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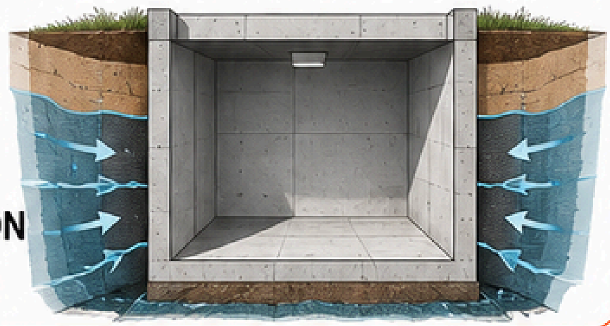
BUILDING भारत™ SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

Building Bharat Sampaark – National Civil Engineering Hackathon

Problem Statement :

WATERPROOFING BASEMENT STRUCTURES FROM THE NEGATIVE SIDE POST-CONSTRUCTION



Theme :

CONSTRUCTION TECHNOLOGIES

INITIATIVE PARTNERS

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1. BACKGROUND

- Basements are an **essential component of modern infrastructure** and are widely used as parking areas, utility spaces, storage zones, metro facilities, equipment rooms, commercial areas, and service corridors. In dense urban settings, deep basements have become increasingly common in residential, commercial, institutional, and infrastructure projects, making their long-term durability and serviceability an important engineering concern.

- One of the most persistent challenges in basement construction is water ingress through retaining walls, raft slabs, lift pits, expansion joints, construction joints, etc. Although waterproofing systems are usually installed on the positive side during construction, failures may occur because of **poor membrane installation, mechanical damage, ageing and deterioration, settlement, cracking, defective joints, inadequate drainage, high groundwater levels, hydrostatic pressure, and aggressive groundwater chemistry.**

- In many completed projects, excavation around the basement perimeter to repair the external waterproofing system is technically difficult, economically unattractive, or practically impossible because of adjacent buildings, roads, underground utilities, or occupied premises. As a result, **repairs often have to be undertaken from the negative side**, that is, from the inner face of the basement while resisting water pressure acting from outside.

- This makes negative-side waterproofing one of the most challenging problems in repair and rehabilitation engineering, particularly because conventional methods often suffer from **incomplete sealing, repeated maintenance, high costs, and uncertain long-term performance.**

2. PROBLEM STATEMENT

- Participants are invited to design an **innovative engineering solution** for **post-construction negative-side waterproofing** of basement structures that can effectively control water ingress while minimizing disruption to ongoing building operations.
The proposed solution may involve **new waterproofing materials, improved repair methodologies, advanced injection systems, monitoring tools, robotics, AI-enabled diagnostics, digital inspection platforms, hybrid repair systems**, or **sustainable rehabilitation materials**, provided the final concept remains technically feasible for use in existing occupied buildings and infrastructure.

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3. OBJECTIVE

The objective of this challenge is to encourage students to develop solutions that **significantly reduce or eliminate basement leakage** while resisting hydrostatic pressure from the negative side. A strong proposal should also **improve the durability of repair systems, reduce or avoid excavation, lower repair costs, extend service life, enable faster implementation, reduce disruption to occupants,** improve inspection and maintenance practices, and support more **sustainable rehabilitation approaches**.

4. EXPECTED SOLUTION AREAS

- **Advanced Waterproofing Materials:**
  Development of new or improved materials, coatings, cementitious systems, crystalline systems, polymers, membranes, or hybrid solutions that can resist hydrostatic pressure and provide long-term durability from the negative side.

- **Smart Injection Systems:**
  Design of advanced chemical grouting, expandable foam, microfine cement, or hybrid injection systems that can seal cracks, joints, and voids effectively even under active water pressure.

- **Leak Detection and Diagnostic Technologies:**
  Innovative tools, sensors, or AI-driven systems to identify leak origin, crack growth, moisture pathways, structural defects, and intervention zones with high accuracy.

- **Digital Platforms and Monitoring Systems:**
  Development of digital inspection platforms, dashboards, IoT-based monitoring systems, and data analytics tools that enable real-time tracking, predictive insights, and efficient maintenance planning.

5. CORE EXPECTATIONS

Students are encouraged to think beyond conventional waterproofing practice and explore **novel yet deployable ideas.** Innovation should remain grounded in **engineering logic and practical application,** with a clear explanation of how it improves **diagnosis, repair effectiveness, durability, monitoring, or lifecycle management.**

The prototype should demonstrate **sound engineering principles** and **practical applicability.**

Teams may draw on materials engineering domains such as **cement chemistry, polymer science, nanotechnology,** and **composite materials,** while also using **digital tools** where software components are required.

Where appropriate, teams may also incorporate structural engineering tools such as **BIM, finite element analysis, structural health monitoring**, or **GIS-based asset mapping.**

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6. PERFORMANCE EXPECTATIONS

The proposed solution should demonstrate **measurable improvement** in one or more performance parameters such as **reduction in active water leakage, resistance to hydrostatic pressure, crack-bridging capacity, adhesion strength, application time, repair-cost reduction, service-life extension, reduced maintenance frequency, ease of installation, sustainability performance, inspection accuracy,** or **reliability of monitoring systems.**

Teams are encouraged to validate their ideas through **laboratory testing, simulations, prototype demonstrations,** or **comparative assessment** against conventional waterproofing systems.

The proposed solution should be **easy to deploy** in occupied buildings and **safe** for both workers and occupants.

It should be suitable for **confined spaces,** adaptable to **different basement configurations, compatible with existing structural systems,** capable of **minimizing downtime**, and supported by **clear maintenance and operational guidance.**

7. EXPECTED DELIVERABLES

Each participating team should submit a **structured problem analysis** covering the nature of basement leakage, causes of waterproofing failure, current repair practices, limitations of existing technologies, and the key stakeholders involved. This should be followed by a clear **engineering solution description** explaining the technical concept, underlying scientific principles, innovation, expected advantages, and proposed application methodology.

Teams should also provide a **prototype or proof of concept** demonstrating the idea's main functionality. Supporting **technical documentation** should include engineering design details, material specifications, mix design where applicable, structural considerations, installation procedure, testing methodology, safety considerations, and scalability assessment.

Experimental validation through **laboratory testing or simulation, comparative evaluation,** or **case-based validation** is strongly encouraged.

In addition, submissions should include a **business model** that identifies the target market, customer segments, commercialization strategy, cost structure, lifecycle benefits, and scalability potential.

A five- to seven-minute **demonstration video** and a **pitch presentation** of up to ten slides should present the problem, innovation, validation, and expected industry impact in a clear and compelling manner.

8. EVALUATION CRITERIA

- Submissions will be assessed on their **understanding of waterproofing challenges, engineering innovation, technical feasibility, durability and performance, prototype demonstration, practical applicability, scalability, business viability**, and the **quality of presentation and demonstration.** Teams should therefore aim to develop solutions that are not only inventive, but also technically sound, durable, practical to execute, and clearly communicated.

Parameter	Description
Understanding of Industry Problem	Depth of understanding of basement leakage issues, causes, impacts, and stakeholder needs.
Innovation and Originality	Creativity, uniqueness of idea, and advancement over existing solutions.
Engineering and Technical Feasibility	Sound engineering principles, technical robustness, and feasibility of implementation.
Quality Improvement and Structural Safety Impact	Potential to improve durability, safety, reliability, and overall structural performance.
Scalability and Industry Readiness	Ease of scale-up, adaptability to different projects, and readiness for industry adoption.
Business Viability	Market potential, cost-effectiveness, lifecycle benefits, and commercialization strategy.
Presentation and Demonstration	Clarity, quality, and effectiveness of prototype, documentation, video, and pitch deck.

9. EXPECTED IMPACT

- A successful solution should **improve the durability** of basement structures, **reduce water ingress** and associated deterioration, **lower maintenance and lifecycle costs**, and **reduce disruption** to building occupants during repairs.
- It should also **strengthen rehabilitation practices** for ageing buildings, promote adoption of **sustainable repair technologies**, support **digitized inspection and maintenance workflows**, and improve the **safety and reliability** of underground structures.
- In a broader sense, such solutions can contribute to more **climate-resilient infrastructure** and better **long-term asset management** in alignment with the vision of **Viksit Bharat 2047**.

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Thank You!

TO ALL PARTICIPANTS, MENTORS & PARTNERS

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