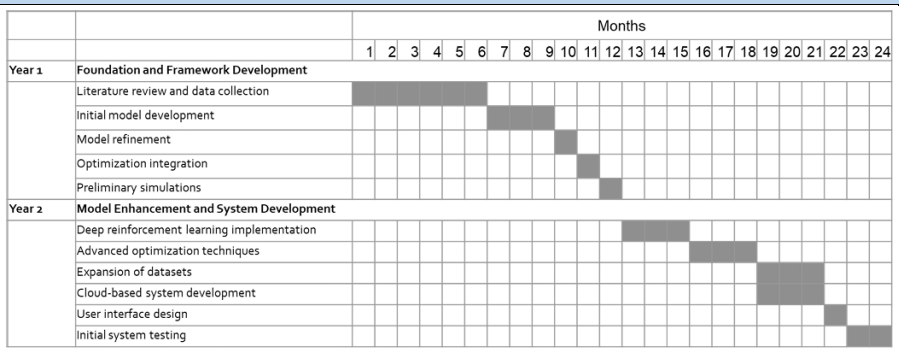
Program Profile		
Program	Program name	AI-Driven Generative Design for Earthquake-Resilient Structures
	Category	A7: Technology Development and Application A3: Industrial Application A8: SDG-Based Responses to Global Challenges

Summary of Program	
Program Name	AI-Driven Generative Design for Earthquake-Resilient Structures
Category	A7, A3, A8
Abstract of Program	Earthquakes remain one of the most serious natural hazards for Bangladesh, where reinforced concrete (RC) structures dominate the urban landscape. Current design workflows are time-consuming, reliant on prescriptive codes, and limited by manual heuristics. This project introduces a novel AI-driven generative design framework that leverages deep generative models and reinforcement learning to create optimized, earthquake-resilient RC building layouts. The system integrates Generative Adversarial Networks (GANs) or Variational Autoencoders (VAEs) for initial structural concepts, while Deep Reinforcement Learning (DRL) refines designs for seismic performance. Genetic algorithms and gradient-based solvers optimize material usage and structural efficiency. The framework will be deployed through a cloud-based platform with a user-friendly interface, enabling engineers to input parameters and receive real-time AI-generated design options. The initiative combines innovation with societal impact, aligning with SDG 9 (Industry, Innovation, and Infrastructure) and SDG 11 (Sustainable Cities and Communities). It has the potential to transform seismic design practice by making advanced optimization tools accessible, cost-effective, and widely applicable.

Details of Program		
Planning		
Objectives	Long-term Goals	• Mainstream AI-assisted generative design in Bangladesh's construction industry. • Establish an international knowledge hub for AI-driven seismic design at WUB. • Influence national codes and guidelines for earthquake-resilient infrastructure.
	Short-term Targets	• Build functional prototypes of generative AI and DRL models by end-2025. • Test pilot building designs using BNBC 2020 provisions. • Produce at least two journal papers and one conference paper from initial results.
	Rationale	Bangladesh's urban areas are vulnerable to earthquakes, yet design practices remain conventional. Generative AI and DRL enable automated exploration of thousands of design alternatives, producing innovative, efficient, and code-compliant layouts at reduced cost and time.
Subject (Leader)	Initiator(s)	HASAN, Md Hasibul

	Champion(s)	HASAN, Md Hasibul
	Major team member(s)	MUKIT, Abdul RAHMAN, Taimur
Environment	Nature/Society	High population density and vulnerable RC buildings amplify seismic risk. Society demands safer, cost-effective solutions.
	Industry/Market	AEC industries face rising design costs and tight deadlines. AI tools create efficiency and competitive advantage.
	Citizen/Government	BNBC 2020 has increased emphasis on seismic safety. Government agencies and local authorities are seeking innovative tools for resilient infrastructure.
Resources	Human resources	Led by faculty experts in structural and computational engineering, supported by student researchers.
	Financial resources	Low initial investment; scalable with external grants and industry partnerships.
	Technological resources	Cloud computing, AI frameworks (TensorFlow, PyTorch), and seismic design software ensure feasibility.
Mechanism	Strategy (Weight/Sequence)	• Develop AI generative models (highest weight). • Train DRL agents for seismic optimization. • Integrate optimization solvers for sizing/material efficiency. • Build cloud-based deployment platform.
	Organization	Conducted under WUB Civil Engineering Department, with collaborations expected in academia and industry.
	Culture	The program is supported by a culture of innovation and interdisciplinary engagement at WUB.
Doing		
Launch date		July 2025
Responsible organization		Department of Civil Engineering, World University of Bangladesh
Program content and process		The project integrates AI-driven generative design with structural seismic performance evaluation. Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) generate preliminary RC structural layouts. Deep Reinforcement Learning agents refine these layouts by optimizing for drift, ductility, and material efficiency. Genetic algorithms and gradient solvers further adjust member dimensions. A cloud-based interface is developed to host the design engine, enabling engineers to specify inputs such as building height, site class, and performance criteria. The AI model then generates and evaluates thousands of design options, producing optimized solutions in real time. This process dramatically reduces design cycles compared to manual methods and enhances resilience by discovering configurations beyond conventional heuristics.
Key highlights of the content/process		• Novel integration of generative AI and DRL in seismic design. • Cloud-based platform for real-time use by engineers. • Significant reduction in design cycle time with improved resilience.
Differences from traditional approaches		Traditional workflows rely on iterative manual design and simulations. The proposed system automates design generation and optimization, ensuring faster and more innovative outcomes.
Progress as of today		Conceptual framework complete; model development and training underway.

Problems in implementation	High computational cost and limited training data for local structures.
Approaches to solve the problems	Use transfer learning and cloud-based GPU resources; develop synthetic datasets for training.
Completion date, if completed	Expected: December 2026.
Seeing	
Impacts on students	Students gain expertise in frontier technologies (AI, DRL, seismic engineering).
Impacts on professors	Strengthens faculty research visibility through high-impact publications.
Impacts on university administration	Elevates WUB's global profile as a leader in AI-driven civil engineering research.
Responses from industry/market	Strong potential adoption by design firms seeking efficiency and innovation.
Responses from citizen/government	Supports government objectives for earthquake resilience and safer urban development.
Measurable output (revenues)	Commercialization potential of AI design platform and consulting services.
Measurable input (expenses)	Investment in computing infrastructure, faculty time, and student support.
Cost-benefit analysis for effectiveness	High benefit-to-cost ratio: scalable, low-cost cloud deployment with transformative design impact.
Future Planning	
Where does the project go from here?	The platform will be expanded to cover high-rise buildings, bridges, and lifeline infrastructure. Partnerships with government agencies and industry will ensure pilot testing. Future plans include integration with BIM systems and real-time earthquake risk assessment.
Addendum	
Exhibits, pictures, diagrams, etc.	 Figure 1: Gantt chart
Reports, mimeos, monographs, books, etc.	Planned peer-reviewed publications.
Others which may help explain the program (including website links)	N/A