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STRUCTURAL ENGINEERS

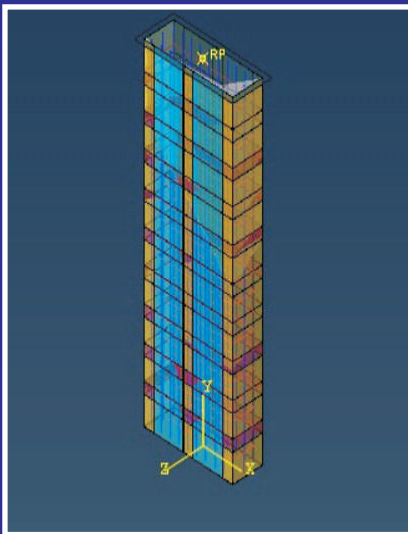
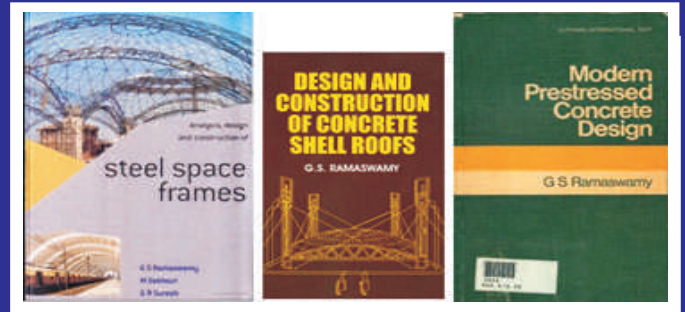
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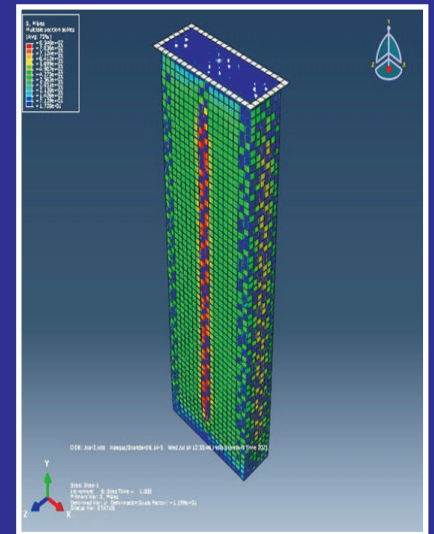
JAN - FEB - MAR 2022



GEM 31
PROF. G. S. RAMASWAMY-
FOUNDER DIRECTOR OF
SERC AND RESEARCHER ON
SHELL AND SPATIAL
STRUCTURES - see page 3



PERFORMANCE OF RCC WALLS
OF HIGH ASPECT RATIO WITH
ACTIVE METHOD OF CFRP
BAND PRESTRESS
- see page 11



HIGHER STUDIES ABROAD – VEDANG VADALKAR see page - 14

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STRUCTURAL ENGINEERS



INDIAN SOCIETY OF STRUCTURAL ENGINEERS

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1. To restore the desired status to the Structural Engineer in construction industry and to create awareness about the profession.
2. To define Boundaries of Responsibilities of Structural Engineer, commensurate with remuneration.
3. To get easy registration with Governments, Corporations and similar organizations all over India, for our members.
4. To reformulate Certification policies adopted by various authorities, to remove anomalies.
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GEM 31 PROF. G. S. RAMASWAMY- FOUNDER DIRECTOR OF SERC AND RESEARCHER ON SHELL AND SPATIAL STRUCTURES

By Dr. N. Subramanian



Prof. G.S. Ramaswamy (1923-2002)

Prof. Guruvayur Subramanian Ramaswamy, was the founder Director of the CSIR Structural Engineering Research Centre, and has done original research on shell and spatial structures. He initiated research on several areas in structural engineering as the director of SERC, and wrote several research papers and three notable books.

EARLY LIFE AND STUDIES

Born on 3 October 1923, GSR, as he was fondly addressed, had his early education in Trichur and joined the College of Engineering, Guindy, (now in Chennai) from where he took his B.E. degree with Honours in 1944. He then travelled to the USA and joined the California Institute of Technology, and earned his M.S. as well as C.E. degrees in 1948.

RESEARCH STARTED AT ANNAMALAI UNIVERSITY

On his return from USA, he was appointed professor and head of the Department of Civil Engineering at the Annamalai University, Chidambaram, Tamil Nadu, when he was only 26 years old. He served as Professor in the Department of Civil Engineering during 1948-1956. Prof. G.S. Ramaswamy initiated an early research on prestressing systems by guiding a post graduate thesis on prestressed

segmental stone beam in the year 1954. This beam consisted of 19 numbers of granite stone blocks of size 305 mm × 305 mm with a drilled hole of 125 mm diameter. The thickness of each block was 110 mm with a mortar thickness of 25 mm. Reinforced concrete block of size 355 mm × 305 mm and length 305 mm equal to the depth of the beam was provided at each end. Freyssinet anchorage consisting of Male and female conical wedges were used for post-tensioning. The Freyssinet system used for post tensioning was brought to the laboratory from the nearby Coleroon (kollidam) river bridge construction site. This stone beam is still preserved as a monument in the Annamalai University in the memory of Prof. G.S. Ramaswamy. The M.E. student who did this thesis is none other than (late) Prof. Srinivasagopalan, who later served in Thiagarajar college of Engineering as Professor, and then as Special officer, Dr. M.G.R. Educational and Research Institute (Dr. M.G.R. University).



The first M.E. (Structural Engineering) thesis specimen on prestressed segmental stone beam in the year 1954, preserved at Annamalai University, Chidambaram, Tamil Nadu (Photo Courtesy: Er M. Durai)

A two year post graduate course in structural Engineering (M.Sc. Structural Engineering) was introduced for the first time in the country by Prof. G.S. Ramaswamy in the year 1953 at Annamalai University.

WORK AT CENTRAL GOVERNMENT RESEARCH INSTITUTIONS

After serving the university for about eight years, he joined the Central Building Research Institute, Roorkee in 1956 as the Head of the Structures Division. During his tenure that lasted for nearly nine years, GSR carried out spectacular R&D projects that earned him universal acclaim and several awards. The technology developed by his group for a unique cost saving flooring scheme involving the use of concrete funicular shells was adopted in the construction of thousands of buildings in India and abroad. It was due to GSR's efforts that the currently popular twisted, concrete-reinforcing steel bars (on which he took a patent) gained acceptance in the country in the early seventies. According to SERC website, this patent on Grip Bars, passed over to the Tata Iron & Steel Company for commercial exploitation, fetched a royalty of Rs. 100 Thousands during the year 1970 [At 2014 rates, the cumulative royalties earned from this single license for CSIR during the period 1970-1984 would roughly amount to a whopping Rs. 30 Millions!].

ESTABLISHMENT OF THE STRUCTURAL ENGINEERING RESEARCH CENTER



Honorable Minister Bharat Ratna Shri. C. Subramaniam is seen overjoyed after unveiling the Foundation stone of CSIR Campus at Taramani in the August presence of His Excellency Shri K.K. Shah, Governor of Tamil Nadu, Dr Atma Ram, Director General CSIR and Prof. GSR, Director, SERC

On 10th June 1965, he founded the Structural Engineering Research Centre (SERC) at Roorkee, whose headquarters later moved to Chennai in 1974. As the Director of SERC and the Coordinating Director of CSIR campus from 1965 to 1976, he initiated pioneering research in a number of disciplines in structural engineering which made him and SERC well-known in national and international circuits. GSR's far-sighted vision enabled the setting up of several advanced laboratories and facilities, including the tower testing station at Pallavaram, which is among the best in the world.



**Honorable Minister Bharat Ratna
Shri. C. Subramaniam speaking after unveiling
the Foundation stone of CSIR Campus at Taramani**

GSR served as the UN Chief Technical Advisor, to Government of Trinidad and Tobago; UN Advisor to the Government of Iraq; UN Advisor to the Deputy Minister of Transportation, Saudi Arabia; also Visiting Professor, University of West Indies and University of Arizona, USA.

He trained and guided many young scientists and engineers presently occupying high offices in India and abroad. He authored several books which have become reference books on the respective topics. Prof. Ramaswamy's main contributions were in concrete shell roofs. His most outstanding contribution to concrete shells was the development of the funicular shell which needed no reinforcement.

OTHER CONTRIBUTIONS

Prof. Ramaswamy was largely responsible for setting up the Structural Engineering Research Centre of CSIR, Building Research Centre, Baghdad and Caribbean Industrial Research Institute, Trinidad from their conceptual stages. Most of the buildings in SERC were conceived by him and contained shell elements, designed by him; Examples are the Concrete Testing Laboratory (CTL) building and the Heavy testing laboratory, which has the funicular brick shell roof. He was Member of the International Advisory Board, International Association for Shells and Spatial Structures, Madrid; and Indian National Science Academy (INSA) Council (1975-77). He also served in several BIS committees. He chaired several committees constituted by the State and Central governments of India.



Honorable Minister Bharat Ratna Shri. C. Subramaniam inspecting the prestressed concrete sleepers being developed at SERC



Prof. GSR showing the laboratory facilities at SERC to Honorable Minister Bharat Ratna Shri. C. Subramaniam



Several examples of shell and spatial structures at SERC, developed under the guidance of Prof. GSR (a) Funicular shell roof for the Concrete Testing Laboratory (CTL) building, (b) A 12.2m-diameter modified Füller dome made of light aluminium alloy tubes, and a 21 m tall mushroom-shaped water tank of 140000-litre capacity, designed as a hyperboloid of revolution



Prof. GSR with other scientists of SERC, Dr Ramaiah and Dr Venkateswarlu

Prof. G.S. Ramaswamy also acted as external examiner to Ph.D. students at different universities in the world.

PRIVATE PRACTICE

After his retirement from SERC, Prof. G.S. Ramaswamy started his own consultancy practice Civil Engineering Consultancy Consortium (CECC) at Chennai. As consultants to the Nagarjuna Coated Tubes Ltd (NCTL), CECC did the conceptual and preliminary design for the steel space frame roof over the Al Wahda sports hall at Abu Dhabi. The final design was done at Prof. Eekhout's office at Delft and the proprietary Tuball Nodes were supplied by Octatube Space Structures BV, The Netherlands, headed by Prof. Eekhout. The tubes were fabricated

at NCTL at Hyderabad and shipped to Dubai. Based on this work, the Consortium won several contracts in the United Arab Emirates. Some of these projects are presented as case studies in his book on Steel Space Frames. CECC also designed some roofs of the Metro Stations at Chennai.

BOOKS AND PAPERS PUBLISHED

Prof. Ramaswamy published three notable books:

1. Ramaswamy, G. S., Eekhout, M. and Suresh, G. R., Analysis, Design and Construction of Steel Space Frames, Thomas Telford Publishing Limited, UK, 2002, 350 pp.
2. Ramaswamy, G. S., Modern Prestressed Concrete Design, Pitman Publishing Limited, London, 1976, 175 pp.
3. Ramaswamy, G. S., Design and Construction of Concrete Shell Roofs, McGraw-Hill Book Company, USA, 1968, 2nd Edition, Krieger, 1984), 745 pp.

His outstanding book Design and Construction of Concrete Shell Roofs is considered as a classic reference on Shell roofs all over the world. His book on Steel Space Frames was coauthored with Prof. Mick Eekhout, professor of product design at the Technical University of Delft, Netherlands and Prof. GSR's son Er. G.R. Suresh.



In addition, he wrote numerous papers in National and International journals and chaired several sessions in National and International Conferences. Some of his notable papers are listed below:

1. Ramaswamy, G.S. and Chetty, S.M.K. (1960) A New Form of Doubly-curved Shell for Roofs and Floors, Bulletin of the International Association for Shell and Spatial Structures, Vol.1, pp. 49-56.
2. Ramaswamy, G.S., N.V. Raman and Zacharia George (1961) "A Doubly-Curved funicular shell roof for a cement store", The Indian Concrete Journal, Jan., pp. 20-23.
3. Singh, S. and Ramaswamy, G. S. (1972) A sector element for thin plate flexure International Journal for Numerical Methods in Engineering, 4 (1). pp. 133-142.
4. Bhattacharya and G. S Ramaswamy (1978) "Analysis of funicular shells by the finite element method," Journal of Structural Engineering, Oct., pp 158-164.
5. Ramaswamy, G. S. (1978) New frontiers in building technology Architectural Science Review, 21 (1-2). pp. 42-43.
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8. Surya Prakash , N. and Ramaswamy, G. S. (1999), Formex configuration processing for a multi-layered long span aircraft hangar International Journal of Space Structures, 14 (3). pp. 225-232.
9. Ramaswamy, G. S. (1999) Review of recent trends in the planning, analysis, design and construction of space frame roofs for aircraft hangars, International Journal of Space Structures, 14 (3). pp. 159-166.

He was a sought after speaker in many forums and has given lectures on several structural engineering topics including shells, space frames, and prestressed concrete structures. Prof. S. Rajasekaran of PSG Tech, who worked with Prof. GSR on many occasions (Prof. Rajasekaran has contributed an invited chapter to GSR's book on Steel Space Frames, and investigated the failure of a shell roof at Madurai Cathedral in 1985 along with Prof. GSR) says that Prof. GSR was always wanted to learn new topics from anyone, even when he past prime age, and asked Prof. Rajasekaran to enlighten him about neural networks.

AWARDS AND HONOURS

Professor Ramaswamy was recipient of the Indian Merchant's Chamber Diamond Jubilee Award; Invention Promotion Board Award; Invention Promotion Shield; and Gammon Award by Institution of Engineers (India). He was elected as Fellow of the Indian Academy of Sciences, Bangalore and Fellow of the Indian National Academy of Engineering in 1972.

He was a member of several professional bodies including the International Association for Shell and Spatial Structures (IASS), the American Concrete Institute and the Institution of Engineers (India).



Prof. G.S. Ramaswamy, founder Director of SERC receiving Memento from Dr R.A. Mashelkar, DG CSIR in 1996

Family and other Information

Professor Ramaswamy had immense interest in literature and fine arts. He was a prolific writer and a great orator. Even a few hours prior to his passing away, he was preparing notes for his next technical book. He passed away peacefully at his residence in Chennai on 9 March 2002. Prof. GSR left behind his wife, a daughter and two sons. With his passing away, the scientific world and the structural engineering profession have lost an outstanding and eminent scientist-cum-consultant.

After his death, SERC established the Professor G.S. Ramaswamy Internship for Undergraduate/ Dual degree students in honor of its founder Director, and this internship is awarded to 10 students every year for duration of 6-8 weeks. Professor G.S. Ramaswamy Memorial lectures are also being organized at SERC from 2003 and are delivered by eminent personalities.

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1. CSIR-SERC Golden-Legacy.pdf (<http://rpsonline.com.sg/proceedings/9789810911393/html/Golden-Legacy.pdf>)
2. Parameswaran, V.S., "Personal News- G.S. Ramaswamy", Current Science, Vol. 83, No. 3, 10 Aug. 2002, pp.330
3. <https://www.sefindia.org/forum/viewtopic.php?t=8425>

About The Author



Dr. N. Subramanian, Ph.D., FNAE is an award winning Author, Structural Engineering consultant and Mentor, currently based at Maryland, USA, with over 45 years of experience in Industry (including consultancy, research and teaching). He was awarded with a 'Life Time Achievement Award' by the Indian Concrete Institute and many other awards for his contributions towards Structural Engineering. He is the author of 26 books, including the famous books on 'Design of Steel Structures', 'Design of RC Structures' and 'Principles of Space Structures' and the recent Building Materials, Testing and Sustainability. (email- drnsmani@yahoo.com)

PERFORMANCE OF RCC WALLS OF HIGH ASPECT RATIO WITH ACTIVE METHOD OF CFRP BAND PRESTRESS

By Dr. Gopal Rai, Mr. Saurabh Samant, Nasrin Shaikh

1. Introduction

Strengthening of existing concrete structure due to increment in designed load, deterioration in concrete structures, corrosion of rebars etc are being carried out using traditional methods of RCC jacketing, steel plate jacketing, externally bonded steel plates and using composite laminates.

In composite laminate system, strengthening of axially loaded structural members is achieved by confinement with FRP materials. In this non-conventional method of strengthening, the Fibers are oriented in transverse direction to the longitudinal axis for confinement. This confinement significantly improves the performance under axial loads, shear and bending. However, the effect of FRP confinement is highly dependent on the shape of concrete member. The FRP confinement is most effective for a circular column, while in the rectangular column, the effectiveness of fiber confinement reduces because the stress induced in the fibers are concentrated at the corners and also the increment in the aspect ratio of column plays the vital role. This study discusses about the role of aspect ratio in the effectiveness of rehabilitation of axial loaded concrete structure using fiber laminates.

2. Limitations of existing study available

With the evolution of high-rise buildings in recent past, structural engineers have been relying on use of RCC walls which act as primary lateral load resisting system. These RCC walls considerably large aspect ratios i.e more than 2. Although strengthening of structural members subjected to

axial forces and bending are well covered in ACI 447-2R and other international codes, there are limitations in the code which prevent the use of FRP confinement for large aspect ratio RCC walls.

Below Table 1 summarizes the various codes which includes the limitations on the aspect ratio for confinement of axial load carrying structural members.

Table 1: Comparison of various codes and its limitations [2]

Standard/Guideline	Loading Condition	Limitations
ACI 440.2R-17	Pure axial compression Combined axial compression and bending	Non Circular cross section: $h/b \leq 2.0$ or $b \leq 900$ mm
S806-12	Combined axial compression and bending	Non Circular cross section: $h/b \leq 1.5$, corner radius, $R \geq 20$ mm
CNR-DT 200 R1/2013	Pure axial compression Combined axial compression and bending	Non Circular cross section: $h/b \leq 2.0$ or $b \leq 900$ mm
GB 50608 - 2010	Combined axial compression and bending	Non Circular cross section: $h/b \leq 1.5$; h or $b \leq 600$ mm; corner radius, $R \geq 20$ mm
DAFStb - Guideline	Combined axial compression and bending	Circular only; $D \geq 120$ mm; column slenderness ≤ 40 ; maximum eccentricity ≤ 0.25 unconfined concrete strength ≤ 58 MPa

3. Active Method of Band prestressing of RCC walls

To cater to the requirement of industry designers and client for strengthening of shear walls with FRP confinement, this paper investigates the effectiveness of band prestressing of a 300mm thick RCC walls with higher aspect ratio. Band prestressing is an active method of prestressing where the shear walls are prestressed with carbon fiber reinforced polymer (CFRP) bands using aluminum anchor plates to restore the strength of the RCC wall to an acceptable level.

Typically, the CFRP bands have a tensile strength of 3800 MPa. In passive mode of confinement, the tensile strength of 600-900 MPa is used for design. In active mode of confinement, these CFRP bands are prestressed by min 25% [4] thereby increasing the tensile strength of the CFRP bands by 25-50%. Table 2 below summaries typical properties of the CFRP band in non-prestressed state.

Table 2: Properties of CFRP Band in Non-Prestressed State

CFRP Band Properties	
Composite Thickness (mm)	0.9-1.33
Elastic modulus (GPa)	60-95
Ultimate elongation	1.80%
Density (g/cm ³)	1.8

4. Proposed Analytical approach for Walls with CFRP Band Prestress

4.1 Consideration for Material Parameters

4.1.1 Concrete

Concrete is modelled using built in concrete-damage plasticity model provided by ABAQUS. The stress-strain relationship under uniaxial compression is plotted using the design stress strain curve of IS 456:2000 which is based on model from Hognestad et al. The equation is presented below:

$$f_c = \left\{ 0.447 f_{ck} \left[2 \left(\frac{\varepsilon}{0.002} \right) - \left(\frac{\varepsilon}{0.002} \right)^2 \right] \right\} \text{ for } \varepsilon < 0.002$$

$$f_c = \{ 0.447 f_{ck} \} \text{ for } 0.002 \leq \varepsilon \leq 0.0035$$

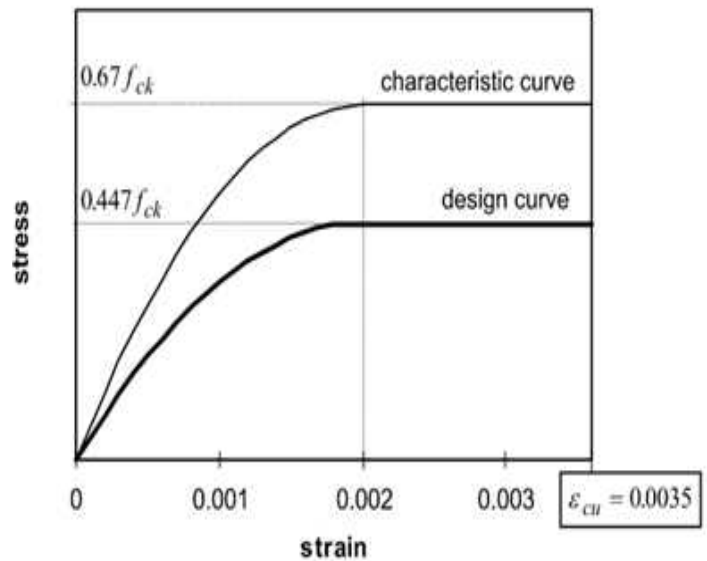


Fig 1: Design stress strain curve for concrete

The tensile behavior of concrete is modelled in a tri-linear manner. Tensile stress-strain curve starts as a linear elastic upto tensile rupture (f_t). Upon reaching tensile strength, stress is reduced to 40% of f_t and then followed by linear descending curve up to 0.01 MPa. The tensile strength f_t is taken as per equation below:

$$f_t = 0.7 \sqrt{f_{ck}} \text{ MPa}$$

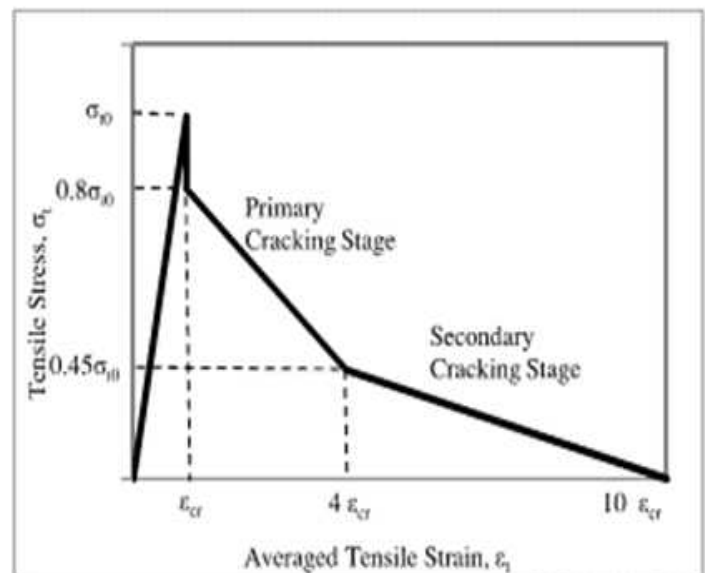


Fig 2: Design stress strain curve for concrete in tension

4.1.2 Steel Reinforcement

The stress-strain behavior of steel reinforcement is taken as design stress strain curve as per IS 456:2000. Steel reinforcement grade of Fe500 is used in the numerical analysis.

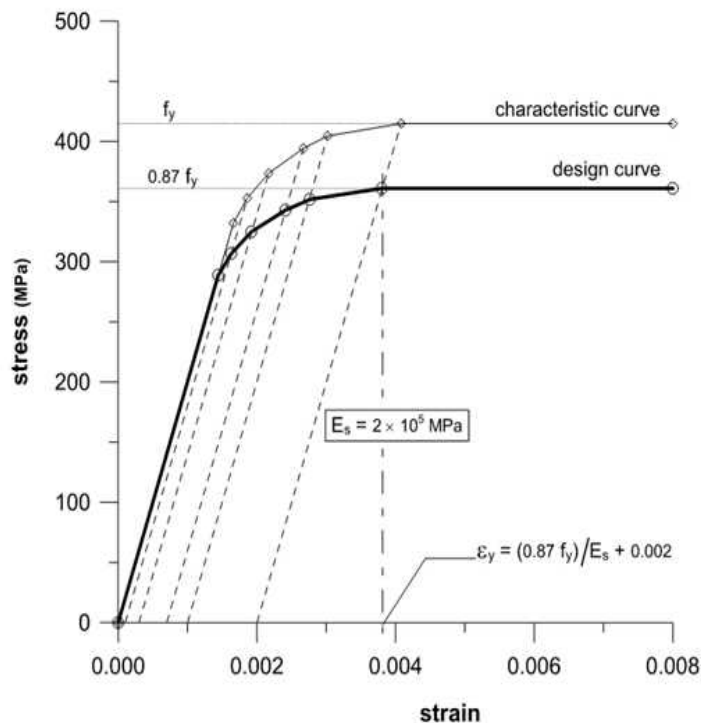


Fig 3: Design stress strain curve for steel reinforcement

4.2 Specimen and Strengthening procedure

In this study, numerical investigation is done on the effect of band prestressing on the load carrying capacity of RCC walls with high aspect ratio. Commercially available and widely accepted FE software ABAQUS is used to study RCC wall subjected to axial loading.

3 RCC wall specimens are analyzed with band prestress. Initially 3 layers of vertical bands are provided in each specimen followed by horizontal prestressed bands at 300mm spacing. The remaining portion is provided with 1 layer of non-prestressed CFRP sheets.

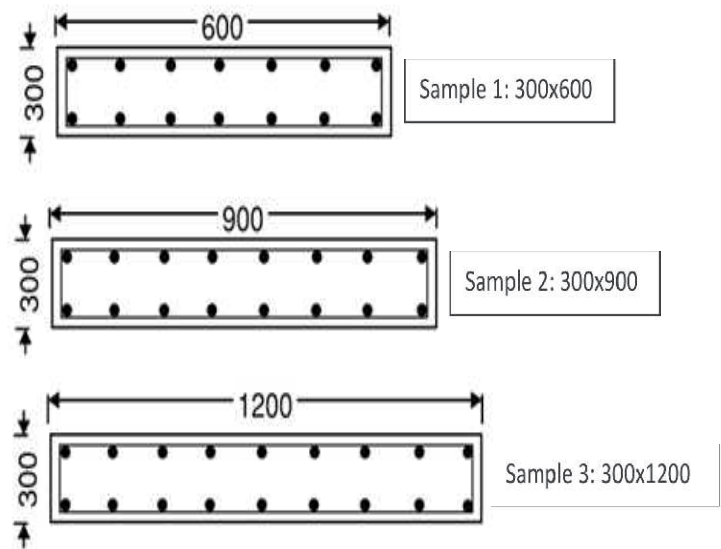


Fig 4: Diagram showing column sizes used in the analytical study

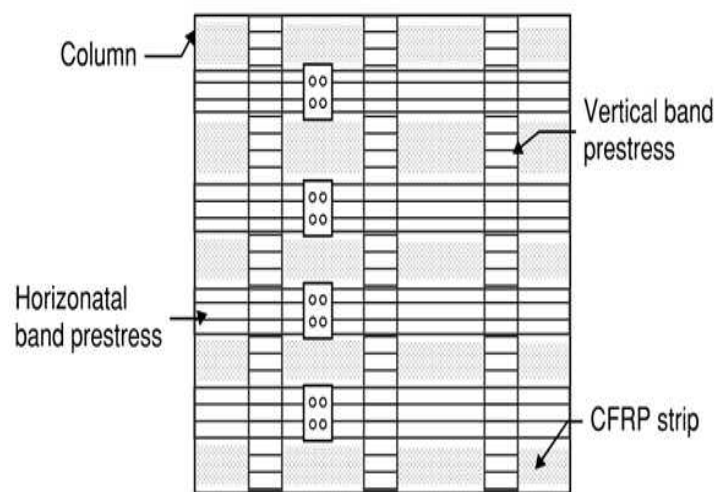


Fig 5: Typical elevation of column with band prestress

Table 2: Geometrical properties of RCC column specimen analysed after band prestressing

Specimen	Grade	Size (mm)	Rebar
Sample 1	M30	300 x 600	8-T16
Sample 2	M30	300 x 900	8-T20
Sample 3	M30	300 x 1200	10-T32

4.3 Analytical Modelling in FEM

Three-dimensional analysis of axially loaded RCC wall with high aspect ratio confined with band prestressing is conducted using CDP model available in ABAQUS software. A 3D hexahedral element of eight node (C3D8) is used for modelling concrete wall. 3D tie element with 2 nodes (T3D2) element is utilized to model vertical reinforcement and stirrups. Interaction between concrete and steel reinforcement is modelled to represent full bond action. Full bond is also assumed between CFRP bands and concrete surface. A rigid plate the top is used for uniform distribution of axially applied load. The model is analyzed using a displacement control option and axial displacement is applied at center of rigid plate.

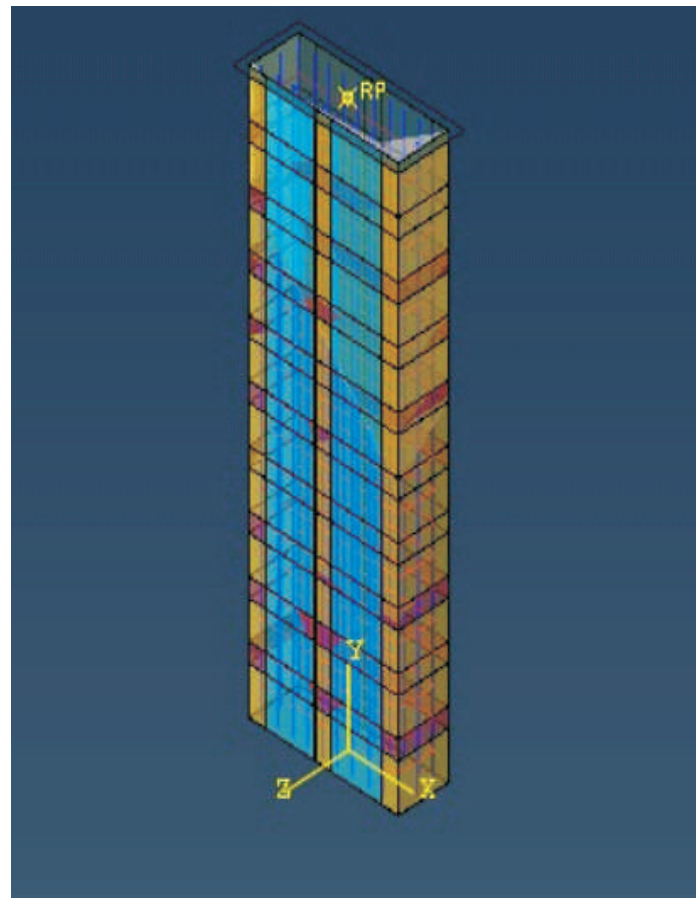


Fig 6: Typical model of RCC wall with band prestressing

5. Results and Discussion

The 3 specimens were analyzed. As a result of confinement with band prestressing, the load carrying capacity of column increases. Table 2 below summarizes the improvement in load carrying capacity of the column when band prestressed

Table 3: Peak Load carrying capacity of RCC specimen after band prestressing

Column Sample	Size (mm)	Load carrying capacity (kN)	Load carrying capacity after band prestressing (kN)	Percentage increase
Sample 1	300 x 600	2620	4341	65.6%
Sample 2	300 x 900	4540	7077	55.8%
Sample 3	300 x 1200	6650	9313	40.0%

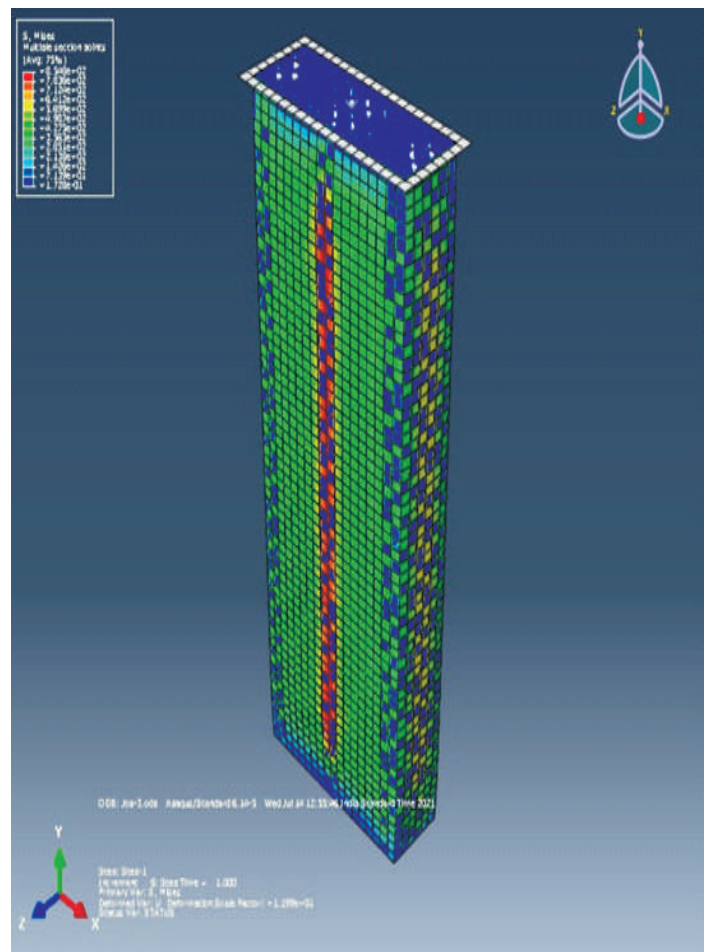


Fig 7: Figure showing von mises stress in RCC specimen with band prestress

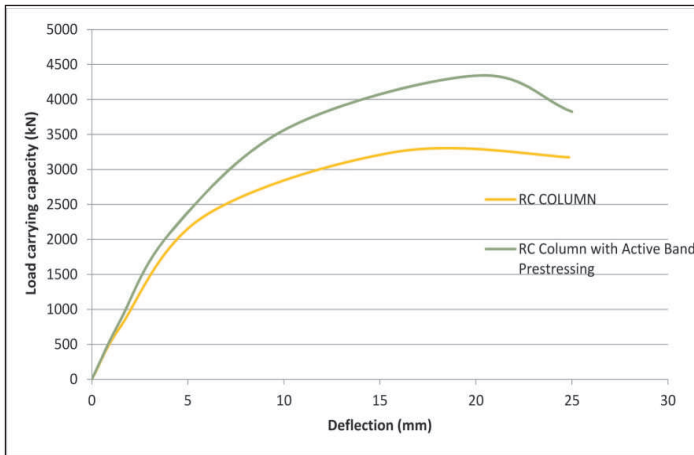


Fig 8: Load deflection plot of RCC Wall vs RCC Wall with Active Band Prestressing (Sample 1)

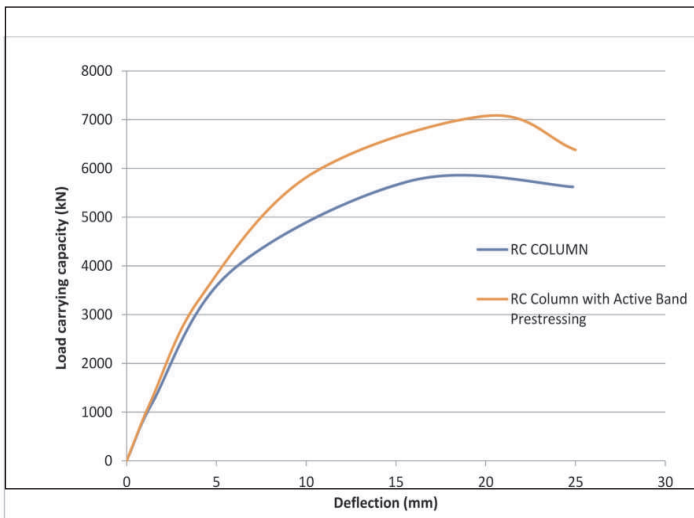


Fig 9: Load deflection plot of RCC wall vs RCC wall with Active Band Prestressing (Sample 2)

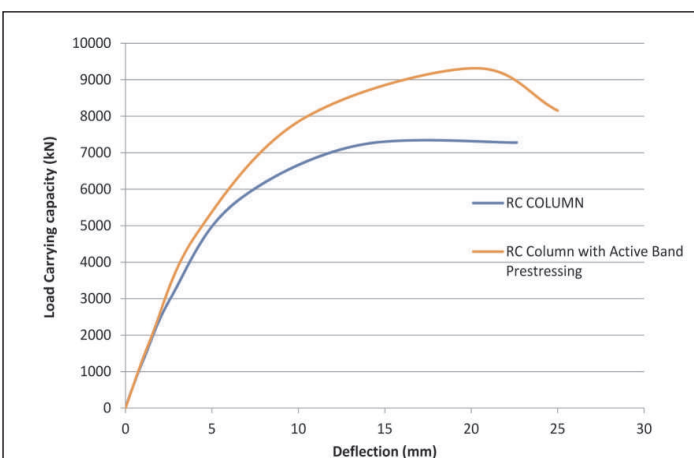


Fig 10: Load deflection plot of RCC wall vs RCC wall with Active Band Prestressing (Sample 3)

6. Conclusion

1. There was a significant increase of 40-65% in the peak load carrying capacity of the RCC walls after active band prestressing.
2. The peak load carrying capacity is found to be in decreasing as the aspect ratio of RCC wall increases.
3. Using active method of band prestressing is an optimized way to achieve peak load carrying capacity as it utilizes ultimate strength of CFRP.
4. With the advanced method of active band prestressing, the passive method of confinement is transformed to active method of confinement thereby achieving higher confining pressure and increase in peak load carry capacity.

7. Future Scope

This paper provides details on effective use of active method of CFRP band prestress for strengthening of RCC walls. It offers the advantage of utilizing the benefits of light weight non prestressed CFRP system with high efficiency offered by external prestressing. This method of prestressing can be used for strengthening of RCC walls of very high aspect ratio. This is an area of further research which can be further worked on.

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About the author :



Dr. Gopal Rai

Education Qualification :- Ph.d (IIT Bombay), Structural Engineer, MACI, MASTR, MIEI, MISSE, MIASE, MICJ

Designation: – CEO
(Dhirendra Group of Company)

Email : raigopal@gmail.com



Mr. Saurabh Samant

Education : M.Tech (IIT Madras), Civil (Structural Engineering)

Designation: Design Head
(DGC Engineering Pvt. Ltd.)



Nasrin Shaikh

Designation : Structural Design Engineer (DGC Engineering Pvt. Ltd.)

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HIGHER STUDIES ABROAD – 5

VEDANG VADALKAR

By Kirty Hemant Vadalkar

I started writing this series with an intention to help our new student friends, who wish to pursue higher studies abroad. There are many universities and many countries. Its difficult for the students to decide on the best university. Its confusing to find several options and to choose the best. Sometimes the profit making “consultants” are not very helpful. Sometimes the ticketing agents give wrong advice. I thought , I can address some of the problems through this series.

I tried to contact students from many universities from different countries, so that we get a first hand experience. In this final article, I will be talking about my own son who studied in the worlds best and renowned university, Stanford. I am also going to make an attempt to see this from a parent’s eye view.

Vedang was a brilliant student always, and was equally involved in various extra curricular activities. During school days, he passed many competitive exams. He is an avid traveler, an enthusiastic nature photographer , a player and a good writer. He completed his bachelor's degree in civil engineering from Mumbai university, in 2016. He worked in a structural consultancy for a year.

Vedang has graduated with a Master’s in Science (MSc) degree in Civil and Environmental Engineering with a specialization in Sustainable Design and Construction from Stanford University in California, USA.



While talking about the University , He says, “Covering 8,180 acres, Stanford has one of the

largest university campuses in the US. It is one of the best universities in the world offering a wide range of courses. Located 35 miles south of San Francisco and 20 miles north of San Jose, Stanford University is in the heart of Northern California’s dynamic Silicon Valley, home to Yahoo, Google, Hewlett-Packard, and many other cutting-edge tech companies that were founded by and continue to be led by Stanford alumni and faculty. Nicknamed the “billionaire factory”, it is said that if Stanford graduates formed their own country it would boast one of the world’s largest ten economies.”

The Sustainable Design and Construction program is a specialization offered by the Civil and Environmental Engineering Department. It prepares students for careers in the built environment: researching, designing, building, and managing sustainable buildings and infrastructure to maximize their life cycle economic value as well as their net contribution to environmental and social functions and services. Core and elective classes cover topics covering cutting-edge information technology such as sensor networks embedded in “intelligent” buildings and infrastructure, micro and macro strategy on infrastructure development across the globe as well as entrepreneurship and organization design for new businesses, and corporate or governmental initiatives aimed at enhancing the sustainability of the built environment. Employers of past SDC graduates include architectural and engineering design firms, general contractors across a range of sizes and geographies, design-build firms and developers focused on delivering green buildings and infrastructure; energy and sustainability consultants; facility management and sustainability departments within large companies; clean-tech startups and venture funds. Several students have also targeted opportunities in the AEC industry by launching their own business directly out of the SDC program.

While talking about his admission process he says, "In my opinion, no coaching classes are necessary for any of the entrance exams in general. I did not attend any classes or counselor sessions for my applications. Currently, most of the universities are offering admissions without entrance exam requirements due to COVID-19. In general GRE and TOEFL/IELTS are easy and just test your basic aptitude and knowledge. Use 5Lb. book for GRE and with dedicated practice, it is very easy to get a decent score." he too got a good score.

About getting into Stanford, he says, "I adopted a very systematic approach for my entrance exams preparation and shortlisting of universities. Research is a crucial part of the application process. Research all the programs and universities in-depth. Talk to students already admitted to the programs you like and get a feel of what it is to be studying at that particular university. Shortlist all the universities you want to apply to, beforehand. Do not start the application process until you are certain that you want to apply to that program and the university. The applications are at least 10 pages long and it is a huge waste of time to start an application and then abandon it. Have a good balance of universities on your shortlist. The rule of thumb is to split it 3 ways between 1. Most ambitious 2. Ambitious and 3. Moderate. Keep in mind that different universities and sometimes even different programs have various deadlines for applications."

About the external help seeking for admission, he says, "In general there is no need for a counselor to "help" you complete all the applications. All the university applications are quite straightforward with SOPs (Statement of Purpose) and LORs (Letter of Recommendation) being the important parts of your application. You need to start writing your SOPs the day you decide to apply for a Master's degree abroad. Writing SOPs is an iterative process and it will improve with every iteration and revision. Have your SOPs proof checked by friends and family.

There are many online forums that will help with proof checking your SOPs for a small fee. Your

SOP is the most important part of the application along with GRE scores. Having a great SOP and decent GRE score will ensure that your application stands apart from the crowd. Do not start from a "draft" or sample SOP. Write your own and then read other SOPs for improving the language or the structure. With dedication and systematic work you can easily complete the application phase and land an admit for a great university."

Vedang exactly followed these steps. I was his proof reader at all times for the SOPs. It is better that the student writes his own SOP and just gets them checked from the family members.

Once the waiting is over, around March or April, and you have the decisions in hand, it is time to decide what university you think is the best for you. When comparing universities and courses check the curriculum course by course. See what courses are mandatory and count towards the degree requirements. Usually the university will have a chart or matrix of available courses. Don't finalize a university solely on the basis of its ranking. Be 100% sure when you accept that the program you are accepting is what you want to do after looking at the core curriculum. You have options of taking different courses during your degree but you have to complete some set number of core courses to satisfy your degree requirements. Look for the funding opportunities available. Talk to seniors about the ease of securing an on-campus job to offset some of the costs. It is also important to consider the job market in the state. Talk to seniors about the job prospects and the ease of securing job interviews and offers. After considering all the above factors make your final decision.

Vedang, too, received admits from multiple universities, all good ones, one from the Ivy league, one higher ranked and finally he received from Stanford. His search was over.

When you have the visa stamp in your passport it is time to start preparing to leave your home in India.

Here are some suggestions for preparing to leave.

Book a flight with as fewer stops as possible. The journey is long and will definitely be tiresome so no point in prolonging your misery. Once you have found a flight combination that works for you, look closely at the baggage allowances for different ticket categories. There are different ticket categories that offer different number of check-in bags. If in doubt do not hesitate to call the airline directly to confirm the luggage allowances for each category. People end up paying extra for luggage at the airport if they are not aware of the allowances beforehand.

Research about the city you will be traveling to. This is an important step as it will help you determine the things you will be carrying with you. For example, if you are traveling to the Bay Area in California or anywhere around New York City, you will not need to carry any Indian grocery items as everything is available locally. Start by packing “the essentials”, these generally include clothes, medications, and electronics. Have a decent mix of formal and informal clothes. You will end up using the informal clothes for most classes and the formal outfits for interviews. Pack some kitchen supplies to get you started and would last for a couple of weeks. Pack a basic set of utensils that will help you cook most meals like a sauce pan with lid, a flat pan for rotis, a plate and a bowl with corresponding silverware. Make sure all your utensils are flat bottomed so that they work with the stoves abroad. Pressure cooker is usually optional as you can buy an instant pot here for cheap.

About the luggage and locks, he says, “Remember to buy good quality stroller bags for check-in luggage with TSA approved locks. I cannot stress enough how important the TSA approved locks are. If you have to travel in the USA you will pass through TSA every time and if they have to open and investigate inside your bag they will break the locks that aren't TSA approved.” let the luggage be within the specified weight limits.

There is a big concern at the immigration. Every traveler, let alone the students, should declare the luggage honestly and follow the laws of the land. Vedang says, “After you land, disclose everything that you have packed, truthfully, on the declaration form. You will be subject to extra screening if you don't and it will end up wasting your time. Usually the immigration officers will ask you these questions , like, what is there in the bag? Have you packed them yourself? and as long as you disclose everything you will be fine.”

Generally, you are allowed to carry cooked foods and not raw ones. if you are carrying any Indian cooked foods, do mention it on the form, honestly.

After about 16-24 hours (depending on your final destination) you will reach your university town/city.

On reaching San Francisco, Vedang found a huge difference between the city here and the place he has landed at. Everything seemed huge as compared to India. The roads, the cars, the bridges, the intersections everything felt a bit overwhelming.

He says, “Be sure to have a plan in place to get from the airport to your apartment. Uber will usually cost a fortune. Coordinate with other students and use services like Supershuttle or university provided pick up services if available. I recommend getting the mundane stuff out of the way on your very first day. This will ensure that you don't fall asleep midday and will help clear up your following days to explore other places.” The mundane things include getting a sim card, opening a bank account, and reporting to your university's international office. That's what he did on reaching the university.

The pattern of studies in Stanford university is very different as compared to most universities in India. He says, “ Here in Stanford, you have to choose the subjects you want to study for that particular semester. Most universities will have a

catalogue of courses offered that semester and you will have to pick subjects depending on the class schedule and the time commitment required for every course. Dedicate as much time possible to discovering courses that interest you. Remember to take courses outside of Civil Engineering to broaden your horizon and learn about different fields. When planning your courses always keep the final degree requirements in mind. Usually, your first week will be spent in attending variety of classes and then deciding which to study for that semester and which to drop. It can be challenging to select a good mix of courses so consult seniors about the workload and commitment required for each course you select. The mix of courses you take should give you enough time for recreation as well. You will be assigned a faculty guide to help you through the process of selection and balancing of your coursework. Take full advantage of this opportunity to learn more about the research work that professor is involved in.” are some of his suggestions.

Vedang says, “During my 2 years at Stanford I ended up taking assortment of courses from Social Dance to Deep Learning. My core curriculum focused on Sustainable Design and Construction and Energy efficient buildings. I also took up courses in Investment Science, Accounting Finance for Construction, Life Cycle Assessment for Complex Systems, Programming Methodologies and Abstraction, and Technical Writing. Our university had the quarter system allowing me to take up more courses as compared to the semester system. I thoroughly enjoyed the wide variety of courses offered and helped me explore the curriculum outside of Civil Engineering.”

He was also a member of the university Archery team. He got to visit different places with the team. It was a good learning experience with a variety of archers from all over the world.

During his course, he made the most of his time. He says, “I have so many fond memories from my time at Stanford. Time during your Master’s degree will be one of the best periods of your life so remember to enjoy every minute of it. One of

the projects I worked on during my first quarter at Stanford was the “Effects of Sea Level rise on the Bay Area”. We worked with an external partner of the department and helped them conduct research and prepare presentations. We also presented our findings to the public at an event at the Exploratorium in San Francisco at the end of our quarter. Another memorable project was working on the Poverty Alleviation through Sustainable Palm Oil Production project. I worked with the Center on Food Security and the Environment as a research assistant. I analyzed satellite data from NASA’s Landsat database and researched sociopolitical dynamics in Indonesia. I also identified and Analyzed 80 test villages located in Kalimantan Barat for forest fire data over a 1-year period.”



After you have completed all the required subjects you are ready to apply for graduation. The graduation ceremonies are a spectacular events complete with great keynote speakers. Batch of 2019 at Stanford was lucky to have Tim Cook as the keynote speaker and it was a great day. Be sure to invite your family members for the ceremony as it is one to be experienced by everyone that was a part of your higher education journey.

We attended the graduation ceremony and were humbled by the appeal of of the President of Stanford university, famous neuroscientist, biotechnology executive and academic leader Marc Tessier-Lavigne to the graduate students, to bow to the parents, to the Almighty and to all those who has

was really colourful and made us feel proud. The graduate students walked in a parade to the famous stadium.

And later on, they were conferred with a degree, personally, by the Dean of each department, at their respective departmental halls. Followed by an appeal to join for lunch hosted by the department. There were many “whose who” in the industry. We walked around the campus, too.



About his work and working experience, Vedang says, “You usually start the job hunt about 6-9 months before your expected graduation date. It is a long and arduous process. Usually, the university will arrange career fairs that will help connect you to prospective employers face-to-face. Take full advantage of these job fairs as they will help you the most in connecting with employers and landing a job interview.” He worked on a project at San Francisco airport as a trainee during his course. He got absorbed there, later.

He says, “I started working with a Project Management company based in the Bay Area right after my graduation. I had interned with the same company in summer and was offered a full-time job after graduation. I worked at the San Francisco International Airport and worked on the Terminal 1 Redevelopment project and the Terminal 2 Renovation Project. It is a very unique experience working at an airport. As an airport employee you are subject to added scrutiny but it is a very unique experience nonetheless. All of the airport is accessible with an airport badge and you can even walk around on the tarmac with proper gear and precautions. As an aero-plane enthusiast from my childhood it was a great experience to walk beneath

the parked planes and learning more about the terminal design and air bridge design.”



And he also got a chance to work with the project management team for the bullet train project in California.

It was my humble attempt to help the students who are desirous of going abroad for further studies. Finance is a major part that worries most of the parents. There are education loans offered by various financial institutions. During their study times, students can earn a bit by offering services and earn at a particular rate of wages. There are visitors to the university, students can offer their services as a guide, there are helpers required at the library, and so many other such jobs. Please don't hesitate to take up some and learn the importance of labour, no job is worthless, and everyone contributes to the economy. Students can earn a bit and support their living there. Always remember to follow the laws of the country, no one can help you bail out if you are caught breaking the laws. Learn to cope up with students from different countries, take it as a good learning experience.

Last, but not the least, adjust with the food available locally. Good food is available every where, even if you are vegetarian, you can find decent options. But be open to food available locally.

I wish all the students a very bright future.

About the author –



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

COLUMNS ARE IMPORTANT FOR THE SAFETY OF BUILDINGS - HANDLE THEM WITH CARE

By Dr. N. Subramanian, Ph.D., FNAE

Abstract

Reinforced concrete (RC) columns are important elements of any building or structure. Even if one column fails, it will lead to the progressive collapse of the entire building or structure, as has been demonstrated in the case of several buildings or structures in the past. Hence, structural engineers should consider them with care, starting from locating, aligning them properly with the beams, analyzing, designing, detailing, and execution at site. This short note examines some of these important aspects of RC columns.

INTRODUCTION

A column is usually a vertical member in a building which is normally subjected to compressive loads in addition to bending moments, which are transmitted to the foundations. In addition to the concrete section, they are reinforced with longitudinal (vertical) bars to resist compression and/or bending; and transverse reinforcement (closed ties) to resist shearing forces. The locating, aligning, analysis, design, detailing, and execution of RC column sections should be done carefully, as the failure of even a single column may result in the catastrophic collapse of the entire building/structure. The author wrote a paper in ICJ showing how the columns are the most abused RC elements at the site (Subramanian, 2011). For example, at the site, the column rods are kinked, if they are not in alignment (see Fig.1a), and the column concrete mix is made at the site, as the quantities involved are usually small. It is normally poured from the top of the column formwork (the quality of concrete is found to be not compromised by pouring from such heights) and not vibrated properly. The honeycombing seen is immediately patched up(see Fig.1b)! In many cases enough concrete cover is not provided to the columns- Cover for columns is 40 mm, which is

always higher than in beams and slabs. In addition, the formwork for column is removed after 24 hours (in beams it stays for a minimum of 7 to 10 days, depending on whether fly ash is in the mix or not). Also, columns are not cured properly, even though the safety of the entire structure is depended on them (Subramanian, 2002). To solve some of these problems, use of self-compacting concrete in columns is suggested.



Fig.1 (a) RC columns with kinked rebars, (b) Honeycombing in RC columns

LOCATING COLUMNS

It is preferable to have columns in buildings or structures in a grid pattern so that they resist the lateral loads (due to wind and earthquake) also effectively. They should be placed preferably under the beam-column junctions and in such a way that the long side of the column is oriented along the span of the beams, so that the bending moments are resisted effectively. Sometimes, due to architectural considerations, it may be necessary to keep the short side of the column along the span of the beams, but it is not efficient and economical. Although columns of different shapes may be used, it is normally rectangular, square or circular in shape. There should not be openings close to the columns or in the form of ventilators, doors, or windows as it will result in short column effect and failure of columns. Open story columns, left on the ground

floor of multi-story buildings are also dangerous as they result in a sudden reduction in stiffness in the ground floor compared to other stories and lead to brittle failure of columns.

ANALYSIS OF COLUMNS

The forces in the columns are often found out by using computer software. If there are long columns, a non-linear analysis may be necessary. If the foundation rests on hard soil, rock, or pile cap, the base of the column may be assumed as fixed in the analysis. But if the foundation rests on soft soil the base of the column may be assumed as hinged in the analysis. As the hinged base will result in heavy bending moment at the top of ground floor level of columns, soil-structure interaction may be considered in the analysis. Buildings modeled with hinged base are more flexible than those with fixed base, and hence their natural period will be larger, leading to smaller base shear and larger lateral drift. Also, buildings with hinged bases and taller columns in ground storeys than in typical upper storeys may have undesirable soft storey effects. Columns may also be provide with heavy grade beams connecting the columns. Addition of plinth beams will alter the stiffness of ground storey columns, but will increases the shear demand on columns sections, if any, below the plinth beam level, inducing short column effects. Thus, when plinth beams are provided in buildings, they should be included in the analytical model. Sunitha et al. 2015, also found that the presence of plinth beams helps increase degree of fixity at column base even with hinged conditions leading to overall behaviour close to that of fixed base.

DESIGN OF COLUMNS

Coming to the design of columns, many times the designers do not take the effective length properly. Several designers also release some joints and design the column for only axial force. Even if the interaction diagrams are used, it is better to choose a point within the dotted lines showing $f_{st} = f_{yd}$ and $f_{st} = 0$. How many design engineers bothered to notice

the dotted lines in the design charts of columns of SP 16:1980?

Murty, 2001 further explains that the IS 456:2000 does not insist under-reinforced designs for columns, even though providing over-reinforced sections are more serious in columns than in beams. He also states that the design point in the P-M interaction diagram should be chosen on the compression axial load side at or below the balanced point, as shown in Fig 2, that is, $P_{design} < P_b$, so that the failure of the column will be by yielding of steel and not by crushing of concrete (Murty, 2001). Over-reinforced column sections should be avoided, particularly when the columns are subjected to both axial load and bending moment. In general, due the insistence of architects, the designers may reduce the column sizes to merge with the thickness of wall, thus pushing the design point more towards the apex of the P-M interaction diagram. This tendency must be avoided especially in earthquake zones, due to the possibility of brittle compression failures. Also, providing smaller column sizes relative to that of beams will result in the beams stronger than the columns. Thus, under earthquake loads, this strong-beam-weak-column system will lead to catastrophic storey collapse mechanisms or sway mechanisms (Murty, 2001).

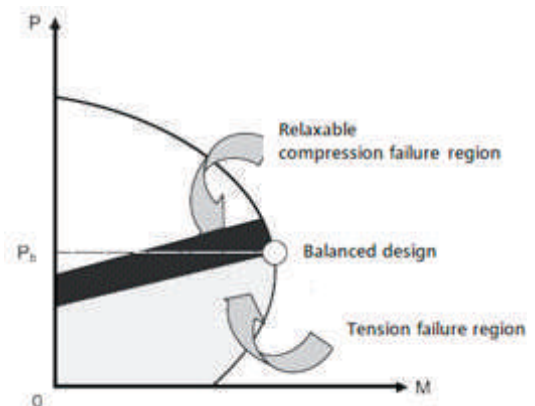


Fig. 2 Desirable tension failure region for design of all important columns, and permissible relaxation of this region in columns of less important structures (Source: Murty, 2001)

(to be continued in next Issue)

NEWS AND EVENTS DURING JAN2022 TO MAR2022

by Hemant Vadalkar

29 Jan 2022 : Epicon Friends of concrete arranged a webinar on “Precast Construction – An Overview””. Precast concrete construction is very popular world wide but not so much used in India. Various industry experts shared their experience in the field of precast concrete construction. Er. Amit Barde from Larsen and Toubro spoke about their experience in construction of mass housing using precast concrete which has speed , quality and economy. Er. Ajit Bhate of Precast India Infrastructures Pvt Ltd talked on his experience on Design ,Production , Installation and Execution of prefabricated concrete structures. Good amount of information on precast concrete construction was shared with a good response from the attendee.

19 Feb 2022 : Epicon Friends of concrete arranged a webinar on “ Geotechnical investigations- Planning and interpretation “. Expert in the field Er. Shekhar Vaishampayan from Subsurface Consultants, Thane and Dr. Jaykumar Shukla from Geodynamics shared their knowledge and case studies on the subject.

Feb 23-25, 2022 : CECR and NIDM jointly organized a webinar on “ Infrastructure – Health mapping standards and Retrofitting of built up facilities “. Experts in the field addressed the gathering.

Introduction

Natural resource depletion, global warming, economic insecurity, and health concerns leads to sustainable development movements across the world. There is a need for mechanisms or approaches that can mitigate the negative effects of development, construction and urbanisation to the environment. Retrofitting an existing building is one of the most environmentally friendly, sustainable and efficient solutions to optimize the energy performance of building. As a matter of fact, when compared to new buildings construction, this kind of intervention reduces the consumption of land

energy and could be applied to a large building stock.

Many structures have been constructed in the country without any structural or proper structural design. In addition to this, there are many structures constructed with poor quality, in terms of materials, workmanship and design. Such structures show distress after a few years of construction. Rehabilitation and retrofitting becomes a necessity in such structures, though a costly affair. In case structures are not rehabilitated in time, deterioration of such structures accelerates at a faster rate. Since a large number of such structures exist in the country particularly in semi urban and urban areas, this is high time that rehabilitation is carried out on large scale, both in government and private sectors.

Decision on Repair and Rehabilitation

Cost of distressed structures depends upon the quality of the design, construction, maintenance, and aging of structures. A structure having design deficiencies requires retrofitting as per latest codes. As per the guidelines for repair, restoration, condition assessment and seismic strengthening of masonry building. “As a thumb rule, if the cost of repair and seismic strengthening is less than about 30% of the reconstruction cost, retrofitting is adopted”. This cost may be only 5 – 6% of cost of reproduction of a building if only seismic members are to be provided but repair and rehabilitation is also to be carried out, it may lead to a very high cost. In case of poor quality construction, rate of distress is very high and cost of repair, rehabilitation and retrofitting is also very high. Also, such structures cannot be brought to the required quality level. For example, if the joints of brickwork have not been filled up properly, any rehabilitation work such as grouting may not fill up all the hollow joints.

Sometimes, it becomes economical to go for reconstruction but due to some other considerations such as non availability of buildings for the users, short life of structures, and litigation etc., repair, rehabilitation and retrofitting are carried out. Even after repair and rehabilitation, such structures need continuous maintenance and may not last for originally designed life.

Rehabilitation and Retrofitting Methods

Repair and rehabilitation methods are to be planned carefully and to be followed in the required sequence. Structural repairs are to be carried out first and thereafter retrofitting works for seismic requirements and then repair of non structural members. Finally, repair and rehabilitation of architectural components should be taken up. Such a sequence is followed as repair of non structural members initially may cover up structural cracks or members requiring structural strengthening.

Weak protective surfaces and materials like concrete, plaster, water proofing materials, and corroded steel are to be removed first. Repair is thereafter to be carried out by ensuring design requirements, compatibility of materials and also other factors mentioned earlier. Repair should also be compatible to design requirements. For example, if a lintel is to be repaired, it should be compatible to seismic retrofitting, if being carried out. For repair of all distressed structures, no standard method and materials may be listed but depend upon structure to structure.

During rehabilitation of distressed structures or retrofitting, following methods may be carried out:

- Sand blasting to remove rust
- Binding/adding additional reinforcement
- Binding of wire mesh
- Anchoring to the existing members through shear keys or anchors
- Welding
- Shotcreting
- Plate bonding
- Jacketing
- Fibre wrapping
- Underpinning

Retrofitting Matrix

The matrix was first developed by the East Midlands Development Agency. It is a self assessment tool that was created to help any individual or organisation to develop their own retrofit strategy or integrated and holistic approach on energy efficient projects that meet the local demands or requirement

and achieving the goals of the projects. It also aimed to help the users to assess their current situation or activities and what is needed to solve problems or enhance their retrofit strategy. It highlights eight critical themes and each one of it sets out a series of suggestion for the users. The eight critical themes in the retrofit strategic matrix tools are - partnership, governance and leadership, evidence and monitoring base, finance and investment, planning, development and regulatory control, skills and knowledge, industry and business development, procurement, cultural and social factors.

Structural Evaluation

Structural evaluation is carried out through condition survey and non destructive testing. Condition survey is carried out at four stages through preliminary inspection, planning, detailed visual inspection and field and laboratory testing. Non destructive testing tests include tests for in-situ compressive strength like rebound hammer test, ultrasonic pulse velocity test, Windsor probe test, pull out test, core tests and load tests. Tests for chemical attack include carbonation tests, chloride test and sulphate test. Corrosion potential assessment can be made from cover meter/Profo meter, half cell method, and resistivity meter. Normally a series of tests or a combination of tests or all tests are carried out based on condition assessment and importance of the structure. Though interpretation of tests is important and to be carried out by the experts, testing procedure is equally or more important as incorrect testing procedure may provide incorrect results. Problem sometimes is that field testing is not normally carried out by the experts themselves. Sometimes results are so erratic that one may require retesting. Results also vary with the equipment used, calibration conditions of the equipment and site conditions and accessibility of the members. Hence, there are numerous factors on which correctness of indirect tests depends and thus one has to be very cautious while doing such tests and interpreting results based on them.

Materials for Repair and Rehabilitation

Selection of materials for repair and rehabilitation depends upon many factors such as:

- Technical requirements
- Cost
- Availability
- Expert's advice
- Importance of the structure
- Balance life of the structure
- Toxicity
- Aesthetic requirements

Technical requirements of materials used for repair may include their shrinkage properties, compatibility to base materials, setting and hardening properties, workability, bond strength, thermal expansion properties, mechanical strength, curing requirements, permeability, and durability. Most of the materials used for repair are cements, admixtures, polymer modified mortars/concrete, aggregates, polymers, epoxies, resins, grouts, plasticizers, steel in the form of reinforcement, sections, nuts/bolts, wire mesh, metallic sheets, glass fibre sheets, carbon fibre sheets, geo-synthetics in the same form or in modified form.

The Benefits & Challenges of Retrofitting

The contribution of existing buildings in regards to sustainability should not be underestimate. Through retrofitting, existing buildings can be benefited for sustainability purposes hence lessening the wastage. The time has come to begin concentrating on retrofitting the existing buildings. Tangible and intangible benefits from greening the existing buildings could be achieved through retrofitting. The tangible benefits are any benefits or advantages that can be measured in financial terms such as cost of construction and intangible benefits are any benefits or advantages that cannot be measured by financial term but it still has significant impact to business or project such as comfort level and satisfactory level.

Suggestion

Retrofitting the existing buildings is one of the most environmentally friendly, economical competent and proven as an efficient solutions to optimize the

energy performance and could also helps to prolong the life of the existing building especially to the historical buildings. Thus, the application of retrofit should be promoted across the construction and conservation industries. More research need to be done in order to have complete sets of detail data on the direct and indirect impacts of retrofit to the environment, cost differences between retrofit with the normal construction of a building, cost of maintenances as well as, the impacts to the end users and to the surround area of retrofitted buildings.

There are large number of un-engineered and engineered structures constructed with poor quality of design, materials and workmanship. Some structures are not even maintained with proper quality. All such structures are highly prone to distress and require frequent repair and rehabilitation. Such structures cannot be demolished due to high cost involved in reconstruction and non availability of assets. Thus, there is a need to develop simple and user friendly guidelines for municipalities, individuals, engineers, architects and contractors.

The programme was conducted in three sessions.

**DAY 1 - Wednesday, February 23rd, 2022
(3:00 PM - 5:30 PM)**

Sub Theme - Health Checkup of Built-Up Facilities

- Keynote Address by - Prof. Chandan Ghosh, Professor & Head – Resilient Infrastructure Division, National Institute Of Disaster Management (NIDM)
- Lead Lecture on “Health Checkup of Built-Up Concrete Structures” by - Dr. Bishwajit Bhattacharjee, Emeritus Professor, Dept of Civil Engineering, IIT, Delhi
- Presentation on “ONLINE Certification and Assessment of Building Health” by - Mr. Manish Bharti, CEO, Cortex Construction Solutions Pvt. Ltd.
- Panel Discussion & Question and Answer

**DAY 2 - Thursday, February 24th, 2022
(3:00 PM - 5:30 PM)**

**Sub Theme - Tools and Techniques
for Retrofitting**

- Presentation on “Rehabilitation of Infrastructure as Nation Building” by - Dr. Gopal Rai, Director, R&M International
- Presentation on “Tools and Techniques for Retrofitting Structures” by - Mr. Nitin S. Verma, Managing – Partner, Adhar Consultancy & Infrastructure (AC&I)
- Presentation on “Resistoflex Building In NOIDA- Construction & Experience Sharing” by - Mr. Ratish Jain, Managing Director, Resistoflex Group
- Panel Discussion & Question and Answer

**DAY 3 - Friday, February 25th, 2022
(3:00 PM - 5:30 PM)**

**Sub Theme - Performance of
Retrofitted Facilities**

- Presentation on “Seismic Upgrade of New Udaan Bhawan Using Fluid Viscous Dampers” by - Mr. Sandeep Shah, Country Head and MD – India Miyamoto International
- Presentation on “Performance Evaluation of Retrofitted Structures – Case Study” by - Er. Chetan R. Raikar, Managing Director, Structwel Designers & Consultants Pvt. Ltd.
- Presentation on “Service Life Enhancement Technologies for Repair of Reinforced Concrete And Steel Structures” by - Er. Sourabh Manjrekar, Director SUNANDA Speciality Coatings Pvt. Ltd.
- Panel Discussion & Question and Answer

26 Feb 2022 : Ultratech Cement arranged a web lecture by Er. Alok Bhowmick on Bridges with external Tendons – future of bridge construction in

India. Er. Alok elaborated on durability and design aspects, various examples of external tendons used in new structures and for strengthening purpose. He cited examples of bridge construction around the world and stressed that it will be used in all long span bridges in future due to many advantages.

19 Mar 2022 : Epicon friends of concrete arranged a webinar on Ductile detailing of tall buildings. Dr. Prof. Yogendra Singh of IIT Roorkee explained various clauses of IS13920 along with its background and implementation.

21 Mar 2022 : IIBE arranged web lecture "MG Setu with Choice of Steel in Superstructure Vs. Replacement in Concrete" on rehabilitation of MG Setu by Er. Atul Bhohe.

Er. Atul explained various alternatives that were studied for the rehabilitation of MG Setu from repairing to reconstruction. He discussed the final and best alternative chosen that is replacement of superstructure in Structural steel based on various parameters under the given circumstances.

28 Mar 2022 : ISSE HQ had written a letter to Maharashtra Industrial Development Corporation (MIDC) Head office, Andheri, Mumbai regarding adopting format of Supervision certificate based on Unified Development Control and Promotion Regulations 2021 along with copies of sample draft formats. Based on the request from many members, ISSE HQ also sent a letter to Municipal Corporation of Greater Mumbai regarding huge increase in annual licensing fees for Structural Engineers from Rs.750 to Rs.5000 and requesting corporation to reconsider the increase to Rs.1000/- which is charges by other local bodies. ISSE also requested not to charge any late fee or penalty for delayed renewal of license.

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A-3027, Oberoi Garden Estate, Off. Chandivali Farm Road, Andheri (East), Mumbai - 400 072
Tel: +91 22 2857 7810 - 11

#63/1, Sri Sai Krupa, Between 16th And 17th Cross West Park Road, Malleshwaram, Bangalore 560003
Tel: +80-23447813

R&M International Pvt Ltd. 612, Prakash Deep building, 7 Tolstoy Marg, New Delhi-110001