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P R E S E N T S



Building Bharat Sampaark – National Civil Engineering Hackathon



Problem Statement :

Development of an efficient segregation method/tool for Construction and Demolition (C&D) waste for efficient utilization in construction industry



Theme : **MATERIALS AND STRUCTURES**

INITIATIVE PARTNERS



SUSTAINABILITY PARTNER



INNOVATION PARTNERS





4. REAL-TIME INDUSTRY NEED

India generates **millions of tonnes of C&D waste** annually from rapidly expanding infrastructure and urban development projects. Contractors, municipal bodies, recyclers, and developers encounter several challenges:



OPERATIONAL CHALLENGES

- Mixed waste arriving at recycling facilities
- Lack of segregation at source
- High dependence on manual sorting
- Slow processing rates
- Space constraints on construction sites
- Limited automation
- Inconsistent quality of recovered materials



ECONOMIC CHALLENGES

- High transportation costs
- Low market value of mixed waste
- Poor recovery efficiency
- High labour costs
- Increased equipment wear
- Reduced profitability of recycling operations



ENVIRONMENTAL CHALLENGES

- Illegal dumping
- Landfill overflow
- Dust pollution
- Water contamination
- Loss of natural resources
- Increased carbon footprint



QUALITY CHALLENGES

Poor segregation results in:

- Contaminated recycled aggregates
- Poor-quality recycled concrete
- Reduced reuse potential
- Inconsistent recycled products
- Limited acceptance by contractors

5. SCOPE OF THE CHALLENGE

Students may develop solutions for:

01



SOURCE SEGREGATION

Waste segregation directly at construction or demolition sites.

02



MOBILE SEGREGATION SYSTEMS

Portable equipment capable of working at project locations.

03



CENTRALIZED RECYCLING FACILITIES

Automation for large-scale C&D waste recycling plants.

04



DIGITAL WASTE MANAGEMENT PLATFORMS

Software solutions for waste tracking, classification, logistics, and reporting.

05



INTELLIGENT MATERIAL RECOVERY SYSTEMS

AI-enabled identification and sorting technologies.

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6. EXPECTED SOLUTION AREAS

Students may choose **one or multiple** engineering approaches.



A. AI-BASED WASTE IDENTIFICATION

Develop Computer Vision models capable of identifying:

- Concrete
- Bricks
- Reinforcement steel
- Timber
- Asphalt
- Tiles
- Plastics
- PVC pipes
- Aluminium
- Copper
- Glass
- Gypsum
- Soil
- Ceramics
- Mixed waste

Possible technologies include:

- Deep Learning
- Image Processing
- Object Detection
- Semantic Segmentation
- YOLO
- OpenCV
- Edge AI



B. AUTOMATED SEGREGATION MACHINE

Develop a prototype capable of separating materials using:

- Conveyor systems
- Mechanical screening
- Vibratory sieves
- Air classification
- Density separation
- Magnetic separation
- Eddy current separators
- Optical sorting
- Robotic sorting arms
- AI-controlled actuators



The prototype should prioritize affordability, portability, and ease of deployment.



C. SMART WASTE BIN SYSTEM

Develop IoT-enabled collection bins capable of:

- Material identification
- Weight measurement
- Fill-level monitoring
- QR code integration
- GPS tracking
- Real-time reporting
- Waste categorization



D. DIGITAL CONSTRUCTION WASTE PASSPORT

Develop a digital identity for each waste stream including:

- Source project
- Material type
- Quantity
- Quality grade
- Recycling potential
- Transportation history
- Processing history
- End-use applications



E. DIGITAL MARKETPLACE

Develop a platform connecting:

- Contractors
- Demolition agencies
- Recyclers
- Ready Mix Concrete plants
- Aggregate suppliers
- Municipal bodies
- Infrastructure companies

The platform should facilitate:

- Material exchange
- Waste auctions
- Logistics optimization
- Demand forecasting
- Price discovery



F. MOBILE INSPECTION APPLICATION

Develop an application enabling engineers to:

- Estimate waste generation
- Categorize waste
- Upload photographs
- Geo-tag waste
- Recommend segregation methods
- Generate digital reports
- Track recycling performance



G. PREDICTIVE WASTE ANALYTICS

Use Artificial Intelligence to predict:

- Waste generation quantity
- Material composition
- Recycling potential
- Equipment requirement
- Transportation optimization
- Revenue from recovered materials



H. ROBOTICS FOR C&D WASTE SEGREGATION

Students may propose robotic systems capable of:

- Object recognition
- Automated picking
- Material classification
- Intelligent sorting
- Hazard detection
- Continuous operation in harsh environments

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7. INNOVATION EXPECTATIONS

Students are encouraged to propose **innovative technologies** such as:



Artificial
Intelligence



Computer
Vision



Robotics



IoT



Edge
Computing



Digital Twins



GIS-based
waste mapping



Drone-based
waste
quantification



Blockchain for
material
traceability



Autonomous
sorting
systems



Sensor fusion



Smart conveyor
systems



AR-assisted
waste
inspection



Generative AI
for waste
optimization



The emphasis should be on **practical, industry-ready innovation**.

8. TECHNICAL EXPECTATIONS

The proposed solution should demonstrate **robust engineering design**.



HARDWARE

- Arduino
- Raspberry Pi
- ESP32
- Industrial PLC
- Servo motors
- Conveyor systems
- Load cells
- RGB Cameras
- Depth Cameras
- LiDAR (optional)
- Ultrasonic Sensors
- Proximity Sensors
- RFID Readers



SOFTWARE

Frontend

- Flutter
- React Native
- Angular

Backend

- Node.js
- Django
- Spring Boot

Database

- PostgreSQL
- MongoDB
- Firebase



ARTIFICIAL INTELLIGENCE

- TensorFlow
- PyTorch
- OpenCV
- YOLO
- Semantic Segmentation
- Object Detection
- Machine Learning
- Predictive Analytics



CLOUD

- AWS
- Azure
- Google Cloud



INTEGRATION

Teams are encouraged to integrate with:

- BIM platforms
- ERP systems
- GIS
- Municipal waste management systems
- Recycling plant management software
- Construction project management systems

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9. PERFORMANCE EXPECTATIONS

The proposed solution should demonstrate measurable improvements in one or more

Key Performance Indicators (KPIs), such as:



Segregation
accuracy (%)



Material
recovery rate (%)



Reduction in
manual sorting
time



Processing
capacity
(tonnes/hour)



Reduction in
contamination
between material
streams



Reduction in
landfill
disposal



Increase in
recyclable
material recovery



Operational
cost savings



Reduction in
transportation
costs



Improvement in
worker safety



Carbon emission
reduction



Revenue generated
from recovered
materials



Teams should support their claims through **prototype testing, simulations, laboratory validation, or engineering calculations.**

10. INDUSTRY APPLICABILITY

The solution should be deployable across:



Building
construction
projects



Demolition
projects



Smart Cities



Metro Rail
projects



Highways



Airports



Bridges



Industrial
developments



Ports



Urban local
bodies



Municipal
corporations



C&D waste
recycling
facilities



Infrastructure
developers



EPC
contractors



The proposed solution should address the practical constraints of Indian construction sites, including **limited space, varying waste composition, labour-intensive operations, and cost sensitivity.**

11. USER EXPERIENCE EXPECTATIONS

The solution should:



Be simple to
operate with
minimal training



Function in
dusty and
outdoor
environments



Support
multilingual
interfaces



Operate on
Android devices
where
applicable



Enable offline
data capture
with cloud
synchronization



Generate
automated
reports and
dashboards



Support role-based
access for contractors,
site engineers, recyclers,
municipal authorities,
and project owners



Be modular
and scalable for
projects of
different sizes

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12. EXPECTED DELIVERABLES

Each participating team should submit:



A INDUSTRY PROBLEM ANALYSIS

- Current C&D waste management practices
- Existing challenges
- Stakeholder mapping
- Benchmarking with national and international best practices



B PROPOSED SOLUTION

- Innovation overview
- Engineering design
- System workflow
- Technology stack
- Expected benefits



C PROTOTYPE

A working prototype demonstrating:

- Hardware (if applicable)
- Automated segregation system
- Mobile or web application
- AI model
- Dashboard
- Sensor integration



D TECHNICAL DOCUMENTATION

Include:

- System architecture
- Mechanical design
- Electrical design (if applicable)
- Software architecture
- AI model description
- Database structure
- APIs
- Scalability strategy
- Safety considerations



VALIDATION STRATEGY

Teams should provide one or more of the following:

- Laboratory testing
- Prototype performance evaluation
- Field simulation
- Comparative benchmarking with manual segregation
- Cost-benefit analysis



BUSINESS MODEL

Describe:

- Target customers
- Revenue model
- Manufacturing or deployment strategy
- Commercial viability
- Lifecycle cost
- Return on Investment (ROI)
- Scalability across India



DEMONSTRATION VIDEO

A 5–7 minute video including:

- Industry problem
- Solution overview
- Prototype demonstration
- Innovation highlights
- Expected impact



PITCH PRESENTATION

Maximum 10 slides covering:

- Industry Challenge
- Existing Problems
- Proposed Innovation
- Engineering Design
- Technical Architecture
- Prototype Demonstration
- Validation Results
- Business Model
- Industry Impact
- Future Roadmap

13. EVALUATION PARAMETER



Understanding of Industry Problem



Innovation and Originality



Engineering and Technical Feasibility



Quality Improvement and Structural Safety Impact



Scalability and Industry Readiness



Business Viability



Presentation and Demonstration

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14. EXPECTED INDUSTRY IMPACT

A successful solution should contribute to:



Significant **reduction** in C&D waste sent to landfills



Increased recovery of **high-quality recyclable** construction materials



Reduced dependence on virgin natural resources such as aggregates and sand



Improved **productivity and automation** in recycling operations



Lower transportation and disposal costs



Enhanced **compliance** with C&D Waste Management Rules and sustainable construction practices



Development of reliable recycled material **supply chains** for infrastructure projects



Promotion of a **circular economy** in the construction sector



Reduction in embodied carbon and environmental impacts associated with construction activities



Creation of **new business opportunities** in recycling, material recovery, and green construction technologies



Support for India's transition toward resource-efficient and sustainable infrastructure in line with the vision of **Viksit Bharat 2047**

15. STRETCH GOALS (BONUS)

Teams seeking advanced recognition may incorporate:



AI-driven optimization of segregation processes based on real-time waste composition



Robotic material recovery using collaborative robots (cobots)



Digital Twin of a C&D waste recycling facility for operational optimization



Blockchain-enabled traceability of recovered materials from demolition site to new construction project



Carbon footprint and lifecycle assessment dashboards for recovered materials



Integration with BIM to generate demolition waste forecasts and material recovery plans before project execution



Smart logistics optimization for waste transportation using GIS and AI



Open APIs enabling integration with municipal waste management systems, ERP platforms, recycling plants, and national digital infrastructure initiatives



Solutions that demonstrate high segregation accuracy, practical deployment potential, affordability, measurable environmental benefits, and strong commercial viability **for the Indian construction industry will receive the highest consideration.**

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PRESENTS



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Thank You!

TO ALL PARTICIPANTS,
MENTORS & PARTNERS

“
Desh ko banana hai। कुछ कर के दिखाना है।
”

**JOURNEY TO
BUILDING BHARAT**
has begun...



ABOUT US



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