NOTES for 2-webbed PSC Slab Deck, cis on Staging in Span (PSC portion)

(Basic Concept of PSC & Elements of PSC Bridge and Prestressing Activities)

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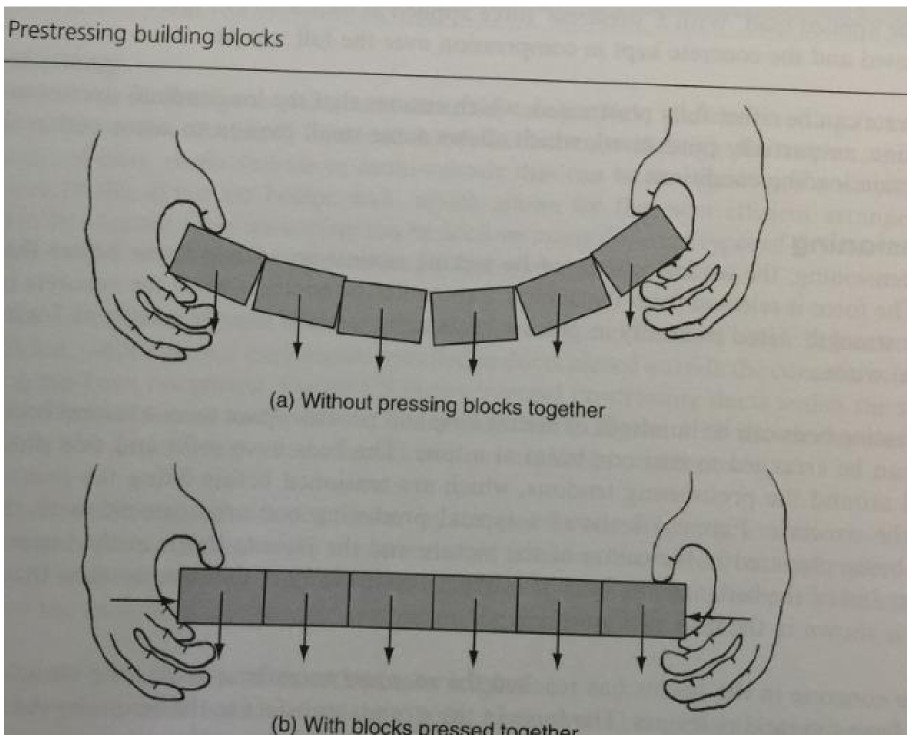
DOR

PRESTRESS

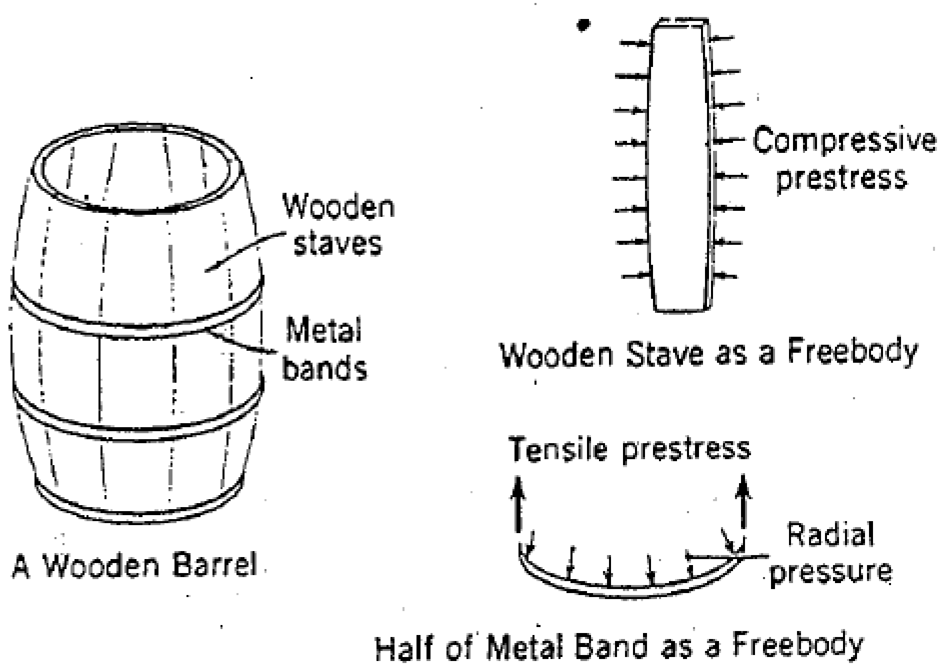
Prestress: Stress in advance

Example: Stack of books: Books pressured from both sides



PRESTRESS

Example: Barrel Construction

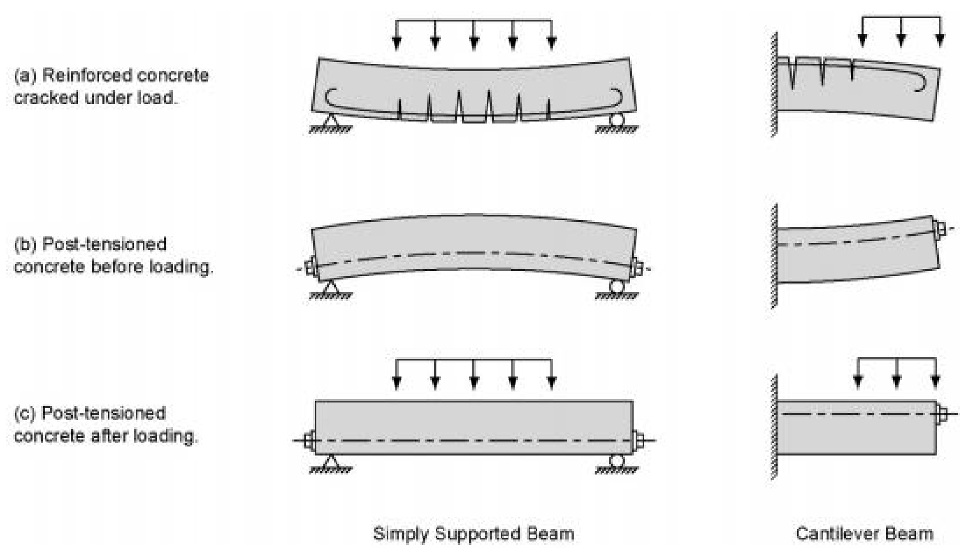


Principle of prestressing applied to barrel construction.

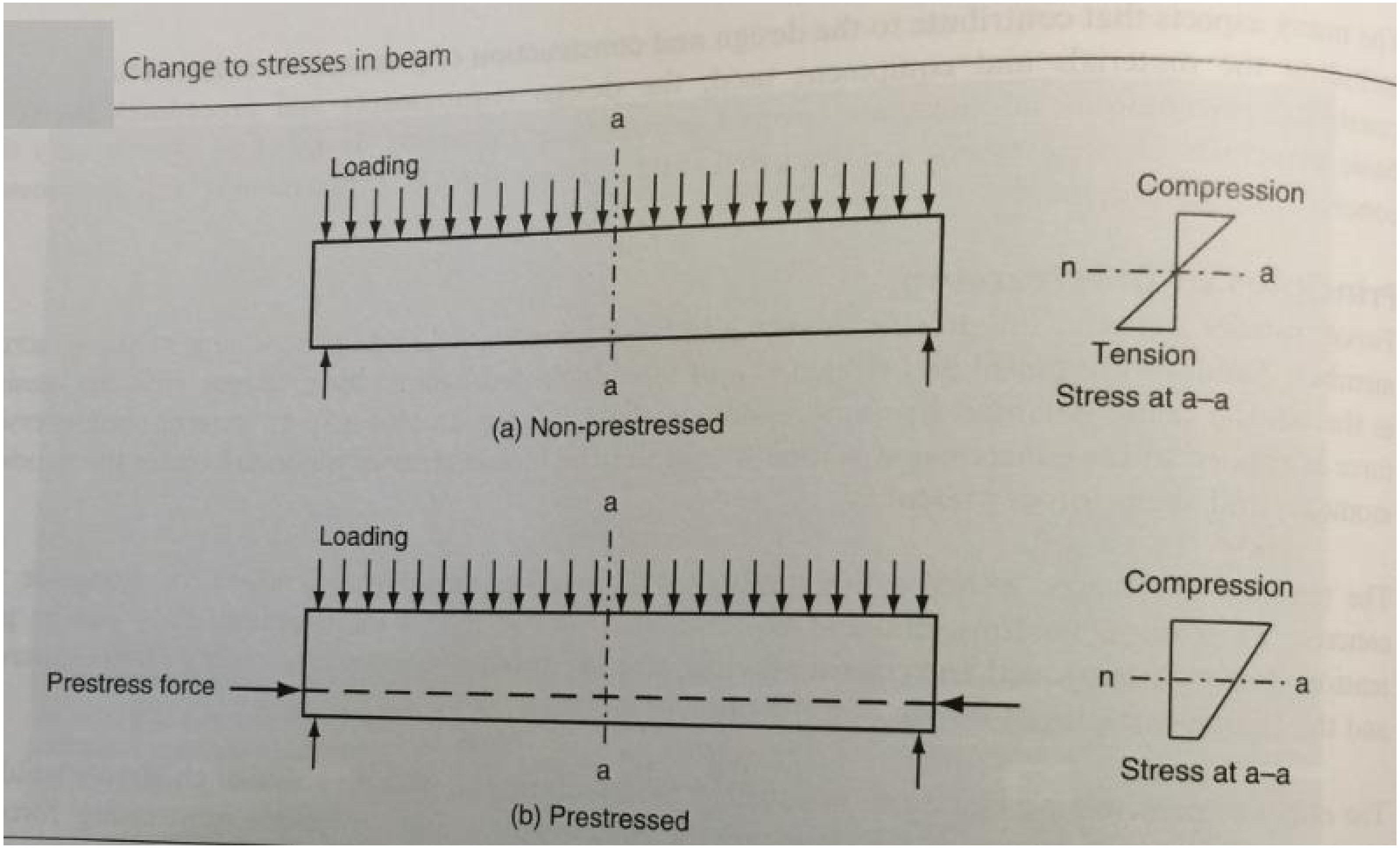
PRESTRESS

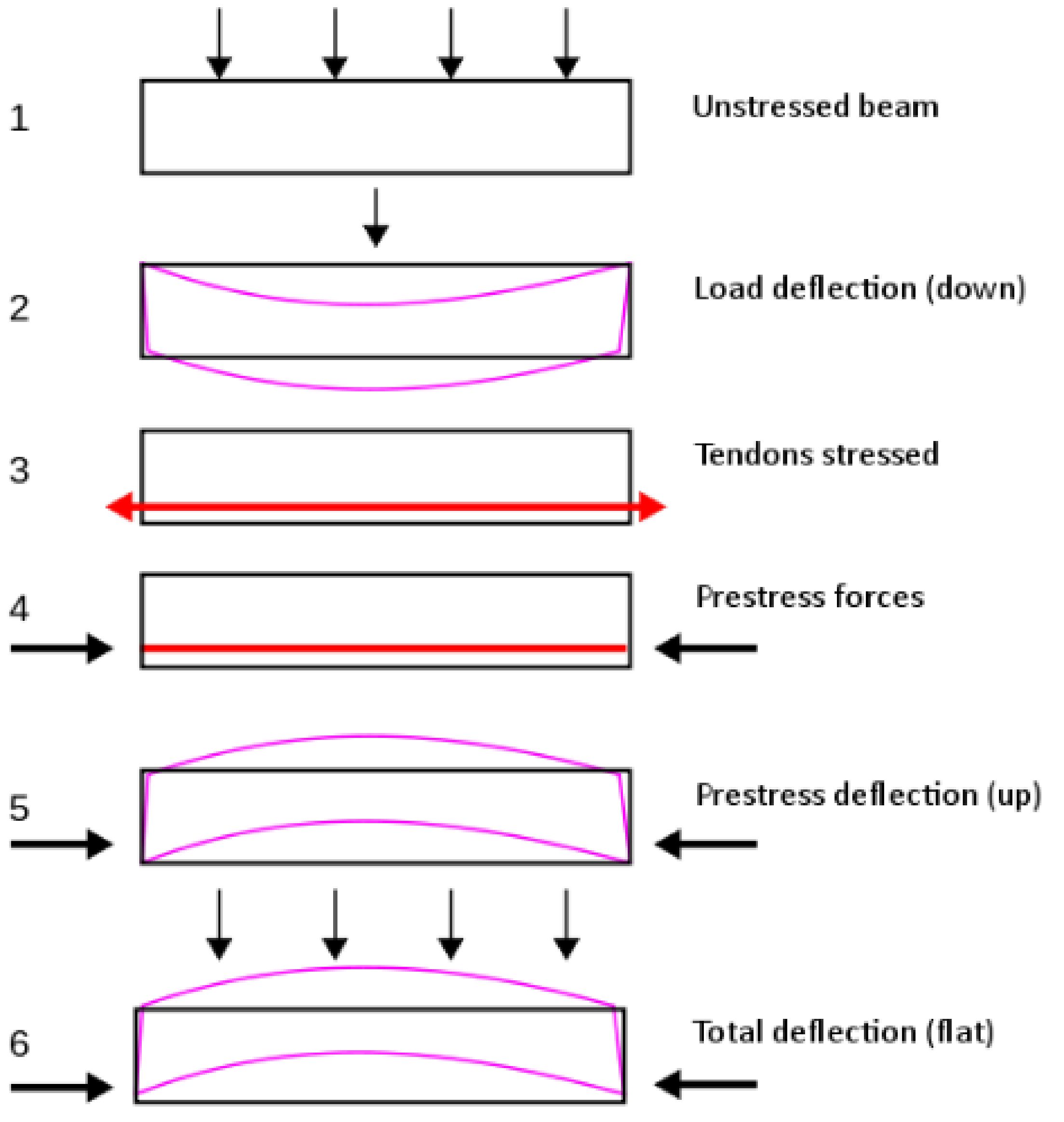
One of the best definitions of prestressed concrete is given by the ACI Committee on Prestressed Concrete:

> "Prestressed concrete: Concrete in which there have been introduced internal stresses of such magnitude and distribution that the stresses resulting from given external loadings are countered to a desired degree. In reinforced-concrete members the prestress is commonly introduced by tensioning the steel reinforcement."



Comparison of Reinforced and Prestressed Concrete Beams


Change to stresses in beam
a
Loading
Compression
n
a
Tension
Stress at a–a
a
(a) Non-prestressed
a
Loading
Compression
Prestress force
n
a
a
Stress at a–a
(b) Prestressed


1
Unstressed beam
2
Load deflection (down)
3
Tendons stressed
4
Prestress forces
5
Prestress deflection (up)
6
Total deflection (flat)

Used high tensile steel wires, with ultimate strength as high as 1725 MPa and yield stress over 1240 MPa. In 1939, he developed conical wedges for end anchorages for post-tensioning and developed double-acting jacks. He is often referred to as the **Father of Prestressed concrete.**

Eugene Freyssinet (France)

i. ***Father of prestressing: Freyssinet (French)***
ii. ***Guyon proved analytically***

METHODS :- a) Pretensioning
b)Post-tensioning

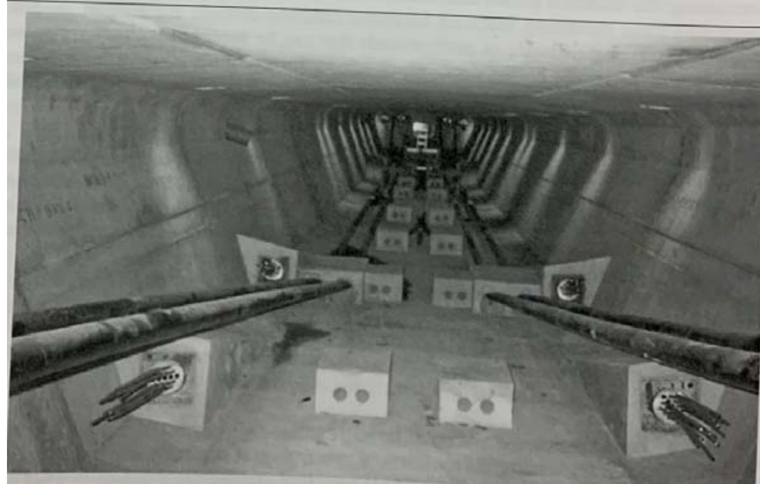
- ***PRETENSIONING*** :- Placing of concrete around reinforcing tendons that have been stressed to the desired degree.

- ***POST-TENSIONING*** :- Reinforcing tendons are stretched by jacks whilst keeping them inserted in voids left pre-hand during curing of concrete.

External and Internal Prestressing

Internal ducts in reinforcement prior to concreting

External tendons inside box girder deck



The stressing jack bears against the concrete

- Concrete is compressed gradually as the strand is tensioned

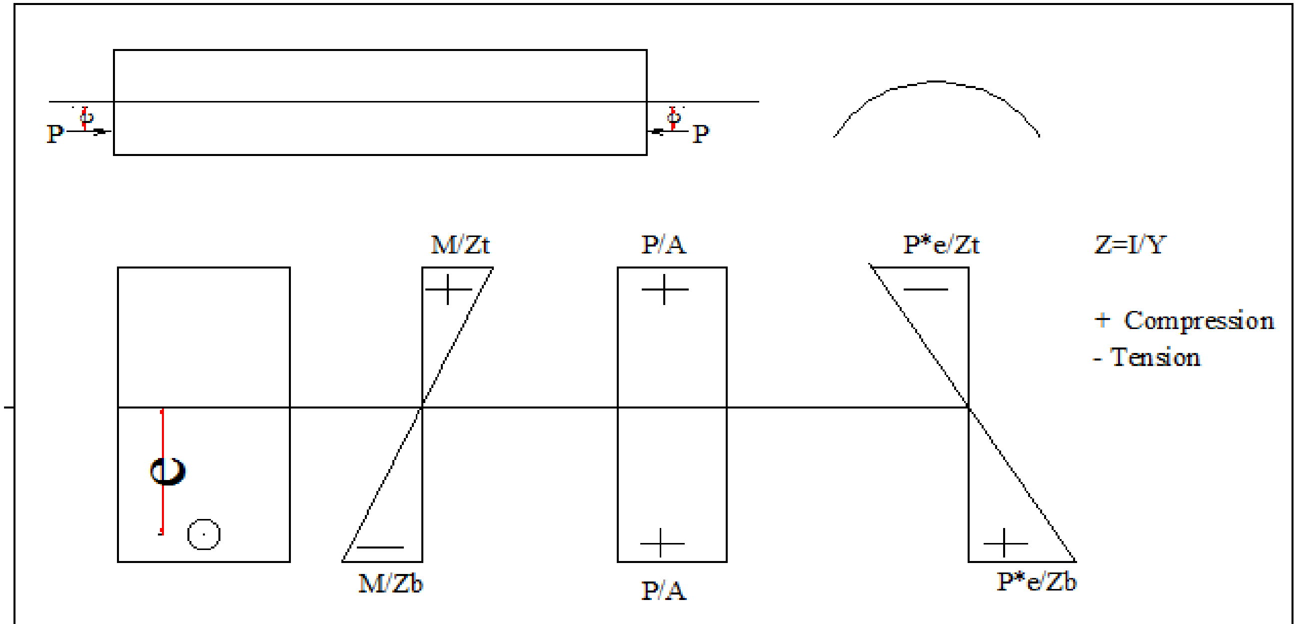
Stress due to axial force

$$\sigma = \frac{P}{A}$$

Stress due to Bending Moment

$$\frac{M}{I} = \frac{\sigma}{Y}$$

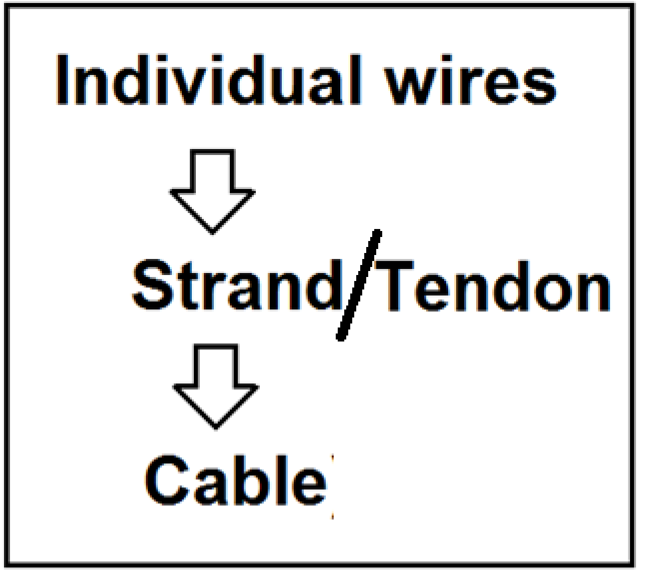
$$\sigma = \frac{MY}{I} = \frac{M}{Z}$$

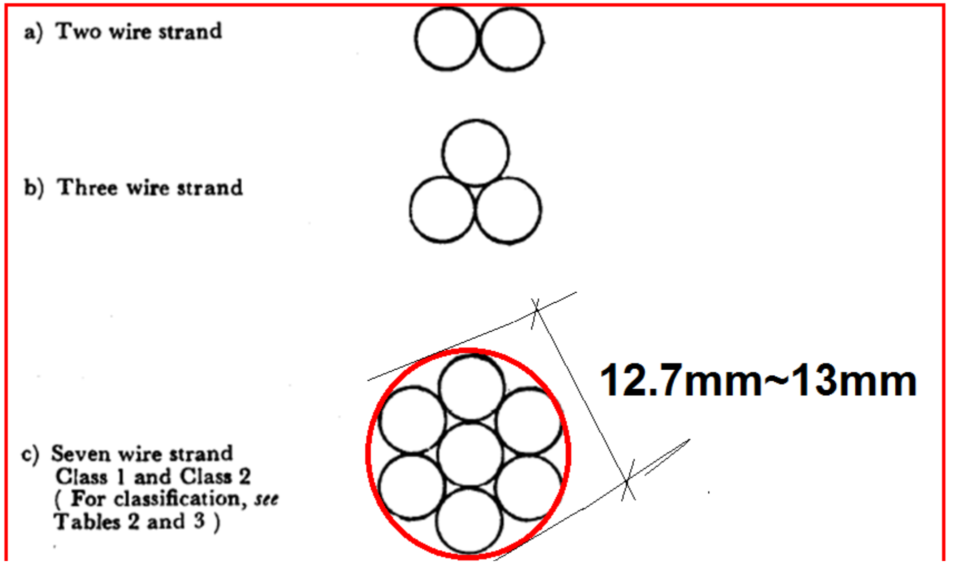


σt=M/Zt+P/A-Pe/Zt

σb=-M/Zb+P/A+Pe/Zb

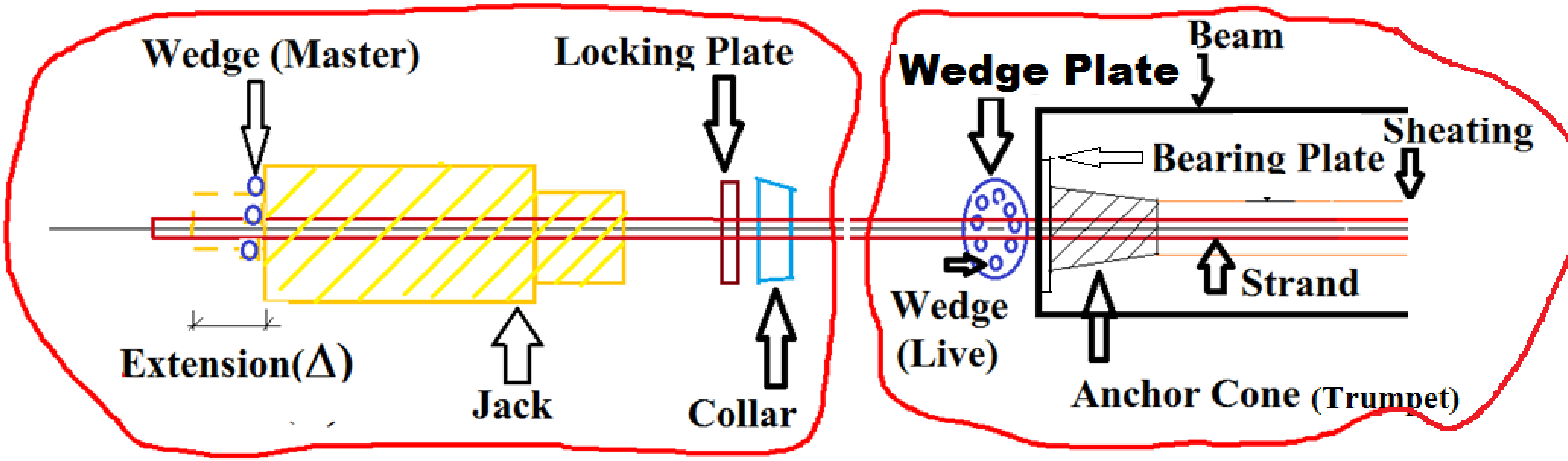
PRESTRESSING CABLE:



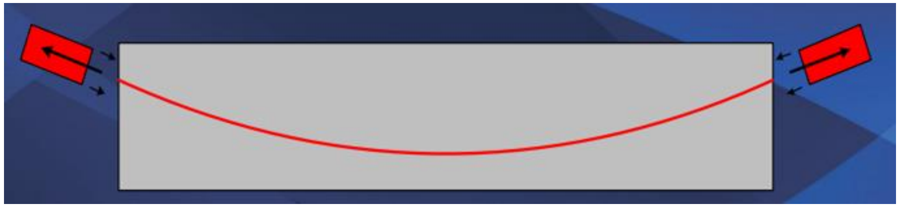


7 Ply – 12 T 13

Prestressing Operation



Prestress Losses



Prestress	Loss between (% of av. P_i)	Due to shrinkage of concrete (% of av. P_i)	Due to creep of concrete (% of av. P_i)	Due to elastic shortening of concrete (% of av. P_i)	Due to relaxation of steel (% of av. P_i)	Total loss (% of av. P_i) P_i = initial prestressing force after friction and slip
Stage I (applied at 7 days)	7 — 28 days	3	2	3.5	6	14.5
	after 28 days	3	8	—	—	11.0
	Total	6	10	3.5	6	25.5
Stage II (applied at 28 days)	after 28 days	3	8	3.5	6	20.5

NOTE: Loss of prestressing force on account of 'curvature-friction and wobble-friction' and 'slip at anchorages at the time of releasing the tensioning-jacks' is accounted for through the friction-effect calculations, and only the 'after friction and slip' prestressing force values used as P_i values.

Cable friction loss calculations

If the force in the cable at its stressing-end is P_0 then allowing for loss in this force on account of frictions due to curvature of cable profile

and wobble effect up to a point distant x from the jacking point, **the force in the cable at that point** will be:

$$P_x = P_0 \cdot e^{-(\mu\theta + kx)}$$

where θ = total angle turned, in elevation and plan, between the two points

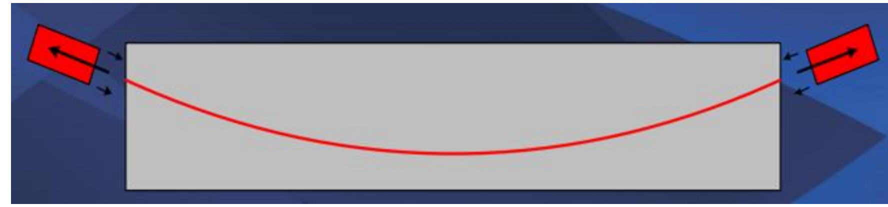
x = distance between the two points, measured along the cable profile (but since rise of cable is small compared to its projected length in plan, x may easily be taken as distance in plan between the two points)

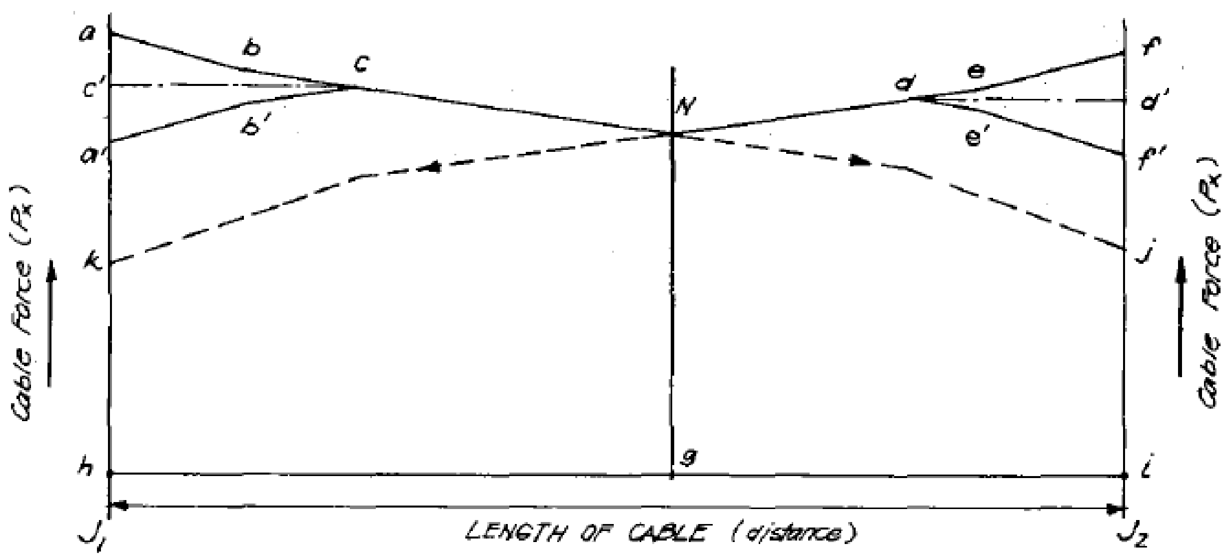
μ = curvature friction coefficient

k = wobble friction coefficient

Values of μ and k depend on type of duct housing the cable (e.g. plane, corrugated, galvanized, flexible, rigid, etc.) and, to some extent, even on the amount of care exercised in handling the duct and how symmetrically and untustled the tendon elements stay inside the duct. As an example, for a rigid, corrugated and unrusted duct, housing high tensile steel wires assumed placed along a circle in cross-section, with the duct remaining unsquashed all along its length, μ may be taken as 0.25 per radian and k as 0.003 per meter length. Duct manufacturers give μ and k values for different types of ducts while the codes usually specify the upper bound values.

Cable Elongation and Slip





(i) Cable elongation at jacking end J_1

$$= \frac{1}{AE} \text{ (area } abcNgha)$$

(ii) Cable elongation at jacking end J_2

$$= \frac{1}{AE} \text{ (area } fedNgif)$$

(iii) Cable slip at end $J_1 = \frac{1}{AE}$ (area $abcb'a'a$)

(iv) Cable slip at end $J_2 = \frac{1}{AE}$ (area $fede'f'f$)

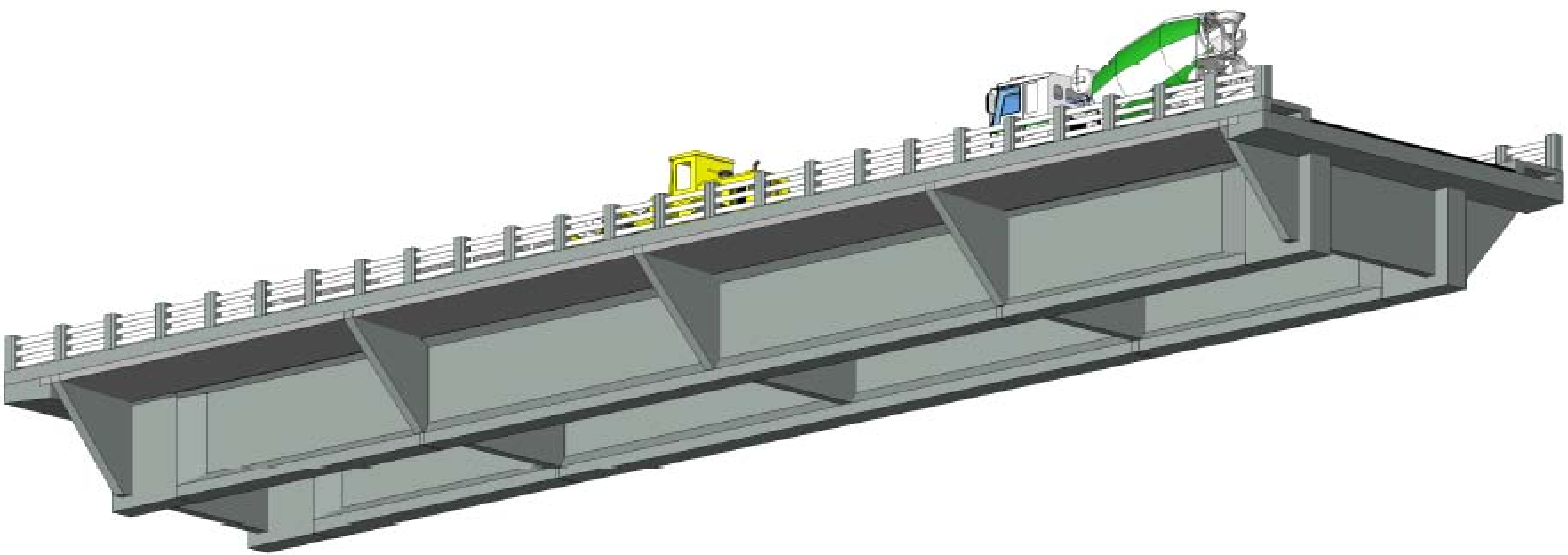
STRESSING DATA & RECORDS

Before starting Stressing Operations, following Data/Record should be available with the Engineer.

1. Tendon Identifications No.
2. Stressing Sequence
3. Length of the Tendon (from Anchorage end to Anchorage end)
4. Total Calculated Elongation
5. Specified Stressing Force - (P)
6. Specified Cross-Sectional Area of Prestressing Steel
7. Specified Modulus of Elasticity of Prestressing Steel
8. Actual Cross-Sectional Area of Prestressing Steel
9. Actual Modulus of Elasticity of Prestressing Steel = (Ea)
10. Ram Area of the Stressing Jack
11. Pressure Gauge Calibration Report
12. Jack Efficiency Report
13. Elongation & Stressing Force to be modified/estimated on the basis of the Actual Jack Efficiency of the jack, Actual Cross-Sectional Area & Actual Modulus of Elasticity of The Prestressing Steel under use.

REFERENCE NOTES

Approximated shape of 2-webbed Prestressed Concrete Slab-Deck



Construction Photographs

Post tension

Construction Photographs

10. CONSTRUCTION SEQUENCE:

- ***Entire Deck (i.e. the Superstructure comprising the cast in situ Prestressed Concrete two webbed slab) shall preferably be concreted in one operation in one day for one span.***

- ***If this is not possible, then the two webs shall be cast one after the other (each up to about 150 mm below the top throat) <u>on one day</u> (if possible) otherwise on two successive days, one after the other, along with the Cross Girders, and then the slab cast on the next day.***
- ***<u>This entire Deck must be cast in-situ on staging in span in no more than three Successive Days.</u>***

17. PRESTRESS

i. ***The Prestressing System assumed here can be SAI Prestressing System OR DYNAMIC Prestressing System AND each cable is either: 19JK13 OR 19DP13 type multistrand.***

- ***An "alternative" equivalent and approved Prestressing system may be used instead so long as the effective Prestressing Force at each section, its eccentricity w.r.t. centroid of each section, and its Moments, Shears, etc. at each section of the Deck are retained unchanged, and the Detailed Design, Detailing and Drawings are duly submitted for checking and approval of the Department of Roads.***

ii. ***Each Prestressing Cable shall be a multistrand cable comprising <u>19 Strands, each strand of 12.7 mm diameter, 7-ply low relaxation High Tensile Steel Conforming to IS 14268 – 1995</u>.***

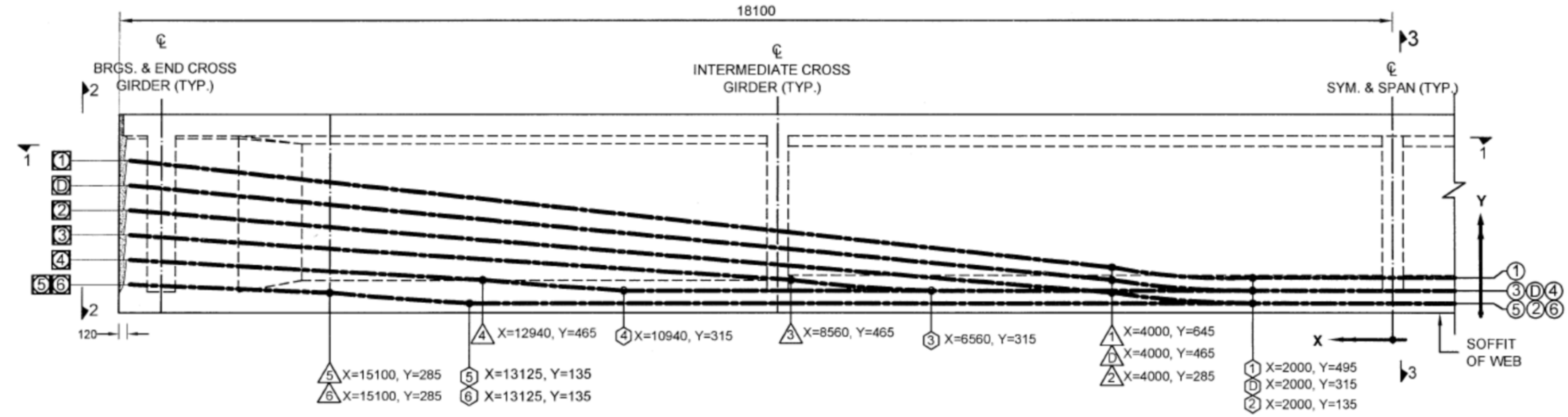
iii. ***<u>Forming a 19 multistranded cable at site:</u>***

a) ***The monostrand is supplied (in large coils) in very long lengths.***

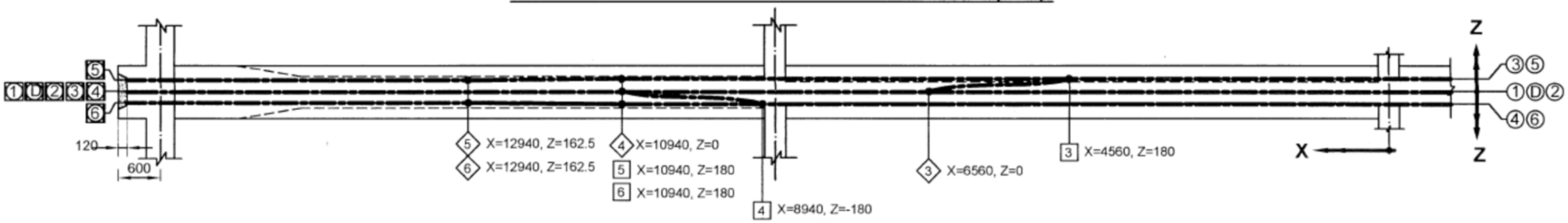
Monostrand supplied in coil

b) ***Cut 19 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.***

- c) ***Bunch together these 19 monostrands into a 'multistrand' holding them together by binding wire tightened around the bunch at about 1.0 m intervals.***
- d) ***Insert these cables in to their respective 90 mm ID Corrugated HDPE Ducts which are already placed to the required profile in the already concreted deck.***



LONGITUDINAL SECTIONAL ELEVATION THROUGH WEB (TYP.)



SECTIONAL PLAN 1-1 (TYP.)

iv. ***Provisions for one 19JK13/19DP13 DUMMY CABLE, i.e. its Anchorages, HDPE Sheathing, and Profile details, have been provided in EACH of the two webbs (longitudinal girders) of the 2-webbed slab superstructure.***

- ***Cable Profile details are shown in the attached relevant Prestressing Drawing.***

- ***Prestressing these Dummy Cables may be required in the event of any exigency at site and/or emergency in future.***
- ***These two Dummy Cables shall be stressed only to the extent required but both must be stressed equally one immediately after the other in order to cause only least Temporary eccentric prestress on the Deck.***

TABLE 3 MINIMUM BREAKING LOAD

(*Clauses* 6.1, 6.2 *and* 7.2.1)

CLASS	DESIGNATION	BREAKING LOAD *Min*
(1)	(2)	(3)
		N
—	2-ply 2 mm	12 750
	2-ply 3 mm	25 500
	3-ply 3 mm	38 250
1	6·3 mm 7-ply	40 000
	7·9 mm 7-ply	64 500
	9·5 mm 7-ply	89 000
	11·1 mm 7-ply	120 100
	12·7 mm 7-ply	160 100
	15·2 mm 7-ply	240 200
2	9·5 mm 7-ply	102 300
	11·1 mm 7-ply	137 900
	12·7 mm 7-ply	183 700
	15·2 mm 7-ply	260 700

8. PERMISSIBLE STRESSES IN PRESTRESSING STEEL

Maximum jack pressure shall not exceed 90 per cent of 0.1% proof stress. For the purpose of this Clause 0.1% proof stress shall be taken as equal to 85% of minimum Ultimate Tensile Strength (UTS).

v. a) Cross-sectional area of H.T.S. in ONE No: 12.7 mm dia. Strand = 98.7 mm^2

b) Cross sectional area of H.T.S. in 19 strands = 19 × 98.7 = 1875.3 mm^2

c) Breaking load i.e. Ultimate Tensile Force Per Strand = 183710 N

i.e. 18726.81 Kg

i.e. 18.72681 Tonne i.e. 18.72681 T.

(ref. Table: 3 of IS 6006 (1983))

d) Breaking load i.e. Ultimate Tensile Force of 19 strands of one Multistrand = 19 × 18.72681

= 355.81 T

e) 0.1% Proof Load per Strand

= 0.85 of Breaking Load per strand

= 0.85 of 18.72681 T

= 15.9178 T i.e. 15918 Kg

i.e. 156155.6 N

i.e. 156.156 KN

f) ***0.1% Proof Load of 19 Strands***

i.e. 0.1% Proof Load per Multistrand here = 19 × 156.156 KN

= 2966.964 KN i.e. 302.443 T

g) g.1 Jacking Force at each end of this Multistand as per Clause 8 of IRC-18 (2000) shall not exceed 90% of 0.1% Proof Load:

i.e. 0.9 × 302.443 = 272.1987 T

- ***which is 0.765 of Breaking Load of 19 Strands*** g.2 ***Hence Jacking Force normally should not exceed 76.5% of the Breaking Load***

g.3 ***However, here we are using a Jacking Force of only 75% of the Breaking Load in the Design, which is 0.75 × 355.81 T = 266.86 T*** ***for a 19-Stranded Multistrand (19JK13, SAI system OR 19DP13, DYNAMIC System, see Note ahead).***

g.4 ***In the very limit (if site exigency so requires) this Jacking Force in a 19JK13/19DP13 multistrand may be increased to a maximum of 270 T but NEVER MORE.***

Exercise 1: Maximum Jacking force for 12 T 13 cable as per codal Provision

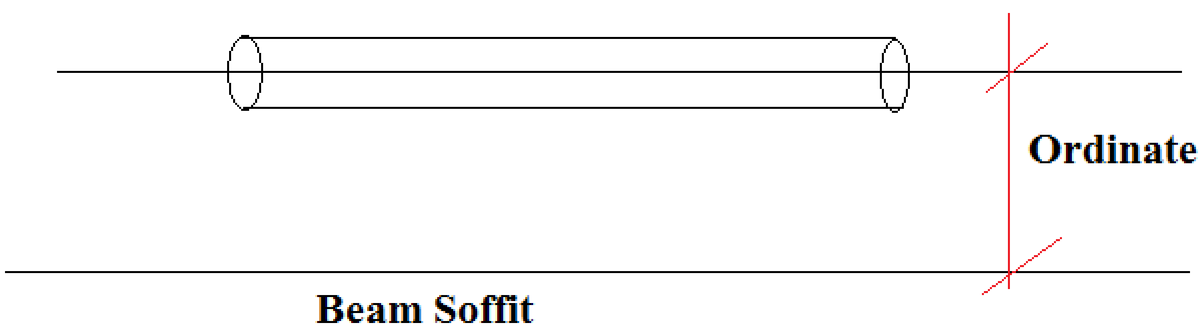
	19 T 13	12T13
J.F. Shall never exceed (T)	272.194	

vi. a) The Prestressing Steel and Accessories shall be subject to Acceptance Tests prior to their actual use on the works. (Guidance may be taken from BS 4447).

- ***The Prestressing Jacks used shall be only those appropriate for tensioning simultaneously all the 19 strands of a multistranded Cable.***

b) **Appropriate *"Prestressing Force Measurement Device" shall be part of the Multistrand Jack and shall be duly checked and calibrated for correctness and removal of zero–error, regularly, in consultation with the concerned Manufacturer.***

vii. ***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.***

viii. ***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.***

ix. ***Before commencement of prestressing, it should be ensured that all the Cables/Ducts are free of any clogs and that the structure members are free to accommodate the horizontal and vertical movements due to application of prestress, and that there is enough space for the movement of the jack piston.***

x. ***Each Cable shall be stressed from both its ends simultaneously, equally and gradually, and the extensions recorded at each suitable increment of Jacking Force.***

xi. ***For tensioning a cable, the initial slack in it shall first be removed (taken-up) by applying a relatively small initial tension from each end as required to remove the slack.***

- ***The initial tension required to remove this slack shall be taken as the starting point for measuring the cable elongations and the correction shall be applied as per clause 12.2.1.3 of IS: 1343 (1980).***

xii. ***The Cable Elongations at their Jacking-Points, mentioned in the attached relevant Prestressing Drawing, are based on the assumption that the Modulus of Elasticity of Cable-steel, E_s, = 1.95×10^5 MPa (i.e. 1.988×10^6 kg/cm^2).***

- ***However, if E_s of the actually supplied Cable-steel at site is slightly different, then the required Elongations at each end shall be re-worked out at site by multiplying the specified values by the ratio of (assumed E_s / actual E_s), and these shall then be the 'correct' specified extentions.***

Modified Elongation (Example)

$$\text{Modified Elongation} = \text{Theo Elong} * \frac{\text{Theo. A value} * \text{Theo. E value.}}{\text{Actual A value} * \text{Actual E value}}$$

S.No.	Coil No.	Actual area (mm^2)	Act. Mod. of elastisity (KN/mm^2)	Duct	Theo. Area (mm^2)	Theo. M.O.E (KN/mm^2)
1	X 3297 E	99.48	197.00	D/S 9,10,11 & 12	98.70	195.00
2	X 3302 A	100.5	197.00	Up/S 6,7,8,9,10,11 & 12	98.70	195.00
3	X 3302 B	99.7	197.00	Up/S 1,2,3,4 & 5	98.70	195.00
				D/S 8		
4	X 3302 D	99.76	202.00	D/S 1,2,3,4,5,6 & 7	98.70	195.00

<u>Modified Elongation</u>

S. No. 1 = $\frac{\text{Theo. Elong. X Theo. 'A' value X Theo. 'E' value}}{\text{Actu. 'A' value X Actu. 'E' value}}$

$$= \frac{188 \times 98.70 \times 1.95 \times 10^5}{99.48 \times 1.97 \times 10^5}$$

= 184.63 mm

Exercise 2: Calculate Modified Elongation

Span=		30	m	35	m	40	m
Cable No-1							
Required extension at each end (mm)as per design		116	mm	133	mm	151	mm
Area of 12.7mm strand assumed in design		98.7	mm2	98.7	mm2	98.7	mm2
Mod of elasticity of strand material assumed in design		1.95E+05	N/mm2	1.95E+05	N/mm2	1.95E+05	N/mm2
Area of 12.7mm strand in field		99.48	mm2	99.48	mm2	99.48	mm2
Mod of elasticity of strand material in site		1.97E+05	N/mm2	1.97E+05	N/mm2	1.97E+05	N/mm2
Modified elongation=		....	mm	....	mm	....	mm

(The elongation provided in standard drawing already accounts 1m grip length)

xiii. Sheathing (Ducting for housing the 19-multistranded Cables)

- *The sheathing for prestressing cables shall be corrugated "HDPE type", 90 mm ID (wall thickness 2.3 ± 0.3 mm as manufactured and 1.5 mm after loss of compression) and shall be tested as per IRC:18 (2000), Appendix 1.*

xiv. ***For the above multistrands in HDPE sheathing, Wobble Friction Coefficient:***

K = 0.002 per meter, and Curvature Friction Coefficient: μ = 0.17 per radian,

have been assumed in Design.

xv. ***Cable-Elongation at each end of each cable*, given in the attached Prestressing Drawing, *has already taken in to account the actual cable-length along its profile between the gripping points of the Tensioning Jacks placed nearest the Anchorages.***

xvi. ***The effect of a 10 mm cable slip (anticipated at each Jacking–end) also has already been taken into account in evaluating the <u>effective prestressing Force at each section along the Cable after friction losses due to Curvature and Wobble</u>.***

xvii. a) <u>Prior to concreting the Deck, INSERT 80 mm ID Plain HDPE Ducts into the 90 mm ID Corrugated HDPE Ducts</u> (which have already been placed to the required cable profiles), protruding them suitably beyond the cable– Anchorages.

b) ***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/cm^2 (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.***

c) ***The 19-stranded multistrands may now be inserted in to their respective 90 mm ID corrugated HDPE Ducts <u>already placed inside the Concreted Deck</u>.***

Extension

Pressure(kg/cm2)

$$\text{Modified Jack Pressure} = \frac{\text{Jacking Force (T)} * 1000}{\text{Ram Area} * \text{Jack efficiency}}$$

Exercise 3: Calculate Modified Jack Pressure

Span=		30	m	35	m	40	m
Cable No-1							
Jacking force (T)		266.86	T	266.86	T	266.86	T
Jack RAM Area		631	cm2	631	cm2	631	cm2
Jack Efficiency		98.96	%	98.96	%	98.96	%
Modified Jack Pressures=			kg/cm2		kg/cm2		kg/cm2

xviii. TENSIONING OF PRESTRESSING CABLES:

a) ***Normally, the specified required extensions shall be achieved at the specified Jacking Forces at stressing ends.***

b) ***In case these required extensions are somehow not achieved at these specified Jacking Forces, the stressing (tensioning) shall be continued (where possible) till the required extensions are obtained but subject to the Jacking Force at each end NEVER exceeding 270T.***

(c) Should the required extensions be obtained at Jack Forces lower than the specified Jack Forces, then the stressing should be continued till the specified Jack Forces are reached but provided the "sum of the 'additional' extensions" so achieved is not more than 5% of the "sum of the 'specified' extensions".

(d) Cables satisfying these provisions shall be locked (i.e. anchored).

(e) However, if the Jack Forces are <u>still lower than their specified values despite the 5% increase in the "sum of the 'specified' extensions</u>", then the particulars of such cables shall be reported to the Designer for further instructions ('locking' but not 'grouting' these cables yet until receipt of instructions, just in case).

(f) If for any cable, the required extension at any one end is not achieved despite the Jack Force in the cable at that end reaching 270 T (the maximum allowable Jacking Force), then the "total balance extension" should be attempted for at the other end BUT the Jacking Force SHALL NEVER EXCEED 270 T.

(g) Also, for any cable, the extension at any one end shall not exceed the "sum total extension required for the cable at that end" by more than 5%.

(h) Extensions should also be checked 24 hours after anchoring the cables to guard against the possibility of 'slow slipping', if any. If the average observed 'slow slip' at anchorages of a cable exceeds 3mm, the matter should be reported to the Designer for any further instructions.

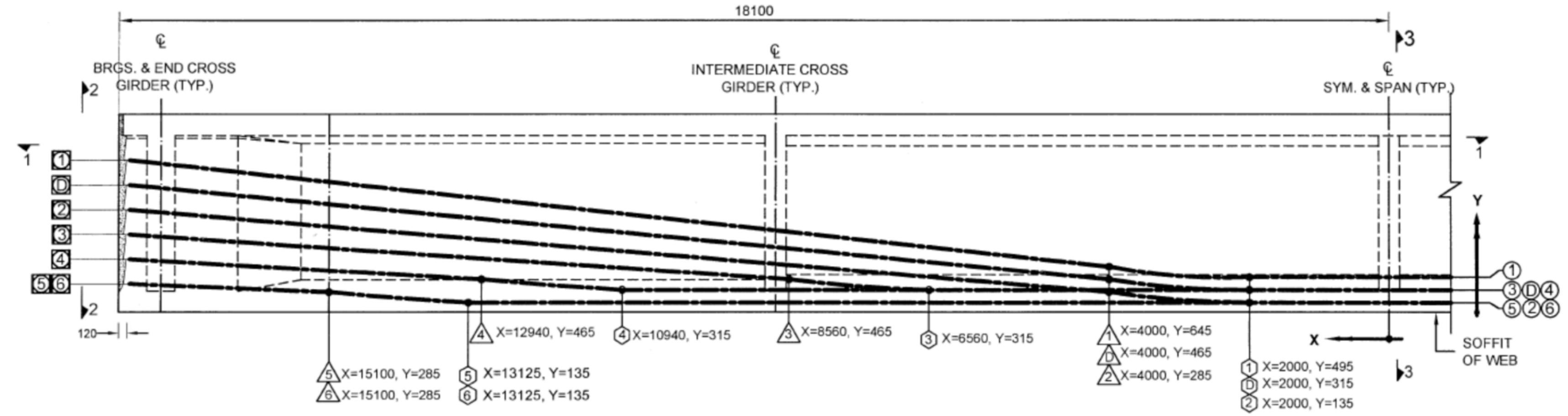
(i) All cables which satisfy the above provisions shall be grouted, taking care that the cables not yet stressed do not get accidentally blocked due any internal grout leak.

xix. ***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.***

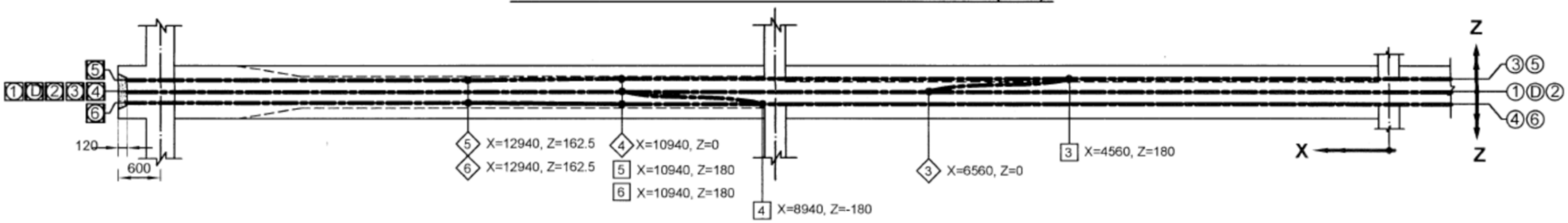
xx. ***Prestressing cables shall be protected against any unacceptable rusting, damage due to 'pitting', and any greasing. The strands must be thoroughly cleaned with petrol at locations where Stressing Jacks and Wedges have to grip them.***

xxi. SEQUENCE OF STRESSING AND STAGES OF PRESTRESSING:

a) ***The Sequence of Stressing of Cables shall be as indicated in the attached relevant Prestressing Drawing and the prestressing shall be accomplished in TWO STAGES: PS-I and PS-II as stated therein.***



LONGITUDINAL SECTIONAL ELEVATION THROUGH WEB (TYP.)



SECTIONAL PLAN 1-1 (TYP.)

The sequence of stressing of multistranded cables shall be as follows :

(i) PS-I Cables (i.e. cables of 1st stage of Prestressing)

- Stress Cable No: 1 in one web;
- Then stress Cable No: 1, followed by Cable No: 2, in the second web;
- Then stress Cable No: 2, followed by Cable No: 3, in the first web;
- Then stress Cable No: 3, followed by Cable No: 4, in the second web;
- Then stress Cable No: 4 in the first web.

(ii) PS-II Cables (i.e. cables of 2nd stage of Prestressing)

- Stress cable No: 5 in the first web;
- Then stress Cable No: 5, followed by Cable No: 6, in the second web
- Then stress Cable No: 6 in the first web.

b) ***First Stage Cables i.e. PS-I cables shall be stressed in their indicated sequence when the last cubic meter of concrete in the deck-slab*** ***(laid last in concreting the "two-webbed slab" Deck)*** ***has attained a work's cube crushing compressive strength of at least 400 kg/cm*** ^{2} ***and is more than 10 days old (after the day of its casting).***

c) ***<u>Cables of PS-II shall be stressed in their indicated sequence when concrete in the deck slab has attained a works cube</u> crushing compressive strength of at least 450 kg/cm^2 and is at least 28 days old (after the day of its casting).***

d) ***The Sequence of stressing the cables in Stage-I Prestressing (i.e. in PS-I) and Stage-II Prestressing (i.e. in PS-II) is shown in the attached relevant Prestressing Drawing.***

e) ***After successfully stressing the PS-I Cables the deck becomes self supporting between its ends. The Contractor may now carefully release the Staging supporting the Deck.***

f) ***The Dirt-walls of the two Abutments shall be constructed after successfully Prestressing and Grouting the cables of the Decks supported by the Abutments.***

xxii. ***After completion of stressing and anchoring a cable, the Jack Force shall be released in such a way so as to avoid shock to the anchorage and the cable.***

xxiii. ***Complete record of all Prestressing and Grouting shall be carefully maintained at site.***

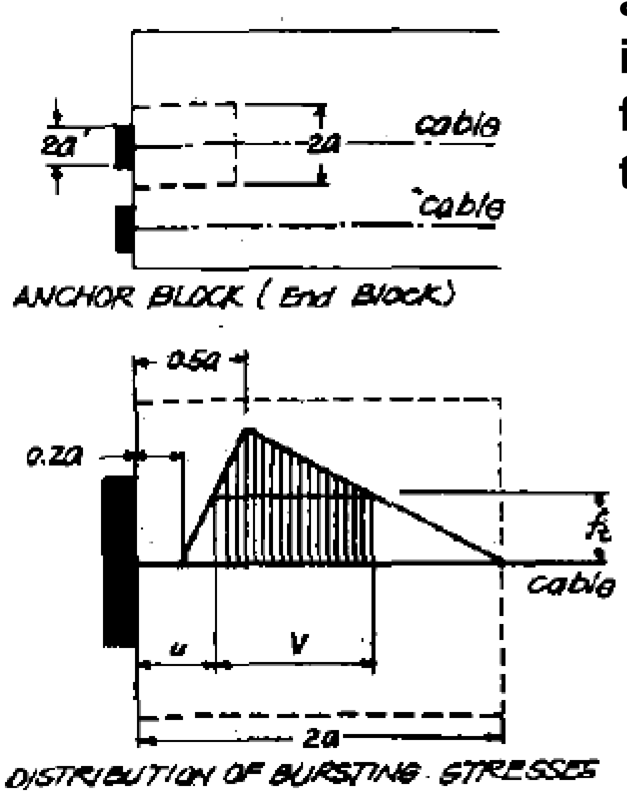
xxiv. ***An appropriately experienced Technical representative of the Supplier of Prestressing system shall carry out and supervise all Prestressing and Grouting Operations at site and ensure, monitor and certify their correctness.***

viii. ***If some delays in Grouting are unavoidable (e.g. due to sequence of construction planned), temporary protection against corrosion shall be provided by ventilating the Ducts with dry/hot air, since any humid conditions contribute considerably to acceleration of corrosion of cable–steel.***

Few Critical issues

1- CABLE ANCHORAGE ZONE

END BLOCKS-CABLE ANCHORAGE ZONE

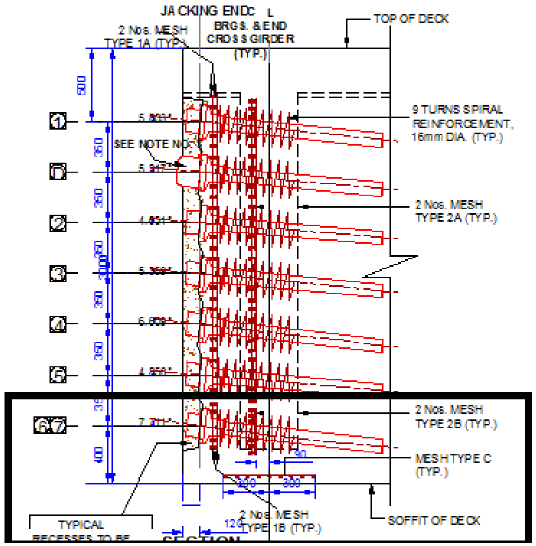


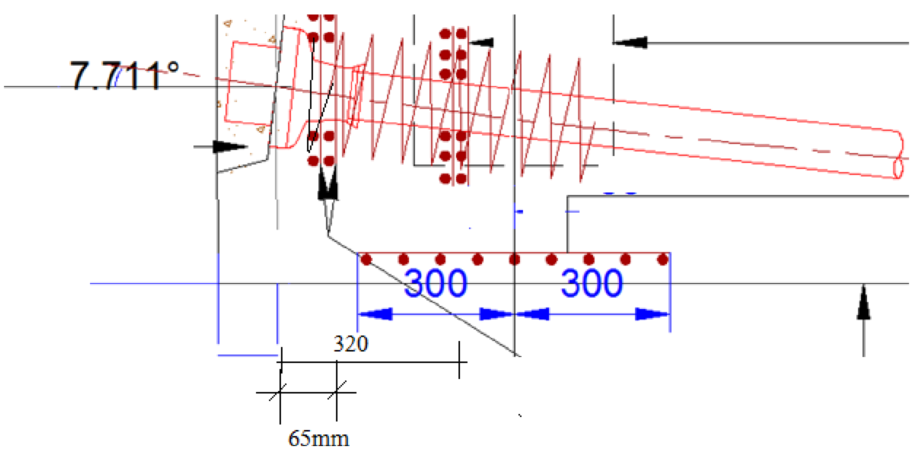
-Prestressing force emanating from the anchorage travels into the concrete member initially in the shape of trajectories (brusting force) that set up stress eddies in 3D within the certain distance called lead in zone.

-Lead in zone- ¾ D to D – (D- Depth of beam)

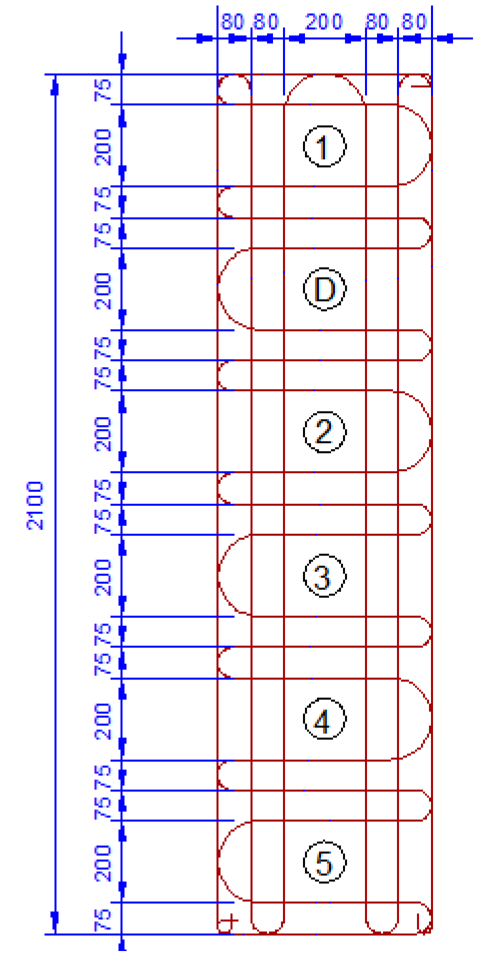
-Brusting: Spiral (Helix) and grill mesh

- Antil spalling reinforcement- Grill meshes



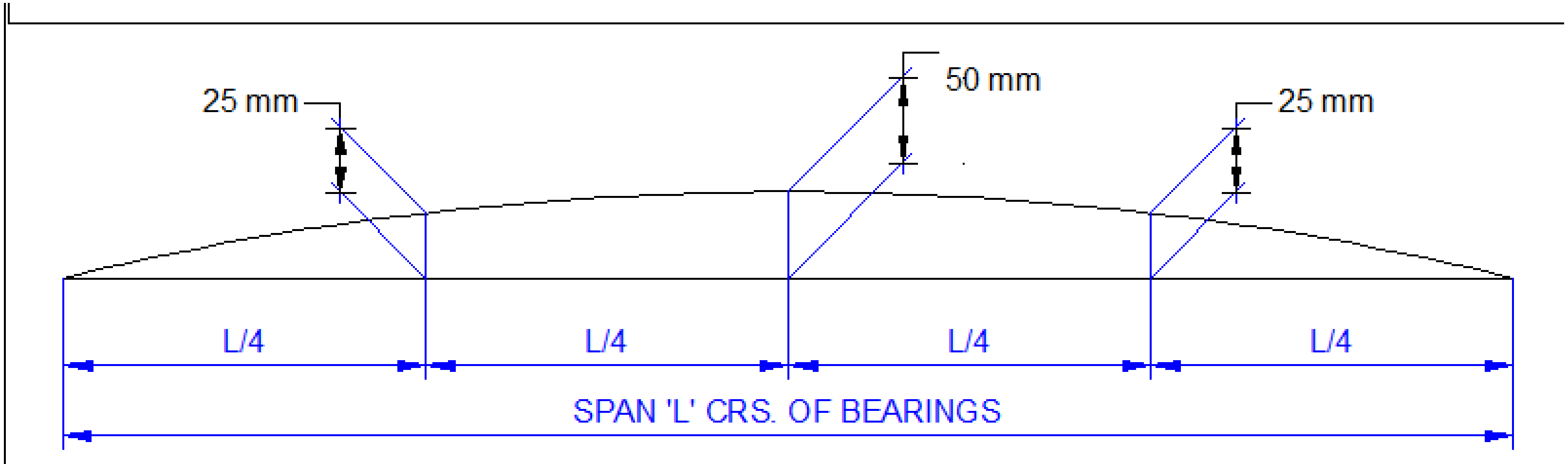


Trumpet length ~220 mm
Spiral length-640mm



2- LONGITUDINAL PROFILE OF BRIDGE DECK

LONGITUDINAL PROFILE OF BRIDGE DECK



LONGITUDINAL CAMBER PROFILE TO BE GIVEN TO SOFFIT OF DECK (TYP.)

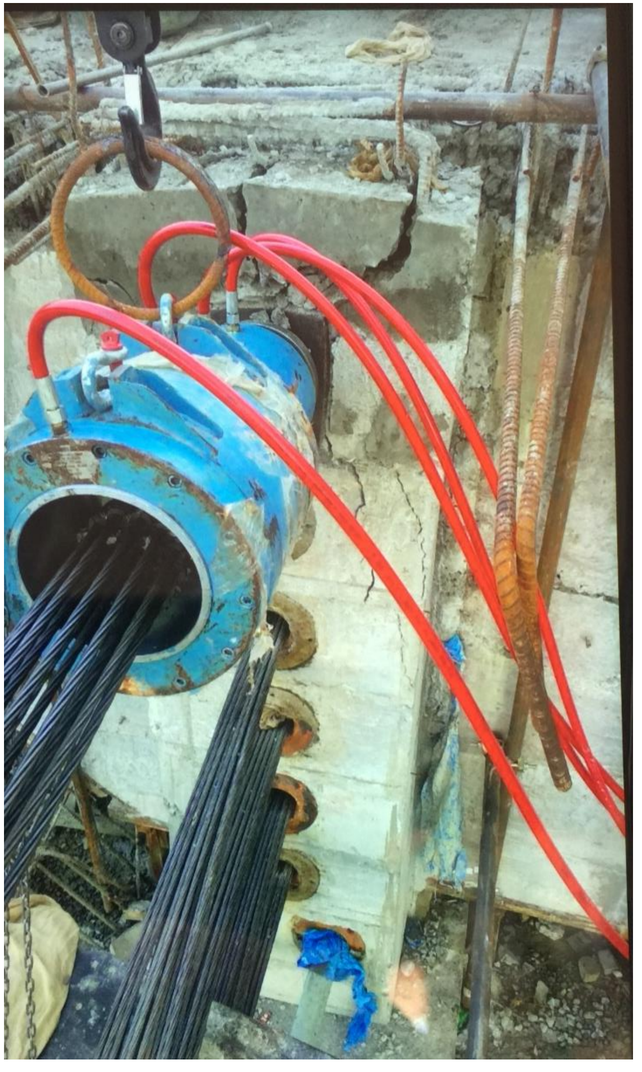
3- TEMPORARY FALSEWORK WASHED AWAY DURING CONSTRUCTION

Seregad,Dadeldhura

Madi Khola, Kaski

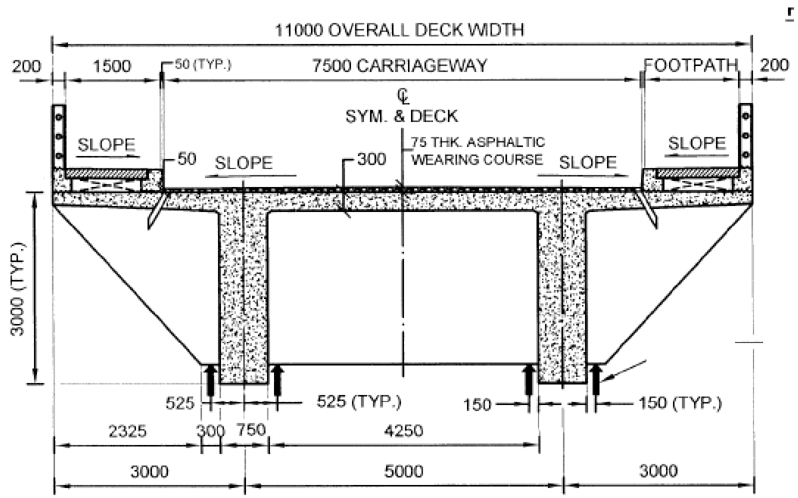
Khadak Khola

4- Bridge failure during Prestressing



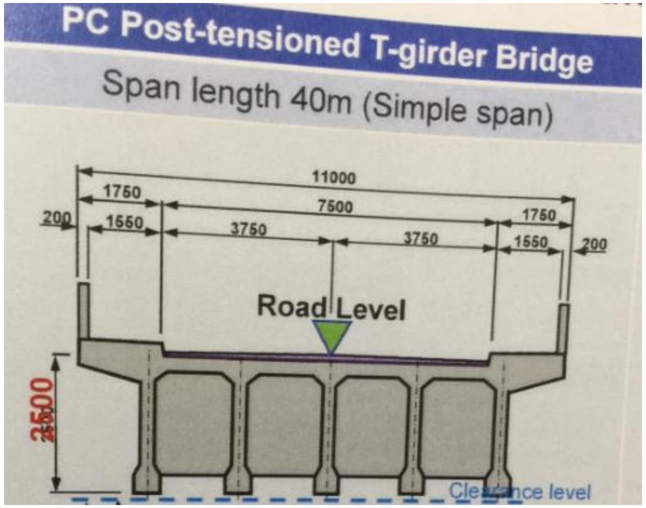
Quality issue?

5- Superstructure Depth (Girder Height) in Standard Drawing

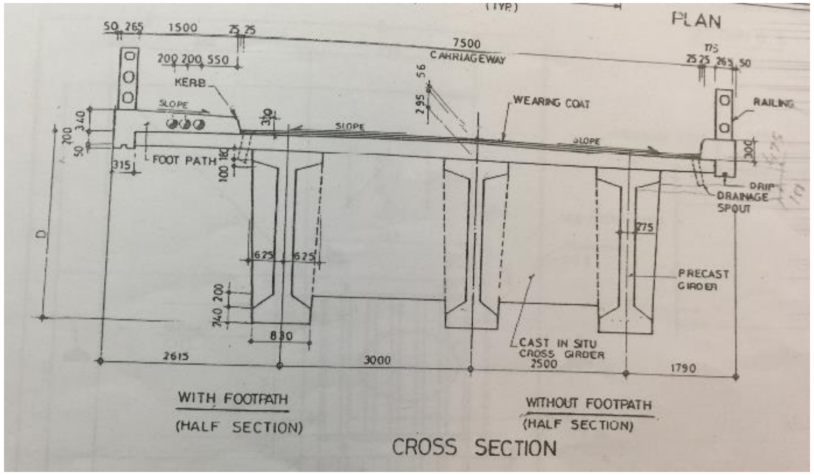


DOR standard-2 Girder

-3m depth



JICA team- 2.5m (more girders)



SPAN L1(m)	DEPTH OF SUPERSTRUCTURE		a
	With Footpath D (m)	Without Footpath D (m)	
30.0	2.5	2.5	2200
35.0	2.95		2100
40.0	3.10	3.35	2200

Ministry of Surface Transport, Indian, Road Congress—3.35m

Thanks