

# STERLING

**ENGINEERING CONSULTANCY SERVICES PRIVATE LIMITED**

Quarterly Newsletter | 22nd March 2010 | Issue: 1

**Inaugural Issue**

## **Special Feature: Palais Royale**

✦ **Past, Current and Upcoming Projects**

✦ **Quarterly Events**



## PALAIS ROYALE - A TREND SETTER

### Introduction:

Palais Royale (pronounced as pa-lai ro-yaal) in French means a Royal Palace.

### Location:

Situated at Worli Naka, this building with a height of 295 m above the ground level has a total structural height of 325 m from the bottom of the foundation to the top of the elevation cap. The base dimensions of the octagonal prismatic building are 84 m x 86 m. The construction area of the building is over three million sq.ft. with 88 slabs.

### Structural Systems:

The residential levels have been provided with a conventional column / beam and solid slab configuration. Presence of an atrium following the principles of Vastu Shastra has provided the structural advantage of a stable form.

### Transfer Level:

In order to transfer the loads of the 244 residential columns to the foundation through the 88 lower columns, transfer girders are provided at +76 m level. The depth of these RCC girders is 9 m and the widths are varying from 1200 mm to 1500 mm as per the design and bearing requirements.

### The Parking and Amenity Levels:

Structural system below transfer girder level comprises predominantly of Post Tensioned Flat Slabs except in the Brahmasthan where the 25 m x 22 m rectangular area is framed by strong post-tensioned beams. The amenity areas carry huge loads, the average intensity of the superimposed loads (SDL + LL) being as high as 35 kN/sq.m at the swimming pool level. The parking levels are designed for the possibility of double stacked parking. Seismic design is corresponding to Earthquake Zone III aimed at operational level performance – maximum allowed drift ratio being 1000 and acceleration in wind limited to 5 milli-g.

### Wind tunnel tests:

Wind tunnel tests by RWDI showed that for a 10 year return period the Total Peak Acceleration in simulated wind conditions was 7.2 milli-g against the criteria of ISO 10137:2007 of 14 milli-g (extrapolated from the criteria for 1 to 5 year return period to 10 year return period).

### Soil Profile :

Soil consultants estimated a safe bearing pressure of 150 T/sq.m with settlement less than 25 mm. Modulus of subgrade reaction of 6500 T/m<sup>3</sup> was recommended for the design of raft foundations. Cross-hole velocity tests yielded average values of Poisson's Ratio, Young's Modulus and Shear Modulus as 0.32, 5200MPa and 200 MPa respectively showing excellent characteristics of the rock profile. Due to presence of weak soil for the upper 8 to 9 m, soil retention system was installed in the form of contiguous concrete infilled tubular steel piles, held to the bedrock. During the excavation for the deep foundation shoring piles were installed with inclined pre-stressed rock anchors.

### Computer Model:

A combination of shell diaphragm and membrane diaphragm was chosen to simulate framing conditions of the structure, in order to optimize the run time and the computer memory. The flat slabs at the parking and amenity levels have been treated as shell elements contributing to the lateral stiffness.

At the residential levels, the lateral resistance is derived from the beam/column frame action. Hence, the diaphragm is modeled as a membrane. Cracked section properties were assigned in accordance with the code recommendations. The foundation raft was analyzed in SAFE, using the reactions obtained from the Etabs Analysis.

### Results of the Analysis:

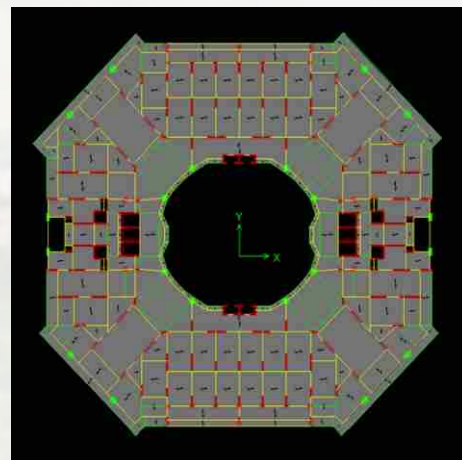
Considering the overall maximum lateral deflection of the building being only 300 mm occurring at the top level, the general performance of the building is well controlled. The massive proportions and the enormous stiffness of the building are evident from the modal frequencies found to be 0.1206 Hz for Mode 1 in Y direction, 0.1349 Hz for Mode 2 primarily in X direction and Mode 3 showing 0.1515 Hz primarily in Z direction as torsion. Fortunately, differential elastic shortening of columns and shear walls due to vertical loads was not found to be significant.

### Analysis of Transfer Girders:

The transfer girders were analyzed by Solid Finite Element Method. Both individual girder models and integrated layout model involving all girders and the three floor levels within the girder depth were assembled in STAAD-Pro. The stress patterns clearly indicated that the girders acted in conformity with strut-tie model corresponding to deep beam action. In-depth research was carried out to design the girders, which are probably the largest transfer girders being constructed in the world.



*A Graphical View of Palais Royale*

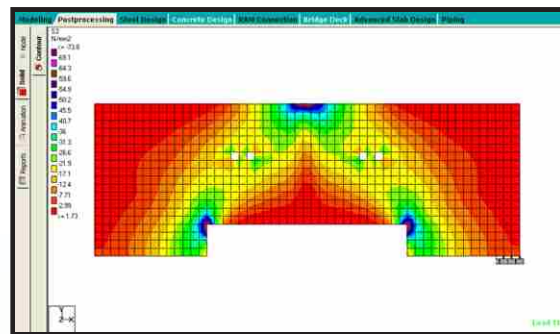


*Plan View of Palais Royale*



### Concrete Information:

M:80 and M:60 concretes have been used for columns / shearwalls and beams / slabs respectively. With the help of an elite team of concrete experts, concrete manufacturers, admixture vendors, contractor's engineers and batching plant operators, innumerable trial mixes were tested for various performance criteria. Eventually, M:80 SCC was finalized with free water cement ratio of 0.225 and free water binder ratio of 0.23. With 450 kg cement content and 168 kg/cu.m fly ash, the target strength was 90 N/sq.mm. Micro silica content was tried starting from 0% and was varied up to 10% to examine the performance. The design was finalized with 5% i.e. 23 kg/cu.m content. Minor adjustments are carried out for aggregate quality variation and moisture content on a routine basis.



Principle stress S3 pattern for dead and live load in a girder.

### Construction Methodology:

Our engineers were actively involved in the finalization of the construction methodology and participated in selecting high performance equipment from vendors all around the world apart from providing structural designs. M:80 concrete, use of self compacting concrete, using surface retarders, introduction of retarded concrete to avoid cold joints, column cages, compulsory use of couplers for rebar splicing, Automatic Climbing System for Walls and cores etc. are some of the salient aspects of the construction method.

### Mock ups:

Starting with this project, Sterling has set up a practice of insisting on setting up true scale mock-ups to study the veracity of the systems. For example, two mock foundation blocks were cast with 3.5 m depth with reinforcing bars as per the actual design requirement, and were cast, cured and monitored for formwork system, feasibility of using SCC, temperature variation, thermocouple working, segregation characteristics, characteristic strength curve and E-value. These mock-ups were tested two months in advance before commencing the actual foundation concreting. Similarly, bottom chord of 2 m depth of the overall 9 m deep transfer girder with all the rebars and other embedments was successfully cast recently.

### Present Status:

The construction has now reached 76 m, after completion of the parking and amenity levels, to the level of transfer girders.



Current Construction stage



Pre-engineered formwork



Automatic climbing formwork for cores

## ✦ Sterling Team Driving Palais Royale:



Ravi Surlekar



Vishal Thakur



Vincent Pereira



Sanjay Khairnar



Sandeep Kudalkar



Saurabh Butala



Sameer Ughade



Sameer Pednekar



Yogesh Rangari



Atul Jagtap



Mubin Lambe



Ketan Naik

## Some Of The Interesting Projects Under Construction

### H. N. HOSPITAL - Girgaum, Mumbai.



#### Special Features:

The new management decided to demolish the original incomplete structure because it had been exposed to weathering action for over 25 years and the structural configuration did not satisfy the revised architectural requirements. Dismantling the old structure without causing any harm to the adjoining heritage building was a challenge. However, the bigger challenge was to excavate 18 metres below the ground level to accommodate three basements under the new building for services and parking. This futuristic hospital boasts of a total height of 110 meters inclusive of 23 floors and 3 basements.

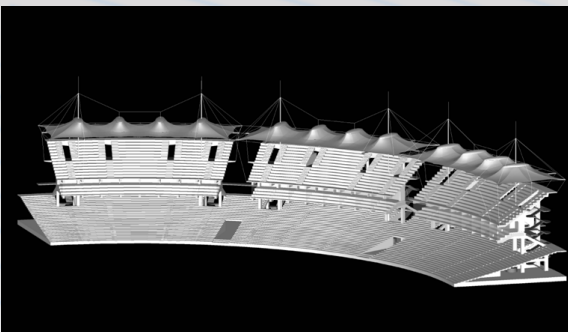
### SUNSHINE TOWER - Dadar, Mumbai.



#### Special Features:

The use of structural steel in this project called Sunshine Towers in Dadar, Mumbai is attracting attention of several architects, engineers and developers. The columns used on the periphery of this building are supplied by Corus from their mill in Japan. The overall size of these columns is just 500mm x 500mm. The plate thickness is as high as 36mm at lower floors and 12mm at the top. The aesthetic advantages of adopting these special sections are quite obvious.

### CHEPAUK STADIUM - Marina, Chennai.



#### Special Features:

The famous old Chepauk stadium is being renovated to suit international standards in order to host the world cup and IPL cricket matches with almost double the capacity of the present. Out of the nine stands, three stands are scheduled to be completed in record-breaking period of four months counting from the day of demolition of the old stands ahead of the IPL season starting in March 2010. Similar construction speed is likely to be seen in the second phase involving construction of the remaining six stands, the demolition of which will begin in May-2010 and the first world cup match will take place in January 2011.

### RAMANUJAN IT CITY - Taramani, Chennai



#### Special Features:

This project has a massive built-up area of 8 million square feet comprising of IT park and office buildings, retail, hotel, residential apartment and a correspondingly huge car park. This project is an exemplar of efficient project management through the 'Alliance Concept'. The structural designs were finalized after preparing and evaluating more than 12 different design alternatives.



### Recently Completed Projects

#### Office Building for India Bulls - Parel, Mumbai.



**Total area:** 30 Lakh sq.ft.

**Special Features:** This enormous building is characterized by an inclined frame of height 80 m in the front wing. In the rear wing, there is a bridging structure connecting the two buildings at a height of 60 m. The front face of the bridging structure acts like a four-floor deep concrete Vierendeel girder.

#### Hotel Grand Chola for ITC Ltd - Guindy, Chennai.



**Total Area:** 16 Lakh sq. ft.

**Special Features:** It is an exotic 7 star hotel with the famed and intricate Chola style facade and a simple structural system involving flat plate and peripheral beams. It houses 750 rooms, suites, luxury service apartments spread over 10 floors above the ground level and the three basements will be used to parking and backhouse facilities. There is a helipad on the top.

#### Office Building and Training Centre for ICICI: Gachibowli, Hyderabad.



**Total Area:** 38 Lakh sq. ft.

**Special Features:** This building is reportedly the largest structural steel office building consuming more than 30,000 Metric Tons of steel. It comprises of three basements with 17 floors rising above ground level and is characterized by the three landscaped refuge windows. Three floor deep trusses are used to create large column free atrium space.

#### Regional HQ and Training Centre for Hindustan Unilever Andheri, Mumbai.



**Total Area:** : 12 Lakh sq. ft.

**Special Features:** This office complex has a large and one of the most beautiful functional atriums with criss-crossing bridges, open staircases, walkways and a massive water wall at one end. The office spaces have large span post tensioned flat plates (without drop panels). The whole complex has been constructed integrating clusters of century old cashew trees in the planning.

### Events in the last quarter

- In November 2009, Vishwas Date and Manish Negandhi gave a presentation on "Earthquake Resistant Design" as part of a workshop organised for the teachers and students of the Architectural Courses at the D. Y. Patil College of Architecture, Navi Mumbai. Their lecture was appreciated by students and faculty members.
- Mr. Kamal Hadker gave a lecture on flat slabs at IIT Bombay in December 2009
- Sterling sponsored a course on Structural Design of Multistoried RCC Buildings organised by Technosis India at S. P. College. Our engineers Mohammad Mulla, Dinesh Baud and Sangeeta Wakadikar attended this course from July till August 2009. Do contact these engineers for further details and course material if any of you are interested.
- On 18th December, 2009, Sterling members-Sanjay Kairnar and Chandrashekhar Pawar participated in a one day course organised by PERI-one of the largest manufacturer & supplier of formwork for the scaffolding systems. There was a display and demonstration of wall formwork, climbing brackets, tableform and column formwork. The key feature of the products was the use of plywood which gives a good finish to the concrete surface.

- Mr. Kamal Hadker and Mr.Girish Dravid became members of CTBUH and took active part in conference held from 3rd to 5th February. The high-point of the conference for Sterling was that Palais Royale was show-cased and received world-wide acclaim for its innovative designs and features.
- Mr. Girish Dravid gave a lecture on High-Rise Structures on 29th December 2009 in Nashik in front of a large gathering of the members of the Architects and Engineers' Association, Nashik.
- Dr. Deepali Hadker was interviewed by the TV channel IBN Lokmat on her Management Degree at S. P. Jain Institute and how the course is relevant to managing a Company.
- Some engineers of Sterling attended a lecture both at Mumbai and Bangalore, by Dr. Ravinder Mysore at the Institute of Engineers Auditorium. This lecture called 'The Tale Of The Teetering Towers', focused on the integrity of an engineer in times of crisis and in situations which test ethics of an engineer - a person who may well be responsible for innumerable lives as well as economic success of the project and the client. Mr. Nagendra Kumar was instrumental in organizing the lecture at the Institute of Engineers Bangalore Chapter

## Down Memory Lane

This feature revives memories of old and remarkable projects

### Indira Gandhi Indraprastha Indoor Stadium, Delhi:



A view of the stadium across the lake



Aerial View of the Stadium complex, New Delhi



The Indoor Stadium with a seating for 50,000 spectators

This 150 M diameter, clear span roof structure was built as part of the sports complex in New Delhi for the 1982 Asian Games. It is India's largest indoor stadium built in record period of 22 months from concept to finish. It has a capacity to seat 50,000 spectators. The roof also supports a sound proof curtain that can be raised or lowered to divide the stadium into two parts and a central compression ring supported on eight pylons along the periphery.

Our Founder Member Mr. N. B. Hadker and Managing Director Mr. Kamal Hadker were personally involved in the design of this roof and received a lot of recognition for the indigenous manner in which the stadium was designed and built using locally available materials and machinery and without using any imported technology or computer software! The stadium will now host the Commonwealth Games in October 2010.

## Research & Development at Sterling

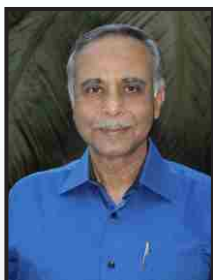
Column jacketing is a common solution in case of requirement of enhancing the capacity of column already constructed. The method could involve jacketing of column by concrete, steel plate bonding or fiber wrapping. The calculations in each case differ in the assumptions. In the concrete jacketing, it is assumed that the new concrete carries the additional / balance load directly. The reinforcement in the new concrete can also be designed for carrying some moments. Fiber wrapping calculations are based on the phenomenon of concrete confinement. In case of steel plate bonding, the load transfer to steel plates is effected by bond stress between the parent concrete and the plates at each level through shear pins and adhesive / grout / mortar. During such an exercise, Vishwas Date decided to verify the assumption of the load transfer to steel plates from the parent concrete by actual experimentation. Till date, no such experiment had been carried out by any agency and no literature was available. Vishwas developed samples of concrete cubes stapled with steel plates, embedded with shear pins etc. and had them tested in one of reputed laboratories in Mumbai. The laboratory was at first not confident of the procedures and was hesitant to carry out such an unconventional experiment. Vishwas realized that their reluctance was because of the necessity to develop the apparatus, which involved some expenditure and time for studies. (In fact, one of the laboratories wasted two months in just deciding whether this test could be carried out at all and then decided to back out of the research. However Vishwas managed to convince the new laboratory to undertake the task.) After the tests were completed and the results were compiled, the laboratory management was very excited and they were in fact proud that they did something beyond routine.

Vishwas compiled the results in December 2009 and confirmed the suitability of the technique that he had used in the on-site strengthening of the columns. The client, the peer reviewer and the contractor were much delighted to have authentic backup to the strengthening scheme given by Sterling and our standing with them improved. The report compiled by Vishwas Date is worthy of being published in any international Structural Engineering magazine.



Vishwas Date

## Chairman's Message



Dear members of the Sterling Family,

Engineering is so much about creativity and a holistic approach to design. Sterling has earned a reputation as consulting engineers who look beyond the conventional boundaries of structural engineering.

Most of our design solutions have been appreciated not just because we produced the most economical design but the most appropriate one. Therefore, I would like all of you to take keen interest in other disciplines such as air-conditioning, MEP and interior designing which are integrated in the final design of the building. Similarly, constructability and speed have become very important issues in recent years. Let us therefore observe interesting projects being executed all around us. Let us learn to appreciate and analyze new ideas and try to adopt them at the right time in our work in hand.

In most cases, our work finally gets concealed by architectural finishes and the common man remains unaware of the significant contribution made by structural engineers. However, we should not be discouraged by the lack of appreciation and recognition from the public. Let's remember that the people who really matter are watching us all the time. They approach us at the right time and request us to help them turn their dreams into reality.

Enjoy your work!

Kamal Hadker

## Notice from the Administration

Sterling Specifications and Standard BOQ are being updated to 2010 version. Those who have collected any new specifications, literature etc. which are not part of the present specifications, or if someone feels that our present specifications should be modified in a certain way, or new items need to be introduced, he/she may send such recommendation to Mr. Sanjay Khairnar at BKC office at the earliest.

## Social Events at Sterling

- ❖ BKC Office Cricket team clashed with UCC, Vasai on 10th and 11th January 2010 and managed to draw the two match series, 1-1.
- ❖ This Republic day was special for Amit Shinde from BKC Office, whose wedding changed the constitution of his life.
- ❖ Bhushan Patil, Sameer Ughade and Atul Jagtap from BKC office also tied the knot in the last quarter. Our heartiest congratulations to all of them.

## Welcomes and Goodbyes

These are the people who joined Sterling family in last quarter:

- Vinayak Naik : Joined as a Senior Design Engineer (Fort)
- Amol Patil: Joined as a Draughtsman (BKC)
- Sneha Parab: Joined as an Intern (BKC)
- Abhijit Patil: Joined as a Junior Engineer (B)
- Pankaj Patil : Joined as a Junior Engineer (BKC)

This is what Abhijit Patil had to say about Sterling:

*"Sterling, which literally means genuine or of highest quality, is a team of highly talented, innovative, and importantly hard working people. An engineer here gets to know and handle every phase of a project leading to his/her multi-dimensional development. The mantra I have learned during my three weeks presence here is 'Stick to the Basics'. Really proud to be a small part of such an organization at the learning phase of my career."*

Fortunately there are no goodbyes!

## Did You Know?

- ❖ Sterling is a 100% smoker-free organization.
- ❖ Since 2003, Bandra (West) Office has been starting the day with a prayer each morning at 9am where employees and seniors interact with one another after the prayers and share a "good thought" for the day.
- ❖ Prior to occupation of Second floor, Queen's Mansion, Fort by Sterling, in 1970, a dance studio occupied the premises and the timber flooring still exists as a reminder of the same!
- ❖ There are at least five Sterling Members whose fathers are/were also part of the Sterling Family. Do you know the present members? We will give their names in the next issue.
- ❖ Total strength of the Sterling family at present is 150!



## Editorial



Although the idea of having a newsletter had been at the back of our mind for a long time, we are glad to finally see it take shape and here it is! With young Vinda David as our Assistant Editor, our engineers have shown that they are not only committed structural engineers but are on the verge of becoming great writers too!

As an organization, spread over four branch offices, we have often felt the need to share information about our latest projects amongst our own engineers located in different offices. We hope that this newsletter will help bridge this gap and bring our offices together.

Each newsletter will feature a Special Project – this time, it is Palais Royale the latest trend setting project we are currently working on. At Sterling we are very proud of the project as well as the dedicated team of engineers and draftspersons working on it. Their contribution is significant and pioneering.

The section called “Down Memory Lane” will feature some of the older yet iconic projects completed by our company and highlight the challenges faced by the engineers and how they managed to overcome them using innovative engineering solutions.

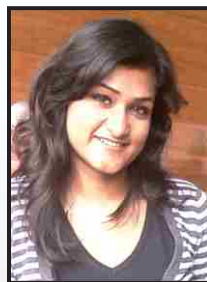
We hope this newsletter will create a sense of belonging to the Company and give an opportunity for all engineers to contribute information about their projects and in turn enhance their writing skills!

One of the ideas of having such a newsletter was also to share with everyone seemingly non-technical information but something that we bring with us to our workplace – hence you will find social events and happenings in the section on “events in the last quarter”. As a learning organization, you will also find our staff actively participating in company sponsored courses as they sharpen their skills. These activities have been highlighted in the newsletter.

I truly hope you will enjoy your first issue and actively contribute for the issues to follow.

*Dr. Deepali Hadker (Editor)*

## Focal Point



It gives me pleasure in presenting the first issue of Sterling's very own Newsletter. This being the first time, it took some time and efforts to assemble information and articles from the busy, diligent and hard-working members of Sterling. I thank all of those who helped me and furnished me with all the facts and figures. My sincere appreciation and gratitude to Dr.

Deepali Hadker, due to whom it was possible to gather scattered data and make this task reasonably easier.

Sterling has emerged as a brand name in the field of Structural Engineering Consultancy and is now acknowledged globally as an organization of remarkable technicians associated with innovative ideas. Publishing a quarterly newsletter will consequently, bring together all the news from the various branches and make us aware of just how much we have progressed as one formidable structural engineering organization.

Preparations for the June 2010 issue have already begun. If anybody would like to contribute to the newsletter, please send in your articles or suggestions to [vindadavid@gmail.com](mailto:vindadavid@gmail.com). We look forward to your support and involvement.

Regards,

*Vinda David (Assistant Editor)*

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