTION AND PRE-TREATMENT OF TIMBER

All timber used on the site, whether for permanent or temporary work, shall be free of borer or other beetle and termite infection. If the work under this contract falls within an area designated under Government Notice R2577 of 197812-29, permanent softwood fixed in the building shall be treated against borer etc in accordance with Government Notice R451 of 1969-03-28 using Class B or C preservative

When treated timbers are cut, the cut surfaces shall be effectively brushed with at least two coats of preservative solution

I.4 CONSTRUCTION IN GENERAL

Where applicable, construction methods shall comply with SANS 10082. Wood and laminate flooring shall be installed in accordance with SANS 10043. Roof trusses shall be manufactured, erected and braced in accordance with SANS 10243

I.5 STRUCTURAL TIMBER

Timbers generally shall be in single lengths and jointing of timbers will only be permitted when the required length is unobtainable. Only the absolute minimum of joints to obtain a particular length will be permitted and such joints are to be evenly spaced along the length of the timber

Finger-jointing of structural timber will be permitted, in which case it shall be manufactured in accordance with SANS 10096

I.6 PLATE NAILED TIMBER ROOF TRUSSES

Plate nailed timber roof trusses shall be of approved design and manufacture and constructed with softwood structural timber by a truss Fabricator holding a current Certificate of Competence awarded by the Institute of Timber Construction

Each roof truss shall have all its members accurately cut and closely butted together and rigidly fixed by CSIR approved patented galvanized metal spiked connectors, precision pressed on both sides of each intersection by an approved method, all in accordance with the manufacturer's instructions

The design, manufacture and transportation of the roof trusses, bracing, etc shall be under the control of a registered Structural Engineer in accordance with SANS 1900, SANS 10160 and SANS 10163, who shall, after erection, provide a certificate confirming that the design, manufacture, transportation, erection and bracing has been carried out in accordance with this specification

The design shall include for all live loads, wind loads and for dead loads imposed by roof covering, purlins, ceilings, etc

Fully detailed shop drawings of all trusses etc, indicating sizes, bracing, loading, etc, shall be submitted to the Principal Agent for approval prior to fabrication

Unless specific erection instructions are given, erection shall be carried out in accordance with the procedures and recommendations of the manual "The Erection and Bracing of Timber Roof Trusses" published by the Institute for Timber Construction and the Council for Scientific and Industrial Research or as detailed by the designer

Roof trusses and bracing shall include design and preparation of shop drawings

I.7 TONGUED AND GROOVED BOARDING

Tongued and grooved boards for floors, panelling, etc shall be in long varying lengths with joints tightly cramped up and secret nailed. Flooring boarding shall be flush jointed with staggered heading joints and machine sanded after fixing

I.8 JOINERY

Skirtings, cornices, rails, etc shall be in single lengths wherever practicable and shall have splayed heading joints where
necessary. Skirtings shall be trenched at back

All horns of door frames shall be checked and splayed back where frames are fixed projecting or flush with surface and built in

Heads of screws in exposed faces of hardwood joinery shall be sunk and match pelleted

Joinery shall have arris rounded angles and shall be blocked and planted on

I.9 VENEERS

All face veneers shall be of kiln dried timber, free from knots, cracks, patchwork, sapwood and other defects, selected and glued, dried and machine-sanded to a smooth finish. All veneers shall be applied under hydraulic pressure

I.10 DOORS

Flush doors shall have solid timber edge strips with concealed edges. Where doors are to be finished with a transparent finish, the veneer and the edge strips shall be timber of the same species and as far as possible of matching colour. Unless otherwise described all flush doors shall be of interior quality, but where exterior quality doors are specified the glue used shall be of the WBP type

Framed and ledged batten doors described as filled in with V-jointed boarding shall be filled in flush on one side with tongued and grooved vertical boarding, V-jointed on one or both sides and of the thickness stated. The boarding shall be in narrow widths, closely cramped up, rebated or tongued on outer edges and housed to grooves in stiles and rails and twice countersunk brass screwed at each intersection with ledges and braces and the inner edges of the abutting stiles and rails shall be chamfered to form a V-joint at junction with the board

Unless otherwise described double doors shall have rebated meeting stiles

I.11 FIXING

All nails and screws shall be of the size, length and type appropriate to their respective uses. All screws for hardwood joinery work shall be brass

Items described as “plugged” shall be screwed to fibre, plastic or metal plugs at not exceeding 600mm centres. Where items are described as “bolted”, the bolts have been given separately

I.12 ADHESIVES

Adhesives shall comply with BS 1204 and 4071 where applicable. Adhesives used in the manufacture of external joinery exposed to excessive moisture (eg kitchen and laboratory worktops) shall be of the WBP type

J. CEILINGS, PARTITIONS AND ACCESS FLOORING

J.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Gypsum plasterboard	SANS 266
Fibreboard products	SANS 540
Gypsum cove cornice	SANS 622
Wood-wool panels (cement-bonded)	SANS 637
Sawn softwood timber : Brandering and battens	SANS 1783-4
Sawn softwood timber : Timber for frame wall Construction	SANS 1783-2
Fibre-cement boards	SANS 803
Plywood and composite board	SANS 929
Wooden ceiling and panelling boards	SANS 1039
Materials for thermal insulation of buildings	SANS 1381-1&4
Expanded polystyrene thermal insulation boards	SANS 1508
Raised access flooring	SANS 1549

J.2 TONGUED AND GROOVED BOARDING

Tongued and grooved boarding for ceilings shall be in long varying lengths, V-jointed one side and with joints tightly cramped up and secret nailed

J.3 CEILINGS ETC

J.3.1 **Brandering**

Brandering for ceilings and eaves soffit coverings shall be symmetrically arranged with necessary smaller panels. Main branders shall be at right angles to roof timbers, with cross branders cut in between and branders shall be fixed with galvanized wire nails driven in on skew alternately in opposite directions

J.3.2 **Ceiling boards**

Ceiling boards shall be in long lengths symmetrically arranged with necessary smaller panels, closely butted and secured at 150mm centres to brandering with galvanized or cadmium-plated clout-headed nails

J.4 GYPSUM SKIM PLASTER

Gypsum skim plaster shall be pure gypsum plaster finished with a steel trowel

J.5 EXPOSED TEE-SYSTEM SUSPENDED CEILINGS

The ceiling panels shall be as described in the items and the panels shall be stiffened at back as recommended by the manufacturer to prevent bowing or sagging

The exposed surfaces of all ceiling panels and supporting members shall be uniform in colour and free from surface blemishes

The suspension grid system shall be an approved patent suspension system comprising 38mm galvanized steel main and cross tee bearers spaced in both directions at centres to suit sizes of ceiling panels used, with the cross bearers fitted between and notched to form flush fit with main bearers. The exposed flange of the tees shall be 25mm wide, covered with a rolled aluminium cap painted a low sheen satin white. Cornices etc shall be as described in the items and shall be finished to match the exposed tees

The main tee bearers shall have holes for cross tees at 300mm centres and holes for hangers at 50mm centres. In addition, main and cross tee bearers shall be holed as necessary for and provided with timber wedges or steel clips where recommended by the manufacturer to prevent ceiling panels from lifting

The web of the exposed cross tee bearers shall extend to form a positive interlock with the main tee bearers and the lower flange shall be cut back to provide a joint free appearance

All hangers shall be galvanized and shall be at centres to meet the requirements of the specification with one end fixed to the suspension grid main bearers and the other end fitted with suitable galvanized fixing cleat securely fixed to the structure. Fixing points shall be agreed to by the Principal Agent before any power shot fixings are made. Hangers shall not be suspended from air-conditioning ducts. Where recommended by the manufacturer, hangers shall be of the rigid type

Component parts and fixings shall be non-corrosive and able to withstand atmospheric pollution. Surfaces of aluminium which are in contact with other materials when fixed, particularly metals, shall be suitably insulated to prevent electrolytic corrosion

Ceilings shall comprise hangers, suspension grid system and ceiling panels, shall be constructed in a manner suitable for carrying air-conditioning diffusers and light fittings in the positions required, shall be set out to layouts approved by the Principal Agent and shall have the standard suspension systems modified as necessary to work around any pipes or light fittings

J.6 FLUSH PLASTERED SUSPENDED CEILINGS

Gypsum plasterboard panels of the specified thickness generally in 1200mm widths and in long lengths shall be fixed grey side down with self-tapping screws to the suspension system with the joints between boards loosely butt jointed and covered with 50mm wide strips of self-adhesive fibre tape

The plasterboard panels shall be finished with gypsum skim plaster trowelled to a smooth polished surface to the thickness etc recommended by the manufacturer

The suspension system shall be an approved patent concealed suspension system consisting of galvanized mild steel bearers suspended on approved non-rusting metal hangers spaced generally at 1200mm centres or to suit layout of air-conditioning ducts and other services etc above ceiling with one end bolted to the bearer and the other end fitted with a galvanized fixing cleat securely fixed to the structure as required

Fixing points shall be agreed to by the Principal Agent before any power shot fixings are made. Hangers shall not be suspended from air-conditioning ducting

Ceilings shall comprise hangers, suspension system, ceiling panels and plaster finish, shall be constructed in a manner suitable for carrying air-conditioning diffusers and light fittings in the positions required, shall be set out to layouts approved by the Principal Agent and shall have the standard suspension system modified as necessary to work around any pipes or light fittings

K. FLOOR COVERINGS, WALL LININGS, ETC

K.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Semi-flexible vinyl floor tiles	SANS 581
Resin modified vinyl floor tiles	SANS 586
Flexible vinyl flooring	SANS 786
Hardwood block and strip flooring	SANS 281
Wood mosaic flooring	SANS 978
Textile floor coverings (pile construction)	SANS 1375
Textile floor coverings (needle-punched construction)	SANS 141
Carpet underlays	SANS 1419
The installation of wood and laminate flooring	SANS 10043
The installation of resilient thermoplastic and similar flexible floor covering materials	SANS 10070
The installation of textile floor coverings	SANS 10186
Sheet linoleum (calendered types), cork, carpet and linoleum tiles	BS 810
Solid rubber flooring	BS 1711
Felt backed linoleum	BS 1863

K.2 LAYING OF MATERIAL

Floor tiles shall be laid with continuous joints in both directions

Patterned floor coverings shall be matched at joints

K.3 GENERAL

Floor coverings, wall linings, skirtings, nosings, etc shall include all preparatory work to screeded or plastered surfaces etc, priming coats and adhesives

Floor coverings and wall linings shall be dressed around and into corners. Wood block and wood mosaic flooring shall be sanded with a sanding machine and sealed with a coat of approved penetrating sealer

Plastic handrails shall have welded and polished butt joints

L. IRONMONGERY

L.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Locks, latches and associated furniture for doors. (Domestic type)	SANS 4
Kitchen cupboards: Built-in and free-standing	SANS 1385
Single action closers	SANS 1510
Padlocks	SANS 1533
Fasteners	SANS 1700
Chalk writing boards for schools	CKS 36

L.2 KEYS

Locks shall have the minimum possible number of interchangeable keys. Cylinder locks and locks described as "en suite" shall be clearly marked with consecutive numbers and each key shall be punched with the corresponding number of the relative lock

L.3 FIXING

Unless otherwise described, ironmongery is to be fixed to wood

Items described as "plugged" shall be screwed to fibre, plastic or metal plugs

Screws, bolts, etc for fixing of ironmongery shall be of matching metal and finish, except for aluminium ironmongery or ironmongery fixed to aluminium in which cases stainless steel screws may be used

All necessary preparation of pressed steel door frames for the fixing of ironmongery to the frames has been included with the pressed steel door frames

L.4 KITCHEN CUPBOARDS

Steel cupboards shall be finished with baked enamel. Tops of floor cupboards shall have laminated plastic covering

Cupboards shall be fitted with all necessary hinges, handles, catches, etc. Cupboards shall be securely fixed with all necessary screws and fibre, plastic or metal plugs

Where cupboards are described as a "series", tops shall be continuous and cupboards shall be bolted or screwed together, including bolts, screws, holes, etc

M. STRUCTURAL STEELWORK

M.1 SPECIFICATION

All structural steelwork shall comply with SANS 1200H or 1200HA as applicable. Structural fasteners shall comply with
SANS 1700

Whenever the term “Engineer” appears in SANS 1200H or 1200HA or in the following Project Specification this shall be deemed to mean the Principal Agent’s representative responsible for this section of the Works

M.2 PROJECT SPECIFICATION INCORPORATING AMPLIFICATIONS, ADDITIONS AND AMENDMENTS TO SANS 1200H AND 1200HA

The following amplifications, additions and amendments to SANS 1200H and SANS 1200HA shall apply and clause numbers refer to either the existing clauses in the relevant SANS or to new clauses which are related to the clauses therein

SANS 1200H

3.1.1 **Weldable structural steel**

Weldable structural steel shall comply with SANS 1431

5.1.2 **Contractor provides shop details**

The Contractor shall be responsible for the preparation of all shop detail drawings

5.1.3 **Engineer provides shop details**

This clause shall not apply

5.3.9 **Protective treatment**

Structural steelwork shall be cleaned and prepared by wire brushing in accordance with SANS 10064 and all surfaces shall be primed as specified to a minimum dry film thickness of 30 micrometres before leaving the workshop. Upon delivery to the site and again after erection all bared surfaces shall be made good with similar primer

8. **Measurement and payment**

This clause shall not apply

SANS 1200HA

5.2.10 **Protective treatment**

Structural steelwork shall be cleaned and prepared by wire brushing in accordance with SANS 10064 and all surfaces shall be primed as specified to a minimum dry film thickness of 30 micrometres before leaving the workshop. Upon delivery to the site and again after erection all bared surfaces shall be made good with similar primer

5.3.7 **Repairs to paint and site painting**
This clause shall not apply

8. **Measurement and payment**

This clause shall not apply

N. METALWORK

N.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Fasteners	SANS 1700
Expanded metal	SANS 190-1&2
Windows and doors made of rolled mild steel sections	SANS 727
Hot-dip galvanized zinc coatings on fabricated iron and steel articles	SANS 121
Strongroom and vault doors	SANS 949
Anodized coatings on aluminium (for architectural applications)	SANS 999
Steel door frames	SANS 1129
Mushroom- and countersunk-head bolts and nuts	SANS 1143
Welding of metalwork	SANS 1044
Adjustable glass-louvred windows	CKS 413
Aluminium sheet and strips	BS 1470
Aluminium extruded tube and hollow sections	BS 1474
Aluminium bars and sections	BS 1476

N.2 STEEL

Steel shall be mild steel of approved commercial quality. Steelwork shall be cleaned and prepared by wire brushing in accordance with SANS 10064 and given one coat of primer as specified before leaving the workshop

N.2.1 **Galvanizing of steel**

Steelwork described as “galvanized” shall be galvanized by means of the hot-dip process after fabrication. Where welding on site is unavoidable, such welded joints shall be cleaned down and cold galvanized to approval

N.3 STAINLESS STEEL

Stainless steel shall be AISI Type 304 stainless steel and shall be buffed to an even satin finish. Stainless steel screws shall be used for fixing stainless steel

N.4 ALUMINIUM

Aluminium extrusions shall be of 6063-T6 alloy and temper. Aluminium sheet and strips shall be of 1200-H4 alloy and temper.
Joints in all aluminium members shall be formed in an approved manner so that the joints are practically invisible. Screw heads, pins, rivets, etc shall be concealed as far as possible. 300 Series stainless steel screws and bolts shall be used for jointing and fixing aluminium work

The surfaces of all aluminium which are in contact with other materials when fixed shall be suitably insulated with a non-absorbent insulating material to prevent corrosion. All aluminium work shall be suitably protected against damage, deterioration or discolouration caused by mortar droppings, paint, etc by taping with removable tape, covering with temporary casings or by covering with motor oil

N.4.1 **Anodizing of aluminium**

Aluminium described as “anodized” shall be treated with Grade 25 coating thickness for exterior use or Grade 15 for interior use as specified, to the required finish. All alloys to be anodized shall be suited to anodizing

N.5 BOLTS AND NUTS

Nuts shall be of at least the strength grade appropriate to the grade of bolt or other threaded element with which they are used

N.6 SCREWING OF METALWORK TO STEEL, WOOD, CONCRETE, ETC

Metalwork described as “screwed” to steel, wood, etc or “plugged” to brickwork, concrete, etc shall be fixed at not exceeding 500mm centres, with necessary holes, countersinking, threading, screws, set screws, self-tapping screws and fibre, plastic or metal plugs

N.7 BOLTING OF METALWORK

Where metalwork is described as “bolted” to steel, wood, brickwork, concrete, etc the bolts are measured elsewhere

N.8 WELDING OF METALWORK

All welds shall be cleaned and filed or ground off smooth to approval. All welded joints shall be continuous

N.9 METALWORK GENERALLY

Metalwork shall have all sharp edges ground smooth. Tubular and pipe work shall include running joints. Rails etc described as “continuous” shall be in long lengths with welded joints

N.10 PRESSED STEEL DOORS, FRAMES, ETC

N.10.1 **Door frames**

Frames shall project not less than 20mm into floor finish. Except where described as galvanized, frames shall be primed as specified before leaving the factory. Frames are to jambs and heads of openings. Frames for single doors shall be provided with two 100mm steel butt hinges and an adjustable striking plate for a mortice lock and frames for double doors shall be provided with four 100mm steel butt hinges. Butt hinges shall be steel butts with loose pins, welded to frames. Where necessary mortar caps shall be welded to frames and back plates shall be welded on behind tappings for screws

N.10.2 **Cupboard door frames**

Cupboard door frames shall be as described in N.10.1, but with thresholds of unequal channel section, two 100mm steel butt hinges to hanging stiles, two 75mm steel butt hinges to hanging stiles above transoms, necessary striking plates for mortice locks and keeps for barrel bolts

N.10.3 **Combination doors and frames**

Combination doors and frames shall be manufactured of 1,6mm thick steel plate. Frames shall be as described in N.10.1. Doors shall be standard design and required profile, with a 44mm wide edge all round, vertical reinforcing ribs pressed in and with two reinforcing rails welded on. The door shall be provided with two lever mortice lock with lock box welded to inside. Doors shall be welded to steel butts

N.10.4 **Transformer room doors and frames**

Transformer room doors and frames shall be manufactured of 1,6mm thick steel plate. Frames shall be as described in N.10.1. Doors shall be of standard design with a 44mm wide edge all round, vertical reinforcing ribs pressed in and with three reinforcing rails welded on. Single doors shall be fitted with a padlock cleat and two 100mm brass pintle hinges and double doors shall be fitted with a padlock cleat, two 150mm bolts and four 100mm brass pintle hinges. Each leaf shall be fitted with a louvered ventilation panel of standard design backed with 6mm mesh galvanized wire vermin proof screen

N.10.5 **Sizes**

The frame widths given refer to unfinished wall thicknesses

N.10.6 **Glazing beads**

Where specified, glazing beads shall be 12 x 12mm standard metal glazing beads mitred at angles and countersunk screwed on at not exceeding 300mm centres with self-tapping screws

N.11 STEEL WINDOWS, DOORS, ETC

N.11.1 **Windows, doors, etc**

All fittings to windows, doors, etc shall be chromium plated. Fixed lights and opening sashes shall be in single squares. Windows etc of single unit construction shall have weather bars at transoms above opening sashes

Composite windows not of single piece construction shall be coupled with standard coupling mullions and transoms that correspond with the window section used

Kicking plates and panels shall be 1,6mm metal plate fixed with standard metal glazing beads mitred at angles and countersunk screwed on at not exceeding 300mm centres with self-tapping screws

Except where described as galvanized, windows, doors, burglar bars, etc shall be primed as specified before leaving the factory

N.11.2 **Burglar bars and flyscreens**

Where windows are described as fitted with burglar bars or flyscreens, these shall be standard type fitted over opening sashes

N.12 ADJUSTABLE LOUVRE UNITS

Adjustable louvre units shall be suitable for hand or longarm operation

Louvre units shall include glass louvres with polished edges and installation, including holes, screws, rivets, preparation of openings, etc

N.13 ALUMINIUM WINDOWS AND DOORS

The foregoing preambles “N.4 – ALUMINIUM” shall apply to aluminium windows, doors, etc in all respects in so far as they are applicable. Aluminium windows and doors shall be manufactured from extruded aluminium members of 6063T6, 6261-T6 or 6082-T6 alloy and temper

Ancillary members such as sills, flashings, infill panels and the like formed from flat sheet material shall be of an appropriate alloy selected from 1200, 3004 or 5251 complying with BS 1470 of a temper suitable for the method of forming and a composition suitable for anodizing or painting as required

Windows, doors, etc shall be of an approved standard system, manufactured by an approved firm experienced in this type of work, and shall meet with the minimum recommended performance requirements as set out by the Association of Architectural Aluminium Manufacturers of South Africa (AAAMSA) in the latest edition of the Selection Guide

The fittings for all opening sashes shall be substantial and, unless otherwise described, shall be of high quality aluminium alloy finished to match the windows, doors, etc on which they occur. Samples of all fittings shall be supplied to the Principal Agent for approval

Top, side and bottom hung opening sashes shall be hung on two aluminium hinges with 300 Series stainless steel pins, nylon bushes and stainless steel washers. Side hung sashes shall have fasteners and sliding stays, top hung sashes shall have peg stays and bottom hung sashes shall have spring catches and concealed arms

Projected out sashes shall have aluminium fasteners and concealed arms of a non-corrosive material compatible with aluminium

The frames which are to be built into openings in brickwork shall be fitted with the manufacturer’s standard type fixing lugs, not less than 20 x 3 x 150mm long, screwed to frame and placed one near each corner and intermediately not more than 450mm apart to sides, top and bottom and where fixed to concrete reveals, wood sub-frames or to preformed openings in brickwork shall have countersunk holes for screws, one near each corner and intermediately not more than 450mm apart to sides, top and bottom

N.13.1 **Glazing beads**

Where so described, openings and sashes of windows and doors shall be fitted with approved channel section aluminium glazing beads sufficient in size and profile to suit the method of glazing employed, finished to match the windows, doors, etc and neatly mitred. Screws where necessary shall be of aluminium or 300 Series stainless steel and have pan or raised heads finished to match the beads

N.13.2 **Finishes**

Windows, doors, etc described as “anodized” shall be treated with Grade 25 coating thickness. Windows, doors, etc described as “factory painted” shall have an electrostatically applied oven baked polyester paint coating not less than 25 micrometres thick

N.13.3 **General**

Aluminium windows, doors, etc shall include glass as described, fixing in position, sealing and protection against damage, deterioration or discolouration by taping with removable tape or covering with temporary casings or motor oil and removing same on completion

N.14 STRONGROOM AND RECORD ROOM DOORS

Strongroom and record room doors shall not be built in as the work proceeds, but shall be fixed later in the openings provided. The Contractor shall ensure that the lock or other important parts of the door are not tampered with. Should any such tampering occur, the Contractor will be held responsible and at the Principal Agent’s discretion shall provide a new door or lock and keys at his own expense. The keys shall not be delivered together with the doors to the building site. The Contractor shall arrange for the manufacturer to send the keys direct to the Principal Agent per registered post. If these instructions are not complied with, a new lock and keys shall be provided by the Contractor at his own expense

N.15 STEEL ROLLER SHUTTERS

Roller shutters shall be of approved manufacture comprising curtain, vertical channel guides and top mechanism. The curtain shall be constructed of 1mm thick machine-rolled galvanized interlocking slats with mild steel end locks spot welded to alternate strips. The bottom shall be provided with a galvanized rail riveted on and vertical edges shall slide in galvanized channel guides formed of steel not less than 2,5mm thick bolted to sides of openings

The mechanism shall be covered in a galvanized sheet iron box. The ungalvanized sections shall be primed as specified before leaving the factory

O. PLASTERING

O.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Common cement	SANS 50197-1(Class 32,5N)
Masonry cement	SANS 50413-1(Class 225X)
Limes for use in building	SANS 523 {Slaked (hydrated) limes}
Aggregates from natural sources – Fine aggregates for plaster and mortar	SANS 1090

O.2 PREPARATORY WORK

Surfaces shall be clean and free of oil and thoroughly wetted directly before any plastering or other in situ finishes are commenced. Concrete surfaces shall be slushed with a mixture of one part cement and one part coarse sand or otherwise treated to form a proper key. Preparatory coats shall be thoroughly scored and roughened to form a proper key

O.3 FINISH

All coats of paving and plastering shall be executed in one operation without any blemishes

O.4 SCREEDS

Screeds shall be composed of one part cement and four parts sand

O.5 CEMENT RENDER

Cement render shall be composed of one part cement and three parts sand finished with a steel trowel to a smooth polished surface and cured for at least seven days after laying

Cement render finish shall be divided into panels not exceeding $6m^2$ with V-joints and deep trowel cuts

O.6 GRANOLITHIC

Granolithic shall be composed of one part cement, one part fine sand, two parts coarse sand and one part granite or other approved stone aggregate that will pass through a 5mm sieve, finished with a steel trowel to a smooth polished surface and cured for at least seven days after laying

Coloured granolithic shall be carried out in two coats in one operation and shall be tinted to the required colour with approved colouring pigment mixed into the finishing coat. Under no circumstances is the pigment to be sprinkled on and trowelled in after the granolithic is laid

Granolithic shall be divided into panels not exceeding $6m^2$ with V-joints and deep trowel cuts

O.7 TERRAZZO

Terrazzo shall be applied in two coats. The undercoat shall be composed of one part cement and three parts sand and shall be finished with a wooden float. The finishing coat shall be composed of one part cement and two parts marble or stone aggregate of a colour and size to obtain the required colour and texture and shall be at least 12mm thick, and applied before the undercoat has dried out. The finishing coat shall be compacted by tamping or rolling until superfluous water has been expelled, finished with a steel trowel and cured for at least seven days after laying. The finished surface shall show at least 80% of the aggregate

Surfaces described as “polished” shall be polished by machine using various grades of abrasive and grouting with tinted cement as necessary between polishings

Surfaces described as “polished” shall be polished by machine using various grades of abrasive and grouting with tinted cement as necessary between polishings

Surfaces described as “brushed” shall be brushed with a steel wire brush on the day the terrazzo has been laid to expose the aggregate as required

Where required, brass or other dividing strips shall be embedded in the undercoat to finish flush with the finished surface

Three sample blocks, each size 300 x 300mm, as separately measured shall be prepared for approval by the Principal Agent and kept in an accessible place on the site until the completion of the contract

O.8 SKIRTINGS

Skirtings shall not exceed 25mm thick and shall have a fair edge with arris or rounded external angle at top edge or V-joint to finish flush with plaster and coved or square junction with floor finish

O.9 THICKNESS OF PLASTER

All plaster, other than skim plaster, shall be not less than 10mm and not more than 20mm thick

O.10 CEMENT PLASTER

Cement plaster shall comply with the following table:

1	2	3
Plaster Class	Cement:sand (common cement)	Cement:sand (masonry cement)
I	1:4 or 50kg to 130 litres	1:3 or 50kg to 100 litres
II	1:6 or 50kg to 200 litres	1:5 or 50kg to 170 litres
III	1:9 or 50kg to 300 litres	1:6 or 50kg to 200 litres

O.11 COMPO PLASTER

Compo plaster shall be composed of one part cement, two parts lime and nine parts sand

O.12 GYPSUM SKIM PLASTER

Gypsum skim plaster shall be pure gypsum plaster finished with a steel trowel

O.13 TWO COAT PLASTER WITH GYPSUM FINISH

Two coat plaster with gypsum finish shall comprise an undercoat of Class II cement plaster finished with a wooden float and a finishing coat of gypsum skim plaster

O.14 ROUGH-CAST PLASTER

Rough-cast plaster shall be applied in two coats. The undercoat shall be composed of one part cement and five parts sand finished with a wooden float. The finishing coat shall be composed of one part cement and three parts stone aggregate that will pass through a 4mm sieve. The finishing coat shall be flicked on with a machine before the undercoat has set to obtain an even texture

O.15 FINE ROUGH-CAST PLASTER

Fine rough-cast plaster shall be as for rough-cast plaster but the finishing coat shall be composed of one part cement and three parts coarse sand

0.16 GENERAL

Rates for plastering described as being on vertical surfaces of brickwork or blockwork shall include concrete columns, beams and lintels flush with the face of the wall

P. TILING

P.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Glazed ceramic wall tiles and fittings	SANS 22
Ceramic wall and floor tiles	SANS 1449
Common cement	SANS 50197-1(Class 32,5N)
Masonry cement	SANS 50413-1(Class 22,5X)
Aggregates from natural sources – Fine aggregates for plaster and mortar	SANS 1090
The design and installation of ceramic tiling	SANS 10107

P.2 TILES, MOSAICS, ETC

Tiles, mosaics, etc shall be even in shape and size, free from cracks, twists or blemishes and uniform in colour

P.3 PREPARATORY WORK

Surfaces shall be clean and free of oil and thoroughly wetted directly before any tiling is commenced. Concrete surfaces shall be slushed with a mixture of one part cement and one part coarse sand or otherwise treated to form a proper key

P.4 CERAMIC WALL AND FLOOR TILING

Where tiles are fixed to plaster or screeds with an adhesive, the adhesive shall be as recommended by the manufacturer of the tiles. Joints shall be straight, continuous and flush pointed with an approved grouting compound

P.5 GENERAL

Tiling described as “on walls” is on brick walls or block walls unless otherwise stated and shall include concrete columns, beams and lintels flush with the face of the wall

Q. PLUMBING AND DRAINAGE

Q.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Sheet metal

Sheet zinc	BS 849
Sheet aluminium	BS 1470
Sheet copper	BS 2870

Rainwater systems

Unplasticized poly(vinyl chloride) (PVC-U) components for external rainwater systems	SANS 11

Pipes and fittings

Steel pipes : Pipes suitable for threading and of nominal size not exceeding 150mm	SANS 62
Plain-ended solid drawn copper tubes for Potable water	SANS 460
Malleable cast iron fittings threaded to ISO 7-1	SANS 4
Polyethylene (PE) pipes for water supply – Specifications	SANS 4427
Cast iron fittings for asbestos cement pressure pipes	SANS 546
Vitrified clay sewer pipes and fittings	SANS 559
Reinforced concrete pressure pipes	SANS 676
Concrete non-pressure pipes	SANS 677
Cast iron pipes and pipe fittings for use above ground in drainage installations	SANS 746
Unplasticized poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings	SANS 791
Fibre-cement pipes, couplings and fittings for sewerage, drainage and low-pressure irrigation	SANS 819
Pitch-impregnated fibre pipes and fittings and jointing	SANS 921
Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems	SANS 966-1
Unplasticized poly(vinyl chloride) (PVC-U) soil, waste and vent pipes and pipe fittings	SANS 967
Rubber joint rings (non-cellular)	SANS 974-1
Copper-based fittings for copper tubes	SANS 1067-1&2
Fibre-cement pressure pipes and couplings	SANS 1223
Polypropylene pressure pipes	SANS 1315
Non-metallic waste traps	SANS 1321-1&2
Vent valves for drainage installations	SANS 1532
Heavy duty cast iron pipe fittings for drainage and gas and water supplies	BS 78

Lead pipes	BS 602
Cast iron pressure pipes for use in drainage and gas and water supplies	BS 1211
Stainless steel pipes for use with compression fittings	BS 4127
Sanitary fittings etc	
Stainless steel sinks with draining boards (for domestic use)	SANS 242
Stainless steel wash-hand basins and wash troughs	SANS 906
Stainless steel sinks for institutional use	SANS 907
Stainless steel stall urinals	SANS 924
Acrylic sanitary ware : Baths	SANS 1402-1
Glazed ceramic sanitary ware	SANS 497
WC flushing cisterns	SANS 821
Flush valves for WC flushing cisterns	SANS 1509
Taps, valves etc	
Water taps (metallic bodies)	SANS 226
Water taps (plastic bodies)	SANS 1021
Single control mixer taps	SANS 1480
Float valves	SANS 752
Plastic floats for ball valves	SANS 1006
Functional control valves and safety valves for Domestic hot and cold water supply systems	SANS 198
Cast iron gate valves for waterworks	SANS 664
Automatic shut-off flush valves for water closets and urinals	SANS 1240
Check valves (flanged and wafer types)	SANS 1551-1&2
Fire extinguishers	
Portable refillable fire extinguishers	SANS 1910
Portable rechargeble fire extinguishers : Halogenated hydrocarbon type extinguishers	SANS 1151
Water heaters and fire hose reels	
Fixed electric storage water heaters	SANS 151
Fire hose reels (with semi-rigid hose)	SANS 543
Drainage covers, gratings, etc	
Cast iron surface boxes and manhole and inspection covers and frames	SANS 558
Cast iron gratings for gullies and stormwater drains	SANS 1115
The installation of polyethylene and poly (vinyl chloride) (PVC-U and PVC-M) pipes	SANS 10112
Water supply and drainage for buildings	SANS 10252-1&2

Cast iron step irons BS 1247

Q.2 GENERAL

Q.2.1 Excavations

Excavations shall be deemed to be in “earth”. Backfilling to excavations shall be executed in 300mm thick layers, watered and compacted. Surplus excavated material shall be spread and levelled over site as directed

Q.2.2 Concrete

Unreinforced concrete shall be Class B prescribed mix concrete and reinforced and precast concrete shall be Class C prescribed mix concrete

Q.2.3 Brickwork

Brickwork shall be of extra hard burnt bricks built in Class I mortar

Q.2.4 Plaster

Plaster shall be 1:3 cement plaster finished smooth with a steel trowel. All angles shall be rounded

Q.2.5 Diameters of pipes etc

Diameters stated for pipes, traps, valves, etc are internal diameters except PVC, polyethylene, stainless steel and copper pipes and traps for which external diameters are stated

Q.3 SHEET METAL WORK

Q.3.1 Galvanized sheet iron

Galvanized sheet iron shall be rolled steel sheet coated on both sides with Class Z275, unless otherwise specified, zinc coating complying with SANS 3575/4998. Sheets shall be free from white rust

Q.4 EAVES GUTTERS

Q.4.1 Galvanized sheet iron gutters

Galvanized sheet iron gutters shall have beaded edges and all joints shall be riveted and soldered. Angles shall be strengthened with 50 x 0,6mm galvanized sheet iron strips soldered on over the internal faces of mitres

Gutters shall be fixed with falls to outlets on 30 x 3mm galvanized mild steel brackets, bent to the shape of gutters, with front ends taken up to the underside of beaded edge of gutter and each screwed to roof timbers or bolted to fibre-cement fascias with 6mm galvanized gutter bolts. Gutters shall be bolted to brackets at front with 6mm galvanized gutter bolts, one to each bracket

Brackets shall be positioned at joints of gutters and intermediately at not exceeding 1,25m centres

Q.4.2 Fibre-cement gutters

Fibre-cement gutters shall have spigot and socket joints. Gutters shall be fixed with falls to outlets on standard aluminium alloy brackets, screwed or bolted to roof timbers or fascias

Q.4.3 Unplasticized polyvinyl chloride (UPVC) gutters

Gutters shall be fixed with falls to outlets on brackets as supplied by the manufacturer, screwed or bolted to roof timbers or fascias

Q.4.4 Aluminium gutters

Aluminium gutters shall be roll formed on site to required lengths and profiles from 3003H14-3SH4 alloy strip not less than 0,7mm thick factory coated on both sides with baked enamel and two coats of silicone modified polyester to a total minimum thickness of 20 micrometres. Angles, stopped ends, etc shall be prefabricated units pop riveted to gutters with joints sealed with mastic. The guttering shall be in continuous lengths between angles, stopped ends, etc

Q.5 RAINWATER PIPES

Q.5.1 Galvanized sheet iron pipes

Galvanized sheet iron pipes shall have seams at the back and shall be jointed with soldered slip joints. Pipes shall be fixed to walls etc with galvanized mild steel holderbats spaced at not exceeding 2m centres with tails driven in or cut and pinned in 1:3 cement mortar

Q.5.2 Fibre-cement pipes

Fibre-cement pipes shall have spigot and socket joints. Pipes shall be fixed to walls etc with standard aluminium alloy holderbats with tails driven in or cut and pinned in 1:3 cement mortar

Q.5.3 Unplasticized polyvinyl chloride (UPVC) pipes

Pipes shall be fixed to walls etc with patented UPVC or aluminium clips and holderbats as supplied by the manufacturer of the pipe

Q.5.4 Aluminium pipes

Aluminium pipes and fixing straps shall be formed from 3003H14-3SH4 alloy strip not less than 0,7mm thick factory coated on both sides as described for aluminium gutters. Pipes shall be in continuous lengths with formed angles, offsets, shoes, etc. Pipes shall be fixed to walls etc with 20 x 0,6mm straps at not exceeding 1,5m centres screwed to 25 x 75 x 100mm hardwood chamfered and oiled blocks plugged to walls

Q.6 STORMWATER CHANNELS

In-situ concrete stormwater channels shall be constructed of unreinforced concrete with segmental channel formed in top. Channels shall be laid to falls on a well rammed earth bottom and finished smooth on exposed surfaces

Precast concrete channels shall be of 25 MPa concrete, generally in 1m lengths, finished smooth from the mould on exposed surfaces, laid to falls on a well rammed earth bottom, jointed in 1:3 cement mortar and pointed with keyed joints

Q.7 JOINTS

Joints of pipes not covered by SANS shall be as follows:

Pipes	Joints
Fibre-cement, concrete, pitch-impregnated fibre and vitrified clay pipes for use under ground in non-pressure pipe lines	Flexible joints in accordance with the manufacturer's instructions
Cast iron for use above ground	Spigot and socket joints with tarred rope yarn and caulking compound or Plain ended joints with stainless steel couplings with neoprene rubber sleeves
Cast iron for use below ground	Spigot and socket joints with tarred rope yarn and caulking compound
Galvanized mild steel	Joints of screwed galvanized steel sockets or bolted galvanized iron flanges Screwed joints with plastic jointing tape or hemp Flanged joints which shall be bolted and provided with rubber gaskets and with flanges screwed to pipes
Joints between pipes of different materials shall be as follows:	
Between cast iron and mild steel	Spigot and socket joints with tarred rope yarn and caulking compound
Between cast iron and clay	Spigot and socket joint with semi-dry cement caulking and 1:2 cement mortar fillet
Between mild steel or copper and clay	Spigot and socket joint with either bitumen or semi-dry cement caulking and 1:2 cement mortar fillet

Q.8 FIXING OF PIPES

Pipes shall be fixed as follows:

Q.8.1	Galvanized mild steel (except those stated in Q.8.3)	To walls with galvanized mild steel brackets for pipes not exceeding 80mm diameter and with galvanized cast iron hinged holderbats with brass pins or bolts for pipes exceeding 80mm diameter; both types with tails cut and pinned in 1:3 cement mortar To woodwork with screw-on type galvanized mild steel holderbats
Q.8.2	Copper and stainless steel	To walls with brass holderbats or screw-on type two- piece spacing clips for pipes not exceeding 75mm diameter and with purpose made holderbats for pipes exceeding 75mm diameter; both types with tails cut and pinned in 1:3 cement mortar To woodwork with screw-on type brass holderbats
Q.8.3	Cast iron and galvanized mild steel for soil, waste and vent pipes	To walls with hinged cast iron holderbats with brass bolts and with tails cut and pinned in 1:3 cement mortar To woodwork with screw-on type galvanized mild steel holderbats
Q.8.4	Polyethylene, polypropylene and patented UPVC or unplasticized polyvinyl chloride	To walls, woodwork, etc with aluminium clips and holderbats as supplied by the manufacturer of the pipes
Q.8.5	Fibre-cement	To walls with aluminium alloy holderbats with tails cut and pinned in 1:3 cement mortar

Q.8.6	Pipes fixed to ceilings	Fixed with holderbats and standard or purpose made hangers, with extended hangers for pipes to falls

Q.9 PIPES LAID IN GROUND

Q.9.1 **Water pipes etc**

Water pipes, gas pipes, etc laid in ground shall be at least 400mm deep from the crown of the pipe to the finished surface

Q92 **Drain pipes**

Excavations taken out too deep shall be filled in with selected soil and compacted. Backfilling to sides and up to 300mm above plastic pipes shall be free from stone or hard substances which will not pass a 10mm mesh

Q.10 CLEANING EYE LIDS

Cleaning eye lids for drain pipe fittings shall be fixed and sealed as follows:

Pipe fittings	**Method of sealing and fixing**
Fibre-cement	Sealed with synthetic rubber or bituminous mastic packing and fixed with screws
Vitrified clay	Polypropylene lid sealed with synthetic rubber packing and pressed into position
Polypropylene and unplasticized polyvinyl chloride	Sealed with synthetic rubber packing and screwed on or pressed into position
Cast iron	Sealed with tallow or putty and fixed with non-ferrous metal screws
Galvanized malleable cast iron and cast brass	Sealed with synthetic rubber packing and screwed in

Q.11 CLEANING EYES

Cleaning eyes shall consist of cast iron frames and lids with letters “CE” (or “SO”) cast in lids. The lids shall be secured with non-ferrous metal screws. Frames shall be jointed to vertical drain pipes. Cleaning eyes shall be encased in unreinforced concrete taken up to ground level and plastered on exposed surfaces

Q.12 INSPECTION EYE MARKER SLABS

Inspection eye marker slabs shall be 350 x 350 x 50mm thick precast concrete finished smooth from the mould, with letters “IE” (or “IO”) formed in top and placed flush in ground or paving

Q.13 GULLEYS

Gulleys shall be built up of traps, vertical piping and gulley heads with loose gratings, all encased in unreinforced concrete to finish flush with gulley head top and taken up to at least 50mm above surrounding finished surfaces. The outer top edge of the concrete encasing shall be splayed and the exposed surfaces plastered

Q.14 DISHED GULLEYS

Dished gulleys shall be built up of traps, vertical piping and gulley heads with loose gratings, all encased in unreinforced concrete and with dished unreinforced concrete hopper size 450 x 450mm overall around gulley head with rounded kerb 50mm wide to front and sides and 25mm wide at back, 100mm high above top of dishing and the hopper plastered on exposed surfaces. Top of hopper shall be taken up to at least 50mm above surrounding finished surfaces

Q.15 SUMPS, CATCHPITS, INSPECTION CHAMBERS, ETC

Q.15.1 **Rainwater sumps**

Rainwater sumps shall be built with half-brick sides on 100mm thick unreinforced concrete bottom, plastered internally on walls and with 80mm high unreinforced concrete kerb at top rebated for grating or cover and plastered on exposed surfaces

Q.15.2 **Stormwater catchpits and inspection chambers**

Brick catchpits and inspection chambers shall be built with one-brick sides on 150mm thick unreinforced concrete bottom projecting 100mm beyond walls all round, plastered internally on walls and with 100mm thick reinforced concrete cover slab with opening rebated for frame of grating or cover and plastered on exposed surfaces

Precast concrete catchpits and inspection chambers shall be constructed in accordance with the applicable details shown on Drawing LE-1 of SANS 1200LE. Precast concrete manhole sections and slabs shall comply with SANS 1294 and pipes shall be SC type and in accordance with SANS 677

Q.15.3 **Sewer inspection chambers**

Brick inspection chambers shall be built as for brick stormwater inspection chambers and with the bottom of the chamber well benched around half round channels, bends, junctions, etc up to sides of chamber in unreinforced concrete finished smooth

Precast concrete inspection chambers shall be constructed in accordance with the applicable details shown on Drawing LD-5 of SANS 1200LD. Precast concrete manhole sections and slabs shall comply with SANS 1294 and the pipes shall be SC type in accordance with SANS 677

Q.15.4 **Stormwater drain junction boxes**

Junction boxes shall be formed of 150mm thick unreinforced concrete bottom and sides to suit the various sizes of the drain pipes and built after the pipes have been laid, with the sides taken up slightly higher than the highest pipe and finished level on top for and covered with a 75mm thick loose precast concrete slab

Q.15.5 **Step irons**

Where inspection chambers exceed 1,2m deep, cast iron step irons shall be provided, built into the wall at 300mm centres and staggered regularly in vertical rows spaced at 200mm centres horizontally

Q.16 STOPCOCK AND METER BOXES

Stopcock and meter boxes shall be built with half-brick sides with a cast iron box and lid complying with SANS 558 set in 75mm wide unreinforced concrete kerb for the full depth of the cast iron box and plastered on exposed surfaces

Q.17 VALVE CHAMBERS

Valve chambers shall be built with half-brick sides with 100mm thick unreinforced concrete kerb to top with rebate for cover and frame to finish flush with adjacent paving or finished ground level and plastered on exposed surfaces

Q.18 CAST IRON COVERS, GRATINGS, ETC

All cast iron covers, gratings, frames and surface boxes shall be coated with preservative solution. Frames shall be cast into concrete. Covers, except covers to stormwater drainage or electrical cable inspection chambers, shall be set in grease

Q.19 CONCRETE ENCASING

Concrete encasing for pipes, bends, traps, gulleys, grease traps, etc shall be unreinforced concrete not less than 100mm thick all round

Q.20 SANITARY FITTINGS

Q.20.1 General

Glazed ceramic, acrylic and porcelain enamelled sanitary fittings and component parts shall be white. Accessories for sanitary fittings shall be chromium plated brass

Waste outlets for baths, basins, etc shall comprise chromium plated brass waste union with grating, rubber washers and locknut, fitted with rubber or vulcanite plug on a chromium plated brass chain and stay

Q.20.2 Stainless steel sanitary fittings

Stainless steel sinks and draining boards, basins, wash troughs and urinals shall be AISI Type 304 satin finished stainless steel. All stainless steel fittings shall be treated on the back with a vermin proof sound deadening coating. Sinks, basins and wash troughs shall be provided with 40mm diameter screwed waste outlets

Q.20.3 Precast concrete wash troughs

Reinforced precast concrete wash troughs shall have a sloping front with ribbed rubbing surface and shall be finished smooth on exposed faces with top edges and inner angles rounded. Each compartment shall be fitted with a 40mm diameter waste outlet. Wash troughs shall each be supported on two reinforced precast concrete pedestals finished smooth on exposed faces

Q.20.4 Steel baths

Steel baths shall be porcelain enamelled internally and painted externally and fitted with waste outlet and overflow grating with coupling

Q.20.5 Acrylic resinous baths

Acrylic resinous baths shall be fitted with waste outlet and overflow grating with coupling

Q.20.6 Acrylic resinous wash hand basins

Acrylic resinous wash hand basins and vanity units shall have a smooth high gloss finish, with outlet openings, soap recesses, tap-holes and integral overflow and shall be fitted with waste outlet and overflow grating with coupling

Q.20.7 Glazed ceramic sanitary fittings

Sinks shall be provided with integral weir overflows

Washdown closet pans shall have washdown action and be provided with smooth finished injection moulded polypropylene heavy duty double flap seats fixed with non-ferrous bolts. Urinal channels shall be provided with outlet gratings fitted in bitumen

Q.20.8 Flush and sparge pipes

Flush pipes for high level cisterns shall be of plastic or drawn galvanized steel

Flushpipes for low level cisterns shall be of plastic

Flush and sparge pipes for urinals with high level cisterns shall be of chromium plated copper piping and of the sizes recommended by the manufacturer of the urinal

Q.21 INSTALLATION OF SANITARY FITTINGS

Sanitary fittings shall be installed as follows:

Q.21.1 Precast concrete wash troughs

Precast concrete wash troughs shall be bedded on top of pedestals which shall be bedded on floors in 1:3 cement mortar

Q.21.2 Stainless steel wash troughs and wash hand basins

Stainless steel wash troughs and wash hand basins shall be fixed to walls on a pair of galvanized mild steel gallows brackets bolted to wall with 6mm diameter expanding bolts

Q.21.3 **Acrylic resinous wash hand basins**

Acrylic resinous wash hand basins shall be fixed to walls on a pair of standard painted cast iron brackets screwed to underside of basin and bolted to wall with 6mm diameter expanding bolts

Q.21.4 **Ceramic wash hand basins**

Ceramic wash hand basins shall be fixed to walls on a pair of standard painted steel or cast iron brackets bolted to wall with 6mm diameter expanding bolts

Q.21.5 **Acrylic resinous baths**

Acrylic resinous baths shall be bedded in 1:5 cement mortar on three cross rows of bricks or bedded solid on a layer of dry river sand and fixed to wall with galvanized steel brackets under edges (in the middle of the sides against walls) bolted to wall with 6mm diameter expanding bolts and sealed along top against wall finishes with patent mildew resistant silicone rubber

Q.21.6 **Washdown closet pans and cisterns**

Washdown closet pans shall be bedded on floors in 1:3 cement mortar. Cisterns shall be fixed to walls with 6mm diameter expanding bolts

Q.21.7 **Ceramic urinals**

Ceramic stall and slab urinals shall be bedded on floors and against walls in 1:3 cement mortar. Slabs, channels, treads, etc shall be jointed in 1:3 cement mortar and pointed in white cement

Ceramic bowl urinals shall be fixed to walls on standard steel brackets bolted to wall with 6mm diameter expanding bolts. Cisterns shall be fixed to walls on standard brackets bolted to wall with 6mm diameter expanding bolts

Q.21.8 **Stainless steel urinals**

Stainless steel stall and slab urinals shall be bedded on floors in 1:3 cement mortar and with backs and sides against walls filled in with fine unreinforced concrete. Cisterns shall be fixed as cisterns for ceramic urinals

Q.22 FIRE HOSE REELS

Fire hose reels shall each be fitted with a 30m long hose of internal diameter not less than 19mm with a 4,8mm internal diameter chromium plated brass nozzle

Q.23 FIRE EXTINGUISHERS

All fire extinguishers shall be fully charged

Q.24 TESTS

Sewerage pipe lines, sanitary plumbing including fittings and hot and cold water supply and fire service shall be tested to the approval of the Principal Agent and Local Authority

The Contractor shall provide all testing apparatus, material and labour required for the tests and inspections

R. GLAZING

R.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Glass in building	SANS 50572-1 to 5
Glazing putty for wooden and metal window frames	SANS 680
Silvered glass mirrors for general use	SANS 1236
Safety and security glazing materials for buildings	SANS 1263-1 to 3
Sealing compounds for the building industry, one Component, silicone-rubber based	SANS 1305
The installation of glazing materials in buildings	SANS 10137
Work on glass for glazing	SANS 1817

R.2 PUTTY ETC

Glazing putty shall be Type I for wooden sashes and Type II for steel sashes. Putty for glazing to unpainted hardwood shall be tinted to match the colour of the wood

Back putty shall not exceed 3mm thick. Putty shall not be painted until it has formed a surface crust, and if the putty does not form a surface crust it shall be replaced

Butyl putty shall be used where glass is to be fixed in aluminium sashes with glazing beads

Non-setting compounds shall be used where laminated glass is fixed in sashes with glazing beads

S. PAINTWORK

S.1 MATERIALS AND WORKMANSHIP

Materials and workmanship shall comply with the following standards:

Decorative paint for interior use	SANS 515
Decorative high gloss enamel paints	SANS 630
Primers for wood (for external work)	SANS 678
Primers for wood (for internal work)	SANS 678
Zinc phosphate primer for steel	SANS 1319
Undercoats for paints (except emulsion paint)	SANS 681
Aluminium paint	SANS 682
Varnish for interior use	SANS 887
Emulsion paints	SANS 1586

Materials for paintwork shall be delivered to the site in unopened containers and applied in accordance with the manufacturer's instructions. Materials shall be suitable for application to the surfaces concerned. Undercoats shall be as
recommended by the manufacturer of the finishing coats

S.2 PREPARATORY WORK

S.2.1 **Plastered surfaces etc**

Plastered surfaces shall be thoroughly inspected and, if necessary, washed down and brushed in order to remove any traces of efflorescence and allowed to dry completely before any paint finish is applied. Before any paint is applied, holes, cracks and irregularities in plaster and other surfaces shall be filled with a suitable filler and finished smooth. Unfinished concrete surfaces shall have all projections rubbed off and shall be thoroughly cleaned with a spirits-of-salts solution (1 part concentrated spirits-of-salts to 4 parts water)

S.2.2 **Metal surfaces**

Metal surfaces shall be sanded, where necessary, washed with a suitable cleaning agent and left smooth

Protective coatings applied by manufacturers to galvanized metal surfaces shall be removed with a suitable agent and the surfaces washed down

Rust, grease and defective factory primers on metal surfaces, as well as pitch on cast iron pipes, shall be removed

S.2.3 **Wood surfaces**

Knots in woodwork shall be treated with knotting. Minor blemishes shall be filled with a suitable filler. Wood surfaces shall be sanded smooth

S.3 APPLICATION OF PAINT

Primers to wood surfaces shall be applied by brush. Primers to other surfaces may be applied by roller with the approval of the Principal Agent. Undercoats and finishing coats may be applied by brush or roller

Paint shall not be sprayed on except in the case of cellulose and other special paints where spray painting is the accepted method of application

Before subsequent coats of paint are applied the previous coat shall be properly dry and shall be sanded down where necessary

S.4 COLOUR SCHEME

A colour scheme comprising colours and the blending of colours approved by the Principal Agent shall be used for the paintwork. The tints of the undercoats shall closely match the finishing coat but nevertheless differ sufficiently to indicate the number of undercoats. Colour samples of the finishing coats shall be provided in all cases

S.5 GENERAL

Paintwork shall include the preparation of surfaces, filling, stopping, sanding and priming of nail heads and screws. Where windows, sashes, etc are to be painted, the rebates of the openings to be glazed shall be primed

T. PAPERHANGING

T.1 PREPARATORY WORK

Plaster surfaces to be papered shall be dry, thoroughly cleaned down, filled with a suitable filler as necessary to obtain a smooth surface and painted thereafter with a single coat of emulsion paint

Wood surfaces to be papered shall be knotted, stopped and sanded

T.2 PAPERHANGING

Wallpaper shall be hung in vertical long lengths. Vertical joints shall be close-fitted and plumb and the paper shall be tightly fitted to skirtings, ceilings, door frames, windows, etc. Horizontal joints will not be allowed

U. EXTERNAL WORKS

U.1 GENERAL

U.1.1 Excavations

Excavations shall be deemed to be in “earth”

U.2 LANDSCAPING

U.2.1 Topsoil

Topsoil shall vary between sandy loamy soil and sandy clayey soil with an ideal composition of 15% to 25% clay, 10% silt/sludge and 65% to 75% sand, with a minimum ratio of organic material of 2%. All material shall be free of harmful deposits as well as unwanted seeds

U.2.2 Compost

Compost shall be composed of properly decayed organic material, free from harmful deposits, salts, seeds and other waste material and shall have a pH of more than 4 and less than 7

U.2.3 Mulch

Mulch shall be approved organic material free from small particles of bark residue, fungus, disease, etc

U.2.4 Lime

Lime shall be agricultural lime of an approved manufacture

U.2.5 Fertilizer

Fertilizer shall be of the type specified, mixed thoroughly into the soil as prescribed. No fertilizer shall be added more than two weeks prior to planting

U.2.6 Backfilling

Backfilling in plant and tree holes shall be composed of two parts topsoil to one part compost mixed thoroughly together and compacted by foot in 100mm layers. Fertilizer shall only be added if prescribed

U.2.7 Pebbles

Pebbles shall be smooth with a uniform colour and form and ranging in size from 50mm to 75mm diameter. Removal of pebbles from river beds shall be done selectively to avoid any major disruption to the ecology of the river and environment

U.2.8 Plant material

U.2.8.1 General

All plant material (plants, shrubs, trees, etc) shall be obtained from a registered nursery and shall be free from damaged parts, parasites, fungus, other plant diseases or insects. No container-bound plants will be acceptable

U.2.8.2 Trees

The height of trees described in the bills of quantities shall be measured from the top of the root ball to the top of the tree. Where trees are pruned, such prune wounds shall not be more than 25mm in diameter and be sealed with an approved sealing compound

U.2.8.3 Shrubs and small plants

Shrubs and small plants shall meet the requirements for height and spread as specified. Thin or sparsely branched plants shall not be accepted. Branches shall be well spread with ample young branches and the plant as a whole shall be growing well

U.2.8.4 Groundcover

Groundcover shall be dense and healthy and shall comply with the minimum requirements for leaf density as specified

Formal grass shall be planted as runners in 50mm deep drills at 150mm centres unless otherwise described

U.2.9 **Cultivation and preparation of planting areas etc**

All surface rocks and stones larger than 50mm shall be removed before commencing cultivation and preparation. The entire area shall be ripped and rotavated using approved machinery by breaking up the earth to a depth of 300mm at 600mm centres in both directions, unless otherwise described, and then levelled. Where fertilizer or compost is specified, it shall be worked into the topsoil after ripping and rotavation to a depth of 300mm and finished to final levels

All fertilizer to areas to be grassed shall be strewn on the final layer before final finishing is commenced and worked mechanically into the top 150mm soil

U.2.10 **Planting procedure**

Holes for shrubs and groundcover shall be as follows:

Shrubs – 500 x 500 x 500mm deep

Groundcover – 300 x 300 x 300mm deep (if not planted in drills)

Holes for trees shall be square, of adequate size to accommodate the root system and suitable for the height of the tree

All plant material shall be watered thoroughly before careful removal from the container and planted in the prescribed planting medium with the top of the soil in the container finishing level with the surrounding area. Water dams size 800mm diameter x 150mm deep and 500mm diameter x 150mm deep shall be formed around trees and shrubs respectively and all planting material shall be watered immediately after planting. Trees, shrubs, etc shall be properly staked or stayed, depending on their size, on the prevailing windy side with patent tree ties

U.2.11 **Maintenance**

All planted areas shall be maintained for a period of three months after practical completion as defined in the contract with the exception of hydroseeded areas which shall be maintained for 12 months after an acceptable cover has been obtained

This maintenance shall consist of keeping clear of weeds and litter, loosening soil where necessary every two weeks, replacing damaged, diseased or dead plants, pruning, cutting and mowing as necessary and watering so as to keep the plant material in a healthy growing condition

U.3 ROADWORK

U.3.1 **Filling**

Filling under roads etc shall be of inert material having a maximum plasticity index of 10, free from large stones etc spread, levelled, watered and compacted in layers not exceeding 200mm thick to a density of 98% Mod AASHTO

U.3.2 **Preparation of sub-grade**

The sub-grade shall be prepared by scarifying for a depth of 150mm and compacting to a density of 98% Mod. AASHTO, including trimming to the correct levels and grades

U.3.3 **Base course**

The base course shall consist of crusher run stone compacted to a density of 98% Mod. AASHTO and finished to the correct levels and grades

U.3.4 **Weed killer**

The completed sub-grade shall be treated with an approved total weed killer

U.3.5 **Bituminous premix road surfacing**

Before spreading the premix material, the base course shall be swept clean and free from all dust, dirt and loose particles, lightly wetted and sprayed with a prime coat of cutback bitumen complying with SANS 308 at the rate of 1 litre/m^2

The material shall consist of semi-gap graded crushed stone aggregate having the following grading:

Sieve size (mm)	% By mass passing sieve
13,2	100
4,75	45-60
2,36	42-55
1,18	40-52
0,3	25-45
0,075	5-12

The aggregate shall be mixed with bituminous road tar binder complying with SANS 748 at the rate of 1m3 of stone to 120 litre of emulsion at atmospheric temperature

The binder shall be added to the stone and mixed until the stone is uniformly coated. Thereafter 5% of clean, dry quartzitic sand shall be added and mixed until evenly distributed through the mixture

The premix shall be applied only after the primer has dried out completely and shall be spread immediately after mixing and rolled on the same day

Spreading shall be done evenly over the prepared base course to a loose depth sufficient to ensure the consolidated thickness specified

Rolling shall commence as soon as the binder has set sufficiently, followed after three days by a final rolling

U.3.6 **Precast concrete block road surfacing**

Paving blocks shall be precast concrete blocks complying with SANS 1058

Blocks shall be laid to true levels and grades on and including a 25mm thick layer of river sand with joints exceeding 2mm and not exceeding 6mm wide

After laying, the paving shall be compacted by means of a vibrating plate compactor, with joints between the blocks filled in, after compaction, by sweeping in fine sand

Infill areas at edges of paving constituting less than 25% of a full block unit and of 25mm minimum dimension shall be filled with Class C prescribed mix unreinforced concrete with top surface trowelled smooth to match blocks. Smaller areas shall be filled with 1:4 cement mortar

U.3.7 **Precast concrete kerbs and channels**

Precast concrete kerbs and channels shall comply with SANS 927, generally in 1m lengths and finished smooth from the mould on exposed surfaces. Kerbs and channels shall be bedded on and jointed in 1:3 cement mortar and pointed with keyed joints. Bases to kerbs shall be Class B prescribed mix unreinforced concrete

U.3.8 **Process control tests**

The Contractor shall be responsible for carrying out all necessary process control tests on the density and moisture content of the compacted sub-grade, base course, etc to ensure that the required compaction is being attained

U.4 FENCING ETC

U.4.1 **Materials**

Materials and workmanship shall comply with the following specifications and requirements :

Wooden poles, droppers, guardrail posts and spacer blocks	SANS 457-2&3
Zinc-coated fencing wire	SANS 675
Prefabricated concrete components for fencing	SANS 1372
Chain-link fencing and its wire accessories	SANS 1373

Fasteners	SANS 1700
Anti-intruder fences	CKS 451
Metal droppers and standards	CKS 451

U.4.2 **Galvanized wire**

All galvanized wire shall be zinc coated wire with Class B zinc coating. Straining wire shall be 4mm diameter galvanized mild steel wire. Tie wire shall be 1,6mm diameter galvanized mild steel wire

U.4.3 **Plastic coated wire**

Plastic coated straining wire shall be 3,15mm diameter Class C galvanized mild steel wire plastic coated to an overall diameter of 3,95mm

Plastic coated tie wire shall be 1,8mm diameter Class C galvanized mild steel wire plastic coated to an overall diameter of 2,5mm

U.4.4 **Galvanized barbed wire**

Galvanized barbed wire shall be 2,5mm diameter mild steel double strand reverse twist zinc coated barbed wire with Class A zinc coating

U.4.5 **Galvanized wire mesh**

Galvanized wire mesh shall be 50mm mesh chain link netting of 2,5mm diameter Class C galvanized mild steel wire

U.4.6 **Plastic coated wire mesh**

Plastic coated wire mesh shall be 50mm mesh chain link netting of 2,5mm diameter Class C galvanized mild steel wire plastic coated to an overall diameter of 3,25mm

U.4.7 **Galvanized welded wire mesh**

Galvanized welded wire mesh shall be fabricated from pre-galvanized wires to rectangular pattern welded together at each intersection using a welding method which forms a zinc oxide protective coating at each intersection

U.4.8 **Razor wire**

Razor wire shall be fabricated from 2,5mm diameter galvanized high tensile steel wire fitted with razor barbs formed of 0,5mm galvanized steel strip clipped on at 37,5mm centres

U.4.9 **Metal droppers and standards**

Droppers shall be of ridged T-section mild steel with a mass of not less than 0,55kg/m. Standards shall be of I- section mild steel with a mass of not less than 3kg/m or of ridged edge Y-section mild steel with a mass of not less than 2,5kg/m, and shall be driven 600mm deep into the ground

Droppers and standards shall have either galvanized, sprayed metal or painted finish as described in the items and in accordance with CKS 451. In addition, those surfaces of standards embedded in the ground shall be coated with bitumen

U.4.10 **Metal posts and stays**

Posts and stays shall comply with CKS 451 and shall be of black galvanized mild steel tubing as specified

Straining posts shall be of 108mm outside diameter x 3mm wall thickness tubing, each with a 300 x 300 x 5mm thick mild steel sole plate and a steel cap welded on

Intermediate posts shall be of 50mm outside diameter x 2,5mm wall thickness tubing, each with a 230 x 230 x 5mm thick mild steel sole plate and a steel cap welded on
Stays for straining posts shall be of 50mm outside diameter x 2,5mm wall thickness tubing, each with a 230 x 230 x 5mm thick mild steel sole plate welded on and fixed raking with top end flattened, bent, holed and bolted to straining post with and including a 5mm diameter galvanized mild steel bolt with nut and washer

Posts and stays shall have either galvanized or painted finish as described in the items and in accordance with CKS 451. In addition, sole plates and portions of posts and stays embedded in ground shall be coated with bitumen

U.4.11 **Timber posts, stays and droppers**

Timber posts shall be 125mm diameter, timber stays shall be 100mm diameter and timber droppers shall be 30mm diameter

U.4.12 **Prestressed concrete posts and stays**

Prestressed concrete posts and stays shall be finished smooth from the mould and uniformly stressed by means of high tensile longitudinal prestressing wires with concrete cover to wires of not less than 20mm

Corner and straining posts shall be 100 x 100mm and intermediate posts and stays shall be 75 x 75mm. Stays shall be fixed raking with top end splayed and glued to posts with a suitable epoxy compound

U.4.13 **Bolts, nuts and washers**

Straining eye bolts, hinge bolts, bolts, nuts and washers shall be galvanized

U.4.14 **Precast concrete fencing**

Precast concrete fencing over sloping terrain shall be stepped to suit terrain, including the use of increased lengths of posts as necessary, excavation, etc

U.4.15 **Concrete bases**

Bases in ground for posts, stays, etc shall be of Class B prescribed mix concrete with tops 100mm below surface of ground

Sizes of concrete bases for posts, stays, etc shall be as follows:

Straining and gate posts	–	450 x 450 x 700mm deep
Intermediate posts	–	300 x 300 x 600mm deep
Stays	–	600 x 300 x 500mm deep

U.4.16 **Security overhangs**

Where fencing is described as having a security overhang, the posts and standards shall have angular (single arm) extension arms

Extension arms shall be attached to the posts and standards by welding in the case of steel and by spiking in the case of timber

Concrete extension arms shall be cast integrally with the post or standard

Barbed wire to security overhangs shall be tightly strained and wired at each intersection with extension arms and shall have barbed wire braces at 450mm centres between standards, posts, etc wired onto the barbed wire and the top straining wire

U.4.17 **Gates**

Gates shall be formed of 40mm outside diameter x 2,5mm wall thickness mild steel tubular framework with welded joints, strongly braced as necessary and filled in with wire mesh as described above, properly strained and securely bound to framework with tie wire

Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 2

INDEX

PART 1: GENERAL AND TECHNICAL SPECIFICATION

1 GENERAL AND STANDARD TECHNICAL SPECIFICATIONS

1.1 General

1. The installation described in this document shall comply with various standard specifications and requirements as well as the Project Specification or Supplementary Technical Specification.

2. The Project Specification (Part 2) shall be read as forming part of the standard specifications. Where there is any discrepancy between the Project Specification and the standard specifications, the Project Specification (Part 2) shall have preference. The Tenderer shall immediately enquire about such discrepancy.

1.2 Specifications and Drawings

The Engineer's drawings covering the various sections of the installation have been provided with the tender document. The working drawings of the contract shall, however, consist of:

1. The Engineer's drawings
2. The Architect's drawings
3. The Structural Engineer's drawings, as applicable
4. The Engineer's drawings of other disciplines, as applicable
5. The drawings of other service installations that are relevant for co-ordination and installation purposes
6. The installation drawings of other Contractors, where applicable.

Unless otherwise stated, three sets of the Engineer's Drawings, Specifications and schedules (if any) and one set of 1.2 will be issued free of charge to the contractor for installation purposes.

Provisions are made in the building structure to accept the specified installation.

The Contractor shall supply to the Engineer three copies of marked-up structural, or other drawings showing all builders work and/or additional requirements to be made in the structure in order to fit in dimensions of apparatus and materials to be installed by him. This information to be supplied in accordance with a programme mutually agreed upon by the Contractor and the Engineer.

Copies of shop drawings, as prescribed in Part 2 hereof, shall be submitted to the Engineer for approval and to demonstrate compliance with the contract documents. Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, manufacturer, supplier or distributor, and which illustrate relevant portions of the work.

The Engineer's approval of shop drawings or samples is limited to check conformity with design requirements and shall not relieve the Contractor of responsibility for erection or installation fit, or for any deviation from the requirements of the contract unless the Contractor has informed the Engineer in writing of such deviation at the time of submission of shop drawings or samples, and the engineer has given written approval for the specific deviation. The Engineer's approval shall not relieve the Contractor of responsibility for erection or installation fit or for errors or omissions in the shop drawings or samples.

The Engineer's drawings and specifications shall be considered binding with regard to the quality, quantity, general scheme, system, arrangement and function of the Contract works. All dimensions specially marked on the drawings shall be strictly followed.

During the execution of the work one of the sets of prints of drawings as mentioned in 1.2 above, and a specification shall be available for reference on site. Any discrepancy between the Drawings and the Specification and/or Schedules shall be drawn to the attention of the Engineer immediately such discrepancy is discovered.

Upon or before receiving final payment, the Contractor shall return to the engineer all such documents bearing the Engineer's name as have been stipulated to be returned. None of the documents herein before mentioned shall be used by any of the parties hereto for any other purposes than this contract and neither of the parties shall divulge or use, except for the purpose of this contract, any information contained in these documents. A deposit may be charged by the Engineer for possession of the specification documents. This deposit will be refunded upon the return of the documents.

1.3 Installation - General

1. The equipment mentioned in this specification shall be installed complete in all respects by the Contractor for this complete contract as specified in this Specification and as indicated on the relevant drawings.

2 Water and drainage connections (if required) will be provided as part of this contract to all equipment requiring connections. Fittings for final connections from these points to the equipment supplied shall form part of this contract.

3 Electrical connections will be provided for all electrically operated equipment to a specific point in close vicinity (2 m) of all items of equipment. The material for the final electrical connections from these points to the various items of equipment and the final connection itself, shall form part of this contract.

4 All equipment mentioned in this specification must be completely pre-wired and pre-piped in the manufacturer's works to form complete units, which shall be ready for installation on arrival on site.

5 All equipment shall be suitable for operation on an electrical power supply of 400/230 V, single/three phase, 50 Hz alternating current.

6 All equipment and the installation thereof, must conform to the Occupational Health and Safety Act of 1983, as amended, with special reference to pressure vessels.

7 All electrical equipment, installations and wiring must conform to the regulations governing such work. All conduits, control panels, control wiring, etc. are to be recessed.

1.4 Metric Calibration of Instruments

All instruments and gauges on all items of equipment shall be in the SI unit metric system.

1.5 Painting

The paintwork of all equipment, which is damaged during the course of the erection and installation and prior to acceptance, must be satisfactorily made good by the contractor(s).

1.6 Information to be provided with the tender

1 Tenderers are required to enter at the time of tender in the Schedule of materials the manufacturers of the materials and equipment, on which their tender is based, and the catalogue numbers and other information by which the materials and equipment may be identified. Sufficient details must be given to enable the unit concerned to be identified without ambiguity. It is not sufficient for a Tenderer to state in the schedules "as specified".

2 All tender offers must be supported with descriptive literature and technical data for each item of equipment offered.

1.7 Commissioning and testing

The commissioning and testing of each item of equipment and system is the responsibility of the contractor concerned with the supply, delivery and installation of the particular items of equipment and systems. All final testing shall be carried out in the presence of the engineer and all tests shall be to his satisfaction.

Recognised and statutory test procedures shall be carried out on all equipment.

1.8 Approval of equipment

All equipment offered must be of an approved and well-known manufacture. Only equipment of proven manufacture and quality will be considered.

1.9 Material

Where stainless steel is specified, this shall mean "chrome nickel steel" type 304 18/8 grade. Lower

grades of steel will not be acceptable.

1.10 Dimensions

The dimensions specified are maximum measurements, which must not be exceeded.

Tenderers must ensure, wherever possible, that the dimensions of equipment offered can be accommodated within the spaces provided and as scaled from the drawings. This requirement is essential for the matching of associated equipment and the building layout.

A workshop drawing indicating equipment layout for each building as well as all relevant dimensions shall be submitted for approval before manufacturing shall commence.

1.11 Trade Names

Where trade names are indicated in this specification, it should be clearly understood that such trade names are never mandatory but merely assist to identify the quality and performance of the article required by the Department.

The tenderer is therefore at liberty to provide his own choice of article provided that the article is of equal quality and performance as the named article.

Quality refers to:

- The value of the article:
  - sturdiness/solidity in make
  - composite materials
  - aspect (appearance)
  - size or volume (if important)
  - price

Performance refers to:

- The output of the article;
  - economical use
  - tamper resistance
    - of article itself
    - of its fixation
  - maintenance
    - cost of
    - ease of
    - accessibility for

Where a trade name is mentioned, it does not imply that the named article complies with the specification in all respects. It is the responsibility of tenderers to verify that equipment and/or materials offered complies with all specification requirements and is capable to perform the required duties.

1.12 The following Standard Specification as issued by the Department of Public Works, although not bound in this document, is applicable:

- Electrical Installation and Equipment pertaining to Mechanical Services, Issue IX 1998.
- Standard Specification for Kitchen Equipment (Architectural)
- SABS 460 : Copper and Copper alloy tubing
- SABS 455 : Covered electrodes for the manual arc welding of carbon and carbon manganese steels
- SABS 044 : Welding : Parts 1 to VII
- SABS 0238 : Welding and thermal cutting processes – Health and safety
- SABS 763 : Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire)
- SABS ISO 3573 : Continuous hot-dip zinc-coated carbon steel sheet of commercial, local

forming and drawing qualities.

- SABS 0214 : The design, fabrication and inspection of articles for hot-dip galvanising.
- SABS 1186-1 : Symbolic Safety Signs Part 1 : Standard signs and general requirements.
- OHS ACT : The Occupational Health and Safety Act, Act 85 of 1993.

PART 2 QUALITY SPECIFICATION

PART 2A

GENERAL SPECIFICATION FOR ELECTRICAL WORK

1. REGULATIONS, LAWS AND BY-LAWS

a) The latest issue of the SABS 0142 " Code of Practice for the Wiring of Premises" hereafter called the Wiring Code"
b) The Occupational Health and Safety Act 1993.
c) The Municipal by-laws and any special requirements of the local supply Authorities.
d) The local Fire Office Regulations.

2. NOTICE AND FEES

The contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local supply Authority. The fee charged by the Supply Authority for connection of the installation of the supply mains, will be arranged and paid by the contractor.

3. SCHEDULE OF FACILITIES.

In all instances where schedules of light, socket outlet and power points are attached or included on the drawings, these schedules are to be regarded as forming part of the specification.

4. QUALITY OF MATERIALS

Only materials of the first class quality shall be used and all materials shall be subject to the approval of the Department. Departmental specifications for various materials to be used on this contract are attached to and form part of this specification

Wherever applicable material shall comply with the relevant South African Bureau of Standards specifications, or to British Standard Specifications, where no SABS specification exist.

Materials wherever possible must be of South African manufacture.

5. DELAYS

If the electrical contractor's work should cause any delay to the building operations, he will be held responsible for any claims arising out of such delay.

6. MAINTENANCE PERIOD AND RETENTION MONEY

The maintenance period shall be three months; calculated from the date the installation has been taken over by the department.
Payment of the retention money will be affected after the lapse of the maintenance period and provided the installation has been in satisfactory working order during this period.

7. CONDUIT AND ACCESSORIES

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof space or elsewhere will be permitted.

The conduit and conduit accessories shall comply fly with the applicable SABS specifications as set out below and the conduit shall bear the mark of approval of the South African Bureau of Standards.

a) Screwed metallic conduit accessories: SABS 162
b) Plain – end metallic conduit and accessories: SABS 1007
c) Non-metallic conduit: SABS 950

Insulted heat-resistant boxes shall be used for outlets of totally enclosed luminaries and other fittings where excessive temperatures are likely to occur.

Luminaires and other fittings shall no be supported by no-metallic conduit or conduit boxes. These fittings

shall be secured to the surrounding structure in a way that is acceptable to the Department.

The Conduit shall be supported and fixed with saddles with a maximum spacing of 1m, even in roof spaces. (Refer to SABS 0142). The contractor shall supply and install ALL ADDITONAL SUPPORTING TIMBER REQUIRED.

It shall be possible to rewire the completed installation in the future without undue difficulty.

Non-metallic conduit and fittings shall not be used under the following conditions:

a) Outside a building (unless protected, or sheltered under eaves).
b) For mechanical load bearing.
c) Where they may be subjected to temperatures below – 10 degrees celsius or above 70 degrees celsius for prolonged periods.
d) As primary electrical insulation.
e) In areas where they may be subjected to mechanical damage.
f) For applications other than those for which they are designed.

PAINTING OF CONDUCTS

Exposed conduit may be painted with normal oil or PVA paints, but care must be taken to ensure that paint used does not contain any component that will soften or have any other detrimental effect on the materials from which the conduit and fittings are manufactured.

CONNECTING OF CONDUIT TO METAL EQUIPMENT/COMPONENTS

When any part of a non-metallic conduit system has to be connected to metal equipment or components (e.g. switchboards, surface socket-outlet, existing metallic conduit system etc.) fitting and joints manufactured specifically for this purpose must be used. Non-metallic conduit must not be threaded to fit metallic connectors.

BEND

In conduit of nominal size not exceeding 25mm, bends may be made as described hereunder. In all other cases bends must be achieved by the use of accessories that are introduced into he conduit run bends shall comply with the relevant requirements of SABS 0142

BENDING

Conductor of nominal size up to 20mm and including 25 mm may be bent by hand provided that the radius of the bend is greater than six times the nominal size of the conduit, and that the external angle of he bend does not exceed 90 degrees. The procedure (which involves the use of a bending spring) should be as follows:

a) Determine the angle through which the conduit is to be bent.
b) Warm the cold conduit over the length to be bend by rubbing with hands.
c) Select a bending spring which matches the conduit size and insert it into the conduit beyond the point where the bend is required.
d) Bend the conduit slowly with one motion (either with the hands alone approximately 1 m apart, or across the knee) to double the required angle, release the conduit and, when its position is stable, withdraw the bending spring (turning it in an anti-clockwise direction to reduce its diameter) and gently correct the angle.
e) Install and secure the conduit immediately following bending.

ADHESIVE JOINTS

All adhesive joints must be made in clean dry area. The surface of all components to be bonded must be dry and clean.

The insertion depth should be marked on the conduit end and the adhesive applied (by means of a soft clean brush) as quickly as possible to the surface to be bonded by brushing lengthwise along the conduit, ensuring that a thin coating of uniform thickness is formed. The joint must be made immediately after the

application of the adhesive by pushing the prepared parts squarely together with a twisting motion of the full insertion depth. Care must be taken to avoid squeezing adhesive into the cableway and all excess adhesive must be wiped off.

Note. Solvent adhesive containing highly volatile liquids and their containers should not be left open.

Cutting of Conduit

A fine-tooth hacksaw should be used to cut conduit to the required length. Each cut end should be square and free from swarf, burrs and loose material. When determining the length of conduit to be cut, allowance must be made for the length of couplings or accessories attached to the conduit. Incorrect determination will cause bulging of the conduit or insufficient joint length.

8. CONDUIT IN ROOF SPACES

In roof spaces, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit shall be secured at intervals not exceeding 1m by means of saddles fixed to the roof timbers by means of screws or acceptable clout nails.

In the case of repairs and renovations, conduct runs from a distribution board shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or in close proximity to the boards.

9. WIRING

Except where otherwise specified in part 3 of the specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted, provided the circuits are of the same loading i.e. not mixed.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduits to be clear of moisture and debris before wiring is commenced.

Unless otherwise specified in Part 3 of this specification or indicated on the service drawings, the wiring to the installation shall be carried out in accordance with “Wiring Code”. In addition to the requirements of the “Wiring Code” concerning the installation of earth conductors of minimum size and maximum length it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductor must be provided and drawn into the conduit with the main conductors to all points, including all lighting points throughout the installation.

Wiring for lighting circuits is to be carried out with 1.5mm² conductors and a 2.5mm² earth conductor. For socket outlet circuits the wiring shall compromise 2.5mm² and a 2.5mm² earth conductor. In certain instances, as will be directed in Part 3 of this specification the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduits in all other instances, such as feeders to distribution boards, power points etc, shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be in accordance with “Wiring Code”.

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 300/500 V grade cable to SABS 1507.

Where cable ends connect into switches, fittings, etc. the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

10. SWITCHES AND SOCKET OUTLETS

All switches and switch socket outlet combination units shall conform to the Department Quality Specifications, which form part of this specification.

Only 16A 3 pin sockets shall be used, unless other special purpose types are Distinctly specified or shown on the drawings.

All light switches shall be installed at 1.4m above finished floor level and all socket outlets as directed in the Schedule of fittings which forms part of this specification or alternatively the height of socket outlet shall be indicated on the drawings.

11. SWITCHGEAR

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-plug units, contactors, time switches, etc., is to be accordance with Departmental Quality Specifications which form part of this specification and shall be equal and similar in quality to such brand as may be specified.

For uniform appearance of switchboard, only one approved make of each of the different classes of Switchgear mentioned shall be used throughout the installation.

12. SWITCHBOARDS

All boards shall be accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Department before installation.

In all instances where provision is to be made on boards for the supply authority's main switch and /or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

Any construction, or standard type board proposed as an alternative to that specified, must have the prior approval of the Department. All busbars, wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other auxiliary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The wording of the labels, in English shall be according to the layout drawings or as directed by the Departments, representative and must be confirmed on site. Flush mounted boards to be installed with the top of the board 2,0 above the finishing floor level.

13. WORKMANSHIP AND STAFF

All employees employed on the service must be under the constant supervision of a registered accredited person.

The workmanship shall be of the highest grade to the satisfaction of the Department.

All inferior work shall, on indication by electrical consulting engineer or the Department's inspecting officers, immediately be removed and rectified by and at the expense of the electrical contractor.

14. EARTHING OF INSTALLATION

The type of main earthing must be as required by the supply authority, if other than Department's representative, who may require additional earthing to meet test standards.

Where required ad earth mat shall be provided, the minimum size, unless otherwise specified, being 1,0m and consisting of 4mm diameter hard-drawn bare copper wires at 250mm centres and brazed at all intersections.

Alternatively or additionally earth rods or trench earths may be required as specified or directed by the Department's authorized representative.

Installations shall be effectively earthed in accordance with the "Standard Regulations" and to the requirements of supply authority. All hot and cold water and waste pipes are to be effectively bonded by means of 12.x 1.6mm solid or perforated copper tape and brass bolts with nuts at intervals not exceeding 18m. Self-tapping screws are not acceptable as means of securing earth conductors.

Connection from the main earth bar on the main board must be made at the cold water main, the incoming service earth conductor, if any, and the earth mat or other local electrode by means of 12,5mm x 1,60mm

solid copper tape or 16mm² stranded (not solid) bare copper wire or such conductor as the Department's representative may direct.

15. MOUNTING AND POSITIONING OF LIGHT FITTINGS

The electrical contractor must note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close-corporation with the building contractor is necessary to ensure that as far as possible, the light fittings are symmetrically positioned with regard to the ceiling pattern.

The layout of the fittings, as indicated on the drawing must be adhered to as far as possible, but the exact positions must be confirmed with the Department's representative.

Fluorescent fittings, installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be ¾ of the length of the fittings apart.

Fluorescent fittings to be mounted on the board ceilings shall be secured by means of two 40mm X No 10 round head screws and washers and in turn secured to the ceiling branderings. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed ¾ of the length of the fitting apart. The use of Butterfly clips to secure the light fittings will not be acceptable.

In addition to the above, an earth conductor is to be taken from the earthing terminal on all fluorescent fittings and solidly bonded onto the conduit installation.

Incandescent fittings are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings, the fittings shall be secured to the brandering or joints by means of two 40mm x No.8 round head screws.

16. VARIATIONS IN EXTENT OF CONTRACT

The Department reserves the right to instruct the contractor to carry out variations to the contractor either in terms of clause 18 of the Standard Conditions of Contract or in accordance with prices quoted by the contractor in the Price Schedule for Variations or Bills or Quantities, whichever is applicable.

For variations not provided for in the Price Schedule, Bills or Quantities the Department may call on the contractor to submit a separate written quotation.

Labour and material shall be based on clause 10 of the Standard Conditions of contract, and no payment will be made for the transport of labour and material to and from the service.

The Department, however, reserve the right to execute any alterations or additions that may be necessary by others.

Before any light fittings are ordered by Contractor, the makes and types of these fittings must be approved by the Department. The Department reserves the right to omit the supply for light fittings, cooking appliances and hot-water cylinders from the contract in whole or in part, and to deliver such material to the contractor by others.

17. DEPARTMENTAL MATERIAL

When certain materials are supplied by the Department to the contractor for installation, the contractor must arrange for taking delivery and providing safe storage of these materials.

The contractor will be held responsible for all damage to or loss of such material while it is his custody.

PART 2B
QUALITY SPECIFICATION

2.1 CONDUIT AND CONDUIT ACCESS

2.1.1 General

This section covers requirements for conduit and conduit accessories for general installations under normal environmental conditions.

2.1.2 Screwed conduit

Conduit shall comply with SABS 162 and shall bear the SABS mark.

All conduits shall be heavy gauge, welded or solid drawn, hot-dip galvanised or black enamelled.

Galvanised conduit shall be hot-dipped inside and outside in accordance with SABS 763.

All conduit ends shall be reamed and threaded on both sides and delivered with a coupling at one end and a plastic cap on the other end.

2.1.3 Metal conduit accessories.

All metal conduit accessories shall be malleable cast iron or pressed steel with brass bushes in accordance with SABS 162. alloy or pressure cast metal accessories or zinc base alloy fittings are not acceptable. All fittings whether galvanised or black enamelled, shall be fitted with brass screws.

Accessories must be hot-dip galvanised to SABS 763.

2.1.4 Circular type boxes

The boxes shall be of the long spout pattern, manufactured of malleable cast iron or pressed steel and stove enamelled jet black or galvanised as required. The two fixing holes shall be diametrically opposite each other, drilled and tapped at 50mm centres.

Junction, draw-in an inspection boxes shall be adequate size and shall be supplied with heavy gauge metal cover plates.

2.1.5 Switch boxes and socket-outlet boxes

All switch boxes and socket-outlet boxes shall be manufactured of pressed galvanised of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and socket-outlets manufactured in accordance with SABS 518 and SABS 1085.

Only galvanised or metal wall boxes will be acceptable to the Department, even if the tenderer offered to use non-metallic conduit and accessories. Light switch boxes shall be 100 x 50 x 50mm with two 20mm knockout on the sides and a single knockout on the top, bottom and back.

Socket-outlet boxes shall be 100 x 100 x 50mm with 20mm knock-outs each on the top, bottom, sides and back.

Where cavity walls are encountered tenderers must allow to install deep back (one end closed) wall boxes. Switch and socket-outlet cover plates shall comply with SABS 1084

2.1.6 Flexible conduit

Flexible steel conduit and adaptors shall comply with BS 731, part 1 where applicable. Flexile conduit shall be of galvanised steel construction and plastic sheathed (complex or equal). Flexible conduit shall only be used as specified and shall then be installed in accordance with SABS 0142.

2.1.7 Plain-end metallic conduit

As an alternative to the threaded conduit, plain-end (unthreaded) metallic conduit with accessories

may be used.

Unthreaded conduit shall be manufactured of mild steel with a minimum thickness of 0,9mm and shall comply with SABS 1007. Bending and setting of conduit shall be done with the correct apparatus recommend by the manufacturer of the conduit.

The Contractor or Supplier shall be responsible for obtaining the approval of local authorities for the use of the system.

All conduit and accessories used in areas within 50km of the coast shall be hot-dip galvanised to SABS 763.

2.1.8 Non metallic conduit

Non-metallic conduit shall comply with SABS 950.

2.1.9 Earth Clamps

Earth clamps shall consist of copper strips at least 1,2mm thick and not less than 12mm wide secured with a brass bolt, nut washer and shall be so constructed that the clamp will fit firmly to the conduit without any additional packing.

2.2 POWERSKIRTING

2.2.1 General

The channel and cover shall be manufactured of 1mm thick rolled sheet steel. The channel and cover shall be epoxy coated after manufacture.

2.2.2 Outlets

Outlets pre-punched on a modular basis shall be provided to accommodate socket outlets or future socket outlets. In addition to standard lengths, covers of 250mm length shall be provided for installation on building module lines.

2.3 PVC-INSULATED CABLES - 600/1000 V GRADE

2.3.1 General

This section covers the requirements for PVC-insulated cables for general installations under normal environmental conditions.

2.3.2 Construction

Cables shall be manufactured in accordance with SABS 1507, shall come only from fresh stocks, and shall be constructed as follows:

a) Unarmoured cables - PVC-insulated/PVC-sheathed
b) Armoured cables - PVC-insulated/PVC-bedded/armoured/black.
c) Single core cable - PVC-insulated/unsheathed

The conductors shall be of high conductivity annealed stranded copper and the cores may be shaped or circular.

The insulation shall be general purpose PVC, 600/1000 V Grade.

The bedding shall consist of continuous impermeable sheath of PVC extruded to fill the core or cores closely and in the case of multi - core cables, to fill the interstices between the cores.

Where armouring is specified it shall consist of one layer of galvanised steel wire in the case of multi-core cables and non- magnetic metallic wire in the case of single core cables. Aluminium strip or tape armouring is not acceptable.

Where specified, an earth continuity conductor shall be provided in the armouring in accordance with SABS 1507.

2.3.3 PVC-Sheathed aluminium -covered cables

Aluminium covered cables shall comprise PVC-insulated copper conductors protected by an aluminium foil tape screen and PVC sheath.
Cable ends shall be made off with compression glands fitted with a neoprene ring to seal the end.

Aluminium sheathed cable shall be installed on surface only, using matching saddles installed at suitable intervals to prevent sagging.

Where exposed to sunlight, the cable shall have a stabilized black outer sheath.

2.3.4 Lengths

Cable shall be manufactured and supplied in one length to be lengths specified unless lengths exceed a standard drum length in which case a ruling shall be obtained from the Engineer.

2.3.5 Tests

At the option of the Engineer, acceptance tests shall be carried out on production runs of the cable in accordance with SABS 1507.

2.4 GLANDS

Glands to be used for terminating PVC/PVC/SWA/PVC cables shall be of the adjustable type.

Glands shall be suitable for general purpose 600/1000 V Grade cable with steel armouring.

The glands shall be made of nickel-plated bronze or brass.

The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass or a heavy galvanised steel locknut screwed into the other end.
The galvanised shall comply with SABS 763.

Non-watertight glands must be easily converted to watertight glands by means of waterproofing shroud and inner seal kit. On the cable entry side of the barrel a concave groove shall be provided to accommodate the top rim of the waterproofing shroud.

The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber, and shall resistant to water, oil and sunlight. The shrouds shall Ht tightly around the glands and cable.

Glands shall be provided with ISO threads and shall be suitable for the specified cable sizes.

Flameproof of glands shall comply with SABS 808, Group 1, 2a and 2b. Suitable accessories shall be provided with glands to be used on ECC armoured cables to facilitate a bolted lug connection of the earth continuity conductors. Groove cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.

For unarmoured cables the cone bush and compression ring of the gland shall be replaced with a synthetic rubber compression bush and ring to provide the required grip on the outer sheath of the cable.

2.5 CABLE TERMINATION AND JOINTS

2.5.1 Heat-shrinkable materials

2.5.1.1 General

The complete kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable An illustrated set of instructions for the installation of the materials shall accompany every kit.

The joints and terminations shall make minimal, if any use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk onto the termination or joint is preferred above other methods.

The materials shall comply with VDE 9278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials of installation.

The heat-shrinkable and other materials used for the terminations and joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

2.5.1.2 Terminations with heat-shrinkable materials

Terminations shall be made of a material that gives lasting protection against ultraviolet radiation.

The cores of all cables terminated outdoors and the cores of 3.3kV and higher voltage cables terminated indoors shall be completely covered with a shrunk-on protective layer against surface tracking, ultraviolet radiation and weathering.

2.6 LIGHT SWICHES

2.6.1 General

This section covers the requirements for switches for use in general installation under normal environmental conditions.

Light switches of one manufacturer only, will be acceptable per project.

2.6.2 Flush and surface mounted switches

All switches shall be suitable for mounting in 100 x 50 x 50mm boxes, shall comply with SABS 163 and shall bear the SABS mark.

Switches shall be of tumbler operated micrograph type rated at 16A, 220/250V.

Switches shall have protected terminals for safe wiring.

Contracts shall be made of silver material.

On multi-lever switches, it shall be possible to individually change any of its switches.

The yoke strap shall be slotted to allow for easy alignment. The covers of surface mounted switches shall have toggle protectors.

Where light switches are installed in partitions, they shall, where possible, be of the special narrow type intended for installation into the mullions.

2.6.3 Watertight switches

Watertight switches shall be of the micrograph type suitable for surface mounting and shall bear the SABS mark.

The housing shall be galvanised cast iron or die-cast aluminium with watertight cover plate and toggle.

The switch shall have a porcelain base and a quick acting spring mechanism and shall be rated at 16A, 220,25OV.

The ON/OFF positions shall be clearly marked on switch housing.

2.6.4 Ceiling switches

Ceiling switches shall be rated at 10A. 220/250V and shall be suitable for ceiling mounting on a round conduit box.

The switch shall be made of high impact strength nylon material.

Adequate space shall be provided within the unit for ease of wiring. The switch colour shall be white and shall be fitted with a nylon cord 1,25m long.

2.6.5 Cover plates

Cover plates shall be finished in ivory coloured baked enamel, anodised bronze or aluminium unless otherwise specified. Cover plates shall overlap the outlets to cover wall imperfections. Cover plates shall comply with SABS 1084.

2.7 UNSWITCHED AND SWITCHED SOCKET OUTLETS

2.7.1 General

This section covers the requirements for unswitched and switched socket-outlets for use in general installations under normal environmental conditions.

Switch sockets of one manufacturer only, will be accepted per project.

2.7.2 Flush and surface mounted switched sockets

All switched socket-outlets shall be suitable for mounting on 100 x 100 x 50mm or 100 x 50 x 50mm boxes, shall comply with SABS 164 and shall bear the SABS mark.

Switches shall be of a tumbler operated micrograph type rated at 16 A, 220/250V.

Terminals shall be enclosed for safe wiring.

Contacts shall be silver material.

Safety shutters shall be provided on live and neutral openings.

The yoke strap shall be slotted to allow for easy alignment.

The covers of surface mounted-switched sockets shall have toggle protectors.

Miniature circuit breakers shall be used in lieu of a switch where specified.

Where 13 A flat pin switched socket-outlets are specified, these shall comply with BS 1363.

2.7.3 Watertight switched sockets

The housing of watertight-switched socket shall be of galvanised cast iron or die-cast aluminium with watertight-machined joints.

The switch shall have porcelain base and a quick acting spring mechanism and shall be rated at 16A, 220/250V.

The ON/OFF positions shall be clearly marked on switch housing.

The socket openings shall be rendered watertight by means of a gasketed cover plate which is screwed into the body of the unit. The cover plate shall be secured to the body of the unit by means of a chain.

2.8 TUBULAR FLUORESCENT LAMP LUMINAIRES FOR INTERIOR APPLICATIONS

2.8.1 General

Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. as applicable, and shall be delivered to site in protective covering.

Lamps shall be delivered separately.

Tenders shall be accompanied by fully descriptive information of luminaires offered.

Photometric date, i.e. polar cubes and coefficients of utilization certified by SABS shall be made submitted tenders for all luminaries offered.

2.8.2 General technical requirements

2.8.2.1 General.

Tubular fluorescent lamp luminaires shall comply fully with SABS 1119 and all amendments as well as the additional requirements of this specification. Luminaires which bear the SABS mark are preferred.

The Engineer reserves the right to have samples of luminaires offered tested by the SABS for compliance with SABS 1119 the cost of such tests shall be borne by the Tenderer.

2.8.2.2 Construction

A luminaire shall consist of a ventilated body manufactured of cold rolled sheet steel not less than 0,8mm thick, suitably braced or stiffened to prevent distortion. The body shall be of sufficient strength for mounting of the entire luminaire.

The luminaire body shall designed to accommodate the control gear, wiring, lamp holders and, where applicable, the diffuser. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.

Except for mounting holes/or slots and the required openings in air-return luminaries, the back of the body channel shall be closed over the full length of the luminaire.

Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.

All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof.

2.8.2.3 Internal wiring

Luminaires shall be completely wired internally; Conductors shall be protected with grommets where they pass through holes in the body.

The wiring shall be totally metal enclosed to prevent any possible contact with live components while changing lamps.

The conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.

The wiring shall terminate on suitable terminal block. There shall be no joints in internal wiring. An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal means of a crimped lug.

2.8.2.4 Lamp holders

Lamp holders shall be telescopic spring loaded type.

2.8.2.5 Control gear

The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.

Ballasts shall comply with SABS 890 and 891, suitable for operation on 220/250 V, 50Hz supplies.

Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in par. 3.5 of SABS 1119 are not exceeded.

Noisy ballasts will not be accepted and shall be replaced at no cost to the Client.

Starters shall comply with BS3772. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

2.8.2.6 Capacitors

Capacitors shall comply with SABS 1250. The power factor of each complete fitting shall be corrected to at least 0.85.

2.8.2.7 Lamps

Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with SABS 1041.

If no colour is specified in Project Specification, the light colour shall correspond to colour 2 (4 300K) of SABS 1041.

Lamps of the same colour shall be provided for an entire installation unless specified to the contrary. There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost to the Client.

2.8.3 Channel Luminaires

Channel luminaires shall consist of a ventilated, enclosed channel body with one more or more lamps as specified. The channel body channel body shall house the ballasts, capacitor, terminals and internal wiring.

Provision will be made for the addition of reflector wings and/or diffusers.

Three sets of mounting slots and knockouts suitable for mounting onto standard round conduit boxes and /or 20mm dia. Conduit pendant rods, shall provided in the rear of the channel, one in the centre and one approximately one sixth from each end.

A knockout suitable for a 20mm dia. Conduit entry shall be provided at each end of the channel. The distance between the back of the luminaire and centre of the knockout shall be approximately 25mm.

The knockouts shall be positioned on the centre line of the channel.

The body channel shall incorporate a removable cover acting as a reflector, manufactured of cold rolled steel, not less than 0.8mm thick, designed and mounted to completely cover the interior of the body channel and its contents and extending over the full length of the luminaire up to the lamp holders.

The reflector shall be firmly held in position with a latching device consisting of knurled, coin slot, captive screws. Plastic, used as a spring mechanism, is not acceptable as fixing device for reflections. The action of the latching device shall not deteriorate due to use and/or ageing.

2.8.4 Industrial Luminaires

Industrial type luminaires shall consist of a basic channel luminaire fitted with detachable side reflections.

The reflectors shall be manufactured of cold rolled steel, not less than 0.8mm thick.

The reflectors shall be designed to improve the downward light output ration and decrease the upward light ratio to value of less than 2%.

2.8.5 Bulkhead fittings with unbreakable polycarbonate lens.

Bulkhead fitting shall be of the circular type and must be manufactured to suite the outdoor and indoor applications and to accommodate the following lamps in respect to the tube of lamps specified.

The base of the fitting shall be of die cast or heavy gauge pressed aluminium. The base shall be treated against corrosion and shall have a black Matt finish.

Threaded conduit entries to take 20mm diameter conduits must be provided on at least two sides and one for back entry. At least two of the conduit entries must be fitted with brass/neoprene stoppers. All control gear shall be suitable for the supply voltage of 22.230 Volt. -5 Hz applications and shall bear the SABS mark of approval or equivalent.

The diffuser shall be injection moulded, prismatic, clear polycarbonate. The diffuser shall be held in position by three stainless steel screws via reinforced holes in the lens and the screws must be provided with gaskets to prevent the ingress of moisture. The fittings shall be provided with either a neoprene or silicon gasket fitted between the diffuser and the base.

The internal finish of the fitting shall be of high-grade heat resistant white enamel and the fitting shall be provided with a removable metal lamp holder platforms. The fitting shall also be provided with a reflector between the lamp and the base, and wiring leads to the lamp holder shall be high heat resistant and preferably covered with silicone.

The overall dimensions shall be approximately 200mm x150 deep for circular in shape fittings.

2.8.6 Flood lights with polycarbonate diffuser

General

The luminaire must be of the wall-mounted type for use with gas discharge lamps of the 125-Watt Mercury Vapour type and must be designed for the functional perimeter lighting of buildings.

Construction details

Diffuser:

The diffuser must be of a precise injection moulding with prisms for optimum light control and manufactured in either tough Ultra —violet resistant acrylic or in highly vandal resistant Uv sterilised polycarbonate.

Diffuser Frame:

The diffuser frame must be of die-cast powder coated corrosion resistant aluminium casting incorporating the diffuser of which both can be removed from the body utilising one captive stainless steel screw.

Luminaire Body:

The luminaire body must be manufactured from black epoxy coated aluminium which can incorporate all the electrical components, the reflector and the gasket which seals frame and body. A back entry hole suitable for a 20mm diameter conduit must be provided to accommodate the wiring entry and two mounting holes suitable for 60mm diameter screws must be provided as a standard feature.

Reflector:

The reflector must be manufactured from ultra pure pre-anodised aluminium for maximum reflection.

Electrical:

The terminal block and lamp holder must be manufactured from porcelain and the wiring must be coated with resistant silicone rubber. All control gear shall be suitable for the supply voltage of 220/230Volt 50 Hz and shall bear the SABS mark of approval or equivalent.

2.8.7 Round wall and ceiling luminaires

Luminaires shall be of the circular type and must be manufactured to suite the outdoor or indoor application and to accommodate the following in respect of the type of lamp specified.

The base of the luminaire shall be made of die-cast aluminium and stainless steel. The base shall be treated against corrosion and shall have a black Matt finish.

A back entry hole suitable for a 20mm dia. Conduit must be provided to accommodate the wiring entry. All control gear shall be suitable for the supply voltage of 220/250 Volt- 50Hz and shall bear the SABS mark of approval or equivalent.

The diffuser shall be polycarbonate with a high impact resistance and held in position by means of a round ring with three stainless steel screws via reinforced holes in the diffuser and the diffuser screws must be provided with gaskets to prevent ingress of moisture. The fittings shall be provided with either a neoprene or a silicone gasket fitted between the lens and the base.

The internal finish of the fittings shall be of high-grade heat resistant white enamel and fitting shall be provided with a removable metal lamp holder platform. The fitting shall also be provided with a reflector between the lamp and the base, and wiring leads to the lamp holder shall be high heat resistant and preferably covered with silicone.

The overall dimension shall be approximately 230mm in diameter x 115mm deep and circular in shape.

2.9 EARTHING ELECTODES

2.9.1 General

This section covers on uncoated, coated and metal clad circular rod electrodes intended to provide an earth in soil for electrical and lightning arrestor systems.

2.9.2 Category and type

Only the following type of earth rods shall be used:

1(a) - Solid copper
(b) - Solid stainless steel
2(a) - Solid steel with bonded copper protection
(b) - Solid steel with plated copper protection
(c) - Solid steel with a shrunk-on copper jacket
3 - Solid steel with a shrunk-on stainless steel jacket
4 - Galvanised steel

2.9.2.1 Bare aluminium is not acceptable as an electrode material.

2.9.2.2 All rods shall be solid and of circular cross section with length as specified in Project Specification.

2.9.2.3 The nominal diameter of the earthing rods shall not be less than 16mm unless the rods are specified for placing in pre-drilled holes in which event the minimum nominal diameter shall not be less than 12mm.

2.9.3 Couplings and conductor clamps

Earthing electrodes shall be provided with (n-1) couplings where n = number of rods supplied.

Rods designed for coupling by means of external sleeves shall provided with an adequate quantity of hydrocarbon or silicon grease to be applied to the coupling before the joint is made. Rods designed for coupling by means of internal pins or splines shall be provided with thin-walled tubes and hydrocarbon or silicon grease to seal the joint.

Conductor clamps shall be provided to suit the type and size of rods provided and the type and size of conductor specified in the Project Specification.

The material of the clamps shall be electrolytically compatible with the rod and conductor materials.

Where brazed or welded connections are specified, the supplier of the rods shall stipulate at least two types of metals, which are compatible with the rod and conductor materials.

An adequate number of driving caps of bolts shall be supplied with rods to protect the ends earthing rods whilst being driven into hard soil.

2.10 SWITCHBOARDS (Up to 1kV)

2.10.1 General

2.10.1.1 Scope

This section covers the manufacturing and testing of flush mounted, surface mounted and floor standing switchboards for general installations in normal environmental conditions and for system voltage up to 1kV.

2.10.1.2 Size

All switchboards shall be of ample size to accommodate the specified switchgear and provide space for future switchgear. For every four (4x) or part of four (4x) 5 kA circuit breakers on a switchboard, space for an additional 5I<A circuit breaker shall be allowed unless future space requirements are clearly specified. For circuit breakers above 5 kA, this factor shall be 15%. The clearance between adjoining switchgear openings shall be as specified.

2.10.1.3 External dimensions

The maximum allowable height of free standing switchboards is 2.2.m where, due to space restrictions, a board exceeds 2.2m in height, equipment not normally requiring access, shall be installed in the top section, enabling equipment normally requiring access to be installed lower down in the board. All other specified external dimensions for switchboard shall be strictly adhered to. If the clearances specified cannot be adhered to as a result of restricting external dimensions, the contractor shall obtain the approval of the Engineer before manufacturing the switchboards.

2.10.1.4 Moisture and vermin

All switchboards shall be rendered moisture proof and vermin proof and shall be adequately ventilated.

2.10.1.5 Load Balance

The load shall be balanced as equally as possible across multi-phase supplies.

2.10.2 Construction of flush mounted switchboards

2.10.2.1 Standard

Flush mounted switchboards shall comply fully with SABS 1180, Part I. Unless the depths of the switchboards are specified, depths shall be determined in accordance with 3.10.4

2.10.2.2 Expanded metal

Where switchboards are to be built into 115mm thick walls, expanded metal shall be spot welded to the rear of the bonding trays. The expanded metal shall protrude at least 75mm on each tray side to prevent plaster from cracking.

2.10.2.3 Knock-outs

Knockouts shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knockouts shall be provided for an equal number of 20mm and 25mm diameter conduits.

2.10.2.4 Panel

Front panels shall have machine punched slots for housing the specified and future flush mounted switchgear. The distance between the inside of the closed doors and the panel shall not be less than 20mm. No equipment may be mounted on the panel unless the panel is permanently hinged to the switchboard frame.

2.10.2.5 Fixing of front panels

The front panels shall be secured to the architrave frame by means of captive fasteners. Alternatively the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws will not be allowed.

2.10.2.6 Door handles and catches

Switchboard doors shall be equipped with handles and catches. Locks shall only be provided when specified. In all cases where lockable doors are higher or wider than 450mm, handles consisting of

a push button and handle combination with spring loaded catch or rotary handle and catch combination shall be installed. Switchboard doors smaller than 450mm in height and which may be equipped with spring loaded flush mounted ring type latches. Square key operated catches are not acceptable unless specified.

2.10.3 Construction of surface mounted switchboards

2.10.3.1Standard

Surface mounted switchboards shall comply with SABS 1180, Part II.

2.10.3.2 Switchboard tray

Surface mounted switchboards shall be equipped with a 1,6mm minimum sheet steel reinforced tray, suitably braced and stiffened to carry the chassis, door and equipment. Lugs to secure the switchboard to a vertical surface shall be made provided.

2.10.3.3Construction

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge at least 20mm to accommodate flush doors.

2.10.3.4 Chassis

A sheet steel chassis for the mounting of equipment shall be bolted to the tray and shall comply with the requirements of par.2.10.4.

2.10.3.5 Front panel and door

The front panel and door shall comply with the above. Doors shall fit flush in the tray when closed.

2.10.3.6 Dimension

Unless the depth of the switchboards is specified, the dimensions shall be determined in accordance with requirements of par 2.10.4

2.10.4 Mounting of equipment

2.10.4.1 Standard

The mounting of equipment shall comply with SABS 1180 where applicable. Equipment to be mounted on the chassis shall be mounted by bolts. Washers and nuts or by bolts screwed into tapped holes in the chassis plate.

2.10.4.2 Mounting of chassis

The chassis of flush mounted and smaller surface mounted boards shall be mounted in accordance with SABS 1180. For all free standing switchboards and surface mounted switchboards where the main switch rating exceeds 100 A (Triple-pole), space for wiring shall be provided between the chassis and tray. This space shall be adequate to install the supply cable behind the chassis and terminate on the main switch without sharp bends in the cable cores.

2.10.4.3 Grouping of equipment

Equipment shall be arranged and grouped in logical fashion.

Where earth leakage units are required, the associated circuit breakers shall be installed adjacent to the unit.

2.10.4.4 Mounting of Circuit breakers

All moulded-case circuit breakers shall be flush mounted with only the toggles protruding. Miniature circuit breakers may be installed in clip-in trays mounted on the frame. All other circuit breakers shall be bolted to the chassis. Special provision shall be made for large main switches when designing the framework. Care shall be exercised that the rear studs of circuit breakers are properly insulated from the steel chassis. Where necessary, insulating material shall be installed that the toggles are in the up position when "ON" and "OFF".

2.10.4.5 Instrumentation

All metering instruments shall be flush mounted in the front panel or door. The rear terminals of instruments mounted on doors shall be covered with an insulating material to prevent accidental contact. Current transformers for metering shall be mounted so that the rating plate is clearly visible. Fuses for instrumentation shall be made mounted in an easily accessible position and clearly marked.

2.10.4.6 Mounting of fuses

Fuse holders shall be mounted semi-recessed in the front panel so that fuses can be readily be changed without removing the front panel. Bus bar mounted fuses for instrumentation shall be used as far as possible.

Where equipment requiring fuses is specified on a board (fuse switches etc.), a ruling shall be obtained from the Engineer on the quantity of spare to be provided.

2.10.4.7 Equipment in main boards

Equipment in main low voltage switchboards and sub-main boards shall be grouped in individual compartments.

2.10.5 WIRING

2.10.5.1 Cabling

Cables connected to incoming or outgoing circuits shall be terminated on a gland plate supplied for this purpose. Power cables up to and including 70mmZ may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor. Connection to the equipment can then be made with cables that are similarly connected to the clamp terminal. All power cables larger than 70mmz shall terminate on bus bars that are connected to associated equipment.

Parallel incoming or outgoing cables shall be connected to a collector bus bar without crossing the conductors.

2.10.5.2 Current ratings

The current rating of conductors for the internal wiring shall be sufficient for the maximum continuous current that can occur in the circuit. This value shall be determined from the circuit breaker or fuse protection of the circuit.

2.10.5.3 Internal wiring

a) Standard 600/1000 V Grade PVC-insulated stranded annealed copper conductors to SABS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2,5mm². Flexible cord of minimum size 1,0mm².

b) Where heat generating equipment is present and internal temperature of the board is likely to exceed 50ºC, silicon-rubber insulated stranded conductors or for the colour identification of conductors.

c) Wiring shall be arranged in horizontal and vertical rows and shall be bound with suitable plastic straps or installed in PVC wiring channels. Under no circumstances may PVC adhesive tape be used for the bunching of conductors shall be used.

d) Bunched conductors shall be neatly formed to present a uniform appearance without twisting or crossing the conductors. Conductors leaving the harnesses shall be so arranged that they adjacent to the chassis.

e) Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped between the two points.

f) The loop shall be arranged to produce a twisting notion when the door opened or closed. A flexible protection sleeve shall be installed over the conductors.

g) Where wiring channels are used, they shall be installed horizontally and vertically. Under no circumstances may power and control circuit wiring be installed in the same wiring channel. Channels shall not be more than 40% full.

h) All wiring between different panels within the same switchboard shall be installed in wiring channels.

i) Grommets shall be installed in each hole in the metal work through which conductors pass.

j) All wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges.

k) Conductors may be jointed at equipment terminal strips only. No other connections are allowed.

l) Where conductors change direction, smooth bends shall be formed with radius of at least 5 times the outside diameter of the conductor or harness.

m) Where screened cables are specified, the screening shall be earthed in switchboard or control board only unless clearly specified to contrary. Screened cables entering control boxes through pressed knockouts, shall terminate in compression glands. Conductors shall as far as possible remain inside the screening at terminations.

   Where possible remain inside the screening at termination. Where conductors have to separate from the screen, the braiding shall be separated and the conductors drawn through the braid without damaging the braiding.

   The conductors shall then be connected to their respective terminals and the screening smooth and connected to the earth terminal.

n) Where neutral connections are looped between the terminals of instruments, it is essential that the two conductors' ends be inserted into a common lug or ferrule and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.

o) Wiring should as far as possible be confined to the front portions of switchboards for ease of access. This requirement is important for wiring between smallest circuit breakers and the associated main circuit breaker as well as the wiring from circuit breaker to lightning and socket-outlet circuit.

p) A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. main circuit breaker feeding other circuit breakers), stub bus bars shall be provided for the various conductors.

2.10.5.4 Load end connections

The supply end connections to all equipment shall under all circumstances be at the top and the load end connections at the bottom.

2.10.5.5 Wiring to circuit-breakers

Equipment with a rating exceeding the current rating of 70mmZ conductors shall be connected by means of bus bars to the main bus bars. Looped connections may only be installed for a maximum of two outgoing circuits. Where there are more than two outgoing circuits, bus bars shall be used and equipment connected individually to the bus bars.

2.10.5.6 Conductor terminations

Conductors connected to terminals complying with the Standard Specification for "WIRING TERMINALS", need not be soldered or ferruled. Connections to circuit -breakers, isolators or contactors shall be made by one of the following methods:

a) A ferrule of the correct size,

b) Soldering the end of the conductor, or

c) Winding a conductor strand tightly around the end to totally cover the end.

All conductors terminating on meters fuse holders and other equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor.

The correct amount of insulation shall be tripped from the end to fit into the terminal. Strands may not be cut from the end of the conductor.

2.10.5.7 Identification

The colour of the conductors for all 220/250V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black.

2.10.6 Paint Finish

Metal components of the framework, panels and chassis shall be painted in accordance with Standard Specification "STANDARD PAINT SPECIFICATION".

2.10.7 Labelling

2.10.7.1 General

Care shall be taken to ensure that all equipment is fully labelled and that accurate descriptions and safety warning notices appear in English.

2.10.7.2 Material

Engraved plastic or ivory-sandwiched strips shall be used throughout. The strips shall bear white lettering on black background for normal labels and red letters on a white or yellow background for danger notices.

2.10.7.3 Switchboards

All equipment on switchboards shall be identified with the necessary labels. The circuit numbers shall appear at grouped single-pole circuit breakers. The circuit numbers shall correspond to the circuit numbers on the final installation drawings. The above mentioned circuits shall be identified on a legend card, which shall be installed on the inside of the switchboard door, or in any other position where it can conveniently be observed. All fuses, including instrument fuses, shall have labels stating function, fuse rating and duty or type where applicable. All other equipment shall be identified separately and their functions shall be clearly indicated.

2.10.7.4 Fixing labels

Labels shall not be fixed to components or trunking but doors panels, chassis or other permanent structures of the switchboard.

Engraved strips be secured to facilitate a neat future alteration of the designation of the labels. Sufficient fixing points shall be provided to prevent labels from warping. Labels in slotted holders shall be secured in position to prevent unauthorised removal. Labels may be secured by the use of brass bolts and nuts, self-tapping screws, slotted label holders or pop- rivets.

2.10.8 Tests

The Engineer shall be notified when the mechanical construction of the switchboard, i.e. frame, panels and base frame, is complete in order that it may be inspected at the factory.

Function tests of all equipment, control and interlocking circuits shall be conducted to satisfaction of the Engineer. Testing equipment and facilities including instruments dummy loads and additional switchgear and cables shall be provided by the Contractor at no extra cost. The Engineer shall be notified in writing two weeks in advance of any test to be conducted, to allow him to present at such tests. A complete report on the tests shall be handed to the Engineer.

2.10.9 Drawings

2.10.9.1 Drawings for approval

A set three print of the shop drawing for the switchboards shall be submitted to the Engineer for approval before the boards are manufactured. The following information shall be presented:

a) A complete wiring diagram of the equipment of the boards.

b) A complete layout of the arrangement of switchboards indicating all equipment dimensions and construction of the boards. The position and method of fixing and sizes of bus bars shall be shown.

c) All labelling information on a separate sheet.

d) The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses, contactors, etc.

The approval of drawings shall not relieve the contractor of this responsibility to the Client to supply the switchboards according to the requirements of this Specification.

2.10.9.2 Completion

The supply contract shall be regarded as incomplete until all tests have been conducted successfully and all information has been handed to the Engineer.

PART 3 PROJECT SPECIFICATION

SPECIFICATION FOR ELECTRICAL WORK

PROJECT SPECIFICATIONS

3.1 CONTRACT WORK

The installation shall be carried out entirely by the Sub-Contractor's own staff and shall not in any way be sub-let. This part of the specification shall have preference to any other part of the specification.

3.2 CONTRACT PRICE ADJUSTMENT

The tender price (contract sum) in this particular Sub-contract shall not be subject to price adjustment (Escalation as per Principal contract)

3.3 SITE

The Tenderers must, before submitting their tenders, acquaint themselves with the local conditions, accessibility of the sites, soil conditions, availability of labour and labour conditions, transport, off loading store and custody conditions for materials and equipment necessary for the completion of the total contract. No claim based on ignorance in this regard shall be considered.

Permission must be obtained from the Client Representative before any Tenderer visits the site, or the Contractor establishes himself of the site.

3.4 EXTENT OF WORK

The work covered by this contract comprises the complete electrical installation, in working order, as shown on the drawings and as per this specification, including the supply and installation of all fittings and the installation of such equipment.

3.5 SUPPLY AND CONNECTION

The Consulting Engineer will arrange with the Eskom for the permanent electrical supply as well as the commissioning thereof. Payment of the service connection shall be made by the Client.

Electrical Sub-Contractor shall be responsible for the supply, installation and connection of all the specified low-voltage cables including the supply cable from the supply point of the Eskom.

3.6 INFORMATION

The tenderer's attention is drawn to the fact that if the schedules of this specification are not complete, his tender cannot be adjudicated and may be disqualified.

3.7 SPECIFICATION AND DRAWINGS

The specification and drawings generally show the character and extent of the proposed work, and shall not be held as showing every minute detail of the work to be executed.

Tenders must ensure that their copy of the specification is complete and that all drawings as listed have been received.

Any discrepancy must immediately be brought to the attention of the **Engineer.**

3.7.1 Contract Drawings

The layout and extent of the electrical installation are shown on the drawings which form part of this document.

The positions of all power-, light- and switch outlets or routes which may be affected by other services must be confirmed by the Contractor with the Consultant before placing such outlets.

3.7.2 "As-built" Drawings

The contractor is to prepare the "as-built" paper prints in strict accordance with this specification. These drawings are to be kept in the site office. Retention money normally due before commencement of the maintenance period will not be released until "as-built" drawings have been prepared to the satisfaction of the Engineer and the Client Representative.

3.8 MAKING GOOD

The successful tenderer will be responsible for making good in all trades of any damage to buildings or other services which he or his employees may have incurred during the construction of the works.

The Contractor will be responsible for keeping the site clean and tidy and shall remove from the site all rubble and litter resulting from the construction work.

3.9 WORDING

The word "approve" means approval by the Client inspection engineer or representative.

3.10 SUPERVISION

Work must under all circumstances be supervised by a qualified and experienced representative of the Contractor who must be registered as an accredited person. The representative must be authorized by the Contractor and must be able to receive instructions on behalf of the Contractor.

3.11 ELECTRICAL EQUIPMENT

All fittings, material and equipment and component parts thereof are to be in accordance with the quality specifications and must have the approval of the Client representative. In addition all equipment shall be designed, manufactured and tested in accordance with the relevant South African Bureau of Standards Specification or otherwise the relevant British Standard Specification.

All material and equipment must be suitable for the supply voltage 415/230V and the necessary precautions shall be taken against corrosion, i.e. exposed metal shall be anti-rust treated to approval and all metalwork to be galvanised or painted.

3.12 CONDUIT AND WIRING

The installation may be in galvanized steel conduit or PVC conduit. All conduits shall be concealed in the building work where possible. Galvanised steel conduit shall be screwed or plain end.

Should for some reason it not be possible to conceal conduit in the building work and conduit must be surface mounted, only galvanised conduit may be used in up country areas.

Steel conduit exposed to damp or weather conditions shall be galvanised to SABS 763.

PVC conduit must comply with SABS 950.

PVC conduit and conduit accessories must be used in areas within 50km off the coast.

All conduits shall bear the stamp or approval by the SABS.

All conduits, regardless of the system employed, shall be installed strictly as described in the project specification. Wiring of the installation shall be carried out as directed in the project specification.

PVC conduit must be supported at 1 000mm intervals maximum.

Galvanised draw wires must be provided in all conduits provided for other services.

All steel conduit joints in concrete slabs and all running joints must be painted.

No chasing by hammer and chisel will be accepted. Slots for conduits must be cut where necessary.

The metal conduit installation must provide a continuous earth.

Bushes on metal conduit shall be of brass only.

All outlet box cover plates must be metal and steel outlet boxes must be hot-dipped galvanised to SABS 763.

Blank cover plates on round outlet boxes must be fixed with flat head brass screws and a gasket to seal the box. Blank cover plates on 100 x 100 mm outlet boxes must be fixed with two countersunk chrome screws.

Where outlet boxes or draw boxes are mounted on finished surfaces the Electrical Contractor shall take care that such outlets are mounted symmetrically. It will not be sufficient to scale the position of any outlet off the drawings. No extra payment will be allowed where the outlets are not mounted symmetrically and have to be changed.

Draw boxes on the lead in sleeves/conduits for the supply to toilet blocks must be flush mounted and must be fitted with weatherproof lids which must have levelled edges. The lids must be fixed with tamper resistant screws to the boxes and must in general comply with the specification on distribution board doors. The draw boxes may not be smaller than 100 x 100 mm. Standard factory made boxes may be considered if submitted beforehand to the Consultant for approval.

3.13 SWITCHES AND SOCKET OUTLETS

All switches and socket outlets shall conform to the quality specification and must be approved by the Client's representative.

FLUSH AND SURFACE MOUNTED SWITCHES.
All switches shall be suitable for mounting in100x50x50mm boxes shall comply with SANS 1663 and shall bear the SANS mark.

Switches shall be of tumbler operated micro gap type rated at 16A, 220/250V.

Switches shall have protected terminals for safe wiring.

WATERTIGHT SWITCHES
Water tight switches shall be of the micro gap type suitable for surface mounting and shall bear the SANS mark.

The housing shall be of galvanized cat iron or die cast aluminium with watertight cover plate and toggle.

The switch shall have a porcelain base and a quick acting spring mechanism and shall be rated at 16A, 220/250V.

The installation of switches and socket outlets shall be carried out in accordance with the project specification.

Light switches must be mounted 1 400mm a.f.f.l.

Switch socket circuits must be protected by 30mA earth leakage units. Light switch and switch sockets of one manufacturer only, will be accepted.

Screws linger than 30 mm to mount light switches or switch socket outlets will not be accepted.

FLUSH AND SURFACE MOUNTED SWITCHED SOCKETS
All switched sockets-outlets shall be suitable for mounting in 100x100x50mm.

Terminals shall be enclosed for safe wiring.

Where 13A flat pin socket-outlets are specified, these shall comply with BS 1363.

WATER TIGHT SWITCHED SOCKETS
The housing of watertight switched sockets shall be of galvanized cast iron or die aluminium with watertight machined joints.

The switch shall have a porcelain base and quick acting spring mechanism and shall be rated at 16A.220/250V.

The socket openings shall be rendered watertight by means of a gasketed cover plate which screwed into the body of the unit. The cover plate shall be secured to the body of the unit by means of a chain.

3.14 DISTRIBUTION BOARDS

3.14.1 General

Supply and install the distribution boards in the position shown on the drawings.

One spare 25 mm dia and three spare 20 mm dia conduits must be supplied from all distribution boards to roof spaces.

Five sets of factory drawings on all distribution boards must be submitted for inspection before manufacture of the distribution boards commence.

The Department must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

3.14.2 Construction

The construction must be in accordance with SABS standards.

All distribution boards must be flush mounted and must have doors which must be pad lockable.

The current capacity of bushbars may not exceed 1.6 A.

Openings into distribution boards must tie up with the installation.

Cables must be mounted with “K”-clamps to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside distribution boards.

3.14.3 Installation

The distribution boards must be placed in such a way that the Building can build them into the walls where applicable. Special provision must be made that the distribution board tray is not damaged while being built in.

The distribution boards must be placed in the position shown on the drawings.

All distribution boards must be installed level.

Apparatus and requirements by the Supply Authority are not indicated on the distribution board diagram and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

A neutral bar associated with each bank of mccb’s must be positioned below each bank of mccb’s and must be wired in the same sequence as the mccb’s. Not more than one conductor per connector will be accepted.

Only hydraulic-magnetic operated mccb’s must be used if the new micro ranges are not used.

Excluding the metering kiosk, 2.5 kA circuit breakers may be accepted in distribution boards.

The minimum conductor size between lightning arrestors and earth shall be 4mm².

Bushbar stubs must be provided where more than one conductor terminates on equipment.

Earth conductors must be fastened with two screws and shoes to earth bars.

Two (2x) keyed alike with 016 keys, Standard padlocks must be provided with the Meter Kiosk.

3.15 LABELLING

Circuits which are not wired must be marked “SPARE” on the distribution boards.

Labels indicating the supply point and size of the supply cable must be provided on each distribution board.

Where switchboards are positioned behind doors of building structure i.e. build-in cupboards, a suitable approved electrical danger sign as well as the applicable distribution boards designation label must be supplied and fitted in a suitable position on the outside top section of one of the entrance doors at each such location.

3.16 POWER DISTRIBUTION BOARDS

Supply and install the power distribution boards in the position shown on the drawings.

The power distribution board should have:

- It should have a dedicated mounting plate for device installation.
- A front plate to block direct access to live parts.
- Prefabricated busbar connections
- Systems for on-site connections and running of auxiliary wires.
- Vertical and flat bars.
- Specific enclosure models dedicated and optimized to receive functional inputs.

The equipment shall be installed and secured to the floor in accordance with the manufacture’s specification.

Five sets of factory drawings on all distribution boards must be submitted for inspection before manufacture of the distribution boards commence.

The Department must be notified at least two weeks in advance of the completion of the distribution boards in order that an inspection may be carried out before delivery.

3.16.1 Construction

The construction must be in accordance with SABS standards.

All Power distribution boards must have doors which must be pad lockable.

Openings into distribution boards must tie up with the installation.

Cables must be mounted with “K”-clamps to the distribution board tray. Earth rings and glands must be used to earth cable armouring inside power distribution boards.

3.16.2 Installation

All Power distribution boards must be installed level.

Apparatus and requirements by the Supply Authority are not indicated on the Power distribution board diagram and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

A neutral bar associated with each bank of mccb’s must be positioned below each bank of mccb’s and must be wired in the same sequence as the mccb’s. Not more than one conductor per connector will be accepted.

Busbar stubs must be provided where more than one conductor terminates on equipment.

Earth conductors must be fastened with two screws and shoes to earth bars.

3.17 LABELLING

Circuits which are not wired must be marked “SPARE” on the Power distribution boards.

Labels indicating the supply point and size of the supply cable must be provided on each Power distribution board.

3.18 POWER POINTS

The Contractor shall make allowance for the complete installation of all power points as indicated on the drawings and described hereunder-:

All sockets or switch boxes shall be manufactured of pressed galvanized steel of at least 1mm thickness. All boxes shall be fitted with the necessary lugs to suit standard flush mounted switches and sockets manufactured in accordance with SANS 1085. Switch and socket cover plates shall comply with SANS 1084.

3.19 BALANCING OF LOAD

The electrical contractor is required to balance the load as equally as possible over the multi-phase supply.

3.20 EARTHING OF INSTALLATIONS

Installations shall be effectively earthed in accordance with the “Standard Regulations” and to the requirements of the supply authority, as well as the Eskom’s Representative, who may require additional earthing to meet test standards. Earthing must comply with S.A.B.S 0142 – 1993.

All hot and cold water as well as waste pipes must be effectively bonded by 12.5 x 1.6mm solid or perforated copper tape (not wire) clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of roundhead brass screws at intervals not exceeding 150 mm.

The earth connection from the main earthbar in the mainboard must be made to the cold watermain and the incoming service earth conductor by means of 16mm² stranded (not solid) bare copper earth wire or such conductor as the Eskom’s Representative may direct. Where applicable all steel roofsheeting as well as steel walkways and stairs shall be suitably earthed.

Furthermore and earth electrode (earth spike) of at least 1,5m long must be provided and driven into the ground at the centre of each gable-end wall of each individual block. These earth electrodes shall be installed at least 1 m from the building’s perimeter and shall clear all aprons and water channels. These earth spikes must be driven into the ground to at least 300 mm below ground level and only after final bonding and tests have been carried out must proper backfilling and compacting of same be executed.

In each instance these earth spikes must be interconnected by means of a 16mm² stranded bare copper earth conductor which must be installed in the inside of the ridging of the roof structure, encased in 20mm flush conduits installed in the gable walls. This earth conductor must be bonded to the roof sheeting at intervals not exceeding 5 m, ensuring that roof sheeting on both sides of the ridging are properly bonded, as specified in the project specification.

The overall earth resistance at the Main Distribution Board shall not exceed 10hm. The contractor shall assess the soil and site conditions at the time of tendering and allow for this to enable him to perform the proper earthing and bonding of all installations.

3.21 LUMINAIRES

Supply and install the luminaries schematically indicated on the drawings. The luminaires must comply with the requirements and the particulars listed hereunder.

The required luminaires types are specified on the drawings and tie up with the types indicated on the layouts. Samples of all luminaires must be approved by the client representative before any order is placed.
All control gear within luminaires, shall bear the stamp of approval by the SABS.

The installation of luminaires must be done in accordance with the relevant clauses in the general project

specification.

All luminaires must be complete with lamps and where necessary, control gear. Starters of fluorescent luminaire for starters must be covered to the approval of the client representatives. Lamp holders for GLs lamps must be porcelain or heavy duty brass.

The following luminaires are indicated on the respective drawings and must conform to the general project specifications of this contract.

3.21.1 Light Fitting Specifications for 4 Classroom Block and 2 Computer Laboratories

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 4x58 Watts LBR fluorescent light fitting.

TYPE B: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

TYPE C: Battery back up emergency.

TYPE D: 2x58 Watts fluorescent light fitting.

TYPE E: 26 Watts water resistant LED wall mounted bulkhead light fitting with 50 000hrs lifetime

3.21.2 Light Fitting Specifications for 2 Classroom Block and 1 Computer Laboratory

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 4x58 Watts LBR fluorescent light fitting.

TYPE B: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

TYPE C: Battery back-up emergency.

TYPE D: 2x58 Watts fluorescent light fitting.

TYPE E: 26 Watts water resistant LED wall mounted bulkhead light fitting with 50 000hrs lifetime

3.21.3 Light Fitting Specifications for Administration Block.

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 4X58 Watts LBR fluorescent light fitting.

TYPE E: Battery back up emergency light.

TYPE F: Signage Entrance/Exit.

TYPE G: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE H: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

3.21.4 Light Fitting Specifications for Library Resource Centre

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE C: Battery back-up emergency light.

TYPE D: Signage light Entrance/Exit.

TYPE E: 26 Watts water resistant LED bulkhead light fitting with 50 000hrs lifetime

3.21.5 Light Fitting Specifications for Multi-Purpose Hall

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 160 Watts LED low bay light fitting with 60 000hrs – 90 000hrs lifetime

TYPE B: 2x58 Watts fluorescent light fitting.

TYPE D: Battery back up emergency light fitting

TYPE E: Signage light Entrance/Exit.

TYPE F: 117 Watts LED Floodlights with 60 000hrs lifetime..

TYPE G: 26 Watts water resistant LED bulkhead light fiting with 50 000hrs lifetime

TYPE H: 5x250 Watts spotlight for stage

3.21.6 Light Fitting Specifications for the Site Reticulation

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 8M 62 Watts solar operated steel pole mounted LED street light fitting with 60 000hrs lifetime.

TYPE B: Steel pole mounted LED light fitting 3.5m 62 watts with 60 000hrs lifetime.

TYPE C: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE D: 26 Watts water resistant LED bulkhead with 50 000hrs lifetime

3.21.7 Light Fitting Specifications for the Workshop

Note: All luminaires must be approved by the Consultant representative prior to the installation of or any order being placed.

TYPE A: 250 Watts high bay light fitting with 60 000hrs – 90 000hrs lifetime.

TYPE B: Battery back up emergency light fitting.

TYPE C: 4x58Watts fluorescent light fitting.

TYPE D: 26 Watts water resistant LED wall mounted bulkhead light fiting with 50 000hrs lifetime

TYPE E: 2x58 Watts fluorescent light fitting.

TYPE F: 117 Watts LED Floodlights with 60 000hrs lifetime.

TYPE H: 26 Watts water resistant LED bulkhead with 50 000hrs lifetime

3.22 PHOTO CELL

The area lighting must be switched direct by the photo cell. The photo cell must be mounted where indicated on the drawings in such a manner that the luminaires will not affect the operation of the photo cell.

The photo cell must be linked with the distribution board by 3 x 1.5 mm 5 PVC conductors drawn in conduit in the roof space.

The photo cell must comply to the following:-

i) Area lights must be switched ON when the illumination dropped to 50 lux.
ii) Area lights must be switched OFF when the illumination raised to 90 lux.
iii) It must be weatherproof and must have a built in time delay of approximately 40 seconds.
iv) Built in protection against voltage surges must be provided.
v) The photo cell must be mounted in an empty bulkhead type 5 luminaire, with an aluminium base.
vi) A sample of the proposed photo cell must be submitted to the Engineer for approval.
vii) 16A rating must be provided.

3.23 CABLE TRAYS

The cable trays shall be manufactured from perforated rolled steel.

The cable trays for the following area shall be of the following standards:

- Vertical building ducts- hot dip galvanized to SANS 32&121.
- Plant rooms, substations, service tunnels-Electro galvanized baked enamel.
- Damp areas, exposed to weather-Hot dip galvanized to SANS 32&121.

3.23.1 SPACING OF HORIZONTAL SUPPORTS.

Horizontal trays shall be supported at the following maximum intervals:
(a) 1.2mm to 1.6mm thick metal with 12mm to 19mm return trays.
(b) 2.5mm thick metal trays with 76mm return.
(c) Cable ladders with 76mm side rail of 2mm thickness and with crossrugs.
(d) 3mm thick PVC trays with 40mm return.
(e) 4mm thick PVC trays with 60mm return.

3.24 POWER SKIRTING.

The channel and cover should be epoxy coated after manufacture.

The outlet pre-punched on a modular basis should be provided to accommodate socket outlets and future socket outlets.

Two or three compartment power skirting shall be supplied and installed in the positions according to the layouts indicated on the drawing.

The top compartment shall be used for power wiring and switched socket outlets, whilst the bottom compartments shall be for telephone and other light current services.

MODULE
Power skirting shall be manufactured from 1mm (minimum) thick sheet in approximately 2.5m lengths.

Each modular cover associated with the power compartment shall be punched and prepared for installation of either a 13A or a 16A , 3 pin standard flush switched socket outlet, whether any is specified or indicated for that module or not. Where socket outlets are not installed, the punched holes shall be blanked off, painted the same colour as the power skirting and installed at the back of the covers. These blanking plates shall be easily removable to permit future installation of socket outlets.

3.25 SWITCHES

All switches shall be suitable for mounting in 100x50x50mm boxes shall comply with SANS 1663.

3.26 SHAVING POINT

All shaver sockets should be a double wound isolating transformer rated at 20VA.
A three hole system shall be provided to provide for 115V OR 230V systems and also to cater for various types of shaver plugs.

Insertion of a shaver plug shall automatically switch on the unit by energizing the primary side of the isolating transformer.
The unit should be protected against overload by a thermal overload device.
The unit shall comply with BS 3052.

3.27 CABLES

TRENCHING

(a) The Contractor shall be responsible for all trenching excavation.
(b) The Contractor shall, before trenching commences, familiarize himself with the routes and site conditions and the procedure and order of doing work shall be planned in conjunction with the general construction programme for other services and building requirements.
(c) The contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and shall be responsible for the cost of repairs.
(d) The contractor shall take all necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and /or employees on site are not endangered.
(e) The Contractor shall ensure that the excavations will not endanger existing structures and roads.

BLASTING

Should blasting be necessary and approved by the client, the Contractor shall obtain necessary authority from the Government Departments and Local Authorities. The Contractor shall take full responsibility and observe all conditions and regulations set forth by the above Authorities.

ROUTES

(a) Trenches shall connect the points shown on the drawings in a straight line. Any deviations due to obstructions or existing services shall be approved by the Electrical Engineer.
(b) The Electrical Engineer reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at the documented rates.

CABLE SLEEVES

(a) Where cables cross the road, other services and where cables enter building, the cables shall be installed in Polyethylene (6mm thickness), asbestos cement pipes or earthenware pipes. Pitch fibre and PVC pipes are not acceptable because of the adhesion that occurs after a period of time between pipe and the sheathing or outer serving of the cables.
(b) Pipes shall be joined in accordance with the manufacture's instructions.
(c) Sleeves shall cross roads at right angles.
(d) All sleeves shall be graded 1:400 for water drainage.
(e) The ends of all sleeves shall be sealed with a non-hardening watertight compound after installations of cables. All sleeves intended for future use shall likewise be sealed.

BACKFILLING

(a) The contractor shall not commence with backfilling of trenches without prior notification of the Electrical Engineer so that the cable installation may be inspected. Should the contractor fail to give a timeous notification, the trenches shall be re-opened at the Contractor's cost.

(b) For high voltage cables (1Kv to 11Kv) a coloured plastic marking tape shall be installed 400mm above the cable. The tape shall be yellow, marked with words" ELECTRIC CABLE/ELEKTRISIE KABEL"in red. These markings shall not be more than 1m apart from centre to centre.

(c) Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill material is 75mm.

(d) The backfill shall be compacted in layers of 150mm and sufficient allowance shall be made for final settlement. The contractor shall maintain the refilled trench at hid expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.

(e) On completion, the surface is made good to match the surrounding area.

(f) In case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

CABLE MAKERS (FOR HV CABLES ONLY, EXCEPT WHERE OTHERWISE SPECIFIED)

(a) Cable makers shall be provided along all HV cable routes but need only be provided along LV cable routes where specified.

(b) Cable makers shall consist of concrete blocks in the shape of truncated pyramids, approx.300mmhigh, 150x150mm at the top and 250x250 mm at the bottom.

(c) Brass plates shall be cast into the tops of the blocks in such a manner that they can not be priced loose. The wording “ELECTRIC CABLE /ELEKTRIESE KABEL” shall be stamped on the brass plates as well as direction arrows and the cable voltage rating.

INSTALLATION OF UNDERGROUND CABLES

(a) Cables shall be installed at the following minimum depths below final ground level:
Up to 11Kv:800mm
(b) The depth of cable pipes beneath roads shall be not less than 1.1m below the formation level.

(c) Where HV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800mm and then covered with 200mm of soil. The soil shall then be compacted, and backfilled layer by layer and compacted until the trench is completely backfilled.

(d) Cables for telephones, communication systems and other low voltages (less than 50V) shall be separated from power cables at least 1m.

Cables shall be manufactured in accordance with SANS 97 and shall come only from fresh stocks.

3.28 STANDBY GENERATOR

Output of the Sets

1x 600kVA stationary indoor prime power rated diesel generator set at 0,8 power factor with the alternator wound for the supply of 400/230 volts, 3 phase, 4 wire, 50 Hz., and running at a speed of 1500 r.p.m.

Factory Installed Standard

Air Inlet	➢ Disposable Air filter ➢ Service indicator.
Cooling	➢ Radiator package mounted ➢ Coolant level sight gauge ➢ Low coolant level sensor ➢ Coolant drain line with valve ➢ Fan and belt guards
Exhaust	➢ Dry exhaust manifold ➢ Stainless steel flex fittings ➢ Exhaust flange outlet
Fuel	➢ Integral narrow single wall fuel tank base ➢ Primary fuel filters ➢ Fuel priming pump ➢ Engine fuel transfer pump ➢ Flexible fuel lines

GENERATOR	➢ Class H insulation. ➢ Self Excited ➢ Class H temperature rise ➢ 450V voltage regulator with single phase sensing and load adjustment module,
Power Termination	➢ Power center house EMCP controller. ➢ Circuit breaker ➢ Segregated low voltage wiring termination panel.
GOVERNOR	Low emissions conversion.
CONTROL PANELS	➢ Emergency stop pushbutton. ➢ Instantaneous phase currents ➢ Instantaneous phase and line voltages ➢ Ac Voltmeter,Ammeter &Frequency. ➢ Engine Speed(rev/min) ➢ Power Factor ➢ Lube oil pressure ➢ Fault Conditions
LUBE	➢ Lubricating oil . ➢ Oil drain line with valves. ➢ Fumes disposal ➢ Oil filter and dipstick. ➢ Oil cooler
MOUNTING	➢ Integral Narrow 8hr tank base. ➢ Linear vibration isolation.
STARTING/CHARGING	➢ 24 VOLT starting motor. ➢ 45 Amp charging alternator. ➢ Batteries with rack and cables. ➢ Battery disconnect switch.

Technical considerations concerning the engineering, design, maintenance requirements etc., are of the utmost importance and will weigh heavily in the adjudication of tender received and Tenderers are advised to submit the fullest possible details with their tenders.

The following shall form part of this contract:

- The termination of the supply cables onto the change-over panel of the alternator set.
- Plant-rooms shall be provided and tenderers are to confirm the required sizes together with all openings etc. Galvanised sound attenuators, aluminium louvers and galvanised double acoustic door form part of this contract and shall be supplied and installed by the generator set contractor.

3.29 DISTRIBUTION TRANSFORMER

This contract shall consist of the supply and installation of an indoor 500kVA transformer in the Services Building above the cable trenches.

The transformer will have the following specifications:

i.	Rating	500kVA
ii.	Primary Voltage	11,000V
iii.	Secondary Voltage	400/231V
iv.	Vector Group	Dyn 11
v.	Tappings	±3% & ±6%
vi.	Off-circuit Lockable Tap Switch	
vii.	Oil level indicator	
viii.	Cooling	ONAN
ix.	Mounting Arrangement	Skid Base with Rollers
x.	Terminations	HV and LV cable boxes
xi.	Tank Construction	Sealed welded cover

All earthing of the equipment shall form part of the tender.

The LV terminals of the transformer shall be designed to accept 3x150mm² 4-core PVC cables.

All text for the labelling shall be provided to the contractor at a later stage, but preparation and installation of labels shall be included in the rates.

3.30 POWER FACTOR CORRECTION

The power factor correction cubicles should be equipped with up to 5 or 4 varpact comfort power modules. The cubicles should have ventilated fans.

The Distribution Board supplier should calculate the reactive and magnetizing power required by the inductive characteristics of all electrical equipment on our single line diagram. After calculating such shunt capacitors should be designed. The total power for each Power distribution board is given.

3.31 UNINTERRUPTIBLE POWER SUPPLY

Specification for		**15kVA UPS System**	**30kVA UPS System**
Item	**Description**	**Requirement**	
1	**General Specifications**		
1.1	UPS Topology	On-line double conversion	On-line double conversion
1.2	In/Out phase configuration	Three phase / Three Phase	Three phase / Three Phase
1.3	Neutral	Neutral passing through	Neutral passing through
1.4	Output waveform on mains run	Sinusoidal	Sinusoidal
1.5	Output waveform on battery run	Sinusoidal	Sinusoidal
1.6	Bypass type	Static and electromechanic	Static and electromechanic
1.7	Transfer Time	Zero	Zero
2	**Input Parameters**		
2.1	Nominal Voltage	400V Three Phase	400V Three Phase
2.2	Voltage Range	-20% +15%	-20% +15%
2.3	Input Frequency	50Hz to 60Hz (autosensing)	50Hz to 60Hz (autosensing)
2.4	Input Current THD at nominal voltage	<3% at full load	<3% at full load
2.5	Input Power Factor at Nominal Voltage	>0.98 from 50% to 100% of nominal load	>0.98 from 50% to 100% of nominal load
3	**Output Parameters with Mains (AC - AC)**		
3.1	Nominal Voltage	400V Three Phase	400V Three Phase
3.2	Nominal Power	15kVA	30kVA
3.3	Active Power	13.5kW	27kW
3.4	Voltage Variation (Static)	±1%	±1%
3.5	Voltage Variation (Dynamic 0-100%; 100-0%)	±1%	±1%
3.6	THDv on nominal power (linear load)	<0.5%	<0.5%
3.7	THDv on nominal power (not linear load P.F. = 0.7)	<1%	<1%
3.8	Frequency	50Hz to 60Hz (autosensing or selectable)	50Hz to 60Hz (autosensing or selectable)
3.9	Frequency Tolerance	Synchronised with input frequency	Synchronised with input frequency
3.10	Overload Capability		
	5min	125% load rate with no bypass intervention	125% load rate with no bypass intervention

Specification for		15kVA UPS System	30kVA UPS System
Item	**Description**	**Requirement**	
	30sec	150% load rate with no bypass intervention	150% load rate with no bypass intervention
4	**Output Parameters in Battery Run (DC - AC)**		
4.1	Nominal Voltage	400V Three Phase	400V Three Phase
4.2	Nominal Power	15kVA	30kVA
4.3	Active Power	13.5kW	27kW
4.4	Voltage Variation (Static)	±1%	±1%
4.5	Voltage Variation (Dynamic 0-100%; 100-0%)	±1%	±1%
4.6	THDv on nominal power (linear load)	<0.5%	<0.5%
4.7	THDv on nominal power (not linear load P.F. = 0.7)	<1%	<1%
4.8	Frequency	50Hz to 60Hz (autosensing or selectable)	50Hz to 60Hz (autosensing or selectable)
4.9	Frequency Tolerance	±1% free run	±1% free run
4.10	Overload Capability		
	5min	125% load rate with no bypass intervention	125% load rate with no bypass intervention
	30sec	150% load rate with no bypass intervention	150% load rate with no bypass intervention
5	**Battery**		
5.1	Battery Type	Lead Acid, sealed, free maintenance VRLA	Lead Acid, sealed, free maintenance VRLA
5.2	Unit Capacity	7.2 or 9Ah (12V)	7.2 or 9Ah (12V)
5.3	Nominal UPS Battery Voltage	240V DC	240V DC
5.4	Battery Charger Type	PWM hi-efficiency, one in each power module	PWM hi-efficiency, one in each power module
5.5	Charging Cycle	Intelligent with boost charge and advanced management	Intelligent with boost charge and advanced management
5.6	Maximum Charging Current	2.5A each power module	2.5A each power module
6	**Static Bypass**		
6.1	Type	Thyristor Bridge	Thyristor Bridge
6.2	Rated Current	1.5In	1.5In
6.3	Overload Capacity in kVA	200% - 1 min / 1000% - 10ms	200% - 1 min / 1000% - 10ms
7	**Physical Parameters**		
7.1	Protection	IP21	IP21
7.2	Standards	IEC 62040-3, IEC60146-1-1, IEC 61000-4-2, EN 50091	IEC 62040-3, IEC60146-1-1, IEC 61000-4-2, EN 50091
8	**Environment**		
8.1	Operating Temperature	0 to 40 degrees Celsius	0 to 40 degrees Celsius
8.2	Humidity	0 - 90% non-condensing	0 - 90% non-condensing
8.3	Maximum Altitude	0 - 2000m without de-rating	0 - 2000m without de-rating

3.32 TECHNICAL SPECIFICATION

The selection of equipment should be submitted with relevant manufactures data to the Engineer for approval before any installation takes place. The cost of replacing any plant equipment ordered prior to approval obtained shall be borne by the contractor.

3.33 TESTING AND INSPECTION

The Contractor shall test the entire installation in terms of Regulation 7 of the Electrical Installation Regulations 1992 of the Occupational Health and Safety Act 1993 and shall issue a Certificate of Compliance on the official form, Annexure 1, obtainable from the Electrical Contracting Board of South Africa.

All 200 V socket outlets shall be tested for polarity and the sensitivity of the earth leakage protection equipment shall be tested by means of an approved instrument.

Each length of cable shall be tested for insulation and polarity by means of a 1 000 Volts designed for that purpose. In the case of underground cables this shall be done before backfilling. In addition, the earth-loop impedance of each main and sub-main feed shall be measured. The earth resistance at each down conductor earth electrode shall be measured. The earth resistance shall be tested by means of an approved instrument.

If there is not power on the day of the test, the contractor shall supply a 3 kW, 230V generating plant for testing purposes.

“DANGER” notices shall be displayed at remote ends of cables under test.

The Engineer reserves the right to witness all tests. The Contractor shall advise the Engineer in writing of all results and furnish copies of all certificates.

Load balancing shall be undertaken by the Contractor in conjunction with the Engineer. Where conductors are altered to achieve satisfactory results they shall be replaced by the Contractor.

The Contractor shall provide all the necessary instruments for the proper testing of the complete installation. If there is reason to doubt the accuracy of such instruments, the Contractor shall take the necessary action to prove their accuracy.

If the results of the first delivery tests are favourable and the installation is found in order, there will be no charge for the test. If the test is found unfavourable a levy of R200-00 will be charged to the contractor for each subsequent test. In the form of a variation order omitting such costs from his contract price.

The Contractor shall ensure that the installation is completed in every respect and that there are not major defects prior to notifying the Engineer (in writing) for a first delivery inspection.

The Engineer will accept zero minor defects during the final inspection. Should this number of defects be exceeded at the final inspection then the Engineer will terminate that inspection and request that another inspection.

Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 3

uMsunduzi
MUSEUM · ISIGCINAMAGUGU

an agency of the
Department of Sport, Arts and Culture

BLOCK M – MAIN MUSEUM & AUDITORIUM

PROPOSED UPGRADES AND INSTALLATION OF ELECTRICAL & MECHANICAL WORKS

LIFT SPECIFICATION

CLIENT:

uMsunduzi Museum
351 Langalibalele Street
Pietermaritzburg
3201

Tel. No.: 033 394 6834

CONSULTING ENGINEER:

LSG Consulting Engineers Inc.
Unit 7/8 Doncaster Park,
10 Derby Place,
Derby Downs Office Park,
Westville, Durban, 3630

Tel. No.: 031 205 2335

REGISTERED NAME OF MECHANICAL CONTRACTOR:

APRIL 2023

UMSUNDUZI MUSEUM: PROPOSED UPGRADES AND INSTALLATION OF ELECTRICAL & MECHANICAL LIFT SPECIFICATION

INDEX

PART A: GENERAL CONDITIONS

1. DEFINITIONS

- "**Best Practice**" means the exercise of that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from time to time from a skilled and experienced, "manufacturer" and/or Lift Contractor seeking in good faith to comply with its contractual obligations as envisaged by the "works information" in accordance with world best class practices.
- "**Budgetary Allowance**" means the monetary value anticipated for finishes which shall not form part of the Contract Appointment. The partial or full allocation of funds from the budgetary allowance shall be at the sole discretion of the Employer and/or Mechanical Consulting Engineer.
- "**Builders Work**" means all the work relating to the construction and/or modification and/or repair and/or finish of the building structure, electrical supply and distribution board, machine space ventilation and all other building related work necessary for the proper and complete installation of the "equipment" in terms of the "works information".
- "**By others**" means services, materials, apparatus or any other part of the "equipment" provided or installed under the main contract by other parties (not the sub-contractor) and not considered to be a direct component of the sub-contractor's scope of work.
- "**Confidence Trials**" means the initial period of operation where the "equipment" is checked and monitored for operational compliance with the "works information".
- "**Covering Letter**" means the covering letter submitted with the tender return or offer noting qualifications, deviations, substitutions and/or alternatives. The Lift Contractor's "supplementary documentation" shall not form part or be considered to form part of the covering letter.
- "**Domestic Sub-Contract**or" means the sub-contractor(s) directly appointed by and under the full direction, control and responsibility of the Lift Contractor. The Domestic sub-contractor(s) shall not be assigned or assume any of the contractual responsibilities of the Lift Contractor.
- "**Escalator**" means any escalator or "passenger" conveyor system and associated space.
- "**Equipment**" means the entire lift, escalator, passenger conveyors or vertical transportation system and associated space.
- "**Equipment Practical Completion**" means that the "equipment" is in a state of completion where it can be made fully operational to provide an efficient and reliable service with safety in terms of the "works information".
- "**Equipment Works Completion**" means the time of full compliance with the "works information" after the "works completion inspection" and "confidence trials" have been satisfactorily concluded, on issue of the "equipment works completion" certificate(s) as specified and on full compliance with the "Principal Agreement".
- "**Group**" shall mean group of escalators serving common landings or a common area, or a group of lifts controlled by a common or central group control system.
- "**High Requirement**" means that the components of the equipment to be provided are of the highest quality and/or design and/or are capable of achieving the highest operational and performance levels for its intended application. By implication, low to mid-range components of the "equipment" and components of the "equipment" that are not capable of meeting the specified safety, operation, reliability and/or performance with an acceptable level of redundancy, shall not be regarded as high requirement components. Note: in some cases, the high requirement components or "equipment" may be the "manufacturers" "Top Range" components or "equipment".
- "**Lift**" means any passenger lift, goods passenger lift, goods lift.
- "**Lift Contractor**" means the party contracting to the Employer for the design, supply, delivery, installation and maintenance of the "equipment" as specified.
- "**Main Offer**" means the compulsory offer tendered or presented which complies in full with the intent and requirements of the "works information".

- "**Principal Agreement**" means the agreement and other contract documents which together form the contract between the Employer and the Lift Contractor. Note: where the Principal Agreement is in conflict with the project specification, the Principal Agreement will supersede the project specification.
- "**Option(s) to the main offer**" means compulsory or optional options to the Main Offer (Options) as called for by the Consulting Mechanical Engineer and is not the Alternative(s) presented by the Lift Contractor.
- "**SANS**" means all the South African National Standards applicable to the "equipment" and is referenced under Section 1.2 of the Project Specification.
- "**Supplementary Documentation**" means the Lift Contractors specification, technical description of the "equipment" or components of the "equipment" offered, technical or other pamphlets or add-ins, terms and conditions of contract and drawings submitted with the tender return or offer. Supplementary documentation shall not be regarded as contractually binding, relevant and/or necessary information in terms of deviations or substitutions unless it specifically deals with issues raised in the "covering letter".

2. SCOPE OF CONTRACT

This contract comprises the design, supply, installation, testing and commissioning of **ONE (1)-OFF new electric lifts** as per schedule to be installed at Umsunduzi Museum complex, specifically on an existing building within the complex: Block M – Main Museum & Auditorium building at 351 Langalibalele Street, Pietermaritzburg, KZN.

The lift's use is to enable disabled/paraplegic persons to travel between the ground and first floors of the main exhibition hall and is to be a steel and glass "scenic" lift with "thru" glass swing doors. There is no existing lift shaft, and as such, design, supply, delivery, and installation of the "scenic" lift shaft will be the responsibility of the Lift Contractor.

The price is to include the design, provision of all labour, "equipment" and services, and the performing of all operations required for the work as indicated on the drawings; or specified herein and in accordance with all applicable requirements of the "Works Information". The price must also be inclusive of the supply and fixing of all holding down and supporting steel elements and associated components.

Protection of Works during Installation:

Adequately protect against damage of all components of the "equipment" during installation.

It is accepted that the Lift Contractor cannot reasonably protect the "equipment" against adverse on-site conditions or water damage. Therefore, the Lift Contractor must immediately inform the Principal Agent in writing, if such damage has occurred or if it can be foreseen that damage to the "equipment" may occur as a result of adverse on-site conditions.

Replace all damaged components of the "equipment" prior to "equipment works completion".

Installation and connections of incoming power mains to the terminals of motor starters, controllers, including fused main line switches of circuit breakers in machine rooms.

Provide immediately after appointment and well in advance of field requirements, all data pertaining to the power feeder system design.

Power Supply:

Prior to the submission of the Tender, verify that the power supply indicated on the drawings is compatible with the "equipment" offered and any changes or upgrading of the electrical supply shall be brought to the attention of the Consulting Mechanical Engineer and Principal Agent at tender stage. Any work to the power supply system necessary to produce a reliable "equipment" operation and which was not brought to the Consulting Mechanical Engineer and Principal Agent's attention, shall be undertaken by the Lift Contractor at no additional cost to the Employer.

3. PROGRAMME AND COMPLETION

Immediately after appointment, in conjunction with the Main Contractor, produce a detailed programme of intent (Gantt chart), setting out the sequence of the construction time periods for the installation and completion of each section of work. Such programme shall be completed in such a manner as to enable its use for monitoring of progress and compilation of forecasts for payment certificates.

Monitor, check and report on the programme on a regular basis in order to present a coherent whole.

4. LOCAL CONDITIONS

Tenderers must acquaint themselves fully with the situation, the local conditions and the requirements of the specification. Later claims by the successful Tenderer for extra payment arising out of underestimating any of the requirements will not be considered by the client.

5. INCLUSIONS AND EXCLUSIONS FROM THE DIRECT CONTRACT

5.1. The Lift Contractor shall design, supply, and install ONE (1)-OFF new electric lifts as per schedule, to be handed over as a complete and functioning unit.

5.2. The Lift Contractor shall design, supply, and install and all electrics and electronics required for operation of the lift shaft, including any lighting required, electrical cabling from the lift control panel, communication wiring, etc.

5.3. The Lift Contractor shall design, supply, and install the steel and glass lift shaft.

5.4. The Lift Contractor shall supply and install all necessary fixing brackets required for the installation of equipment in the shaft.

5.5. The Main Contractor will make small building alterations that may have been agreed upon prior to signing of the contract, such as the casting of machine bases if required, as well as the layering of screed on the floors, plastering and painting of walls.

5.6. The electrical supply to each control panel will be provided by others at 230 volts, 1 phase, 50 Hz, which will be terminated on the control panel fused isolators.

5.7. The Electrical Contractor will provide separate circuit breakers in the distribution board.

5.8. The Lift Contractor shall make his own arrangements for obtaining temporary power for lighting and power operated tools. Such temporary connections required during the course of the erection of the lift shall form part of this sub-contract. The lift shall be tested once the permanent power is available and the Lift Contractor shall timeously advise the Electrical Engineer of his testing programme in order that the necessary arrangements can be made.

6. STANDARDS AND SAMPLES

Provide all work in accordance with the requirements of the particular South African National Standard (SANS), CIBSE, the Occupational Health and Safety Act 85 of 1993 as revised as well as all other relevant published SANS Standards and current regulations of all other codes applicable to the work. Standards to be applied shall include but shall not be limited to:

6.1. The Machinery and Occupational Safety Act of SA of 1983, as amended.

6.2. SA Bureau of Standards Specification - as applicable.

6.3. BSS VDE and ICE Standards and Codes of Practice.

6.4. The latest edition of the Standard Wiring Regulations (SABS 0142-1981) as amended.

6.5. Any regulations, bylaws or safety regulations applied by the local authority.

6.6. SANS 10142 – Wiring of Premise – Low Voltage installations.

6.7. SANS 10400 – National Building Regulations with particular reference to:

6.7.1. SANS 10400 Part S – Facilities for disabled persons

6.7.2. SANS 10400 Part T – Fire Protection

6.8. SANS 10400 – N, 2008 Edition 3 – Application of the National Building Regulations

6.8.1. Part N – Glazing

6.9. SANS 10137 – 2009 Edition 4 – Installation of glazing in buildings.

6.10. SANS 1543 / SANS 21 (EN 115) – Escalators and passenger conveyors.

6.11. SANS 53015 (EN 13015) – Maintenance for lifts and escalators.

Samples of equipment and material intended for use in the sub-contract works may be requested by the Engineer before work is commenced and such samples may be retained until completion of the sub-contract.

Copies of relevant SABS and test reports shall also be submitted to the Engineer on request and the Tenderer shall state with the tender the respective standard to which the lift and motors etc. comply.

“Equipment” shall be new and approved by the local authorities having the appropriate jurisdiction.

Provide all components of the “equipment” from the same “manufacturer”.

7. QUALIFICATIONS

7.1. Simply offering alternative components of the “equipment” / or presenting deviations in the tender “supplementary documentation” without making specific reference to deviations in the “covering letter” shall not be regarded as an acceptable qualification or deviation in terms of the “works completion”.

7.2. Submission of “supplementary documentation” without a “covering letter” shall mean that the Lift Contractor has tendered to specification in every respect.

7.3. Making reference to standard “equipment” or components of the “equipment” in a “covering letter” without detailing the specific deviations or substitutions shall mean that the standard “equipment” offered complies in full with the Project Specification.

7.4. Without limiting the requirements and intention of **Section 1.7.1 to 1.7.3** of the Project Specification, furnish a document which gives a complete description of all components of the “equipment” wherein the components proposed does not comply with the “works information”, or is in conflict with the work of other trades as specified or shown in the “works information”. Failure to furnish such a document shall be interpreted to mean that the Lift Contractor agrees to meet all requirements of the “works information”. Any conflict with the work of other trades brought about by the Lift Contractor shall not result in any added cost to the Employer.

7.5. Unless with prior written authorisation from the Consulting Mechanical Engineer, components of the “equipment” supplied and installed that is in conflict with the “works information” shall not be accepted and at no additional cost to the Employer, the Lift Contractor shall supply, replace or modify the “equipment” or components of the “equipment” as the case may be to meet the requirements of the “works information”.

7.6. The onus and responsibility for bringing to the attention of the Consulting Mechanical Engineer any components of the “equipment” that is or may be considered in conflict with the “works information” remains exclusively with the Lift Contractor.

8. APPROVALS AND SUBSTITUTIONS

8.1. Where the words “for approval” or “approved” are used and it is desired to substitute a different make or type of apparatus from that specified, all information pertinent to the adequacy and adaptability of the proposed components of the “equipment” shall be submitted to the Principal Agent and Consulting Mechanical Engineer for approval prior to the “equipment” being ordered or released for manufacture.

8.2. Approvals for “equipment” specified or proposed substitutions shall not be given merely upon the submission of “manufacturer’s” part names.

8.3. Approvals for all components of the “equipment” submitted as a substitution for that specified or shown on the drawings may be granted if such components meet the intended and anticipated requirements

pertaining to performance, reliability, operation, duty rate, space conditions, weight and quality of workmanship.

9. VERIFICATION, STANDARDS AND DEVIATIONS

Notwithstanding the Lift Contractors obligations in terms of **Section 7. (Qualifications).**

9.1. Presentation / submission of the tender return or offer shall without question, imply that the Lift Contractor has read and understood the content, meaning and intentions of the "works information" and has tendered accordingly. Therefore, deviations from the "works information" shall not be accepted.

9.2. When the "works information" cannot be met in terms of specific design requirements; substitution or alternative components of the "equipment" may be considered provided that the substituted components do not reduce the intended performance, operation, duty rate, redundancy and reliability requirements as specified. Deviations or substituted components of the "equipment" not clearly shown and detailed in the tenderers "covering letter" under the heading, **"DEVIATIONS"**, shall not be considered or accepted and shall not limit the Lift Contractors responsibility to provide "equipment" in terms of the "works information".

9.3. Tender "supplementary documentation" showing the technical details, load, speed size, performance and operation of the "equipment" offered, and the Lift Contractors conditions of contract shall only serve as an informative document in terms of the equipment offered, program, organization and staff, and shall not be considered as seen or accepted qualification in terms of the "works information". Components of the "equipment" offered as substitution that do not comply with Section 1.5.2 of the Project Specification, whether or not shown in the "supplementary documentation" shall not be considered or accepted.

9.4. It is accepted that the "manufacturers" of the "equipment" are continuously introducing new designs of "equipment" or components of the "equipment". However, although the Principal Agent or Consulting Mechanical Engineer has not specified specific makes of equipment and has only specified the design, operation, reliability, performance and duty cycle requirements, there are a number of components of the equipment offered by "the manufacturers" that shall not be accepted. "Supplementary documentation" (pamphlets) for components of the "equipment" offered in terms of the Project Specification may be provided for aesthetic reasons only and shall not be regarded as seen or accepted deviations or alternatives to the technical requirements of the "equipment" as specified. "Supplementary documentation" for the components of the "equipment" including but not limited to the following, shall be presented / delivered immediately on request by the Consulting Mechanical Engineer to do so:

- Control equipment
- Drive equipment
- Buttons and signals
- Fixture faceplates

9.5. Not to restrict or limit the Lift Contractor's technical input, advice or experience; substitute equipment better suited to the installation as a whole may offered. Provide all technical details and descriptions of the substituted components of the "equipment" for consideration by the Principal Agent and Consulting Mechanical Engineer.

9.6. Should any person (Architect, Quantity Surveyor, Principal Agent, Project Manager, Employer etc.) request components of the "equipment" that in any way technically deviates from the "works information", inform the Consulting Mechanical Engineer in writing before entering into detailed discussions with the person whom requested the revised components or placing the order for the manufacture and supply of the revised "equipment". Should approval for the revised "equipment" or components of the "equipment" not be obtained from the Consulting Mechanical Engineer, the Lift Contractor shall be liable for all costs associated with providing "equipment" in terms of the "works information".

10. GENERAL RESPONSIBILTY

10.1. The work throughout shall be executed to the highest standards and to the entire satisfaction of the Principal Agent and Consulting Mechanical Engineer who shall interpret the meaning of the "works information" and shall have the authority to reject any work or "equipment" or components of the "equipment" which in his judgement is not in full accordance therewith.

10.2. The Lift Contractor shall put his work in place as fast as reasonably possible, shall at all times keep a competent Foreman in charge of the work and shall facilitate its inspection by the Principal Agent and/or Consulting Mechanical Engineer, and shall arrange any rubbish caused by on-site work in orderly piles and remove from site promptly.

10.3. The Lift Contractor warrants that the "equipment" and workmanship shall be of the highest grade, installed in a practical and first-class manner in accordance with "best practice" and ready and complete for full operation at "equipment works completion". It is specifically intended that all components of the "equipment" and labour which is usually provided as part of the "equipment" as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether or not shown or described in detail in the "works information".

10.4. The Lift Contractor shall thoroughly acquaint himself with the work involved and shall verify on-site measurements necessary for the proper installation of his work. He shall also promptly furnish information well in advance of field requirements and shall co-operate with and co-ordinate the work of others as may be applicable.

10.5. Components of the "equipment" damaged in transit shall not be set and shall be replaced without additional cost to the Employer.

10.6. The Lift Contractor shall be required to take out adequate insurance to cover its obligations and the "works information" and to keep them current for the duration of the Contract. On request from the Employer or Consulting Mechanical Engineer, the Lift Contractor shall provide the details and validity of the aforesaid insurance policies.

10.7. Take all the necessary precautions to ensure that the building finish or any of its services are not damaged during the installation of the lift or that none of the building's staff or construction staff are harmed, which entails:

- Ensuring that the floor and walls are not damaged during the installation of the lift.
- Without limiting the Lift Contractor's obligation and responsibilities in terms of the Project Specification; inform the Consulting Mechanical Engineer of lift installation requirements in the Tenderer's Covering Letter.
- Check the space and route requirements necessary for the installation prior to tender and inform the Consulting Mechanical Engineer accordingly. This shall include but shall not be limited to shop fittings, shop fronts, doors, dry walls etc.
- Without exception all cutting with an angle grinder or cutting torch and welding, shall be carried out after normal business hours unless, written authorisation to carry out this work in normal business hours has been obtained from the Employer and Consulting Mechanical Engineer. Irrespective of authorisation granted, it shall remain the Lift Contractor's sole responsibility to take whatever precautions are necessary to eliminate the risk of injury to persons, damage to the property or equipment and fire and smoke related risks, and the Lift Contractor shall be fully responsible and liable for injury to persons or damage to property in this regard. Notwithstanding the Lift Contractor's obligation and responsibility to protect the building and its contents from damage as well as implement and apply good and safe working practices, the Lift Contractor shall ensure that:
    - All precautions related to the fire detection system shall be taken prior to commencing work that may generate smoke or excessive heat.
    - Fire extinguishers are made available and the Lift Contractor's site / installation personnel are properly trained in the use thereof.
    - No cutting, welding or grinding shall be permitted where there is a presence of oil or flammable material, without first assessing the situation and eliminating the risk with regards to fire and/or smoke.

- The use of a cutting torch and welding machine shall not be accepted unless prior written approval has been obtained from the Consulting Mechanical Engineer. It is intended that lift components are pre-manufactured off site, however, should on site welding be unavoidable, it shall be by a person certified in the welding trade and formally authorised by the Lift Contractor. Approval shall be for specific items / components only and these items shall be noted in the approval granted. The Consulting Mechanical Engineer reserves the right to request from the Lift Contractor, the official document authorising the Lift Contractor's employee or domestic Lift Contractors employee responsible for on-site welding. Damage to or reducing the design parameters / criteria of pre-manufactured components by way of welding, cutting torch or grinding shall not be accepted and shall be replaced with new correctly designed pre-manufactured components.
- Provide all hoarding / barricades and safety notices as specified.

10.8. Obtain approval from the Direct Contractor's appointed Structural Engineer or the Structural Engineer as appointed by the Principal Agent or Employer for all cutting / core drilling of existing lift structural supports and slabs.

10.9. Provide the "builders work" structural, mechanical and electrical which is work necessary to complete the entire installation including but not limited to:

- **Electrical:** Carry out site visits to clearly determine the extent of the work related to the electrical requirements.
- **Shop Drawings:** Submit together with the tender, detailed shop drawings indicating the position of the lift, structural and electrical work required to satisfactorily install the new lift.
- Building related work not clearly indicated and detailed at tender stage shall be carried out at no additional cost to the Employer.

11. LIFT CONTRACTOR'S SUBMISSION OF WORKS BY OTHER TRADES

Notwithstanding the Lift Contractor's obligations in terms of the Project Specification with regards to included "builders work".

11.1. Inform the Principal Agent and Consulting Mechanical Engineer in writing clearly detailing all electrical, mechanical and structural work necessary for the proper installation of the "equipment". Comments referring to the excluded work on the Lift Contractor's plans, layouts or shop drawings shall not be regarded as sufficient detail and shall not replace the document(s) called for under this section.

11.2. It is intended that at the outset of the installation, all parties shall clearly understand their responsibilities with regards to the proper and complete installation of the "equipment". Failure to furnish the information covered under this section shall result in the Lift Contractor being held liable for all work, which may become necessary for the proper and complete installation of the "equipment".

11.3. Items to be clearly detailed in the Lift Contractor's submission of work by other trades or the Lift Contractor's work to be closely organised with other trades, shall include but shall not be limited to:

- Structural support requirements and reactions
- Boarding station pit requirements
- Beam to beam measurements
- Lifting hook requirements

12. CO-ORDINATION

Notwithstanding the Lift Contractor's obligation terms of the Project Specification with regards to included "builders work".

12.1. Due to the nature of the installation, a fixed sequence of operations is required to properly install the "equipment". Therefore, closely schedule the work in order that the installation may be carried out in the proper sequence without delaying the completion of the entire project.

12.2. The Lift Contractor shall familiarise himself with the requirements of the other trades and shall carefully check space requirements with other trades to ensure that the components of the "equipment" can be installed in the proper sequence in the spaces allotted.

13. SETTING OUT OF WORK

The Lift Contractor must provide detailed workshop drawings for approval prior to commencement of work.

The Lift Contractor shall be responsible for the correct setting out of any holes that may be required in the shaft walls or floors for which he must submit detailed drawings.

14. DAMAGE TO BUILDING AND INJURY TO PERSONS

The Lift Contractor will be held responsible for any damage to the building caused by him or any of his employees.

Immediately after appointment, issue a document for distribution to the on-site staff, the Consulting Mechanical Engineer and Principal Agent, detailing all safety procedures to be followed during the installation period. This document shall cover safety procedures pertaining to:

- Work carried out on landings.
- Movement of materials through the occupied building.
- Relocating of hoarding to facilitate the movement of materials into the work areas.

Occupational Health & Safety Act Mandatory: In terms of the Occupational Health & Safety Act, the Lift Contractor as the "Mandatory" shall issue the necessary documentation pertaining to its on-site duties and appoint a Safety Officer who shall regularly inspect the site and ensure safe working conditions and procedures at all times.

Barricading / Off Landings / Foyers:

Provide barricades and safety notices for the area/foyer where work is in progress. Signage to warn persons of unsafe conditions related to work in progress shall not be regarded as sufficient without physically barricading off the working area.

15. DELIVERY AND STORAGE

The Lift Contractor must make his own arrangements for the transportation of material and workmen to the site. He will be responsible for the safe storage of all materials, tools and equipment against theft or damage, whether such materials or equipment is installed under this contract or not.

Should the Lift Contractor believe that the normal site security measures are inadequate to control the theft of components of the "equipment" stored on site; then the Lift Contractor shall initiate and implement additional security measures as deemed necessary. Notwithstanding the aforementioned, the Lift Contractor shall be fully responsible for and shall replace at no additional cost, components of the "equipment" stolen and/or damaged.

Lift Order:

Ensure that the order for the Lift / "equipment" is placed so that its arrival in the country will coincide with the installation programme. Additional costs of storage for lift arriving too early shall not be entertained and the cost will be absorbed by the Lift Contractor.

Lifts delivered to site shall be suitably packed and crated and the protection may only be removed once the lift can be moved into a protected storage area.

If the lifts cannot be stored in an enclosed covered area, then PVC covering of sufficient strength shall be wrapped around the lift to eliminate the ingress of moisture and dust.

Site storage can be discussed with the Principal Agent, Structural Engineer and Consulting Mechanical Engineer and if acceptable, the location of this storage area shall ensure that works within the storage area remain unobstructed and the lift can be moved into position relatively easily.

16. DRAWINGS

Details of the lift shafts, machine rooms etc. are shown on drawings included at the end of this document. The drawings are for information only. The Lift Contractor is to verify all dimensions, electrics and structural components required.

17. PREPARATION OF DRAWINGS

The following information shall be submitted with the tender:

17.1. Completed specification of all equipment proposed, including make and country of origin. (See also Schedules of Information required - Part 3).

17.2. The Tenderer shall submit:

- Drawings of pamphlets or brochures with sufficient detail to enable the Engineer to assess the type of equipment and the quality and suitability.
- Overall dimensions of plant.
- Specifications and positions of all services required to render the installation fully operational.
- Details of attachments, fixings and foundations other than those specified herein. (Note: The above drawings are required for the purposes of assessing the practicability of arrangements in relation to the building design and for establishing the additional cost of building and other services and need only be as detailed as these requirements dictate).

17.3. A schedule of recent major contracts completed within 100 km of the site of work unless the Tenderer has previously performed contracts for the Engineer.

17.4. Full details of spares facilities which the Tenderer (or his agent) holds in normal stock in the close proximity of Durban or the site, as well as the service facilities which exist in the area.

17.5. Immediately following his appointment, the Lift Contractor shall prepare detailed dimensioned drawings showing:

- All building and structural requirements of his plant and equipment.
- The detailed positioning and specification of all services required (i.e. electrical and drainage).
- Circuits, diagrams and schedules of all control systems proposed.

17.6. Two copies of these and all other drawing prepared by the Lift Contractor for the performance of the sub-contract shall be submitted to the Engineer, free of charge, for approval. Time of submission of drawings is to be dictated by the building programme and in any event drawings requiring modification or alteration to any proposed building work shall not be submitted later than four weeks before the scheduled commencement of such building work. On approval by the Engineer, one signed copy of each drawing or, alternatively, one copy with any necessary modifications indicated thereon, will be returned to the Lift Contractor, who shall accordingly modify his original drawings as necessary and forward two copies to the Engineer.

18. UNTIMELY SUBMISSION OF DRAWINGS

Any extra expense incurred due to any addition and/or amendment made by the Lift Contractor after the drawings mentioned in Clause 1.12 – and/or the other appropriate Clauses above – have been submitted, or due to the untimely submission of drawings, shall be for the Lift Contractor's account.

19. FINAL DRAWINGS

The Lift contractor shall furnish the Engineer (for onward transmission to the Employer) with two sets of linen-backed drawings of the plant as finally completed, incorporating all variations made during the course of construction.

Such drawings shall be submitted no later than two weeks after the completion of the sub-contract works.

20. BUILDING ALTERATIONS

Small building alterations, if agreed to, may be arranged by the Engineer.

Tenderers must, however, clearly state in their tender and indicate on the drawings to be submitted, the extent of any building alterations they require, so that the cost thereof can be assessed when tenders are compared.

Building alterations, for which requests are submitted by the successful tenderer after he has been notified of the acceptance of his tender, will be arranged for by the Employer, but the cost thereof will be for the Lift Contractor's account.

21. MANUFACTURING STANDARDS OF MOTORS AND STARTERS

Motors and starters may be manufactured in accordance with either British, American or European standards. Tenderers must state however to what standards the machines offered are made and must give details of the time rating of the machines.

22. ITEMS

The installation shall include everything necessary and installed to the approval of the Engineer. The supply and installation of equipment required for adherence to the Standards and Codes may not have been indicated in detail on the drawings or in the other parts of the specification but will nevertheless be considered included in the contract value.

The same make and type of apparatus shall be used for similar items throughout the installation.

23. TOOLS AND SPARE PARTS

The subcontract shall include for the supply of all special purpose tools necessary for performing normal maintenance operations on all plant and equipment supplied and installed under the sub-contract.

24. FIXING DEVICES AND GUARDING

All bolts, nuts, studs and miscellaneous fixing devices shall be ISO or another approved equivalent standard.

The guarding of apparatus installed under the sub-contract shall be in accordance with the Factories, Machinery and Building Work Act (as amended) and to the final approval of the Factory Inspector on site examination.

25. LUBRICATION

The sub-contract shall include for the execution of the first fill of oil and grease for all parts of the work.

26. OPERATING INSTRUCTIONS, OWNER'S & MAINTENANCE MANUALS

Operating instruction and maintenance manuals will be regarded as a critical item required for "equipment works completion". The information included and presentation shall be functional, user-friendly and accurate.

Presentation: The presentation of the operating instruction and maintenance manuals shall be as follows:

- Section 1: Index
- Section 2: Description of the System and Component Detail
- Section 3: User Operating Instruction and Safety Procedures
- Section 4: Complete Set of Layout / Engineering Drawings
- Section 5: Complete Principal / Wiring Drawings
- Section 6: Certificates of Compliance, Permission to Install & Concessions
- Section 7: Test and Commissioning Certificates and Data Sheets
- Section 8: Copy of the Contract Specification
- Section 9: Specimen Copy of "Maintenance Agreement"
- Section 10: Maintenance Procedure Manual

Operating Instructions:

Instruction for the Employers designated operating personnel in the proper normal and emergency operation and safety procedures of the vertical transportation systems.

Manuals: (To Suit Contract & Equipment Type)

Provide **FOUR (4)** hard copies and **FOUR (4)** USBs of operating instructions and maintenance manuals for each type of "equipment" prior to "equipment works completion". The manuals shall include:

- ✓ Index as specified.
- ✓ Detailed description of the vertical transportation system including:
  - Building Map if applicable
  - "Unit" Numbers and Designation
  - Technical Detail, Duty Rates and Design Criteria
  - Floors Served, Load, Speed etc.
- ✓ Detailed "User" operating instructions and safety procedures. These instructions should include but are not limited to:
  - Special control features, if applicable
- ✓ Complete set of layout / engineering drawings including design capabilities.
- ✓ A set of complete "As Built", field modified electrical wiring diagrams and single line diagrams showing the electrical connections and functions in a reproducible form.
- ✓ Copies of the Certificates of Compliance, permission to install and all special concessions.
- ✓ Test and commissioning certificates and data sheets including the following:
  - Setting of Timing to Switch to Eco-Drive
  - Nominal Speed and Eco-Drive Settings
  - Number of Steps
- ✓ Copy of the Contract Specification
- ✓ Specimen copy of the "maintenance agreement"
- ✓ Detailed maintenance procedure manuals

27. COMPLETION OF WORKS

Completion of the sub-contract works shall include the instruction of a person or persons, appointed by the Employer, in the correct and efficient operation and in the function of the installation.

28. APPLICATION TO THE INSPECTOR OF MACHINERY

The Lift Contractor shall submit all necessary drawings and information to the Inspector of Machinery and shall submit the necessary applications for the erection and use of the lift and pay the required fees.

29. TESTS AND INSPECTION

Notwithstanding the carrying out of tests at the manufacturer's works, or the submission of test certificates, the Lift Contractor will in no way be relieved of the responsibility for the successful and efficient operation of the equipment on site of his liability for its conforming to the various laws. The Engineer reserves the right to carry out any tests prior to final acceptance to ensure that the equipment conforms to this specification. After completion, either in part or as a whole, the complete installation shall be tested in accordance with the Acts, Ordinance, Regulations, By-laws and rulings applying to the particular installation.

30. VISITS TO SITE

So that provision can be made in the tender, undertake the site visits to understand the nature of the ground access to the site, areas suitable or available for storage of components of the "equipment" and any other circumstances which could affect work and rates. No claim in this respect shall be considered late.

31. CUTTING AND PATCHING

Furnish at tender stage all information so that the necessary openings for work can be built into floors and walls in a timely manner.

Locate the position of inserts and sleeves for pipes, conduits, wire troughs and ducts accurately on shop drawings before the concrete floors are poured.

Existing Buildings:

The Lift Contractor shall obtain approval from a Structural Engineer of its choice or as appointed by the Principal Agent for all cutting / core drilling of existing floor slabs or structural supports or beams. Should the Lift Contractor proceed with the cutting or core drilling of floor slabs or structural supports or beams without written approval from a Structural Engineer, the Lift Contractor shall be held liable for any consequence associated with the weakening of the slabs, beams or supports covered under this section.

NB: Lift Contractor to supply all machine steels for the lift installation including brackets and fixing to support the load bearing machine steels.

32. DOMESTIC SUB-CONTRACTOR

The Lift Contractor shall be held responsible for the performance of the specified service under the actual conditions of installation. The same shall apply in cases where special adjustments or other services are necessary to ensure the proper and efficient functioning of apparatus even though not specifically called for. It is intended that the entire installation when finally delivered shall be ready in every respect for satisfactory and efficient operation.

The Lift Contractor may appoint a Domestic Sub-Contractor to install the “equipment”, however, in this case the following conditions shall apply:

The Lift Contractor shall remain responsible for the day-to-day management of the installation and on-site works and shall attend all the design and site meetings as may be called for by the Principal Agent or Consulting Mechanical Engineer.

Should the Domestic Sub-Contractor not perform in accordance with the said “works” the Principal Agent reserves the right to have the Domestic Sub-Contractor removed from the site and replaced with Construction Staff directly employed by the Lift Contractor.
The commissioning, final adjustments and the issuing of the Certificates of Compliance shall remain the direct responsibility of the Lift Contractor’s field engineers or commissioning engineers.

The Lift Contractor shall be responsible for the inspection and acceptance of the work carried out by the Domestic Sub-Contractor prior to “equipment works completion”.

Without restricting the Lift Contractor’s contractual obligations and responsibilities, the Principal Agent and Consulting Mechanical Engineer reserves the right to recommend nominate or approve Domestic Sub-Contractors.

PART B: GENERAL DESCRIPTION OF THE LIFT SYSTEM (+ PARTICULAR REQUIREMENTS OF THE LIFT SYSTEM)

1. GENERAL REQUIREMENTS

The equipment offered shall be suitable for continuous operation under the following conditions:

a) Electricity Supply

1-phase, 3-wire, 50 Hz AC with a nominal voltage of 230 V varying between 95% and 110% of the nominal voltage. Lift contractor to verify all electrical requirements.

TECHNICAL SPECIFICATIONS

- Fire control with fireman's switch located on main floor (most commonly ground level)
- Emergency power control from emergency generator
- To include Automatic Rescue Device (ARD) in the event of power outage
- "Motor Room Less" Elevators
- Permanent magnet gearless motor
- Handrails on side & rear walls (as per regulations)
- Rubber floors
- Stainless steel finishes
- Removable lift protection curtains/sheets installed.
- Provisions for special needs persons – communications systems on all landings (voice announcements, braille, acceptable button heights, etc.)
- Intercom system with master station located in the control room
- Lift pit drainage (if required)
- Regulatory shaft lighting with two-way switch, power socket in pit, pit ladder and ventilation cut-out by builder (if required).

All dimensions in this document are for information only, and it is the Contractor's responsibility to confirm all measurements & dimensions for preparation of the installation drawings and the installation of the new equipment.

LIFT NO. 1: DISABLED LIFT (STEEL AND GLASS)

No lift shaft – Lift contractor to provide a full design/installation solution based on available space. (Steel & glass)

LOAD/PASSENGERS:	**400 kg / 1 passenger with wheelchair passenger**
CAR DIMENSIONS:	**970 mm W x 1 420 mm D x 2 000 mm H**
STOPS & OPENINGS:	**2 stops. 2 openings opposite to each other (thru openings)**
LIFT SHAFT DIMENSIONS:	**1 555 mm wide x 1 725 mm deep (external)**
HEADROOM:	**Approximately 2 500 mm**
PIT DEPTH:	**Approximately 150 mm**
TRAVEL:	**4.5 m (to be verified)**
SPEED:	**0.15 m/s**

CAR:	**Multi-beam detectors across car entrance**
LANDING DOORS:	**Swing door – 860 mm W x 2 000 mm H**
CONTROL SYSTEM:	**Relay logic, constant pressure control.**
BUTTONS & SIGNALS:	**Left front standing inside car facing out (Call buttons, alarm, door open, door close, emergency light, emergency stop)**
FEATURES:	**Fireman's control with break glass unit on main landing**

NB:

1) Ensure shaft sizes are site specific as dimensions given on drawings for information and tender purposes only.
2) Lift supplier to confirm travel distance and available headroom and pit, lifts to be machine room-less.

2. MOTOR ROOM EQUIPMENT

2.1. V.V.V.F. AC Driving Motor

The Drives shall be A.C. Motors with variable voltage, variable frequency drive carefully matched to the motor characteristics to give high starting torque and low starting current. The acceleration and retardation shall be completely smooth and step-less. The motor shall have sufficient capacity to operate at contractual duty continuously without overheating. Where separately driven cooling fans are used, interlocking shall be provided to prevent the driving motor from operating in the event of failure of the cooling fan.

A Declaration of Conformance in accordance with the EU. Electromagnetic Compatibility.

2.2. Gearless Lift Machines

The machine shall be of the Permanent Magnet Gearless type. The machine is to be traction sheave mounted to the common shaft with the rotor. The motor stator is to be bolted to the multifunctional support.

The traction sheave shall be provided with accurately machined rope grooves, the profile of which is to be selected with due regard to the specified duty, to ensure sufficient and even traction and long rope and groove life. The sheave shall have sufficient metal thickness to allow for future re-grooving and shall be easily removable.

2.3. Brake

The brake shall be of the drum or disc type mounted on the motor and shall be operated by a DC solenoid acting on two self-aligning brake shoes lined with friction material. The shoes shall be independently mounted and shall be spring-applied and electrically released. One half of each brake must be capable of holding the car in the event of failure of the other half. The brake shall operate in the event of a power failure, or the operation of any other safety device designed to stop the lifts.

2.4. Hand Turning Gear

The lift machine shall be provided with a hand winding wheel and manual brake release lever to facilitate the safe turning of the machine by hand or an approved battery-operated circuit.

2.5. Mounting of Lift Motor

The Lift Contractor shall supply and install suitable structural steel bearing plates and supports for the mounting of the lift machine within the lift shaft. (Note: No machine steel cut-outs provided for).

Anti-vibration mountings shall be provided to minimise the transmission of vibrations to the structure and to ensure the silent and smooth operation of all the equipment. Tenderers shall describe the methods to be used to achieve the desired results.

2.6. Diverter Sheaves

The diverter sheaves shall be manufactured and engineered to suit the application and shall run in permanently lubricated roller bearings mounted on support steelwork. The sheaves shall be provided with grooves as specified for the traction sheaves.

2.7. Controller

The Solid-state control gear shall be assembled, and floor mounted with the top floor landing frame.

Contacts breaking heavy currents shall be provided with magnetic blow-outs and arc chutes. Contact surfaces shall be of silver-to-silver. Copper-to-copper contacts will not be accepted.

All wearing parts must be easily renewable, and flexible connections must be used for all moving contacts. Springs or movable joints shall not be current carrying.

The controller must incorporate all switchgear, relays and other equipment necessary for the operation and protection of the lift, and must be so designed that the car will automatically be brought to a stop in the event of:

a) Interruption of the main power supply, or the interruption of any one phase of the main supply, or if a phase reversal of the main supply has occurred.
b) Operation of the governor due to speed.
c) The operation of the final limit switches.
d) The interruption of the floor selector drive protection switch.
e) Potential free contactors for automatic change over between normal and emergency power supply to be provided.
f) Provision must also be made for the transfer of emergency power from one lift to the other.

The controllers shall be provided with adequate suppression devices to eliminate radio and television interference. The controller and brake may operate on DC obtained from a rectifier or auxiliary motor generator set.

The power supply for the control circuitry shall be obtained from a stabilised power supply which shall smooth out the voltage dip normally prevalent on the output voltage of a diesel engine driven alternator set during the initial application of load.

All terminals of the machinery and control gear shall be marked with distinctive letters or numbers, and corresponding markings shall appear on the contract drawings.

2.8. Governor

An over speed governor, driven directly by an independent rope attached to the car, shall be provided in the lift shaft and shall be designed to operate the safety gear fitted to the car when the speed of the car, due to any cause, exceeds its normal maximum speed by more than a predetermined value. The tripping speed of the governor shall be selected with due regard to the contract speed. The tripping speed shall be approximately inversely proportional to the contract speed and shall for contract speeds ranging from 0.25 m/s to 5.0 m/s not exceed the contract speed by more than 40 % and 20 % respectively.

The governor shall be provided with control switches which shall be wired into the control circuits to shut-off the power supply to the drive motor and brake before or at the same time that the safety gear is operated.

3. EQUIPMENT INSTALLED IN LIFT SHAFT

3.1. Guide Rails and Roller Shoes

The guide rails for the car and counterweight shall consist of planed steel tees with milled, tongued and grooved joints. Metal splice plates shall be of a suitable length and fixing brackets for guide rails shall be provided at intervals not exceeding 2.4 m. Guide rail fixings shall be located in such positions that when the car is on any landing the guide shoes on the car will be at a fixing bracket. The bottom end of each guide rail shall be provided with a soleplate fixed to the pit floor.

All brackets shall be secured by means of approved expandable concrete anchor bolts of adequate size and length.

The lift shall be fitted with sliding type guide shoes with fitted lubricators.

3.2. Ropes

Ropes shall be of the best quality and of suitable number, size and manufacture to ensure proper operation of the lifts, and to give satisfactory wearing qualities. All ropes shall consist of at least six strands wound around a hemp core centre and shall comply with BS 329: 1968. Rope tension equalisers shall be provided and shall be so designed that each rope can be individually adjusted. Equalisers reducing the suspension to a single bolt or shaft will not be acceptable.

3.3. Buffers

Suitable buffers shall be provided for the car and counterweight and shall be so adjusted that in the case of over-travel no parts of the car or counterweight shall touch the shaft ceiling, and that the retardation of the car does not exceed the limits as laid down in the European Safety Rules for the Construction and Installation of Electric Lifts (EN 81) as incorporated in BS 5655: Part 1.

3.4. Over-Travel Protection

Normal and final terminal stopping switches shall be provided in the hoist way, which shall be operated independently of each by the car and shall respectively be arranged to stop the car and prevent its normal operation should it travel beyond the zone of the normal stopping device at the upper and lower terminal floors or travel within the top and bottom clearance with the buffers operative.

3.5. Stop Switch in Pit

A watertight stop switch shall be provided in the pit and the lift shaft in a position that can be reached from the lower landing and the pit floor.

3.6. Cat Ladder

The necessary Cat Ladder which will be required for the easy and safe maintenance of the lift shall be supplied and installed by the Lift Contractor.

4. LIFT CAR

4.1. Construction

The lift car shall be an assembly consisting of the sling, the platform and the cabin.

The sling shall be constructed of rolled steel angle or channel sections bolted or welded together to form a rigid framework which shall be suitably braced and reinforced to withstand the operation of the safety gear without permanent distortion.

The car platform shall consist of a 3 mm thick mild steel plate or 20 mm thick hardwood floor laid on closely spaced steel channel sections welded to a steel frame which in turn shall be laid on rubber pads in a structural steel frame. Load weighing devices shall be incorporated. The floor shall be finished with heavy duty "Norament" floor sheeting in a colour to be selected by the Architect. The car platform is to be equipped with a non-skid threshold plate manufactured from solid aluminium.

The cabin shall be designed as a fully enclosed car with a flat roof and solid full height Stainless Steel panels on the sides and the back. The back of the cabin shall be specially reinforced to prevent damage to the panels when bumped by trolleys.

The rear and side panels shall be Stainless Steel with brushed satin finish. The front return panels, entrance columns, stiles and trimmings shall be manufactured from solid 1.6 mm thick stainless steel with a brushed satin finish.

As an option a 400 mm wide silvered glass mirror shall be provided at the rear of the cabin in the side walls between the handrail and the ceiling of the cabin.

The cabin shall be securely fixed to its sling and platform in such a manner that the cabin is not subjected to strains in the event of an unequal distribution of load occurring over the floor area.

A robust handrail, consisting of Stainless Steel, spaced 50 mm off the panelling, must be provided across the rear and side walls of the lift car. The spacer blocks to which the handrails are secured shall be fixed to the panels by means of 2 x M 10 bolts with locknuts or other approved method.

In addition to the above, the following features shall also be embodied in the car:

g) Surface mounted standard 2-lamp open fluorescent luminaries, providing an illumination level. LED Down lighters to be fitted in the lift ceiling and shall bear the SABS mark.
h) The lamps shall be provided with an emergency battery-inverter unit by means of which the lamp will be operated for at least 60 minutes. In the event of a power failure. This lamp shall operate at full output under normal conditions.
i) A silent running electric fan for ventilation of car with a capacity of at least 750 m^3/h.
j) Luminous car position indicator and "Up/Down" travel indicators installed above the entrance doors.
k) An alarm bell with a 150 mm diameter dome and 22 V, AC coil shall be mounted under the car.
l) A tip up seat must be allowed for in the car, as per SNP (special needs passengers) requirements.

A timber work platform or a car canopy capable of supporting a minimum of 4 persons on which the serviceman can stand whilst travelling or working on the shaft or car equipment shall be provided over as large an area as practically possible, on top of the lift car.

The inspection certificate for the lift shall be installed in a suitable frame in the machine room.

The successful Tenderer will be required to submit a detailed sketch indicating the proposed design for the car after discussions with the Architect and Engineer. The approved sketch design shall be changed into a working drawing which shall be submitted for final approval before manufacture is commenced.

4.2. Car Operating Panel

The lift shall be provided with two (2) operating panels which shall be flush mounted in the car enclosure and shall contain the following:

a) A bank of buttons on each side of the car numbered to correspond with the floors served and of a type as called for in Clause 2.6.4.
b) An emergency alarm push-button (coloured red) connected to an alarm bell located under the car.
c) A "Door Open" push-button to hold the doors in the open position.
d) A "Door Close" push-button to close the car doors.
e) An "On/Off" toggle switch for the extract fan (on one panel only).
f) A loading function to be included (Key operating)
g) An overload indicator with buzzer.
h) Ventilation fan switch.
i) Electronic digital position up and down direction indicator.
j) The functions of all buttons and switches shall be identified by means of engraved symbols on the buttons and below the switches where applicable.
k) A flush-mounted loudspeaker/microphone intercom unit with press-to-talk pushbutton to facilitate communication with the reception desk in cases of emergency.

Note: The Lift Contractor shall allow for the supply of a similar intercom unit to be surface or flush mounted. Architect to verify position. Spare cores shall also be provided in the lift's trailing cable to facilitate wiring of the car intercom station to the reception area.

The car operating panel to be mounted on the side of the car at a height accessible to handicapped persons in wheelchairs. The faceplates of the car operating panels shall be of brushed stainless steel not less than 1.6mm thick.

4.3. Car Doors

The lift shall be fitted with swing type opening doors as specified.

The automatic car doors shall be of full light curtains.

The car and landing doors shall be interlocked by means of electro-mechanical locks so arranged that no landing door can be opened unless the car is opposite the landing. It shall be possible for the lift machine to operate unless all doors are closed, or for the landing doors to be opened while the lift is travelling, except under levelling conditions. In the event of a power failure, it shall be possible to open the doors from inside the car, provided it has been stopped within reach for manual operation of the landing door locking devices. All electro-mechanical interlocks are to be of a substantial construction to be able to withstand the impact of repeated opening and closing cycles and shall be adequately enclosed to prevent accidental contact with persons using the lifts.

A "door open" push-button must be provided in the car operating panel to enable the closing of doors to be stopped and reversed if required.

4.4. Safety Device

A safety device, acting on each of the car guide rails, shall be fitted to the bottom of each lift car. The safety device shall be operated by an over speed governor, located in the lift motor room. The safety device shall be arranged to stop the car without excessive shock whenever the car over speeds downwards due to the breakage of all suspension ropes or other causes. Prior to the application of the safety device, the motor and brake circuits shall be opened to cut-off the power to the motor and apply the brake.
The safety device shall be designed and shall generally comply with the requirements of the European Safety Rules for Electric Lifts (CN81) as incorporated in BS 5655.

4.5. Automatic Levelling

The lifts shall be provided with a self-levelling feature, which will automatically bring the car to rest level with the floor landings, within a maximum tolerance of 6.0 mm under all conditions of load.

The door operator of the automatic doors shall start functioning when the car reaches the levelling zone so that the doors are fully open when the car has been levelled with the landing.

4.6. Travel and Landing Indicators and Gongs

Floor indicator panels of the LED or electronic type, showing the position of the car in the shaft shall be provided on each floor. These panels shall be located centrally above the landing doors and shall incorporate the up and down direction indicators at the left and right-hand sides respectively.

The up and down direction of travel indicators shall be of the arrow-shaped illuminated type. The arrows shall be moulded in high quality white acrylic plastic and shall protrude from the plate. The face plates shall be of brushed stainless steel. At the terminal landings two direction arrows indicating the same direction shall be provided. As an alternative electronic-type direction indicators may be offered.

A single-stroke pre-arrival gong shall be installed flush in the head of the door frame directly below the floor indicator panel. The gong shall sound when the lift is about to stop at a landing. The horizontal portion of the door frame behind which the gong is mounted shall be die-punched with a series of narrow slots to ensure that the sound from the gong penetrates clearly into the lift lobby.

4.7. Call Buttons

The type of buttons to be provided on landings and the operating panel of the lift car shall both be of the illuminated, vandal proof, mechanical, button and comply with EN 81 Standards. The call buttons shall be mounted at a height easily accessible to handicapped persons in wheelchairs.

The “Up” and “Down” call buttons shall be installed at the intermediate landings whilst single call buttons are to be installed at the top and bottom terminal landings. At each landing the buttons shall be located on either side of the lift doors at a height of approximately 1050 mm above finished floor level. Call button face plates shall be of satin finished brushed stainless steel as to match the face plates of the travel and landing indicators. The “UP” and “DOWN” call buttons on the intermediate landings shall be installed in separate boxes on either side of the landing doors in order to minimize the possibility of both being pressed at the same time.

5. STAINLESS STEEL

All stainless steel referred to shall be chrome nickel Type 304, 18/8 grade with a satin brushed finish.

6. OPERATION OF THE LIFTS

6.1. Normal Operation of Lift

The operation of the abovementioned lifts shall be fully automatic collective/selective as described below:

6.2. Operation – Full Collective

The car shall not be started unless the car door is closed and all hoist way doors are locked in the closed position.

Operation shall be automatic by means of the car and landing buttons. Calls registered by the momentary actuation of the car or landing buttons shall cause the car to stop in the order in which the landings are reached in each direction of travel. All stops shall be subject to respective car or landing buttons being actuated sufficiently in advance of the arrival of the car at that landing to enable the stop to be made. The direction of travel for the idle car shall be established by the first car or landing button actuated.

“Up” landing calls shall be answered while the car is travelling up and “down” landing calls shall be answered while the car is travelling down. The car shall reverse after the uppermost or lowermost car or landing calls has been answered and proceed to answer car calls and landing calls registered in the opposite direction of travel.

If the car without registered car calls arrives at a floor where both up and down hall calls are registered, it shall initially respond to the hall call in the direction the car was travelling. If no car call or hall call is registered for further travel in that direction, the direction lanterns, furnished, will indicate the changed direction when the car call is registered.

A time limit relay will hold the car for a few seconds at the landings at which stops are made to enable passengers to enter or leave the car. Pressure of a car button for another landing before this time elapses will cause the car to start, provided the car door and hoist way doors are closed. When the car has answered the farthest call, this interval will permit a car button call to be registered to establish the direction of the car travel, even if other calls are registered.

7. PROVISION FOR INTERCOM

The Electrical Sub-Contractor shall supply and install a 20 mm conduit from the lift shaft to the reception area to facilitate the installation of wiring to the intercom unit.

8. MAINTENANCE

The Lift Contractor shall maintain the elevator for a period of 12 months commencing on the date that the elevator is accepted for use.

All work shall be performed between 08:00 and 17:00 hours of regular working days and will consist of programmed examinations and any necessary adjustment and lubrication of the equipment by competent employees. The required supplies and parts shall be furnished.

Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 4

uMsunduzi
MUSEUM · ISIGCINAMAGUGU

an agency of the
Department of Sport, Arts and Culture

BLOCK M – MAIN MUSEUM & AUDITORIUM

PROPOSED UPGRADES AND INSTALLATION OF ELECTRICAL & MECHANICAL WORKS

HVAC SPECIFICATION

CLIENT:

uMsunduzi Museum
351 Langalibalele Street
Pietermaritzburg
3201

Tel. No.: 033 394 6834

CONSULTING ENGINEER:

LSG Consulting Engineers Inc.
Unit 7/8 Doncaster Park,
10 Derby Place,
Derby Downs Office Park,
Westville, Durban, 3630

Tel. No.: 031 205 2335

REGISTERED NAME OF MECHANICAL CONTRACTOR:

APRIL 2023

UMSUNDUZI MUSEUM: PROPOSED UPGRADES AND INSTALLATION OF ELECTRICAL & MECHANICAL HVAC SPECIFICATION

INDEX

PART A: DETAILED TECHNICAL SPECIFICATION

1. GENERAL

Where the terms “Main Contractor,” “Builder,” “Electrical Contractor,” “Sub-contractor,” or “Mechanical Contractor” are used in this document, it is referring to the entity that is tendering for the works and/or their sub-contractors.

The International System of Units (SI) shall be used for all materials, equipment, and measurements.

Words used in the singular, where the context so permits, shall be deemed to include the plural and vice versa.

The Works shall comply with the Standard Specification which details the intrinsic properties (including materials and workmanship) of the installations, in so far as it is not overridden by the Conditions, Detailed Technical Specification (which includes all Drawings and Bill of Quantities) and/or written instructions of the Engineer.

The Mechanical Contractor is required to check all dimensions on site prior to preparing drawings for the installation of equipment and manufacture of ductwork and shall be held responsible for ensuring that all installed components, ductwork, and pipework conforms to the building structure.

2. BRIEF DESCRIPTION OF PROJECT

The Works are to be carried out at the Umsunduzi Museum complex, specifically on an existing building within the complex: Block M – Main Museum & Auditorium building at 351 Langalibalele Street, Pietermaritzburg, KZN.

The building is existing, and the intent is to upgrade the HVAC in the areas that have existing systems and install new HVAC system(s) on those areas that do not have any HVAC.

3. SCOPE OF WORKS

The Scope of Works includes the supply, delivery, installation, testing, commissioning, maintenance, and guarantee of the new HVAC system in the buildings, as detailed on the drawings and BOQ as follows:

- Decommissioning and removal of all existing HVAC systems currently installed within the building.
- 2-OFF new split / hybrid type, reverse cycle DX air handling units, in the auditorium and ground floor exhibition areas.
- New heat recovery VRF system(s), in office areas.
- New heat pump VRF systems in computer lab, library/archive areas and exhibition hall.
- New pre-cooled fresh air system(s) in the main exhibition hall.
- New fresh air supply systems to all air-conditioned areas.
- New extraction systems to ablutions, kitchens, and stores.
- New pipework and ductwork required for all HVAC systems.
- New electrical and communication wiring for all HVAC equipment.

4. RESPONSIBILITIES

By submitting this tender, it shall be assumed the Mechanical Contractor has fully studied this document. The Contract, as detailed in these specification documents and the accompanying drawings, comprises of the manufacture, supply, transport, delivery, hoisting, installation, testing, commissioning, setting in operation, maintenance, leaving in complete working order and guarantee of the entire air-conditioning plant as specified. The Contract (except so far as the Contract otherwise provides) includes the provision of all labour, materials, contractor’s equipment, and everything else, whether of a temporary or permanent nature required.

Responsibility of the Mechanical Contractor

- Supply, installation, testing and commissioning of all required services,
- Coordination with professionals (electrical, structural, etc.), security, other contractors, etc.,
- Coordination of HVAC drainage with the plumber, electrics with the electrical contractor, fire linkage with the fire contractor, etc., and where these fellow contractors are not available, the responsibility shall fall upon the Mechanical Contractor,
- Provision of Builder's Work and Shop drawings,
- Provision of As-built drawings and O&M manuals complete with USB's (4 copies), commissioning data, maintenance schedules, compliance certificates, etc., and
- 12-month free maintenance and guarantee period.

5. DESIGN AND SYSTEM CRITERIA

External Design Conditions

Elevation	:	620 m Above Sea Level
Outside summer conditions	:	33.3 °C DB & 23.9 °C WB
Outside winter conditions	:	5.6°C
Internal Design Conditions	:	22 °C ± 1°C with 40-60% RH

6. PROGRAMME

i) Building work shall commence soon, and the Mechanical Contractor shall be required to commence work immediately on receipt of instructions to proceed. The Main / Mechanical Contractor must state the complete construction time in months and coincide with the programme requirements from the Employer.

ii) The Mechanical Contractor shall submit a copy of their Programme to the Engineer for approval. After submission to and approval by the Engineer of such Programme, the Mechanical Contractor shall adhere to the order of procedure and method stated therein, unless they obtain the written permission of the Engineer to vary such order or method.

iii) The Mechanical Contractor is responsible for co-ordinating site Works under the Contract to suit the Programme. Exact dates must be known for delivery of major equipment to meet key installation dates.

iv) The times required for the submission of Builder's Work drawings shall be two (2) weeks, and Shop drawings shall be one (1) week from the date of acceptance of this Tender, unless otherwise stated.

v) The entire air-conditioning and ventilation installation must be commissioned, tested, and taken over by the Engineer as noted in the Commissioning Programme.

7. BUILDER'S WORK

All Builder's Work including openings or holes through the building structure or partition walls; trenches, ducts and cutting; and all plinths, concrete bases, supports, etc. required for the installations shall be carried out as part of the building works by the Main Contractor (or the Mechanical Contractor, as the case may be), provided that the Mechanical Contractor has submitted full details of such requirements within a reasonable time to the Engineer for approval, so that due consideration may be given before they commence the building works in accordance with the building programme in the areas concerned. After obtaining the said approval of the Engineer, the Main Contractor may carry out the Builder's Work as the Works proceed.

The Main Contractor must carry out all "cutting-away" and "making-good" as required to facilitate the Works.

The Mechanical Contractor shall ensure that such works are essential for the execution of the installations. If any of such works is proved to be non-essential, unnecessary and/or abortive, the Mechanical Contractor shall bear the full cost of such works including but not limited to any unnecessary or incorrect cutting-away and making-good and shall reimburse the Employer for all costs incurred in this connection.

All expenses properly incurred, and losses suffered by the Employer because of the Mechanical Contractor's failure to comply with the above requirements are recoverable by the Employer from the Mechanical Contractor as a debt under the Contract.

8. DRAWINGS

The Mechanical Contractor shall produce and co-ordinate the following drawings of all services included in this contract: Builder's Work drawings, Shop drawings (Design & Installation drawings) and As-built drawings. All drawings are to be submitted in electronic format (CAD and PDF) and hardcopy as specified.

The Mechanical Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by them, whether such drawings and particulars have been approved by the Engineer or not – provided that such discrepancies, errors, or omissions are not due to inaccurate information or particulars furnished in writing to the Mechanical Contractor by the Engineer or the Architect.

Drawings submitted by the Mechanical Contractor shall only be of standard sizes from A0 to A4, prepared to such scales that will clearly show all necessary details. The Engineer's decision as to what constitutes a reasonable scale shall be final.

The Works shall be carried out in accordance with the relevant tender drawings appended to this document. The tender drawings shall be deemed to indicate the general layout and requirements only and are not Shop drawings. The Mechanical Contractor shall ensure they are in possession of all information required for the installation of the Works and shall – if necessary – request copies of all relevant architectural and structural drawings.

It shall be binding upon the Mechanical Contractor to establish with or obtain from the Main Contractor the scheduled time of commencement and programming of all building work impacting the Mechanical Contractor in respect of this clause. The Mechanical Contractor shall allow reasonable time in the Programme for vetting of the Shop and Builder's Work drawings by the Engineer and for drawing resubmissions as necessary. When submitting any drawings, the Mechanical Contractor shall advise the Engineer if early approval is necessary to avoid delay in completion of the Works. Approvals by the Engineer shall not be deviated from, unless authorised in writing by the Engineer.

Any extra expense incurred due to any addition and/or amendment made by the Mechanical Contractor after the drawings mentioned above have been submitted or due to the untimely submission of drawings, shall be for the Mechanical Contractor's account.

8.1. Shop Drawings

i) The Mechanical Contractor shall, in the stated or in adequate time before each section of the work proceeds, prepare, and submit for acceptance by the Engineer, detailed Shop drawings to demonstrate how they propose to install the works. These drawings shall be fully dimensioned and shall be based on the basic intentions of the Engineer's drawings. The drawings shall show the full extent of the installations, including the positions, sizes, weights, arrangements, operating clearances, performance characteristics, etc. of all equipment, ductwork, pipework, electrics, wiring diagrams, controls, supports, fixings, and accessories.

ii) No equipment shall be delivered to site and no work shall be executed until the Shop drawings have been approved in writing by the Engineer. All alterations to Shop drawings, whether due to co-ordination or otherwise, shall be carried out by the Mechanical Contractor at their expense. Work installed or equipment ordered prior to approval of the Shop drawings shall be liable to rejection by the Engineer, and removal and/or replacement by the Mechanical Contractor, at the Mechanical Contractor's cost.

iii) The Mechanical Contractor shall provide at least four (4) hardcopies and one electronic copy (CAD and PDF), unless otherwise specified in writing, of the approved Shop drawings to the Engineer for distribution.

8.2. Builder's Work Drawings

i) The Mechanical Contractor shall, in the stated or in adequate time before each section of the work proceeds, prepare, and submit for acceptance by the Engineer, detailed Builder's Work drawings. These drawings shall be fully dimensioned and contain all openings required in the slabs, walls and partitions and equipment foundation details with weights and sizes.

ii) No Builder's Work shall be executed until the Builder's Work drawings have been approved in writing by the Engineer. All alterations to Builder's Work drawings, whether due to co-ordination or otherwise, shall be carried out by the Mechanical Contractor at their expense. Work performed prior to the approval of the Builder's Work drawings shall be liable to rejection by the Engineer, and removal and/or replacement by the Mechanical Contractor, at the Mechanical Contractor's cost.

iii) The Mechanical Contractor shall provide at least four (4) hardcopies and one electronic copy (CAD and PDF), unless otherwise specified in writing, of the approved Builder's Work drawings to the Engineer for distribution.

8.3. As-built Drawings

i) The Mechanical Contractor shall submit, no later than two (2) weeks after Practical Completion (or Sectional Completion as the case may be) of the Works, detailed As-built drawings to the Engineer for approval. These drawings shall be complete with all details concerning the mechanical installations, along with appropriate pipework, ductwork and cable sizes, pressures and flow rates for recommissioning purposes and access points for operating and maintenance purposes. The Mechanical Contractor shall ensure all As-built drawings are an accurate representation of the installations, before submitting them to the Engineer.

ii) The Mechanical Contractor shall provide one hardcopy and one electronic copy (CAD and PDF) of the approved As-built drawings (included as part of each of the 4 required O&M manuals and USB's) to the Engineer for distribution.

iii) The Mechanical Contractor shall provide and install in the relevant major plant room glass-framed, non-fading prints of the following:

- Schematic diagrams showing the layouts and positions of the major equipment items and identification of all valves and dampers with the final settings/adjustment for regulating devices, and
- Plant room record drawings showing all plant items, pipework, ductwork, etc. including all electrical and control schematics and diagrams.

Glazing shall be polished plate of not less than 6mm thickness mounted in natural finish, extruded, and anodised aluminium frames with the prints mounted on acid free mounting board and the whole backed with marine grade plywood not less than 8mm thick.

9. OPERATION AND MAINTENANCE (O&M) MANUALS

Before completion of the Works, the Contractor shall hand, free of charge to the Engineer, four (4) copies of the O&M manuals and 4-OFF USBs for the entire plant covered by the Works as specified in the Standard Specification. Training as per the Standard Specification is mandatory.

10. ITEMS

i) The installation shall include everything necessary and installed to the approval of the Engineer. The design and installation of the equipment required for adherence to the Standards and Codes may not have been indicated in detail in the Specifications; but will nevertheless be considered included in the Contract Value.

ii) The same make and type of apparatus shall be used for similar items throughout the installation.

11. EQUIPMENT AND MATERIAL

i) The Mechanical Contractor shall submit catalogues and manufacturer's specifications of the proposed equipment and material, in English and SI units, for the approval of the Engineer in writing before any equipment or material is procured.

ii) It is the intent of these Specifications that wherever a manufacturer of a product is specified, the terms "equal and approved" are used. The substituted item must conform in all respects to the specified item and written approval of the Engineer is necessary before any equipment or material is procured.

iii) Consideration will not be given to claims that the substituted items meet the performance requirements with lesser construction (such as lesser exchange surface, etc.). Performance as delineated in schedules and in

the specifications, shall be interpreted as minimum performance. In many cases, equipment is oversized to allow for pickup loads which cannot be delineated under the minimum performance.

iv) Substituted equipment, where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Mechanical Contractor's full expense.

v) All other things being equal, preference shall be given to South African manufactured materials and/or equipment. All equipment and/or materials required for the installation under these Specifications shall be new and without blemish or defect.

vi) The Engineer's decision shall be final.

12. PROTECTION OF EQUIPMENT AND MATERIAL

The Mechanical Contractor shall be responsible for the safe custody of all materials and equipment as stored or installed by them. In addition, the Mechanical Contractor shall adequately protect all equipment and material against theft, fire, damage, or inclement weather and carefully store all equipment and material received on site but not yet installed in a safe and secure place, unless otherwise specified.

All cases of theft or fire must immediately be reported to the Main Contractor and Engineer with full details. Failure to do so may result in these cases of theft or fire not being considered.

13. SITE SUPERVISION

The Mechanical Contractor shall keep on the site a competent and technically qualified site supervisor to control, supervise and manage all their installations on site. The site supervisor shall be vested with suitable powers to receive instructions from the Engineer or their representative.

The site supervisor shall be technically competent and have adequate site experience for the installations. The qualified and competent site supervisor shall have minimum 5 years on-site experience for similar types of installation works. The Mechanical Contractor shall immediately replace the site supervisor whose experience, skill, or competency is, in the opinion of the Engineer, found to be inadequate for the Works.

All tradesmen must be experienced in the trade and the Works carried out shall be to the satisfaction of the Engineer.

14. PIPEWORK

The Mechanical Contractor shall supply and install all pipework, valves, fittings, etc. as specified and/or shown on the Tender drawings and in accordance with the Standard Specification.

The following types of piping shall be installed:

Refrigerant Pipework	-	Copper (Refrigerant Grade)
Drainage Pipework	-	uPVC

Note: Binder points (for pressure and temperature) are to be provided to measure differentials at the following points:

- Evaporator inlet and outlet,
- Balancing valve inlet and outlet,
- Strainer inlet and outlet.

15. INSULATION

Insulation shall be provided in accordance with the Standard Specification. All insulation used for the Works must be free from any ozone-depleting substances in both manufacture and composition (proof to be submitted if requested by the Engineer).

16. MAINTENANCE AND SERVICING

The Mechanical Contractor shall price for a free 12-month maintenance and guarantee period, which shall be in accordance with the Standard Specification.

17. ELECTRICAL EQUIPMENT AND WIRING

The complete electrical installation and all electrical equipment and materials covered under this Contract shall comply will all relevant standards, including the following:

- SANS 10142-1:2017 (as amended),
- Occupational Health and Safety Act, 1993,
- Normal requirements laid down by Eskom,
- Latest requirements of the IEC and British Standard Institute, where no SANS codes of practice exist,
- All rules and regulations issued by local and other authorities having jurisdiction over the Contract,
- The Standard Specification and drawings appended hereto.

Any deviation from these specifications shall be conditional upon the written approval of the Architect, Engineer or his appointed representative.

The Mechanical Contractor shall employ the services of an electrical specialist, who shall be responsible for the application, engineering, documentation, supply, installation, commissioning, and maintenance of the system.

The Mechanical Contractor shall secure approval of all authorities required for the installation. The Engineer or their representative reserves the right to call for test certificates and characteristic curves of every item of equipment to prove compliance – with the standard to which it is built – in manufacture and performance. Test certificates shall be issued by a recognised testing authority and shall be submitted at the same time called for.

Every effort shall be taken to protect materials – either fixed or unfixed – from damage. All items shall be protected against the ingress of dust and moisture, so that no damage results to any item or system. All large items requiring removal and exceeding 25 kg in mass, shall be fitted with lifting lugs or eyes. All items of equipment mounted outdoors, in AHUs or in a wet or possibly wet environment, shall be weatherproof.

Supply and installation shall include all equipment detailed on the approved Shop drawings and wiring diagrams. The equipment, such as starters, contactors, relays, etc., used in the electrical installation shall be fully catalogued products. All items of the electrical installation shall be readily accessible for quick and easy replacement. Adequate space shall be provided around all items for easy removal of parts.

Commissioning shall include the validation of the systems as detailed on the Shop drawings and wiring diagrams; and demonstrating that the electrical system does in fact provide the sequence of operation, control and safety operation as detailed on the approved wiring diagrams. In addition, commissioning shall involve the close co-operation of the electrical specialist contractor and the automatic control system contractor with the Mechanical Contractor in adjusting the electrical system to provide the results intended.

Methods of recording and presentation shall be required for incorporation in the O&M manuals and display in the plantrooms. Other documentation required shall include the installation, testing and maintenance instructions, including the performance curves/selection tables for the expected range of operating conditions.

On completion of all inspections, tests and commissioning of the Works, the Contractor shall issue the Engineer with a certificate of compliance by an accredited person.

18. CONTROL AND MONITORING SYSTEM

Controllers are to be provided and installed as per the Drawings / BOQ. A central control system is to be provided, which incorporates all new HVAC equipment installed and must be capable of connecting to other BMS systems.

PART B: STANDARD SPECIFICATION

1. CENTRAL REFRIGERATION MACHINE, DX EVAPORATORS AND HEAT REJECTION PLANT

1.1. GENERAL

In this section, refrigeration machine may refer to chiller or heat pump.

The refrigeration plant for air-conditioning purposes shall generally be of the mechanical, vapour compression type. Only non-flammable class 1 refrigerants should be adopted. Class 2 refrigerants may only be considered on an individual project basis, and subject to the Engineer's approval. Class 3 refrigerants are prohibited.

The refrigeration machine shall be factory assembled and tested complete "packaged" units which may have reciprocating, centrifugal, screw or scroll type compressors, as specified in the Detailed Technical Specification.

The plant shall include any accessories necessary to ensure continuous and reliable automatic operation and remote monitoring and control. Power supply voltage-dip ride-through devices shall be provided to delay the protective shut down of refrigeration machine. Fast restart to allow the refrigerant machine to restart and going to a postlude operational mode shall be required for minimising downtime. Each unit shall be capable of running continuously at the lowest step of cooling or heating capacity provided without any adverse effect.

Compressor and motor speeds shall not exceed 50 rps for reciprocating type and for screw type. For non-oil-free centrifugal type, the motor speed shall not exceed 50 rps and the compressor speed shall not exceed 250 rps. For oil-free centrifugal type, both motor and compressor speed shall not exceed 800 rps. Energy efficient motor to optimise the system coefficient of performance shall be required. The noise level of the refrigeration machine shall comply with the requirements as specified in the Detailed Technical Specification or the relevant environmental protection ordinances, whichever is more stringent. If acoustic silencers are required in order to achieve the required noise level, it shall be factory-built and shall not de-rate the machine efficiency and capacity as specified in the Detailed Technical Specification.

For non-oil-free chiller, each compressor shall form a separate oil circuit with its own oil separator, filter and positive lubrication oil safety control circuit to ensure proper functioning of each compressor and accessories.

Appropriate corrosion resistant materials and assembly methods shall be used including isolation of dissimilar metals against galvanic interaction, etc.

All units shall comply, where applicable, with the following codes: ISO 5149:2014, ASHRAE Standard 90.1: 2013, ASHRAE Standard 189.1-2014, ANSI / ASHRAE Standard 15 -2013 (Packaged with ANSI/ASHRAE 34-2013); AHRI Standard 550/590:2012 Testing and Ratings; BS EN 14511-1:2013 to BS EN 14511-4:2013 Testing and Ratings and Code of Practice for Electricity (Wiring) Regulations and Code of Practice for Energy Efficiency of Building Services Installation.

The proposal from the Mechanical Contractor shall be supplied with characteristic curves to show the energy consumption in kilowatts, pressure drop through the evaporator, chilled or hot water flow rates and temperatures, condenser fan speeds, etc., for each unit at 25%, 50%, 75% and 100% of full capacity.

Sound pressure level characteristic curves shall also be supplied, in dB measured in accordance with ANSI/AHRI standard 575:2008 for 25%, 50%, 75% and 100% of full capacity.

1.2. HEAT PUMPS

i) Heat pumps shall be the air-to-water or water-to-water type, as specified. Air-to-water heat pumps shall operate in reverse refrigeration cycle whilst water-to-water heat pumps shall use the building cooling load as a heat source for water heating. Each heat pump shall include compressor, motor, evaporator, condenser, lubrication system, capacity control, solid state control centre and indication accessories.

ii) The refrigerant circuit shall be leak tested at factory, evacuated and pumped up with a holding charge of refrigerant under positive pressure prior to the delivery of the unit. If this holding charge is lost on arrival, the system will not be accepted.

iii) The unit shall consist of factory assembled, charged, wired, insulated and tested system using an environmentally friendly refrigerant.

iv) The capacity control of the heat pump shall be based on the leaving hot water temperature sensing in order to maintain constant leaving water temperature.

v) A water flow switch shall be installed in the water piping line to prevent the unit from starting when water is not circulation through the evaporator.

1.3. CONDENSERS

1.3.1. Air-Cooled

i) Air-cooled condensers shall have tube-and-fin or micro-channel configuration, approved by the Engineer.

For tube-and-fin design, the condenser shall have copper tubes with:

- Aluminium fin coated with corrosion protection coating;
- Electro-tinned copper fins;
- Type of fin as otherwise indicated in the Detailed Technical Specification.

Corrosion protection coating of the condenser fins shall be applied in factory by the condenser manufacturer. Fins with minor damage shall be combed straight. Units with extensive damage to fins will not be accepted. Provision shall be made for the purging of non-condensable from the condenser.

For micro-channel design, the condenser shall have overall aluminium structure in construction with corrosion protection coating which shall be applied in factory by the condenser manufacturer.

ii) Air-cooled condensers mounted outside buildings shall have weather-proof fan motors. The units shall discharge air vertically upwards. If specified to discharge horizontally, they shall be protected by an integral wind deflector or purpose-made baffle. The structure and casing of units shall be constructed of material which is either corrosion resistant or treated against corrosion after manufacture in the factory.

iii) Automatic control of the condensing pressure shall be incorporated. Modulation of air flow shall be by staging of condenser fans or by variable speed devices and the fan motor shall be selected for this application and de-energised when necessary.

iv) Fans shall comply with limitations on permitted noise levels where indicated in the relevant Technical Specification. Fans shall have sufficient static pressure to cater for the additional acoustic treatment such as silencer, if any, in order to meet the noise requirements.

v) The complete condenser coil shall be pressure tested at the manufacturer's work.

vi) Units shall be installed on vibration isolation devices. The Mechanical Contractor shall, according to the manufacturer's recommendation, advise the requirements on strength of the roof curb structure for supporting the unit. Selection of the vibration isolators shall be submitted to the Engineer for approval prior to execution of work.

vii) The unit shall be installed so that air can circulate through the condenser coils without any hindrance, and the air discharged from the condenser fans is not recycled. If the unit has to be placed near a wall or an obstacle that may prevent satisfying air circulation, sufficient distance as recommended by the manufacturer shall be maintained between the unit and the obstacle.

1.4. EVAPORATORS

1.4.1. Air Cooling

i) Air-coolers using direct expansion of primary refrigerant shall be provided with refrigerant distributors. Connections to the tubes shall be designed to ensure equal flow of refrigerant to each tube.

ii) The flow of refrigerant to a multiple circuit with dry expansion evaporator shall be controlled by an externally equalised thermostatic or electronic expansion valve which shall not "hunt" at any step of compressor unloading.

iii) The design of the refrigerant passages in direct expansion type evaporation shall ensure that the return (or suction) connections are arranged such that any oil present is always carried back to the compressor even at the lowest stage of capacity reduction.

1.5. PUMP DOWN OF SYSTEM

The control system for reciprocating compressors in DX systems shall be so arranged that, on the compressor stop circuit being actuated, the compressor will automatically pump down the system before it stops running.

Pump down shall not be required where the compressor is stopped by a safety cut-out when its driving power will be immediately terminated; or on fully manually operated systems.

1.6. REFRIGERANT PIPEWORK AND FITTINGS

Pipework for refrigerant systems shall be of copper or steel, which shall be internally degreased and cleaned.

Refrigerant piping shall be sized to avoid excessive pressure drop of the fluids or gases they carry. The recommendations of SANS, the CIBSE and/or ASHRAE /or other reputable/factory standards approved by the Engineer on the sizing of refrigerant piping shall be complied with.

Joints in copper pipe shall be flanged, flared (up to 20 mm OD only), or brazed with or without capillary fittings.

Joints in steel pipe shall be flanged or welded. Mitre or segmented bends will not be accepted.

Screwed joints will not be accepted in refrigerant pipes except on the equipment accessories. In such cases, the thread shall either be of taper form and used in conjunction with PTFE tape or an anaerobic sealant, or of parallel form associated with machined joint faces and a suitable joint.

Plastic pipe with compression fittings will be accepted for feed piping to control cabinet door mounted pressure gauges and similar fittings. The grades of pipe used shall withstand the test pressure applied and the effects of refrigerant and oil. Plastic pipe will not be accepted for any other refrigerant pipework.

Compression fittings will not be accepted on refrigerant pipework.

Refrigerant pipework shall not be arranged for running compressors in parallel (i.e. with common suction and/or discharge pipes). The use of multi-compressors each having an independent refrigerant circuit in a common evaporator will be permitted provided pressure tests between adjacent refrigerant circuits in the evaporator are carried out during manufacturing.

The pipework shall be so designed that oil in the refrigerant leaving the compressor (and passing any oil separator fitted) shall be carried through the system and back to the compressor at the lowest stage of capacity unloading.

Pipework shall be firmly supported and secured to minimise vibration. Vibration eliminators shall be fitted to the compressor suction and discharge pipes to minimise transmission of vibration or noise. Where indicated, a gas pulsation damper shall be fitted at the refrigerant discharge pipe, in the plant room, as close as possible to the refrigeration compressor.

All parts and components containing refrigerant shall be clean and dry before they are connected to the system. No mill scale shall be permitted in pipes and all pipes shall be capped on Site until welded in. Prior to charging refrigerant to the refrigeration system, field pressure tests shall be carried out. Any leak found shall be repaired before the system can be considered tight.

Hangers, clips and other hanging or clamping studs shall be galvanised and they shall not be welded to tubes and pressure vessels containing refrigerant. Pipework and other parts shall be erected and clamped so that vibration and noise are kept to minimum.

Both insulated and uninsulated components, pipes and vessels shall be cleaned and painted with anti-corrosion primer. Finished coatings shall be applied to uninsulated metals. Insulated vessels shall be supported on high density insulation material at the support cradles.

The air-conditioning installation works in connection with the handling (including installing, commissioning and testing) of hydrofluorocarbon (HFC) and blend type refrigerants shall be undertaken by a minimum percentage of workers who shall have a valid certificate of completing satisfactorily the relevant refrigerant handling training courses organised by the recognised association as specified in the contract. Upon request, details and particulars of these workers shall be submitted to the Engineer for approval.

1.7. REFRIGERATION PLANT ACCESSORIES AND CONTROLS

i) Every refrigeration system shall be protected by a pressure relief device unless it is so constructed that pressure due to fire conditions would be safely relieved. The equipment provided shall comply with ANSI/ASHRAE -15-2013 (Packaged with ANSI/ASHRAE 34-2013 or BS EN 378-2:2008+A2:2012 as appropriate and the outlet piped to discharge outside the building.

ii) Systems using a thermostatic expansion valve shall have the following items preceding it in the refrigerant liquid pipe: A solenoid valve, a sight glass, a refrigerant drier (replaceable), a refrigerant strainer and a capped refrigerant charging valve.

iii) An evaporator pressure regulating valve where fitted shall be protected by a strainer, and an evaporator pressure gauge shall be provided, up-stream of the valve, fitted with means of isolation.

iv) Units having a DX evaporator at a higher level than the compressor shall operate on a pump down cycle. On water chilling installation, the chilled water pump shall be kept running during this process.

v) Refrigerant stop valves which incorporate a spindle gland shall be of the back seat type. The spindle gland shall be serviceable with the valve "in-situ".

vi) A flow switch shall be provided in the chilled water pipeline to each shell and tube evaporator to prevent the compressor starting or continuing to run if the water flow is below the minimum stipulated by the evaporator manufacturer.

vii) A low temperature thermostat with manual reset shall be provided for each shell and tube evaporator to stop the compressor(s) if the chilled water flow temperature falls below +3 °C. For other settings as recommended by the manufacturer shall be submitted for approval.

viii) Full flow driers with strainers shall be supplied for all refrigerant liquid lines and shall be completed with isolating valves and bypass arrangements. Driers shall be of the renewable cartridge type.

A suitable sight glass shall be provided, either built-in to the drier, or as a separate component installed adjacent to the drier to show through a suitable glass eye whether the moisture content of the refrigerant is within permissible limits.

ix) Strainers shall be provided before all expansion valves, float valves, solenoid valves, etc. Except where the expansion valve is fitted just downstream of a solenoid valve, only one strainer needs to be fitted.

x) Full flow strainers of the cleanable and renewable type shall be fitted at the suction of all compressors. All strainers and driers shall be easily and readily accessible for cleaning or replacement of cartridges.

xi) Full flow oil filters shall be incorporated in all force-feed lubricating system.

xii) Where oil separation equipment is to be provided, it shall be completed with traps, strainers, floats, receivers and gauges. The oil separator shall be a fabricated steel shell with dished steel endplates and ample and accessible cleaning handholes. The oil return control floats shall not be fitted inside the shell. No pipes shall be fitted inside the shell. No pipes shall be connected through the lids of cleaning or access holes. Adequate provision shall be made for purifying and flushing the system.

xiii) Energy meters shall be provided for chilled (or hot) water system for energy audit purposes.

1.8. ELECTRICAL WORK

The Mechanical Contractor shall supply and install suitable power cables, cable trays, galvanised iron supports, starters/motor drives, isolators, control, safety earth bonding and all necessary accessories to connect power from the isolator to each electricity-driven equipment. The Mechanical Contractor shall allow for adequate cable size for power/control/earthing systems and protection devices to meet the current demand, voltage-drop and fault tripping requirements of the equipment offered.

2. AIR CLEANING EQUIPMENT

2.1. GENERAL

To improve indoor air quality and protect air-conditioning equipment, outdoor air and re-circulated indoor air shall be filtered to remove dust, bacteria, pollens, insects, and dirt particles before it enters the air-conditioning system.

Filters shall be of proprietary product and have the specified performance and fire property in accordance with the test methods of one or more of the standards stated hereinafter.

For filters used in corrosion resistant ductwork, the associated housing, holding frames, enclosures and all metal surfaces in contact with the air stream shall be applied with the same coating as the ductwork. Accessories, of which the operation would be affected by the coating, shall be of AISI 316 stainless-steel with the coating omitted.

Unless otherwise stated, the design air velocity at the face of filters shall not exceed 2.5 m/s. Product test reports for the listed efficiency including all details as prescribed in the testing methods of one or more of the standards shall be provided.

Primary and secondary filters shall be secured by means of no less than four (4) holding 304 stainless-steel clips. Secondary and HEPA filter housings shall be fitted with Magnehelic manometers marked with the filter's operating parameters. The clean and change out resistance of the filter shall be clearly marked on the manometer.

Holding frames shall be equipped with fixtures for easy removal of the filter cells without the use of any special tools. For filter cells installed inside AHUs, separate housing is not required. However, the holding frames shall be factory mounted in the AHU casing and installed to provide service from the air side.

2.2. STANDARDS

2.2.1. Performance of Air Filters

The performance of air filters shall comply with the following standards:

- ASHRAE Standard 52.2-2012 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size;
- ISO 14644-1 – Clean-room Classification Standard;
- Underwriters Laboratories UL 586:2009 – High Efficiency, Particulate, Air Filter Units;
- European Standard BS EN-13779:2007 - Particulate Air Filters for General Ventilation;
- European Standard BS EN1822-1:2009 to BS EN 1822-3:2009 and BS EN 1822-4:2009 to BS EN 1822-5:2009 – High Efficiency Air Filters (EPA, HEPA and ULPA);
- SANS 1424:2013 – Filters for use in Air-conditioning and General Ventilation; and
- Any other standards equivalent to the standards above and approved by the Engineer to suit particular project requirements.

2.2.2. Fire Property of Air Filters

The fire property of air filters and its associated accessories shall comply with the following standards as well as the requirements of the Fire Services Department:

- British Standard Institution BS 476-4:1970 – Non-Combustibility Test for Materials;
- British Standard Institution BS 476-6:2009 – Fire tests on building materials and structures;
- Underwriters Laboratories UL 900:2004 – Standard for Air Filter Units, Class 1 or Class 2; and
- European Standard DIN 53438-3:1984.

2.3. PRIMARY FILTERS

2.3.1. Washable Panel Filter

This type of filter shall be constructed of aluminium to withstand washing by water or steam. The filter panel shall be constructed from multiple layers of expanded aluminium mesh or glass, natural or synthetic fibre, with the layers being corrugated or plain and arranged alternately at right angles at one another. Filter media shall be supported on both sides with a rigid and thicker aluminium expanded metal mesh.

Filters shall be 50, 25 or 12.5 mm thick with a rolled or extruded aluminium frame. The frame section shall be ribbed for stiffness and its inner edges treated to prevent sharpness and increase strength. Corners shall be mitred and riveted where it is necessary. Folding handles shall be applied to the short side of all washable filter panels for easy removal and cleaning. The filter support frame shall be suitable for the installation on either side.

It shall have the minimum efficiency reporting value (MERV) by ANSI/ASHRAE Standard 52.2-2012 and initial resistance at 2.5 m/s face velocity as shown in the table below, unless otherwise specified. The filter shall operate to a final resistance of 150, 100 or 75 Pa for 50, 25 or 12.5 mm thick panels respectively.

Thickness [mm]	MERV	Initial Resistance [Pa]
50	> 5	< 50
25	> 4	< 30
12.5	> 3	< 25

Where coated filtration media is specified, each layer of expanded aluminium shall be furnished with a thixotropic flame-resistant filter coating before assembly into a pack. The adhesive shall have a flash point exceeding 180 °C. Performance data for expanded aluminium filter panels oiled with a thixotropic adhesive shall have the minimum efficiency reporting value by ANSI/ASHRAE Standard 52.2-2012 and initial resistance at 2.5 m/s face velocity as shown in the table below, unless otherwise specified. The filter shall operate to a final resistance of 150, 100 or 75 Pa for 50, 25 or 12.5 mm thick panels respectively.

Thickness [mm]	MERV	Initial Resistance [Pa]
50	> 6	< 55
25	> 5	< 35
12.5	> 4	< 30

2.3.2. Disposable Panel Filter

The filter shall be of glass or synthetic fibres media panel type. It shall have the minimum efficiency reporting value not less than 6 by ANSI/ASHRAE Standard 52.2-2012 and initial resistance not exceeding 75 Pa at 2.5 m/s face velocity, unless otherwise specified in the Detailed Technical Specification. The filter shall operate to 250 Pa final resistance.

The glass or synthetic filter media shall be supported between two media retainers inside a reinforced cardboard retaining frame. The media retainers shall be suitably designed and fabricated to provide adequate support, such as combined metal mesh and grilles, throughout its whole working life, the filter element shall be bonded together with a cured resin, with a light adhesive coating, and suitably treated such that the filter media are not affected by air moisture, vermin proof and resistant to fungal growth.

2.3.3. Disposable Pleated Panel Filter

The extended surface pleated filter shall be of similar design for disposal panel filter, but it shall be used when higher air cleaning efficiency and higher air flow rates are required. It shall have the minimum efficiency reporting value not less than 7 by ANSI/ASHRAE Standard 52.2-2012 and initial resistance not exceeding 75 Pa at 2.5 m/s face velocity, unless otherwise specified in the Detailed Technical Specification. The filter shall operate to 250 Pa final resistance. The pleated media shall be bonded to the expanded wire mesh to maintain its high efficiency and constant air flow rate.

2.3.4. Renewable Panel Filter

It shall be used for heavy dust loading conditions when the maintenance cost is the main decision factor. The filter media shall be of glass or synthetic fibre with a thickness of 50 mm unless otherwise specified. The filter media shall be replaceable and held in position in a permanent wire basket, which shall be designed for easy filter element replacement. It shall have the minimum efficiency reporting value not less than 6 by ANSI/ASHRAE Standard 52.2-2012 and initial resistance not exceeding 75 Pa at 2.5 m/s face velocity, unless otherwise specified in the Detailed Technical Specification. The filter shall operate to 250 Pa final resistance.

3. DUCTWORK AND ACCESSORIES

3.1. GENERAL

Ductwork shall be off site pre-fabricated from good quality full sized zinc coated hot dipped galvanised flat steel sheet to BS EN 10346:2015, Grade DX51D+Z, coating type Z275 unless otherwise specified in the Detailed Technical Specification or the Drawings. Any damaged ductwork found shall be replaced.

Unless otherwise specified, duct sizes given on the Drawings are all clear internal dimensions and allowance shall be made for both internal and external insulation on the ducts where applicable.

The development of components for round, oval and rectangular ductwork shall be carried out by a computer software which can produce all development plans from the proposed ductwork layouts including all types of ductwork fittings and accessories. The software shall be able to work out the development plans with utilisation factor not less than 94%.

Automatic or semi-automatic machines shall be employed for the bending, folding and assembly of ductwork from sheet metal components developed. Proper machines are required for the manufacturing of all ductwork accessories including flanges, stiffeners, splitter dampers, etc. in order to enhance quality.

All rectangular ductwork shall have flange joints, of the proprietary type, tested and certified for air leakage and deflection. Sealant and gaskets shall be provided as recommended by the flange manufacturer.

Construction and materials used for ductwork, fittings and accessories shall be inert, non-hygroscopic, vermin- and moisture-proof, asbestos- and CFC-free, and shall not support growth of bacteria or pose a fire hazard.

Bends and branch vanes, dampers, etc. shall be of the same material as used for the ductwork and/or of heavier gauge, securely mounted. Take-offs from the main ducts shall be conical, bell mouth or shoe-type, as square take-offs are not permitted.

Internal roughness and obstructions to air flow (other than dampers, splitter, vanes, etc.) will not be accepted for ductwork constructed from sheet materials. Sharp edges or corners on the outside of ductwork, fittings and supports will not be accepted.

At each point where a duct passes through a roof or external wall, a weather "cravat" or other purpose made arrangement shall ensure a weatherproof fixing. All intake and discharge openings to the building shall be fitted with 10 mm galvanised mesh bird wires and is additional to any grilles/louvers indicated for these locations. All ducting shall be made waterproof and corrosion free if exposed to the weather. Ducts exposed to weather shall not be less than 1 mm material thickness, painted with two coats of bitumastic solution to approved colour.

All ductwork shall be cleaned internally and externally before the system is set into testing, commissioning and operation. Timing of this work shall be set such that minimum inconvenience is caused to the work of other trades. All ventilation, supply and return air ducting shall be pressure tested with a maximum permissible leakage of 5% at a test pressure of twice the working pressure.

3.2. STANDARDS

Ductwork shall comply with the following standards:

- SANS 1238:2005 – Air-conditioning Ductwork, as amended;
- SANS 10173:2003 – The Installation, Testing and Balancing of Air-conditioning Ductwork, as amended;
- Where the SANS standards are silent or unclear on a particular aspect, the SMACNA (Sheet Metal and Air-conditioning Contractors National Association) standard for ducts shall be applicable.

3.3. HANGERS AND SUPPORTS

All ductwork shall be securely supported by hangers, brackets and other appropriate forms of support as detailed in SANS 1238:2005, as amended. All metal mounting and fixing brackets shall be pre-fabricated off-site.

All supports and hangers for air ducts installed shall be rigid galvanised steel rod, angle bar or U-channel construction free from rust and approved by the Engineer. All hangers shall be provided with screwed lengths drop rods with open turn buckles for adjustment of duct level. All fixings shall be provided with washers and lock-nuts and projecting ends

of drop rods shall be cut off and protected with plastic caps. Sheet metal straps are not permitted, nor is pop rivets which can penetrate the vapour seal of the insulation.

All ductwork shall be securely supported so as to prevent vibrations or movements and arranged to allow expansion due to thermal stresses without distortion of the ductwork, rupture of insulation or damage to the supporting structure. Additional ductwork supports shall be positioned close to dampers, diffusers and all similar equipment which are not subjected to distortion, in addition to those hangers and supports generally required. Allowance shall be made in ductwork construction for instrument and controls connections and adequate local stiffening shall be incorporated to provide ridge mountings.

Approval shall be obtained from the Engineer for hangers and support/installation/shop drawing designs before manufacture and installation. Furthermore, approval for the method design and calculation of fixing to the structure shall also be obtained as this may have structural implications.

3.4. FLEXIBLE CONNECTIONS

Flexible joints shall be provided on all in-line fan inlet and outlet connections, at expansion joints in the building and elsewhere on ductwork where indicated. Flexible joints shall be of the same cross-sectional area as the mating fan inlet/outlet or duct section; and have bolted flanges to join the two component sections. The centre lines of flexible joint connections shall be coaxial.

Flexible joints shall consist of, or be externally protected by, material having a fire penetration time of at least 15 minutes when tested in accordance with BS 476-20:1987 and shall comply with BS 476-7:1997, Section 2, Class 1 (surface of very low flame spread).

Under no circumstances shall materials containing asbestos fibres be used. The material used for the flexible connections shall withstand the specified conditions of temperature and air pressure and comply with the standard of air tightness.

Flexible connections to ducting conveying conditioned air shall be externally insulated with 25 mm thick thermal insulation, complete with aluminium foil vapor barrier (FRK). The insulation shall be mechanically secured at maximum intervals of 200 mm to the adjoining ducting by means of spot welded pins with securing washers/heads of diameter not less than 30 mm.

3.5. FLEXIBLE DUCTWORK

Where flexible ductwork is indicated, or required between rigid ductwork and items of equipment, the internal diameter of the flexible duct shall be equal to the external diameter of the rigid duct and equipment spigot. Each section of flexible ductwork shall be kept to a minimum length, with a maximum specified of 1.5 m; and have no more friction loss factors than the equivalent of two 90° bends, unless otherwise approved by the Engineer. The leakage from any section of flexible ductwork shall not exceed 1% of the local design air flow rate at the local maximum static pressure.

The flexible duct shall be installed as straight as possible. In situations where bending is required, the bending radius shall be sufficient to prevent tensioning of the bend and restriction of the throat likely to cause deformation and/or leakage. The radius ratio R/D for bends shall be not less than 2, where R is the centre line radius and D is the diameter of the flexible duct. In no case shall flexible ductwork be used to correct misaligned ducts or to be used between rigids sections of ductwork to change direction.

Flexible ductwork shall be non-combustible and have a liner and a cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre fabric. The fabric shall be impregnated and coated with plastics. It shall be reinforced with a bonded galvanised spring of stainless-steel or other approved wire helix between the liner and the cover. An outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions. Flexible ductwork without a liner may not be used. Alternatively, flexible ductwork shall consist of flexible corrugated metal tubing of stainless-steel, aluminium, tin plated steel or aluminium coated steel. The metal surface(s) may be coated with a plastics material. In no cases shall material containing asbestos fabric be used.

Joints at flexible duct connections shall be made with a sealant which permanently retains adhesion and elasticity throughout the design working temperature range; or shall be made with clips and complete with aluminium tape as

approved by the Engineer. The installation details and method of application of such connections shall be in accordance with the ductwork manufacturer's recommendations and as approved by the Engineer.

3.6. DAMPERS

3.6.1. General

Dampers shall be provided to regulate and balance the air system. Dampers on grilles or diffusers shall be used for fine control only.

All dampers shall be of flanged type with independent housing and control mechanism for connection to ductwork and shall be sufficiently rigid to prevent fluttering and comply with BS EN 1751:2014.

Air volume control dampers shall be of the aerofoil, double skin, opposed blade low leakage type with seals on blade edges and casing jambs, low pressure drop and noise regeneration characteristics. Damper blades in rectangular ductwork shall not exceed 225 mm in width and 1500 mm in length. Blades shall be of hollow section constructed from the same material of the ductwork or of stainless-steel encapsulating an internal double contoured steel longitudinal reinforcing bar, mounted on square section steel spindles. The units shall be of low-leakage design by incorporation of synthetic trailing edge seals and a peripheral gasket which shall be tested according to BS 476-6:1989+A1:2009 and BS 476-7:1997 and shall be approved by the FSD. All manually and automatically operated dampers shall be fitted with position indicators provided externally and the final setting position shall be permanently marked. Manual dampers shall include a device for positioning and locking the damper blades. Damper handles shall be equipped with device for padlocking in the final balanced position.

Each air volume control damper in the ductwork shall be fitted with a non-corrodible label stating the actual air flow in m^3/s when in the fully open position, its overall cross sectional area, and the degree to which the damper has been closed in order to achieve the design or actual air flow.

Unless otherwise indicated, quadrants and operating handles shall be of die-cast aluminium or other material approved by the Engineer with the words "OPEN" and "SHUT" cast on the quadrant. Quadrants shall be securely fixed, and the damper spindles shall be closely fitted in the quadrant hubs to prevent any damper movement when the damper levers are locked.

Access openings with readily removable air sealed covers shall be provided adjacent to all dampers except the volume control dampers of which the adjustment can be made outside the ductwork. Subject to limitations of ductwork size the dimensions of access openings shall not be less than 300 mm x 300 mm and they shall be located within 300 mm of each damper so as to afford easy access for inspection and maintenance.

3.6.2. Butterfly, Bifurcating and Multi-leaf Dampers

Butterfly dampers shall each consist of 2 plates, edge seamed, of at least the same thickness as the material from which the associated ductwork is made, and rigidly fixed to each side of a mild steel operating spindle, the ends of which shall be turned and housed in non-ferrous bearings.

Bifurcating dampers shall be of 2 mm thick sheet for sizes up to 450 mm square, for larger sizes the thickness shall be as specified. The damper blades shall be rigidly fixed to square section mild steel spindles, the ends of which shall be turned and housed in non-ferrous bearings.

Each leaf of a multi leaf damper shall consist of 2 plates of material of the same thickness as the associated ductwork and rigidly fixed to each side of an operation spindle, the ends of which shall be housed in brass, nylon, oil impregnated sintered metal, PTEE impregnated or ball bearings. The ends of the spindles shall be linked so that one movement of the operating handle shall move each leaf for an equal amount. The mechanism shall be located outside the air stream.

For system, static pressure below 1000 Pa or ductwork velocity below 12 m/s, blade of at least 50 mm wide shall be used. For static pressure at or above 1000 Pa, at least 100 mm wide blade shall be used. Central blade reinforcement bar shall be provided for damper span longer than 1500 mm. Single module of a damper shall not exceed 2000 mm width and 1000 mm height.

Alternatively, multi leaf damper blades may be of a single plate, at least 1.6 mm thick and suitably stiffened, and the blade linkages may be within the ductwork.

3.6.3. Self-closing (Non-return) Dampers

Self-closing dampers shall present a minimum resistance to air flow under running conditions and take up a stable position in operation. Maximum resistance shall be presented under reverse air flow conditions such that they will be forced to close and remain so. Resilient strips or other purpose made devices shall be provided to prevent the damper from rattling and as an aid to air sealing under reverse flow conditions.

Blades shall be rigidly constructed of steel or aluminium sheet of not less than 0.8 mm (22 gauge) and shall be free of all buckles. Blades of less than 300 mm in height shall be fitted with a 3 mm (10 gauge) bright steel spindle at each end. Blades of 300 mm and over in height shall be fitted with an 8 mm bright steel spindle at each end. Spindles shall be carried by sealed ball bearings. Bearing shall be accessible for cleaning and lubrication and shall be mounted in a rigid galvanised steel frame. The maximum length of each blade without a central bearing shall be 1000 mm.

3.6.4. Fire Dampers

Fire or smoke dampers shall be provided wherever a ductwork passes through a floor slab or a fire resisting wall which is expressly built for the purpose of preventing the spread of fire; or other locations are required by the Engineer or Fire Services Department.

Fire or smoke dampers used singly or in combination shall have an overall fire resistance rating not less than that indicated and certainly not less than that for the wall or floor slab in which they are situated. The damper blades shall be constructed to the approved and recognised testing authority and possess a rating equivalent to the fire resistance of the structure it protects. These blades shall be housed in a corrosion resistant casing constructed to avoid distortion due to stress in fire conditions.

A stainless-steel spring tempered flexible gasket shall be inserted between the blade and the casing for elimination of closing friction and retardation of smoke. Provision shall be made to accommodate expansion of the damper blades within the casing in fire conditions to prevent jamming and to retard the spread of smoke. A fire or smoke damper installation frame supplied by the same manufacturer shall also incorporate provision for expansion within the surrounding structure together with masking flange for building into the structure.

Each fire or smoke damper casing shall be air-tight, continuously welded and clearly marked with a permanent indication of the direction of air flow and the side at which the access/maintenance opening is located.

The folded continuous interlocked blade type of damper may be used for vertical or horizontal ductwork applications. The closing force for these types of dampers shall be provided by stainless-steel springs. An automatic locking device shall be provided to ensure that the blades are held in the closed position after release.

Spring actuated pivoted single-bladed or multi-bladed dampers may be used for vertical or horizontal ductwork applications. Multi-bladed dampers shall be provided with a means to ensure that all the blades close simultaneously. Gravity operated multi-bladed fire dampers shall not be used in vertical ductwork. Gravity operated single bladed dampers may be used for horizontal ductwork provided means are incorporated which ensure reliable and positive closure when operating in maximum air flow rate conditions.

Each fire or smoke damper shall be held in the open position by a corrosion resistant retaining device incorporating a fusible element which shall operate at a temperature of 69 °C, unless otherwise indicated.

3.6.5. Motorised Shut-off Dampers

Motorised shut-off dampers shall be similar to fire/smoke dampers and shall be opened or closed by the motorised mechanism. Each of the dampers shall be in "open" position normally; but shall be closed when there is a fire, or the AHU is shut off. The motorised mechanism shall be actuated by associated automatic fire control.

3.6.6. Terminal Dampers

Grilles and air diffusers with rectangular neck connections shall be provided with an opposed blade damper (OBD), screwed or riveted to the neck connection and designed specially to facilitate final balancing of the system.

Damper frames, blades and operating mechanism shall be constructed from an aluminium alloy or, alternatively, formed mild steel suitably finished to give protection to the material during the design working life.

Blades shall be made of solid section material and shall be firmly held in position by a spring steel retaining mechanism. The blade setting mechanism shall be accessible through the grille or diffuser blades and shall be suitable for operation with an "Allen" key. Where dampers are visible through the grille or diffuser they shall be finished with a matt black paint.

3.7. GRILLES AND DIFFUSERS

3.7.1. General

The grilles and diffusers shall be rated in accordance with ANSI/ASHRAE standard 70-2006 and Air Diffusion Council Test Code 1062R4.

All grilles and diffusers shall have a concealed fixing system and shall have a quick release frame to facilitate cleaning. All supply grilles and diffusers shall be mounted on substantial frame and shall be provided with soft rubber or felt joining ring inserted under the frame to prevent air leakage and the formation of condensate on the fitting. Ceiling diffusers and grilles shall be fixed to spigots extending not less than 100 mm from the ducting and shall be securely fixed so that no screws or other fixing devices are visible.

All grilles and diffusers shall not be less than the size indicated; where no size is given they shall be capable of handling the air flows and distribution indicated without producing unacceptable air flow noise. The Mechanical Contractor shall select the supply air grilles and diffusers to achieve good air distribution and adequate air movement in the conditioned space.

In order for the ceiling grilles and diffusers to match with the false ceiling layout pattern, the actual size of the grilles and diffusers shall be confirmed by the Engineer before ordering. For all grilles and diffusers smaller than the ceiling tile on which they are installed, they shall be located in the centre of the ceiling tile. The exact location of the ceiling grilles and diffusers shall be co-ordinated with other services. The Mechanical Contractor shall confirm the exact location with the Engineer before works commence. Where grilles and diffusers are to be incorporated into false ceilings, before any grilles or diffusers are installed into ductwork or fan coils, the Mechanical Contractor shall ensure that the Main Contractor marks out the ceiling line on the adjacent plastered walls/columns and indicates where ceiling tee bars line up or the joints occur so such datum can be worked to.

The finishing colour of the grilles and diffusers shall be approved by the Architect as different colour may be specified in different areas. The Mechanical Contractor shall co-ordinate with the Main Contractor and other specialist contractors especially the ceiling and electrical contractor for the integration of the air diffuser into the ceiling and luminaire.

3.7.2. Grilles

Grilles shall be of steel, aluminium, PVC or as otherwise indicated. Steel grilles shall be protected against rusting and supplied in fully finished stove-enamelled or otherwise specified condition.

Each supply air grille shall have 2 sets of separately adjustable louvres, 1 set horizontal and 1 set vertical, and shall be completed with an opposed blade multi-leaf damper. Alternatively, in lieu of the opposed blade multi-leaf damper a rhomboidal air controller may be provided; this air controller shall control both the volume of air passing and the distribution of air across the grille face. The louvre and the damper or air controller shall be adjustable from the front of the grille. For up to 10 grilles, 1 set of tools required for adjusting the louvre and dampers or air controllers shall be provided. From 11 to 24 grilles, 2 sets and above 25 grilles, 3 sets of tools shall be provided.

Return air grilles shall have either a single set of louvre or bars (either vertical or horizontal) or a lattice, egg crate or expanded metal front. Each return air grille shall be completed with an opposed blade multi-leaf damper or a rhomboidal air controller operable from the front. Where return air grilles are fitted for fan coil units, they shall be arranged such that the central core of the grille is hinged and demountable for access to the filter for cleaning. Mounting frames for these grilles shall include provision for fixing the filter in position.

Door grilles shall be of extruded aluminium construction selected for fitting into doors of varying thickness; and shall be finished in a colour to suit the Architect requirements. Door grilles shall be fixed to doors by means of countersunk screws with a colour to match the door grille.

3.7.3. Diffusers

Diffusers shall be of steel or aluminium. Steel diffusers shall be protected against rusting and shall be stove enamelled for finished colour approved by the Architect. Diffusers shall incorporate an edge seal; diffusers mounted on ceilings shall have anti-smudge rings. Pan type diffusers shall be provided except where cone type diffusers are indicated.

Diffusers shall be provided with volume control dampers of the iris, flap or sleeve type which shall be adjustable from the front of the diffuser. Where the length of a vertical duct to a diffuser is less than twice the diameter of the diffuser an equalising deflector shall be fitted. The design of the supply air diffuser shall be capable to induce adequate air movement and provide the throw to cover the entire air-conditioning space without causing air turbulence and cold draft.

Linear diffusers shall be constructed of extruded aluminium section and include a control damper at the rear of the vanes giving volume control down to complete shutoff and operated from the face of the diffuser. Linear diffusers for supply air shall have adjustable blades to give directional control of air flow. The linear diffuser shall be capable of maintaining a horizontal discharge pattern at a turn down ratio down to 20% of the maximum specified air volume without air dumping. The linear diffuser shall be completed with factory fabricated plenum with suitable inlet connection for flexible ductwork. The plenum and diffuser neck shall be constructed of galvanised steel sheets internally lined with 25 mm 48 kg/m^3 glass cloth faced fibreglass insulation enclosed in galvanised perforated metal liner. Where linear diffusers are mounted in a continuous line there shall be means of ensuring alignment between consecutive diffusers and of equalising pressure behind the vanes. The dummy portion of the diffuser shall be internally covered by a demountable galvanised metal enclosure to block the view into the ceiling void from below. The linear slot diffuser shall be constructed of extruded anodised aluminium, with multiple slots for the required air flow rate. Each diffuser shall be completed with a factory fabricated plenum of the same construction as the linear diffuser.

The square face diffuser for VAV system shall be constructed of aluminium and with large turn down ratio. Each ceiling mounted square face diffuser shall have a factory assembled diffuser and an air plenum. The air plenum shall be provided with dividing plates such that the diffuser back is divided into an annulus area and a square central area. In the entry to the diffuser plenum, the flow cross section shall also be divided into two parts, one part serving as a bypass and the other equipped with a self-contained, weight balance damper. The damper shall be balanced with a weight in such a way that the horizontal outlet jet velocity remains nearly constant over a flow rate range of 100 to 20% of maximum in order to prevent stagnant area, wide temperature gradient and drop of air jet in the conditioned area.

For VAV diffusers, the self-contained controls shall be modular, enabling simple and economical change-over from slave to master and vice versa. The master shall be controlled via the BMS. The controls shall include an automatic reversing function to fully open the diffuser when the AHU is in heating mode.

3.8. TEST HOLES

Test holes shall be provided wherever necessary for effective balancing and testing, whether these provisions are shown in the Drawings or not. Test holes shall be of 25 mm diameter and fitted with an effective removable sealed cap made of plastic plugs or die cast metal cupped blanking plates. Test points shall be provided for all dampers and items of equipment to enable fan duties and items to be assessed and for the commissioning of the system.

Test holes shall be positioned at points with stable air flow and not affected by upstream and downstream fittings or obstructions. Test holes shall be located at the inlet and discharge of all fans and air handling units to measure static pressure, before and after air heaters and cooling coils, filters to measure temperature and pressure differentials and other points required for regulating and commissioning of the air distribution system.

3.9. ACCESS DOORS

Access doors shall be provided where indicated or required for inspection, maintenance, and replacement of all instruments, controls and other equipment, and should thus be sized appropriately – with a minimum size of a 300-500mm square. Access doors shall be provided at all dampers, filter banks, and at the inlet and outlet sides of axial type fans. Access doors shall be constructed in accordance with SMACNA standards and shall be installed in a reinforced frame, suitable insulated and effectively vapour sealed when closed. Where access doors are intended for main access, the locking mechanism shall be capable of operation from both sides.

4. AIR HANDLING

4.1. AIR HANDLING UNITS

4.1.1. General

Each type of Air Handling Unit (AHU) offered shall be the product of a manufacturer who has made similar product for a period of at least five years. Individual components forming part of the AHU shall, in addition to this section, comply with the appropriate sections contained elsewhere in this Standard Specification.

AHUs shall comply with the manufacturer's own ISO 9001:2008 quality assurance standard in respect of design and manufacturing and be "type" tested to the following minimum requirements:

- Air leakage test to HVAC Standard DW/144:2013 Class B or BS EN 1886:2007 Class L2;
- Thickness of casing according to the construction clause below;
- Conductivity of thermal insulation not greater than 0.02 W/m °C rating at the operating temperature; and
- Insertion loss through panels at 125 Hz and 250 Hz of 20 dB and 20 dB reduction respectively.

The Mechanical Contractor shall submit technical information of each unit together with the above "type" test certificates for the Engineer's approval.

Air handling units shall be mounted on a hot dipped galvanised I beam or U-channel mounting frame which is either fixed on concrete plinths by builder or ceiling mounted by suspension galvanized steel hangers. Sufficient space shall be allowed for installation of drain trap and fall of condensate drain. Neoprene pad shall be installed continuously between the air handling unit mounting frame and concrete plinth as vibration absorption media.

For ceiling mounted AHUs, the mounting frame and hanging rods shall be designed to account for the operation loading of the AHU and the associated ducting and piping. Hanging rods shall be threaded and completed with locking nuts for level adjustment. All AHU steel supports shall be hot dipped galvanised.

The routing of piping, ducting, electrical, control wiring and accessories shall be so arranged that all access panels of the air handling unit shall be free from obstruction.

Modules heavier than 50 kg shall be provided with eyebolts or other purpose made lifting facilities nearby.

All gauges and meters other than insertion type shall not be mounted on the casing of the AHU on site to avoid breaking the thermal insulation. All provisions required for connection must be purposely installed in the factory.

4.1.2. Construction

AHU assemblies shall be of rigid double skin fully modular construction with each section having similar cross-sectional dimensions and of the same construction type. All individual components and sections shall be assembled using proprietary and approved fastening techniques. Locking devices shall be used with all fastenings which are subject to vibration.

Each module shall be supported by rigid galvanised steel post frame or extruded aluminium alloy framework or other composite material frame as specified with thermal break design and flush mounted with dismountable sandwich panel, corrosion resistant treated and strengthened where necessary to prevent minimum deflection and drumming even at 2500 Pa differential pressure. The post frame and corner pieces shall be fixed together to provide strength equal to welding. The removal of the side panel shall not affect the structural integrity of the unit.

The construction of the unit shall be such that the inner surface of the unit is thermally broken from the outside surface without any cold bridge formed. The frame member and corner piece shall be filled with injected foam insulation or other approved insulation.

The double skin or sandwich panel shall be no less than 50 mm thick with injected expanded polyurethane foam insulation or other approved insulation encapsulated by epoxy or approved coated finishing solid sheet steel. Non-hydroscopic sealing shall be provided between the panel and the framework. The width of the frame member and corner piece shall be the same as the thickness of the panel.

The whole construction shall be hygienically designed, and the internal surface shall be smooth to avoid any framework protrusion inside the casing.

Casing material shall not be less than the thickness as indicated below, unless otherwise specified.

Component	Minimum Material Thickness
Casing framework	2.0 mm
Cooling coil casing	1.6 mm
Panel for polyurethane insulation (each face)	0.8 mm
Other	1.2 mm

For sections with UV equipment installed, the casing material of the internal surface shall be aluminium alloy, stainless steel 304 or better.

4.1.3. Fan

All fans shall be backward curved centrifugal fans, double inlet, double width; or single inlet, single width unless an alternative requirement is specified in the particular specification and/or equipment schedule. All fans shall be mounted together with their motors on a galvanised steel base frame isolated from the main casing by means of 98% efficient spring vibration isolators. The vibration isolators shall have a minimum deflection of 25 mm.

The fan discharge shall be isolated from the casing by a flexible connection. Fans shall be direct driven or driven by at least a two-belt arrangement for motors rated higher than 4 kW. Selection of fans and motors shall be at their peak operating efficiency. Fan motors shall be supplied and installed by the AHU manufacturer unless otherwise specified.

All fans should be constructed to a fully developed design and shall be capable of withstanding the pressures and stresses developed during continuous operation at the selected duty. Additionally, all belt driven fans shall be capable of running continuously at the range of 10% to 15% in excess of the required duty speed.

Fans shall be selected to give the air volume flow rates and sound power levels specified in the Contract. Fan performance curves giving values of sound power levels and fan efficiency at the selected duty shall be submitted to the Engineer for approval. Values of resistance to airflow of items of equipment, ductwork and/or the total distribution system indicated in the Contract are based on basic design assumptions, the Mechanical Contractor shall verify these values based on the actual equipment offered and installed and to provide fans capable of delivering the required air volume when operating against the actual total installed system resistance.

4.1.4. Access Doors

The access doors shall be no less than 400 mm wide and vertically sized for the full height of the unit or no less than 400 mm wide by no less than 1550 mm high where the unit height exceeds 1900 mm. Quick access doors shall be provided for filter section, coil section, transfer section, humidifying section, damper section, etc. Heavy duty double hinges and two quick release fasteners shall be provided for all quick access doors.

Where return or fresh air ductwork connects to air handling units, access to the filters shall be through side access panels at the filter chambers.

4.1.5. Access Sections

Access sections shall be provided between heating and cooling coils to allow air blasting or steam blasting of coils for cleaning and/or sterilising purposes. Adequate access must be provided both upstream and downstream of coils to facilitate cleaning and sterilising.

4.1.6. Anti-Corrosion Treatment

For outdoor or other specified applications, all metal surfaces must be properly treated and suitably painted. Galvanised sheet metal finish is not acceptable. All external metallic surfaces of the units shall be painted with two coats of undercoat, and two coats of anti-corrosion epoxy based paint with each layer dry film thickness of 150 microns; or other approved finishing applied in the factory. Field painting after the installation is not accepted. Finishing coating shall be non-toxic. For indoor applications, all metal surfaces shall be suitably painted with anti-corrosion paint.

4.1.7. Thermal and Acoustic Insulation

The unit shall be cold bridge free without sweating as per the specified Thermal Bridging Factor TB2 Class BS EN1886:2007, being expanded polyurethane foam or other approved material. The insulation shall provide a high degree of noise attenuation. Thermal insulation shall be securely fixed to or built into all sections of plant and equipment handling heated or cooled air.

Special surface protection shall be provided as specified to avoid damage in sections having walk-in access. Adequate lighting completed with door operated switch equipped at the factory shall be provided for AHUs with handling capacity greater than 5 m^3/s.

4.1.8. Air Filters

The filter section shall be provided by the air handling unit manufacturer or specialist manufacturer of filter holding frame approved by the Engineer. The construction of filter section shall comply with the requirements of the "*Air Cleaning Equipment*" clause of this Standard Specification and shall ensure that there will not be bypass of un-filtered air. The filter section consisting of the filter elements and the filter fixing frames must have a positive means of sealing off the unfiltered air by-passing the filter elements.

Each individual filter section in the AHU shall be completed with a dedicated pair of copper tuber pressure tapings, adequately sealed for filed connection of differential pressure sensor. Each individual filter section shall also be connected to a dedicated manometer mounted on outside for local indication.

The filter section shall not be located closer than 500 mm to any electric heaters or water heating battery.

4.1.9. Identification Plate

All AHU shall bear the manufacturer's nameplate giving the manufacturer's name, serial and model number, and date of manufacturing; and an identification plate showing the AHU equipment number and essential performance data as indicated on the Equipment Schedule.

4.1.10. Air Cooling Coils

Cooling coils shall be mounted on non-corrosive aluminium or stainless-steel slide rails. Coil sections shall be arranged to provide removal of coils from the access side of the section. Cooling coil casing shall be equipped with flanged ends drilled and corrosion treated to receive counter flanges on connecting ductwork or equipment.

Cooling coils shall utilise the full unit available cross sectional area. Cooling coils shall be constructed from one of the following combinations:

- Copper tubes expanded into aluminium fins;
- Copper tubes expanded into copper fins;
- Copper tubes expanded into tinned copper fins; and
- Copper tubes expanded into epoxy coated aluminium fins.

Tube thickness shall not be less than 0.4 mm. Fin thickness shall not be less than 0.13 mm with suitable fin spacing. The resistance to airflow through a coil section shall not exceed 125 Pa considering the wet air condition. The face velocity of airflow shall not exceed 2.5 m/s.

Access doors with air seals shall be provided on both the upstream and downstream of the cooling coils.

Cooling coils shall be factory tested and certified to at least one and a half times the working pressure. All coil capacities, pressure drops, and selection procedures shall be rated in accordance with AHRI 410:2001.

The same methodology shall be applied for air heating coils.

4.1.11. Drain Pan

Drain pans shall be made of insulated 1.2 mm thick AISI 304 stainless steel. Water shall not be carried over from a cooling coil into the remainder of the system and an eliminator section shall be provided, wherever necessary or indicated. The eliminator shall be readily removable for cleaning.

The drain pan serving the cooling coil shall be extended or a separate tray be provided to collect water from the eliminator. Drain pan shall be sloped towards a bottom drain connection and pipework shall be installed from each connection to the nearest sump or gully. The drain pan shall be accessible for cleaning and disinfecting without the coil having to be removed.

The drain pipework shall include a water trap of minimum 50 mm deep depends on the maximum fan pressure at the rated speed to prevent entry or exit of air to or from the system. On stacked coil, intermediate drain troughs shall be provided. All drain pans shall be adequately insulated with durable, non-smell and non-peeling under cooling/heating and air flow design conditions. Sealing devices shall be provided at tops and bottoms of coils to minimise air by-pass and water carry-over.

4.1.12. Chilled Water Connections to Cooling Coils

The flow and return connections and headers shall be made of heavy gauge seamless flanged copper tube or steel tube with external coating. Provision shall be made for thermal expansion of the tubes, for effective venting of the coils and their connections and for the draining of the headers and tubes.

Coil connections shall be arranged so as to enable same side connections to the flow and return pipework, and to have the supply and return connections to headers to give counter flow of air and water. Equal flow of water shall be through all the tubes in the coils.

Up to and including 50 mm bore connections may be made using ground-in spherical seated unions. Pipework of 65 mm bore and above shall be connected using flanged joints. Isolating valves shall be provided on flow and return connections and arranged so as to facilitate easy removal of the coils.

For the connection between the coil header and the external G.I. or black steel pipe work, suitable fitting/device or methodology approved by the Engineer to prevent galvanic corrosion effect of different pipe materials jointing together shall be provided.

4.1.13. Electric Type Air Heaters

Electric air heaters shall consist of a number of sheathed heating elements of the enclosed type mounted in a sheet steel casing. The elements shall be so installed that they can be removed for cleaning or renewal without dismantling ductwork. The surface temperature of the elements shall not exceed 400 °C when measured in an air flow of 2.5 m/s at ambient temperature. A high temperature limit cut-out device with hand reset button shall be incorporated such that the limit device sensor is nearest to and above the heating elements which are energised by the first control step. The device shall operate within two minutes at a temperature of 68.5 °C.

The control of electric air heaters, except for remote boosters, shall be interlocked with the fan motor starters and an air flow control of the pressure or sail switch type so that the heaters cannot operate unless the fan is running.

Electric air heaters which are installed as boosters in branch ducts remote from the fans shall have an air flow control of the pressure or sail switch type which shall isolate the heating elements from the electricity supply in the event of the failure of air flow.

The number of elements in the heater shall be the same as or a multiple of the number of steps in the controller; or using modulating power controller alternatively. All heaters and heater sections of more than 3 kW loading shall be balanced over 3-phases and the complete heater bank shall be arranged for balanced operation on a 3-phase 4-wire system.

The connections from each element shall be taken to a readily accessible terminal box arranged for conduit entry. Each heater section shall be separately fused and the neutral point of all 3-phase star-connected sections shall be brought out to a link in the terminal box. Near hot areas the wiring insulation shall be of a quality suitable for the maximum working temperature.

The total resistance of the heaters to airflow shall not exceed 15 Pa and the face velocity shall not exceed 6 m/s.

Note for energy efficiency design: Heating by hot water from waste heat reclaim or from heat pump system aiming for high operating efficiency should be considered.

4.2. FAN COIL UNITS

4.2.1. General

Fan coil units shall comply with the manufacturer's own ISO 9001:2008 quality standard in respect of design and manufacturing and be type-tested to BS 4856-2:1975 or other acceptable standards, such as ANSI/AHRI, Euro vent, GB/T, etc., for thermal volumetric and acoustic performance.

Fans, filters, cooling coils, heating coils, motors, thermal and acoustic insulation shall comply with the appropriate sections of this Standard Specification and the following requirements:

- Fans shall be of the Double Inlet Double Width (DIDW) forward curved centrifugal or tangential flow types and shall be of galvanised/mild steel, aluminium, reinforced glass fibres or rigid plastic material as specified in the Detailed Technical Specification;
- Motors shall be quiet running and have sleeve or ball bearings factory lubricated for life. Motor windings and electrical components shall be impregnated or protected to avoid trouble from condensation;
- The fan motor shall be of the single phase permanent split capacitor type provided with three speed tapped windings, or brushless direct current (BLDC) type provided with low noise pulse width modulation for variable speed control as specified in the Detailed Technical Specification;
- The BLDC type fan motor shall comply with the following requirements:
    - Motor shall consist of hall magnetic pole sensing elements and be controlled by pulse width modulation (PWM) of modulating speed with minimum speed setting;
    - Motor shall be totally enclosed in an aluminium alloy casing, complete with 8-pole (or above) coil, permanent magnet rotor and permanently lubricated ball bearing;
    - Motor shall be insulated with class B (or above) with built-in thermal cut-out protection;
    - Motor converter and driver shall be enclosed and complete with overload, start and stall protection;
    - Motor shall be capable to deliver over a speed range of 30-100% continuously and smoothly; and
    - Power factor and total harmonic distortion shall have performance not less than permanent split capacitor type.
- All fan coil units' capacity and air flow rate shall be selected based on the performance of the units at medium fan speed.

4.2.2. Casings

Casings shall be of galvanised iron sheet metal with thickness not less than 1.0 mm suitably stiffened to minimise drumming and vibration and shall be protected against corrosion and, for those exposed to view, finished on outside with stove primer. All corners shall be rounded off without sharp edges. Casings shall be lined with material to act as both thermal and acoustic insulation. Casings shall include space for pipework connections and valves, and there shall be ready access to the fan and motor, filter, damper, drain pan, pipework connections and valves, for maintenance purposes.

The motor and fan shall be mounted on a detachable mounting chassis that can be removed from the fan coil enclosure as one assembly (with extended cables) to facilitate fan and motor cleaning. It shall then also be possible to remove the fan impeller scroll casing in order to properly clean the fan blades. Fan and motor assemblies shall be completed with neoprene rubber anti-vibration mountings.

4.2.3. Coils

Cooling coils shall be a minimum of two-rows constructed with copper tubes and shall be arranged horizontally and shall include an air vent cock and drain valve.

The chilled water cooling coil shall be rated in accordance with AHRI 410:2001 and constructed from seamless copper tubes mechanically bonded to aluminium fins. Tubes shall have brazed copper return bends. Fins shall have smooth drawn collars of length equal to fin spacing and mechanically bonded to tubes. Fins shall be of the plate type, corrugated to ensure maximum air contact.

Each coil shall be provided with motorised 2-way solenoid control valve and isolation valves. Flexible pipe connectors completed with union joints to facilitate removal of the entire unit shall be provided. The connector shall be copper or

stainless steel braided polymer tubing limited to 300 mm long and suitable for the system pressure. Working pressure of coil shall be of a minimum of 1200 kPa and to suit system pressure design.

All units shall include an easily removable filter capable of treating the total air volume. Filters shall, unless otherwise specified, be washable. It shall be supported in a stiff aluminium/stainless steel detachable frame.

Drain pans shall be made of one piece stamped high grade AISI 316 stainless-steel sheet with no weld and protected against corrosion with a minimum of 10 mm thick flexible closed cell elastomeric insulation. Drain pans shall be large and deep enough to collect all condensate from the coil, return bends and pipework connections. The pan shall be removable and have a slight fall to the drain connection, which shall have a copper male connector. For units whose loads include a high proportion of latent cooling the fall to the drain point and the size of the drain connection shall be adequate to deal with the condensed moisture.

A built-in condensate pump shall be provided for the removal of condensate. A water sensing system with low, high and warning limits shall be provided which actuates the running of condensate pump at high water limit and trigger the alarm system at warning level. When water level reaches the warning limit, the sensing system shall cut off the unit operation. An alarm signal shall be given locally. Condensate pump shall be designed to run continuously at some essential areas as specified. The power source for condensate pump and the associated control system shall be independent from that of the fan coil unit such that the pump can still be operated after the units have been switched off.

4.2.4. Noise Level

The noise data provided shall include an octave band analysis of the sound power level of each unit when operating at its full or the stated design speed.

4.2.5. Electric Heaters

Electric heaters shall be of maximum 2 kW capacity of the black heat sheathed element type, plain or finned, and shall be provided with a safety cut-out thermostat set to operate at 50 °C.

Sail switch is to be fitted for each heater battery and is to be connected in series with the safety cut-out thermostat to switch off the heater in the event of reduced air flow.

4.3. HAZARDOUS APPLICATIONS

Where fans are required to handle toxic, corrosive, flammable, explosive or high temperature gases, the materials and form of construction shall be selected to suit the particular application. Protectively coated fans shall meet with the appropriate requirements of the previous content relating to fans generally and to particular types of fans; the form of protection shall be as indicated. Where protective coatings are required for use with corrosive gases, the coating shall cover all parts of the complete fan, motor and casing assembly which will be in contact with the corrosive gases. No fan shall be installed if the protective coating has been damaged in any way. Impellers shall be of coated steel, stainless steel, aluminium or fire-proof plastic as indicated.

Where fans are installed in a potentially explosive atmosphere, the EU ATEX 100a directive shall be complied.

All steel mounting brackets, bolts, washers and nuts shall be hot dip galvanised and painted with protective coatings to meet the appropriated corrosive environment.

5. NOISE AND VIBRATION CONTROL

5.1. GENERAL

The Mechanical Contractor shall install sufficient noise and vibration control measures on the plant/equipment, the interconnected piping, ductwork and conduit so when the installed plant/equipment are put into operation, the resulting noise and vibration levels at locations within the building and at adjacent or nearby buildings shall not exceed the acceptable limits. Noise levels must be in accordance with regulations set out in SANS 10103:2008.

Unless otherwise specified in the Detailed Technical Specification, the total noise level in occupied areas within the building, whether it be airborne, structure-borne or ductwork-borne, shall not exceed the following limits when all the plant/equipment installed by the Mechanical Contractor are put into operation:

Broadcasting and recording studios, concert, opera halls	NC 25
Theatres, assembly halls and churches	NC 30
Cinemas	NC 35
Hospital wards and operating theatres	NC 35
Homes, bedrooms	NC 35
Private offices, libraries, courtrooms and schoolrooms	NC 35
General offices	NC 40
Mechanised offices	NC 45
Restaurants, bars, cafeterias and canteens	NC 45
Department stores and shops	NC 45
Swimming baths and sports arenas	NC 50
Kitchens	NC 50
Factories (light engineering)	NC 65
Factories (heavy engineering)	NC 75

The specified noise criteria shall apply based on fundamental principles, such as those in ASHRAE Fundamentals SI Handbook 2013 to all areas as measured at a level of 1.5 m above the floor and the measuring points shall be 1.5 m away from the walls or doors of the rooms.

5.2. EQUIPMENT BASES

Floor mounted equipment shall be installed on 100 mm high concrete housekeeping pads provided by the Main Contractor covering the whole floor area requirements of the equipment bases plus a minimum of 150 mm further on each side or on inverted beams at the roof. Vibration isolators shall be mounted on this concrete pad or inverted beams.

Unless otherwise specified in the Detailed Technical Specification, plant/equipment to be isolated shall either be supported by structural steel bases or concrete inertia bases.

5.2.1. Welded Structural Steel Bases

Bases shall be constructed of adequate "I" or channel hot dipped galvanised steel members reinforced as required to prevent the bases from flexing at start-up and from misalignment of drive and driven units.

All perimeter members shall be of steel sections with a minimum depth equal to 1/10th of the longest dimension of the base but need not exceed 350 mm provided that the deflection and misalignment are kept within acceptable limits as determined by the equipment manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 50 mm.

5.2.2. Concrete Inertia Bases

Concrete inertia bases shall be formed within a structural steel beam or channel frame reinforced as required to prevent flexing, misalignment of the drive and driven units or transferral of stresses into equipment. The base shall be completed with height saving brackets, concrete reinforcement and equipment bolting down provisions.

In general, the thickness of concrete inertia bases shall be of a minimum of 1/12th of the longest dimension of the base but never be less than 150 mm. The base depth needs not exceed 300 mm unless specifically required.

Base forms shall include minimum concrete reinforcement consisting of 13 mm bars or angles welded in place on 150 mm centres running both ways in a layer of 40 mm above the bottom, or additional steel as is required by the structural conditions.

Unless otherwise specified, concrete inertia bases shall weigh from 2 to 3 times the combined weight of the equipment/plant to be installed thereon.

Base forms shall be furnished with drilled steel members and with anchor-bolt sleeves welded below the holes where the anchor bolts fall in concrete locations.

Height saving brackets shall be provided in all mounting locations to maintain a base clearance of 50 mm.

5.3. PLANT / EQUIPMENT VIBRATION ISOLATION

All rotating or reciprocating equipment shall be mounted on vibration isolation mountings or suspended from vibration isolation hangers.

The Mechanical Contractor shall ensure that there is no rigid connection in whatever form between the isolated equipment and the building structure which will otherwise short-circuit the vibration isolation system and degrade its performance. This includes the necessary co-ordination with other trades by the Mechanical Contractor.

All isolators shall operate in the linear portion of their load versus deflection curve. The load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50 % above the design deflection.

All vibration isolators shall have their known undeflected heights or calibration markings so that, after adjustment when carrying their loads, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that correct degree of vibration isolation is being achieved according to the design.

The static deflection of the isolator at each support point shall not differ from the design objective for the equipment as a whole by more than ±10 %.

The ratio of lateral to vertical stiffness for spring shall be not less than 0.9 nor greater than 1.5.

All neoprene mountings shall have hardness of 40 to 65 durometers, after minimum aging of 20 days or corresponding over-aging.

In order to resist corrosion, all vibration isolation mountings and hangers shall be treated as follows:

- Springs to be neoprene coated or hot dip galvanised;
- Wearing hardware to be cadmium plated steel or stainless steel of an appropriate grade; and
- All other metal parts to be hot dip galvanised.

All vibration isolators and associated equipment bases shall whenever possible be of the product of a single manufacturer. Acceptable manufacturer’s systems shall strictly comply with the design intent of this and/or the Detailed Technical Specification. The Mechanical Contractor shall verify the isolation requirements are complete, the equipment offered is correct and suitable in meeting the design requirements on the vibration levels.

5.3.1. Selection Guide for Equipment Base and Vibration Isolator

Unless otherwise specified, the selection of the type of equipment base and vibration isolator (mounting/hanger) for different plant/equipment and on different floor spans and levels shall follow the requirements as indicated in the Selection Guide for Vibration Isolation (Table 47 in the Chapter 48 for "Sound and Vibration Control" of the ASHRAE Applications Handbook) and the static deflection of the vibration isolator selected shall either provide a minimum isolation efficiency of 90% in ground floor areas and 95% in upper level areas or be not less than the corresponding values shown in Table 47. However, the Mechanical Contractor shall be responsible to ensure that the selected vibration isolation system is suitable for the specific plant/equipment and the specific building structure on which the plant/equipment is mounted.

5.4. PIPEWORK VIBRATION ISOLATION

Unless otherwise indicated, all horizontal and vertical pipework throughout the building having connection to vibrating equipment shall be isolated from the building structure by means of noise and vibration isolation hangers for a distance of at least 15 m or 100 times the pipe diameter from the vibrating equipment, whichever is the greater. At least three of the first hangers from the equipment should provide the same deflection as the equipment isolators, with a maximum limitation of 50 mm deflection. The first three hangers adjacent to the equipment shall also be of "positioning" or "pre-compressed" type, to prevent load transfer to the equipment flanges when the piping system is filled. This "floated" pipe run shall include, where situation permits, bends in two mutually perpendicular directions in order to give three degrees of freedom of movement, with approximately equal distance between successive elbows or bends.

All piping to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping, and a clearance of 10 to 15 mm around the outside of the piping shall be maintained. This clearance space shall be tightly packed with glass fibre or rock wool and caulked airtight after installation of piping.

The inlet and outlet connections of all vibrating equipment shall be fitted with either flexible connectors or flexible hoses as appropriate.

5.5. DUCTWORK VIBRATION ISOLATION

Flexible connections shall be provided between the vibrating equipment and the ductwork. Thrust restraints shall be used to maintain a slack position of the flexible ductwork connections.

Except where the ductwork passing through compartment walls requires a fire damper, all ductwork to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of ductwork, and a clearance of 20 to 32 mm around the outside surfaces of the ductwork shall be maintained. This clearance space shall be tightly packed with glass fibre, caulked airtight and sealed with approval sealant after installation of ductwork.

In case where fire damper is required, ductwork to be isolated shall be fitted with a flexible joint on the side of the fire damper where the vibration is originated.

5.6. DUCTWORK SILENCERS

The outer casing of rectangular ductwork silencers shall be fabricated from galvanised steel not thinner than 0.8 mm or aluminium. Seams shall be "lock-formed" and mastic filled. Each silencer shall be provided with flanged inlet and outlet. The internal baffles or splitters shall be of galvanised perforated steel not thinner than 0.5 mm and having a nominal open area of 30 %.

All internal components shall be spot welded in place with welds on centres not exceeding 100 mm. All spot welds shall be treated after with anti-corrosive epoxy resin or other approved coating.

Mani folded silencers shall be installed with continuous metallic nosing crimped in place. Nosing pieces and tails shall be provided as per manufacturer’s design. The filler material shall be of inorganic mineral or glass fibre of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof.

Before ordering ductwork silencers, the Mechanical Contractor shall submit for the Engineer’s approval the proposed manufacturer’s certified test data for pressure drop and insertion loss ratings.

The silencers shall be located at least three ductwork equivalent diameters from fans, coils, elbows, branch take offs, or other ductwork elements.

The silencer shall be leak-proof at a differential air pressure of 2 kPa.

Sound attenuators that form part of a system that operates under smoke/fire conditions shall have their lining covered with perforated plate. Silencers installed in any extract system from a kitchen canopy shall be lined with Melinex-type film to prevent the build-up of grease.

6. THERMAL INSULATION

6.1. GENERAL

Thermal insulation shall comply with the requirements of SANS 10400-XA, BS 5422:2009 and BS 5970:2012 or other statutory standards such as IEC, ISO and etc. or equivalent.

The insulation used for the air conditioning installation is "air" insulation which shall be of adequate strength and rigidity to maintain the thickness of air; have an adequate number of closed air cells within the material to minimise heat loss due to convection and conduction; and be covered on the exposed surface with good quality foil to stop heat loss from radiation.

Insulation materials and their finishes shall be free from asbestos. The Mechanical Contractor shall also notify the Engineer should the presence of asbestos be suspected.

Insulation materials and finishes shall be inherently proof against rotting, mould and fungal growth and attack by vermin, be non-hygroscopic and in all respects, be suitable for continuous use throughout the range of operating temperatures and for the environment indicated.

Insulation materials and their finishes shall be with the following hazardous substances as impurities shall not exceed the following:

- Volatile Organic Compounds (VOCs): 500µg/m^2/hr
- Arsenic: 50ppm
- Cadmium: 10ppm
- Hexavalent chromium: 10ppm
- Lead: 300ppm
- Mercury: 10ppm
- Selenium: 20ppm
- PBDEs (polybrominated diphenyl ether): 100ppm
- PBBs (polybrominatedbyphenyls): 100ppm

The thermal insulation works shall be undertaken by a minimum required percentage of workers who shall have a valid certificate of completing satisfactorily the thermal insulation training courses organised by the recognised association as specified in the contract. Upon request, details and particulars of these workers shall be submitted to the Engineer for approval.

In general, all ductwork and equipment shall be insulated if the air conveyed within the ductwork and the air external to it have a temperature difference which may cause an unwanted condensation or heat loss either on the duct surface or within the ductwork or result in unwanted thermal exchange between the external and inside air of the ductwork.

Thermal insulation shall be applied to chilled or hot water pipework distribution systems and to components within distribution systems such as valves, storage vessels, strainer and accessories.

All insulation shall fit tightly to surfaces to be covered, and all slabs and sections shall be built up close, butting edges being mitred, chamfered or shaped as necessary. Any minor interstices left in insulation shall be filled and sealed with granules embedded in suitable and approved adhesive compound.

Insulated pipes and ducts shall be supported on the outside of the insulation, with load spreading galvanised iron or corrosion treated steel metal plates of suitable size and thickness between the insulation and supports to prevent the insulation being crushed. A higher density load bearing quality insulation or hard wood block should be used at support points as recommended by the insulation manufacturer and as directed by the Engineer.

At the point of support, specially prepared blocks of hardwood or Styrofoam material must be positioned to ensure the integrity of the vapour barrier and cladding where applicable by bonding the supports to the insulation.

All materials delivered to site shall be new, and where appropriate, colour coded and labelled at the factory to identify different grades, sizes and types. The insulation shall be protected from damage or deterioration before, during and after fixing. Damaged or compressed insulation should be replaced.

Immediately before applying insulation, clean all surfaces until these are free of rust, scale and grease, and are thoroughly dry. Under no circumstances should the insulation be applied to wet surfaces.

Any surface to be insulated, which shows any sign of rusting or damage, shall, prior to insulating, be thoroughly scrapped and wire brushed as necessary to remove all rust, scale, etc. Surfaces shall then be cleaned with appropriate solvent to remove all oil, grease and dirt prior to the application of two coats of grey epoxy primer paint and insulation. Only clean and dry insulation shall be applied in any case, and it shall be free from damage before application.

All materials including the thermal insulation itself, together with adhesives, paint, bands, sheeting, etc. shall be supplied with a reasonable margin for cutting, wastage and making good damage and loss. All materials shall be stored in a suitable manner so as to prevent them from damage or deterioration before fixing.

All insulation shall be applied so as to give a smooth, homogeneous and linear surface. All rigid sections shall be concentric, and accurately matched for thickness. Steps and undulations in the surfaces are not acceptable. Any sections or slabs having damaged ends will be rejected. Continuous insulation shall be provided through all sleeves and insulation joints shall be staggered with respect to joints on the associated pipework or ductwork systems. Insulation damaged for whatever reasons will be rejected.

Where thermal insulation is applied to the outside of piped and ducted services, equipment and plant used to convey, store or generate fluids or gases at temperatures lower than the design ambient dew point temperature indicated, a water vapour barrier shall be provided unless it can be demonstrated that the insulation material itself provide adequate barrier throughout its thickness to the approval of the Engineer. The separate type vapour barrier where employed shall not be pierced or otherwise damaged by supports or by the application of external cladding.

Where relevant, moisture and vapour barriers, whether applied to the ductwork, hangers or projections, shall be continuous and completely provided throughout the surface of the insulation, and the insulation complete with the barrier shall be properly and firmly bound on the duct or pipe surface by appropriate fixing provisions. Such fixing provisions shall in no way impair the insulation or the vapour barrier. The Mechanical Contractor shall be responsible for any damages on the insulation or barrier due to improper installation and shall make good or replace the damaged insulation as appropriate and any subsequent wetting of the insulation due to improper installation or material shall be replaced by the Mechanical Contractor at his own cost.

Flexible connections on air conditioning ductwork shall be insulated with flexible blanket made from non-flammable material. The insulated blanket is to be wrapped with vapour barrier. The blanket shall be wrapped around the flexible connection, overlapped and secured in place by metal bands at both ends to the rigid ducts.

6.2. TYPES OF THERMAL INSULATION MATERIALS

The type of insulation required for a particular installation will generally be indicated in the Detailed Technical Specification. Where this is not so, the Mechanical Contractor shall request this information from the Engineer.

6.2.1. Phenolic Foam Insulation

For pipe insulation and pipe support, the phenolic foam joint shall be of unique Z-shape slip along the longitudinal joint sealed with adhesive and shall be provided with shiplap joints (male and female joint) at both circumference ends. The shiplap joints shall be a minimum width and depth of 10mm respectively in contact with each other for thermal lock purpose and sealed with adhesive.

Rigid cut sections shall be used with factory applied class 'O' facing for pipework. "Butt-joints" of slabs shall be sealed with minimum 75 mm wide matching class 'O' self-adhesive tape as recommended by the insulation manufacturer. Overlap of factory applied class 'O' facing for cut pipe sections shall be sealed with manufacturer’s recommended adhesive tape.

Factory-preformed insulated fittings formed to suit standard radius elbows, long bends and tees shall be used wherever available, otherwise, the Engineer’s permission shall be sought to neatly cut and mitre the insulation to fit around fittings. In the latter, great care must be taken to ensure that all mitred joints are a close fit and the aluminium foil adhesive tape is neatly applied as a finish coating.

Flanges and other protrusions shall be insulated by factory-fabricated oversized sections ordered to suit the diameter of the flange or adjacent pipe insulation whichever is the greatest. The oversized section shall overlap on to the adjacent pipe insulation by a minimum of 75 mm width on each side.

Pipe supports shall fit around the outside of the insulation. The insulation at the support points shall be made of heavy density load bearing phenolic foam in preformed sections of same thickness as the adjacent pipe insulation. This shall be complete with the same external finish to class 'O' as used on the adjacent standard pipe insulation.

Reference shall be made to the insulation manufacturer recommended support details to ensure the load bearing and dimensions of high density foam and associated galvanised metal plate supports are correctly inserted to spread the point loads involved.

6.2.2. Fibreglass Insulation

All fibreglass insulation shall be completely sealed by effective vapour barrier and self-adhesive foil tape.

All fibreglass insulation shall be completely sealed at all joints. All holes, tears, punctures, etc. made in the vapour barrier shall be completely sealed with the same specified foil tape. If damage in a definite insulation area exceeds 5% of the insulation surface or duct or pipe, the Mechanical Contractor shall be responsible for replacement with new one.

When pins are required to be used to support the fibreglass blanket, all the pins must be fire resistant and sealed by same specified foil tape after installation.

The material shall be adhered to the ducts with moisture and fire resistant adhesive of an approved type. Where preformed fibreglass sheets are to be adhered to flat surfaces such as ductwork the method of fixing shall be approved by the Engineer before the commencement of work.

6.2.3. Flexible Closed Cell Elastomeric Insulation

The flexible closed cell elastomeric insulation sheet shall be supplied in rolls in dimensions recommended by the manufacturer for application over ductwork so that the top, adjacent and bottom sheets lapped with adjacent sheets edges and corners. Adhesives shall be applied evenly to the entire contact surfaces if the elastomeric insulation sheet is not a self-adhesive sheet with adjacent sides lapped to maintain a uniform thickness at corners.

When shifting large bore flexible closed cell elastomeric tube which has become elliptical during storage, the slit shall be made in the flattened surface.

If the Flexible Closed Cell Elastomeric Insulation is exposed to weather, inside plant room or services duct, protection finish coating recommended by the insulation manufacturer shall be applied.

All coatings must be supplied by the original insulation manufacturer and application shall strictly follow the manufacturer’s installation manual to obtain the required result.

6.2.4. Polystyrene Insulation

Unless otherwise instructed by the Engineer, polystyrene insulation shall be covered with 25 mm square wire netting of 1 mm diameter galvanised steel wire netting reinforcement and coated on the top with 15 mm cement plaster smoothed and finished with painting.

6.2.5. Pre-insulated Panel of Foam Insulation with No Ozone Depleting Substances for Construction of Air Ducts

Whenever the foam insulation is used for pre-insulated duct systems without galvanised iron sheet metal, the following guidelines should be followed:

Wherever necessary, the ducts must be provided with appropriate reinforcements to guarantee sufficient mechanical seal against a maximum internal pressure of 500 Pa during operation. The maximum deformation of the duct must not exceed 3% of its width or 30 mm in any case.

The joints between one duct and adjacent one shall be performed using flanges with unexposed bayonet coupling and shall be ensured for the appropriate pneumatic and mechanical seal. Elbows shall be provided with turning vanes wherever indicated.

The ducts shall be supported by appropriate supports at intervals no more than 4 m whenever the greater side of duct is less than 1 m, and intervals no more than 2 m whenever the greater side of duct is more than 1 m.

Accessories such as volume dampers, fire barriers or duct heater/heating coil/cooling coil and etc., shall be provided with independent support in such a way that their weights are not imposed on the ducts.

The ducts shall be provided with appropriate test points for the sensors and inspection doors for cleaning and inspection all along the route.

6.3. MEASURES TO PREVENT SMOKE & TOXIC FUMES PROPAGATION IN THE EVENT OF FIRE

Unless otherwise indicated, all thermal insulating materials used within any building shall be with fire performance of Class “O” as stipulated in BS 5422: 2009. A class “O” (national class) material is one which:

- has a Class 1 surface spread of flame rating in accordance with BS 476-7:1997 and has a fire propagation index of not more than 12.0 and a sub-index of not more than 6.0 in accordance with BS 476-6:1989+A1:2009; or
- is of limited combustibility (“Materials of limited combustibility” – E.2 of Annex E, BS 5422:2009); or
- is non-combustible (“Non-combustible materials” – E.1 of Annex E, BS 5422:2009).

Test reports to substantiate the fire properties of the insulation material shall be issued by laboratories accredited by the Thermal Products & Systems Association of South Africa (TIPSASA) when requested by the Engineer. The Mechanical Contractor shall bear the cost and provide the relevant certificates in order to prove the physical properties of the insulation to be used in the projects are conforming to the specification.

6.4. VAPOUR BARRIERS

Where thermal insulation is applied to the outside of pipework and ductwork, equipment and plant used to convey, store or generate fluids or gases at temperatures lower than the design ambient dew point temperature indicated, a water vapour barrier shall be provided. The vapour barrier where deployed shall be applied such that it is continuous and gives protection to the whole surface of the insulation which it protects.

It shall not be pierced or otherwise damaged by supports or by the application of external cladding.

The insulation on continuous pipework and ductwork shall be sectionalised by vapour barriers to be applied at a maximum of 5 m intervals to isolate condensation problems caused by perforation of external barrier to the affected section.

All joints shall be either factory or on job site fabricated. All joints shall allow for 50 mm overlap of vapour barrier and the joints shall be completely sealed using foil tape with a minimum width of 75 mm. Any and all punctures, holes, tears, etc. that can be seen or occur on the job site shall be completely sealed with the same tape as specified above.

The material chosen for the vapour barrier and its method of application shall be compatible with the thermal insulation on which it is to protect. The following shall be used:

- Wet-applied vapour barriers of the cut-back bitumen type, bitumen emulsions with or without elastomer latex, vinyl emulsions and solvent based polymers;
- Elastomer sheets with all joints adequately overlapped and continuously sealed;
- Polyvinyl chlorides, polyethylene, polyisobutylene or other plastics tapes or sheets;
- Epoxide and polyester resins;
- Sheet metal with all joints adequately overlapped and continuously sealed to a vapour-tight condition; or

- Metal foil used alone or laminated to building paper, building sheet or plastics film with all joints adequately lapped and continuously vapour sealed.

Facing materials used on insulation materials to provide vapour barrier shall not be more than 0.8 mm thick. All metal foil vapour barrier and foil tape used shall be of Class 'O' as stipulated in BS 5422: 2009.

6.5. PIPEWORK AND FITTINGS

6.5.1. Application

Thermal insulation shall be applied to pipework of refrigerant, chilled water or hot water distribution systems, pipework of thermal fluids of heat recovery systems, cold condensate drain-pipes, and all components within distribution systems such as valves and storage vessels, etc.

Refrigerant pipework insulation shall be 25 mm “Armaflex,” equal and approved. Chilled water pipe insulation thickness should be as follows, unless otherwise specified in the Detailed Technical Specification:

- 15 mm - 65 mm NB : 35 mm thick
- 76 mm – 150 mm NB : 40 mm thick
- 175 mm – 300 mm NB : 50 mm thick
- Over 300 mm NB : 65 mm thick

Pipework insulation shall also be deemed to include all open vents, cold feeds, chilled/hot water tanks, expansion tanks, valves, flanges, fittings, pumps, accessories, other chilled water plant and hot water plant items whether specifically mentioned or not. Fittings are to be insulated in conformity with the pipework in which they are incorporated, and of the same thickness. All such items where proper treatment on pipework connected to the puddle flanges in tunnel and trench is required shall be provided with relevant insulation filled 0.8 mm thick hammered aluminium split boxes, arranged for easy removal, the box to enclose up to valve handle and to have a lid for valve access. The insulation on the pipes immediately adjacent to flanges, etc., shall be neatly swaged off to allow the insulated boxes to be removed without damage to the pipe insulation.

6.5.2. Fixing Methods

The insulation shall fit closely to the pipework and other surfaces without gaps between joints. Each section of preformed insulation shall be secured to the pipe by means of circumferential bands of non-ferrous metal, plastics fabric, or adhesive tape. Preformed sheet materials shall be secured to chilled water containers and flat surfaces in the same manner as specified for ductwork. Valves, flanges and other fittings shall be insulated with "oversize" sections, around valves fittings shall be filled with fibrous material, pieces of shaped insulation or other approved infill. Covers which are to be removable shall be separately secured. Two vapour barriers shall be provided, one to totally enclose the main insulation and the other to cover the removable insulation.

At all points of support, both insulation and outer covering shall be continuous and shall not be punctured or fouled by the supports. The insulation at supports shall be material of sufficient compressive strength to take the loads transmitted to the supports. The load-bearing insulation shall be extended on each side of the supports.

6.5.3. Effects of Weather

At entries into buildings the weather-proofed insulation shall extend not less than 150 mm beyond the inner face of the wall and be sealed to prevent the entry of water from the outside into the building to the satisfaction of the Engineer.

Outside buildings, services exposed to the weather; either of the following weather-proof covering shall be provided as indicated:

- Enclosed in fabricated sheet hammer clad aluminium casings. The casing shall be not less than 0.8 mm thick for pipework of 150 mm and above measured over the insulation and not less than 0.6 mm thick on smaller pipework;
- Enclosed in roofing felt, sealed with adhesive with overlaps of at least 50 mm, wrapped with 25 mm spaced wire mesh of 1 mm thick, galvanised steel wire netting reinforcement, laced with 1 mm thick galvanised wire and painted two coats of bituminous paint or application with 15 mm thick cement plaster and paint;

- Enclosed in poly-isobutylene sheet not less than 0.8 mm thick of tensile strength not less than 3.4 MN/m², lapped and sealed at all joints; or
- Be treated with two coats of elastomeric polymer-based heavy-duty mastic with reinforcing membrane to give a weather resistant finish.

6.6. DUCTWORK AND AIR HANDLING PLANT

6.6.1. Application

Internal ductwork insulation to be 25mm "*Sonic Liner*" and external ductwork insulation to be 50mm foil backed fibreglass.

Thermal insulation shall be applied to air distribution ductwork and to components within distribution systems such as fans, heater, heating coil, cooling coil casings which convey conditioned air within plant rooms and up to and including all terminal points in the system.

Air distribution systems conveying conditioned, warmed or chilled air through conditioned spaces shall be insulated. Exhaust, ventilation or outdoor air passing any conditioned space should also be insulated.

All ductwork (including re-circulation ductwork) conveying warmed or chilled air through unconditioned spaces or the open air shall be insulated.

Distribution systems conveying untreated outdoor air and exhaust air need not be insulated unless such air distribution interconnecting with heat recovery system/device or passing through conditioned space.

6.6.2. Fixing Methods

Fixing methods for insulation shall minimise direct metal paths which thermally bridge the insulation, particularly when the insulation is metal faced. The full insulating effect shall be maintained at connections and access openings and panels including the edges of such openings, fasteners and stiffeners either by means of purposely made boxes or by increasing the general thickness of insulation. Where insulation is applied in layers, all joints in all layers shall be staggered.

At all points of support, the insulation and outer covering and vapour seal shall be continuous and shall not be pierced or protruded by the supports. The insulation at supports shall be of the material with sufficient compressive strength to take up the loads transmitted to the supports.

Pre-formed sheet insulation shall be applied with adjacent sides lapped at joints and corners to maintain a uniform thickness. The insulation shall be fixed securely with adhesives conforming to NFPA-90A:2012 and by impaling on fasteners which must be galvanised iron metal studs' split prongs, plastics studs or other approved devices fixed to the thickness and weight of the insulating materials and finishes to be applied and shall be spaced at approximately 300 mm centres. Fastenings shall be finished flush with the surface of the insulation to which they are applied. Adhesives shall be compatible with the insulation and in their dry state be non-flammable. Under no circumstances shall adhesives be used which attack or dissolve the ductwork or insulation.

Aluminium foil or plastics faced preformed sheet insulation materials shall be placed on the outside of ductwork with adjacent sides lapped to maintain a uniform thickness at joints and corners. All joints shall be sealed with foil tape and held in place with contact adhesive. The adhesive shall be suitable for the range of ambient temperature and humidity encountered.

Reinforcement of self-setting cement shall be 25 mm spaced wire mesh of 1 mm diameter galvanised steel wire netting reinforcement. Cement finishes applied to thermal insulation shall always be completely dry before the application of any sealing primer and final decorative coating. Cement application shall be planned and executed in sections to avoid joints between wet cement and cement already dried.

6.6.3. Effects of Weather

Where thermal insulation is protected against the effects of weather by plastics sheet or roofing felt, particular care shall be taken to ensure a watertight seal at all joints. The sheet material shall be adhered to the external surface of the insulation and all joints shall be lapped, secured and sealed by adhesives or solvent welding. All jointing and

sealing materials and methods of application shall be to the recommendations of the sheet supplier. Poly-isobutylene sheet shall be not less than 0.8 mm thick and have a tensile strength not less than 3.4MN/m^2.

Where an insulated duct passes through an external building element, adequate precautions shall be taken to prevent the entry of rainwater from the outside into the building. Details shall be submitted to the Engineer for approval well before the construction starts.

6.6.4. Flexible Insulation

Flexible insulation shall have all circumferential and longitudinal joints sealed with tape of the same material or highly compatible with the main insulation facing. The external surface of the insulation shall be wrapped over with 25 mm mesh spaced wire mesh of 1 mm diameter galvanised steel wire netting reinforcement and the netting joints shall be secured with a lacing of 1 mm galvanised wire. Care shall be taken to ensure that the insulation material is not crushed during this application.

6.6.5. Internal Insulation

Thermal insulation and/or acoustic insulation materials shall be applied to the inside of ductwork only where specified by the Detailed Technical Specification or Drawing. The insulation material shall be cut to accurately fit the internal duct surfaces. The insulation shall be fastened to the duct using adhesive spread over the entire surface in combination with piercing fasteners finished flush with the insulation surface. Particular care shall be taken to ensure that the edges of all internal insulating materials, whether exposed or butted against similar edges, are sealed and secured to the internal surfaces of the duct. They shall be protected with galvanised iron channel sheet metal of not less than 0.8 mm thickness and 13 mm width. Alternatively, they may be provided with other approved means of protection to prevent erosion and peeling. All materials shall have adequate strength and ability to resist erosion at the maximum design air velocity and shall not produce dust.

Unless otherwise specified in the Detailed Technical Specification, fibreglass insulation with scrim glass fibre cloth face finish or elastomeric insulation shall be used for internal lining material.

7. UNITARY AIR-CONDITIONERS

7.1. GENERAL

Unitary air-conditioners shall include:

- Single package unit;
- Packaged unit and remote condenser;
- Condensing unit and blower coils;
- Condensing unit with variable refrigerant volume flow and indoor fan coil units;
- Multi-split system; and
- Water-cooled package and water pump package.

Unitary air-conditioners shall be factory fabricated and assembled. The equipment shall be rated and tested in the same country of manufacture and meet the requirements of internationally recognised quality assurance standards approved by the Engineer.

The most energy efficient model in the series shall be selected for submission.

Refrigerants for the refrigeration and air-conditioning system shall comply with flammability safety classification.

Unless otherwise specified, electrical equipment of the unitary air-conditioners shall be suitable for use with 3-phase and neutral, 4-wire, 380/220 V, 50 Hz source neutral earthed system with provision of bonding. Transformers may be used for equipment designed for operation on voltages other those specified above, however, these shall be installed within the unit.

Air-cooled condensers and condensing units of unitary air-conditioners shall be selected to give rated capacity with condensing temperature not exceeding 50°C for the ambient condition.

7.2. CASING

Casings of condensing unit of unitary air-conditioners shall be constructed of rigid galvanised sheet steel and painted, suitably reinforced with channels and sections to form a robust cabinet. Casing for outdoor installation shall be of weatherproof finish, preferably galvanised, painted or anodised aluminium.

Removable panel for casings shall be provided to give access to all working components, parts, and connections for installation and service. The compartment housing for the direct-expansion coil and blower shall be adequately insulated to prevent water condensation and shall contain a suitable drip pan with a drain connection. The compartment housing for the compressor shall be treated for effective sound insulation to ensure that the noise emitted is within the limits as specified.

7.3. COMPRESSOR

Compressors shall be rotary, scroll or reciprocating of either the hermetically sealed type or the semi hermetically sealed type. Compressor shall be complete with internal motor protection, lubrication, crankcase heater, and internal and external vibration isolation. Each compressor shall form a separate refrigerant circuit with its own condenser, evaporator and controls except multi-split system and VRF.

7.4. SUPPLY AIR FAN AND MOTOR

Supply air fans shall be centrifugal type of ample sized for operation against the specified static pressure. Fan motors shall be permanently lubricated and have adequate power so as to be non-overloading throughout the range of the fan characteristic. The motor shall be high efficiency motor.

All fans shall be statically and dynamically balanced. Fans shall be equipped with permanently lubricated bearings suitable for the installed altitude of the fan. Motors shall be installed in accordance with the relevant clauses of the "*Electric Motors & Electrical Equipment*" section.

7.5. COOLING AND HEATING COILS

Cooling and heating coils shall be of the direct expansion type and constructed with copper tubes and aluminium fins to give high heat transfer performance. The coils shall have sufficient number of rows of tubes to provide efficient dehumidification of the air in addition to its cooling.

Adequate water collecting tray for run off and removal of the condensation shall be provided. Each coil or circuit shall be controlled by a separate thermal expansion device.

7.6. AIR-COOLED CONDENSERS

Air-cooled condensers shall, unless otherwise specified, be suitable for outdoor installation with ample capacity to dissipate heat from the air conditioning system – either horizontally or vertically. Condenser coils shall be constructed with copper tube and aluminium fins. Special corrosion resistant treatment for the condenser coils and fins shall be considered for the equipment to be located in corrosive environments.

7.7. REFRIGERANT PIPING

Refrigerant piping shall include all necessary valves, fitting and insulation. All insulation shall comply with the "*Thermal Insulation*" section of this Standard Specification; and be properly protected with mechanical means such as metallic cladding or cement plastering and painting. Size of the refrigerant pipe and fittings shall be in accordance with the recommended standards as stated in the "*Central Refrigeration Machine, Direct Exchange Evaporators and Heat Rejection Plant*" section of this Standard Specification.

7.8. SAFETY CONTROL

Controls shall be factory wired. Field wiring in conduit or trunking shall be limited to interconnections between separate pieces of equipment and power wiring. Each unit shall be protected and controlled by a factory built control panel incorporating all necessary devices, switches, indicator, etc. Functions required shall include those such as isolating switches and emergency stop facilities.

Safety protections shall include low pressure cut out, high pressure cut out, low refrigerant temperature cut out, high compressor discharge temperature cut out, and other protections necessary for the proper and safe operation of the unit. Overload protections shall be provided as well.

7.9. OPERATIONAL CONTROL

For a conventional split type A/C unit, a wired or wireless remote controller shall be provided for the selection of room temperature setting, fan speed and timer setting, as specified. For an advance multi-zone modular split type, the hardwired remote controller shall be of the liquid crystal display (LCD) type with an on-off switch for operational features such as speed selection, timer setting, temperature setting, self-diagnosis function and auto restart function.

7.10. SINGLE PACKAGED AIR-CONDITIONER

Single package unit shall be of the completely self-contained type with factory wired controls and factory assembled components and piping. The unit shall include one/two rotary, scroll or reciprocating compressors of either the hermetically sealed or semi-hermetically sealed type, condenser coil, condenser fan and motor, direct expansion cooling coil, blower, air filters, drier of the renewable cartridge type completed with isolating valve, expansion valve, controls and safety devices all housed in a weather-proof and metal casing of robust construction yet attractive appearance.

7.11. PACKAGED AIR-CONDITIONER WITH REMOTE CONDENSER

The unit shall contain all components factory assembled, (as the single packaged unit with the exception of the condenser), in a sturdy painted galvanised iron metal casing arranged for vertical or horizontal mounting inside the building. The remote condenser shall be air-cooled/water-cooled and installed outside the building. The interconnecting refrigerant piping shall be field connected.

7.12. SPLIT CONDENSING UNIT AND AHU

The condensing unit shall include rotary, scroll or reciprocating compressors, air-cooled condensing coils, fans and motors control and safety devices, piping and all necessary accessories factory assembled in a weatherproof painted galvanised iron casing. The refrigerant circuit shall be field connected to the matched AHU or fan coil units each

completed with direct expansion cooling coil, expansion valve, blower with motor and the necessary number of air filters in a well-insulated, sturdy galvanised iron metal casing with paint to an attractive appearance.

7.13. VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

The air conditioning system shall be of the multi-zone modular split type. Each zone shall consist of one air-cooled outdoor condensing unit connected to a group of indoor fan coil units in one single refrigerant circuit. For multi compressors outdoor unit, one shall be inverter control compressor. The inverter compressor shall be incorporated with a frequency inverter control to achieve the optimum flow of refrigerant in response to the actual load.

The entire system completed with all necessary piping and accessories shall be supplied and designed by a single proprietary manufacturer who has proven record for its product. The Mechanical Contractor shall submit their calculation to prove the performance of the equipment with the required length and level difference for approval.

7.14. MAINTENANCE SERVICING PLATFORM

Where unitary air-conditioners are installed at levels that are normally inaccessible from ground, an adequately sized service platform complete with railings and steel cat ladder with safety wings shall be provided. Such platforms shall be of reasonable substantial rigid galvanised metal construction and shall be well protected against corrosion. The design must be approved by the Engineer before installation.

8. CONTROL AND MONITORING SYSTEM

Provide, install and set into operation all the automatic control devices shown on the relevant diagrams and/or in the specifications, and interlock same as required to perform their function correctly. The Sub-contractor shall note that the various controls shown on the drawings, and as mentioned herein indicate the basic control elements and functions required only. They shall additionally furnish all ancillaries necessary to fulfil the desired plant operation.

All control equipment shall comply with the following:

- Valve and damper operators shall be quiet in operation. In the event of power failure, operators shall be provided with spring return so that they will "fail safe" in either the normally open, or normally closed position as required.

- Operators operating in sequence with other operators shall have adjustable operating ranges and starting points, to permit adjustment of the control sequence as required by the operating characteristics of the system.

- Thermostats shall have bimetal, vapour pressure, liquid filled, or resistance type sensitive elements, and humidistats shall have sensitive elements of human hair, or other suitable material of approximately equal sensitivity, or of the hygroscopic resistance type.

- Room thermostats, electronic sensors and room humidistats shall be securely attached to suitable bases mounted on the walls or other building surfaces. Each thermostat, electronic sensor or humidistat shall be located where shown, or, if not shown, where it will respond to average temperature or humidity in the area controlled.

- Thermostats, sensors and humidistats generally shall be mounted 1.15m above the floor, unless otherwise indicated on the drawings, and shall not be mounted on outside walls or partitions if other locations are possible. Thermostats mounted on outside walls shall be provided with insulating bases.

- Room thermostats and room humidistats in which the adjusting mechanism is integral with the sensing element shall have locked, or concealed adjusting devices, by means of which the operating points can be adjusted through a range of not less than 5 degrees and 10%, respectively, above and below the operating points specified.

- Electric temperature control systems operating at less than the normal lighting circuit voltage shall be provided with transformers to supply power for the equipment.

- Transformers and line voltage controllers serving individual ventilation or air-conditioning units may not be fed from the fan motor leads.

- Transformers other than transformers in bridge circuits shall have primaries wound for the correct control circuit voltage. Each transformer shall have adequate capacity to operate simultaneously all apparatus connected to it and shall be capable of carrying a 25% overload one hour.

- Each transformer shall be enclosed in a steel cabinet with conduit connections; and shall have a fused disconnect switch on the primary side; and a fuse cut-out or thermal cut-out on the secondary side if the output exceeds 50V amperes. One leg of the secondary winding of every transformer shall be properly earthed.

Air-Conditioning, Ventilation and Exhaust Plants

Plants shall be switched ON and OFF automatically, by means of an electrically operated time switch, driven by a totally electronic unit to allow the switch to continue operating, without interruption to its programme, during power failure of up to eight (8) hours.

Time switches shall incorporate a weekend cut-out feature and shall be set to operate the Plant during the selected operating hours.

Time switches shall be installed within the electrical switch panel and shall be interlocked with a rotary type MANUAL\OFF\AUTO over-riding control switch, so that the plant may be operated manually, or switched off on Public Holidays, without interruption of the program of the time switch. MANUAL\OFF\AUTO switches shall be mounted in the positions indicated on the drawings.

Where applicable, as indicated on the wiring diagrams, the time switch shall be replaced with an optimised start control system equal to **LANDIS & GYR, STAEFA, SATCHWEL** or equal, which shall automatically start and stop the plant. The control shall include an outdoor and indoor thermostat which shall influence the plant starting time, to ensure the desired indoor temperature at the beginning of the occupied period.

Where applicable, as indicated on the relevant diagrams, plants shall be protected against low voltage or single phasing by an electronic single phase/low voltage monitoring device, pre-set to trip the entire plant should the line voltage drop by more by more than 10% or the loss of one or more phases. The device shall be set to reinstate the operation of the plant five minutes after the voltage has returned to normal.

Fire safety thermostats of the rigid tailstock type shall be mounted in the return air stream to each unit, or behind the common return air opening to the plant room, as applicable and if indicated on the drawings, to sense the return air temperature and shut down the entire system should the return air temperature exceed ±40ºC. These safety thermostats shall be of the manual reset type.

Plants shall be started in sequence by means of time delay relays. The timing between switching stages shall be set at not less than 20 seconds.

Where applicable, the temperature control circuit of each compressor unit shall be interlocked with the condenser fan switch so that the compressors will not operate unless the fan switch contacts are closed.

Cooling and heating thermostats, or temperature sensors, shall be installed in the positions indicated on the drawings to control cooling and heating, as specified. Thermostats or temperature sensors positioned within the conditioned space shall be mounted on neat, recessed wall boxes of sufficient size, to project at least 25mm on all sided of the controller.

Each refrigerant circuit within the packaged air conditioning units shall include a dual pressure switch with manual reset on the high-pressure side, and an oil pressure switch with manual reset feature, to stop the compressor if the oil pressure drops below a preset minimum, all as previously specified herein.

Ventilation fans shall be interlocked with the air conditioning plant as called for on the relevant drawings. Fresh air intake fans shall be interlocked to operate only when the plant is switched on.

An additional manual override facility shall be provided to operate fresh air fans, for service inspection purposes. Exhaust fans will be switched on and off at their relevant control points.

9. ELECTRIC MOTORS & ELECTRICAL EQUIPMENT

9.1. GENERAL

Unless otherwise specified, the Mechanical Contractor shall provide and install all low and high voltage electrical equipment necessary for the complete installations under the Contract and shall carry out all necessary wiring from the points of power supply provided by others as indicated on the Drawings.

Unless otherwise specified, all apparatus, equipment, materials and wiring shall be suitable for use with a 3-phase and neutral, 4-wire, 400/230V ± 6 %, 50 Hz ± 2 %.

The Mechanical Contractor shall be responsible for the accuracy of all installation and shop drawings and wiring diagram and for the correct internal wiring of all pre-wired equipment supplied under the Contract.

All electrical equipment, wiring and installation work, and materials shall comply with the SABS Code of Practice for the Wiring of Premises, and the additional requirements of the local authorities who have jurisdiction over the site of Works, as well as being in accordance with best modern practice.

Equipment shall be protected against atmospheric corrosion, including that caused by salt-laden air. Materials used shall not be susceptible to mould growth or attack by vermin.

Cables for power circuits shall not be less than 2.5 mm^2 copper conductors and cables for control circuit shall not be less than 1.5 mm^2 copper conductors.

All electric wiring to be installed into refrigerated situations where the temperature is to be maintained at or below 0 °C shall be either MICS or elastomeric cables that are applicable for the designed operating environment.

9.2. LOW VOLTAGE – ELECTRICAL EQUIPMENT

9.2.1. Electric Motors

9.2.1.1. General

All electric motors shall be of the high efficiency squirrel-cage induction totally enclosed fan-cooled type and comply with IEC 60034-1:2006 and other associated Parts of the Standard.

Motors shall be current catalogues products, preferably of South African origin, and documentation shall include performance curves for the expected range of operational conditions. Motors shall comply with SABS 948, BS 2613, BS 170, as amended and other applicable standards of their country of manufacture.

The motors shall be insulated to IEC 60085:2004 with Class F as the minimum insulation.

Motor enclosures shall be in accordance with IEC 60034-5:2006 and the 'degree of protection' shall be appropriate to the location in which the motors are operating, and the environment indicated. Unless otherwise specified, motors shall be protected with enclosures to at least IP44 for indoor and IP55 for outdoor application.

Motors of 2.2 kW output or above shall be suitable for operation from three-phase supply.

The synchronous speed of the motor shall not exceed 25 rev/s unless otherwise approved.

Motors arranged for automatic restart shall have a label of durable material permanently fixed to it in a prominent position clearly inscribed to warn of automatic starting and instructing the user to isolate before inspection.

9.2.1.2. Insulation Test

All low voltage motors shall have a minimum insulation resistance of 1 megaohm between phases and to earth when tested with an approved 500 V DC insulation tester.

9.2.1.3. Starting Torque and Current

Motors shall have starting torque characteristics to suit the connected load and the type of starting.

9.2.1.4. Maintenance Access and Safety

The electrical and mechanical arrangements of all motors shall be such that the necessary periodical testing, cleaning and maintenance can be carried out in a minimum of time with economy of labour.

9.2.1.5. Noise and Vibration

All motor rotors shall be dynamically balanced. The vibration and noise level generated by the motors shall not exceed the recommended limits as stipulated in IEC 60034-9:2007 and IEC 60034-14:2007 respectively. The Engineer will reject motors that operate with unacceptable noise and vibration.

9.2.1.6. Minimum Motor Efficiency

Unless otherwise specified, the efficiency at rated output of the single-speed, three-phase, cage-induction motors shall comply with or better than the nominal efficiency limits for 'Premium Efficiency' (IE3) class in IEC 60034-30:2014 and the efficiency levels shall be measured based on the test methods defined in IEC 60034-2-1:2014.

9.2.1.7. Continuous Rating

The motors shall be continuously rated to IEC 60034-1:2014. They shall be adequately rated to meet the service demands of driven units connected thereto under normal conditions without overload. The continuous rating of the motors shall cover the full specified range of duty plus a further 5% margin for compressors, 15% margin for fans and 10% for pumps.

9.2.1.8. Tachometers

In all cases of direct drive (except hermetic), an application point shall be provided for speed checking by a tachometer.

9.2.1.9. Terminals

One large terminal box of approved design shall be provided, mounted on the stator casing only. Each end of each stator phase must be brought out to a terminal in the box. For motors rated 10 kW and above, adequate clearance between termination shall be allowed for the use of cable lugs.

Exception for armoured cables, all other cables appearing above floor level shall be enclosed in approved trunking, solid or flexible conduit, with approved provision for movement of the motor. The terminal boxes for cable connection shall be suitably arranged to make a neat joint with the conduits or cables.

9.2.1.10. Belt Drives and Pulleys

Belt drives shall comply with BS 3790:2006 and be capable of transmitting at least the rated power output of the driving motor with one belt removed. A minimum of two belts per drive shall be used and all multi-belt drives shall use matched sets.

Slide rails shall be provided for all motors driving through belts. Purpose-made adjusting devices shall be provided to enable belt tension to be altered and motors to be secured.

Belt driven machinery such as fans shall be fitted with pulleys suitable for the belt drive used. Pulleys may use split taper bushings for drives up to 30 kW. Alternatively, and in any case for output above 30 kW, pulleys shall be secured to the fan and motor shafts by keys fitted into machined keyways. Keys shall be easily accessible so that they can be withdrawn or tightened. Where gib head keys are used they shall not protrude beyond the end of the shaft. For keys without gib heads, they shall be drilled and tapped to accept an extractor bolt.

9.2.1.11. Protective Guards

Protective fixed guards shall be provided at all forms of open power transmission systems including belt drives and drive couplings, and to dangerous parts of machinery to prevent inadvertent access or contact. The protective guards shall be rigidly constructed. It shall not be possible to remove any guard without the aid of a tool.

For belt drives, the guards shall be of galvanised steel wire of not less than 2.5 mm diameter attached to a rigid galvanised steel rod or angle framework. The mesh size and the location of the guard shall prevent finger contact with any enclosed danger point. Alternatively guards may be constructed from galvanised sheet steel of not less than 0.8 mm thick stiffened to ensure a rigid enclosure. Removable access panels shall be provided in guards to allow tachometer readings to be taken on both driving and driven shafts and also belt tension to be tested. The sizes of guards including the dimensions and locations of access panels shall also allow the size and position of the motor.

9.2.1.12. Motor Fed by Converter

As converter drive can generate repetitive voltage overshoots at the terminals of a motor connected by cables, which can reduce the life of a motor winding insulation system if these repetitive voltage overshoots exceed the repetitive voltage stress withstand capability of the motor winding insulation system, the motor winding insulation shall have the pulse withstand capability at least equal that depicted by Curve A (for motors up to 500 V AC) of Figure 17 of IEC TS 60034-25:2014.

In order to avoid damage by bearing currents in converter fed operation, motor of frame size 225 or larger shall be fitted with isolated bearing at the non-drive end.

9.2.2. Variable Speed Drives (VSDs) for Pumps

The drives shall be either wall-mounted or floor-mounted in a well ventilated location and in accordance with the manufacturer's standard installation recommendations.

The drives shall be located away from any nearby water pipework to avoid possible damage by water leaking or water pipe bursting. In case that such location could not be identified, the Mechanical Contractor shall provide all necessary protective means to avoid the damage.

The distance between the drives and the controlled motors shall be within the range as recommended by the manufacturer. The Mechanical Contractor shall submit calculations including his selected interconnecting cable sizes to the Engineer to substantiate that the overall performance shall meet the design requirements.

For essential air-conditioning services subject to the approval of the Engineer and requiring to meet special building functions and client's operational requirements, all major and essential electric motor drives in the air-conditioning systems shall be configured in such a way that there is a minimum chance of serious interruption and/or breakdown of the entire plant operation due to a single point of failure for major and essential electric motor drives in the systems. The Mechanical Contractor shall provide sufficient redundancy and/or backup provisions such as installation of alternate motor starters as appropriate where necessary for maintenance by-pass of variable speed drives in the motor control equipment and ancillaries.

9.2.3. Motor Switchgear, Starter and Control Panels

9.2.3.1. General

Motor switchgear, starters and controls shall be supplied and installed to perform the operation and control of the equipment to be provided. The control panels or switchboards shall incorporate all control devices, timers, accessories and wiring necessary for proper operation.

9.2.3.2. Local Motor Control Panels

The local motor control panel shall be of wall-mounted factory built assemblies of low voltage switchboard or distribution board housing the motor starter and switchgear.

The panel shall be of steel construction, self-supporting, with modular top, side and back panels and doors of sheet steel built up on substantial framing with all necessary stiffeners, supports and return edges to provide a rigid construction and clear accessibility to all internal components within the panel. The thickness of the sheet steel shall be at least 1.6 mm.

All panels shall, but not be limited to, include the following operational features:

- Local auto/on/off switch for each equipment;
- Starter or variable speed drive as shown on the Drawings or as specified;
- Fuse switch or circuit breaker for each equipment;

- Isolating switch for each main incoming supply and for each motor starter;
- Protective, control and auxiliary relays;
- Current transformer;
- Digital multifunction power meter for each outgoing circuit and incoming supply of 60 A 3-phase or above;
- Hour run meter;
- LED Indicating lamps, push buttons, selectors and control switches;
- Emergency stop push buttons; and
- Labelling.

9.2.3.3. Motor Control Switchboard

The motor control switchboard (hereafter called the "MC Switchboard") shall be a free-standing floor-mounted low voltage switchboard to group centrally the motor starters, controls and switchgear for the air-conditioning and ventilation equipment etc.

The MC Switchboard shall be designed and fabricated to comply with IEC 61439-2:2011.

The MC Switchboard shall, but not be limited to, include the following provisions:

- Local auto/on/off switch for each equipment;
- Air circuit breaker, fuse switch and/or moulded case circuit breaker;
- Busbars;
- Isolating switch for each main incoming supply and for each motor starter;
- Starter or variable speed drive as shown on the Drawings or as specified;
- Protective, control and auxiliary relays;
- Current transformer;
- Digital multifunction power meter for each outgoing circuit and incoming supply of 60 A 3-phase or above;
- Hour run meter;
- LED Indicating lamps, push buttons, selector and control switches;
- Emergency stop push buttons; and
- Labelling.

9.2.3.4. Motor Starters

i) <u>General Requirements</u>

Motor starters shall generally comply with the requirements of the IEC 60947-4-1:2009 or IEC 62271-106:2011/CORR1:2014.

The duty of the starters shall be suitable for the mechanical and electrical duties imposed by the motors being switched and in particular, the starting torque, current, starting time and frequency of operation.

Motors of more than 0.5 kW rating shall be provided with a starter designed to perform the following functions efficiently and safely:

- To start the motor without damage to the drive or driven equipment whilst regulating the starting current to the satisfaction of the power supply company and ensuring that at all stages of starting, the motor will develop sufficient torque to accelerate the load;
- To stop the motor;
- To prevent damage to the motor due to overload, under voltage, disconnection of one phase;
- To prevent damage to reduced voltage started motors and danger to personnel due to resumption of the electricity supply following a failure;
- To limit the damage to the motor due to stalling or internal electrical or mechanical faults by quickly disconnecting the supply; and
- To prevent damage to the motor or the starter itself due to improper unskilled or hesitant operation or failure to complete a starting sequence once it is connected.

Each motor starter assembly shall comprise fused switchgear, contactors, protection relays, main and auxiliary contacts, and associated accessories. For starter to be installed in motor control switchboard, the whole unit shall be enclosed in the switchboard from which no access can be gained to adjoining sections of the switchboard. Both the main and auxiliary contacts shall be rated for uninterrupted and intermittent duty.

All starters shall be of the electrically held-on pattern and shall not release until the voltage falls below 75% of nominal value.

The duty rating of the contactors shall not be less than intermittent duty class 12 60% on-load factor. Where specified in the Contract, the solid state soft motor starter can be used to start motors over 2 kW.

Overload relay shall be of thermal type unless otherwise specified. Overload relay shall be able to operate at an ambient air temperature of 40 °C and have a setting range of 50% to 150% rated operational current.

For an assisted start starter, timer shall be of solid state plug-in type with 0 to 15 seconds setting. For star/delta and reversing starter, mechanical and electrical interlocks shall be fitted with the contactor.

Control circuits shall be operated on main supply derived from the control panel or switchboard and protected by fuse to IEC 60269-1:2006.

Where duplicate equipment is provided, the starter for each equipment shall be housed in a separate panel. Unless otherwise indicated, where an equipment is provided with duplicate motors, two starters shall be supplied; a single starter with a local changeover switch will not be accepted.

ii) Direct-On-Line Starters

Unless otherwise specified for the specific type of installations, motors rated below 11 kW shall be direct-on-line provided that the maximum starting current does not exceed six times the rated motor full load current, otherwise star-delta starters shall be provided.

The starters shall, but not be limited to, include the following:

- Fused switchgear;
- Triple pole air break contactor;
- A triple pole motor protection unit incorporating over-current and single-phasing protection with manual reset facilities;
- Under-volt release protection device. Unless otherwise specified, it shall be arranged to provide automatic restart on restoration of mains voltage;
- Current transformers with suitable ratio, output and accuracy for motor protection;
- Local/off/remote control selector switch lockable in each position;
- Start and stop push buttons;
- Indicating lamps for motor running, off and tripped on fault;
- Dry contacts wired to terminals for remote indication of motor running, off, tripped on fault and summary alarm to supervisory control panels;
- Terminals wired to provide for connection to emergency stop push button and remote start/stop of the motor;
- Hour run meter; and
- Lamp test button.

iii) Star-Delta Starters

Unless otherwise specified for the specific type of installations, motors rated at and above 11 kW and up to 55 kW shall be star-delta started to limit the maximum starting current to within 2.5 times the rated motor full load current.

Star-delta starters shall be equipped as per DOL starters specified above, with the following additional provisions:

- Triple pole air break contactors with electrical and mechanical interlock arranged for automatic star-delta transition;
- Calibrated and adjustable solid state timer for automatic star-delta transition; and
- A triple pole motor protection unit incorporating over-current, single-phasing and earth leakage protection with manual reset facilities. The earth leakage protection unit shall be selected to isolate the motor circuit with a maximum fault disconnection time of 5 seconds in case of earth leakage without causing nuisance tripping of the motor circuit due to motor starting and transient current transformer saturation.

iv) Auto-Transformer Starters

Unless otherwise specified for the specific type of installations, motors rated above 55 kW shall be reduced voltage started by means of auto-transformer to limit the maximum starting current to within 2.5 times the rated motor full load current.

Reduced voltage starters shall be equipped as per star-delta starters specified above, with the following additional provisions:

- Triple pole air break contactor with electrical and mechanical interlock arranged for automatic reduced voltage transition;
- Air-cooled copper winding auto-transformer with Class F insulation enclosed in an earthed metal casing suitably ventilated by splash proof louvres. Suitable tappings shall be arranged for closed transition reduced voltage motor starting; and
- Calibrated and adjustable solid state timers for switching over from reduced voltage to full voltage connection.

9.2.4. Automatic Power Factor Correction Capacitors

The power factor correction equipment shall include capacitors, protective devices, contactors, control relays, current transformers, cabinet, cables, cable glands, trunkings, control wirings, necessary accessories, etc. The overall power factor at the main and motor control switchboard shall be improved to not less than 0.9.

The capacitor bank shall be wall or floor mounting cubicle-type, built up from static primary capacitor unit. The capacitor bank together with its associated equipment shall not be installed inside the switchboard, where practicable. However, if it is not practical due to physical constraint or other justified reasons, the equipment shall be installed in a separate compartment segregated from the rest of the switchboard.

9.3. HIGH VOLTAGE – ELECTRICAL EQUIPMENT

This section covers the design, manufacture, testing and delivery of high voltage induction motors and associated switchgear of rated voltages 3.3, 6.6 or 11 kV. Unless otherwise specified, the system fault levels shall be assumed to be 150, 225 and 380 MVA respectively.

The Standard Specification relating to high voltage electrical equipment shall be request by the Mechanical Contractor when applicable.

9.4. LABELLING

For electrical panels or other items, lettering shall be:

- Black on white for normal purposes;
- Red letters on white where connected to essential supply; and
- Green letters on white where operated by direct current.

For electrical components, the letter heights shall be as follows:

- Identifying equipment in cabinets - 3 mm;
- Door cabinets - 8 mm;
- Switches & indicators on panel faces - 3 mm

Where proprietary type, rail mounted terminals are utilised in electrical cabinets, the manufacturer’s "clip-in" identification tabs shall be used.

9.5. WARNING NOTICE

Warning notices shall be provided as required by the Electricity Ordinance (Cap. 406) and the Code of Practice for the Electricity (Wiring) Regulations (Cap. 406E). In addition, the following warning notices in English shall be provided at the appropriate positions:

- A label having minimum size of 65 x 50 mm marked with the words ‘DANGER - HIGH VOLTAGE’ in red lettering not less than 5 mm high to be fixed on every container or enclosure of equipment for operating at voltages exceeding "low voltage"; and
- A label to be fixed in such a position that any person may gain access to any moving parts of an item of equipment or enclosure will notice or be warned of such a danger.

10. PAINTING, FINISHING & PROTECTIVE TREATMENT

10.1. GENERAL

All surfaces except otherwise specified in the particular specification, other than those indicated to be left self-finished such as stainless steel, anodized aluminium, shall be finished in first class paint work. All metallic surfaces shall be wire-brushed and cleaned to make it free from rust, scale, dirt and grease prior to painting. Primer shall be applied to metal surface on the same day as they have been clean. All work shall be carried out by qualified tradesmen/skilled workers.

All paints shall be submitted for the approval of the Engineer. The volatile organic compound (VOC) content, in grams per litre, of all paint and primer shall not exceed the prescribed limit under the Air Pollution Control (Volatile Organic Compounds) Regulation or the limit set by EPD, whichever is more stringent.

All painting works shall be completed and left in ventilated environment for at least one week, or the curing period recommended by the paint manufacturer whichever is longer, before occupation or handover of the renovated area to minimise VOC exposure.

All surfaces shall be painted and finished as specified in the Particular Specification to meet and match the aesthetic architectural design as required.

10.2. NUMBER OF PAINT COATS REQUIRED

All painted surfaces are to receive at least one primer coat and two coats of the finishing colour. For external installation / equipment installation, polyurethane paint shall be used for finishing colour to provide better UV resistance unless otherwise specified. Ferrous surfaces shall receive one coat of rust inhibiting primer, one under-coat and two finishing coats.

Where painting is carried out in occupied areas with central air-conditioning or areas without good natural ventilation, pre-painting preparation and primer coat shall be carried out off-site and only the finishing coats shall be painted on-site.

10.3. IDENTIFICATION OF PIPELINES

All pipework in the plant/machinery rooms shall be finished generally in accordance with SANS 10140-3:2003 and ISO 3864-1:2011. All pipework, where exposed on surfaces outside the plant/machinery room, shall be painted either as in the plant/machinery room or to match the surrounding surface with distinguishing colour code bands plus flow arrows in the specified colour scheme as directed by the Engineer.

The basic identification colour or the decoration colour shall be applied over the whole length of the pipe with colour code indicators placed at all junctions, at both sides of valves, service appliances, bulkheads, wall penetrations and at any other places where identification is necessary as directed by the Engineer.

Valves may be painted in the same colour as the associated pipework. However, if the pipeline is part of the fire services installation and has been coded only with the safety colour, the valves involved shall be fully painted "safety-red".

The direction of flow of fluid shall be indicated by an arrow over the basic identification colour and painted white or black in order to contrast clearly with the basic identification colour.

10.4. MACHINERY AND PIPEWORK

All machinery, unless otherwise specified, shall be finished in a colour as instructed by the Supervising Officer at the time of installation. The Mechanical Contractor shall seek the Engineer’s instructions in good time to obtain the materials required. In the event that no instruction is given, the plant shall be painted in opaline green with black relief on flanges in accordance with BS EN 60073:2002.

10.5. COPPER PIPEWORK

Copper pipes and fittings for refrigerant, which are not insulated shall be polished bright by sanding, wiped with mineral spirits and coated with an approved heat resisting clear synthetic varnish.

10.6. COWLS, GRILLES, WEATHER LOUVRES, ETC.

All non-aluminium cowl and grilles etc., shall be hot dipped galvanised after manufacture and shall be primed and painted externally in accordance to the above general requirements.

10.7. PROTECTION OF PLANT, EQUIPMENT, PIPEWORK, ETC.

10.7.1. Temporary Dehumidifiers and/or Air-conditioners

For temperature and/or humidity sensitive electrical or electronic control panels and equipment, the Mechanical Contractor shall where necessary protect them against high humidity and/or temperature by operating portable or temporary dehumidifiers and/or air conditioners in the enclosures containing this equipment.

In order to protect this equipment against dust infiltration, the Mechanical Contractor shall store them in a dust free room or enclose them in heavy duty PVC sheets or bags. Where necessary, filters shall be provided in the temporary air-conditioning systems.

10.7.2. Metal Surface

All stainless-steel parts shall be covered with PVC wrapper of tape until handover. All ferrous parts shall be painted or greased (whichever is most suitable). All bright parts (chrome plates, polished stainless steel or aluminium, etc.) which are liable to deterioration shall be covered with tallow or a suitable protective coating during the progress of work. Upon completion of work, the protective coating shall be removed, and the parts polished as appropriate.

Any damage to the primer or protective coatings shall be made good. When it is necessary to remove, or partly remove the protection for installation or making connections, the Mechanical Contractor shall ensure that the standard of protection provided originally is re-applied at the earliest possible time.

10.7.3. Rust and Foreign Matter

All plants, pipes valves, and fittings shall be, as far as possible, thoroughly cleaned and cleared of rust and other foreign matters both before erection and before subjection to pressure tests.

10.8. PROTECTIVE MEASURES AGAINST CORROSION

Where normal painting is not practicable, all possible measures to prevent corrosion to the plant shall be applied such as special protective coverings, special anti-corrosive paints, etc. as recommended by the supplier or specified in the Detailed Technical Specification.

11. INSPECTION, TESTING & COMMISSIONING DURING CONSTRUCTION PERIOD

Throughout the execution of the installations, the Mechanical Contractor shall be responsible for ensuring compliance with the statutory and related requirements, manufacturers' recommendations and specifications and shall notify the Engineer of any infringement which directly or indirectly detracts from the safe and satisfactory operation of the installations whether or not such infringement relates to the works covered in the installations or to those associated with others. All sub-standard works or defects found during inspection, testing and commissioning shall be rectified or replaced to the satisfaction of the Engineer, at the Mechanical Contractor's expense.

11.1. MASTER PROGRAMME FOR TESTING AND COMMISSIONING WORKS

The Mechanical Contractor is required to submit a programme for testing and commissioning works within the first three months after acceptance of his Tender. The programme shall indicate the tentative dates of all tests and commissioning works that will be carried out throughout the Conditions and all necessary submissions and approval relating to testing and commissioning. The Mechanical Contractor shall ensure that the testing and commissioning programme matches the master programme for construction and that all testing and commissioning works are complete before the prescribed or extended date for completion of the Works. The programme shall also be updated as the Installations progress towards completion.

The programme shall detail the types of testing and commissioning works required, the breakdown of the programme into floor-by-floor and/or area-by-area basis, the tests that are required during construction and before completion of the installations, the period of each test with float time allowed, the milestone dates for the key activities of works etc. Critical path programme shall be submitted. The Mechanical Contractor shall plan the programme so as to minimise overlapping of different tests arranged simultaneously in different areas of the site.

A detailed checklist of all the installations to be commissioned and tested shall be submitted at the same time. The checklist will be used for progress monitoring and shall be updated from time to time as the installations progress towards completion.

11.2. NOTICES OF INSPECTION, TESTING AND COMMISSIONING WORKS

For items to be witnessed by the Engineer or their representative, the Mechanical Contractor is required to provide advanced notice for inspection, testing and commissioning works, together with details of date, time and list of items to be inspected or tested.

Off-site inspections and tests shall be notified of at least one week before commencement of the inspection or test. On-site inspections, tests and commissioning shall be notified of at least 3 days before commencement of inspection, testing or commissioning of any part or parts of the installations.

11.3. LABOUR AND MATERIALS

The Mechanical Contractor is responsible for provision of all labour and both consumable and non-consumable materials for carrying out the inspection, testing and commissioning works at their expenses. Unless otherwise indicated in the Conditions, all electricity supply, water supply, chemicals, and other fuels, such as diesel, LP gas and town gas necessary for the operation of the plant during preliminary runs and for full adjustments and inspection and commissioning tests shall also be arranged and provided at no cost by the Mechanical Contractor. The Mechanical Contractor shall also properly drain the water and exhaust the gas during and after the inspection, testing and commissioning works as required. The Mechanical Contractor shall provide and adopt measures to avoid damage to the building, installations, decorations and fixtures during the inspection, testing and commissioning works for any of the installations.

The Mechanical Contractor shall also provide all necessary calibrated equipment, apparatus and tools for carrying out the inspection, testing and commissioning works. Certified true copy of calibration certificates shall be submitted. The period between calibration and testing shall not exceed the calibration period as recommended by the equipment/instrument manufacturer or 12 months whichever is shorter.

The Mechanical Contractor shall despatch competent and experienced commissioning personnel to carry out the inspection, testing and commissioning works.

11.4. TYPE-TEST CERTIFICATES

"Type-tests" for materials and equipment, where specified, shall be carried out at the manufacturer's works, recognised institutions or accredited laboratories in order to demonstrate their compliance with the specified requirements. "Type-test" certificates together with the corresponding drawings, sketches, reports and any other necessary documents shall be submitted to the Engineer for approval before delivery of the materials and equipment. Cases where appropriate, "type-test" certificates will be accepted are as follows:

- Fans: "type-test" certificates showing fan characteristic curves (ISO 5801:2007/Cor 1:2008), "type-tests" certificates for sound power levels (BS EN ISO 5136: 2010), fan dynamic balancing test certificates completed with a method of statement from manufacturer on testing to Grade 2.5, 4 & 6.3 on appropriate fan types in accordance with ISO 1940-1:2003/Corr 1:2005 and ISO 21940-14:2012.
- Pumps: "type-test" certificates for head, discharge, speed and power input (BS EN ISO 9906:2012 as appropriate).
- Electric motors: "type-test" certificates in accordance with BS EN 60034-1:2010 and/or IEC 60072-1:1991, IEC 60072-2:1990 & IEC 60072-3:1994.
- Low voltage starter switchgear and control gear assembly: "type-test" certificates for starter (e.g. auto-transformer) and control panels assembly as a whole in accordance with IEC 61439-1:2011.
- High voltage switchgear and motor control switchboard: "type-test" certificates for high voltage switchgear and switchboard in accordance with IEC 62271-100:2008+AMD1:2012.
- Other electrical equipment, such as air heaters (but excluding thermostatic control equipment): "type-test" certificates in accordance with BS EN 60335-1:2012+A11:2014, BS EN 60669-1:1999+A2:2008, BS 5733:2010+A1:2014 and BS EN 60670-22:2006.
- Refrigeration plant: "type-tests" Certificates for hydraulic and air pressure testing at works in accordance with BS EN 378-1:2008+A2:2012, BS EN 378-2: 2008+A2:2012, BS EN 378-3:2008+A1:2012and BS EN 378-4:2008+A1:2012.

11.5. OFF-SITE TESTS / FACTORY TESTS

Factory tests and off-site tests as required shall be carried out at the manufacturer's works, laboratories by independent regulatory/testing bodies, independent accredited laboratories or elsewhere as approved. This shall include quality control tests and general inspection tests in factory recommended by the manufacturer or for compliance with relevant standards.

Where collection of test samples on the site is required for the off-site tests, i.e. indoor air quality test and water quality test for fresh water cooling tower, the Mechanical Contractor shall submit the sampling and analysis methodology, including but not limited to the proposed independent accredited laboratory and the procedures for collection and analysis of test samples and submission of test results, for the Engineer's approval. The Mechanical Contractor shall notify in advance the date for collection of test samples to the Engineer, who shall supervise the sampling, transport and delivery of the test samples. Collection of test samples shall be conducted by the independent accredited laboratory unless otherwise agreed by the Engineer. The collected test samples shall be kept in sealed and locked containers inaccessible to unauthorised persons at all times. The test results in sealed envelope shall be submitted by the independent accredited laboratory to the Engineer directly.

Where specified, performance tests shall be carried out in factory for each or some of the offered equipment before delivery. After the performance tests, factory test report/certificate certified by a qualified factory engineer shall be submitted in duplicate to the Engineer for approval immediately after the tests and before the equipment is dispatched from the manufacturer's works.

Factory tests shall be witnessed by an independent approved agency where specified. The Mechanical Contractor shall note that the Engineer may require witnessing the tests and inspection of locally and/or overseas manufactured equipment during construction at the manufacturer's works.

11.6. SITE TESTS

The Mechanical Contractor shall carry out site tests for all static systems during construction period for individual components and/or part of the installed works to ensure safe and proper operation of the complete installation according to the specified requirements. Such tests shall include integrity test of welds and pressure test on the

hydraulic systems where applicable. Any component or equipment set to operate at or below the test pressure shall be isolated or removed prior to applying the pressure test. Site tests for electrical works in the installations shall comply with the COP for the Electricity (Wiring) Regulations unless otherwise specified. Registered or suitably qualified workers shall be deployed to conduct site tests, where applicable, for the installations.

Works to be permanently covered up shall be subject to inspection and testing before covering up. If the Engineer or their representative discovers any work that has been covered up before inspection and testing, this work shall be uncovered for inspection and testing to the satisfaction of the Engineer or their representative. The cost involved in uncovering the work, inspecting, testing and re-concealing the work together with any consequential losses shall be paid by the Mechanical Contractor at no additional cost to the Client.

In particular, the following arrangements shall also be included:

- The Mechanical Contractor shall carry out "on-site" tests in respect of all static systems to ensure safe and proper operation as conforming to the design intent. Such tests shall include test of welds and pressure tests on the hydraulic systems. Any items of equipment set to operate at or below the test pressure shall be isolated or removed prior to applying this test.
- On completion of cleaning operations, each water distribution system shall be re-charged with clean water and then subjected to a hydraulic test.
- All ductwork shall be tested for air leakage.

11.7. INSPECTION

11.8. Inspection of Materials and Equipment Delivered to Site

The Mechanical Contractor shall provide details of materials and equipment delivered to the site including, but not limited to, brand name, model number, country of origin (if specified), their tested standards and record of the Engineer's approval, purchase order, delivery order, record of delivery, payment vouchers, ex-factory certificate and shipping voucher, and all other relevant documents as applicable to the Engineer for identification and verification of the materials and equipment delivered to the site are in compliance with the approved submissions.

11.9. Visual Inspection

The Mechanical Contractor shall be responsible for arranging adequate provisions to facilitate visual inspections and checking of the work in progress to be carried out by the Engineer or their representative from time to time during the construction period. The Mechanical Contractor shall keep such inspection record for checking from time to time. Any defective works or sub-standard works found during visual inspection and checking shall be rectified or replaced before proceeding with further tests.

Visual inspection and checking shall include but not limited to the inspection and verification of the installed equipment being the approved brands and models and checking of any visible damages (such as scratches or dents, or painting problems) found on the equipment surface.

11.10. Handover Inspection and O&M Manuals

The Mechanical Contractor shall carry out detailed inspections for all components and equipment installed by him and make all necessary checking including operational settings for all equipment and systems in accordance with the instructions and recommendations from the manufacturer and to the satisfaction of the Engineer before the handover of the installations.

If it is considered difficult or impossible to gain access to a part or parts of the complete installation for dismantling or maintenance purposes, the Mechanical Contractor shall be required to carry out demonstrations on dismantling and assembling those parts/components of the installation to confirm the provisions are adequate. The Mechanical Contractor shall be responsible for carrying out all necessary modification work at no additional cost to the Client to alleviate the difficulties associated with dismantling or maintenance access.

The Mechanical Contractor shall note that the installations cannot be handed over until all the foregoing requirements where applicable have been carried out to the satisfaction of the Engineer.

The Mechanical Contractor shall provide the following documents and data before the handover inspection:

Test Certificates

- Copies of manufacturer's works test records/certificates on plant items comprising heat generating plant, heat exchangers, chillers, packaged air-conditioning units, tanks, vessels, motors, fans, pumps, etc.;
- Copies of hydraulic and pressure test records/certificates for works carried out on site;
- Copies of boiler and/or refrigeration plant efficiency test/record certificate;
- Copies of Registered Surveyor's test/record certificates for pressure vessels (if any);
- Copies of performance test/record certificate including water balancing, air balancing, room conditions, etc. These certificates shall be accompanied with all appropriate charts and diagrams;
- Copies of all noise test/survey records on every noise emitting plant and machineries, individual room/space and a statement of compliance with the statutory requirements under the current Noise Control Ordinance (Cap. 400); and
- Copies of works completion certificates for electrical works.

Installation "As-built" Drawings

The installation drawings to be supplied with the instruction manuals shall be neatly prepared and photographically scaled down to the same size as the manuals and bound therein or separately in a matching cover. They shall be compiled generally in accordance with the following outline and under the following headings:

- Plant layout drawings showing the actual positions and sizes of all equipment, ducts, pipes, dampers, valves, controls, measured air quantities at all fan intake and discharge points, and all other items relevant to the system.
- Schematic drawings (controls, wiring and piping schematics) noting the normal and abnormal gauge readings, control points, scale and time settings, differential bands, throttling ranges, time relays, overload settings, actual rated amps of all electrical components, and all other variable features of the system and components.

Operation and Maintenance Manuals and User Manual (4 hardcopies and 4 CD's provided to Engineer)

To be bound in a durable Vinyl hardback folder with name of job, Contractors' and Engineer details stamped on the front. The full O&M's are to also be duplicated on CD's to be submitted to the Engineer with the hardcopies.

To be compiled generally in accordance with the following outline and under the following headings:

i) Index (detailed)

ii) General Description of Plant (as installed)

iii) Plant Operation and Starting and Stopping Procedures
   - To include automatic and manual start up and shut down procedure: end of season shut down procedure (if applicable), and operation log sample pages.

iv) Automatic Controls and Switches
   - Description of operating sequences including time clock settings where required, duplicating and supplementary to instructions in plant room. Functions of all switches, indicator lights, alarm etc. Instructions for resetting controls and cut outs and adjusting same.

v) Electric & Mechanical Equipment
   - General description and list of complete motor nameplate data and scale and actual overload settings. Equipment to include supplier's name and telephone number and equipment make, model numbers, etc.

vi) Test Report
   - Copy of "Final Test" report as accepted by the Engineer. Draft copy of "Operating Instructions" for Engineer's approval shall contain a copy of the "Preliminary Test" report.

vii) Installation Drawings

viii) Copies of Instructions Framed in Plant Room

ix) Maintenance Schedule
   - Set out item, frequency, materials to be used, etc. as necessary for normal preventive plant maintenance.

x) Manufacturers Descriptive Literature
   - To include manufacturer's operating and maintenance instructions, performance curves/charts and spare parts lists, with detailed description of parts, make, model number, supplier's name and address.

Manufacturer's Name Plate

Every item of plant/equipment supplied by a manufacturer, if any, shall be fitted with a clearly engraved, stamped or cast manufacturer's name plate properly secured to the plant/equipment/apparatus and showing:

- Manufacturer's Name;
- Serial and/or Model No.;
- Date of Supply;
- Rating/Capacity; and
- Test and Working Pressure (where applicable).

Instructions Framed in Plant Room

The instructions for operation of the plant shall include demonstrations of the correct performance and function of each piece of equipment under both automatic and manual control. If necessary, this service shall be arranged in two parts to adequately demonstrate operation of the plant under summer and winter conditions to ensure adequate education of the owner's representative.

Operating instructions are to be framed behind glass or transparent plastic and mounted in the plant room to Engineers approval. Schematic drawings shall be photographically reduced and framed behind glass and mounted in the plant room to Engineers approval. In the absence of a plant room, an alternative position shall be determined after consultation with the Engineer.

Labels and Related Instructions

Labels and the related instructions shall be provided according to relevant clause(s) of this General Specification.

11.11. DOCUMENTATION AND DELIVERABLES

The Mechanical Contractor shall submit full commissioning and testing report to the Engineer within 14 (fourteen) days after completion of the commissioning and testing of the installations. The report shall be in accordance with the requirements approved by the Engineer.

12. TRAINING, INSPECTION, ATTENDANCE, OPERATION AND MAINTENANCE DURING MAINTENANCE PERIOD

12.1. GENERAL REQUIREMENTS

Unless otherwise specified in the Detailed Technical Specification, the Mechanical Contractor shall provide training, inspection, attendance and operation and maintenance services for the installations during the Maintenance Period as specified in this Standard Specification.

The interruption of electricity supply and functioning of the installations during execution of works shall be kept to the minimum. Such interruption shall only be allowed with the prior approval of the Client representative.

The Mechanical Contractor shall provide all the Level One Services as specified in this Standard Specification for all installation works.

Level Two Services detailed in this Standard Specification shall only be carried out if specified as a 12-month maintenance and guarantee period in the Detailed Technical Specification. The specified Level Two maintenance responsibilities shall be priced separately in the Tender.

12.2. TRAINING

Training for the operation and maintenance of system and equipment shall be provided and arranged by the Mechanical Contractor; and shall be priced in the Tender bill. The training shall include all training facilities, material and handouts etc. The Mechanical Contractor shall submit a “Training Schedule” at least 3 months prior to the prescribed or extended date for the completion of Works for the Engineer’s approval.

The schedule shall include but not limited to the following requirements:

- Provision of facilities and training programmes to ensure the Client’s operation and maintenance staff acquire full knowledge and operation, breakdown and routine maintenance, diagnosis and hence operate and maintain reasonably effectively and efficiently the system/equipment including the monitoring and control system offered. The training proposal shall include all aspects of operation and maintenance of the plant including the use of special tools.
- Equipment portfolio to include quantity of equipment, equipment cost, recommended serviceable life by the manufacturer and cycle of major overhaul;
- The training proposal shall also include details and duration of the training course(s), qualifications of the instructor and the qualification requirements for the trainee(s);

12.2.1. Training Requirements

The training course shall contain, but not be limited to, the following:

- General description of the system and its associated equipment as a whole;
- Start-up and shut-down procedures and safety precautions;
- A detailed description of the functions of all switches and indicators on control console;
- Troubleshooting procedures;
- Preventive and corrective maintenance requirements to ensure proper operation of a system or equipment under the maintenance programme;
- Identification and adjustment of all the operating parameters which affects the performance of the plant;
- Check-list of all the periodic inspection and servicing of the plant;
- Illustration of the construction of major components of the plant by sectional views;
- Dismantling and reassembling procedures during a major repair;
- Critical dimensions such as bearing clearance, wearing ring clearance, thrust clearance, torque table for bolts and nuts, etc.;
- The use of special tools;
- Calibration for testing equipment, measurement, record and performance assessment; and
- Any other items as found necessary.

12.3. INSPECTION, ATTENDANCE, OPERATION AND MAINTENANCE REQUIREMENTS

12.3.1. Response and Attendance to Emergency and Fault Calls

The Mechanical Contractor shall attend to emergency, fault and complaint calls arising from defective work materials and/or system operation within one hour at any time during the Maintenance Period and rectify all defects leading to fault or breakdown of the equipment and/or system within the time as specified in contract documents. The costs for the attendance, labour, materials and spare parts for repair, submission of fault/breakdown reports, etc. are deemed to have been allowed for in the Tender.

12.3.2. Maintenance Schedule

The Mechanical Contractor shall prepare and submit the maintenance programme before the commencement of the Maintenance Period for the approval of the Engineer.

Upon the approval of the above maintenance programme and before the commencement of the Maintenance Period, the Mechanical Contractor shall prepare a comprehensive maintenance schedule for all installations and indicate dates for routine and periodic inspection, servicing and maintenance of the installations.

12.3.3. Inspection During the Maintenance Period

The Mechanical Contractor shall, in addition to the routine servicing and maintenance, make further inspections for the installations to check and, if necessary, re-adjust the equipment/systems to meet actual operation conditions and to test installations to meet statutory requirements including submission of reports and certificates.

12.3.4. Joint Inspection at the End of the Maintenance Period

The Mechanical Contractor shall attend inspections to the installations at the expiry of the Maintenance Period in order to facilitate the acceptance and handing over of the installations to the Client's operation and maintenance agents. The Mechanical Contractor shall conduct site checking and make necessary adjustments to the equipment/systems one month before expiry of the Maintenance Period to ensure that the Installations are in good working order, safe and satisfactory operation condition for handover. If the installations are unacceptable by the Engineer, the works covered above may have to be repeated at the Mechanical Contractor's expenses.

12.4. LEVEL ONE SERVICES – MANDATORY RESPONSIBILITIES DURING MAINTENANCE PERIOD

The Mechanical Contractor shall also be fully responsible for the following within the Maintenance Period, in addition to the related aspects as stipulated in other clauses under this section:

12.4.1. Instruction to Employer's Operation and Maintenance Staff

After the Works has been successfully handed over and put into operation, the Mechanical Contractor shall provide full time attendance for a period of at least 20 consecutive days or as stated in the Detailed Technical Specification, by a qualified operator(s) who shall be fully conversant with the operation and maintenance of the plant. Their duties shall be to operate the systems and to guide and instruct the Client's operation staff such that they will become fully conversant with the operation of the complete installations.

Note: This commitment shall be carried out where the operational responsibilities are to be immediately transferred to the Client's own staff or at the end of Levels Two Services operational arrangements.

12.4.2. Completion of Any Outstanding Work

The Mechanical Contractor shall complete all outstanding works listed thereon and rectify any defects that have arisen up to that time according to time frame as specified in the list of defects and outstanding works issued together with the letter of substantial completion.

12.4.3. Servicing, Replacement and Replenishment

During the Maintenance Period, the Mechanical Contractor shall supply and install, without additional charge to the Client, replacements for all and any equipment or parts thereof or liquids or gases, which may, in the opinion of the Engineer, became unserviceable, especially where the causes are attributable to faulty materials, workmanship, or inadequate performance. The Mechanical Contractor shall, at his own cost, cover replacement of liquids or gases,

oils and refrigerant which may be lost by leakage or become contaminated or in other respects unserviceable. No replacement of plant or parts of plant shall be carried out at any time unless the Engineer has previously been notified and approved.

In the execution of servicing and maintenance, repair and operation work on site, apart from transportation, necessary labour, tools, equipment and testing instruments, the Mechanical Contractor shall also be responsible for keeping adequate stocks of spare parts/equipment and other items necessary to maintain all emergency repair in an efficient, satisfactory and safe operation condition at all time.

12.4.4. Annual Inspection and Submission of Maintenance Certificate

Before the expiry of the Maintenance Period, the Mechanical Contractor shall carry out and submit the annual inspection and submission of ventilation certificate for the ventilating system as required under Building (Ventilating Systems) Regulations to the Director of Fire Services of the completed installations.

12.5. LEVEL TWO SERVICES – SPECIFIED CONTRACTOR'S MAINTENANCE RESPONSILIBIES DURING MAINTENANCE PERIOD

Where specifically required in the Contract, such as period of a 12-month maintenance and guarantee period included in the Tender, the Mechanical Contractor shall allow for and carry out full and comprehensive maintenance of the installations during the Maintenance Period by skilled craftsmen. The works shall in addition to those required under the LEVEL ONE SERVICES include also the following:

12.5.1. Mechanical Contractor's Responsibilities for Breakdown Call-Out

The Mechanical Contractor shall offer efficient and prompt response to breakdown call-out for the installation/equipment failure. The expedition of response shall be in accordance with the following categories:

- VERY URGENT for installations breakdown including failure of chiller, compressor, circulation pump, pipe burst, water dripping, fire alarm and electricity power failure, the Mechanical Contractor shall respond and attend to the Very Urgent calls within 30 minutes;
- URGENT for abnormality of equipment operation, the Mechanical Contractor shall respond and attend to the Urgent calls within 1 hour from the receipt of the calls; or
- NON URGENT for abnormal room air condition, the Mechanical Contractor shall respond and attend the fault within 4 hours.

The investigation report and proposal for repair/improvement/ modification shall be submitted timely with time frame as instructed by Engineer or their representative.

The Mechanical Contractor shall promptly complete any repair necessary for resuming the breakdown installation. In case immediate permanent repair is not possible due to safety related reason, the following "time for repair" targets counted from the receipt of breakdown or fault call shall be complied with:

- Complete temporary repair for resumption of the suspended or breakdown services to a safe operating condition within 24 hours; and
- Complete permanent rectification works within 3 working days unless long component and parts delivery time is required.

12.5.2. Maintenance Programme and Schedule

The Mechanical Contractor shall prepare, submit and seek endorsement on the maintenance program before the anticipated commencement of the Contract Maintenance Period. The maintenance programme should include Monthly Routine Service, Half-Yearly Service and Annual Maintenance.

Upon the approval of the above maintenance program, the Mechanical Contractor shall prepare a comprehensive maintenance schedule for all installations and indicate dates for routine maintenance of the installations before the anticipated substantial completion.

12.5.3. Co-ordination

The Mechanical Contractor shall co-operate and co-ordinate with the Engineer's representatives, user department, user department's maintenance agent, utility supply companies and the public authorities for the smooth execution of maintenance works.

12.5.4. Plant Log and Breakdown / Fault Call Report

The Mechanical Contractor shall submit daily record of the following reports at 3 (three) month intervals:

- Record of current status of plant and major equipment, all services, maintenance and repair/replacement carried out for the plant and equipment including the following details:
    - supply and return chilled water temperature;
    - lubrication oil pressure gauge readings;
    - refrigerant pressure gauge readings;
    - system chilled water flow rate and its percentage against designed value;
    - circulation pump suction and discharge pressure;
    - refrigerant compressor suction and discharge pressure; and
    - dry and wet bulb temperature of supply air at designed offices, function and conference rooms and that of return air at system return and outdoor air condition.

- Equipment Breakdown Report
    - Equipment breakdown report shall be submitted after the rectification work and shall have full details of findings during investigation/examination on cause of breakdown, account of repair/replacement work needed, suggested precaution and/or action required to prevent the recurrence of similar incident.

12.5.5. Repair and Maintenance Records

The Mechanical Contractor shall be responsible for maintaining a log-book in each of the specific locations (e.g. switch room, plant room, etc.) as agreed with the Engineer or their representative. Every attendance and details of work done for the installations including but not limited to repair, servicing and maintenance shall be entered into the log-book by the Mechanical Contractor so as to form a comprehensive record of attendance and works done. The log-book must be completed in English. In addition, the Mechanical Contractor shall also keep repair and maintenance records for the installations in his own office and shall be required to forward such records for checking if so requested by the Engineer.

Failure to keep a record in the log-book with the serviceman's name shall render the service done on that particular date not done. The maintenance costs are paid up-front, however should any of these services not be done, the pro-rata costs shall be deducted from the retention monies which gets released at the end of the 12-month maintenance period.

12.5.6. Monthly Works

12.5.6.1. General

- To check the condition of the plant and equipment such as chillers, compressors, condensers, heat recovery equipment, heat pumps, coils, chilled water pumps, make-up water tanks, AHUs, fan coil units, water treatment equipment and the associated electrical, electronic, mechanical controls and circuit boards; and thus to ensure the plant and equipment are satisfactorily operating within design conditions;
- To check and record on log sheets the system performance and related parameter readings such as inlet/outlet temperatures, pressures, humidity, etc.;
- To check the condition of the operating refrigerant and recharge as necessary;
- To check the lubricating system of all running pumps, cooling fans, fan blowers, compressors, control mechanisms and any other running parts; cleaning, greasing and oiling where necessary;
- To check for abnormal running noise and vibration and rectify accordingly;
- To check that the control and monitoring system is working satisfactorily, parameters are set accordingly, and rectify if necessary (including any motorised dampers, control valves, etc.);

- To examine all mountings (gauges, pressure relief valves, etc.) to see that they are not damaged, and restore to full working order, or replace if necessary;
- To examine the condition of joints, valves, covers and seal for leaks, repair accordingly;
- To check water leakage from the pipework and equipment and repair if required (drain pans included);
- To keep all supply and return grilles and louvers clean and clean and replace any filters if required;
- To check fan blades, belts and bearings, and make necessary adjustments/replacements accordingly;
- To check all electrical wiring and connection and circuit protection devices including switchgears and starters, and rectify or replace accordingly;
- To check the corrosion of metal surface, framework and support/mounting brackets, etc., and to reinstate the surface by removing rust and repaint if necessary;
- To check the operating conditions of water cooling tower including the running current, water refilling rate, water quality and other important operating parameters; to conduct water quality and bacterial test; and to make all necessary submission to the regulating authority; and
- To check and ensure that the operation conditions of the water treatment system are in accordance with the Specifications and recommendation by the manufacturer.

12.5.7. Half-Yearly Works

- To inspect the condition of pipe fittings, supports, ductwork, hangers, etc., for sign of corrosion. Remove the rust and repaint with primer and finish coating as necessary;
- To check the performance of controls and safety cut-outs and check all control panel indication lamps, rectify as required;
- To clean electrical panels including wiring terminals and connection points;
- To touch up with finish-coating where there is any rust or sign of corrosion of the equipment by first removing the rust/corrosion;
- To check and adjust, if necessary, the air flow in the air-ductwork system;
- To clean all the air-cooled condenser coils by high-pressure water or steam jet with approved cleaning detergent to ensure that high heat transfer efficiency is maintained;
- To clean the cooling/heating coils (excluding fan coil units) by high-pressure water or steam jet with approved cleaning detergent to ensure that high heat transfer efficiency is maintained;
- To check and serve all IAQ control and sensing equipment including CO_2 sensors, air movement sensors, thermostat, humidifiers, dehumidifiers, humidistat, pressure and volume control dampers;
- To inspect components of ventilation system for cleanliness and microbial growth and clean them; and
- To clean, dislodge and disinfect cooling towers, if applicable.

12.5.8. Annual Works

- To inspect the condition of pipe fittings, supports, ductwork, hangers, etc., for sign of corrosion. Remove the rust and repaint with primer and finish coating as necessary;
- To check the condition of pipe work and ductwork. Recondition and if instructed, replace the deteriorated portion in accordance with the Specification, acceptable engineering practice and standard;
- To refit the isolating valves, change the gland and gasket, and recondition globe valves, etc. if necessary;
- To examine, check and maintain the proper operation of associated electrical panels in the plant room. Repair and renew as appropriate;
- To check, test and recalibrate or replace as necessary, all control and safety devices;
- To check inlet guide vane of centrifugal compressor;

- To check, test, adjust, clean and repair/rectify defects if required for all electronic circuit boards and control/sensing/detection devices including building automation system if available in the system;
- To inspect and clean all internal surface of ductwork including the supply and return air plenums. The cleaning of ductwork shall not affect the normal operation of the building. The Mechanical Contractor shall arrange the cleaning work after the building office hour;
- To check and re-tighten any loose bolts and nuts in proper sequence.

12.6. SPARE PARTS AND SPECIAL TOOLS

For plant and/or equipment included in the Contract, the Mechanical Contractor shall provide the types of spare parts generally wherever these are appropriate to the plant and/or equipment involved plus any additional items for the particular plant and/or equipment.

Unless otherwise specified, within 4 (four) months of the acceptance of the Tender, or in such period of time as has been agreed by the Engineer in writing, the Mechanical Contractor shall submit in respect of the proposed plant and/or equipment a list of the manufacturer's recommended spare parts that are likely to prove necessary to service the plant and/or equipment during the first year's operation and parts required immediately following the expiry of the Maintenance Period.

The spare parts submission shall include diagrams or catalogue details of the parts concerned. Unless specified in detail, the criteria by which the Mechanical Contractor shall judge the need for spare parts to be included in the list shall be any part or component of the plant or equipment that is subject to frictional wear, vibration or temperature fatigue, rupturable to safety (or otherwise), corrosion, erosion, unacceptable deposits and/or saturation by contaminants (such as for filters), normal fair wear and tear and is likely to fail or reach an unacceptably low performance level within a period of three years or less from its commencement of operation.

The list shall include at least the following items where they are part of the installations:

- Springs, valves, valve rings, valve plates, etc.;
- Bearings or bearing bushes;
- Electric carbon brushes;
- Electrical main and arcing contacts;
- Driving belts in matched sets;
- Standard and special replaceable type air or liquid filter media;
- Gaskets and jointing, seals, gland packings, etc.;
- Rupturable safety devices, sight glasses;
- Replaceable heat exchanger tubes;
- Plug-in relays, indicator light lamps, non-standard fuse cartridges;
- Overload heaters/coils; and
- Flexible hoses and similar.

Any of the above spare parts and/or disposable items which are required to replace defective or prematurely worn out parts that arise during the Maintenance Period shall be replaced by the Mechanical Contractor at no cost to the Client before the Maintenance Certificate is issued. The above items shall not be exhaustive. The Mechanical Contractor shall be responsible for the replacement of other parts and components for normal operation of the installations.

Additionally, the Mechanical Contractor shall submit within the same period a priced schedule for the supply of any special tools necessary for servicing and maintenance of any part of the installations. Instructions for purchase of any special tool shall be issued separately but the basis for charging shall be similar to that for the Mechanical Contractor's equipment manufacturer's recommended spare parts. The purchase of the needed spare parts and tools shall be secured by Engineer's instruction. The exact types and quantities shall be determined by the Engineer based on the Mechanical Contractor's best advice and at the most appropriate time during the Contract Period when requirements can be most realistically assessed taking account of the installations as installed or still being installed.

Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 5

Bartsch

BARTSCH CONSULT (Pty) Ltd

UMSUNDUZI MUSEUM

ROOF LEAK REPAIR SPECIFICATIONS AND METHODOLOGY – MAIN BUILDING UMSUNDUZI MUSEUM, 351 LANGALIBALELE STREET, PIETERMARITZBURG, KZN, 3201

PREPARED BY
BARTSCH CONSULT

Rev. 00 - JUNE 2023

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1. BACKGROUND

The uMsunduzi Museum precinct consists of multiple heritage buildings on a site located at the corner of Langalibalele & Boshoff Street in central Pietermaritzburg.

Bartsch Architects was awarded a tender by the uMsunduzi Museum to carry out the final stages of an existing upgrades and refurbishment project, undertaken by the Client 10 year prior. The previous project never reached construction stage, and the Client now desires to implement that project scope for construction. The project is now known as the "*Refurbishment and Upgrading of uMsunduzi Museums Buildings"* project.

The existing project consisted of upgrading the electrical, mechanical, fire and universal access facilities, as well as maintenance related building work to all of the buildings falling with-in the Museum precinct.

After budget constraints and consideration of the updated recommendations from the Consulting team, the Client identified Block M (Main Building) as the prioritised building to focus on for this contract.

During the period of preparation of tender and construction documentation, repair works were being carried out on the roof of the main building under a separate contract. It was intended that these roof repairs would be complete prior to the upgrading of the electrical, mechanical, fire & universal access.
While this process was being undertaken for these upgrades it was brought to the team's attention that the roof repair work carried out had not succeeded in resolving the water leaks throughout the main building. The team was then asked to prepare a roof assessment report on the current condition of the main building roof, highlighting what is considered as being the main causes for the water leaks.

Upon completion and presentation of the assessment report, the team was requested to prepare the necessary documentation and specifications to have the main building roof correctly repaired. This document serves as the specification and methodology document for this work and will subsequently be accompanied by detailed drawings.

2. GENERAL PROJECT INFORMATION

Project Team:

Employer:

The uMsunduzi Museum

351 Langalibalele Street
Pietermaritzburg, 3201
KwaZulu-Natal

Tel: 033 394 6834 lbarnwell@msunduzimuseum.org.za

Project Manager:

Charles Consulting

4 Rockdale Avenue, Westville
Durban, 3610
KwaZulu-Natal

Tel: 031 266 8615 serica@vcags.co.za

Architect:

Bartsch Consult (PTY) LTD

Suite 8, NTE House, Redlands Estate
1 George MacFarlane Lane
Pietermaritzburg, 3201
KwaZulu-Natal

Tel: 033 342 8527 admin@bartschkzn.co.za

Quantity Surveyor:

TBA

Contractor:

TBA

(public project, subject to tender processes)

Site:

The uMsunduzi Museum

351 Langalibalele Street
Pietermaritzburg, 3201
KwaZulu-Natal

Extent of the works:

1. Roof Coverings:

- Repair/ Replace Tiled Roof Covering
- Repair/ Replace Sheet Metal Roof Covering
- Repair/ Replace Roof Underlay
- Repair/ Replace Lead Roof Covering
- Repair/ Replace Flat Roof Waterproofing
- Repair Roof Covering Overhang into Gutters
- Repair Roof Covering Overhang into Valleys

2. Roof Valleys

- Repair/ Replace Tiled Roof Valleys
- Repair/ Replace Tiled Roof Valley Structure
- Repair/ Replace Sheet Metal Roof Valleys
- Repair/ Replace Sheet Metal Roof Valley Structure

3. Roof Flashings, Ridge Caps & Hip Caps

- Repair/ Replace Tiled Roof Ridge Caps
- Repair/ Replace Sidewall & Headwall Flashing
- Repair/ Replace Dormer & Turret Roof Ridge Caps
- Repair/ Replace Dormer & Turret Roof Flashing Between Sheet Metal Covering and Tiled Covering

4. Box Gutters

- Repair/ Replace Box Gutter Waterproofing
- Repair/ Replace Box Gutter Structure
- Repair Waterproof Junction Connections Between Box Gutters and Walls
- Repair Waterproof Junction Between Roof Covering and Box Gutter
- Install New Hail Guard Mesh

5. Eave Gutters

- Repair/ Replace Gutters
- Replace/ Repair Damaged and Broken Gutter Brackets

6. Fascia & Barge Boards

- Replace Damaged and Rotten Fascia & Barge Boards
- Repair Fascia & Barge Boards That Have Weathered

7. Downpipes

- Repair/ Replace Downpipes From All Gutters
- Repair/ Replace Downpipe Hopper Heads
- Repair/ Replace Downpipe Brackets
- Repair/ Replace Downpipe Shoes
- Fit New Spreaders onto End of Downpipes That Discharge onto Lower Roofs

8. Dormer & Turret Roof Structure

- Repair/ Replace Timber Support and Framing Structure
- Repair/ Replace Timber Eaves and Barge Boards
- Replace/ Repair Timber Louvers & Sills

9. Parapet Wall Copings

- Repair/ Replace Plaster Copings Atop Walls
- Repair Mortar Joints of Roller Brick Course Atop Walls

10. Mouldings Waterproofing Layer

- Repair Waterproof Layer of Protruding Wall Mouldings

11. Timber Windows & Louvers

- Repair/ Replace Timber Windows
- Replace Missing Glass Windowpanes
- Repair/ Replace Timber Louvers

12. External Timber Ceilings & Eave Closures

- Repair/ Replace Timber Ceilings
- Repair/ Replace Timber Eave Closures

Quality of the works:

The Museum Main Building is a listed Heritage building (National Monument) and therefore only experienced and qualified tradesmen are permitted to carry out the works for this project where any changes to the existing building and its finishes are affected.

The work carried out must in all instances where reasonably possible be a like for like process, where all new or repaired elements are to match in material/ profile/ fitment etc. as what is current and considered to be original methods.

All work and specifications to be carried out for the project must be done in strict accordance to this specification and methodology document and accompanying detail drawings.

Issued drawings:

Architects: 5044-101a Existing Main Museum Roof Layout with Areas of Work for Repairs

3. REPAIR SPECIFICATIONS & METHODOLOGY

Roof Coverings

1.1 Broseley Tiled Roofs:

PREPARATION
• Identify areas of broken tiles • Determine required number of tiles and procure tiles to match (tiles may have to be imported if local reclaimed stock not sufficient) • Remove tiles in sections, working from eave to ridge (working only in areas that can be completed in single day) • Tiles to be carefully removed and kept safe for reuse. Weight to be evenly spread across roof sections when working, to mitigate breakage of existing roof tiles
INSPECTIONS
• Inspect battens for strength and stability, and whether there is wood rot or deterioration • Inspect the roof underlay • Inspect the tile fixing nails/ screws • Inspect removed tiles to determine they are not damaged and are reusable
APPLICATION

• Remove Any Broken Roof Tiles:
  ○ Remove tiles from eave end upward towards affected area, keeping all removed tiles and fixings safe and secure for reuse
• Remove Any Battens That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  ○ Replace with new timber battens, to match existing in size (38x38mm).
  ○ Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
• Remove Badly Damaged Underlay Or Repair Existing:
  ○ Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
  ○ Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides
• Replace & Refit Roof Tiles:
  ○ Replace damaged roof tiles with new Broseley tiles, to match existing, using tiles procured prior to work commencing
  ○ Reuse existing copper fixing nails where possible, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens
  ○ Replace unusable fixing nails with new copper nails to match, if cooper nails are not available use 45x6mm galvanised Timber Screws, screws to have 3mm thick rubber washer between tile and screw head. All fixings to be lightly hammered/ tightened so as to not break tiles and allow for movement

1.2 Sheet Metal Roofs:

PREPARATION
• Identify roof sheets that require repair • Identify roof sheets that require replacement • Identify quantity of roof sheet fixings required • Identify required length of timber purlins for replacement
INSPECTIONS
• Inspect purlins for strength and stability, and whether there is wood rot or deterioration • Inspect the roof underlay • Inspect the roof sheet fixings • Inspect the condition of the roof sheeting
APPLICATION
• Remove Roof Sheets & Repair: o Remove existing sheets, send roof sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) o Repaired roof sheets to be galvanised o Paint roof sheets top side & underside, prior to install. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets. o Fix sheets with 65mm Topspeed galvanised fixings, on crest of roof sheets, 3x fixings per sheet at every purlin, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens o Final coat of paint to be applied once installed to both sides, with 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets. • Remove Roof Sheets & Replace: o Remove existing sheets o Replace roof sheets with new 0.8mm galvanised Corrugated 10.5 Profile roof sheets, to have a min of 2.5 side laps, and 250mm end laps o Paint roof sheets top side & underside, prior to install. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets. o Fix sheets with 65mm Topspeed galvanised fixings, on crest of roof sheets, 3x fixings per sheet at every purlin o Final coat of paint to be applied once installed to both sides, with 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets. • Remove Any Purlins That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe: o Replace with new timber purlins, to match existing in size (38x38mm).

- Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Remove Badly Damaged Underlay Or Repair Existing:
  - Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
  - Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides

1.3 Lead Roof Covering (Dormer & Turret Roofs):

PREPARATION
• Identify roof sheets that require refurbishment • Identify roof sheets that require re-fixing • Identify quantity of roof sheet fixings required • PPE and precautions to be in place for working with lead products
INSPECTIONS
• Inspect purlins for strength and stability, and whether there is wood rot or deterioration (internally) • Inspect the roof underlay (internally) • Inspect the roof sheet fixings
APPLICATION

• Re-fit Roof Sheets:
  ○ Refit existing roof sheets where fixings are loose or missing, using new 65mm Topspeed galvanised fixings, fixings to go where existing are located, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens
  ○ Crest seams which are pulling apart to be re-seamed, so that the crests are properly and securely fitted/ sealed
• Refurbish Roof Sheets:
  ○ Existing Roof sheets to be scraped, sanded and prepared for new paint finish
  ○ Paint roof sheets. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
• Remove Badly Damaged Underlay Or Repair Existing:
  ○ Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
  ○ Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides

1.4 Replace Flat Roof Waterproofing:

PREPARATION

- Identify waterproofing that requires replacement
- Identify quantity of waterproofing required
- Identify quantity of water outlet fittings
- Repair waterproofing in sections (working only in areas that can be completed in single day)

INSPECTIONS

- Inspect substructure for strength and stability, and whether there is wood rot or deterioration (when timber)
- Inspect substructure for strength and stability, and whether there is spalling (when concrete)
- Inspect water outlet fittings for condition and functionality

APPLICATION

- Remove Fittings & Fixtures:
    - Existing fittings and fixtures to be removed, and kept safely aside for re-use/ fitment at later stage
- Replace Damaged Substructure (timber):
    - Damaged timber structure to be replaced with new, new timber to match existing in size and profile, new timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x Coats Carbolinium prior to installation
    - All fixings for timber substructure to be new galvanised fittings and fixtures, when fixings are cut ends to be fully treated with cold galvanised paint 2x Coats
- Repair Damaged Substructure (concrete):
    - Clean concrete surface of all debris and impurities
    - All Spalling to be wire brushed to remove all loose aggregate and debris
    - Concrete to be cleaned of all fine dust
    - Any exposed reinforcement to be cleaned and sanded, ready to receive protective coating, using Sika Monotop 1010-ZA
    - Apply SikaLatex to area where concrete repair mortar will be applied
    - Apply non-shrink concrete repair mortar, using Sika MonoTop-4200 Multi Flow
- Repair/ Replace Water Outlets:
    - Water outlets that are damaged and non-functioning to be repaired where possible.
    - Water outlets which are beyond repair to be replaced with new, using steel FulBore outlets (side discharge or vertical discharge), as by Harscan
- Replace Existing Waterproofing:
    - Remove all existing waterproofing layers
    - Prepare all substrates by cleaning of all debris/ dirt/ impurities
    - All corner junctions between roof and walls/ upstand beams to have 50mm chamfer filets done, using non-shrink grout by SikaGrout-212
    - Apply 3-4mm Liquid Rubber HB Sealant monolithic water proofing coating to flat roofs and over filets and up onto walls (to above the lowest wall/ outlet point), apply HB-Sealant & water mixture as primer, apply HB-Sealant in multiple thin layers to achieve the 3-4mm thickness (30-60min dry time between layer application), Geo-Fabric to be used to seal & reinforce joints/ wider gaps/ transitions/ upturns

- Apply 1x coat of UV resistant GreenCoat Rubberising compound to waterproof layer, colour to be Light Grey

1.5 Repair Roof Overhangs into Gutters:

PREPARATION

- Identify roof overhangs into gutters that are not adequate or sufficient
- Identify quantity of roof tiles or sheet metal covering required to repair overhangs
- Procure required tiles or roof sheets needed to carry out overhang repair work
- Repair in sections (working only in areas that can be completed in single day)

INSPECTIONS

- Inspect substructure for strength and stability, and whether there is wood rot or deterioration

APPLICATION

- Remove Roof Tiles & Roof Sheets Of Affected Area At Gutter:
  - Existing tiles to be carefully removed and kept aside for reuse
  - Existing fixings to be kept aside for reuse
- Remove Any Battens/ Purlins That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  - Replace with new timber battens/ purlins, to match existing in size (38x38mm/ 76x50mm)
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
  - Fix with use 100x6mm galvanised Timber Screws, 1x fixing at each truss/ rafter & purlin junction
- Remove Badly Damaged Underlay Or Repair Existing:
  - Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
  - Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides
- Refit Existing Roof Tiles With Correct Overhang Into Gutter:
  - Refit existing roof tiles, to have proper overhang into gutter, of at least 55mm
  - Replace damaged roof tiles with new Broseley tiles, to match existing, using tiles procured prior to work commencing
  - Reuse existing copper fixing nails where possible, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens
  - Replace unusable fixing nails with new copper nails to match, if cooper nails are not available use 45x6mm galvanised Timber Screws, screws to have 3mm thick rubber washer between tile and screw head. All fixings to be lightly hammered/ tightened so as to not break tiles and allow for movement
- Remove Roof Sheets & Refit/ Replace:
  - Remove existing sheets
  - Replace roof sheets which are not correct in length with new 0.8mm galvanised Corrugated 10.5 Profile roof sheets, to have a min of 2.5 side laps, and 250mm end laps, sheets to have proper overhang into gutter of at least 55mm

- Paint roof sheets top side & underside, prior to install. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
- Fix sheets with 65mm Topspeed galvanised fixings, on crest of roof sheets, 3x fixings per sheet at every purlin, existing holes in purlins to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens
- Final coat of paint to be applied once installed to both sides, with 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.

Roof Valleys

2.1 Broseley Tiled Roof Valleys:

PREPARATION

- Determine required number of tiles and procure tiles to match (tiles may have to be imported if local reclaimed stock not sufficient)
- Determine required valley gutter lengths and valley gutter support structure
- Remove valley tiles in sections, working from eave to ridge (working only in areas that can be completed in single day)
- Tiles to be carefully removed and kept safe for reuse. Weight to be evenly spread across roof sections when working, to mitigate breakage of existing roof tiles
- PPE and precautions to be in place for working with lead products

INSPECTIONS

- Inspect existing valley gutter, and whether it is adequate and functioning
- Inspect valley support structure for strength and stability, and whether there is wood rot or deterioration
- Inspect the tile fixing nails/ screws
- Inspect removed tiles to determine they are not damaged and are reusable

APPLICATION

- Remove Roof Tiles:
  - Remove tiles from eave end upward towards ridge, keeping all removed tiles and fixings safe and secure for reuse
- Remove Valley Gutter:
  - Remove existing valley gutter
  - Remove all waterproofing coatings and determine if gutter is reusable, and keep safely aside for re-use
- Remove Any Battens & Gutter Support Structure Valley Boards That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  - Replace battens with new timber battens, to match existing in size (38x38mm).
  - Replace gutter support structure valley boards, to match existing in size (22x152).
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Refit Existing Valley Gutter:

- Existing gutter sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF SHEET METAL
- Existing gutter sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF SHEET METAL
- Existing gutter sheets to be cleaned of all waterproofing layers and paint, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF LEAD
- Sheets to be fully galvanised – ONLY IF SHEET METAL
- Fix gutters with copper nails, if nails not available then fix gutter with 45mm Topspeed galvanised fixings, onto top of valley edging batten, every 750mm along length of valley

- Replace Existing Valley Gutter (where required):
  - Replace valley gutter with new gutter to match existing in profile, with new 0.8mm galvanised sheeting, to have 200mm laps, with upper gutter sections going over the top of the lower sections, single strip of Bu-Tack butyl tape for full width of gutter at each lap 75mm from lap edge.
  - Fix gutters with copper nails, if nails not available then fix gutter with 45mm Topspeed galvanised fixings, onto top of valley edging batten, every 750mm along length of valley
- Waterproof Coating To Valley Gutter:
  - Apply 2-3mm Liquid Rubber HB Sealant monolithic water proofing coating to flat roofs and over filets and up onto walls (to above the lowest wall/ outlet point), apply HB-Sealant & water mixture as primer, apply HB-Sealant in multiple thin layers to achieve the 3-4mm thickness (30-60min dry time between layer application), Geo-Fabric to be used to seal & reinforce joints/ wider gaps/ transitions/ upturns
  - Apply 1x coat of UV resistant GreenCoat Rubberising compound to waterproof layer, colour to be Light Grey
- Replace & Refit Roof Tiles:
  - Replace damaged roof tiles with new Broseley tiles, to match existing, using tiles procured prior to work commencing, tiles to have proper overlap into valley gutter of at least 100mm
  - Refit existing roof tiles, tiles to have proper overlap into gutter of at least 100mm
  - Reuse existing copper fixing nails where possible
  - Replace unusable fixing nails with new copper nails to match, if cooper nails are not available use 45x6mm galvanised Timber Screws, screws to have 3mm thick rubber washer between tile and screw head. All fixings to be lightly hammered/ tightened so as to not break tiles and allow for movement

2.2 Sheet Metal Roof Valleys:

PREPARATION
• Determine required number of roof valley sheets that need replacement • Determine required valley gutter lengths and valley gutter support structure • Remove roof sheets that make up the valley in sections, working from eave to ridge (working only in areas that can be completed in single day) • Roof sheets to be carefully removed and kept safe for repair and reuse

INSPECTIONS

- Inspect existing valley gutter, and whether it is adequate and functioning
- Inspect purlins and valley support structure for strength and stability, and whether there is wood rot or deterioration
- Inspect the fixing nails/ screws
- Inspect removed roof sheets to determine they are not damaged and are reusable

APPLICATION

- Remove Roof Sheets That Form Valley:
    - Remove sheets from eave end upward towards ridge, keeping all removed sheets safe and secure for reuse
- Remove Valley Gutter:
    - Remove existing valley gutter
    - Remove all waterproofing coatings and determine if gutter is reusable, and keep safely aside for re-use
- Remove Any Purlins & Gutter Support Structure Valley Boards That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
    - Replace purlins with new timber purlins, to match existing in size (76x50mm).
    - Replace gutter support structure valley boards, to match existing in size (22x152).
    - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Refit Existing Valley Gutter:
    - Existing gutter sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF SHEET METAL
    - Existing gutter sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF SHEET METAL
    - Existing gutter sheets to be cleaned of all waterproofing layers and paint, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick) – ONLY IF LEAD
    - Sheets to be fully galvanised – ONLY IF SHEET METAL
    - Fix gutters with copper nails, if nails not available then fix gutter with 45mm Topspeed galvanised fixings, onto top of valley edging batten, every 750mm along length of valley
- Replace Existing Valley Gutter (where required):
    - Replace valley gutter with new gutter to match existing in profile, with new 0.8mm galvanised sheeting (900mm girth), to have 200mm laps, with upper gutter sections going over the top of the lower sections, single strip of Bu-Tack butyl tape for full width of gutter at each lap 75mm from lap edge.
    - Fix gutter with 45mm Topspeed galvanised fixings, onto top of valley edging purlin, every 750mm along length of valley
- Waterproof Coating To Valley Gutter:
    - Apply 2-3mm Liquid Rubber HB Sealant monolithic water proofing coating to flat roofs and over filets and up onto walls (to above the lowest wall/ outlet point), apply HB-Sealant & water mixture as primer, apply HB-Sealant in multiple thin layers to achieve the 3-4mm thickness (30-60min dry time between layer application), Geo-Fabric to be used to seal & reinforce joints/ wider gaps/ transitions/ upturns

- Apply 1x coat of UV resistant GreenCoat Rubberising compound to waterproof layer, colour to be Light Grey

- Repair & Replace Existing Valley Roof Sheets:
  - Send roof sheets to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick)
  - Roof sheets to be galvanised
  - Paint roof sheets top side & underside, prior to install. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Fix sheets with 65mm Topspeed galvanised fixings, on crest of roof sheets, 3x fixings per sheet at every purlin
  - Final coat of paint to be applied once installed to both sides, with 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Gap between valley roof sheet ends at valley gutter to be a maximum of 35mm
- Replace Existing Valley Roof Sheets With New (where required):
  - Replace roof sheets with new 0.8mm galvanised Corrugated 10.5 Profile roof sheets, to have a min of 2.5 side laps, and 250mm end laps
  - Paint roof sheets top side & underside, prior to install. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Fix sheets with 65mm Topspeed galvanised fixings, on crest of roof sheets, 3x fixings per sheet at every purlin
  - Final coat of paint to be applied once installed to both sides, with 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Gap between valley roof sheet ends at valley gutter to be a maximum of 35mm

Roof Flashings, Ridge Caps and Hip Caps

3.1 Broseley Tiled Roof Soakers & Stepped Flashings:

PREPARATION
• Identify areas of missing flashings • Determine required lengths of new flashings • Remove tiles along length of wall in sections, working from eave to ridge (working only in areas that can be completed in single day) • Tiles to be carefully removed and kept safe for reuse. Weight to be evenly spread across roof sections when working, to mitigate breakage of existing roof tiles • PPE and precautions to be in place for working with lead products
INSPECTIONS
• Inspect battens for strength and stability, and whether there is wood rot or deterioration • Inspect the roof underlay • Inspect the tile fixing nails/ screws

- Inspect removed tiles to determine they are not damaged and are reusable

APPLICATION

- Remove Stepped Flashings:
  - Any remaining stepped lead flashings to be removed and kept aside
- Remove Roof Tiles:
  - Remove tiles from eave end upward towards affected area, keeping all removed tiles and fixings safe and secure for reuse
  - Broken roof tiles to be discarded
  - Keep fixing nails aside for reuse
- Remove Left Over Soaker Flashings:
  - Any remaining lead soaker flashing to be removed and kept aside
- Remove Any Battens That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  - Replace with new timber battens, to match existing in size (38x38mm).
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Remove Badly Damaged Underlay Or Repair Existing:
  - Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
  - Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides
- Refit And Replace Soaker Flashings:
  - Install existing soaker flashings from eave to ridge, in correct method of; tile-soaker-tile-soaker-tile etc. until ridge. Soaker upturn to be a minimum of 75mm against wall, fixings to be copper nails at top end of each soaker into batten
  - Install new soaker flashings from eave to ridge, using new 0.8mm galvanised sheeting (225mm girth) bent to match existing, in correct method of; tile-soaker-tile-soaker-tile etc. until ridge. Soaker upturn to be a minimum of 75mm against wall, fixings to be copper nails at top end of each soaker into batten
- Replace & Refit Roof Tiles:
  - Replace damaged roof tiles with new Broseley tiles, to match existing, using tiles procured prior to work commencing
  - Reuse existing copper fixing nails where possible
  - Replace unusable fixing nails with new copper nails to match, if copper nails are not available use 45x6mm galvanised Timber Screws, screws to have 3mm thick rubber washer between tile and screw head. All fixings to be lightly hammered/ tightened so as to not break tiles and allow for movement
- Refit And Replace Stepped Flashings:
  - Install new stepped flashings from eave to ridge, using new 0.8mm galvanised sheeting (225mm girth) bent and cut into stepped shape, 30mm bent lip to be set into brick joint (mortar to be removed prior setting of stepped flashing), flashing to go down and over up-turned section of soaker against wall, secure bent lip of flashing into brick joint of wall using friction hold ‘u’ shim in joint gap between brick and flashing, install at every step of flashing. Seal stepped flashing into brick joint of wall using Sikaflex Construction+ for full length along all edges cut into wall

3.2 Sheet Metal Roof Flashings:

PREPARATION
• Identify areas of missing and damaged flashings • Determine required lengths of new flashings (working only in areas that can be completed in single day)
INSPECTIONS
• Inspect purlins for strength and stability, and whether there is wood rot or deterioration • Inspect the fixing nails/ screws
APPLICATION

• Remove Flashings:
  ○ Any remaining damaged flashings to be removed
• Remove Any Purlins That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  ○ Replace with new timber battens, to match existing in size (76x50mm).
  ○ Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
• Fit New Flashings Along Side Walls:
  ○ Install new side wall flashings from eave to ridge, using new 0.8mm galvanised sheeting (375mm girth) bent into shape, flashing to be set onto sheet metal roof covering and firmly against wall, 25x35x1000mm Poly-Strip to go between roof sheet and flashing for full length, fix flashing into purlin (on crest of roof sheet) using 65mm Topspeed roofing screws. Install new counter flashing into wall, using new 0.8mm galvanised sheeting (200mm girth) bent into shape (to be 85° bend, to provide flush fitment against flashing), with friction hold lip on bend which gets set into wall, brick to be cut 30mm deep to receive bent lip of counter flashing. Seal counter flashing into brick cutline using Sikaflex Construction+ for full length along all edges cut into wall
• Fit New Flashings Along Head Walls:
  ○ Install new side wall flashings from eave to ridge, using new 0.8mm galvanised sheeting (400mm girth) bent into shape, flashing to be set onto sheet metal roof covering and firmly against wall, 25x35x1000mm Poly-Strip to go between roof sheet and flashing for full length, fix flashing into purlin (on crest of roof sheet) using 65mm Topspeed roofing screws. Install new counter flashing into wall, using new 0.8mm galvanised sheeting (200mm girth) bent into shape (to be 85° bend, to provide flush fitment against flashing), with friction hold lip on bend which gets set into wall, brick to be cut 30mm deep to receive bent lip of counter flashing. Seal counter flashing into brick cutline using Sikaflex Construction+ for full length along all edges cut into wall

3.3 Flashings at Broseley Tiled Roof and Dormer & Turret Roofs:

PREPARATION
• Identify areas of missing and damaged flashings • Determine required lengths of new flashings • Determine required number of fixings required

- This flashing replacement must take place when repair work is being done on the roof sheets of the dormer & turret roofs (working only in areas that can be completed in single day)
- PPE and precautions to be in place for working with lead products

INSPECTIONS

- Inspect purlins for strength and stability, and whether there is wood rot or deterioration
- Inspect the fixing nails/ screws
- Inspect the underlay of tiled roofs at junction where flashings are being repaired/ replaced

APPLICATION

- Remove Roof Sheets From Dormer & Turret Roofs:
    - Carefully remove the roof sheets and keep aside for reuse
    - Keep all fixings aside for reuse
- Remove Roof Tiles:
    - Remove tiles from eave end upward towards affected area, keeping all removed tiles and fixings safe and secure for reuse
    - Broken roof tiles to be discarded
    - Keep fixing nails aside for reuse
- Remove Flashings:
    - Any remaining damaged flashings to be removed and kept aside for reuse
- Remove Any Purlins That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
    - Replace with new timber battens, to match existing in size (76x50mm).
    - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Remove Badly Damaged Underlay Or Repair Existing:
    - Replace with new Sisalation 405 FR, fitted underside of battens and atop trusses using galvanised stranding wires. All laps to be minimum 150mm throughout, underlay to lap up and over last batten and fall into gutter
    - Repair underlay where possible with construction Jointing Tape, to be applied in a weave pattern over the affected area, repair patch to be 150mm bigger than the damaged section on all sides
- Refit And Replace Apron Flashings:
    - Install existing apron flashing against head of turret/ dormer roof connection with tiled roof. Apron upturn to be a minimum of 75mm against turret/ dormer roof structure, secure in place using new 0.8mm galvanised straps (35mm wide) fixed to structure and head junction with copper nails, strap to run under apron along top of roof tiles and return up and over apron flashing edge securing it into place
    - Install new apron flashing against head of turret/ dormer roof connection with tiled roof using new 0.8mm galvanised sheet metal. Apron flashing to be shaped to fit around dormer/ turret roof head junction with tiled roof, all seams to be fully braised, upturn to be a minimum of 75mm against turret/ dormer roof structure, secure in place using new 0.8mm galvanised straps (35mm wide) fixed to structure and head junction with copper nails, strap to run under apron along top of roof tiles and return up and over apron flashing edge securing it into place
- Refit And Replace Soaker Flashings:
    - Install existing soaker flashings from bottom to top of dormer/ turret roof, in correct method of; tile-soaker-tile-soaker-tile etc. until ridge. Soaker upturn to be

a minimum of 75mm against dormer/ turret roof structure, fixings to be copper nails at top end of each soaker into batten
    - Install new soaker flashings from eave to ridge, using new 0.8mm galvanised sheeting (225mm girth) bent to match existing, in correct method of; tile-soaker-tile-soaker-tile etc. until ridge. Soaker upturn to be a minimum of 75mm against wall, fixings to be copper nails at top end of each soaker into batten
- Replace & Refit Roof Tiles:
    - Replace damaged roof tiles with new Broseley tiles, to match existing, using tiles procured prior to work commencing
    - Reuse existing copper fixing nails where possible
    - Replace unusable fixing nails with new copper nails to match, if copper nails are not available use 45x6mm galvanised Timber Screws, screws to have 3mm thick rubber washer between tile and screw head. All fixings to be lightly hammered/ tightened so as to not break tiles and allow for movement
- Re-fit Roof Sheets:
    - Refit existing roof sheets where fixings are loose or missing, using new 65mm Topspeed galvanised fixings, fixings to go where existing are located, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens
    - Crest seams which are pulling apart to be re-seamed, so that the crests are properly and securely fitted/ sealed

3.4 Broseley Tiled Roof Ridge Caps & Hip Caps:

PREPARATION

- Identify areas of broken & damaged caps
- Determine required number of caps and procure caps to match (caps may have to be imported if local reclaimed stock not sufficient)
- Remove caps in sections where they are damaged, working along length of ridge & working from eave to ridge when hips (working only in areas that can be completed in single day)
- Caps to be carefully removed and kept safe for reuse. Weight to be evenly spread across roof sections when working, to mitigate breakage of existing roof tiles

INSPECTIONS

- Inspect battens for strength and stability, and whether there is wood rot or deterioration
- Inspect all removed caps to determine they are not damaged and are reusable

APPLICATION

- Remove Any Broken/ Damaged Caps And Caps Which Have Missing & Damaged Mortar:
    - Remove caps that are affected, keeping all removed caps safe and secure for reuse
    - Clean all mortar from the caps, ready to be refitted/ receive new caps
- Remove Any Battens That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
    - Replace with new timber battens, to match existing in size (38x38mm).
    - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Refit Roof Caps:

- Refit roof caps once they and non-removed are prepared and ready for re-fitment
- Secure caps by bedding onto mortar, with mortar joints between caps, mortar to be made smooth and flush with caps at joints, mortar to fill all gaps between caps and roof tiles
- Bedding mortar for caps and joint mortar between caps to have Sika-1 waterproofing admixture

- Replace Roof Caps:
  - Replace damaged roof caps with new caps, to match existing, using caps procured prior to work commencing
  - Secure caps by bedding onto mortar, with mortar joints between caps, joints to be made smooth and flush with caps at joints, mortar to fill all gaps between caps and roof tiles
  - Bedding mortar for caps and joint mortar between caps to have Sika-1 waterproofing admixture

3.5 Sheet Metal Roof Ridge Caps & Hip Caps:

PREPARATION

- Identify areas of broken & damaged caps
- Determine required length of caps and procure caps to match existing
- Remove caps in sections where they are damaged, working along length of ridge & working from ridge to eave when hips (working only in areas that can be completed in single day)
- Caps to be carefully removed and kept safe for reuse if not damaged

INSPECTIONS

- Inspect battens for strength and stability, and whether there is wood rot or deterioration
- Inspect all removed caps to determine they are not damaged and will be reusable once they have been refurbished

APPLICATION

- Remove Any Broken/ Damaged Caps:
  - Remove caps that are affected, keeping all removed caps safe and secure for reuse
  - Existing capping sheets to be cleaned of all waterproofing layers and paint, once sheets are clean and neat check if condition of sheet is acceptable for re-fitment (must be min 1.2mm thick) and have no damage
  - Existing reusable capping to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick)
  - Capping to be fully galvanised before being fitted
- Remove Any Battens That Have Signs Of Wood Rot Or Deterioration And Which Are Not Deemed Safe:
  - Replace with new timber battens, to match existing in size (38x38mm).
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation
- Replace Ridge & Hip Caps (where required):
  - Replace caps with new caps to match existing in profile, with new 0.8mm galvanised sheeting (900mm girth), to have 200mm laps, with upper sections

going over the top of the lower sections, single strip of Bu-Tack butyl tape for full width of cap at each lap, 75mm from lap edge. o Ridge & hip caps to have 25x35x1000mm Poly-Strips for full length of capping fitted between capping and roof sheet prior to fixing into place o Fix caps with 65mm Topspeed galvanised fixings, into purlins (fixing must be on crest of roof sheet)

3.6 Dormer & Turret Roof Ridge Caps:

PREPARATION
• Identify roof capping that require refurbishment • Identify roof capping that requires replacement • Identify roof capping that require re-fixing • Identify quantity of fixings required • PPE and precautions to be in place for working with lead products
INSPECTIONS
• Inspect purlins/ ridge cap structure for strength and stability, and whether there is wood rot or deterioration • Inspect removed capping to make sure it's not damaged and can be reused • Inspect fixings
APPLICATION
• Replace Roof Caps: o • Re-fit Roof Caps: o Refit existing roof sheets where fixings are loose or missing, using new 65mm Topspeed galvanised fixings, fixings to go where existing are located, existing holes in battens to be plugged with timber plugs cut from new treated batten, cold glue to be used when inserting plugs into battens o Crest seams which are pulling apart to be re-seamed, so that the crests are properly and securely fitted/ sealed o Roof caps to be • Refurbish Roof Caps: o Existing Roof sheets to be scraped, sanded and prepared for new paint finish o Paint roof sheets. Fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.

Box Gutters

4.1 Replace Box Gutter Waterproofing:

PREPARATION
• Identify waterproofing that requires replacement • Identify quantity of waterproofing required • Identify quantity of water outlet fittings

- Repair waterproofing in sections (working only in areas that can be completed in single day)
- Determine required amount of hail guard required for box gutters
- PPE and precautions to be in place for working with lead products

INSPECTIONS

- Inspect substructure for strength and stability, and whether there is wood rot or deterioration (when timber)
- Inspect substructure for strength and stability, and whether there is spalling (when concrete)
- Inspect existing box gutter, does it require replacement
- Inspect water outlet fittings for condition and functionality

APPLICATION

- Remove Fittings & Fixtures:
    - Existing fittings and fixtures to be removed, and kept safely aside for re-use/ fitment at later stage
- Remove Existing Waterproofing:
    - Remove all existing waterproofing layers, including layers that are on walls/ upstand beams
- Remove Existing Box Gutter (sheet metal):
    - Box gutter to be carefully removed, and kept safely aside for reuse
    - Box gutter to be checked to make sure there is no damage and that it can be used again
- Replace Damaged Substructure (timber):
    - Damaged timber structure to be replaced with new, new timber to match existing in size and profile, new timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x Coats Carbolinium prior to installation
    - All fixings for timber substructure to be new galvanised fittings and fixtures, when fixings are cut, ends to be fully treated with cold galvanised paint 2x Coats
- Repair Damaged Substructure (concrete):
    - Clean concrete surface of all debris and impurities
    - All Spalling to be wire brushed to remove all loose aggregate and debris
    - Concrete to be cleaned of all fine dust
    - Any exposed reinforcement to be cleaned and sanded, ready to receive protective coating, using Sika Monotop 1010-ZA
    - Apply SikaLatex to area where concrete repair mortar will be applied
    - Apply non-shrink concrete repair mortar, using Sika MonoTop-4200 Multi Flow
- Repair/ Replace Water Outlets:
    - Water outlets that are damaged and non-functioning to be repaired where possible.
    - Water outlets which are beyond repair to be replaced with new, using steel FulBore outlets (side discharge or vertical discharge), as by Harscan
- Refit Existing Box Gutter:
    - Existing gutter to be sandblasted and cleaned, once sheets are clean and neat check gauge of sheet is acceptable for re-fitment (must be min 1.2mm thick), with no holes in base or lower section of sides – ONLY IF SHEET METAL
    - Sheets to be fully galvanised – ONLY IF SHEET METAL
    - Fix box gutter with copper nails (only into substructure on the vertical side of the gutter, 15mm from top edge, NEVER INTO THE BASE OR LOWER EDGE), if nails not

available then fix gutter with 35mm Topspeed galvanised fixings, into top edge of substructure, every 750mm along length of gutter
Gutter have 200mm laps in the direction of the fall, with upper gutter sections going over the top of the lower sections, single strip of Bu-Tack butyl tape for full width of gutter (base & vertical sides) at each lap 75mm from lap edge

- Replace Existing Box Gutter (where required):
  - Replace valley gutter with new gutter to match existing in profile, using new 0.8mm galvanised sheeting (900mm girth)
  - Fix box gutter with copper nails (only into substructure on the vertical side of the gutter, 15mm from top edge, NEVER INTO THE BASE OR LOWER EDGE), if nails not available then fix gutter with 35mm Topspeed galvanised fixings, into top edge of substructure, every 750mm along length of gutter
    Gutter have 200mm laps in the direction of the fall, with upper gutter sections going over the top of the lower sections, single strip of Bu-Tack butyl tape for full width of gutter (base & vertical sides) at each lap 75mm from lap edge
- Redo Box Gutter Waterproofing:
  - Prepare all substrates by cleaning of all debris/ dirt/ impurities
  - All corner junctions between roof and walls/ upstand beams to have 50mm chamfer filets done, using non-shrink grout by SikaGrout-212
  - Apply 3-4mm Liquid Rubber HB Sealant monolithic water proofing coating to flat roofs and over filets and up onto walls (to above the lowest wall/ outlet point), apply HB-Sealant & water mixture as primer, apply HB-Sealant in multiple thin layers to achieve the 3-4mm thickness (30-60min dry time between layer application), Geo-Fabric to be used to seal & reinforce joints/ wider gaps/ transitions/ upturns
  - Apply 1x coat of UV resistant GreenCoat Rubberising compound to waterproof layer, colour to be Light Grey
- New Hail Guard To Be Installed On All Box Gutters:
  - Install 50x50mm galvanised steel angle iron along wall, using 8mm Hilti Anchor fixings every 750mm for full length for box gutter
  - Install 2x strips of BuTack Butyl Tape for full length of angle iron, between wall and angle iron
  - Fit galvanised steel raised expanded mesh Mentex 118/VEM 315F, mesh to have profile bent into it for length of mesh piece, mesh to be slotted into position under the roof covering for length of roof covering and fitted onto steel angle iron, using 45mm Topspeed fixings
  - Install new counter flashing into wall and over angle iron fitted to wall, using new 0.8mm galvanised sheeting (105mm girth) bent into shape (to be 85° bend, to provide flush fitment against flashing), with friction hold lip on bend which gets set into wall, brick to be cut 30mm deep to receive bent lip of counter flashing. Seal counter flashing into brick cutline using Sikaflex Construction+ for full length along all edges cut into wall

Eave Gutters & Fascia Boards

5. & 6. Replace/ Repair Eave Gutters & Fascia Boards:

PREPARATION
• Identify gutters that require replacement

- Identify quantity of gutters required
- Identify quantity of fascia boards that require replacement
- Determine number of new gutter brackets needed

INSPECTIONS

- Inspect substructure for strength and stability, and whether there is wood rot or deterioration
- Inspect existing gutter, does it require replacement
- Inspect gutter spigots that discharge into downpipes

APPLICATION

- Remove Gutters:
  - Existing gutters to be removed, to be inspected and determined whether they are reusable or not (to be free from holes, corrosion, bends, warping, deformation etc.), keep safely aside if reusable
  - Remove gutter brackets, inspect to determine if they are reusable (to be free from corrosion, deformation etc.), keep safely aside if reusable
- Inspect & Remove Fascia Boards:
  - Existing fascia boards to be checked to structural integrity and whether there is wood rot, warping, cracking, deterioration etc.
    If any of the above occurs then they are to be removed and discarded
  - Existing fascia boards that are satisfactory must be removed and kept safely aside so they can be refurbished and refitted
- Refit New Fascia Boards & Existing Refurbished Boards:
  - New fascia boards to be fitted, to match existing in size (222x22mm), using 100x6mm galvanised Timber Screws, 1x fixing at each truss/ rafter
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all to have first two painted finishing coats applied prior to be installed, once fitted final third painted finishing coat to be applied
  - Timber to be fully prepared for paint, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel
- Refurbish Existing Fascia Boards:
  - Existing fascia boards to have existing finish fully removed, to be fully scrapped sanded to a smooth finish ready to receive painted finish
  - Reinstall fascia boards onto roof truss/ rafters, using 100x6mm galvanised Timber Screws, 1x fixing at each truss/ rafter, all to have first two painted finishing coats applied prior to be installed, once fitted final third painted finishing coat to be applied
  - Paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel
- Install New Gutters:
  - Fit new seamless aluminium 0.9mm gauge 155mm OGEE gutters (white) on aluminium hanger brackets, brackets to be fitted with 35x6mm galvanised Timber Screws, installed to fall towards downpipes
  - Fit new aluminium spigots shaped and sized to go into downpipes, spigots to be sealed with SikaFlex-11 FC+, and fitted onto gutter with Closed End Sealed Aluminium rivets
- Inspect & Remove Barge Boards:
  - Existing fascia boards to be checked to structural integrity and whether there is wood rot, warping, cracking, deterioration etc.
    If any of the above occurs then they are to be removed and discarded

- Existing fascia boards that are satisfactory must be removed and kept safely aside so they can be refurbished and refitted
- Refit New Barge Boards & Existing Refurbished Boards:
  - New fascia boards to be fitted, to match existing in size (222x22mm & 22x114mm), using 100x6mm galvanised Timber Screws, 1x fixing at each purlin/ batten
  - Timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all to have first two painted finishing coats applied prior to be installed, once fitted final third painted finishing coat to be applied
  - Timber to be fully prepared for paint, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel
- Refurbish Existing Barge Boards:
  - Existing barge boards to have existing finish fully removed, to be fully scrapped sanded to a smooth finish ready to receive painted finish
  - Reinstall barge boards onto roof purlins/ battens, using 100x6mm galvanised Timber Screws, 1x fixing at each purlin/ batten, all to have first two painted finishing coats applied prior to be installed, once fitted final third painted finishing coat to be applied
  - Paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel

Downpipes & Hopper Heads

7.1 Repair/ Replace Downpipes:

PREPARATION

- Identify downpipes that require replacement
- Identify quantity of downpipes required
- Determine quantity of new downpipes required
- Determine number of new downpipe brackets required
- Determine number downpipe discharge shoes that are required

INSPECTIONS

- Inspect downpipe for holes, deterioration & rusting
- Inspect existing brackets for rusting and deterioration

APPLICATION

- Remove Downpipes:
  - Existing downpipes which are not repairable to be removed
  - Brackets from downpipes must be removed and kept safely aside for reuse (if not damaged), brackets to be checked they are adequate to be reused
- Refurbish Existing Downpipes & Reinstall:
  - Existing removed downpipes which are useable to be fully refurbished, all paint and waterproofing to be scrapped and removed, downpipe to be fully sanded down to raw material, all rusting and pitting cleaned off
  - Small holes and cracks in downpipe to be repaired with braising, and sanded smooth
  - Larger holes to be squared off, steel plate to be cut out and inserted into gutter on the inside, plate to be cast-iron weld into place, recess which is formed to be filled with steel putty/ filler, patch to be fully sanded

- Downpipes to be fully painted prior to be installed, fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
- Refurbished downpipes to be refitted using existing refurbished brackets

- Remove & Refurbish Downpipe Brackets & Reinstall:
  - Existing removed brackets which are useable to be fully refurbished, all paint and waterproofing to be scrapped and removed, downpipe to be fully sanded down to raw material, all rusting and pitting cleaned off
  - Brackets to be fully painted prior to be installed, fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Brackets to be refitted to walls with new galvanised expanding M10 anchor bolts (2x per bracket), into existing fixing holes, fixings to be painted once fitted (to match hopper paint spec)
- Remove & Refurbish Existing Hopper Heads & Discharge Spigots And Reinstall:
  - Existing removed hopper heads which are useable to be fully refurbished, all paint and waterproofing to be scrapped and removed, downpipe to be fully sanded down to raw material, all rusting and pitting cleaned off
  - Small holes and cracks in downpipe to be repaired with braising, and sanded smooth
  - Larger holes to be squared off, steel plate to be cut out and inserted into gutter on the inside, plate to be cast-iron weld into place, recess which is formed to be filled with steel putty/ filler, patch to be fully sanded
  - Hopper heads to be fully painted prior to being reinstalled, fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.
  - Hopper heads to be refitted to walls with new galvanised expanding M10 anchor bolts (2x per hopper), into existing fixing holes, fixings to be painted once fitted (to match hopper paint spec)
  - Discharge spigots from the gutter into the hopper head, to be removed and refurbished, if refurbishment is not achievable then the a new spigot is to be made to match existing using 2mm galvanised steel sheet, all joins to be fully seam welded, to be prepared for paint finish, paint to match hopper head
  - Refit discharge spigots (prior to installing hoppers), using Sikaflex-113 Rapid Cure adhesive sealant
- Fit Missing Downpipe Shoes With New Purpose Made Shoes (prior to installing refurbished downpipe):
  - New downpipe discharge shoe to be fabricated, to match existing in shape and size, using 2mm galvanised sheet metal, all joins to be fully seamless by way of braised continuous joints
  - New shoe to be fitted onto bottom of downpipes using Closed Sealed Stainless Steel rivets
  - Downpipe to be painted in full once shoe is fitted and prior to installing downpipe, fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/

	cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets.

7.2 Install New Downpipe Spreaders (all downpipes that discharge onto a roof surface):

PREPARATION
• Identify downpipes that require spreaders • Identify quantity of spreaders required
INSPECTIONS
• Inspect existing spreader to determine if adequate
APPLICATION

• Remove Spreaders:
  ○ Existing spreaders to be removed and discarded when not fully adequate
• Install New Spreaders:
  ○ New downpipe spreader to be fabricated, to match existing downpipe in shape and size, using 2mm galvanised sheet metal, all joins to be fully seamless by way of braised continuous joints
  ○ Spreader to be 1000mm long, with removable capped end one side and fixed capped end on opposite side, face of pipe length to have 13x 45mmØ cut-outs spread equally across the length so as to discharge onto below roof surface
  ○ New spreader to be fitted onto bottom of downpipe discharge shoe using Closed Sealed Stainless Steel rivets
  ○ Downpipe to be painted in full once shoe and spreader is fitted and prior to installing downpipe, fully clean from all debris/ oil/ wax/ grease & dirt using a degreaser/ cleaning solution, coated with 1x Dulux Galvanized Iron Primer & 1x coats Dulux RockGrip Steel Primer & 1x coat Dulux Undercoat & 2x coat Dulux PearlGlo water based tinted or equal & APPROVED. All in strict accordance to manufacturers details & spec/ data sheets

Dormer & Turret Roof Structure

8.1 Repair/ Replace Timber Structure:

PREPARATION
• Identify structure that requires repair • Identify structure that requires replacement • Only qualified and approved carpenter may carry out the fabrication work
INSPECTIONS
• Inspect existing timber for strength and stability, and whether there is wood rot or deterioration
APPLICATION
• Remove All Fitting & Coverings To Expose Timber Structure: ○ Existing coverings and fitting to be removed and kept safely aside for reinstallation (where required)

- Refurbish Existing Structure:
    - Timber structure to be fully scrapped, cleaned and sanded, all ready to receive new paint finish
    - All loose fixings to be fixed back together, using same timber jointing technics as current or using 100x6mm galvanised Timber Screws or a combination of both, screws to be counter sunk and plugged with timber plug cut from fully CCA treat SA Pine (S5) timber batten
    - Prepared timber to be painted with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel
- Replace Existing Structure:
    - Timber structure which is deemed unsafe and inadequate for refurbishment to be replaced in full with new
    - All timber to be replaced as a like for like basis, with existing timber structure being fully recorded and photographically captured for reference, dismantled timber pieces are to be marked and labelled for reference of reassembling new pieces
    - New timber pieces to be fabricated to match existing in size and profile, using high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
    - New structure to be reassembled and reinstalled into position where existing was removed
    - Structure to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel. First 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed
- Refit/ Replace Flat Roof Sheeting & Flashings:
    - Refer back Item 3.3 and follow accordingly

8.2 Repair/ Replace Timber Trims & Barge Boards:

PREPARATION
• Identify timber that requires repair • Identify timber that requires replacement
INSPECTIONS
• Inspect existing timber for strength and stability, and whether there is wood rot or deterioration
APPLICATION

• Remove Timber Trims & Barge Boards:
  ○ Existing timber pieces to be removed and kept safely aside for refurbishment and reuse, after being inspected
• Refurbish Existing Timber Trims & Barge Boards:
  ○ Timber to be fully scrapped, cleaned and sanded, all ready to receive new paint finish
  ○ All loose fixings to be fixed back together, using same timber jointing technics as current or using 100x6mm galvanised Timber Screws or a combination of both, screws to be counter sunk and plugged with timber plug cut from fully CCA treat SA Pine (S5) timber batten
  ○ Prepared timber to be painted with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel

- Replace Existing Timber Trims & Barge Boards:
    - Timber which is deemed inadequate for refurbishment due to deterioration or wood rot to be replaced in full with new
    - All timber to be replaced as a like for like basis, with existing timber structure being fully recorded and photographically captured for reference
    - New timber pieces to be fabricated to match existing in size and profile, using high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
    - New timber to be reassembled and reinstalled into position where existing was removed
    - Timber to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel. First 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed
- Refit/ Replace Flat Roof Sheeting & Flashings:
    - Refer back Item 3.3 and follow accordingly

8.3 Repair/ Replace Timber Louvers & Sills (Turrets and Dormers):

PREPARATION
• Identify louvers & sills that require repairs • Identify louvers & sills that require replacement • Only qualified and approved carpenter may carry out the fabrication work
INSPECTIONS
• Inspect existing louvers and sills for strength and stability, and whether there is wood rot or deterioration
APPLICATION

• Remove Louvers & Sills:
  ○ Existing louvers & sills to be removed and kept safely aside for refurbishment and reuse, after being inspected
• Refurbish Existing Louvers & Sills:
  ○ Timber to be fully scrapped, cleaned and sanded, all ready to receive new paint finish
  ○ All loose fixings to be fixed back together, using same timber jointing technics as current or using 100x6mm galvanised Timber Screws or a combination of both, screws to be counter sunk and plugged with timber plug cut from fully CCA treat SA Pine (S5) timber batten
  ○ Prepared timber to be painted with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel, first 2x Finishing Coats to be applied prior to being installed and final coat to be applied once installed
• Replace Existing Timber Trims & Barge Boards:
  ○ Louvers and sills which are deemed inadequate for refurbishment due to deterioration or wood rot to be replaced in full with new
  ○ All timber to be replaced as a like for like basis, with existing louvers and sills being fully recorded and photographically captured for reference
  ○ New timber louvers & sills to be fabricated to match existing in size and profile, using high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved

- New louvers and sills to be reassembled and reinstalled into position where existing was removed
- Timber to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel, first 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed

- Refit/ Replace Flat Roof Sheeting & Flashings:
  - Refer back Item 3.3 and follow accordingly

Parapet Wall Copings

9.1 Repair/ Replace Plaster Copings:

PREPARATION

- Identify copings that require patch repair work
- Identify copings that require cut out and replacement

INSPECTIONS

- Inspect copings for cracking, water ingress and deterioration

APPLICATION

- Patch Repair To Copings:
  - Sections of copings to be scrapped, rubbed and cleaned from all paint dirt and debris, clean all mould using a 4:1 Water & Chlorine mixture, allow to fully dry before any repair work takes place
  - Cracks and chips to be repaired with new plaster, plaster to have high cement content for strength, plaster mix to have waterproofing Sika-1 admixture
  - Once all sections are repaired, entire length of coping to be prepared to receive damp barrier coating, paint with 1x Coat SikaTop Seal-107 ZA and 1x Coats Dulux PrePaint Dampshield
  - Entire coping to receive final paint finish, paint with 1x Coat Dulux Rockgrip Plaster Primer and 3x Coats Dulux Rockgrip Supertex (grey)
- Cutout & Replacement Of Coping:
  - Sections of copings that are severely damaged and cracked to be cut out in sections, care to be taken as to not damage the existing brickwork
  - New coping to be cast into place where existing has been cut out, brickwork to be fully cleaned and prepared ready to receive new coping, brickwork and exposed sides of copings to have Sika Cemflex bonding agent applied prior to casting of new copings, new copings to be cast into place using shutter mould which is shaped to match existing coping exactly, chicken mesh wire to be used in plaster copings for reinforcement, 5mm expansion joint to be done between old and new plaster
  - Expansion joints between old and new copings to be filled with Sikaflex Construction+, join to have closed cell polyethylene backing cord
  - Cracks and chips to be repaired with new plaster for full length of coping where new sections have been cast, plaster to have high cement content for strength, plaster mix to have waterproofing Sika-1 admixture
  - Once all sections are replaced and repaired, entire length of coping to be prepared to receive damp barrier coating, clean all mould using a 4:1 Water &

Chlorine mixture, allow to fully dry before any repair work takes place, paint with 1x Coat SikaTop Seal-107 ZA and 1x Coats Dulux PrePaint Dampshield ○ Entire coping to receive final paint finish, paint with 1x Coat Dulux Rockgrip Plaster Primer and 3x Coats Dulux Rockgrip Supertex (grey)

9.2 Repair/ Replace Brick Copings:

PREPARATION
• Identify brick copings that require mortar repair work • Identify copings that require brick & mortar replacement
INSPECTIONS
• Inspect coping mortar joints for degradation and disintegration • Inspect coping bricks for cracking, degradation and spalling
APPLICATION
• Patch Repair To Brick Mortar: ○ Mortar which is soft and degrading or missing to be repaired with new mortar, existing mortar to be scrapped out until solid mortar is reached ○ Cleared out joint to be wire brushed and cleaned of all dust and dirt, ready to receive new mortar ○ Joints to have 1x Coat Sika Plasterstik applied prior to new mortar being done, only in joints ○ Joint to be filled with new mortar, pointing of joint to match that of existing, mortar to be Class II and to have Sika-1 admixture • Replace Brick Coping: ○ Bricks which are spalling and degrading to be carefully removed, keeping damage to surrounding bricks to a minimum ○ Opening where brick is removed to be wire brushed and cleaned of all dust and dirt, ready to receive new mortar and brick ○ All sides of opening to have 1x Coat Sika Plasterstik applied prior to new mortar and bricks being fitted ○ New bricks to be fitted with new mortar, bricks to be reclaimed red clay face bricks where possible and to be same profile as existing, pointing of joints to match that of existing, mortar to be Class II and to have Sika-1 admixture ○ New brick which is not reclaimed to be Corobrik De Hoop Red Smooth FBS, to match existing in profile and size

Mouldings Waterproofing Layer

10. New Waterproofing To Protruding Wall Mouldings:

PREPARATION
• Identify quantity of waterproofing required
INSPECTIONS
• Inspect substructure for strength and stability, and whether there is wood rot or deterioration (when timber) • Inspect substructure for strength and stability, and whether there is spalling (when concrete)

- PPE and precautions to be in place for working with lead products

APPLICATION

- Remove Any Waterproofing Layers:
  - Existing waterproofing to be removed and discarded
- Replace Damaged Substructure (timber):
  - Damaged timber structure to be replaced with new, new timber to match existing in size and profile, new timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x Coats Carbolinium prior to installation
  - All fixings for timber substructure to be new galvanised fittings and fixtures, when fixings are cut ends to be fully treated with cold galvanised paint 2x Coats
- Repair Damaged Substructure (concrete):
  - Clean concrete surface of all debris and impurities
  - All Spalling to be wire brushed to remove all loose aggregate and debris
  - Concrete to be cleaned of all fine dust
  - Any exposed reinforcement to be cleaned and sanded, ready to receive protective coating, using Sika Monotop 1010-ZA
  - Apply SikaLatex to area where concrete repair mortar will be applied
  - Apply non-shrink concrete repair mortar, using Sika MonoTop-4200 Multi Flow
- Apply New Waterproofing Layer:
  - Prepare all substrates by cleaning of all debris/ dirt/ impurities
  - All corner junctions between mouldings and walls/ upstand beams to have 50mm chamfer filets done, using non-shrink grout by SikaGrout-212
  - Apply 3-4mm Liquid Rubber HB Sealant monolithic water proofing coating to flat roofs and over filets and up onto walls (to above the lowest wall/ outlet point), apply HB-Sealant & water mixture as primer, apply HB-Sealant in multiple thin layers to achieve the 3-4mm thickness (30-60min dry time between layer application), Geo-Fabric to be used to seal & reinforce joints/ wider gaps/ transitions/ upturns
  - Apply 1x coat of UV resistant GreenCoat Rubberising compound to waterproof layer, colour to be Light Grey

Timber Windows & Louvers

11.1 Replace Damaged Timber Windows With New:

PREPARATION

- Identify quantity of new windows required, including glass panes
- Only qualified and approved carpenter may carry out the fabrication work

INSPECTIONS

- Inspect wall reveals and window sills

APPLICATION

- Remove Windows Which Are Degraded & Rotten:
  - Existing windows to be removed and kept safely aside
  - Carefully remove all ironmongery and fittings, keep safely aside for reinstallation onto new window
- Fabricate New Timber Windows:

- New timber windows to be fabricated, windows to match existing exactly (using removed window as a template)
- Timber for windows to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
- Fabrication method of windows to match that of existing windows, for all joins and fixings
- Window to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel. First 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed
- Fit window into existing opening, using 100x8mm galvanised Hilti wall anchors, fixings to only be done on side and top frame of window (not sill frame)
- Window perimeter to be fully sealed both internally and externally with Sikaflex Construction+ sealant
- Fit window with new 4mm clear toughened safety glass, held in place with putty backing and timber glazing bead on the external

11.2 Replace Damaged & Missing Glass With New:

PREPARATION
• Identify quantity of new glass panes required
INSPECTIONS
• Inspect timber glazing beads for integrity
APPLICATION

• Remove Broken Glass Panes:
  ○ Existing windows which have broken glass panes, to have all panes removed
• Install New Glass Panes:
  ○ New timber glassing beads to be fabricated where required, to match existing exactly, using high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
  ○ Fit window with new 4mm clear toughened safety glass, held in place with putty backing and timber glazing bead on the external
  ○ Window to be fully prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel

11.3 Replace/ Repair Damaged & Missing Timber Louvers:

PREPARATION
• Identify louvers & sills that require repairs • Identify louvers & sills that require replacement • Only qualified and approved carpenter may carry out the fabrication work
INSPECTIONS
• Inspect existing louvers and sills for strength and stability, and whether there is wood rot or deterioration
APPLICATION
• Remove Louvers & Sills:

- Existing louvers & sills to be removed and kept safely aside for refurbishment and reuse, after being inspected

- Refurbish Existing Louvers & Sills:
  - Timber to be fully scrapped, cleaned and sanded, all ready to receive new paint finish
  - All loose fixings to be fixed back together, using same timber jointing technics as current or using 100x6mm galvanised Timber Screws or a combination of both, screws to be counter sunk and plugged with timber plug cut from fully CCA treat SA Pine (S5) timber batten
  - Prepared timber to be painted with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel, first 2x Finishing Coats to be applied prior to being installed and final coat to be applied once installed
- Replace Existing Louvers & Sills:
  - Louvers and sills which are deemed inadequate for refurbishment due to deterioration or wood rot to be replaced in full with new
  - All timber to be replaced as a like for like basis, with existing louvers and sills being fully recorded and photographically captured for reference
  - New timber louvers & sills to be fabricated to match existing in size and profile, using high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
  - New louvers and sills to be reassembled and reinstalled into position where existing was removed
  - Timber to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel, first 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed

External Timber Ceilings & Eave Closures

12.1 Refurbish Water Damaged Ceilings:

PREPARATION
• Identify quantity of ceiling that requires refurbishment • Only qualified and approved carpenter may carry out the fabrication work
INSPECTIONS
• Inspect ceiling slates and ceiling substructure for wood rot and deterioration
APPLICATION

• Remove All Rotten & Deteriorated Timber Ceiling Slates & Substructure:
  ○ Existing damaged ceiling slates to be removed
  ○ Carefully remove any cornice that may be reused, keep safely aside for reinstallation at later stage
• Install New Ceiling Substructure:
  ○ Existing substructure to be refurbished, replacing any damaged timber with new (76x50), timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation, any cut ends during installation to be treated with 2x Coats Carbolinium

- New timber T&G ceiling slates to be installed to existing/ refurbished substructure, timber for ceiling T&G slates (22x75) to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
- Ceiling slates to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel. First 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed
- Fit existing refurbished cornice back into place, new cornice to be fabricated where required, to match existing in size and profile, timber to be as per ceiling slates and have the same finish

12.2 Refurbish Water Damaged Eave Closures:

PREPARATION

- Identify quantity of closures that requires refurbishment
- Only qualified and approved carpenter may carry out the fabrication work

INSPECTIONS

- Inspect closure slates and substructure for wood rot and deterioration

APPLICATION

- Remove All Rotten & Deteriorated Timber Slates & Substructure:
  - Existing damaged closure slates to be removed
  - Carefully remove any cornice that may be reused, keep safely aside for reinstallation at later stage
- Install New Ceiling Substructure:
  - Existing substructure to be refurbished, replacing any damaged timber with new (76x50), timber to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved, all surfaces to be treated with 2x coats Carbolinium prior to installation, any cut ends during installation to be treated with 2x Coats Carbolinium
  - New timber T&G closure slates to be installed to existing/ refurbished substructure, timber for ceiling T&G slates (22x75) to be high grade SA-Pine (S5) fully CCA treated (H3) fine saw cut (rough), all SABS approved
  - Closure slates to be prepared for painted finish, paint with 1x Wood Primer & 1x Dulux Undercoat & 3x Dulux Trade Eggshell Enamel. First 2x Finishing Coats to be applied prior to being installed and final 3rd coat to be applied once installed
  - Fit existing refurbished cornice back into place, new cornice to be fabricated where required, to match existing in size and profile, timber to be as per closure slates and have the same finish

4. PROVISIONAL TABLE OF QUANTITIES

LOCATION OF WORK	CURRENT AREA/ LENGTH	PROVISIONAL AREA/ LENGTH FOR REPLACEMENT
Broseley Roof Tiles	1236²	25% of current
Sheet Metal Roof	251m²	75% of current
Flat Lead Roof	25m²	50% of current
Protruding Wall Mouldings	32m²	100% of current
Box Gutters	135m²/155m	100% of current
Flat Roof	150m²	100% of current
Eave Gutters	236m	75% of current
Tiled Roof Valleys	75m	100% of current
Sheet Metal Roof Valleys	5m	100% of current
Tiled Roof Ridges/ Hips	195m	60% of current
Sheet Metal Roof Ridges/ Hips	11m	100% of current
Tiled Roof Flashings	120m	100% of current
Dormer Roof Flashings	45m	100% of current
Turret Roof Flashings	30m	100% of current
Sheet Metal Flashings	130m	100% of current
Plaster Copings (200mm thick)	135m²	50% of current
Brick Copings	70m	100% of current
Timber Fascia Boards	240m	75% of current
Timber Barge Boards	30m	100% of current
New Timber Windows	20	100% of current
New Glass Panes	55 (350x350mm)	100% of current
Refurbished External Ceilings & Eave Closures	400m²	75% of current
New Hail Guards (box gutters)	NIL	155m

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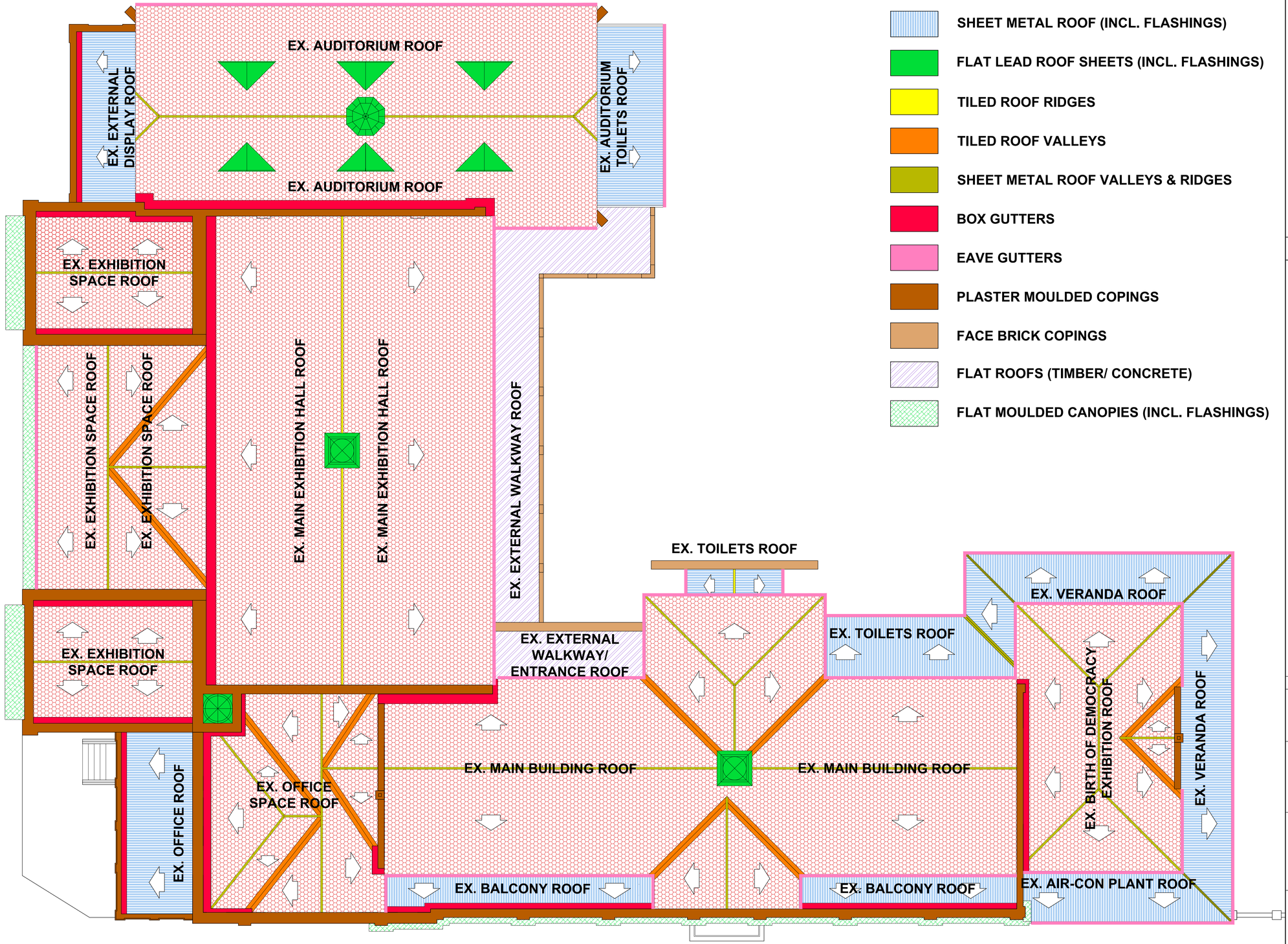
Prepared by:

Mr. JA Meintjes (Pr. Arch.)

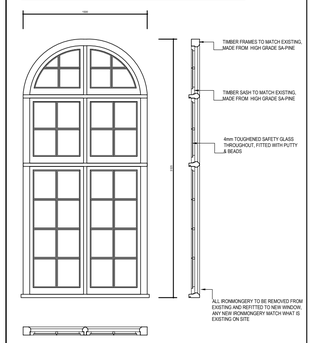
ANNEXURE A



- BROSELEY TILED ROOF (INCL. FLASHINGS)
- SHEET METAL ROOF (INCL. FLASHINGS)
- FLAT LEAD ROOF SHEETS (INCL. FLASHINGS)
- TILED ROOF RIDGES
- TILED ROOF VALLEYS
- SHEET METAL ROOF VALLEYS & RIDGES
- BOX GUTTERS
- EAVE GUTTERS
- PLASTER MOULDED COPINGS
- FACE BRICK COPINGS
- FLAT ROOFS (TIMBER/ CONCRETE)
- FLAT MOULDED CANOPIES (INCL. FLASHINGS)

TYPICAL WINDOW

ALL DIMENSIONS ARE GUIDELINES. EVERYTHING MUST BE CHECKED AND MEASURED ON SITE PRIOR TO ANY FABRICATION TAKING PLACE. ALL WINDOWS ARE TO MATCH EXISTING WINDOWS EXACTLY



NEW WINDOW

- ALL TIMBER TO HIGH GRADE SA-PINE
- ALL WORK TO BE CARRIED OUT BY APPROVED AMAFA SPECIALIST SUB-CONTRACTOR
- FINISH: ONE COAT WOOD PRIMER, ONE COAT UNDERCOAT & THREE COAT ENAMEL
- IRONMONGERY: REMOVE FROM EXISTING WINDOW, AND REINSTALL ONTO NEW WINDOW

Occupancy Classification : C2

Owner:
Name: uMSUNDUZI MUSEUM
Sign: _____ Date: _____

Architect:
Name: JA Meintjes
Sign: _____ Date: _____
Professional registration No.: 6428

BARTSCH

LADYSMITH: TEL(036) 631 1888, P.O.BOX 1097, LADYSMITH 3370
QUEENSTOWN: TEL(045) 839 5728, HARRISMITH: TEL(058) 623 471
EAST LONDON : TEL(043) 727 0765, BLOEMFONTEIN: TEL(051) 300 547
CAPE TOWN : TEL(021) 252 225, PRETORIA: TEL(012) 346 0526
WINDHOEK : TEL(0926461) 237 403, PMB: TEL(033) 347 1325

Project:
PROPOSED UPGRADES AND INSTALLATION OF ELECTRICAL & MECHANICAL WORKS: MAIN BUILDING (BLOCK M) - uMSUNDUZI MUSEUM, ERF 2535, 351 LANGALIBALELE STREET, PIETERMARITZBURG, KZN, 3201

Drawing Description:
PLAN - EXISTING MAIN MUSEUM ROOF LAYOUT, WITH AREAS OF WORK FOR REPAIRS

Drawn: REC P	Date: MAY 2023	Stage: Sub.
Scale/s: 1:100 @ A1	Checked:	
Drawing number: 5044 - 101a		Revision: 00

ANNEXURE 6

UMsunduzi
MUSEUM · ISIGCINAMAGUGU
an agency of the
Department of Sport, Arts and Culture

Joint Venture Agreement
(March 2004)
(First Edition of CIDB document 1017)

1. **PREAMBLE**

This agreement is made and entered into by and between

_____

_____

_____

of the first part and

_____

_____

_____

of the second part and

_____

_____

_____

of the third part.

(allow for additional parties as necessary).

Whereas the foregoing parties have resolved to form a Joint Venture under the title of

_____

_____

_____

for the exclusive purposes of securing and/or executing the Contract to be awarded by

(name of Employer)

to the UMSUNDUZI MUSEUM in respect of the following project:

for *(brief description of Contract)*

Refurbishment and Upgrading of uMsunduzi Museums Buildings

Now it is hereby agreed as follows :

2. DEFINITIONS AND INTERPRETATION

2.1 Definitions

The following words and expressions shall have the meanings indicated, except where the context otherwise requires. Defined terms and words are, in general, signified in the text of the Agreement by the use of capital initial letters, but the absence of such letters does not necessarily signify that a term, or word, is not defined.

'Agreement' means the agreement between the Members of the Joint Venture and includes this model form of agreement together with the Preamble, Specific Provisions, if any, Schedules 'A', 'B' and 'C' and any relevant Documents prepared prior to the signing of the Agreement and appended thereto.

'Contract' means the contract with the Employer for the supply of the Deliverables, for the purposes of securing and executing which, the Joint Venture has been formed.

'Deliverables' means the works and/or services, equipment, materials, goods, etc. to be furnished by the Joint Venture to the Employer in terms of the Contract.

'Document' means any written, drawn, typed, printed, or photographic material, which relates to the Agreement.

'Employer' means the person, or body, which is to award the Contract and will employ the Joint Venture if it is awarded the Contract.

'Joint Venture' means the joint venture formed by the Members in accordance with the Agreement.

'Management Committee' means the body established in terms of the Agreement to manage all aspects of the work of the Joint Venture in securing and executing the Contract and in meeting the provisions for the Agreement.

'Member' means a person, or body which, being a party to the Agreement, is a member of the Joint Venture.

'Member's Interest' means the proportion expressed as a percentage, which the total monetary value of all resources provided and contributions made by a Member towards the execution by the Joint Venture of the Contract bears to the total of such values by all Members and, unless otherwise indicated in the Agreement, represents the extent to which the Member participates in the fortunes of the Joint Venture.

'Representative' means the person representing a Member on the Management Committee.

'Schedules' means Schedules 'A', 'B' and 'C' which set out general, financial and other information relating to the Members and the obligations, duties, rights, risks and benefits arising from their participation in the Joint Venture.

'Specific Provisions' means the variations, if any, required to this standard form of agreement for the specific purposes of the Agreement.

2.2 Interpretation

Unless inconsistent with the context, an expression in the Agreement which denotes:

- any gender shall include the other genders
- a natural person shall include a juristic person and vice versa
- the singular shall include the plural and vice versa

2.3 Headings

The headings to clauses of the Agreement shall not be considered part thereof, nor shall the words they contain be taken into account in the interpretation of any clause.

2.4 Law

The Agreement shall be construed in accordance with and governed by the laws of the Republic of South Africa and the English language versions shall prevail.

2.5 Language

English shall be exclusively used by the Members in the preparation of Documents unless otherwise indicated.

2.6 Conflict between Agreement and Contract

Should any provision of the Agreement be in conflict with the terms of the Contract, the Agreement shall be amended to the approval of the Management Committee so as to eliminate the conflict.

3. JOINT VENTURE GENERAL

3.1 Establishment and Purpose

The Joint Venture established by the Members in terms of the Agreement is an unincorporated association with the exclusive purposes of securing and executing the Contract for the benefit of the Members.

3.2 Termination

The operation of the Joint Venture and the validity of the Agreement shall terminate if and when it becomes evident that the Joint Venture will not be awarded the Contract, or, if the Joint Venture secures the Contract, when all obligations and rights of the Joint Venture and the Members in connection with the Contract and the Agreement have ceased and/or been satisfactorily discharged.

Unless otherwise decided by the Management Committee, the Agreement shall not terminate if a Member changes its name, or is taken over by, or merged with, another body.

This agreement will terminate when any one of the Members resigns, are liquidated or opts out of this agreement and the Joint Venture will be in breach of contract with the Employer and their contract could be cancelled.

3.3 Exclusivity

Unless otherwise agreed by the Management Committee, or provided for in the Contract no Member shall engage in any activity related to the Contract other than as a Member of the Joint Venture and Members shall ensure that their subsidiaries and other bodies over which they have control comply with this requirement.

3.4 Participation of Members

Except as may otherwise be stipulated in the Agreement, each Member shall be responsible for all costs incurred by it prior to the date of inception of the Agreement.

Subsequent to the date of inception of the Agreement, each Member shall, participate in the operations, risks, responsibilities and fortunes of the Joint Venture including, inter alia, the provision of funding, sureties, guarantees, insurances, human and other resources and participation in profits and losses to the extents indicated in the Schedules. Participation in any aspect not covered in the Schedules shall, if an agreement cannot be reached between the Members, be to the same extents as indicated by the Members Interests.

3.5 Management

The affairs of the Joint Venture shall be directed and controlled by the Management Committee, as set out in Section 4 hereof.

3.6 Confidentiality

All matters relating to the Agreement and the Contract shall be treated by the Members as confidential and no such matter shall be disclosed to any third party without the prior written approval of the Management Committee.

No Member shall be party to the dissemination of publicity relating to the Contract, or the Agreement, without the prior written approval of the Management Committee and the Employer.

3.7 Assignment

No Member shall cede, assign, or in any other way make over any of its rights, or obligations, under the Agreement without the prior written consent of the Management Committee.

3.8 Subcontracting

No Member shall subcontract any obligation, work or duty for which it is, itself, responsible in terms of the Agreement without the prior written consent of the Management Committee.

3.9 Variations to Agreement

No variation, modification, or waiver of any part of the Agreement shall be of any force, or effect, unless unanimously agreed by the Members and reduced to writing.

3.10 Liability

Each Member warrants that it will indemnify the other Members against all legal liabilities arising out of, or in connection with the performance of its obligations under the Agreement.

It is acknowledged by the Members that they may be held jointly and severally liable in respect of claims against the Joint Venture by the Employer or third parties.

4. MANAGEMENT OF JOINT VENTURE

4.1 General

The affairs of the Joint Venture shall be directed, controlled and managed by the Management Committee, which, within the terms of the Agreement and the Contract, shall have full authority to bind the Members in all matters relating to the affairs of the Joint Venture.

Communication between the Joint Venture and the Employer, or third parties, relating to the Contract shall be conducted exclusively by the Management Committee, or by such person as it may delegate to perform this function.

The Management Committee shall have the power to appoint a project manager and/or such other persons as it may see fit to appoint for the purpose of executing the Contract and may delegate such of its powers, responsibilities and duties as it may consider necessary, or desirable, to persons or bodies appointed or seconded for this purpose.

Such administrative functions as are necessary to ensure the effective operation of the Management Committee shall be performed by its chairman.

4.2 Management Committee

4.2.1 *Composition*

The Management Committee shall, unless otherwise agreed by all the Members, consist of one Representative of each Member and each Member shall be obliged, at all times, to maintain a Representative on the Management Committee.

Each member shall, not later than three working days after the signing of the Agreement, appoint its Representative and notify the other Members of the name and contact details of the Representative. Such Representative shall have the power to bind the Member that he represents in all matters relating to the execution of the Contract and the performance of the Agreement.

A Member shall be entitled, after giving the other Members not less than three working days written notice of his intention to do so, appoint, remove and/or replace, an alternate who shall, at any meeting of the Management Committee from which the Representative whom he represents is absent, be vested with all rights and powers and subjected to all the obligations of the absent Representative.

The chairman of the Management Committee shall be the Representative of the Member which has the largest Member's Interest. If two, or more, Members have the same, largest Member's Interest, the chairmanship shall rotate between the Representatives of such Members at three monthly intervals, the order of rotation to be determined by ballot.

Notwithstanding the foregoing, the chairmanship of the Management Committee may be determined, or changed, at any time by unanimous decision of the Management Committee.

No remuneration shall be paid by the Joint Venture to Representatives or their alternates for serving on the Management

4.2.2 *Meetings*

Meetings of the Management Committee shall take place at such times and places as the Management Committee may determine, provided that the chairman shall convene a meeting of the Management Committee to be held not later than ten working days after he has been requested, in writing, by a Member to do so. Not less than five working days written notice of any meeting of the Management Committee shall be given to all Representatives and their alternates.

The Management Committee may permit, or invite, persons other than Representatives or alternates to attend any of its meetings, but such persons shall not have voting rights.

4.2.3 *Decisions*

Each Representative shall have one vote on the Management Committee and where, in terms of this clause, a casting vote is required, this shall be exercised by the chairman.

All decisions of the Management Committee shall, desirably, be unanimous. Accordingly, if unanimity cannot, initially, be achieved in regard to a decision, the meeting at which that decision is sought shall be adjourned for a period of 48 hours to enable Representatives to consult with their principals. If, on resumption of the adjourned meeting, unanimity can still not be achieved, the decision, provided it is not one requiring unanimity of the Members, shall be taken by majority vote and, in the event of a tie, the chairman shall exercise a casting vote.

A Member not satisfied with a majority decision of the Management Committee may declare a dispute, to be dealt with in terms of Clause 8 hereof, but the majority decision shall, nevertheless, be implemented with immediate effect.

Decisions of the Management Committee, whether taken at a meeting, or otherwise, shall be recorded in written minutes, which shall be distributed by the chairman to reach the Representatives not later than five working days after those decisions were taken. Such minutes shall be deemed to have been affirmed by the Representatives unless written notice of dissent is received by the chairman not later than three working days after receipt of the minutes by the Representative.

4.2.4 Powers and duties

The functions, responsibilities and powers of the Management Committee shall include, inter alia, those listed below:

4.2.4.1 Formulating overall policy in regard to the achievement of the objectives of the Joint Venture.

4.2.4.2 Managing the day to day affairs of the Joint Venture.

4.2.4.3 Monitoring, directing and co-ordinating the activities of the Members to ensure that the objectives of the Joint Venture are achieved and that the obligations and responsibilities of the individual Members are met.

4.2.4.4 Monitoring and controlling the financial affairs of the Joint Venture and ensuring that proper books of account and financial records relating to affairs of the Joint Venture are maintained in an approved form and submitted to the Management Committee for approval at regular intervals, which shall not be longer than one month.

4.2.4.5 Determining the necessity for and the details of any changes in the duties and responsibilities of Members provided that any resulting changes in Members' Interests shall be unanimously approved by the Members.

4.2.4.6 Determining the terms and conditions of employment of personnel and the emoluments applicable to staff seconded to the Joint Venture by the Members.

4.2.4.7 Controlling and approving the appointment of all subcontractors.

4.2.4.8 Procuring, after the completion of the Contract and the release of all bonds, guarantees and sureties given in respect of the performances of the Joint Venture and the Members, the preparation and auditing of a final set of accounts, on the basis of which the final profits, or losses, attributable to the individual Members shall be determined and any necessary adjustments effected.

5 RESOURCES OF JOINT VENTURE

The resources to be utilised by the Joint Venture in securing and executing the Contract shall, insofar as these are to be provided directly by the Members, be as set out in the Schedules and may, from time to time, be amended by decision of the Management Committee, provided that the Member's Interests are not, except with the unanimous approval of the Members, affected thereby.

Similarly, specific areas of responsibility of the Members for the performance of work and the provision of facilities shall be as set out in the Schedules and may, from time to time, be amended by decision of the Management Committee, provided that the Members' Interest are not, except with the unanimous approval of the Members, affected thereby.

5.1 Schedule ‘A’ (General)

Schedule ‘A’ shall contain general information relating to the Joint Venture including, inter alia, the following :

1. The Employer’s name and address.
2. A brief description of the Contract and the Deliverables.
3. The name, physical address, communications addresses and domicilium citandi et executandi of each Member and of the Joint Venture.
4. The Members’ Interests.
5. A statement indicating whether, or not, Specific Provisions apply to the Agreement.
6. A schedule of insurance policies which must be taken out by the Joint Venture and by the individual Members.
7. A Schedule of sureties, indemnities and guarantees that must be furnished by the Joint Venture and by the individual Members.
8. Details of the persons, who, in the event of failure by the Members to reach agreement on the appointments of mediator and arbitrator, will nominate appointees to these positions in terms of Clauses 8.2 and 8.3.

5.2 Schedule ‘B’ (Financial)

Schedule ‘B’ shall contain information regarding the financial affairs of the Joint Venture including, inter alia, the following :

1. The working capital required by the Joint Venture and the extent to which and manner whereby this will be provided and/or guaranteed by the individual Members from time to time.
2. The banking accounts that are to be opened in the name of the Joint Venture and the manner in which these are to be operated.
3. The rates of interest that will be applicable to amounts by which Members are in debit, or credit, to the Joint Venture.
4. The names of the auditors and others, if any, who will provide auditing and accounting services to the Joint Venture.
5. The intervals at which interim financial accounts and forecasts will be prepared for approval by the Management Committee.
6. Insofar as not covered in Schedule ‘C’, the basis on which contributions of various types by the Members towards the work of the Joint Venture in securing, executing, managing and satisfactorily completing the Contract, will be valued.
7. The basis on which profits and/or surplus cash will, if available from time to time, be distributed to Members.
8. The basis upon which losses, if any, are to be apportioned to Members.

5.3 Schedule ‘C’ (Contributions by Members)

Schedule ‘C’ shall set out the contributions of various types, other than cash, that will be made by the individual Members towards the work and obligations of the Joint Venture and shall, as far as possible, indicate the monetary values to be placed on such contributions, which may include, inter alia, the following :

1. Staff seconded to the Joint Venture.
2. Work carried out and services provided to, or on behalf of, the Joint Venture.
3. Plant, equipment, facilities etc. made available for use by the Joint Venture.
4. Materials and goods supplied to, or on behalf of, the Joint Venture.
5. Licences, sureties, guarantees and indemnities furnished to, or on behalf of, the Joint Venture.
6. Joint Venture Disclosure form required for the Contract.

6. BREACH OF AGREEMENT

If a Member breaches any material provision of the Agreement, or delays or fails to fulfil its obligations in whole, or in part, and does not remedy the situation within fourteen calendar days of receipt of notice from the Management Committee, or another Member, to do so, the other Members shall have the right, without prejudice to any other rights arising from the default, to summarily terminate the Agreement and re-assign the defaulting Member’s rights and obligations in the Joint Venture as they see fit and withhold any moneys due to the defaulting member by the Joint Venture.

Each Member shall indemnify the other Members against all losses, costs and claims which may arise against them in the event of the Agreement being terminated as a result of breach of the Agreement by the said Member.

7. INSOLVENCY OF MEMBER

Should a Member be placed in liquidation, or under judicial management, whether provisionally or finally, or propose any compromise with its creditors, the other Members shall be entitled to proceed in terms of Clause 6, as if the Member had breached the Agreement.

8. DISPUTES

8.1 Settlement

The Members shall negotiate in good faith and make every effort to settle any dispute, or claim, that may arise out of, or relate to, the Agreement.

If agreement cannot be reached, an aggrieved Member shall, if he intends to proceed further in terms of Clause 8.2 hereof, advise all other Members in writing that negotiations have failed and that he intends to refer the matter to mediation in terms of Clause 8.2.

8.2 Mediation

Not earlier than ten working days after having advised the other Members, in terms of Clause 8.1, that negotiations in regard to a dispute have failed, an aggrieved Member may require that the dispute be referred, without legal representation, to mediation by a single mediator.

The mediator shall be selected by agreement between the Members, or, failing such agreement, by the person named for this purpose in Schedule 'A'. The costs of the mediation shall be borne equally by all Members.

The mediator shall convene a hearing of the Members and may hold separate discussions with any Member and shall assist the Members in reaching a mutually acceptable settlement of their differences through means of reconciliation, interpretation, clarification, suggestion and advice. The Members shall record such agreement in writing and thereafter they shall be bound by such agreement.

The mediator is authorised to end the mediation process whenever in his opinion further efforts at mediation would not contribute to a resolution of the dispute between the Members.

8.3 Arbitration

Where a dispute or claim is not resolved by mediation, it shall be referred to arbitration by a single arbitrator to be selected by agreement between the Members or, failing agreement, to be nominated by the person named for this purpose in Schedule 'A'.

The Member requiring referral to arbitration shall notify the other Members, in writing, thereof, not later than thirty calendar days after the mediator has expressed his opinion, failing which the mediator's opinion shall be deemed to have been accepted by all Members and shall be put into effect.

Arbitration shall be conducted in accordance with the provisions of the Arbitration Act No. 42 of 1965, as amended, and in accordance with such procedure as may be agreed by the Members or, failing such agreement, in accordance with the rules for the Conduct of Arbitrations published by the Association of Arbitrators and current at the date that the arbitrator is appointed.

The decisions of the arbitrator shall be final and binding on the Members, shall be carried into immediate effect and, if necessary, be made an order of any court of competent jurisdiction.

9. DOMICILIUM

The Members choose domicilium citandi et executandi for all purposes of and in connection with the Agreement as stated in Schedule 'A'. A Member shall be entitled to change his domicilium from time to time, but such change shall be effective only on receipt of written notice of the change by all other Members.

Member No. 1

Thus done and signed at _____ this _____ day of _____20___

For and on behalf of_____*[Company]*

by *[name]* _____ who warrants his authority to do so.

_____

As witnesses 1. _____ As witnesses 2. _____

Member No. 2

Thus done and signed at _____ this _____ day of _____20___

For and on behalf of_____*[Company]*

by *[name]* _____ who warrants his authority to do so.

_____

As witnesses 1. _____ As witnesses 2. _____

Member No. 3

Thus done and signed at _____ this _____ day of _____20___

For and on behalf of_____*[Company]*

by *[name]* _____ who warrants his authority to do so.

_____

As witnesses 1. _____ As witnesses 2. _____

[Allow for additional parties as necessary].

ANNEXURE 7

HEALTH AND SAFETY IMPLEMENTATION COSTING

Contractor to give a breakdown of his Health and Safety costs on this sheet.

ITEM	DESCRIPTION	UNIT	QUAN-TITY	MONTHS (Indicative)	RATE	AMOUNT
			(a)		(b)	(a) x (b)
1	**MEDICALS**					
1.1	Pre-employment medical	Nr.				
1.2	Re-medicals - yearly	Nr.				
	TOTAL					
2	**PERSONAL PROTECTIVE EQUIPMENT**					
2.1	Overalls	Nr.				
2.2	Hard Hats	Nr.				
2.3	Safety boots/shoes	Nr.				
2.4	Gloves	Nr.				
2.5	Gumboots steel toe cap	Nr.				
2.6	Safety glasses	Nr.				
2.7	Reflector Bibs	Nr.				
2.8	Barricading Material	M				
2.9	Dust masks	Box 20				
	TOTAL					
3	**FIRE FIGHTING**					
3.1	Fire extinguishers - 4.5Kg	Nr.				
3.2	Surveys - Annual Service	Nr.				
	TOTAL					
4	**HEALTH AND SAFETY PERSONNEL**					
4.1	Safety Manager	Nr.				
4.2	Safety Officer	Nr.				
4.3	Construction Phase Safety, Health, Environmental and Waste Management Plan	Nr.				
	TOTAL					
5	**FACILITIES**					
5.1	Provision of ablution facilities	Nr.				
5.2	Service and maintenance of ablution facilities	Nr.				
5.3	Provision of eating areas	Nr.				
5.4	Cleaning of Lay down and other storage areas	Nr.				
5.5	Wash hand basin	Nr.				
5.6	Hot and Cold running water	Nr.				
5.7	Degreasing & Toilet soap	Nr.				
	TOTAL					

6	**FALL PREVENTION / PROTECTION**					
6.1	Safety harnesses with double lanyards	Nr.				
6.2	Safety harnesses with Scaffold hooks	Nr.				
6.3	Lifelines and vertical fall arrest systems	Nr.				
6.4	Scaffolding – material, erection and inspection (Estimate for project)	Nr.				
6.5	Temporary hand railing material and kick flats	Nr.				
6.6	Chin Straps	Nr.				
	TOTAL					
7	**FIRST AID**					
7.1	Replenishment of boxes and other supplies	Nr				
	TOTAL					
8	**TRAINING**					
8.1	SHE Representative	Nr.				
8.2	First Aid Level 1	Nr.				
8.3	Fire Fighting	Nr.				
	TOTAL					
9	**SIGNAGE**					
9.1	All Signage as required by Law, regulatory, warning and information	Nr.				
9.2	Posters for awareness	Nr.				
	TOTAL					
10	**ELECTRICAL**					
10.1	Replacement of Locks required for lockouts	Nr.				
10.2	Replacement of tags	Nr.				
10.3	Replacement for Permit books	Nr.				
10.4	Replacement of Callipers	Nr.				
	TOTAL					
11	**OTHERS (Project Specific)**					
11.1		Nr.				
	TOTAL					
GRAND TOTAL TO BE CARRIED TO THE PRELIMINARIES AND GENERAL IN BILL OF QUANTITIES						

Refurbishment and Upgrading of uMsunduzi Museums Buildings

ANNEXURE 8

WAIVER OF CONTRACTOR'S LIEN

DEFINITIONS

Contractor: _____

Employer: uMsunduzi Museum KZN

Agreement: GCC FOR CONSTRUCTION WORKS - SECOND EDITION 2010

Works (description): **Refurbishment and Upgrading of uMsunduzi Museums Buildings**

Site: 351 Langalibalele Street, Pietermaritzburg, KwaZulu- Natal

AGREEMENT

The Contractor waives, in favour of the Employer, any lien or right of retention that is or may be held in respect of the Works to be executed on the Site

Thus done and signed at _____ on _____
[Date]

_____ _____
Name of signatory Capacity of signatory

_____ _____
As witness For and on behalf of the contractor who by signature hereof warrants authorisation hereto