STRUCTURAL ENGINEERING

QUARTERLY JOURNAL OF

INDIAN SOCIETY
OF
STRUCTURAL ENGINEERS

ISSE

VOLUME 11-3

Jul-Aug-Sep - 2009

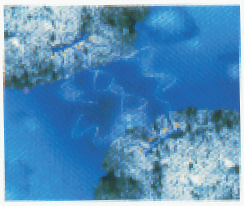
CONSTRUCTION OF LONGEST RAILWAY BRIDGE AT COCHIN

(See page 4 inside)

LET US BUILD A STRONG STRUCTURE OF INDIAN SOCIETY

CONSTRUCTION CHEMICALS

Latest technologies from the No. 1 in the world



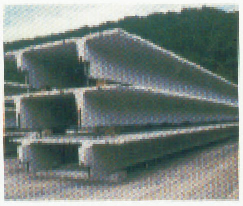
GLENIUM™ sureTEC
Total Performance Control™ in Ready mix concrete

PROTECTOSIL® CIT
Total control of corrosion in concrete structures

MASTERPREN® PVC
Un-bonded PVC membranes for watertight basements

MASTERFLEX™ 900
Re-injecable hose for watertight construction joints

UCRETE®
World's toughest floors made from PU Concrete

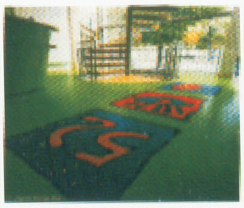


GLENIUM™ ACE
Precast concrete with Zero Energy System™

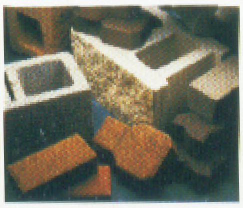
CONIROOF™
Spray applied refurbishment to leaking roof waterproofing

CONIDECK™
Park deck protection system based on flexible PU systems

MASTERPREN® TPO
preformed membranes for watertight roofing



MASTERTOP™
Range of designer & decorative flooring surfaces



RheoFIT™
Admixtures for Manufactured concrete products

MBrace® FRP
FRP composites for strengthening of structures

The construction chemicals division of the BASF group is the world's largest provider of construction chemicals products, systems and services for new construction, repairs and renovation. The product range consists of admixtures for concrete & mortars, Industrial & decorative flooring surfaces, protective coatings for concrete & facades, tile adhesives, repairs & strengthening, precision grouts, sealants & adhesives, expansion joints and watertight systems for roofing & basements. The division also specialize in underground construction products & solutions for shotcrete, waterproofing, injection, soil conditioning, rock support and fire proofing. Please call us to discover the latest range of construction chemicals

BASF Construction Chemicals (India) Pvt. Limited
C-68, Turbhe MIDC, Mumbai - 400 613 India
Phone: +91 22 4157 7777 Fax:2761 9242 email: basfcc@vsnl.net

BASF
The Chemical Company

www.basf-cc.co.in

STRUCTURAL ENGINEERING

QUARTERLY JOURNAL OF

INDIAN SOCIETY OF STRUCTURAL ENGINEERS

ISSE

VOLUME 11-3, JUL-AUG-SEP 2009

● E-mail : issemumbai@gmail.com ● Website : www.isse.org.in

FOR PRIVATE CIRCULATION ONLY

Head Office : C/O. S G Dharmadhikari, 24, Pandit Nivas, 3rd Floor, S K Bole Marg
Dadar (W), Mumbai - 400 028 ● Tel. 91-22 24365240 ● Fax . 91-22 -2422 4096

Regd. Office : The Maharashtra Executor & Trustee Co. Ltd., Bank of Maharashtra, Gadkari Chowk
Gokhale Road (N), Dadar, Mumbai - 400 028

Charity Commissioner Reg. No. E 17940, Mumbai   Donations are exempted from Income Tax under 80-G

The contents of this journal reflect the views of the respective authors and contributors and do not necessarily reflect the views of ISSE. ISSE is not liable for any damage or inconvenience directly or indirectly caused to anyone who may have acted on the information contained in the journal.

Contents

Editor : N K Bhattacharyya
Jt. Editor : Hemant Vadalkar

Fraternity News

WELCOME NEW MEMBERS

(Jul-Aug-Sept 2009)

LIFE MEMBERS

M-947	Kolakkadan Mohammed H.	M-948	Chittarivenkata Shyah Prasad V.
M-949	Vengurlekar Sharad	M-950	Bambole Abhay Namdeorao
M-951	Vaidya Pranesh D.	M-952	Patel Ashishkumar J.
M-953	Jaisinghani Girdharlal K.	M-954	Junnare Kaustubh Ramesh
M-955	Kalawar Sucheta Milind	M-977	Sayyad Sumir Musa
M-978	Mehta Ravindra D.	M-979	Kakarla Ratnakar
M-987	Velayudham Chandran	M-988	D. Srinivasan
M-989	Ravindra R.	M-990	Dubey Rajesh B.
M-991	Naik Vivek Govind	M-992	Kolte Jyoti D.

ORGANISATION MEMBER

OM-15	Soft Tech Engineers (P) Ltd.	OM-16	Outokumpu India Pvt. Ltd.

REVISED STRENGTH AS ON 30-6-2009

Members : 992 Organisation Members : 16 Junior Members : 9

Patrons : 29 Sponsors : 8

TOTAL STRENGTH : 1054

OUR INTENTIONS

1. To restore the desired status to the Structural Engineer in construction industry and to create awareness about the profession.
2. To define Boundaries of Responsibilities of Structural Engineer, commensurate with remuneration.
3. To get easy registration with Governments, Corporations and similar organisations all over India, for our members.
4. To reformulate Certification policies adopted by various authorities, to remove anomalies.
5. To convince all Govt. & Semi Govt. bodies for directly engaging Structural Engineer for his services.
6. To disseminate information in various fields of Structural Engineering, to all members.

FIELDS CONSIDERED AS ASPECTS OF STRUCTURAL ENGINEERING

- Structural Designing & Detailing
- Computer Software
- Materials Technology, Ferrocement
- Teaching, Research & Development
- Rehabilitation of Structures
- Construction Technology & Management
- Geo-Tech & Foundation Engineering
- Environmental Engineering
- Non Destructive Testing
- Bridge Engineering

& Other related branches

ISSE Publications

Title	Donation Rs.
Publications :	
• Design of Reinforced Concrete Structures for Earthquake Resistance	800
• Professional Services by Structural Design Consultant - Manual for Practice	200
Proceedings :	
• National Conference on Corrosion Controlled Structure in New Millenium	400
• Workshop on ISO-9001 for Construction Industry	200
• Brain Storming Session on Use of Speciality Products in Structures	250
• Workshop on Software Tools for Structural Design of Buildings with CD	550
• Workshop on Structural Audit	200
• Workshop on-Seismic Design of Building	200
• Workshop on Effective Use of Structural Software.	200
• Workshop on Effective Use of Structural Software - CD	150
• Workshop on Shear Walls in Highrise Buildings	200
• Seminar on Innovative Repair Materials / Chemicals	250
• Seminar on Foundations for Highrise Buildings	200
• Seminar on Structural Detailing in RCC Buildings	250

(The above volumes are available at ISSE Head Office)

BE AN ISSE AUTHOR

Articles and technical papers are the heart of a technical journal. We invite you to write technical articles and papers for publication in the ISSE Journal. You may write about:

- An innovative concept or approach
- Proposed theoretical, computational or practical improvement on an existing concept
- An experimental study
- Guidelines and standards developed
- Compilation of rare/scattered information on the latest technological advances
- A case study: Challenges in design and construction
- Your viewpoint on current professional practices

While submitting your article for publication, please follow the guidelines given below:

- Page size: A4, Top, Bottom, Left and Right margins: 1”, Font: Arial, 10 pt
- Max length of article: 5 pages including tables and figures
- The manuscript should contain the title of article and names, qualifications, designations, addresses and email addresses of the authors.
- The matter should be relevant to the subject and should be organized in a logical flow. It may be divided into sections and sub-sections, if necessary.
- While, sketches and drawings should preferably be in Corel-draw, other appropriate formats are also acceptable. Photographs should be sharp and clear.
- Figures, photographs and tables should be numbered and should have captions.
- Notations, if used, should be clearly defined.
- Article should be sent by email to isse@vsnl.net with a copy to mail@technoesis.co.in

Articles may be reviewed and suitably edited before publication.

CONSTRUCTION OF LONGEST RAILWAY BRIDGE AT COCHIN

Vivek G. Abhyankar

Abstract :

A Technical report on the Construction of Longest Railway Bridge at Cochin by M/s AFCONS Infrastructure limited erstwhile Asia Foundation Construction Company Ltd., and Rodio-Hazarat Company for Railway Vikas Nigam Limited (RVNL). Various problems faced during construction and the creative solution thereof were devised by the project team.

Key Words :

Bridge, Auto launching, Launching Girder, PSC Girder, U-Trough, Casting yard, casting bed, stacking bed, kinematics, anchoring, DCPT

General :

Cochin is an important city in the state of Kerala, nicely developed by the continuous efforts of the state and central government. Rapid infrastructure development is now taking place in Cochin. AFCONS has completed many projects in the past in Cochin including bridges, jetties etc. Rail Vikas Nigam Limited, a Government undertaking under the Ministry of Railways, wanted to construct a cross railway line to connect two places 'Idapalli' and 'Vallarpadam'. The length of total railway line is about 4.62km, of which 3kms are passing over a creak. AFCONS, with experience in marine constructions and familiarity with Cochin and its sub soil condition, did this longest railway bridge in a record time with quality. RVNL issued a certificate of appreciation for the quality. But during actual construction of the project, AFCONS came across many technical / non technical hurdles which were resolved with ingenious solution described in this article.

Media Report (part of article published in 'Construction Week' dt 1st Nov'09) :

This 4.62 Km long railway bridge is almost complete and waiting for the commissioning ceremony. It is connecting the mainland to the proposed international container transshipment terminal (ICTT) on Vallarpadam Island across the picturesque Vembanad Lake. This will be the longest rail bridge in India surpassing the currently held record by the Nehru Setu Bridge near Dehri on the river Sone located on the Kolkata – Delhi Line. The Nehru Setu is 3.065 Km long. This project being very crucial for commissioning the operations of ICTT and is being monitored closely by the Prime Minister's Office (PMO) for meeting the ambitious tight time schedule. In spite of initial time delays on account of land acquisition by the state authorities, RVNL is confident of completing the railway link ahead of schedule as their main contractor, AFCONS is well geared up and doing an excellent job.

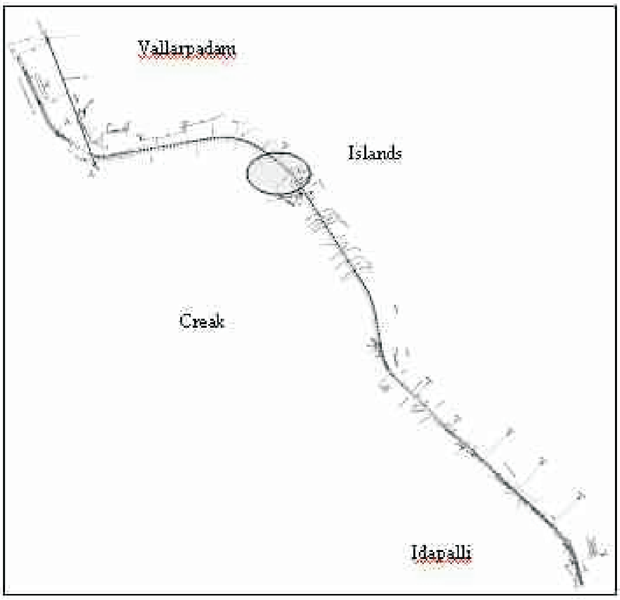


Fig 1. Bridge Alignment of RVNL Rail Bridge.

The bridge would create a record of longest railway bridge so far constructed in India and construction of such a bridge in shortest time period of less than 30 months. The speedy construction is possible with deployment of latest equipments into the project by AFCONS and the freedom given by the RVNL in selection of innovative technical proposals. The highly sophisticated beam launcher equipment used for launching the pre-cast superstructure (concrete beams) was specially designed and imported for this project. It is capable of launching 12 spans in a month covering 600 mts length of the bridge. With modern technology of pumping of concrete for a length of 1800m., a lot of time was saved as there was no easy access to most of the bridge foundation locations.

The total estimated cost was about Rs. 300 crore. The bridge, made up of 134 pillars which are supported on pile foundation. Depths of piles varied between 45m to 55m. About 50,000 tonnes of cement and 18,000 metric tones of steel had gone into the structure. The ambitious ICTT project, is expected to save exporters of crores of rupees “wasted” in transshipment of their goods through other ports. The project is set to transform the industrial environment in the state.This rail link is throwing up spurt of major projects in the area viz a Rs. 1,600 Crore LNG terminal, a port based Special Economic Zone, International Ship Repair Complex, Single Body Moorings for Kochi Refineries Ltd., Petro Chemical Complex for Gas Authority of India, International bunkering terminal, Bulk cargo terminals, Cruise ship terminals and an international marina

Construction Challenges :

A) Casting yard on very weak soil :

Cochin being on the costal line has extremely weak soil strata of top 45 to 50m depth consisting of weak clays. This made the project construction challenging. Initially the casting yard required for the pre-casting operation of the PSC girders was planned to be designed with the bored concrete cast-in-situ piles. Because, the safe bearing capacity of soil available at the ground level was about 3-5T/sqm, with higher level of ground water table. During preliminary design, it was noticed that the higher loads on piles were demanding larger pile depth, resulting increase of self weight of piles. Hence additional extra pile length was required. Geotechnical data available was in the form of DCPT (Dynamic cone penetration test), which when converted to SPT values indicated very poor strata (N=5 to 10). After preliminary exercise, it was decided to scrap the proposal of using piles, and to use isolated footing with wider base mats. The ground improvement techniques could help to modify the low SBC from 5 to 10T/sqm. Use of 'Stone columns' to allow consolidation of soil, improving the bearing capacity of soil was initially thought of. But cost and tight project schedule of time available for installation works discouraged use of stone column. Hence only traditional method of soil replacement was possible. Except the rainy season, the GWT gets lowered and clay gets dried and hardened, leading to temporary high SBC.But it is not fully reliable.

The special electrically operated trolley to carry PSC girder was designed considering the lower SBC of soil to transfer the load of PSC girders to ground safely. Fig. 5 and 6 show Precast Post-Tensioned U-Trough girder (20m Long), in loaded position on motorized trolley and the Casting Yard, EOT and girder handling in progress, wherein the various Electromechanical units as described are clearly seen. M/s Hebencraft made the trolley as per the project requirements of Afcons (10T/m)

With very low SBC, expected settlements were also high. This problem was tackled by employing a team of dedicated supervisors to keep a watch on the movement and provide the track with shim / packing plates, whenever needed. The original design, proposed by the client had 600MT single box girder, which demanded higher value of SBC. Also the auto launching of such a heavy and huge box girder was not advisable in open windy alignment. This problem was resolved by the team members by re-designing the span as twin-PSC I Girders, each weighing around 260MT. Thus the requirement of SBC was reduced to less than 50% of that required. The matter was presented to RVNL for their approval, and with their approval the work was done easily.

B) Foundations

It was a huge challenge to construct the pile foundations for the piers along the 3 KM alignment. It was necessary to construct the piles on marshy land and in the creek.

The Abutment had two groups of piles each group consisting of six piles. All RCC piers had two groups of piles each group consisting of four piles. One group of pile was designed to support the present bridge alignment, whereas the additional group of pile was constructed as per the contractual requirements to support the future rail track, adjacent to the present alignment. All the piles were bored cast in site RCC piles of 1.2m diameter and about 50m depth below the creak bed level. The piles in each group were spaced at 3.60m distance. All the piles were driven by driving a steel liner up to stable depth.

The piles were driven using rigs mounted on pontoons. During pile driving, the stability of pontoons was ensured by three ship-anchors driven at about 120deg angle. As the area is of backwaters, the tidal variations are very less at Vallarpadam area (about 500mm only). Hence, the water is almost stagnant. In addition to this, a temporary soil bunt was built from either sides of the land to access the required spans. This further reduced the velocity of water.

The alignment was passing through the islands. At these places, the land was found to be marshy and pile driving with the pontoon was not possible. At such places, soil filling was done to create working surface, and routine 'Land piling' was done using tripod.

AFCONS being versatile in marine construction works could complete the piling activity within the schedule.

C) Launching of the girders :

Further problems were faced while planning and designing the Girder-Launching system. The curvature of the bridge being large (varying from 350m to 800m), the launching system was required to be designed to cater for deviation of about 14 to 20 degrees. There were 5 such curves in the entire alignments. Also the girder to be launched were of two types – namely 20m Long x 7m wide x 1.8m deep PSC U-trough girders and 40m long x 1.4m wide x 2.775m deep PSC 'I' girder. A central pinion arrangement and all the electromechanical devices (viz. rollers, winches, suspension unit, LG legs etc.) were to be designed to cater for such high curvatures. Then it was decided to refer to an expert on this problem. M/s NRS Asia was most competitive to give prompt and effective solution to this problem. The auto Launching Machine (launching girder – LG) supplied by NRS is shown in Fig. 11 and 12. This machine could smoothly erect all the spans of the bridge.

As mentioned above, it was planned to construct the bridge only with 40m Long 'T' girders. But after initial surveys, it was noticed that the water levels being high, if the 'T' girder is used, the bearing of initial few span may get submerged during high tide. This gave a jerk to entire planning and hence Initial few spans had to be converted into 20m-U trough of lesser depth.

As the 'Start of the Bridge' i.e. abutment 'A1' on Edapalli side, is covered with thick population, the construction was decided to be started from abutment 'A2' i.e. 'Vallarpadam' end. It was noticed that a busy road just crosses the alignment near A2. This demanded relocation of abutment. A bare land was allotted to install 'Casting Yard' on this side opposite to the road. This demanded the Girders to be launched crossing busy traffic. It was not possible during day time. Hence launching of girders had to be performed in night time only.

The widths of the supports of Auto-Launching machine were so designed to facilitate the erection of even a 7m wide U-Trough girder comfortably. The front and the rear leg were the main load carrying members fitted with two additional auxiliary supports. During launching operations for stability purpose, the LG legs had to be anchored to the pier with the help of HT bras. The reaction of Bridge Launcher (LG) on erected spans had also to be restricted so that the maximum design BM and SF are not exceeded at any stage.

D) Construction Details :

1) Concrete mix.

The grade of concrete used for piles was M50 and for the super-structure was M40. The concrete mix was designed by the in-house QAQC team of AFCONS and the continuous concrete supply was ensured by batching plants located near the casting yards.

2) Shuttering

The steel formwork was detailed by Design team of Afcons. The same was used at site for construction pile-caps, piers and the PSC girders also. The shuttering for pile cap was supported on the pile liners using friction clamps and wedges. The PSC 40m 'I' girders and the 20m 'U-Trough' girders were provided with movable formwork to save the construction time. The movable formwork was supported on rails and turn-buckles.

3) PSC Girders

The design of 20m 'U trough' girder was provided by the consultant and the 40m was provided by AFCONS as per the project requirements.

- The depth of 20m 'U-Trough' girder was 1.8m with the 500mm Thk. base slab. The overall width of this girder was 6.95m. each 20m girder had 14 number of Post tensioning cables. These spans were provide with Neoprene bearings.
- The depth of 40m 'I' girder was 2.7m with 1.4m overall width. Each span of 40m length had two PSC 'I' girders, with a 200mm thk. RCC deck at top. The deck slab was cast in situ. Each 40m girder had total 10 number of Post tensioning cables. Meto bearings were used for these spans.
- The design and construction of curved spans were challenging tasks. But close interaction between site and head office team could complete this task also. After the construction of girder and deck slab, the kerbs / crash barriers were constructed using a Form-traveler, which could render a smooth finish to the structure.

4) Construction sequence

The RVNL rail Bridge was constructed by end-on method i.e. span by span construction starting from one abutment, proceeding towards the other. The abutment A1 is located within the residential area and no space was available. Therefore, construction was started from abutment A2 at Vallarpadam. The required large space for casting yard (about 50m x 200m long) was available only at Vallarpadam end. The first 20 spans from abutment A2 were of 20m length of PSC U-trough type. Further 98 spans of PSC 'I' Girder type were to be erected. Again the last 9 spans were of 20m 'U-trough' girder type.

The erection of these spans was done using a Launching Girder supplied by M/S NRS Asia. The Girders were cast and Post Tensioned in the casting yard itself. Later the finished Girders were loaded on the Motorized Chariot (shown in the Fig 6) using the EOT crane. These chariots and the EOTs were designed and supplied by M/s Hebencraft to match with the project requirements. These trolleys had wheels which were placed on rails. After loading the girders on chariot (specially designed Trolley) they were transported to the desired span of the bridge. After reaching at the desired position the LG picked up the Girder and placed it at desired location. After completing one span in this way the, LG was made to move to the next span using mechanical arrangement design for this purpose. Initially the speed of launching was very slow. But once the project team got familiar with the various steps involved in one cycle of LG, the rest of the spans could be launched in a very less time. As the LG move from one span to the next the rails had to be extended ahead to facilitate the trolleys to reach upto the desired span.

After the LG progressed significantly ahead, the RCC cast-in-situ deck construction was started. To facilitate the movement of girder carrying trolley independent of deck casting operation, the rails were supported on small concrete pedestals, spaced on the top of the girder at designed spacing. The top of these pedestals was required to be flush with the desk slab top. Thus these pedestals got buried inside the deck slab after concreting of deck slab was over, without causing any disturbance to the rails.

The height of trolley was so designed that the Girder loaded on the top of the trolley will not foul with the already erected span (especially when the 7m wide U girder was moved to last few spans over the initial spans of 'U' type.

E) Quantities :

Length – 4.62 KM Railway bridge
Estimated cost – Rs. 300 Crore
Time frame – 30 months
Number of piers –134
Piles – Bored cast in situ 1.2m diameter up to 50m depth.
Cement - 50,000 MT
Steel - 18,000 MT

Acknowledgements : AFCONS Infrastructure limited provided the technical information about the project for the benefit of engineering fraternity.

Author : Vivek G. Abhyankar. Sr. Manager (Design) – AFCONS Infrastructure limited. The author has more than 10 years experience in the design and detailing of various enabling works and the permanent works (RCC and Steel structures). Email : abhy_vivek@yahoo.com

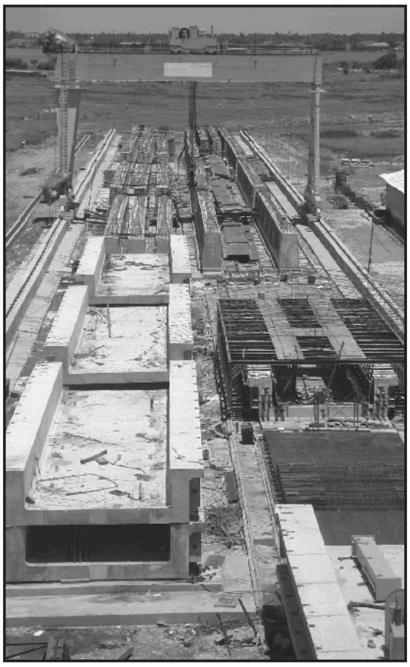


Fig. (1) – Arial view of Casting Yard. The two level stacking of 20m 'U' girder can be observed

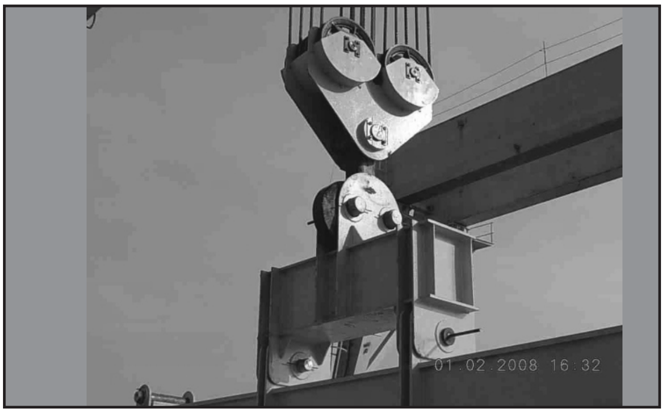


Fig. (4) – Connection between Lifter and EOT hooks

Fig. (2)– The view of two giant EOT used in Casting Yard for handling the Girders

Fig (5) Casting Yard, EOT and girder handling in progress

Fig. (3)– Connection between Girder and the Lifting arrangement

Fig (6). Precast Post-Tensioned U-Trough girder (20m Long), in loaded position on motorized trolley (chariot)

Fig. (7) - Launching Girder at Start of the Bridge

Fig. (8) – Alignment of Bridge

Fig (9) – Arial view on bridge alignment

Fig. (10) – Curvature at start of the bridge can be seen

Fig . (11) Bridge Launching Girder (LG)
used by AFCONS at RVNL bridge

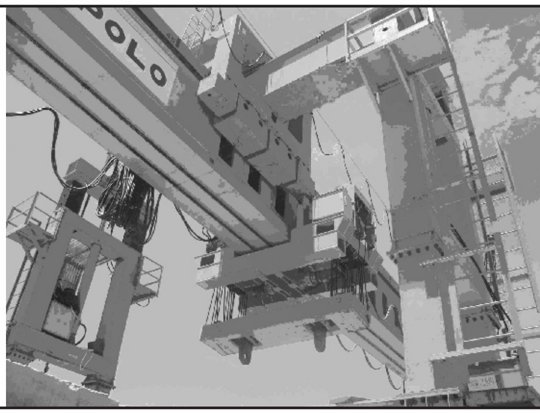


Fig. (12) Closer view on the Lifting Mechanism of the LG

PILE FOUNDATION : QUALITY ASSURANCE

V. V. Nori

Introduction :

Experience shows that variation occurs in cast-in-situ piles because of faulty construction techniques. Unlike concrete in, conventional foundations, concrete in cast-in-situ piles is beyond reach of direct inspection . Both boring and concreting involve operation underground and unless carefully controlled, there exists considerable risk of constructing defective piles.

Construction of cast-in-situ piles involve several operation which are underground . Consequently diligent supervision of experienced personnel is needed to attend to dangers and risks involved in various operations as prerequisite for satisfactory construction of pile foundation. Some are discussed here in.

Sulphate resistant cement are used if subsoil contains soluble sulphate . However , it must be borne in mind that recent experience in middle east has shown that sulphate resistant cement offers poorer resistance to corrosion of reinforcing steel in a chloride rich environment.

Precast concrete piles assure integrity of concrete shaft. and are less vulnerable against chemical attack. Because, concrete gets fully matured by the time it comes in contract with ground water. High grade concrete with protective coatings present no problems in precast piles and are preferable in an aggressive environment. Other methods of quality assurance are same as one would apply to any precast concrete work.

Cast-in-situ bored piles :

Operation involving temporary casings:

A pile bore is made through various types of strata. Some of these may be water bearing and unstable. Since the present economics of construction precludes use of permanent steel liners ,temporary steel liners are frequently used and removed either progressively as the concreting proceeds or at the end of concreting operation . The casing should always be driven ahead of the boring . Otherwise overbreaks may occur as shown in Fig.1. In such a situation as the casing is driven, water filled cavities are formed outside the temporary casing (Fig.2)

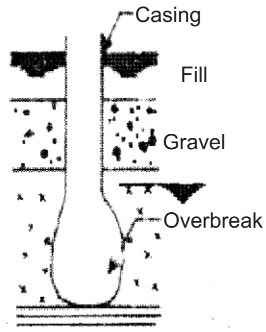


Fig. 1

Over break because of boring ahead of casing

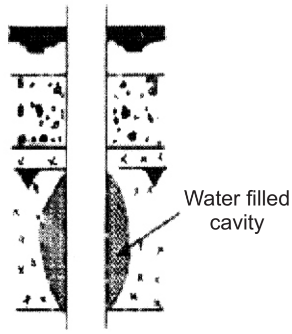


Fig. 2

Water filed cavities outside temporary casing

As the casing is withdrawn , if concrete has a low slump , a temporary stable column of concrete is formed in the region of overbreak. This green concrete disintegrates because of presence of groundwater in the cavity formed by the overbreak, causing necking of the pile as shown in (Fig 3). If the concrete has a high workability , situation is somewhat improved because the free flow of concrete displaces the groundwater in the cavities . Even then, this displaced water gets trapped between the casing and the bore hole ,resulting disintegrating of concrete outside the reinforcement cage.

Even if the cavity caused by overbreak is not filled with groundwater, there is still danger of the cavity collapsing during withdrawal of casing and causing necking of pile due to pressures exerted by sudden collapses. It is therefore very important to ensure that the temporary casing is driven ahead of the pile bore so that no cavities are formed

Joints between temporary casings should be watertight . Normally individual casing pieces are screwed together. However, for diameters larger than 750mm, there is a tendency to use butt joints, connections, being made with the help of four lugs welded on the outer face of the casing (Fig. 4). Such joints may not be watertight ,and permit deposition of significant amounts of fine silt because of percolation of groundwater through thin silt layers

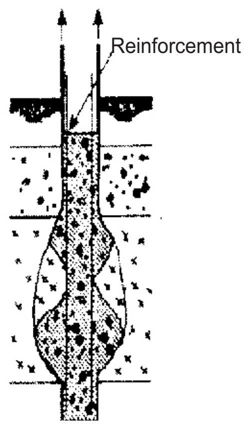


Fig. 3

Necking during withdrawal of casing due to over breaks in the bore

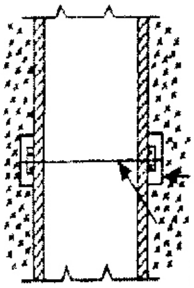


Fig. 4

Joints between casing should be screwed type butt should not be used

Several precautions have to be taken if the temporary casings are removed in stages. Firstly, during unscrewing casing pipes and tremie pipes, concrete operations come to a halt. This increases the duration of concreting ,which is not desirable because concrete tends to stiffen. Stiff concrete tends to arch across the casing causing necking during lifting of casing (fig. 5). It is also very important that inside surfaces of the casing are kept scrupulously clean and free from deformation. Else these defects assist the concrete to arch during lifting of temporary casings .

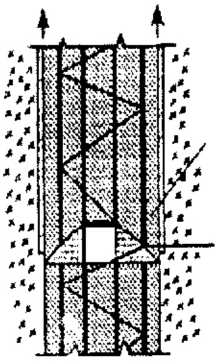


Fig. 5

Necking caused by low slump concrete arching during raising of temporary casing

Stiffening of concrete mixture prevents proper placement of concrete with the tremie pipe. Some available records of large diameter long test piles which failed much before the test load ,show that the concreting time for those piles was as much as 6 to9 hours. Lifting of concrete together with the casing has also been reported in a few of the piles that failed.

Every time a casing is lifted for removal, spot measurements of the level of top of concrete should be recorded and checked . Excessive stiffening of concrete creates large cavities.

It is necessary to ensure that there is adequate head of concrete at all times above the lower tip of the casing so that it may counteract ground water pressure (Fig 6). Even if the concrete is being placed in dry condition , the casing should not be lifted to such an extent that the surrounding soil squeezes the concrete ,causing necking.

As a consequence, possible hazard of specifying deep cut offs of pile foundation for basement should be carefully evaluated especially for piles with temporay casings

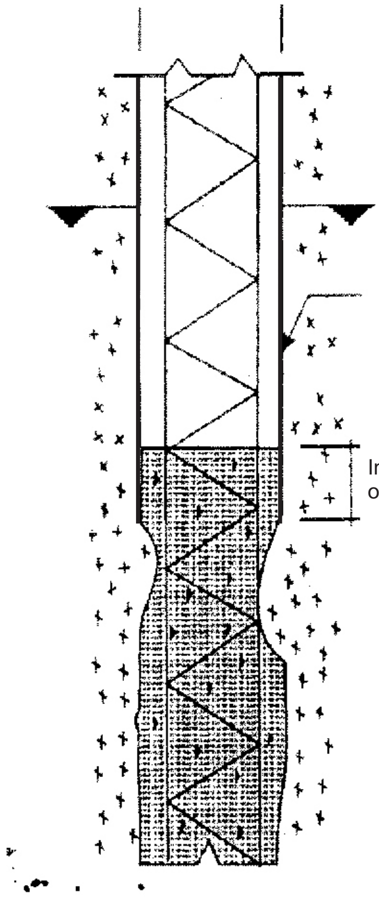


Fig. 6

Necking caused by raising the temporary casing too high

Use of drilling mud :

Use of drilling mud to stabilise the bore is adopted by many piling contractors. Temporary casing is provided only for top 1.5meters ,since this appears to be the only satisfactory manner of preventing side collapse for the top 1 meter or so . Another point is that the level of drilling mud in the bore should be at list 1 to1.5m above groundwater level so that the bore is stable (Fig 7). It is important that no heavy equipment is permitted to move in the vicinity of a bore stabilized by the drilling mud , especially if it is ready for receiving concrete. This could cause side collapses causing contamination of concrete or necking of piles.

Reinforcement :

Reinforcement is normally light in case of piles carrying only vertical loads. However, for piles resisting significant lateral loads, reinforcements are increased. In any case, percentage of main reinforcement should not exceed 1.5%. The clear gap between vertical reinforcing bars should not be less than 80mm center to center. Otherwise congestion of reinforcement hampers free flow of concrete, resulting defective piles. Even when minimum reinforcement is

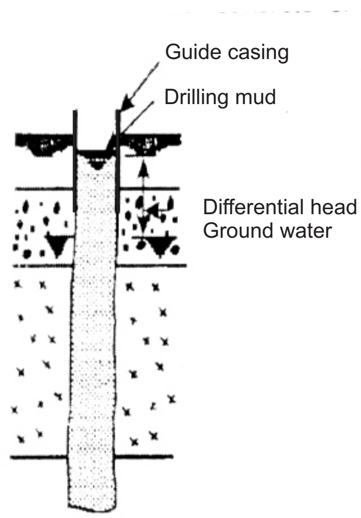


Fig. 7

Drilling mud should counteract grounder water effects

provided it should be fabricated into a cage which is rigid enough to be handled and lowered into the bore without undue deformation. Circular cover blocks placed on the helical reinforcement are very convenient both for lowering the cage as well as for the flow of concrete (Fig. 8)

Workability of concrete

Even if the concrete is placed in a dry bore, techniques for ensuring a sound cast-in-situ concrete shaft are quite different from those for ensuring sound concrete is shuttered column above ground. Not only concrete has to be placed at considerable depths from ground, but also there is no way by which this concrete can be compacted using mechanical vibration. This requires that the concrete should be cohesive having a high workability (minimum slump of 150mm)

If low slump concrete is used, compacting will be poor , and the concrete may not flow out of the reinforcement.While withdrawing the temporary casing a stiff concrete tends to arch across the lift with the casing causing separation cracks and soil intrusion (Fig. 9). If the concrete mix is not cohesive, it will segregate as it travels downward.

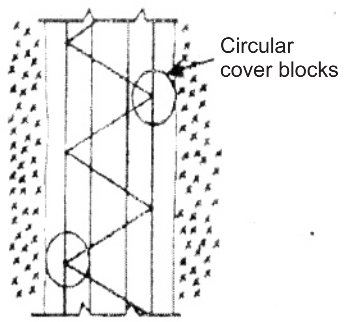


Fig. 8

Circular cover help in lowering and positioning reinforcement cage easily

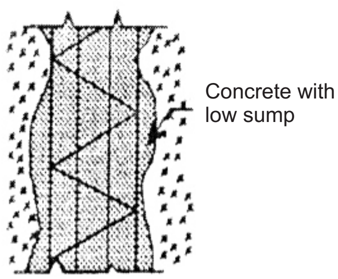


Fig. 9

Defects because of low slump concrete not flowing easily

Placing concrete under water with tremie pipe

The underlying principle or tremie concrete is that concrete bring heavier than water, displaces water upward in the bore (Fig.10). The first obvious requirement is that concrete should have a high workability so that it flows easily (min 150mm slump)

The first batch of concrete which is discharged into the bore gets contaminated with the water in the bore. This batch of concrete acts as a seal and prevent the contamination of subsequent batches of concrete discharged over the first batch. That is why it is important that the tremie pipe should remain continuously buried in concrete.

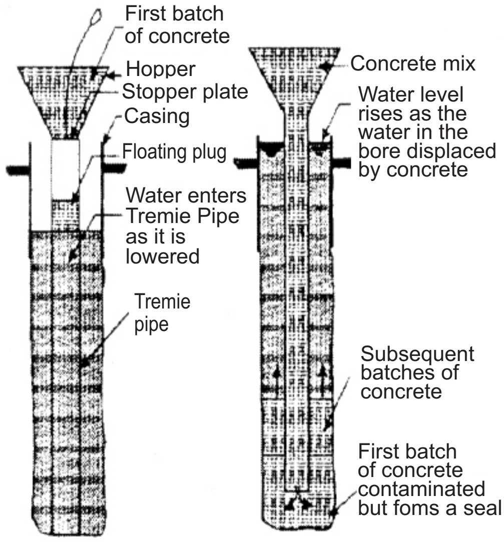


Fig. 10

Tremie concrete

Accidental raising of tremie pipe above the concrete cause the water in the bore to rush into the tremie pipe and seal is destroyed. Pushing the tremie pipe into the concrete and resuming concreting will most certainly trap defective concrete in the pile shaft.

Concrete consumption :

It is normally understood that nominal outer diameter of casing will also be the nominal diameter of the pile since when the casing is withdrawn ,the concrete fills the void created by the casing. However when casing is used only for top few meters (as it happens in case of bores stabilized by drilling mud) and the soil strata is stiff ,the actual diameters may be smaller than the outer diameter of the casing by as much as 50mm. It is therefore a good practice to take spot measurement during concreting of the pile and make comparison of the actual concrete consumption with the expected concrete consumption

It must be noted that it is not enough to check only the total concrete consumption since a smaller volume of concrete in the lower part of the pile may be compensated by larger volume of concrete in the upper part of the pile. It is very important that occurrence of any such unusual phenomena be brought to the notice of the resident engineer for appropriate action

Founding strata:

This is invariably decided based on soil investigation with routine tests. However at site, engineers are called upon to confirm the strata especially when the piles are founded on rock. This is done in the following manner :

* Inspection of rock samples and comparing them with those obtained from the soil investigation
*Conducting standard penetration Tests.
* Observing rate of penetration measured in centimeters per unit chiseling energy input.

A thorough investigation of soil strata before starting any piling work would make process of decision making with regard to the founding strata much easier .

It is necessary to clean the founding strata before commencement of concreting. This is usually done by flushing of bottom of the bore with water or drilling mud as the case may be . Prior to commencement of concreting it is a good practice to record and check with the earlier spot levels of the founding strata taken on termination of chiseling operation .

Cast-in-situ driven piles :

Soil movement :

These piles are also called displacement piles since the process of driving compacts and displaces the surrounding soil . The resulting soil movements may causes damage to previously cast piles . It is therefore very important to plan the sequence of driving and to decide the time intervals between driving piles in the vicinity of previously cast piles.

Lateral and vertical movement of the soil can cause defects in previously cast piles especially if they are green. The tendency of the soil to heave can cause horizontal cracking of adjoining pile.

Selection of shoe :

Normally conical shoes are used for driving the casing. However when driven piles are made to bear on rocky strata ,flat shoes are preferred.

Casing and workability of concrete :

Casings have to be kept scrupulously clean and smooth. Otherwise necking may result during withdrawal of the casing because of tendency of concrete to arch across hard encrustations of protrusions in the casing. The concrete must possess a high workability for ensuring self compaction and the mix must be cohesive. Otherwise it will segregate when dropped into the casing.

Precast concrete piles :

Precast concrete work :

Quality assurance procedures of precast concrete piles are identical to any other precast concrete work. The lifting points have to be decided in advance so that the resulting bending moments are within acceptable limits.

The piles have usually an octagonal cross selection. For pre-bored piles a central grouting pipe is provided. The end is almost flat with grooves to permit passage of grout injected into the central pipe. For driven piles, tube end is pyramidal with high concentration of reinforcement at end to withstand driving stresses .

Prebored piles :

The diameters of the bore is approximately 80mm more than the diameter of the precast pile. Precautions to be taken during the formation of the bore are same as that for the cast-in situ piles. Because of precasting, integrity of the pile shaft is assured . Fresher water is pumped at pressure to clean the bore before lowering the pile on to the bottom.

The pile is lowered into the bore till the tip is approximately 300mm above the bottom of the bore . After aligning the pile into its correct position ,cement sand grout is injected through the central hole. The grouting operation is stopped when the grout start overflowing above the guide casing . If temporary casing are used for forming the bore, these are withdrawn gradually while maintaining the level of grout .

Precast driven piles :

Precautions to be observed during driving of precast piles are somewhat similar to those taken for cast-in-situ driven piles. Because of precasting, damage to the integrity of the piles driven earlier in close proximity is minimized. However corrective steps such as redriving may have to be taken if heaving occurs .

Unnecessarily conservative set criteria may cause severe damage to piles at the bearing points . It is virtually impossible to detect defects caused by excessive hammering . It is better to experiment with different empirical formula in the initial stages and establish a correlation with the wave equation method which appears to have a stronger theoretical basis

General :

Record of actual pile location ,pile length , depth of founding strata etc. have to be maintained very systematically and reported to the design engineers. Pile eccentricities may require redesign of pile caps, introduction of tie beams etc. Frequently any additional costs incurred as a result of misalignment of piles are to be borne by the pilling contractor.

When specifying deep cut-offs as in the case of basement , the pile locations have to be rechecked and confirmed after carrying out the excavation for basement . There have been instances where pile eccentricities at the basement level were found be totally different from what was recorded at the ground level.

References :

1 Thornburn S. and Thornburn J Q : Reviews of problems associated with construction of cast - in - place concrete piles DOE and CIRIA Piling Develpoment Group Report Pg2

2 Seminar on Pile Foundations Corrosing, Detailing and Ground Anchors, ING-IABASE, Madras 1979.

3 Tomlinson M. Pile Design and Construction Practice. Third Edition - A Viewpoint Publication.

Authore : Dr. V. V. Nori is the senior most Structural Engineer & Chairman of M/s Shirish Patel & Associates Consultant Pvt. Ltd. Email : nori@spacpl.com

TALL BUILDINGS AND THE PROP-CANTILEVER EFFECT

Satish Jain

Introduction: The skyline of today's big cities is changing with upcoming tall and sleek building towers resembling the classical slender cantilever beam standing upright and subjected to lateral forces. It isn't just the look but structural systems like shearwall cores in today's skyscrapers do behave like true cantilevers (See Fig.1).

With sky-scrapers comes the demand for huge parking space and other building utilities. Such spaces are now more commonly provided with deep basements. These basements themselves may be over five stories deep.

A close cousin of the cantilever is the propped cantilever. Imagine moving the prop-support much closer to the fixed support and compare it to the tower with a basement. Now you have a tower that not-only looks like a propped-cantilever but we will find that it behaves like one as well (See Fig 2 & 3.)

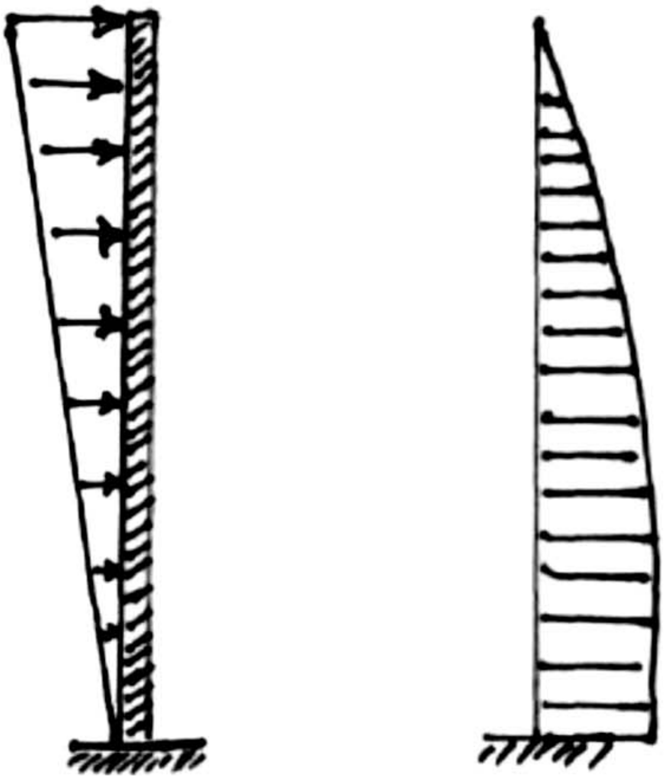


Figure 1: Cantilever tower with triangular lateral loading and shear force diagram.

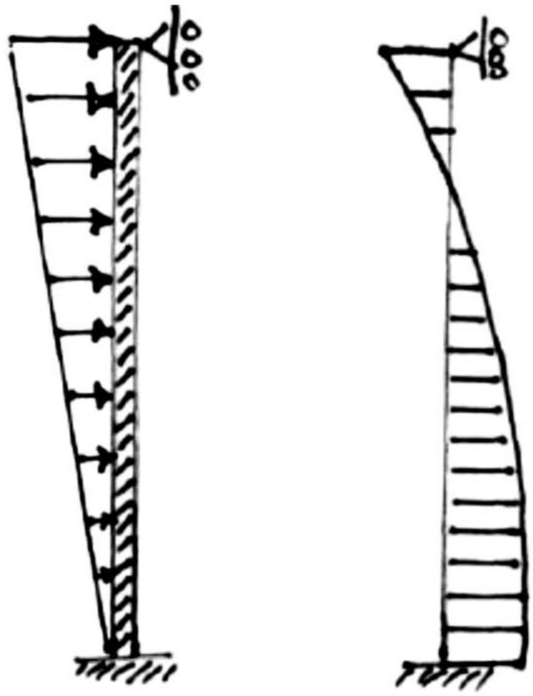


Figure 2: Propped Cantilever and shear force diagram

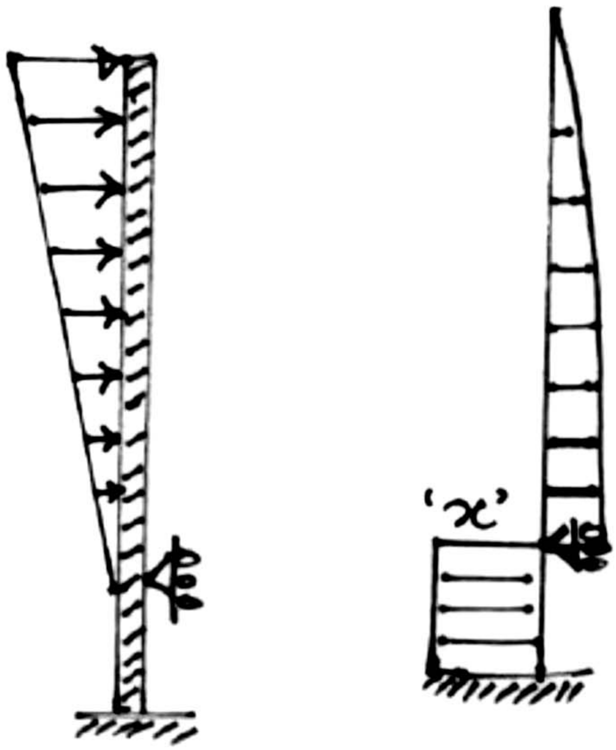


Figure 3: Propped cantilever resembling tower with deep basement and shear force diagram.

Shear reversal: The propped-support as shown in the model, has infinite in-plane rigidity and as per laws of mechanics not only takes reaction but the line-member at that point is associated with a shear reversal too.

Compare this model with that of a tall building having a deep basement and a shear wall core for a structural system. The ground level slab is attached with both the shearwalls and the basement walls thus increasing the stiffness of the structural system many folds. The in-plane stiffness of the slab is close to what may be termed as a rigid diaphragm. This ground level slab acts as a prop support. The shear reversal is seen in the shearwalls and the sum total of this reversal is the reaction that is experienced by the ground floor slab.

It is worth noting here that traditionally for building with basements; the structural models have been analyzed by curtailing the basement and fixing the supports at the ground floor. The ground floor slab is 'not' designed for in-plane shear in such cases.

Such practices may have been 'ok' for traditional moment-framed structures where the base shear is distributed between the numerous columns but with tall shearwall buildings, high shear force concentration occurs in the ground floor diaphragm close to the shearwalls and needs to be considered while designing the slab.

Stiffness of the propped-support: It is a common knowledge that the more fixed a support is the more stress or force it attracts whereas the more you release the fixity of a connection maintaining stability, the less stress or force it attracts. This phenomenon can be easily explained by taking the same stick model with a pinned propped-support and replacing the pin with a spring of varying spring constant. One can see from figure 4 that by replacing roller prop that offers infinite in-pane stiffness by a spring support, there is reduction in the shear reversal. This phenomenon can be directly applied to the ground floor diaphragm by taking its appropriate in-plane stiffness instead of considering it a rigid diaphragm. Such modeling will not only relieve the design shear force in the slab but will also reduce the shear-reversal in the shearwalls

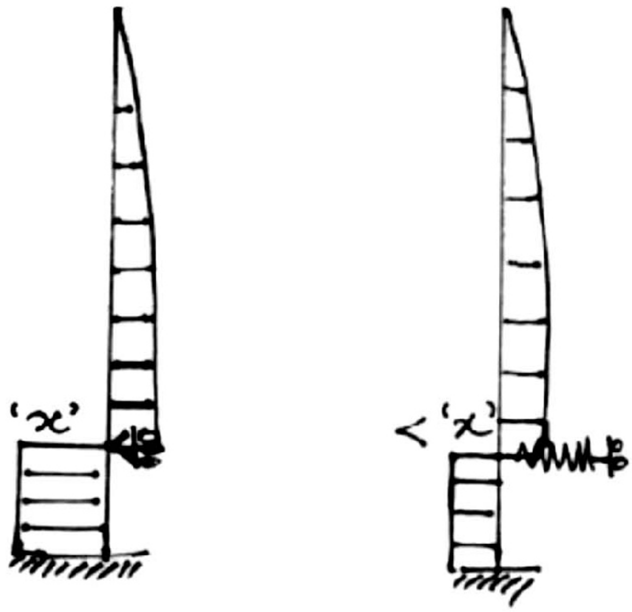


Figure 4: Effect of non-rigid prop on shear reversal

Podium diaphragms: The prop-effects taking place in tall buildings at the base is also called the back stay effect. A very common architectural design feature of tall buildings is the podium, which may be few stories high and is generally area wise much bigger than the footprint of the typical tower slab. This podium is generally associated with higher mass and stiffness. The higher mass is because of the podium's large size and higher stiffness because the structural engineer typically adds lateral resisting elements in the podium thus increasing its stiffness. This may lead to the back-stay effect taking place at the onset of the podium level and once again at the ground level where the basement walls start below. In such cases, it is extremely important for the structural engineer to design both the ground floor and the highest podium level slabs for shear transfer as well as carefully look at the change in shear in the shearwalls at these levels.

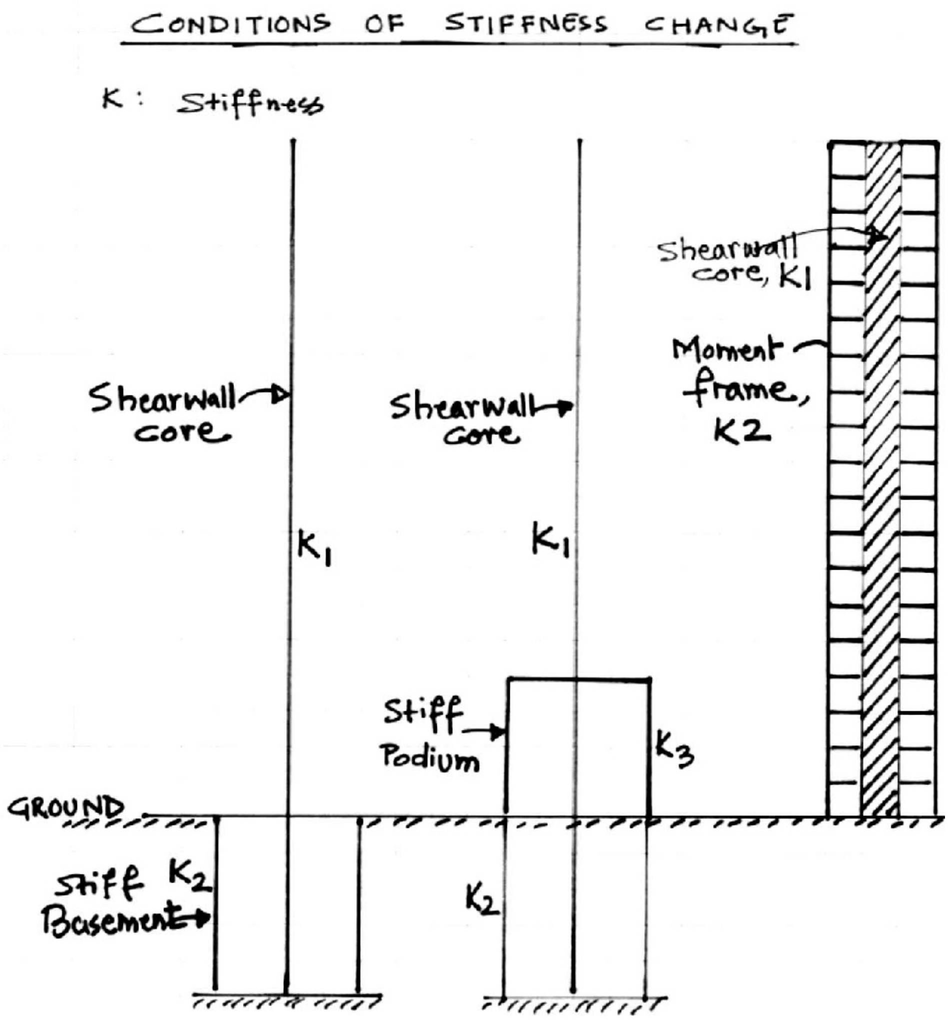


Figure 5: Effect of non-rigid prop.

Caution with Response-Spectrum Analysis: All tall buildings are today analyzed with response-spectrum analysis. The trap lies in the fact that by its very nature, the results of the response-spectrum analysis are always positive. At diaphragms experiencing the back stay effect, there is a good chance of the shear to reverse direction in the shearwalls. You will find that the shear-force diagram from a response-spectrum analysis will not show this shear-reversal but will continue to show shear in the same direction as the shear in the stories above (See Fig. 6).

Back-Stay Modeling Assumptions: As buildings get taller, the difference between the analytical results and the actual behavior of the structure may be far away. This is because of the modeling assumptions, actual design and the soil-structure interaction. One of the methods followed today to safe-guard against this discrepancy is to bracket the analytical solutions using an upper bound and a lower bound set of modeling assumptions. The upper bound assumptions are used to get stronger diaphragm action and the lower bound assumptions are used to get weaker diaphragm action. The upper-bound assumptions involve using a higher stiffness value for the diaphragms, basement walls and the soil-spring under the basement walls whereas using a lower spring-value for the modeling the rest of the foundations. On the other end of the spectrum is the lower bound assumption involving a lower stiffness value for the diaphragms, basement walls and the soil-spring under the basement walls whereas using higher soil-spring stiffness for the rest of the foundations.

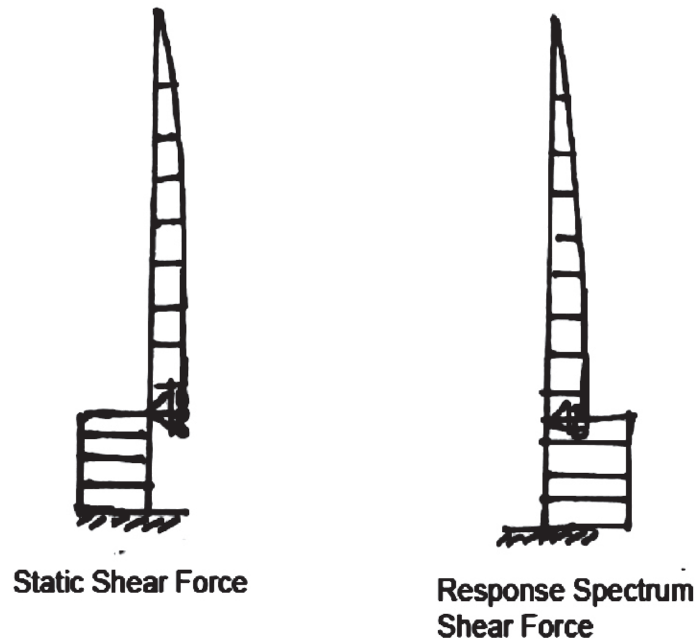


Figure 6 : Response Spectrum Shear Force Diagram.

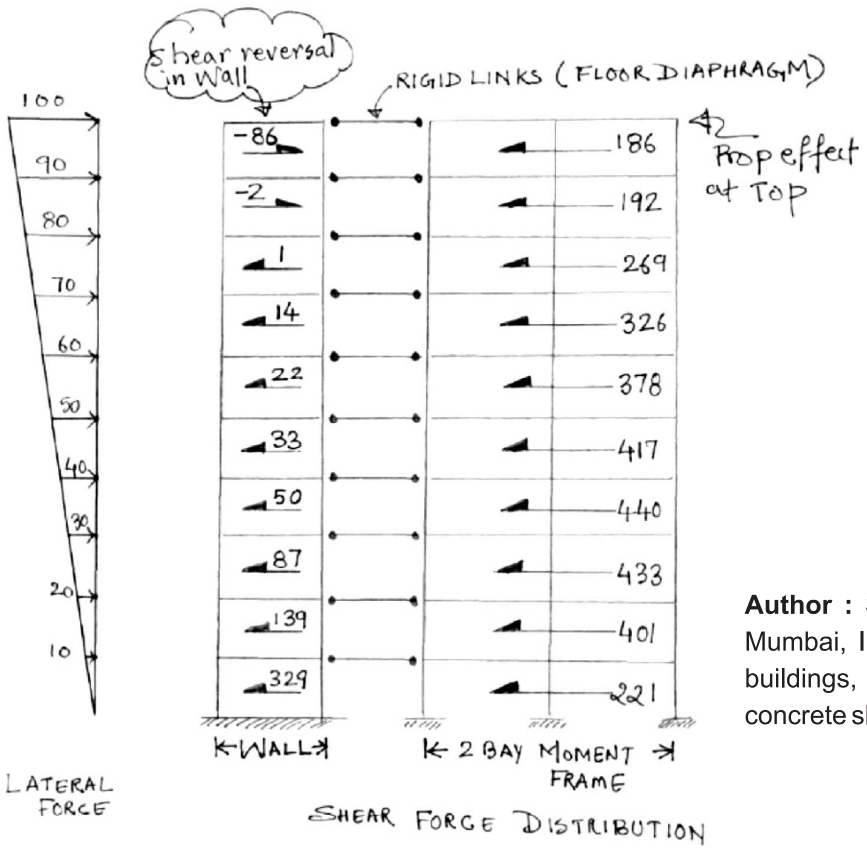


Figure 7: Prop- Cantilever effects in Dual Systems

The Dual System and the Prop-Effect:

Consider a dual system with shearwalls and moment-frames. Apply force to a diaphragm with a dual system and one would expect the force to distribute itself in proportion to the stiffness of the lateral force resisting elements. Now refer to Fig 7. At the top floor, although the sum total of the wall and frame shear force equals the applied force of 100 units, but one can observe that the wall experiences a negative shear. The shear wall is acting as a propped cantilever supported by the frame at the upper stories. This phenomenon is enforced by equal displacement compatibility at each storey. Tall shearwalls behave in flexure and the frames in shear and hence want to displace and rotate in conflicting manner over the height of the building. Connecting them by a rigid slab at each floor imposes the equal displacement compatibility. This can be easily missed out if distribution of forces at a floor is done by hand computation and the same is applied for every storey.

Author : Satish Jain. Director, SJC Structural Engineers Mumbai, India. Specializes in planning and design of tall buildings, advanced seismic analysis and post-tensioned concrete slabs. Email: satishj@sjcse.com

AN INNOVATIVE CONCEPT OF DESIGN OF SHALLOW FOUNDATIONS IN EXPANSIVE SOILS

Prof. G. B. Chaudhari.

- **Abstract-**
- During past several years, many researchers are making sustained effort to understand the behaviour of expansive soils and suggest suitable solutions to the problems arising in design and construction of shallow foundations for structures located in expansive soil deposits. As per IS 2911 (Part III) one of the method of ensuring normal service conditions for structures built on expansive soils is to support such structures using under reamed pile foundation. However, in some cases structures supported on under reamed piles have shown considerable distresses.
- Expansive soil is accepted to be more beneficial for agricultural activities. However, it is considered to be highly treacherous for civil engineering structural foundations.
- After understanding the behaviour of expansive soils, Prof. G.B.Chaudhari has suggested that these soils are also good for civil engineers.
- He has revealed that the expansive pressure magnitudes and expansive pressure profiles are the important parameters that are to be adopted in the analysis and design of shallow and deep foundations for satisfactory performance of superstructures resting on them.

- **Functions of foundation-**
- Basically foundation accepts the loads from a structure and transfers it to soils below it in the stressed zone. There are two basic functions a foundation has to perform under the imposed loads i) soils do not under go shearing failure and ii) soils do not settle more than permissible limits.
- **Behaviour of foundation in submerged condition-**
- In general, the loads on foundation act in vertically downward direction. However, when the loads on foundation act in vertically upward direction, then it is likely that foundations can get lifted upward. For example, when water level rises and foundation gets submerged, then if the upward rising water buoyancy force is greater than downward force on foundation; it is likely that foundation will get lifted up. In this condition it is necessary to increase the downward force on foundation so that foundation does not get lifted up.
- **Behaviour of foundation in expansive soil-**
- Similarly, in case of expansive soils, if the expansive pressure acting vertically upward is higher than the vertically downward force of foundation, then it is likely that foundation will get lifted up. In this condition it again becomes necessary to increase the vertically downward force on foundation so that foundation does not get lifted up. This indicates that we should place more load on foundation such that foundation shall settle by about 5cms or so and never it gets lifted up. This concludes that expansive soil load bearing capacity shall be equal to or greater than the expansive pressures of soils.

- **Sub surface ground explorations of expansive soils can be done using-**
- a) Trial pit Method and b) Rotary drilling method.
- In case of trial pit method it is possible to inspect the large mass of soils and also it is possible to collect undisturbed soil samples in vertical and horizontal positions with the help of core cutters. In case of rotary drilling method attempt shall be made to collect undisturbed soil samples of 10cms diameter and of about 15cms in length at 0.5m depths interval and up to required depths or up to hard stratum. A typical sketch of a trial pit is shown below.

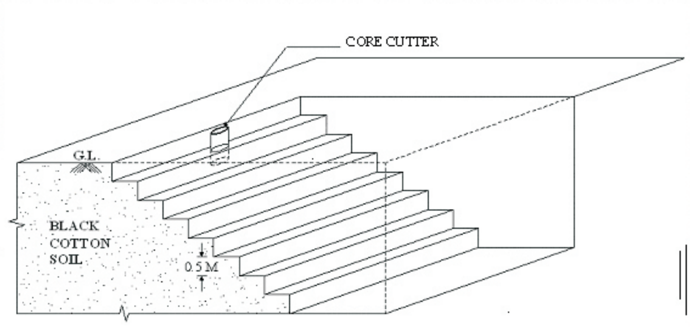


Figure No.2.10 : - EXCAVATION OF PIT FOR TAKING SAMPLES

- Laboratory tests on expansive soils- Following tests can be conducted on uds/ds (remolded) soil samples.
- In situ Density & Moisture content, & Specific gravity of soil,
- Sieve analysis & Atterberg limits,
- UU Direct shear test
- One dimensional consolidation test
- Expansive pressure-
- Laboratory set up for determination of expansive pressure is shown in fig, below-

TIME	LOAD
15MIN	L1
30MIN	L2
1 HOUR	L3
2 HOUR	L4
4 HOUR	L5
24HOUR	L6
48 HOUR	L7
72 HOUR	L8
96 HOUR	L9

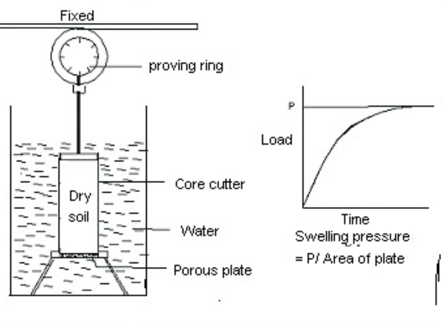


Figure No.2.11 - APPARATUS FOR DETERMINATION OF SWELLING PRESSURE V.J.T.I. METHOD

- Expansive pressure tests were conducted by G.B. Chaudhari (1988-1991) on undisturbed soil samples collected at G.L. and at 0.5m depths intervals up to 3m to 4m depths, and then it was revealed that expansive pressure is varying with depths. This study has given the concept of 'Swelling Pressure Profiles' and in general five main profiles were noticed as shown below.

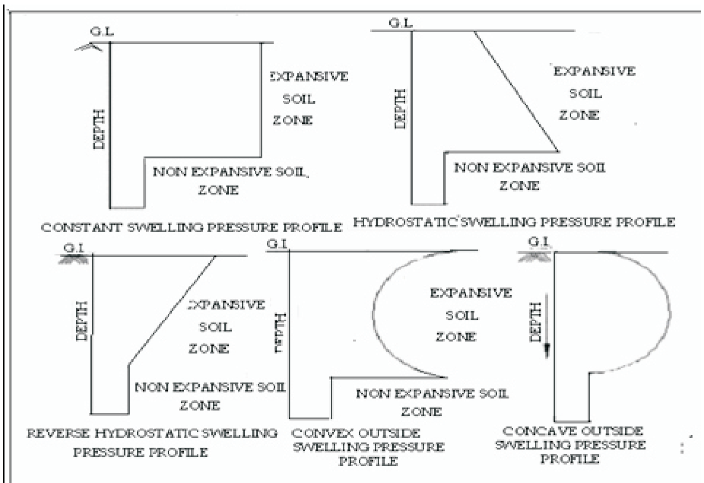


Figure No.2.12:- TYPES OF SWELLING PRESSURE PROFILES IN EXPASIVES SOILS

- Identification- Identification of expansiveness of expansive soils was done as per the magnitudes of swelling pressures of soils.
- In general, in some of the areas, expansive soil swelling pressures were observed in the range of 1kg/sq.cm to 4kg/sq.cm.How ever, the maximum expansive pressure reported by Dr, Alamsing was 16 kg/sq.cm

SWELLING PRESSURE KN/M^2	DEGREE OF EXPANSION
0 - 50	LOW
50 - 150	LOW - MEDIUM
150 - 300	MEDIUM - HIGH
300 - 600	HIGH TO VERY HIGH
600 ABOVE	VERY HIGH

- **<u>Design analysis-</u>**
- i) First find out the type of super structure/s- say Compound Wall, Buildings, etc., to be constructed.
- ii) Then, carry out soil investigation. Determine various parameters of expansive and non expansive soils. Determine swelling pressure profiles.
- iii) Consider about 1 to 2 times the maximum swelling pressure as the bearing capacity of expansive soils. This is the safe load on footing foundation. Now, it is necessary to restrict the settlements of foundation up to about 5cms, so that foundation will not get lifted up. The stress on foundation under which footing will settle by about 5cms is considered as allowable stress for design of foundation.
- To achieve the above requirements, a rigid flexible WSEL (Wedge Shear Elements Layer) was developed (G.B.Chaudhari (1978)). A WSE layer of 25cms thickness consists of plum (soling stones pieces of 20 to 23 cms sizes) + plc (plain lime concrete)/ or pcc (plain cement concrete) of grade (1: 5: 10). WSE number of layers were placed below 15cms thick pcc/plc of grade (1: 3: 6) of foundation.
- These rigid flexible WSELs will offer both ways obstructive resistance to upward swelling pressures and downward structural loads and transfers these loads by arching action at wider dispersion angle of 45º. Rigid flexible WSELs-it acts like a spring. It improves the bearing capacity of soils. It induces uniform settlement due to increase in rigidity of foundation in presence of rigid flexible WSELs. It induces elastic settlement. Due to rigid flexible WSELs, even long term consolidation settlements will develop in short time -during construction/ occupation –periods.
- Rigid flexible WSELs number of layers is to be determined or designed as per magnitudes of swelling pressure and type of super structure and intensity of loadings. It is advisable to place minimum two layers of rigid flexible WSE below foundation.
- For low to high swelling pressures, rigid flexible WSELs can be used. Since rigid flexible WSELs acts as double acting arch it will resist the upward expansive soil pressures with small displacements of rigid flexible WSELs.
- **<u>Settlement-</u>**
- Load the safe stress on the top of footing foundation resting on a 'rigid flexible WSELs', and check the settlements using following expression.
- Si = immediate settlement/ elastic settlement= q B (1- μ^2) I/ E
- q = intensity of stress on top of pcc/plc of 15cms thickness.
- B= width of foundation, in cms
- μ = Poisson's ration in fully saturated state (=0.5)
- I = Shape and rigidity factor (= 0.8 for square/ circular/ rectangular shaped foundation)
- E = modulus of elasticity in fully saturated conditions of expansive soils + rigid flexible WSELs (200 kg/sq.cm for two layers, 300 kg/sq.cm for three layers and 500 kg/sq.cm for four layers of WSELs.)
- And, Sp= plastic settlement = mv p H
- mv= 1/E, in sq.cm/kg,
- p = intensity of stress at mid height of H.
- H= thickness of stressed zone below WSELs.
- Or,
- Sc= one dimensional consolidation settlement
- = [(Cc H)/ (1+ e0)] log 10 (p0 + p)/pc,
- Cc= compression index,
- H= thickness of stressed zone below WSELs
- e0= Initial void ratio,
- p0 = Soil over burden pressure at mid height of H,
- p= increment of stress at mid height of H,
- pc= precompression pressure.
- H= thickness of stressed zone below WSELs.

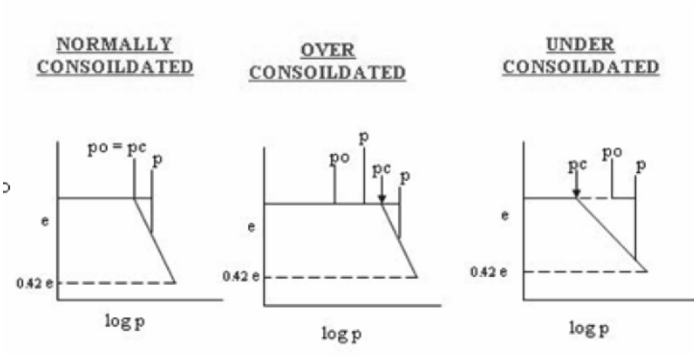
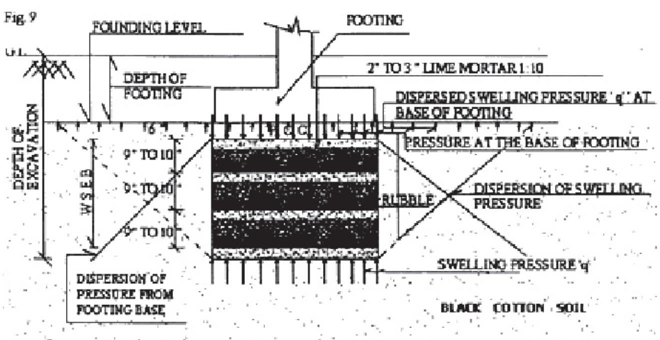


FIG.9- CLAYEY SILTY SOIL – FIELD CONSOILDATION GRAPHS

- In general, determine the applied stress on foundations which will force the foundation to settle by total settlement of the order of 5cms and foundation will not get lifted up.

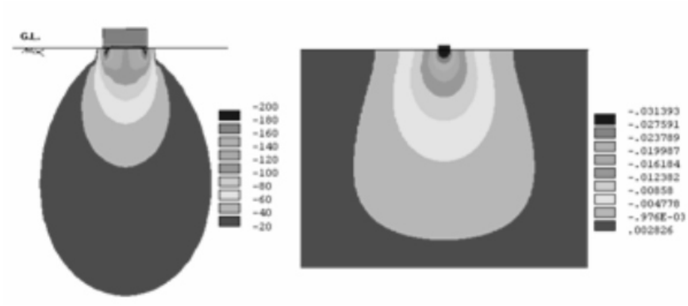
Note that WSELs acts as double acting arch and disperses stresses vertically downward pressure and vertically upward pressure at 45degrees at vertically downward displacement of foundation. Refer Fig. given below



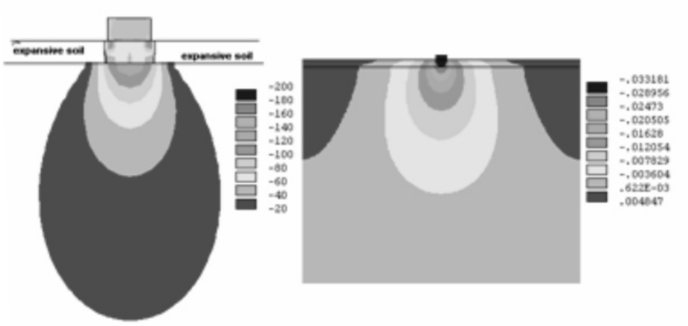
THREE LAYER WEDGE SHEAR ELEMENT UNDER DOUBLE WEDGE ACTION

- To understand the effect of expansive pressures on the stressed zone, study was conducted using FEM analysis by several ME students. One such example is given below for information.
- FINITE ELEMENT ANALYSIS OF STRIP FOOTINGS & ITS INTERACTION IN SOIL INCORPORATING THE EFFECT OF CONVEX OUTSIDE SWELLING PRESSURE PROFILE
- -BY-CHAWRE VISHAL S. - R0LL.NO: CD - 041054
- - UNDER THE GUIDANCE OF PROF. G.B. CHAUDHARI
- -IN STRUCTURAL ENGINEERING DEPARTMENT, V.J.T.I. MUMBAI.
- GLIMPSES OF STRESS DISTRIBUTION – GIVEN BELOW-

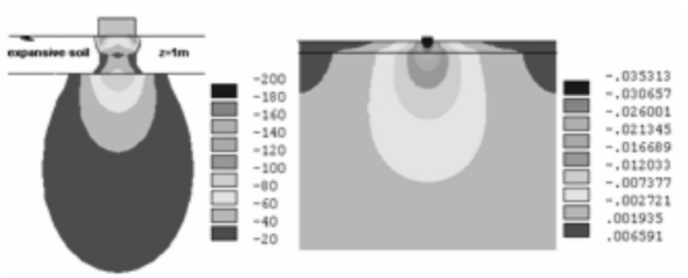
- I) STRIP FOOTING ON GROUND LEVEL WIDTH OF FOOTING = 1M, DEPTH OF EXP. SOIL=0.0M (non- expansive- soil)



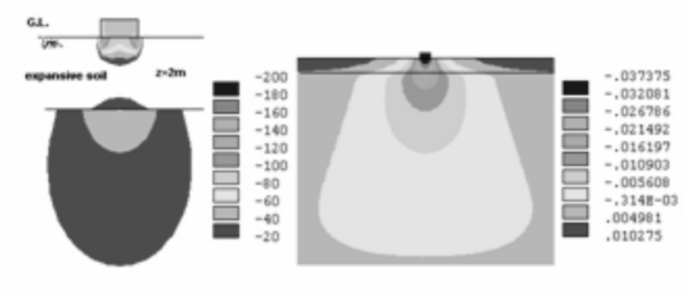
- II) STRIP FOOTING ON GROUND LEVEL WIDTH OF FOOTING = 1M, DEPTH OF EXP. SOIL=0.5M SWELLING PRESSURE = 100 kN/sq.m



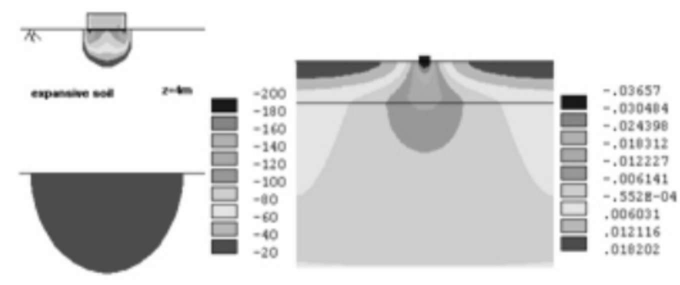
- III) STRIP FOOTING ON GROUND LEVEL WIDTH OF FOOTING = 1M, DEPTH OF EXP. SOIL=1.0M SWELLING PRESSURE =100 kN/sq.m.



- IV) STRIP FOOTING ON GROUND LEVEL WIDTH OF FOOTING = 1M, DEPTH OF EXP. SOIL=2.0M
- SWELLING PRESSURE = 100kN/sq.m



- v) STRIP FOOTING ON GROUND LEVEL WIDTH OF FOOTING = 1M, DEPTH OF EXP. SOIL=4.0M SWELLING PRESSURE = 100 KN/m2



- Like this study was conducted for single and group of footings of shapes square, circular, rectangular for various soil pressures and various profiles of expansive soils. Also study was conducted on under reamed piles with single and double bulbs in various soil pressures and various expansive soil pressure profiles.

Author : Prof. G B Chaudhari. M. Tech (Geo-tech) Emeritus Fellow. V.J.T.I. Mumbai. Geotech Consultant.
Email : gobchaudhari75@gmail.com

Invitation

The President &
Advisory Trustees of

INDIAN SOCIETY OF
STRUCTURAL ENGINEERS

request the pleasure of your company
on the 12th Inaugural Day of the Society

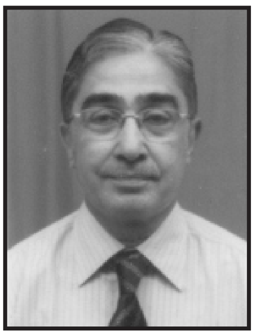
at 5.30 p.m. on Friday, 29th January 2010

Venue : Institution of Engineers (India) Hall, Haji Ali - Mumbai - 400 034

A lecture on Quality in Construction Management"
will be delivered by
Shri P. S. Suresh
Project Manager, L & T, ECC Division

RSVP : E-mail : issemumbai@gmail.com Tel. : 2436 5240, 2422 1015

CONGRATULATIONS !



Our Advisory Trustee Shri. Javahar R. Raval won a Gold Medal from Institution of Valuers, as the Best Writer of the Article "Valuation for One Time Settlement with Bank - A Case Study" published in their Monthly Journal 'Indian Valuer' during the year 2009.

Our Hearty Congratulations to Shri Raval, who is also Re-elected as All India National Executive Council Manager of Institution of Valuers for years 1010 - 2012.

THE COUNCIL ON TALL BUILDINGS VISITING MUMBAI

Figure CTBUH 2008 World Conference in Dubai

The Council on Tall Buildings and Urban Habitat (CTBUH), based at the Illinois Institute of Technology in Chicago, is one of the world's largest international not-for-profit organizations with an organizational network of 387,584 architects, engineers, developers, building owners, financiers, contractors, consultants, urban planners etc. working in 3,209 offices around the world. Founded in 1969, Council disseminates multi-disciplinary information on tall buildings and sustainable urban environments, to maximize international interaction of professionals involved in creating built environment and make latest knowledge available to professionals in a useful form.

Across the world, Mumbai has been believed to be the next major hotspot in India for builders, developers, architects, planners and financers. In line with its plans to host international conferences and congress, it intends to hold the CTBUH 2010 World Conference – INDIA for remaking of sustainable cities in the vertical age, scheduled on 3rd-5th February 2010 at The Renaissance, Mumbai.

26/11 terror is attacks vis-a-vis global success of films like Slumdog Millionaire have shown contrast in lifestyle that exists in Mumbai and the need to restructure this dual world. Mumbai is on the world map with regards to its urban planning issues and the constant positive growth it gives to Indian economy. It is attracting developers and financers who are interested in infrastructure development. Mumbai is home to India's largest slum Dharavi and at the same time, Indian real estate industry expects to reach $ 60 billion. Infrastructure investment in India is pegged at $320 billion and 1000 high rises have been proposed in Mumbai alone. MMRDA's Chief transportation planner, Mr. Ramana attended CTBUH 2009 World Conference in Chicago and spoke on the world class transportation infrastructure (metro rail and mono rail) that is coming up in Mumbai. About 100 delegates confirmed their attendance for the Mumbai conference.

The real estate industry is at a blossoming stage in the country and there is a need to learn more from the developed world. The Mumbai conference will provide information to all Indian builders and developers who have now moved from constructing individual buildings to small townships. Debates will search for finding indigenous planning solutions for each city to discuss impact of climate on high rises in Mumbai. Green spaces on ground as well as in the sky will be discussed. Indian real estate industry can learn from the mistakes of the west regarding environmental friendly economically viable construction.

Mumbai World Conference expects over 700 delegates and more than 50 global speakers who will disseminate their state of the art knowledge, A world class congress like this will build a roadmap towards the colossal growth of the real estate industry.

Speaker Dr. Ken Yeang, Director, Llewelyn Davies Yeang (London) and T. R. Hamzah & Yeang (Kuala Lumpur) will talk on the eco skyscrapers, while Ming Zang, Senior Partner/Design Director, Mulvanny G2 Architecture will discuss the need for innovative, different planning solutions for global cities. Ahmad Abdelrazaq, Executive Vice President, Samsung C&T / Highrise & Complex Buildings will talk on the use of the latest technology in highrise construction and Tim Johnson, AIA, NCARB, LEED® AP, Partner, NBBJ will speak on designing vital urban environments.

The conference is jointly organized by Remaking of Mumbai Federation (RoMF) and CTBUH. Source : Remaking of Mumbai Federation (RoHT). For information and registration log on to www.ctbuh2010-india.com

ISSE LETTER TO MCGM HIGH RISE COMMITTEE

To:
The Chairman
High Rise Committee,
C/o Chief Engineer,
Development Planning Department,
4th Floor, Head office,
Municipal Corporation of Greater Mumbai.

Sir,

Sub: **Suggestions for high rise buildings and safety.**

Indian Society of Structural Engineers is a body of about 1000+ engineers connected with the building industry. We have been making earnest efforts to have healthier structures by frequent seminars, publication of books like "Seismic Design of R.C.C. structures", and also quarterly journal on structural engineering subjects.

We sincerely feel that incorporation of our suggestions stated below would substantially contribute to your efforts for achieving better and safe structures.

1. **Proof checking** of the entire building design and basement can be done though professional bodies like IIT/ VJTI / SP college or by senior consulting engineer having more than 15 years of experience. This will ensure the compliance to the codal provisions and safety aspects.
2. For having better quality of concrete (for avoiding cold joints and bad concrete) near beam column junctions, it is advisable to have same grade of concrete for column and beam-slab. Minimum grade of concrete shall M30.
3. **Strict Quality Control at site**: There has to be some mechanism to ensure the quality at site. Third part quality audit will be helpful. Testing laboratory must be provided at site.
4. Minimum concrete thickness for retaining wall / shear wall / lift wall shall be **230mm**.
5. For high rise building, foundation system should be preferably on raft / piles or raft supported on piles as per the requirement. Single isolated foundations should not be allowed.
6. Fire safety is very important in high rise building superstructure and for multiple basements below the ground. Basements shall be protected from becoming gas chambers in the event of fire.
7. Constructing multiple basements is a very tricky and complex affair. Detailed method statement along with design of the supporting system for deep excavation shall be submitted including geotechnical assessment of the proposal. Dewatering of the area is to be planned in advance. Excess dewatering may pose problems of stability of soil around. Second opinion from professional bodies / Geotechnical experts shall be submitted along the main proposal for deep excavations and safety of the adjoining structures.
8. In the soil retaining system, Rock anchors should not be allowed to project beyond the plot boundary as it can damage the services or foundations of the adjoining structures..
9. Open space between the boundary wall and the basement wall / podium should be more than **6.0m**. Presently 1.5m distance is allowed which is inadequate for construction activity, safety and routing of services.
10. Sufficient distance between the adjacent buildings should be maintained considering safety against fire and earthquakes. Fire damage or partial collapse of the structure should least affect the adjacent structures. Minimum distance of 12m should be maintained between the two buildings.
11. Keeping in mind the safety of the occupants, **no concessions shall be given to inadequate open spaces.**
12. No projection / architectural feature to be allowed on the dead wall face of the buildings
13. Ornamental projections like elevation treatment, flower beds, niche, etc shall be limited to **1.0m** from building face.
14. No water bodies like swimming pool etc shall be allowed on terrace or any other floor level. This can be provided at ground level only.
15. Last podium slab shall be designed for heavier loading like 1 t per sq. m as it is used for storage of material during construction and maintenance.

16. **Stair cases and passages** – For high rise buildings minimum width of stair and passage shall be 2.0m. The width or number of stair cases can be increased based on the safety aspects considering height of building and number of occupants to be served.
17. **Freight Lift** – As per DP regulations, at least one freight lift shall be provided.
18. **Refuge area** – Sufficient refuge area required for rescue operations at certain heights shall be provided considering the number of occupants in the structure. The refuge area of 150 Sq.ft mentioned in DP rules 1991 seems to be inadequate.
19. **Submission of Structural drawings** : We suggest that the submission of structural design, drawings & calculations shall be insisted only after clearance / approval of the architectural drawings by the high rise committee. Any change suggested in the architectural plan by the committee may lead to rework on the structural arrangement, drawings and calculations. This suggestion will avoid duplication of work and will save lot of time.
20. Demolition plan & repair- maintenance plan for the structure should be prepared and submitted during the planning stage. This aspect will become more critical in future if not planned today.

We are ready to help BMC and open for any discussions on the above subject whenever called for.

Yours truly,

(S.G. Dharmadhikari)
President, ISSE

Forthcoming Event
One Day Workshop on

"Pile Foundations"

Saturday, 20.02.2010 from 09.30 a.m. to 05.30 p.m.

Venue :The Institution of Engineers (I), 15 K. Khadye Marg, Haji Ali, Mahalxmi, Mumbai - 400 034.

Organised by

Indian Society of Structural Engineers (ISSE)
in association with Indian Geotechnical Society (IGS)
and
The Institution of Engineers (I), MSC
will be arranging a full day workshop on "Pile Foundations"

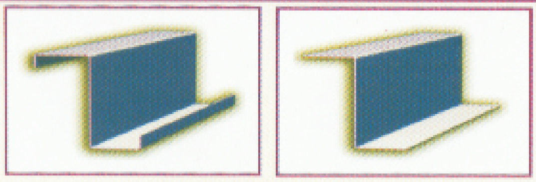
Various aspects of geotechnical parameters, modeling of the foundation systems, analysis, design, detailing, construction aspects, monitoring and quality control at site for pile foundations along with case studies will be discussed during the workshop. Eminent structural and geotechnical engineers like **Dr. N. V. Nayak, Dr. S. Y. Mhaiskar, Dr. V. V. Nori, Mr. S. R. Ambiye, Mr. V. T. Ganpule, Prof. G. B. Chaudhari, Mr. D. J. Ketkar, Mr. Ravikiran Vaidya** will share their experience.

Registration fees : Rs. 700/- for members of ISSE, IEI and IGS
Rs. 900/- for others.
Cheque or DD should drawn in favour of "Indian Society of Structural Engineers".

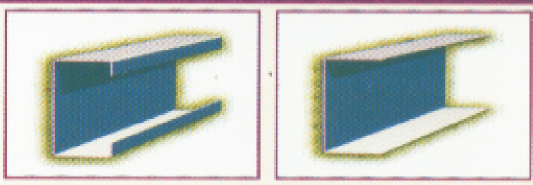
For more details contact ISSE office Tel. 2435 5240 Telefax : 2422 4096

Thakkar Group Is One of the Largest Independent Engineering Group Manufacturing a Wide Range of Cold Roll Formed Sections & Pre Engineered Metal Building Systems.

HR / Galvanized Finish Yield Strength : 240 / 340 Mpa

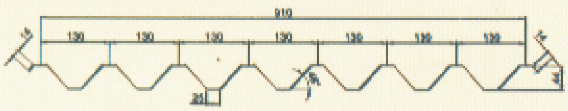


ZED SECTION

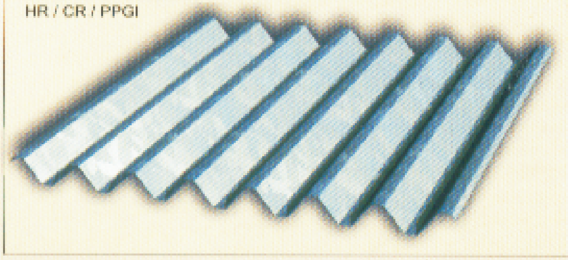


CEE SECTION

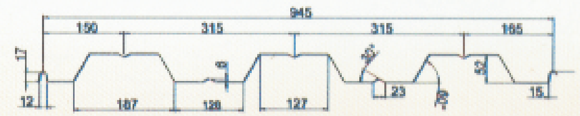
DECKING PROFILE "910" (44 /130)

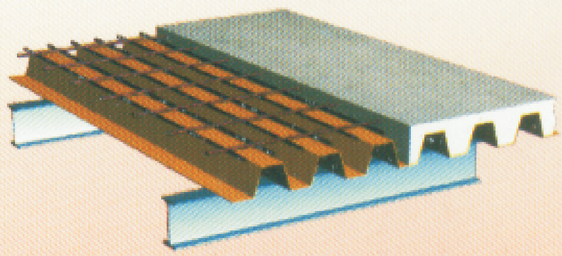


Thickness: 0.6 - 2 mm
Galvanized / Galvalume
HR / CR / PPGI



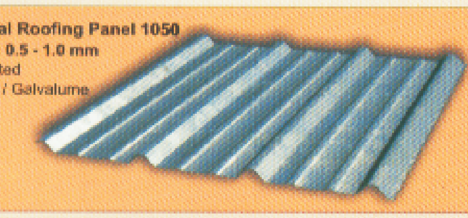
DECKING PROFILE "945" (52 /315)



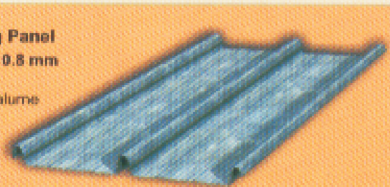


Save up to 15% in Concrete & Reinforcement by Rola Deck Composite Floor Deck

Trapezoidal Roofing Panel 1050
Thickness: 0.5 - 1.0 mm
Colour Coated
Galvanized / Galvalume



Clippon Roofing Panel
Thickness: 0.45 - 0.8 mm
Colour Coated
Galvanized / Galvalume



Colour Coated Roof Sheet

THAKKAR GROUP OF COMPANIES
HEAD OFFICE
601-602, Siddharth Arcade, Factory Lane,
L.T. Road, Borivali (West), Mumbai-400 092. INDIA.
Tel. : 91-22-2899 2174 / 2898 4630 / 2899 3246 / 2833 6381 / 9821081441
Fax: 91-22-2899 3048
E-mail: metcraft@vsnl.com/mktg@metcraftindia.com
Website: www.thakkargroup.com

WORKS
Wada & Palghar.

D- 2899-3478 / 98210-81441

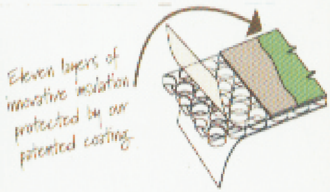
Green Insulation

THE INTELLIGENT SOLUTION®

Reflecta-Range™

Leading the way in protection against oxidisation and corrosion

The product Structure



The
REFLECTA-RANGE™
of Products

- **REFLECTA-SHIELD™**
- **REFLECTA-CELL®**
- **REFLECTA-GUARD™**

Green Insulation™ products are suitable for
Residential • Commercial • Industrial Building applications

✓ Energy Saving ✓ Lasting Comfort ✓ Safe and Green

Authorised Distributor :
Roofex

Suite No.19, 1st Floor,
Plot No. 3A, Udyog Nagar,
Goregaon (W), Mumbai - 400 062.

Tel.: 91-22-2876 6563 / 2876 8881
Fax : 91-22-2876 3244

E-mail : hitesh@roofex.in
Web : www.roofex.co.in