SUPPORTED BY

Office of the Principal Scientific Adviser to the Government of India

Manthan

INCUBATION & SUPPORT BY

NITI Aayog

ATAL INNOVATION MISSION

JSW

PRESENTS

Association of Infrastructure Industry(India)

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

Building Bharat Sampaark -

National Civil Engineering Hackathon

Problem Statement : Self Clearing / Self Cleaning Drain Inlet System

Theme : Public Infrastructure

INITIATIVE PARTNERS

AICTE

NIUA राष्ट्रीय नगर कार्य संस्थान National Institute of Urban Affairs

50 Years 1976 से राष्ट्र की सेवा में Serving the Nation since 1976

SUSTAINABILITY PARTNER

JSW Cement

Start Strong. Grow Stronger.

INNOVATION PARTNERS

JSW Steel

JW

TLC2

TATA PROJECTS

JSW

PRESENTS

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

1. BACKGROUND

Urban flooding has become one of the most significant infrastructure challenges facing Indian cities. Rapid urbanization, increased impervious surfaces, climate change-induced extreme rainfall events, and inadequate maintenance of stormwater drainage systems frequently result in waterlogging, traffic disruption, infrastructure damage, public health risks, and economic losses.

One of the primary causes of urban flooding is blockage of stormwater drain inlets (gully pits, catch basins, kerb inlets, and grated drain inlets) by:

- Plastic waste
- Leaves
- Paper
- Construction debris
- Sand and silt
- Tree branches
- Domestic solid waste
- Packaging materials
- Bottles
- Cloth
- Organic waste

Most municipal authorities rely on manual cleaning, which is:

- Labour-intensive
- Unsafe
- Time-consuming
- Reactive rather than preventive
- Expensive to maintain
- Difficult during heavy rainfall
- Limited by manpower availability

Blocked drain inlets reduce hydraulic capacity, causing stormwater to accumulate on roads and public spaces, resulting in flooding even when the downstream drainage network has sufficient carrying capacity.

The Indian construction and urban infrastructure industry requires an innovative self-clearing or self-cleaning drain inlet system capable of automatically preventing or removing debris accumulation while maintaining uninterrupted stormwater flow with minimal maintenance.

The solution should be suitable for Indian urban conditions, where debris loads, sediment deposition, traffic loading, vandalism, and varying rainfall intensities present unique operational challenges.

2. INDUSTRY PROBLEM STATEMENT

Design an innovative self-clearing or self-cleaning drain inlet system that minimizes clogging, reduces manual cleaning, improves hydraulic performance, and enhances the resilience of urban stormwater drainage systems.

The solution may consist of:

- Mechanical systems
- Hydraulic systems
- Passive engineering designs
- Smart sensors
- IoT-enabled monitoring
- AI-enabled predictive maintenance
- Robotics
- Hybrid hardware-software solutions

- Minimizes clogging
- Reduces manual cleaning
- Improves hydraulic performance
- Enhances urban drainage resilience
- Cost-effective, durable & easy to maintain

The proposed system should operate effectively under real Indian road and drainage conditions while remaining affordable, durable, and easy to maintain.

SUPPORTED BY
Office of the Principal Scientific Adviser to the Government of India
Manthan

INCUBATION & SUPPORT BY
NITI Aayog
ATAL INNOVATION MISSION

JSW PRESENTS

Association of Infrastructure Industry (India)

BUILDING भारत™ SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

3. CHALLENGE OBJECTIVE

Students are expected to develop a solution that:

- Prevents drain inlet blockage
- Automatically removes or diverts debris
- Maintains uninterrupted stormwater flow
- Reduces flooding caused by clogged inlets
- Minimizes manual maintenance
- Improves worker safety
- Reduces lifecycle maintenance costs
- Enables predictive maintenance
- Increases drainage efficiency
- Supports smart city infrastructure

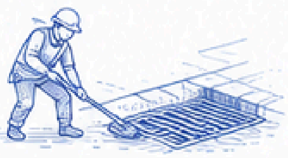
4. REAL-TIME INDUSTRY NEED

Across Indian cities, thousands of drain inlets become blocked during monsoon seasons due to accumulated debris.

Current industry challenges include:

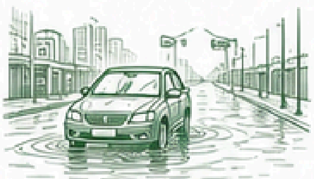
OPERATIONAL CHALLENGES

- Frequent inlet clogging
- Slow manual cleaning
- Limited municipal manpower
- Delayed maintenance
- Traffic disruption during cleaning
- Poor accessibility
- Inconsistent maintenance schedules



HYDRAULIC CHALLENGES

- Reduced inlet capacity
- Surface flooding
- Overflow onto roads
- Localized flooding
- Reduced drainage efficiency
- Sediment accumulation



SAFETY CHALLENGES

- Manual entry into confined spaces
- Exposure to contaminated water
- Risk during heavy rainfall
- Roadside maintenance hazards

ECONOMIC CHALLENGES

- High maintenance costs
- Flood-related infrastructure damage
- Traffic delays
- Emergency response expenses
- Frequent replacement of damaged components

5. SCOPE OF THE CHALLENGE

Students may develop solutions for:

- Roadside kerb inlets
- Gully traps
- Catch basins
- Surface drain grates
- Highway drainage systems
- Bridge deck drainage
- Parking areas
- Smart city infrastructure
- Industrial drainage
- Airport drainage
- Metro station drainage
- Residential stormwater systems

JSW

PRESENTS

आं Association of Infrastructure Industry(India)

BUILDING भारत™ SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

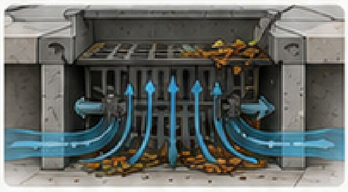
6. EXPECTED SOLUTION AREAS

Students may choose one or more engineering approaches.

A. PASSIVE SELF-CLEANING DRAIN INLET

Develop a system using innovative hydraulic or mechanical principles such as:

- Optimized grate geometry
- Self-cleaning grill profiles
- Debris deflection mechanisms
- Inclined inlet designs
- Rotating grates powered by water flow
- Floating debris separators
- Sediment traps with automatic flushing
- Vortex-assisted cleaning
- Flow-induced cleaning mechanisms



The design should minimize clogging without requiring external power wherever possible.

B. SMART MECHANICAL CLEANING SYSTEM

Develop a compact mechanical solution capable of:

- Detecting accumulated debris
- Automatically removing blockages
- Depositing debris into a collection chamber
- Preventing downstream blockage
- Operating autonomously during rainfall

Possible mechanisms include:

- Rotary brushes
- Chain scrapers
- Conveyor systems
- Rotating screens
- Automatic rakes
- Pneumatic cleaning systems

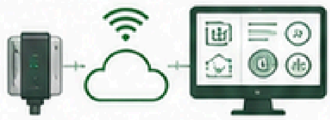
C. AI & IoT MONITORING PLATFORM

Develop an intelligent monitoring system capable of:

- Detecting blockage levels
- Measuring water levels
- Measuring flow velocity
- Detecting sediment accumulation
- Sending maintenance alerts
- Predicting future blockage
- Prioritizing maintenance locations

Possible technologies:

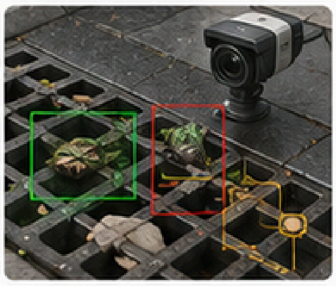
- Ultrasonic Sensors
- Water Level Sensors
- Flow Sensors
- Cameras
- Computer Vision
- AI Analytics
- GSM/LoRaWAN Communication



D. COMPUTER VISION-BASED DEBRIS DETECTION

Develop an AI solution capable of identifying:

- Plastic waste
- Leaves
- Sand accumulation
- Floating debris
- Waterlogging
- Sediment deposition

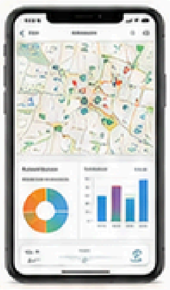


The system should generate automated maintenance recommendations.

E. DIGITAL MAINTENANCE PLATFORM

Develop a mobile or web application enabling:

- GIS mapping of drain inlets
- QR-code asset identification
- Inspection scheduling
- Maintenance history
- Live blockage monitoring
- Performance dashboards
- Work-order management



GIS MAP | INSPECTION | LIVE ALERTS | DASHBOARD | WORK ORDERS

F. SMART DEBRIS COLLECTION CHAMBER

Develop an integrated debris collection unit that:

- Captures solid waste
- Allows uninterrupted water flow
- Is easily removable
- Reduces manual handling
- Indicates when cleaning is required

G. PREDICTIVE MAINTENANCE ENGINE

Use Artificial Intelligence to predict:

- Probability of blockage
- Cleaning frequency
- High-risk locations
- Rainfall impact
- Sediment accumulation trends
- Asset performance degradation

7. INNOVATION EXPECTATIONS

Students are encouraged to integrate:

- Artificial Intelligence
- Internet of Things (IoT)
- Robotics
- Computer Vision
- Digital Twins
- Smart Sensors
- Edge Computing
- GIS
- Cloud Computing
- Drone-assisted inspection (where appropriate)

Sustainable materials

Energy harvesting technologies (e.g., micro-hydraulic or solar-assisted systems)

The emphasis should be on creating robust, low-maintenance, and field-deployable solutions.

JSW PRESENTS

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

8. TECHNICAL EXPECTATIONS

The proposed solution should demonstrate sound engineering design.

HARDWARE	SOFTWARE	ARTIFICIAL INTELLIGENCE	CLOUD	INTEGRATION
Arduino	**Frontend**	OpenCV	AWS	Teams are encouraged to integrate with:
ESP32	Flutter	TensorFlow	Azure	Smart City Command Centres
Raspberry Pi	React Native	PyTorch	Google Cloud	Municipal Asset Management Systems
PLC Controllers	Angular	YOLO		GIS Platforms
Ultrasonic Sensors	**Backend**	Image Segmentation		SCADA Systems
Water Level Sensors	Node.js	Object Detection		Stormwater Network Digital Twins
Flow Meters	Django	Predictive Analytics		Public Works Department maintenance systems
Cameras	Spring Boot			
Load Sensors	**Database**			
Motors and Actuators	PostgreSQL			
Solar Power Modules (optional)	MongoDB			
	Firebase			

9. PERFORMANCE EXPECTATIONS

The proposed solution should demonstrate measurable improvements in one or more Key Performance Indicators (KPIs), such as:

Reduction in drain inlet blockage frequency	Increase in hydraulic efficiency	Reduction in manual cleaning operations
Reduction in flood incidents caused by inlet blockage	Reduction in maintenance costs	Reduction in response time for maintenance
Debris capture efficiency (%)	Water flow continuity during storm events	Reliability under high-intensity rainfall
Energy efficiency (if powered)	Ease of maintenance and replacement	

Teams should support their performance claims using hydraulic calculations, prototype testing, laboratory demonstrations, CFD simulations, or field-scale validation.

JSW PRESENTS

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

10. DESIGN CONSTRAINTS

The proposed solution should consider:

- Heavy monsoon rainfall
- Mixed municipal solid waste
- Fine sediment and silt
- High traffic loading
- Corrosion resistance
- Vandal resistance
- Ease of retrofitting into existing drain systems
- Low manufacturing cost
- Minimal power consumption
- Long service life
- Compliance with relevant drainage and highway engineering practices

Solutions should preferably be adaptable to existing municipal infrastructure without requiring major civil modifications.

11. USER EXPERIENCE EXPECTATIONS

The solution should:

- Require minimal operator intervention
- Be simple to install and maintain
- Function reliably during continuous rainfall
- Operate in harsh outdoor environments
- Support multilingual mobile interfaces
- Provide automated alerts and dashboards
- Enable offline data capture with cloud synchronization
- Offer role-based access for municipal engineers, contractors, maintenance teams, and city administrators
- Provide real-time monitoring and performance insights
- Ensure easy support and training

JSW PRESENTS

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

12. EXPECTED DELIVERABLES

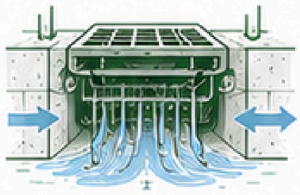
Each participating team should submit:

A. INDUSTRY PROBLEM ANALYSIS

- Existing drainage challenges
- Causes of inlet blockage
- Stakeholder analysis
- Benchmarking with global best practices

B. PROPOSED SOLUTION

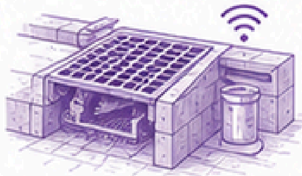
- Engineering concept
- Working principle
- Innovation
- Hydraulic design
- Expected benefits



C. PROTOTYPE

A working prototype demonstrating:

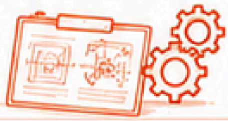
- Mechanical system
- Hydraulic mechanism
- Sensor integration
- Digital platform
- AI model (if applicable)



D. TECHNICAL DOCUMENTATION

Include:

- Mechanical design
- Hydraulic calculations
- Structural design
- System architecture
- Electrical design (if applicable)
- Software architecture
- AI model description
- Scalability strategy
- Safety considerations



E. VALIDATION STRATEGY

Teams should provide one or more of the following:

- Hydraulic laboratory testing
- CFD simulations
- Rainfall simulations
- Prototype testing
- Comparative analysis with conventional drain inlets
- Lifecycle cost analysis

F. BUSINESS MODEL

Describe:

- Target customers
- Manufacturing strategy
- Commercialization plan
- Installation cost
- Maintenance model
- Return on Investment (ROI)
- Scalability for municipalities and infrastructure agencies

G. DEMONSTRATION VIDEO

A 5–7 minute video including:

- Industry challenge
- Solution overview
- Prototype demonstration
- Performance evaluation
- Expected impact

H. PITCH PRESENTATION

Maximum 10 slides covering:

1. Industry Challenge
2. Existing Problems
3. Proposed Innovation
4. Engineering Design
5. Technical Architecture
6. Prototype Demonstration
7. Validation Results
8. Business Model
9. Industry Impact
10. Future Roadmap

13. EVALUATION PARAMETER

1. UNDERSTANDING OF INDUSTRY PROBLEM
2. INNOVATION AND ORIGINALITY
3. ENGINEERING AND TECHNICAL FEASIBILITY
4. QUALITY IMPROVEMENT AND STRUCTURAL SAFETY IMPACT
5. SCALABILITY AND INDUSTRY READINESS
6. BUSINESS VIABILITY
7. PRESENTATION AND DEMONSTRATION

SUPPORTED BY
Office of the Principal Scientific Adviser to the Government of India
Manthan

INCUBATION & SUPPORT BY
NITI Aayog
ATAL INNOVATION MISSION

JSW PRESENTS

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

14. EXPECTED INDUSTRY IMPACT

A successful solution should:

- Significantly reduce urban flooding caused by blocked drain inlets
- Improve the hydraulic efficiency of stormwater drainage systems
- Reduce dependence on manual drain cleaning and associated safety risks
- Lower lifecycle maintenance costs for municipalities and infrastructure operators
- Improve the resilience of urban drainage networks during extreme rainfall events
- Support smart city initiatives through real-time monitoring and predictive maintenance
- Reduce environmental pollution by enabling efficient collection of floating debris before it enters drainage networks and natural water bodies
- Provide retrofit-friendly solutions suitable for India's existing drainage infrastructure
- Improve public safety, mobility, and urban resilience during the monsoon season
- Contribute to sustainable urban infrastructure development in support of the vision of Viksit Bharat 2047

15. STRETCH GOALS (BONUS)

Teams seeking advanced recognition may incorporate:

- Digital Twin integration for city-wide stormwater network monitoring and simulation
- AI-driven optimization of maintenance schedules using rainfall forecasts, historical blockage patterns, and sensor data
- Energy-autonomous operation using solar panels or micro-hydraulic energy harvesting
- Integration with weather forecasting APIs for pre-monsoon and real-time operational preparedness
- Robotic inspection modules for underground drainage systems
- Carbon footprint and lifecycle assessment of the proposed solution compared with conventional maintenance practices
- Open APIs enabling integration with municipal GIS platforms, SCADA systems, Smart City Integrated Command and Control Centres (ICCCs), and asset management software

Solutions that demonstrate superior hydraulic performance, innovative engineering, affordability, ease of retrofit, durability under Indian field conditions, and measurable reductions in maintenance requirements and flood risk will receive the highest consideration.

SUPPORTED BY

Office of the Principal Scientific Adviser to the Government of India

Manthan

JSW

PRESENTS

INCUBATION & SUPPORT BY

NITI Aayog

ATAL INNOVATION MISSION

आ Association of Infrastructure Industry (India)

BUILDING भारत SAMPAARK

INNOVATION BOOT CAMP IN CIVIL ENGINEERING

Thank You!

TO ALL PARTICIPANTS, MENTORS & PARTNERS

"*Desh को बनाना है। कुछ कर के दिखाना है।*"

JOURNEY TO
BUILDING BHARAT
has begun...

ABOUT US

www.bbsampaark.in | priya@bbsampaark.in | Write to Us

INITIATIVE PARTNERS

AICTE

NIUA
राष्ट्रीय नगर कार्य संस्थान
National Institute of Urban Affairs

50 Years

SUSTAINABILITY PARTNER

JSW Cement
Start Strong. Grow Stronger.

INNOVATION PARTNERS

JSW Steel

JW

TLC2

TATA
TATA PROJECTS