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INDIAN CONCRETE INSTITUTE





President's Message

Dear fellow members of ICI and readers,

The concrete and construction industry stands at a defining moment. As India accelerates its infrastructure ambitions from multimodal logistics corridors to resilient urban systems the responsibility on our profession has never been greater. The Indian Concrete Institute continues to play a pivotal role in shaping this transformation by advancing knowledge, strengthening professional capacity, and championing sustainable construction practices.

Over the past quarter, ICI has conducted knowledge sessions on Ultra High Performance Fibre Reinforced Concrete (UHPFRC) in Nagpur. The interactive sessions provided a great insight into the developments and opportunities in this area. It was an occasion to meet with those who are directly involved in the concept, planning, design, casting and execution of the UHPFRC structures in India.

Recently, ICI Goa Centre conducted a One-day Workshop on Advances in Concrete Technology. Eminent speakers including those within ICI, spoke on the fast changing advances in the area

of materials, construction, durability and sustainability of concrete.

I heartily compliment ICI-Nagpur and Goa Centres for organizing such event. I would request all centres of ICI to take help from our Education & Training Committee to organize more such events in their Centres.

I am happy to place before you the latest edition of ICI Journal. I would request researchers and practicing professionals to make use of this platform and share their knowledge through ICI Journal.

With best wishes,

Dr. Ramachandra. V

President, ICI

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Diamond Wire Saw Cutting for Selective Removal of Well Cap Concrete in a Cable-Stayed Bridge Foundation on the River Ganga, Bihar



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Abstract

A selective concrete removal operation was undertaken on the well cap foundation of a cable stayed bridge pier in the River Ganga, Bihar, following a construction related structural accident. The damaged central portion of the 12 m diameter and 3 m deep reinforced concrete well cap required removal and recasting while preserving the surrounding steining, embedded sacrificial steel truss, and adjacent bridge components under construction. Owing to the confined working conditions and the requirement for controlled demolition, diamond wire saw cutting was adopted in conjunction with core drilled pilot holes for wire installation. Approximately 339 m³ of concrete (about 848 tonnes) was divided into 1.0 m × 1.0 m × 3.0 m blocks and removed using an 80 tonne barge mounted crane. The cutting and lifting operations were executed in a planned sequence and completed within the contractual period of three months through continuous multi shift working. The project included management of dewatering incidents, implementation of environmental protection measures, and strict safety controls. The successful completion of the work demonstrates the suitability of diamond wire saw technology for precision concrete removal and rehabilitation of large bridge foundations in challenging riverine environments.

1. Introduction

Rehabilitation of bridge foundations in active river environments is particularly challenging due to restricted access, fluctuating water levels, and the need to protect existing structures during construction ^[1]. These

Keywords: Diamond wire saw cutting; bridge foundation rehabilitation; well cap; cable stayed bridge; selective concrete removal; riverine construction.

challenges become more critical when major foundation elements require partial removal and reconstruction, and the importance of selecting appropriate demolition techniques based on site constraints and structural sensitivity cannot be overstated.

This paper presents the rehabilitation of a well cap foundation of a cable stayed bridge under construction across the River Ganga in Bihar. Following a structural accident and subsequent technical assessment, the central portion of the well cap required removal and recasting while preserving the surrounding steining and supporting ongoing construction at adjacent foundations. Inspection and assessment of the foundation followed established bridge maintenance guidelines ^[2].

Conventional demolition methods were unsuitable because of space constraints and the risk of vibration induced damage. Diamond wire saw cutting was therefore adopted for the controlled removal of approximately 339 m³ of heavily reinforced concrete. The paper describes the planning, execution, and key engineering considerations associated with this precision concrete removal operation in a challenging riverine environment.

2. Project Background and Problem Statement

2.1 Bridge Description

The project involves a cable stayed bridge across the River Ganga in Bihar, India, founded on deep circular well foundations in accordance with IRC:78 ^[3]. Each foundation comprises a reinforced concrete well cap supported by a circular steining and designed to transfer pier loads to the foundation system.

During construction, a structural accident led to the collapse of a portion of the bridge superstructure. Subsequent investigation identified structural non conformities in the well cap of one pier, necessitating removal and reconstruction of the affected section.

2.2 Well Cap Configuration

The affected well cap was a circular reinforced concrete element measuring 12 m in diameter and 3 m in depth, constructed of M40 grade concrete as per IS 456:2000^[4]. A sacrificial steel truss was embedded within the well cap as permanent internal formwork. The concrete was found to be of good quality and free from visible distress.

The well cap contained heavily congested reinforcement designed in accordance with the requirements for a major cable stayed bridge foundation^[5]. This made conventional demolition methods unsuitable. The structure was located within a circular steining that extended above the river water level, providing a dry working environment under normal conditions.

2.3 Remediation Requirement

The remediation works required removal of the central portion of the well cap to a depth of 3 m while preserving the surrounding steining and structurally sound peripheral portion of the well cap. The selected method was required to avoid vibration and impact effects that could affect adjacent structures and the foundation system. The work also had to be completed within the stipulated three month construction period and included the removal and disposal of approximately 339 m³ (about 848 tonnes) of reinforced concrete under constrained riverine access conditions.

3. Evaluation of Alternative Demolition Methods

Prior to selection of the removal methodology, various concrete demolition techniques were evaluated considering the site constraints, structural requirements, and construction programme^[6]. The principal considerations and suitability of the available methods are summarised in Table 1.

Diamond wire saw cutting was selected owing to its ability to provide controlled and vibration free concrete removal under confined site conditions. The technique can cut through heavily reinforced concrete and embedded steel components while producing clean, accurately defined cuts suitable for block lifting. Its compact equipment footprint enabled operation within the restricted working area, and the water cooled cutting process minimised environmental impact by generating only concrete slurry without dust or fumes.

4. Equipment and Resources

4.1 Diamond Wire Saw Units

Concrete cutting was carried out using two hydraulic diamond wire saw machines operating simultaneously^[7]. Each system comprised a hydraulic power unit and a continuous diamond wire consisting of steel cable fitted with diamond impregnated beads. The wire was threaded through pilot holes drilled at the corners of the designated concrete blocks and driven around a series of guide pulleys to produce the required cuts. Cutting was achieved through the abrasive action of the moving wire, enabling efficient penetration through both concrete and

Table 1: Evaluation of concrete removal methods for well cap remediation

Method	Vibration / Impact	Heavy Rebar	Confined Space	River Risk	Verdict
Hydraulic Breaker	Very High	Poor — rebar deflects	Poor	High — vibration to steining	Rejected
Pneumatic Chisel	High	Poor	Moderate	High	Rejected
Controlled Blasting	Very High	Good	Unsuitable	Very High	Rejected
Thermic Lance	Nil	Good	Moderate	Moderate — fume hazard	Rejected
Diamond Wire Saw + Core Drill	Nil	Excellent	Excellent	Low	Selected

embedded reinforcement. Continuous water supply was provided at the cutting interface for cooling of the wire and removal of concrete slurry.

To meet the project schedule, both wire saw systems operated continuously in three shifts of eight hours each. The round the clock operation ensured sustained production and facilitated completion of the concrete removal works within the contractual period of three months.

4.2 Core Drilling Equipment

Diamond core drilling was carried out to create pilot holes at the corners of the proposed cut blocks for threading and positioning of the diamond wire. The drilling operation was performed through heavily reinforced concrete using water cooled core drilling equipment. Core drilled holes were also utilised for installation of lifting anchors used during block extraction.

4.3 Barge-Mounted Crane

An 80 tonne capacity crawler crane mounted on a steel barge was deployed for lifting and removal of the cut concrete blocks. The barge was positioned alongside the well foundation and secured to provide a stable working platform in the river environment. As the cutting progressed, the crane barge and associated floating work platforms were repositioned using a tugboat to maintain efficient access to the active work area and facilitate safe lifting operations.

4.4 Floating Work Platforms

Floating steel work platforms were installed around the well foundation to provide access for cutting, drilling, lifting, and supervision activities. Scaffolding erected from these platforms provided safe working levels at the required elevations within the well cap. The platforms were repositioned as required during the progress of the works to maintain access to the active cutting locations.

4.5 Lifting Hardware and Chemical Anchors

Following completion of the perimeter cuts, each concrete block was lifted using chemical anchor bolts installed in the top surface of the block. Epoxy based chemical anchors of suitable capacity were used to provide secure lifting points. The blocks were connected to the crane hook through lifting chains and extracted

vertically in a controlled manner prior to further cutting operations.

5. Methodology and Sequence of Operations

5.1 Overview of Cutting Strategy

The cutting sequence was planned to progress from the centre of the well cap towards the periphery, thereby maintaining stability of the remaining concrete mass and facilitating safe extraction of individual blocks. The removal zone, covering approximately 113 m² of plan area, was divided into 1.0 m × 1.0 m blocks extending through the full 3.0 m depth of the well cap. Each block had an approximate weight of 7.5 tonnes, allowing safe handling and removal using the barge mounted crane.



Fig.1: View of the well cap enclosure showing exposed congested reinforcement at the cut level, the barge mounted crane positioned for lifting operations, and the surrounding circular steining. Concrete removal was carried out progressively from the centre towards the periphery.

5.2 Pilot Hole Drilling

Prior to cutting, pilot holes were core drilled at the corners of each block through the full depth of the well cap to facilitate threading of the diamond wire. Owing to the heavily reinforced concrete, core drilling was a critical preparatory activity. To maximise productivity, core drilling operations were carried out ahead of the cutting works, ensuring a continuous supply of prepared blocks for the wire saw machines and minimising operational downtime.

5.3 Wire Saw Cutting Sequence

Following installation through the pilot holes, the diamond wire was connected into a continuous loop and operated under controlled tension to produce the required cuts. Continuous water supply was maintained during cutting for wire cooling and slurry removal. Each block required four vertical cuts to separate it from the surrounding concrete mass.

Cutting commenced at the centre of the well cap and progressed outward in a planned sequence. The work was executed in concentric zones, with cutting parameters adjusted as necessary to accommodate variations in reinforcement density. Floating platforms and lifting equipment were repositioned periodically to maintain efficient access to the active work area.

5.4 Piece Extraction

Upon completion of the perimeter cuts, the concrete block remained supported on the sacrificial steel truss. Chemical anchor bolts were installed in the top surface of the block and connected to the crane through lifting slings. The block was then lifted vertically from its position using the barge mounted crane and placed on the barge deck. The removed blocks were subsequently transported to a designated riverside location for further size reduction and disposal.



Fig.6: A diamond-wire-cut concrete prism (1.0 m × 1.0 m × 3.0 m, ~7.5 tonnes) being lifted vertically from the well cap by the barge-mounted crane. The clean planar faces produced by wire saw cutting are clearly visible.



Fig.7: Close-up view inside the well cap during extraction (24 February 2026). The precision planar faces of the diamond wire saw cuts are evident on both the extracted block and adjacent cut surfaces. Diamond wire saw machine and hydraulic hoses are visible in the foreground.

5.5 Management of Dewatering Incidents

Minor water ingress was encountered on a few occasions due to localised defects in the steining. The inflow was controlled using rapid setting grout, and dry working conditions were restored through dewatering pumps. These incidents were managed without significant impact on the construction programme.

5.6 Treatment of the Sacrificial Steel Truss

Following completion of the concrete removal works, the embedded sacrificial steel truss became fully exposed. The truss was subsequently dismantled by flame cutting and removed, thereby preparing the well cap base for the recasting operation.

6. Quantitative Data and Production Rates

Operation of two diamond wire saw systems in three daily shifts provided a production capacity substantially higher than the minimum required for the project. This additional capacity accommodated variations in reinforcement congestion, temporary interruptions due to dewatering activities, and periodic repositioning of the crane barge and work platforms. As a result, the concrete removal works were completed within the contractual period of three months.

Table 2: Summary of quantitative data for the well cap removal operation

Parameter	Value
Concrete grade	M40
Well cap diameter	12.0 m
Well cap plan area (full circle)	113.1 m ²
Depth of concrete removed	3.0 m
Total volume of concrete removed	~339 m ³
Total weight of concrete removed	~848 tonnes
Individual prism dimensions (plan)	1.0 m × 1.0 m
Individual prism depth	3.0 m
Individual prism volume	3.0 m ³
Individual prism weight	~7.5 tonnes
Estimated number of prisms	~113 (incl. boundary cuts)
Wire saw machines deployed	2 (operating 24 hrs/day, 3 shifts)
Crane capacity	80 tonnes (barge-mounted)
Contractual completion period	3 months (~78 working days)
Minimum required production rate	~1.5 prisms/day
Achieved production rate	~8–10 prisms/day (two saws, 3 shifts)
Total linear cutting achieved	~1,300 m (estimated)
Concrete unit weight assumed	2,500 kg/m ³

7. Site Setup, Logistics, and Environmental Considerations

7.1 River Site Setup

The mid river location of the pier required all personnel, equipment, and materials to be transported by boat or barge. A barge mounted crane provided the primary lifting facility, while floating work platforms supported construction activities and were repositioned as required during the operation.

The steining wall extended above the river water level and acted as a natural cofferdam, enabling dry working conditions within the well. This eliminated the need for a separate external cofferdam system and simplified execution of the rehabilitation works.

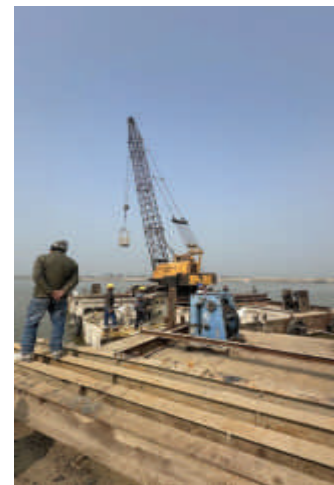


Fig.2: 80-tonne barge-mounted lattice boom crane positioned alongside the well cap steining wall. Floating work platforms are visible at left. The entirely river-borne working setup with no land access is clearly illustrated.



Fig.3: Wide-angle view from the river showing the complete floating plant assembly — crane barge, generator units, and work platforms — alongside the exposed caisson steining. Adjacent cable-stayed bridge pylon shafts under construction are visible at right.



Fig. 4: Secondary wide-angle view of the barge assembly and the two adjacent pier shafts. The mid-river working environment and absence of any land-based access infrastructure are evident.

7.2 Simultaneous Adjacent Construction

Remediation works were carried out while construction activities continued at adjacent well caps. Careful coordination of lifting operations, floating platform movements, and marine traffic ensured uninterrupted progress of neighbouring works. The vibration free nature of diamond wire saw cutting was a key factor in facilitating simultaneous construction activities.

7.3 Environmental Safeguards and Worker Safety

Concrete slurry generated during cutting operations was collected within the well enclosure and transferred to settling tanks on the barge, preventing discharge into the river. Settled solids were disposed of at approved locations on land. The cutting process utilised only water for cooling and slurry removal, eliminating the need for chemical additives and minimising environmental impact.



Fig. 5: Interior of the well cap enclosure (6 February 2026) showing the circular steining wall, exposed reinforcement dowels projecting from the cut base, and temporary water pooling in the lower levels following a minor steining defect. The enclosure is being dewatered prior to resuming cutting operations.

The work environment involved confined space operations, lifting activities, work at height, and over water exposure. Key safety measures included:

- Mandatory use of life jackets for all personnel working on floating platforms and around the well cap.
- Atmospheric monitoring of the well cap enclosure before commencement of each shift.
- Continuous supervision by a dedicated safety officer.
- Availability of a standby rescue boat throughout the operation.
- Establishment of exclusion zones during wire saw cutting activities.
- Verification of chemical anchor capacity prior to each lifting operation.
- Preparation and approval of lift plans for all crane lifting activities.

8. Technical Challenges and Innovations

8.1 Heavily Congested Reinforcement

Dense reinforcement throughout the well cap reduced cutting rates and increased wire wear. This challenge was addressed through the use of high performance diamond wire and continuous monitoring of cutting parameters.

8.2 Access and Lifting Geometry

The confined geometry of the well cap required precise crane positioning and controlled lifting of cut blocks. Pre planned lift paths and the use of chemical anchors ensured safe and efficient block extraction.



Fig.8: Intermediate stage of well cap removal showing several prisms already extracted, revealing the sacrificial steel truss at the base. Remaining prisms, some mid-cut, are still in place. The barge crane is visible at upper right, and two pylon shafts of adjacent piers are visible across the river.

8.3 Novel Barge-as-Lifting-Platform Concept

The use of a barge mounted crane provided an effective lifting solution for the mid river location, eliminating the need for temporary access structures or land based lifting equipment. Repositioning of the barge enabled efficient access to all lifting locations throughout the operation.

8.4 Maintaining Stable Working Conditions in the River

Seasonal variations in river water level were accommodated through flexible barge mooring and platform arrangements. The steining acted as a natural cofferdam and successfully maintained dry working conditions, with only minor instances of water ingress requiring temporary dewatering measures.

9. Results and Outcomes

The concrete removal works were completed within the contractual period of three months and achieved all project objectives. Key outcomes included:

- Removal of approximately 339 m³ (about 848 tonnes) of reinforced concrete from the central portion of the well cap.
- Preservation of the surrounding steining and peripheral well cap without observable damage or distress.

- Safe lifting and removal of all cut concrete blocks.
- Complete exposure and subsequent removal of the sacrificial steel truss.
- Preparation of the foundation for the recasting works.

The diamond wire saw method produced clean and accurately defined cut surfaces, facilitating controlled block removal and demonstrating its suitability for precision rehabilitation of major bridge foundations. Concurrent construction activities at adjacent foundations continued without interruption throughout the operation.

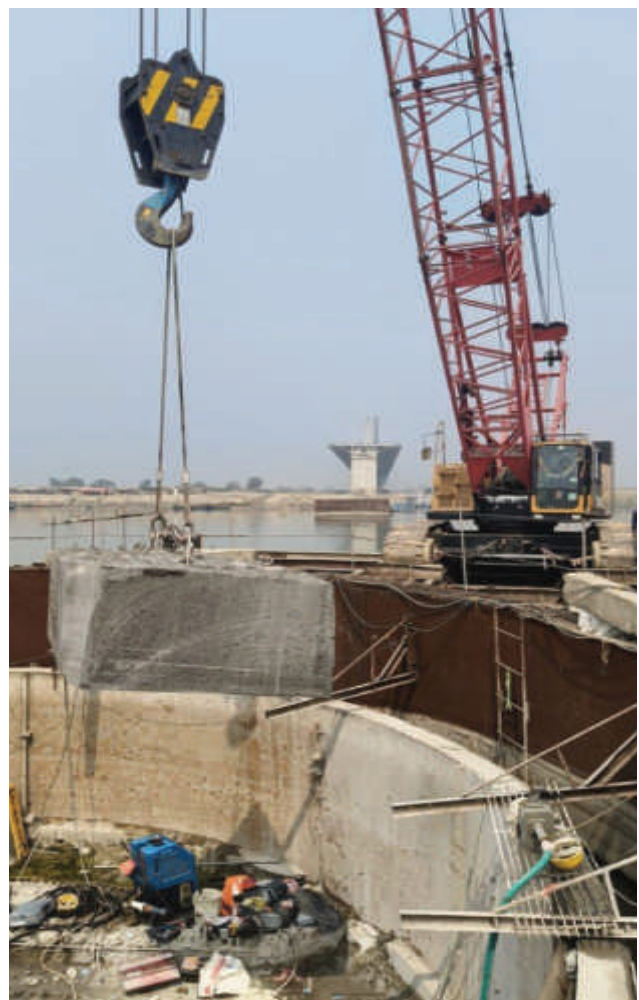


Fig.9: Final stage of the operation: a large boundary prism being extracted by the barge-mounted crawler crane. The cable-stayed bridge pylon tower under construction is visible across the river, confirming that concurrent bridge construction continued without interruption throughout the remediation works.

10. Comparison with Conventional Methods

Table 3: Comparative assessment — hydraulic breaker vs. diamond wire saw cutting

Aspect	Hydraulic Breaker	Diamond Wire Saw (This Project)
Vibration / Impact	Very high — damage risk to steining	Zero — no vibration generated
Rebar handling	Ineffective — rebar deflects breaker	Cuts through rebar continuously
Piece size control	Unpredictable fragments	Precise $1.0 \times 1.0 \times 3.0$ m prisms
Concrete dust / fumes	Heavy dust generation	Water-suppressed slurry only
Adjacent structure risk	High	Negligible
Concurrent work feasibility	Not feasible	Fully compatible
Programme reliability	Unpredictable	Consistent, measurable rate
Confined space suitability	Poor	Excellent
Environmental impact	High (noise, dust, debris)	Low (slurry only, contained)

11. Conclusions

- Diamond wire saw cutting enabled precise and controlled removal of heavily reinforced concrete while preserving the surrounding foundation elements.
- The vibration free process allowed rehabilitation works to proceed safely alongside ongoing construction activities.
- The combination of a planned centre outward cutting sequence, chemical anchor lifting, and a barge mounted crane ensured efficient execution in a constrained mid river environment.
- The project demonstrates the effectiveness of diamond wire saw technology for complex bridge foundation rehabilitation where conventional demolition methods are unsuitable.

Acknowledgements

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Goal-Seek® Assisted Design of Reinforced Concrete Members



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Abstract

Goal Seek is a versatile application of MS Excel which has numerous business applications. In goal seeking, Excel plugs different values into a cell until it finds a value that works. Goal Seek determines the input required to produce a desired output. It amounts to finding a problem for a given solution or an inverse analysis. This paper applies this tool to design of RC beam, slab and column. More design problems can be solved with the use of Goal Seek.

Introduction

Structures have been designed ever since human being came into existence by using various means. Computational scenario has been changing over last 75 years. It started with intuition and hand calculations to design charts and monographs to slide rules to pocket calculator to main frame computers. Now it rests with desk top and laptop. Quantum computers which are still a couple of years away. Goal Seek feature of MS-Excel is applied in this paper. This is a more modern way to design reinforced concrete members. Standard notations [1, 2] are used. This paper uses schematic spreadsheets to bring formulas and output together. Any user can directly input the formulas into a worksheet to obtain results. But user must have knowledge of MS-Excel. See more detail in concluding remarks.

MS-Word and MS-Excel offer enormous computing, drawing and processing power for the design engineers. Designers must cross check carefully all the designs obtained from computer applications for accuracy and validity. This paper applies an MS Excel application Goal Seek to design of singly reinforced concrete beams and slabs.

Keywords: Analysis; Beam; Chart and Graph; Column; Concrete; Design; Detailing reinforcement; Goal Seek; MS Excel; Reinforced Concrete; Reinforcement; Slab; Spreadsheets; Structures; T-beam; What-If analysis;

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Goal Seek in MS Excel

In a forward analysis of relation $Y = f(x)$, value of dependent variable Y (or the result) can be found for any value of independent variable x (or input). However, many times, it is required to determine value of independent variable x for any given value of dependent variable Y . This is inverse or backward analysis. Goal seek determines input required to produce a desired output. Goal seek adjusts a cell value so a calculation will have a desired answer and it is used when the desired result of a single formula is known, but not the value formula needs for the result. Excel plugs different values into a cell until it finds a value that satisfies design equations. It amounts to finding a problem for a given solution. Goal seek, however, accommodates single variable problems only. Some well known and existing applications of Goal Seek are as follows:

- Budget Forecasts
- Loan Payments
- Break-Even Analysis
- Grade Calculations and Grade Point Targets

Goal Seek is a special what if tool to determine which cell in a worksheet needs to change to reach the required answer. Excel take existing values to determine the result. Goal Seek requires three following components:

- A formula to run values through or set cell contains a formula
- A target value to achieve
- A cell that it can change while testing the values. The cell to be changed must be referred to in the formula. Changing cell contains a variable.

To find Goal Seek: Click on Excel button to open it. Main headings on the ribbon of MS Excel are HOME, INSERT, PAGE LAYOUT, DATA, REVIEW, VIEW, ADD-Ins. A click on DATA group of commands opens a further dialogue box; Select DATA TOOLS and What-If Analysis. Click on What-If Analysis to find options:

Scenario Manager....

Goal Seek..... [Choose this option] See Figure 1

Data Table....

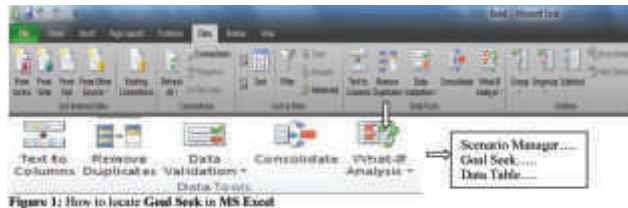


Figure 1: How to locate Goal Seek in MS Excel

Fig.1: How to locate Goal Seek in MS Excel

Stepwise procedure to use Goal Seek:

- Open a blank Excel worksheet and add labels in the first column to make it easier to read the worksheet.
- Add the known values against the appropriate row.
- Add the formula for Goal Seek. See following rule.
- Access Goal Seek data box and supply desired input from the worksheet. Click OK to see the results.
- Click cancel to reject Goal Seek solution. Command undo can also be used to reject Goal Seek Solution.

RULE: Cell identified in "Set Cell" box must contain a formula. No execution takes place without it.

"To Value" box must contains a valid number. See Figure 2.

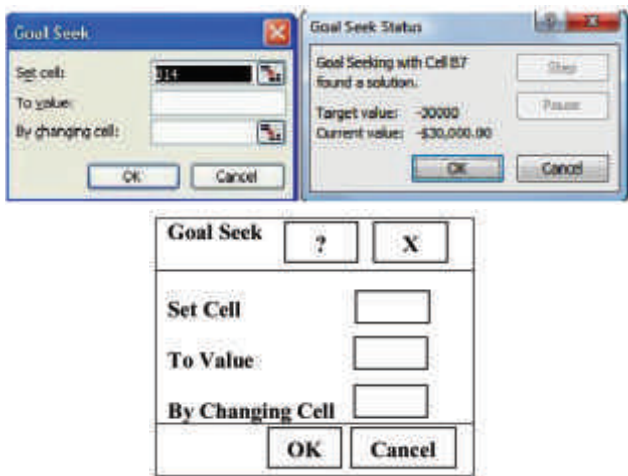


Fig.2: Real and Schematic screen shot of real Goal Seek dialogue box for analysis presented in this paper

Goal Seek dialogue box will be drawn in this paper as shown in Figure 2. It resembles actual dialogue box.

? Button opens help menu. X button closes goal seek dialogue box. Empty cells need input to give result.

Set cell box is address of a cell which must contain a formula

To Value box must contain a number which is specified in the problem

By Changing Cell box is adress of cell which is to receive the result of goal seek

Design of Singly Reinforced Concrete Beams and One-way Slabs

The limit state design concept to be used in this paper is described in IS-456 [1] and SP-16 [2]. SP-16 [2] gives several charts and tables to enable a designer in getting results as per IS-456 [1] without having to numerically solve equations. These charts are no doubt helpful but now that application software MS-Excel is readily available, this paper shows how to avoid chart reading and obtain desired results at the press of a button. In following analysis f denotes stress; ϵ denotes strain and E denotes modulus of elasticity. Subscript s denotes steel and c denotes concrete.

Inputs to Design: Design bending moment M_u

Member Size: Width b , Total Depth D , Effective Depth d and Span L

Ultimate Strength of concrete f_{ck}
[Design Strength in structure is $0.67f_{ck}$]

Ultimate strength of steel reinforcement f_y
[Design strength in structure is $0.87f_y$]

Three grades of steel namely, 250 N/mm^2 , 415 N/mm^2 and 500 N/mm^2 are recognized.

Area of steel in a beam/slab A_s is usually specified through a non-dimensional steel ratio $\rho = A_s/bd$

Whereas beams width b is an input design parameter, slabs are designed for per meter width ($b = 1000\text{mm}$).

Output of Design: Balanced steel ratio ρ_b [= A_s/bd at balanced condition] and limit moment M_u^b

Required area of steel reinforcement $\rho = A_s/bd$ with checks $\rho < \rho_b$ and $M_u < M_u^b$

IS-456 [1] gives upper and lower limits on the area of

$$\text{reinforcement } \frac{0.85}{f_y} < \frac{A_s}{bd} < \frac{0.04D}{d}$$

All design problems of structural mechanics must satisfy conditions of strain compatibility, stress strain laws, force and moment equilibrium. Application of these conditions yields solution of Table 1 for design of RC beam/slab. These equations are readily available in SP-16 [2] but are explicitly written in following table for use in the spreadsheet of MS Excel and in Goal Seek. Subscript/superscript b denotes balanced or limiting value.

Stress-Strain Law: $f_s = E_s \epsilon_s$ for steel; $f_c = E_c \epsilon_c$ for concrete;
Code specification for $E_s = 200000 \text{ N/mm}^2$ and $E_c = 5000 \sqrt{f_{ck}} \text{ N/mm}^2$

Code specifies at limit state (also balanced state): $\epsilon_c = 0.0035$ for concrete and $\epsilon_s = 0.002 + 0.87f_y/E_s$ for steel

Let x_u be the depth of neutral axis from top face of beam/slab.

Moment equilibrium at working condition gives reinforcement area A_s for given value of design moment M_u . This requires solution of a quadratic equation. SP-16 [2] gives Tables 1-4 [Pages 47-50] for beams and Tables 5-44 [Pages 51-80] for slabs to directly and conveniently obtain area of reinforcement A_s required to resist applied moment M_u . But a linear interpolation may be needed in some cases which can also be done on MS-Excel. This paper proposes use of Goal Seek feature of MS-Excel instead which avoids interpolation with linearity assumption.

Table 1: Expressions for singly reinforced flexural analysis/design of beams/slabs [2]

Condition	Working Condition	Balance Condition
Strain Compatibility	$\frac{x_u}{d} = \frac{\epsilon_c}{\epsilon_c + \epsilon_s}$	$\left(\frac{x_u}{d}\right)_b = \frac{0.0035}{0.0055 + 0.87 f_y / E_s}$
Force Equilibrium	$\frac{x_u}{d} = \frac{A_s}{bd} \frac{0.87 f_y}{0.36 f_{ck}}$	$\left(\frac{A_s}{bd}\right)_b = \frac{0.36 f_{ck}}{0.87 f_y} \left(\frac{x_u}{d}\right)_b$
Moment Equilibrium	$M_u = 0.87 f_y \left(1 - 0.416 \frac{x_u}{d}\right) \left(\frac{A_s}{bd}\right) bd^2$	$M_u^b = 0.36 f_{ck} \left(\frac{x_u}{d}\right)_b \left[1 - 0.416 \left(\frac{x_u}{d}\right)_b\right] * bd^2$

Spread sheet 1 for solution of beam design problem of Example 1

	A	B	OUTPUT	
1	Beam Design Data			
2	Width b	300	300	
3	Total depth D	600	600	
4	Effective depth d	562.5	562.5	
5	f(y)	415	415	
6	f(ck)	15	15	
7	E(s)	200000	200000	
8	Smallest A_s/bd	= 0.85/\$B\$5	0.0020482	
9	Largest A_s/bd	=0.04*\$B\$3/\$B\$4	0.0426667	
10	X_u/d (balance)	=0.0035/(0.0055+0.87*\$B\$5/\$B\$7)	0.4791075	
11	M(balance)	=0.36*\$B\$6*\$B\$10*(1-0.416*\$B\$10)*\$B\$2*\$B\$4*\$B\$4	196633781	
12	Rho(balance)	=(0.36*\$B\$6*\$B\$10)/(0.87*\$B\$5)	0.0071657	
13	As(balance)	=\$B\$12*\$B\$2*\$B\$4	1209.214	
14				
15	Design Moment M	=0.87*\$B\$5*\$B\$16*(1-1.005*\$B\$16*\$B\$5/\$B\$6)*\$B\$2*\$B\$4*\$B\$4	170000000	Goal Seek
16	Rho (required)	To be calculated by Goal seek Changing Cell	0.0059422	
17	As (required)	=\$B\$16*\$B\$2*\$B\$4	1002.7389	
18				
19	Test 1: $A_s > A_{min}$	=IF(\$B\$17 > \$B\$8, "SAFE", "REVISE")		
20	Test 2: $A_s < A_{bal}$	=IF((\$B\$17 < \$B\$13, "ACCEPT", "REJECT")		

Example 1: Design a RC BEAM (SRCB) with Concrete strength = 15 N/mm² Steel strength = 415 N/mm²

Beam width = 300 mm Beam depth = 600 mm
Effective depth = 562.5 mm (for 25mm bars)

Moment of resistance = 170 kNm. Choose $M = 1.7 \times 10^8$ N.mm to obtain consistent result.

Prepare a spread sheet in MS Excel to begin design. A schematic layout of this spread sheet is as follows.

Enter design values and Activate Goal Seek as follows.
NOTE: All formulas in MS-Excel start with an = sign.

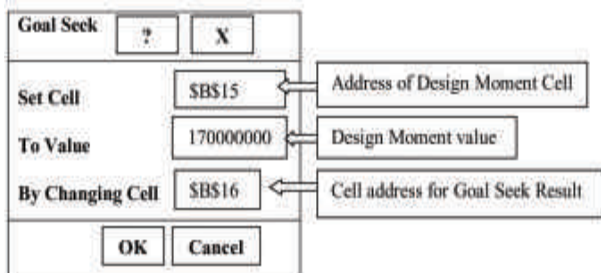


Table 2: Results of Analysis

	Limiting Value	Design value
Moment of resistance	1.965×10^8 N.mm	1.7×10^8 N.mm
Area of reinforcement	1210 mm ²	1003 mm ²

Comparison of results [Table 2] suggests that beam can be designed as singly reinforced.

Smallest $A_s/bd = 0.00205$; Largest $A_s/bd = 0.0427$;
Balance $A_s/bd = 0.00716$; Calculated $A_s/bd = 0.00594$.
OK.

Notice that values in rows 8 to 13 automatically update as soon as the design input data in rows 2 to 7 is input or changed. This example is solved in SP-16 [2] on page 11. Results obtained here match with the reported solution. Logical testing of results of analysis is important, for example, $(\text{Smallest } A_s/bd) < (A_s/bd) < (A_s/bd)^b$

Chart and Table given in SP-16 [2] could be used to design this beam. Calculate M_u per meter width $[170/0.3 = 567]$ Then use Chart 6 (p.23) for $f_y = 415$ N/mm² and $f_{ck} = 15$ N/mm² to give $A_s/bd = 0.006$ for use in design.

Alternatively, use Table 1 (p. 47) to calculate A_s/bd for $M_u/bd^2 = 1.79$ N/mm². Interpolation is required between values of $M_u/bd^2 = 1.78$ and 1.80 to obtain design value of $A_s/bd = 0.00594$. Goal Seek gives this value with ease. Designer has to detail reinforcement [Chart 95, p. 229]. See last section of this paper. Goal Seek provides no assistance in detailing.

Example 2: Design a one-way reinforced concrete slab: depth 100 mm, effective depth = 80 mm (width 1000 mm)

Design Bending moment is 9.6 kN.m per meter; Concrete strength = 15 N/mm² Steel strength = 415 N/mm²

This problem is solved in SP-16 [2] on page 11-12. Take the spreadsheet as above and input design values.

Spread sheet 2 for solution of slab design problem of Example 2

	A	B	OUTPUT	
1	Slab Design Data			
2	Width b	1000	1000	
3	Total depth D	100	10	
4	Effective depth d	80	80	
5	$f_t(y)$	415	415	
6	f_{tck}	15	15	
7	E(s)	200000	200000	
8	Smallest A_s/bd	$= 0.85/\$B\5	0.0020482	
9	Largest A_s/bd	$= 0.04 * \$B\$3 / \$B\4	0.05	
10	X_u/d (balance)	$= 0.0035 / (0.0055 + 0.87 * \$B\$5 / \$B\$7)$	0.4791075	
11	M(balance)	$= 0.36 * \$B\$6 * \$B\$10 * (1 - 0.416 * \$B\$10) * \$B\$2 * \$B\$4 * \$B\4	13257810	
12	Rho(balance)	$= (0.36 * \$B\$6 * \$B\$10) / (0.87 * \$B\$5)$	0.0071657	
13	A_s (balance)	$= \$B\$12 * \$B\$2 * \$B\4	573.25699	
14				
15	Design Moment M	$= 0.87 * \$B\$5 * \$B\$16 * (1 - 1.005 * \$B\$16 * \$B\$5 / \$B\$6) * \$B\$2 * \$B\$4 * \$B\4	9600000	Goal
16	Rho (required)	To be calculated by Goal Seek (Changing Cell)	0.0047934	Seek
17	A_s (required)	$= \$B\$16 * \$B\$2 * \$B\4	383.47374	

Goal Seek	?	X
Set Cell	SBS15	
To Value	9600000	
By Changing Cell	SBS16	
OK Cancel		

For design bending moment 9600000 N.mm, $A_s/bd = 0.0047934$ is obtained. It matches with printed result [2]. Include logical tests in rows 18 and 19 as described in solution of Example 1.

Chart and table given in SP-16 [2] could be used in design of slab. Following steps are involved.

Obtain $M_u/bd^2 = 2.07$ from Table D (p.10) for $f_y = 415$ N/mm² and $f_{ck} = 15$ N/mm² to suggest that slab can be designed as singly reinforced for design moment of 9.6 kN.m per meter. [b = 1000 mm and d = 80mm]

Read Chart 4 [for d = 5 - 30 mm (p.21)] $A_s/bd = 0.00475$; $A_s = 0.00475 * 100 * 8 = 3.8$ cm² per meter

This reading may require interpolation. Reading a chart involves personal judgment also.

Table 15 (p. 58) gives 8 mm dia. bars at 13 cm. spacing provide 9.8 (> 9.6) kNm per meter moment of resistance.

Table 96 (page 230) also provides area of bars for 3.8 cm² per meter with 8 mm dia. bars at 13 cm spacing. Goal Seek gives required A_s/bd value with ease but provide no detailing assistance. See last section of this paper.

Example 3: Design a Singly Reinforced RC BEAM with width 250mm and overall depth 500 mm (effective depth 460mm). It is to carry Limit state moment of 125 kNm. Use $f_y = 250$ N/mm² and $f_{ck} = 15$ N/mm²

Analysis of this problem finds that applied factored bending moment of 125 kNm which the beam is to carry exceeds the balanced moment M_u^b which is nearly 118 kNm. A designer has two alternatives to choose from:

(1) Design this beam as a doubly reinforced beam [See Following Section] (2) Increase width or depth or both to push up M_u^b beyond applied moment 125 kNm. Second alternative if adopted enables a singly reinforced design and requires assistance of What-If analysis. Beam width could be increased to push up M_u^b beyond applied moment but increasing depth gives quadratic effect because it carries power of two. This strategy is described in spreadsheet 3. A What-If analysis provides information given in Table 3.

Table 3: What-If analysis to push up M_u^b

Beam Width B	Total Depth D	Effective depth d (=D - 40)	M_u^b kNm
250	525	485	131
270	500	460	128
250	520	480	129

Spread sheet 3 for solution of beam design problem of Example 3

	A	B	OUTPUT	
1	Beam Design Data			
2	Width b	250	250	
3	Total depth D	525	525	
4	Effective depth d	485	485	
5	$f(y)$	250	250	
6	$f(ck)$	15	15	
7	E(s)	200000	200000	
8	Smallest A_s/bd	= 0.85/\$B\$5	0.0034	
9	Largest A_s/bd	=0.04*\$B\$3/\$B\$4	0.043299	
10	X_u/d (balance)	=0.0035/(0.0055+0.87*\$B\$5/\$B\$7)	0.531309	
11	M(balance)	=0.36*\$B\$6*\$B\$10*(1-0.416*\$B\$10)*\$B\$2*\$B\$4*\$B\$4	1.31E+08	
12	Rho(balance)	=(0.36*\$B\$6*\$B\$10)/(0.87*\$B\$5)	0.013191	
13	A_s (balance)	=\$B\$12*\$B\$2*\$B\$4	1599.424	
14				
15	Design Moment M	=0.87*\$B\$5*\$B\$16*(1-1.005*\$B\$16*\$B\$5/\$B\$6)*\$B\$2*\$B\$4*\$B\$4	1.25E+08	Goal
16	Rho (required)	To be calculated by Goal seek (Changing Cell)	0.012664	Seek
17	A_s (required)	=\$B\$16*\$B\$2*\$B\$4	1519.672	

Goal Seek	?	X
Set Cell	\$B\$15	
To Value	125000000	Design moment value
By Changing Cell	\$B\$16	
OK Cancel		

Include logical tests in rows 18 and 19 as described in solution of Example 1. Charts and Tables of SP-16 [2] can also be used in design of this beam as given in Example 1 but Goal Seek gives no detailing assistance. See last section of this paper for choosing number of bars or spacing of bars.

Role of What-if Analysis on Design of Reinforced Concrete Members

In structural design, loading specified in codes of practice is applied on the structure. It gives distribution of shear force and bending moment on various structural members. Given properties of construction materials, role of structural designer is to choose sizes of various members according to design constraints. Following example shows how a What-If analysis leads the designer to most appropriate member sizes. This kind of analysis is conventionally known as parametric study. A What-If analysis gives an immediate reply whereas a parametric study may require further computations. A What-If analysis was necessary in Example 3.

Example 4: Design a singly reinforced rectangular beam to carry bending moment $M = 65 \text{ kN.m}$.

Choose M15 concrete $f_{ck} = 15 \text{ N/mm}^2$ and mild steel $f_s = 250 \text{ N/mm}^2$.

Design requires selection of width b and depth D of the beam. Then area of reinforcement A_s can be found.

Selection of beam sizes b , D , d have to be such that $M < M_u$ (Balance).

Prepare a spreadsheet 4 as follows. First 10 rows are similar to spreadsheets 1 and 2.

Assume that design moment $M = M_u$ (Balance) so that design bending moment causes balanced failure.

Step 1: Select a suitable trial value for beam width b based on experience

Step 2: Calculate $\left(\frac{x_u}{d}\right)_b = \frac{0.0035}{0.0055 + 0.87 f_y / E_s}$

Step 3: Calculate value of this expression

$$\frac{M_u}{bd^2} = 0.36 f_{ck} \left(\frac{x_u}{d}\right)_b \left[1 - 0.416 \left(\frac{x_u}{d}\right)_b\right] = \text{say, } S$$

Step 4: Calculate $d = \sqrt{[M/(b \cdot S)]}$ This value of d results in a balanced failure as per assumption.

Step 5: Select another value of b and repeat steps 2 to 4.

Steps 1 to 5 provide a table containing assumed values of beam width b and corresponding effective depth d to cause balanced failure. Both b and d can be changed but change of d provides a quadratic effect as it carries a power of two. The designer can choose an appropriate combination and must provide larger effective depth to suppress compression failure and ensure a tensile failure. Steps 1 to 5 are implemented in spreadsheet 4 and provide Table 4 for information of designer. Further analysis can be done in usual way once the beam size has been determined.

Spreadsheet 4 for What-if Analysis

	A	B	OUTPUT
1	Beam Design Data		
2	Beam width b	200	200
3	f(y)	250	250
4	f(ck)	15	15
5	E(s)	200000	200000
6	Design Moment	65000000	65000000
7	Xu/d (balance)	=0.0035/(0.0055+0.87*\$B\$3/\$B\$5)	0.531309
8	Mu(balance)/bd ²	=0.36*\$B\$4*\$B\$7*(1-0.416*\$B\$7)	2.234935
9	Effective depth d	=SQRT(\$B\$6/(\$B\$2*\$B\$8))	381.3373

Table 4: Result of What-If analysis in Example 4

Assumed Beam Width (mm)	Calculated Effective depth (mm)
200	381.34
225	359.53
250	341.10
275	325.20
300	311.36

Construction of Design Tables

A What-If analysis together with Goal Seek enables construction of tables for ready use in design of singly reinforced beams and slabs. See Table 1 (p. 47) in SP-16 [2]. Following expressions are used.

$$M_u = 0.87 f_y \left(1 - 0.416 \frac{x_u}{d} \right) \left(\frac{A_s}{bd} \right) b d^2 \text{ Where } \frac{x_u}{d} = \frac{A_s}{bd} \frac{0.87 f_y}{0.36 f_{ck}}$$

Spreadsheet 5 Construction of design tables

	A	B
1	Design Table Construction	
2	Concrete Strength f_{ck}	15
3	Steel Strength f_y	250
4	Balanced Rho	Input from Table E: SP-16 [2, p. 10] Divide by 100 [0.0132]
5	M_u/bd^2	$= 0.87 * \$B\$3 * \$B\$6 * (1 - 1.005 * \$B\$3 * \$B\$6 / \$B\$2)$
6	Rho (required)	
7	Check	$= IF(\$B\$6 < \$B\$4, "OK", "REJECT")$

Goal Seek	0.55	X
Set Cell	\$B\$5	
To Value	0.55	M<sub>u</sub>/bd<sup>2</sup>
By Changing Cell	\$B\$6	
OK Cancel		

Table 5: Sample What-If Results for Concrete Strength $f_{ck} = 15 \text{ N/mm}^2$ and $f_y = 250 \text{ N/mm}^2$

M_u/bd^2	Goal Seek Analysis	Quoted in SP-16 [2]
0.55	0.002646	0.265
1.00	0.00502	0.502
1.26	0.006501	0.650
1.38	0.007217	0.722

Prepare a spreadsheet 5 with required input. Invoke Goal Seek. Change value of M_u/bd^2 . Table 5 has results.

Table 1 in SP-16 [2] reports no result for $f_y = 415 \text{ N/mm}^2$ beyond $M_u/bd^2 > 2.06$. Reason for this is as follows.

For $f_{ck} = 15 \text{ N/mm}^2$ and $f_y = 415 \text{ N/mm}^2$

$M_u/bd^2 = 2.00$, Goal Seek gives $\rho_t = 0.006841$

$M_u/bd^2 = 2.10$, Goal Seek gives $\rho_t = 0.007297$

Balanced ratio ρ [$f_{ck} = 15 \text{ N/mm}^2$ and $f_y = 415 \text{ N/mm}^2$] is 0.0072. Table E: SP-16 [2, Page 10]. Divide by 100.

Therefore, a check should be built in row 7. This check prompts a REJECT signal.

Design of Axially Loaded Short Columns

Code provisions in Clauses §25 and §39 of IS - 456 [1] apply in the design of an axially loaded short column.

See also SP -16 [2] in Section 3 on Page 99.

Gross area of a RC column is a sum of concrete and steel reinforcement areas: $A_g = A_c + A_s$

The cross-section of a column is specified as $A_g = (B \times D)$. $B = D$ in a square column so that $A_g = B^2$

Design Equation [§39.3] $P_u = 0.4 f_{ck} A_c + 0.67 f_y A_s$
write $A_c = A_g - A_s$

Write as $P_u = A_g [0.4 f_{ck} + \rho (0.67 f_y - 0.4 f_{ck})]$
where $\rho = A_s / B \times D = A_s / A_g$ is non-dimensional

This design equation gives required value of A_g to support load P_u .

Charts 24-26 [p. 109-111] and Chart 63 [p. 148] in SP-16 [2] apply for design of short compression members.

Example 5: Design a short axially loaded COLUMN [2]. Determine cross-section area ($B \times D$) and reinforcement amount A_s . Column may be square with dimensions $B = D$ or rectangular with dimensions B and D .

Design Load 3000 kN
Concrete $f_{ck} = 20 \text{ N/mm}^2$
Steel $f_y = 415 \text{ N/mm}^2$
Unsupported length 3m

Assume 1% reinforcement to be provided.
 $A_s = 0.01 \times B \times D = 0.01 \times A_g$

Substitute values in design expression:
 $3000 \times 1000 = BD \times (0.4 \times 20 + 0.01 \times (0.67 \times 415 - 0.4 \times 20)) = 10.7005 BD$

$BD \text{ (Required)} = 280360.7 \text{ mm}^2$

This value was obtained from Chart 25 (p. 110] of SP-16 [2]. It was reported to be 2700 cm² giving cross section dimensions as B = 60cm and D = 45cm. Value obtained in the present solution differs from it. It emphasizes that reading from a graph involves fair amount of personal judgment. Prepare a spreadsheet as follows to continue.

Check for allowed eccentricity (§25.4):

$$e_{\min} = \text{Unsupported length}/500 + \text{lateral dimension}/50 \\ = 6 + \text{lateral dimension}/30$$

Calculate $e_{\min}$ twice treating B and D, in turn, as lateral dimension. Denote as $e_{\min}(D)$ and $e_{\min}(B)$.

§39.3 for short axially loaded compression member $e_{\min}(D)/D < 0.05$ and $e_{\min}(B)/B < 0.05$

Use consistent units for B, D and $e_{\min}$.

For a square column $B = D = \sqrt{280360.7} = 529.49$ mm.
Select 550x550 cm² as size of a square column.

For square column 550x550 mm

$$e_{\min} = 6 + 550/30 = 6 + 18.3 = 24.3 \text{ mm}$$

$$e_{\min}/550 = 0.044 < 0.05 \text{ OK}$$

In case of a multi-story building, a rectangular column may be required. The designer now has to determine values of B and D to complete design. MS Excel offers What-If analysis facility which a designer can use to try various combinations of B and D till making a final selection. The size of square column may guide design of a rectangular column. For example, select B = 475 mm and find $D = 280360.7/475 = 590.233$, Select 600 mm

Prepare a Table to record results of above What-If analysis.
Use this table to guide the final selection.

B	D	Product
475	600	285000
425	675	286875
450	625	281250
500	600	300000

Spreadsheet 6 for design of axially loaded short column [Answers are derived in mm or mm² units]

	A	B	C
1	Design Load	3000 kN	
2	Concrete	20 N/mm ²	
3	Steel	415 N/mm ²	
4	Steel Area	1%	
5	Gross-Section A_g (mm ²)	=B\$1*1000/[0.4*B\$2+B\$4* (0.67*B\$3-0.4*B\$2)]	
6	Unsupported Length	3000 mm	
7	SQ OPTION:		
8	Square column B = D	=SQRT(B\$5) = 529.41 mm	
9	Select B = D	550 mm	
10	Product B*D	=B\$9*B\$9	=IF(B\$10>B\$5,"OK","REVISE")
11			
12	RECT OPTION:		
13	Select B	475	
14	Calculate D = A_g/B	=B\$5/B\$13 (280360.7/475)	
15	Select D	600	
16	Product B*D	=B\$15*B\$13 (285000)	=IF(B\$16>B\$5,"SIZE OK","REVISE")
17	What-If Analysis		
18	Choose B		
19	Find D	=B\$5/B\$18 Round it off	
20	Select D	600	=IF(B\$20*B\$18>B\$5,"OK","REVISE")
21	Eccentricity Check		
22	e(min) for B	=B\$6/500 + B\$18/30	
23	e(min) for D	=B\$6/500 + B\$20/30	
24	e(min) for B/B	=B\$22/B\$18	
25	e(min) for D/D	=B\$23/B\$20	
26	Check 1 on B	=IF(B\$24<0.05,"OK","REVISE")	
27	Check 2 on D	=IF(B\$25<0.05,"OK","REVISE")	

Design of Doubly Reinforced Beam

A Doubly Reinforced Beam becomes necessary under following situations.

- Beam dimensions have limitations and must be determined and fixed from other considerations.
- Design BM exceeds moment capacity of a corresponding Singly Reinforce Beam.
- Required steel ratio ρ exceeds balanced steel ratio of Singly Reinforce Beam.

Reinforcement in compression zone of a singly reinforce beam is provided as stirrup support so a beam becomes a doubly reinforced by default. Presence of compression reinforcement may, however, be ignored when steel ratio $\rho < \rho_b$ because yielding of tensile steel governs beam strength and presence of compression reinforcement has little effect on lever arm. Presence of compression reinforcement is found to reduce long-term deflection of beam but its outward buckling must be prevented. Explicit derivation of design equations is necessary for inclusion in the spreadsheet. Derivation of design equations require following assumptions (See Figure 3 for notations):

- Both tensile and compressive reinforcements yield at limit state.
- Compression failure is suppressed and tension failure occurs.

The strain is identical in steel and concrete in compression zone, however, stress is different because of difference in modulus of elasticity of these materials. Presence of concrete is neglected in tension zone in flexure analysis. It is noticed in SP-16 [2] that M/bd^2 values for design of a Doubly Reinforced Beam in Tables 45-56 [pages 81-92] starts where M/bd^2 values for design of a singly reinforce beam in Tables 1-4 [pages 47-50] stops due to overshooting of balanced value. This subdivision of a doubly reinforce beam into two parts is highlighted in Figure 3.

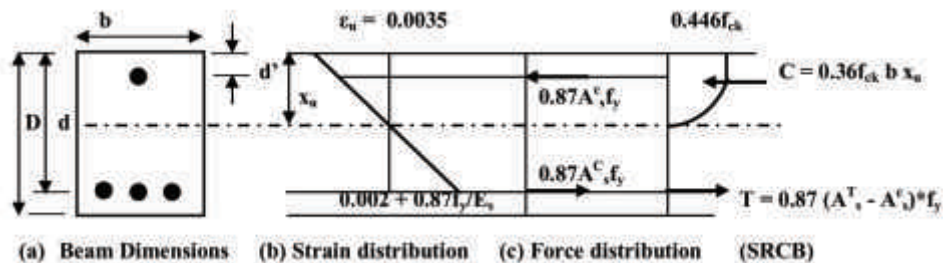


Fig.3: Strain and Force distributions in a doubly reinforced concrete beam

Apply Strain Compatibility: Similar triangles property of

strain distribution gives $\frac{\epsilon_u}{x_u} = \frac{\epsilon_s - \epsilon_y}{d'}$

Substitute as per Code of Practice [1] $\epsilon_u = 0.0035$ and $\epsilon_y = 0.002 + 0.87f_y/E_s$ with $E_s = 200000 \text{ N/mm}^2$

Solve to obtain Equation (1). Equation (1) establishes position of neutral axis.

$$\frac{x_u}{d'} = \frac{\epsilon_u}{\epsilon_u - \epsilon_y} = \frac{0.0035}{0.0035 - (0.002 + 0.87f_y/E_s)} = \frac{700}{300 - 0.87f_y} = \frac{804.6}{345 - f_y} \quad (1)$$

Apply Force Equilibrium:

$$0.87f_y A_s^T = 0.36f_{ck} b x_u + 0.87A_s^C f_y$$

$$0.87f_y [A_s^T - A_s^C] = 0.36f_{ck} b x_u$$

Divide both sides by quantity $(b \cdot d)$ to get

$$0.87f_y (\rho^T - \rho^C) = 0.36f_{ck} \left(\frac{x_u}{d'} \right) \left(\frac{d'}{d} \right)$$

ρ^T and ρ^C are tension and compression steel ratios

Therefore,

$$(\rho^T - \rho^C) = 0.4138 \frac{f_{ck}}{f_y} \frac{d'}{d} \frac{\epsilon_u}{\epsilon_u - \epsilon_y} = 0.4138 \frac{f_{ck}}{f_y} \frac{d'}{d} \frac{804.6}{345 - f_y} \quad (2)$$

It is instructive to note that Equation (2) holds when denominator $(345 - f_y)$ is greater than zero.

Apply Moment Equilibrium: Total moment capacity = $M_1 + M_2$

M_1 = Couple consisting of force in compression steel of area A_{sc} and force in equal amount of tension steel
 $= A_{sc}(d - d') = A_{sc}(1 - d'/d) \cdot d = \rho_c (1 - d'/d) \cdot bd^2 \quad (3)$

Where $\rho_c = A_{sc}/bd$ is compression steel ratio.

M_2 = Contribution of remaining amount of tension steel
 $= (A_{st} - A_{sc}) \cdot (d - 0.416 x_u) \cdot 0.87f_y \quad (4)$

Equation 4 applies to a SRCB with tension steel area = $(A_{st} - A_{sc})$

From Table 1 for SRCB:

$$M_u = 0.87 f_y \left(1 - 0.416 \frac{x_u}{d} \right) \left(\frac{A_s}{bd} \right) b d^2 \text{ Where } \frac{x_u}{d} = \frac{A_s}{bd} \frac{0.87 f_y}{0.36 f_{ck}}$$

Design Aids for Doubly Reinforced Beam: SP-16 [2] gives Charts 19 and 20 [p. 41-42] which are prepared for $f_s = 217.5 \text{ N/mm}^2$ and are applicable for mild steel reinforcement of 250 N/mm^2 . Table G [Page 13] gives multiplication (reduction) factors to apply on other steel grades in Charts 19 and 20 [p. 41-42]. Factors of 0.6 applied to $f_y = 415 \text{ N/mm}^2$ and factor of 0.5 applied to $f_y = 500 \text{ N/mm}^2$ reduce these to 250 N/mm^2 . It is not specified how use of these reduction factors with higher steel strength will ensure yielding at limit state in a doubly reinforced beam. See also Annexure G and §38.1 [1].

Example 6: Design a rectangular beam of size $[B = 30 \text{ and } D = 60 \text{ cm}]$ with 25 mm diameter bars ($d = 562.5 \text{ mm}$)

Design Moment 320 kNm $f_{ck} = 15 \text{ N/mm}^2$ and $f_y = 415 \text{ N/mm}^2$ $d' = 37.5 \text{ mm}$ ($d'/d = 0.07 \approx 0.1$)

$M_u/bd^2 = 3.37 \text{ N/mm}^2$ Reduction factor from Table G for $A_{sc} = 0.63$ for $A_{st} = 0.6$

This beam was designed in SP-16 [2, page 13] using various tables and chart.

Design of this beam as given in SP-16 [2] requires: $A_{st} = 1885 \text{ mm}^2$ and $A_{sc} = 705 \text{ mm}^2$

An alternative approach is as follows. Solution of Singly Reinforced Beam gives (See Example 1)

Moment of resistance of SRCB under Balanced Conditions = $196.634 \text{ kNm} < \text{design moment}$

Under Balanced Conditions $\rho_{bal} = A_{st}/bd = 0.0071657$ and $A_{st} = 1209.214 \text{ mm}^2$

Compression reinforcement must be provided for Excess Moment = $320 - 196.634 = 123.366 \text{ kNm}$

Consider that compressive steel A_{sc} and equal amount of tensile steel form a couple with lever arm $(d - d')$.

Equate moment of this couple to excess bending moment assuming that A_{sc} is at yield stage.

$$0.87 A_{sc} f_y (d - d') = A_{sc} * 415 * 525 * 0.87 = 189551.25$$

Therefore, From Figure 3c, $A_{sc} = (123.366 * 10^6) / 189551.25 = 650.832 \text{ mm}^2$

Therefore, total tensile steel area $A_{st} \approx 1860 \text{ mm}^2$ and compressive steel area $A_{sc} \approx 655 \text{ mm}^2$

These values are close to the solution of SP-16 [2, p. 13] and are within limits of truncation and round-off approximations to two decimal places required in preparation of charts and graphs. A structural designer can use above strategy to estimate extra bending moment capacity generated by compulsory stirrup support bars to be provided in compression area. Spreadsheet 1 is appended as follows to implement this strategy. Note the row number 15 to append Spreadsheet 1.

	A	B
21	Excess Moment	123366000
22	Lever Arm (d - d')	525
23	Comp Reo Area	=B\$21/(0.87*B\$5*B\$22)
24	Total Tension Reo Area	=B\$13 + B\$23

Design of Flanged Beams

Floor slabs in building construction are usually cast together with a support beam. A part of slab in this form of construction acts together with the upper part of support beam in resisting applied longitudinal and transverse loading. A T-Beam forms if slab is present on both sides of support beam or an inverted L-beam if slab is present only on one side of support beam. Such beams (Figure 4) are termed as flanged beam in which slab portion forms the flange. Code provision of §23.1, §23.2.1, §26.5.1.8 and Annexure G [1] and Tables 57-59 (p. 93-95) in SP-16 [2] apply in definition and analysis of flanged beams. It is important to ascertain that flanged beams form between supports where bending moments are positive and slab is on the compression side. Table 6 summarizes recommendations of IS-456 [1] in the use of following design equations. Factor Y_f appears to correct flange thickness to account for nonlinear parabolic distribution of compression stress.

Equation B:

$$M_u = 0.36 \frac{x_u^{\max}}{d} \left(1 - 0.42 \frac{x_u^{\max}}{d} \right) f_{ck} b_w d^2 + 0.45 f_{ck} (b_f - b_w) D_f \left(d - \frac{D_f}{2} \right)$$

Equation C:

$$M_u = 0.36 \frac{x_u^{\max}}{d} \left(1 - 0.42 \frac{x_u^{\max}}{d} \right) f_{ck} b_w d^2 + 0.45 f_{ck} (b_f - b_w) Y_f \left(d - \frac{Y_f}{2} \right)$$

$$Y_f = 0.15x_u + 0.65 D_f \quad [\text{Not greater than } D_f]$$

- Code provision of §23.1 [1] fixes width of flange in T-beams. Flange thickness usually D_f varies between 125 - 150mm in a typical residential buildings. It may go up to 200 mm in large commercial buildings.
- Provisions of IS-456 [1] on T-beams appear to be analysis oriented. But a What-If analysis can be done.
- Expressions for calculations of (x_u/d) and (x_u^m/d) in beams (Table 1) do not involve member geometry, so these apply to flanged beam also.
- A T-beam typically contains big amount of compression area as flange, therefore, at ultimate state, steel will be most likely at yield. Also, a large amount of tension reinforcement is usually required in the web so, effective depth must be liberally chosen to provide for up to two layers of tension reinforcement as given below.

For one layer of reinforcement, effective depth $d = D - \text{cover} - \text{stirrup dia.} - \text{bar diameter}/2$

For two layers of reinforcement, effective depth $d = D - \text{cover} - \text{stirrup dia.} - \text{bar dia.} - \text{spacing between bars}/2$

Example 7: Analyze a T-beam of size 960x375mm; Web Width = 200 mm; Flange Thickness = 125 mm

Effective Depth = 375 - 60 = 315 mm; $D_f/d = 0.3968$;
 $f_{ck} = 20 \text{ N/mm}^2$ $f_y = 415 \text{ N/mm}^2$

Use code [1] specified procedure.

Assume balanced condition. Expression for x_u^m from Table 1 estimates depth of NA as follows.

$x_u^m = 0.48 \times 315 = 151.2 \text{ mm}$ [$>125 \text{ mm}$] NA under balanced condition is in Web.

$D_f/x_u = 0.8267 > 0.43$; Equation C in Table 6 applies.

$Y_f = 0.15x_u + 0.65D_f = 103.93 < D_f$ OK Equation C gives $M_u = 241.74 \text{ kNm}$ round off to 240.0 kNm

Assume $x_u = x_u^m$ and apply $\frac{x_u}{d} = \frac{A_s}{bd} \frac{0.87f_y}{0.36f_{ck}}$

solve for A_s . Solution gives $A_s^b = 2895 \text{ mm}^2$

Actual area of reinforcement should be below $A_s^b = 2895 \text{ mm}^2$ to ensure a tensile limit state.

Input several values of $A_s < 2895 \text{ mm}^2$ and calculate corresponding moment capacity with a What-If analysis presented in spreadsheet 7 and Table 7. A suitable combination of moment capacity and A_s may be selected.

$A_s = 2600 \text{ mm}^2$ gives $x_u = 135.8 \text{ mm}$ [$>125 \text{ mm}$]. NA is still in web. Recalculate M_u replace x_u^m by x_u .

$D_f/d = 0.3968$ is unchanged but $D_f/x_u = 0.92 > 0.43$ Equation C gives $M_u = 237.37 \text{ kNm}$

Table 6: Summary of recommendations of IS-456 [1] and use of above design equations

Case		Further Requirement	Recommendation	Design Strategy
$X_u < D_f$	Neutral Axis is in Flange	$D_f/d < 0.2$ Stress distribution in flange is nearly uniform with centroid at $D_f/2$	Analyze as a rectangular beam: width equal to width of flange. Cracked concrete below NA has no strength.	Use Table 1 and Spreadsheet 1
$X_u > D_f$	Neutral Axis is in Web	$D_f/d < 0.2$ & $D_f/x_u < 0.43$ $x_u^m > x_u > D_f$	Analyze as a T-beam Substitute x_u^m by x_u	Use Design Equation B
		$D_f/d > 0.2$ & $D_f/x_u > 0.43$ $x_u^m > x_u > D_f$	Analyze as a T-beam Substitute x_u^m by x_u	Use Design Equation C

Spreadsheet 7: What-If Analysis for design of T-beam of Example 7.

	A	B	OUTPUT
1	Design of T-Beam: [N & mm]		
2	Concrete strength f_{ck}	20	
3	Steel strength f_y	415	
4	Flange width b_f	960	
5	Flange thickness D_f	125	
6	Total depth of T-beam D	375	
7	Amount of cover	60	
8	Beam width b_w	200	
9	Reduced Depth $D - D_f$	= $\$B\$6 - \$B\5	250
10	Effective Depth d	= $\$B\$6 - \$B\7	315
11	Depth of NA at balance x_u^m/d	= $700/(1100+0.87*\$B\$3)$	0.47910749
12	Check Neutral Axis	=IF($(\$B\$11*\$B\$10)>\$B\5 , "NA in Web", "NA in Flange")	NA_in_Web
13	Calculate D_f/d	= $\$B\$5/\$B\10	0.3968254
14	Calculate D_f/x_u^m	= $\$B\$5/(\$B\$11*\$B\$10)$	0.82825964
15	Calculate Y_f	= $(0.15*\$B\$11*\$B\$10+0.65*\$B\$5)$	103.887829
16	$D_f/d < 0.2$ & $D_f/x_u < 0.43$ (M_u by Equation B)	= $0.36*\$B\$11*(1-0.42*\$B\$11)$ * $\$B\$2*\$B\$8*\$B\$10*\$B\$10+0.45*\$B\$2*$ ($\$B\$4-\$B\$8)*\$B\$5*(\$B\$10-0.5*\$B\$5)$	270569066
17	$D_f/d > 0.2$ & $D_f/x_u > 0.43$ (M_u by Equation C)	= $0.36*\$B\$11*(10.42*\$B\$11)*\$B\$2*\$B\$8*\$B\$10*\$B\$10+0.45*\$B\$2*(\$B\$4-\$B\$8)*\$B\$15*(\$B\$10-0.5*\$B\$15)$	241607313
18	Steel Area A_s	= $(\$B\$11*0.36*\$B\$2*\$B\$4*\$B\$10)/(0.87*\$B\$3)$	2889.21523
19	Choose A_s	2600	
20	Calculate new X_u	= $(\$B\$19/\$B\$4)*(0.87*\$B\$3)/(0.36*\$B\$2)$	135.81
21	Check Neutral Axis	=IF($\$B\$20>\$B\5 , "NA in Web", "NA in Flange")	NA_in_Web
22	Calculate M_u (x_u^m) Use Equation C	= $0.36*(\$B\$20/\$B\$10)*(1-0.42$ * $(\$B\$20/\$B\$10))*\$B\$2*\$B\$8*\$B\$10*\$B$ $\$10+0.45*\$B\$2*(\$B\$4-\$B\$8)*\$B\$15$ * $(\$B\$10-0.5*\$B\$15)$	237.37

Table 7: WHAT-IF Analysis of T-Beam by changing area of steel reinforcement < 2895 mm²

Steel Area mm ²	Depth of NA	Location of NA	M_u by Eq. C kNm
2800	146.26	Web	240.33
2700	141.03	Web	238.87
2600	135.81	Web	237.37
2500	130.59	Web	235.85
2393	125.00	Web/flange	234.17

Note that a simple expression $M_u = 0.87f_y A_s d$ gives: $A_s = 240000000/(0.87*415*315) = 2110 \text{ mm}^2$ although it puts neutral axis in flange. This value $A_s = 2110 \text{ mm}^2$ is 73% of $A_s = 2895 \text{ mm}^2$ which applies under balanced condition.

Alternate Procedure for T-beams Analysis or Design

T-beam is sub-divided into a web beam [width b_w] + a flange beam [width $(b_f - b_w)$].

Both these beams are again rectangular Singly Reinforced Beam (Figure 4).

Total area of reinforcement A_s is divided in web area A_s^w and flange area A_s^f ; So that $A_s = A_s^w + A_s^f$.

Total moment capacity M_u of T-beam = Moment capacity of web beam M_u^w + of flange beam M_u^f .

ANALYSIS PROBLEM: Steel area A_s , beam dimensions and material properties are given.

Moment capacity M_u is unknown. Calculate (See Table 1) value of x_u/d and x_u^m/d .

Check $x_u^m/d > x_u/d$ to ensure a tensile limit state; revise beam dimension and properties if $x_u^m/d < x_u/d$.

Check against flange width D_f . If $x_u < D_f$; Perform a rectangular beam analysis of width b_f (Table 6).

If $x_u > D_f$; It indicates following T-beam analysis.

Analysis of flange beam of width $(b - b_w)$

Consider uniform compressive flange force and apply force equilibrium: $0.446f_{ck}(b - b_w)*D_f = 0.87A_s^f f_y$

This condition gives value of A_s^f . Calculate $A_s^w = A_s - A_s^f$

Use expression $M_u = 0.87f_y \left(1 - 0.416 \frac{x_u}{d}\right) \left(\frac{A_s}{bd}\right) bd^2$

repeatedly with known values of A_s^w and A_s^f

Calculate moment capacity contributions of web and flange beams. Add these to get final answer M_u .

DESIGN PROBLEM: Required moment capacity, beam dimensions and material properties are given.

Area of steel A_s to ensure tensile limit state is unknown. As per the proposed procedure $A_s = A_s^w + A_s^f$

Calculate value of x_u^m from given material properties. Area of steel reinforcement A_s is unknown.

So, following trial procedure is necessary to locate neutral axis (value of x_u). Only one trial is often sufficient.

- Given expected M_u ; Assume $x_u = D_f$ (NA at bottom of flange to give lever arm $= d - D_f/2$)
- Calculate value of A_s from moment equilibrium equation.
- Use this value of A_s to calculate x_u/d from force equilibrium. Check new x_u against previous x_u

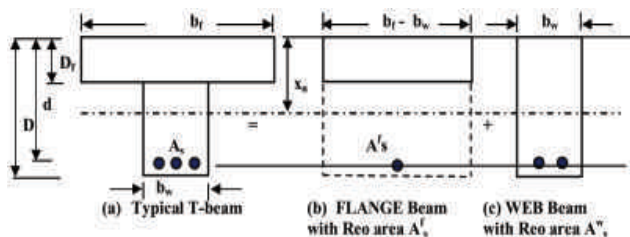


Fig. 4: Geometry of a T-beam and its subdivision for simplified analysis

- This new $x_u > D_f$ will indicate T-beam analysis.

- Check against maximum x_u^m as calculated from expression of Table 1.

When Neutral Axis in flange: T-beam is analyzed as a singly reinforced beam of width b_f (See Table 6).

When Neutral Axis in Web: Following solved Example 8 illustrates design procedure.

Example 8: Find steel area A_s for T-beam subjected to a moment of 240 kNm.

T-beam size is 960x375mm; Web Width = 200 mm; Flange Thickness = 125 mm

Effective Depth = 375 - 60 = 315 mm; $D_f/d = 0.3968$;

$f_{ck} = 20 \text{ N/mm}^2$ $f_y = 415 \text{ N/mm}^2$

Assume balanced condition. Expression for x_u^m from Table 1 estimates depth of NA as follows.

$x_u^m = 0.48 * 315 = 151.2 \text{ mm} [> 125 \text{ mm}]$ the neutral axis under balanced condition is in web. $A_s^b = 2895 \text{ mm}^2$

Start trial procedure to locate x_u .

Assume $x_u = D_f = 125$ Use $M_u = 0.87f_y \left(1 - 0.416 \frac{x_u}{d}\right) \left(\frac{A_s}{bd}\right) bd^2$

Calculate value of $A_s = 2527.5 \text{ mm}^2$

Apply Where $\frac{x_u}{d} = \frac{A_s}{bd} \frac{0.87f_y}{0.36f_{ck}}$

with above value of A_s and calculate x_u .

$x_u = 132 \text{ mm} > 125 \text{ mm}$

A T-beam analysis is indicated.

Analysis of Flange Beam: Use flange thickness D_f and width $(b - b_w)$ as follows to calculate A_s^f

Apply force equilibrium: $0.87A_s^f f_y = D_f * (b - b_w) * 0.36f_{ck}$
 $A_s^f = 1894.5 \text{ mm}^2$ $M_f = 0.87 * f_y * A_s^f * (d - 0.5 * D_f) = 172.7 \text{ kNm}$

Analysis of Web Beam: $M_w = M_u - M_f = 240 - 172.7 = 67.3 \text{ kNm}$

This requires use of spreadsheet 8 together with Goal Seek

Spreadsheet 8: Calculation of A_s^w [See rows 15-17 of Spreadsheet 1]

	A	B	OUTPUT
1	Design Moment M_w	$=0.87*415*200*315*315$ $(1-1.005*\$B\$2*415/20)$ $*\$B\2	67300000
2	Rho (required)		0.01282
3	A_s^w required	$=\$B\$2*200*315$	808

Goal Seek

Therefore, $A_s = 1894.5 + 808 = 2703 \text{ mm}^2 < A_s^b = 2895 \text{ mm}^2$ OK

This result is compatible with data of What-If analysis given in Table 7.

Selection of Number of Bars/spacing for Required Target Reinforcement Area

Analysis presented in this paper and any design exercise of RC members leads to the area of reinforcement. A designer or analyst then is required to choose size of bars and number of such bars. Spreadsheet 9 does this job for a designer or analyst. Size of reinforcing bars and area of one such bar is extracted from SP-16 [2, Tables 95 and 96].

Cell C5 contains formula: $=\text{ROUNDUP}(\$B\$5/C3,0)$. Ratio $(\$B\$5/C3)$ is target area/area of one bar. Notice absolute reference $\$B\5 for target area and relative reference for area of one bar (C3) This formula is copied to cells D5-O5 by AUTOFILL process: relative reference C3 changes from $=\text{ROUNDUP}(\$B\$5/C3,0)$ to $=\text{ROUNDUP}(\$B\$5/O3,0)$. Function ROUNDUP rounds the number obtained by calculation to next higher number with zero decimal figures to obtain integer output.

Target reinforcement area for beams is placed in cell B5. Excel immediately gives number of bars of sizes ranging from 6mm to 36mm. Minimum number of bar is 1. Required area of reinforcement in spreadsheet1 is 1005 mm^2 . It requires 9 bars of 12mm dia. and 4 bars of 20mm dia. An analyst or designer now can make a suitable choice from results of spreadsheet 9. Spreadsheet 9 gives complete result as soon as a target reinforcement area is input.

Lower part of spreadsheet 9 applies for design of slabs [2, Table 96, p. 230] which is little more complex.

Designer is required to choose spacing besides the number/size of bars.

Following conversions apply.

Area of reinforcement at any spacing = Area of one bar $\times [1000/\text{Spacing of bars}]$

Area of reinforcement at 200 mm spacing = Area at 100 mm spacing/2

Area of reinforcement at 300 mm spacing = Area at 100 mm spacing/3

Spreadsheet 9: Select number of bars of a size for target area (Units are mm for size and mm^2 for area)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Number of Bars														
2	Bar Size		6	8	10	12	14	16	18	20	22	25	28	32	36
3	Bar Area		28	50	79	113	154	201	254	314	380	491	616	804	1018
4	FOR BEAMS (Number of bars)														
5	Target (mm^2)	1005	36	21	13	9	7	5	4	4	3	3	2	2	1
6															
7	FOR SLABS (Spacing in mm per 1000 mm)														
8	Target (mm^2)	1340	20	37	58	84	114	150	189	234	283	366	459	600	759
9															

Area of one 12 mm bar = 113 mm^2 12 mm bars at 50 mm spacing = $113 * 1000 / 50 = 2260 \text{ mm}^2$

Target reinforcement area is placed in cell B8. Cell C8 contains formula: =ROUNDDOWN(1000*C3/\$B\$8,0)

This formula is copied to cells D8-O8 by AUTOFILL process so that relative reference C3 changes as given above.

In this case, output in a cell gives spacing of bars per 1000 mm provided the bar size in row 2 of that cell is chosen.

This output may be rounded to a multiple of 5 or 10 which may be nearest for field application.

Output of spreadsheet 9 for slabs is read as follows:

Target reinforcement area of 1340 mm^2 per 1000 mm is met by 12mm dia. bars placed at 84 mm c/c.

Target reinforcement area of 1340 mm^2 per 1000 mm is met by 16mm dia. bars placed at 150 mm c/c.

The spreadsheet 9 permits a What-If analysis to enable a designer to select the most favorable design.

In fact, a What-If analysis in spreadsheet 9 can generate entire Tables 95 and 96 of SP-16 [2].

Concluding Remarks

Use of Excel spreadsheets in engineering calculations is common. Internet search reveals that Goal Seek utility has been extensively used only in financial and budget planning. Use of Goal Seek in this paper in structural design of Reinforced Concrete members such as beam and short column is original. First two examples show derivation of required area of reinforcement. Third example presents a What-If analysis which precedes Goal Seek. It helps a designer in fixing size of a reinforced concrete beam to handle given moment leading to a singly reinforced beam. Short columns can also be similarly designed. A straight forward What-If analysis together with Goal Seek provides an efficient means to

construct design tables. This paper deals with problems of design of Reinforced Concrete members where area of steel reinforcement is unknown. Several spreadsheets (schematic) are presented for this purpose. Given the area of steel reinforcement (analysis), design equations directly provide required moment capacity. This research is a modern alternative of tables and charts of first 95 pages of SP-16. However, these graphs and charts [2] are useful to verify numerical computations. More research is in progress. Reader and user of this paper should have some knowledge of Excel.

Excel offers speed, unprecedented accuracy and total visibility. Goal Seek, however, does not assist in reinforcement detailing. A designer has to use other means to detail reinforcement in Reinforced Concrete members. Excel only partially helps in making faster design decisions. This paper partially resolves this problem also.

This paper presents schematic spreadsheets instead of screenshots of Excel worksheet. Schematic spreadsheets are thought to be more informative for following reason. Formulas in MS Excel remain hidden while calculation result appears in the cell. Select a cell and formula in this cell is displayed in Formula Bar. Press [CTRL + grave apostrophe (found on the keyboard on the left of exclamation key)] together to switch back and forth from displaying formulas to displaying values on worksheet. MS Excel cannot display formulas and output together. The schematic spreadsheets of this paper (instead of Excel screenshots) bring formulas and output together for greater understanding by a user who may not have in-depth knowledge of MS Excel and still wants to use MS Excel. Formats of Schematic spreadsheets of this paper and actual Excel worksheets are identical. It is readily possible to transfer formulas from Schematic spreadsheets to actual Excel worksheets.

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Insight Brief: Net Zero by Design - Material Minimalism First, Technology and Transition Next



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Aun Abdullah - Lodha

Abstract

The construction sector has traditionally approached carbon reduction through substitution of high-emission materials with lower-carbon alternatives. However, a more fundamental strategy lies in material minimalism designing with the objective of reducing overall material demand before considering substitutions (Chusid, 2018). This approach emphasizes efficiency in space planning and structural design, ensuring that only what is essential is drawn from natural resources.

For India, the challenge is particularly pressing: the nation must simultaneously expand its built environment to meet rapid urbanization needs while drastically curbing embodied carbon emissions (MoHUA, 2021; UNEP, 2022). Replicating global templates is insufficient; the Indian context demands solutions rooted in material security, scalability, and resource efficiency (NITI Aayog, 2021). Housing, as the largest consumer segment, offers significant opportunities for decarbonization if design practices are optimized to maximize performance per unit of material consumed. Baseline studies indicate embodied carbon levels of 400–450 kgCO₂e/m² in Indian mass housing projects (Bansal et al., 2020), highlighting the scope for reduction through improved design methodologies.

This paper examines strategies to achieve this transition, drawing on case studies that demonstrate the impact of thoughtful planning, efficient structural systems, and ecosystem-level alignment among stakeholders. It concludes by outlining a roadmap for mainstreaming material minimalism, positioning it as a critical pathway for India's sustainable growth.

Keywords: Material minimalism; Embodied carbon; Sustainable construction; Mass housing; Design efficiency; Material security; Low-carbon built environment

1. Introduction

The way we design and construct buildings has a profound influence on carbon emissions. Globally, the building and construction sector contributes nearly 37% of greenhouse gas emissions, underscoring the urgency of rethinking design priorities (UNEP, 2022). While functionality and safety have traditionally formed the foundation of design, the carbon impact of material use has often been overlooked. For decades, structural design has been governed by codes and standards guided by two primary aspects strength and serviceability (BIS, 2000; BIS, 2007). These frameworks have served their purpose well, but sustainability must now be accorded equal weight. Designers are required to revisit fundamental principles and initiate a philosophical shift in material consumption, embedding sustainability alongside Strength, Serviceability, and Safety (Rao and Jha, 2019).

Structural form and efficiency are intrinsically linked. Designs that utilize direct load paths, regular geometries, and optimized structural schemes demand fewer resources, resulting in lighter and more refined spaces (Ashraf et al., 2017). Simplicity, therefore, is not merely an aesthetic principle but a cornerstone of sustainability (Chusid, 2018). Parallel to this, public education plays a vital role in fostering climate consciousness and sensitizing society to the hidden environmental costs of complex, resource-intensive spaces (IGBC-CII, 2020).

For India, where the scale of upcoming development is unparalleled, this shift is non-negotiable. Carbon-insensitive models of the past cannot be sustained. Instead, development must balance material security with climate resilience, rethinking building design to integrate innovation, performance, and sustainability from the outset (NITI Aayog, 2021). Baseline

assessments for mass housing indicate embodied carbon levels of approximately 400–450 kgCO₂e/m², demonstrating both the challenge and opportunity for large-scale decarbonization (Bansal et al., 2020).

Lodha has been pioneering this design philosophy for over a decade, showing that resource efficiency and elegance can coexist, and that sustainability-driven solutions can form the basis of both performance and aesthetics.

Decarbonizing construction rests on three interdependent and overlapping layers of transformation:

Material Minimalism – The most immediate, cost-effective, and high-impact strategy, achieved through sustainable design thinking that reduces overall material use. This approach delivers rapid and substantial reductions in embodied carbon (Gieseke et al., 2016).

Low-Carbon Technologies – A crucial yet gradual process shaped by regulatory, safety, supply chain, and economic factors. This includes innovations such as low-emission concrete and steel, as well as recycled and alternative materials. Gains in this layer will emerge progressively (Rao and Jha, 2019).

Clean Energy Transition – System-wide emission reductions achieved by decarbonizing material production through renewable energy, hydrogen, carbon capture utilization and storage (CCUS), and electrification (NITI Aayog, 2021). Some advances in this area are already feasible, though a full transformation will require time.

For deep carbon reduction, these layers must be pursued in the right sequence. The first and third layers provide immediate opportunities and must be maximized early. Otherwise, the incremental progress from low-carbon technologies alone will be insufficient to achieve the scale of change required.

2. India's Urban Context

India's urban transformation is unfolding at an unprecedented scale. Estimates suggest that nearly 100 million new homes will be required over the next decade to meet housing demand (MoHUA, 2021). The speed and scale of this development have few historical parallels, with only China's recent urban expansion offering a comparable example (World Bank, 2019). By contrast, Western nations underwent urbanization over much

longer timeframes, during periods when climate risks were less immediate. India, however, faces this challenge in an era where climate change is already a pressing reality, making it untenable to follow the same development trajectories of the past (NITI Aayog, 2021).

This wave of urbanization will be built primarily with reinforced cement concrete (RCC), which remains the dominant construction material shaping India's cities. Yet, cement and concrete together account for nearly 40% of embodied carbon in buildings (IEA, 2020). Unless new approaches are adopted, India's housing expansion risks locking in high-carbon assets for decades to come. Addressing energy security, material security, and climate security must therefore be at the core of future development strategies (UNEP, 2022).

The challenge is clear: How can India build at this unprecedented scale and speed while ensuring durability and minimizing lifecycle carbon emissions?

Shifting the Focus: The Median Matters

Conversations on sustainable buildings often highlight the exceptional iconic green projects, experimental prototypes, or high-performance structures. While these examples can inspire innovation, they rarely represent the majority of real-world construction. In reality, it is the median building – the ordinary mass housing project – that will define India's urban footprint. Mainstreaming sustainable design into this segment is therefore critical

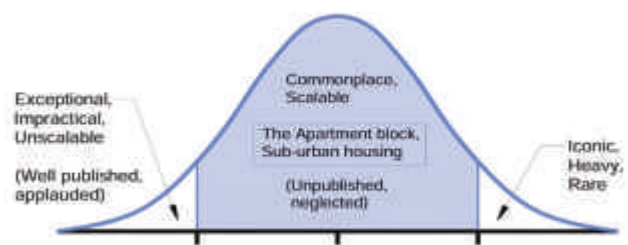


Fig.1 Shifting the Focus - The Median Matters

for large-scale decarbonization (Bansal et al., 2020). Instead, the emphasis should be on the median – the apartment blocks, suburban owner-developed housing, and other commonplace forms of construction. This is the segment where the real impact lies. Unlike the leading edge of innovation, where isolated breakthroughs provide symbolic but limited gains, or the trailing edge, where experimental concepts remain too immature to scale, the median represents the space where

meaningful, scalable improvements must occur (Giesekam et al., 2016; Bansal et al., 2020).

It is important to clarify that this discussion is not about the already well-established and codified design practices of the structural engineering profession (BIS, 2000; BIS, 2007), but rather about rethinking how these mainstream buildings can be delivered with far greater efficiency, material consciousness, and sustainability.

3. Creation of Enclosed spaces - Basic Structural Forms

Space is usually defined and enclosed by an architectural system imposed on a structural system. As an example, consider a high-rise office building consisting of lightweight exterior curtain walls and movable interior partitions fastened to a multistory structural frame. The frame must resist all applied loads including the weight of the walls and partitions, the live load, and the effects of the external environment. The floor system, which is usually a combination of structural and architectural components, completes the subdivision of interior space. For a discussion on Basic Structural Forms, we refer here to the chapter on Structural Forms in the book entitled "Structural Engineering" cited in the first reference. Reference is also made to the chapter on the Brief History of Structural Theory cited in the second reference.

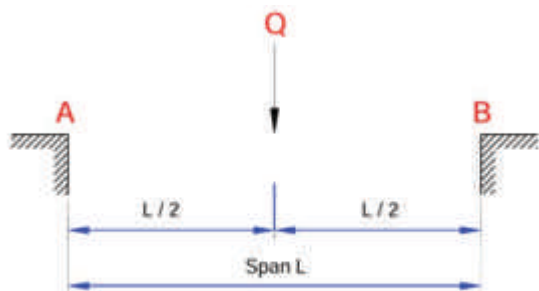


Fig.2 Point Load from Space to Supports

The ultimate role for any structural system is that of transmitting forces through space from the source of load to the foundation. The technical success of the system depends on how efficiently this flow of load is accomplished. As an illustration, let us consider a simple case of transferring a point load from space to the supports A and B as shown in Figure 2. The basic structural forms from the standpoint of force transmission through space can be classified as follows:

3.1 Tension or compression structures

In tension or compression structures, the load is transmitted by a single state of stress as shown in Figures 3(a) and 3(b). The pure tension structure is form-active in that it takes on a certain geometry for any given loading. It provides a highly efficient usage of material. The compression structure also can be quite efficient, but its load capacity is usually limited by buckling rather than by the inherent strength of the construction material.

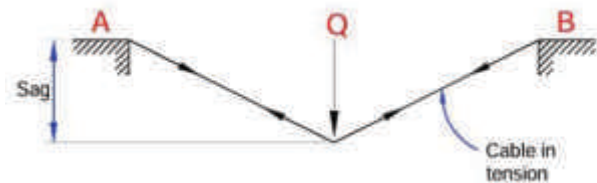


Fig.3(a) Tension Structure

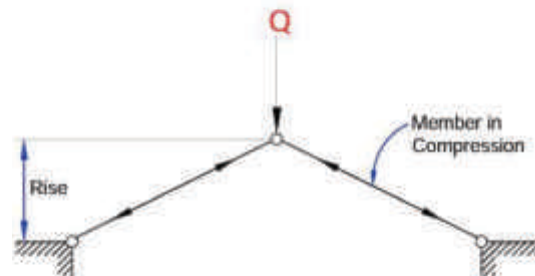


Fig.3(b) Compression Structure

Tension Structures: A tension structure redirects the applied loading to the supports by tension alone in the primary members of the structure. It requires a construction material with high tensile load capacity. The shape of a tensile structure is a unique function of the magnitude and position of the applied loads.

Compression Structures: There are two simple structural forms suited for carrying forces by compression alone - the column and the arch. A column is a straight member loaded along its centroidal axis with a compressive load. Except when it is extremely short, the column is less efficient than a tensile member because it has the tendency to buckle when compressed. The ideal arch form for a given loading is the inverse of the funicular shape. It can be built from materials that have high compressive strength, and it must have sufficient stiffness to prevent buckling.

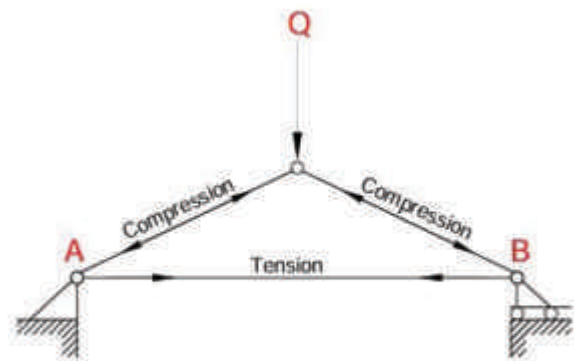
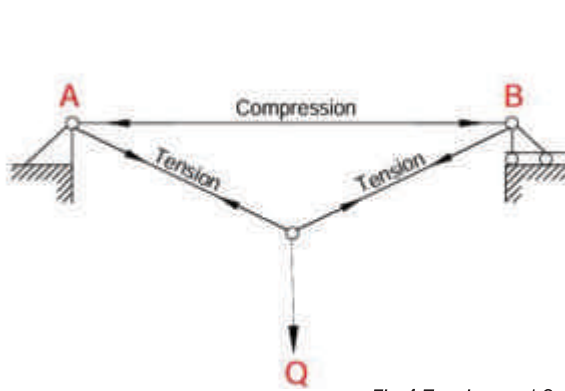


Fig.4 Tension and Compression Structure (Truss Form)

3.2 Structures with tension and compression elements (Truss Form).

The truss, made up of a pinned assemblage of members, carries variable loadings through the mechanism of varying magnitude of the member axial forces. It has excellent efficiency and is usually very stiff.

A truss is a triangular form with both tensile and compressive elements. The force transmission is provided by redirection of the loads into a series of forces in equilibrium with each other and any external loads at each hinged joint. The truss always consists of a number of straight components with roughly half in tension and the other half in compression. Any number of geometrically rigid triangles can be interconnected to give a stable configuration.

If loads are applied only at the joints, it does not have the undesirable bending in members. The assemblage of members is capable of redirecting any conceivable system of joint loads to any proper set of support points. Finally, the number of truss members and their precise configuration are design variables that give great flexibility to the engineer in shaping the structure to fit the specified problem at hand.

3.3 Structures Transmitting Loads by Bending Action

If user space requirements necessitate more clear heights above and below the truss, truss form is not feasible because the forces in the members grow rapidly as the height of the truss is decreased. A shallow truss might be considered as a possible solution, but we must be aware of what a decrease in truss depth does to the forces in the truss members.

Although a very shallow truss is theoretically feasible, there will be a large number of joints and individual members in the truss, and the cross-sectional area of each chord member will become large. The truss can be replaced by a solid element, called a beam in which the top portion of the beam acts as a compression chord and the bottom portion as the tension chord. In addition to resisting the tension and compression forces, the beam fibers also must carry the forces that would have been resisted by the truss verticals and diagonals.

Bending or flexural structures, in which load normal to the member is transmitted along the member by bending action. The typical bending structure is not as efficient as a pure tension or compression structure, but it remains

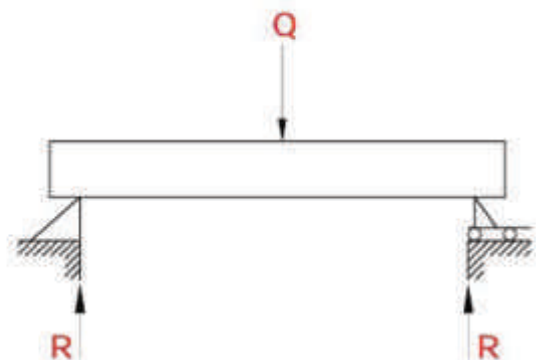
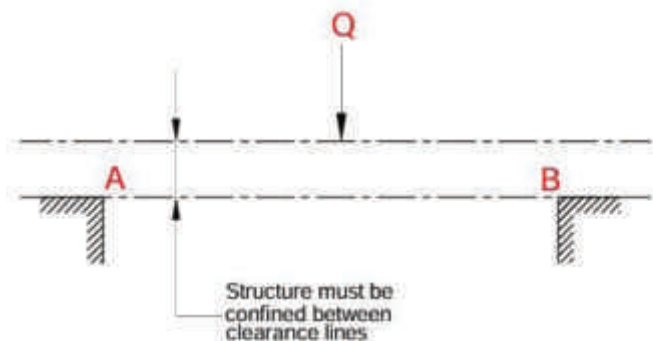


Fig.5 Bending or Flexural Member

one of our most widely used forms because of its simplicity and adaptability to almost any situation.

Bending action is also the primary load-carrying mechanism in slab floor systems. A slab can be viewed as a continuum of beam elements, spanning in either one or two directions to supporting walls or girders.

4. The Need for Controlling Flexure in the Structural System

A variation of the basic beam form is the frame, made up of a number of beam and column elements. A sizable percentage of modern construction is dependent on the frame form, even though it is often less efficient structurally than other forms. The clear rectangular openings afforded by a conventional frame make up highly functional spaces.

The precise configuration of a multistory, three-dimensional frame is influenced strongly by gravity loads and lateral loads. The frame form is often clubbed with core walls for efficient transfer of lateral shear. The horizontal lateral loadings are transmitted to the foundation of the building by bending and shear action of the core walls. The vertical members of such structures must carry both the gravity-induced compressive loadings as well as bending action induced by the gravity and lateral loads.

An increased appreciation of form will come with a better understanding of structural behavior. Structural engineers shall address the below three key questions in proposing best structural system for any given situation:

- How does the structure transmit its loads to its supporting foundation?
- What type of deformations and stresses are produced by the force transmission?
- How could the form be improved for material efficiency without compromising its function and aesthetic appeal?

Goal of structural engineer is to utilize the material employed to the maximum structural advantage. A rectangular beam member is less efficient compared to utilization of material in the pure tension or compression members. Hence different geometrical shapes were developed viz. I sections, tubular sections to maximize the moment of inertia for use in design. However in the cast in situ RCC buildings, it is common to use rectangular sections considering the ease of forming.

From the above discussion it is clear that the structural engineer shall focus on ways to reduce the degree of bending in a multi story structure for enhancing the material utilization efficiencies. Attention shall be paid at system level optimization for achieving the goal. When forces flow naturally, materials perform at their peak. This principle, though simple, demands a fundamental shift in how we conceptualize structural framing.

To illustrate the concept, consider two scenarios: (i) a slab supported on a beam-column frame, as depicted in Figure 6(a), and (ii) a slab directly supported on a structural wall, as shown in Figure 6(b). In the beam-column framing, the beam and column sections must be designed to withstand the localized moments, denoted as M_{xa} . Conversely, when the slab is supported by walls, a wider slab section is designed to resist the bending moment per unit length, denoted as M_{yb} . It is important to note that M_{xa} is significantly larger than M_{yb} , and generally, this moment M_{yb} falls within the slab's moment-resisting capacity.

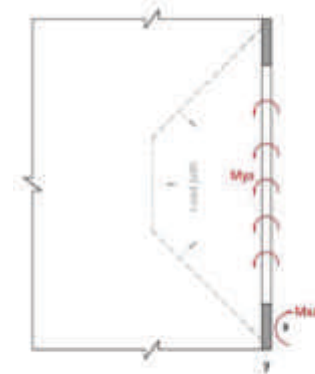


Fig.6(a) Slab supported on Beam-Column Frame

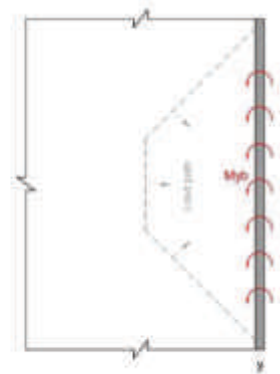


Fig.6(b) Slab supported on Shear Wall

Figure 7 shows a floor framing for a G+24 story high-rise building with distributed shear walls. which is an extension of the concept illustrated above.



Fig.7 Floor Framing - Distributed Walls with Minimum Frame Action

Traditional framed structures with core walls localize the load paths onto the columns, increasing overall material demand in the structure. For carbon savings, convert the partition walls in full or part into structural walls wherever possible and minimize the frame action to reduce the degree of bending within the structural system as a whole. The salient features that need to be taken into consideration in arriving at a distributed wall system are

- Smaller spans are preferable, as the design moment increases in proportion to the square of the span length.
- Minimize the column-beam framing and design floor plates with shorter spans that can directly span across walls, ideally placing walls at partition wall locations.
- Shorter spans eliminate the need for internal beams within the units, enhancing both aesthetic appeal and reducing form work costs and construction time.
- Shifting to a distributed wall system results in larger concrete capacities in vertical members than required for strength, but this helps optimize the amount of steel reinforcement needed.
- Additionally, smaller spans improve the performance of wet areas by reducing the risk of leaks, contributing to more durable and maintenance-free structures.

Finally, a note on seismic performance. While distributed walls may seem structurally redundant, they experience lower stress levels from gravity and lateral loads. Consequently, the resulting compression and tensile stresses, as well as the associated strains, are on the lower side, leading to overall material savings in reinforced concrete high-rise buildings. Lower axial strains indicate greater inherent ductility in the members, which is highly desirable for improved seismic performance.

The above illustration aims at bringing attention to the fundamental principles for achieving the low-carbon structural design.

5. Levers for Material Minimalism in Design

5.1. Direct Load Paths to the Foundations

- Efficient structural systems are those that channel loads directly to the ground with

minimal redirection or transfer. Just as tree roots provide a direct and efficient path for distributing weight into the soil, a well-designed structure should ensure that gravity and lateral loads flow across the full height of the structure, maintaining a consistent load path uninterrupted to the foundation.

- A crucial strategy for achieving this efficiency is to eliminate transfer structures, such as transfer slabs and deep transfer beams, by maintaining consistent functional use across different levels and avoiding abrupt changes in occupancy requirements.

5.2. Controlling Flexure in the Structural System

- When designing structural systems, transition from framed structures with core walls to distributed wall systems.
- Smaller spans are preferable, as the design moment increases in proportion to the square of the span length
- In smaller homes, such as affordable housing, slabs can span directly onto walls, eliminating the need for beams entirely.
- In premium housing projects with larger spans, voided slabs, with or without post-tensioning, can significantly reduce material consumption.
- Composite floor systems with steel beams are often highly effective for commercial floors with large lease spans.
- A three-car span offers greater material efficiency than a four-car layout when optimizing parking grids.

5.3. Achieving Regular Geometries and Symmetry

- The most efficient structural forms are often the simplest, as a well-balanced design reduces stress concentrations and optimizes material usage.
- Avoiding vertical and plan irregularities helps prevent the need for additional reinforcement to counteract uneven force distribution.

5.4. Designing for Durability

- Concrete is inherently prone to cracking, so exposed and wet areas require careful

consideration in floor framing design to minimize tensile strains.

- Applying post-tensioning to keep cantilever beams and slabs uncracked enhances durability, especially for exposed decks.
- A durable, leakproof structure minimizes the need for repairs, reducing additional material consumption over its lifespan.
- Material efficiency in a structure is not just about the initial usage but also about its longevity and durability.

Impact of these levers on Embodied Carbon

At Lodha, we have consistently maintained an A1–A5 embodied carbon (EC) of 400–450 kgCO₂e/m² by applying the strategies outlined above. This is supported by our EC baselining and repeated measurements across projects. Our approach includes the use of widely adopted low-carbon materials such as supplementary cementitious materials (SCMs), recycled steel, AAC blocks, and other circular supply chain components.

The Indian Green Building Council (IGBC) Net Zero Carbon Rating System caps embodied carbon at 700 kgCO₂e/m² for certification. A Near Net Zero Carbon rating requires a 75% offset, while Net Zero Carbon demands a 90% offset. The RIBA 2030 Challenge targets 540 kgCO₂e/m² by 2030, down from 675 kgCO₂e/m² in 2025, factoring in maintenance and end-of-life emissions. Adjusted for construction-stage emissions, this equates to 380 kgCO₂e/m². The ILFI Net Zero Carbon Buildings standard sets a 500 kgCO₂e/m² benchmark, allowing carbon credits to achieve net-zero status.

We are ready to advance decarbonization through pilots and scaled deployment, leveraging advanced technologies, optimized material mixes, and innovative solutions. However, realizing these solutions requires a collective effort across the entire ecosystem.

Crucially, material efficiency begins with better design, not just better materials. Integrating these four levers into the early design process allows buildings to minimize embodied carbon before even selecting low-carbon materials or alternative construction methods.

6. Ecosystem Development

For material minimalism to become mainstream, the entire ecosystem must evolve in sync, aligning policy,

industry practices, and market forces to make efficiency a defining principle of construction.

- Building Codes - Building codes shall incorporate prescriptive measures for sustainability.
- Policy & Regulation – Incentivizing resource-efficient projects through tax relief, and flexibility on the regulations, etc. For instance, if site constraints lead to a shortfall in required parking, forcing the construction of a basement with heavy transfer structures, the developer should have the option to forgo those additional units and instead utilize or sell TDR.
- Industry Awareness – Engineers, architects, and developers should champion material minimalism, viewing efficiency as progress rather than a limitation. Training programs, workshops, and design competitions can accelerate this shift and embed it into mainstream practice.
- Market Demand – We must cultivate market demand for efficient building design by actively promoting the value of sustainability to owners and buyers. Implementing financial incentives, like preferential interest rates or subsidies for buildings exceeding code requirements, will effectively stimulate this demand.

A well-orchestrated push across these levers will redefine material use in construction. Lodha has been at the forefront of this movement, demonstrating that smart design can deliver sustainable, high-performance buildings. With the right policies, industry engagement, and market demand, this approach can become the new standard for construction in India and beyond.

7. Conclusion

Decarbonizing construction rests on three interdependent and overlapping layers of transformation - Material Minimalism, Low Carbon Technologies, and Clean Energy Transition. Material minimalism can provide immediate gains by following the levers identified in this paper.

India's material security and growth critically depends on decarbonizing the scalable, commonplace segment of urban housing. However, meaningful changes are

required to bring in alignment across the entire ecosystem. Policy must incentivize efficiency, professionals must embed it into practice, and market forces must reward it.

Lodha's experience shows that this transformation is both possible and necessary. By prioritizing material efficiency, baselining embodied carbon, and working with the supply chain to adopt lower-carbon solutions, we see a clear path to reducing embodied emissions significantly. These strategies, applied at scale, can fundamentally reshape the country's carbon footprint. This paper is part of an ongoing series that will delve deeper into key examples and case studies to drive further discussion.

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News From Centres

ICI - Ahmedabad Centre

1. Technical Session on Minerva Tower :

The Indian Concrete Institute-Ahmedabad Centre marked a significant milestone by participating in the Technical Session on India's Tallest Tower – Minerva, conducted for the first time in Gujarat on 15th March 2026 at CEPT University, Ahmedabad.

The session was organized by Knowledge Studio – Neha Consultant in association with Wonder Cement Limited, bringing together leading structural engineers and architects from Ahmedabad.

The event witnessed an overwhelming participation of 500+ technocrats and young engineering minds from across Gujarat, making it a highly impactful technical gathering.

The session was delivered by renowned experts:

- Er. Umesh Joshi – Partner, JW Consultants LLP, Pune
- Er. Rucha Watve – Partner, JW Consultants LLP
- Er. Anjana Krishnan – Windtech Consultants LLP
- Ar. Vikas Jonwal – Principal Architect, Hafeez Contractor

The ICI Ahmedabad Centre leadership team played an active role throughout this journey:

- Er. Manoj Kawalkar – President (Elect) ICI
- Er. P.N. Jain – Chairman
- Ar. Nitesh Shah – Vice Chairman
- Er. Hitesh Barot – Secretary
- Er. Nitin Chaudhary – Treasurer

The session offered deep insights into the architectural and structural challenges of high-rise construction, making it a memorable and enriching experience for both professionals and students.



2. Participation in Concrete Catalyst 2026

The ICI-Ahmedabad Centre actively participated in Concrete Catalyst 2026, a state-wide competition for engineering students across Gujarat, successfully culminating in the Grand Finale on 15th March 2026.

The initiative was from Knowledge Studio – Neha Consultant in association with Wonder Cement Ltd. as Knowledge Partner, creating a powerful platform to bridge academia and industry.

The competition spanned 16 events across Gujarat, engaging and impacting 6000+ engineering students, making it one of the most unique and large-scale technical initiatives in the state. The following ICI-Ahmedabad Centre leadership team played an active role throughout this journey:

- ❖ Er.Manoj Kawalkar – Elect President (National)
- ❖ Er.P.N.Jain – Chairman
- ❖ Ar.Nitesh Shah – Vice-Chairman
- ❖ Er.Hitesh Barot – Secretary
- ❖ Er.Nitin Chaudhary – Treasurer

Their collective involvement significantly contributed to the success of this initiative, reinforcing ICI's commitment to technical excellence, knowledge sharing, and nurturing future-ready engineers. This collaboration stands as a strong example of how institutional support and industry partnership can create meaningful impact in shaping the next generation of civil engineers.



ICI - Bhubaneswar Centre

1. A Session on “From Collapse to Clarity: Insights into Earthquake-Induced Failures”

ICI-Bhubaneswar Centre and UltraTech Cement organised an insightful technical event on 29th April 2026 at Hotel Swosti Premium, Bhubaneswar, bringing together 95+ professionals from the fields of engineering, architecture, academicians, and officials from Government Engineering Departments.



The program commenced with the ceremonial lighting of the lamp. The Welcome Address was delivered by Dr.Dinakar Pasla, Chairman, ICI-Bhubaneswar Centre, who greeted the dignitaries and participants and set the context for the evening. Chief Guest for the evening Er.Ashwini Biswal, CGM, IDCO highlighted the importance of quality construction and role of Engineers, Architects and other stakeholders in ensuring quality construction. This was followed by address from Er.Pradip Kumar Jha, Zonal Technical Head, UltraTech Cement. He laid focus on the relevance of such knowledge sharing platforms and UltraTech's commitment to support in such endeavours.



The keynote presentation was delivered by Dr.Suresh Ranjan Dash, IIT, Bhubaneswar on the topic "From Collapse to Clarity: Insights into Earthquake-Induced Failures." In his detailed presentation, he elaborated on the context, major earthquake occurrences, observations and learnings from those havocs, some cases and basic design elements to take care of such possible hazards due to earthquakes.



The event was skillfully hosted by Ar.Payal Saha, who ensured smooth flow and coordination of the proceedings. The formal vote of thanks was delivered by Er.Shyama Sundar Mishra, who expressed gratitude

to all dignitaries, speakers and participants for their presence and contributions to the success of the event. The program concluded with a networking dinner, providing participants an opportunity for informal interaction and professional exchange. The event was well-received and appreciated for its technical depth.

2. A Session on "Innovative Construction Techniques in Signature Bridge, Delhi

ICI-Bhubaneswar Centre, IGBC-Bhubaneswar and UltraTech Cement organised an insightful technical event on 8th May 2026 at Bhubaneswar, bringing together professionals from the fields of engineering, architecture, academicians and officials from Government Engineering Departments. Notable dignitaries present were Dr.G.Sri Devi, Pro VC, CV Raman University, Er.Rama Ballav Swain, Retd. EnC, PWD, Dr.N.C.Moharana, KIIT Bhubaneswar and Er.PK.Parhi.



The program commenced at 7:00 PM with the ceremonial lighting of the lamp, symbolizing the beginning of the knowledge-sharing session. The welcome address was delivered by Dr.Dinakar Pasla (Chairman ICIBC), who greeted the dignitaries and participants and set the context for the evening. This was followed by addresses from Dr.Manonjay Rath (Chairman, IGBC) and Pradip Kumar Jha (Zonal Technical Head, UltraTech Cement). Dr.Rath highlighted the importance of sustainability, carbon footprints, green homes in contemporary architecture, civil engineering and construction practice.



The keynote presentation was delivered by Er.K.P. Abraham on the topic “Innovative Construction Techniques in Signature Bridge, Delhi.” In his detailed presentation, he elaborated on “Project context and conceptual ideation; Structural and architectural design principles; Key engineering challenges encountered during execution; Adoption of advanced construction methodologies; Integration of modern technologies in bridge construction; Notable engineering and operational highlights of the project. The session provided valuable insights into large-scale infrastructure development and innovation in bridge engineering.

Er.Lingaraj Gouda, Engineer-in-Chief, Water Resources Department, Government of Odisha was honoured for his outstanding contributions to the field of civil engineering. He was presented with a shawl and citation as a mark of recognition and respect.

The event was skillfully hosted by Ar.Payal Saha, who ensured smooth flow and coordination of the proceedings. The formal vote of thanks was delivered by Er.Praveen Kumar, who expressed gratitude to all dignitaries, speakers, and participants for their presence and contributions to the success of the event.

The program concluded with a networking dinner, providing participants an opportunity for informal interaction and professional exchange. The event was well-received and appreciated for its technical depth.



3.Installation Ceremony of New Executive Committee :

The Indian Concrete Institute-Bhubaneswar Centre celebrated the formal Installation Ceremony of its newly elected Executive Committee for the term 2026-2028 on 8th of May 2026 at Swosti Premium, Bhubaneswar. The core of the event was the formal induction of the new leadership team. The outgoing committee officially handed over the charge to the new office bearers. The new office bearers are as follows:

S. No.	Name	Position
1	Er. Pradip Kumar Jha	Chairman
2	Er. P. K. Parhi	Hon. Secretary
3	Er. Rajesh M. Agarwal	Treasurer
4	Er. Tapas Sahoo	Member
5	Er. Biranchi Narayan Acharya	Member
6	Er. Pramod Agrawal	Member



The installation ceremony was attended by lifetime members of ICI-Bhubaneswar Centre, other Engineers, and Architects of Odisha. Er.K.P. Abraham, Past Vice-President – ICI North, graced the occasion.

The outgoing Chairman Dr.Dinakar Pasla welcomed the new committee members and expressed his gratitude to the fraternity for their support. He reflected on the milestones achieved during his term, including successful technical seminars, industry-academia programs, and ICI-Bhubaneswar Centre Awards.

In his inaugural address, the newly installed Chairman, Er.Pradip Kumar Jha, outlined the roadmap for the upcoming term. He assured to take the centre to newer heights seeking guidance from the previous office bearers and urged the fraternity to make this institution stronger and even more vibrant.

4.A Technical Session on “Innovative Construction Techniques in Signature Bridge, Delhi” :

A Technical Seminar on the topic “Innovative Construction Techniques in Signature Bridge, Delhi” was successfully organised by the ICI-Bhubaneswar Centre in association with UltraTech Cement at Cuttack. The programme witnessed enthusiastic participation from professionals and academicians associated with the construction and infrastructure sector totaling more than 90 Engineers, Architects, Academicians, Government officials, and Industry professionals. Mrs.Shyama Mishra welcomed the distinguished speaker, guests, and participants. She highlighted the importance of adopting innovative construction practices and knowledge sharing among professionals.



The Keynote Technical Session was delivered by Er.K.P.Abraham, Delhi, an eminent expert in the field of bridge engineering and construction technology. During his presentation, he elaborated on : The design and structural uniqueness of the Signature Bridge, Delhi ; Advanced construction methodologies used in the project ; Engineering challenges encountered during execution ; Safety measures and quality control practices ; Innovative technologies adopted for large-span bridge construction ; Practical insights and case studies from the project execution. The session was highly informative and interactive, providing valuable exposure to the participants. The speaker was felicitated

with a shawl and a memento by the organisers for his valuable and insightful presentation.

The event was gracefully hosted by Ar.Payal Saha, who conducted the programme smoothly and ensured active engagement of the audience throughout the session. The organisers, ICI Bhubaneswar Centre and UltraTech Cement, expressed their gratitude to the speaker, guests, and all participants for making the event meaningful and successful.



ICI - Chennai Centre

Two-Day Interactive Seminar on “Design and Construction of Reinforced Concrete Structures – New Directions”

The Indian Concrete Institute-Chennai Centre, in association with IIT Madras and SRM Institute of Science and Technology, successfully organised a Two-Day Interactive Seminar on “Design and Construction of Reinforced Concrete Structures – New Directions” on 13–14 March 2026 at IIT Madras Research Park, Chennai.

A major highlight of the programme was the discussion on the upcoming revision of IS:456, which introduces a broader design philosophy encompassing safety, serviceability, durability, robustness, integrity, and restorability, going beyond the traditional strength-based approach. The sessions also discussed the integration of IS:1343 into the revised code and the implications for future structural design practices.

The seminar featured distinguished speakers from academia and industry, including Prof.C.V.R.Murty, Prof.Manu Santhanam, Prof.Rupen Goswami, and Prof.Radhakrishna G. Pillai from IIT Madras; Prof.K.P.Jaya from Anna University; Er.G.Sivakumar of

BindTech Concrete Research; Er.Siddappa A. Hasbi of Kvalitet Resources LLP; and industry experts Er.Jayasankar K., Er.L.R.Manjunatha, and Er.Amol Patil. Their expert presentations covered a wide range of topics including durability design, performance-based specifications, structural health evaluation, and quality control practices in concrete construction.

The sessions also explored high-performance concrete mix design, the role of supplementary cementitious materials (SCMs), service life modelling, corrosion control in aggressive environments, the science of curing, precast concrete systems, and practical approaches to on-site quality control. Case studies demonstrating the use of GGBS and slag cements in coastal environments and the application of silica fume in high-performance concrete provided valuable practical insights for practicing engineers.

The event also saw participation from academicians, researchers, industry professionals, and students, making it a vibrant platform for sharing knowledge and discussing emerging trends in concrete technology and structural engineering.

The two-day seminar concluded with insightful discussions emphasising the importance of durability-oriented design, performance-based specifications, and improved quality control practices to ensure the long-term sustainability and resilience of reinforced concrete structures.



ICI - GOA Centre

One-Day All India Seminar on "Advances in Concrete Technology" :

The Indian Concrete Institute-Goa Centre successfully organized a One-Day All India Seminar on "Advances in Concrete Technology" on 19th June 2026 in Goa. The seminar brought together leading experts from industry, academia, government organizations, and consulting practice to deliberate on emerging technologies, sustainability, durability, and innovations in shaping the future of concrete construction in India.

The inaugural function was graced by Shri Digambar Kamat, Hon'ble Minister for Public Works, Government of Goa, as the Chief Guest. Other dignitaries on and off the dais included Dr.V.Ramachandra, President, ICI, Er.Manoj Kawalkar, President (Elect) ICI, Dr.Vishal Thombare, Vice-President (West), Er.R.Radhakrishnan, Secretary General ICI, Dr.Jennifer Lewis, Chairperson, ICI-Goa Centre, Er.Satyesh Kakodkar, Secretary, ICI-Goa Centre, Er.Reuben Mascarenhas, Treasurer ICI-Goa Centre and distinguished representatives from the concrete and construction industry. In his address, Shri Digambar Kamat emphasized the critical role of concrete infrastructure in nation-building and highlighted the need for engineers to embrace emerging technologies for creating safer, smarter, and more sustainable infrastructure.

The technical programme featured a series of insightful presentations by renowned experts from across the country.

The seminar commenced with Er.Salil Gadgil, who discussed Modern Solutions for Corrosion Problems, highlighting contemporary approaches to addressing

one of the most significant durability challenges faced by reinforced concrete structures. This was followed by Dr.Achal Kumar Mittal, who presented on the new provisions for structural concrete design in the draft revision of IS:456, providing valuable insights into the future direction of concrete design practice in India.

The second technical session featured Er.Sudeep Joshi, who delivered an engaging presentation on Ultra-High Performance Fibre Reinforced Concrete (UHPFRC) covering design principles, execution methodologies, and practical case studies. Er.Bhushan Nahire showcased the engineering challenges and innovations associated with the Iconic Curved Cable-Stayed Bridge at Vasco, Goa, a landmark infrastructure project for the state.

Following the inaugural session, Dr.Vishal Thombare presented on the special materials utilized for the Mumbai Coastal Road Project, offering participants a glimpse into the advanced concrete technologies and materials deployed in one of India's most ambitious urban infrastructure projects. Er.K.Jayasankar subsequently addressed the audience on 'Enhancing Cement and Concrete Usage Efficiency in Construction – A Net Zero Approach, focusing on sustainability and resource optimization in the construction sector'.

The final technical lecture by Dr.Nadeem M. examined the Influence of Microfine Additives on Durability Parameters and Service Life Prediction of Concrete, emphasizing the importance of material science in extending the life cycle of concrete structures and improving long-term performance.

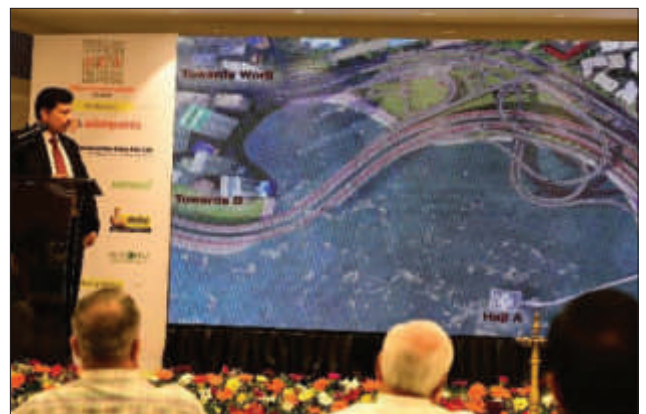
A major highlight of the seminar was the Panel Discussion on “Challenges in the Use of New Concrete Technologies & the Way Forward.” The discussion brought together eminent professionals including Er.Pradeep Garg (Chief Engineer, CPWD, New Delhi), Dr.Vishal Thombare (Executive Engineer, BMC, Mumbai), Er.Rajan Kamble (Superintending Engineer, WRD Goa), Er.Madhav Kamat (Consultant, Goa), and Er.Sudeep Joshi. The panel deliberated barriers to adoption of innovative concrete technologies, implementation challenges, skill development requirements, sustainability concerns, and policy interventions needed to accelerate modernization within the construction industry.

The seminar also featured an exhibition by leading industry sponsors and solution providers, enabling delegates to interact with manufacturers, technology developers, and construction material specialists. The event provided an excellent platform for networking, knowledge sharing, and collaboration among engineers, researchers, academicians, contractors, consultants, government officials, and students.

The programme was attended by 124nos. delegates from across India and received an enthusiastic response from participants. Through this seminar, ICI-Goa Centre reaffirmed its commitment to advancing knowledge, promoting innovation, and fostering professional excellence in concrete technology for the development of durable, sustainable, and resilient infrastructure.

PHOTO GALLERY







ICI - Hubballi Dharwad Centre

Installation Ceremony :

The Installation Ceremony of the Office Bearers of the Indian Concrete Institute, Hubballi Dharwad Centre for the term 2026–2028 was held on 19/04/2026 at Hubballi. The programme commenced with invocation followed by the welcome address and introduction of dignitaries. The ceremony was graced by Dr.V.Ramachandra, President, Indian Concrete Institute, as the Chief Guest and Mr. Rahul A. Koti, Managing partner, Koti steel as the Guest of Honour. The programme was sponsored by KOTI STEELS. During the programme, the Annual Report of the Hubballi Dharwad Centre for the previous term was presented by the Secretary, Dr.Anand M.Hunashyal, highlighting the various technical activities, seminars, professional programmes, and student initiatives organized by the Centre. The newly elected office bearers formally assumed charge for the term 2026–2028.

Office Bearers :

Chairman – Er. Suresh M. Kiresur
Secretary – Dr. Anand M. Hunashyal
and 8 Executive Committee Members.

The outgoing committee members were felicitated and appreciated for their valuable contributions and dedicated service towards the activities and development of the Hubballi Dharwad Centre during the previous tenure. In his address, the newly installed Chairman, Er. Suresh M. Kiresur, emphasized the Centre's commitment towards promoting concrete technology, sustainable construction practices, technical knowledge dissemination, and strengthening industry-academia collaboration in the region. The Chief Guest, Dr.V.Ramachandra, appreciated the activities of the Hubballi Dharwad Centre and encouraged the newly installed team to continue organizing technical programmes and professional development activities for the benefit of the engineering fraternity. The programme concluded with Vote of Thanks followed by dinner and networking interaction among members and guests.



ICI Secretary briefing Annual report of 2026-28



Felicitation of New Chairman, ICI Committee 2026- 28



New Office bearer of ICI Committee 2026-28 with Guest

ICI - Jabalpur Centre

Annual Endowment Awards 2025 Program :

CI-Jabalpur Centre organized Annual Endowment Awards on 29th March 2026. The awards were presented in various categories for Outstanding Construction Work in the Mahakaushal, Vindhyaachal, and Bundelkhand regions. Chief Guest of the program, Er.Sanjay Dahriya, Chief Engineer of the Public Works Department (Buildings) Jabalpur division, highlighted the need for similar events, saying that such encouragement inspires others to do good work. Special Guest, Chief Engineer of the Public Works Department Jabalpur, Er.R.L.Verma, praised the work.

At this solemn ceremony, Er.R.P.Dubey, retired Superintending Engineer of the Public Works Department Jabalpur, was honoured with the Lifetime Achievement Award for his outstanding work in the field of bridges, flyovers, and concrete structures. Guest speaker Er.Mohammad Abu Asif's Technical Lecture on 'Re-development of the Rani Kamlapati Railway Station, Bhopal' was a special attraction. Engineers and Architects were honoured in the following categories:

- For Residential Individual, Arch Sajal Sahu, Er.Rahul Thakur, and Motif Architects & Design Associates;
- For Multi-Story, Arch.Deepak Bajaj and Er.Chetan Bajaj, Shahdol;
- For Commercial Building, Shrikhande Design Private Limited and Pankaj Khandelwal, Katni, and Architect Syndicate Jabalpur, and MD Associates;
- For Institution Building, Kalantre Associates were awarded.

The Best Infrastructure Construction Award was given to the Public Works Department, Jabalpur, and Nagarjuna Construction Company, who constructed the Weerangana Rani Durgavati Flyover, the longest in the State. In addition, 29 Engineers and Architects were presented with certificates of appreciation. A special jury committee was formed for the selection of these awards in which Dr.Rajiv Chandak, Mr.Luv Raghav, Er.Shri Gopal Gupta, Dr.Manish Dubey, Architect Sujit Kalantre, Prof.R.K.Grover and Er.Siddharth Singh were the members. The vote of thanks for the program was given by the Organization Secretary Dr.Sanjay Verma and the special support was given by the executive committee's Er.Sudhir Mishra, Er.Neeraj Byotra, Arch.Vaibhav Singhai, Er.Sanjay Vishwakarma, Er.Prabhat Srivastava, and Er.Sanjeev Jain. About 200 Engineers and Architects from 25 districts were present in this program. The award function is supported by JK Cement Limited.



ICI - Jaipur Centre

Installation Ceremony:

Installation Ceremony of the newly elected Executive Committee of ICI-Jaipur Centre for the session 2026-28 was successfully conducted on 29th May 2026 during a Technical Meet held at Hotel Marriott, Jaipur. The event witnessed the participation of around 80 Civil Engineers representing various Government Departments, organizations, industries, and esteemed members of ICI. The newly elected office bearers and Executive Committee members formally assumed their responsibilities during the ceremony.



The programme also provided an excellent platform for technical interaction, knowledge sharing, and strengthening professional networking among the participants.



ICI - Kakinada Centre

1. Webinar on “Basic Concepts of Earthquake Resistance of Buildings”:

The Indian Concrete Institute-Kakinada Centre, in association with ACCE (I), Kakinada Centre, organized a Technical Webinar on “Basic Concepts of Earthquake Resistance of Buildings” on 29th March 2026.

The session was delivered by Er.P.Vishnu Sai, who elaborately explained the fundamental principles of earthquake engineering and their application in building design. The presentation covered seismic forces acting on structures, structural behaviour during earthquakes, ductility concepts, load paths, importance of regularity in buildings, and key provisions of Indian seismic design codes.

The speaker highlighted practical aspects of earthquake-resistant planning and structural detailing, enabling participants to understand how engineers can minimize structural damage and enhance life safety during seismic events.

The webinar witnessed active participation from practicing engineers, architects, academicians, and engineering students. An interactive question-and-answer session was conducted at the end, wherein participants clarified various technical aspects related to seismic design and construction practices.

2. World Health Day Celebration :

On the occasion of World Health Day, the ICI-Kakinada Centre, jointly with ACCE (I), Kakinada Centre, organized a health awareness programme under the theme “Together for Health, Stand with Science” on 7th April 2026.

The programme was conducted with the objective of emphasizing the importance of health, well-being, and maintaining a balanced lifestyle among professionals working in demanding technical and construction-related fields.

Dr.Ravi Vadrevu delivered an informative session highlighting the significance of preventive healthcare, healthy lifestyle practices, stress management, regular medical check-ups, nutrition, and physical fitness. The speaker also addressed common health concerns faced by working professionals and emphasized the role of scientific awareness in maintaining overall well-being.

The programme provided an excellent platform for members to interact with healthcare professionals and gain practical insights into maintaining good health amidst busy professional schedules.

ICI-Kakinada Centre expresses its gratitude to MODULIN – The Ultimate Modular Solutions, Kakinada, for sponsoring the programme and supporting this health awareness initiative.





3. Webinar on "Fire Safety" :

The ICI-Kakinada Centre, in association with ACCE (I), Kakinada Centre, organized a webinar on "Building Fire Safety Codes, Regulations and Best Practices" on 19th April 2026.

The expert session by Prof.Dr.Badam Sundara Rao focused on the importance of fire safety in buildings, relevant statutory requirements, and the latest provisions of fire safety regulations. The speaker explained the principles of fire prevention, fire protection systems, emergency evacuation planning, and compliance requirements for various categories of buildings.

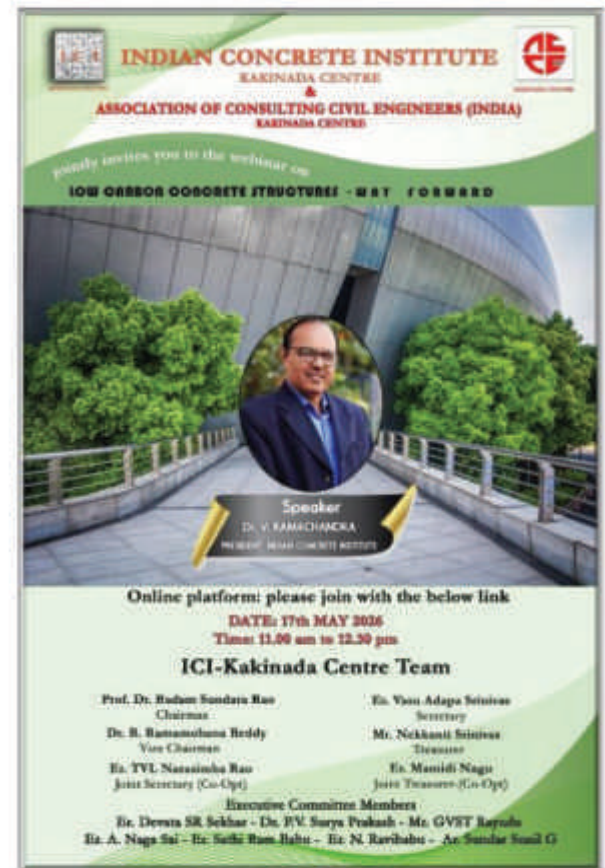
The presentation also covered practical aspects of fire safety design, including fire-resistant construction, detection and alarm systems, sprinkler systems, means of egress, and coordination with statutory authorities.

Participants actively engaged in discussions and raised several practical questions related to fire safety compliance in residential, commercial, and institutional buildings.

4. Webinar on "Low Carbon Concrete Structures" :

The ICI-Kakinada Centre, jointly with ACCE (I), Kakinada Centre, organized a Technical Webinar on "Low Carbon Concrete Structures" on 17th May 2026.

The session focused on sustainable construction practices and the growing need to reduce carbon emissions associated with concrete production and construction activities. Dr.V.Ramachandra explained the concept of embodied carbon in construction materials and discussed strategies for developing environmentally responsible concrete structures.



The lecture covered the use of supplementary cementitious materials, optimized concrete mix designs, innovative construction technologies, durability considerations, and life-cycle assessment approaches aimed at reducing the carbon footprint of concrete structures.

The webinar generated significant interest among practicing engineers, academicians, researchers, and students, leading to an engaging interactive discussion session.

ICI - Kolkata Centre

Seminar on Salient Features of Revision of IS:456 and IS:1893 :

Seminar on Salient features of revision of IS:456 and IS:1893 at Kolkata was organised by ICI-Kolkata Centre in association with Adani Cement. More than 110 engineers, architects, consultants of Kolkata attended the seminar.

A brief on ICI was presented by Chairman Er.Santanu Adhikari & VP(East) Dr.Kaushik Bandyopadhyay. Presentation on the topic was made by Dr.Debashish Bandyopadhyay & Dr.Saroj Mandal. Past President Dr.Subhagit Sarswati was felicitated by Chairman, Santanu Adhikari.

The session was very interactive.



ICI – Lucknow Centre

1. Annual Construction Excellence Awards 2026

Indian Concrete Institute, Lucknow Centre organised “Construction Excellence Awards 2026” on 14th March 2026 at Lucknow. The Chief Guest was Dr.Navneet Sehgal (IAS), Former Chairman, Prasar Bharati. The Guest of Honour was Er.A.K.Dwivedi, Engineer-in-Chief & HOD, UP-PWD. Keynote Speaker was Er.Amit Barde, Head – Precast Initiative, L&T Ltd.

Event Overview

A high-level Technical Session on “High-Rise Buildings with Precast Technology” was conducted in accordance with the annual technical activities calendar approved by the ICI Lucknow Centre Executive Committee. More than 250 engineers, architects, academicians and construction professionals from Lucknow and nearby

regions participated in the programme, making it a highly impactful professional gathering.

The event was graciously supported by industry partners and well-wishers, reflecting the strong collaboration between academia, industry and professional bodies in advancing modern construction practices and concrete technology.

Technical Session Highlights

The keynote technical session was delivered by Er.Amit Barde, Head – Precast Initiative at Larsen & Toubro Ltd., who shared valuable insights from his extensive national and international experience in precast construction. The presentation focused on the growing relevance of precast technology for high-rise residential and commercial buildings in India.

The Construction Excellence Awards 2026 were presented to recognize outstanding contributions and achievements in the field of construction, with special emphasis on quality, innovation, sustainability and safety practices. The awards ceremony was a key highlight of the evening and provided a platform to honour organizations and individuals who have set benchmarks in excellence in construction.

The following Individual Awards were presented during the ceremony :

- ❖ (Late) Er.R.C.Baranwal – Lifetime Achievement Award
- ❖ (Late) Ar.Ranjoo Kumar – Outstanding Contribution to Concrete Construction (Women)
- ❖ Ar.Roli Singh–Outstanding Contribution to Concrete Construction (Emerging Professional)
- ❖ Dr.S.P.Shukla – Outstanding Contribution to Academia/ Research
- ❖ Er.Inderjit Singh– outstanding Contribution to Sustainable Construction

In addition, 11 Structure Awards were also presented under various categories.

The Annual Construction Excellence Awards 2026 and the accompanying technical session successfully fulfilled their objectives of knowledge dissemination, professional interaction and recognition of excellence in construction. The event reinforced the role of ICI Lucknow Centre as a leading professional platform committed to promoting advanced construction technologies and best practices.



Inaugural address by Er.A.K.Singh, Chairman, ICI-Lucknow Centre



Address by Chief Guest Sh.Navneet Sehgal (IAS)



Technical Session by Er.Amit Barde



Glimpses of Construction Excellence Awards 2026

2.10th Anniversary Celebration & Technical Session :

The ICI-Lucknow Centre successfully celebrated its 10th Anniversary on Saturday, April 25, 2026 at Lucknow. The programme marked a significant milestone commemorating 10 years of the establishment of ICI Lucknow Centre since its foundation on 23rd April 2016. The celebration witnessed participation from engineers, academicians, consultants, industry professionals and members of the construction fraternity. The event featured a technical session on "Net Zero Emissions in Concrete Constructions" delivered by Dr.V Ramachandra, President, Indian Concrete Institute. The session highlighted sustainable construction practices, reduction of carbon footprint in concrete construction and the importance of innovation and technology in achieving environmental goals for the construction industry. The programme also included felicitation of distinguished members and inaugural executive committee members of ICI-Lucknow Centre in recognition of their valuable contribution towards the growth and success of the centre during the past decade.

The programme reflected the centre's commitment towards professional excellence, knowledge sharing and promotion of sustainable construction practices. The event also served as an opportunity to acknowledge the contributions of founding members and stakeholders who have supported the growth of the centre over the last decade.



Felicitation of Dr.V.Ramachandra



Felicitation of Chief Guest



Felicitation of Inaugural Executive Committee chaired by Prof. Emeritus (Dr.) Sudhir Misra

3. Technical Session on 'Quality Control and Quality Assurance in Construction' :

The ICI-Lucknow Centre, in association with Harcourt Butler Technical University (HBTU), Kanpur and JK Cement Ltd., successfully organized a Technical Session on 'Quality Control and Quality Assurance in Construction' on May 23rd, 2026 at HBTU, Kanpur.



The event witnessed active participation from students, academicians, practicing engineers, and industry professionals. The programme aimed to enhance awareness and understanding of quality practices in construction, which play a critical role in ensuring durability, safety, and overall performance of structures. The keynote address was delivered by Dr. Sanjeev Kumar Singh, Chief Scientist at CSIR-CBRI, Roorkee, who shared deep insights into modern quality control techniques, testing methodologies, and best practices adopted in construction projects, especially high-rise buildings. He shared case studies where quality controls were not to the mark and how the buildings needed repairs within a short span of use.

The event was graced by Prof. Samsher, Hon'ble Vice-Chancellor, HBTU, as the Chief Guest, and Ar. Manoj Kumar Singh Yadav, Chief Town planner of UP as the Guest of Honour.

The technical session was successfully conducted with enthusiastic participation. It reinforced the importance of robust QA/QC systems in construction and promoted collaboration between academia and industry.



ICI - Nagpur Centre

1.Tech-Talk (Pinnacle Talk Series -3) :

The ICI-Nagpur Centre, in association with the Institution of Engineers (India), Nagpur Local Centre, organized Talk 3 of the Pinnacle Talks Series for ICI Students' Chapter members on 13th March 2026.

The lecture was delivered by Er.Devendra Matte, Director, Matte Infra-Ventures Pvt. Ltd., Nagpur on topic, "Innovation in Demolition". The session was highly informative and interactive, providing valuable insights into modern demolition techniques and innovations in the field. A total of 135 students from various ICI Student Chapters attended the session and benefited from the expert talk.

Er.Bhagwat Patil welcomed the guest speaker and participants. Dr. Ranjit N. Patil briefed the students about the upcoming ICI Fest 2026 activities. Dr.Swapneel Satone delivered the concluding remarks and proposed the vote of thanks.

The program was also graced by the presence of Dr.Sandeep Shirkhedkar and Prof.Yogesh Lanjewar.



2. Technical Site Visit

ICI-Nagpur Centre, in association with ACCE (I), ALE, and IEI Nagpur Local Centre, organised a Technical Site Visit to the Nagpur Sports Hub, Mankapur on Saturday, the 9th May 2026 at 9.00 am.

The Nagpur Sports Hub is a major upcoming sports infrastructure project comprising a multi-sports arena, sports club, convention centre, swimming complex, along with various indoor and outdoor sports facilities. It is a large-scale project worth more than Rs.550 Cr

spread over 62 acres. It's a very ambitious Sports Hub project by Government of Maharashtra with Olympic standards Sports Infrastructure.

The visit was coordinated by the project stakeholders, including representatives from the Architect, PMC, Structural Design Team, and PWD Officials, providing valuable insights into project planning and execution.

Er.Prashant Shankarpure, Dy. Engineer PWD, Er.Nitin Tongase, Structural Consultants, Team of M/s.TRANSSTADIA, Architects & PMC, and Er.Sureshbhai Patel from contractors M/s.Super Constructions were instrumental in organizing the site visit.

Office bearers of IEI, ICI & ALE participated the site visit.



3. Workshop on: "Ultra-High Performance Fiber Reinforced Concrete" :

The Indian Concrete Institute, Nagpur Centre in association with Shree Cement Ltd. organized a workshop on: "Ultra-High Performance Fiber Reinforced Concrete (UHPFRC)" on 15th May 2026.

The Venue for the workshop was Hotel Centre Point, Nagpur, from 9:30 am to 5:00 pm.

The workshop held four sessions by Guest Speakers: Er.Sudeep Joshi, Er.Nilotpal Kar, and Mr.Chandan Vaidya.

Technical session I - Design of UHPFRC, Case Study of Missing Link Project by Er. Sudeep Joshi; Technical Session II - Super High Dispersant, Low Viscosity Technology for UHPFRC by Er. Nilotpal Kar; Technical Session III - Role of Steel Fibers in UHPFRC by Mr.Chandan Vaidya; and Technical Session IV - Execution of UHPFRC & Few Case Studies by Er. Sudeep Joshi.

Key Highlights of the technical sessions were:

- UHPFRC – Design and Execution
- Super High Dispersant, Low Viscosity Technology for UHPFRC
- Structural and Durability Advancements
- Role of Steel Fibers in UHPFRC
- Materials

Chief Guest of the function was Er.Vikas Ramgude, Retd Jt. Managing Director, MSIDC; Guest of Honour, Er. Sambhaji Mane, CE, PWD; and Dr.V.Ramachandra, President, ICI presided over the function.

Er.Manoj Kawalkar, National President-Elect, ICI and Er.Vinay Gupta, Chairman, Edu. & Training Comm., ICI were Guest of Honour along with Er.R.Radhakrishnan, Secretary General, ICI as Special Guest for the workshop.

The workshop was also graced with presence of Special Invitees like Er.L.K.Jain (Past President, ICI); Er.Vivek Naik (Past President, ICI); Dr.R.Saraswati (Past President, ICI); Dr. H.D. Chandewar (GC Member, ICI); Er.Naresh Borkar (SE, MSIDC); Er.Prashant Bhandarkar (SE, NIT); and Er.Prasad Sevekari.

The technical sessions were followed by panel discussion, and hi-tea.



ICI - New Delhi Centre

Structural Excellence Summit:

CI-New Delhi Centre joined with Asian Paints and organized a "Structural Excellence Summit" on 13th May 2026 at New Delhi.

- ❖ Prof.Umesh Kr.Sharma from IIT Roorkee delivered talk on "Systematic Approach for Evaluation and Repair of Corroded RCC structures"
- ❖ Er.Pradeep Garg, Chief Engineer, CPWD delivered talk on "Modern Water Proofing Solutions Adopted in Building Constructions by CPWD"
- ❖ Er.Salil Gadgill, Repair & Rehabilitation Expert from Asian Paints, delivered talk on "Repair of Corroded RCC Structures Using Novel Technologies"
- ❖ Panel Discussion held on the topic "Repair & Retrofitting - Importance & Challenges". It was Moderated by Dr.Achal Mittal, VP(North) ICI. Panelists were DG(MES), MD (NCRTC-Delhi), Principle CE(Delhi PWD) & CE(Design) DMRC.
- ❖ New Products for Repair & Retrofitting works also launched by Asian Paints during this meet.

The meet was attended by about 150 delegates from CPWD, Delhi PWD, MES, DMRC, NCRTC, EIL, ICI New Delhi, Ghaziabad, Gurugram & Roorkee Centres and several other Government institutions.



ICI - Rajamahendravaram Centre

Field Visit :

ICI-Rajamahendravaram Centre organized a Field Visit of members to RMC Plant of UltraTech on 13.06.2026. Dr.K.V.Narasimha Rao delivered a Technical Talk on "Advanced Concrete Mix Design using Artificial Intelligence". More than 80 members participated in the event.



ICI - Surat Centre

Installation Ceremony :

ICI-Surat Centre celebrated the Installation Ceremony of newly elected office bearers of the Centre for the period 2026-2028, on 23.04.2026.

S.No.	Name	Position
1	Er.Hiren Gajendra Desai	Chairman
2	Er.Mitul Harshadrai Patel	Secretary
3	Dr.Kashyap A. Patel	Treasurer
4	Er.Biren T.Kansara	Member
5	Er.Manish Rasiklal Shah	Member
6	Dr.C.D.Modhera	Member
7	Er.Thakkar Ankit Anil	Member
8	Er.Choksi Zabirbhai M	Member
9	Er.Sumant Kachru	Member

During the ceremony, the following Points & Actionable Items were discussed :

- Design Concrete Workshops
- Internship Program Initiatives
- Short Term Courses for New Engineers



- ICI Expert Lectures – Concrete Talk series – Webinars – Panel Discussions
- ICI Students Chapters Lectures
- New ICI Registration & Enrollment Drive
- Technical Tour Programs
- Students Chapter – Certification



ICI - Warangal Centre

Installation Ceremony of New Office Bearers :

The Installation Ceremony of the newly elected Executive Committee of the Indian Concrete Institute-Warangal Centre for the term 2026–2028 was organized with great enthusiasm and participation from practicing engineers, architects, academicians, industry partners, neighbouring professional bodies, and members of the engineering fraternity.

The program was graced by Er.Manoj Kawalkar, National President (Elect), ICI, as the Chief Guest, Er.R.Radhakrishnan, Secretary General, ICI, as the Guest of Honour, and Er.Mohammed Hidayath Ali as the Special Invitee.

The event commenced with a warm welcome address by the outgoing Chairman, Er.B.Laxman, who welcomed the distinguished guests, practicing engineers, company partners, representatives of

neighboring professional organizations, and delegates. The outgoing office bearers, comprising Er.B.Laxman (Chairman), Er.Pavana Krishna Paka (Secretary), and Er.Syed Riyaz (Treasurer), highlighted the activities and achievements of the centre during their tenure.



Following the welcome address and presentation of the outgoing committee's achievements, Er.Mohammed Hidayath Ali, who served as the Witness for the election process, formally announced the results of the elections for the ICI Warangal Centre Executive Committee for the term 2026–2028.

He congratulated the newly elected office bearers and Executive Committee members and expressed confidence in their ability to lead the centre towards greater professional excellence and growth in the coming years.

Thereafter, the Installation and Oath-Taking Ceremony was administered by Er.R. Radhakrishnan, Secretary General, Indian Concrete Institute. The newly elected Chairman, Secretary, Treasurer, and Executive Committee Members solemnly took the oath of office and pledged to uphold the objectives, values, and professional standards of the Indian Concrete Institute. The ceremony marked the formal assumption of responsibilities by the new Executive Committee and symbolized the beginning of a new and dynamic chapter for ICI Warangal Centre.



The new Executive Committee for the term 2026–2028 comprises of :

Chairman : Er. K. Raja Prabhakar
 Secretary : Er. K Veeraiah
 Treasurer : Ar. G Ravinder
 Executive Committee Members:
 Ar.Ch.Jagan Mohan
 Er.G.Bhavani Prasad
 Ar.D.Sai Dileep
 Er.MD Azmath Ali
 Er.B.Shiva Teja
 Er.G.Venkatesh



Following the Oath ceremony, Er. K. Raja Prabhakar, in his acceptance address, expressed his sincere gratitude to the members for reposing their trust and confidence in the newly elected team. He assured the gathering that the Executive Committee would work collectively to strengthen the activities of the Centre and further the objectives of the Indian Concrete Institute.

Highlighting his vision for the forthcoming term, Er. K. Raja Prabhakar outlined a comprehensive action plan focused on enhancing technical knowledge dissemination, strengthening industry–academia interaction, increasing member engagement, expanding student chapter activities, organizing quality

technical programs, and fostering collaboration with professional bodies and industry stakeholders. He emphasized the importance of teamwork, innovation, and professional excellence in positioning ICI Warangal Centre as one of the most active and vibrant centres in the country.



A significant milestone of the event was the official launch of the ICI Warangal Centre Website, which was unveiled in the presence of the Chief Guest, Guest of Honour, Special Invitee, and distinguished dignitaries. The website is envisioned as a dynamic digital platform for members, serving as a hub for information sharing, event updates, technical resources, student chapter

activities, and professional networking. The launch reflects the Centre's commitment to embracing digital transformation and enhancing communication, accessibility, and engagement among members and stakeholders.

Addressing the gathering, Er. Manoj Kawalkar, National President (Elect), ICI, congratulated the newly elected team and appreciated the commendable efforts of the outgoing committee. He emphasized the importance of professional excellence, knowledge sharing, and active participation in advancing the objectives of ICI.

The ceremony was further enriched by the presence of distinguished leaders from neighbouring professional bodies and industry organizations.

They conveyed their best wishes to the newly elected team and felicitated the new Executive Committee, expressing confidence in its leadership and commitment to professional development.

Representatives of the ICI Student Chapters from Vaagdevi College of Engineering, SR University, KITS Warangal, and KITS Huzurabad were felicitated for their active involvement in ICI activities. The outgoing Executive Committee members were honoured for their dedicated service, while the newly installed Office Bearers and Executive Committee Members were felicitated by the dignitaries and representatives of neighbouring professional organizations.

The Installation Ceremony marked the beginning of a new chapter for ICI Warangal Centre, reaffirming its commitment to promoting concrete technology, professional excellence, industry-academia collaboration, and the overall advancement of the construction industry in the region.

ICI JOB / INTERNSHIP PORTAL
You will be hearing from
HQ soon.

News From Student Chapters

Anjuman College of Engineering and Technology, Nagpur

1. Expert Lecture :

Department of Civil Engineering, Anjuman College of Engineering and Technology, Nagpur organised an Expert lecture by Dr.Sandeep Shirkhedkar, imaGIS Engineering Solutions Pvt. Ltd, Nagpur on 7th April 2026. A total of 55 students attended the lecture.

2. Site Visit :

The Department of Civil Engineering, Anjuman College of Engineering and Technology, Nagpur, organized an educational site visit to a Flyover Construction Project at Mhalgi Nagar on 9th April 2026 in collaboration with ICI-Nagpur Centre.

Around 50 students participated and gained valuable practical exposure to ongoing infrastructure development. Special gratitude was expressed to Khalatkar Construction Infra. Ltd., for providing this opportunity, and to Er.Avinash Neware (Project Manager) for his insightful explanation of the project.

Faculty Incharge for this visit was Prof.Syed Sohailuddin and Prof.Md. Azaz. Head of Department, Dr.Rashmi G. Bade planned this visit under the guidance of Prof. (Dr.) K.S. Zakiuddin, Principal ACET.

3. Expert Lecture on “Repair, Retrofitting and Rehabilitation”

Department of Civil Engineering, Anjuman College of Engineering and Technology, Nagpur organized an Expert Lecture on “Repair, Retrofitting and Rehabilitation” by Er.Bhagwat Patil, Secretary ICI-Nagpur Centre on 13th April 2026, under the guidance of Prof. (Dr) K.S.Zakiuddin, Principal ACET, Head of Department, Dr.Rashmi G. Bade, and faculty incharge Dr.Naseeruddin Haris and Mr.Aquib Ansari. The lecture was organized and conducted successfully. A total of 55 Students attended the lecture.



KDK College, Nagpur

1.A 3-Credit Add-on Course on “Applied Vastushastra” :

A 3-Credit Add-on Course on “Applied Vastushastra” was successfully organized by the ICI Students' Chapter, Department of Civil Engineering, KDK College, in association with ICI-Nagpur Centre from 09.02.2026 to 05.03.2026.

Dr.Rajni Kirpan, a Vastu Expert, served as the Resource Person for the course. After successful completion of the course and evaluation, certificates were issued by the Department of Lifelong Learning, RTM Nagpur University.

The course was coordinated by Dr.Ashay Shende. A total of 74 Civil Engineering students successfully completed the course and examination.



2. Expert Lecture on “Importance of Project Management” :

The Department of Civil Engineering, K.D.K. College of Engineering, Nagpur organized an Expert Lecture on “Importance of Project Management” on 13th March 2026 in association with the Indian Concrete Institute, Nagpur Centre.

The session was delivered by Er.Rajesh Lambe, Director, NR Project Management Services LLP, who shared valuable insights on project management practices in construction projects. The lecture was highly informative and beneficial to the students.

Dr.Swapneel Satone, Head, Department of Civil Engineering, and Dr.V.D.Vaidya attended the lecture. Dr.Pallavi Bisen coordinated the program.



3. SPARK-2026 :

The ICI Student Chapter of the Department of Civil Engineering, KDK College of Engineering (KDKCE), Nagpur, in association with the Indian Concrete Institute, Nagpur Centre (ICI-NC), successfully organized SPARK-2026, the XXII National Level Symposium, on the theme “Emerging Technology Trends in Engineering.” Conducted in hybrid mode, the symposium witnessed enthusiastic participation from Diploma, Undergraduate, and Postgraduate students from across the country.

The event attracted more than 1,050 students, making it one of the largest technical gatherings of its kind. A total of 154 technical papers, 47 research and innovative projects, and more than 50 poster presentations were received and showcased during the symposium, reflecting the research aptitude, creativity, and technological capabilities of young engineers and innovators.

Projects and poster presentations were evaluated by eminent academicians from reputed institutions and industry experts, who appreciated the quality, originality, and practical relevance of the entries. Cash prizes were awarded to winners and runners-up across various competitions in recognition of their outstanding performances. A major academic highlight of the symposium was the publication of all accepted research papers in the ISBN Proceedings, providing significant scholarly value and academic recognition to the contributors.

SPARK-2026 once again proved to be a vibrant platform for young minds to present innovative ideas, exchange knowledge, and contribute meaningfully to the advancement of engineering and technology while strengthening collaboration between academia and professional bodies such as ICI-NC.



NIT, Tiruchirappalli :

Moments 2026 (Annual Technical Symposium) :

The Indian Concrete Institute Student Chapter, NIT Tiruchirappalli, successfully organized a series of technical and interactive events as part of Moments 2026, the Annual Technical Symposium of the Civil Engineering Department, NIT Trichy, on 11th April 2026. The events aimed to promote practical understanding, innovation, and technical knowledge in the field of concrete technology among students.

1. Guest Lecture :

A Guest Lecture was delivered by Dr. Keerthana Kirupakaran, Assistant Professor, IIT Madras, on the topic: "Advanced Concrete Composites for Sustainable Construction: Fibre and Textile Reinforced Concrete." The session provided valuable insights into emerging trends in sustainable construction materials, applications of fibre-reinforced and textile-reinforced concrete and case studies highlighting durability and performance improvements. The lecture witnessed active participation from students and faculty, followed by an engaging Q&A session.

2. Concrete Quiz Competition :

The Concrete Quiz event tested participants' theoretical and practical knowledge in concrete technology.



- Conducted in a single round (interactive rapid-response format)
- Covered topics such as materials, mix design, properties, and applications of concrete
- Participation: Teams of up to 2 members from multiple colleges
- Prize pool: ₹2500

The event was competitive and encouraged quick thinking, conceptual clarity, and teamwork among participants. Prize money and certificates were distributed to the winners and participants in recognition of their performance and participation.

3. CubeCraft – Concrete Strength Challenge :

The CubeCraft (Concrete Strength Challenge) focussed on hands-on application of mix design principles. Participants were required to design and cast an M30 concrete cube (150×150×150 mm), predict and achieve target strength, and present their mix design and methodology.

Evaluation was based on:

- Compressive strength (7-day testing)
- Accuracy of predicted strength
- Sustainability and material efficiency
- Quality and finish of the cube
- Innovation in mix design
- Prize pool: ₹4500

The cubes were tested in the Strength of Materials Lab and participants demonstrated practical understanding of concrete technology. Prize money and certificates were distributed to the winners in recognition of their performance and participation.



Conclusion :

The events collectively provided a platform for students to bridge the gap between theoretical knowledge and practical application. From expert insights in advanced materials to competitive and hands-on activities, the initiative successfully enhanced technical competence and engagement in the field of concrete technology.

P.E.S. College of Engineering, Mandya :

Technical Webinar on “Necessity of Sustainable Concrete in Modern Day Constructions” :

The Department of Civil Engineering, P.E.S. College of Engineering, Mandya, in association with the Industry Institute Interaction Cell and the Indian Concrete Institute-Bengaluru Centre, organized a Technical Webinar on “Necessity of Sustainable Concrete in Modern Day Constructions” on 3rd June 2026 through online mode.

The programme commenced with a Welcome Address by Er.H.R.Girish, Hon. Chairman, Indian Concrete Institute-Bengaluru Centre. In his address, he welcomed the resource person, faculty members, and students, and emphasized the growing importance of sustainable construction practices in addressing environmental challenges faced by the construction industry.

The resource person for the webinar was Er.Kowshika V.R., Director, M/s.Qcrete Readymix India Pvt. Ltd., Bengaluru. The expert delivered an insightful presentation on the “Necessity of Sustainable Concrete in Modern Day Constructions”. The session highlighted the environmental impacts of conventional concrete production and stressed the need for adopting eco-friendly alternatives to ensure sustainable infrastructure development.

The speaker discussed various strategies to improve sustainability in concrete construction. The importance of optimized mix design, efficient utilization of resources, reduction of construction waste, and enhancement of durability and service life of structures was also explained in detail.

The webinar also covered recent developments in sustainable concrete technologies and the role of the

ready-mix concrete industry in promoting green construction practices. Practical examples and industrial experiences shared by the speaker provided participants with valuable insights into the implementation of sustainable materials in the field.

The session was highly interactive, with enthusiastic participation from students and faculty members. The resource person addressed the queries effectively and encouraged students to contribute towards environmentally responsible engineering practices.

The programme was graced by the presence of Dr.D.S.Sandeep Kumar, Associate Professor and Head, Department of Civil Engineering, P.E.S. College of Engineering, Mandya and Prof.Shivaraj G. Nayak, Assistant Professor and Coordinator of the programme, whose support and guidance contributed significantly to the successful conduct of the event.

The programme concluded with a vote of thanks delivered by Dr.Santhosh B. S., Hon. Secretary, Indian Concrete Institute-Bengaluru Centre.

Poornima College of Engineering, Jaipur :

1.Laboratory visit to MNIT Jaipur

The Department of Civil Engineering, Poornima College of Engineering, Jaipur under the Centre of Excellence for Sustainable Construction Materials & ICI Student Chapter organized Laboratory Visit to MNIT Jaipur. Faculty Coordinator was Dr.Ayush Meena (Assistant Professor, PCE).

The visit provided students with an opportunity to explore advanced laboratories and understand real-time applications of civil engineering concepts, on 23rd March, 2026.

The visit included multiple laboratories such as the Waste Resource Lab, Concrete & Road Material Labs, Geotechnical & Structural Analysis Lab, Environmental Engineering Lab, Hydraulic & GIS Labs, and the National Earthquake Testing Facility (NETF). Students also visited the MNIT Innovation & Incubation Centre and Raman Laboratory.

This visit was aligned with the Civil Engineering curriculum and covered key domains such as: Sustainable construction materials and waste management; Concrete technology and material testing ; Geotechnical and structural analysis; Environmental engineering and water treatment ; Hydraulic systems and GIS applications ; Surveying and geological investigations ; Earthquake engineering and dynamic testing and Innovation and entrepreneurship in civil engineering.

During the visit, students were guided by faculty members and laboratory experts from MNIT Jaipur. Each lab session included demonstrations, explanations of equipment, and discussion of real-world applications.



The laboratory visit to MNIT Jaipur was highly informative and enriching for the students. It provided valuable exposure to advanced equipment, modern testing techniques, and ongoing research in civil engineering.

The visit successfully bridged the gap between theoretical learning and practical application. Students gained a deeper understanding of sustainable construction practices, material testing, structural analysis, and emerging technologies. Overall, the visit enhanced students' technical knowledge, practical skills, and awareness of current advancements in the field of civil engineering.

2. Survey Camp at Chandwaji, Jaipur

The Department of Civil Engineering, Poornima College of Engineering, Jaipur under the Centre of Excellence for Sustainable Construction Materials & ICI Student Chapter organized a three-day Survey Camp at Chandwaji, Jaipur during 3rd April 2026 to 5th April 2026. Dr.Ayush Meena, Assistant Professor, PCE & Mr.Mohit Kumar Tiwari, Assistant Professor, PCE were the Survey Camp Faculty Coordinators. The Survey Camp Faculty & Technical Assistant Co-Coordinator were Dr.Mayank Gupta, Assistant Professor, PCE, Mr.Harlal Singh Kataria, Technical Assistant, Mr.Satendra Sharma, Technical Assistant & Mr.Lokesh Kumawat, Technical Assistant. M/s.Pavan Gurjar, Astha Garg, Aryan Bairwa, Priyanshu Raj, Hanuman Gurjar, Praveen Yadav, Pranay Porwal & Jatin Bansal acted as the Survey Camp Student Coordinators.

The survey camp covered practical aspects of surveying aligned with the academic curriculum, including:

- Traverse Survey and adjustment methods
- Levelling and RL transfer
- Profile levelling and cross-sectioning
- Trigonometric levelling
- Field data recording, calculation, and plotting using Excel and graph sheets

Students were divided into groups and assigned different tasks as per the schedule. Each group performed all activities in rotation, ensuring equal exposure.



The Survey Camp 2026 was highly successful in achieving its objectives. Students gained valuable hands-on experience in surveying techniques and developed practical skills essential for civil engineering. The camp effectively bridged the gap between theoretical concepts and field applications. It also enhanced students' confidence in handling instruments, performing calculations, and working in teams. Overall, the survey camp was an enriching and learning-oriented experience that will contribute significantly to students' professional development.

Priyadarshini Bhagwati Collage of Engineering, Nagpur

ICI FEST 2026

The Department of Civil Engineering at Priyadarshini Bhagwati Collage of Engineering, Nagpur, on 24th and 25th March 2026 successfully

organized ICI FEST 2026 in association with the Indian Concrete Institute-Nagpur Centre, a grand technical event that witnessed enthusiastic participation from students across various regions of India. The fest aimed to promote innovation, technical knowledge, and practical skills among budding Civil Engineers.

A total of 1186 participants actively took part in the fest, representing different engineering colleges from Nagpur and other states, including Kerala, Chhattisgarh, Gujrat, Madhya Pradesh, Telangana, Jharkhand, etc. The event served as a vibrant platform for students to showcase their creativity, technical expertise, and problem-solving abilities.

The fest comprised a variety of technical and creative competitions, including Paper Presentation (Four Parallel events for Civil and other allied branches), Poster Presentation, Model Creativity, Bridge Making, Rapid Fire on Concrete, Drafting using CAD, Civil Engineering Quiz, Ideathon, Clay Modelling, Kabad Se Jugad, and Mix Design Competition. Each event was designed to enhance students' understanding of civil engineering concepts while encouraging innovation and teamwork.

The inaugural function was graced by the esteemed Chief Guest, Er.Prashant Bhandarkar, Superintending Engineer, Nagpur Improvement Trust, Nagpur. The event was further honored by the presence of distinguished guests, including Er. Manoj Kawalkar, President (Elect) Indian Concrete Institute, and Er.P.P.Deshpande, Chairman, Indian Concrete Institute-Nagpur Centre, along with other dignitaries from Indian Concrete Institute, Nagpur.

The program was conducted under the able guidance of Dr.A.M.Shende, Principal of PBCOE, Nagpur, who served as the Program Chairperson. The event was convened by Dr.Ranjit N. Patil (LMC member ICI-NC and HoD Civil Engg. Dept. PBCOE), whose leadership ensured the smooth execution of all activities.

The organizing team played a crucial role in the success of the fest. The event was coordinated by Dr.N.B.Thikare (Secretary), Prof.R.H.Mohankar (Co-Secretary), and Prof.K.D.Thanekar (Treasurer), along with the dedicated support of faculty members and student coordinators.

Participants displayed remarkable talent and innovation throughout the competitions. The winners emerged from various reputed institutions across Kerala and multiple colleges in Nagpur, reflecting the wide reach and competitive spirit of the fest.

ICI Fest 2026 concluded on a successful note, leaving behind a legacy of learning, innovation, and collaboration. The event not only enhanced technical competencies but also fostered a spirit of teamwork and creativity among students, making it a memorable and enriching experience for all.

PHOTO GALLERY



Ramaiah Institute of Technology, Bengaluru :

Workshop on “From Innovation to Implementation:
3D Concrete Printing for Next-Generation Infrastructure :

The Department of Civil Engineering, Ramaiah Institute of Technology, Bengaluru, in association with the Industry Institute Interaction Cell and the Indian Concrete Institute-Bengaluru Centre, organized a 3 day Workshop titled “From Innovation to Implementation: 3D Concrete Printing for Next-Generation Infrastructure, from 21st May 2026 to 23rd May 2026.

The programme commenced with a Keynote Address-cum-Technical Lecture by Er.H.R.Girish, Hon.

Chairman, Indian Concrete Institute-Bengaluru Centre. He welcomed the resource person, faculty members & students and delivered the technical lecture, (session-1) on “3D Printing in Civil Engineering: Revolutionizing the Future of Construction” and emphasized on the growing importance of sustainable construction practices in addressing environmental challenges faced by the construction industry. The Technical Session-2 on “3D Printing Demonstration” was at Idea Lab, RIT Bangalore, and Site Visit was to M/s. AJAX Engineering Limited, Doddaballapur Road, Bangalore.

The resource person for the Technical Session-3 was Dr.Mallikarjun Hulagabali, Deputy Manager, AJAX - School of Concrete, M/s. AJAX Engineering Limited, Bengaluru. The expert delivered an insightful presentation on the “3D printing Equipment and Construction Workflow” at M/s.AJAX Engineering Limited, Bengaluru. Session highlighted the environmental impacts of conventional concrete production and stressed the need for adopting eco-friendly alternatives to ensure sustainable infrastructure development. The speaker discussed various strategies and the importance of optimized mix design, efficient utilization of resources, reduction of construction waste, and enhancement of durability and service life of structures was also explained in detail.



RNS Institute of Technology, Bengaluru :

Inauguration of ICI Institutional Membership and Students' Chapter :

The inauguration of the Indian Concrete Institute Institutional Membership and Students' Chapter in the Department of Civil Engineering, RNS Institute of Technology, marked a significant milestone in strengthening professional engagement and technical development among students and faculty members. The programme provided valuable insights into the importance of professional bodies in enhancing knowledge, fostering industry-academia collaboration, and promoting continuous learning.

The Technical Talk on “Advent of 3D Printing: Future of Concrete and Construction” delivered by Er.H.R.Girish, Chairman, ICI-Bengaluru Centre, exposed participants to emerging technologies and innovative construction practices that are shaping the future of the Civil Engineering profession. The session enhanced awareness on automation, sustainability, and digital transformation in the construction industry.

The establishment of the ICI Student Chapter and Institutional Membership creates opportunities for students and faculty members to participate in

technical workshops, seminars, industrial visits, certification programmes, research activities, and networking events organized by ICI. The programme concluded successfully with active participation from

students and faculty members, reinforcing the department's commitment to professional excellence, innovation, and lifelong learning.



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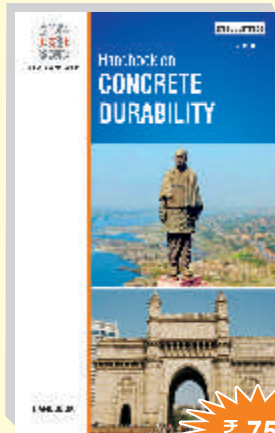


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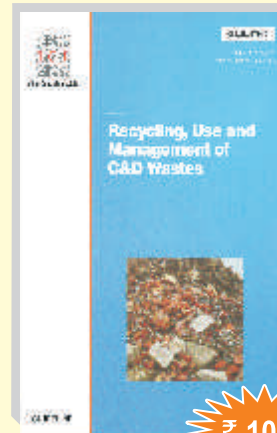
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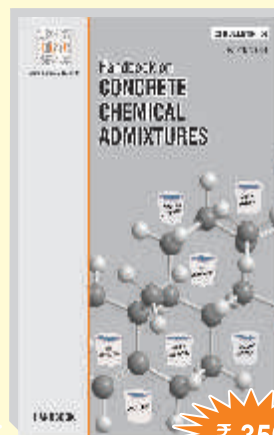
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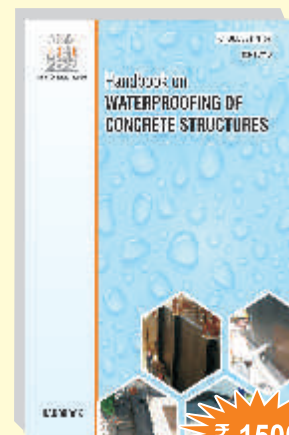
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