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INDIAN SOCIETY

OF

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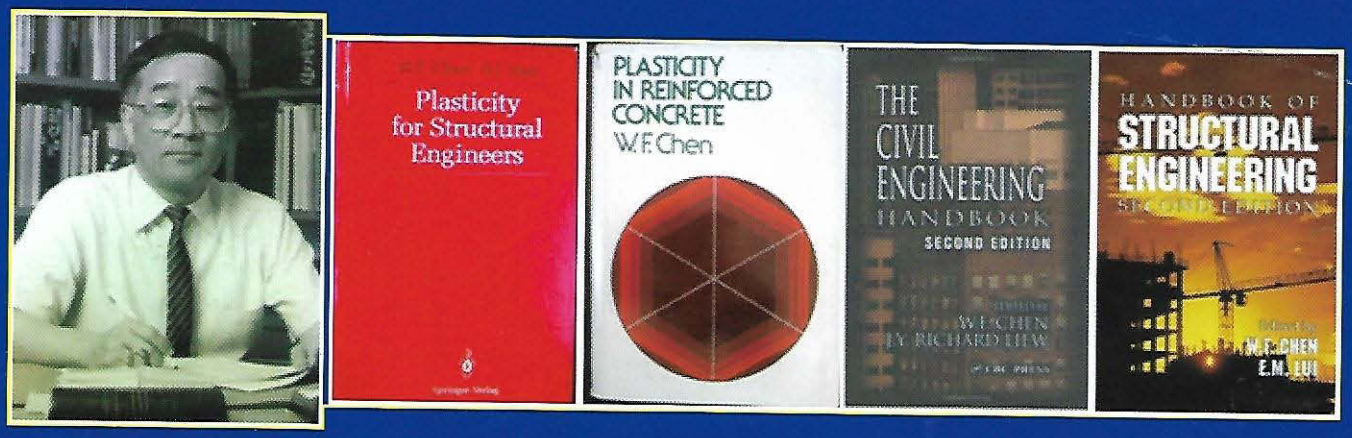

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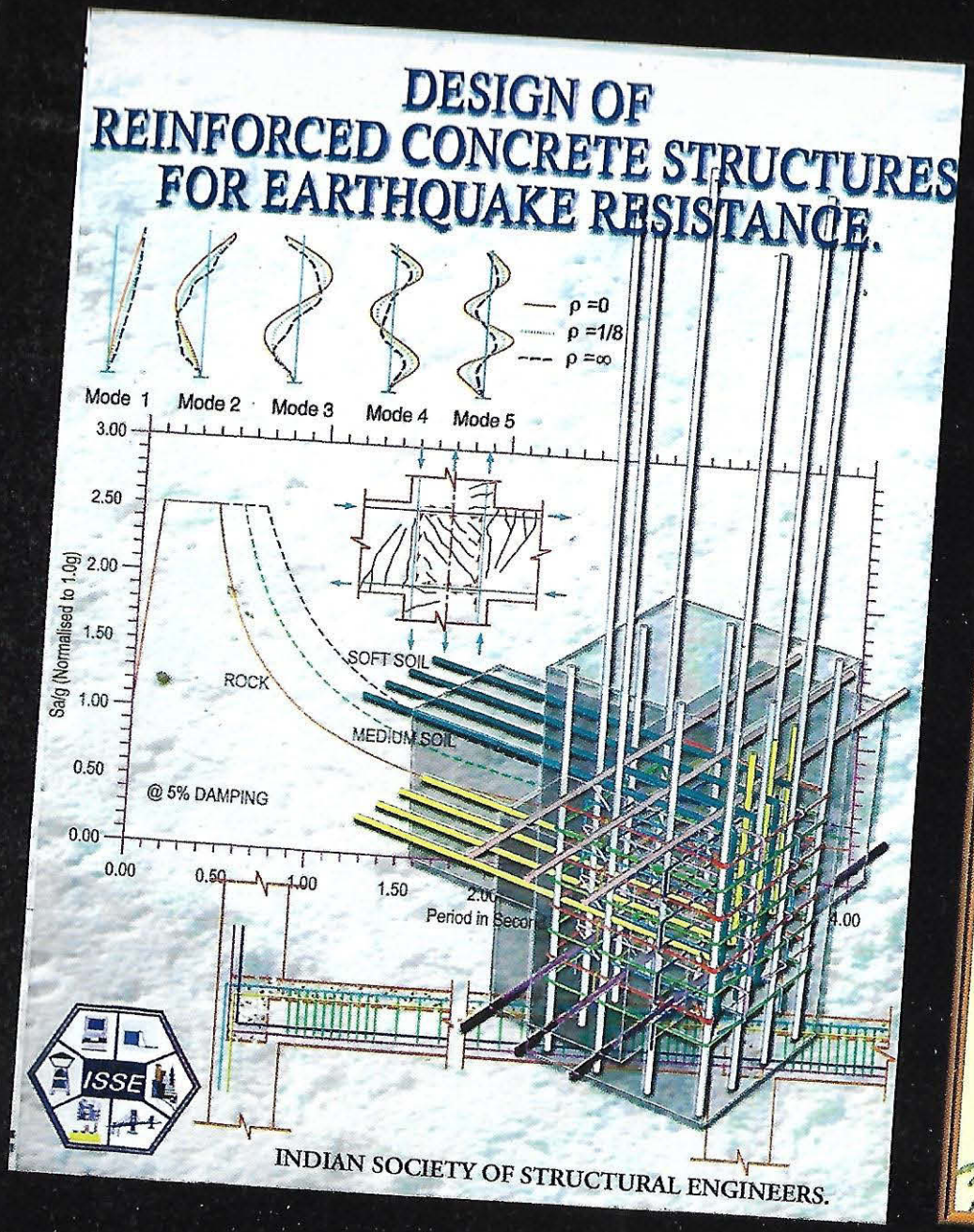
LET US BUILD A STRONG STRUCTURE OF INDIAN SOCIETY


DESIGN OF
REINFORCED CONCRETE STRUCTURES
FOR EARTHQUAKE RESISTANCE.
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ρ =1/8
ρ =∞
Mode 1
Mode 2
Mode 3
Mode 4
Mode 5
Sa/g (Normalised to 1.0g)
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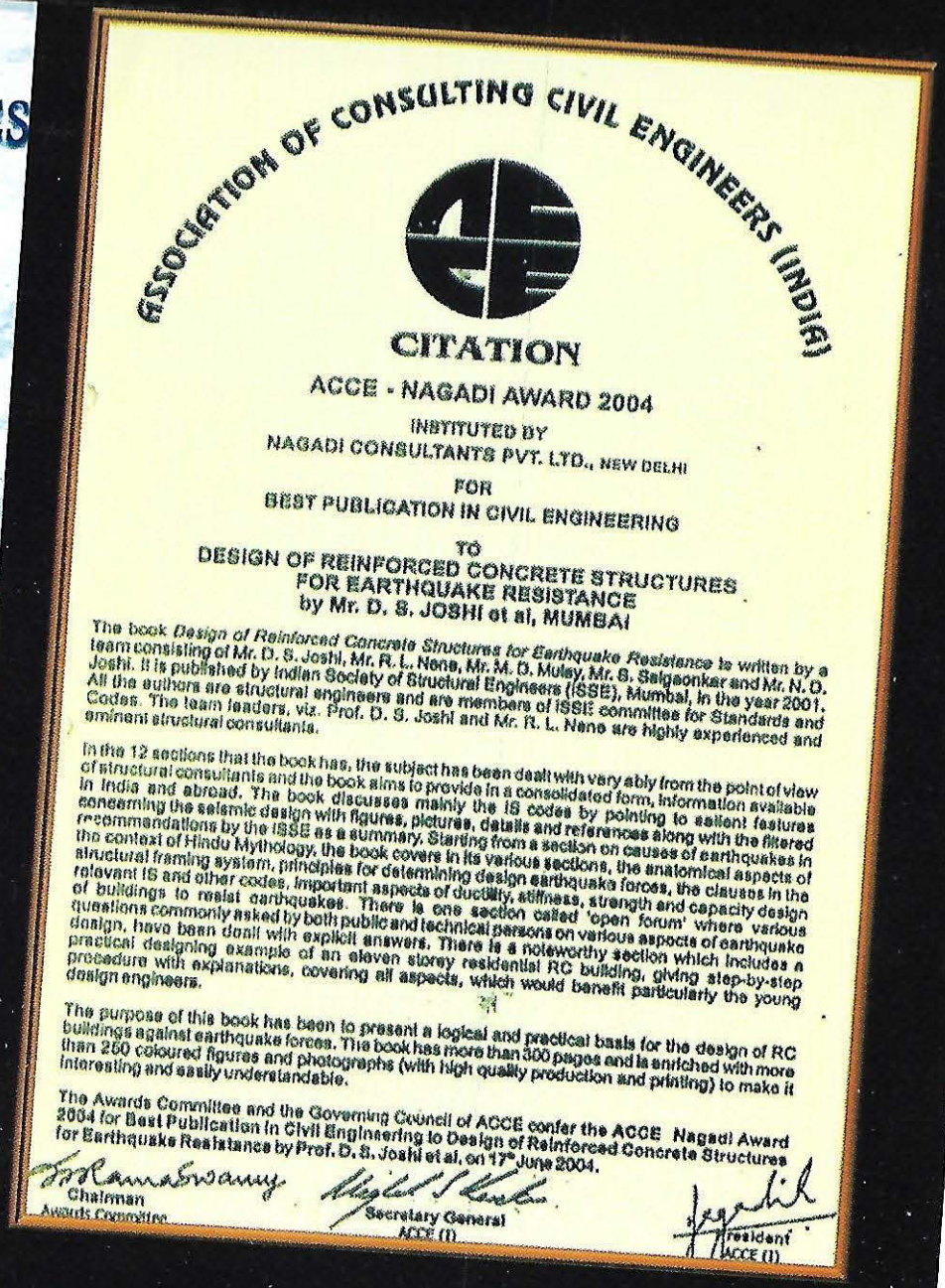
ASSOCIATION OF CONSULTING CIVIL ENGINEERS (INDIA)
CITATION
ACCE - NAGADI AWARD 2004
INSTITUTED BY
NAGADI CONSULTANTS PVT. LTD., NEW DELHI
FOR
BEST PUBLICATION IN CIVIL ENGINEERING
TO
DESIGN OF REINFORCED CONCRETE STRUCTURES
FOR EARTHQUAKE RESISTANCE
by Mr. D. S. JOSHI et al, MUMBAI
The book Design of Reinforced Concrete Structures for Earthquake Resistance is written by a team consisting of Mr. D. S. Joshi, Mr. R. L. Nene, Mr. M. D. Mulay, Mr. S. Salgaonkar and Mr. N. D. Joshi. It is published by Indian Society of Structural Engineers (ISSE), Mumbai, in the year 2001. All the authors are structural engineers and are members of ISSE committee for Standards and Codes. The team leaders, viz. Prof. D. S. Joshi and Mr. R. L. Nene are highly experienced and eminent structural consultants.
In the 12 sections that the book has, the subject has been dealt with very ably from the point of view of structural consultants and the book aims to provide in a consolidated form, information available in India and abroad. The book discusses mainly the IS codes by pointing to salient features concerning the seismic design with figures, pictures, details and references along with the filtered recommendations by the ISSE as a summary. Starting from a section on causes of earthquakes in the context of Hindu Mythology, the book covers in its various sections, the anatomical aspects of structural framing system, principles for determining design earthquake forces, the clauses in the relevant IS and other codes, important aspects of ductility, stiffness, strength and capacity design of buildings to resist earthquakes. There is one section called 'open forum' where various questions commonly asked by both public and technical persons on various aspects of earthquake design, have been dealt with explicit answers. There is a noteworthy section which includes a practical designing example of an eleven storey residential RC building, giving step-by-step procedure with explanations, covering all aspects, which would benefit particularly the young design engineers.
The purpose of this book has been to present a logical and practical basis for the design of RC buildings against earthquake forces. The book has more than 300 pages and is enriched with more than 250 coloured figures and photographs (with high quality production and printing) to make it interesting and easily understandable.
The Awards Committee and the Governing Council of ACCE confer the ACCE Nagadi Award 2004 for Best Publication in Civil Engineering to Design of Reinforced Concrete Structures for Earthquake Resistance by Prof. D. S. Joshi et al, on 17th June 2004.
Chairman
Awards Committee
Secretary General
ACCE (I)
President
ACCE (I)

STRUCTURAL ENGINEERS
QUARTERLY JOURNAL

INDIAN SOCIETY OF STRUCTURAL ENGINEERS

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Patrons : 37	Organisation Members : 22	Sponsor : 8
Members : 1626	Junior Members : 45	IM : 01

TOTAL STRENGTH 1739

- ❄ 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

1. To restore the desired status to the Structural Engineer in construction industry and to create awareness about the profession.
2. To define Boundaries fo Responsibilities of Structural Engineer, commensurate with remuneration.
3. To get easy registration with Governments, Corporations and similar organizations 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.

Gem 16 : Prof. W. F. Chen - A pioneer in soil plasticity, stability & steel design

Dr. N. Subramanian
Er. Vivek G. Abhyankar

Prof. Wai-Fah Chen (1936-)

Dr Wai-Fah Chen — a Chinese-born American academic and widely recognized structural engineering specialist in the field of mechanics, materials, and computing — has certainly led a fascinating life. A wellrespected leader in the field of plasticity, structural stability, and structural steel design over the past halfcentury, he has made major contributions to introduce the mathematical theory of plasticity to civil engineering practice, especially in the application of limit analysis methods to the geotechnical engineering field. Having headed the engineering departments at the University of Hawaii and Purdue University, Chen is a widely cited author and the recipient of several national engineering awards, including the 1990 Shortridge Hardesty Award from the American Society of Civil Engineers and the 2003 Lifetime Achievement Award from the American Institute of Steel Construction.

Early Life

Wai-Fah Chen and his twin brother, Wai-Kai, were born in Nanking, the capital of Nationalist China in 1936. The Sino-Japanese War just started at that time(1937-1945) . His father retreated with the government to Chongquing, with his eldest brother, Hollis, while his mother took the other children back to her parents' home in a remote village near the county Ching-TienHsien in Chekiang Province, to escape the war. After the Sino-Japanese War in 1945, his family reunited in Nanking, and settled down in a very nice house near the old palace. Young W.-F. Chen was ten years old and he and his twin brother Wai-Kai attended a primary school for children of the Chinese Air Force personnel near his house. His elder sister, Eileen was attending the famous King-Ling Girls Junior High School. He recalls that this was the first time they were living together with his father and siblings except his eldest brother, Hollis.

Unfortunately, this peaceful time did not last long and the Civil War between Nationalist and Communist startedimmediately after the Sino-Japanese War. Again, his father was forced to plan another family retreat and family separation followed shortly. In the summer of 1948, his parents sent the children back to the coast city, Wen-Chow, 100 miles from their native county, Ching-TienHsien, to stay with their Aunt. There, he and his brother Wai-Kai entered the fifth grade in a private primary school.

In the winter of 1949, his parents again hired an agent in Taiwan and asked him to escort three of the children back to Taiwan. What happened next, as narrated by Prof. Chen in his book "My Life's Journey", looks like the 2017 war movie*Dunkirk*. They traveled with the agent in a boat. With lot of interruptions by pirate ships, Army, etc., and after a long wait, the boatfinally docked at a place called Ta-Chen. The children saw wounded soldiers and people being killed. At this locationtheir agent suddenly disappeared. Then, somehow, they were transferred to a bigger ship called *J-Phone*. Though this ship belonged to a Nationalist intelligence office, it acted as a pirate ship, shooting at other

ships. After a few days, it dockedin a small island near Taiwan. After a few days of living in the island, the children found that their ship, *J-Phone*, also disappeared. With lot of sufferings on board of another ship, they finally sailed to Keelung Harbor, Taiwan. They were allowed to go out of the harbor only during the night. As their parents were unaware of their travel, they were pleasantly shocked when the children reached their Taipei house in the night and reunited.

Engineering Education in Taiwan and USA

In Taipei, he and his twin brother, Wai-Kai entered as sophomores in the Junior High School of the Taiwan Normal University. He observes that in the school, which had mainly students retreated from Mainland China, boys and girlswere separated due to the conservative approach adopted by the schools there! In 1955, he graduated from the Senior High School of the Taiwan Normal University, passed the national examination, and entered the National Cheng-Kung University (NCKU) in Tainan, Taiwan.With American aids and educational reform, higher education in Taiwan was Americanized, with the help of Purdue University in West Lafayette, Indiana, USA acting as their counterpart.He had to follow English textbooks for the first time and several of his classes were taught by professors from Purdue University. He received his BSCE degree from NCKU in 1959.

After graduation, his father asked him to join the newly established Chinese Air Forces Academy as a fighter pilot, though personally, Prof. Chen wanted to become a teacher, following the footsteps of their family tradition. Anyway, young Chen got enrolled as a graduate student in the Department of Civil Engineering in Lehigh University, USA, in 1961, when the famous Prof. L.S. Beedle was the Chairman of the Department. Chen says that his tuition was waived and in addition, he received $2000 per academic year as assistantship, and he used to send $50 per month from this to Taiwan to support his parents (this practice of sending money lasted 45 years!). He also bought engagement ring for his wife Linlin in 1966 for $750! The subject of *Plastic Design of Steel Structures* was researched at Lehigh at that time. His immediate research supervisor was John Hanson, who was doing Ph.D. on shear strength of RC beams, and young Chen helped him to test RC beams(Hanson later became distinguished Professor of North Carolina University). Chen received his M.S. Degree in 1963.

Then he decided to transfer to Brown University in Providence, Rhode Island to focus on theoretical work of solid mechanics.There he worked for his Ph.D. with Daniel C. Drucker (he and Prof. William Prager, at Brown University, did pioneering work on modern theory of plasticity), during 1963-66, on structural limit analysis and earned his Ph.D. in Solid Mechanics in 1966.

Teaching Career at Lehigh

Dr. Chen joined as a faculty in Lehigh University in 1966 and served as an assistant, associate and full professor of civil engineering during 1966-1976.He first worked with Prof. L.W. Lu and worked on the research project "*Columns under bi-axial Loadings*" and on "*Beam-to-Column Connections*" under Prof. Beedle. With Beedle,he contributed to the writing of the ASCE's Manual 41 on *Plastic Design in Steel*. Chen also contributed chapters to the books edited by Beedle such as "*Structural Stability: A World View*" and "*Tall Buildings and Urban Environmental Series*" published by McGraw-Hill. Prof. Chen recalls that Prof. Beedle, who headed the Structural Stability Council (SSRC) for 25 years and founded the Council on Tall Buildings and Urban Habitat (CTBUH), and asked fellow faculty to get involved in these organizations and contribute their expertise.

Teaching and Research at Purdue

Prof. Chen at Purdue University

After leaving Lehigh in 1976,Prof. Chen joined Purdue as Professor of Structural Engineering, and later became Head of Structures in 1980 and appointed the first George E. Goodwin Distinguished Professor of Civil Engineering in

1992. There, he built and expanded the core group of faculty in engineering and applied mechanics. He also started research activities on construction safety assessment, domain-specific software development, and advanced analysis of steel design, among others. During his 23 years of stay, till 1999, at Purdue he produced 46 Doctoral students and guided several Masters students. His first Japanese student T. Atsuta (with whom he wrote the outstanding 2 volume *Theory of Beam-Columns* book) sent several students from Japan and from 1980s he had several Ph.D. students from Taiwan, Arab countries and Korea. In 1981 he returned to China, the first time since he escaped to Taiwan in 1950, when he was invited by the Nanjing Institute of Technology, China to give lectures for two weeks.At his later years at Purdue he was active in the field of Advanced Analysis.It has to be noted that this field is now well developed, verified and coded first by the American Institute of Steel Construction in its 2005 AISC Specifications.

Educator at University of Hawaii

Since 1999, Chen has been Dean of the College of Engineering at the University of Hawaii at Manoa. In this new role, he worked to strengthen faculty, improving facilities at the college, and to attract good students. After his retirement in 2006, he is continuing to work as a Research Professor of Civil Engineering at the University of Hawaii.

Notable achievements:

Prof. Chen was the first to show his students how limit analysis could be used in the analysis and design of practical soil mechanics problems in engineering practice and reproduce almost all the existing solutions in the well-known textbook by Terzaghi in a simple and original manner. He wrote textbooks to introduce the highly mathematical theory of plasticity into standard civil engineering teaching curriculum. Collaborating with his former Ph.D. students, who are now working as professors in different countries of the world, he has written several important books and Handbooks for the benefit of practicing engineers and researchers.

He notes in his biography that he is most proud of being a *'admired friend'* of his fellow associates and former students, rather than being called as an educator, teacher or a practicing engineer.

He is humble to state that his success was due to the fact that he had the privilege of standing on the shoulders of three giants- Prof. Drucker, his thesis adviser at Brown University, Prof. Beedle, his mentor at Lehigh University, and Prof.Goldberg, his colleague at Purdue University

Awards and Honours

Prof. Chen was included in the book *Giants of Engineering Science*, a biographical monograph examining the life and works of ten of the world's leading engineering scientists. Chen has been well cited for his contributions to structural and geotechnical mechanics. He was elected as a member of the National Academy of Engineering (NAE) in 1995.

Receiving the AISC Lifetime Achievement Award

Receiving the Brown Medal

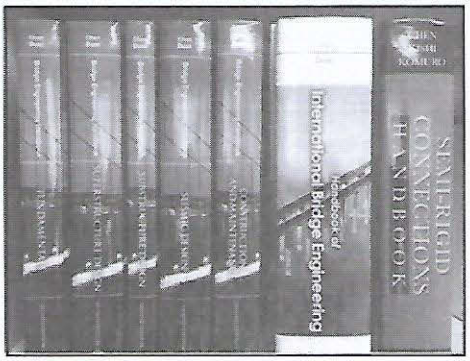
When elected to the National Academy of Engineering

His other Awards and honoursinclude:

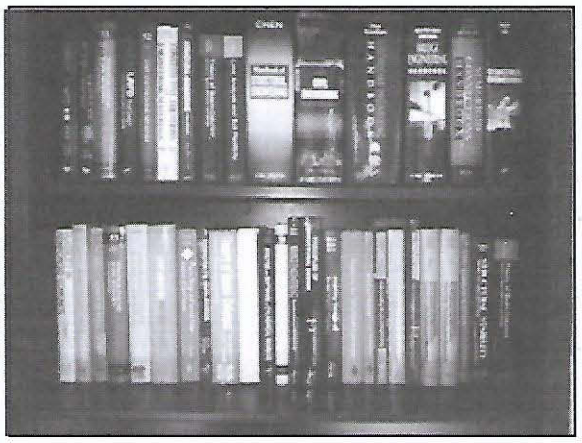
- 1984 US Senior Scientist Award, Alexander von Humboldt Foundation, Germany
- 1985 T.R. Higgins Lectureship Award, American Institute of Steel Construction
- 1985 Raymond C. Reese Research Prize of the ASCE
- 1988 Distinguished Alumnus Award, National Cheng-Kung University
- 1990 Shortridge Hardesty Award of the ASCE
- 1991 Honorary Fellow, Singapore Structural Steel Society
- 1997 Awarded Honorary Membership of the ASCE
- 1998 Elected to the Academia Sinica (Taiwan's National Academy of Science)
- 1999 Distinguished Engineering Alumnus Medal, Brown University
- 2003 Lifetime Achievement Award, America Institute of Steel Construction.
- 2003Featured in the biographical monograph "*Giants of Engineering Science*" as one of ten of the world's leading engineering scientists, UK.

Books Published

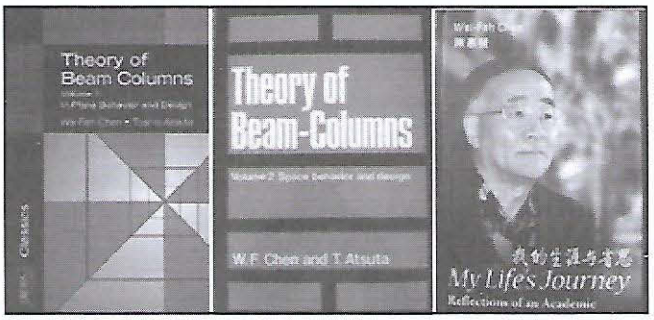
In addition to his teaching, Chen is the author or co-author of more than 18 books, 41 contributed book chapters, 344 refereed technical journal papers, 244 papers in conference proceedings and symposium volumes, and the editor of 22 books (which include several voluminous Handbooks). Following his 2003 Lifetime Achievement Award from the American Institute of Steel Construction, Chen wrote his autobiography titled "*My Life's Journey*."

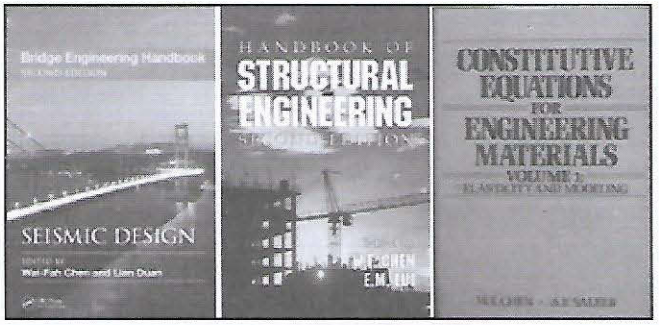


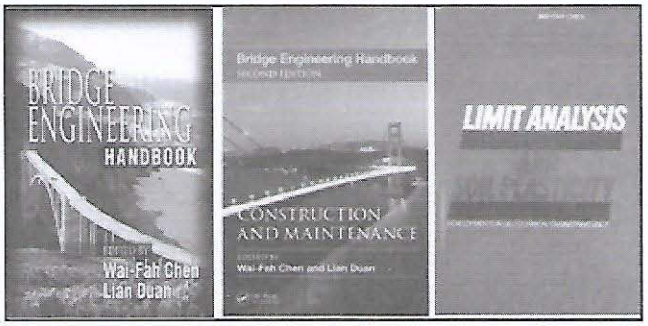
Prof. Chen's most recent 3 Handbooks including 5-volume Bridge Engineering Handbook, an International Bridge Engineering Handbook and a very unique collection of valuable semi-rigid connection test data ready for practicing engineers to use.

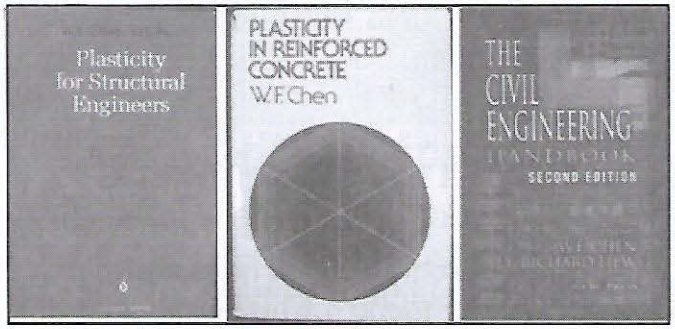


Books of Prof. Chen- at a glance









Personal information:

Most of his siblings and children are also highly educated. Prof. Chen's elder brother, Hollis (Electrical engineer, Ph.D., Syracuse University), became a professor at Ohio University in Athens, Ohio; his twin brother, Wai-Kai (Electrical engineer, Ph.D., Illinois U), served as a professor and Head at the University of Illinois at Chicago campus, and his younger brother, William(Statistics, Ph. D., University of Georgia), worked at the Department of Treasury, and was once a professor at Morehead University, Ohio.His elder sister, Eileen Chiang, (BS in Textiles, Taiwan), worked at American Express and his younger sister, Helena Yuen, worked at General Dynamics.

His wife Linlin Chen (BS, Mathematics, University of Illinois)-She also wrote a cooking book "*A Tiger in the Kitchen- Healthy Chinese cooking made easy*" which is a collection of most of their family favorable dishes.His elder son, Eric Chen, is anElectrical engineer,(Ph. D., University of Illinois, and MBA, Chicago University), works now as Director of Finance at Thermo Fisher Scientific. His second son, Arnold Chen is also an Electrical engineer,(Ph. D., University of Illinois), and is working now as Director of Entrepreneurship at Purdue University, and his youngest son, Brian Chen is a Ph. D.in Structural engineering, University of Texas at Austin, and MBA, University of California at Los Angles and works now as Principal Manager of Southern California Edison.

Prof. Chen with his son Brian and Lehigh guru Dr. L.S.Beedle after Chen received his AISC lifetime achievements award

Hisfamily reunion photo, when he celebrated his golden anniversary in 2016 in Las Costa in San Diego.

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Code of Ethics for Engineers

Girish Dravid

Introduction

Think of the millions of visitors to the New Empire State Building in New York or the innumerable footsteps of the stock brokers running up the fish-bone staircases of the Stock Exchange Building in Mumbai, for all these numbers of years! Think of the monumental bridges crossed by millions of travelers all across India since last 150 years. The hallowed halls of education, commerce and administration have been instrumental in shaping the history and economies of nations. Engineers are the craftsmen of civilizations facilitating progress and ensuring welfare. The ultimate responsibility of an engineer lies in recognizing the monumental impact of his creation on the life and times of the present day and many more generations to come.

There has been a spate of building collapses in the recently completed year 2016 causing many casualties and loss of property. There have been other instances of major fires breaking in the buildings, killing several lives. There were news of railway accidents due to faults developed in the tracks and other media reports where innocent two wheelers succumbed to death due to potholes on the roads. In most of the cases, the indication a professional engineer can identify, is that there could have been instances of negligence on account of poor quality of engineering planning, design, execution and administration. It is time for the professional engineers to introspect and review their own code of professional ethics, in order to uphold the increasingly falling dignity in the eyes of public.

Model Code of Ethics for Engineers

Engineering societies worldwide have published and adopted their own Ethical Standards since then, notable among them are The Royal Academy of Engineers, National Society of Professional Engineers, Association of German Engineers, Association of Professional Engineers, Scientists and Managers and Engineers Australia. Today, almost every engineering association has its own code of ethics, mission and vision statements which are imposed on its members. Institution of Engineers India also has a code of conduct. Engineering Council of India formed a special Code of Ethics Committee in 2002 and has come up with a Code of Ethics for professional engineers in 2003. On the state level, professional engineers are required to obtain a working license, which demands adhering to certain rules and regulations while practicing as a professional engineer.

Fundamental Principles of Code of Ethics

Upholding and advancing honesty, integrity, honour and dignity of the engineering profession is the fundamental objective of forming a code of ethics. The principle stresses the need for using the knowledge and skill for the human welfare and environment, being honest and impartial, serving the public, employers and clients with fidelity, striving to increase the competence and prestige of the engineering profession and supporting the professional and technical societies of their disciplines. As can be deduced from the above, the primary concern behind the principle is that of survival of the profession with dignity in the eyes of the public. This becomes the backbone to ensure the perpetuity of the profession and for acquiring credibility in order to survive as a respectable service provider to the public.

Fundamental Canons of Code of Ethics

The following seven canons form the gist of all Codes of Ethics, adopted by various organizations.

Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development[3] in the performance of their professional duties.
2. Engineers shall perform services only in areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession and shall act with zero-tolerance for bribery, fraud, and corruption.
7. Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.

Overlap of Business and Professional Ethics

Business strategies of an organization can override the professionally ethical demand, such as securing a contract at unreasonably lower fees, at the same time making the client believe that the scope of services mentioned in the Request For Proposal can be fulfilled in such low fees. It is but common sense, that it is not possible to deliver the wholesome services that a professional engineer is expected to provide within fees below a certain threshold. Even if the consultant strives to provide minimum required services mentioned in the RFP, it is expected for him to work out the profit and loss for each of the projects that he undertakes. The expenses towards salaries of employees, software and hardware costs, establishment maintenance, conveyance and travel, communications - are becoming increasingly disproportionate to the remuneration that a practicing engineering organization can receive. In such a case, the business policy of picking up projects by bending Canon No. 5 in the above table may take precedence. What may follow later during execution of the assignment, can be imagined - not enough option studies, no thought to optimization by applying different techniques and theories, less attention to details and buildability, employing cheaper and consequently inexperienced and less-skilled resources, avoiding internal review processes and other methods of cutting costs, that result in sub-standard work. This is but one scenario that could ensue out of business policy taking over the ethics of fair competition.

Communications and Whistleblowing

A client appoints a consultant to act as his agent, to build an engineered product which conforms to accepted standards, industry practices, that is safe to use, is a quality product and is sustainable, at the same time consumes optimum resources and finances and can be delivered within the practically assigned period of time. In all this, the focus of the engineer must be on the creation of the product which conforms to the design brief. In case, the engineer feels that any consequence of his actions or non-actions, during the execution of the assignment may affect the project adversely, it becomes his duty to inform the relevant officials promoting the project immediately about the factors affecting the project, their causes, their effects on quality, time and cost, and remedial measures if already thought of. This requires an inherent integrity and honesty in the engineer to communicate such news promptly to the client without regard to possible backlash on him personally.

The professional must have the integrity to put the ethics of profession ahead of personal interest. While the client may be upset with the knowledge that he will have to undergo unplanned additional spending and time on the project, in the long run, he will be thankful to have avoided a probable mishap, ruining his reputation permanently.

Agent of Client

A professional engineer is appointed by the client to serve his need to build an engineering product that is performance-perfect, aesthetic, useful and economical to produce. Canons of Code of Ethics for engineers prescribing continuous upgrading of knowledge and skills imply that the engineer knows the best possible techniques of design and manufacture of the engineered product with quality, speed and least cost. For this purpose, it is expected that the professional engineer invests time and money in subscribing to various knowledge sharing organizations, magazines, books, purchases latest official software, spends on buying powerful computing machines and communication and printing accessories, sets aside budget for attending educational and informative seminars and in general be in the forefront of design, production and maintenance technology. But being updated has a cost - both in terms of time and money, which are least available for a practicing engineer in our country.

Another important responsibility of an engineer is

to take the right decisions irrespective of whether the client feels them to be in his immediate interest or not. Sometimes, the engineer may choose not to guide the client with the fear that it may create unpleasantness or he may lose client's favour. However, such actions are contrary to the integrity of the engineer. Guiding the client in the correct manner, asking him to follow the laws of engineering, abide by the rules and laws of land pertaining to the development of the engineered product - are certainly the primary responsibilities of the engineer and will truly define him as the agent of the client.

Field of Expertise

Although a canon says that the engineer should restrict his services in the field of his expertise, it becomes necessary to learn some other subjects just to assuage the pressure from the client. A good example is that of structural engineers, who are expected to provide consultancy on waterproofing and fire resistant treatment. Author does not wish to comment on such transgressions, as he himself is not an expert in other fields to judge others who resort to such practices.

Peer Review or Value Engineering

While appointing a peer reviewer is a welcome move by the client, the conflict may arise depending on the attitudes of the players - the designer and the peer reviewer. Generally, the peer reviewer has a different set of procedural beliefs than the designer's and this creates situations where a sort of compromise is reached in the end rather than an agreement. Example can be given in cases where a structural design engineer wishes to be conservative based on his past experience in the field and wishes to resort to manual calculations since he believes in them. On the other side, a peer reviewer belonging to a new order, solely believing in analytical software and insisting on removing any margins over and above the software based design requirements may lure the client with comments that promise economy in designs, often portraying the designer as committing a monumental blunder and acting against the interest of the client. Here, both are surely acting as agents of the client and intend only well. However, the conflict may lead to compromise or sub-quality product with respect to belief systems of both the individuals.

In some instances, there have been perceptible efforts on one or both the parties to project themselves superior to the other, resulting in erosion of mutual obligation of respect to professionals. There have been examples, where a peer reviewer ended in being appointed as a designer on the same project on which he was a peer reviewer. This becomes a transgression of scope, even if it was the client who was instrumental in bringing about such a change of role.

Professional ethics becomes all the more important when one is asked for his opinion on someone else's designs and detailing. It surely is unethical to deal with such requests without the knowledge of the original designer.

Relationship between mishaps and Code of Ethics

Mishap is an outcome of extreme negligence or ignorance towards technical appropriateness of the engineering designs and documents. Not having enough updated technical expertise, lack of communication, absence of integrity and honesty, not performing a whistleblower's function, not acting as agent of client in true sense and defaulting on other such codes of ethics can be easily tracked to be attitudinal and non-material reasons towards such incidents.

Last words

It is important for all professionals to be aware of their responsibilities towards public, clients, customers, associate professionals in allied and supplementary fields, employers and employees. Having a Code of Ethics for the organization for which one works and is associated with, will bind the practicing engineer in the responsibility towards the public. An engineer must nurture and undertake the responsibility of serving the public and the nation with the confidence that the fraternity is equipped with such moral and ethical values that defines courage and pride in their truest sense.

Author :

Girish Dravid
Director Sterling Engineering Consultancy Services Pvt . Ltd., Mumbai.

NMMC office building : Breath taking structure with several unique features

Prof. M G Gadgil

1.Introduction

Recently inaugurated head office of the Navi Mumbai Municipal Corporation at CBD Belapur is a marvel in structural engineering having many extra-ordinary features, presenting challenges to the structural designer. The structure is circular in plan with out to out diameter of 90 m (approx). The structure has a central atrium of 43m dia (c/c of circular peripheral columns) having first slab at fourth floor level of the outer structure, i.e. at 19 m level above ground level. There are two smaller domes of 14 m dia at fourth floor level and one large dome of 38 m dia at terrace level (37m above ground) in structural steel with GRC roofing panels. There are several pt slabs, annular in shape having radial spans ranging between 12 to 21 m. Columns are circular and rectangular in shape with few shear walls in C and L shape. Footings are isolated square/rectangular in shape with few combined footings. General front elevation of the structure is given in **fig 1**

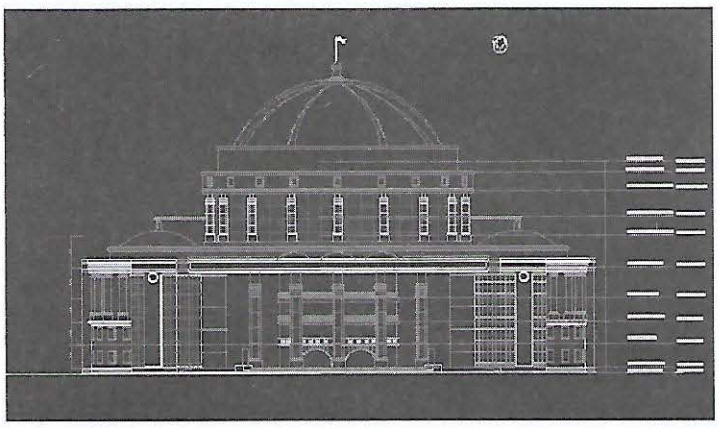


Figure 1

Figure 1A

2. Circular Floor grid system of 43m dia

The most difficult and challenging component of the office building was the central circular floor grid system above the central atrium. Initial obvious choice of the structural designer was for structural steel plate girders. However due to constraints at site of not being able to use crane for erection etc. it was thought at a later stage to explore other options like PT beams or floor grid system. Several options to structural steel plate girders were explored and the one adopted finally is shown in **Figure 2**. Due to restrictions of headroom etc. the beam depth was restricted to 1600 mm. At the planning stage of alternative floor grid systems, other construction activity had progressed to fourth floor level which had added more restrictions on working space.

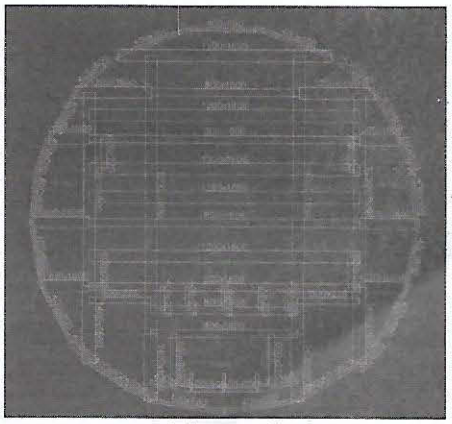


Figure 2

Planning had to be done for floor grid system at three levels simultaneously so that construction could progress smoothly. There were service staircases going from fourth floor to fifth and from fifth to terrace level needing cut outs at different locations.

3. Design data for the floor grid system

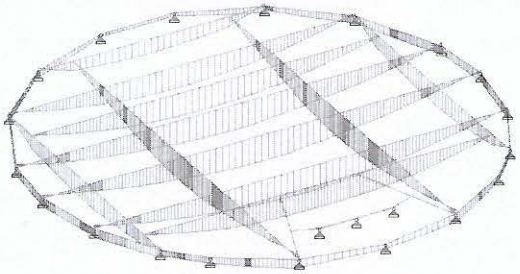
i. Material
   a. concrete grade M45
   b. Non PT steel reinforcement Fe 500
   c. HT wires with braking stress 1860 MPa

ii. Loads
   a. Selfwt – density of concrete 25 kN/m^3
   b. Superimposed dead load for floor 4 and terrace 5 kN/m^2
   c. Superimposed dead load floor 5 7 kN/m^2
   d. Live load 10 kN/m^2

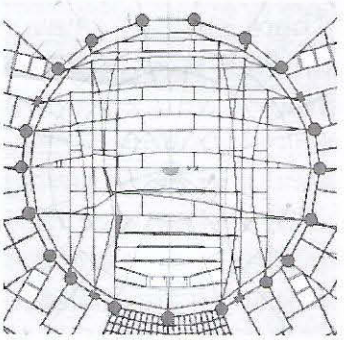
iii. Pre-stressing
   a. Jacking stress 1400 MPa
   b. Loss in prestress — 280 MPa (constant).

4 Design of PT beams in floor grid system at three different levels

The floor grid system at three different levels was a highly indeterminate structure and designing the same with PT option presented many challenges. The software adopted for the design was ADAPT builder. There was some apprehension about reliability of design produced by this software. To develop confidence well established softwares like STAAD-pro, SAFE and ETABS were employed. Moments and shear calculated using these softwares were compared with those calculated using ADAPT only for dead and live loads. It was noted that, each software, due to its internal working, produced results which were not agreeing with each other in all respect with 100 % accuracy. A comparison of BMD for grid system at 4th floor level grid is given in **Figure 3**. A comparison of Reactions obtained using two different softwares is given in **Table 1.** After this stage, design was carried out for pre-stressed conditions. Max of 6 cables, each with 19 strands of 15.2 mm dia were used. The end section and middle section of the beam with cables is shown in **Figure 4**. Stresses in beams were limited to 16 MPa and 4 MPa in compression and tension respectively. However at few locations we had to allow higher value of tensile stress at bottom. This was permitted considering provisions of IS 1343. Stresses at top and bottom under Initial stage of loading are given in **Figure 5** Several trials were taken to arrive at the final no of cables in each grid beam. Design of non PT steel (Fe 500 grade) was carried out to resist balance moment and shear and also to develop required ultimate BM. Final non PT steel reinforcement at midspan and at support is shown in **Figure 6.**

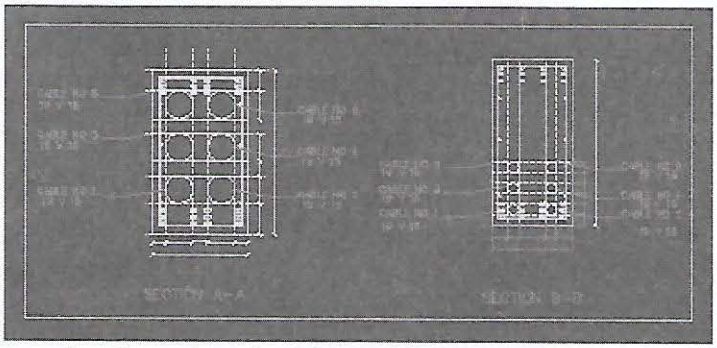


STAAD BMD Figure 3



ETABS BMD Figure 3

Longitudinal section through PT Beam Figure 4



Section at end and at midspan of PT Beam Figure 4

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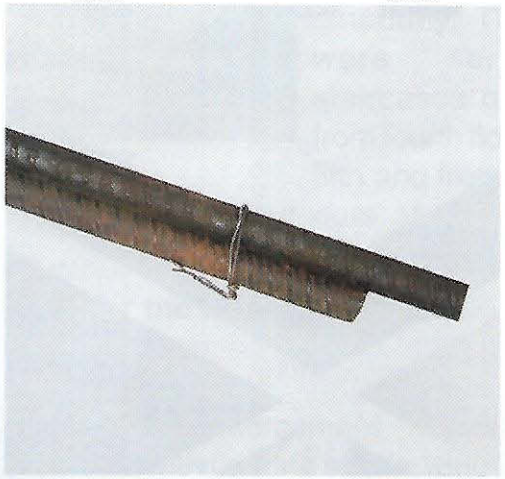

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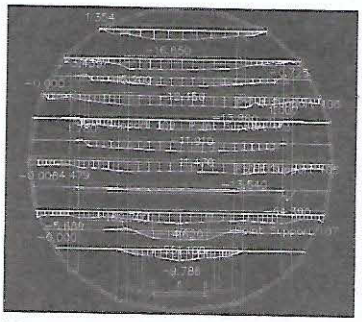
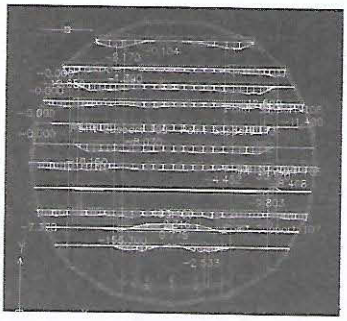
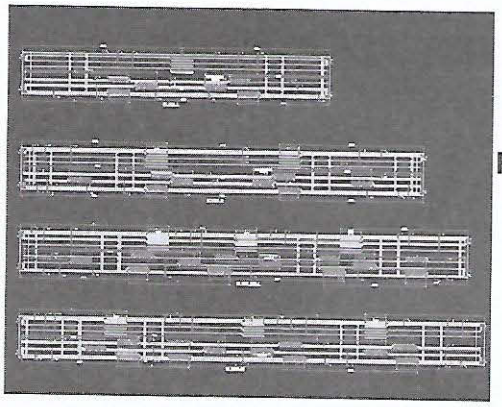


Bottom stresses Initial stage (self wt plus PT) sketch 5



Top stress at Initial stage (self wt plus PT) sketch 5



Non PT Reinforcement in PT Beams Figure 6

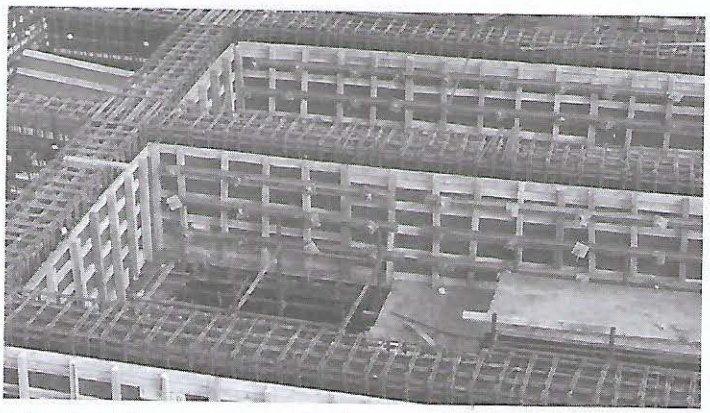
Table1

Comparison of Reactions at 4 th floor

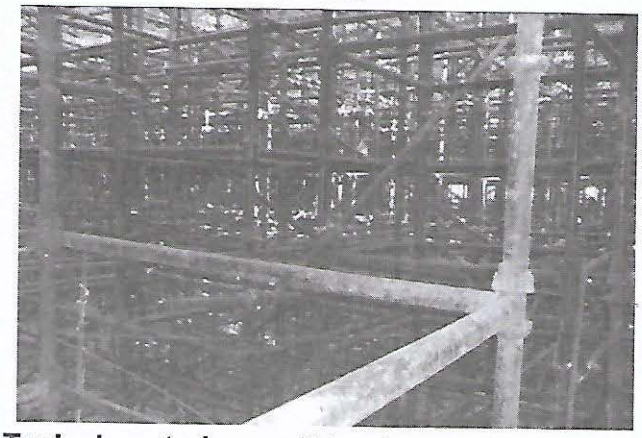
		ADAPT	STAAD
ID	Label	Fz kN	Force-Y kN
1	Point Support 1	4086	4264.589
2	Point Support 2	1831.5	1425.53
3	Point Support 3	1743.8	1996.979
4	Point Support 4	220.26	220.312
5	Point Support 5	270.31	270.376
6	Point Support 6	253.05	253.118
7	Point Support 7	185.02	185.07
8	Point Support 8	173.46	173.507
9	Point Support 9	1701.7	1702.7
10	Point Support 10	1851.3	1832.158
11	Point Support 11	325.77	325.857
12	Point Support 12	1842.3	1817.2
13	Point Support 13	1695.8	1696.617
14	Point Support 14	170.76	170.799
15	Point Support 15	185.72	185.765
16	Point Support 16	251.81	251.869
17	Point Support 17	248.03	248.088
18	Point Support 18	205.4	205.448
19	Point Support 19	1744.9	2007.287
20	Point Support 20	1438.4	1000.104
21	Point Support 21	4526.2	4725.524
22	Point Support 22	317.93	318.015
23	Point Support 23	317.54	317.628
	Summation	25587	25594.54

5. Design of centering and shuttering for floor grid system 19 m above ground level

Beams of 1600 mm depth had to be cast and the first slab was at an elevation of 19 m above GL. Thus special centering was required for concreting at this height and special precaution had to be taken while casting grid system at higher level. Further, beam sides and bottoms along with cross members, tie rods and props had to be specially designed. Marine ply, timber batten, structural sections and circular pipes were used as shuttering and centering. A typical section showing the centering and shuttering is shown in **Figure 7**. There was basement in the atrium area and hence back propping was required to transfer wt of green concrete onto firm strata.



Typical Arrangement of shuttering Plates for PT Beams Figure 7



Typical centering and Bracing arrangement for PT grid floor Figure 7 A

6. Need and design of bearings supporting floor grid beams

It was proposed right from the planning stage to keep central circular floor structurally isolated from rest of structure so that only gravity load gets transferred to the column and there is structural separation between the two. For this purpose pot

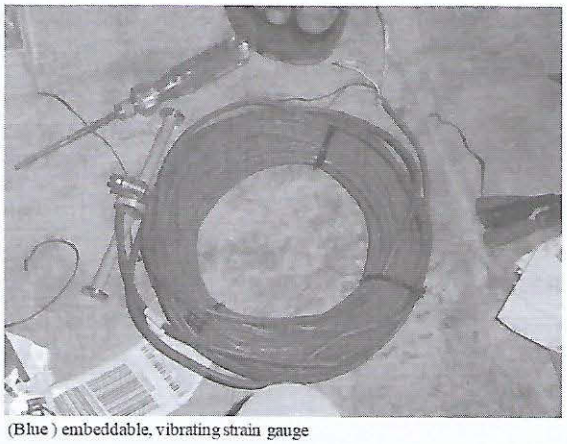
bearings were proposed as vertical support for floor grid beams. These bearings were of two types, i) fixed bearings ii) free bearings These bearings were designed for vertical reactions at beam ends and displacements under seismic condition. The coefficient of friction between steel plate and PTFE surface was kept at 0.03. A typical fixed and typical free bearing are shown in **Figure 8**

Fixed and Free bearings used to support PT Beams Figure 8

7. Strain measurement using embeddable and surface mounted strain gauges

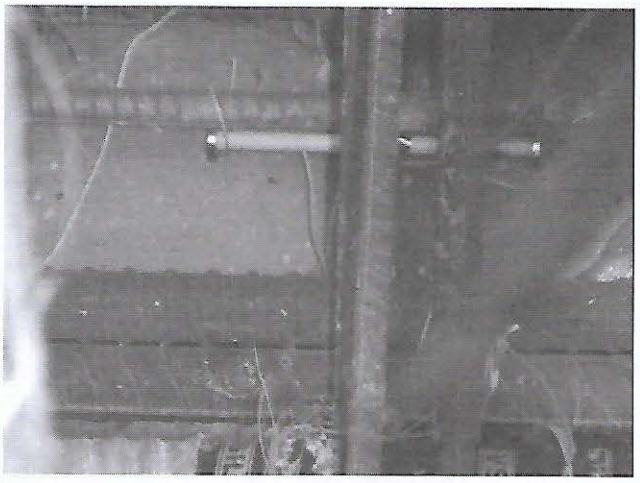
Considering the sheer size of the structure, its importance and to develop more confidence about actual behaviour of the structure, it was proposed to use embeddable and surface mounted strain gauges

For this purpose vibrating type strain gauges were embedded in several major beams at each floor level (level 4,5 and 6). A typical photograph of the Vibrating strain gauge used in PT Beams is shown in Figure 9 Typical locations of strain gauges are shown in Figure 10 Readings of strain were taken before and after stressing of cables. A comparison of calculated and measured strain gauges is shown in table 1



(Blue) embeddable, vibrating strain gauge

Figure 9



Srain Gauge placed at location in PT Beam Figure 10

Table2

comparison of stresses calculated and measured

Beam No	loc	Measured stress	Calculated stress	%difference
Beam1	Bottom	-9.16	-14.59	37.19
Beam1	Top	-0.51	-4.55	88.73
Beam2	Bottom	-2.28	-11.6	80.37
Beam2	Top	-6.43	-7.3	11.9
Beam4	Bottom	-10.08	-11.7	13.88
Beam4	Top	-4.94	-6.9	28.47
Beam7	Bottom	-6.88	-10.1	31.85
Beam7	Top	-11.60	-4.8	141.7
Beam 9	Bottom	-8.29	-11.5	27.88
Beam 9	Top	-4.78	-5.1	6.205
Beam11	Bottom	-6.57	-18.5	64.49
Beam11	Top	-12.00	-8.5	41.13
Beam12	Bottom	-8.67	-12.8	32.25
Beam12	Top	-4.09	-2.5	63.76
Beam13	Bottom	-4.06	-9.9	58.97
Beam13	Top	-8.10	-4.2	92.85
Beam14	Bottom	-5.15	-27.1	80.99
Beam14	Top	-10.00	-14.3	30.06
Beam15	Bottom	-2.11	-5	57.79
Beam15	Top	-7.72	-2.2	250.8

8. Pre-stressing of cables

There were in all 102 cables to be stressed. This was done in a particular sequence so that no beam attracts excessive load. Considering stress level of 1400 MPa in cable and considering that there were 19 strands of 15.2 mm dia in each cable, max force applied was 500 tons. Stressing was done in 6 stages and elongation was recorded at each stage of stressing. A typical stressing record of beams B1 to B15 is shown in table 3

Table 3

Sr No	Beam	location	Reading at no load with prop	Reading at full load with prop	Reading after removal of props
1	B1	bottom	2517.6	2371.2	2409.7
		top	2722.3	2717.2	2606.1
2	B2	bottom	2380	2318.6	2169.2
		top	2867.6	2677.8	2720.5
3	B4	bottom	2699.2	2417.7	2466.6
		top	2586.3	2450.1	2298.5
4	B7	bottom	2669.2	2484	2354.8
		top	2673.4	2345.3	2288.1
5	B9	Bottom	2538.6	2773.2	2241.6
		top	2786.1	2650.8	2505.4
6	B11	bottom	2534.5	2666.2	2639.6
		top	2988.9	2649.6	2222.6
7	B12	bottom	2724	2478	2536
		top	3126	3023	2895
8	B13	bottom	2654.6	2549.5	2656
		top	3127.9	2898.8	2724.3
9	B14	bottom	2521.1	2388.2	2255.4
		top	2988.7	2705.8	2707.2
10	B15	bottom	2706.3	2646.6	2519.5
		top	2868.1	2753.1	2125.1

9. Loosening and retightening of centering for casting upper slabs

While casting slabs at 5 th floor level and terrace floor level it was important to see that the centering takes load of one slab only at any given point of time. To ensure that, it was proposed to loosen the centering after stressing of a floor grid and retightened the same. This ensured that only one slab transfers load to centering.

10. Floating columns for galleries

There were floating columns supporting gallery slabs at level 2 and 3 above 5 th floor slab. Hinge type behaviour was ensured at the bottom end of floating columns by providing 10d as the anchorage length of bars at bottom junction of column and slab at 5 th floor level.

11. Concreting of grid system in stages

Considering the total volume of concrete in each floor and considering requirement of working space during concreting and from safety consideration, it was decided to do the concreting in two stages, stage1 – concreting up to bottom of slab (i.e. concreting of beam web only), stage 2 – concreting of floor slab only after about 10 days of stage 1 concreting. Concreting at each stage was done continuously without any construction joint.

12. Strengthening of existing foundations for increased loads

Due to change of floor grid system from steel beams to PT beams, dead load of the grid system had increased. Initially it was thought that the general margin of safetyin design of foundation would absorb this increase in load. However it was realized later on, that footings as provided earlier would get overloaded in the present system of floor grid system. The overloading, when investigated, showed that there was problem in reinforcement provided while soil pressure was within limit. To take care of these deficiencies it was decided to increase the depth of footing by adding adequate layer of concrete on top of existing (deficient) footings. A typical sketch showing details on such footing with relevant reinforcement details is shown in **Figure 11**

13. Non technical side of the challenge

I came across the project as a proof checking authority from VJTI when I was a faculty member there. However the design by structural consultant, though structurally ok presented serious erection difficulties at planning stage and therefore attempt was made by the contractors M/s Ashwini infra to search for an alternative feasible solution. In the month of sept 2010 they approached me for the purpose along with Mr Bhujbal rao, the PT contractor for the project. After a brief study of the project I agreed to investigate alternatives and give them a feasibility report. In the month of Dec 2010 - Jan 2011 I gave them feasibility report. This report talked about technical feasibility and approx cost estimate. I got a go ahead in the month of Jan 2011 under the condition that every design required for this option shall be vetted by the structural designer for the rest of the RCC work or an agency selected by him and then by VJTI. Without much pondering I accepted the conditions and realized later that it was one hell of a condition. The structure was gigantic in size, highly indeterminate and required modern tools for its analysis and design. Not many in industry had this experience, and to be honest, was also included in **that many**!!!! In the end ended in designing this gigantic structure, it bearings, centering and shuttering for the floor gri

system, organizing strain measurement system for the same and strengthening system of foundation of a newly built (unique) structure and getting the designs/ schemes approved from as many as 5 different agencies. I only remembered the artists in history who built Taj mahal , qutub minar and the modern day scientists and engineers those who undertook mission to moon. I firmly relied on the theories I learnt all these years and the common sense. A great help in this respect was provided by the contractor M/S ashwini infra, in particular its engineers Mr Mahesh Varde and Mr Jayesh marathe and Mr Parikh, the director of the company who used their experience of construction to provide extra safety during and after construction. The same response was obtained from Mr Amarnth from Bangalore who proof checked floor grid system at each floor very meticulously using a different software and resolved differences / discrepancies in results obtained in a very rational way. Dr Nori, a very respectable, senior and knowledgeable consultant from Mumbai gave very valuable tips in getting confidence in the design of such risky project. I am really indebted to all these experienced people for successful completion of this project, But I must say that I heaved a great sigh of relief when the centering for first slab was removed after prestressing of first slab in the month of oct 2012 exactly 2 years after my start of work. The chief engineer of NMMC, Mr Dagaokar showed excellent maturity and always told me that I should feel full satisfaction and safety in the design and then only he would undertake the construction work. Though he was under tremendous pressure from NMMC to complete the project in time he gave me all time in the world to prepare a safe design. Same mature approach was shown by the Architect Mr Hiten Sethi who conceived this beautiful and challenging structure and Mr Nikhil Sanghavi and his engineer Mr Rupesh Choudhary who officially took all the responsibility may be after concluding that I am not perhaps a totally unreliable and incompetent engineer !!!!

Author :

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Senior Consulting Engineer, Mumbai
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Construction of 75 m long deck type truss Jangtulam Chu Bridge in Bhutan

Varun Poddar

Introduction

Project Dantak of Border Roads Organization is tasked with maintenance and construction of several key infrastructure projects in Bhutan. Three most important financial and cultural hubs of Thimpu, Paro and Phuentsholing are connected with only one highway.

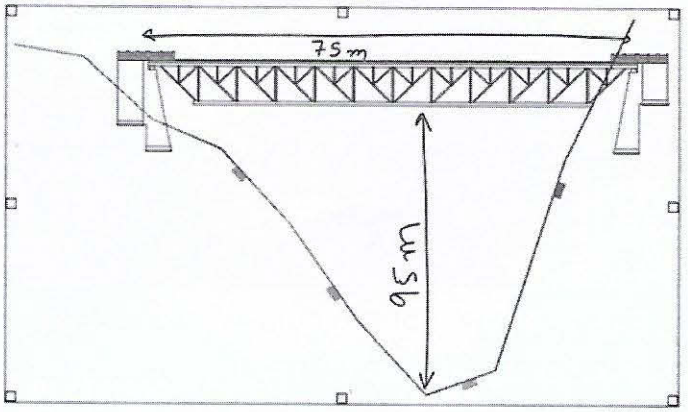
The highway is double lane throughout the complete length of it, except the portion between Damchu and Chukha. Due to difficult terrain, it is not possible to convert the existing road to double lane standards. Therefore, to reduce the number of accidents and commuting time on the Damchu - Chukha stretch of the highway, a new alignment was proposed by BRO and funded by MEA (Ministry of External Affairs, India).

The new stretch will be greenfield road of 27 km with three major bridges running along the Wang Chu River. Three major bridges were envisioned along the stretch. Poddar Construction Company, Delhi was awarded the contract for design and construction of all the three bridges. Engineering Project Consultants, Mumbai was appointed the Primary Consultant for the design of the bridges. All the designs were proof checked by IIT Bombay and vetted by DGBR, Delhi.

One of the three bridges in the project was 75 m deck type truss bridge. This article describes the construction procedure of the truss. Only construction aspects of the structure have been covered in this article. Brief technical summary of the structure is given in Table 1.

Table 1 (Technical summary of the structure)

Technical Summary of the Structure	
Length	75 m
Carriageway	7.5 m
Deck Width	12 m
Structure Type	Deck type truss
Foundations	Open
Substructure	Wall type abutments
Grade of steel	E250
Structural Steel Quantity	280 MT
Concrete Quantity	1200 cum
Reinforcement Steel Quantity	160 MT
Connection type	Bolting



S No	Dia of bolt	Torque Used
1	16 mm	2200 kgcm
2	20 mm	4400 kgcm
3	22 mm	6000 kgcm
4	24 mm	7600 kgcm
5	30 mm	15100 kgcm
6	36 mm	26500 kgcm

Figure 1 (General Arrangement Drawing)

Fabrication

E250 grade steel was procured from Jindal Steel for fabrication of superstructure of the bridge. Fabrication was done in a workshop rented in Phuentsholing, Bhutan. MIG welding was used for fabrication of structural members.

Maintenance of pre camber is essential during the fabrication procedure to maintain the desired alignment of the completed superstructure. For this reason, pre camber of 150 mm was maintained.

As the road leading up to the site from Phuentsholing is very narrow and due to load restrictions on bridges en route, maximum length of fabricated members were kept at 13.5 m and weight was restricted to 8 MT. All the members were marked as per pre decided scheme to properly store the members at the site and avoid confusion during erection. Also, since access to the bridge location was only from the Chukha side, all the members were stored on Chukha side and then launched from the primary sling.

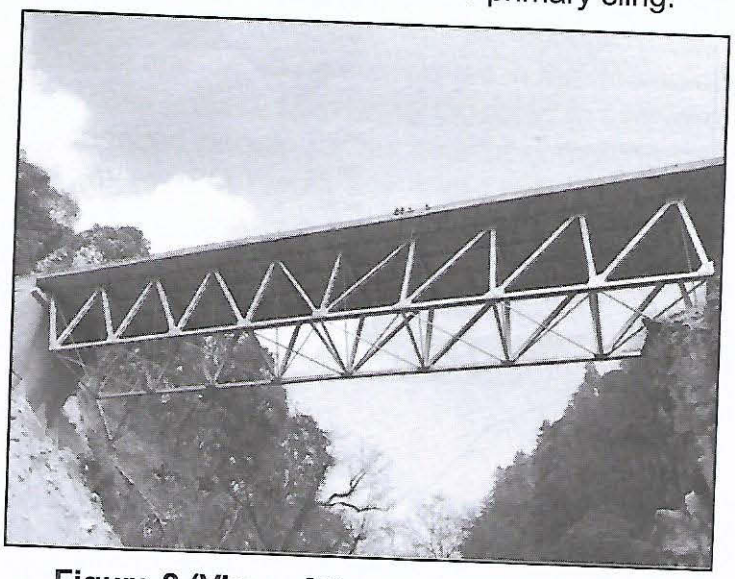


Figure 2 (View of the completed bridge)

Connections

Bolting was used for connections between different members of the truss. All the bolts were snug tightened during erection procedure to maintain the proper alignment and transfer of forces during erection process.

Once the erection was completed and final alignment and elevation were achieved, all the bolts were fully tensioned using a hydraulic wrench. HSFG bolts of grade 8.8 were used in the project.

Table 2 gives the torque used for full tensioning of the bolts.

Erection

Erection of the truss members required elaborate scheme to launch and hold members in position for final bolting operation.

Accordingly, scheme reminiscent of suspension bridge was formulated with anchors and towers to hold the entire weight of truss during erection procedure.

S NoDia of boltTorque Used116 mm2200 kgcm220 mm4400 kgcm322 mm6cm424 mm7600 kgcm530 mm15100 kgcm636 mm26500 kgcmFigure 3 below is representative of the arrangement made at the site.

Table 2 (Torque required for tensioning of bolts)

S No	Dia of bolt	Torque Used
1	16 mm	2200 kgcm
2	20 mm	4400 kgcm
3	22 mm	6cm
4	24 mm	7600 kgcm
5	30 mm	15100 kgcm
6	36 mm	26500 kgcm

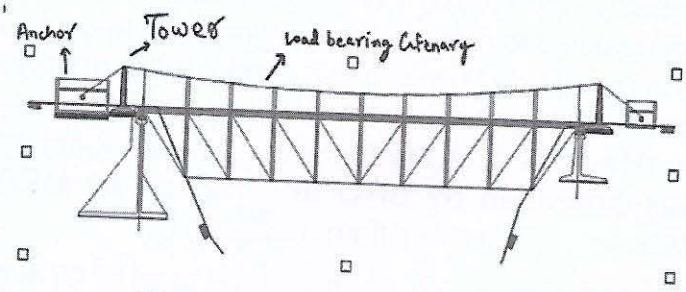


Figure 3 (Erection Scheme)

Members were individually picked up by a crane with a capacity of 14 T and transferred to primary sling for transportation to the final position of the member.

The member was transported using mechanical winch machines installed on the abutment at each end. The winches were operated manually with the hand.

Once the member reaches its desired location, it is then transferred to load bearing catenary to be held at the same spot until the final connections are made.

Erected members were kept in position with the use of turnbuckle, D shackle, and chain pulley.

Bottom chords were first erected in place and snug tightened with bolting. Once the entire bottom chord got erected, the load could be shared between load bearing catenary and abutments by placement of wooden blocks between abutment and the chord. Vertical and diagonal members were then launched using the same procedure and snug tightened. Top chords and bracings were launched in the end.

Anchors

Two anchor blocks were constructed at each end of the bridge to resist the construction loads during the construction stage. Anchor blocks were designed to resist both the sliding and uplifting forces from wire ropes. This was mainly achieved by making a large hollow structure with reinforced walls and filling it with boulders and soil recovered from the excavation of the foundations.

Steel box was embedded in between the reinforced wall for anchoring the load bearing catenary. Wire ropes were wound around the steel box to resist both the horizontal and vertical forces from the erection sequence.

In addition to providing anchorage for load bearing catenary, primary sling were anchored with the help of steel beam embedded under the weight of rock fill. The primary sling passed over the hand winch positioned on top of anchor block for ease of handling of the members while being transported to their final locations. Figure 4represents the cross section view of the anchor block.

On completion of the bridge, wire ropes and the embedded steel box were recovered and box was completely filled with boulder and earth to provide approach for the bridge. Since the anchor block was completely embedded in the ground, dismantling of the structure was not required.

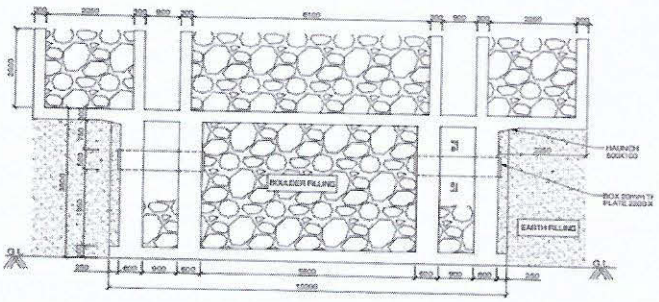


Figure 4 (Cross section view of anchor block)

Towers

Two towers on each side of the bridge were erected on footing just behind the abutments to transfer the loads in wire ropes to the anchors. Towers were designed mainly for carrying the vertical forces and any unbalanced horizontal forces. Each tower was provided with two saddles, one for primary sling and the another one for load bearing catenary. Soil compaction with rammer was done before laying of footing for the towers as a prevention against any subsistence during erection procedure. It was realised that using abutments as a base for towers is both economical and time saving. However, as the forces from temporary erection were not considered in the design of the abutment, the idea of tower erection on abutment was dropped and towers were instead placed on the excavated ground behind the abutments. After the completion of erection, towers

were dismantled to provide way for the approach road.

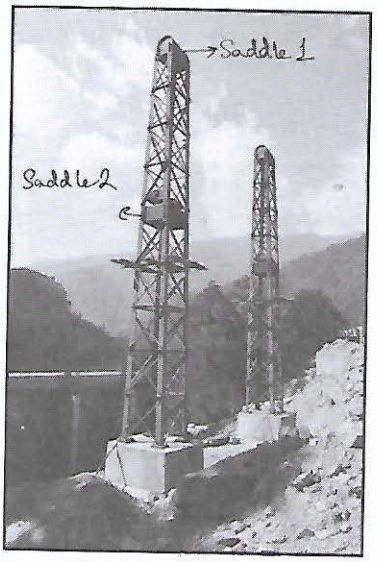


Figure 5 (Towers)

Wire Ropes

Wire ropes were used to hold the structure in place during erection purpose. 8 wire ropes of 48 mm dia were used to hold the structure.

Initially, a plastic rope was used to cross the valley to act as a guide rope for crossing of load bearing ropes. Chain Pulley and counter weight were then used for crossing of 48 mm dia wire ropes.

All the ropes had to go over the saddle fixed to the tower and then into the anchor blocks to be tightened around the steel box embedded in the

anchor. Hand winch and chain pulleys were then used to adjust the profile of the wire to match that of the catenary for final placement of members.

The members were further held in position using Turn Buckles, D Shackle, Clamps and Thimble.

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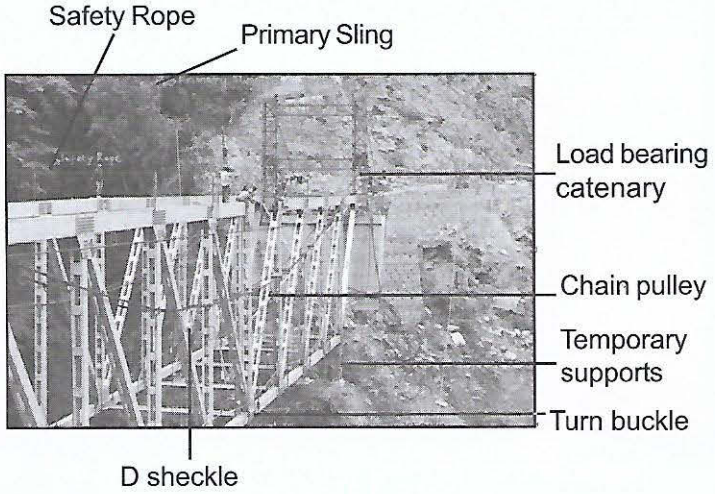

Figure 6 (Erection under progress)

Deck Casting

After the erection was completed, truss was aligned as per the drawing using chain pulleys and placed on the bearings already fixed on the pedestals. For casting of deck, brackets were fabricated for providing support to the casting operations. After the completion of the casting of deck, all the brackets and formwork had to be removed from below the truss which was both time consuming and a potential safety hazard for the workers. It was realized that use of corrugated GI sheets could

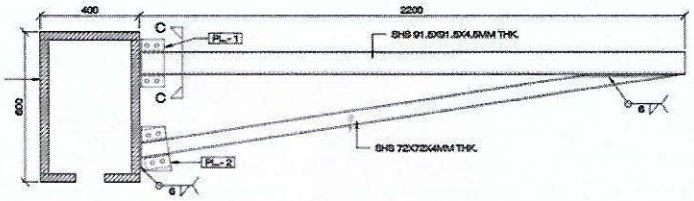

Figure 7 (Sketch of cantilever bracket for deck casting)

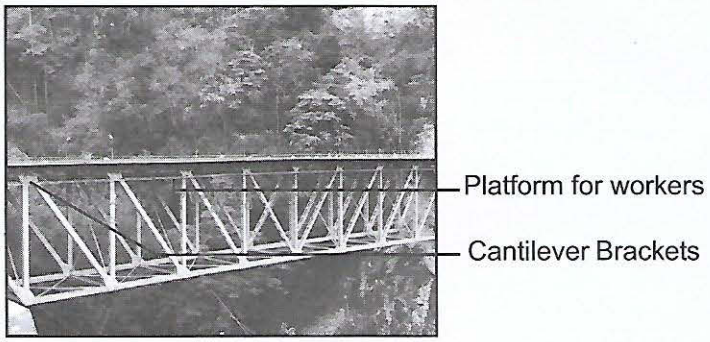

Figure 8 (Deck Casting arrangement)

have considerably sped up the work and also increased the safety of workers.

Load Testing

Load testing was performed in accordance with IRC SP 51. For the purpose of providing loads, platforms using ISMBs were assembled and dead load using sand bags were provided.

Deflections were measured at longitudinal centre of the bridge on both the edges of the carriageway. One side of the bridge was loaded eccentrically to stimulate the worst possible load distribution on the structure.

For the purpose of measurement of deflections, two deflectometer were suspended with the help of wire rope from the edges of the carriage way. Small platforms were built at the locations of the deflectometer for providing steady base for measurement of the readings. Wire ropes were provided with additional weights to counter against the slack. Due to the wind tunnel effect in the valley, it was difficult to restrain the wire rope in its position. As a counter measure, the wire rope was tied from all the three directions and anchored into the ground. To guard against minor movements arising out of wind, the tip of deflectometer was placed inside the nut welded on top of base plate placed on the footing. Total station was used to measure the deflections as well to corroborate the readings from the deflectometer.

Maximum deflection of 15.85 mm was observed against the allowed limit of 30.1 mm.

Figure 9a (Sand bags and platform)

Figure 9b (Deflectometer arrangement)

Conclusion

This report has demonstrated all the important stages and components of construction of the particular bridge. However, what is not covered in the report is the numerous difficulties faced during the execution of this challenging project. Few of the major issues that had to be dealt with during construction were severe cold, high winds, extremely remote location and thus very rudimentary facilities, absence of approach to one end of the structure. In addition to the difficulties posed by nature, a major source of impediment was the reality of working in a foreign country and thus issues such as hiring people with right skills, getting immigration permit of all the necessary workers, retention of employees in such a hostile environment.

The successful completion of the bridge is a testimony to determination and hard work of hundreds of workers who worked day and night to complete the structure within the time schedule.

Acknowledgement

The successful execution of the project involved co ordination between various agencies as listed under.

Client: Dantak, Border Roads Organization

Contractor: Poddar Construction Company, Delhi

Principal Consultant: Engineering Project Consultants, Mumbai

Associate Consultant: Structarch Consultants

Erection Contractor: M/s Md Jainuddin

I am grateful to the Dantak for providing with the exciting opportunity and also assisting the contractor in troubleshooting all the local and compliance related issues.

Special thanks is due to all the hard workers of erection team who risked their lives on a daily basis during the erection by working at frightful heights and in extreme weather conditions. The entire team of contractor is due for an acknowledgment for maintaining a perfect safety record without any major or minor accident.

I'd also like to personally thank Mr RH Banka of Engineering Project Consultants for providing technical guidance during the execution of the project and encouraging me to write this article. I'd further like to thank Shri Hemant Vadalkar of Vadalkar and Associates for working out forces in wire ropes at different points of loading.

Last but not the least, I want to thank Shri BL Poddar (My Dad) for giving me this opportunity to execute this challenging project and being a guiding light throughout the construction of the bridge.

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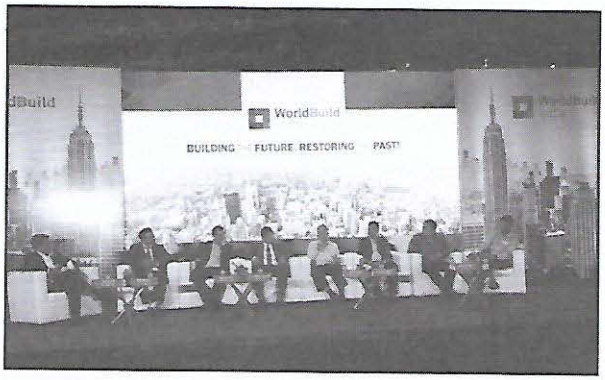
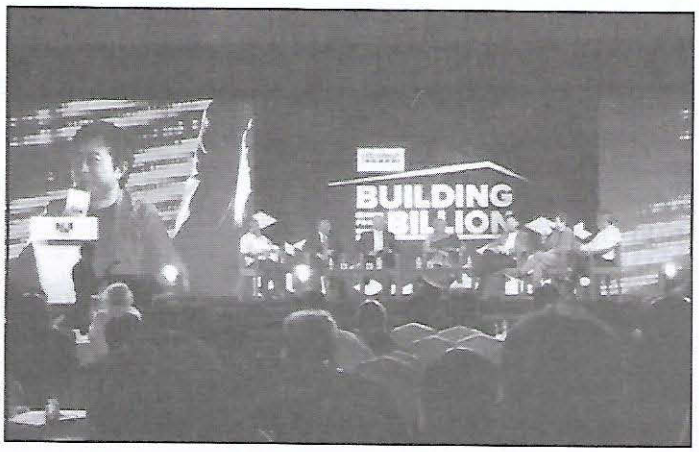
News and Events during Apr – Jun 2018



21 Apr 2018 : World Build India arranged exhibition of construction equipment and materials at Bombay Exhibition centre, Goregaon, Mumbai. Technical seminar with a theme of Mega Structures was arranged. The program was curated by Dr. Deepali Hadker and various project case studies were presented by eminent consultants and project managers.



27 April 2018 : Ultra Tech Cement arranged a seminar on 'Building for a Billion' an initiative by INDIA NEXT at Hotel Sahara Star, Mumbai. Awards were presented to Architects for international design competition on "Housing every Indian" along with distinguished Jury Members and world-renowned speakers.

Concept of compact housing was presented by Hong Kong based architect.

Panel discussion by eminent dignitaries on 'Housing for a Billion - Strategic Solutions and Possibilities' was conducted.

25 May 2018 : Two days workshop on Performance based design was arranged by Epicons Friends of Concrete at Mumbai. Prof. Yogendra Singh, Head Department of Earthquake Engineering, IIT Roorkee explained the evolution of design concept from coefficient method to Performance Based Design. He also touched upon push over analysis, non-linear Time History Analysis methods and answered queries raised by consulting engineers. Dr. Vijay Khose discussed Non-linear static (pushover) and Non-linear Time History analysis with an example in ETAB. Case study on Performance based design of High Rise Tower was presented by Tushar Chavan of Optimal Consultancy Services. Programme was attended by around 80 engineers.

6 June 2018 : One day workshop on "Energy conservation Building code 2017 (ECBC2017)" was arranged by Maharashtra Energy Development Agency (MEDA) and ICMQ India at Savitribai Phule Natya Mandir Conference room, Dombivli East, Dist Thane. Energy efficient building planning, efficient electrical systems, renewable energy like solar and wind, sensor based controls, energy efficiency star rating etc was discussed by

experts in the field. Architects, Engineers and MEP Consultants attended the workshop in large number.

16 and 17 June 2018 : Two days Workshop on Tall building with CVRM including IS1893, IS13920, IS16700 and Performance based design was arranged at VNIT Surat. Report by Sachi Parekh.

Designing safe & stable buildings with understanding and considering the recent advancement had been done with IS 1893 (Part :I) -2016 and IS :13920 (2016) with newly introduced Tall Building code -IS 16700 (2017). It is necessary to understand the code provisions- it's implementation, interpretation and implication with crystal clear concepts. To achieve this goals one has to be well equipped with innovative competition with through understanding of principles supported by powerful analytical technique to visualize the behaviour of the building. The building having more than 250 m height with irregular configuration are considered as code exceeding building and It is recommended to adopt Performance Based Design (PBD). PBD is a major shift from traditional structural design concepts and represents the future of earthquake and wind engineering. These new procedures help assure that the design will reliably meet a desired level of performance during a given earthquake or wind a major lateral force. The fundamental component of PBD is nonlinear dynamic analysis where an attempt is made to capture the real behavior of the structure by explicitly modeling and evaluating post-yield ductility and energy dissipation when subjected to actual earthquake ground motions. PBD is also being used for the design of structures subjected to extreme wind and hurricane / cyclone conditions.

Two days workshop was held on 16th And 17th June, 2018 At Class Room Complex, SVNIT Campus ,Ichchanath, Surat, Gujarat under the umbrella of Centre For Continuing Education (CCE) , Sardar Vallabhbhai National Institute of Technology (SVNIT), and Sanrachnatmka Engineering and Technological Upliftment Foundation (SETU Foundation)-SURAT. In this technology-packed seminar, Dr. C V R Murty, Tall Man of Earthquake Engineering – Director, IIT (Jodhpur) had assisted to understand the clauses of code provision with the theory and application of PBD, along with Er Rajiv Shrama and Er Hemant Kumar who are business partner & steering CSI in India. They presented Application , Modeling Techniques, Fundamentals and idealization with software . The program was attended by Practicing Structural Consultants from various firms representing public and private companies and Academicians. The honored chief guest of the workshop for The Inauguration Function were Dr S R Gandhi(Director-SVNIT,Surat), Dr C H Solanki(Professor and Head, Applied Mechanics Department, SVNIT-Surat), Dr. D. V. Bhatt (Chairman, CCE,SVNIT-Surat) and Er. Hetal Mehta, (President, The Southern Gujarat Chamber of Commerce and Industry –SGCCI, Surat). The Felicitation Function is honored by Er. NKK Prasanna (Head E & M Department, Reliance Industries Limited, Hazira, Surat) and Er. Nitinbhai Oza (MD & CEO, Surat Prestech Pvt. Ltd.,Surat). The foundation of the two days workshop were Er Kamal Parekh (MD & CEO,Shri Sarjan Technocrats Pvt Ltd-Surat) and Er Hiren Desai (Sai Consultants-Surat).The program was well coordinated by Er Sachi Parekh (SSTPL - Surat) and Prof Atul K Desai (SVNIT,Surat).

The Topics covered in the program are as follows:

- Discussion and Implementation of Clauses of IS 1893(Part : I)-2016 and IS 13920 (2016)
- Discussion and Implementation of Clauses of IS 16700 (2017) and Introduction to PBD
- Etabs , SAP & Safe - Application - Modeling Techniques & Fundamentals of Software Idealization

The concluding remarks from the Technical session:

1. CODAL CHANGES IN IS 1893(Part : I)-2016

- Design response spectra is extended for natural period up of 6 sec and will remain same for all buildings
- The Empirical equations are revised For the calculation of approximate natural Time period of the buildings.
- Response Reduction Factor (R) has been revised. R Remains same for Steel and Concrete and special provision for flat slab is introduced.
- Definition and explanation on Height of the building

• The first three modes together contributes at least 65 percent mass participation factor in each principal plan direction

• The Fundamental natural periods of the building in two principal plan directions are away from each other at least 10 percent of the larger value

• The Cracked section properties for column, walls and beams are defined

• Floating Columns Prohibited in SMRF

• RC Frame building with open storey ,Construct RC Shear wall or braced frame in selected bays to minimized irregularities By increasing strength and stiffness

• Circular column is not recommended because of less stiffness and less strength as compare to Rectangular column

2. CODAL CHANGES IN IS 13920-2016

• Identify the Appropriate system judiciously as load resisting frame system (LRFS) based on relative stiffness and location from all RC Frames and design those members for full lateral force. For the judicious selection of LRFS, Select only those frames or shear walls which participate significantly and should participate 85-90% of base shear.

• Use of mechanical couplers allows for modular and mechanized construction

• Floating Shear Walls are not allowed

3. IS 16700 (2017) and PERFORMANCE BASED DESIGN (PBD):

• Structural as well as Non Structural elements need to take care under Earthquake shaking

• Step by step clause discussion

• Fix the Hazard Level which is important parameter to achieve expected performance level in PBD

It was finally concluded that, various forums provide the platform for discussion and debates among the technocrats, academicians or professionals but never ever gets concluded with a solutions which the construction industry or the representative of industries like structural designers across India demands. Engineers don't want to compromise code provisions but need guidelines and specific practices to act upon to make the building stock safe and stable.

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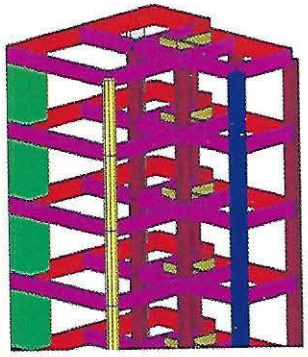

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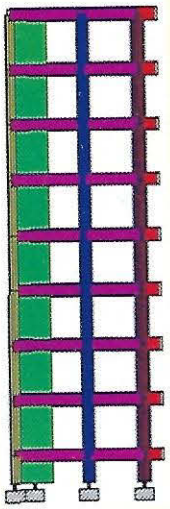
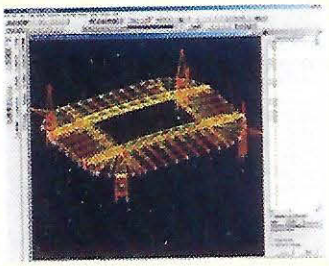
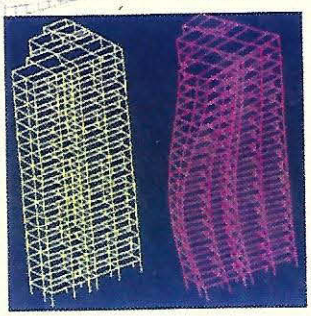
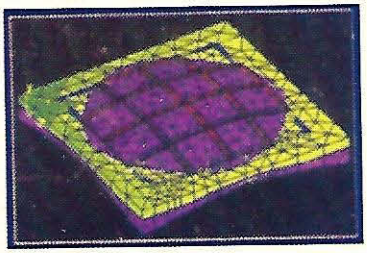
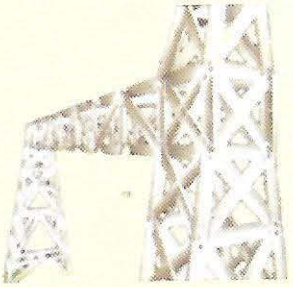


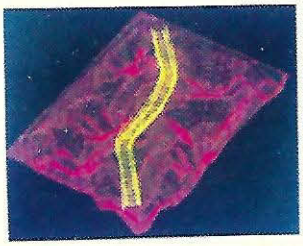


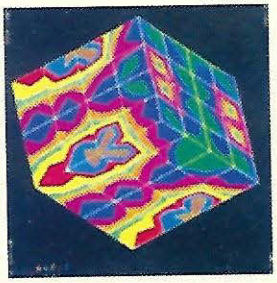
Pro Steel
(Fabrication)
STAAD.foundation
SectionWizard
RAM Concept
(Flat Slab & PT Slab)
STAAD.beava
STAAD.Pipe
Power Draft
(Drafting Tool 3D)
Bentley Structural
Rebar











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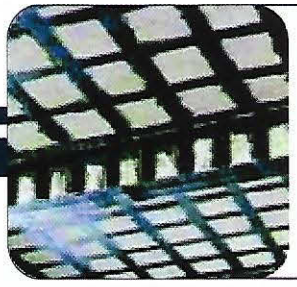

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