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In Pre-stressing System, development of mechanism, anchoring devices in pre and post tensioned concrete structures

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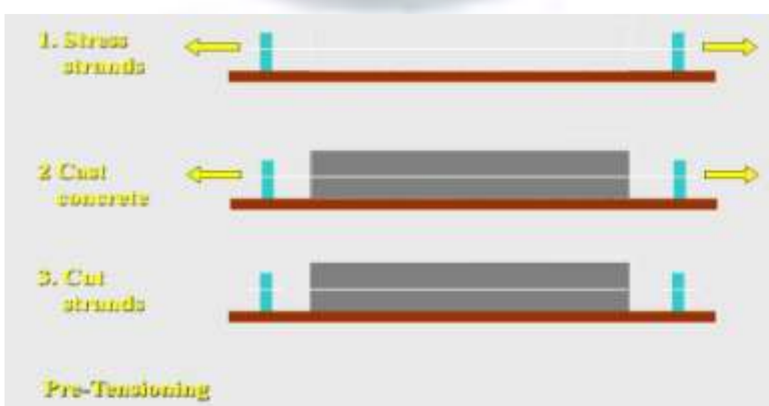
Abstract: The System of pre-stressing in concrete structure is quite different from RCC. concrete Technology adopted. In the pre-stressing system as we know devices are of two types, Which are pre- tensioning & post-tensioning, used in prestressing for pre & post tensioning device mechanism development of Anchoring system in concrete structural element. Where, FRP System is advisable in modern type of Pre stressing the electricity with Low voltage and high current is used as in anchoring device for a concrete member & sulpher Coating is used for duct material before the casting of concreting to Structure member. While supplying electricity in the structure sulpher get melted up because heat generated in the structure. The structure is anchored by nutting at both the ends with high strength steel alloy. This method of Devising may be promoted & adopted for providing pre-stress in concrete member in to-days practice.

INTRODUCTION

Theoretical considerations precede the design and development of anchoring system. Pre stressing in concrete technology is quite different form reinforced concrete in the sense that technologically both are in divergent mode. Pre-stressing is the application of a predetermined force or moment to an element in structures such that combined internal stresses resulting from applied force or moment and positive from external loads will be within specific limits and hence section is entirely compressive. Wires or strands, that is TENDONS are stressed between two anchorages. In fact structural behavior of RCC. and Pre-stressed concrete totally separate. While steel is an integral part in RCC. steel stressing. Bond between steel and concrete plays an important part in RCC. and tension in steel develops when concrete begins to crack and during cracking strains of concrete are transferred to steel through bond. In Pre-stressing bond between steel and concrete does not exist, that is stress in steel does not depend on strain in concrete. Stress in steel varies with bending moment along the length of beam in RCC. whereas there is no variation in stress in steel along the length of beam in Pre-stressing, giving anchoring a less complex analysis. Crack control in RCC. is a problem so much so that stress in steel should be limited. In Pre-stressing with the inclusion of anchoring crack control is not difficult. There is no need to limit stress in steel. The phenomenon of steel acting as tension flange of a beam analogous to section is a part of RCC. Otherwise steel does not act as a tension flange in pre-stressed concrete giving rise to actual and not ambiguous analysis of anchors.



Post-tensioning Pre-stress diagram

REVIEW OF LITERATURE

The design and development of anchoring mechanisms are a function of pre-stressing perfection the compression and takes part in resisting moments. There is no corrosion of steel and sections are much smaller. Self weight is reduced because anchors also do not add to self weight of structural elements, This saves cost of foundations which have to bear less loads.
According to **IS 1343 (1980)** anchoring devices may add to a smaller section of disadvantages along with high strength concrete and steel as well as skilled labor, yet there is an overall economy in using pre-stressed concrete because decrease in member sections results in decrease in design loads, Economical structure and foundations. The only common items in RCC. and pre-stressing are materials – concrete and steel, but anchors need high strength tendons to establish compressive stresses in all sections. FRP reinforcement can have advantage over steel in being lighter in weight, higher in tensile capacity, more resistance to corrosion and electromagnetically transparent. Several manufacturing methods are available for fabrication of FRP reinforcement for concrete. For rod and grid type reinforcement, pultrusion and braiding are the most commonly used manufacturing methods because of low cost, high quality and efficient fiber orientation. Flat or round FRP rods come in a variety of surface shapes, E.g. Dimpled, Indented or Coated with sand in order to provide better bonding with concrete.

Taerwe et. al. (1992) has considered that concrete is conventionally reinforced with steel bars and tendons. It is well known that the deterioration of concrete structures can mostly be attributed to corrosion of the reinforcing steel. This results from exposure to environments high in moisture and chlorides. Chlorides come from sources such as sea water or de-icing salts used in the winter time on bridges and parking garages.

Coating the steel reinforcement with a layer of epoxy has been the most common method of several practices used for controlling corrosion some recent failures have left doubts about the dependability of epoxy coating protection. Galvanizing of steel reinforcement, another form of protective coating, is suspected of un satisfactory protection in chloride contaminated concrete, of impairing steel to concrete bonding & of causing hydrogen embritalment of pre-stressing tendons.

Nanny et.al. (1996) concluded that ultimate load capacity is generally controlled by the anchor rather than the tendon itself, suggesting that anchor efficiency can be improved. It is explained that the three classes of anchor systems (That is wedge, resin potted and spike) offer advantages and disadvantages. The degree of complicity in terms of installation procedure varies for wedge type anchors, dry lubrication and sand coating on the two faces of the wedges are helpful. Protection of the tendon can be attained with a sleeve. High temperature did not adversely affect the performance of the system tested. Wedge anchor systems are suitable for pre-tensioning application. Spike anchors if used with dry fiber ropes may work relatively well. This system requires the longest setup time resulting from the combination of removal of the plastic sheath, combing and spreading of the individual fibers and proper placement of the spike with a uniform distribution of fibers all around it.

For wedge anchors, grit should be present on the wedge surface to ensure proper gripping of the tendons. When comparing carbon stress tendons with Arapree tendons both of which utilize plastic wedges, the carbon stress system with applied grit does not show the slippage of the untreated Arapree wedges. For resin/Grout Potted anchors, failure may be due to pull-out of the tendon from the resin/Grout anchor without rapture of the tendon however parabolic system may show shifting and erecting of the resin plugs. The plotted anchors are by for the easiest to setup for testing when pre-installed. The practical drawbacks include pre-cutting the tendons to length and curing time for the resin/Grout.

Lin & Ned (2001) assert that in pre- tensioning, anchoring mechanism is not integral working part of structural element. However at the construction stage and/or manufacturing of pre-tensioning members, tendons are stretched by jacks and anchored at the ends. After concrete has set and hardened, the tendons are separated from anchors thereby imposing pre-stressing in the beam or structural elements. The system consists of two bulk heads anchored against the ends of a stressing bed. The tendons are pulled between the two bulk heads. A pre-stressing bed is used for casting usual units and possibly shorter units. It supports vertical reactions due to which pre-stressing of bent cables can be done. Hoyer system shall be analyzed. The anchoring devices for holding pre-tensioning strands to the bulkheads remain on the wedge and friction principle. One common device consists of a split cone wedge, which is made from a tapered conical pin. The existing tapered conical pin is drilled axially and tapped & then cut in half longitudinally to form pair of wedges. The anchoring block has a conical hole in which tapered conical pin holes are strands. These grips can be used for single wires as well as for twisted wire strands. Alternately the pin is not drilled, but is cut in half longitudinally and the flat surface is machined and serrated. As a third option, quick release grips which are more complicated and costly, are used especially when wires are to be held in tension only for short periods. Another method, under study is to add mechanical end anchorages to the pre-tensioned wires. Dorland anchorage, consisting of clips, can be gripped to the tendons under high pressure and the edges of the clips can then be welded together at several points. In such mechanical anchorages, tendons of greater diameter can be permitted. In post-tensioning systems, mechanical pre-stressing, electrical pre-stressing by application of thermal energy and chemical post-stressing by using expanding cement shall be the part of research.

METHODOLOGY / LABORATORY WORK

Some of the systems shall be studied, analyzed and verified in efficiency and strength so that minimum pre-stress losses occur. The first anchoring system FREYSSINET had quite useful advantages and yet needed improvement and / or additions and deletions. Other systems under study shall be Magnel Blaton, Gifford Udall (with two types of anchoring-plate anchorage and tube anchorage), PSC Mono wire system & Lee Mecall systems. Electric pre-stressing shall be experimented in which bars shall be stretched by means of heating using electrical energy. It shall be considered as a transition from RCC. to pre-stressing. Chemically pre-stressing or self stressing shall be experimented in which self stressing cement shall be used that expands chemically after setting and during hardening. Finally comprehension of theoretical nature of pre-stressing anchoring technology which is a significant part can be analyzed on rational basis and critical study of the existing devises modification there of as well as attempt towards development of better and efficient mechanisms will be a purposeful possibility. Role of welding shall be attempted and highlighted practically for strong grips.

Advantage of pre-stress concrete over RCC:

- Complete section comes into play hence, In Pre-stressing requires, small section for loading.
- The shear resistance of a section is increased.
- The Pre-stressed member, gives more resistance to frutigue, impact and vibrations.

Electrical pre-stressing:

This is modern type of pre-stressing. We use electricity for working of Anchoring device system. It is introduced by Biller & Carlson. For post-tensioning we use sulphar coating to cause duct material while casting with concrete. When electric current is passed through the tendons it get heated up and sulphar coating gets melted. The tendons made up of high strength alloy ends as threaded & Nuted. With tightening them the section achieves anchoring.

PRACTICAL APPROACH

We tuck for Fe-410 steel bar – 8mm dia.
It has properties between cast iron and wrought iron. It is due to this property of getting hardened and tempered, and also, have 0.1%-1.1% of carbon. It has granular like structure.
It has sp.Gr.7.85 also, with melting point between 1300^0 to 1400^0Centigrade.
The ultimate compressive strength it has 180-350 MPa. & ultimate tensile strength is 310-700 MPa.
It is tough, malleable and ductile in nature.
The coat thickness of sulphar material, which forms a duct in to the beam, provided on steel bars, considered to be 0.5mm.of thickness.
Mould may be made up of wood/steel is used to cast a beam by concrete with sulpher coated steel bars. The mould used is shown in figure below having dimensions 420x150x150 mm. cube.
M15 Grade concrete, with ratio1:2:4 is prepared of required strength then it is allowed to fill the mould to cast required beam section. After 24 hours it gets hardens and taken out from the mould &cured for 7- days. The casted beam required is two for our experiment of same dimensions. The prepared beam as figured below-
Now the base plate on both ends of beam is placed. Electric current is passed so that coating is malted & at bars nuts are tightened at both sides so that required anchoring purpose is solved.

FIGURE:- Beam with sulphur coated steel bar

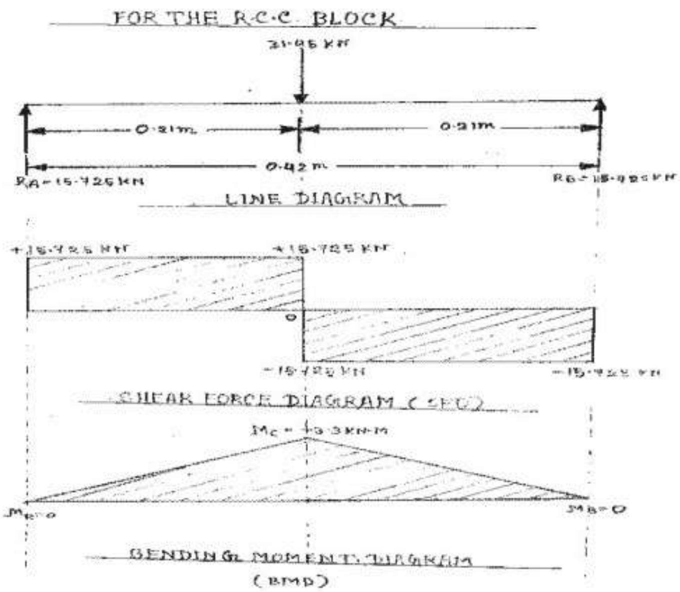
FIGURE: Transverse test on pre-stress beam

FIGURE: Transverse test on RCC beam

Figure- Shows "Universal Testing Machine" With Plotter & Hydraulic Load Dial.

RESULT

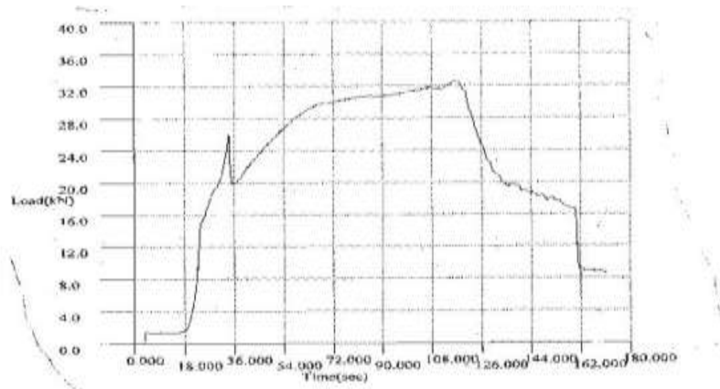
The Peak load for Pre-stress beam = 32.50 KN.
The Peak load for RCC beam = 31.45 KN.



Heat generated in the beam section is 170^0 C which causes, sulpher melted & bars get, elongated, at this time we will tighten the nuts by using mechanical tools. Some losses will occur in Beam section after anchoring been done hence it needs 24 hours for further test . Now considering beam as simply supported & using UTM (Universal Testing Machine) as for calculation of bending moment. This process is applied for both the conditions that is flat &Transverse so that graphs may be made for both the conditions. Under UTM the distance between supports is fixed. Width, Thickness & Crosshead Travel is first found then Peak Load, Cross Head Travel at Peak &Transverse strength is found. Plotter attached with UTM machine draw complete graph till start to specimen break.

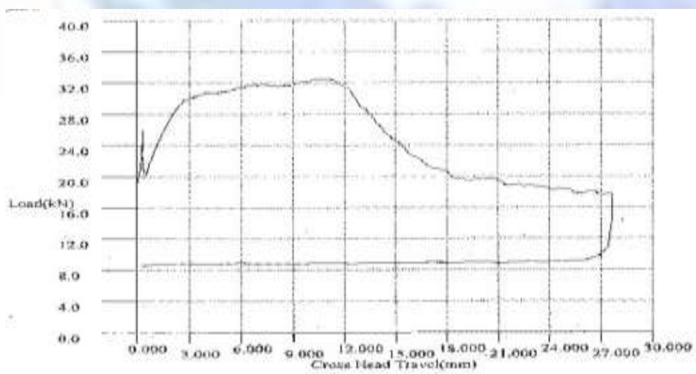
Transverse Test Report is as under:

1)
Machine Model : TUE-C-1000.
Machine Serial No. : 2009/50
File name : A4, CIVIL, UTM.
Material Type : RCC Beam 1 (Pre-stress)
Distance between
Supports : 420.00 mm
Width : 150.00 mm
Thickness : 250.00 mm
Max. Cross head
Travel : 250.00 mm
Peak Load : 32.50 KN.
Cross head Travel
at Peak : 11.20 mm
Transverse strength :06.07 N/mm^2



Transverse Test Report is as under:

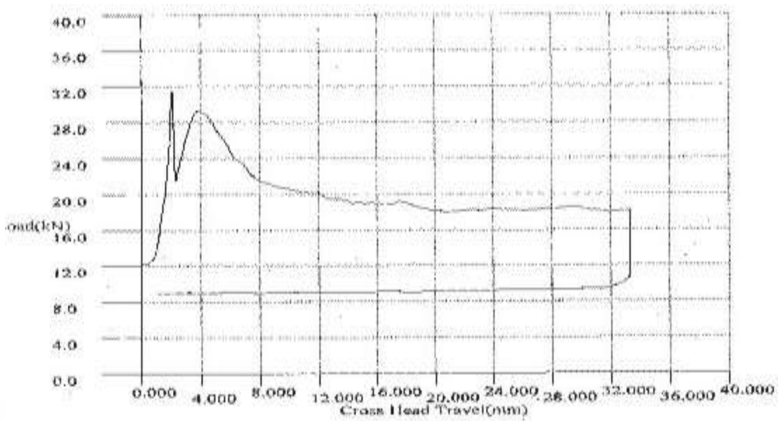
2)
Machine Model : TUE-C-1000.
Machine Serial No. : 2009/50
File name : A4, CIVIL, UTM.
Material Type : RCC Beam 2 (Pre-stress)
Distance between
Support : 420.00 mm
Width : 150.00 mm
Thickness : 250.00 mm
Max. Cross head
Travel : 250.00 mm
Peak Load : 32.50 KN.
Cross head Travel
at Peak : 11.20 mm
Transverse strength :06.07 N/mm^2



Transverse Test Report is as under:

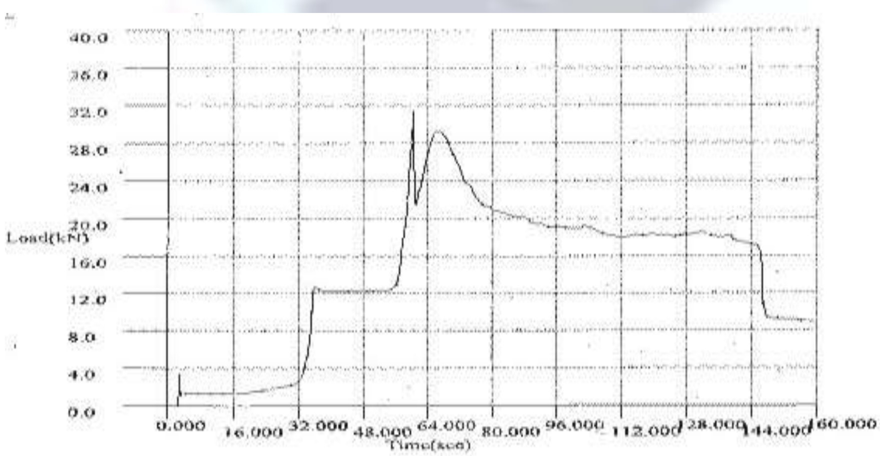
3)
Machine Model : TUE-C-1000.
Machine Serial No. : 2009/50
File name : A4, CIVIL, UTM.
Material Type : RCC Beam 3
Distance between
Support : 420.00 mm
Width : 150.00 mm
Thickness : 250.00 mm

Max. Cross head
Travel : 250.00 mm
Peak Load : 31.45 KN.
Cross head Travel
at Peak : 2.20 mm
Transverse strength :05.87 N/mm^2



Transverse Test Report is as under:

4)
Machine Model : TUE-C-1000.
Machine Serial No. : 2009/50
File name : A4, CIVIL, UTM.
Material Type : RCC Beam 4
Distance between
Support : 420.00 mm
Width : 150.00 mm
Thickness : 250.00 mm
Max. Cross head
Travel : 250.00 mm
Peak Load : 31.45 KN.
Cross head Travel
at Peak : 2.20 mm
Transverse strength :05.87 N/mm^2



CONCLUSION

We concluded from study of that, pre stressed concrete anchoring devices could be greatly adopted by the civil engineering. As all process of pre stressed concrete helped us very much in understanding the working mechanism of the system & many tools available for performance of structure called anchoring devices, Further we understood that structures by pre stress are more reliable, strong enough & reduced in size as compared to RCC sections . Hence we can noticed that, by use of anchoring devices better concrete structures can be achieved, also pre- stressed beam can take more load then is taken by RCC beam. It is one of the simplest method for anchoring the beam at cheaper rate because it can be economically produced. High strength alloy steel can be used for applying prestressing concrete. The structure may adopt, by applying this method effectively. The best way for pre stress producing in tendon may be used.

RECOMMENDATIONS

As we knew about the methods of pre stressing i.e. pre & post tensioning systems are better effective in their respective fields but the post-tensioning system has less loss then the other system of pre-tensioning in pre stressing. The reliability and accuracy of anchoring device meet the requirement of design &specifications. High strength alloy steel can be used for applying prestressing concrete. The structure may adopt, by applying this method effectively.

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