STERLING

ENGINEERING CONSULTANCY SERVICES PRIVATE LIMITED

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Merry Christmas & Happy New Year 2018

ITC Infotech, Bangalore

www.sterlingengg.com

ITC INFOTECH CAMPUS BANGALORE

S. B. Malekar

Project Location and General Information :

The **ITC Green Centre** building is the Phase I construction of the proposed redevelopment of the 34 acre ITC Park Campus in Pulikeshinagar, Bangalore.The Building Complex consists of two main office wings above ground level with approximate length of 196 M in East-West directions and width of 23 M in North-South directions.There are eleven office floors in each wing. The offices are spread over approximate total height of 54 M above ground level. Typical floor to floor heights are 4.0 M with first storey height of 6.0 M above ground level.The two E-W wings are connected together at 4th, 5th and 6th floor levels with a structurally isolated connecting bridge of 27M length, 22.4 M width and 7.8 M height. Below the office wings are four basements with approximate length of 243 M and width of 97 M. The basements are used mainly for parking and installing raw, filtered and fire water tanks, STP, Electrical Rooms, Transformers, Ventilation shafts and fans along with the associated equipments and machinery. Ground floor level is used for entrance lobby, retail and restaurants. Part of the floor is used for landscape, water bodies etc.The superstructure space is basically used for offices (1st to 11th floors). The central areas of about 22.4 M x 110.0 M at 4th and 5th floors are used as canteen / cafeteria. Also at 4th floor, 60 M x 21 M area is allotted for kitchen. At the Building Terraces are located Solar panels, cooling towers, ventilation equipments, O. H. Water tanks, lift machine rooms and the Articulated Jib Mast Telescoping BMU system with twin tracks for cleaning of external glass cladding of the buildings. There are in all, 24 public lifts, 4 services lifts, 8 shuttle lifts (basement to ground level) and 2 canteen lifts (4th floor to 7th floor).Total built-up area of the complex is approximately 213,600 sq. m.

Structural Schemes :

The structural schemes are suitably adopted to achieve structural and functional integrity, desirable performance under characteristic service design loads, resistance to wind and earthquake forces, durability and maintainability. The building is essentially a RCC framed structure with flat slab construction and two large shear wall cores per wing housing lift shafts, the stairs and other service rooms. Column grids of 11.2 M x 9.0 M were adopted with initial study of various options and optimisations. The central floors and the connecting bridge was adopted in structural steel for achieving faster construction of this section simultaneously with adjacent building wings to meet tight construction schedule. Secondary beams and columns in this section are designed as composite sections. In the long wings of the building, expansion joints were avoided due to probability of leakages and the scheme of shrinkage strips was adopted.

Excavation Protection Scheme :

Excavation involved for basements was of the order of 15 M. Ground water table was at 5 M below existing ground level. The scheme of Reinforced Shotcreting with soil nailing was adopted. A reliable and efficient dewatering system was installed and maintained during the construction of substructure. Scheme of under raft drainage was adopted as per recommendations of the Geotechnical Experts.

Foundation Design :

Based on the Geo-Technical Investigations and recommendations of Prof. Murthy, raft foundation was adopted under the main tower. The analysis of the raft was carried out with SAFE software adopting soil subgrade modulus of 1600 KN/Cu. M.

Structural Analysis :

The Building is a RCC shear wall-column–flat slab frame structure inclusive of structural steel connecting bridge. A complete two wing computer model was generated on ETABS software.

Steel Connecting Bridge :

The connecting structural steel bridge has a separate structural scheme with three two floor deep trusses in N-S directions to support the internal floor. Secondary beams carrying RCC slab cast over metal deck. The Bridge is supported on six specially designed Lead Rubber Bearings. The isolated bridge structure was also analysed using STADD-PRO software. The design was carried out using British Code of Practice BS-5950. Special scheme and methodology statements were developed by the Contractor for shop fabrication, transportation, site assembly and the erection of steel members.

Feature of Impressive Picture Windows :

As per Architectural Planning, "Impressive Picture Windows" were created at the centre of North and South wings. The floors at 7^{th} and 8^{th} levels were deleted and columns on grid 12 were terminated at 6^{th} floor level. A bridge like structure was created by provision of steel girders at 9^{th} and 12^{th} levels and interconnecting steel columns on the central grid. These two floors are in steel with floor slabs cast on metal decks. The intermediate floors at 10^{th} and 11^{th} levels are maintained as RCC flat slabs. The central grid supports for these floors are in the form of steel hanger columns connected to girders at 9^{th} and 12^{th} levels. Thus, the loads of 10^{th} and 11^{th} floors are shared by floors at 9^{th} and 12^{th} levels.

Special scheme and methodology statements were developed by the contractor for shop fabrication, transportation, site assembly and the erection of steel members.

- The concrete grade adopted was M40 and M50. The reinforcing steel used is IS 1786 Fe 500 D grade.
- The structural steel members conformed to IS 2062 grade E 350 (Fe490).
- Tubular members used for provision of Trellis conformed to IS 4923 Yst 310.
- All flat slab floors are in pre-stressed concrete.

Multi Purpose Hall :

A separate building for multi-purpose hall 37 M long x 24 M wide is planned over part of basements using some of the columns provided in basements. The building has 27 M x 22.4 M hall with clear height of about 8.6 M. The roof over the hall is in structural steel with main beams spanning 22.4 M. Roof RCC slab is cast over metal deck spanning over steel secondary beams. The North bay (9M x 24M) with intermediate floors is in RCC housing stairs, toilets, AHUS, Electrical Rooms etc.

Main Security Building :

The Main Security Building is a single storey building of about 210 sq. m. with a roof at 4.5 M above the ground floor. For flexibility of internal planning, only peripheral columns are adopted. Internal room walls are supported on ground floor slab. On external facade glass cladding is adopted. The superstructure of the building is in structural steel with rigid jointed main frames and simply supported secondary beams. The RCC roof slab is cast over metal deck.

Malekar Sir with Ketan, Rahul, Pradeep, Sujit, Udit, Nilesh, Anand, Shekhar & Anand.

VGS JALDHARA, MUMBAI "TUNNEL FORMWORK" Dhawal Sambare

Every Project has its own importance, uniqueness and special features from a Structural Engineer's point of view. So was the case with the Residential Towers (Sale and Rehab) by M/s Omkar Realtors, at Goregaon, Mumbai. One of the features which made this Residential project stand out from others is the type of form work system used, viz. "Tunnel Formwork".

Client wanted to complete the construction of the Rehab tower (Ground Floor + 23 Floors) at the earliest, as they had to pay for the rent until the residents were shifted back to the rehab tower. Hence, Tunnel formwork system was adopted as it helps in huge reduction of time per production cycle, though its cost is high compared to the conventional formwork system. The same formwork was used for the Sale Tower of Ground + 3 podiums + 33 Floors.

Tunnel form work system is an industrialized construction technique in which structural walls and slabs are cast (in situ) simultaneously using steel forms composed of vertical and horizontal panels set at right angles. A production cycle of 3 days was achieved, which proved to be advantageous in saving time resulting in reduction of overall cost. According to the slab calculations, strength of 3 MPa was required at the time of de-shuttering, including construction loads. As per IS 456: 2000, the strength of concrete at the time of de-shuttering should be twice the stress to which it may be subjected, hence required strength of concrete at the time of de-shuttering informed at site was 8 MPa.

Co-ordination between all the consultants involved in a project is a key factor for its successful completion. And it becomes very crucial, especially for a project with tunnel formwork system. After proper co-ordination between service consultant and tunnel form vendor, services runs were installed in slabs and walls before concrete was poured. Tunnel formwork has some restrictions. It cannot be used in Basements as removal of formwork is not possible. It is not convenient for Halls, theatres etc. with large spans. It is not possible to provide sunken slabs.

Connecting the City : People, Density & Infrastructure Girish Dravid

As the representative of Indian Chapter of Council on Tall Buildings and Urban Habitat, Girish Dravid attended its annual international conference at Sydney, Australia, from 29th October till 3rd November, 2017. There were over 1200 participants from 47 countries and 200 speakers distributed in nine parallel tracks! The theme of the conference was "Connecting the City".

The highlight of the conference was to spread awareness about our responsibility to ensure that urban structures address the greatest challenges of our time: unprecedented population growth; mass urbanization; climate change; environmental degradation; social, political and economic change; and the rapid advance of myriad technical innovations.

Physical urban infrastructure, circulation, greenery, and urban functions traditionally restricted to the ground level would all, ideally, continue up and into the building, such that the buildings themselves become an extension of the city: a part of the two-dimensional horizontal urban plane flipped vertical.

LODHA - VENEZIA Kalpesh Mhatre

The Twin towers at Kala Chowkee soar to a height of more than 200 meters in the sky. Each tower has a floor area of 7500 square feet, and has 59 residential floors with plan dimensions of 30m x 30m. With height to width ratio reaching nearly 7.5, it posed several structural problems which were solved ingeniously. Both towers have solid cores which are designed to resist nearly the entire lateral load. The west tower which is taller and slimmer has outrigger girders in structural steel at fire check floors to gather more stability.

Around the two towers is a complex car park structure which has public car park in the basement, bus parking at ground and first floor and car parking for the apartments above with a roof top garden. This structure has three basements and five upper floors. The garden above terrace has been themed on the waterways of Venice and has several waterways and water bodies.

Due to height and open space constraints the construction of towers also was a challenging task. High performance concrete was used in 2.2 meter deep raft. Pre engineered shuttering system was used for constructing the upper floors.

DOSTI VIJETA Kalpesh Mhatre

In one of Thane's prime location, stands the 100 meter tall luxurious apartment tower. It has two basements which house the mechanical car parking. The building has a floor area of 19,200 square feet with plan dimension of 76 m x 29 m and has 29 residential floors. It has three wings.

The building construction was originally planned with conventional form work. However, after constructing a few floors the conventional form work system was replaced with pre-engineered aluminum shuttering. This change posed some structural challenges which were dealt with without causing any delays in construction schedule. The non-uniform architectural façade also posed both constructional and structural challenges.

Residential Building at Modern Mills for K Raheja **Dinesh Bhaud**

Overlooking the Worli sea face, this high rise residential building commands scenic views of the city and surrounding heritage structures such as the Haji Ali Darga, Mahalakshmi Temple and Race course, Mazagaon dock etc. This building has a unique slenderness ratio of 11.85, standing 237 meters above ground level and spanning only 20 meters in width and 77 meters in length! To withstand the enormous wind loads a special device system in the form of a dedicated damper floor is used to control the lateral sway and bring down the acceleration values. Keeping these values within permissible limits, there will be no discomfort felt by the residents of this building.

The high end residential building is well equipped with two basement floors, seven podiums/parking floors and one amenity floor. Resting on these floors are 47 typical residential floors including seven-part refuge floors, four service floors and four fire check floors (fire check floors are utilized as outrigger floors), one damper floor, a terrace an LMR, and a overhead water tank.

A conventional R.C.C framed structure with columns and shear walls, this building has been provided with a shear core at the center along its length to resist the lateral forces which are prominent in structures with such height. Apartments will have conventional beam slab system.

By restricting the depth of the beams running through the building to 600 mm in typical floors and 450 mm in parking floors, sufficient head room has been achieved. All the columns, running from foundation to terrace level are designed without any transfer of load path, thus completely avoiding the need for floating.

Four, 1.8m high structural outrigger floors provide additional strength to the building against lateral loads. Dampers are provided at the top floor in the form of liquid tanks/ reservoirs, the position and configuration of which will be decided upon the micro level analysis to be performed by a wind engineering specialist. This tall building is anchored by a 3.5 meter thick raft resting on hard rock having uniform safe bearing capacity.

Speakers left to right

Umesh Joshi, J + W Consultants
Girish Dravid, Sterling Engineering
Anil Hira, Buro Happold
Dr. Suresh Kumar, RWDI
Hemant Vadalkar, STAAD Engineers
Dr. Deepali Hadker, Sterling Engineering
Dr. Vasu Nori, Shirish Patel and Associates
Kamal Hadker, Sterling Engineering
Alan Klembczyk, Taylor Devices
Sandeep Shah, Miyamoto International
Allwyn Noronha, ITC
Hitesh Barot, Ambuja Cement

Distinguished Speakers at World Build India, 2017

ARTESIA - METAL BOX for K Raheja

Abdul Hafiz

Artesia is a unique, high end, high rise residential building presently under-construction in Worli next to the landmark Doordarshan Tower. The building has two basements, a Ground floor, five podiums / parking floors, one stilt level, and 45 typical residential floors (including seven-part refuge floors, six service levels, three fire check floors) a terrace, Lift Machine Room, and overhead water tank. The building height up to terrace level is 225 m above existing natural ground level.

The building is unique because of its "Mass irregularities" along the height of the building. A part of the typical floor stops at 18th floor and the remaining plan area continues up to terrace. Because of this uneven distribution in mass about the axis, the building has a tendency to tilt in one direction under heavier gravity load on one side, thereby producing tension in the half of the central shear core on the opposite side. Displacement and tension become worse under lateral load. To bring down building deflection within safe limit and to nullify the tension effect, high tensile bars have been used in part portion of core wall which experiences tension.

Compression is induced in the wall by vertical tensioning of these bars after casting of core wall. The reason for choosing high tensile bars over pre-stressing cables was to use them as compressive reinforcement in case of reversal of forces.

The building is a framed structure with composite column and central structural core wall. The central core wall has been designed to resist entire lateral loads. Columns are designed as Gravity columns. However, they have been designed to resist at least 25 % of the lateral load.

Floor system for residential units is flat plate peripheral beam system. All the columns are Encased Steel-composite columns, running from foundation to terrace without any transfer of load path, floating is completely avoided.

Three structural outrigger floors are provided with 1.8 meters height each. These floors provide additional strength to the building against sway. This tall building is anchored by the 3.5 meter thick raft resting on hard rock having uniform safe bearing capacity of 150 Tons/sq.m.

Team Sterling At Worldbuild India 2017

ITC KOHINOOR HYDERABAD

Manish Negandhi

ITC Kohinoor is a Luxury Hotel and Serviced Apartments project in Hyderabad. The topography of the site was such that the levels within the site varied by approximately 3 m from North end of the plot to the South. This enabled the planning of basements quite effectively. The estimated construction cost for the project was approximately 600 crores. The total area for the project is 8.4 lakh sq. ft. The conceptual design was done by W. S. Atkins and Thomas Associates were appointed as the local Architects.

Hyderabad has a semi-arid climate throughout the year. Keeping this in mind the architects had oriented the building mass in such a way that the building had minimum solar gain in summer and maximum in winter. The mass is tapered downwards to further reduce solar heat gain on East and West Facades. The Tower mass is floats above the podium creating a clear canvas of green landscape. This lift creates a link between the front and rear landscaped areas.Inspired by the volcanic stone rock formations famous in Hyderabad, the edges of the building have been smoothened to reflect this landscape.

Services above the podium are concealed in green mounds coming out of the landscape. Those mounds connect the tower to the ground and support the mass. This projection of the podium services helps to expose some of the hotel facilities like ballroom, meeting rooms and health club. Within the green valley created by the podium mounds, a metaphor of the Koh-I-Noor diamond was used to house the front of house facilities; creating islands within the artificial jungle. These functions include the reception desks, the lobby lounge and All Day Dining area. The project is broadly is divided in three wings viz West Wing, Central Wing and East Wing.

Architect's suggested column free area in the central wing spanning 36 m. Sterling worked out cost comparative statements for various spans for the central wing. Based on the comparative statements it was concluded to have minimal columns in the central wing. Accordingly, the central wing is supported on end walls and four columns breaking the spans to 12 m.

Various alternatives along with costing for the central wing were presented to finalize the scheme. Based on the comparative statements it was concluded to adopt Option 3 for the central wing. Girders were the most complex members of the structure and hence utmost care was taken in the design and analysis of the same. It may be quite uncertain to judge the exact behavior of the Girders and hence different closely relevant theories were applied in the analysis of the Girders. They were analyzed and designed as per the theories listed below:

1. Classical method (Simple flexural theory):
2. Line element in Etabs
3. Spandrel in Etabs
4. Strut and Tie method

The final design satisfies all the above mentioned different analysis, design and detailing methodologies; thus assuring to overcome limitation of individual methods.

NEW CUFFE PARADE, WADALA Santosh Kadam

These world class iconic office spaces have been developed by Lodha in New Cuffee Parade. Majestic branching tree columns are the stamp of its signature address and intelligent floor plans are provided by Architects - Woha from Singapore.

The Tower stands 29 storied high and is crafted after overcoming various structural engineering challenges. The most important task was to control its deflection. For this, the central core and the tree columns act as the lateral load resisting system. The exterior branches of trees columns were finalize after many iterations for removing redundant members.

External PT forces are applied at L05 level to balance the tensile force in 500 mm thick transfer floor, due to outward deflection of flared columns with 2 m projection. Approximately, 40,000 KN force has been applied on all four sides of the building in 2 stages of the project completion. In order to avoid the PT force acting on core walls in minor direction, these forces and tendons are applied diagonally to the floor plate. The other challenging task was to design and detail the tree shaped RCC columns. This was done by first establishing the load path for varying shape of the tree columns. Deep corbels are provided to support the tree shaped columns to cater to the architectural requirement. The tower is almost 90% complete and the balance work is in progress at a fast pace.

Mr. Kamal Hadker was invited to speak at a Webinar on 17th November 2017.

This was part of TISCON's eDiscovery Seminar series where eminent engineers and architects are invited to speak about the latest cutting-edge industry information and opportunities to grow in their fields. Mr. Kamal Hadker presented his seminar on how Steel becomes the inevitable choice for tall structures. He cited examples of projects like the Bombay Stock Exchange, Four Seasons Hotel, CrossRoads II, ICICI Headquarters in BKC, Sunshine Tower in Dadar, Residence Antilia and Kingfisher Towers. The seminar was followed by an interactive question and answer session conducted on-line.

GODREJ TREES Vikhroli Aniruddha Dhupkar

"The Trees" is a flag ship project of Godrej Properties Limited set in the lush green vicinity of a creek in Vikhroli. This is mainly a residential project with wide mix of spaces from studio apartments to lavish penthouses numbering to more than 700. The project is divided into two phases with one common double basement having 9 buildings. The total residential area is about 55,000 square feet. Due to aviation requirements, the buildings are limited to a maximum height of 57 meters from the ground.

The Clients wanted to provide all modern facilities to the residents with built in flexibility of planning. This posed several challenges to our structural engineering team. The aviation requirement put severe constraints on floor to floor heights. In order to have flexible planning, number of beams and columns were also reduced. Both these aspects had to be accommodated in structural design. Requirements of penthouses and duplex flats posed another challenge as internal staircases had to be accommodated in the buildings without significantly altering the floor plate layout. Planning of services such as air-conditioning and plumbing was done with these special requirements. As a result the structural plans had to be carefully fine-tuned with all these aspects.

With these challenges in place engineering team at Sterling worked in close coordination with construction team resulting into a meticulously planned structure constructed in a record time. Once completed, the Trees project is expected to be a landmark in this area.

Kandeel by Pradeep

DIWALI 2017 Celebrations at Sterling

This year, Diwali celebrations marked a very special time for all staff members at Sterling. All the three branches of Sterling Mumbai, came together and celebrated Diwali as "One Family". There was enthusiasm in the air, sparkling diyas and beautiful rangolis very creatively made by our talented engineers and draftsman who were all dressed in their best Diwali attire. A Rangoli competition was held and the Fort Office team won the 1st place! Everyone enjoyed the traditional "pharal" and sweets. The atmosphere in the office was full of joy and celebration and the feeling of togetherness prevailed.

Ravi and Team

Rangoli in the office lobby

Janata Raja

Salt Rangoli

Welcome Rangoli

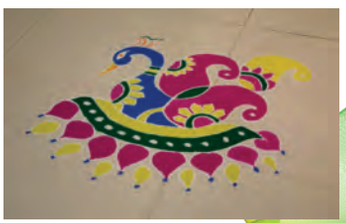
Hemali and Team

Diptesh, Vishal, Kiran

Dinesh and Team

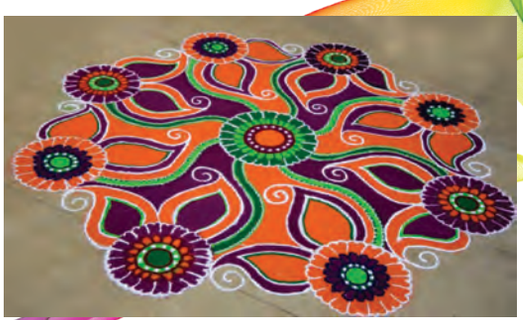
Rangoli by Dinesh and Team

Flower Rangoli by Hemali and Team



Rangoli in Reception Area

Winning Team with Mrs. Savita Dravid



Vibrant Winning Rangoli

LIFETIME ACHIEVEMENT AWARD TO MR. KAMAL HADKER

In the Structural Engineering Category, **ACE Alpha Awards** gave **Mr. Kamal Hadker the Lifetime Achievement Award** for his contribution to Structural Engineering and Nation Building. The Award was presented by **Dr. R. C. Sinha** (IAS Retd.), Advisor to the Government of India, Ministry of Road Transport and Highways and Ministry of Shipping.

The Award ceremony took place at the Hotel Sahara Star in Mumbai on the 3rd of November 2017.

- *We are proud to announce that **Sterling Engineering** was conferred with an award for being the STRUCTURAL CONSULTANT of "TRITVAM PHASE 1 - COCHIN".*

  The felicitation was held at KOCHI MARRIOT HOTEL on 30th October 2017 organised by Ultratech Cement and Indian Concrete Institute.

- ***Sterling Engineering** won the **Birla Super Award** for it's contribution to Kingfisher Towers, Bangalore 2017 as an Outstanding Concrete Structure of Karnataka.*

2018 ... BRING IT ON !

From the Editors Desk

Dr. Deepali Hadker

As I put together my thoughts for the last newsletter of this year, I am filled with a sense of gratitude and pride for the work completed by us. It is with renewed enthusiasm that we will all welcome the New Year, head on! Celebrations are in the air and we wish all of you a Very Merry Christmas and a successful, peaceful and satisfying 2018!

Our cover story showcases the striking ITC Green Centre in Bangalore which we recently completed. Do take a look at the article by Dhawal Sambare where he describes a completely new technique called "Tunnel Forming" which was used at the VGS Jaladhara project in Mumbai.

As the challenges keep coming in, we are able to provide structural solutions for them in an aesthetic manner - for instance, the article on NCP project in Wadala describes the tree shaped columns which give a unique vocabulary to the building. Standing tall and slender, the buildings at Modern Mills and Venezia are simply stunning! We applaud the sincere efforts and hardwork put in by our dedicated team of engineers & draftsman who strived towards overcoming these challenges and are now seasoned to face new unexplored horizons!

May we make the most of the opportunities and chances we get in the year 2018!

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