Department of CIVIL Engineering

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Design of RCC structures
2.	Course Code	CE-501
3.	Academic Year	2024-25
4.	Semester	5th
5.	Number of Lesson plans	50
6.	Faculty Assigned	Mr. Abhishek Chandra

Faculty Signature

Lesson Plan No. 1	Course Name: Design of RCC Structures Topic: Introduction to WSM	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Articulate the concept of working Stress method b. Explain the different recommendation of IS code IS 456
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Working Stress method introduction - Assumptions in WSM - Use of WSM 2. **Concept** (30 minutes) a. a. Detail concept involved in WSM b. Elastic theory - Use of WSM in Concrete Structure Designing 3. Exercise (5 minutes) – - Designing where WSM concept is applied - How it is different from other concept. - Recommendations of design codes IS 800 and SP6 (1). https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on use of concrete as structural Material in Construction 2. Homework - Explain various method used for design of R.C.C structures including their merits and demerits 3. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is the cube strength different from the cylinder strength for the same grade of concrete Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 2	Course Name: Design of RCC Structures Topic: Introduction to ULM	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Articulate the concept of Ultimate load method b. Explain the use of concrete as building material and their properties.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Concrete as building Materials - Advantages of concrete over other building materials 2. **Concept** (30 minutes) a. Detail study of the stress strain behavior of Concrete b. Manufacturing of Concrete, its constituents components. c. Ultimate load method introduction d. Assumptions in ULM e. Use of ULM in Concrete Structure Designing 3. Exercise (5 minutes) – - What does a Concrete as a building materials brings up to the table of a designer - How their Disadvantages can be compensated by proper use. https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students Designing where ULM concept is applied and how it is different from other concept. 2. Homework - Distinguish between *static modulus* and *dynamic modulus* of elasticity of concrete. - Show the stress strain relationship curve for concrete and mild steel. Also explain this behaviour Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Can concrete be assumed to be a *linear elastic* material? Discuss • Is the *modulus of rupture* of concrete equal to its *direct tensile strength*? Discuss Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 3	Course Name: Design of RCC Structures Topic: Introduction to LSM	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Articulate the concept of Limit State method and explain the LSM recommendations from design codes IS 456
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Limit state method introduction - Assumptions in LSM - Use of LSM 2. **Concept** (30 minutes) a. Detail concept involved in LSM b. Stress block Diagram c. Design Stress-Strain Curve Use of LSM in Concrete Structure Designing 3. Exercise (5 minutes) – - Choose a suitable section for beam, column each and list out their all properties https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on “Working stress method” and “limit state method” design philosophy used in concrete structures in detail. 2. Homework (a) Define characteristic strength. (b) Determine the ‘mean target strength’ required for the mix design of M25 concrete, assuming moderate quality control. (c) Limit state (d) Characteristic strength (e) Design value (f) Partial safety factor (g) Factored load (h)Moment of resistance Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - The standard flexure test makes use of a ‘third-point loading’. Is this necessary? Can a single point load at midspan be used as an alternative - How would you define ‘durable concrete’? Discuss the ways of ensuring durability - What steps can a designer adopt at the design stage to ensure the durability of a reinforced concrete offshore structure

	- Describe the characteristics of failure at limit state of collapse in flexure for under reinforced and over reinforced sections Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 4	Course Name: Design of RCC Structures Topic: Analysis of Singly reinforced beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of Singly reinforced beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Types of loads - Different IS code for loading - About Singly reinforced beam [Shape and Size] - Collapse of beams 2. **Concept** (30 minutes) a. Classification of cross section of beams b. Calculation for Compressive force and its point of action in Beam cross section c. Steps for analysis of beams d. A rectangular beam section has dimensions of 300 x 600 mm. It is reinforced with 4 Nos. 25 dia bars. Find moment capacity of section. Using WSM. Assume clear cover of 20 mm, M-20 concrete and Fe 415 steel. 3. Exercise (5 minutes) – Calculate the design wind pressure if the basic wind speed is 44 m/s, risk coefficient is 1, topography factor is 1, terrain is with closely spaced buildings and height of building(class A) = 20m https://nptel.ac.in/courses/105/105/105105104.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on application of different types of loads on structural member 2. Homework - Determine the ultimate moment of resistance of a balanced reinforced section of 300 mm breadth and 600 mm effective depth using M25 concrete and Fe 500D steel. Also find the area of steel required to balance the section. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - Q1 The partial safety factor for material strength for concrete is - (a) 0.67 (b) 1.5 (c)1.15 (d) 0.87 - The partial safety factor for material strength for steel is - (a) 0.67 (b) 1.5 (c)1.15 (d) 0.87 - Q3. The partial safety factor for DL and LL is

	- (a) 0.67 (b) 1.5 (c)1.15 (d) 0.87 - Q4. For design purpose, at limit state of collapse in flexure, maximum compressive stress in concrete is taken as - (a) 0.67fck (b) 0.446fck (c)0.87fck (d) None - Q5. The minimum strain in tension reinforcement at yielding in limit state of collapse in flexure is - (a) 0.002 (b) 0.002+fy/(1.15*Es) (c) 0.02+.87fy/Es (d) 0.0035 - Q6. The maximum strain in concrete at the outermost compression fibre at limit state of collapse in bending is - (a) 0.002 (b) 0.002+.87fy/Es (c) 0.002+.87fy/Es (d) 0.0035 Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 5	Course Name: Design of RCC Structures Topic: Design of Singly reinforced beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of Singly reinforced beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Moment of resistance with respect to reinforcement - IS code recommendations 2. **Concept** (30 minutes) a. Derivation of moment of resistance b. Steps for Design of Singly reinforced beams c. Design a singly reinforced concrete beam of rectangular cross section for an effective span of 6m carrying a working live load of 35 kN/m. Use M25 Grade concrete and Fe-415 HYSD steel 3. Exercise (5 minutes) – - Give the codal provisions regarding the minimum requirements of a Beam. - https://nptel.ac.in/courses/105/105/105105104/
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of Singly reinforced beam 2. Homework - A rectangular beam section has to dimensions of 300 x 600 mm. It has to resist a moment of 150 kN-m. Design the beam using LSM. Assume suitable data. - Design a singly reinforced concrete beam which has width 300mm, total depth 700mm, with cover of 40mm to the centre of the reinforcement. Design the beam if it is subjected to a total bending moment of 120 kN-m. Use M20 concrete amd HYSD bars of grade 415. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Q1 The limiting values of the depth of neutral axis(x_u) from outermost compressive fibre for Fe 250, Fe 500 and Fe 415 are (a) 0.53d, 0.48d, 0.46d (b) 0.53d, 0.46d, 0.48d (c) 0.48d, 0.46d, 0.53d (d) 0.46d, 0.48d, 0.53d Q2. The depth of centre of compressive force of concrete from the centroid of tension reinforcement in a singly reinforced beam in bending for Fe 500

	grade of steel is (a) 0.46x_u (b) 0.48x_u (c) 0.53x_u (d) (d-0.416x_u) Q3. If the depth of neutral axis x_u is less than the limiting depth of neutral axis the section is called as (a) Balanced Section (b) Over-Reinforced Section (c) Under-Reinforced Section (d) none Q4. The approximate value of shrinkage strain in concrete is (i) 0.0035 (ii) 0.035 (iii) 0.00035 (iv) 0.35 Q5. The relation b/w modulus of rupture f_{cr}, splitting strength f_{cs}, & direct tensile strength f_{ct}, is given by (i) $f_{cr} = f_{cs} = f_{ct}$ (ii) $f_{cr} > f_{cs} > f_{ct}$ (iii) $f_{cr} < f_{cs} < f_{ct}$ (iv) $f_{cs} > f_{cr} > f_{ct}$ Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 6	Course Name: Design of RCC Structures Topic: Design of Singly reinforced beam applying all checks	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of Singly reinforced beam using Limit State method applying all checks
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Get student familiar with the Size of reinforcement Available in Market - Cover, Effective depth and Steel distribution 2. **Concept** (30 minutes) a. Use of Design aids b. Deflection Criteria according to IS 456 c. Using LSM determine and provide the tension reinforcement at mid span section of a simply supported RC beam having B = 400 mm, D = 600 mm, effective cover (c') = 50 mm, width of support = 400 mm, clear span = 5 m, super imposed working load = 45 kN/m. Use M-20 and fe-415. Give neat sketch 3. Exercise (5 minutes) – Show that deflection control in normal flexural members can be achieved by limiting span/effective depth ratios.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on the deflection limits as per IS code recommendations? 2. Homework - Design a singly reinforced concrete beam of rectangular cross section for an effective span of 6m carrying a working live load of 35 kN/m. Use M25 Grade concrete and Fe-415 HYSD steel. Apply all the Checks. https://nptel.ac.in/courses/105/105/105105104/ Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - What are the advantages and disadvantages of providing large clear cover to reinforcement in flexural members Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 7	Course Name: Design of RCC Structures Topic: Analysis of Doubly reinforced beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of Doubly reinforced beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - About Doubly reinforced beam [Shape and Size] - Collapse of beams 2. **Concept** (30 minutes) a. Detail Steps for analysis of doubly reinforced beams b. A rectangular doubly reinforced concrete beam has the following details: **Width of the beam (b):** 300 mm **Effective depth (d):** 500 mm **Cover to compressive steel (d'):** 50 mm **Concrete grade:** M25 **Steel grade:** Fe415 **Area of tensile reinforcement (As):** 1800 mm² **Area of compressive reinforcement (As'):** 600 mm² Analyze the doubly reinforced beam and determine: ➢ The depth of the neutral axis ➢ The ultimate moment of resistance of the beam. 3. Exercise (5 minutes) – - Why do we use both tensile and compressive reinforcement in a doubly reinforced beam - How does the presence of compressive steel affect the moment of resistance in a doubly reinforced beam? https://nptel.ac.in/courses/105/105/105105104/ Think–Pair–Share
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on doubly reinforced beam, and when is it used in RCC design 2. Homework A rectangular doubly reinforced concrete beam has the following details: • Width of the beam (b): 250 mm • Overall depth of the beam (D): 600 mm • Effective depth (d): 550 mm • Cover to compressive steel (d'): 50 mm • Concrete grade: Steel grade: • Area of tensile reinforcement (As): 1500 mm² • Area of compressive reinforcement (As'): 500 mm² Analyze the doubly reinforced beam and determine: 1. The depth of the neutral axis 2. The ultimate moment of resistance of the beam. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	- Discuss the impact of increasing the compressive reinforcement on the load-carrying capacity of a doubly reinforced beam. - In what scenarios would you prefer a doubly reinforced beam over a singly reinforced beam in practical construction? - Explain the role of balance, under-reinforced, and over-reinforced sections in the context of doubly reinforced beams. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 8	Course Name: Design of RCC Structures Topic: Design of Doubly reinforced beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of doubly reinforced beam using Limit State method applying all checks
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - About Compression Reinforcement - Moment capacity of doubly reinforced beam 2. **Concept** (30 minutes) a. Detail design steps for doubly reinforced beam b. Design a doubly reinforced concrete beam of 300 mm wide and 400 mm effective depth for an ultimate moment of 150 kN-m using M20 concrete and 250 steel 3. Exercise (5 minutes) – - In a doubly reinforced beam, the additional reinforcement on the compression side is provided to: a) Increase the ductility of the beam b) Resist the shear forces c) Resist additional moment when the section is inadequate as a singly reinforced beam d) Reduce the depth of the beam In the Limit State Method, the partial safety factor for steel in the design of a doubly reinforced beam is generally taken as: a) 1.0 b) 1.15 c) 1.25 d) 1.5 The purpose of providing doubly reinforced beams is to: a) Increase shear capacity b) Resist tensile stresses c) Reduce deflection d) Increase moment of resistance beyond what a singly reinforced section can provide Which of the following is true about the neutral axis in a doubly reinforced beam? a) It always lies in the tensile zone b) It shifts towards the compression side c) It remains at the centroid of the section d) It lies closer to the tension steel In the design of a doubly reinforced beam, the compressive stress in concrete is considered as: a) 0.67 fckf_{ck}fck b) 0.36 fckf_{ck}fck c) 0.45 fckf_{ck}fck d) 0.5 fckf_{ck}fck

	Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of doubly reinforced beam 2. Homework Design a doubly reinforced rectangular concrete beam with the following details: • **Width of the beam (b):** 300 mm • **Effective depth (d):** 550 mm • **Overall depth (D):** 600 mm • **Factored moment (M_u):** 300 kNm • **Concrete grade:** M20 • **Steel grade:** Fe415 Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - If a beam is subjected to a higher moment than what a singly reinforced section can resist, explain how you would design a doubly reinforced beam to resist the additional moment. Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 9	Course Name: Design of RCC Structures Topic: Analysis of T- beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of T- beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - About T- beam [Shape and Size] - Advantage and use of T-beam 2. **Concept** (30 minutes) a. Detail Steps for analysis of T-beams b. Given a T-beam with a flange width of 1200 mm, flange thickness of 100 mm, web width of 300 mm, and effective depth of 600 mm, calculate the depth of the neutral axis when subjected to a factored bending moment of 400 kNm. Assume fck=25MPa and fy=415MPa 3. Exercise (5 minutes) – - In a T-beam, the effective width of the flange is primarily influenced by: a) The span of the beam b) The thickness of the web c) The depth of the beam d) The width of the column When the neutral axis of a T-beam lies within the flange, the beam section is analyzed as: a) A rectangular section b) A doubly reinforced section c) A flanged section d) An L-beam If the neutral axis of a T-beam lies within the web, the flange contributes to: a) Compression only b) Tension only c) Both compression and tension d) Shear resistance In the analysis of a T-beam, the depth of the neutral axis is primarily determined by: a) The width of the flange b) The area of tensile reinforcement c) The thickness of the flange and the stress distribution in the concrete d) The span of the beam Which of the following is NOT an assumption made in the Limit State Method for T-beams? a) Plane sections before bending remain plane after bending

	b) The maximum strain in concrete is 0.0035 c) The tensile strength of concrete is considered in design d) The stress-strain relationship of steel is assumed to be bilinear https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on analysis of T-beam in LSM 2. Homework Analyze a T-beam where the neutral axis falls within the flange. The T-beam has a flange width of 1000 mm, flange thickness of 150 mm, web width of 250 mm, and an effective depth of 600 mm. If the beam is subjected to a factored moment of 350 kNm, determine the area of tensile reinforcement required. Assume fck=20MPa and fy=500. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - Explain the significance of the flange and web in a T-beam. How does the T-beam differ from a rectangular beam in terms of moment resistance? Why is the width of the flange limited in the design of a T-beam? How is the effective flange width determined according to IS 456:2000. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 10	Course Name: Design of RCC Structures Topic: Design of T- beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of T- beam using Limit State method applying all checks
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Behavior of T-beam under different loading condition 2. **Concept** (30 minutes) a. Detail design steps for T- beam b. Design a T-beam for a given factored bending moment of Mu=500 kNm. The T-beam is part of a floor system with the following details: • Effective span of the beam: 8 meters • Thickness of slab (flange thickness: 150 mm • Width of the web: 300 mm • Effective depth: 550 mm • Concrete grade: M25 • Steel grade: Fe500 c. Exercise (5 minutes) – - In the design of a T-beam, the effective flange width is: a) Equal to the actual width of the flange b) The lesser of the actual flange width and the distance between adjacent beams c) Always greater than the width of the web d) Calculated based on the depth of the beam only The depth of the neutral axis in a T-beam is determined by: a) The width of the flange b) The effective depth of the beam c) The location where the concrete reaches its ultimate stress d) The distance from the top fiber to the centroid of the tensile reinforcement When the neutral axis of a T-beam is located within the flange, the flange contributes to: a) Only tensile strength b) Only compressive strength c) Both tensile and compressive strength d) Shear strength In the Limit State Method, the moment of resistance of a T-beam is primarily governed by: a) Shear strength b) Deflection limits c) The compressive and tensile strength of the concrete and steel

	d) The bond strength of reinforcement Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of T beam 2. Homework Design a T-beam section of 250 mm width of web, 1000 mm width of flange, 100 mm thickness of flange when subjected to an ultimate moment of 300 kN-m using a concrete of gradeM20 and Fe 500D steel. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions - What is the difference between singly reinforced and doubly reinforced T-beams? In what situations would you use each type, and how does the design process differ? - What is a T-beam, and how does it differ from a rectangular beam in terms of structural performance? Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 11	Course Name: Design of RCC Structures Topic: Shear stress in a beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain the shear stress develop in a beam and its impact.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Modes of cracking - Brief concept of Design shear strength of concrete 2. **Concept** (30 minutes) a. Detail behavior of beam under shear stress b. Shear transfer mechanism **Aggregate Interlock:** Concrete transfers shear through the interlock between aggregates across cracks. When a beam cracks, the roughness of the crack surfaces helps transfer shear. **Frictional Resistance:** Shear friction between the cracked surfaces also contributes to shear transfer. **Confinement Effects:** Proper reinforcement in the beam helps confine the concrete, improving its shear capacity. This is achieved through transverse reinforcement or stirrups. **Shear Reinforcement (Stirrups):** **Function:** Stirrups (transverse reinforcements) are used to resist shear forces and provide additional strength. They help prevent shear failure by holding the concrete in place and resisting shear forces. **Design:** The spacing and quantity of stirrups are designed based on the shear force the beam will experience. The amount of shear reinforcement is determined using design codes like IS 456:2000 **Concrete and Reinforcement Interaction:** **Strain Compatibility:** The interaction between concrete and reinforcement in resisting shear forces is crucial. The design ensures that the concrete and reinforcement work together to resist applied loads. **Crack Formation:** The formation of cracks in concrete beams can affect the shear transfer mechanism. The design must account for these cracks and ensure adequate reinforcement to prevent shear failure. c. Shear Failure Modes: **Shear Compression Failure:** Occurs when the concrete cannot resist the compressive stresses due to shear, leading to diagonal cracks and failure. **Shear Tension Failure:**

Occurs when the tensile strength of the concrete is exceeded,causing diagonal cracks and potential failure.

Shear Reinforcement Failure:

Occurs when the shear reinforcement is insufficient to resist the applied shear forces, leading to potential failure.

3. Exercise (5 minutes) –

Which of the following mechanisms contributes to shear transfer in concrete beams?
a) Aggregate interlock
b) Frictional resistance
c) Confinement effects
d) All of the above

In a concrete beam, which failure mode is associated with the concrete's inability to resist compressive stresses due to shear?
a) Shear tension failure
b) Shear compression failure
c) Flexural failure
d) Bearing failure

What is the primary function of stirrups in a concrete beam?
a) To resist tensile forces
b) To provide additional compressive strength
c) To resist shear forces
d) To increase the effective depth of the beam

The shear strength of concrete in a beam is primarily influenced by:
a) The width and depth of the beam only
b) The type of reinforcement used
c) The grade of concrete and the aggregate interlock
d) The live load and dead load on the beam

When calculating shear strength provided by stirrups, which of the following factors is NOT considered?
a) Area of stirrups
b) Yield strength of the stirrups
c) Spacing of the stirrups
d) Effective depth of the beam

According to the Limit State Method, shear reinforcement is typically required when:
a) The beam is subject to high bending moments
b) The shear force exceeds the shear strength provided by concrete alone
c) The beam has a small effective depth
d) The beam is subjected to thermal stresses

In the context of shear transfer, what does 'aggregate interlock' refer to?
a) The bond between reinforcement bars and concrete
b) The frictional resistance across cracks
c) The mechanical interlocking of aggregate particles across a crack

	d) The interaction between the concrete and external loads https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Shear reinforcement in Beams 2. Homework - Describe the different types of shear failure modes in concrete beams. How can these failure modes be identified, and what design strategies can be employed to prevent them? How does the effective depth of a concrete beam influence its shear capacity? Explain the relationship between effective depth and shear reinforcement. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Describe the shear transfer mechanisms in concrete beams and explain how they contribute to the beam's overall shear strength. • What is the role of aggregate interlock in shear transfer in concrete beams? How does it affect the beam's performance under shear loads? Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 12	Course Name: Design of RCC Structures Topic: Analysis of Singly reinforced beams for shear	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of Singly reinforced beams for shear using Limit State method applying all checks
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Shear Strength Calculation: - Design Codes and Standards: 2. **Concept** (30 minutes) a. Serviceability and Safety: b. Steps for Analysis of Singly reinforced beams for shear c. Codal procedure for Analysis of shear reinforcement Analyse the beam with below Data:- - Beam width b=230 mm - Beam effective depth d=450 - Applied shear force Vu=150 kN - Concrete grade: M25 - Steel grade: Fe500 - Shear reinforcement provided: 2 legged stirrups @ 200 mm c/c a) Calculate the shear strength provided by concrete. b) Determine the shear strength provided by stirrups. c) Verify if the provided shear reinforcement is sufficient. 3. Exercise (5 minutes) – The minimum shear reinforcement in a beam is given by the expression (a) $A_{SV} \geq \frac{0.4\, b_{SV}}{0.87 f_y}$ (b) $A_{SV} \geq \frac{0.85bd}{f_y}$ (c) $A_{SV} \geq \frac{V_{us}\, s_v}{0.87 f_y d}$ (d) none The minimum tension reinforcement in a beam is given by the expression (a) $A_{SV} \geq \frac{0.4\, b_{SV}}{0.87 f_y}$ (b) $A_{SV} \geq \frac{0.85bd}{f_y}$ (c) $A_{SV} \geq \frac{V_{us}\, s_v}{0.87 f_y d}$ (d) none In a beam subjected to vertical loads only, the transverse reinforcement resist (a) Axial load (b) bending moment (c) shear Force (d) shear force & bending moment In a beam subjected to vertical loads only, the main reinforcement

	resist (a) Axial load (b) bending moment (c) shear Force (d) shear force & bending moment The value of shear strength of concrete τc depends on (a) fck (b) percentage of tension reinforcement (c) both (d) none. If nominal shear stress in a beam is less than design shear strength of concrete then shear reinforcement (a)shall be provided (b) shall not be provided (c) may be provided (d) none https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Analysis of beam for Shear 2. Homework - A rectangular bam section of 250 mm width and 450 mm effective depth is reinforced with 4 bars of 18 mmØ. Find the moment of resistance of section. Also determine the shear reinforcement required to resist shear forces of (I) 30kN, (ii) 60 kN, (iii) 150 kN and (iv) 250 kN at service state. Consider a concrete of grade M20 and Fe 500D steel. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Describe the significance of the shear span-to-depth ratio in concrete beams. How does this ratio influence the beam's shear strength and overall behavior? • What is the 'shear crack' in a concrete beam, and how does it affect the shear transfer mechanism? Discuss methods to control or mitigate shear cracks in beams. • Explain the difference between 'shear strength' and 'shear capacity' in the context of concrete beams. How are these terms used in structural design and analysis?Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 13	Course Name: Design of RCC Structures Topic: Analysis of doubly reinforced beams for shear	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of Doubly reinforced beams for shear using Limit State method applying all checks.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Design and placement of stirrups - Types and spacing of shear reinforcement 2. **Concept** (30 minutes) a. Concepts and Definitions b. Design Considerations: Effect of additional compression reinforcement on shear capacity c. Design Procedures: • Calculation of bending moment and shear forces • Checking for both bending and shear capacities d. Design Codes and Standards: IS 456:2000 (Indian Standard for Plain and Reinforced Concrete) **Numerical** • Beam width, b=230 mm • Effective depth, d=450 mm • Applied shear force, Vu=150 kN • Concrete grade: M25 • Steel grade: Fe500 • Provided shear reinforcement: 2 legged stirrups of 8 mm diameter at 200 mm c/c 1. Calculate the shear strength provided by concrete. 2. Determine the shear strength provided by stirrups. 3. Check if the provided shear reinforcement is sufficient. 3. Exercise (5 minutes) – In a doubly reinforced beam, which type of reinforcement is added to increase the beam's capacity for resisting shear? a) Additional longitudinal reinforcement b) Additional compression reinforcement c) Additional tension reinforcement d) Additional shear reinforcement (stirrups) The shear strength provided by concrete in a doubly reinforced beam can be calculated using: a) The depth of the beam and the type of loading b) The width of the beam and the grade of concrete c) The effective depth and the shear span-to-depth ratio d) The compressive strength of concrete and the effective depth

	When designing shear reinforcement for a doubly reinforced beam, which factor is NOT directly considered in the shear reinforcement design? a) The applied shear force b) The depth of the neutral axis c) The width of the beam d) The spacing of the stirrups In the Limit State Method, the shear capacity of a doubly reinforced beam is checked by: a) Comparing the applied shear force to the shear strength provided by concrete and stirrups b) Ensuring that the beam's deflection does not exceed serviceability limits c) Checking the beam's moment capacity against the applied moment d) Verifying that the beam's compressive strength is adequate Which of the following is true about the effect of compression reinforcement on shear strength in a doubly reinforced beam? a) Compression reinforcement does not affect shear strength b) Compression reinforcement increases the shear strength of the beam c) Compression reinforcement reduces the shear strength of the beam d) Compression reinforcement affects only the beam's flexural strength To determine the required shear reinforcement in a doubly reinforced beam, the following is used: a) The maximum bending moment the beam can resist b) The shear force the beam is subjected to and the shear strength provided by concrete c) The depth of the neutral axis and the width of the beam d) The effective depth and the concrete cover What is the primary role of stirrups in a doubly reinforced beam? a) To resist axial loads b) To provide additional bending strength c) To resist shear forces d) To increase the beam's depth https://nptel.ac.in/courses/105/105/105105104/ Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Shear reinforcement for doubly reinforced Beams 2. Homework - A doubly reinforced beam is simply supported over a span of 4.5 m and is reinforced with 2-12 Ø bars in compression and 3-16 Ø bars in tension. The beam has a width of 250 mm and total depth of 400 mm with a effective cover of 50 mm. Check the beam for the limit state of collapse in deflection using modification factor as per IS: 456 Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions • Explain the concept of a doubly reinforced beam. Why is additional reinforcement provided in doubly reinforced beams, and how does it affect the shear capacity of the beam? Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 14	Course Name: Design of RCC Structures Topic: Design of reinforced beams for bending and shear	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of reinforced beams for bending and shear combined using Limit State method applying all checks
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Calculate Design Moments and Shear Forces: - Use load combinations from design codes to determine the maximum bending moments and shear forces - Typical load combinations include dead loads (DL), live loads (LL), and any other applicable loads 2. **Concept** (30 minutes) **a. Perform Combined Checks** **Flexure and Shear Check:** Verify that the beam's combined bending and shear capacities are adequate by performing combined loading checks. **b. Serviceability Checks:** **Deflection Check:** Ensure that the beam's deflection under service loads is within acceptable limits. **Crack Control:** Verify that crack widths are controlled according to design codes. **c. Detailing and Reinforcement Placement** **Detail Reinforcement:** Provide details for the placement of both tensile and shear reinforcement. Ensure proper anchorage and development length of the reinforcement bars. **Check for Minimum Reinforcement:** Ensure that minimum reinforcement requirements are met for both bending and shear. **Design a beam for following Data** Beam width, b=230 mm Effective depth, d=450 mm Applied bending moment, Mu=100 kNm Applied shear force, Vu=50 kN Concrete grade: M25 Steel grade: Fe500 3. Exercise (5 minutes) – Which of the following is true about the Limit State Method for designing reinforced concrete beams? a) It ensures that beams will not fail due to bending or shear at ultimate loads. b) It focuses only on the serviceability of beams under normal loads. c) It considers both the ultimate strength and serviceability criteria of

beams.
d) It is based solely on the service load conditions of the beam.

In the Limit State Method, the shear strength of a reinforced concrete beam is primarily provided by:
a) Concrete alone
b) Steel reinforcement alone
c) Both concrete and shear reinforcement (stirrups)
d) Concrete cover and reinforcement detailing

To determine the effective depth (d) of a reinforced concrete beam, which of the following parameters is essential?
a) The width of the beam
b) The depth of the beam's neutral axis
c) The distance from the extreme compression fiber to the centroid of the tensile reinforcement
d) The type of concrete used

In the design of a reinforced concrete beam, the main function of stirrups is to:
a) Increase the bending strength of the beam
b) Provide resistance against shear forces
c) Enhance the aesthetic appearance of the beam
d) Reduce the beam's weight

Which of the following factors is NOT considered when calculating the shear strength of concrete in a beam?
a) Concrete grade
b) Width of the beam
c) Effective depth of the beam
d) The applied bending moment

The term "bending moment capacity" of a beam refers to:
a) The maximum shear force the beam can resist
b) The maximum moment the beam can withstand before failure
c) The amount of deflection the beam will experience
d) The maximum axial load the beam can support

In the Limit State Method, which of the following is used to ensure serviceability of the beam under service loads?
a) Checking the beam's ultimate moment capacity
b) Ensuring deflection does not exceed specified limits
c) Verifying that the beam's shear strength is adequate
d) Calculating the beam's minimum reinforcement

The strength reduction factor (φ) in the Limit State Method is used to:
a) Increase the strength of concrete and steel
b) Account for the variability in material strengths and loading conditions
c) Determine the depth of the neutral axis
d) Calculate the amount of deflection

	In the design of doubly reinforced beams, compression reinforcement is used to: a) Increase shear strength only b) Improve bending strength and control crack width c) Decrease the beam's depth d) Replace tensile reinforcement Which design code provides guidelines for the design of reinforced concrete beams, including checks for bending and shear, in India? a) IS 456:2000 b) AISC Manual c) Eurocode 2 d) ACI 318 Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of Beam 2. Homework - Beam width, b=250 mm - Effective depth, d=500 mm - Applied bending moment, Mu=120 kNm - Applied shear force, Vu=80 kN - Concrete grade: M25 - Steel grade: Fe500 **1. Calculate the required area of tensile reinforcement for bending.** **2. Determine the shear strength provided by concrete.** **3. Calculate the required shear reinforcement.** Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Explain how the bending moment and shear force are combined in the design of a reinforced concrete beam • Describe the role of shear reinforcement (stirrups) in reinforced concrete beams • What is the difference between ultimate limit state and serviceability limit state? Students will answer and discuss. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 15	Course Name: Design of RCC Structures Topic: Limit state of collapse in bond	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe about the limit state of collapse in bond
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Brief concept of bond stress and how it decide the effectiveness of the Structural member - Bond Strength 2. **Concept** (30 minutes) a. Factors Affecting Bond Strength: • Concrete Quality • Reinforcement Quality • Concrete Cover: b. Bond Failure Mechanisms: • Splitting of Concrete • Pull-Out Failure • Concrete Crushing c. Design Considerations for Bond Strength: • Development Length: • Anchorage Length: • Minimum Cover: d. Limit State of Collapse in Bond (Design Approach): • Check Development Length • Check Anchorage Conditions • Ensure Adequate Concrete Cover 3. Exercise (5 minutes) – What does the development length in reinforced concrete design refer to? A. The length of reinforcement required to ensure effective anchorage. B. The length of the beam needed to resist bending moments. C. The thickness of concrete cover provided to reinforcement. D. The distance between two adjacent bars in a reinforcement grid. Which factor is least likely to affect the bond strength between concrete and reinforcement? A. Concrete grade B. Diameter of the reinforcement C. Surface condition of the reinforcement D. Environmental temperature during curing In the context of bond failure, what is 'pull-out failure'? A. Concrete around the reinforcement crushing due to high bond stresses.

	B. The reinforcement being pulled out of the concrete due to inadequate bond strength. C. The development length of reinforcement being insufficient. D. The concrete splitting along the longitudinal axis of the reinforcement. What is the primary purpose of providing adequate concrete cover over reinforcement? A. To reduce the cost of concrete B. To increase the aesthetic appearance of the structure C. To protect the reinforcement from environmental damage and ensure bond strength D. To increase the overall weight of the beam Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Bond stress 2. Homework - What is the role of bond strength in the design of reinforced concrete beams? - What is the role of bond strength in the design of reinforced concrete beams? - How does concrete cover affect the bond strength and overall durability of a reinforced concrete beam? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • What factors influence the bond strength between concrete and reinforcement? • Discuss the different types of bond failure mechanisms in reinforced concrete beams. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 16	Course Name: Design of RCC Structures Topic: Development length and Anchorage in beams	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain development length and Anchorage in beams
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - To Development Length - To Anchorage 2. **Concept** (30 minutes) a. Development Length • Definition • Importance • Factors Affecting Development Length: i. Concrete Strength ii. Reinforcement Strength iii. Reinforcement Diameter iv. Type of Reinforcement v. Concrete Cover vi. Surface Condition • Formula for Development Length b. Anchorage • Definition • Importance: • Types of Anchorage: i. Straight Anchorage: ii. Hooks: iii. Laps: iv. Bends: v. Mechanical Splices: • Design Considerations for Anchorage: • Minimum Embedment Length • Hook and Bend Details • Lap Splicing 3. Exercise (5 minutes) – **Given:** • Diameter of the reinforcing bar: 20 mm • Concrete grade: M25 (fck=25 MPa) • Steel grade: Fe500 (fy=500 MPa) **Calculate the development length (ldl_dld) required for the reinforcement.** Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Development Length and Anchorage

	2. Homework - Design a reinforced concrete beam where the main reinforcement is provided using 20 mm diameter bars of Fe500 steel. The concrete grade is M25. Determine the development length required for the reinforcement bar - For the same beam as above, if a 90° hook is provided at the end of the reinforcement bar, calculate the effective anchorage length. Assume that the anchorage value of a 90° hook is 8 times the diameter of the bar. - Two 16 mm diameter Fe500 bars are to be lapped in an M30 grade concrete beam. Determine the required lap length, assuming full tension lap splicing. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the concept of development length ensure the safety and stability of a reinforced concrete structure? • What might be the consequences of underestimating the required development length in a beam's design? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 17	Course Name: Design of RCC Structures Topic: Design of beams with Curtailment of bars	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of beams with Curtailment of bars
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Curtailment of bars - Bending moment profile in beams 2. **Concept** (30 minutes) a. Curtailment of Bars Steps for Bar Curtailment: 1. Determine Bending Moment Diagram: 2. Calculate Required Reinforcement: 3. Curtailment Length: 4. Check Shear Capacity: 5. Spacing of Bars: 3. Exercise (5 minutes) – Which of the following is the primary concern in the serviceability limit state design of a reinforced concrete beam? A) Ultimate strength B) Deflection control C) Shear capacity D) Bond strength Which factor most directly influences the deflection of a reinforced concrete beam under service loads? A) Concrete grade B) Span length C) Reinforcement spacing D) Type of load (dead or live) What is the minimum development length required for a 16 mm diameter Fe500 steel bar embedded in M25 concrete? A) 300 mm B) 400 mm C) 500 mm D) 600 mm Curtailment of bars in a reinforced concrete beam should be done: A) At the point of maximum bending moment B) At the point of zero bending moment C) At the supports D) Beyond the theoretical cut-off point by at least the development length

	In a reinforced concrete beam, excessive deflection can lead to: A) Increased shear capacity B) Cracking of finishes C) Reduced flexural strength D) Improved load distribution Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of beams with Curtailment of bars 2. Homework - Design a simply supported reinforced concrete beam of 6 m span, subjected to a uniformly distributed load of 15 kN/m. The beam cross-section is 300 mm × 500 mm, using M25 grade concrete and Fe500 steel. Suggest the curtailment of bars. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Why is it important to consider the bending moment distribution when determining where to curtail reinforcement bars? • How do serviceability criteria, such as deflection and crack width, influence the overall design of a reinforced concrete beam? • How does the concept of development length relate to the anchorage of bars, and why is it critical in the design of reinforced concrete structures? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 18	Course Name: Design of RCC Structures Topic: Design of beams for Serviceability	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of beams for Serviceability
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Serviceability conditions of beams - Load factors and combination 2. **Concept** (30 minutes) a. Serviceability Limit State Design • Deflection Control: • Crack Width Control: • Vibration Control: Steps for Serviceability Design: 1. Calculate Service Loads: 2. Check for Deflection: 3. Check for Crack Width: 4. Vibration Control (if applicable): b. Moment of inertia for deflection calculation 3. Exercise (5 minutes) – Which of the following methods is used to control the crack width in a reinforced concrete beam? A) Increasing concrete cover B) Using larger diameter bars C) Reducing the span length D) Increasing the stirrup spacing For a simply supported beam subjected to a uniformly distributed load, the maximum bending moment occurs: A) At the midspan B) At the supports C) At 1/3rd of the span length D) At 1/4th of the span length The primary purpose of anchoring the reinforcement bars in a beam is to: A) Increase the shear capacity B) Prevent slipping of bars under tension C) Improve concrete compaction D) Reduce the beam's weight Which of the following is NOT a consideration in the serviceability design of beams? A) Limiting deflection B) Controlling crack width C) Ensuring sufficient ultimate load capacity

	D) Vibration control In the design of beams, curtailment of bars is generally avoided in which region? A) Near the midspan B) Near the supports C) In the region of maximum shear D) In the region of minimum bending moment Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of beams for Serviceability 2. Homework - Design a simply supported reinforced concrete beam of 6 m span, subjected to a uniformly distributed load of 15 kN/m. The beam cross-section is 300 mm × 500 mm, using M25 grade concrete and Fe500 steel. Design for serviceability - A simply supported reinforced concrete beam with an effective span of 6 meters is subjected to a uniformly distributed load of 15 kN/m (including self-weight). The beam has a rectangular cross-section with a width of 300 mm and an effective depth of 500 mm. The beam is reinforced with 4 bars of 16 mm diameter. The concrete grade is M25 and the steel grade is Fe500. a) Calculate the maximum deflection of the beam under the given loading. b) Check if the deflection is within the permissible limits as per IS 456:2000. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How do environmental factors influence the design choices you make for serviceability and durability in RCC beams? • How would you approach the design of a beam that spans a large open space with minimal support, considering both strength and serviceability requirements? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 19	Course Name: Design of RCC Structures Topic: Analysis of Cantilever beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analysis of Cantilever beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - About Cantilever beam [Shape and Size] - Behavior of cantilever beam under different loading condition 2. **Concept** (30 minutes) a. Reinforcement distribution in Cantilever beam b. Steps for analysis of cantilever beams A cantilever beam of effective span 4 meters is subjected to a uniformly distributed load of 10 kN/m. The beam has a rectangular cross-section with a width of 300 mm and an effective depth of 500 mm. The concrete is of grade M25, and the reinforcement is Fe500 steel. • Perform the analysis to check for the ultimate limit state of bending. • Check the beam for the serviceability limit state, focusing on deflection. • Ensure the design is adequate for shear. 3. Exercise (5 minutes) – What is the maximum bending moment for a cantilever beam subjected to a uniformly distributed load www over its entire span LLL? a) wL28\frac{wL^2}{8}8wL2 b) wL22\frac{wL^2}{2}2wL2 c) wL24\frac{wL^2}{4}4wL2 d) wL212\frac{wL^2}{12}12wL2 Which of the following factors primarily influences the deflection of a cantilever beam? a) Cross-sectional area of the beam b) Length of the beam c) Load applied on the beam d) All of the above In the Limit State Method, what is the typical value used for the partial safety factor for concrete in the ultimate limit state? a) 1.0 b) 1.15 c) 1.25 d) 1.5 For a cantilever beam, which location experiences the maximum shear force? a) At the free end b) At the mid-span c) At the fixed support d) Along the entire length of the beam What is the typical criterion for the serviceability limit state concerning

	deflection in a cantilever beam? a) Deflection should not exceed span/350 b) Deflection should not exceed span/250 c) Deflection should not exceed span/500 d) Deflection should not exceed span/100 Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Analysis of Cantilever beams 2. Homework - A cantilever beam with a span of 2.5 meters carries a uniformly distributed load of 15 kN/m. The beam has a rectangular cross-section with a width of 200 mm and an effective depth of 400 mm. Concrete grade is M25, and steel is Fe415. - A cantilever beam of span 5 meters supports a concentrated load of 20 kN at its free end. The beam has a rectangular cross-section with a width of 300 mm and an effective depth of 600 mm. The concrete is of grade M30, and the reinforcement is Fe500 steel. - A cantilever beam of span 3 meters carries a uniformly distributed load of 12 kN/m over its entire length. The beam has a rectangular cross-section with a width of 250 mm and an effective depth of 450 mm. The concrete is of grade M20, and the reinforcement is Fe415 steel. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Why is the concept of "Limit State" used in structural design, and how does it ensure safety and serviceability in the design of cantilever beams? • In a cantilever beam, the maximum bending moment occurs at the fixed support, while the maximum deflection occurs at the free end. Why is it important to consider both of these aspects in the design process? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 20	Course Name: Design of RCC Structures Topic: Design of Cantilever beam	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of Cantilever beam using Limit State method
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Load Calculation and Analysis • Maximum Bending Moment and Shear Force • Support Reactions and Internal Forces 2. **Concept** (30 minutes) a. Limit State Method Overview • Introduction to LSM • Serviceability Limit State b. Load Calculation and Analysis • Maximum Bending Moment and Shear Force • Support Reactions and Internal Forces c. Design for Bending • Moment of Resistance • Reinforcement Calculation • Design of Cross-Section d. Design for Shear • Shear Force Calculation • Shear Reinforcement • Shear Capacity of Concrete e. Serviceability Checks • Deflection Calculation. • Crack Width Control • Vibration and Stability f. Curtailment of Bars • Curtailment Practices • Development Length g. Design Codes and Standards • IS 456:2000. h. Detailing of Reinforcement • Reinforcement Detailing • Construction Practices 3. Exercise (5 minutes) – What is the typical range of values for the depth of neutral axis (xu) in a cantilever beam in the Limit State Method? a) 0.1d to 0.3d b) 0.36d to 0.48d c) 0.5d to 0.7d d) 0.8d to 0.9d

	In a cantilever beam design, if the calculated deflection exceeds the permissible limit, which of the following is a possible design adjustment? a) Increase the beam depth b) Decrease the beam span c) Increase the modulus of elasticity of concrete d) All of the above Which of the following reinforcement is provided to resist shear in a cantilever beam? a) Longitudinal bars b) Stirrups c) Compression reinforcement d) Distribution reinforcement In the Limit State Method, which of the following is considered in the design of a cantilever beam for serviceability? a) Flexural strength b) Shear strength c) Deflection and crack width d) Torsion Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on design of Cantilever beams 2. Homework - Design a cantilever beam of length 4 meters for a uniformly distributed load of 10 kN/m. Assume the beam is made of concrete of grade M20 and steel of grade Fe415. The width of the beam is 230 mm, and the effective depth is 500 mm. is of grade M20, and the reinforcement is Fe415 steel. - Design a cantilever beam of length 3 meters subjected to a point load of 15 kN at the free end. Assume concrete grade M25 and steel grade Fe500. The width of the beam is 250 mm, and the effective depth is 450 mm. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Cantilever beams are subjected to significant deflection compared to simply supported beams. How does the designer ensure that the deflection remains within acceptable limits without compromising the structural safety? • In the design of cantilever beams, why is shear reinforcement often more critical than in simply supported beams? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 21	Course Name: Design of RCC Structures Topic: Analysis of beams for Torsion	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analyse a beams for Torsion
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Elastic theory of torsion - Application and effect of torsion on beams 2. **Concept** (30 minutes) a. Understanding Torsion in RCC Beams Torsional Moment (Tu) Torsional Reinforcement: Equivalent Shear Force (Ve): b. Design Steps Determine Torsional Moment (Tu): Calculate Equivalent Shear Force (Ve): Design for Shear Reinforcement: Design for Torsional Reinforcement: Check for Torsional Cracking Moment (Tcr): c. Design Considerations Torsional Stiffness: Interaction with Other Forces: Detailing: Code Provisions: d. Challenges and Limitations 3. Exercise (5 minutes) – The equivalent shear force (Ve) in an RCC beam subjected to shear force (Vu) and torsional moment (Tu) is given by: a) Ve = Vu + Tu b) Ve = Vu + 1.6 * Tu / b c) Ve = Vu - 1.6 * Tu / b d) Ve = Vu * 1.6 * Tu / b Torsional reinforcement in an RCC beam primarily consists of: a) Longitudinal reinforcement only b) Transverse reinforcement only c) Both longitudinal and transverse reinforcement d) None of the above The primary purpose of providing longitudinal reinforcement in a torsionally loaded RCC beam is to: a) Resist shear stresses a) Resist torsional stresses c) Increase the section modulus d) Improve bond between concrete and steel

	The spacing of stirrups in an RCC beam subjected to torsion is primarily governed by: a) Shear force b) Torsional moment c) Both shear force and torsional moment d) None of the above The torsional cracking moment (Tcr) of an RCC beam is: a) The maximum torsional moment the beam can resist without cracking b) The minimum torsional moment required to cause cracking c) The torsional moment at which the beam fails in torsion d) None of the above Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Analysis of beams for Torsion 2. Homework - Design a rectangular RCC beam of dimensions 250mm x 500mm (b x d) to resist an ultimate shear force of 150 kN and an ultimate torsional moment of 80 kN-m. Use M25 concrete and Fe415 steel. - A rectangular RCC beam of dimensions 250 mm x 400 mm (b x d) is subjected to an ultimate shear force of 120 kN and an ultimate torsional moment of 60 kN-m. Design the beam for shear and torsion using M25 concrete and Fe415 steel. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the shape of the cross-section influence the torsional stiffness and strength of a beam? • What are the challenges in detailing reinforcement for torsion in RCC beams? • How does the choice of concrete and steel grades affect the torsional capacity of a beam? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 22	Course Name: Design of RCC Structures Topic: Design a beams for Torsion	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design a beams for Torsion
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Preliminary Design • Determine the Beam Dimensions • Load Calculations 2. **Concept** (30 minutes) A. Detail steps for Design of Beam for Torsion - Check if Torsion Reinforcement is Required: - Provide Torsional Reinforcement: - Calculate the Torsion Reinforcement: - Design Stirrup Spacing: - Design for Shear and Bending - Check Shear Reinforcement: - Check Flexural Reinforcement: - Detailing - Provide Detailing for Reinforcement: - Check for Serviceability: 3. Exercise (5 minutes) – **Which of the following is a primary consideration when designing an RCC beam for torsion?** A) Concrete compressive strength B) Beam width C) Stirrups diameter and spacing D) Reinforcement cover **According to IS 456:2000, which of the following is TRUE regarding torsional reinforcement?** A) Torsional reinforcement is only required for beams with a span less than 4 meters. B) Torsional reinforcement is required only when the torsional shear stress exceeds the permissible limit. C) Torsional reinforcement is not necessary if the beam is subjected to bending. D) Torsional reinforcement is fixed regardless of the magnitude of the torsional moment. **In the context of RCC beam design, what does the effective depth (deffd_{eff}deff) refer to?** A) The distance from the top of the beam to the centroid of the tensile reinforcement B) The distance from the bottom of the beam to the top of the concrete

	cover C) The total depth of the beam including the concrete cover D) The distance from the top of the beam to the centroid of the compressive reinforcement **If the diameter of stirrups is increased, which of the following is likely to be TRUE?** A) The spacing of the stirrups must be increased. B) The torsional shear stress will increase. C) The capacity to resist torsion will generally increase. D) The shear capacity of the beam will decrease. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of beams for Torsion 2. Homework Design a reinforced concrete (RCC) beam for torsion given the following parameters: The beam has a width of 300 mm and an effective depth of 500 mm. The torsional moment acting on the beam is 50 kNm, and the stirrups used are 10 mm in diameter. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • What are the potential impacts on the overall structural integrity and safety if torsional reinforcement is not adequately designed? • In what scenarios might the torsional moment in a beam become critical, and how can such scenarios be anticipated during the design phase? • How do different design codes (e.g., IS 456:2000 vs. Eurocodes) approach torsion in RCC beams, and what are the key differences in their requirements? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 23	Course Name: Design of RCC Structures Topic: One way slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain one way slab and its various IS recommendation
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Load distribution in slab - Difference between one way and two way slab 2. **Concept** (30 minutes) A. Characteristics of a One-Way Slab - **Support and Load Distribution:** - **Reinforcement:** - **Primary Reinforcement:** - **Secondary Reinforcement:** - **IS Recommendations for One-Way Slabs (IS 456:2000)** - **Span-to-Depth Ratio:** - **Minimum Thickness:** - **Reinforcement Detailing:** - **Main Reinforcement**. - **Distribution Reinforcement:**. - **Longitudinal Reinforcement:** - **Distribution Reinforcement:** - **Maximum Reinforcement:** - **Shear Reinforcement:** - **Deflection Limits** 3. Exercise (5 minutes) – In a one-way slab, the primary reinforcement is provided: A) Perpendicular to the direction of span B) Along the length of the slab, parallel to the span direction C) In both directions equally D) Only on the bottom of the slab According to IS 456:2000, what is the maximum span-to-depth ratio for one-way slabs under live loads? A) 15 B) 20 C) 26 D) 30 What is the minimum thickness recommended for residential one-way slabs as per IS 456:2000? A) 100 mm B) 125 mm C) 150 mm

	D) 200 mm According to IS 456:2000, what should be the minimum area of longitudinal reinforcement for one-way slabs? A) 0.15% of the cross-sectional area B) 0.12% of the cross-sectional area C) 0.25% of the cross-sectional area D) 0.10% of the cross-sectional area For one-way slabs, the maximum allowable deflection under service loads according to IS 456:2000 should not exceed: A) Span/150 B) Span/200 C) Span/250 D) Span/300 What the typical minimum cover to the reinforcement is in a one-way slab as specified by IS 456:2000? A) 15 mm B) 20 mm C) 25 mm D) 30 mm Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on one way slab and its various IS recommendation 2. Homework - How does the span-to-depth ratio of a one-way slab affect its structural performance, and what factors should be considered when determining this ratio - How does the provision of secondary reinforcement in a one-way slab help in controlling cracking and ensuring durability, and what is the typical amount of secondary reinforcement required? - What are the implications of using non-standard thicknesses or reinforcement in one-way slabs, and how might these deviations affect the overall safety and performance of the slab? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the span-to-depth ratio of a one-way slab affect its structural performance, and what factors should be considered when determining this ratio? • What are the potential consequences of not providing adequate reinforcement in the direction of the span for a one-way slab, and how can these consequences be mitigated? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 24	Course Name: Design of RCC Structures Topic: Simply supported one-way slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design a Simply supported one-way slab
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Bending Moments and Shear Forces. - Stress-Strain Relationships 2. **Concept** (30 minutes) A. Design Codes and Standards B. Slab Analysis Types of Slabs: Load Distribution: Moment Distribution: C. Load Calculations D. Deflection and Crack Control E. Reinforcement Detailing F. Serviceability and Durability **Design of a Simply Supported One-Way Slab** • Span of the slab, LLL = 4 m • Width of the slab, bbb = 1.2 m • Effective depth, ddd = 150 mm • Concrete grade, fckf_{ck}fck = 25 MPa • Steel grade, fyf_yfy = 415 MPa • Live load = 4 kN/m² • Dead load = 6 kN/m² 3. Exercise (5 minutes) – What is the primary factor affecting the bending moment in a simply supported one-way slab? A) Width of the slab B) Depth of the slab C) Span of the slab D) Concrete grade According to IS 456:2000, what is the maximum span-to-depth ratio for a simply supported one-way slab? A) 20 B) 26 C) 30 D) 40 For a simply supported one-way slab, the effective depth of the slab is

	considered to be: A) Distance from the bottom of the slab to the centroid of the tension reinforcement B) Distance from the top of the slab to the centroid of the compression reinforcement C) Distance from the top of the slab to the bottom of the slab D) Distance from the bottom of the slab to the top of the slab In a one-way slab design, which of the following formulas is used to calculate the maximum bending moment? A) Mu=wL28M_u = \frac{wL^2}{8}Mu=8wL2 B) Mu=wL26M_u = \frac{wL^2}{6}Mu=6wL2 C) Mu=wL2M_u = \frac{wL}{2}Mu=2wL D) Mu=wL210M_u = \frac{wL^2}{10}Mu=10wL2 Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design a Simply supported one-way slab 2. Homework - Consider a simply supported one-way slab with a span of 4 meters and a width of 1.2 meters. The effective depth of the slab is 150 mm, and it is made of concrete with a grade of 25 MPa and steel reinforcement of grade 415 MPa. The slab is subjected to a dead load of 6 kN/m² and a live load of 4 kN/m² - Consider another simply supported one-way slab with a span of 5 meters and a width of 1 meter. The effective depth of the slab is 200 mm, with concrete grade 30 MPa and steel grade 500 MPa. The slab is subjected to a dead load of 7 kN/m² and a live load of 5 kN/m². Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the choice of concrete and steel grades impact the overall design of a one-way slab? • In what scenarios would you prefer a one-way slab over a two-way slab, and why? • What are the consequences of not providing adequate shear reinforcement in a one-way slab? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 25	Course Name: Design of RCC Structures Topic: Design of Cantilever slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of Cantilever slab
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Definition and types of cantilever slabs - Difference between cantilever and simply supported slabs 2. **Concept** (30 minutes) A. Design Codes and Standards B. Slab Analysis Types of Slabs: Load Distribution: Moment Distribution: C. Load Calculations D. Deflection and Crack Control E. Reinforcement Detailing F. Serviceability and Durability Consider a cantilever slab with a length of 3 meters and a width of 1.5 meters. The effective depth of the slab is 200 mm, with concrete of grade M25 and steel of grade Fe415. The slab is subjected to a uniform load of 8 kN/m² (including dead and live loads). 3. Exercise (5 minutes) – According to IS 456:2000, what is the minimum depth for a cantilever slab? A) 120 mm B) 150 mm C) 200 mm D) 250 mm What is the primary purpose of providing shear reinforcement in a cantilever slab? A) To increase bending strength B) To resist bending moments C) To prevent shear failure D) To enhance aesthetic appeal How does the effective depth of a cantilever slab affect its design? A) It determines the load distribution B) It influences the bending moment capacity C) It affects the slab's width D) It changes the load intensity For a cantilever slab, what is the effect of increasing the length of the cantilever on the maximum bending moment?

	A) It decreases the bending moment B) It has no effect on the bending moment C) It increases the bending moment D) It decreases the load intensity Which of the following statements is true about the reinforcement in a cantilever slab? A) Reinforcement is only needed at the free end B) Reinforcement is required throughout the entire length of the cantilever C) Reinforcement is not required if the slab is less than 2 meters long D) Reinforcement is needed only at the support Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of Cantilever slab 2. Homework - Consider a cantilever slab with a length of 4 meters and a width of 1 meter. The effective depth of the slab is 250 mm, with concrete of grade M30 and steel of grade Fe500. The slab experiences a uniform load of 10 kN/m^2. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the choice of cantilever length impact the structural performance and reinforcement requirements of the slab? • In what ways do the load conditions (dead load, live load, etc.) affect the design decisions for a cantilever slab? • What are the consequences of neglecting shear reinforcement in a cantilever slab design, and how can it be avoided? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 26	Course Name: Design of RCC Structures Topic: Design of Continuous slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design of Continuous slab
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Definition and types of continuous slabs - Difference between simply supported and continuous slabs - Load distribution and support conditions 2. **Concept** (30 minutes) A. Design Codes and Standards B. Slab Analysis Types of Slabs: Load Distribution: Moment Distribution: C. Load Calculations D. Deflection and Crack Control E. Reinforcement Detailing F. Serviceability and Durability Design a continuous one-way slab for an office building with the following specifications: Span lengths: 4 m between supportsWidth of the slab: 2.5 m Effective depth (d): 200 mmConcrete grade: M25 Steel grade: Fe415 Uniformly distributed load (w): 10 kN/m² (including dead and live loads) 3. Exercise (5 minutes) – What is the primary advantage of a continuous one-way slab over asimply supported slab? A) Lower bending moments at supports B) Reduced deflection C) Reduced shear forces D) Increased load capacity For a continuous one-way slab, the maximum bending moment at themid-span is typically calculated using which formula? A) wL28\frac{wL^2}{8}8wL2 B) wL210\frac{wL^2}{10}10wL2 C) wL2\frac{wL}{2}2wL D) wL26\frac{wL^2}{6}6wL2 According to IS 456:2000, what is the minimum percentage ofreinforcement required for a continuous one-way slab?

	A) 0.12% B) 0.15% C) 0.20% D) 0.25% In a continuous one-way slab, which of the following factors primarily influences the amount of negative reinforcement required at the supports? A) Span length B) Load intensity C) Effective depth D) Support conditions For a continuous slab with equal spans and uniform loading, what is the approximate ratio of maximum negative moment at the supports to the maximum positive moment at mid-span? A) 1.0 B) 1.2 C) 1.5 D) 2.0 What type of reinforcement is typically provided to resist shear forces ina continuous one-way slab? A) Longitudinal bars B) Stirrups or shear links C) Compression reinforcement D) Bent-up bars Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design of Continuous slab 2. Homework Design a continuous one-way slab for a residential building with the following specifications: • Span lengths: 5 m between supports • Width of the slab: 3 m • Effective depth (d): 250 mm • Concrete grade: M30 • Steel grade: Fe500 • Uniformly distributed load (w): 12 kN/m² (including dead and live loads) Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How can deflection control be integrated into the design of continuous one-way slabs, and what are the key factors that affect deflection? • How can the design of continuous one-way slabs be optimized for both structural performance and cost-effectiveness? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 27	Course Name: Design of RCC Structures Topic: Introduction to two way slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe two way slab and its various IS recommendation
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Two-Way Slab - Types of Two-Way Slabs - Load distribution in slab 2. **Concept** (30 minutes) - Design Considerations - Deflection Control - Effective Depth 3. Exercise (5 minutes) – What is the primary characteristic that differentiates a two-way slab from a one-way slab? A) Two-way slab spans in both directions, while a one-way slab spans in only one direction. B) Two-way slab is thicker than a one-way slab. C) Two-way slab is used only in residential buildings. D) Two-way slab is supported by walls only, while one-way slab is supported by columns only. According to IS 456:2000, what is the minimum percentage of reinforcement required for a two-way slab? A) 0.10% B) 0.12% C) 0.15% D) 0.20% Which design method is typically used for calculating bending moments and shear forces in a two-way slab? A) Euler-Bernoulli Beam Theory B) Moment Distribution Method C) Direct Design Method D) Strut-and-Tie Method In a two-way slab, what is the primary purpose of drop panels? A) To increase the slab thickness B) To provide additional shear reinforcement C) To reduce the shear stress around columns and increase the effective depth D) To improve the aesthetic appearance For a continuous two-way slab, the maximum bending moments at the

	supports and mid-span are typically found using which of the following? A) IS 456:2000 coefficients B) Manual calculations only C) Approximate values without reference to codes D) Computer software for one-way slabs What type of reinforcement is used to resist shear forces in a two-way slab? A) Longitudinal bars B) Stirrups or shear links C) Compression reinforcement D) Bent-up bars Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on two way slab and its various IS recommendation 2. Homework - How does the distribution of loads in two directions affect the overall design and performance of a two-way slab compared to a one-way slab? - What are the advantages and potential challenges of using drop panels and column capitals in two-way slab design? - How does the choice of reinforcement affect the serviceability and durability of a two-way slab? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • In what ways can the design of a two-way slab be optimized for both structural efficiency and cost-effectiveness? • What impact does the deflection of a two-way slab have on the usability and aesthetics of a building, and how can it be controlled effectively? • In what ways can the design of two-way slabs contribute to the sustainability of a building project? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 28	Course Name: Design of RCC Structures Topic: Design of Two-way slab	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design a Two-way slab with corners allowed to uplift
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Basic Principles of Two-Way Slabs: - Design Codes and Standards: 2. **Concept** (30 minutes) 1. Determine Slab Dimensions: - Span Lengths - Thickness. - Load Data: - Dead Load: - Live Load: - Concrete and Steel Properties: - Concrete Grade: - Steel Grade 2. Preliminary Design - Thickness of the Slab: - Effective Depth Calculation: 3. Moment Calculation - Determine Bending Moments: - Positive Moments (Mid-Span): - Negative Moments (Supports): 4. Reinforcement Design - Calculate Required Reinforcement: - Positive Moments - Negative Moments - Shear Reinforcement: - Shear Force Calculation. 5. Design for Uplift Conditions - Adjust Moments for Uplift: - Corner Reinforcement: 6. Deflection and Serviceability - Deflection Check: Consider designing a two-way slab for a building floor. The slab dimensions are 6 meters by 6 meters. Assume a uniformly distributed load of 12 kN/m², which includes both dead and live loads. We start with a preliminary slab thickness of 150 mm. 3. Exercise (5 minutes) –

	When designing a two-way slab with uplift at corners, which of the following is a critical consideration? a) Increased shear reinforcement b) Increased positive moment at mid-span c) Reduced negative moments at supports d) Increased slab thickness The lever arm used in the reinforcement design for a two-way slab is typically taken as: a) 0.80 times the effective depth b) 0.85 times the effective depth c) 0.90 times the effective depth d) 0.95 times the effective depth Which IS code provides the guidelines for the design of two-way slabs in India? a) IS 456:2000 b) IS 3370:2009 c) IS 13920:2016 d) IS 13311:2018 For a two-way slab with corners allowed to uplift, what type of reinforcement is most likely to be affected? a) Main reinforcement at mid-span b) Shear reinforcement near supports c) Stirrups in the corners d) Reinforcement for punching shear What is the primary purpose of using drop panels or column capitals in a two-way slab design? a) To reduce the thickness of the slab b) To increase the load-carrying capacity at supports c) To reduce the cost of construction d) To facilitate easier construction Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design a Two-way slab with corners allowed to uplift 2. Homework - Consider a two-way slab that measures 7 meters by 7 meters. The slab is subjected to a uniformly distributed load of 15 kN/m², which includes both dead and live loads. Assume an initial slab thickness of 200 mm. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • How does the presence of uplift conditions at the corners of a two-way slab impact the overall structural behavior and load distribution? What adjustments are necessary to account for these conditions in the design? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 29	Course Name: Design of RCC Structures Topic: Two-way slab with corners are prevented to uplift	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design a Two-way slab with corners are prevented to uplift
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Load Distribution in Two-Way Slabs - Uplift Prevention in Slabs - Different boundary condition - 2. **Concept** (30 minutes) • Design Considerations • Support Conditions • Reinforcement Detailing • Design Codes and Standards • Calculation of Bending Moments • Design Example • Step-by-step calculation of a two-way slab design. A two-way slab with dimensions 4 m × 3 m is supported on all sides and subjected to a total load (dead load + live load) of 10 kN/m². The corners are prevented from uplift. Determine the bending moments in both directions using the moment coefficient method as per IS 456:2000. Assume the slab is simply supported and calculate the required reinforcement if the concrete grade is M20 and the steel used is Fe 500. 3. Exercise (5 minutes) – **What is the primary reason for preventing uplift at the corners of a two-way slab?** A) To reduce the overall load on the slab B) To ensure even distribution of reinforcement C) To prevent cracking and ensure structural stability D) To increase the span of the slab **Which method is commonly used to calculate bending moments in two-way slabs according to IS 456:2000?** A) Finite Element Method B) Yield Line Theory C) Moment Distribution Method D) Moment Coefficient Method **In a two-way slab with corners prevented from uplift, which of the following will most likely be true?** A) The slab will experience lesser moments near the center. B) The slab will have higher negative moments at the corners. C) The slab will require less reinforcement at the corners.

	D) The slab's thickness can be reduced. **If a two-way slab is designed using M25 grade concrete and Fe 500 steel, what is the maximum permissible spacing of main reinforcement bars according to IS 456:2000?** A) 300 mm B) 450 mm C) 500 mm D) 250 mm **Which of the following factors is NOT directly considered in the design of a two-way slab?** A) Slab thickness B) Type of aggregate used in concrete C) Effective span of the slab D) Live load on the slab **When calculating the moments in a two-way slab using the moment coefficient method, the coefficient depends on which of the following?** A) Concrete grade B) Ratio of longer to shorter span C) Thickness of the slab D) Load on the slab Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Design a Two-way slab with corners are prevented to uplift 2. Homework - Consider a two-way slab with dimensions 6 m × 5 m, simply supported along all edges. The slab is subjected to a uniform live load of 5 kN/m² and a dead load (including the self-weight of the slab) of 7 kN/m². The corners of the slab are prevented from uplift. The concrete grade is M25, and the steel reinforcement used is Fe 415. Design the slab thickness, and determine the required reinforcement in both the longitudinal and transverse directions. Assume an effective cover of 20 mm for the reinforcement. Use the moment coefficient method as per IS 456:2000 to calculate the bending moments in both directions. Ensure that the design considers the prevention of uplift at the corners and complies with the minimum and maximum reinforcement requirements. - . Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • Consider a scenario where the corners of a two-way slab were not properly designed to prevent uplift. What potential structural problems might arise during the slab's lifespan, and how could these issues be mitigated during the design phase? • Reflect on a real-world construction project where a two-way slab

	was used. If you were involved in the design, what challenges would you anticipate in ensuring that the corners are adequately prevented from uplift? How would you address these challenges during the design and construction phases? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 30	Course Name: Design of RCC Structures Topic: Detailing of reinforcement for slabs	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Draw the detailing of reinforcement for slabs
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Reinforcement Detailing for One-Way Slabs - Reinforcement Detailing for Two-Way Slabs 2. **Concept** (30 minutes) - Anchorage and Lapping of Reinforcement - Cover to Reinforcement - Detailing for Shear Reinforcement - Bar Bending Schedules (BBS) • Preparation of bar bending schedules for RCC slabs. • Understanding notations and formats for BBS. • Calculation of cutting lengths and total quantities of reinforcement. - Reinforcement Detailing as per Codes and Standards - Practical Aspects of Reinforcement Placement - Detailing for Serviceability Requirements - Case Studies and Practical Examples • Design the reinforcement for a one-way slab that spans 4 meters with a width of 3 meters. The slab is simply supported on two opposite sides and carries a live load of 3 kN/m² and a dead load (including the self-weight of the slab) of 5 kN/m². The concrete grade is M20, and the steel used is Fe 415. Assume an effective depth of 120 mm. Calculate the required area of steel and detail the reinforcement, including the spacing of bars. - **Common Mistakes in Reinforcement Detailing** • Discussion of typical errors in reinforcement detailing and how to avoid them. • Impact of improper detailing on structural performance. 3. Exercise (5 minutes) – - Describe the process of preparing a Bar Bending Schedule (BBS) for an RCC slab. What information is included in a BBS, and how is it used during construction? - How is shear reinforcement detailed in RCC slabs? Under what conditions is shear reinforcement necessary, and how is it designed and placed? - Discuss the factors that influence the spacing of reinforcement bars in RCC slabs. How does bar spacing affect the structural

	performance and constructability of the slab? - Explain the difference between main reinforcement and distribution reinforcement in an RCC slab. How is each type of reinforcement calculated and placed**?** Think-pair-repair
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on Drawing the detailing of reinforcement for slabs 2. Homework - A two-way slab with dimensions 5 m × 4 m is simply supported on all edges. The slab is subjected to a uniform load of 6 kN/m² (including dead and live loads). The slab corners are prevented from uplift. Design the reinforcement using M25 concrete and Fe 500 steel. Assume an effective cover of 25 mm and an effective depth of 150 mm. Calculate the main and distribution reinforcement required. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions • What are the key considerations in the detailing of reinforcement at the corners of a two-way slab that is prevented from uplift? Why is special attention required in these areas? • Explain the concept of development length in the context of RCC slabs. How is the development length calculated, and what factors influence its value? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 31	Course Name: Design of RCC Structures Topic: Introduction to RCC column	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Classify the different types of column
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - About column, strut and pedestal 2. **Concept** (30 minutes) a. Classification based on • Shapes • Materials • Type of loading • Slenderness Ratio • Type of lateral reinforcement b. Effective length of column c. Difference between short and long column 3. Exercise (5 minutes) – What is the primary factor that differentiates a short column from along column? a) Shape b) Type of material c) Slenderness ratio d) Type of loading Which of the following is NOT a classification of columns basedon shape? a) Rectangular b) Circular c) Square d) Wooden Columns are classified as short or long based on which of thefollowing? a) Effective length b) Axial load c) Lateral reinforcement d) Moment of inertia What type of lateral reinforcement is commonly used in a columnto prevent buckling?

	a) Circular ties b) Rectangular bars c) Helical reinforcement d) Woven wire mesh
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework - To note all the IS code recommendation regarding columns. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Explain how the slenderness ratio influences the behavior of short and long columns. What are the key differences in theirfailure modes? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 32	Course Name: Design of RCC Structures Topic: IS code specification regarding column	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe all the IS code specification regarding column
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Cover and its importance in column - Maximum and minimum Percentage of steel - Slenderness Limit 2. **Concept** (30 minutes) a. IS code specification regarding column Longitudinal Reinforcement Transverse Reinforcement b. Arrangement of Transverse Reinforcement 3. Exercise (5 minutes) – The effective length of a column depends on which factor? a) The length of the column only b) End conditions (support conditions) c) Type of loading d) Cross-sectional shape In a column with a slenderness ratio greater than 12, the column is classified as: a) Short b) Long c) Intermediate d) Composite What is the primary purpose of lateral reinforcement in columns? a) To increase the column's axial load capacity b) To enhance the column's resistance to buckling c) To reduce the effective length of the column d) To change the shape of the column Which of the following materials is NOT typically used in column construction? a) Steel b) Concrete c) Aluminum d) Plastic

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework - Discuss the importance of lateral reinforcement in a column. In which scenarios would you prefer helical reinforcement over circular ties. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions How do the material properties (steel, concrete, etc.) influencethe design and classification of columns under different loading conditions? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 33	Course Name: Design of RCC Structures Topic: Analysis of axially Loaded short column	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Analyse an axially Loaded short column
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Different type of load applied on column 2. **Concept** (30 minutes) a. Limit state of collapse: Compression b. Analyze a short column with - Rectangular ties - Helical ties c. Steps for analysis of column 3. Exercise (5 minutes) – What is the primary function of rectangular ties in a short column? a) To carry axial load b) To resist buckling of longitudinal bars c) To increase the concrete strength d) To reduce the effective length of the column Which type of reinforcement is more effective in providing confinement to concrete in a short column? a) Rectangular ties b) Helical ties c) Longitudinal bars d) Stirrups For a short column with helical ties, what additional factor must be considered in the load capacity calculation? a) Helix pitch b) Helix confinement factor c) Longitudinal bar diameter d) Slenderness ratio What is the typical spacing of rectangular ties in a short column according to most design standards? a) 50 mm b) 100 mm c) 150 mm d) 250 mm

	In a short column with helical reinforcement, the column is morelikely to fail by: a) Concrete crushing b) Buckling of longitudinal bars c) Yielding of ties d) Concrete splitting
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework - A reinforced concrete short column with rectangular ties has a cross-sectional dimension of 300 mm x 500 mm. The column has 6 longitudinal bars of 20 mm diameter and rectangular ties of 8 mm diameter spaced at 150 mm. The grade of concrete is M25, and the grade of steel is Fe500. Calculate the axial load capacity of the column considering the contribution of bothconcrete and steel.. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Considering the axial load-bearing capacity of short columns, discuss how the presence of lateral reinforcement (rectangularvs. helical) affects the failure mode of the column. How can this understanding guide an engineer when designing critical structures like bridges or towers? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 34	Course Name: Design of RCC Structures Topic: Design of axially Loaded short column	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design a axially Loaded short column
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Design Aid used for designing column 2. **Concept** (30 minutes) a. Steps for design of Short Axially loaded column b. Design a short column with - Rectangular ties - Helical ties c. Steps for Design of column 3. Exercise (5 minutes) – In the design of axially loaded short columns, the load-carrying capacity primarily depends on: (a) Concrete strength only (b) Steel strength only (c) Both concrete and steel strength (d) Column height What is the slenderness ratio for a short column? (a) Less than 12 (b) Less than 50 (c) Greater than 50 (d) Less than 200 What is the minimum percentage of longitudinal reinforcement required for a short column as per IS 456? (a) 0.8% (b) 1.0% (c) 0.6% (d) 1.5% Which type of reinforcement bars are recommended for columns subjected to axial loads as per IS 456: 2000? (a) Fe 250 (b) Fe 415 (c) Fe 500

	(d) Fe 600
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework - Design a short rectangular column section subjected to an axial load of 1200 kN. The column dimensions are 300 mm x 500 mm, the grade of concrete is M25, and steel used is Fe 500. Determine the amount of steel required using the limit state method. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Discuss how slenderness ratio affects the design of columns.What are the practical considerations when designing short columns in comparison to long columns? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 35	Course Name: Design of RCC Structures Topic: Column subjected to bending	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design column subjected to axial compression and bending
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - IS code design consideration - Pu-Mu interaction curve 2. **Concept** (30 minutes) a. Modes of failures b. Concept related to design of column subjected to compressionand uniaxial bending c. Steps for Design of column Subjected to compression and uniaxial bending 3. Exercise (5 minutes) – When a column is subjected to both axial compression and bending, which of the following is true? (a) Axial load is ignored. (b) Bending moment is ignored. (c) Both axial load and bending moment are considered. (d) Only the axial load is considered for design. Q2. In the design of a column subjected to axial compressionand uniaxial bending, the moment capacity of the column depends on: (a) The axial load only. (b) The moment only. (c) Both axial load and moment. (d) The concrete grade only. Q3. Which of the following interaction diagrams is typicallyused in the design of columns subjected to combined axial compression and bending? (a) Load-moment interaction curve. (b) Shear-bending interaction curve. (c) Axial-torsional interaction curve. (d) Moment-deflection curve.

	Q4. The term "uniaxial bending" in column design refers to: (a) Bending about both principal axes. (b) Bending about only one principal axis. (c) Bending due to torsion. (d) Bending due to shear forces.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework - A reinforced concrete column is subjected to an axial load of 1200 kN and a bending moment of 90 kNm about its minor axis. The column has a rectangular cross-section of 300 mm x 500 mm and is reinforced with 6 bars of 20 mm diameter, using M25 concrete and Fe 500 steel. Design the column using the limit state method. Check if the column is safe for the given loading. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is it necessary to use interaction diagrams or charts in the design of columns subjected to combined axial compression and bending? How do they simplify the design process? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 36	Course Name: Design of RCC Structures Topic: Introduction to footing	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe the foundations used in construction
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Purpose of foundation - Critical section 2. **Concept** (30 minutes) a. Classification of foundation b. Codal Provision for design of Isolated footing c. IS code recommendations 3. Exercise (5 minutes) – Which of the following is NOT a type of shallow foundation? (a) Raft foundation (b) Strip footing (c) Pile foundation (d) Isolated footing A deep foundation is generally preferred when: (a) The soil has a high bearing capacity near the surface. (b) The load from the structure is small. (c) The soil near the surface is weak, and the load needs to be transferred to deeper strata. (d) The construction is temporary. Raft foundation is typically used when: (a) The load from the structure is light. (b) The structure consists of isolated columns. (c) The bearing capacity of the soil is low and a large area needsto support multiple columns. (d) The structure is located on rocky strata. For isolated footings, the critical section for one-way shear istaken at:

	(a) The face of the column. (b) A distance of d/2 from the face of the column. (c) A distance of d from the face of the column. (d) The mid-point between the column and the edge of the footing.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework To note all the IS code recommendation regarding foundations Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions In foundation design, particularly for footings subjected to axialloads and moments, why is it important to follow IS 456:2000? Discuss how adherence to codal provisions impacts the overall serviceability and safety of the structure. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 37	**Course Name: Design of RCC Structures** **Topic: Design of isolated footing**	**Course No.: CE-501**

Objectives	At the end of the lesson the student shall be able to: a. Design isolated footing
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - When to use Isolated footing - IS recommendation - Reinforcement detailing and types used 2. **Concept** (30 minutes) a. Design Steps for Isolated rectangular Footing - By one way shear criterion - By two way shear criterion - By bending moment criterion b. Design an isolated footing with specific soil bearing capacityand load 3. Exercise (5 minutes) – Punching shear in an isolated footing is checked at: (a) A distance d/2 from the edge of the column. (b) The face of the footing. (c) A distance d from the edge of the column. (d) At the bottom of the footing. The minimum cover for the reinforcement in footings as per IS 456:2000 is: (a) 15 mm (b) 25 mm (c) 50 mm (d) 75 mm IS Code Recommendations for Footing: According to IS 456:2000, the minimum reinforcement in either direction of an isolated footing should not be less than: (a) 0.15% of the gross sectional area. (b) 0.12% of the gross sectional area. (c) 0.30% of the gross sectional area.

	(d) 0.50% of the gross sectional area. What is the maximum spacing allowed for main reinforcementbars in an isolated footing as per IS 456:2000? (a) 200 mm (b) 300 mm (c) 450 mm (d) 400 mm
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework Consider the importance of checking both one-way and two-way shear in the design of isolated footings. How do these checks ensure that the foundation will not fail under heavy loads? Reflect on the consequences of ignoring these checks in foundation design Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Reflect on how the choice between a shallow foundation (e.g., isolated footing) and a deep foundation (e.g., pile foundation) ismade in real-world construction projects. What factors, such as soil conditions and load requirements, influence this decision? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 38	Course Name: Design of RCC Structures Topic: Development length check in footing	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Apply development length check and draw the detail section of footing
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Development length - Reinforcement detailing and types used 2. **Concept** (30 minutes) a. Design an isolated footing subjected under axially loaded column and check for development length b. Also draw a detail drawing of the section 3. Exercise (5 minutes) – Development length is the minimum length of the bar requiredfor: (a) Transferring the compressive stress to the concrete. (b) Transferring the tensile stress to the concrete. (c) Preventing shear failure in concrete. (d) Ensuring bond between two adjacent bars. The development length of reinforcement depends on: (a) The diameter of the bar and the strength of the concrete. (b) The length of the bar and the bond stress. (c) The grade of the concrete and reinforcement. (d) The diameter of the bar, the grade of steel, and bond stress. Which of the following IS code specifies the requirements forthe development length of reinforcement bars? (a) IS 456:2000 (b) IS 1893:2016 (c) IS 13920:1993 (d) IS 800:2007
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students

	2. Homework When designing an isolated footing, how does checking the development length of reinforcement bars help ensure structural integrity? Reflect on why improper development length could leadto failure in the connection between the footing and the column. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions When drawing the detailed section of a footing, the placementand extension of reinforcement into the footing is critical. How does detailing reinforcement with proper development length help in achieving both structural strength and durabilityover the lifespan of the structure? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 39	Course Name: Design of RCC Structures Topic: Introduction to combined footing	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe combined footing and its various IS recommendation
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - When to use Combined footing - IS recommendation - Reinforcement detailing and types used 2. **Concept** (30 minutes) a. Design Steps for combined Footing b. About strap footing 3. Exercise (5 minutes) – In the detailing of isolated footings, the development length ofbars extending from the column into the footing should be: (a) Equal to the clear cover provided. (b) Greater than the footing depth. (c) Greater than or equal to the calculated development length. (d) Equal to the diameter of the bar. In an isolated footing, the bottom reinforcement is usually provided: (a) In the longitudinal direction only. (b) In both longitudinal and transverse directions. (c) In the transverse direction only. (d) No reinforcement is required in footings. The purpose of providing stirrups in the column extending intothe footing is: (a) To resist shear stresses. (b) To confine the concrete and resist buckling of longitudinalbars. (c) To transfer compressive forces from the column to the footing. (d) To increase the tensile strength of the footing.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation

	from students 2. Homework Development length is critical for the bond between steel and concrete. Reflect on the consequences of using insufficient development length in highly loaded areas such as footings. How might this affect the overall safety and serviceability of the structure? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Consider a real-life scenario where a footing fails due to insufficient development length or improper detailing. How would this failure manifest, and what preventive measures can be taken during the design and construction phases to avoid such issues? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 40	Course Name: Design of RCC Structures Topic: Design of combined footing	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Design combined footing
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Development length - Reinforcement detailing and types used 2. **Concept** (30 minutes) a. Design an combined footing with specific soil bearing capacity and load Design a combined footing for two columns C1 and C2 spaced 4 meters apart. Column C1 carries a load of 600 kN andcolumn C2 carries a load of 400 kN. The allowable bearing capacity of the soil is 200 kN/m². The width of the footing is restricted to 2.5 meters due to site constraints. Assume the footing to be rectangular in plan and the concrete grade used isM25. 3. Exercise (5 minutes) – In a combined footing, the centroid of the column loads should: (a) Be closer to the lighter column. (b) Be closer to the heavier column. (c) Coincide with the centroid of the footing. (d) Be independent of the location of the columns. The critical section for maximum bending moment in a combined footing generally occurs: (a) At the middle of the footing. (b) At the edge of the footing. (c) At the face of the columns. (d) At the centerline of the columns. In a combined footing, if one column carries a larger load thanthe other, the size of the footing should: (a) Be adjusted to make the soil pressure uniform. (b) Be reduced to minimize material usage.

	(c) Have no impact on soil pressure distribution. (d) Be symmetrical regardless of the column loads.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework When designing a combined footing, reflect on the importance of aligning the centroid of the loads with the centroid of the footing.What are the potential risks if this condition is not met, and how does it affect soil pressure distribution and foundation performance? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions In the context of varying loads on the columns, how would the design of the combined footing be adjusted to ensure uniform soil pressure? Reflect on how you would account for differential settlement and stress distribution during the design. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 41	Course Name: Design of RCC Structures Topic: Introduction to high Rise buildings	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe high Rise buildings and its need
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - High rise structure: Introduction 2. **Concept** (30 minutes) Types of High-Rise Structures: Advantages and Disadvantages 1. Concrete High-Rise Structures: 2. Steel High-Rise Structures: 3. Composite High-Rise Structures (steel + concrete): 4. Modular and Precast High-Rise Structures: 3. Exercise (5 minutes) – Which of the following is an advantage of steel high-rise structures? (a) High fire resistance. (b) High compressive strength. (c) Faster construction. (d) High cost of formwork. Composite high-rise structures combine: (a) Concrete and brick. (b) Steel and glass. (c) Steel and concrete. (d) Precast concrete and wood. Which of the following is a disadvantage of modular high-rise construction? (a) Increased material costs. (b) Limited design flexibility. (c) Increased fire risks. (d) Slower construction speed

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework Different structural systems are used in high-rise buildings, such as tube systems, diagrid systems, and core-outrigger systems. Reflect on how the selection of a particular structural system depends on factors like height, wind load, seismic zone, and architectural design. What considerations would you prioritize when choosing a structural system for a 50-story skyscraper? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions High-rise structures have evolved significantly over the past century. Reflect on the challenges that engineers and architects faced in early high-rise construction and how advancements in materials and technology have overcome these challenges in modern designs. How do you foresee theseinnovations continuing to shape the future of high-rise buildings? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 42	Course Name: Design of RCC Structures Topic: Construction technique for high Rise buildings	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe the different construction technique for high Rise buildings
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Various types of loads act on the structure - Types of high rise structure: Advantages and Disadvantages 2. **Concept** (30 minutes) Evolution of High-Rise Structural Systems 1. Early Skeleton Frame (Steel Frame) Structures: 2. Shear Wall Systems: 3. Tube Structures: 4. Diagrid and Outrigger Systems: 5. Core and Outrigger Systems: Construction Techniques and Special Materials Used in: • Chimneys: Techniques and Materials • Dams: Techniques and Materials • Buildings: Techniques and Materials 3. Exercise (5 minutes) – The tube structural system, which resists lateral loads, was first popularized in which of the following buildings? (a) Empire State Building. (b) Willis Tower (Sears Tower). (c) Burj Khalifa. (d) Shanghai Tower. Which structural system connects the outer columns of a high-rise building to the core for enhanced lateral stability? (a) Skeleton frame system. (b) Outrigger system.

	(c) Shear wall system. (d) Diagrid system. Construction Techniques and Special Materials Slip form construction is widely used in the construction of: (a) Residential buildings. (b) Chimneys. (c) Bridges. (d) Dams. Which of the following materials is typically used in the construction of dams? (a) High-strength glass. (b) Roller-compacted concrete. (c) Lightweight steel. (d) Precast concrete
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework Reflect on the environmental impacts of high-rise construction. With the advent of special materials like high-strength concrete and advanced steel, how can engineers ensure that these materials are sustainably sourced and used in a manner that minimizes the carbon footprint of high-rise buildings? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions High-rise buildings are becoming more sustainable through the use of green materials and energy-efficient designs. Reflect on the use of smart materials (like self-healing concrete) and green construction techniques. How do these innovations contribute to sustainability in the construction of high-rise structures? What trade-offs might exist between adopting new technologies and traditional methods? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 43	Course Name: Design of RCC Structures Topic: Special problems of high Rise construction	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain the special problems of high Rise construction
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - High rise structure: Introduction and definition - List of problems in constructing a high rise structure - List of world best skyscrapers - Classification according to structural behavior 2. **Concept** (30 minutes) **Construction Challenges in High-Rise Buildings** a. Lightweight Structures b. Wind And Earthquake Resistant Design c. Geotechnical Investigations d. Provision of Basements e. Efficient Vertical Transportation System f. Construction and Fire Safety g. Speed of Construction h. Repair and Maintenance i. Provision Of Efficient Plumbing Services j. Use Of Information Technology **Material Handling Challenges of High-rise Construction** 3. Exercise (5 minutes) – Which of the following materials is typically used in the construction of dams? (a) High-strength glass. (b) Roller-compacted concrete. (c) Lightweight steel. (d) Precast concrete. Which construction technique is commonly used in high-rise buildings for fast vertical progression? (a) Post-tensioning. (b) Jump form construction.

	(c) Shotcrete. (d) Brick masonry. Case study on the problems faced by engineers, prior and after the construction of worlds few sky scrapper
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework Listing and study on the problems faced by engineers, prior andafter the construction of worlds few sky scrapper (Burj Khalifa) Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions High-rise buildings are becoming more sustainable through the use of green materials and energy-efficient designs. Reflect on the use of smart materials (like self-healing concrete) and green construction techniques. How do these innovations contribute to sustainability in the construction of high-rise structures? What trade-offs might exist between adopting new technologies and traditional methods? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 44	Course Name: Design of RCC Structures Topic: Fire hazards in buildings	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain fire hazards in buildings.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Major Fire hazard in India 2. **Concept** (30 minutes) a. Impact of fire hazard b. General strategy for fire safety c. Introduction to Building codes and standards 3. Exercise (5 minutes) – Which of the following is a common cause of fire in buildings in India? (a) Natural disasters. (b) Electrical short circuits. (c) Flooding. (d) Earthquake tremors. Which of the following is an effect of fire hazards in buildings? (a) Structural damage. (b) Reduced fire insurance premiums. (c) Increased oxygen supply. (d) Slower response time from emergency services. According to reports, which type of buildings are more prone tofire hazards in India? (a) High-rise residential buildings. (b) Single-story houses. (c) Industrial complexes. (d) Rural homes Which of the following is part of the general strategy for fire safetyin buildings?

	(a) Ignoring minor electrical faults. (b) Proper fire exit planning. (c) Limiting the use of fire alarms. (d) Storing flammable materials near heat source
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework Write a note on Strategies for improved fire safety by taking some examples of Fire Hazards in India Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Fire hazards can have devastating effects on both life and property. Reflect on the role of building codes and standards, such as the National Building Code (NBC), in preventing such disasters. How do you think stricter enforcement of these codes could reduce the impact of fire hazards in high-risk areas? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 45	Course Name: Design of RCC Structures Topic: Techniques used to prevent fire hazards	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. List out the techniques used to prevent fire hazards in buildings
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Causes of fire in buildings - Effects of fire hazard in buildings 2. **Concept** (30 minutes) a. Fire safety provisions within a building b. Limitations of current building code provisions c. Regulation and enforcement 3. Exercise (5 minutes) – Group discussion in the class on Common and civic sense impact on prevention the Fire hazards
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework Regulation and enforcement of fire safety measures are critical to preventing fire disasters in buildings. Reflect on how the involvement of multiple agencies and stakeholders (such as government bodies, builders, and residents) can improve the regulation process. What changes would you suggest to ensure that fire safety regulations are consistently followed and updated? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions The National Building Code (NBC) of India provides guidelines for fire safety. Which part of the NBC specifically addresses fire and life safety? (a) Part 4. (b) Part 2. (c) Part 1. (d) Part 8. Which of the following fire safety provisions should be within a building to prevent fire hazards?

	(a) Installation of fire detection systems. (b) Usage of only wooden doors. (c) Reducing emergency exits. (d) Use of flammable materials in insulation. What impact does a fire hazard typically have on theoccupants of a building? (a) Enhanced air quality. (b) Threat to life and health. (c) Increased property value. (d) Improvement in structural integrity. Which of the following is a building code standard related tofire safety in India? (a) IS 456. (b) NBC Part 4. (c) IS 875. (d) IS 800. Which of the following is a limitation of current fire safety provisions in many Indian buildings? (a) Over-enforcement of fire safety codes. (b) Inadequate installation of fire alarm systems. (c) Excessive emergency exit points. (d) Fire drills being conducted too frequently. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 46	Course Name: Design of RCC Structures Topic: Low cost housing and techniques	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain low cost housing and various techniques
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - What is Low-cost housing? - Low cost housing and Urbanization 2. **Concept** (30 minutes) **Detail study on Low-cost Housing** a. Micro Units, Co-living spaces and Single resident Occupancy General strategy for fire safety b. Manufactured Homes/ Mobile Home Parks 3. Exercise (5 minutes) – Listing of Innovative construction techniques for Low cost housing
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework - Write a note on Affordable Housing Schemes in India Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions What is the primary goal of low-cost housing? (a) To create luxury living spaces for affluent people. (b) To provide affordable homes for low- to middle-income groups. (c) To develop homes with the latest architectural designs. (d) To build housing complexes with high-end materials. Which of the following is a key advantage of low-cost housing? (a) Increased government subsidies for all. (b) Use of high-quality, expensive materials. (c) Affordability for a larger population. (d) Extended construction timelines.

	How does urbanization impact the demand for low-costhousing? (a) It reduces demand in urban areas. (b) It increases the need for affordable housing due to population growth. (c) It promotes rural housing projects. (d) It eliminates the need for housing altogether. Which of the following best describes one of the primarytypes of low-cost housing? (a) Luxurious penthouses. (b) Co-living spaces for shared accommodations. (c) High-end gated communities. (d) Private mansions. The supply and demand balance for low-cost housing in urbanareas is typically affected by: (a) Government policies and economic conditions. (b) Population decline in urban centers. (c) Rising demand for rural homes. (d) A decrease in urban employment opportunities. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 47	Course Name: Design of RCC Structures Topic: Design and advantages of low cost housing	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Describe the types, Design and advantages of low cost housing
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Types of Low-cost Housing and its advantages - Supply and Demand 2. **Concept** (30 minutes) **Detail study on Low-cost Housing** a. Tiny Houses/ Tiny Houses on Wheels b. Low-cost housing and sustainability: Social Impact, Economic Impact and Environmental Impact **Different Govt. Schemes** 1. Pradhan Mantri Awas Yojana (PMAY) 2. Pradhan Mantri Gramin Awas Yojana 3. DDA Housing Scheme 4. Rajiv Awas Yojana 3. Exercise (5 minutes) – Which of the following describes micro-units in low-cost housing? (a) Large single-family homes. (b) Small, compact apartments designed for urban areas. (c) Houses with multiple bedrooms and bathrooms. (d) Expensive residential plots in rural areas. What is the main advantage of co-living spaces in low-cost housing? (a) Privacy for each resident. (b) High rental costs. (c) Shared amenities and reduced individual costs. (d) Full ownership of individual units. Manufactured homes or mobile home parks are typically designedto:

	(a) Be permanent structures that cannot be moved. (b) Be easily transportable and cost-effective. (c) Be luxury vacation homes. (d) Cater to upper-class residents. Tiny houses are known for their: (a) High construction costs and complex designs. (b) Minimalist living spaces and affordability. (c) Requirement for large plots of land. (d) Extensive use of luxury materials. In terms of sustainability, low-cost housing can have a positivesocial impact by: (a) Increasing social inequality. (b) Providing affordable shelter for low-income groups. (c) Excluding underprivileged populations from housing. (d) Discouraging urban development.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework - Sustainability is a key factor in modern low-cost housing projects. Discuss how the social, economic, and environmental impacts of low-cost housing can be balanced. How would you approach designing or implementing a low-cost housing project that is both affordable and sustainable? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Reflect on the relationship between urbanization and the growing demand for low-cost housing. How do you think urban planners and policymakers should address the housing needs of rapidly growing cities, particularly for low- and middle-income populations?. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 48	Course Name: Design of RCC Structures Topic: Introduction to Pre-Cast Construction	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain Pre-Cast Construction.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Introduction to Pre-Cast Construction - Types of Pre-Cast Construction Elements 2. **Concept** (30 minutes) - Advantages of Pre-Cast Construction - Challenges and Limitations of Pre-Cast Construction - Construction Techniques for Pre-Cast Elements - Specialized Materials and Innovations in Pre-Cast Construction - Case Studies in Pre-Cast Construction 3. Exercise (5 minutes) – Which of the following is a key characteristic of pre-cast construction? (a) On-site casting of concrete elements. (b) Fabrication of building components in a controlled factory environment. (c) Use of wooden structures for walls and floors. (d) Delayed construction schedules. One major difference between pre-cast and traditional constructionis: (a) Pre-cast construction requires more labor on-site. (b) Pre-cast construction involves faster construction due to prefabricated elements. (c) Pre-cast construction is more expensive than traditional methods. (d) Pre-cast structures are weaker than traditional ones. Types of Pre-Cast Construction Elements Which of the following is an example of a pre-cast structural element? (a) Cast-in-place concrete wall.

	(b) Pre-cast column and beam. (c) Wooden trusses. (d) Earth masonry blocks. Pre-cast wall panels are mainly used for: (a) Load-bearing walls only. (b) Façades and decorative purposes. (c) Foundations of buildings. (d) Roofing systems
Closure	1. Summarize the Lesson Learning Outcomes and get affirmationfrom students 2. Homework - Pre-cast construction often faces challenges related to transportation and logistics. What are some potential solutions to these challenges, and how can the industry innovate to improve the movement and installation of pre-cast elements on-site? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Consider the environmental benefits of pre-cast construction, particularly in waste reduction and recycling. How could future innovations in material science and manufacturing processes further enhance the sustainability of pre-cast building techniques? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 49	Course Name: Design of RCC Structures Topic: Pre-Fabricated Construction and Techniques	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain Pre-Fabricated Construction and Its Techniques
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) - Introduction to Pre-Fabricated Construction Types of Pre-Fabricated Construction 2. **Concept** (30 minutes) - Advantages of Pre-Fabricated Construction - **Challenges and Limitations of Pre-Fabricated Construction** o Transportation logistics and costs. o Design constraints and limited customization. o On-site assembly issues and site-specific conditions. **Construction Techniques in Pre-Fabricated Construction** o Factory production techniques for pre-fabricated elements. o Assembly methods on-site (e.g., cranes, lifts). o Connection techniques for joining pre-fabricated components. **Materials Used in Pre-Fabricated Construction** o Common materials (e.g., steel, concrete, wood). o Innovations in materials (e.g., lightweight composites, high-performance concrete). **Case Studies and Applications** 3. Exercise (5 minutes) – Which of the following is an advantage of pre-fabricated construction? (a) Increased construction costs. (b) Longer project timelines. (c) Enhanced safety and reduced on-site labor. (d) Decreased quality control.

	What is a significant challenge in pre-fabricated construction? (a) The ease of customizing designs for each project. (b) The simplicity of on-site assembly. (c) Transportation logistics and costs for large components. (d) Lack of trained personnel in the field. Which technique is commonly used to transport pre-fabricated elements to the construction site? (a) Manual handling by workers. (b) Cranes and lifts for large components. (c) Drones for small pieces. (d) None of the above. Factory production of pre-fabricated components primarily ensures: (a) Inconsistent quality and performance. (b) Standardized and controlled manufacturing processes. (c) Increased costs and extended lead times. (d) Greater dependency on skilled labor on-site.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework What are the potential social implications of adopting pre- fabricated construction in urban areas? How might it affect community development and housing accessibility? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions In your opinion, how can technological advancements, such as automation and digital fabrication, enhance the effectiveness of pre-fabricated construction techniques? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 50	Course Name: Design of RCC Structures Topic: Modular Construction and Techniques	Course No.: CE-501

Objectives	At the end of the lesson the student shall be able to: a. Explain Modular Construction and Its Techniques.
Teaching Aids (if any)	a. Power point presentation b. White board and Marker c. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Introduction to Modular Construction Types of Modular Construction 2. **Concept** (30 minutes) Advantages of Modular Construction Challenges and Limitations of Modular Construction Construction Techniques in Modular Construction • Factory processes for creating modular components. • On-site assembly techniques and methods for connecting modules. • Quality assurance and inspection processes. Materials Used in Modular Construction Case Studies and Applications • Examples of successful modular construction projects (e.g., residential, commercial). • Analysis of the impact of modular construction on timelines, costs, and quality. Future Trends in Modular Construction • Emerging technologies in modular construction (e.g., 3D printing, robotics). • The role of modular construction in sustainable building practices. 3. Exercise (5 minutes) – What is modular construction primarily characterized by? (a) Use of traditional materials only. (b) On-site construction without pre-fabrication. (c) Factory-manufactured components assembled on-site. (d) Exclusive use of concrete blocks. Which of the following best describes a modular building? (a) A building constructed entirely on-site. (b) A building made up of pre-fabricated sections transported to thesite.

	(c) A building that can only be temporary. (d) A structure made solely from wood.. What distinguishes temporary modular structures from permanentones? (a) Temporary modules are made from concrete. (b) Permanent modules can be relocated easily. (c) Temporary modules are designed for short-term use. (d) There is no difference; both are the same. What type of modular construction allows for easy scalability? (a) Traditional building methods. (b) Modular buildings that can be expanded by adding more modules. (c) Buildings that use only local materials. (d) Non-prefabricated structures..
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students 2. Homework As technology advances, how do you see the future of modular construction evolving? What innovations do you think will have the most significant impact? Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Reflect on the role of modular construction in addressing the housing crisis in urban areas. How do you think modular methods could help meet the growing demand for affordable housing? Spend 5 minutes to evaluate student assimilation of the lesson contents