

C2.1 Non-Prestressing Steel Placement

All non-prestressing steel shall conform as per Table 1.7 and 1.8. The sampling and frequency of testing shall be as described in section C1.5. All reinforcement not complying with the Specification shall be removed from site.

Unless otherwise shown on the Drawing, bending and cutting shall comply with IS: 2052.

C2.1.1 Bends and Hooks Forming End Anchorages

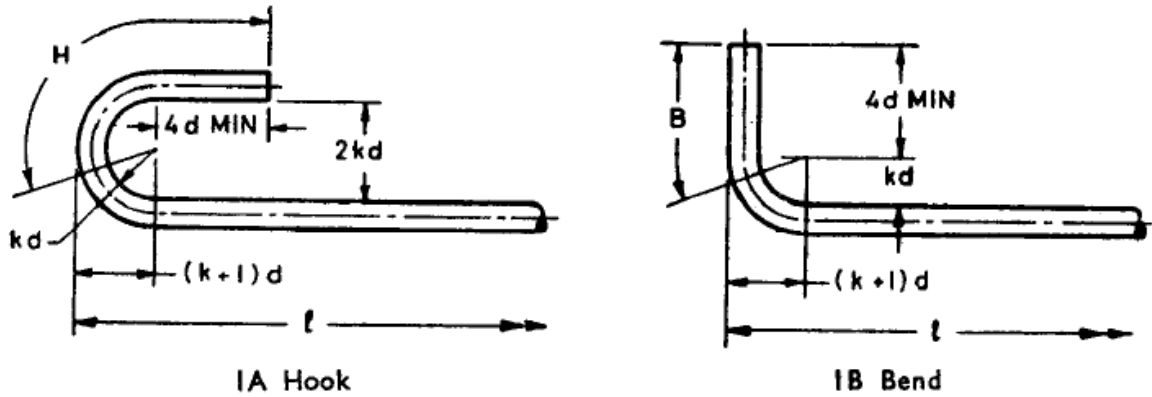


Figure 2.1 : Hook and Bend Details

Unless otherwise indicated in the schedule, a semicircular hook or a bend forming an anchorage to a bar shall be bent with an internal radius in accordance with Fig. 1A and Fig. 1B, respectively. The hook and allowances shall be in accordance with Table 2.1.

Table 2.1 Hook and Bend Allowances

Nominal Size of Bar,mm	Hook :Cold Worked Steel Bars,mm	Bend :Cold Worked Steel Bars,mm
10	130	75
12	155	75
16	210	95
20	260	120
22	285	130
25	325	150
28	365	170
32	415	190
36	470	215
40	520	240
45	585	270
50	650	300

Binders, Stirrups, Links and the Like - In the case of binders, stirrups, links, etc, the straight portion beyond end of the curve at the end shall be not less than eight times the nominal size of the bar.

C2.1.2 Curved Bars

Bars specified to be formed to radii exceeding those given in Table 2.2 need not be bent, but the required curvature may be obtained during placing.

C2.1.3 Bending and Cutting Tolerances

Bars shall be bent in accordance with the appropriate dimensions shown in the schedule. Where an overall or an internal dimension of the bent bar is specified, the tolerance, unless otherwise stated, shall be as in Table 2.3

Any excess in length of bar supplied over the total of the lengths of the various portions of the bar between bends, including the specified tolerances or not, shall be taken up in the end anchorages, or in

the portion of the bar which shall be indicated on the schedule. The cutting lengths shall be specified to the next greater whole 25mm of the sum of the bending dimensions and allowance.

Table 2.2 Bars Bent to A Radius

Nomina Size of Bar, mm	Critical Radius,m
10	3.5
12	5
16	8
20	12
22	18
25	24
28	34
32	40

Table 2.3 Permissible Bending and Cutting Tolarances

Bar	Dimensions		Tolerance	
	Over, cm	Up to and Including,cm	Plus,mm	Minus,mm
For Bend Bars	-	75	3	5
	75	150	5	10
	150	250	6	15
	250	-	7	25
For Straight Bars	All lengths		25	25

The cutting tolerance for bars to be bent shall be the tolerance given for straight bars, To allow for this cutting tolerance when dimensioning bent bars, at least one dimension shall not be specified.

C2.1.4 Fixing Reinforcement

The economy of reinforced concrete design will be fully realized only when the reinforcements are maintained at their designed positions at all times. The important factors in fixing the reinforcement are precision and convenience.

Reinforcement shall be thoroughly cleaned. All dirt, scale, loose rust, oil and other contaminants shall be removed before placing it in position. If the reinforcement is contaminated with concrete form previous operation, it shall be cleaned before concreting in that section.

Reinforcement shall be placed in position as given on the detailed design drawing fixing of reinforcement and concreting, the position of the reinforcement shall be checked prior to concreting.

Minimum lap-length of reinforcement bars shall be 50-65d where d is the dia. of the smaller diameter bar to be lapped (unless otherwise specified). Not more than 50 percent of reinforcement crossing a section shall be lapped at that location. All laps in reinforcement shall be properly staggered and minimum distance between the laps shall be 1.33 times the lap length.

The precautions shall be taken to prevent displacement of reinforcement during shuttering and concreting.

Tying of Reinforcement Bars - Bars crossing each other, where required, shall be secured by binding wire (annealed) of size not less than 0.90mm and conforming to IS: 280-1962 Specification for Mild Steel Wire (Revised), in such a manner that they will not slip over each other at the time of fixing and concreting.

Every compression bar shall be tied at least in two perpendicular directions. Stirrups may be staggered, provided it is ensured that the corresponding stirrups form a uniform pattern in elevation.

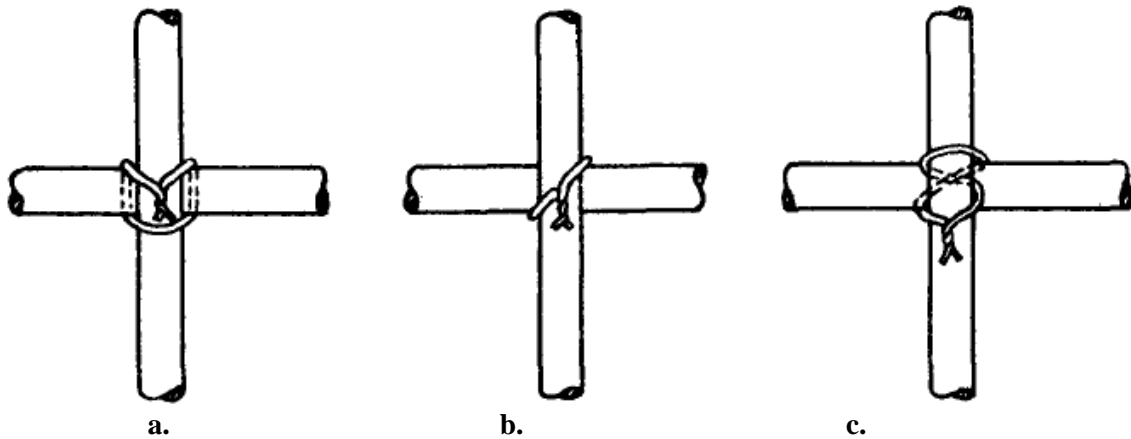


Figure 2.2 Three methods of tying reinforcement bars

Three methods of tying reinforcement bars are illustrated in Fig. 2.2 of the three methods, the method illustrated in Fig. 2.2 should be preferred to method given in Fig. 2.2b, and that given in Fig. 2.2.b to the one given in Fig. 2.2.c.

Cover Block

Cover blocks, which are generally of cement mortar, shall be used to ensure the required cover for reinforcement. Cover blocks are generally square or rectangular in plan with or without binding wire embedded in them which will be tied to the reinforcement at the time of placing. Rings with suitable hole at the centre may also be used.

The mortar or concrete used for the cover blocks or rings shall not be leaner than the mortar or concrete in which they will be embedded.

To provide necessary cover for reinforcement at any section, only single cover blocks shall be used.

C2.2 Prestressing Steel Placement

C.2.2.1 Cover and Spacing of Prestressing Steel

Wherever prestressing cable is nearest to concrete surface, the minimum clear cover measured from outside of sheathing, shall be 75 mm.

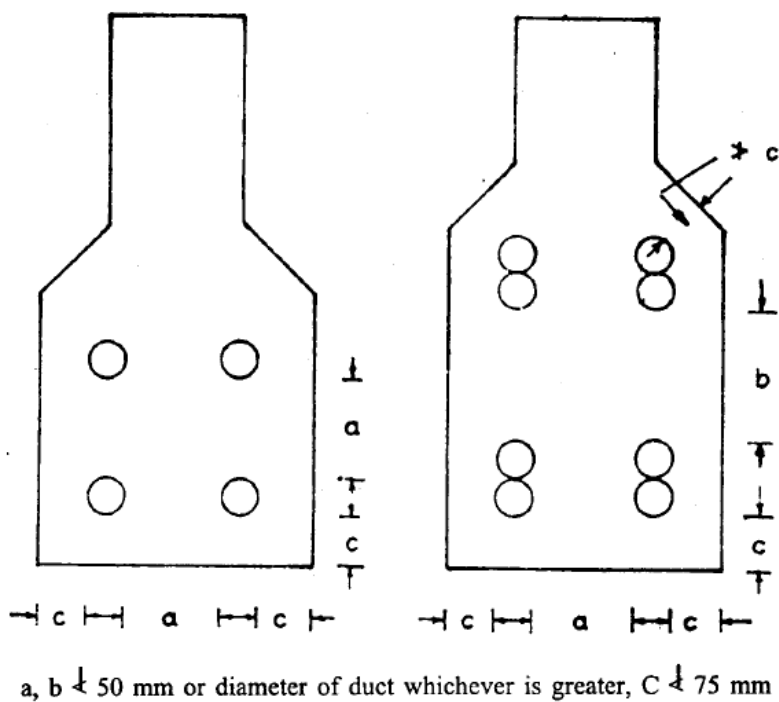


Figure 2.3 Cable Cover

A minimum clear distance of 50 mm or diameter of the duct, whichever is greater, shall be maintained between individual cables when grouping of cables is not involved.

Grouping of cables shall be avoided to the extent possible. If unavoidable, only vertical grouping of cables, upto 2 cables may be permitted as shown in Fig. 2.3. The minimum clear spacing between groups shall be diameter of the duct or 50 mm, whichever is greater.

Individual cables or ducts of grouped cables shall be deflected or draped in the end portions of members. The clear spacing between cables or ducts in the end one metre of the members as specified in figure 2.3 shall be maintained.

The placement of cables or ducts and the order of stressing and grouting shall be so arranged that the prestressing steel, when tensioned and grouted, does not adversely affect the adjoining ducts.

All cables shall be threaded by threading machine or any contrivance into preformed ducts. Wherever two stage prestressing is contemplated, a dummy core shall be provided in the preformed ducts of the second stage cables, which shall be pulled out after the first stage prestressing and grouting is over. Thereafter, the cables for the second stage shall be threaded into the preformed ducts. Where prestressing in more than two stages is contemplated, the above procedure shall be followed for subsequent stage cables also.

Stressing of cable/part of cable to avoid shrinkage cracks shall not be treated as a stage.

C.2.2.2 Splay of Cables in Plan and Minimum Radius of Cables In Elevation

The splay of cables in plan, for bringing them from their position in the bottom flange at mid-span into the web towards the supports shall not be more than 1 in 6. The points of splay shall be suitably staggered on both sides of the longitudinal centre line of the web of the girder. The minimum radius of curvature, spacing and cover for curved cables shall be specified to ensure that bursting of the side cover both perpendicular to the plane of curvature and in the plane of curvature of the ducts does not take place.

C.2.2.3 Emergency Cables/Strands

Besides the design requirements, additional cables/strands shall be symmetrically placed in the structure so as to be capable of generating prestressing force of about 4 per cent of the total design prestressing force in the structure. Only those cables which are required to make up the deficiency shall be stressed and the remainder pulled out and the duct hole shall be grouted.

C.2.2.4 Others

- Cut lengths out of the long mono-strand, each length being equal to actual length of the concerned cable required between its stressing Jacks plus additional lengths beyond the Jacks to enable gripping the strands adequately by the Wedges of the Jacks.
- Bunch together designed monostrands into a 'multistrand' holding them together by binding wire tightened around the bunch at about 1.0 m intervals.
- Insert these cables in to their respective Sheathing Ducts which are already placed to the required profile in the already concreted deck.
- All Prestressing Cables shall be laid to smooth profiles using the specified profile ordinates given in the attached Prestressing Drawing. Short 12 mm dia. cross-bars shall be spot welded to the stirrup legs at approximately 2 m centers along the length of cables to give the necessary profile to the cables.
- At the time of installation of Cable-Sheathing (HDPE Ducts), the sheathing materials shall be examined for any possible punctures/cuts/etc. and the same shall be sealed with waterproof tape. The number of joints should be kept to the minimum, and each joint adequately sealed against the

possibility of any ingress of any material and mortar. Joints in adjacent ducts should be staggered by at least 300 mm. Adequate concrete shield should exist between the adjacent ducts to prevent any accidental flow of grout from one duct to the other and the ducts shall be strictly maintained in their correct alignment and profile during the placing of concrete.

- Prestressing tendons may be gripped by wedges, yokes, double cones or any other approved type of gripping devices. The prestressing wires may be gripped singly or in groups. Gripping devices shall be such that in a tensile test, the wire or wires fixed by them would break before failure of the grip itself.
- Prior to concreting the Deck, INSERT 80 mm ID Plain HDPE Ducts into the 90 mm ID Corrugated HDPE Ducts (which have already been placed to the required cable profiles), protruding them suitably beyond the cable-Anchorage.
- After concreting of the Deck is over, REMOVE these 80 mm ID Plain HDPE Ducts AND quickly blow oil-free compressed air through the emptied 90 mm ID Corrugated HDPE Ducts in order to flush them clean. Stand-by flushing equipment, capable of developing a pumping pressure of 20 Kg/cm² (2 MPa) and a sufficient capacity to flush out any blockages due to any accidental partial grout leaks in ducts, shall be kept available at site.
- The 19-stranded multistrands may now be inserted in to their respective 90 mm ID corrugated HDPE Ducts already placed inside the Concreted Deck.
- Prestressing tendons shall never be heated or exposed to flame or to welding. Protruding Ends of tensioned strands of Grouted Cables, protruding beyond anchorages, shall only be saw-cut, not flame-cut. Recesses at anchorages (in the girder-ends) shall be filled and sealed with non shrink cement mortar after the protruding strand-ends of tensioned, anchored and grouted cables are cut to suit.
- Prior to placing the shuttering, the Contractor should demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and, if the prestressing reinforcement has been placed, that the Cable-steel is free and not bonded in the duct.
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