

ROCK REVETMENT SPECIFICATION

Porthloo

Isles of Scilly Dune & Flood Defence Scheme

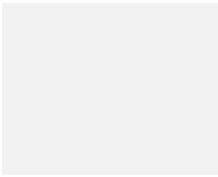
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1 Introduction

Porthloo is located on the western side of St. Marys. The bay measures approximately 300m across and is flanked to the north and south by rocky outcrops. At the southern end of the beach is a boat yard which is protected from wave run-up by an existing engineered dune which extends halfway along the beach. The northern extent of the beach is backed by an earth embankment which retains the road. The embankment currently has an assortment of various sized rocks and is susceptible to erosion and overtopping from wave events.

2 Scope of Works

The works comprise the construction of a rock armour revetment between the existing engineered dune and the cliff at the northern end of the bay. The revetment works are to minimise erosion and scour along the embankment which retains Porthloo lane and to reduce overtopping to the residential and commercial properties located behind the road.

3 Environmental Conditions

Tide Levels at St. Mary's, Isles of Scilly:

Table 1: All levels are relative to Chart Datum (CD). CD is 2.91m below local datum.

	Chart Datum	Local Datum
Highest Astronomical Tide (HAT)	6.3m	3.39m
Mean High Water Springs (MHWS)	5.7m	2.79m
Mean High Water Neaps (MHWN)	4.3m	1.39m
Mean Low Water Neaps (MLWN)	2.0m	-0.91m
Mean Low Water Springs (MLWS)	0.7m	-2.21m
Lowest Astronomical Tide (LAT)	0.0m	-2.91m

Note: the above levels are still water levels. Significant variation to these levels may be caused by atmospheric and storm conditions. In addition, wave heights will vary dependent on the sea state, which can also increase or decrease the water level.

The contractor will need to programme the works to coincide with the tidal cycle and weather conditions, to avoid the risk of people/machinery becoming trapped by the incoming tide.

4 Rock Revetment Specification (Particular Specification)

The General Specification for the rock revetment shall be The Rock Manual – The Use of Rock in Hydraulic Engineering 2nd Edition (CIRIA C683) 2007, supplemented by additional clauses contained in this section.

Where a discrepancy between the above General Specification (The Rock Manual 2nd Edition) and this Particular Specification occurs, then the clauses in this Particular Specification shall prevail.

4.1 Rock Armouring

The rock shall be pre-screened off site to remove fines prior to placement. Methods of placing rock shall be such as to minimise disturbance to the foreshore.

The areas may be adjusted by the *Supervisor* as work proceeds according to the site conditions found.

The armour stone shall comply with BS EN13383 as referenced in the Rock Manual and the particular requirements of this specification. The rock grading envelope is shown in Table 2 and shall comply with the corresponding grading below.

Primary Rock Armour

Standard Heavy Grading

Table 2: BS EN13383 grading

Class designation	Extreme Lower Limit	Nominal Lower Limit	Nominal Upper Limit	Extreme Upper Limit	Effective Mean Mass	
					Lower Limit	Upper Limit
Passing requirements	<5%	<10%	>70%	>97%		
1000-3000Kg	700kg	1000kg	3000kg	4500kg	1700	2100

Properties of suitable armour stone shall be in accordance with Table 3 to follow.

Table 3: Armour stone properties

Property	BS EN Symbol	BS EN Ref	Description	Armour Requirement	Armour Category
Process Type		3	Production method	Natural	
Petrographic Type		Annex C	Geological Classification	Igneous, metamorphic or sedimentary	
Density		5.2	Oven dried particle density	Min 2600 kg/m ³	
Length to Thickness Ratio	LT	4.3	Overall shape	Max 5% greater than 3:1	LT _A
Crushed or Broken Surfaces	RO	4.4	Amount of non-rounded surfaces	Max 5% by number with less than 50% crushed or broken surfaces	RO ₅
Water Absorption	WA	7.3	Amount of water absorbed when immersed	Max 6.2% gain in mass	WA _{1.5}

Block Integrity		Annex B	Presence of internal flaws or fissures	No significant fracture when dropped 3.0m onto horizontal test bed of secure heavy armour rock.	
Colour			General colour within natural variation	To match existing rock armouring.	

4.2 Transportation and Stockpiling of Armour stone

An armour stone storage area is to be confirmed with the *Project Manager* and will need to be stored in a location as not to interfere with passage of vehicles along the road or impede access to the foreshore for the commercial activities at the boat yard.

If the Contractor is transporting the rock by road then he shall:

- I. Obtain the approval of the *Project Manager* and the appropriate Authorities prior to transporting the rock to the foreshore.
- II. Ensure all vehicles are roadworthy and have the necessary safety certificate and insurance issued by the relevant authorities.
- III. The Contractor shall have an emergency procedure in place should there be an incident in which rock falls onto the highway during transportation or whilst transferring the rock to the stockpile.
- IV. Suitable plant and equipment must be on station or locally available to ensure that the road is kept clear.

If the Contractor is transporting the rock to site via barge, then he shall:

1. Obtain the approval of the *Project Manager* and the appropriate Authorities prior to transporting the rock to the site. He is also responsible for ensuring that relevant Notices to Mariners are issued as per the Harbour Master's guidelines.
2. Ensure all barges are seaworthy and have the necessary safety certificate and Insurance issued by the relevant authorities. Permission for safe mooring of sea transport vessels is obtained from the relevant authorities. The supplier shall have an emergency procedure in place should there be an imminent threat of sea and wind conditions beyond the safe mooring design conditions.
3. Ensure adequate side and deck protection is in place on the vessel to prevent any armour stone dislodged during transit from causing damage or capsizing the vessel.
4. A suitable tug must be on station or locally available while the barge is at anchor.

4.3 Placing Armourstone – General

Placing of the materials shall be one continuous operation, to ensure that none of the underlying layers are left unprotected over a distance greater than agreed or for a duration greater than agreed between the *Contractor* and *the Supervisor*. If the operation has to be interrupted, temporary protection of the underlying layers shall be provided with the same material as to be used for the final construction.

Armourstone placing for the cover layer shall comply with the following requirements:

- This armour stone shall be individually placed to achieve a dense, fully interlocked slope. Placing shall commence at the toe and proceed upwards towards the crest. Stones shall be placed in such a way that they obtain their stability from interlocking and frictional resistance, and not from friction at one contact point alone.
- Tipping of armour stone from trucks into final position shall not be permitted.
- Armour stone shall be placed according to the standard placement method summarised in Table 4 to achieve a minimum “three-point support” and be stable to the lines and levels shown on the drawings.

Table 4: Recognised Armourstone placement methods

Method	Details
Random Placement	This is without the control of orientation and should not be assumed to be any tighter than would be expected if the stones were placed out of view underwater by single cable release from a crane using a spatial positioning grid.
Standard Placement	This is where minimum orientation control is applied so that the block attitude is effectively governed by its orientation in the stockpile before lifting. However, a minimum of three points of contact within the layer being placed should be ensured.
Dense Placement	This involves the rotation of stones until the orientation achieved is expected to give the maximum number of point contacts and minimum voids. Individual stones are removed and replaced if necessary.
Specific Placement	This is when the procedures coupled with stone shape constraints are specified to be other than random, standard or dense.

- The surface of the armoured slope shall present an angular uneven face to the water to achieve the desired energy dissipation of waves. Pieces of armour stone smaller than the equivalent of the extreme lower limit value of the grading shall not be used to fill interstices or prop larger stones in order to achieve the required profile.
- Pieces of armour stone broken during handling or placing shall be removed immediately at the Contractor’s expense.
- Any void below the finished profile level as shown on the drawings in excess of 0.75 the average stone size (D_{n50}) shall be filled with an appropriate stone or stones. Determination of the acceptability of any void shall be by means of the survey probe or other test sphere or cage of diameter $0.75 D_{n50}$.

Vertical achievable placing tolerances for armour stone shall be in accordance with Table 5:

Table 5: Vertical placement tolerances

	Dry – i.e. above low water, placed using land-based plant	Below low water placed using land-based plant	Below low water, placed by water-borne equipment
Maximum allowable deviations based on individual measurements	$\pm 0.3 D_{n50}$	$\pm 0.5 D_{n50}$	$\pm 0.8 D_{n50}$

Notwithstanding the above tolerances, the following criteria shall apply to the armour stone cover layer:

- The tolerances on two consecutive mean actual profiles shall not be negative.
- Notwithstanding any accumulation of positive tolerances on underlying layers, the thickness of the layer shall not be less than 80 per cent of the nominal thickness when calculated using mean actual profiles.
- The *Contractor* shall make good any parts of the *Works* that has been subject to any settlement within the structure that is beyond the specified allowable limits and that may occur up to one year after completion of the works. Making good of settlement shall be with materials and in a manner approved by the *Supervisor*.

4.4 Revetment Geotextile

The revetment rocks shall be placed on geotextile:

2.162 (A) Geotextiles

17. **Revetment geotextile** shall have the following properties:

	Unit	Specification
Dynamic perforation (cone drop) EN ISO 13433	mm	1
Tensile strength-MD EN ISO 10319	kN/m	65
Tensile strength-CD EN ISO 10319	kN/m	65
Elongation-MD EN ISO 10319	%	80
Elongation-CD EN ISO 10319	%	80
CBR Puncture Resistance EN ISO 12236	N	1200
Opening Size O_{90} EN ISO 12956	μm	<69
Waterflow normal to the plane EN ISO 11058	l/s/m ²	30

MD= machine direction/ CD = cross direction

Clause numbering refers to the CESWI & EA. A suffix "A" on the clause number indicates an additional clause.

4.5 Test Section

At the commencement of placement of the armour stone the *Contractor* shall be required by the *Supervisor* to construct a test section of structure which shall be used to demonstrate the quality of placing of armour stone layers, for approval by the *Supervisor*. A 10m length will be adequate. The *Contractor* shall obtain approval from the *Supervisor*.

For the approved test panel the *Contractor* shall record accurately for agreement:

- The grading of the armour stone used.
- The quantity (tonnes) and volume (m³) of material used.

During the progress of the *works*, the *Contractor* may, from time to time, be required to demonstrate that the placed packing density being achieved is in accordance with the approved test panel. The visual quality achieved in test panels shall be maintained throughout the remainder of the *Works*. Areas of placed armour stone that show an appearance distinguishably different from the agreed test section in terms of quality of the

construction finish may be rejected. Block counting methods may be used to further substantiate grounds for rejection or acceptance by the *Project Manager*. Rejected sections shall be reworked until the test section quality is achieved.

4.6 Working in the Water Environment

Each placed layer shall be protected by the subsequent layer as soon as possible after placement in order to minimise wave damage in the event of storms during the construction period.

The *Contractor* shall make good any location where material has been eroded by wave and/or current action or removed by other cause before placing the appropriate material for the overlying (protective) layer.

Notwithstanding the above, the *Contractor* shall take all reasonable care to avoid disturbing a previously placed layer by avoiding dropping armour stone or any other potentially disturbing placing methods.

Preference will be given by the *Supervisor* to methods of working that progress from upstream/updrift to downstream/downdrift and thereby reduce undesirable siltation in the work area prior to stone placement. For work above low-tide level, sufficient fine material on the surface of already placed stones (including stones within the layer being placed) shall be removed from those areas where surface contact will arise between the stone being placed and those already placed to ensure sound bearing and interlock between stones. The *Contractor* shall make due allowance for the removal of such material.

4.7 Measurements of Armourstone

Measurement of armour stone layers shall be carried out using a probe with a spherical foot of diameter $0.5 \times D_{n50}$ unless for reasons such as health and safety, an alternative method is deemed necessary. If the *Contractor* intends to use an alternative method to the spherical foot probe, the alternative method for obtaining individual armour stone surface heights across the profile shall be submitted to the *Supervisor* for approval. The submission shall include the conversion factor to be used to relate the reference levels in the design drawings to that would be measured by the alternative method.

No layer shall be covered by a subsequent layer until the profile of the former layer has been approved by the *Supervisor*. The *Contractor* shall give an agreed minimum period prior notice of survey to the *Supervisor* and shall provide facilities for his attendance during surveys. The minimum period shall take into account the working method, sea state and current conditions.

4.8 Survey

Upon completion of the works the *Contractor* will undertake a level survey. Measurement profiles shall be at intervals along the length of the revetment approved by the *Supervisor*. These will generally be every 10m. The *Contractor* shall provide and maintain chainage markers at the approved measurement intervals until the level survey has been completed and accepted by the *Supervisor*. Chainage markers should be visible from both the land and seaward side of the structure.

Surveyed sections shall extend to a distance of 5m beyond the constructed toe and 2m for the other edges.

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