

River Training Work
and Protection Work

2500

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2501 DESCRIPTION

River training and protection work shall include construction of guide bunds, guide walls, bank protection, flooring and approach embankment protection as required for ensuring safety of the bridge structure and its approaches against damage by flood/flowing water. Construction of various components shall conform to IRC:89 and these specifications or as directed by the Engineer.

2502. GUIDE BUND

2502.1. This work shall consist of construction of embankment of guide bund and provision of pitching/rivetment on slopes, apron, toe protection, curtain walls etc. as indicated on the drawing in accordance with these specifications or as approved by the Engineer.

The provisions given hereunder are applicable only to guide bunds for bridges across alluvial rivers. Guide bunds for bridges across submontane rivers shall call for supplemental specifications.

2502.2. The alignment and layout of guide bund shall be as indicated on the drawing or as approved by the Engineer. The construction of embankment for guide bund shall conform to provisions of Section 300 of these Specifications. Pitching, filter underneath pitching and turfing, apron, toe protection, curtain walls, etc., shall be as per these specifications.

2502.3. Guide bunds shall generally be made of locally available materials from the river bed preferably cohesionless materials. Trial pits shall be taken in borrow holes to examine suitability of soil for construction and also to decide the types of earth moving machinery to be arranged. The borrow pits should be sufficiently away from the location of the launching apron. No borrow pits should be dug on the river side of the guide bunds.

Construction of guide bund shall be taken in hand alongwith the construction of the bridge. Every effort shall be made to complete the work of the guide bund in one working season. Where there is any doubt about completion of the whole guide bund within one working season, suitable measures shall be planned and executed for protection of completed work. In such cases the construction of guide bund shall be started from abutment towards upstream.

2502.4. Construction of apron and pitching of the guide bunds shall generally conform to clause 2503 and 2504 of these Specifications. Sufficient length of pit along the guide bund shall be ready within one to two months of commencement of work so that the placing of stones in the apron and in the slope pitching can be commenced. As a guideline, earthwork should be completed within 80 per cent of working season and about 70 per cent working season shall be available for laying apron and pitching. No portion of the guide bund should be left below HFL before the onset of monsoon. Bottom of apron pit shall be as low as permitted by sub-soil water/lowest water level. Sufficient labour and appropriate earth moving machinery and trained staff shall be deployed in construction.

2502.5. The Contractor shall furnish his planning for approval of the Engineer regarding transport of stones from the quarries to the site of work taking into account the quantities of stone required to be transported every day, train/truck, etc., deployed, available ferry or boats and labour available for loading and unloading and for laying within the time frame for construction of guide bund. Adequate reserve of stones should be maintained for major works as decided by the Engineer. Reserve stones shall be stacked far away from the main channel of the river.

2502.6. Where the alignment of guide bund or the approach embankment crosses a branch channel of the river, the branch channel may be either diverted to the main channel of the river with the help of spurs, etc. or closed by a properly designed closing dyke or closure bund before taking up construction of guide bund.

2503. APRON

2503.1. General

This work shall consist of laying boulders directly or in wire crates on the bed of rivers for protection against scour.

Where the required size of boulders are not available economically, cement concrete blocks of equivalent weight shall be used. The grade of concrete shall be M 15 nominal mix. (This holds good for pitching on slopes and flooring also). Cement concrete blocks shall be preferred where practicable.

The stones used in apron shall be sound, hard, durable and fairly regular in shape. Stone subject to marked deterioration by water or weather shall not be used.

Quarry stones are preferable to round boulders as the latter roll off easily. Angular stones fit into each other better and have good interlocking characteristics.

Where the required size stones are not economically available, cement concrete blocks in M15 grade conforming to Section 1700 or stones in wire crates in combination may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred, wherever practicable.

2503.2. Laying Boulder Apron

The size of stone should conform to clause 5.3.7.2 of IRC:89.

The size of stone shall be as large as possible. In no case any fragment shall weigh less than 40 kg. The specific gravity of stones shall be as high as possible and it shall not be less than 2.65.

To ensure regular and orderly disposition of the full intended quantity of stone in the apron, template cross walls in dry masonry shall be built about a metre thick and to the full height of the specified thickness of the apron at intervals of 30 metres all along the length and width of the apron. Within these walls, the stone then shall be hand packed.

The surface on which the apron is to be laid shall be levelled and prepared for the length and width as shown on the drawings. In case the surface on which apron is to be laid is below the low water level, the ground level may be raised upto low water level by dumping earth and the apron laid thereon. The quantity of stone required in the apron shall be re-worked out by taking the toe of pitching at higher level.

2503.3. Laying Wire Crates and Mattresses in the Apron

Wire crates shall be made from hot dipped galvanized mild steel wire of diameter not less than 4 mm in annealed condition having tensile strength of 300-450 MPa conforming to IS:280. The galvanizing coating shall be heavy coating for soft condition conforming to IS:4826.

The mesh of the crate shall not be more than 150 mm.

Wire crates for shallow or accessible situations shall be 3 metre x 1.5 metre x 1.25 metre in size. Where these have to be deposited and there is a chance of overturning, the crate shall be divided into 1.5 metre compartments by cross netting.

For deep or inaccessible situations, wire crates can be made smaller subject to the approval of the Engineer.

Wire crates built in-situ, shall not be larger than 7.5 metres x 3 metres x 0.6 metre, nor smaller than 2 metres x 1 metre x 0.3 metre. Sides of large crates shall be securely stayed at intervals of not more than 1.50 metres to prevent bulging.

The netting shall be made by fixing a row of spikes on a beam at a spacing equal to the mesh. The beam must be a little longer than the width of netting required. The wire is to be cut to lengths about three times the length of the net required. Each piece shall be bent at the middle around one of the spikes and the weaving commenced from one corner.

A double twist shall be given at each intersection. This twisting shall be carefully done by means of a strong iron bar, five and half turns being given to the bar at each splice.

The bottom and two ends of the crate or mattress shall be made at one time. The other two sides shall be made separately and shall be secured to the bottom and the ends by twisting adjacent wires together. The top shall be made separately and shall be fixed in the same manner as the sides after the crates or mattress have been filled.

Wherever possible, crates shall be placed in position before filling with boulders. The crates shall be filled by carefully hand-packing the boulders as tightly as possible and not by merely throwing in stones or boulders.

For laying of wire crates in aprons of bridges, two situations arise:

- i) Where the crates are to be laid in deep water and have to be dumped and then joined together.
- ii) Where depth of water is low or dry bed is available. In such cases, the crates can be laid at site.

2504. PITCHING / REVETMENT ON SLOPES

2504.1. Description

This work shall consist of covering the slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer of granular material called filter. While river side slopes are given this protection against river action, the rear slopes, not subjected to direct attack of the river,

may be protected against ordinary wave splashing by 0.3-0.6 metre thick cover of clayey or silty earth and turfed.

2504.2. Pitching/Filter media

2504.2.1. Pitching : The pitching shall be provided as indicated in the drawings. The thickness and the shape of stone pitching shall be shown on the drawing.

The stone shall be sound, hard, durable and fairly regular in shape. Quarry stone should be used. Round boulders shall not be allowed. The stones subject to marked deterioration by water or weather shall not be accepted.

The size and weight of stone shall conform to clause 5.3.5.1 of IRC:89. No stone, weighing less than 40 kg shall, however, be used. The sizes of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.

Where the required size stones are not economically available, cement concrete blocks in M15 grade conforming to Section 1700 or stones in wire crates may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred wherever practicable. Use of geosynthetics has been dealt with in Section 700.

2504.2.2. Filter media : The material for the filter shall consist of sand, gravel, stone or coarse sand. To prevent escape of the embankment material through the voids of the stone pitching / cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching, one or more layers of graded materials, commonly known as a filter medium, shall be provided underneath the pitching.

The gradation of the filter material shall satisfy the following requirements :

Provision of a suitably designed filter is necessary under the slope pitching to prevent the escape of underlying embankment material through the voids of stone pitching/cement concrete blocks when subjected to the attack of flowing water and wave action, etc. In order to achieve this requirement, the filter may be provided in one or more layers satisfying the following criteria :

$$\frac{D_{15} \text{ (Filter)}}{D_{85} \text{ (Base)}} < 5$$

$$4 < \frac{D_{15} \text{ (Filter)}}{D_{15} \text{ (Base)}} < 20$$

$$\frac{D 50 \text{ (Filter)}}{D 50 \text{ (Base)}} < 25$$

- Notes :
1. Filter design may not be required if embankment consists of CH or Ch soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching.
 2. In the foregoing, D 15 means the size of that sieve which allows 15 per cent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85.
 3. If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
 4. The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

2504.3. Construction Operations

Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and a uniform slope throughout. Depressions shall be filled and thoroughly compacted.

The filter granular material shall be laid over the prepared base and suitably compacted to the thickness specified on the drawings.

The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3, in case of dry rubble pitching and shall be in nominal mix cement concrete (M 15) conforming to Clause 1704.3 in case of cement concrete block pitching.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids

are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals and all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

2504.4. Toe Protection

In conformity with clause 5.3.7. of IRC:89, a toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to protect the slope pitching from falling even when the apron is not laid at low water level. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3 in case of dry rubble pitching or pitching/ revetment with stones in wire crates and in nominal mix cement concrete (M 15) conforming to Clause 1704.3 in case cement concrete blocks have been used in pitching. For protection of toes of bank slopes terminating either in short aprons at bed levels or anchored in flooring / rocky bed, the provisions of clause 8.2.2 of IRC:89 may be complied with. The relevant specifications of the protective works for individual components will be followed.

2505. RUBBLE STONE/CEMENT CONCRETE BLOCK FLOORING OVER CEMENT CONCRETE BEDDING

2505.1. This work shall consist of constructing rubble stone / e.c. block flooring laid over a cement concrete (M 15) bedding. The floor protection will comprise rigid flooring stated above with curtain walls and flexible apron.

2505.2. Construction Operations

Excavations for laying the bedding and floor protection works shall be carried out as per specifications under proper supervision. Before laying the foundation and protection walls, the excavated trenches shall be thoroughly inspected by the Engineer-in-Charge to ensure that :

- a) There are no loose pockets and unfilled depressions left in the trench.
- b) The soil at the founding level is properly compacted to true lines and level so as to have an even bedding.
- c) All concrete and other elements are laid in dry bed.

Cement concrete nominal mix (grade M 15) of 300 mm thickness shall then be laid in accordance with provisions given in Section 1700 except that the surface of the concrete shall not be given a smooth finish. The paving work shall be embedded in green concrete.

Flooring shall consist of 150 mm thick flat stone/cement concrete blocks (Nominal mix Grade M 15 conforming to Section 1700). It shall be bedded on a layer of cement mortar (1:3) prepared to Clause 1304. Spalls shall be used to fill in the voids. The joints shall then be filled with cement mortar and finished neat. The stone shall break joints and the joints shall not exceed 20 mm in thickness. Spacing of joints may be 20 m or so. The top of flooring shall be kept to 300 mm below the lowest bed level.

2506. DRY RUBBLE FLOORING

This work shall consist of constructing dry rubble flooring at cross drainage works for relatively less important works.

The base for the flooring shall be prepared to the specified levels and slopes and compacted suitably with hand rammers or other means to have an even bedding.

The thickness of flooring shall be made with one stone only. The stones shall then be laid closely on the prepared base in one or more layers as specified and the bond used shall be as specified by the Engineer.

2507. CURTAIN WALL AND FLEXIBLE APRON

2507.1. Curtain Wall

The rigid flooring shall be enclosed by curtain walls (tied to the wing walls) with a minimum depth below floor level of 2 m on upstream side and 2.5 m on downstream side. The curtain wall will be in cement concrete M 15/stone masonry in cement mortar 1:3. The rigid flooring shall be continued over the top width of curtain wall.

2507.2. Flexible Apron

Flexible apron 1 m thick comprising loose stone boulders (weighing not less than 40 kg) shall be provided beyond curtain walls for a minimum distance of 3 m on upstream side and 6 m on downstream side. The

work of floor protection shall be simultaneously completed along with the work on bridge foundations.

2508. TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2509. MEASUREMENTS FOR PAYMENT

The protection works shall be measured as set forth below. If directed by the Engineer for measurement, the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking.

The earth work in construction of embankment for guide bund shall be measured in cubic metres unless otherwise specified.

The boulders/cement concrete blocks and wire crates in apron shall be measured in cubic metres.

The filter and stone pitching shall be measured separately in cubic metres unless otherwise specified.

Rubble stone/cement concrete blocks, flooring and cement concrete bedding shall be measured in cubic metres for each class of material.

Preparation of base for laying the flooring shall be deemed incidental to the work.

For laying apron, excavation upto an average depth of 150 mm shall be deemed to be included in the main item and shall not be measured separately unless otherwise specified. Excavation more than 150 mm shall be measured in cubic metres as given in Clause 304.

2510. RATE

The contract unit rate for the construction of embankment for guide bund shall cover the cost of all materials including transportation, laying, compacting, all labour, tools, equipment, sampling and testing, supervision and all incidentals necessary for completing the work according to these specifications.

The contract unit rate for one cubic metre of finished work of apron shall include the cost of all material, labour, tools and plant for completing the work according to above specifications. Excavation upto an average depth of 150 mm shall also be deemed to be included in the rate as

dressing of the bed. Excavation beyond this depth shall be paid for separately unless otherwise specified.

The contract unit rate for one cubic metre of filter or stone/cement concrete block pitching on slopes shall include the cost of preparing the bases, putting to the profiles, laying and compacting the filter and stone pitching of dry rubble/cement concrete block rivetment for embankment slopes to the specified thickness, lines, curves, slopes and levels and all labour and materials as well as tools and plant required for the work.

The contract unit rate for rubble stone/cement concrete block flooring shall include the cost of all material, labour and tools and plant for completing the work as per these specifications.
