

Type of course	Course Code	Name of the course	L	T	P	Credit
DE	NCED526	Design of precast concrete structural systems	3	0	0	3

Course Objective
<p>The objectives of this course are to:</p> <ul style="list-style-type: none"> <li>• Introducing system-based design of precast concrete buildings and bridges</li> <li>• Develop understanding of precast connections, joints, and detailing requirements</li> <li>• Expose students to accelerated bridge construction (ABC) and modular construction concepts</li> <li>• Bridge the gap between academic design approaches and industrial precast practice</li> </ul>
Learning outcomes
<p>Upon successful completion of this course, students will be able to:</p> <ol style="list-style-type: none"> <li>1. Design precast concrete structural components and complete building systems</li> <li>2. Design and detail precast connections and joints with strength and ductility considerations</li> <li>3. Evaluate seismic performance of precast buildings and shear wall systems</li> <li>4. Apply principles of accelerated bridge construction in precast bridge design</li> <li>5. Incorporate constructability, manufacturing, transportation, and erection constraints in design</li> </ol>

Unit No.	Topics to be covered	Contact Hours	Learning outcome
1	Introduction to Precast Concrete Systems: Precast concrete systems vs cast-in-situ construction: philosophy, workflow, and performance; Advantages and limitations of different construction techniques: precast, cast-in-situ, hybrid systems; Precast product-based manufacturing: standardization, modularity, and quality control; Design considerations for precast concrete: system selection, repetition, tolerances, and robustness.	6L	<ul style="list-style-type: none"> <li>• Analyze and differentiate precast concrete systems from cast-in-situ construction, and describe precast manufacturing processes, product-based design philosophy, and typical precast elements.</li> </ul>
2	Advanced Materials for precast structures: Introduction to Fiber Reinforced Concrete (FRC), Ultra-High-Performance Concrete (UHPC), Textile Reinforced Concrete (TRC), 3D printed concrete (3DPC) and digital fabrication; Overview of sustainability and carbon reduction benefits of precast construction. Precast Structural Systems for Buildings: Principles of precast concrete construction; Precast building systems: Frame systems, Load-bearing wall systems; Comparison of precast and cast-in-situ construction.	12L	<ul style="list-style-type: none"> <li>• Describe the role of advanced materials such as UHPC, TRC, and 3D printed concrete in modern precast construction.</li> <li>• Focus on importance of sustainability and role of precast structural systems in construction.</li> <li>• Compare precast and cast-in-situ construction from a structural perspective.</li> </ul>
3	Precast Connections and Joints: Importance of connections in precast structures; Classification: dry, wet, and hybrid connections, Bolted, welded, grouted, and post-tensioned	12L	<ul style="list-style-type: none"> <li>• Classify precast connections based on structural behavior and construction methodology.</li> <li>• Explain the design philosophy,</li> </ul>

	connections; Design philosophy: strength, ductility, and robustness, Beam-column, wall-wall, and wall-floor connections; Failure modes and lessons from earthquakes.		failure modes, and detailing requirements of precast connections with respect to strength and ductility.
4	Design, Manufacturing, Quality control and Erection of Precast Concrete Structures: Seismic behavior of precast vs cast-in-situ structures; Emulative and jointed precast seismic systems; Precast Bridges and Accelerated Bridge Construction (ABC): Precast prestressed bridge girders; Deck panels, pier caps, and substructure elements; Connection systems in ABC bridges; UHPC joints and modular bridge construction; Manufacturing, Erection, Constructability and Quality Control: Design for manufacture and assembly; Transportation, lifting, and erection considerations; Tolerances and quality control in precast elements.	12L	<ul style="list-style-type: none"> <li>• Explain the seismic behavior and design principles of precast concrete frames and shear wall systems.</li> <li>• Describe the principles of ABC construction and connection systems used in modular precast bridges, including UHPC joints.</li> <li>• Explain manufacturing and quality control, transportation, lifting, and erection constraints influencing design.</li> </ul>
	Total Contact Hours	<b>42L</b>	

**Textbooks:**

1. Elliott, K.S. (2019). Precast concrete structures. CRC Press, 2<sup>nd</sup> Edition.
2. Canadian Precast/Prestressed Concrete Institute (2017). CPCI Design manual- Precast and prestressed concrete (structural/architectural). CPCI, 5<sup>th</sup> Edition.

**References:**

1. Precast/Prestressed Concrete Institute (2017). PCI Design Handbook Precast and Prestressed Concrete (MNL-120-17). PCI, 8th Edition.
2. David Darwin, Charles W. Dolan, Arthur H. Nilson (2015). Design of Concrete Structures. McGraw-Hill, 15<sup>th</sup> Edition.
3. Nawy, E.G. (1996). Prestressed concrete. A fundamental approach. Pearson, 5<sup>th</sup> Edition.
4. Relevant Indian Standard (IS) -IS 1343, IS 456, IS 1893, and Indian Road Congress (IRC)- IRC 112, IRC 22, IRC 83, IRC: SP:114-2018.