

SMART STRUCTURES

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AI & ML Revolutionizing Architectural Engineering



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Smart Structures: AI & ML Revolutionizing Architectural Engineering

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Architects are the magicians of the modern world—crafting dreams into stone, steel, and light. With every unique structure, they don't just build walls, they create miracles that stand the test of time.



Ar. Neeta Mishra is a distinguished Architect and Planner with over three decades of expertise in both industry and academia. Currently serving as an Associate Professor at Amity School of Architecture and Planning, Amity University Chhattisgarh, she blends practical insight with academic excellence.

Her prolific career includes collaborations with leading professionals across Maharashtra, Madhya Pradesh, and Chhattisgarh, where she has executed diverse projects—from intimate residential designs to expansive infrastructure developments. As the founder of Niket Consultants, she has carved a niche in housing and commercial architecture, delivering innovative and sustainable solutions.

Since transitioning to academia in 2000, Ar. Mishra has enriched architectural education through research, publishing extensively in reputed journals. Her academic focus spans Building Construction, Materials, and Solid Waste Management.

Beyond her professional achievements, she is an avid sketcher, reader, and lifelong learner, embracing knowledge as an endless journey. Her disciplined approach and passion for growth continue to inspire students and peers alike.



Ar. Arpita Das is a dynamic architect with 9 years of expertise in academia and practice, harmonizing creativity, logic, and innovation. Guided by the philosophy—'God lies in details'—she crafts designs with meticulous precision, ensuring both beauty and functionality. Specializing in Industrial Design, she merges aesthetics with practicality, delivering unique spatial solutions. As an educator, she nurtures future architects to think critically and design thoughtfully. Her infectious enthusiasm, dedication to excellence, and keen eye for detail make her an inspiring mentor. Ar. Arpita's passion for architecture and education cements her influence in shaping the built environment and the minds that will redefine it



Ar. Swarna Junghare is an Assistant Professor in Architecture & Interior Design with three years of teaching experience and seven published research papers at national and international levels. A registered member of the Council of Architects, she balances academia with professional practice in architecture and interior design. Beyond her design expertise, she actively contributes to the SETU Parents Forum, fostering stronger parent-child relationships. A multifaceted talent, Ar. Swarna is an accomplished Kathak dancer, vocalist, and award-winning artist in drawing, dance, and singing competitions. Her blend of creativity, academic rigor, and artistic passion makes her a dynamic educator and practitioner.



Ar. Khushboo Sahu is an accomplished architect and educator specializing in urban design. After earning her B.Arch (2016) and M.Arch in City Designing from SCET Surat (2018), she began her academic career in 2018. Currently teaching at Amity University Chhattisgarh since 2019, she passionately mentors future architects while pursuing research in Urban Design, Riverfront Development, and Biophilic Design.

As a Research Scholar, she explores innovative approaches to create sustainable urban spaces. Her work reflects a deep belief in design's power to transform cities into livable, eco-friendly environments. Beyond academics, she remains committed to advancing architectural knowledge through both teaching and research.



Ar. Garima Tamrakar is a multifaceted Urban Planner, Architect, Researcher, and Author. A gold medalist with a Master's in Urban & Regional Planning from SPA Bhopal (Best Thesis Award recipient), she now serves as Assistant Professor at SPA Bhopal, specializing in sustainable urban development and smart infrastructure. Her professional journey includes impactful research at the Atal Bihari Vajpayee Institute, contributing to urban policy and governance.

An accomplished writer, Garima has published research on urban competitiveness and AI in architecture, while her poetry graces multiple anthologies. She is currently preparing to launch her debut book, blending her technical expertise with creative literary expression to shape more livable cities and inspire through words.

Preface

*The architectural and engineering landscape is undergoing a profound transformation, driven by the rapid advancements in artificial intelligence (AI) and machine learning (ML). **Smart Structures: AI & ML Revolutionizing Architectural Engineering** is a comprehensive exploration of how these cutting-edge technologies are reshaping the way we design, construct, and interact with the built environment. This book is designed for architects, engineers, educators, and students who seek to understand and harness the potential of AI and ML to create smarter, more sustainable, and resilient structures.*

The journey begins with an introduction to AI and ML in architecture (Section 1), laying the foundation for readers unfamiliar with these technologies. Section 2 delves into core AI and ML concepts, demystifying complex topics and illustrating their relevance to architectural engineering. From there, the book transitions into practical applications, exploring AI-driven design and optimization (Section 3), where generative algorithms and parametric tools unlock unprecedented creative possibilities. Section 4 examines AI's role in construction and project management, highlighting innovations like autonomous machinery and predictive analytics that enhance efficiency and safety.

Sustainability takes center stage in Section 5, which explores how AI and ML enable energy-efficient smart buildings and resilient urban ecosystems. No technological revolution is without its challenges, and Section 6 critically addresses ethical, regulatory, and practical hurdles while forecasting future trends. Section 7 brings theory to life through compelling case studies, showcasing real-world projects where AI has redefined architectural excellence. The

book concludes with actionable recommendations (Section 8), guiding professionals and institutions on integrating AI into practice and education.

The appendices serve as a valuable resource, offering a curated list of AI tools (Appendix A), insights into AI's role in architectural training (Appendix B), and a glossary of essential terms (Appendix C) to ensure clarity and accessibility.

Smart Structures is not just a technical manual; it is a call to embrace innovation while preserving the human-centric essence of architecture. As AI and ML continue to evolve, their thoughtful integration promises to elevate the profession, enabling architects and engineers to tackle global challenges—from climate change to urbanization—with newfound precision and creativity.

We invite you to explore this transformative journey and envision a future where technology and design converge to build a better world.

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