STRUCTURAL ENGINEERING

QUARTERLY JOURNAL OF

INDIAN SOCIETY

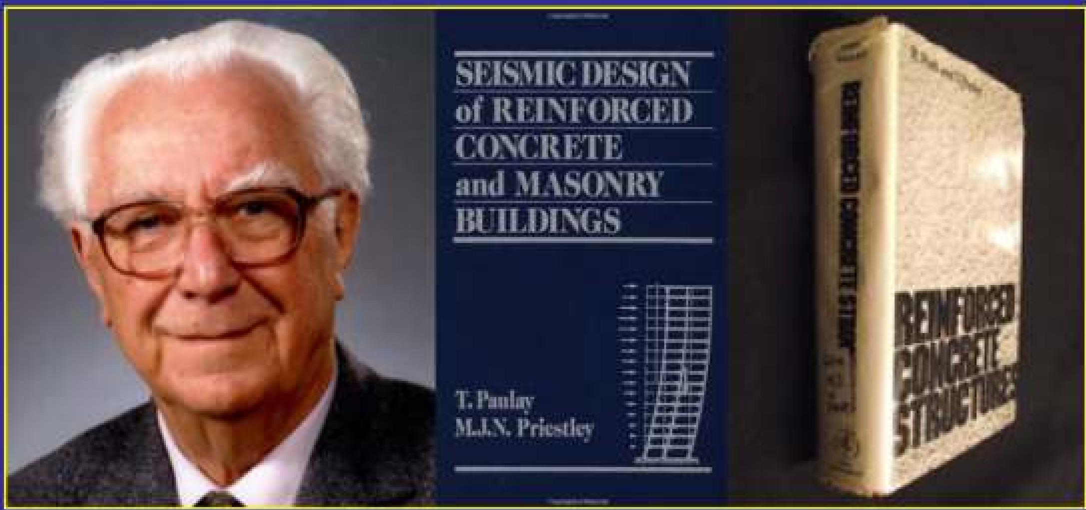
OF

STRUCTURAL ENGINEERS

ISSE

VOLUME 18-3

July-Aug-Sept 2016



GEM 9: Prof. Tom Paulay-One of the Legends of Earthquake Engineering

(See Page 3)

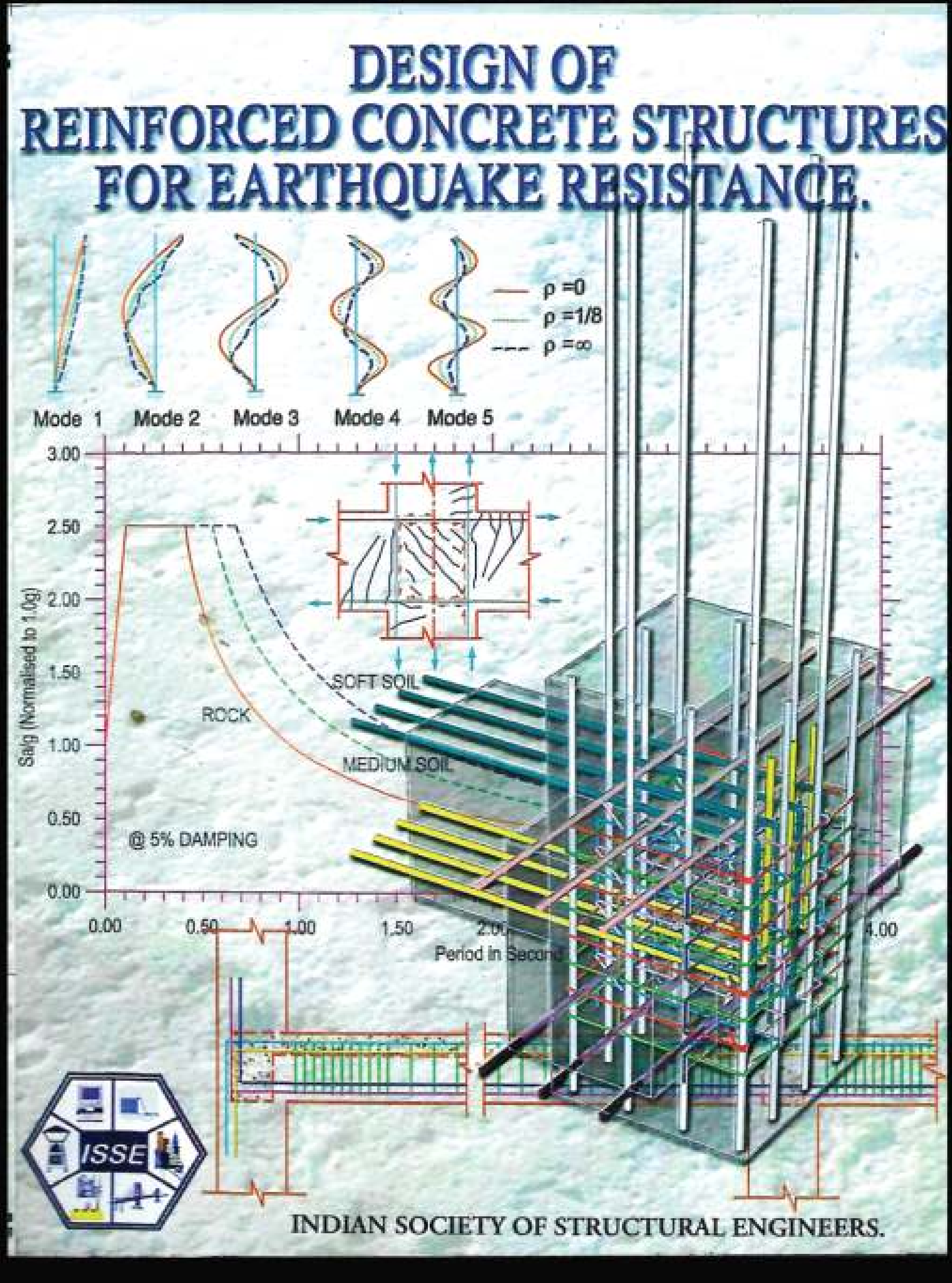
Report on ISSE function : Nene memorial lecture on 4th Aug 2016 in Mumbai

(See page 15)

Report on ISSE function : Technical lecture on 22nd Jul 2016 in Mumbai

(See page 17)

LET US BUILD A STRONG STRUCTURE OF INDIAN SOCIETY



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

ISSE

VOLUME 18-3, JULY-AUG.-SEPT. 2016

Head Office : C/O S.G. Dharmadhikari, 24, Pandit Niwas, 3rd Floor, S. K. Bole Road, Dadar (W.), Mumbai 400 028 • Tel. : 91-22 24314423 / 24221015
• E-mail : issemumbai@gmail.com • Website : www.isse.org.in
Regd. Office : The Maharashtra Executor & Trustee Co. Ltd., Bank of Maharashtra, Gadkari Chowk, Gokhale Road (N.), Dadar (W.), Mumbai 400 028.
Charity Commissioner Reg. No. E-17940, Mumbai   Donations are exempted from Income Tax under 80-G

Contents

Editor : Hemant Vadalkar

Fraternity News

WELCOME TO NEW MEMBERS

(April – May – June 2016)

M-1484	Mr. Chetan Jagdish Trivedi.
M-1485	Mr. Faiz Abdul Majeed Sagri.
M-1486	Mr.Kaustubh Raosaheb Shingte.
M-1487	Mr. Vikas Tukaram Londhe
M-1488	Mr. Rajesh Jayantilal Shah.
M-1489	Dr. Mrs. Deepa Shri
M-1490	Mr. Ravindra Shivajirao Pansare
M-1491	Mr. Himanshu Bharatlal Parikh
M-1492	Mr. R. Balamourougane.
M-1493	Mrs. Priyanka Deepak Harkal.
M-1494	Mr. Tushar Jayantrao Patil.
M-1495	Mr. Sanjay Mahadeo Bemblekar.
M-1496	Mr. Thirugnanasambandam K.S.
M-1497	Mr. Mahesh Srinivas Acharya.
M-1498	Mr. Dasari Venkata Siva Naga Krishna.
M-1499	Mr. MD. Rokibul Islam
M-1500	Mr. Rajesh Shivaji Khatate.
M-1501	Mr. Vijayan Balaji Subbramanian
M-1502	Mr. Vipin Mittal
M-1503	Mr. Tejas Vinod Sura
M-1504	Mrs. Priyanka Gupta.
M-1505	Mr. Sanat Narendra Mehta.

M/S. Adhi College of Engineering and Technology

Patrons : 35　　Organisation Members : 23　　Sponsor : 8

Members : 1505　　Junior Members : 42　　IM : 01

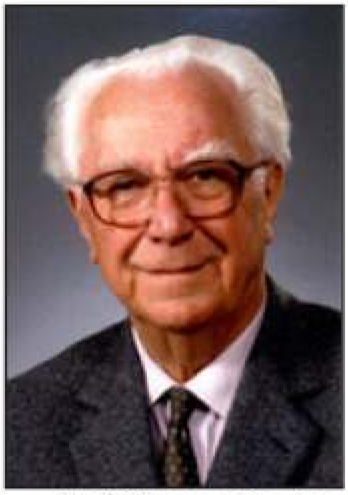
TOTAL STRENGTH 1614

- ❄ 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 9: Prof. Tom Paulay-One of the Legends of Earthquake Engineering

Dr. N. Subramanian
Er. Vivek G. Abhyankar



Prof. Thomas Paulay
(26th May 1923 -28th June 2009)

Thomas Paulay was born on 26thMay 1923, in Sopron, Hungary, about five miles from the Hungarian-Austrian border, as the only son of Mr. George (György) Paulay, who was a German and Mrs. Margaret, who was a Hungarian. As the town he grew up was so close to Austria, he had Austrian influence, and was proficient in the German language. His father had military training and became cavalry officer in Hungarian army. After World War I, during 1920, Mr. George settled in Sopron and married Mrs. Margaret.

Early Years

Thomas Paulay attended primary school, run by the state in his town, for four years (he recalls in his interview with R. Reitherman that half the boys in his school came with barefoot, as shoes were expensive and hence were used only during winter months. He also expressed his desire to become a cavalry officer like his father, and learnt horse riding from his father!). From age eleven to nineteen he attended the military school. In 1941, he was admitted to the Royal Hungarian Military Academy in Budapest, when the government of Hungary decided to join Germany in the war (2nd World war) against the Soviet Union. In 1943, when he was just 20 years old, he graduated with distinction from the Military Academy. On the same day, August 20, he became a second lieutenant in the Hungarian Army.

Tom Paulay, age 17, with his father's two favorite horses

World War II and Wounded Three Times

In June 1944, Thomas Paulay's squadron went to war and he was wounded by some small-sized shrapnel penetrating his lungs. (He said that a German soldier just put some plaster on the wound and it was a miracle that he was not infected). Three weeks later, when his wounds healed, he was in charge again in the Army against Russians with 283 men and 308 horses. Their job was to blow up bridges and slow down the Russian Tanks. He was injured again in Sept. 1944, which almost killed him, when he was ordered to defend the capital city of Poland, Warsaw. He was taken to a small military hospital in Poland, and after three days sent back to Sopron and recovered after 3 months. He was wounded the third time, at the end of 1944, when a building collapsed on him, when it was hit by an artillery shell-this resulted in his partial deafness. This partial deafness is remembered by both students and colleagues of Prof. Paulay.

Escaping from Russian Army

When Thomas Paulay was released from the hospital, eighty percent of Hungary was occupied by the Russians. Hence he crossed the Enns River in Austria in May of 1945, and a few days later, on May 8, the war in Europe ended and he was in the American side of occupied Austria, a small town by name Windischgarsten. While helping American soldiers to get accommodation, he met his future mother-in-law.

Civil Engineering Education in Budapest

After five months, Paulay went back to Hungary with a horse-drawn cart. After months of explorations of possible new career, he went to the Technical University of Budapest in 1946 and met the Dean of the School of Architecture. As the Russian army controlled the student entries, he could not get a seat in Architecture and hence, to our fortunes, selected Civil Engineering!

Professor Paulay described lectures in the bombed out ruins of the university with the lecturers writing on the blackboards whilst wearing knitted gloves and two raincoats to keep out the cold. In some classes like Mathematics, there were 700 students, and as there were only 600 seats, others were standing or sitting on the stairs. He had to live in the top storey of a four-storey building, which was bombed and hence had no windows and no heating! Even the class rooms were not having heating and all suffered in cold weather. The harsh economic conditions, and the reduced immediate demand for engineers, resulted in a 75% failure rate in the first year. At the beginning of the second year of his studies, the Dean of Architecture allowed him to be admitted in Architecture, but Paulay gratefully declined this offer. During his studies, many of his college mates were arrested by secret political police or permanently disappeared. In 1948 he fled to Austria and West Germany to escape Stalin and Red Army control. In reference 4, he also explains how he miraculously escaped from a train with a friend, Steven and travelled to Austria and then to West Germany, with the help of an Austrian detective and the architecture students of the University of Vienna.

Hard time in West Germany

Then Paulay joined the Technical University of Munich, which was damaged far worse than the university in Budapest. The U.S. Army provided a hot lunch to students and served a rich soup, and he eat half of it for lunch and kept the other half for dinner. He spent three years in Germany as a stateless refugee, working with a charitable organization and hence couldn't continue his studies. Paulay then retuned back to Windischgarsten on 28th Nov. 1948 and married Herta and their daughter Dorothy was born in 1949.

Herta and Tom Paulay at the banquet of the 2003 Symposium to Celebrate the Lifetime Contributions of Tom Paulay and Bob Park. (Photo by Fumio Watanabe)

Coming to New Zealand

In 1951, when Paulay was 27, was granted a scholarship by a group of Catholic students at Victoria University in Wellington and immigrated to New Zealand with his wife and eldest daughter. After six weeks sailing, they arrived in Wellington, and Paulay started to work as a maintenance labourer of New Zealand Railways, in a small town south of Christchurch, and learnt to speak fluently in English!

Graduating with a Bachelor of Engineering degree from Canterbury

After some correspondence, the Civil Engineering Department at the University of Canterbury, agreed to admit Paulay as a third year student [he ended up in a class two years ahead of Bob Park, with whom he collaborated later in the same university, in his extensive research on earthquake resistant design of RC structures]. Professor Harry Hopkins, who joined the University just then, asked him to design a garage for the city buses, without any interior columns, as the last examination, lasting 14 days. Paulay chose to design a RC shell roof, which was then not covered in the syllabus for civil engineering.

Professional Experience

On completing his studies in 1954, he joined the consulting engineering practice of Don Bruce-Smith where he worked for the next eight years designing many reinforced concrete buildings.

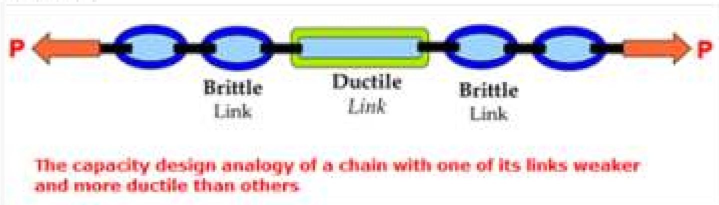
In 1961 he was invited by Professor Hopkins to apply for a lecturer position in the Department of Civil Engineering to teach structural design. Professor Paulay initially told his classes that the courses would be taught in Hungarian but with a very strong New Zealand accent. Professor Paulay's three-hour Friday afternoon design classes often ran overtime and sometimes rolled over to Saturdays as well. Even 20 years after he retired, some of the final-year design afternoons are still referred to as "the Tom Paulay afternoons".

During his 28 years with the Department of Civil Engineering, Professor Paulay had a profound worldwide influence on the design of engineering structures to resist earthquakes and his work was a major contribution to the international standing of the department in the field of earthquake engineering. This was largely due to the combined efforts of Tom Paulay and Bob Park (who was also a Royal Society Fellow, and who died in 2004), in developing state-of-the-art structural testing laboratories at Canterbury, capable of testing large-scale models of seismic-resisting elements of structures. This was combined with a fresh outlook on seismic design philosophy, at a time when it was just beginning to be understood that structural strength was less important than deformation capacity.

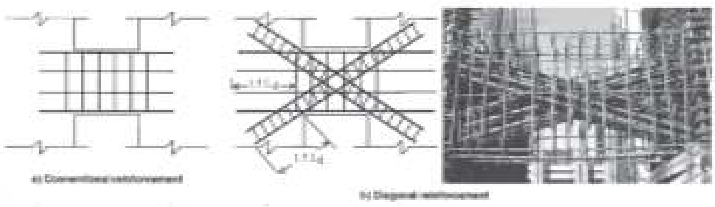
Professor Paulay is remembered for his enthusiasm and practical knowledge of structural design, his interest in the welfare of the students, and the use of recent research findings and ideas in his teaching. This helped build an interest in seismic engineering and it had a major influence on design practice in New Zealand.

His landmark Research on Capacity Design

Prof. Paulay possessed the key attributes of a top researcher: innovation and intuition. This enabled him to develop completely new concepts, rather than the incremental changes and improvements made by lesser mortals. In 1969, as part of his doctoral studies under the supervision of Professor Hopkins, he recognized the deficiencies in deformation capacity of the coupling beams of coupled wall buildings, and developed the innovative concept of diagonal reinforcement—a simple yet elegant solution that greatly reduced potential for damage and increased safety by increasing the controlled deformation capacity. This technique has since been widely implemented in practice, all over the world. He in reference 4 quips about the reaction of the international community on this important innovation" Once this technique became better known, many friends used to greet me, from a distance, for example during ACI conventions, by crossing their arms over their heads."



The concept of capacity design, developed by Profs. Park and Paulay

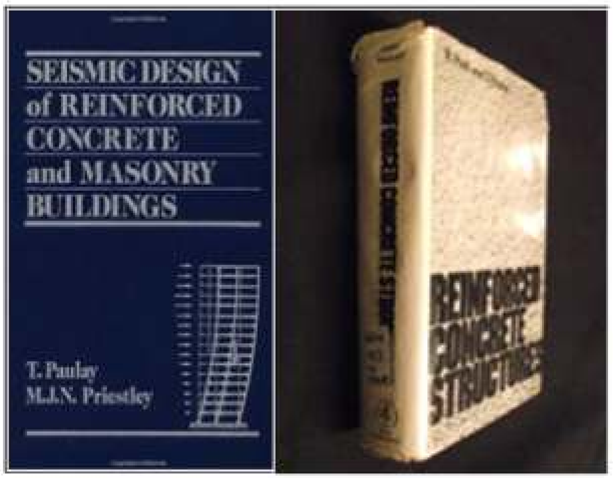


Diagonal reinforcement in a story-high coupling beam, an innovation introduced by Prof. Paulay and followed internationally

Together with Bob Park he developed and extended the concepts of seismic capacity design to "tell the structure how to behave" as he put it. In this approach to seismic design, a strength hierarchy is provided to the structure so that inelastic action under seismic attack is concentrated in carefully defined and detailed locations of the structure. The strength hierarchy ensures that regardless of the characteristics of the earthquake, more vulnerable parts of the structure are always protected. Capacity design has now become a corner stone of the seismic design codes of most countries, though New Zealand still leads the world in its application.

During his time at UC he supervised and co-supervised 16 PhD students and 26 Master's students. Prof. A.R. Santhakumar, now retired as Dean of Anna University and Emeritus professor at IITM, was one of the Ph.D. students of Prof. Paulay. Prof. ARS experimentally validated the concept of diagonal reinforcement in coupling beams by building a one-quarter-scale, seven-storey, coupled wall specimen, conventionally reinforced, and another specimen with the diagonal reinforcement and comparing their behaviors. Together with his colleagues and students Prof. Paulay investigated in great detail the seismic behaviour of the joint region between beams and columns in frame buildings. This region had been largely ignored by designers and researchers alike, as being of little importance to seismic performance. His carefully designed experiments showed that beam/column joints were in fact highly vulnerable to damage, and that their behaviour was complex. Design approaches were developed to describe this behaviour, and to ensure that beam/column joints would not compromise the seismic response of the structure as a whole.

He recognized the logical error in treating torsion of buildings under seismic attack as an elastic phenomenon, and developed rational alternative design approaches, based on inelastic response. He continued to write elegant, insightful research papers in this and allied areas into his late seventies and early eighties. This work on torsion is still at the forefront of knowledge in the field, and is the basis for ongoing current research in seismic regions of the world. These are only a few in the long list of topics in which he made highly significant contributions.



PUBLICATIONS

His 1975 book with Professor Bob Park, Reinforced Concrete Structure, became the seminal work on capacity design. Professor Paulay also recognized the power of modern computer analysis to extend the work in the laboratory and many masters students over the next few years carried out significant research to determine the over-strength factors required to ensure that undesirable soft-storey failures would not occur in a major earthquake.

His work on structural walls, which resulted in the book Design of Reinforced Concrete and Masonry Buildings, co-authored with Nigel Priestley in 1992, again brought the latest research findings into the design world.

Profs. Park and Paulay at the university of California at San Diego, during the 70th Birthday of Paulay in 1993

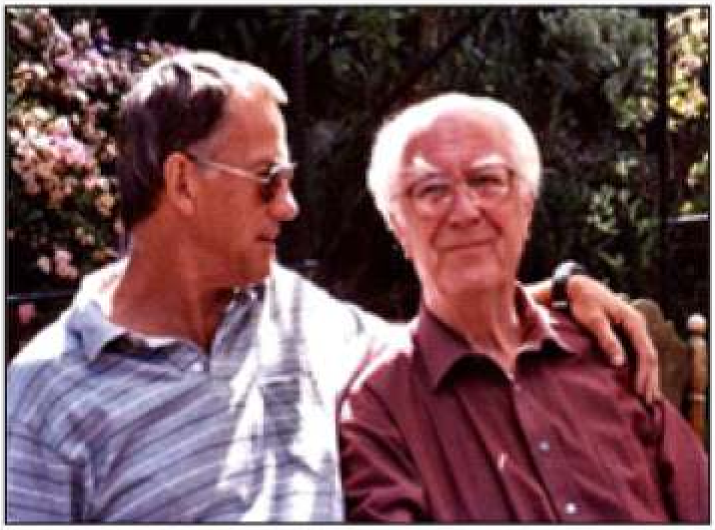
Prof. Bob Park, Tom Paulay, and Nigel Priestly celebrate their collective 200th birthday

Prof. Paulay has also authored numerous papers presented in several international journals and conferences, which have been referred by researchers extensively, all over the world.

Professor Paulay was promoted to a personal chair in civil engineering in 1975 in recognition of his contribution to research and teaching. He retired from the University in 1988 and was made an emeritus professor the following year. Even after his retirement, he continued his research interests and supervision of postgraduate students, for another 15 years!

GREAT COMMUNICATOR AND REVIEWER

Prof. Paulay was a great written communicator, (though sometimes in his own brand of Hungarian English) and would write voluminous comments when presented with a draft technical paper that the author thought might be of interest to Tom, or might benefit from his comments. Prof Priestley in his obituary note about him writes that "One never had the paper returned with a terse comment such as "very interesting" or "nonsense" from Tom. One usually gets a detailed examination and critique of the work that not uncommonly exceeded the original work in length, and which would have taken days to prepare. Because of this conscientious attitude to review, he was in constant demand from the top international earthquake engineering journals".



Prof. Nigel Priestley with Prof. Tom Paulay in New Zealand, 2005

AWARDS AND ACCOLADES

Prof. Paulay received numerous honours, both civic and technical, including the Order of the British Empire in New Zealand in 1986, The Order of Merit of the Republic of Hungary, Fellowship of the Royal Society of New Zealand. He also received honorary doctorates from the Swiss Federal Institute of Technology, Zurich, Switzerland, (1988), the Technical University of Budapest, Hungary,(1990), the Technical University of Bucharest, Romania (1996) and the National University of Cuyo, Mendoza, Argentina (1999), and a great number of national and international awards for research excellence—too many to list. Professor Paulay was a member of the New Zealand Society of Earthquake Engineers, serving one term as president. He was a Fellow of the Royal Society and served as president of the International Association for Earthquake Engineering from 1992 to 1996. At the 14th World Conference on Earthquake Engineering in Beijing in October 2008 he was named one of the "Legends in Earthquake Engineering".

DEMISE

The death of Tom's wife Herta in 2007 had a profound effect on him, from which he never fully recovered. New Zealand lost one of its most eminent structural engineers with the death of Emeritus Professor Tom Paulay on 28 June 09, at the age of 86, after a year-long struggle with cancer. With his death, an era of New Zealand earthquake engineering has come to an end. He is survived by his daughters, Dorothy and Esther, son Gregory and six grandchildren.

Professor Paulay will be very much missed by the many thousand civil engineers in New Zealand and overseas who have benefited from his great teaching and the effects of his work in design approaches in earthquake engineering will continue long into the future. His colleagues in the Department of Civil and Natural Resources Engineering will also miss his cheery smile and sense of humour which seemed to infect all around him.

Acknowledgments:

We wish to acknowledge that the photos, except the first one, are reproduced from "Connections: The EERI Oral History Series, EERI publication number OHS-12" (Ref. 4). The authors would like to thank Earthquake Engineering Research Institute, Oakland, California, USA, for their kind permission to reproduce these photos, which originally appeared in their publication.

Sources and further reading:

1. Prof. Athol Carr: http://www.canterbury.ac.nz/newsroom 090708c.shtml
2. http://www.civil.canterbury.ac.nz/events/pandp/10Fenwick.pdf
3. http://www.civil.canterbury.ac.nz/staff/Paulay/tpaulay_publications.shtml
4. R. Reitherman (Interviewer), Connections-The EERI Oral History Series - Robert Park and Thomas Paulay, Earthquake Engineering Research Institute and New Zealand Society for Earthquake Engineering Inc, 2006, 200pp. [https://www.eeri.org/site/images/projects/oralhistory/park_paulay.pdf]
5. http://www.royalsociety.org.nz/organisation/academy/fellowship/obituaries/thomas-paulay/

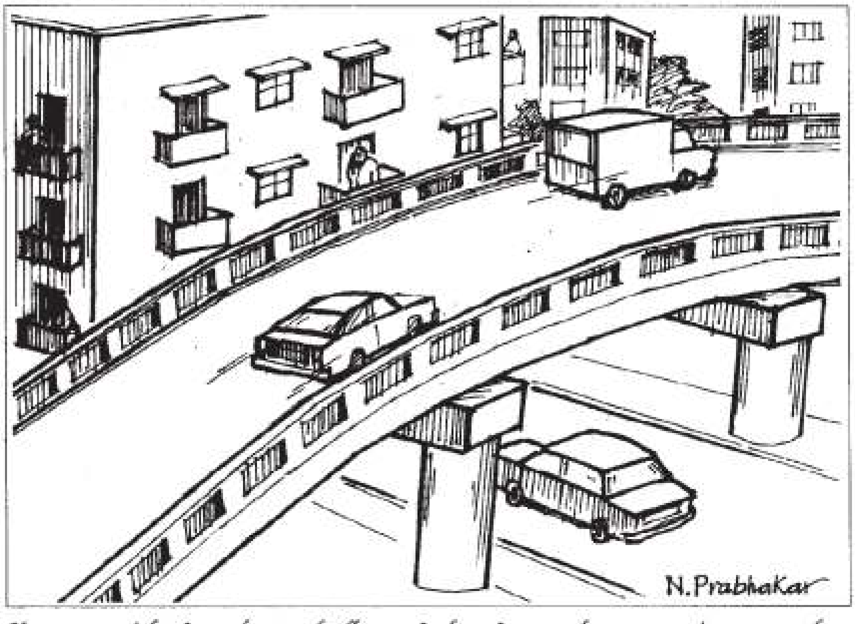
Authors

Dr. N. Subramanian
Civil / Structural Consultant (USA)
Author of many technical books
Email : drnsmani@yahoo.com

Er. Vivek G. Abhyankar
Sr. Manager (Design)
AFCONS Infrastructure Ltd.
Email : abhy_vivek@hotmail.com

"Courtesy Indian Concrete Journal "

Believe it or not



Yes, you are right, I am close to the flyover. In fact, I am so close you can jump across from the flyover into the balcony of my flat !!!

Review of Along-Wind Loading in IS 875 (Part 3): 2015

K. Suresh Kumar

Introduction

Wind gusts induce dynamic loads on structures. Along-wind loading simply means the wind-induced force along the direction of the wind and this is pictorially shown in Figure 1. Along-wind loading consists of three components namely mean, background fluctuations and resonant fluctuations. Mean component represents the static force acting on the building. Both background as well as resonant fluctuations represents the dynamic force acting on the building. Background fluctuations are the result of free-stream wind turbulence, turbulence generated by adjacent buildings, and the turbulence caused by the building itself once the flow passes the building. Resonant fluctuations represent the inertial force caused by the structural movement as a result of the interaction with the wind.

The codes and standards address the wind-induced dynamic loads in the along-wind direction using a simplified gust factor approach. This approach essentially factors the along-wind mean loads by a gust factor to find the peak along-wind loads on the structure. The gust factor considers temporal and spatial variation of gust impact on the structure covering both background and resonant fluctuations. This paper reviews the provisions for calculating along-wind loads in the current IS code. Derivation of the equations with physical significance along with worked out examples are presented.

Derivation

For a single degree of freedom system, the response (***x***) to the along-wind (drag) load ***D(t)*** can be expressed generally by the equation

$$m\ddot{x} + c\dot{x} + kx = D(t) \qquad (1)$$

Where, ***m*** represents the mass, ***c*** represents the damping and ***k*** represents the stiffness of the structural system.

Response of a single degree of freedom system, x(t) can be expressed as sum of mean $\overline{x}$ and fluctuation $\tilde{x}$

$$x(t) = \overline{x} + \tilde{x} \qquad (2)$$

Mean response of the system can be expressed as

$$\overline{x} = \frac{\overline{D}}{k} \qquad (3)$$

Where, $\overline{D}$ is the mean along-wind force or drag force. Spectral density of response can be derived from basic structural dynamic principles as

$$S_x(f) = \frac{1}{k^2}\left|H(f)\right|^2 S_D(f) \qquad (4)$$

Where $S_D(f)$ is the spectral density of drag force, ***f*** is the frequency, $|H(f)|^2$ is the mechanical admittance, f_a is the structural frequency, and β is the damping coefficient.

$$\left|H(f)\right|^2 = \frac{1}{\left[1-\left(\frac{f}{f_a}\right)^2\right]^2 + 4\beta^2\left(\frac{f}{f_a}\right)^2} \qquad (5)$$

From quasi-steady assumptions,


$D(t) = \overline{D} + \tilde{D} = \frac{1}{2}\rho(\overline{V} + \tilde{V})^2 C_D A$

where, ρ = air density, $\overline{V}$ = mean wind speed, $\tilde{V}$ = wind speed fluctuation, C_D = drag coefficient, A = projected frontal area

From above one can deduce

$\overline{D} = \frac{1}{2}\rho\overline{V}^2 C_D A, \quad \overline{\tilde{D}^2} \approx \rho^2\overline{V}^2\overline{\tilde{V}^2} C_D^2 A^2$

$\tilde{D} = \frac{1}{2}\rho(2\overline{V}\tilde{V} + \tilde{V}^2) C_D A, \quad$ After neglecting the higher order terms

$$\overline{D^2} \cong \rho^2 4\overline{V}^2 \overline{V^2} C_D{}^2 A^2 = \frac{4\overline{D}^2}{\overline{V}^2}\overline{V^2} \quad (6)$$

Spectral density of drag force can be written as

$$S_D(f) = \chi^2(f).\frac{4\overline{D}^2}{\overline{V}^2}S_v(f) \quad (7)$$

Where, $\chi^2(f)$ is the aerodynamic admittance defining the modification of oncoming velocity fluctuation to the subjected load fluctuation on the structure. Quasi-steady theory permits the representation of load/response in terms of the oncoming wind velocity field. Typical mechanical and aerodynamic admittance are shown in Figure 2 for a particular damping and structural frequency. Note that the mechanical admittance amplitude will peak at the structural frequency. When this structural frequency nears the dominant wind energy frequencies (less than 0.5 Hz), then the resonant component of the wind loading will be higher. The aerodynamic admittance seems nearly constant at lower frequencies and the amplitude reduces at higher frequencies.

Substitute Eq. (7) in Eq. (4), the following is obtained

$$S_x(f) = \frac{1}{k^2}|H(f)|^2\frac{4\overline{D}^2}{\overline{V}^2}.\chi^2(f).S_v(f) \quad (8)$$

Applying Eq. (3) in Eq. (8) will result into

$$S_x(f) = \frac{4\overline{x}^2}{\overline{V}^2}|H(f)|^2.\chi^2(f).S_v(f) \quad (9)$$

Then the variance of response can be written as

$$\sigma_x{}^2 = \int_0^\infty S_x(f).df = \int_0^\infty \frac{4\overline{x}^2}{\overline{V}^2}|H(f)|^2.\chi^2(f).S_v(f).df \quad (10)$$

Further simplifying will result into

$$\sigma_x{}^2 = \frac{4\overline{x}^2\sigma_v{}^2}{\overline{V}^2}\int_0^\infty |H(f)|^2.\chi^2(f).\frac{S_v(f)}{\sigma_v{}^2}.df \cong \frac{4\overline{x}^2\sigma_v{}^2}{\overline{V}^2}[B+R] \quad (11)$$

Where, the response spectrum has two components as shown in Figure 3. The major hump, where the energy is spread out for a wide range of frequencies, is called background (B) component. The sharp hump, where the energy is concentrated for narrow band frequencies, is called resonant or inertial component. Note that it is evident from Figure 3 that as the frequency decreases or structure becomes flexible (towards the left side of the spectrum), the resonant response (R) generally increases as a result of higher energy content in the forcing spectra. On the other hand, when the structure becomes stiffer (toward the right side of spectra), the resonant response will diminish as a result of lower energy content in the forcing spectra.

From Eq. (11),

$$\int_0^\infty |H(f)|^2.\chi^2(f).\frac{S_v(f)}{\sigma_v{}^2}.df = [B+R] \quad (12)$$

The integration of the response spectra is complex. Multiplication of the mechanical admittance function $|H(f)|^2$ with the forcing spectra creates the resonant hump. So for background (B) calculation, the mechanical admittance function can be assumed to be one and this will deduce the expression for B as

$$B = \int_0^\infty \chi^2(f).\frac{S_v(f)}{\sigma_v{}^2}.df \quad (13)$$

For resonant component (R), the aerodynamic admittance and the spectra values can be calculated for the structural frequency followed by the integration of the mechanical admittance function which creates the resonant hump in spectra.

$$R = \chi^2(f_a).\frac{S_v(f_a)}{\sigma_v{}^2}\int_0^\infty |H(f)|^2.df \quad (14)$$

Integration by poles can provide

$$\int_0^\infty |H(f)|^2.df = \frac{\pi f_a}{4\beta} \quad (15)$$

Then the resonant component can be simplified to

$$R = \chi^2(f_a).\frac{\pi f_a S_v(f_a)}{4\sigma_v{}^2\beta} \quad (16)$$

In IS 875 (Part 3):2015, the empirical expressions have been recommended for B and R, which are primarily based on Australian wind loading standard.

Peak response can be written as

$$X_{max} = \overline{x} + g\sigma_x \quad (17)$$

Where, **g** is the peak factor.

Gust factor is defined as peak response divided by mean response. Response can be in any form such as shear force, moment, deflection etc. Gust factor can be expressed as,

$$G = \frac{x_{\max}}{\bar{x}} = \left(1 + g\,\frac{\sigma_x}{\bar{x}}\right) \qquad (18)$$

Eq. (11) can be written as

$$\frac{\sigma_x}{\bar{x}} = \frac{2\sigma_v}{\bar{V}}\sqrt{B+R} \qquad (19)$$

Substitute Eq. (19) in Eq. (18), one can obtain

$$G = \left(1 + \frac{2\sigma_v}{\bar{V}}\sqrt{g^2(B+R)}\right) \qquad (20)$$

Now one can relate the gust factor equation from IS 875 to Eq. (20),

$$G = \left(1 + \frac{2\sigma_v}{\bar{V}}\sqrt{g^2(B+R)}\right) = 1 + r\sqrt{\left[g_v^2 B_s(1+\phi)^2 + \frac{H_s g_R^2 SE}{\beta}\right]} \qquad (21)$$

Where, $r = 2I_h = \frac{2\sigma_v}{\bar{V}}$ and two different peak factors (g_v & g_R) for background and resonant components. Note that there is an error in the expression for G in the code on Page 47, where ϕ is mistakenly written as ***g***. 4 shows the procedure for the computation of gust factor as per IS 875 in a flow chart format.

The empirical expression used in IS code for background component is provided below

$$B = B_s(1+\varphi)^2 = \frac{1}{\left[1 + \frac{\sqrt{0.26(h-s)^2 + 0.46 b_{sh}^2}}{L_h}\right]} \cdot \left(1 + \frac{g_v I_{h,i}\sqrt{B_s}}{2}\right)^2 \qquad (22)$$

The variation of $\mathbf{B_s}$ with respect to **h** and $\mathbf{b_{sh}}$ is plotted in Figure 5. It is clear that $\mathbf{B_s}$ is significantly influenced by the height of the structure, not so much by the average width. As the height increases, $\mathbf{B_s}$ decreases. Physically, as the height increases, the higher portion of the structure is subjected to lesser turbulence and as a result the overall background component reduces.

The expression for resonant component is shown below

$$R = \frac{H_s SE}{\beta} = \left(1 + \left(\frac{s}{h}\right)^2\right) \cdot \frac{1}{\left[1 + \frac{3.5 f_a h}{V_{h,d}}\right]\left[1 + \frac{4 f_a b_{0h}}{V_{h,d}}\right]} \cdot \frac{\pi N}{(1+70.8N^2)^{5/6}} \cdot \frac{1}{\beta} \qquad (23)$$

Where, ***S*** is named as the size reduction factor. By equating Eq. (21) and Eq. (16), one can deduce that the size reduction factor represents the aerodynamic admittance at the structural frequency, which is

$$S = \frac{1}{\left[1 + \frac{3.5 f_a h}{V_{h,d}}\right]\left[1 + \frac{4 f_a b_{0h}}{V_{h,d}}\right]} = \chi^2(f_a) \qquad (24)$$

The variation of S is shown in Figure 6. In general, based on Figure 6 and the simple behavior of aerodynamic admittance shown earlier in Figure 2, lower frequencies or lower reduced frequencies shall fetch larger size reduction factor. The spectrum of turbulence in the approaching wind is

$$E = \frac{\pi N}{(1+70.8N^2)^{5/6}} = \frac{\pi f_a S_v(f_a)}{4\sigma_v^2} \qquad (25)$$

Where,

$$\frac{f_a S_v(f_a)}{\sigma_v^2} = \frac{4N}{(1+70.8N^2)^{5/6}} \qquad (26)$$

Where, reduced frequency $= \frac{f_a L_h}{V_{h,d}}$ Eq. (26) is the well known Von Karman spectrum of wind turbulence. Using Eq. (26), one can obtain the expression for ***E*** in Eq. (25). The variation of ***E*** is plotted in Figure 7 against **N**. Generally, when the structural frequency or reduced frequency reduces, the spectrum amplitude E rises as discussed earlier. Physically as the structure becomes flexible, more inertial force is induced from the wind. Figure 8 shows the variation of the peak factor $\boldsymbol{g_R}$ with respect to the structural frequency. As the structural frequency increases, $\boldsymbol{g_R}$ increases.

The following section shows two example calculations of gust factors for tall buildings.

Sample Calculations

Example 1

Input		
Basic Wind Speed in m/s, $\mathbf{V_b}$	44	
Terrain Category	3	
Height (m)	104.5	
Height at which action effects calculated, s	0	
Average width between s and h in m, b_{sh}	18.8	38.4
First mode frequency in along-wind in Hz, $\mathbf{f_a}$	0.357	0.286
Structural damping, β	0.02	
Design Wind Speed		
$\mathbf{V_{des} = V_B . M_{z,cat}}$		
$\mathbf{k_{2,i}}$ **@ h**	0.794	
Mean Hourly wind speed at h, Vz	34.94	

Calculations			
Turbulent Intensity, I_h		0.156	
Roughness Factor, r		0.312	
Velocity Peak Factor, g_v		4	
L_h		152.83	
B_s		0.74	0.72
Height factor, Hs = 1+(s/h)^2		1	
g_R		3.78	3.72
fa.h/Vh		1.07	0.86
fa.bh/Vh		0.19	0.31
S		0.12	0.11
N		1.56	1.25
E		0.07	0.08
Phi		0.27	0.27
Background	$g_v^2 B_s (1+\phi)^2$	18.94	18.45
Resonant	$\frac{H_s g_R^2 SE}{\beta}$	5.70	5.93
G		2.55	2.54

Comments: Note that this is relatively an intermediate height building with higher frequencies in suburban terrain category. The results show that the resonant dynamic component is much smaller than the background component, which is expected for a building of this size with high frequencies as discussed during the derivation section. The higher gust factors are a result of rougher terrain category and larger background component.

<u>Example 2</u>

Input			
Basic Wind Speed in m/s, V_b		44	
Terrain Category		2	
Height (m)		305.9	
Height at which action effects calculated, s		0	
Average width between s and h in m, b_{sh}		35.3	70.6
First mode frequency in along-wind in Hz, f_a		0.113	0.105
Structural damping, β		0.02	
Design Wind Speed			
$V_{des} = V_R \cdot M_{z,cat}$			
$k_{z,i}$ @ h		1.040	
Mean Hourly wind speed at h, Vz		45.76	
Calculations			
Turbulent Intensity, I_h		0.087	
Roughness Factor, r		0.174	
Velocity Peak Factor, g_v		3	
L_h		199.90	
B_s		0.56	0.55
Height factor, Hs = 1+(s/h)^2		1	
g_R		3.47	3.45
fa.h/Vh		0.76	0.70
fa.bh/Vh		0.09	0.16
S		0.20	0.18
N		0.49	0.46
E		0.14	0.14
Phi		0.10	0.10
Background	$g_v^2 B_s (1+\phi)^2$	6.06	5.96
Resonant	$\frac{H_s g_R^2 SE}{\beta}$	16.85	14.97
G		1.83	1.80

Comments : Note that this is relatively a taller building with lower frequencies in open terrain category. The results show that the resonant dynamic component is much larger than the background component, which is expected for a taller building with low frequencies as discussed during the derivation section. The lower gust factors are primarily due to open terrain conditions. The same building in suburban condition will fetch a higher gust factor. So in general, (1) rougher the terrain condition, higher the gust factor, and (2) lower the frequency, higher the gust factor.

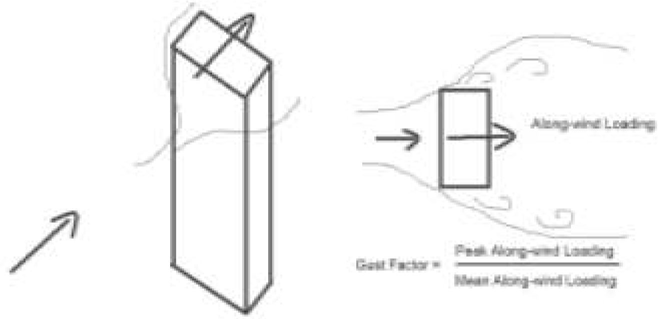


Figure 1. Pictorial representation of along-wind loading scenario

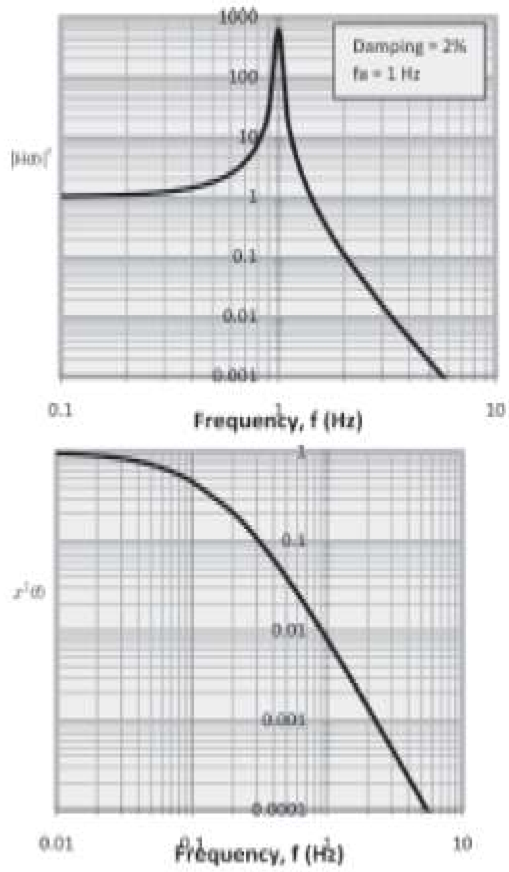


Figure 2. Typical mechanical and aerodynamic admittance functions

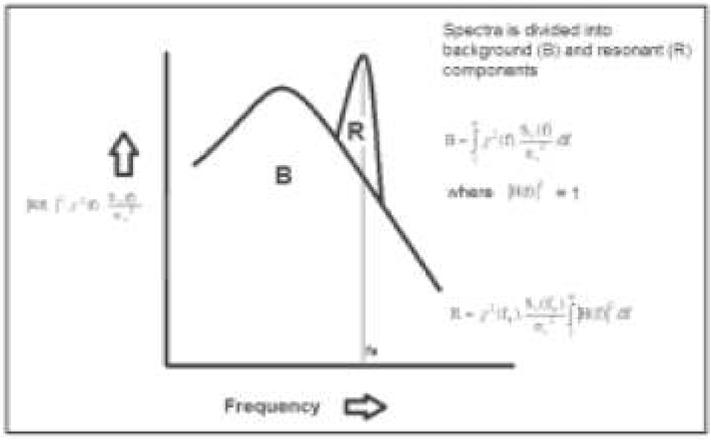


Figure 3. Pictorial representation of response spectrum and its integration

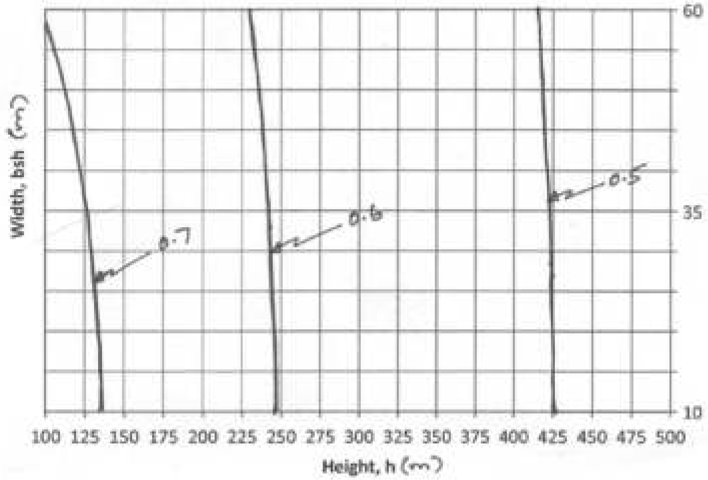


Figure 5. Variation of Background factor (Bs)

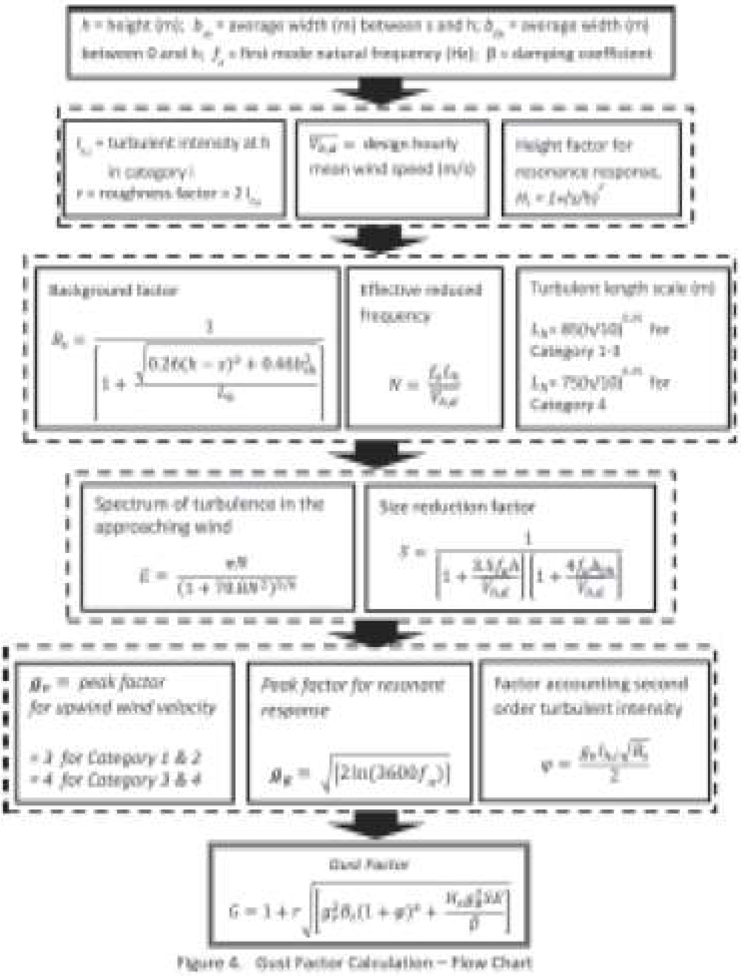


Figure 4. Gust Factor Calculation – Flow Chart

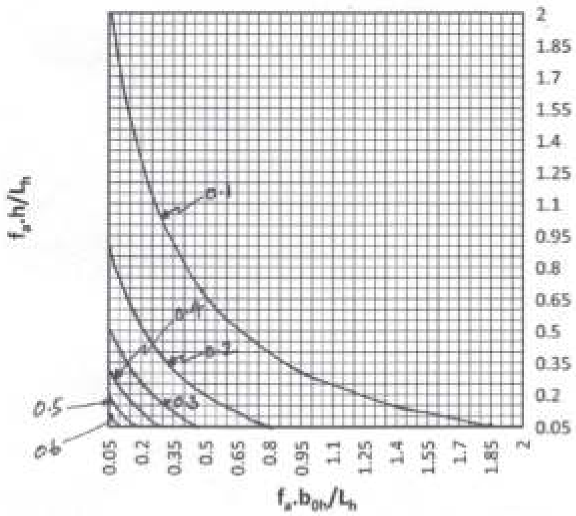


Figure 6. Variation of size reduction factor (S)

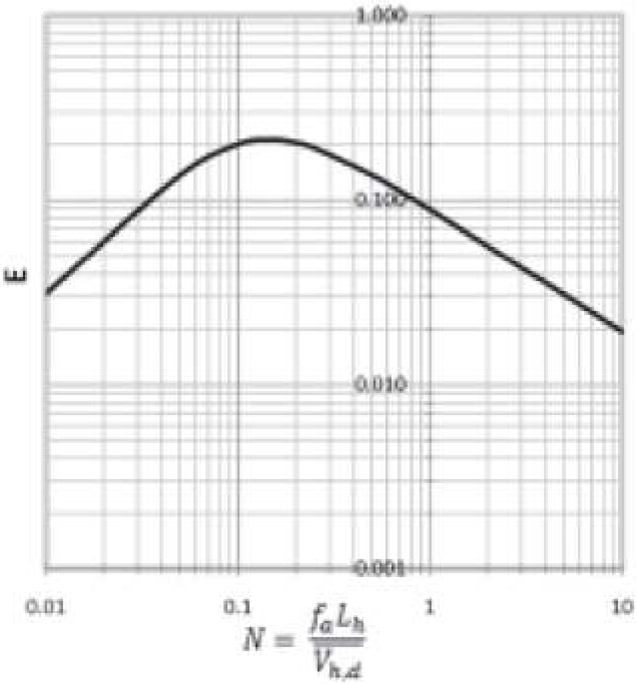


Figure 7. Spectrum of wind turbulence in the approaching wind

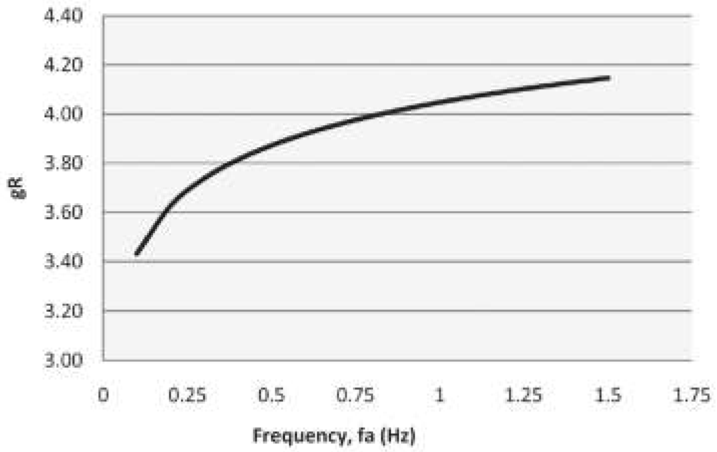
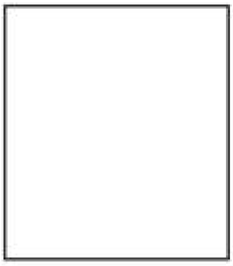


Figure 8. Peak factor for resonant response

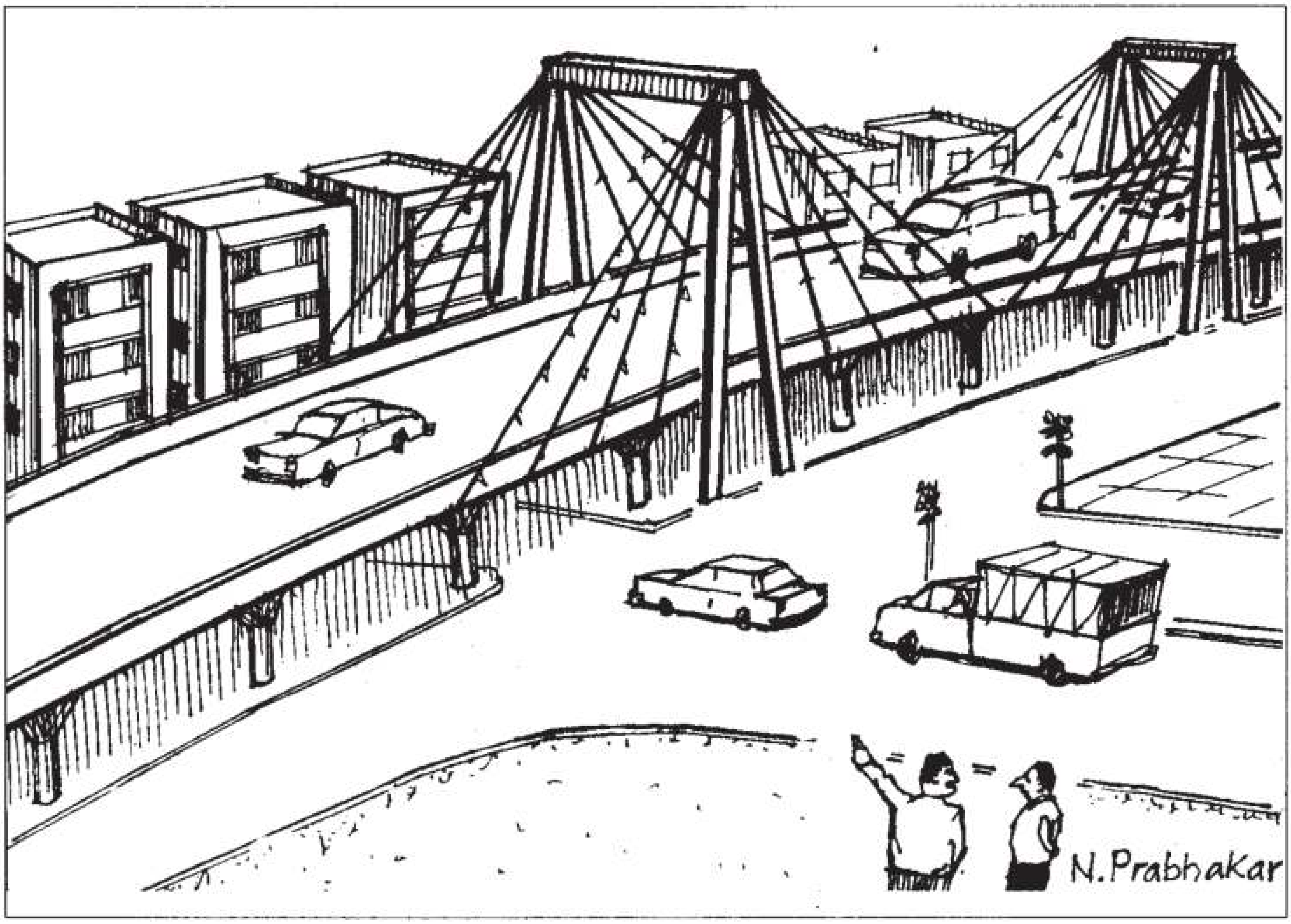
Authors



K. Suresh Kumar,
PhD, PEng, MASCE
Principal / Managing Director
RWDI Consulting Engineers
(India) Pvt. Ltd.
Email: Suresh.Kumar@rwdi.com

"Courtesy Indian Concrete Journal "

Believe it or not



No, No, they are not cable-stayed supports for the bridge deck. They are only hessian ropes which were provided to tie buntings for the inaugural ceremony

Report on ISSE function : Nene memorial lecture on 4th Aug. 2016 in Mumbai

By Hemant Vadalkar

Indian Society of Structural Engineers (ISSE) arranged a technical lecture in memory of its founder Late R L Nene. The speaker for the lecture was Prof. D. S. Joshi, President ISSE and topic was "IS codes for Civil Engineers". Function was arranged at the auditorium of The Institution of Engineers Maharashtra State Centre, Mahalaxmi, Mumbai.

Prof. D. S. Joshi offering floral tribute to Late R. L. Nene

ISSE President Shri D. S. Joshi welcomed all. He appealed to all to participate in technical lectures , seminars and workshops arranged by ISSE for civil and structural engineers. He also requested all the members for their active participation in ISSE activities.

Prof. D.S. Joshi delivering the lecture

Mr. Hemant Vadalkar introduced Prof. D.S. Joshi who had written a book on Earthquake resistant design of structures. He appealed to all practicing consulting engineers to share their knowledge and experience through ISSE platform like lectures, seminars and journal.

Prof. D.S. Joshi touched upon the new provisions in the revised IS1893 Part1 Earthquake Resistant Design of Structures – Buildings. He elaborated on some of the new provisions of the code like –

1. Increase in importance factor from 1.0 to 1.2 for occupancy more than 200 persons.
2. Sa/g curve is simplified with horizontal line up to 0.4 seconds.
3. He insisted that building shape and configuration is decided by architects which is beyond the control of structural engineers. Code suggests to have regular configuration. Local authorities should not approve the plans if it does not satisfy the code guidelines.
4. Calculation of redundancy factor requires non-linear analysis which is difficult for all types of structures.
5. Minimum design earthquake has been provided for each zone now.
6. New equation for time period estimate with concrete or masonry walls has been suggested.
7. Analysis considering masonry diagonal struts has been recommended which is difficult to follow in actual practice due to uncertainty of infill walls.
8. Dynamic amplification factor of 1.5 has been again suggested for accidental torsion which is difficult to calculate and implement.
9. For RCC frames with open ground floor, minimum wall density of 4% has been recommended for Zone 3 which does not seem to be rational considering that column density is only 0.2% to 0.3% of built up area.

ISSE had submitted its suggestions to code committee on IS1893.

Next presentation was made by team from

Deltakraft on the CAD Technology Grabert . They had demonstrated the advanced features in drafting 2D and 3D building drawings.

At the end, Shantilal Jain explained how the code committee functions and codes are revised. He appealed to structural engineers to actively participate in code revision by providing timely feedback on various draft codes under circulation.

The ISSE function was supported by Grabert India Software Pvt. Ltd.

The program was conducted by Mr. Hemant Vadalkar. It was attended by about 60 engineers.

Shantilal Jain explaining code formation

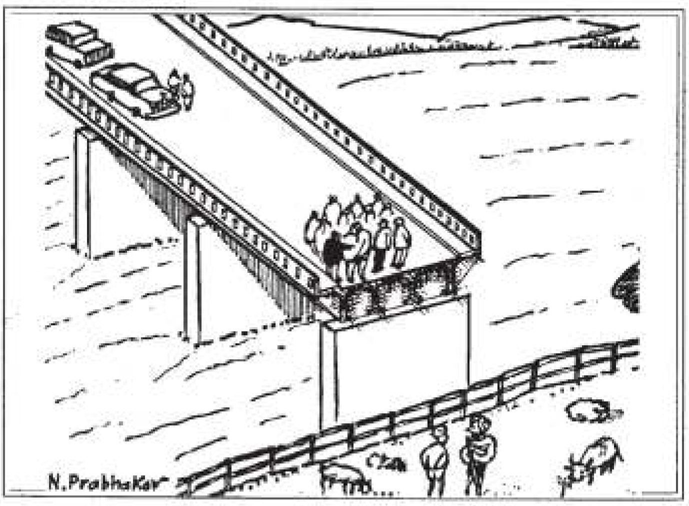
Mr. Dnyanesh Kulkarni from Deltakraft presenting Grabert CAD software

Hemant Vadalkar conducting deliberations

Audience

"Courtesy Indian Concrete Journal "

Believe it or not



Land at this end of bridge approach is still under dispute and not yet acquired. Hence, we are unable to complete the bridge for the past eight years, Sir !

Believe it or not

Yes, how time has passed quickly. I only laid foundation stone for this bridge when I was a young junior minister. I am now happy to open the bridge as a senior cabinet minister

Report on ISSE function : Technical lecture on 22nd July 2016 in Mumbai

By Hemant Vadalkar

Indian Society of Structural Engineers (ISSE) in association with The Institution of Engineers (I) Maharashtra State Centre arranged a technical lecture on "Structural Steel Connection design and Detailing" by Dr. Siddhartha Ghosh, IIT Bombay

Function was arranged at the auditorium of The Institution of Engineers Maharashtra State Centre, Mahalaxmi, Mumbai.

ISSE President Shri D. S. Joshi welcomed all. He appealed to all to participate in technical lectures , seminars and workshops arranged by ISSE for civil and structural engineers. He also requested all the members for their active participation in ISSE activities. He explained the contents of ISSE letter to MCGM on proposed draft DCR 2034 providing suggestions and objections from ISSE related to portion of Structural consultants.

Mr. Hemant Vadalkar introduced main speaker Dr. Siddhartha Ghosh who is an eminent personality and part of code committee on Steel design.

Dr. Siddharth Ghosh deliberated on the concept of steel connection design and code provisions in IS800-2007. Dr. Ghosh had shown good videos of various type of connection failures like shear, tension and tearing of plates. The content of his presentation was very precise on the subject with lot of technical information. His students who are working on a software for steel connection made the presentation on part of software and its working. The software when fully operational will save a lot of time in trial connection design and will help in choosing appropriate type of connection including detail calculations.

Second presentation was from TATA Structura. Experts from TATA Tubes Mr. Vinit Singh and Girish Joshi presented examples of how elegantly steel tubes can be used for structural applications. They had shown projects around the world for the use of tube structures. Many new airport terminals have been designed using tubular steel sections for its appealing aesthetics.

This ISSE function was sponsored by Maharashtra Pipe distributor-Business Development Partner of TATA Structura.

The program was conducted by Mr. Hemant Vadalkar. Function was very well appreciated and response was overwhelming. The attendance was 150+.

Hemant Vadalkar addressing the gathering

Prof. D.S. Joshi felicitating Dr. Siddhartha Ghosh

Prof. D. S. Joshi explaining DCR2034 letter to MCGM from ISSE

Dr. Siddhartha Ghosh talking on connection design

Mr. Girish Joshi from TATA Tubes

Hemant Vadalkar

Audience

INDIAN SOCIETY
OF
STRUCTURAL ENGINEERS

ISSE

C/o. S. G. Dharmadhikari, 24, Pandit Niwas, S. K. Bole Marg, Dadar (W), Mumbai - 400 028
Tel. : 91 - 22 - 2431 4423, 2422 1815 E-mail : issemumbai@gmail.com Website : www.isse.org.in

Ref : BMC/DCR Cl 45&46/02
Date : 2 Aug 2016

To,
The Chief Engineer Development Plan
6th floor, Municipal Corporation Head Quarters,
Mumbai - 400 001.

Subject : **Municipal Corportaion Circular No : CHE/DP/49/Gen/2015-16 Dt. 29/12/2015.; CHE/DP/41375/Gen. Dt. 29/12/2015.**

Respected Sir,

We have come to know about the MCGM circulars mentioned above with respect to DCR clause 45 & 46 whcih is regarding structural safety, quality of materials, workmanship and tests.

We think that the role and responsibility of a structural engineer is not clearly understood.

Therefore, we would like to clarify as under -

1. A structural engineer is responsible for accuracy of structural design, structural drawings and specifying the structural material form the point of strength and stability of the structure as per National Building Code (NBC).
2. It is the responsibility of the owner / Developer to appoint different agencies for successful execution of the project such as architects for planning, municipal approval and specifying materials of construction from consideration of functional requirements, aesthetics and environment, structural engineer for structural design, geotechnical consultant for suggesting appropriate foundation system and founding strata, contractor for execution of the work, PMC/ site supervisor for quality control, meterial testing and day to day supervision for good workmanship at contruction site. These agencies are reponsible for their respective role. However, the entire construction activity is under total control of the owner.

3. Structural engineer / his representative visits construction site only when requested by the representative of the owner to check the work done at site with respect to his structural drawings and is not responsible for any day to day supervision of the work any construction activity under execution at site.
4. We hope that, it amply clarifies the role and responsibility of a structural engineer and other agencies and therefore request MCGM not to insist on such certificate form a structural engineer which is beyond his scope of work.

It is our humble request that the office of CE DP shall suitably modify the above circulars.

Thanking you.

Yours truly,
For and on behalf of members of Indian Society of Structural Engineers

Prof. D S Joshi
ISSE President

Enclose : List of supporters for Modification on MCGM Circular on DCR CL 45 & 46

INDIAN SOCIETY OF STRUCTURAL ENGINEERS

ISSE

C/o. S. G. Dharmadhikari, 24, Pandit Niwas, S. K. Bole Marg, Dadar (W), Mumbai - 400 028
Tel. : 91 - 22 - 2431 4423, 2422 1015 E-mail : issemumbai@gmail.com Website : www.isse.org.in

CHIEF ENGINEER DEV. PLAN RECEIVED M.C.G.M.

Ref: BMC/DCR2034/ Suggestions/01
Date : 22 July 2016
To,
The Chief Engineer Development Plan
5th floor, Municipal Corporation Head Quarters,
Mumbai 400001

Subject : Suggestions and objections on the DCR 2034 from Indian Society of Structural Engineers.

Sir,

Indian Society of Structural Engineers (ISSE) is a premier association of Professional Structural Engineers with its Head Quarters at Mumbai looking after the development of the profession to the benefits of Indian society with the focus on construction industry in particular. We assist Government, Self Government, Municipal Corporations and other Corporate bodies in framing their policies for sound and stable structures in their built assets.

We publish a technical journal for free circulation amongst members and complementary to heads of industries. We have published an award winning book on " Design of reinforced concrete structures for earthquake resistance" for the guidance of Professional structural engineers. This deals with practical design aspects as per relevant codes of practice. We have more than 1600+ structural engineers as our members.

On behalf of practicing structural engineers, we would like to present our views and suggestions/ objections on the DCR2034 published by Municipal Corporation of Greater Mumbai.

Kindly take a note of above suggestions and make necessary amendments in the Draft DCR2034.

Thanking you
Yours truly,

Prof. D. S. Joshi

President ISSE

Encl:
1.Suggestions by ISSE (4pages)
2. Draft certificate of stability
3.Signatures from supporting members 81 numbers.

Section / Clause No. / Page no	Content in DCR2034	Comments / Modified Wordings	Justification for the Proposed Change
Part II Page 30 (ix) Supervision certificate	Supervision at site and testing of material should not be in the scope of Structural Engineer.	Separate Site supervisor or PMC is to be appointed by the owner / architect who should provide supervision certificate and should certify the material testing reports.	Scope of services for Structural engineer is to provide structural design and drawings as per relevant codes of practice.
Part II Section (4) Page 31 Signing of plans by owners and licensed personnel		We suggest MCGM to issue licenses to "Geotechnical consultants" who can certify the bearing capacity of foundation strata, deep excavation for basements and stability of foundation systems.	In the past , there are many foundation failures, cases of settlement or tilting of buildings, damage to adjacent building due to basement excavation , accidents due to collapse of shoring system during deep excavation for multiple basements. These failures can be minimized if experts like licensed Geotechnical consultants are on board for a construction project.
Part II Page35 Section 12 (4)Inspection : Un-authorised development	Commissioner can take suitable action against the professional on record.	If the owner does any un-authorised work without the knowledge of the professional on record, a professional should not be held responsible for the act of owner.	It is not logical to take action against a professional unless it is proved by investigations that he is involved in any un-authorised or illegal construction activity. Generally owner is controlling all construction activities.
Part IX Section 49 Structural Safety & Services	Supervision and completion certificate by Architect and Structural Engineer shall contain that norms of IS1893-2002 have been followed in the design and construction of buildings.	Separate certificate from Architects should be insisted mentioning that provisions of IS1893 have been followed in the planning especially configuration aspect. This includes shape of building, regular and irregular configuration, avoiding loose mass for elevation treatment, avoiding large cantilevers, avoiding soft storey as per code provision has been followed.	The planning aspect of the building is controlled by architects based on client's requirements, aesthetics and municipal bylaws. Structural engineers have no control over planning aspects as mentioned. Therefore, a certificate is to be insisted from architects that all the configuration aspects are complied with in the planning. If the architectural planning is are not as per IS1893 requirements, MCGM should not approve those plans in the first place.
Annexure 5 page342	Supervision memo of Structural Engineer	Title should be " **Acceptance letter of Structural Engineer**"	
		Wording to be revised in para 2 as – " I further confirm that the structural design and calculations shall be in conformity with the provisions of IS codes 875, 1893 and 4326 taking into consideration the seismic forces and **to the best of my knowledge and belief and as per approved architectural drawings provided to me**"	

Section / Clause No. / Page no	Content in DCR2034	Comments / Modified Wordings	Justification for the Proposed Change
Annexure -9	Form of Supervision	This is to be submitted by supervising agency like PMC or site supervisor who is supervising the construction work. Name of structural engineer should be removed from this form as he is not doing any day to say supervision.	
Annexure - 10 Sr no 3) Structural Engineer	DETAILS OF THE QUALIFICATION, DUTIES, RESPONSIBILITIES AND REGISTRATION PROCESS	Duties d) **Certificate of supervision not to be insisted from Structural Engineer** if he is not supervising the construction work on a day to day basis.	
		Responsibility : ~~The structural engineer shall be responsible for the structural safety and stability of development carried out on site.~~ To be modified as " **The structural engineer is responsible for the correctness of structural design.**" He shall ensure	The scope of services for structural engineer is limited to structural design and drawings only. Safety at site and supervision of construction is taken care by other agencies.
New suggestions 1	Registration of Builders / Developers	Developer / Builder registration must be made mandatory to improve the quality of construction. Action can be taken against them for any violation of norms or bad work or use of poor quality material.	
2	Parking requirements affecting structural safety	Huge parking requirements in the building is posing problem in deciding on good structural arrangement as the column locations for parking bays and other floors are different. Architects are forcing structural engineers to delete columns or provide floating columns to accommodate parking requirements. This is affecting stability of building.	It is suggested to have separate structure for parking where-ever possible. If it is to be included in the same building, more importance should be given to structural requirements than accommodating required parking slots. Pit parking with no slab at ground floor are dangerous from hygine as well as formation of soft storey during seismic event. Therefore this should be discouraged totally.
3	Structural Audit provisions can be added in DCR2034 with necessary modifications.	Present MCGM ward notices insists on submitting **Structural stability certificates** by Structural engineer carrying out structural audit.	It should not be insisted, as structural stability certificate can be only given by original structural designer. A person doing structural inspection can only provide fitness / habitable certificate based on his investigations.
4	NDT during structural audit	Non Destructive tests are made mandatory by MCGM notices for structural audits.	A medical practitioner decides on type of tests required for a particular patient and disease. Similarly, let the structural engineer take a call on whether any tests are required and if yes which tests are to be performed.

Draft

CERTIFICATE OF STABILITY AND COMPLETION OF STRUCTURE

To,

DY C.E.

....

Project details :

Ref : Municipal file no :

Sir,

I have undertaken assignment as Consulting structural engineer for the project mentioned above. Following are the agencies involved in the project-

1. Name and address of Owner/ Developer :
2. Name and address of Architect / License Surveyor
3. Name and address of contractor :
4. Name and address of Site supervisor / PMC :

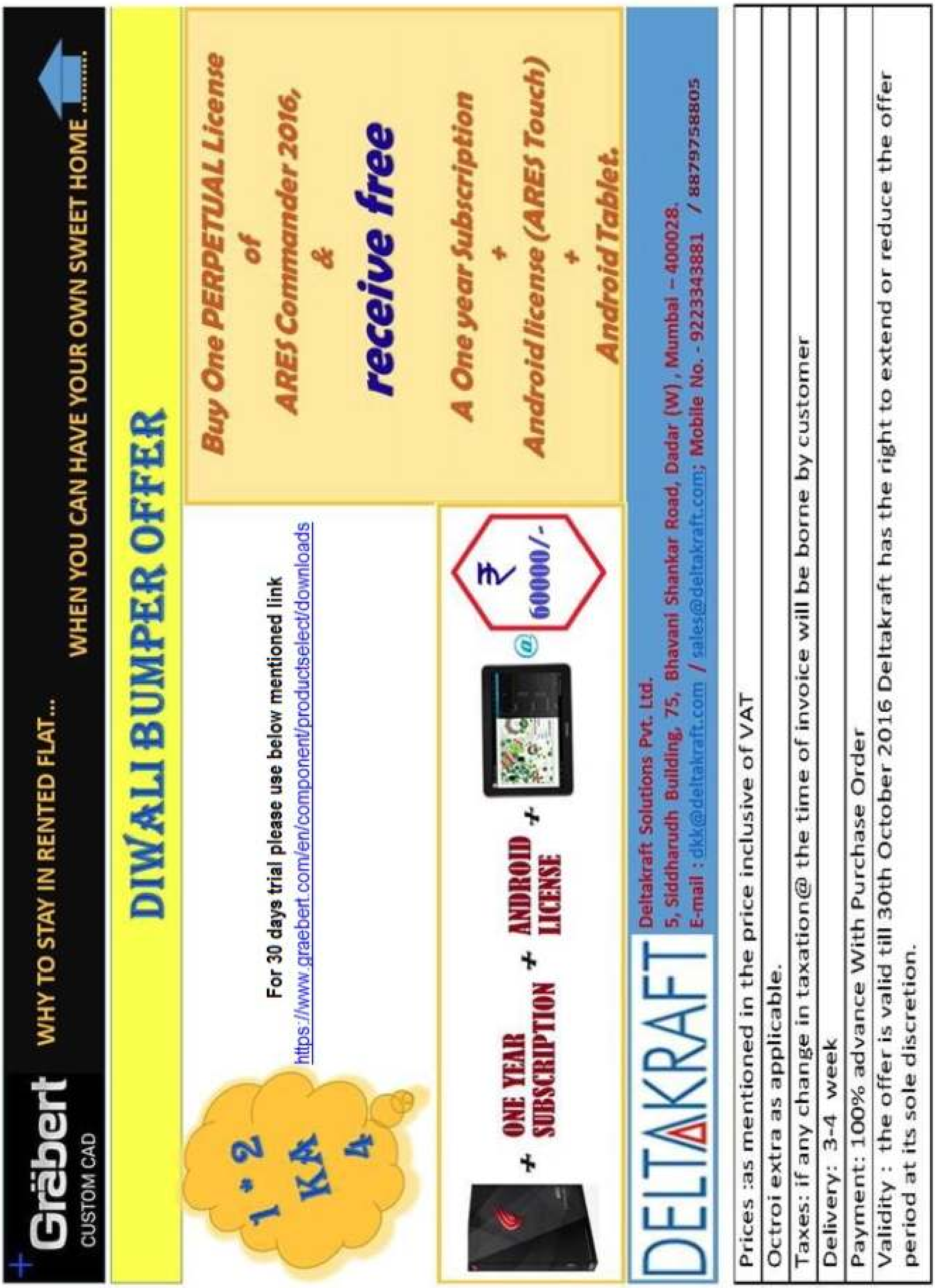
Based on completion certificate of Site supervisor (Licene no -) letter no dated , test reports and periodic site inspection carried out through our staff from time to time, I hereby certify that the structural work for the above mentioned building has been carried out as per our structural design and details and to the best of my knowledge, the said structure is safe and stable for its intended use.

This certificate is issued on the clear understanding that my/ our overall responsibility for the structural stability of the building and its proper structural performance will cease the moment any additions or alterations to the structure by accident or due to tampering by the users/ occupants for any reasons whatsoever. My/ our responsibility will also cease in the event of overloading or lack of proper maintenance of structure or any such act, which is detrimental to the structure.

Yours truly ,

Name and Signature of Consulting Structural Engineer

License no



Edited and published by Hemant Vadalkar for ISSE, C/o S. G. Dharmadhikari, 24, Pandit Niwas, 3rd floor S. K. Bole Road, Dadar(W.), Mumbai 400 028. Tel. +91-22-24314423. e-mail issemubai@gmail.com Web : www.isse.org.in for private circulation and printed by Sudarshan Arts, 10 Wadala Udyog Bhavan, Naigaon Cross Road, Wadala, Mumbai - 400 031.


TISCON
READYBUILD
CUSTOMISED REBAR SOLUTIONS
JOY of
hassle-free construction through customised rebar solutions
Tiscon Readybuild is a rebar downstream service, offering customised rebar solutions at the construction site itself. There are currently 2 offerings- Cut & Bend services and Reinforcement Bar Couplers for speedy construction and enhanced productivity.
Space Management
On Time In Full delivery (OTIF) helps in managing space efficiently
Easy Procurement
Timely availability makes the procurement process easy
Inventory Management
Readybuild tags make identification easy
No Labour-related Worries
Lower labour involvement reduces labour cost and errors
No Wastage
Zero wastage on-site eliminates disposal needs
Quality Control
High quality rebars customised as per requirements
Assurance of Safety
No cutting or bending at site - hence less chance of accidents
Indu Corporation Pvt. Ltd.
75 Dr. Annie Besant Road, Worli, Mumbai - 400018
Email Id: bharat.solanki@inducorp.co.in / rahul.gaikwad@inducorp.co.in
Phone: Bharat Solanki (98706 04455), Rahul Gaikwad (98211 22133)
For more details call toll free: 1800 345 8282. Email: tatareadybuild@tatasteel.com

SANRACHANA

SANRACHANA™
Structural Strengthening Pvt. Ltd.

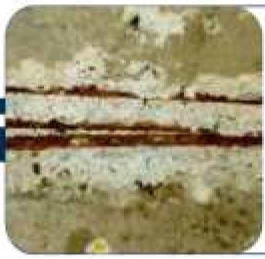
Leaders in Structural Retrofitting

SANRACHANA™
Structural Strengthening Pvt. Ltd.

Specialty Retrofit Contracting Services
- Concrete repairs
- Structural strengthening
- Seismic retrofitting
- Historic restoration

UP GRADE

Improving Performance Of Hardened Concrete
- Specialty monomer & low viscosity grouts
- External wrapping of carbon fiber composite
- Near surface reinforcement & micro jacketing



SHIELD™

Engineering Solutions For Corrosion Damages
- Bipolar penetrating type corrosion inhibition system
- Cathodic protection system
- Execution of corrosion damaged repairs

DATA STRONG

Strengthening Data Centre & Ware Houses
- Post-tension carbon laminates
- Near surface reinforcement
- Steel fabrication
- Span shortening

E-mail:
sanrachana@yahoo.com

Tel:
+91-22-25400203,
+91-22-25440435

Web:
www.sanrachana.in