STRUCTURAL ENGINEERING

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STRUCTURAL ENGINEERS

ISSE

VOLUME 23 - 2 **APR - MAY - JUNE 2021**

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STRUCTURAL ENGINEERS

INDIAN SOCIETY OF STRUCTURAL ENGINEERS

ISSE

VOLUME 23 - 2, APR- MAY- JUNE 2021

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Editor : Hemant Vadalkar

AIMS & OBJECTIVE OF ISSE

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

FIELD OF INTEREST

- 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

Fraternity News

WELCOME TO NEW MEMBERS

(APR - MAY - JUNE 2021)

01M	1962	Sarvanan K. S.
02M	1963	Vikraman P.
03M	1964	Ruhul Ameen Faisal Ahmed Tungekar
04M	1965	Amol Dattatray Sakhare
05M	1966	Sanjeevan Rama Kurup
06M	1967	Ashok Shripal Bhilavade
07M	1968	Mohd Azam
08M	1969	Vishruth Jain
09M	1970	Ganesh Machhindra Shinde
10M	1971	Amodh Madhav Luman
11M	1972	Sagar Vijayrao Katore
12M	1973	Karan Narayan Lalwani
13M	1974	Kunal Vilas Phulphagar
14M	1975	Nishita Sharma
15M	1976	Umesh Ashok Nawale
16M	1977	Varun Vinayak Rao
17M	1978	Udit Shashikant Hiray
18	JM58	Rohit Ravikumar
19	JM59	Rahul Satish Kadam

Patrons : 38
Members : 1978
Student Members : 224
Organisation Members : 33
Junior Members : 59
Sponsor : 8
IM : 03

TOTAL STRENGTH : 2,343

GEM 28 DR. B. VIJAYA RANGAN - RESEARCH PROFESSOR, PAR EXCELLENCE

By Dr. N. Subramanian

Prof. B. VijayaRangan (b. 1939)

Prof. Rangan at his desk in Perth, Australia

Dr B Vijaya Rangan is currently an Emeritus Professor of Civil Engineering at Curtin University, Perth, Australia. He also served as the Dean, Faculty of Engineering and Computing, Curtin University prior to his retirement in 2005. Dr Rangan has over 50 years of experience in teaching, research, professional and consultancy activities and, has taught and conducted research at major international institutions in Australia, Canada, USA, and India. He has published over 250 papers in international technical journals and conference proceedings and 60 research reports in the field of concrete structures and concrete technology.He has received many prestigious international awards and prizes for research and professional contributions.

Prof. Rangan has written several practice oriented papers in the ACI Structural Journal on various aspects of structural design. In his papers we can surely find a practical angle and even a worked out example. He always proposed simple and effective solutions to intricate structural engineering problems. He also co-authored a very successful and useful book on Concrete Design, which is popular not only in Australia but also all over the world. He has also co-edited a reference book entitled "Large Concrete Buildings" and contributed Chapters to other international books.

Many of his research findings have been adopted in several codes of practices in countries like Australia, India and USA.All of us are aware of Table 19 of IS 456, which is based on the research done by him in the 1960s!

His recent work on geopolymer concrete is noteworthy, as it has revolutionized the making of concrete, and will eliminate the emission of CO2 into atmosphere-which is the drawback of using concrete, considering it as second only to water in terms of human consumption!

EARLY LIFE

Prof Rangan was born in a tiny village in India called Kunnathur, Tirupur district, Tamil Nadu in 1939. His parents hail from an average family. His father worked as a clerk to a lawyer and the mother was a housewife. He was the first son of the family, with three younger brothers and a younger sister. Due to his father's work place, he lived in a town called Arani near the village where he did his high school studies in a local school until Grade 10. After that, he went to another larger town called Vellore, Tamil Nadu to do his Grades 11 and 12.

ACADEMIC QUALIFICATIONS

After competing his schooling, young Rangan completed his Bachelor's Degree from the College of Engineering, Guindy, at that time belonging to the Madras University, India in 1961. Many of his classmates, including Er Parakalan, who later retired as Chief Engineer in Railways, still affectionately call him as "Vathiyaar" (Teacher) as he resolved their doubts in various subjects. [Interestingly, Er Parakalan's (It is also the name of Thirumangai Azhwar, the last of the Azhwars) father, Mr. A.S. Nagarajan, was a movie director and wrote the script of the entire movie Karnan and also to many others movies].

He directly registered for his Ph.D. Degree at the Indian Institute of Science (IISc), Bangalore, India, under the guidance of another Gem of Structural Engineering, Prof. KTS Iyengar. He earned his doctorate degree in 1967, for his thesis on "Investigations on Reinforced and Prestressed Concrete Beams under Combined Bending, Torsion & Shear". He fondly recalls that Prof .Govinda Rao, Head of Civil Engineering Department at IISc was impressed with the research report he wrote based on the work done by him at PSG Tech and allowed him to go directly to do PhD. He admires Prof .Govinda Rao as a very generous and kind person, as he looked after young Rangan very much all through his time at IISc. Prof. Rangan feels that he is just lucky to have his blessings and kindness.

Professional Affiliations

Prof. Rangan is associated with several professional associations, which include the following.

- Fellow, Engineers Australia
- Fellow, American Concrete Institute
- Honorary Member, Concrete Institute of Australia
- Honorary Life Fellow, Indian Concrete Institute
- Member, Engineering Earth and Applied Sciences Discipline Panel, Australian Research Council (1993-95)

RESEARCH AND TEACHING

After completing his bachelor's degree he worked as a Research Fellow and Associate Lecturer, of Council of Scientific and Industrial Research (CSIR), in PSG College of Technology, Coimbatore, India, during 1962 – 1963, under the mentorship of Prof. V. Ramakrishnan. Dr. Rangan now recalls that Prof. Ramakrishnan gave him an opportunity at PSG Tech., although he was barely qualified for the job. He also feels that Prof. Ramakrishnan is very fond of him always and owes his academic career to him. Young Rangan then joined the Indian Institute of Science, Bangalore, India and worked as Research Fellow, during 1963 – 1967.

After earning his Ph.D. from I.I.Sc., he flew to USA and worked there as a visiting lecturer, at the Department of Materials Engineering, The University of Illinois, Circle Campus, Chicago, Illinois, from 1967 – 1969. Then from 1969-70, he worked as Assistant Professor in the School of Mines and Technology, Rapid City, South Dakota, USA. Prof. Ramakrishnan also was with him at the university.

He moved to Australia in 1970 when he started to work as a Lecturer in the School of Civil Engineering at The University of New South Wales (UNSW), and in 1974 promoted as Senior Lecturer. In between he also worked as a Visiting Professor at the Department of Civil Engineering, University of Calgary, Calgary, Canada and Visiting Scientist, Structural Engineering Research Centre, Madras, India, during1976 - 1977.

Prof. Rangan with the then VC of Curtin University and Prof. V. Ramakrishnan

He was promoted as Associate Professor in Civil Engineering, UNSW during 1977 and served as the Head of Structural Engineering Department, UNSW from 1987– 1989. He moved to Perth in 1990 to take charge as Professor and Head, School of Civil Engineering, Curtin University, and worked in that position from1990 – 2000. He took over as Professor and Head, School of Engineering, Curtin University, from 2000 – 2002. He was elevated as the Dean, Faculty of Engineering and Computing, Curtin University, from 2003. From August 2005 he is serving as an Emeritus Professor of Civil Engineering, Curtin University.

Prof. Rangan says that in the Australian system, it is very hard to get research students. It is because PhD in Australia is needed only when someone wishes to pursue academic career. Most Australians do not pursue academic career as they can do far better financially working in the industry. In spite of this Prof. Rangan has guided 10 PhDs 6 Masters students; he also notes that most of his research students are from overseas (last three PhD students who did work in the area of geopolymer were from Indonesia). He is proud of all his students and says that all of them have reached very high positions. He is happy to say that all these research students consider him as their big brother or even father. Many undergraduates also reached high positions and fondly remember him. Prof. Rangan is happily satisfied that he served as a good and helpful teacher.

PRESTIGIOUS PRIZES AND AWARDS

Prof. Rangan was recognized for his work with several prestigious prizes and awards, which include the following:

- Nicolaides Prize (1967) Institution of Engineers (India)
- Raymond Reese Structural Research Award (1975) American Concrete Institute
- Merit Award for Excellence in Concrete (1977) Concrete Institute of Australia
- Canadian Commonwealth Fellowship (1977)
- Building Science Forum Book Award (1977)
- ACI Fellow Award (1987), American Concrete Institute
- American Concrete Institute Special Award for sustained and outstanding contributions to Concrete Technology in Australia (1997)
- Special Award for significant research on Geopolymer Concrete, Geopolymer Institute, France (2005)
- Honorary Life Fellow, Indian Concrete Institute, India (2009)
- Honorary Member, Concrete Institute of Australia (2011)

Meeting of concrete researchers: From left to right- Dr. George Hoff (former president of ACI), Profs. V. Ramakrishnan, V.M. Malhotra, and Rangan, and Mr. Cliff MacDonald (Director of Forta Corporation)

Prof. Rangan and his PhD students discussing with Prof Joseph Davidovits on Geopolymer Technology

RESEARCH INTERESTS

Prof. Rangan's research interests include

- Concrete Structures, and Concrete Technology including Geopolymer Concrete,
- High-Strength and High-Performance Concretes and
- Concrete-filled Steel Tubular Composite Columns

PARTICIPATION IN CODES AND STANDARDS

Dr Rangan actively served in the Standards Australia Committee on Concrete Structures for more than 25 years and has contributed significantly to the development of present and previous Australian Standards on Concrete Structures.

PUBLICATIONS

Prof. Rangan has authored several books and book chapters in addition to authoring several research papers in reputed journals

Books and Chapters in Books:

He is aco-author of the well-known text book Concrete Structures and its predecessor Reinforced Concrete, which are widely used by university students and professional engineers in Australia and have sold over 50,000 copies since the publication of the first edition in 1976.

- Warner R. F., Rangan B. V., Hall A. S., Reinforced Concrete, Addison-Wesley Longman Cheshire Melbourne, 3rd edition 1989, 553 pages (First edition 1976; Second edition 1982).

- Rangan B.V. and Warner R.F. (Editors), Large Concrete Buildings,Addison-Wesley Longman Scientific & Technical, London, 1996, 320 pp.
- Warner, R.F., Rangan, B.V., Hall, A.S. and Faulkes, K.A., Concrete Structures, Addison Wesley Longman, Australia,1998, 974 pp.
- Sarker, P. K., and B. V. Rangan. 2014. "Geopolymer Concrete Using Fly Ash." In Fly Ash: Sources, Applications and Potential Environmental Impacts, Nova Science Publications Inc., New York, USA, pp. 271-289.
- Rangan, B.V. 2008 "Low-Calcium Fly Ash-Based Geopolymer Concrete" Chapter 26, In Concrete Construction Engineering Handbook,Second Edition, Editor-in-Chief: E.G. Nawy, CRC Press, New York, pp. 26.1-26.20.
- Rangan, B. V. 2009 "Engineering properties of Geopolymer Concrete", Chapter 11, InGeopolymers: Structure, Processing, Properties and Industrial Applications, Edited by John L. Provis and Jannie S.J. van Deventer, Woodhead Publishing Limited, Oxford, pp.211 -226.
- Rangan, V. 2008. "Low-Calcium, Fly-Ash-Based Geopolymer Concrete", In Concrete Construction Engineering Handbook 2. CRC Press ,Boca Raton, Florida.
- Rangan, V. 2005. "Advances in Design of Concrete Structural Members", In Recent Advances in Structural Engineering, Universities Press Hyderabad, India, pp. 1-38.

Research Papers

Prof. Rangan has published over 250 papers in technical journals and conference proceedings and authored over 60 research reports. Only a few of his important papers are listed below:

1. Rangan, B. V.2014. "Geopolymer concrete for environmental protection."The Indian Concrete Journal, 88: 41 – 59.
2. Hardjito, D., S. Wallah, M. Sumajouw, and V. Rangan. 2004. "On the development of fly ash based geopolymer concrete." ACI Materials Journal, 101: 467-472.
3. Rangan, B. V. 1998. "High-performance high strength concrete: Design recommendations." Concrete International, 20 (11): 63-68.
4. Rangan, B. V. 1997. "Rational design of structural walls." Concrete International, 19 (11): 29-33.
5. Rangan, B. V. 1990. "Strength of reinforced concrete slender columns." ACI Structural Journal, 87 (1): 32-38.
6. Rangan, B. V., and A. S. Hall. 1983. "Moment and Shear Transfer Between Slab and Edge Column." Journal of the American Concrete Institute, 80 (3): 183-191.
7. Rangan, B. V. 1982. "Control of Beam Deflections by Allowable Span-Depth Ratios." Journal of the American Concrete Institute, 79 (5): 372-377.
8. Rangan, B. V. 1978. "Rational Approach to Control of Slab Deflections." Journal of the American Concrete Institute, 75 (6): 256-262.
9. Rangan, B. V. 1974. "Limit States Design of Slabs Using Lower Bound Approach." ASCE Journal of Structural Div,100 (ST2): 373-389.
10. Rangan, B. V., and A. S. Hall. 1973. "Strength of Rectangular Prestressed Concrete Beams in Combined Torsion, Bending and Shear." Journal of the American Concrete Institute,70 (4): 270 278.

SPECIAL INTERESTS

Prof Rangan has a keen interest in the Tamil literature and poetry. He has composed many Tamil poems. He corresponded and talked to the great Tamil Poet Kannadasan (who is more famous for his movie songs) during his College of Engineering, Guindy years. Mr Kannadasan published one of Prof. Rangan's song in his magazine Thendral (http://www.tamilonline.com/thendral/). Prof. Rangan has presented several lectures on Tamil literature and conducted a Tamil radio programme for a year on a local radio station in Perth.

Hear this:
https://1drv.ms/u/s!As6no43F3V4U4zSnIDhrZcPpsbT4

(The above is a radio program Prof. Rangan ran in 1991. The recording is average as it is converted from old analog version to digital)

FAMILY

Prof. Rangan married his wife Saraswathi in 1962. They have two children : Daughter, Dr. Vijaya Ramamurthy, is a doctorate in commerce/business and lives with her family in Perth Australia (https://srgexpert.com/our-people/dr-vijaya- ramamurthy/) and son, Dr Gopala Rangan is a nephrologist with a doctorate degree and lives with his family in Sydney (https://www.westmeadinstitute.org.au/people/researcher-profiles-search/associate-professor-gopala-rangan/biography). Both his son and daughter are authorities in their chosen profession and have also published papers.

Prof. Rangan with his family

Prof Rangan his wife Saraswathi

Professor Ian Gilbert' views on Dr. Rangan: (courtesy: ICJ)

I first met Vijay in 1975 when I joined the School of Civil Engineering at the University of New South Wales (UNSW). At that time, Vijay had already established himself as one the country's brightest and best researchers in the field of concrete structures. For the next 15 years we worked in the same Department, both of us teaching and researching in the field of concrete structures.

Since he left UNSW, we have remained in regular contact often through our work on Standards Committees. As an academic and as a researcher, Vijay has been outstandingly successful. He is Australia's most prolific and widely read researcher in the field of concrete structures and he is known throughout the industry both nationally and internationally. Through his books and papers, he is also known to almost every Australian civil engineering student. He has made a major contribution to his profession.

As a friend, Vijay has also been outstanding successful. He is generous in his advice, always willing to help, and he can be relied on for support, encouragement, loyalty and wise counsel. His friendship, in good times and bad, has meant much to me over many years and it has been and will always be highly valued.

Prof. Ian Gilbert, Emeritus Professor of Civil Engineering, University of NSW, Australia

Rangans have two grandsons and one grand daughter; the first grandson is a Mechanical Engineer, the second grandson is completing an Economics Honours degree, and the granddaughter is currently studying to be a Chemical Engineer.

References:

1. "Professor B. Vijaya Rangan, A prolific and widely respected researcher in the field of concrete structures", The Indian Concrete Journal, V. 86, No.10, Oct. 2012, pp.39-40.

2. https://staffportal.curtin.edu.au/staff/profile/view/vijaya-rangan-f186d448/

About The Author

Dr. N. Subramanian is an award winning author, consultant, researcher, and mentor, currently based at Maryland, USA, with over 45 years of experience in Industry (including consultancy, research and teaching). He was awarded with a 'Life Time Achievement Award' by the Indian Concrete Institute and many other awards for his contributions towards Structural Engineering. He is the author of 26 books, including the famous books on Design of Steel Structures, Design of RC Structures, Principles of Space Structures, and Building Materials, Testing and Sustainability and 270 papers. He is also the past VP of ICI and ACCE(I).

Email id : drnsmani@gmail.com

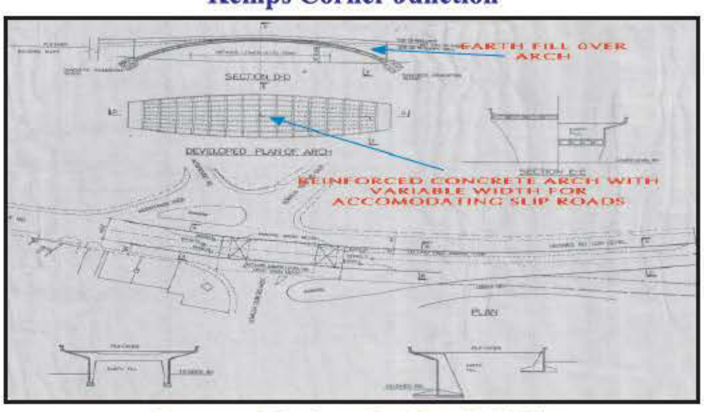
KEMP'S CORNER FLYOVER

By Shirish B. Patel
Consulting Civil Engineer

ABSTRACT

Kemps Corner flyover was the first flyover to be built in India. Kemps Corner intersection was already very congested in 1962. Wilbur Smith & Associates recommended a four lane flyover for easing the traffic along with widening the approaches for accommodating two additional lanes on either side. The layout was such that about 100 m2 was required for parking with a mandatory main span of 30.5 m. Bids were invited by Bombay Municipal Corporation on a design and construct basis. Akerkar & Company was the lowest bidder and the site was handed over to them towards the end of August 1964. Challenges there were many. The ground on both sides had to bear the heavy weight of the structure. The clearance from the road had to allow for plying of red double-decker buses on the roads below.

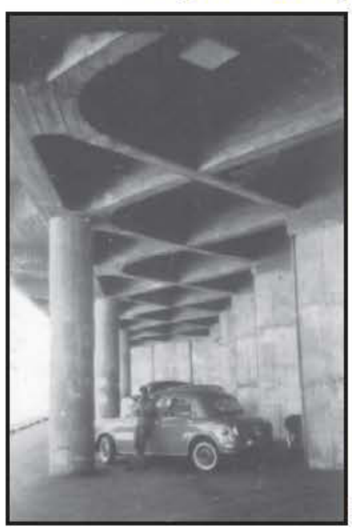
Kemps Corner Junction



Proposed Design-Tendered(1964)

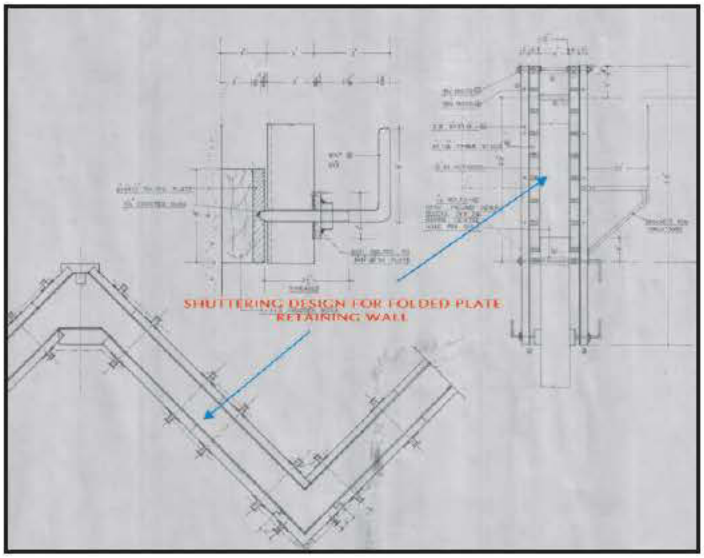
No borehole data was available and informal enquiries revealed that rock was available at about 1.2m below road level. Tender design was a flat arch of variable width spanning 54.8 m. The deck was cellular with earth fill on the springing and the shape was funicular so the arch suffered only small bending moments. Analogue computer at the Atomic Energy was generously made available which made the task of finding funicular shape much easier. By middle of September 1964 soil investigation revealed that founding strata was very poor and the concept provided at tender stage had to be abandoned and new design had to be rapidly put in place.

Kemps Corner Flyover as built (1965)



Dia-grid approaches

Meanwhile there arose another difficulty that concerned acquisition of land of one small building which meant revising alignment and introducing cantilevers in the transverse direction. Finally shallow pre-stressed box girder with overhangs on either side was the only feasible solution. Timely completion of the project was of paramount importance. To this end all enabling structures were designed by SPA. Concrete hinges were used for the first time in India. It is truly remarkable that the flyover was completed in such a short time despite so many complications.



Inspection of concrete hingeny
Bombay Muncipal Corporation

Kemps Corner Load Testing (1965)

The flyover was opened to traffic in May 1965. In words of Shirish Patel's flyovers and similar infrastructure interventions are usually driven by public servants who take upon themselves the sense of ownership of the project - the engineers, or planners and architects employed in Government or in one of its agencies. It is the quality of these public servants that ultimately determines the quality of the results. The Kemp's Corner Flyover was driven by M.S. Nerurkar. It was he who pushed for it, and discussed and approved each suggestion for change in design or construction method.' They did it jointly for their city.

Shirish Patel's vision can be easily traced to the very first five years of the firm. Considering various options, refining the designs so that optimal use of resources is achieved, importance of innovation and aesthetics. He actively participated in the structural design each of the above projects guiding, inspiring and encouraging young engineers in their formative years.

1. Invitation to tender :

Wilbur Smith & Associates conducted a traffic study of Bombay in 1962-63. Among the recommendations, made for easing traffic was one for the construction of a lane flyover at Kemp's Corner, to be undertaken simultaneously with the widening of Hughes Road to 6 lanes.

In April 1964 the Bombay Municipal Corporation invited tenders for construction of the flyover based on Contractors' structural designs, the general arrangement to be as specified by the Municipality. This called for construction of a bridge with approaches, approximately 1,000 ft. long overall. The width specified was 49ft. overall and 46 ft. between kerbs. The maximum gradient was restricted to 1 in 18.3 or 5 ½ per cent. Over the old intersection a clear span of 100ft. was required with a headroom of 18 ft below, together with the provision of 10,000 sq.ft of parking area under the approaches. No particular column arrangement was specified within the parking area. The loading specified was IRC Class AA or 4 lanes of Class A, which ever gave the more severe conditions. A clear width of 324 ft. was provided between the flyover and India House for the left turn by-pass from Gowalia Tank Road East. Kemp's building and Panday building , the building diagonally opposite, were expected to come down before work on the flyover started. Gibb Road was to be diverted through the Parsi Dongerwadi property to Gowalia Tank Road West. A construction period of 4 months was suggested.

A verbal enquiry elicited the information that sound rock for foundations would be available a few feet below the road surface. The Municipality has some experience of soil conditions

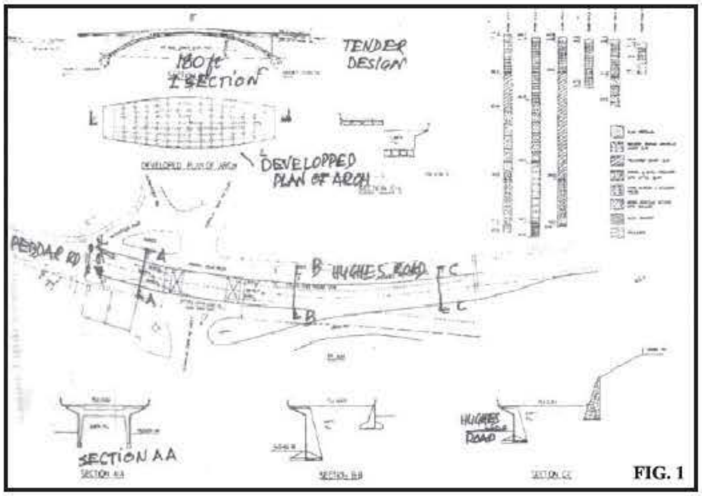


FIG. 1

in the area from the Gibbs Road retaining wall work carried out some years earlier. It was indicated that a tender design based on the assumption that rock would be 4 ft. below ground level would be acceptable.

Six tenders were received by the Municipality on 15 July 1964, each with its own alternative design. Five of the designs had 100 ft. prestressed concrete main spans. The sixth design proposed a 180 ft. span cellular reinforced concrete arch. This design, as it happened, was accompanied by the lowest tender, the difference between this and the next tender being about Rs. 1,00,000. Tenders ranged from Rs. 12,83,000 to Rs. 25,43,000.

A Technical Committee appointed to report on tenders recommended acceptance of the lowest tender with the Arch design. The Municipality indicated acceptance verbally on 24 July, and the work was formally assigned on 11 August 1964.

2. The Arch design :

Fig. 1 has been prepared from the Drawings submitted with the Tender.

A preliminary investigation showed that a cellular reinforced concrete arch approximately 180 ft. span would be substantially cheaper than a 100 ft. prestressed span, and the arch was accordingly adopted for the Tender design.

It was decided to have solid fill above the arch instead of an open spandrel design for two reasons: first, a separate road deck above the arch would take about a month longer to construct than paving on fill; second, the Municipal requirements were for a 100 ft. clear span with 18 ft. minimum headroom. If the roadway was not to be excessively raised, this meant a fairly flat arch over the central 100 ft. A continuation of this flat arch on either side beyond the central 100 ft. meant a very longs span. The fill was useful in adding weight at the ends of the arch, thereby forcing the funicular arch profile more quickly down and reducing the total span.

A cellular section for the arch was found more economical than a solid section. The cellular section had greater moment of inertia for a smaller cross-sectional area. More than the saving in concrete, this allowed the arch to be so designed and the cross-sections to be so adjusted that under dead load and nominal live load the arch profile would be funicular and all sections would be under a compressive stress in the region of 500 psi; with full live load the bending moments at any section would produce stresses of the order of 500 psi maximum resulting in a stress range in the concrete of 0 to 1000 psi compression. This meant that no steel would be required under working load conditions and the only steel to be provided would be that required for temperature and shrinkage stresses, and to take care of ultimate load. It was proposed to form the cells using timber boxes which would be lost in the concrete.

Several arrangements for the provision of the required parking space were tired, but in most cases it was found that the utility of the parking areas was reduced by the presence of columns. Some column-free space was available under the ends of the arch, beyond the central 100 ft. required to be kept clear, and for the rest wherever headroom permitted it was decided to inset the approach ramp retaining walls and provide 10 ft. cantilevers for the upper roadway, giving column-free "parking lanes" below. These had the advantage that in hours of heavy traffic they could be used as extra traffic lanes if desired.

49 ft'. wide abutments – the width of the roadway above_were found to foul the entry to the parking lanes. To avoid this it was decided to narrow the arch at the abutments to 29 ft., flaring to 49 ft. at the crown. The arch would carry side retaining walls to contain fill and to carry appropriate cantilevers for the upper roadway. Tapering the arch towards the abutments would not affect the arch action materially; the only complication that arose was that of torsion across the section caused by a vehicle located eccentrically on the upper roadway. Such a torsion exists even in a normal arch, but it is generally ignored in analysis. With the tapered arch it was found that the cellular section could comfortably carry the torsion imposed. Transfer of torsion across the hinge at either end of the arch was a more difficult problem which remained not fully resolved when the design was submitted for tender. Another problem not fully resolved was the behavior of the fill over the arch, particularly near the abutments where it would be about 18 ft. deep. It was thought that a granular fill might be needed over the arch and for a short distance into the approaches.

Detailed design of the scheme began in mid-July 1964 as soon as word of approval was unofficially received. The profile of the roadway was first carefully established allowing comfortable vertical parabolic crest and sag curves at gradient changes, with a minimum sight distance of 200 ft. With the roadway profile established, the shape of the funicular arch could be expressed by

$$Hy = \iint w\,dx\,dx$$

where H = horizontal thrust at supports (constant)
y = rise of arch above datum
x = distance horizontally from origin
w = weight of fill above the arch at any point.

Since w was an elaborate function involving the roadway profile, the tapering of the arch in plan and the funicular arch profile itself, the equation above became quite complex to solve. Trial and error procedures converged too slowly. The problem was found to be ideally suited for solution on an Analogue Computer using high-gain amplifiers. The Analogue Computer at the Atomic Energy Establishment was generously made available for the work and a solution was quickly obtained.

3. Foundation Investigations :

The site was handed over to the Contractors for preliminary work on 27 August 1964. A trial pit located over the South abutment of the arch went down 17 ft. in soft soil. It became clear that rock might not be available at shallow depths as anticipated. There was also not indication available as to its quality, nor any knowledge of the strata below. It was decided to carry out trial bores at each arch abutment, recovering samples along the length of each bore and carrying out standard penetration tests wherever required.

Six bores were specified, three at each abutment, located as shown in Fig.1 where bore-hole logs are also shown. The bore log results were puzzling, particularly on Hughes Road. The explanation, discovered much later in the project, is that the entire length of hill side from Walkeshwar to Bubulnath, Hughes Road, Kemp's Corner, Forjett Street and the East of Cumballa Hill abutting on the Dhobi Ghats of Tardeo is an old quarry face. Rock levels are consequently quite irregular and the overburden is fill of uncertain character deposited many years ago.

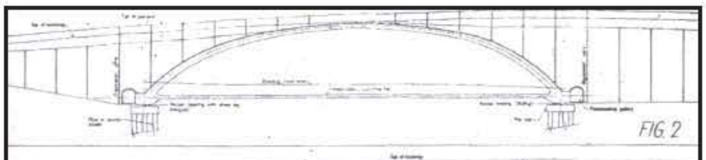


FIG. 2

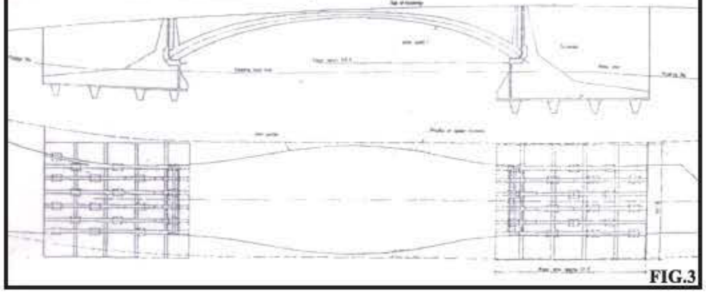


FIG.3

On the Pedder Road side sandy clay mixed with boulders of all sizes was found just below the surface. Any attempt to remove this and reach rock would mean delay and considerable expense and would probably endanger adjoining buildings. On the Hughes Road side rock suitable for carrying the arch thrust was found at about 70 ft. depth. Any foundation using the rock at 70 ft. depth would be disproportionately costly and would considerably delay the work.

Meanwhile the arch design was well advanced. The Municipal engineers were in favour of retaining the arch design if this could be done at reasonable cost, partly because they felt the arch was aesthetically preferable to a prestressed main span and partly because a total change of design would mean a loss of design time and consequent delay in the project. Two proposals for retaining the arch design were therefore put forward. It should be made clear that neither of these proposals would have been entertained by the designers had foundation conditions been know at the time of tendering.

The first proposal was to introduce a horizontal prestressed concrete tie about 6 ft. below the lower roadway to take up the horizontal thrust of the arch. The entire bowstring assembly of arch and tie would be statically determinate and could rest on piles or open foundations which would be free to settle without disturbing the arch action (Fig. 2). Prestressing galleries under the fill would provide access to the arch abutments and prestressing would proceed simultaneously with loading of the arch with fill. A prestressed concrete tie was preferred over other types of ties because of the relatively small extensions it would undergo with varying load conditions on the arch. The tie could either take the form of a wide, shallow slab cast directly on soil at 6 ft. depth or it could be made up of half-a-dozen separate parallel beams placed edge-wise on soil. The latter would be preferable, for if settlement of the foundations occurred the tie would be required to follow this settlement by slicing through the soil below. However this slicing action seemed extremely uncertain and if the soil were to exert unforeseen reactions on the tie, very-severe shear faces could develop and damage the tie. The prestressed tie proposal was therefore dropped.

A second proposal was to use the massive approaches on either side as thrust blocks resisting the horizontal thrust blocks resisting the horizontal thrust of the arch. (Fig. 3) Triaxial compression tests on soil samples from both abutments had meanwhile been called for.

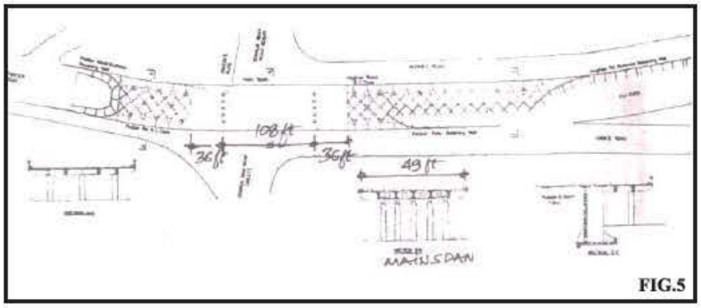


FIG.5

These indicated for undisturbed samples taken at 4 ft. depth on Peddar Road a value of C = 11 psi and ф = 80, and at 20 ft. dept on Hughes Road C = 8 psi and ф = 20. The soil was too poor to carry the arch thrust safely, even if this were distributed over a 200 ft. length of the approach on Hughes Road.

The arch design was consequently abandoned and work on a fresh design using a prestressed concrete main span began on16 September 1964.

4. The Present Design :

There was some difficulty concerning acquisition of Pan-day's building. The alignment of the Flyover therefore needed to be altered by swinging it towards India House to avoid Pan-day's building. This had the disadvantages that the left turn by-pass between India House and the Flyover would be reduced to about 12 ft. width (instead of the 24 ft. originally provided) permitting only single-lane traffic, and that the junction with Peddar Road would then become a sharp S-bend in plan which together with the reverse gradient would make for uncomfortable driving at that point. It was decided therefore to adopt a structural system for the deck using side cantilevers of approximately 8'-6" clear on each side. The cantilever part of the deck could then be notched to accommodate Panday's building without interfering with the main beams carrying the deck. This permitted a straighter alignment and an 18 ft. by-pass on the India House side (Fig.5). The deck over the notch would be constructed later after demolition of Panday's building

The clearance below the bridge originally stipulated as 18 ft., was reduced to 17 ft. after discussion with the Municipal engineers. This resulted in improved gradients on the approaches. Double-decker bus heights are just over 15 ft., Fire Brigade equipment is not as high, and clearance in London, where the some double-decker buses are used are specified as 16'-6". The 17 ft. clearance was therefore felt to be ample.

To minimize gradients on the approaches it was desirable that the main span be structurally as shallow as possible, consistent with economy. A hollow box section was therefore preferred and in addition the main span was extended over its support into cantilevers whose presence relieved the moments at mid-span. The cantilevers would also provide column-free parking areas below. With a central span of 107'-9" centre-to-centre, 36 ft. cantilevers were found satisfactory, giving maximum reduction in moments at mid-span without causing excessive negative moments over the supports, or excessive variations in moments, a factor which can sometimes control the section in prestressed concrete.

In cross-section the span is a hollow box-girder 49.5" deep x 32' wide, divided into 4 cells (Figs. 5 & 6). The 8'-6" cantilever brackets on either side are continued across the section as diaphragms. In view of the high torsional rigidity of the box section, diaphragms are not particularly useful for transverse distribution of load. They were provided in this case as a convenient means of carrying bracket moments into the main section and for locating transverse cables.

The analysis of the main span for transverse distribution of loads presented some difficulties. The presence of the cantilevers obviously improves the distribution in the span, but the effect could not readily be taken into account. The span was accordingly analysed as a simply-supported 107'-9" span using Morice & Cooley's method, ignoring the cantilevers, a conservative procedure. The behavior of the cantilevers themselves, under an eccentrically placed abnormal load could not however be assessed confidently by any known method. As it happened, the cantilever moment values for the exterior girders under abnormal loading (70 ton tank Class AA) even allowing conservative distribution factors were found to be less than the moment's caused by 4 lanes of Class A loading. The latter values were consequently adopted for design.

Since the deck slab of the box-girder is under longitudinal compression from prestressing forces a question arose as to the behavior of the slab immediately over a diaphragm when a wheel load crosses the diaphragm. The wheel load would cause longitudinal bending moments in the slab and the resulting compression added to the prestressing compression gave stresses far in excess of permissible values. The deck slab was therefore chamfered and thickened at its junction with each diaphragm.

The box girder was cast in-situ. Construction joints were provided transversely across the entire cross section, with sections cast alternately to minimize the effects of shrinkage. Each section was cast in two operations, the bottom slab and lower half of each web being cast first and the remainder being cast after placing cell shuttering and top slab steel. A minimum concrete strength of 5,500 psi on 6" cubes at 28 days was specified. 18 sets of cubes were taken (6 cubes per set). The average 28-days strength of all cubes was 6250 psi. The worst set of 3 cubes averaged 5125 psi.

Each web of the box section was provided with 18 cables of 12 wires 7 mm diameter providing 90 longitudinal cables in all with a total prestressing force after losses of approximately 3,100 tons. Losses due to causes other than friction were estimated at approximately 17 per cent; losses due to friction would vary from cable to cable but some cables were 180' long and draped so the maximum losses due to friction would be nearly 20 per cent.

The number of cables provided exceeded the theoretically required number by 5 to 7 per cent, a precaution against possible wire failures.

The cables were profiled so that the line of thrust in the concrete coincided as closely as possible with the centroid of the section under conditions of dead load and nominal live load. This would reduce the effect of creep to a shortening of the deck without causing upward or downward deflections.

Cables were enclosed in 2" dia. flexible M. S ducting. These ducts were held to correct profile in plan & elevation by supporting them at 2 ft. centres on "dollies" welded from 12 mm M.S. bar. Each dolly was accurately fabricated from a drawing to hold each of the 18 ducts it carried in correct location.

Many of the cables emerged on the soffit of the 36' cantilevers and it was required that these cables be stressed prior to removal of shuttering. The Gifford

Udall single-wire stressing system was therefore preferred, its small jack being thought more suitable for overhead work in cramped conditions. Wires were stressed from both ends simultaneously. Stressing provided more time consuming than expected, requiring an average of 20 man-hours per cable including cleaning identifying wires, stressing and grouting. Four jacks were in use simultaneously, with telephone communication between operators at each end of a wire.

Two anchorages failed partly, the cause being poor concreting behind the anchor plate. In one case the plate sank into the concrete 1/5", in the other case 3/4", both when the last wires were being stressed. In addition, about a dozen wires slipped during or immediately after anchoring. The cause proved troublesome to locate; it was apparently due to excessive surface hardness of the wire from one particular coil of wire delivered by the manufacturers, so that the teeth of the anchoring wedges failed to bite into the wire.

On account of elastic strain, creep, shrinkage and temperature strain, it was estimated that the main span between columns would shorten by a maximum of 1.1 inches. It was found possible to accommodate this movement by deflection of the supporting columns thus eliminating the need for sliding or roller bearings below the deck. The supporting columns proved flexible enough to follow the shortening of the deck while developing a force of approximately 43, 500 lbs. at the top of each column. It was decided therefore to provide a hinge at the top of each column permitting rotation of the deck over each support due to relative settlements of foundations and rotation due to the action of live loads.

The delivery time quoted for cast steel bearings was too long to suit the construction schedule. Neoprene rubber pad bearings had the merit that the longitudinal shortening of the deck could be easily accommodated by using thick "sliding" Neoprene bearings at one end. However since the bearings are compressible under load, direct casting of the deck on the bearings presented difficulties and the only satisfactory procedure for placing the bearings in position seemed to be complete stressing the deck, carry it on jacks, slip the bearings into positions and lower the deck on the bearings. This operation with jacks was regarded as a complication best avoided. Concrete hinges were consequently decided on as being the most quickly obtainable and the simplest to install. They would also require less maintenance.

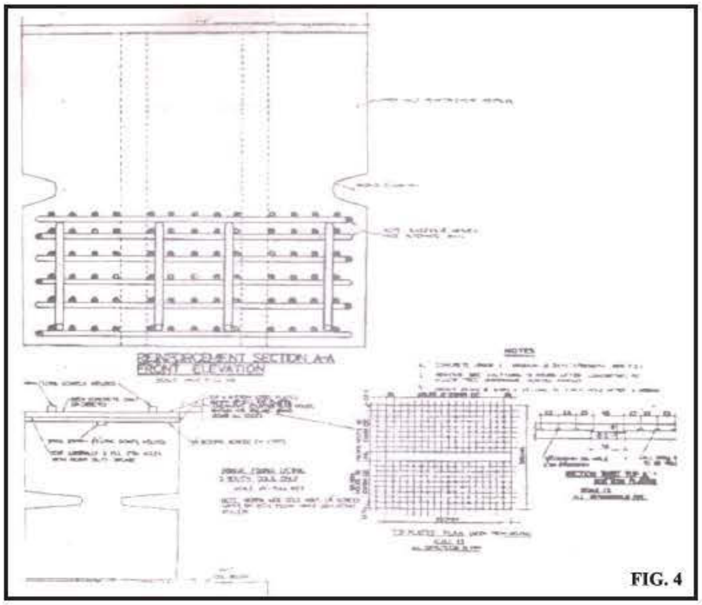


FIG. 4

A mean stress of 5000 psi across the throat under maximum vertical load was decided on together with a mean stress of 1100 psi on the ends of the hinge. Since a throat width of between a third and a quarter of the end dimension is recommended a throat size of 5" x 16" was selected, the notching of section by 2" on each side in the transverse direction (from 20" to 16") being considered desirable to present spalling at those points (Fig. 4). The height of the throat, 1 ¼", is a quarter of the throat width. This is perhaps an upper limit but was required in view of the desired rotations. The overall height of the hinge was selected arbitrarily to be in proportion with the other dimensions.

Bursting stresses in each half of a hinge block were calculated using Guyon's theory of stress distribution in end blocks. The theoretical requirement of reinforcement was 3.2 per cent. mild steel in the direction of bursting at the worst affected section, about 3" above the throat. Studies of other examples of hinges showed reinforcement varying from 2.8 per cent to 4.7 per cent. 4 per cent reinforcement was therefore provided in the longitudinal direction in each half of the hinge, and half that in the transverse direction.

Reinforcement across the throat provided before casting has been found to lead to shrinkage cracks across the throat. These cracks close under load and apparently entail no subsequent harmful effects. It was thought better practice, however, to provide no reinforcement across the throat before casting. Two through holes 1 ½" diameter were provided instead and three weeks after casting bars 1" dia. just shorter than the height of the hinge were grouted into each hole. The bars will carry any sudden impact shear on the hinge. Normal horizontal forces can be carried without difficulty across the throat and account of the high compressive stress existing due to vertical load. No reinforcement was specified to connect columns and hinges, or hinges and deck. ¼" mortar bedding laid directly on top of columns was specified to carry the hinge and each hinge was covered with ¼" mortar pad before the deck was cast.

Horizontal forces can be comfortably transmitted by friction across these contact surfaces and the isolation of the hinges will permit future replacement should this be necessary. It will also permit jacking of the deck to its original position in case of foundation settlement.

It was further decided to equip all 5 hinges over one support with machined steel plates between the hinges and the deck to permit sliding. The calculation of horizontal force on each hinge was based on many uncertain factors and it was thought advisable to provide the plates as a means of relieving this horizontal force should it develop to excess.

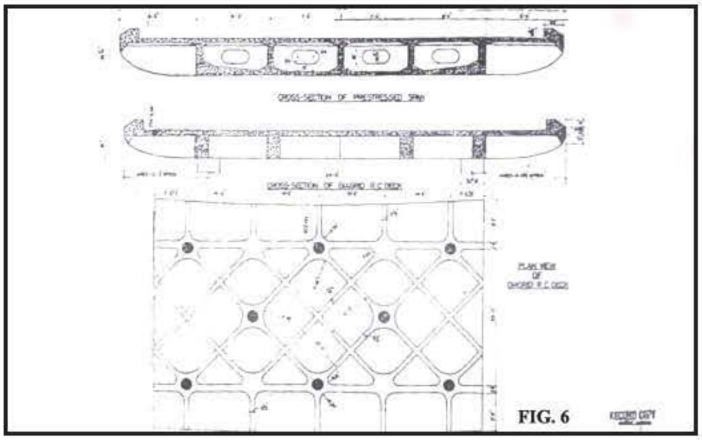


FIG. 6

For the main span columns the 30" dia. shuttering required for the approach deck columns was used but extended by 9" wide planks into a 30" x 39" oval section.

Foundations for the main span columns are different at the North and South ends. On the North, good murrum mixed with boulders was found at 8 ft. below road level and an open rectangular footing provided exerting a pressure of 1.4 tons per sq.ft. On the South, bore-holes and triaxial shear tests confirmed the presence of a very poor clay between 12 ft. and 30 ft. below road level. Calculated settlements for an open footing were of the order of 2 or 3 inches and consequently a bored pile foundation was provided below the 5 columns at the South end. The bored piles 22" dia. were taken down to a firm stratum at about 40 ft. depth. As an added precaution the piles were capped with a 12 ft. wide cap reinforced as a footing, which would bear on the soil at 8 ft. depth if the piles failed to provide the full reaction expected of them.

The design of the RC diagrid approach decks evolved from the pattern of parking below. It was found that angular parking was best for maximum utilization of the width available below. This parking pattern dictated a diagonal arrangement of columns and this in turn a diagonal beam pattern above. (Fig. 6) The analysis proved troublesome, particularly because two major longitudinal beams over the external line of columns are orthogonally and not diagonally oriented. A technique of "reaction distribution" was developed for the analysis. The system was treated as an open grid (no plate action due to the presence of the slab) with torsion between beams ignored.

The South approach required a longitudinal retaining wall approximately along the centre-line-of the flyover, with parking below the deck on one side and fill to be retained on the other. It was natural to design the wall as a zig-zag folded-plate wall, each panel serving as a slab in one direction and as a buttress for adjoining slabs in the other direction. Dimensions were chosen so that each fold of the wall accommodated one parking space. The diagrid beam patter was continued for the deck above (Fig.7)

5. Load-Testing:

It was thought desirable to load-test the structure before opening it to traffic. 4 days were set aside for this work.

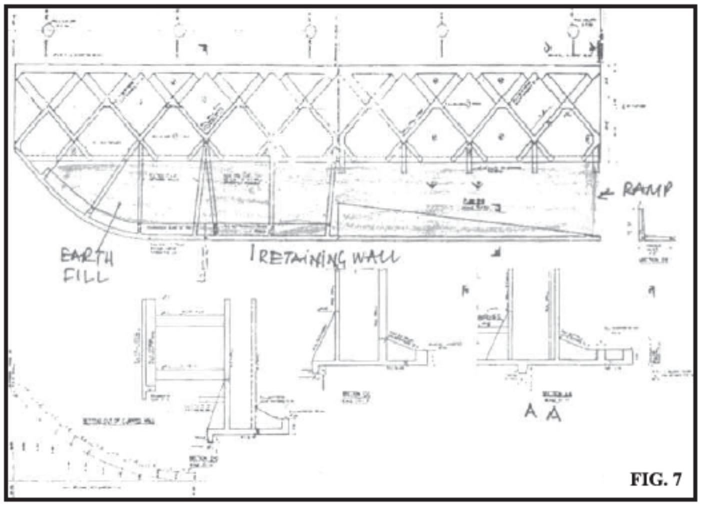


FIG. 7

The Indian Institute of Technology, Powai, generously made available a great deal of equipment and enough staff members to conduct the test and take all observations. The heaviest vehicle available for the test was a 40 ton capacity trailer on hire. The weight of the tractor unit was 9.1 tons. The trailer was first loaded to 26.5 tons and its front and rear axles weighed separately on a 20-ton weigh-bridge, the biggest available in Bombay. The 35.6 ton unit was used on the first day in testing the main span. At night a further 9 tons of sand-bags were loaded on the trailer and the fully loaded vehicle weighing 44.6 tons used on the second day on the main span and on the third day on the R. C Diagrid approach deck.

32 deflection gauges reading to 1/1000" and 1/10,000" were fixed at various locations below the Northern half of the main span and below the North cantilever. The tractor-trailer unit was placed in several pre-determined locations on top of the bridge in the central lane and in a lane on one extreme side. Instantaneous deflections were noted and also deflections after a time lapse of 15 minutes. Initially it was thought that it might be possible to study the creep effect by taking readings at the intervals of one hour and two hours but it was found that temperature movements of the bridge obliterated any creep affect and made the study of creep very difficult. A total movement of the free ends of the cantilever of approximately 1" due to daily variations in temperature was noted. At the end of the first day after the trailer had been loaded with an additional 9 tons, the vehicle was left on the bridge overnight and readings taken. The maximum deflections at mid-span and at the free cantilever end under the 44.6 ton loading were of the order of 1/4".

The general conclusions that could be drawn from a study of readings taken during these two days of testing the main span were that actual deflections were approximately 2/3 the calculated values indicating a 50 per cent greater stiffness than calculated. The transverse deformation ofthe section under eccentrically placed loa ding confirmed the high torsional rigidity of the box section.

On the third day the R. C. diagrid approach deck on Peddar Road was tested again using 32 deflection gauges located at different points below the deck. Several faint cracks had been observed in the beams on this deck. The largest ones were 0.2 mm wide and were found in all 14 beams intersecting at one of the central columns. The cracks extended from slab to slab down the side of a bean across the bottom and up the other side. It was thought that these cracks might be due to settlement of the central column. During the test no widening of the cracks could be observed using measuring devices sensitive to .05 mm. The cracks were observed again three months after the bridge was opened and showed no apparent widening. The maximum deflection of any of the beams in the diagrid deck under the 44.6 ton load was 1/40".

6. Acknowledgement :

The author gratefully acknowledges the assistance of several persons who went out of their way to help him in the project: in particular, Mr K K Nambiar and members of the staff of the Concrete Association of India; Mr. J. Rangnath of the Atomic Energy Establishment and his staff on the Analogue Computer. Brigadier Bose, Dr. C. K. Ramesh, Professor Mastanchenko and members of the I.I.T staff. The author also gratefully acknowledges the constant support and encouragement received from Shri S. V. Desai and Shri M. S Nerurkar of the Bombay Municipal Corporation. He is also grateful for the continuous cooperation and very devoted work put in by the other engineers of the Corporation, by the Contractor and his staff and by the author's own staff in the work.

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About the author :

Engineer Shirish B Patel is an eminent and outstanding structural engineer with more than five decades of experience. He is known for his out of the box thinking and innovative approach in designing outstanding structures over last fifty five years. He is heading the most prestigious design engineering firm M/s Shirish Patel and Associates Consultants Pvt. Ltd, Mumbai which trained many structural engineers. This article has been reproduced for the benefit of ISSE members.
Email : shirish@spacpl.com

MUNICIPAL CORPORATION OF GREATER MUMBAI

No.ChE/001518/DPWS / HRB Dated .04.2021

Subject: Expert Review Panel (ERP) as per IS-16700 of 2017 for High Rise building.

Reference: i) MCP/6093 dated 24.07.2019
ii) MCP/7185 dated 08.02.2021

Hon'ble Municipal Commissioner has accorded sanction to empanel the following Consultants on Expert Review Panel (ERP).

A. Practicing Structural Engineer
1. Mr. Achyut Watve of M/s.J+W Consultants
2. Mr. Umesh Joshi of M/s.J+W Consultants
3. Mr. Girish Dravid of Sterling Engineering Consultancy Services Pvt.Ltd.
4. Dr. V.S. Kelkar of Dr. Kelkar Designs Pvt. Ltd.
5. Mr. Shantilal Jain of M/S Struct Bombay Consultants
6. Mr. Arun Kashikar Structural Engineer Ex. TCE/Tata housing

B. Academic experts in Structural Engineering
1. Prof. Abhay Bambole (VJTI)
2. Prof. Y.M. Desai, (IITB)
3. Prof. Keshav Sangle (VJTI)
4. Dr. M.M. Murudi (SPCE)

C. Geotechnical expert
1. Dr. S.Y.Mhaiskar (Academic Expert/ Consultant)
2. Dr. Anand Katti (Academic Expert/ Consultant)
3. Dr. D.N. Dewaikar (Academic Expert/ Consultant)
4. Dr. Deepankar Choudhury (IITB,Academic Expert)
5. Mr. Jaydeep Wagh (Practicing Consultant)
6. Mr. Gaurav Parab (Practicing Consultant)
7. Mr. Shekhar Vaishampayan (Practicing Consultant)

E. Base Isolation and department expert
1. Dr. R.S. Jangid (IIT, Bombay)
2. Prof. K.M. Bajoria (IIT, Bombay)
3. Dr. A.A. Bage (SPCE)
4. Prof. G.R. Reddy (BARC)
5. Dr. Manish Kumar (IIT, Bombay)

26/04/2021
(V.P. Chithore)
Ch.E.(D.P.) & Dir.(E.S. & P.)

HIGHER STUDIES ABROAD 2

By Kirty Hemant Vadalkar

It is commonly found that students prefer US for higher studies. Apart from various universities of the US, there are many universities offering higher studies and are recognised for their contribution.

I was curious about Siddhesh as he preferred Technical University of Delft (Tu Delft) , for higher studies as a structural engineer. Yes, a lot of information was available on Google, I wanted to find out his first hand experience.

We all know Europe is beautiful and so attractive that we prefer these countries to visit as tourists, but a young engineer from a structural background choosing to study in one of those beautiful countries was really generating my interest.

Siddhesh G Rajadhyaksha
(eng.siddheshgr@gmail.com)

I knew Siddhesh earlier as a very sincere student of Datta Meghe COE. His father is a reputed structural engineer of Mumbai. Siddhesh worked in a reputed structural design firm for some time after his graduation where he was posted to work in the design team of Mumbai metro. But he wanted to pursue his higher studies abroad so he quit the job after sometime.

TU Delft is the most renowned university in Europe and is located in a town called Delft in The Netherlands. The university is about 180 years old and began as an academic institute focussed on hydraulic structures because the average ground level of The Netherlands is below sea level. Today the university ranks 2nd in the world for Civil and Structural Engineering and also for Architecture and Build Environment.

Apart from its recognition Siddhesh had an interesting reason to choose the university. He says,"Other than it's academic appeal, as a cyclist, I was really enthusiastic about The Netherlands as a country because of it's avid network of cycling paths. Also, I felt it would be more challenging and out of my comfort zone, as I had no friends or family anywhere in Europe." this reason really appealed me. Netherlands is a country with maximum citizens preferring to reach their destinations on a cycle. Very minute observation Siddhesh! He is also very enterprising and wanted to be on his own without any so called comfort zones which may be becoming uncomfortable at times!

The admission process was similar to most foreign universities wherein you require a motivational letter and a few letters of recommendations in addition to your CV for the application. While they don't require a GRE score, they do need a TOEFL or IELTS score to make sure that you are proficient in English.

Siddhesh did not take any coaching classes for his MS applications and did it all on his own. Applying to TU is straight forward as they stick to the guidelines they mention on their website.

About his first day on the foreign land he says, "My first day in Delft was truly amazing and about how I had imagined it would be. Walking around the many canals and the many more pretty bridges that the Dutch have built over them for commuting. Also seeing a lot of young people, it immediately felt like a student city. Having settled in after the long commute, I walked for about 6 mins from my student housing to get to the campus. To give you an idea, there is a main cycle path that runs across the campus with different faculty buildings on either side of the road. The buildings are a mix from modern glass facade buildings, olden architecture brick buildings and at the very end of the campus is a nuclear reactor(Fun fact: One of the only universities to have their own reactor)." I really appreciate the built in civil engineer in Siddhesh.

Siddhesh finds that the academic structure at TU is very different compared to the Indian structure. The academic year is split into four quarters, with each quarter being 10 weeks long. The courses are taught for 8 weeks and exams for the remaining 2 weeks. This is a very hectic timeline, to learn about 4 courses each quarter so meticulous time planning is the key. He thinks time management was the biggest challenge for him before he started his education at TU.

The MSc programme at TU requires 120 credits to be achieved to obtain the degree. For the Structures course Siddhesh had about 40 credits of mandatory elective, which comprised Analysis of Slender Structures, Steel Structures 2 & 3 and Structural Dynamics and many more. The final graduation project requires 40 credits and the remaining could be any electives, relevant to the study.

The professors for all his courses were truly experts in their relevant field of study. The pattern of teaching was properly structured and were very interesting. Dr. Ir. Frans Van Der Meer was one of his professors for the Finite Element Course and Siddhesh also decided to do the thesis with him.

When asked about the most memorable event during his course, he says,"Well it's hard to pick out a memorable event as there were so many but I would say the most iconic was when I had the opportunity to go on a two week study trip to China with my student association U-BASE with 22 other friends and 2 professors. We visited almost all the big design firms in China, went to the sites of very interesting projects and also atop the second tallest building in the world, The Shanghai Tower. It was not just all study but also a lot of dinners, cultural events and parties." All work and no fun makes Jack a dull boy!!

As for his graduation project, Siddhesh worked on the nonlinear constitutive model of unidirectional fibre reinforced composites. Here, he had to formulate the constitutive model for mesoscale FEM and had to hard code into the finite element framework. This was all done with the help of an open source library in C++ that the department uses.

As regards the fee structure, it has changed quite a bit in the past two years so the best estimate can be obtained from the TU Website. But just for reference it had cost him about 16,000 euros tuition fee per academic year.

There are scholarships available that TU offers themselves. There is a TU excellence scholarship in which the university funds your tuition fees and living expenses for full two years. However there are only 2 of these per faculty and quite hard to get as Civil Engineering Faculty has many sub branches like Structural Engineering, Building Engineering, Hydraulic Engineering, Construction Management and Geosciences.

His overall studying experience was very satisfying. As he thinks, "the knowledge was built up from a very fundamental level and developed really in the following courses."
While the exams were very difficult the students were really surprised at the contents of the paper but have high regards for the professor who would have set the paper, such was the standard.
But he thinks two months for a master's level course was not sufficient a time and students had to rush.

I was quite amused to know about the graduation ceremony. Normally, what comes to our mind on saying ," graduation ceremony"is a grand colourful function. But at TU, the concept of graduation ceremony is very different. Each student graduates on the day they publicly defend their thesis. The chair of the committee will host the ceremony and at the end of the defense will award the degree. The student takes a seat and signs the degree on both sides, as it's written in Dutch on one side and English on the other. The student is then officially graduated. This is usually followed by a small ceremony in the same room with friends, family, professors and a few drinks. Unfortunately for Siddhesh, due to the current pandemic, he had the defense online and had to collect the degree later in the week.

It is not very easy nor is it very difficult to find jobs in the Netherlands. Certainly there are times when they require a Dutch speaking person but there's still a lot of jobs out there. One needs to really put themselves out there and network with professionals to look for opportunities. This formula has almost worked out for everyone and hardly anyone is left without a job.

The work culture is very open and the hierarchy in the Netherlands is very shallow. This is amazing as you are heard and your opinions are acknowledged. Also the working timings and etiquettes are excellent and almost all offices have a concept of Friday midday borrels (Vrimibo in Dutch) wherein they chill over a beer to bring in the weekend.

Siddhesh finds the cultural and living gap is real and poses the biggest struggle for any international person. And he suggests that the best way to cope up with the gap is to keep yourself in with company. He also thinks involvement in various associations is also very helpful as to keep oneself busy and as also to maintain a sound mental health to avoid the pressures of fast and demanding academic life.

As regards food, there are ample options for both vegetarians, vegans and non vegetarians in The Netherlands. The fresh produce of vegetables, dairy products and meat is very good. Also in most restaurants there will always be a vegan option so it is manageable.

In foreign countries what matters the most the strict legal adherence. Even in The Netherlands, there are a few laws to keep in mind but they are mostly related to cycling around. The Netherlands is a very open country so nothing too restrictive.

I found Siddhesh's story very interesting, the university is top ranked, the country is totally different so are the protocols. He opted for a totally unknown country. Collecting information through web is different and experiencing it in person is totally different. What really appealed me was his enterprising nature. He has excelled in his studies and I am sure he will contribute his mite as a dynamic structural engineer. I wish him a very bright future ahead.

About the author –

Kirty Hemant Vadalkar, working with engineering students for a long time, helping them in their career planning and further studies. Certified STAADPro trainer, conducting training programs for past 25 years. Email - kirtyvadalkar@gmail.com

NEWS AND EVENTS DURING APRIL – JUNE 2021

by Hemant Vadalkar

23 April 2021 : ISSE student chapter arranged a lecture on "Bridge inspection and maintenance" by **Er. Mahesh Tendulkar.** ISSE student chapter Walchand college of Engineering , Sangli coordinated the event under the guidance of Madhav Chikodi. Er. Mahesh shared his experience in inspecting various bridges in Maharashtra and showed site photographs of various types of deterioration. Bearings are important key components in the functioning of bridges but these are most neglected during maintenance. He discussed various IRC guidelines for bridge inspection recording observations.

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23 Apr 2021 : Ultratech and ICI arranged a lecture on sustainable pavements – Concrete Roads by **Er. Ashwin Moghe.** Er. Ashwin discussed type of pavements namely flexible pavements, rigid pavement and composite pavements like Ultra thin white toppings. He discussed the life cycle cost and sustainability of different types of pavements. He elaborated cost effective and long lasting solutions of concrete roads with some case studies.

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24 Apr 2021 : ACCE Bangalore arranged a web lecture on Precast concrete construction by Er. P. Suryaprakash.

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8 May 2021 : Narendra Ajugia, Eminent Structural Engineer and active member of ISSE lost the fight against Covid-19 on 8 May 2021. It is a huge loss to the fraternity. Heartfelt condolences from ISSE group !!!

Narendra M Ajugia joined Shirish Patel and Associates Consultants Private Limited (SPACPL) in 1982 as a "Design Engineer". At the time of his passing, he was the Chief Executive Officer and Vice Chairman of (SPACPL)

Professional Background

B E (Civil Engineering) with Honours, University of Bombay 1981
Fellow, Institution of Engineers India
Member, American Concrete Institute
Member, Indian Society of Structural Engineers

He was SPACPL's team leader in a variety of industrial projects, tall buildings, IT parks, Hotels and Town planning maps for the Vasai-Virar Sub-region in north Bombay. Right from the day he joined SPACPL he evinced considerable interest in the construction problems. His site visits were meticulous which earned him respect from the site staff.

He adapted himself effortlessly into computer aided design and emphasised the importance of acquiring state of the art software that would help engineers in documenting design work of high quality. When working with architects he would patiently listen to the aesthetic issues and evolve structural framing that complied with their requirements. He was very quick in understanding the limitations of new materials that were now available in the building industry. A special mention must be made of the details evolved for accommodating profiled Aluminium sheets as a roofing material for covering huge Doubly Curved Roofs in Structural Steel. His innovative effort culminated in winning the Third Prize for Most Outstanding Structural Steel Design – Roof of EON for Panchshil at Karadi, Pune

He actively participated as a Member ISSE in the deliberations in matters that concerned "Indian Standard Code IS1893 for Seismic Design of Tall Buildings".

He was very fond of carpentry which led him into designing and making furniture at home. He was a fervent devotee of Lord Swaminarayan (BAPS). Inspired by Mahatma Gandhi he would regularly spin yarn daily without fail.

But above all he was a compassionate and kind, smiling person with a gentle sense of humour, always helpful with his juniors, treating everyone with equal respect.

Tushar Chaudhary senior structural engineer from Optimal Design Consultancy passed away due to covid.

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24 May 2021 : Congratulations to all appointed members on the Expert Review Panel of MCGM as per IS-16700-2017 for high rise building as per MCGM circular dated 26 April 2021

May 2021 : ISSE Student chapter arranged a lecture by Er. Swapnil Kamerkar, Design Engineer M/s SCON Infrastructure Mumbai on Introduction to Pre-stressed concrete and its application.

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12 June 2021 : Association of Consulting Civil Engineers(ACCE), India, Bangalore centre arranged a webinar series on "Professionalism in Civil Engineering" every Sat from 12 June to 21 Aug 2021. Various eminent professionals across India have been invited to share their views on this burning issue. Er. Sangeeta Wij, Er. P. Surya Prakash, Er. Avinash Shirode, Er. Sanna Ratnavel, Dr. Arvind Galgali, Er. Raju Gogia, Dr. A. Joseph, Prof. Mahesh Tandon and Er. D Ranganath will address various issues like model building bye-laws, building failures, Unprofessionalism in Government and private organizations, civil engineering profession, model Civil engineering bill.

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18 June 2021 : ISSE Student chapter lecture on Structural Systems for high rise building by Amodh Luman. Er. Luman described various structural systems adopted for high rise buildings and their efficiency. Madhav Chikodi arranged the lecture.

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25 June 2021 : ISSE in association with Ultratech Cement arranged a webinar on Innovative Cementitious materials by Dr. Yusuf Mehta, Professor, Civil Engineering Dept, Rowan University, New Jerey, USA. Dr. Mehta touched up on the research going on the concrete durability and sustainability aspects. He emphasised that use of supplementary cementitious material in concrete will be useful for durability and reducing carbon footprint.

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21 to 26 June 2021 : Lovely University Punjab arranged Webstruct 2021 International webinar. ISSE members Dr. Mahua Chakrabarti, Shanitilal Jain and Hemant Vadalkar were invited to make presentations in the forum. Hemant Vadalkar introduced ISSE and its activities to the participants and students and talked on Software applications in Structural Engineering using STAADpro software. He gave outline of software STAADpro for structural engineering analysis and design. Dr. Mahua Chakrabarty spoke on "Probability and Engineering". Shantilal Jain touched upon the " Challenges in design and construction of tall buildings". Faculty around the world addressed the webinar during the week long function which was very well appreciated by all the participants.

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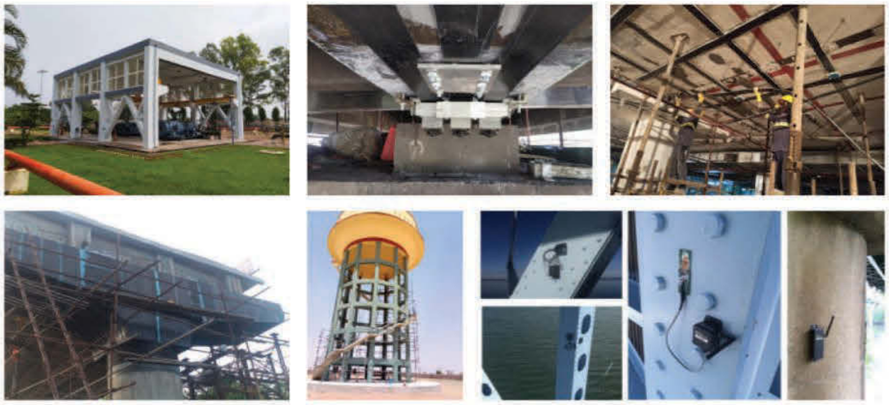

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