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VOLUME 20-4

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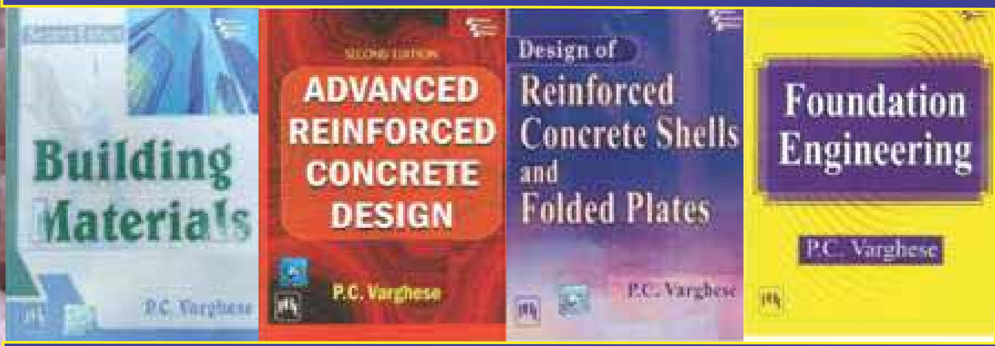
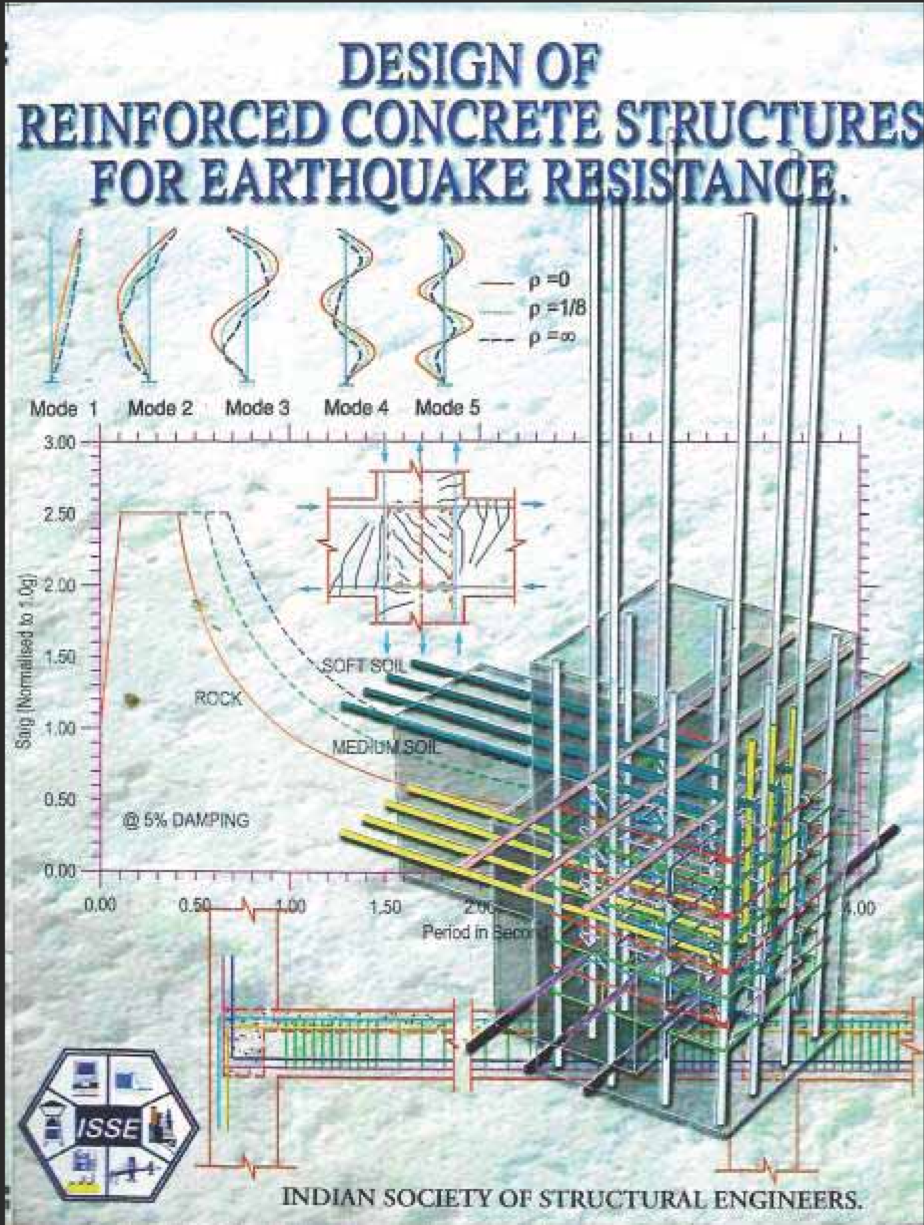


GEM 18 Prof. P.C. Varghese- Excellent Teacher, Consultant and Renowned Author

News and Events during Oct – Dec 2018

(Page 22)

LET US BUILD A STRONG STRUCTURE OF INDIAN SOCIETY



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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

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Fraternity News

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Patrons : 37	Organisation Members : 22	Sponsor : 8
Members : 1657	Junior Members : 31	IM : 01
Student Members : 36		

TOTAL STRENGTH 1792

- ❄ 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 18 Prof. P.C. Varghese- Excellent Teacher, Consultant and Renowned Author

Dr. N. Subramanian
Er. Vivek G. Abhyankar

(3rd March 1921 to 15th July 2018)

Prof. Varghese- A portrait from 1940's

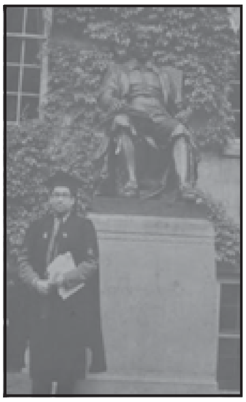
Author of several books, and Technical Papers, Prof. P.C. Varghese, was a well known professor of Structural Engineering, at IITM. Prof. Varghese lived a long life and served the Civil / Structural engineering profession for over 60 years and taught at premier institutes like the IITM and College of Engineering, Guindy and Moratuwa University, Colombo. Besides, he was a reputed consultant of Structural engineering as well as soil mechanics in India and abroad. He also served as UNESCO Chief Technical Advisor in Colombo.

SCHOOLING AND BASIC ENGINEERING EDUCATION

Shri. Puthenveetil Chandapillai Varghese was born on 3rd Mach1921 at Mavelikara, Kerala. He did his primary schooling at Mavelikara itself. In 1939 he completed his Pre-Degree education at CMS College, Kottayam. Later, he joined Loyola College, Madras, for his B.Sc. Degree (with key subjects as Mathematics, Physics and Chemistry) and completed it in 1941. The consistent urge for seeking knowledge made him to join B.Sc. Degree (Civil Engineering) at College of Engineering, Trivandrum, which he completed in 1945.

EXPERIENCE AND FURTHER STUDIES

During 1947, young Varghese joined the Building Research Station, Roorkee, as a Scientist. He received a Scholarship from the Ministry of Irrigation and Power, Government of India, to study Soil Mechanics and Earth Dams. Thus, in 1948 he went to the Harvard University, USA, for doing his MS Degree (Civil Engineering). After completing the same creditably, he decided to do another Masters degree in Soil Mechanics at the Harvard University itself, in 1949. During this course, he was lucky enough to work with the famous Professors like Karl Terzaghi (known as the father of soil mechanics) and Arthur Casagrande (who made great contributions in geotechnical engineering). In addition, he could get training with US Corps of Engineers, Tennessee Valley Authority, which is widely known to the engineering world, because of their variety of publications in Civil / Structural Engineering.



With Prof. Casagrande at Harvard University and Graduating from the University in 1949

After these memorable years in USA, Prof Varghese returned back to India, to serve his mother land in the year 1950. Initially, he worked as an Assistant Soil Specialist, Hirakud Dam Project in Odisha. At the end of this rigorous fieldwork for two years, he joined IIT Kharagpur in 1952 and worked with Prof. Lyse, Head (CE) and researched on concrete structures. He was soon deputed on a UNSESCO Fellowship to do research on concrete with the famous Prof. A. L.L. Baker, at Imperial College, London, UK. In 1954 Prof. Varghese did his Ph.D. at IIT-Kharagpur itself.

After completion of his Ph.D., he preferred to join institute rather than Industry. He had the privilege of working as one of the founding staff members of IIT Kharagpur from 1950 to 1961. He also worked as a Construction Engineer for campus development works of CPWD, at IIT Kharagpur.

In 1961, he joined IIT-Madras as the Head of the Civil Engineering department. Prof. Varghese served there from 1961 till 1972, and did excellent work during the formative years of IITM. During his stay with IIT-M, he obtained German Government funding and technical support to develop the Structural Engineering Laboratory and also the Hydraulics Laboratory. He also encouraged and groomed several faculty members and graduates into leadership roles. Several professors, who followed him at the structures as well as soil mechanics departments, did Ph.D. under his guidance.

At the 1st Convocation of IIT Madras as Head of Department

Discussing with German delegation and staff and at IITM laboratory with them

From 1972 to 1982 he served the Moratuwa University, Colombo (Sri Lanka) as UNESCO Chief Technical Advisor. Prof. Varghese also acted as UN advisor to the Ministry of Works, Sri Lanka during this period. He had the honour of working with (and Leading) a team of International experts. There he worked with the UNCHS and the Ministry of Works and Housing on many building projects. In 1983 he returned back from Sri-Lanka and settled down at Chennai.

TEXT BOOKS

After getting settled at Chennai, Prof. Varghese joined College of Engineering, Anna University, Chennai as a Honorary Professor, in 1984, and worked there till recently writing books and giving guest lecture to students., He published the following through PHI learning , and all of them are used in several universities as text books.

1. Building Materials , 2nd edition
2. Building Construction, 2nd edition
3. Foundation Engineering
4. Design of Reinforced Concrete Foundations

5. Limit State Design of reinforced Concrete
6. Advanced Reinforced Concrete Design , 2nd edition
7. Design of Reinforced Concrete Shells and Folded Plates
8. Maintenance, Repair & Rehabilitation And Minor Works Of Buildings
9. Engineering Geology for Civil Engineers

He studied Shell Structures at the Imperial College, London and also taught the subject at IIT Kharagpur and IIT Madras. As a result of this, he wrote a book on this complex subject in a very simple language, with less mathematics and more concepts and applications. The book covered wide range of topics from historic development of shells to modern theories and included typical design of folded plates and shells. In the forward to this book, Dr. P. Mannar Jawahar, the then Vice chancellor of Anna University, has appreciated Prof. Varghese for his efforts. The examples in this book are based on the "Notes for a Short Course on Concrete Shells and Folded plates for Practicing engineers", prepared in the year 1972, by him and Prof. P. S. Rao at IIT Madras.

This book written by Dr. Varghese on foundation engineering was appreciated by Students, professors and practitioners as it contains many practical aspects. Having 60 years of professional experience, all the books written by Dr. Varghese are a blend of theory and practice and also contain several simple tools and tips.

EPILOGUE

Prof. Varghese passed away peacefully at his residence in Chennai on 15th July 2018.

He laves behind his wife and four children. His wife Achamma Varghese is the daughter of K V Koshy of the Kandathil family. His children include Dr P V Alexander, Moly George, Dr Sarah Thomas, and Prof Koshy Varghese (now working as a professor in the Building Technology & Construction Management Division at IITM). Children in-law: Radha Alex, K. George (Raju – is an entrepreneur in Chennai), Dr Thomas Alexander (Cardiologist, Kovai Medical Centre and Hospital, Coimbatore), and Annu Varghese. The late P.C. Mathew, ICS, and Dr P.C. George are his siblings.

References

1. Presentation prepared by IIT-Madras on 26th Aug'11

2. Correspondence with – Prof. C. Ganapathy, Prof. P. Meher Prasad, Prof. Koshy Varghese, and Prof. C.V.R. Murthy.

Acknowledgement

We wish to thank Prof. Koshy Varghese for providing the photos.

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Gravity Columns and Floating Columns

By Vasant S. Kelkar, Ashish Bhangle, Prabhat Pandey

Introduction

Gravity Columns are Columns which are designed to resist only vertical loads and are not designed for effects of lateral loads like wind and EQ. In metros like Mumbai with the small sizes of plots especially in redevelopment projects, floating of few columns or shear walls on transfer girders to give clear spaces for parkings, driveway, ramps etc. at lower levels becomes inevitable. But in the latest IS codes there are severe restrictions on providing Gravity columns or floating columns/walls which are a part of lateral load resisting system. U.S. codes do not have such severe restrictions. Authors views on these two aspects are discussed in this paper.

Gravity Columns

In design of buildings under vertical and lateral loads, columns, shear walls along with beams framing into them resist the lateral loads due to wind and earthquake. There could be some columns which do not have beams framing into them or when they are supporting flat slabs. Such columns will not give much resistance to lateral loads due to wind and EQ. Such columns called Gravity columns could then be designed to only carry vertical loads.

There are conflicting views about design of Gravity columns. Design of such columns is discussed below considering the provisions of IS codes, ASCE 07-05 and ACI 318.

Clause 3.6 of IS 13920-2016 defines Gravity Columns in Buildings as "It is a column which is not part of the lateral load resisting system and designed only for force actions (that is, axial force, shear force and bending moments) due to gravity loads. But it should be able to resist the gravity loads at lateral displacement imposed by the earthquake forces."

Clause 11 of IS 13920-2016 states that Gravity Columns "shall be detailed according to Cl. 11.1 and 11.2 for bending moments induced when subjected to 'R' times design lateral displacement under the factored equivalent static design seismic loads". This is in line with philosophy of EQ resistance design which requires building structure to have sufficient ductility to withstand with some deformation or damage but without collapse the maximum expected EQ during its lifetime of magnitudes R times the design EQ. Hence, gravity columns should also be able to withstand the large displacement in such earthquake.

It is not clarified in the code how the moments due to R times design lateral displacements under the factored equivalent static design seismic loads are to be calculated. Some designers then consider Gravity columns in the 3-D analysis of the building, obtain moments/shears in them under design seismic loads and multiply them by R value assumed for the building to get the values of moments specified in Cl. 11 of IS 13920.

The above procedure seems irrational – because then the Gravity columns will have to be designed for 3 to 5 times the moment/shears for which they would be designed if they were considered part of lateral load resisting structure. It would then be better and economical not to consider them as Gravity columns but as lateral load resisting members and include them in the 3-D structure analysis – in which case they are not required to be designed for R times the corresponding moments.

Cl. 12.12.5 of ASCE 07-2016 also requires that members not included in seismic force resisting system to be adequate for gravity load effects plus "Seismic forces resulting from displacement due to the design storey drift (∆)". Here, ∆ is taken equal to drift under factored EQ load multiplied by deflection amplification factors Cd given in the code and divided by the importance factor (Cl. 12.8.6 of ASCE 07). Generally values of Cd are equal to or less than corresponding R values for the type of structure of the building. Considering that ∆ is drift under factored EQ loads, the resulting drift to be considered for calculating the seismic forces (after multiplication by Cd) will be about R times the drift under factored EQ loads i.e. the provision is similar to that in Cl. 11 of IS 13920-2016.

Cl. 12.12.5 of ASCE 07 specifies that "RC concrete frame members not designed as part of the seismic force resisting system shall comply with section 18.14 of ACI 318".

Cl. 18.14 of ACI 318-14 entitled "Members not designated as part of the Seismic–Force– Resisting System" states that frame members, not assumed to contribute to lateral resistance (such as Gravity columns), shall be designed to support the gravity loads while subjected to the "design displacements". Cl. 2.2 and commentary of the code defines design displacement äu as that calculated considering effects of cracked sections, effects of torsion, effects of vertical forces acting through lateral displacements (i.e. P - ∆ effect), effect of deformation of diaphragm etc. with modification factors to account for expected inelastic response.

Obviously, if a Gravity column has to be designed for moments/shears arising out of design displacement äu plus those due to gravity loads then it will require much bigger size and reinforcement than if it were designed only for gravity loads. Then there is no advantage of designing a Gravity column.

However, Cl. 18.14.3.3 of ACI-14 permits that moments/shears under äu plus those due to gravity loads can exceed capacity of the Gravity columns. It even permits such moments/shears due to äu not be calculated at all provided that in either case the reinforcement in the Gravity column is provided as per ductile detailing requirements of code. This clause states:

18.14.3.3 Where the induced moments or shears exceed ϕM_n or ϕV_n of the frame member, or if induced moments or shears are not calculated, (a) through (d) shall be satisfied:

(a) Materials, mechanical splices, and welded splices shall satisfy the requirements for special moment frames in 18.2.5 through 18.2.8.
(b) Beams shall satisfy 18.14.3.2(a) and 18.6.5.
(c) Columns shall satisfy 18.7.4, 18.7.5, and 18.7.6.
(d) Joints shall satisfy 18.8.3.1.

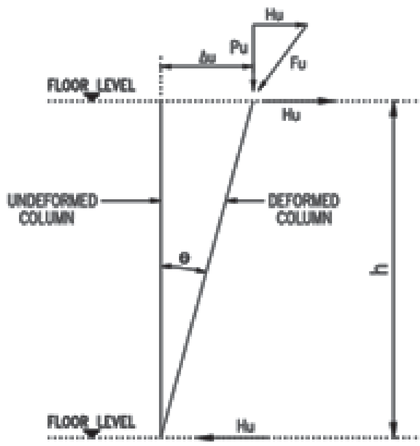
IS 13920 – 2016 also has a similar provision for Gravity Columns –

Its clause 11.2 states "When induced bending moments and shear forces under said lateral displacement combined with factored gravity bending moment and shear force exceed design moment and shear strength of the frame, 11.2.1 and 11.2.2 shall be satisfied".

The principle behind this, as per commentary on Cl. 18.14.3.3 of ACI-14, is that with ductile detailed reinforcement the Gravity column will yield under äu but will continue to sustain the gravity loads as expected.

Figure 1 shows a Gravity column which is designed only for gravity loads and so in the lateral load analysis it may be considered as hinged at its top and bottom floor levels by giving moment releases to it at such joints (or by giving it a very low value of moment of inertia). As a Gravity column the column will be designed for the resulting vertical loads plus moments/shears from gravity load analysis plus those due requirement of minimum eccentricity and slenderness as per code.

Such column under lateral loads will develop plastic hinges at top and bottom but still will be able to sustain displacements äu without failure provided its reinforcement is as per ductile detailing requirements of code. It will be able to sustain the gravity load as per equilibrium of forces shown in figure 1.



$Fu = Pu/\cos\theta$, $Hu = Pu \tan\theta = Pu \cdot \Delta u/h$
Hu transferred to lateral load resisting frames/walls by floor diaphragm.

Table 9, v) Note 4 of IS1893-2016: $\Delta/h \leqslant 0.001$ For Flat slab buildings

Hence: As per Cl. 11 IS 13920: $\Delta u/h \leqslant 0.003$ For R = 3
Gives $Hu \leqslant 0.3\%$ of Pu
Also then Increase in axial load in column from Pu to Fu is small.

From the force diagram in Fig. 1 it is seen that even after displacement äu, equilibrium is achieved with a nominally increased axial force in the column and small horizontal forces in the floors (forming a couple to resist moment due to äu) which will be transferred to lateral load resisting frames/walls by the floor diaphragms.

In a typical building with flat slab floors the lateral loads may be resisted by core walls and moment frames on the facades. The intermediate columns between central cores and facade which support the flat slabs could be designed as Gravity columns to resist only the vertical loads (plus any moments under gravity loads including those due to min. eccentricity, slenderness etc.). These columns should however be provided with links as per ductile detailing requirement of code.

Sizes and reinforcements in columns designed thus as Gravity columns can be smaller than if they were included in the 3-D frame to resist lateral loads. Reduction of sizes of such columns helps in increasing carpet area, facilitating parking and reduced cost. Hence, consultants can consider designing some columns as Gravity columns to get the benefits.

It is imperative that flat slabs supported on Gravity columns should be provided with shear reinforcement near the columns as per code to prevent shear failure under äu.

Floating Columns or Shear walls

In many multistoried buildings in metro cities, there are residential or commercial floors at upper levels while on the lower "podium" floors and basements there are open plazas, retails areas, parkings, driveways. Hence, it may not be possible to continue some of the columns or shear walls of upper floors through the lower floors to foundation and inevitably they have to be floated on transfer girders at a suitable floor level such as first residential floor. Otherwise planning the building with all structural columns/wall continuing to foundation may not be possible for the architects and then project may not be viable to satisfy especially the parking requirements.

As per clause 10.1.10 of IS-13920-2016 (please see snapshot below) Special Shear Walls cannot be discontinued to rest on transfer beams and columns. Special Shear Walls are walls with ductile detailing.

10.1.10 Special shear walls shall be founded on properly designed foundations and shall not be discontinued to rest on beams, columns or inclined members.

The above clause does not apply to Ordinary Shear Walls (which have no ductile detailing) and they could be floated on transfer beams. But then as per Cl. iv) Note 1 of Table 9 of IS1893 (part 1) – 2016 (Please see snapshot below) RC structures in Zones III, IV, V have to be designed with ductile detailing i.e. ordinary shear walls cannot be used in a building which is in Zone III and above.

iv)	**Dual Systems** (*see* Note 3)	
	a) Buildings with ordinary RC structural walls and RC OMRFs (*see* Note 1)	3.0
	b) Buildings with ordinary RC structural walls and RC SMRFs (*see* Note 1)	4.0
	c) Buildings with ductile RC structural walls with RC OMRFs (*see* Note 1)	4.0
	d) Buildings with ductile RC structural walls with RC SMRFs	5.0

NOTES

1 RC and steel structures in Seismic Zones III, IV and V shall be designed to be ductile. Hence, this system is not allowed in these seismic zones.

As per Cl. VI of Table 6 of IS1893-2016 (please see snapshot below) even floating columns which are part of lateral load resisting system are prohibited.

vi) **Floating or Stub Columns**

Such columns are likely to cause concentrated damage in the structure.

This feature is undesirable, and hence should be prohibited, if it is part of or supporting the primary lateral load resisting system.

From the above it seems that a designer cannot provide a floating (discontinuous) column or wall in a building which are part of lateral load resisting system.

However, Sr. no. iv) of Table 5 of IS1893:2016 seems to indeed permit out of plane offsets in column/walls resisting lateral loads (which means upper column/wall are floating) even in zones III, IV, V subject to lower permissible drift in the storey below.

ASCE7-16 does not have such stringent restrictions. Its clause 12.3.3.3 gives forces for which members supporting discontinuous walls or frames have to be designed. Figures C12.3-2, C12.3-4 and C12.3-5 in its commentary show such discontinuous walls. Cl. 12.3.3.3 requires the supporting members to be designed to resist the seismic effects including over strength factor of its Cl. 12.4.3. The over strength factor of ASCE is generally 2.5.

Thus, if a wall or column is discontinuous on a transfer girder then to comply with ASCE7 requirements the transfer girder should be designed for about 2.5 times the design EQ loads. EQ in vertical direction has to be added or subtracted to give the most critical results for, say, tensile steel at bottom and top of the RCC transfer girder.

It is does not seem that ASCE code requires the columns supporting the transfer girder and its framing beams to be designed with the over strength factor Ù all the way to the foundation. But this can be done to be on the conservative side.

IS 1893-2002 did have a clause 7.10.3 a) in which it permitted columns and beams of a soft storey to be designed for 2.5 times the shears and moments calculated under design seismic loads, besides other requirements. But this has been deleted in the latest IS1893-2016.

Thus, in the authors opinion if the transfer girder and other structure below a discontinuous wall/column are properly designed as per ASCE7-16 code then the structural consultant could permit few columns/wall to be floated in a building even if they are part of lateral load resisting system – notwithstanding the very stringent provision of IS code to the contrary which need to be reviewed and revised.

Conclusions

The authors' views as per the above discussion can be summarized as below:

1. Gravity columns could be used without designing them for bending moments/shears due to 'R' times the lateral displacements under the factored static design seismic loads required by Cl. 11 of IS 13920-16. But then they should be detailed for ductility as per code.

2.Floating columns should be avoided. But where they are unavoidable with small plots and parking requirements in cities like Mumbai, floating columns even if they are a part of lateral load resisting system, could be permitted. But then the transfer girders and columns supporting them should be designed for Omega times (about 2.5 times) the moments/shears under design EQ loads as per ASCE.

3.IS code committee may consider amendments in code provisions considering the above.

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“Life cycle cost and extending service life of Structures”

By Hemant Vadalkar

1. Introduction :

Most of our civil engineering projects are planned and sanctioned based on the initial cost of construction alone. Different design alternatives and corresponding cost estimates are worked out by the planners and design team. Generally, the option having low initial cost of construction is selected by the owner. This may not necessarily be the best and economical option if the life cycle cost is considered.

2. Life cycle cost analysis (LCCA) technique is very useful tool to decide most economical option among various alternatives. LCCA is a process of evaluating the economic performance of a building over its entire life It considers total cost during the asset's economical life span. For civil engineering projects, it can be used to select the best alternative. The total life cycle cost consists of cost of design and planning, initial cost of construction, cost of operation, replacement cost of some components, cost of maintenance, cost of repairs or upgrades during the service life and cost of disposal. It can be applied to Roads, bridges, infrastructure projects, buildings or any civil engineering structure. Therefore, life cycle cost analysis must be considered to select the most appropriate and economical option at the planning stage itself. **Life-Cycle Cost Analysis (LCCA)** can be described as “An economic evaluation method for determining the most cost- effective option out of competing alternative.”

Ample technical literature is available on the subject. Figure 1 and Fig 2 indicates the cost components in life cycle cost analysis.

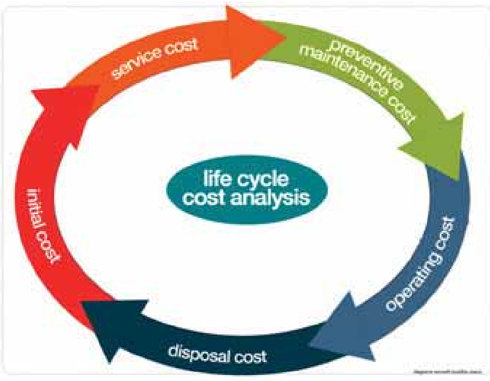

Fig. 1: Life cycle cost components

LCCA is based upon the assumptions that multiple building design options can meet programmatic needs and achieve acceptable performance, and that these options have differing initial costs, operating costs, maintenance costs, and possibly different life cycles. For a given design, LCCA estimates the total cost of the resulting building, from initial construction through operation and maintenance, for some portion of the life of the building (generally referred to as the LCCA “study life”). By comparing the life cycle costs of various design configurations, LCCA can explore trade-offs between low initial costs and long-term cost savings, identify the most cost-effective system for a given use, and determine how long it will take for a specific system to “pay back” its incremental cost. Because creating an exhaustive life cycle cost estimate for every potential design element of a building would not be practical, the Guidelines for LCCA focus on features and systems most likely to impact long-term costs.

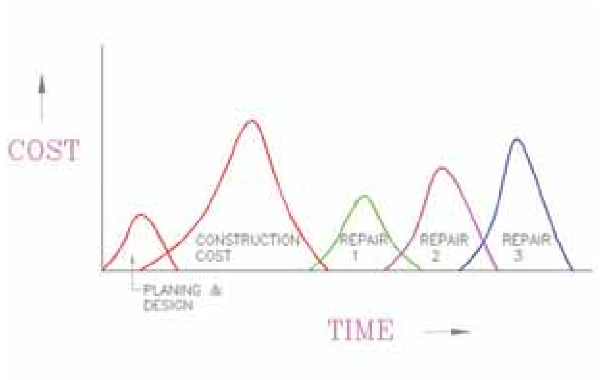

Fig. 2 : Costs to be added to get the life cycle cost.

Figure 3 shows saving potentioal in life cylce cost if the projects are scientifically planned and executed. It also shows change potential with time during the life of the asset.

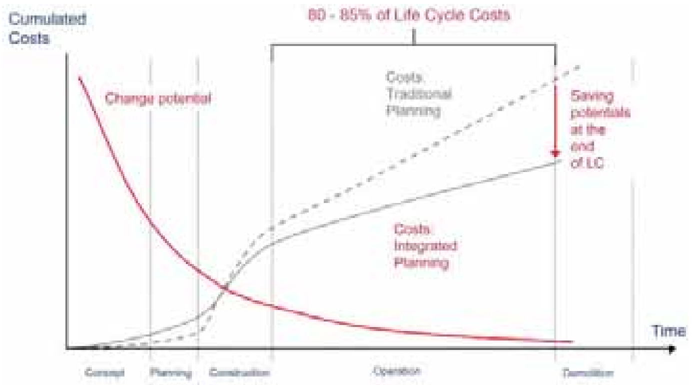

Fig .3 : Cost v/s time

The value of money today and money that will be spent in the future are not equal.

Project costs that occur at different points in the life of a building cannot be compared directly due to the varying time value of money. They must be discounted back to their present value through the appropriate equations. The discount rate is defined in terms of opportunity cost.

3. Basic terms used in the life cycle cost calculations

3.1 Discount rate

In order to be able to add and compare cash flows that are incurred at different times during the life cycle of a project, they have to be made time-equivalent. To make cash flows time-equivalent, the LCC method converts them to present values by discounting them to a common point in time, usually the base date. The interest rate used for discounting is a rate that reflects an investor's opportunity cost of money over time, meaning that an investor wants to achieve a return at least as high as that of her next best investment. Hence, the discount rate represents the investor's minimum acceptable rate of return.

To factor in the inflation effect, real discount rate can be worked out based on the nominal rate and inflation rate by the following formula

Real discount = {(1+nominal) /(1+inflation)} - 1

Thus, if the nominal rate is 10% and inflation rate is 4%, real discount rate will be

Real discount = (1+0.1)/(1+0.04) -1 = 0.0576 i.e. 5.76%

The basic discount equation is given as

PV = Fn /(1+D) ^n

Where PV = Present value

Fn = Future value at n year

D = Discount rate

n= number of years in future

Life-cycle cost analysis (LCCA) is a method for assessing the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a building or building system. LCCA is especially useful when project alternatives that fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings. For example, LCCA will help determine whether the incorporation of a high-performance HVAC or glazing system, which may increase initial cost but result in dramatically reduced operating and maintenance costs, is cost-effective or not

3.2 Length of study period: The study period begins with the base date, the date to which all cash flows are discounted. The study period includes any planning/construction/implementation period and the service or occupancy period. **The study period has to be the same for all alternatives considered.**

3.3 Net present Value (**NPV**) can be calculated based on the equation

NPV = Initial cost + Sum (fn *Yn)

fn is present value factor = 1/ (1+d)^n

n is year of expenditure
Yn is expenditure in year n
d is the discount rate

3.4 Life cycle cost (LCC) : Basic equation of life cycle cost is

LCC = C1+ C2 -CR

Where

LCC : Life cycle cost of an asset

C1 = is the initial cost (design + construction cost) at year zero.

C2 = Present value (PV) of all recurring cost like running cost, repair cost, maintenance cost, component replacement cost, upgrade cost, interest on borrowed money etc

CR = Present value (PV) of the residual cost at the end of study life (Salvage value- demolition cost).

Future cost of an item can be calculated if present cost and escalation rate is known by the equation

$C_n = C_0 * (1 + e)^n$
Where Cn = future cost after n years
C0 = present cost
e= escalation
n= number of years

3.5 Payback Calculation

For evaluating the cost-effectiveness of LCCA alter-natives, we can check their "payback" against the base case. The payback term is the time it takes an option to have the same life cycle cost as the base case.

4.0 Examples for Life cycle cost comparison

Consider two examples one for pavement and other for building.

Example 1 : Lifecycle cost comparison of different type of pavements

Consider an example of alternative pavement options with varying initial cost and life cycle cost. A flexible (bituminous) pavement has less initial cost say Rs. 1500/sq.m compared to higher cost for rigid (concrete) pavement say Rs2200/sqm.

One more alternative of ultra thin white topping over the bituminous road has been considered which has reduced maintenance cost.

From the figure 4 it can be seen that payback period is at the intersection of both lines. Life cycle cost of pavement consists of initial cost, maintenance and repair cost, resurfacing cost, user cost etc. for a study period of 30 years. The life cycle cost of rigid pavement is lower than flexible pavement.

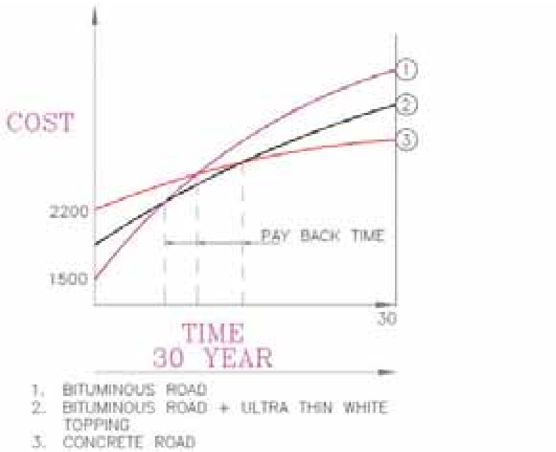

Fig. 4 : Life cycle cost for three pavement alternatives for 30 years

Performance of the pavement starts degrading with time. One has to see that the performance should be above the prescribed minimum acceptable level. After some time, rehabilitation is required to upgrade the performance. This is a cyclic process which continues during the life time. This can be seen from figure 5.

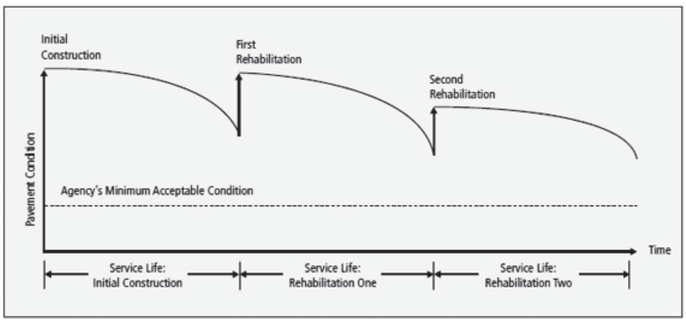

Fig.5: Performance v/s time for any one design alternative

Example 2 : Consider a building example for life cycle cost calculations.

Consider initial cost of construction is Rs. 3000/- per sq. ft at present date in 2018. Approximate cost break up is as given in Fig 7 below.

Real Discount rate is assumed as 6% . Study period considered is 60 years.

Total life cycle cost is worked out for three alternatives.

Case1 : Ordinary construction by saving on design, material and workmanship cost and cutting corners in quality of construction. Initial cost of construction reduced to Rs.2500 per sq. ft. But cost of repairs is very heavy during subsequent years.

In one case the building is not at all repaired by the occupants after construction. The building deteriorated and finally collapsed at the age of 25 years.

Case 2 : Building constructed with proper design, good material and quality control. Cost of construction is Rs.3000/ sq. ft. Subsequent repair cost is relatively less in subsequent years.

Case 3 : Extremely good design. Durability parameters introduced in design and construction stage. Corrosion inhibitor used in concrete to protect the steel, anti-carbonation paint used to coat concrete surface. Increase in cost due to these materials is up to 5 %. Stainless steel rebars are provided in place of carbon steel which resulted in cost increase by around 15%. (Reinforcement item rate considered is Rs.75 per kg for carbon steel and Rs 150 per kg for SS). Overall cost increase is about 20% compared to Case2. Cost of repair will be minimum over the span of 60 years. Building is functional beyond 60 years and objective life span is 100 years.

Building performance v/s time can be plotted for all the three alternatives. This is shown in fig.6. Building cost distribution is indicated in Fig 7a and 7b as % of total cost. Figure 8 shows the typical life cycle cost distribution in a building.

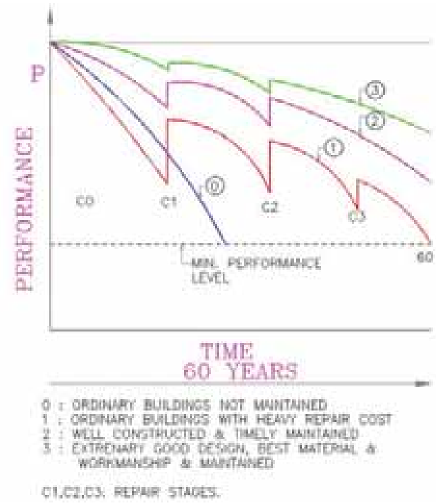

Fig. 6 : Performance of building v/s time for three alternatives

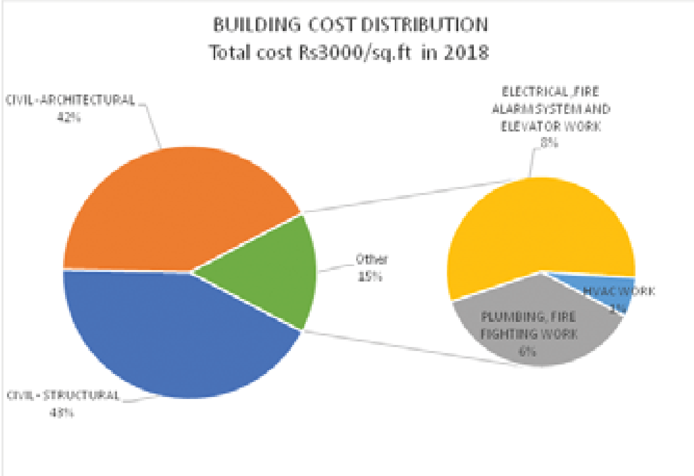

Fig.7a : Building cost distribution Structural – Architectural and other.

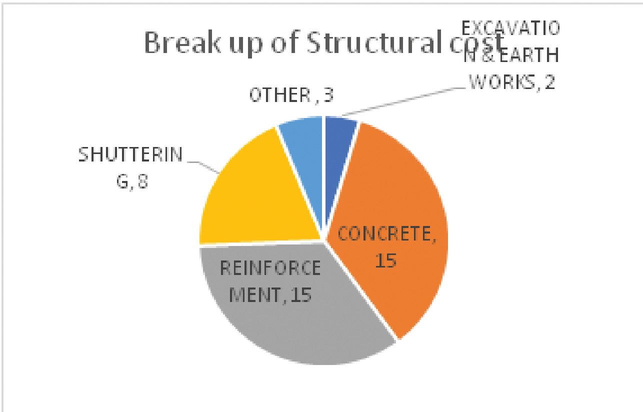

Fig. 7b : Cost break up for structural items.

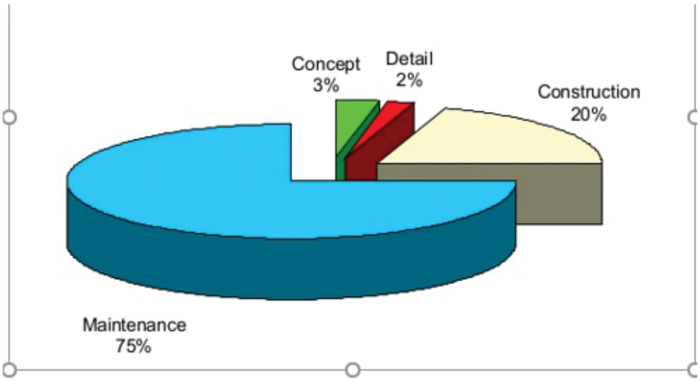

Fig. 8 : Distribution of life cycle costs for a building

Table 1 provides calculations of life cycle cost for three alternatives. It can be seen from the table 1 that life cycle cost saving of 22% can be achieved for Case2 and cost saving of 27% is achieved for Case3 compared to a base case

Life cycle cost calculations for three cases of buildings

Assumed discount rate d = 6.00%
Study period years = 60
Reduction factor = 1/(1+d)^n
Present value (PV) = Reduction factor * Cost incurred

			Case 1 building		Case 2 Building		Case3 Building	
Description	Year	Reduction factor	Cost incurred	PV of cost	Cost incurred	PV of cost	Cost incurred	PV of cost
Initial cost Rs/sqft	0	1.000	2500	2500	3000	3000	3600	3,600
	5	0.747		0		0		0
Repair	10	0.558	2000	1117	1000	558	500	279
	15	0.417		0		0		0
Repair	20	0.312	3000	935	1500	468	750	234
	25	0.233		0		0		0
Repair	30	0.174	4000	696	2000	348	1000	174
	35	0.130		0		0		0
Repair	40	0.097	5000	486	2500	243	1250	122
	45	0.073		0		0		0
Repair	50	0.054	6000	326	3000	163	1500	81
	55	0.041		0		0		0
Repair	60	0.030	7000	212	3500	106	1750	53
Total NPV Life cycle cost				6273		4886		4543
Life cycle Cost saving				Base		22.10%		27.57%

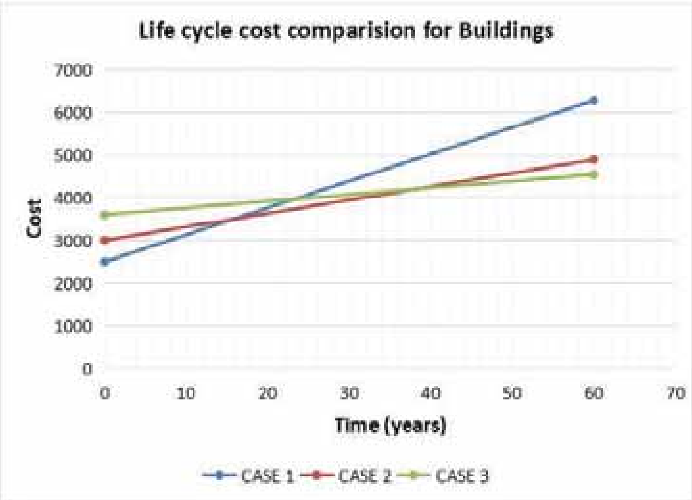

Fig. 9 Life cycle cost comparison for building

Though, the initial cost of construction for building in case3 is higher, the life cycle cost is lower for that building. This is evident from table 1 and Figure 9.

5.0 Predicting Service life of a building :

For predicting residual service life of a building, some mathematical models are available. **ACI-365** provides guidance on service life prediction based on various measured parameters. Different corrosion models are used to predict the residual life of structure which accounts for chloride concentration at concrete surface, chloride diffusion coefficient of concrete, Concrete cover thickness.

Durability & Service Life is defined in ACI 365

5.1 Durability is the ability of a *structure or its components* to maintain serviceability in a given environment over a specified time.

5.2 Service life is the period of time after installation during which all the properties exceed the minimum acceptable values when routinely maintained.

5.3 Technical service life is the time in service until a defined unacceptable state is reached, such as spalling of concrete, safety level below acceptable, or failure of elements.

5.4 Functional service life is the time in service until the structure no longer fulfils the functional requirements or becomes obsolete due to change in functional requirements, such as the needs for increased clearance, higher axle and wheel loads, or road widening.

5.5 Economic service life is the time in service until replacement of the structure (or part of it) is economically more advantageous than keeping it in service.

5.6 Some software tools are available to predict service life of structure. **Life-365** software developed by consortium of concrete corrosion inhibitor association, National ready mix concrete association, Slag cement association and Silica fume association USA is being used by various researchers to study the corrosion model based on various parameters.

6.0 Factors affecting Service life of a building –

Various factors right from design, materials, workmanship and maintenance practices will affect the service life of a structure.

Design considerations : Design parameters for strength, serviceability and durability

Material specifications : Appropriate selection of material based on type of structure, environmental conditions, intended design service life

Workmanship : Implementation of good engineering practices in all items of work and strict adherence to the specifications

Regular and timely maintenance : Constant monitoring, inspections, preventive maintenance, timely repair as and when required.

Rules of 5's is very interesting to understand the importance of durability in the initial stages which states -

Rule of 5's: "$1 spent on durability in the design phase is equivalent to $5 in the execution phase, and to $25 in the service phase"
(DeSitter, 1980s)

A common question asked by people and which is bothering all civil engineers is "Why our present day structures constructed with latest technology and modern materials has a short life span compared to structures built by our ancestors which are standing for centuries?"
Every civil engineer has to think over this valid question and try to find answers. I could think about some of the reasons for this.

Some of the reasons for reduced service life of modern day structures could be –

1. Higher stress level due to competitive designs
2. Deficiencies in design, material specifications and quality control at site.
3. L1 criteria (minimum initial cost design)
4. Neglect of timely maintenance of the structure

5. Corrosion of steel - Single major factor affecting life of structure

7.0 Corrosion of steel : Corrosion of steel is a natural process which cannot be stopped but can be delayed. If we can increase initiation time for corrosion, we can increase service life. Process of corrosion is well documented and known. When the PH of concrete cover is more than 12, it protects the steel. Due to carbonation of cover concrete, PH drops below 7 which means, it cannot protect the steel any more. Chloride ion ingress and diffusion in concrete initiates corrosion of steel which is not protected by carbonated cover concrete. As the volume of corrosion products is much higher than original volume of steel, it exerts pressure on concrete cover. This results in cracking and spalling of cover concrete. If not attended in time, this may lead to collapse of structure. Popular corrosion curve is as shown in Fig10.

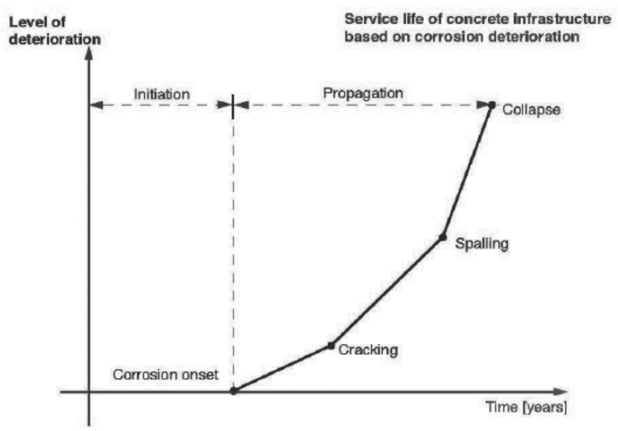

Fig. 10 : Corrosion deterioration of concrete structures with time

Once, the corrosion starts, its like a cancer to the structure. We should aim at delaying the initiation time for corrosion.

Some of the tenders specify design life of 100 years. How to obtain 100 year service life of our future structures and how to maintain our old structures is a big question ???? We need to understand the degradation mechanism. Correct use of materials, composition, production, protection, repair and restoration is the key to achieve this goal.

7.1 Corrosion protection techniques –

There are certain techniques that can be employed to mitigate the corrosion problem. Based on the project requirements, following options can be considered.

1.Use of TMT or CRS Steels
2.Use of Stainless steels for better corrosion resistance
3.Various Protective Coatings can be used like
Organic Coatings
Fusion Bond Epoxy coating
Galvanization
4.Admixtures in Concrete to enhance durability
5.Migrating Inhibitors can be used in concrete mixes
6.Cathodic Protection to steel

Out of the available options, use of stainless steel rebars seems to be a much promising option for extending life span of RCC structures with affordable incremental cost. Some of the Indian manufacturers have started producing SS bars. Bureau of Indian Standard had come out with code Stainless Steel Rebars IS16651:2017

Rate of corrosion for different type of steel can be seen from Table 2

Table 2 : Corrosion rate for different material

Corrosion Rate (in micro meter / year)

Period	10 Years		
Metal	RURAL (µm / yr)	MARINE (µm / yr)	SEVERE MARINE (µm / yr)
Mild Steel	4.32	37.1	219
430	< 0.0025	0.0406	0.1727
304	< 0.0025	0.0076	0.0406
316	< 0.0025	< 0.0025	0.0279
Stainless Steel Grade G (Ferritic)	**< 0.0025**	**0.104**	**1.722**

Pitting & Crevice corrosion Resistance Equivalent Number (PREN).

Some of the Govt. Organizations like Railways have started using stainless steel in their structures by taking our circulars in that regard.

CRS100 Ferritic Stainless Steel cost comparison in 2017 is given by one of the manufacturers in India

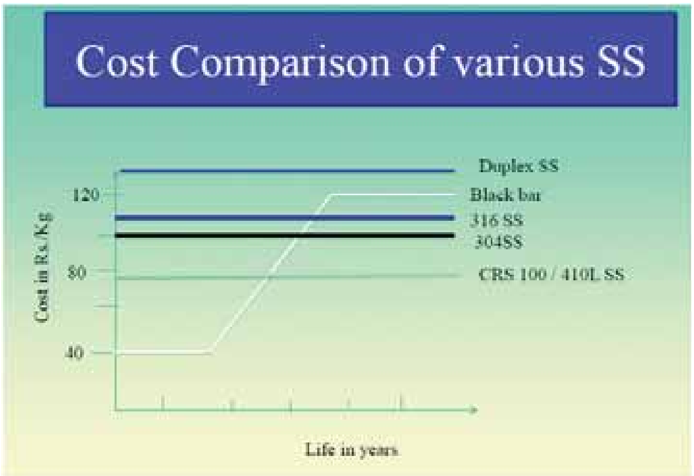

Fig.11 Cost comparison of various Stainless Steel options

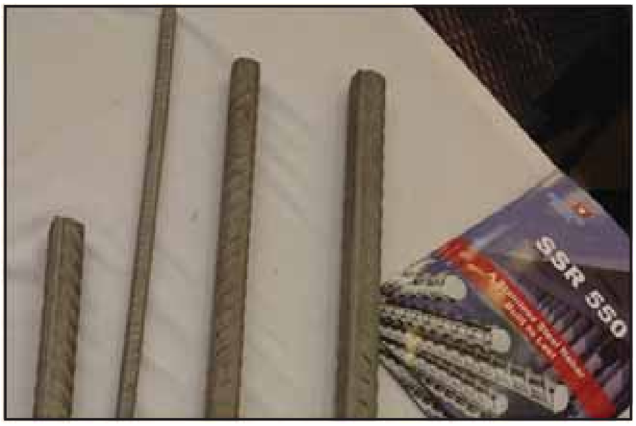

Fig. 12 Ferritic Stainless Steel reinforcement bars

8.0 How can we increase service life of our RCC Structures ?

For healthy and durable concrete structures, we need to implement durability parameters in the project design process. Parameters listed below if implemented can enhance service life of RCC structures –

1.Minimum cement content for strength and durability

2.Use of Pozzolans (Fly ash, GGBS, Silica fume..)

3.Minimum w/c ratio by using suitable admixtures

4.Adopt best practices in concrete production, transportation, placement, compaction, protection and Curing

5.Reduced concrete permeability is the key : Specify desired level of permeability and check concrete by conducting permeability tests. Water permeability / Rapid Chloride Permeability Test (RCPT).

6.Concrete cover : correct concrete cover can be provided by use of best quality Factory made concrete cover blocks.

7.Limiting chloride and sulphate content in concrete

8.Limiting crack width to less than 0.1mm

9.Use of corrosion inhibitor in concrete.

10.Use of corrosion resistant steel like galvanized / stainless steel reinforcement

11.Protective coating on concrete surface (Anti-carbonation paints) for blocking entry of aggressive elements into concrete.

12.Periodic inspection , monitoring and timely repair

9.0 Conclusion :

1.Life cycle cost analysis must be carried out for choosing the best alternative. Minimum life cycle cost will be the best option though the initial cost is more.

2.Durability parameters must be implemented from planning to execution for achieving longer service life of our assets. This will help in achieving sustainable construction and minimum life cycle cost.

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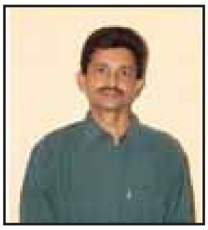

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SAD DEMISE

We had lost eminent civil engineers during the last quarter. ISSE team pays tribute to the departed soul.

1. D. V. Karandikar (22 Sept 2018) – Senior Geotechnical Consultant, Mumbai. He was known for his deep knowledge on the subject and provided solutions to complex geotechnical problems.
2. Prof. D. S. Joshi (24 Nov 2018) – Senior Structural Consultant and ISSE President. His book on Design of Reinforced concrete Structures for Earthquake resistance will guide civil engineers.
3. M. D. Tambekar (15 Dec 2018) – Ex. Chairman of IEI Maharashtra centre and arbitrator in civil engineering projects. He chaired many sessions in the technical seminars and it was pleasure listening to his experience.

‘Comparative Study of Gust factor values as per IS 875 (part 3): 2015, IS 875 (part 3) draft code: 2007 and Australian Code AS 1170-2: 2002’

By Satish Marathe, Avinash Jadhav

Abstract:-

IS 875 part III- Design Loads (other than Earthquake) for buildings and structures – Code of practice went through its third revision in 2015. This standard primarily deals with wind loads to be considered when designing buildings, structures and components thereof. Equations for background factor, size reduction factor, energy ratio and length scale turbulence have been included for gust factor method in current revision. This paper deals with comparative study of gust factor values obtained using, IS 875: 2015, IS 875 draft code and Australian code for wind loads AS 1170 -2: 2002. The changes in the equations in IS 875 with respect to Indian draft code and AS 1170-2: 2002 are presented in tabular form. In AS1170-2:2011 Gust factor calculations are same as 2002 version.

Keywords: - *Gust factor method, Background factor, size reduction factor, Energy ratio, Length Scale turbulence*.

Introduction:-

Wind speeds vary randomly both in time and space. Hence, assessment of wind load and its response are very important in designing buildings or structures. Majority of structures in practice do not suffer wind induced oscillations and need not be examined for dynamic wind effects. Nevertheless there are various types of structures that need to be examined for dynamic wind effects using Gust factor method. The along and across wind responses are to be determined and applied simultaneously while designing the Structure.

To obtain the along-wind response of a flexible structure (time period > 1.0 sec), the design wind pressure p_z has to be multiplied by the dynamic response factor C_{dyn} or G. This approach is based on the stochastic response of an elastic structure acted upon by turbulent wind producing random pressures. The structure is considered to vibrate in its fundamental mode of vibration. The dynamic response factor, C_{dyn} or G includes the effect of non-correlation of the peak pressures by defining a size reduction factor, S. It also accounts for the resonant and the non-resonant effects of the random wind forces. The definition of dynamic response factor C_{dyn} or G has changed from that in the earlier Code (1987 edition) which was applied to the wind loading due to hourly mean wind speed, against the 3-sec gust speed being used now.

The equation for C_{dyn} or G contains two terms, one for the low frequency wind speed variations called the non-resonant or ‘background’ effects, and the other for resonance effects. The first term accounts for the quasi-static dynamic response below the natural frequency of vibration of the structure while the second term depends on the gust energy and aerodynamic admittance at the natural frequency of vibration as well as on the damping in the system.

The resonant response is insignificant for rigid structures (T < 1.0 Sec). For flexible structures, the background factor Bs may be small resulting in reduced wind forces obtained from dynamic analysis as compared to the static analysis. Turbulence intensity, Ih is defined as the average level of fluctuations in the wind speed as a ratio of the mean wind speed.

Literature Review:-

Gust is defined as positive or negative departures of wind speed from its mean value, lasting for not more than, say 2 min over a specified interval time.

Wind gustiness introduces dynamic load effects which the codes and standards account for by factoring up the mean loads by a gust factor. For a very small structure and a short duration gust, the gust factor is unity. On the other hand if the averaging interval is 10 minutes or more, the gust factor is greater than unity. The equations for gust factor method in Indian standard and draft code seems to be adopted from the Australian code. The Australian code gives a much more detailed insight on the gust factor method compared to the Indian standard and draft code. The equations in Indian standard and draft code are modified over the ones given by the Australian code for some unknown reasons.

The criteria for application of gust wind in Indian and Australian code is the same except that the IS code is silent on structures that are not covered using the equations for Gust factor method.

The equations for gust factor method in Indian Standard, draft and Australian codes are presented in tabular form.

Sr. No	IS 875: 2015	IS 875 DRAFT CODE:2007	AUSTRALIAN CODE AS 1170-2: 2002
1)	**I_h- Turbulence Intensity @ ht.=h**		
	Calculated as per formula in 6.5 IS 875: 2015	Table provided in the draft	Table provided in the Code
2)	**g_v- Peak factor for upwind velocity**		
	3- for category I and II 4- for category III and IV	3.5	3.7
3)	**B_s- Background factor**		
	$\dfrac{1}{1+\dfrac{[0.26(h-s)^2+0.46b_{sh}^2]^{0.5}}{L_h}}$	$\dfrac{1}{1+\dfrac{[36(h-s)^2+64b_{sh}^2]^{0.5}}{2L_h}}$	$\dfrac{1}{1+\dfrac{[0.26(h-s)^2+0.46b_{sh}^2]^{0.5}}{L_h}}$
4)	**s- Level at which effects are to be determined**		
	0	0	0
5)	**b_{sh}-**		
	Average breadth of structure between s and h	Average breadth of structure between s and h	Average breadth of structure between s and h
6)	**L_h- Effective turbulence at ht.= h**		
	$85\left(\frac{h}{10}\right)^{0.25}$ for category I, II and III $70\left(\frac{h}{10}\right)^{0.25}$ for category IV	$100\left(\frac{h}{10}\right)^{0.25}$	$85\left(\frac{h}{10}\right)^{0.25}$

7)	**H_s- Height factor for resonant response**		
	$1+\left(\frac{s}{h}\right)^2$	$1+\left(\frac{s}{h}\right)^2$	$1+\left(\frac{s}{h}\right)^2$
8)	GR- Peak factor for resonant response		
	$\sqrt{2\ln(3600f_a)}$	$\sqrt{2\ln(3600f_a)}$	$\sqrt{2\ln(600n_a)}$
9)	S- Size reduction factor		
	$\frac{1}{\left[1+\frac{3.5f_0h}{\bar{\bar{V}}_{h,d}}\right]+\left[1+\frac{4f_0b_{0h}}{\bar{\bar{V}}_{h,d}}\right]}$	$\frac{1}{\left\{\left[1+\frac{4f_0h(1+g_vI_h)}{V_h}\right] + \left[1+\frac{4f_0b_{0h}(1+g_vI_h)}{V_h}\right]\right\}}$	$\frac{1}{\left\{\left[1+\frac{3.5n_ah(1+g_vI_h)}{V_{des,\theta}}\right] + \left[1+\frac{4n_ab_{0h}(1+g_vI_h)}{V_{des,\theta}}\right]\right\}}$
10)	**E- Spectrum of turbulence**		
	$\frac{\pi N}{(1+70.8N^2)^{5/6}}$	$\frac{\pi N}{(1+70N^2)^{5/6}}$	$\frac{\pi N}{(1+70.8N^2)^{5/6}}$
11)	**β- Ratio of structural damping to critical damping**		
	Welded Steel Structure- 0.01 Bolted Steel Structure- 0.02 RCC or Prestressed- 0.016	0.01 0.02 0.02	0.02 0.05 0.05
12)	**N- Effective reduced frequency**		
	$\frac{f_0L_h}{\bar{V}_{h,d}}$	$\frac{f_0L_h(1+g_vI_h)}{V_h}$	$\frac{n_aL_h(1+g_vI_h)}{V_{des,\theta}}$
13)	**Gust Factor (C_{dyn} or G)**		
	$1+2I_{hi}\left[g_v^2B_s(1+\emptyset)^2 + \frac{H_sg_R^2SE}{\beta}\right]^{0.5}$	$\frac{1+2I_{hi}\left[g_v^2B_s+\frac{H_sg_R^2SE}{\beta}\right]^{0.5}}{1+g_vI_h}$	$\frac{1+2I_h\left[g_v^2B_s+\frac{H_sg_R^2SE_t}{\zeta}\right]^{0.5}}{1+g_vI_h}$
14)	**F_Z (N or KN)**		
	$C_{fz}A_zP_dG$	$C_fA_eP_zC_{dyn}$	$(0.5\rho_{air})A_{ref}\left[V_{des,\theta}\right]^2C_{fig}C_{dyn}$

Example:-

Consider a steel tower 8m x 8m with a total height of 61m and floors to floor ht at 1.75m. The tower has elastic cladding on all sides. The Structure is located in terrain category 3 as per IS 875 part 3: 2015.

Time period as per equation $\frac{0.09\square}{\sqrt{d}}$ = 1.94 sec

All the results are tabulated at s=0 i:e base of the building and at z= 19.7m, 40.7m, 49.45m, 61.1m.

Check for gust factor method to be applied or not.

1) If Frequency of the structure is less than 1Hz.
   F= 1/T = 1/1.94 = 0.515 Hz.
2) If height of structure to minimum lateral dimension ratio is greater than 5.
   = 61/8 = 7.625

Gust factor method is to be applied if either of the above criteria is satisfied. In this particular case both the criteria are met with.

Results:-

The comparative results for values of various terms/ equations for the above used in gust factor method are presented in the table below.

Sr. No	IS 875: 2015	IS 875 DRAFT CODE:2007	AUSTRALIAN CODE AS 1170-2: 2002
1)	**I_h- Turbulence Intensity @ ht.=h**		
	0.177	0.183	0.183
2)	**g_v- Peak factor for upwind velocity**		
	3- for category I and II 4- for category III and IV	3.5	3.7
3)	**B_s- Background factor**		
	0.8086	0.4580	0.8086
4)	**s- Level at which effects are to be determined**		
	0	0	0
5)	**b_{sh}-**		
	Average breadth of structure between s and h= 8m	Average breadth of structure between s and h= 8m	Average breadth of structure between s and h= 8m
6)	**L_h- Effective turbulence at ht.= h**		
	133.64	157.22	133.64
7)	**H_s- Height factor for resonant response**		
	1	1	1
8)	**G_R- Peak factor for resonant response**		
	3.88	3.88	3.387
9)	**S- Size reduction factor**		
	0.148	0.073	0.079
10)	**E- Spectrum of turbulence**		
	0.054	0.035	0.038
11)	**β- Ratio of structural damping to critical damping**		
	0.02	0.02	0.05
12)	**N- Effective reduced frequency**		
	2.15	4.15	3.61
13)	**Gust factor- G or C_{dyn}**		
	2.885	**0.879**	**0.958**
14)	**F_z (KN)**		
	54.52	**16.61**	**18.11**

Conclusion:-

1. The results clearly show that the values of G in the Australian code and Indian draft code are in sync with each other. While the values obtained from the Indian standard are almost 3 times the values obtained from Indian draft and Australian code
2. The values for F_z also show an increase of about 3 times in the Indian standard code over the values obtained from draft and Australian code.
3. There is no justification provided in the code on why the values of G differ so much in comparison to the draft code and Australian code. When the equations in the IS 875: 2015 seems to be adopted from them.
4. From the results it is clear that it is rational to use the Gust factor method and the equations thereof as mentioned in the draft code or Australian code.

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1. IS 875 PART III: 2015- Design loads (Other than Earthquake) for buildings and structures- Code of Practice
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3. AUSTRALIAN/ NEW ZEALAND STANDARDS AS NZS 1170-2: 2002- Structural design actions, part II- Wind actions.
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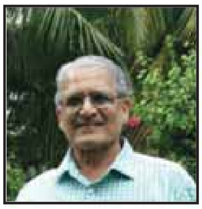

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News and Events during Oct – Dec 2018

4 and 5 Oct 2018 : National Building code 2016 workshop at Indian Institute of Technology , Bombay.

Institution of Engineers India Maharashtra Centre in association with Indian Institute of Technology , Bombay and Bureau of Indian Standards organized two days workshop on National Building code of India 2016 and revised seismic codes.

Mr. Sanjay Pant, Director(Civil) BIS provided overview of all the sections of NBC2016. Mr. Shashikant Jadhav gave information on development control regulations as per section 2. Mr. Sandip Goel talked on Fire safety aspects as given in section 3. Mr. Jose Kurian elaborated on Construction Management Practices and safety. On the second day Prof. Ravi Sinha discussed modelling and analysis issue on IS1893. He emphasised that true behaviour of the structure can be captured only if we try to simulate actual structure like stairs, water tanks, cut-outs in the slabs. He also cautioned that , flexible or rigid diaphragm option to be used carefully by the users considering actual configuration and openings in

the slab. Weak connection between two wings of the building if modelled using rigid diaphragm option will lead to erroneous results. Prof. CVR Murthy discussed some of the clauses of IS1893 and IS13920. Ms Alpa Sheth talked on provisions of new high rise building code IS16700. Dr. Anand Katti emphasised on importance of geotechnical investigations. He expressed concern about quality of investigations and samples collected by unskilled persons at site. Programme was attended by civil engineers in large number.

31 Oct 2018 : STEEL DAY 2018 celebrated in Mumbai.

The theme was "Steel Construction - Challenges & Solutions". This summit highlighted the advantages and applicability of steel in buildings, bridges, and industrial plant construction. The main objective of this gathering was to showcase the design, engineering and fabrication capabilities of steel construction through presentations, case studies and panel discussions.

2 Nov 2018 : ISSE Lecture on Challenges in Basement construction at Mumbai

Indian Society of Structural engineers arranged a lecture on Challenges in basement construction. In all metro cities, buildings are having multiple level basement for parking and services requirements. With the increasing depth of excavation, stability of adjacent structures becomes critical. In the recent past, there were mishaps during the basement construction due to failure of shoring system. Prof. G B Chaudhary eminent geotechnical consultant explained safety aspects and precautions to be taken during basement construction with the help of case studies. About 200 engineers attended the function.

Dr. N V Nayak felicitating Prof. G B Chaudhary

Prof. G B Chaudhary talking on the subject

15 -17 Nov 2018 DFI-India 2018 : 8th Conference on Deep Foundation Technologies for Infrastructure Development in India was held at IIT Gandhinagar

17 Nov 2018 : ISSE Pune Seminar on revised Seismic codes

Seminar on "Revised Codes IS:1893(Part 1)-2016, IS:13920-2016

IS:16700–2017 & its implementation" was arranged by Indian Society of Structural Engineers (ISSE)

Prof. C V R Murthy during presentation

Pune on17 Nov 2018. The seminar was arranged at PYC hall, Pune. The response for the seminar was overwhelming. For the first time in Pune, more than 375+ structural engineers from Pune, Solapur, Satara, Mumbai, Kolhapur, Aurangabad attended it.

Eminent IIT Professor and Director of IIT Jodhpur Prof. C.V.R. Murty and Er. Ranjith Chandunni (Committee Member, CED 38:5)were invited for the presentation on IS :1893, IS: 13920 and IS: 16700 respectively. Er. Rajiv Sharma (CSI, Delhi), Er. Vishwas Date (Director, SCube) were also invited for the panel discussion.

ISSE Pune center secretary Er. Kishor Jain welcomed the delegates, followed by brief about ISSE and program details by ISSE Pune chairman Er. Dhairyashil Khairepatil.

Prof. Murthy in his excellent presentation on IS 1893 shared the views on revision made in the revised code expectations of the BIS. He strongly recommended and insisted to all the consultants on application of the code provisions in the design with compromising. Further heexplained in detail about the various building framing to be adopted to resist the earthquake forces and its behavior. He strongly imposed on adoption of strong column and weak beam concept. Addressing on the IS 13920 clauses he mentioned about major change as, it is now design and detailing.

Er. Ranjith Chandunniin his presentation explained about introduction of new code for tall buildings in India for first time. He shared few case study of tall buildings design by him along with analysis and design concepts to be followed. He also urge structural consultant to send their comments and quarries on this code.

The second part of the seminar begin with introduction of panelist by ISSE treasurer Er. Parag Deshpande .The panel discussion in form of Question and Answer session was conducted by ISSE chairman Pune Er. Dhairyashil Khairepatil and ISSE Pune MC members Er. Ajay Kadam on behalf ISSE Pune with panelist Prof Er. CVR Murty, Er. Rajiv Sharma,Er. Ranjith Chandunni, Er. Vishwas Date. About 50+ question related to practical problems of structural analysis due to present architectural practice, building with different shapes, opening in building, sizing of structural members, contribution of shear walls, torsion in the building, RC frames building with unreinforced masonry infill walls, PT construction, floating columns, foundations, software limitations, etc were addressed by the panelist. Er. Prof. Murthy strongly address on, avoiding floating columns, provisions of shear walls in both directions, building plan in shape without corner cuts and preferably should be rectangular in shape.

In the concluding remarks Prof. Murthy requested structural engineer, association and senior members to contribution in the code writing.

Er. Milinda Mahajan proposed a vote of thanks. Program was well appreciated by the structural consultants.

Panel Discussion

22 Nov 2018 : The 79th Annual Session of Indian Road Congress (IRC) was held at the historic city of Nagpur. It was attended by dignitaries from practicing consulting engineers, contractors and Engineers from Government Departments. Hon. Central Minister Nitin Gadkari addressed the gathering.

6 Dec 2018 : News in Maharashtra times regarding ISSE Demand for state level single point registration of Structural Engineers.

राज्य पातळीवर एकदाच नोंदणी करा

सोशल नेटवर्किंग

स्ट्रक्चरल इंजिनीअरची मागणी

तुमचे उपक्रम कळवा

CEMCON2018 : 7-8 Dec 2018 at Pune
National Conference on Defect Free construction - Emerging Technologies and Materials was held at Pune.

14-15 Dec 2018 : International conference on Advances in Science and Technology of concrete by India Chapter of American Concrete Institute held at Mumbai.
Galaxy of International experts participated in the conference on concrete. Experts from USA, Europe, China, India and other countries participated and made presentations. To mention a few stalwarts like Dr. Surendra Shah,Prof. Ravindra Gettu, Prof. Venkatesh Kodur, Dr. V. M. Malhotra, Dr. Nemkumar Banthia, Muhammed Basheer, Dr. S.K. Ghosh addressed the gathering. Various topics like high performance concrete, repair and rehabilitation of concrete structures, fire damaged structures, sustainable concrete, durability parameters, various tests on concrete, ACI562 Evaluation and assessment of repair and ACI563 Repair specifications were discussed. Deliberations were conducted in four parallel sessions for two days. More than 50 presentations were made by experts during the conference. Proceedings of the conference was published in the form of three printed volumes. More than 550 delegates attended the conference.

20-22 Dec 2018 : Symposium on Earthquake Engineering
The 16th Symposium on Earthquake Engineering was held at Department of Earthquake Engineering IIT Roorkee. Many technical papers were presented by national and international experts. This Symposium provided a platform for researchers, professionals, planners and policy makers associated with Earthquake Engineering to share their views and opinions.
About 350 delegates attended the event. For further details please visit https://www.iitr.ac.in/16see/

New team of office bearers at ISSE HQ has been elected.

We appeal to all our members to actively participate in the activities of ISSE. Join us in conducting the seminars, provide technical write up for journal, bring up the issues faced by Structural and civil Engineers and suggest solutions, get more life members to ISSE for strengthening the institution, help us in getting advertisements and sponsors. All members are requested to update their address, telephone and email by sending mail to issemumbai@gmail.com or issehq@hotmail.com

President – Shantilal Jain

Secretary- Hemant Vadalkar

Treasurer – Manasi Nandgaonkar

ISSE Team wishes Happy New Year to all our members !!!!

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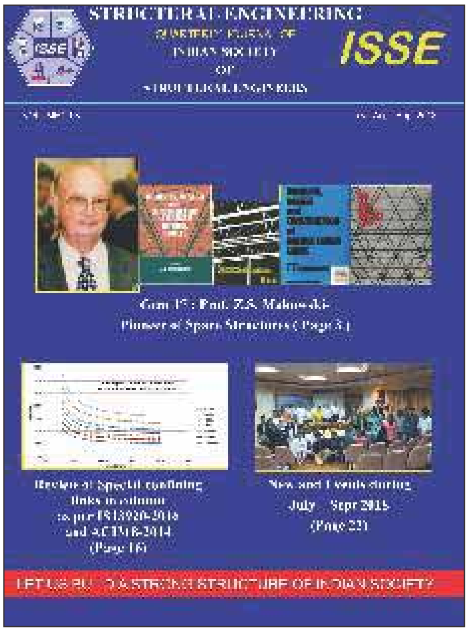
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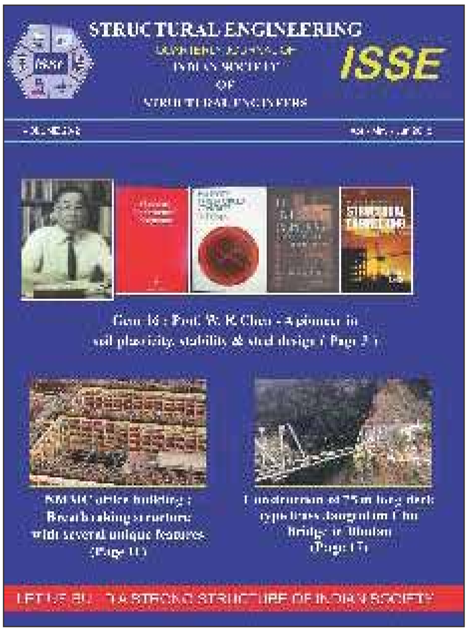
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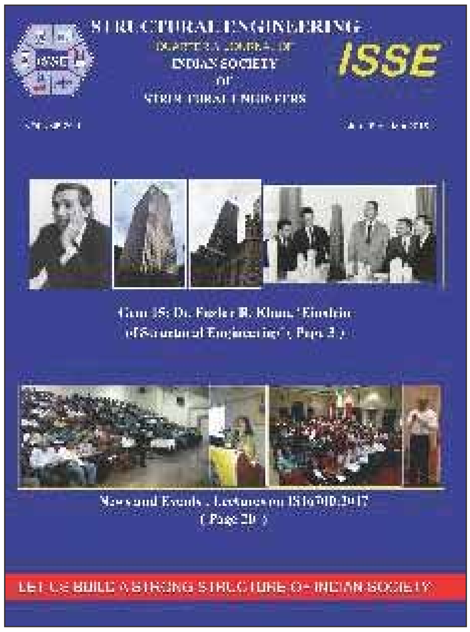
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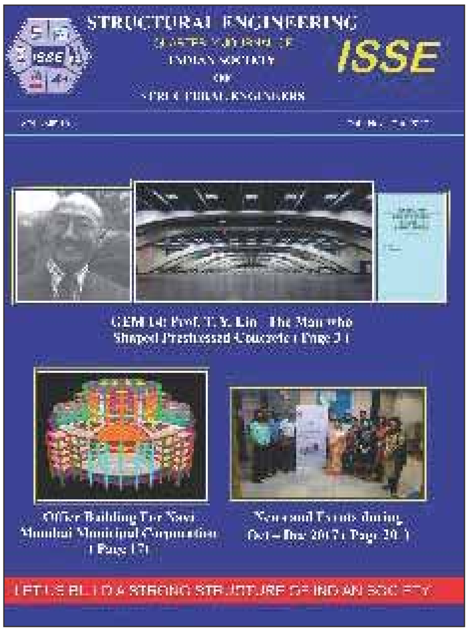
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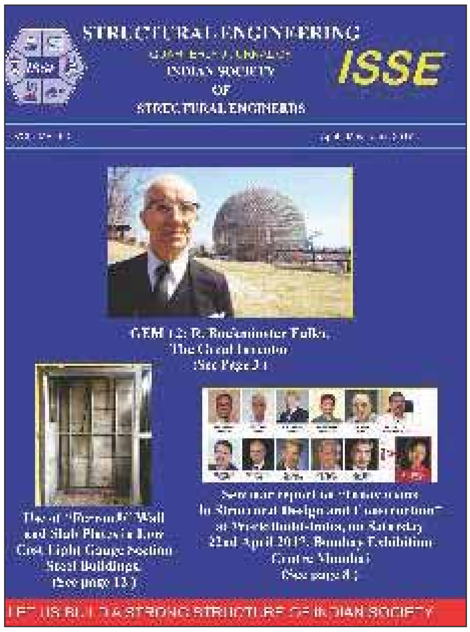
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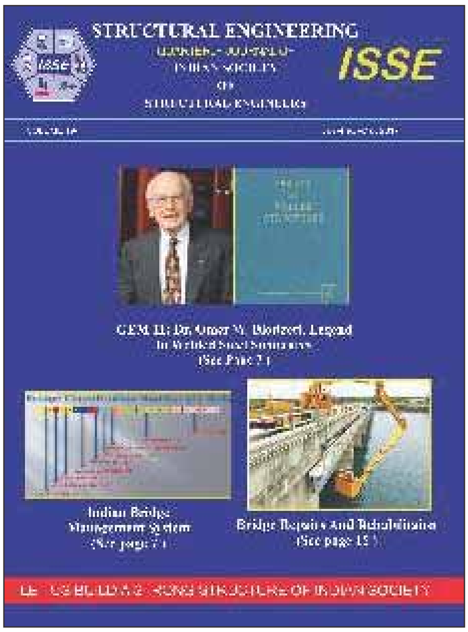
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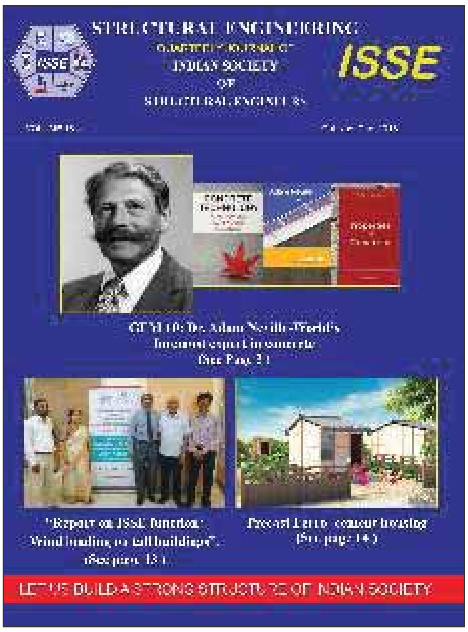
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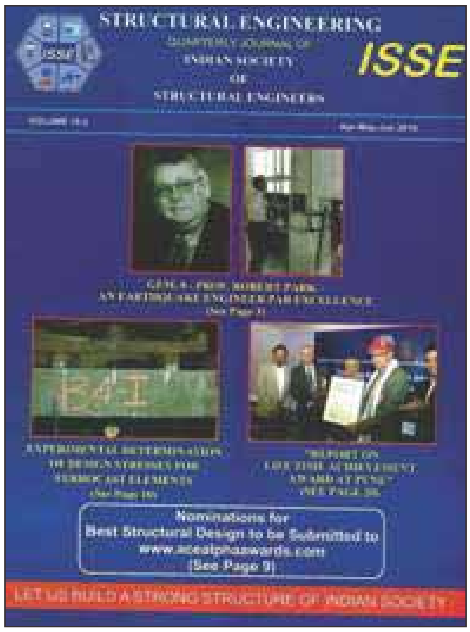
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