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LOW-COST MODULAR PREFABRICATED WOODEN BRIDGES

SM/BHU/84/010

BHUTAN

Technical report: Steel for the UNIDO Bridge *

Prepared for the Kingdom of Bhutan
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of C. R. Francis, consultant in timber construction

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STEEL COMPONENTS

1. Material

The steel components are fabricated from mild steel flats and round bars. Details of sizes and quantities are shown in Table 1. The sizes are given in metric units but equivalent inch sizes are equally acceptable.

Particular note should be taken of the following points:

1. Steel must conform to Indian Standard 2062-62 for Fusion Welding quality steel (previously known as Tested Steel).
2. Steel should be supplied in the as rolled sizes. Plates sheared to size are badly distorted and require excessive work to flatten them. Cutting them to length should be done on the workshop hacksaw. The exception to this is the steel for PP 9 which should be gas cut from plate.
3. Particular care should be taken over the quality of the 12mm bars. These are most commonly available as hardened anti-burglary bars which are difficult to crop and impossible to cut in the power hacksaw without excessive blade damage.
4. Just as for timber, orders must be placed sufficiently far in advance to allow for delays in order approval, purchase procedures and delivery.

Addresses of steel manufacturers in India are given in Appendix A.

Description	Size	Position	1 Bridge	N ₆
<u>MS bar X 6 m</u>				
Rounds	Ø12	Pins	40 pcs	214
"	Ø38	Top chord pin	1 pc	54
"	Ø50	Bottom chord pins	2 pc	105
<u>Flats</u>				
"	50 x 10	PP5 + washer	4 pcs	94
"	75 x 10	PP9A	1 pc	36
"	75 x 6	Brace	2 pc	42
"	100 x 6	Bottom chord	1 pc	29
"	100 x 10	PP13	1 pc	47
"	100 x 12	PP10	2 pc	113
"	100 x 15	Bottom chord	3 pc	213
"	125 x 10	ditto	16 pc	940
"	150 x 6	PP5	5 pc	212
"	200 x 12	Bearings	1 pc	113
"	300 x 10	PP9	2 pc	283
			Total	2575
<u>MS Bolt hex head c/w nut & Spring washer</u>				
"	M12 x 150		40 pc	
"	M12 x 240		40 pc	
"	M24 x 50	Brace	40 pc	
"	M24 x 90		40 pc	
"	M24 x 175		20 pc	
"	M24 x 250		40 pc	
"	M24 x 300		16 pc	
"	M20 x 300	Kerb	26 pc	
<u>Coach Screw</u>	12 x 125	hor diag brace	40 pc	
<u>Nail</u>	4" x 7	ga		140
<u>Nail</u>	6" x 5	ga		30
<u>Split Pin</u>	Ø6 x 75		60 pc	

Table 1 Steel and hardware quantities for one 15m bridge

2. Fabrication

Marking Out. Marking out for drilling should be done from accurately set out templates. The templates should be painted red to distinguish them from ordinary work pieces and should be drilled with holes just big enough to take a centre punch - 7 mm dia.

3. Drilling

Drill bits must be maintained sharp and free of broken cutting edges. The first sign of bluntness is that the swarf is no longer in long coils but short broken pieces. Then the drill MUST be stopped, examined and resharpened.

Sharpening should only be done on the rim of the grindstone and this must be dressed square and flat with the diamond dressing tool. The whole of the end of the drill must be ground back, not just the cutting edge.

The cutting angles to be maintained are the point angle and the angle shown in Fig 1. The sliding bevel should be used to check the point angle.

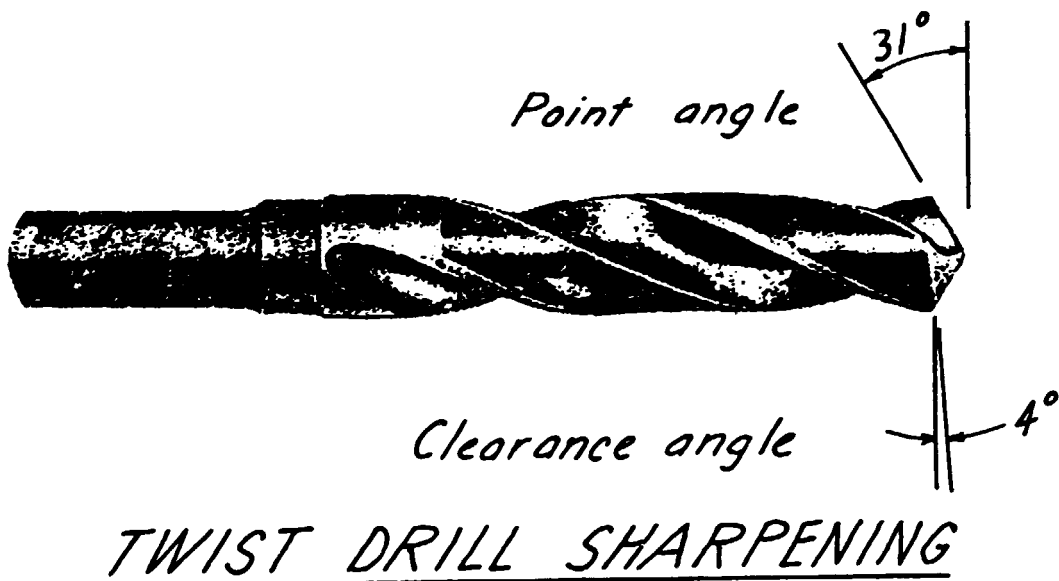


Figure 1

A common fault is to grind a small flat just back of the cutting edge. This must be avoided or the drill will not cut without excessive feed pressure which leads to breakages.

3. Drilling Contd

Recommended feeds and speeds are:

Hole Diameter mm	Speed r.p.m.	Feed per rev mm
8	1300	0.025
12	875	0.04
27	400	0.08
38	275	0.12
52	200	0.16

For holes larger than 12 mm diameter a pilot hole should be drilled first, then followed by the main drill. The arm must be high enough so that the drill bits can be changed without moving the arm.

Work pieces must be clamped down solidly on the table or held in the drilling vice.

Coolant must always be used. Mix 1 part of soluble oil with 20 parts of water ($\frac{1}{2}$ litre to 5 litres).

Instructions for precision sharpening of large twist drills are given in Appendix B.

4. Welding

Welding rods should be suitable for downhand welding of mild steel and should comply with Indian Standard 814 for Normal Penetration Electrodes. Welding rods must be kept dry and not be exposed to damp air. Opened packages should be kept wrapped in plastic. Storage should be in an airtight steel chest kept continuously heated by a 100 watt electric light bulb. This is particularly important in the monsoon season.

Welding should only be done by experienced operators. Good quality welding will have a regular bend and be free of blow holes or undercutting. Components should be positioned so that all welding is in a downhand position.

All slag must be chipped off and the welds cleaned with a wire brush.

5. Painting

After all welding is complete, steel should be painted with one coat of steel primer and one coat of enamel.

Touch up painting of enamel should be done after erection.

APPENDIX A

Sales Manager
The Indian Iron and Steel Co.
IISCO House
50, Chowringhee Road
Calcutta - 700071

Sales Manager
Tata Iron and Steel Co. Ltd.
Zamshedpur
Bihar
India

Commercial Director
Steels Authority of India Ltd.
Ispat Bhawan
Lodhi Road
Delhi - 110003

Zonal Manager
TATA Iron and Steel Company
3rd Floor
Bank of Baroda Building
Parliament Street
New Delhi - 110001

Sales Manager
Steel Authority of India Ltd.
Jeevan Vihar
5th Floor
Parliament Street
New Delhi - 110001

APPENDIX B

Lathe Grinding of Large Twist Drills

1. Fix the drill in the 4-jaw lathe chuck so that each jaw bears on equal length of ground shank. Check that it is correctly centred.
2. Set the top slide 59° and attach the grinder into the tool holder so that its shaft is parallel to the slide. Set the grinder shaft to centre height. Cover all beds, slides, feed screws with sacks.
3. Run the lathe at 200 rpm and grind the rear side of the point to a 118° ($2 \times 59^{\circ}$) cone. Check that the point of the cone is in the centre of the web between the drill flutes.

Take light cuts, working across with the top slide and feeding by screwing back on the cross slide. Grind until the cutting edges are clean.

4. Remove the lathe headstock cover. Disconnect the electricity. Set the speed to 50 rpm and rotate the drill so that the flutes are level. Check with spirit level.
5. Make a paper protractor scale to fit round the rim of the 4-jaw chuck. The scale should be divided into 180 divisions. One division equals two degrees.

Attach the protractor scale to the chuck rim, and set the magnetic-base scribe to point to zero degrees on the scale. Raise the grinder in the toolpost so that its centre is at the same height as the cutting edge of the drill. Position the grinder so that it just grinds the cutting edge of the drill. Set the cross index to zero.

6. Rotate the lathe forwards 2° (one division on the protractor scale) and feed the grinder towards you by 0.10mm (4 small divisions on the index). Starting behind the drill, grind across and back using the top slide screw. Take the grinding wheel back clear of the drill.
7. Repeat Step 6 - rotate 2° , feed 0.10mm, grind - until the whole of the face is ground. This will mean rotating the lathe about 100° taking 50 cuts. Be careful not to touch the other cutting edge as it comes round under the grinding wheel.
8. Set the protractor to 180° so that the second cutting edge is in position, reset the grinding wheel as in Step 5, and grind the second face of the drill.

General: Keep the wheel cutting by jiggling the top slide feed screw. Do not let the grinder stall. If the wheel becomes glazed, dress lightly with the diamond dresser.