



TRANSNET SOC LTD

**DCT BERTHS 203 TO 205 - RECONSTRUCTION, DEEPENING AND
LENGTHENING**

PORT OF DURBAN

SPECIFICATION – SCOUR PROTECTION AND REVETMENTS

1785-CO-000-C-SPC-0008 Rev T-00

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CONTENTS

1.0	SCOPE.....	1
1.1	Project.....	1
1.2	Scope.....	1
2.0	NORMATIVE REFERENCES.....	2
2.1	Reference Documents.....	2
2.2	Standard Specifications.....	2
2.3	<i>Employer's</i> Project Specific Specifications and Standards	2
3.0	DEFINITIONS.....	3
3.1	Chart Datum Port	3
3.2	Co-ordinate System.....	3
3.3	Tidal Levels.....	3
3.4	Method Statements	3
3.5	Technical Definitions	3
4.0	REQUIREMENTS.....	5
4.1	Method Statements	5
4.2	Materials	5
4.2.1	Requirement for Rock to be provided by <i>Contractor</i>	5
4.2.2	Rock Gradings and class limits.....	5
4.2.3	Rock Quality Requirements	6
4.2.4	Geotextile	6
4.2.5	Geotextile tubes	6
4.3	Equipment.....	6
4.3.1	General	6
4.3.2	Marine Equipment	7
4.3.3	Survey Equipment.....	7
4.4	Methods and procedures.....	7
4.4.1	Sequence	7
4.4.2	Preparation of trenches and slopes	7
4.4.3	Filter fabric/geotextile.....	7
4.4.4	Geotextile Tubes	7
4.4.5	Placing of Rock	7
4.4.6	Stockpiling of rock	8
4.4.7	Grading of rock armour layers.....	8
4.5	Surveys	8
4.5.1	Requirements of Marine Surveys	8
4.5.2	In-survey.....	8
4.5.3	Out-surveys	9
4.5.4	Timing of surveys.....	9
5.0	COMPLIANCE WITH REQUIREMENTS	10
5.1	Testing and Sampling	10
5.1.1	General	10



5.1.2	Sampling	10
5.1.2.1	Size and Composition of Samples	10
5.1.2.2	Methods of recovering samples	11
5.1.2.3	Transportation and identification of the samples	11
5.1.3	Testing	11
5.2	Tolerances	11
5.2.1	Placement of scour protection	11
5.2.2	Scour Protection Profiles and Tolerances	11
5.2.2.1	Vertical tolerances	11
5.2.2.2	Horizontal edge tolerances	12



1.0 SCOPE

1.1 Project

This specification is a project specific technical specification for the DCT Berths 203 to 205 Reconstruction, Deepening and Lengthening Project in the Port of Durban.

1.2 Scope

The scope of this specification covers the *Employer's* requirements for the supply, construction, production, testing, transport, placement, tolerances, acceptance criteria and survey for the construction of the rock scour protection and rock revetments. The extent of the scour protection and rock revetments is shown on the 1785-CO-040 series of drawings.

Specific emphasis is placed on durability in the marine environment. It covers basic Materials, Plant, quality, construction, tolerances, tests and acceptance criteria.

The dimensions, grading, rock layer thicknesses and layer types shown on the construction drawings shall be strictly observed. No alterations shall be made except on the receipt of the written approval of the *Supervisor*.

It shall be the responsibility of the *Contractor* to satisfy himself that the available quarries are capable of supplying rock of the sizes, quality and quantity required (as described in this technical specification) for the duration of the contract, failure in which the *Contractor* is to source Material which meets the required specification from an alternative source at his own cost.

The construction of the scour protection includes for the procurement of specified grading of rock from quarries in the Durban area or alternative quarry sites.

2.0 NORMATIVE REFERENCES

2.1 Reference Documents

The *works* shall be carried out as specified in the following documents:

- a) This Specification
- b) Industry Codes, Standards and Specifications as listed in Section 2.2
- c) *Employer's* Project Specific Technical Specifications as listed in Section 2.3
- d) Project Drawings:
 - 1785-CO-040 series of drawings – Scour protection
- e) Method statement prepared by the *Contractor*, as described in Section 4.1
- f) Project Geotechnical Reports, included in Part 4 - Site Information.

2.2 Standard Specifications

The *Contractor* shall provide and maintain current copies of all the standard specifications referred to herein below on the site for reference by both parties.

The governing standard for this specification shall be:

- a) CIRIA, C683 – The Rock Manual, The use of rock in hydraulic engineering (2nd Edition), 2007, Revised August 2008

The construction of the rock scour protection and rock revetments shall comply with the following standard specifications:

- b) SANS 1200 A:1986 General
- c) SANS 1200 C:1980 Site clearance
- d) SANS 1200 D:1988 Earthworks
- e) BS 6349 – Maritime Works Series
- f) BS 812 – British Standards Institution – Method for sampling and testing mineral aggregates (or equivalent BS EN revision)
- g) US Army Corps of Engineers: Coastal Engineering Manual

2.3 *Employer's* Project Specific Specifications and Standards

The construction of the rock scour protection and rock revetments shall also comply with the following Project Specific Specifications and Standards:

- a) 1785-CO-000-C-SPC-0004 – Dredging and Reclamation (Including Vibro Compaction)
- b) 1785-CO-000-C-SPC-0016 - Sandbank Extension
- c) Project Environmental Specifications (PES) as contained in the Works Information and annexures.

3.0 DEFINITIONS

All definitions of responsibilities shall be in accordance with the NEC Engineering and Construction Contract (ECC) for the construction of the *works*.

Where the standard specifications referenced in this specification refer the “Engineer”, replace this term with the term “Supervisor”.

For the purpose of this specification, the following definitions shall apply:

3.1 Chart Datum Port

Chart Datum Port refers to the reference level used in the Port of Durban, which is 0,900 m below Mean Sea Level. All levels referred to in this document are relative to Chart Datum Port (CDP).

3.2 Co-ordinate System

The co-ordinate system to be used for all setting out and survey shall be World Geodetic System 1984 (WGS84), LO31, referred to as WG31.

3.3 Tidal Levels

The Astronomical Tide Predictions as defined by the SA Navy Hydrographer and Chart SAN 2006 are as follows:

Table 3.1 – Tide Data

Tide	Abbreviation	Level m, Chart Datum Port
Highest Astronomical Tide	HAT	2.287
Mean High Water Springs	MHWS	1.997
Mean Level	ML	1.097
Mean Low Water Springs	MLWS	0.197
Lowest Astronomical Tide	LAT	-0.013

3.4 Method Statements

Method statements shall be compiled by the *Contractor* for all activities. The method statements shall be submitted to the *Supervisor* for acceptance three weeks in advance of the particular activity being undertaken. Full details of all proposed Equipment (including temporary *works*) and methods shall be provided for acceptance by the *Supervisor*.

No activity shall commence until the method statement has been accepted by the *Supervisor*.

Further details of the requirements of particular method statements are provided in Section 4.

3.5 Technical Definitions

Rock Grading Class

- A class of broken rock comprised of certain specified proportions of stones within certain specified ranges of sizes or weights (or Class Limits).

Class limits

The following Class Limits refer to specified stone sizes or weights that characterize a Rock Grading Class:

- Extreme lower class limit (ELCL) refers to either the nominal diameter or the weight of a stone in relation to which 2% by mass of the whole Rock Grading Class comprises smaller, lighter stones.
- Lower class limit (LCL) refers to either the nominal diameter or the weight of a stone in relation to which 10% by mass of the whole Rock Grading Class comprises smaller, lighter stones.
- Upper class limit (UCL) refers to either the nominal diameter or the weight of a stone in relation to which 70% by mass of the whole Rock Grading Class comprises smaller, lighter stones.

Extreme upper class limit (EUCL) refers to either the nominal diameter or the weight of a stone in relation to which 97% by mass of the whole Rock Grading Class comprises smaller, lighter stones.

D_{nx}

- D_{nx} refers to a nominal stone diameter by comparison with which stones smaller than D_{nx} represent “x” percent by mass of the whole sample (for example, D_{n10} = 50mm means that 10% by mass of the corresponding sample consists of stones smaller than 50mm, while the balance - i.e. 90% - consists of stones that are larger than 50mm).

Effective mean weight W_{em}

- The arithmetic average weight of all blocks in a sample excluding any stone fragments.

Fine-graded quarry stone

- A grading which is determined with the aid of sieve sizes.

Graded quarry stone

- Quarried stone which is graded by sieve sizes or by weight of the stone.

Heavy-graded quarry stone

- A quarried stone grading which is determined by weight for stones of mean weight of at least 300 kg per stone.

Light-graded quarry stone

- A quarried stone grading which is determined by weight or size of stone for mean weights less than 300 kg per stone.

Load of quarried stone

- The quantity of quarried stone per unit of transport.

Nominal stone diameter D_n

- The nominal stone diameter, D_n, shall be calculated as the cube root of the volume of the stone. The volume shall be calculated by dividing the mass of the stone by the saturated surface dry density. Where a numbered subscript is given to D_n, this refers to the percentage by weight of stones in the grading having a smaller nominal stone diameter.

Quarried stone

- Broken, natural stone.

Saturated surface-dry

- The condition of the aggregate when all permeable pores of each particle are completely saturated with water and its surface has no free moisture.

Stone fragment

- A stone is designated as a “stone fragment” in relation to a particular Rock Grading Class, if its nominal diameter or weight is less than the extreme lower class limit (ELCL) applicable to that Rock Grading Class; i.e. a stone is designated a “fragment” if its nominal diameter or weight is such as to place it within the smallest 2% of a Rock Grading Class; for example, in case of Rock Grading Class 150-90-50, for which the ELCL is 0.5kg, any stone that weighs less than 0.5kg is designated a “fragment” in relation to that Class.

Geotextile Tubes

- A “geotextile tube” refers to a sand-filled sleeve of geotextile fabric having an approximately oval cross section.

4.0 REQUIREMENTS

4.1 Method Statements

The *Contractor* shall prepare method statements that shall include *inter alia*:

- Nature and sources of materials with test certificates and results
- The results of tests on representative samples thereof indicating compliance herewith, certified as having been performed in accordance with the corresponding testing standards by a SANAS approved, independent testing organization.
- Method of material storage and production, delivery and quality control
- Method of placing

4.2 Materials

4.2.1 Requirement for Rock to be provided by *Contractor*

The *Employer* does not provide any rock to be used in the *works* and it is ultimately the *Contractor's* responsibility to source the rock required for the scour protection *works*, in the sizes and quality specified, as shown on the drawings and detailed in this specification.

4.2.2 Rock Gradings and class limits

Rock Grading Classes are designated herein and on the *works* drawings by references such as "150-90-50 (mm)" where:

- 150 refers to the largest nominal diameter of stones within the corresponding Rock Grading Class,
- 90 refers to the average nominal diameter of stones within the corresponding Rock Grading Class,
- 50 refers to the smallest nominal diameter of stones within the corresponding Rock Grading Class.

The following rock gradings and class limits will be required in the *works*:

Rock Grading Class Designation by Size	Rock Grading Class Designation by Mass	POSITION
150 - 90 - 50	9 - 2 - 0.3	Basin and quay wall scour – Lower layer
275 - 230 - 175	60 - 30 – 14	Basin scour – Upper layer
650 - 540 - 400	730 - 420 – 170	Quay wall scour – Upper layer

Class limits - 150 - 90 - 50

Class Limit	Limit Mass	% By weight s maller
ELCL	0.5 kg	< 2% may be smaller than 0.5kg
LCL	1 kg	< 10% may be smaller than 1kg
UCL	7.5 kg	>70% must be smaller than 7.5kg
EUCL	8.7 kg	>97% must be smaller than 8.7kg

Class limits - 275 - 230 - 175

Class Limit	Limit Mass	% By weight s maller
ELCL	12 kg	< 2% may be smaller than 12kg
LCL	15 kg	< 10% may be smaller than 15kg
UCL	50 kg	>70% must be smaller than 50kg
EUCL	58 kg	>97% must be smaller than 58kg

Class limits - 650 - 540 - 400

Class Limit	Limit Mass	% By weight smaller
ELCL	420 kg	< 2% may be smaller than 420kg
LCL	450 kg	< 10% may be smaller than 450kg
UCL	615 kg	>70% must be smaller than 615kg
EUCL	645 kg	>97% must be smaller than 645kg

4.2.3 Rock Quality Requirements

- Density:** The average density of quarry stone must be at least 2 700 kg/m³ with 90% of the stones having a density of at least 2 600 kg/m.
- Water absorption:** The average water absorption of quarry stone shall be less than 2%, and the water absorption of nine (9) of the individual stones less than 2.5%.
- Resistance to impact and mineral fabric breakage:** The average point load index (in the planar direction of the most pronounced layering, should any visible anisotropy exist) shall be at least 4,0MPa.
- Block integrity:** Blocks from heavy gradings must be free from visually observable cracks, veins, fissures, shale layers, stylolite seams, laminations, foliation planes, cleavage planes, unit contacts or other such flaws which could lead to breakage during loading, unloading or placing.
- Impurities:** Quarried rock shall not contain visually observable or chemically detectable impurities or foreign matter in such quantities as are damaging to the constructive application of the quarried stone, or for the environment in which the quarried stone is applied.

4.2.4 Geotextile

Filter fabric for placement in the scour protection may be of woven or non-woven construction, and shall conform to the following requirements:

Table 4.1: Filter fabric/geotextile requirements

Property	Units	Value	Test Method
Trapezoidal Tear Strength	N	>1 050	ASTM D4533-85
Tensile Strength	kN/m	>40	SANS 0221-88
CBR Puncture	kN	>6,0	SANS 0221-88
Pore size (apparent opening size) O _{95H}	µm	50 - 150	NFG 38.C17
Permeability	m/s	>1*10 ⁻⁵	SANS 0221-88
Porosity (non-woven fabrics)	%	>60	Calculation
Percentage open area (woven fabrics)	%	>5	Measurement

4.2.5 Geotextile tubes

Geotextile tubes to be supplied and installed by the *Contractor* shall conform to specification 1785-CO-000-C-SPC-0016.

4.3 Equipment

4.3.1 General

The *Contractor* shall provide for all the necessary plant to deliver the specified rock quality and gradings, transport the rock to the site and place the scour protection, as shown in the drawings, to the required tolerances. The *Contractor* shall further provide Equipment for the accurate control of placing the rock and for surveying of the scour protection layers, to prove compliance with the relevant tolerances.

The *Contractor* shall provide Equipment that is suitable for controlled placement of the scour protection. Land based or waterborne Equipment is acceptable provided the placement of rock is undertaken in a controlled manner. Refer to section 4.4 for further details regarding examples of suitable placement methods.

4.3.2 Marine Equipment

General requirements for marine Equipment are provided in the main body of the Works Information.

4.3.3 Survey Equipment

The requirements for survey equipment for undertaking in-surveys and out-surveys is specified in the *Employer's* specification for Dredging Reclamation and Sandbank Extension. The same requirements are applicable to surveys undertaken for the scour protection *works*.

4.4 Methods and procedures

4.4.1 Sequence

The construction of scour protection shall be undertaken for the specified areas of sandbank toe, sandbanks slopes, basin slopes and each berth consecutively, in the sequence specified for berth deepening i.e. DCT Berths 203 to 205 Reconstruction, Deepening and Lengthening Project in the Port of Durban, with completion and hand over of each berth before occupation will be given for the commencement of construction on the following berth. The specified order of construction is as follows:

1. Quay wall scour protection

- a) Dredge caisson trench and scour trench
- b) Place and fill caisson
- c) Final trimming and level of the scour protection trench after caisson placement
- d) Place geofabric and scour layers

2. Basin scour protection other than adjacent to sandbank

- a) Confirmation by survey of compliance of the basin dredging with the specified geometry and placement of scour protection thereafter shall be completed within 14 days of completion of the basin dredging.

3. Scour protection adjacent to sandbank

- a) Confirmation by survey of compliance of the sandbank extension and of the adjacent basin dredging with the specified geometry, along with placement of basin scour protection adjacent to the sandbank thereafter, shall be completed within 14 days of completion of the sandbank extension and adjacent basin dredging *works*.

4.4.2 Preparation of trenches and slopes

The dredging, profiling and cleaning of the scour protected areas is dealt with in the *Employer's* specification 1785-CO-000-C-SPC-0004 Dredging and Reclamation (Including Vibro Compaction).

Any sediment exceeding 0.10m thick revealed by dive survey that may have accumulated after completion of dredging shall be removed by airlift before geotextile is placed.

4.4.3 Filter fabric/geotextile

Prior to placing the scour protection, the geotextile shall be made continuous either by firmly stitching together using double stitching with 500 mm overlap, or by providing overlaps of not less than 1500 mm. The fabric shall be laid with care to avoid overstretching or puncturing of the fabric during and after laying thereof. When un-stitched laps are used, acceptable measures shall be implemented to ensure that the 1500 mm overlaps are maintained until the scour protection is in position. The method of laying fabric on any dredged slopes shall be such as to ensure that the fabric is not stretched or damaged by down-slope creep due to stone placement.

4.4.4 Geotextile Tubes

Installation of geotextile tubes shall be in accordance with specification 1785-CO-000-C-SPC-0016.

4.4.5 Placing of Rock

Quarried rock which will be placed in the *works* shall be transported and handled in such a manner as to minimise segregation and breakage of the rock.

Rock shall be placed to the position and slopes indicated on the drawings.

The underlayer shall be placed to achieve a dense underlayer but shall not be compacted. The underlayer shall be placed carefully to avoid damage to the geotextile. The underlayer shall be placed to achieve an even distribution of stone sizes without concentration of smaller stones.

The rocks shall be placed in such a way that they do not obtain their stability on a plane by frictional resistance alone, but also by interlocking. The *Contractor* shall take measures to ensure this prior to placing further rock.

Placement of both the smaller underlayer and the larger upper layer shall be in a controlled manner. Controlled placement is defined as either bulk armourstone placement in relatively small quantities per cycle or as the individual placement of heavier pieces of armourstone. Uncontrolled dumping of bulk material such as end tipping from a dump truck or bulldozing the material off a flat topped barge is not permitted. Acceptable methods of controlled placement include:

- a) Hydraulic excavator with bucket or grab attachment
- b) Wire rope crane with grab
- c) Placement using a tube or chute

4.4.6 Stockpiling of rock

Stockpiles of rock shall be contained within the *Contractor's* site establishment boundaries and work area to the acceptance of the *Supervisor*. Separate stockpiles shall be made and identified for different rock grades. The stockpiles shall be formed so that they do not constitute a hazard; the location, side slopes and heights and other factors affecting safety shall be as accepted by the *Supervisor*.

The *Contractor* shall make a risk assessment for the transportation to and handling of rock on site, and implement a strict risk control plan and maintain good operational practice throughout the period of supply and installation for the construction of the rubble mound structures. A stockpile plan must be drawn up which is commensurate with the overall project planning, giving due regard to the quarry output capacity and production lead-in time. Stockpiles on site must be sized, taking into considerations the type of grading, access, weight limitations, manoeuvring and handling requirements (tipping or tipping and stacking) and risk of cross contamination (no overlaps of grades). If possible, a one-way rotation system should be instituted for controlling traffic. The stockpile area must be checked for services to avoid risk of damages. The *Contractor* shall prevent unauthorized pedestrian access, keep stockpile areas well lit during night operation, maintain equipment in adequate working condition, and keep suitable backup equipment nearby.

4.4.7 Grading of rock armour layers

The grading of rock armour layers shall be correctly maintained and to this end the *Contractor* shall at his own cost take all actions necessary to remove any rocks that may have been displaced by wave or other action and washed or swept or otherwise moved into voids of previously placed armouring before any further armouring necessary to complete the sections is placed.

4.5 Surveys

4.5.1 Requirements of Marine Surveys

The requirements for marine surveys are as per those specified in the *Employer's* specification for Dredging Reclamation and Sandbank Extension.

4.5.2 In-survey

The approved in survey is a combination of the following out surveys specified in the *Employer's* specification for Dredging Reclamation and Sandbank Extension:

- a) On completion of dredging and profiling within the basin, the entire basin area (excluding the berth pocket dredging) shall be surveyed to ensure compliance with the dredging tolerances.
- b) On completion of berth dredging for the caisson and scour trench (berth pocket dredging), the trenches shall be surveyed to ensure compliance with the dredging tolerances.
- c) On final completion of the sandbank extension, a survey of the completed extension shall be undertaken to ensure compliance with the placement tolerances for the sandbank.

4.5.3 Out-surveys

On completion of each layer of scour protection the *Contractor* shall carry out an out survey of the scour protection. This survey shall be carried out in collaboration with the *Supervisor* who will delegate staff to check the *Contractor's* work and to undertake spot checks as necessary.

The out survey will comprise a combination of a dip survey and multibeam survey as detailed below:

- a) Multibeam survey on a 3m grid as specified in the *Employer's* specification for Dredging Reclamation and Sandbank Extension.
- b) Dip survey of the scour protection to ensure compliance with the required tolerances. The stone levels shall be taken on a 3 m x 3 m grid and the levels shall be recorded to an accuracy of 50mm. The *Contractor* will also be required to undertake underwater video inspections of the scour protection.
- c) Dip survey measurements to survey the profile shall be carried out using a probe with a spherical end of diameter 0.5 Dn50. For a land-based survey this will generally be connected to a staff or EDM target; for an underwater survey it will generally be a weighted ball on the end of a sounding chain.
- d) The multibeam survey will be calibrated against the dip survey.

The results shall be recorded on a drawing to a scale of 1:1000, which shall be submitted to the *Supervisor*. Relevant features such as design depths, buoys, identification of ground survey control stations and quay numbers shall be shown on the drawing. The orientation (north point) shall be indicated together with the drawing scale. The datum to be used shall be Chart Datum Port.

The out-surveys shall be used for checking tolerances only and will not form the basis for re-measurement.

4.5.4 Timing of surveys

Surveys shall be carried out as follows:

- a) In-surveys – no more than two weeks before commencing the lower stonelayer scour protection placement in any area of the trench.
- b) Out-surveys – as soon as the relevant stone layer has been completed and the required tolerances have been achieved.

5.0 COMPLIANCE WITH REQUIREMENTS

5.1 Testing and Sampling

5.1.1 General

Except where noted in this specification, all inspection, sampling and testing shall be done in accordance with BS 812 or similar approved industry standard.

When, on the basis of visual judgement of the quarried rock batch to be inspected, non-homogeneity or possible non-homogeneity of the batch is considered to exist with regard to one or more of the relevant qualities, that batch shall be divided into parts considered to be homogeneous. Sampling shall then be carried out on the individual parts.

When one of the parts does not satisfy the requirements, the whole batch of quarried stone shall be considered unsatisfactory.

If separation of the divided part(s), which does (do) not satisfy the requirements, is possible without difficulty, the remaining part of the batch may be regarded as a separate batch.

Samples used for testing may be reincorporated into the *works* provided they have met the required specification. Samples failing the specification or damaged during testing shall be disposed of by the *Contractor*.

5.1.2 Sampling

5.1.2.1 Size and Composition of Samples

Samples for determining particle distribution:

For the determination of the particle distribution of a fine-graded quarry stone, at least six sub-samples shall be taken if the sampling takes place from a stockpile or a ship's load. In all other cases the number of sub-samples shall be at least three.

The weight in kilograms of each sub-sample (W_s) shall be not less than the upper class limit (UCL) in millimetres of the Rock Grading Class concerned if such $UCL < 100$ mm (for example, if the $UCL = 80$ mm, then $W_s > 80$ kg).

The weight in kilograms of each sub-sample (W_s) shall be not less than 2x the upper class limit (UCL) in millimetres of the Rock Grading Class concerned if such $UCL > 100$ mm (for example, if the $UCL = 120$ mm, then $W_s > 240$ kg).

Samples for determining weight distribution:

For the determination of the weight distribution of the light or heavy graded quarry stone, at least six sub-samples shall be taken if the sampling takes place from a stockpile or a ship's load. In all other cases the number shall be at least three.

The sub-samples, including all rock fragments, shall together constitute one sample that shall include at least 200 pieces of stone heavier than the upper class limit (UCL) of the designated rock grading class.

When the determination of the weight distribution concerns a ship's load containing less than 200 pieces of stone, the whole load is taken to be one sample.

Samples for determining shape and rock quality:

A single sample for the purpose of confirming compliance with the specified rock shape and quality shall include at least 100 stones larger and/or heavier than the upper class limit (UCL) corresponding to the designated Rock Grading Class concerned.

Samples for determining grading designated by size and average weight:

At least four sub-samples shall be taken if sampling is from a ship's load or from a stockpile. In all other cases, the number shall be at least two.

The sub-samples, including all rock fragments, together constitute one sample. This sample must contain at least 100 pieces of stone retained on the square hole of size 500 mm x 500 mm for the light grading class.

5.1.2.2 Methods of recovering samples

The necessary care shall be exercised to ensure that representative samples are recovered and that during sampling, the degree of filling of a grab, or other extraction equipment, does not adversely affect the representivity of the sample recovered.

5.1.2.3 Transportation and identification of the samples

For the transportation of a sample, precautions shall be taken to avoid loss or deterioration of the material, and to ensure that the sample is not contaminated. All samples shall be accompanied by a certificate which contains the following information:

- a) A reference to this specification
- b) The name of the producer and location of the quarry
- c) The description and class designation of the grading
- d) The number of stone pieces in the sample
- e) Details on location and method of sampling, including the date of sampling
- f) The name of the individual who took the sample

5.1.3 Testing

Testing shall be carried out in accordance with BS 812 and shall include but not be limited to the following:

- g) Weighing
- h) Determination of shape
- i) Determination of rock density
- j) Determination of water absorption at atmospheric pressure
- k) Determination of block integrity by the drop test breakage index (CIRIA 1991)

Reports shall be generated by the *Contractor* and submitted to the *Supervisor* for approval for all testing as per the requirements of BS 812.

5.2 Tolerances

5.2.1 Placement of scour protection

Tolerances for the dredging and profiling of the scour protection trench and slopes are given in the *Employer's* specification for Dredging Reclamation and Sandbank Extension.

5.2.2 Scour Protection Profiles and Tolerances

The *Contractor* shall ensure that cumulative tolerances meet with tolerance requirements as defined within this specification.

5.2.2.1 Vertical tolerances

Scour protection shall be constructed to the dredge profile and rock layer profile levels as shown on the drawings and shall comply with the vertical tolerances in Table 5.1 below.

Notwithstanding the tolerances in Table 5.1, the following shall apply to armour layers:

- a) The tolerances on two consecutive mean actual profiles shall not be negative.
- b) Notwithstanding any accumulation of positive tolerances on underlying layers, the thickness of the layer shall not be less than 80% of the nominal thickness when calculated using mean actual profiles.

Table 5.1: Vertical Placing Tolerances for Primary Armour Rock

Depth of placing below Chart Datum	All Primary Armour	
	On individual measurements	Design profile to actual*
Dry, i.e. above Chart Datum	$\pm 0.3 D_{n50}$	+ 0.35 D_{n50} - 0.25 D_{n50}
Below Chart Datum	$\pm 0.5 D_{n50}$	+ 0.60 D_{n50} - 0.40 D_{n50}



*All tolerances refer to the design profile to actual mean profile unless stated otherwise.

5.2.2.2 Horizontal edge tolerances

Lines: A maximum deviation of +0.5 m shall be permitted. No negative tolerance shall be allowed.