

## CHAPTER 23

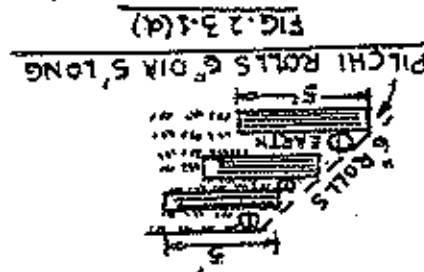
## RIVER AND CANAL PROTECTION WORKS

## SPECIFICATION NO. 23-1—Pilchi Farash or Sarkanda Pitching

1. Pilchi farash or Sarkanda for forming the rolls shall be cut from green plants. The rolls shall be 6 inches (15 cm.) diameter and of 3 or 5 feet (1 or 1.5 metres) in length as specified. The rolls shall be cut to an equal length and shall be so made that trunk ends of the pilchi branches are on one side.

**Material.**

2. The reach where this type of pitching is to be done shall be cleaned of all humps and irregularities to provide an even bed for the bottom layer of the pitching. The pitching shall be of 6 inches (15 cm.) dia layers of pilchi, etc., laid as a header and of specified length alternating with 6 inches (15 cm.) covering of earth for consolidation as shown in Fig. 23-1 (a) below.

**Construction.**

3. Rate includes supply of pilchi, farash or sarkanda involving carriage within one mile, labour for making rolls and laying pitching as detailed above including pegs and tying with wire. The rate does not include the cost of wire which is to be supplied by the department.

**Rate.**

**SPECIFICATION NO. 23-2—Pilchi, Sarkanda and Bamboo  
Mattresses**

**General.**

1. Mattresses woven out of sarkanda, pilchi or other wild reeds and shrubs shall be used for providing slope protection to canal and river works where other means are not available, or are found to be uneconomical. Such mattresses should be expected to provide a rather temporary protection, and shall be improved, replaced or repaired annually.

**Construction.**

2. Pilchi and sarkanda reeds shall be hand woven or joined together to form mattresses about 6 inches (15 cm.) thick, their construction and thickness being subject to Executive Engineer's approval. Bamboo mattresses shall be in the form of screens made out of first class bamboos 12 to 14 feet (3.5 to 4 metres) long. The bamboos shall be split into two and tied together with coir or other suitable yarn to form a screen with one foot (30 cm.) rhombus openings.

**Installation.**

3. The mattresses shall be rolled and laid over a layer of brushwood or branches placed against the slope, if so specified. Bamboo screens shall generally be used to hold in place such brushwood protection.

The rolled mattresses or screens should be held down by wooden stakes or "killas" driven vertically into the slope. The size, spacing, and general arrangements of stakes, brushwood, and the mattresses shall be specified by the Engineer-in-charge.

## SPECIFICATION NO. 23.3—"Gachi" Pitching

"Gachi" pitching is suitable only for protection of slopes against erosion in case of small irrigation channels. This type of pitching consists of silt "gachies" obtained from the existing berm. It shall be laid with average thickness of one foot (30 cm.) and joints of "gachies" shall be broken.

"Gachi"  
Pitching.

**SPECIFICATION NO. 23.4—Fixing "Floating Spurs" in  
Irrigation Channels**

In this type of spurs branches are hung from banks as shown in Fig No. 23.4 (a).



FIG: 23.4(a)

The method comprises of driving pegs 2 inches (50 mm.) to 3 inches (75 mm.) diameter and of suitable length in the existing berm of the channel. The pegs shall be strong enough to hold the leafy green branches of the trees hanging in the flowing water. For every spur at least two pegs or stakes shall be driven in a direction perpendicular to the flow of water. The spur or branches of a tree shall then be tied to the stakes with coir rope so that the spur remains nearly at right angles to the flow of water. The floating branches shall be of such lengths as to extend to the line in the channel up to which formation of berm is required. The formation of the berm with this type of spurs is uniform and the work can be done in running water. The "floating" spurs prove the best method when berming up accompanies the scouring of bed.

Floating spurs should be put up in silting seasons when silt in the water is maximum. When full berms have formed, the protruding branches should be allowed to rot, as cutting them would disturb the berm formation.

**SPECIFICATION NO. 23.5—Stacking and Bushing**

1. Stacking and bushing is generally done in irrigation channels to form berms where they do not exist or to reduce channel width where the existing section is required to be reduced according to the remodelled conditions. Stacking and bushing for the formation of berms may be of the following two types :—

General.

(i) Longitudinal bushing.

(ii) Cross fixed spurs.

2. It shall consist of a line of pegs 2 to 3 inches (50 to 75 mm.) dia., 3 feet (one metre) apart or as directed by the Engineer-in-charge on one or both sides parallel to the length of the channel with brushwood interwind behind the stakes and providing cross spurs 50 feet (15 metres) apart. Top layer of bushing shall preferably have thorny bushes to safeguard against damage by stray cattle. Stacking and bushing shall be done in a closure. Longitudinal bushing shall be done in small reaches with big branches closely enmeshed so that they do not float when water comes.

Longitudinal  
Bushing.

Longitudinal bushing is used with advantage where the channel was locally wide, with the important precaution that the branches round the pegs are well pressed so that erosive action on the pegs is reduced by the leaves around them.

3. Cross fixed spur consists of a line of pegs 2 inches to 3 inches (50 to 75 mm.) diameter and 3 feet (one metre) apart projecting from the bank of the channel to the designed bed line interwined with brushwood. Top of pegs shall approximately be at the full supply level of the channel. Double lines of pegs with brushwood in between them may also be driven according to the necessity at site.

## SPECIFICATION NO. 23.6--Slope Protection with Sand Bags

Sand bags.

1. Sand bags shall be specified as a means of temporary protection only. Empty cement bags shall generally be used, and shall only be three-quarters to four-fifth filled with dry soil, and sewn up before being laid in place. Sand shall be preferred for filling the bags. The bags should be placed tightly against each other; where necessary the base of the sand bag pitching being widened by laying the bags with their lengths normal to the bank.

Rate.

2. Rate shall include filling empty cement bags with sand or earth and sewing including cost of string. Laying in position and lead shall be as specified in the Schedule of Rates. Rate does not include cost of empty cement bags.

## SPECIFICATION NO. 23.7—Dry Brick Pitching

1. Slope and bed protection upstream and downstream of canal structures such as bridges, falls, rapids, regulators, syphons, etc., should generally consist of dry brick pitching. The details of slope and bed protection for a particular structure shall be specified in its design.

General.

2. Pucca third class bricks shall normally be used for dry brick pitching. No kutchra or pilla bricks or bats shall be used. However, Jhama or over-burnt bricks and brickbats may be specified for protection of channel bed against scour downstream of a canal fall or other structures.

Materials.

3. Dry brick pitching should be laid with a resultant smooth surface, on bed and side slopes upstream and downstream of bridges, discharge flumes, and upstream and downstream of falls, regulators and syphons. Ribbed or cellular brick pitching shall generally be specified for bed and side slope protection downstream of falls, rapids, regulators and syphons designed to work under pressure. Such pitching in the bed shall have the ridges or cell boundaries flush with the bed level.

Constructional details.

In all dry brick pitching, the top course shall consist of brick on edge, and the pitching shall be bedded on a minimum of 3 inches (75 mm.) thick layer of rammed dry brick ballast or gravel. All bricks shall be laid tightly fitting together to provide a stable, yet pervious surface protection mat. The bond of brick pitching shall be specified either in the design or by the Executive Engineer.

4. All dry brick pitching on slopes shall be supported by masonry or concrete toe-walls carried to suitable depth below the channel bed. Brick pitching on bed and side slopes shall be protected upstream and downstream by masonry or concrete curtain walls, top of which should be flush with top of pitching.

Protection of pitching.

Where a large area has to be pitched, the pitching shall be divided into square or rectangular units of specified sizes separated by stabilizing masonry walls.

5. Brickbat and jhama brick pitching shall sometimes be specified for protection of channel beds, especially downstream of distributary falls. Such pitching should be laid horizontal at the bed level, and shall extend to a distance detailed in the design. The thickness of such bed pitching depends upon the size and capacity of the channel, and it shall be specified by the Engineer-in-charge.

Brickbat pitching of Channel beds.

The brickbat pitching shall not be dumped but shall be properly packed and placed by hand.

## SPECIFICATION NO. 23.8—Wire Crates

- Size.** 1. Generally size of wire crates shall be 4 ft. × 4 feet (1.2 m × 1.2 m). In shallow situations size may be increased whereas in deep and inaccessible situations the same may be decreased. Actual size of wire crates shall be as specified by the Engineer-in-charge.
- Gauge of Wire.** 2. The crates shall be made from No. 6 or 8 or 10 S.W.G. (4.75 or 4.00 or 3.25 mm.) galvanised iron wire as specified by the Engineer-in-charge.
3. Unless otherwise specified, the mesh of the guage or crate shall be 6 inch X 6 inch (15 cm. X 15 cm.) or 10 inches X 3 inches (25 cm. X 75 cm.).
- Weaving.** 4. 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 is bent at the middle round one of the spikes and the weaving commenced from one corner.
- A double twist shall be given at each intersection.
- Bottom ends and sides.** 5. The bottoms and two ends of the crate 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 wire together.
- Joining the sides.** 6. This twisting shall be carefully done by means of a strong iron bar, five half turns being given to the bar at each splice.
- Placing and closing.** 7. Wherever possible, crates shall be placed in position before filling with brickbats, bricks, or boulder as the case may be. The top shall be made separately and shall be fixed in the same manner as the sides after the crate has been filled. Where it is not possible to construct wire crates *in situ*, tipping of the same shall be resorted to.
- Filling of Materials.** 8. (a) Bricks and Brickbats.—Pucca third class bricks or pucca brickbats should be used. No kutchra or pilla bricks or bats shall be allowed to be used in filling. Jhama and overburnt bricks or brickbats shall be preferred.
- (b) Boulders —Boulders used for filling shall generally conform to specification No. 3.31. No dimension of boulders shall be less than 6 inches (15 cm.). No boulder shall weigh less than 40 lbs. (18 kgs.).
- Filling to be hand packed.** 9. The crate shall be filled by carefully hand packing the material as tightly as possible and not by merely throwing in the same.



### SPECIFICATION NO. 23-9—Dry Stone or Boulder Pitching

1. Stone riprap or dry stone pitching should be used for protection of slopes if suitable rock or boulders are available in sufficient quantities. Stone riprap or pitching should extend from the maximum water level, including allowance for wave action, down to about 3 feet (one metre) below the lowest expected draw down level for dams and dikes and one foot (30 cm.) below the bed level in case of canals, channels and guide bunds, etc., or as specified in the drawings. Where boulder pitching is protected by a flexible apron in the form of wire crates, the pitching shall be continued up to the bottom of the apron.

2. Stone riprap may be dumped or hand placed. Dumped riprap is cheaper and should be used where stone is plentiful. Its thickness should vary from 18 inches (45 cm.) to 5 feet (1.5m) depending upon the slope, height, exposure, and wave action. Hand placed riprap may be more economical than dumped riprap in that a lesser thickness may be used. A thickness of 18 to 24 inches (45 to 60 cm.) of well laid and durable stone riprap should be sufficient to withstand severe wave conditions. Type and thickness of riprap at site shall be as per drawings.

3. Boulder used in the dumped riprap shall conform to specification no. 3.31. If quarried stone is used, it shall be hard, dense and durable and not subject to slaking, solubility or rapid weathering. Boulders or stone pieces in the dumped riprap shall be reasonably well graded in sizes ranging from  $\frac{1}{2}$  cubic feet to  $\frac{1}{2}$  cubic yard (0.014 to 0.38 cu. metres) with a maximum of 25 per cent smaller than  $\frac{1}{2}$  cft. (0.014 cu. metre) and a minimum of 30 per cent larger than 3 cft. (0.084 cu. metre). Rock for such riprap shall be dumped, preferably mechanically, and graded off in such a manner as to insure that the larger pieces are uniformly distributed and the smaller rock fragments and spalls serve to fill the spaces between the larger rocks and in such a manner as will result in a reasonably smooth surface and a uniform layer of riprap of the thickness specified. Rock pieces larger than  $\frac{1}{2}$  cubic yard ( $\frac{1}{2}$  cubic metre) in the volume may be allowed in the riprap, if embedded in place so that the top surfaces are at the established grade for the surface or riprap. The inclusion of objectionable quantities, as determined by the Engineer-in-charge of loose dirt, sand, and rock dust shall not be permitted.

When the compacted soils of the underlying layer are of such gradation that there is danger of fines being washed out through the voids in the riprap, a layer or blanket of graded gravel shall be provided below the riprap. Unless otherwise specified, the thickness of the gravel layer shall be 6 to 12 inches (15 to 30 cm.)

General

Types of stone riprap.

Dumped Riprap.

## SPECIFICATION NO. 23.9—Dry Stone or Boulder Pitching

Hand placed  
riprap or pitching.

4. Boulder used in the hand placed riprap shall conform to specification no. 3.31. If quarried stone is used it shall consist of clean, hard, dense and durable rock fragments having roughly square or rectangular and reasonably flat exposed faces. Grading of boulders or quarried stones shall be such that at least 50 per cent of the surface shall be of boulders or stones which in depth are equal to the specified thickness or riprap. The remaining boulders or stones shall have minimum weight not less than 40 lbs. (18 kgs.).

Hand placed pitching or riprap should be of the same quality and appearance as dry rubble. It should consist of stones which can be picked up and used by one man, laid on edge on a properly prepared and graded gravel bed of specified thickness. Stone of a flat stratified nature should be placed with the principal bedding planes normal to the slope. Joints should be broken as much as possible, and joint openings to the underlying fill should be avoided by carefully arranging the various sizes of stones and by closing the openings with spalls, small rock fragments, or gravel. The placing methods and selection of sizes must be such as will insure a pavement of reasonably smooth surface and uniform average thickness.

The bottom or lower band of riprap on the upstream face of an earth dam should rest on a shoulder or berm in the embankment. The bottom course should be formed with headers twice as deep as the other stones and set into the bank in a trench at the inner edge of the berm.

As for dumped riprap, a layer or cushion of graded gravel, 6 to 12 inches (15 to 30 cm.) thick, shall be provided under the hand placed pitching where there is danger of fines being washed out from the underlying fill.

### SPECIFICATION NO. 23.10—Grouted Stone Pitching

1. Grouted stone pitching shall generally be used, where specified, for protection of beds and slopes upstream and downstream of structures such as culverts, bridges, falls, etc., where swift and turbulent flow is encountered. It is desirable to grout stone pitching or riprap where boulders and heavy sediments are being transported along the bed of the channel.

**General.**

2. Grouted stone riprap shall be similar in quality, and shall be laid, as hand placed riprap described in specification no. 23.9. The thickness of stone pitching which has to be grouted shall be as specified, and generally less than that of hand placed riprap. The thickness of gravel blanket or concrete cushion to be placed under the pitching, if any shall also be specified.

**Construction.**

After the main pitching stones have been laid in place, the voids shall be tightly packed with spalls, stone fragments and gravel. All loose surface material shall then be swept away.

3. The pitching to be grouted should then be thoroughly wetted, surplus water being permitted to drip or drain off. In the meantime, cement sand grout of the specified proportion and consistency should be mixed in a standard concrete mixer. Cement concrete with gravel smaller than  $\frac{1}{2}$  inch (5 mm.) size may also be used as grout where it is placed manually. In the case of grouted boulder pitching, grouting should be carried within 3 inches (75 mm.) of the top of stones, a surface being given with a trowel.

**Grouting.**

For smaller jobs, and where the pitching is horizontal or at a flat slope, cement grout may be carried and poured with hand buckets. Care should be taken that no grout is wasted or permitted to draw off, and the batch mixed at a time should be just sufficient to be used before the initial setting of cement.

For large jobs, a grouting pump of a suitable capacity with an agitator trough shall be used to pump the grout. The grout pipes, valves, etc., shall be kept clean by flushing with water before and after each grouting shift. Great care shall be exercised to maintain proper pressure and to minimise the waste of grout. A wetting agent, or an agent which greatly increases the fluidity of the grout shall be added to the mixing water in quantities as specified by the Executive Engineer.

On small level pitching jobs, it may be specified to tamp the surface with wooden tampers but generally the pitching shall not be disturbed or tampered with after completion of grouting.

Grouted pitching shall be cured by keeping it wet for at least 14 days after the grout has set.