



**Anti-climb Device Replacement Project
Transmission Western Grid
Report**

Technology

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Replacement Project
Transmission Western Grid**

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Compiled by

Shaina Bisoon Dayal

Design Engineer

Date: 23/08/2019

Reviewed by

Bharat Haridass

Senior Consultant

Date: 23/08/2019

Authorised by

Dan Dukhan

Middle Manager (acting)

Date: 23/08/2019

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Disclaimer

The opinions/suggestions in this report are provided in response to a specific request from Transmission Western Grid. Opinions/suggestions presented in this report apply to the site conditions and features as they existed at the time of Lines Engineering Services (LES) investigations and those reasonably foreseeable. These opinions/suggestions do not necessarily apply to conditions and features that may arise after the date of this report, about which LES had no prior knowledge nor had the opportunity to evaluate.

Prepared by **Line Engineering Services (LES)**

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Revision

Date	Rev.	Compiled by	Clause	Remarks
August 2019	1	Shaina Bisoon Dayal		First issue

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1. Executive Summary

The Transmission Western Grid requires the replacement of existing anti-climb devices (barbed wire type) that are ineffective; stolen, damaged or corroded. A total of 20 lines consisting of 348 structures are in need of replacement. The replacement of the barbed wire type with the same type is not recommended as the same issues will persist. The palisade (if designs are available) and razor wire flat wrap type must be installed instead of the barbed wire type. The majority anti-climb device type will be the razor wire flat wrap, which is cost effective, easy to install and has had better results (in preventing corrosion and theft) in the distribution sector and other transmission grids than the barbed wire type.

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2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

To outline the scope required for the replacement of anti-climb devices from the barbed wire to the razor flat wire type and/or palisade type, in the Transmission Western Grid.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

2.2 References

Parties using this document shall apply the most recent edition of the following documents:

2.2.1 Normative References

- [1] SANS 10280-1:2013 – Overhead power lines for conditions prevailing in South Africa
- [2] 240-47172520 – The Standard for the Construction of Overhead Powerlines (TRMSCAAC)
- [3] 05TB-028 – Technical Bulletin: Anti-climbing devices for lattice towers.
- [4] 240-147174608 - Anti-Vandal Guideline for Powerlines

2.2.2 Informative references

- [1] Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)
- [2] Construction Regulations, 2014. Government Notice No. 37305 of 7 February 2014
- [3] 240-53458961 – Process Control Manual (PCM) for Perform Line Engineering
- [4] 240-71380115 – Routine Inspection and Maintenance of Transmission lines

2.3 Definitions and abbreviations

2.3.1 Definitions

Anti-climb device	In this case it is a measure installed on a tower (at a height approximately 3 m from ground) to aid in the prevention of unauthorised climbing of the tower to protect the public from injury and/or death.
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2.3.2 Abbreviations

ACD	Anti-climb device
OHS	Occupational Health and Safety

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3. Investigation

In compliance with the OHS Act, it is a requirement that all towers be fitted with an effective anti-climb device (ACD) to be safe guarded from any unauthorized climbing to prevent any injuries or death. The Western Transmission Western Grid has initiated a project to replace all ACD's that have been stolen or are ineffective in preventing un-authorized people from climbing the structures.

There are three types of ACD's currently used within Eskom; barbed wire, razor wire flat wrap and the palisade type. The barbed wire type was installed on old existing lines, however currently the use of the existing barbed wire type is not acceptable as it is easily stolen a short period of time after being installed (in high vandalism areas) and deteriorates in corrosive areas.

Currently the palisade type has only been designed for all fairly new transmission towers and is installed on newly built and will be used on future transmission powerlines. Palisade designs for older towers have not been done and will require a significant amount of time, resources and design information for every tower. Some of the towers in the grid are copyright to companies that presently do not exist, which means that every tower will have to be analysed on site for specific parameters required.

The razor wire flat wrap ACD type is therefore recommended where the palisade type is not available. This design can be implemented on the tower's barbed wire existing brackets with minimal or no additional intervention. The razor wire flat wrap is easy to install, cost effective and lasts longer than the previous barbed wire type. This ACD is also applicable for highly corrosive areas. It has been used in the distribution sector and on some transmission lines and was found to be very effective with it still intact even after installation in certain high vandalism areas for more than a few years.

A detailed list of the lines and the towers that require replacement were done including whether; the structure is self-supporting or guyed, the amount of extra brackets required and the amount of razor or palisade ACD's to be installed. **Table 3.1** lists this information for each transmission line. **Table 3.2** lists the quantity required for each tower type.

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Table 3.1: Powerlines and amount of towers that require ACD replacement.

Line	Voltage	Total	Self - supportin g	Guyed	Brackets Required	Razor wire flat wrap	Palisade
Bacchus Kappa No1 400kV Line	400	0	-	-	-	-	-
Gourikwa Proteus No1 400kV Line	400	0	-	-	-	-	-
Gourikwa Proteus No2 400kV Line	400	0	-	-	-	-	-
Palmiet Bacchus No1 400kV Line	400	0	-	-	-	-	-
Bacchus Proteus No1 400kV Line	400	8	7	1	8	8	
Droerivier Kappa No1 400kV Line	400	11	11	0	11	11	
Droerivier Kappa No2 400kV Line	400	1	1	0	1	1	
Droerivier Proteus No1 400kV Line	400	52	4	48	52	52	
Gamma Kappa No1 765kV Line	765	0	-	-	-	-	-
Acacia Koeberg No1 400kV Line	400	35	35	0	35	35	
Acacia Koeberg No2 132kV Line	132	9	9	0	9	9	
Acacia Muldersvlei No1 400kV Line	400	33	33	0	33	33	
Acacia Philippi No1 400kV Line	400	3	3	0	3	3	
Acacia Philippi No2 400kV Line	400	3	3	0	3	3	
Bacchus Muldersvlei No1 400kV Line	400	20	20	0	20	14	6
Kappa Muldersvlei No1 400kV Line	400	5	5	0	5	5	
Kappa Sterrekus No1 765kV Line	765	0	-	-	-	-	-
Koeberg Stikland No1 400kV Line	400	14	14	0	14	14	
Muldersvlei Stikland No1 400kV Line	400	0	-	-	-	-	-
Palmiet Stikland No1 400kV Line	400	0	-	-	-	-	-
Ankerlig Aurora No1 400kV Line	400	5	0	5	5	5	
Ankerlig Aurora No2 400kV Line	400	56	56	0	56	56	
Ankerlig Koeberg No1 400kV Line	400	2	2	0	2	2	
Ankerlig Koeberg No2 400kV Line	400	10	10	0	10	10	
Ankerlig Sterrekus 400kV Line	400 Future	0	-	-	-	-	-
Aurora Juno No1 400kV Line	400	10	10	0	10	10	



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Line	Voltage	Total	Self - supportin g	Guyed	Brackets Required	Razor wire flat wrap	Palisade
Helios Juno No1 400kV Line	400	0	-	-	-	-	-
Koeberg Ankerlig 132kV Line	132 Future	0	-	-	-	-	-
Koeberg Sterrekus No1 400kV Line	400	9	9	0	9	9	
Muldersvlei Sterrekus No1 400kV Line	400	4	4	0	4	4	
		290	236	54	290	284	6
Cumulative 15% risk	Total	348	285	63	348	339	9

Table 3.2: Quantity per tower type.

Tower Series	Tower Type	Amount	Structure type	ACD Type
501	A	13	Self-supporting	Razor wire flat wrap
	B	-		
	C	-		
	D	-		
	E	-		
	F	-		
	G	-		
	H	-		
	S	2		
504	A	22	Self-supporting	Razor wire flat wrap
	B	11		
	C	13		
	D	12		
	E	-		
	F	-		
	S	4		
506	A	10	Self-supporting	Razor wire flat wrap
	B	134		
510	A	-	Self-supporting	Razor wire flat wrap
	B	-		
	C	2		
	D	5		
	E	5		
	F	4		
	G	-		
510	H	-		
	J	-		
513	B	6	Self-supporting	Razor wire flat wrap
	C	2		
515	A	2	Self-supporting	Razor wire flat wrap
	B	59	Guyed	
	C	4	Self-supporting	

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Tower Series	Tower Type	Amount	Structure type	ACD Type	
	D	-	Guyed	Razor wire flat wrap	
	E	3			
	F	-			
	FS	4			
	G	-	Self-supporting		
517	A	5	Self-supporting	Palisade	
	E	2			
	F	2			
523	A	-	Self-supporting	Razor wire flat wrap	
	B	2			
	C	-			

A total of 20 lines require replacement consisting of approximately 348 structures; including 285 self-supporting and 63 guyed structures. At this stage the condition and availability of the ACD brackets are unknown therefore conservatively all new brackets should be acquired. Currently the palisade design is only available for the 517 structures therefore the remaining structures will require razor wire flat wrap type.

3.1 Razor wire flat wrap design and installation

Refer to **Appendix A** for the ACD designs. **Figure A1** is for inland applications that are for structures approximately >30 km from the coast and **Figure A2** is for coastal applications within 30 km from the coast.

Refer to **Appendix B** for the Technical bulletin 05TB-028 that indicates a detailed installation of the razor wire flat wrap for existing structures.

3.2 Palisade design and installation

The existing tower's leg extension will be required for each leg as the palisade design differs per leg extension. Drilling of additional holes on existing tower members may be needed.

As a further anti-vandal measure, a seam weld of the nut to the bolt thread or the installation of anti-vandal bolts is recommended for the ACD attachment bolts to the tower [4].

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4. Conclusion

A total of 20 lines consisting of 348 structures are in need of replacement. The replacement of the barbed wire type with the same ACD type is not recommended as the same issues will persist. The palisade (where designs are available) and razor wire flat wrap must be installed. The majority anti-climb device type will be the razor wire flat wrap, which is cost effective, easy to install and has had better results (in preventing corrosion and theft) in the distribution sector and other transmission grids than the barbed wire type.

APPENDIX A – Razor Wire Flat Wrap Design

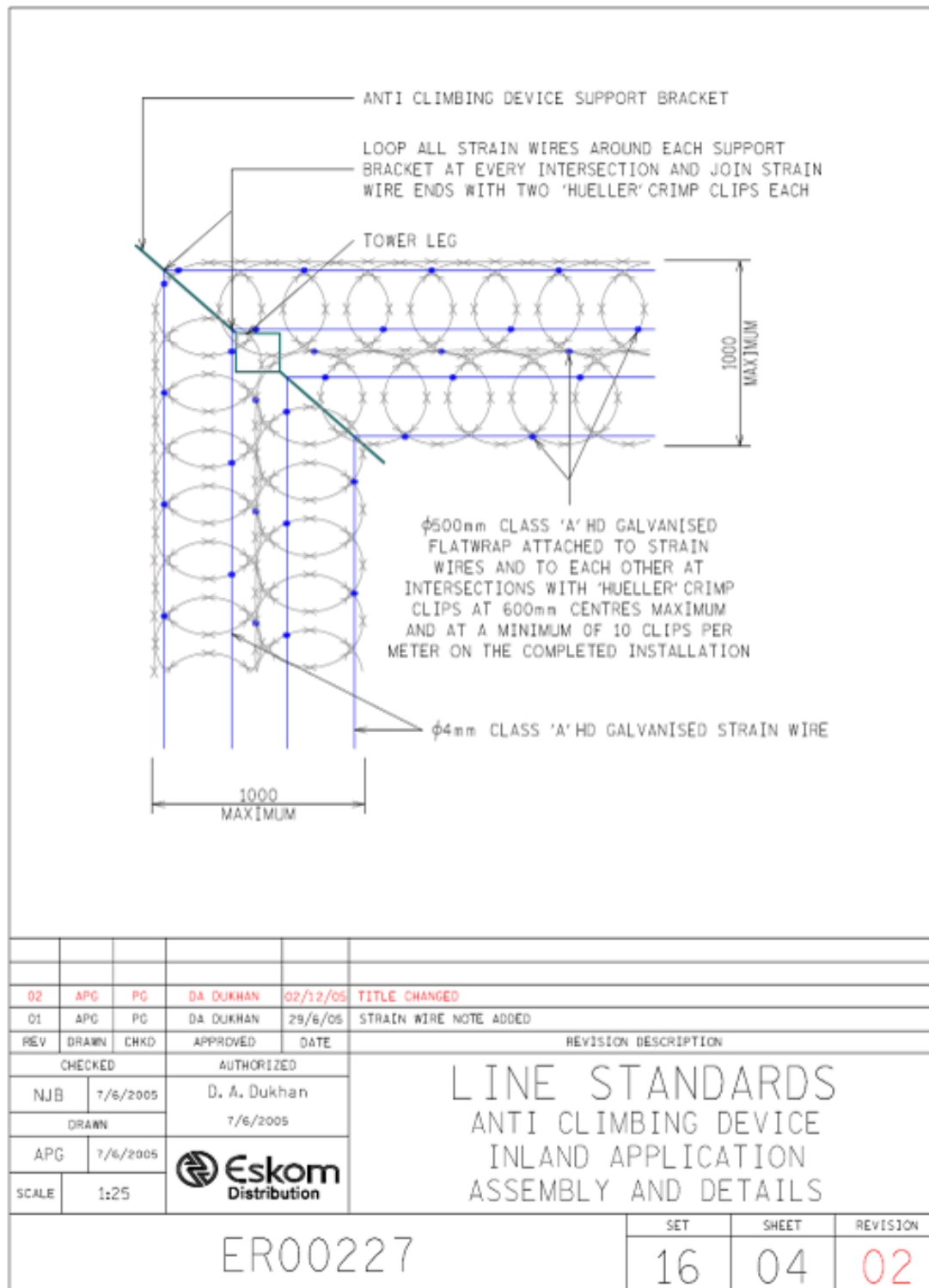
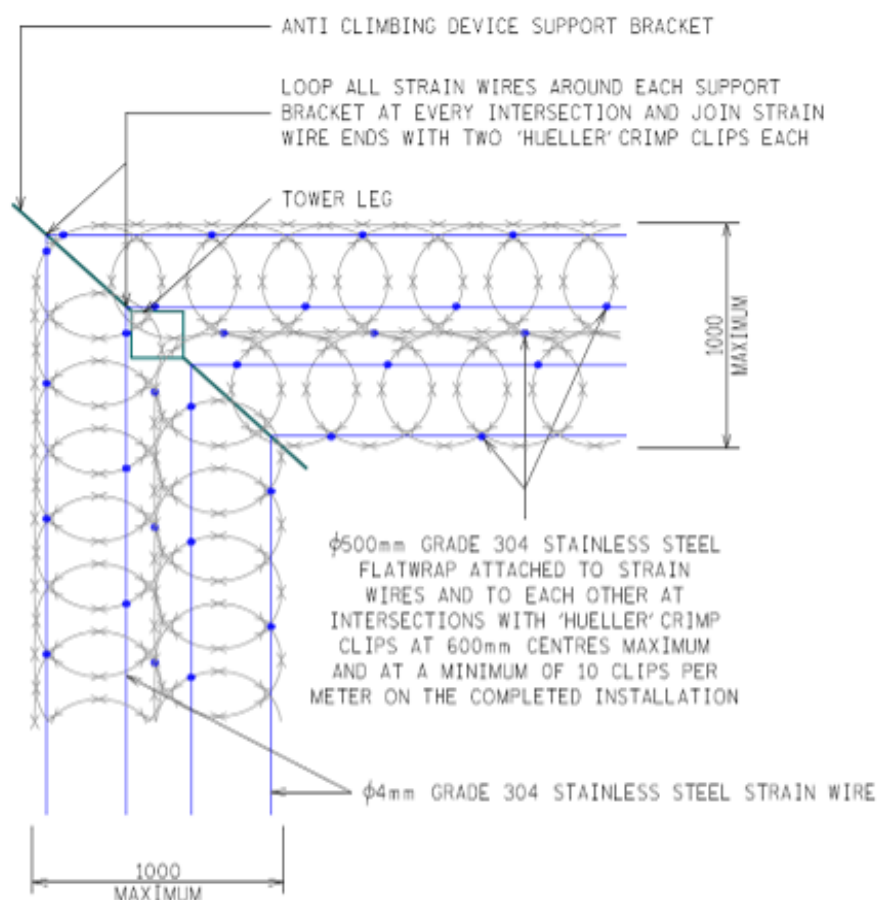


Figure A1: Razor wire flat wrap ACD - Inland Application




REV	DRAWN	CHKD	APPROVED	DATE	REVISION DESCRIPTION						
CHECKED		AUTHORIZED		LINE STANDARDS ANTI CLIMBING DEVICE COASTAL APPLICATION ASSEMBLY AND DETAILS							
PG	02/12/2005	DA DUKHAN 02/12/2005									
DRAWN											
APG	02/12/2005										
SCALE	1:25										
ER00227					<table><tr><td>SET</td><td>SHEET</td><td>REVISION</td></tr><tr><td>16</td><td>27</td><td>00</td></tr></table>	SET	SHEET	REVISION	16	27	00
SET	SHEET	REVISION									
16	27	00									

Figure A2: Razor wire flat wrap ACD – Coastal Application

APPENDIX B – Distribution Technical Bulletin

DISTRIBUTION
TECHNICAL BULLETIN

01/10/2005

Enquiries: S le Roux / B Branfield
Tel: (011) 871 3201 / (043) 703 2489**TECHNICAL BULLETIN: 05TB-028****Part 6: HV lines****TITLE: ANTI-CLIMBING DEVICES FOR LATTICE TOWERS****Background**

Some existing anti-climbing devices have been installed in a manner such that persons are able to lift the barbed wire and gain access to the lattice tower legs. This bulletin addresses methods in which to modify the existing anti-climbing devices (ACD's) to prevent unauthorized access to the tower.

Lattice towers are supplied with an anti-climbing device. In some cases the bracket may vary but the concept is similar. *Insert 1* below shows the conventional device with brackets clamping onto the legs of a lattice tower. The barbed wire forms the horizontal "table" to severely inhibit any person from climbing past the device.

THE PHOTOGRAPHS BELOW ARE INDICATIVE ONLY AND MAY NOT REPRESENT THE ACTUAL SCENARIO ON SITE.

Insert 1: Conventional anti-climbing device

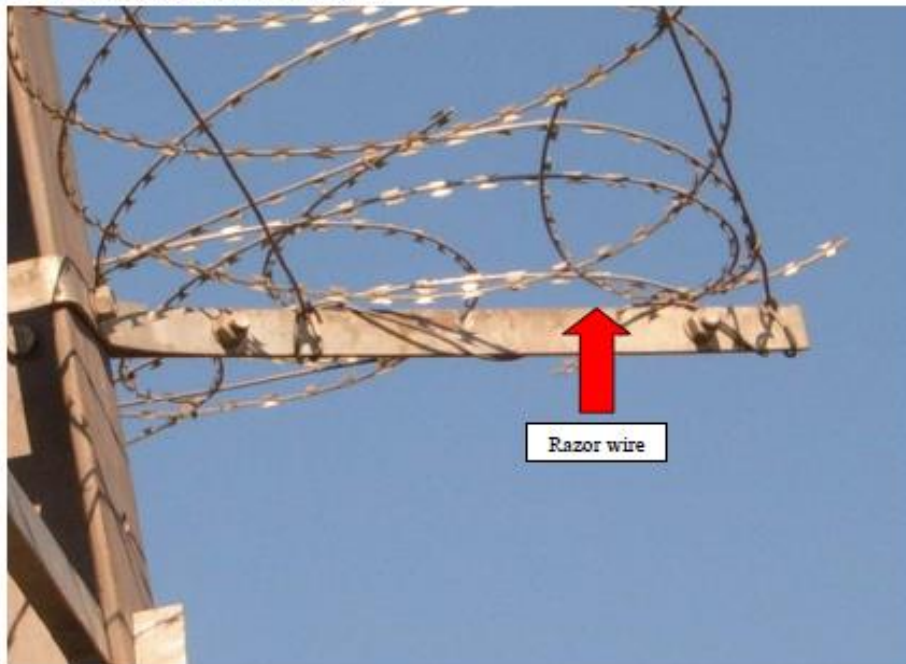
The brackets are fabricated from steel with a slot provided for the connection of the wires. The slots can be seen on "Insert 2" below. The device relies on tension in the barbed wire to prevent it from being lifted vertically. Once the barbed wire is lifted out of one slot, the wire whole system becomes slack and is easily removed. Theft of the barbed wire is common in some densely populated areas.

Insert 2: Barbed wire captured by vertical slots



ESKOM, KZN have modified the ACD device to consist of flat razor wire and plain steel wire as shown in "Insert 3". They have found it both effective as an ACD and have experienced less theft of the wire.

Insert 3: Modification as installed by KZN



Method of installation

ACD Brackets:

The ACD brackets shall be securely bolted onto the legs of the lattice towers. They shall not move vertically or horizontally when a force is applied to them.

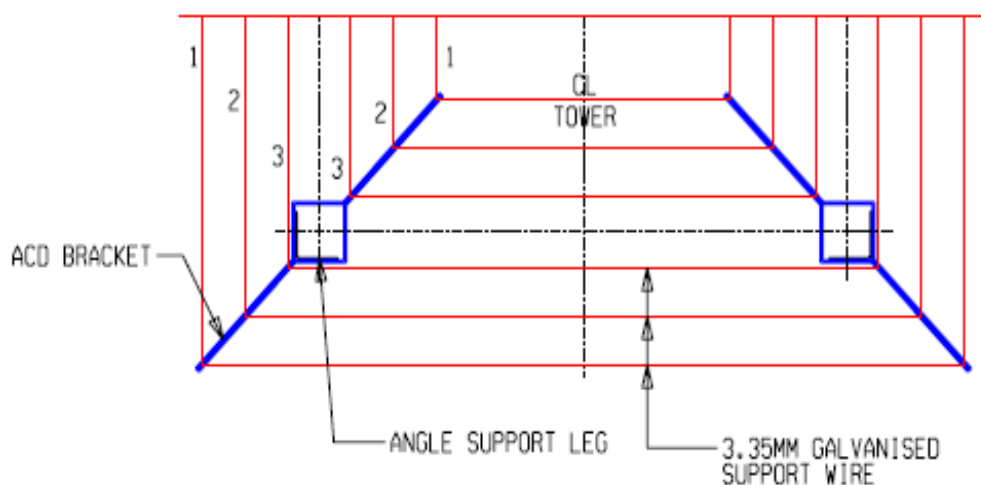


Figure 1. Half-section through tower

Placement and fitting of support wires

Numbers 1, 2 and 3 in Figure 1 above represent the layout of the 3.35mm heavily galvanized steel wires to achieve support for the razor wire i.e. one outer support, one inner support and one center support per side.

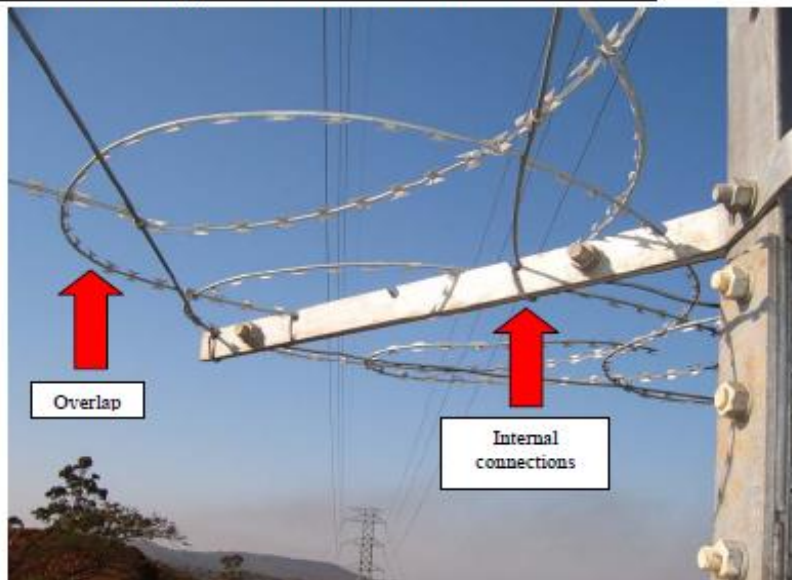
A 3.35mm heavily galvanized wire shall be connected to the brackets at positions 1, 2 and 3. The start of the wires forming the horizontal support shall be securely connected to the brackets by wrapping them around the steel brackets at least once and securing them by binding the wire back over itself. Where a wire join is required the join shall occur on an ACD bracket and the wire shall be wrapped around the steel brackets at least once and secured by binding the wire back over itself as for a start joint.

Internal connections shall be wrapped around the depth of the bracket to ensure that they are secure as shown in "Insert 4".

The wires shall be pulled up as tight as possible.

NOTE: FOR COASTAL APPLICATIONS THE USE OF STAINLESS STEEL MAY BE CONSIDERED.

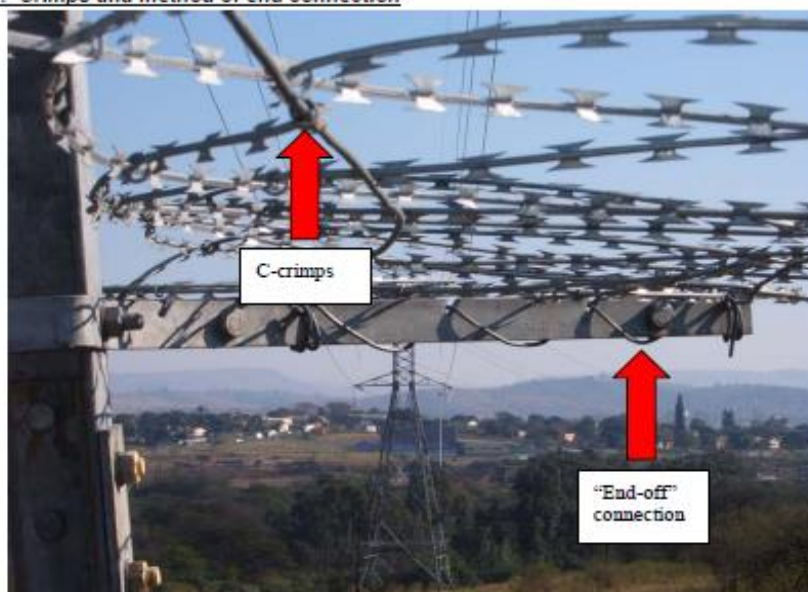
Insert 4: Connection of support wire onto ACD arm and razor wire overlap



Placement and fitting of flat wrap razor wire

The flat wrap razor wire shall be laid on top of the galvanized support wire. The radius of the razor wire shall extend over the inner and outer support wires to allow an overlap. This is depicted on the above photograph. Attention shall be paid to the inner corner where the wires numbered 5 meet at the leg of the tower. The razor wire shall extend over this area sufficiently to prevent any person from passing through it. At the intersection points of the support wire and the flat wrap razor wire a C-clip shall be applied to connect the two together. There shall be no loose connections at any point where the razor wire overlaps the galvanized wire. All critical points shall be connected with a maximum distance between C-clips of 500mm.

Insert 5: Crimps and method of end connection



All ACD's installed shall severely inhibit any persons from climbing the structures.

Required modifications to existing ACD's on lattice towers and required action

	Description	Action
1	The brackets and wire are in good condition. The wire is secured onto the brackets preventing vertical lifting of the wire out of the bracket.	No action required.
2	The brackets and barbed wire are in good condition but the barbed wire is not tied onto the ACD brackets. The tension in the barbed wire is taught.	The barbed wire shall be bound onto the ACD brackets using 3.35 galvanised binding wires to ensure that the barbed wire cannot be lifted from the bracket. This shall be done even if the tension of the barbed wire restricts the vertical movement of the barbed wire from the ACD bracket.
3	The bracket is loose at the structure but is in good condition. The tension in the wires is loose due to the bracket being loose.	Loose bolts shall be re-tightened and loose wires shall be re-tensioned. The wires shall be bound onto the ACD as for point 2 above.
4	The bracket is in good condition but the tension in the wires is loose.	The wires shall be re-tensioned and the tie wires shall be bound onto the ACD as for point 2 above.
5	The bracket is in good condition but the barbed wire/razor wire is rusted.	The barbed/razor wire shall be removed. New 3.35mm heavily galvanized steel wire and flat wrap razor wire shall be installed as explained in "Method of Installation".
6	The bracket and the barbed/razor wire are not in good condition.	The brackets shall be replaced and new 3.35mm galvanized steel wire and flat wrap razor wire installed as explained in "Method of Installation".
7	New installations	New 3.35mm heavily galvanized steel wire and flat wrap razor wire shall be installed as explained in "Method of installation".

ALL TRANSMISSION LATTICE TOWERS SHALL BE FITTED WITH ANTI-CLIMBING DEVICES WHICH ARE INSTALLED IN ACCORDANCE WITH THIS TECHNICAL BULLETIN.

The following drawings, from Eskom Eastern region (KZN), are attached as a guideline for new installations for ACD's for coastal and inland applications.