



सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

Technologies for Enhancing Urban Resilience in Buildings



Prof. R. Pradeep Kumar
CSIR Central Building Research Institute, Roorkee
Ministry of Science and Technology
Government of India

Overview

- **Construction sector is expanding rapidly due to**
 - **Urbanization**
 - **Infrastructure development and**
 - **Real estate growth**
- **Infrastructure Budget outlays in FY 2024-25**
 - **₹ 1.1 Million Crore**
 - **3.5 % of GDP**

Key Issues

Disaster Safety



Energy Efficiency



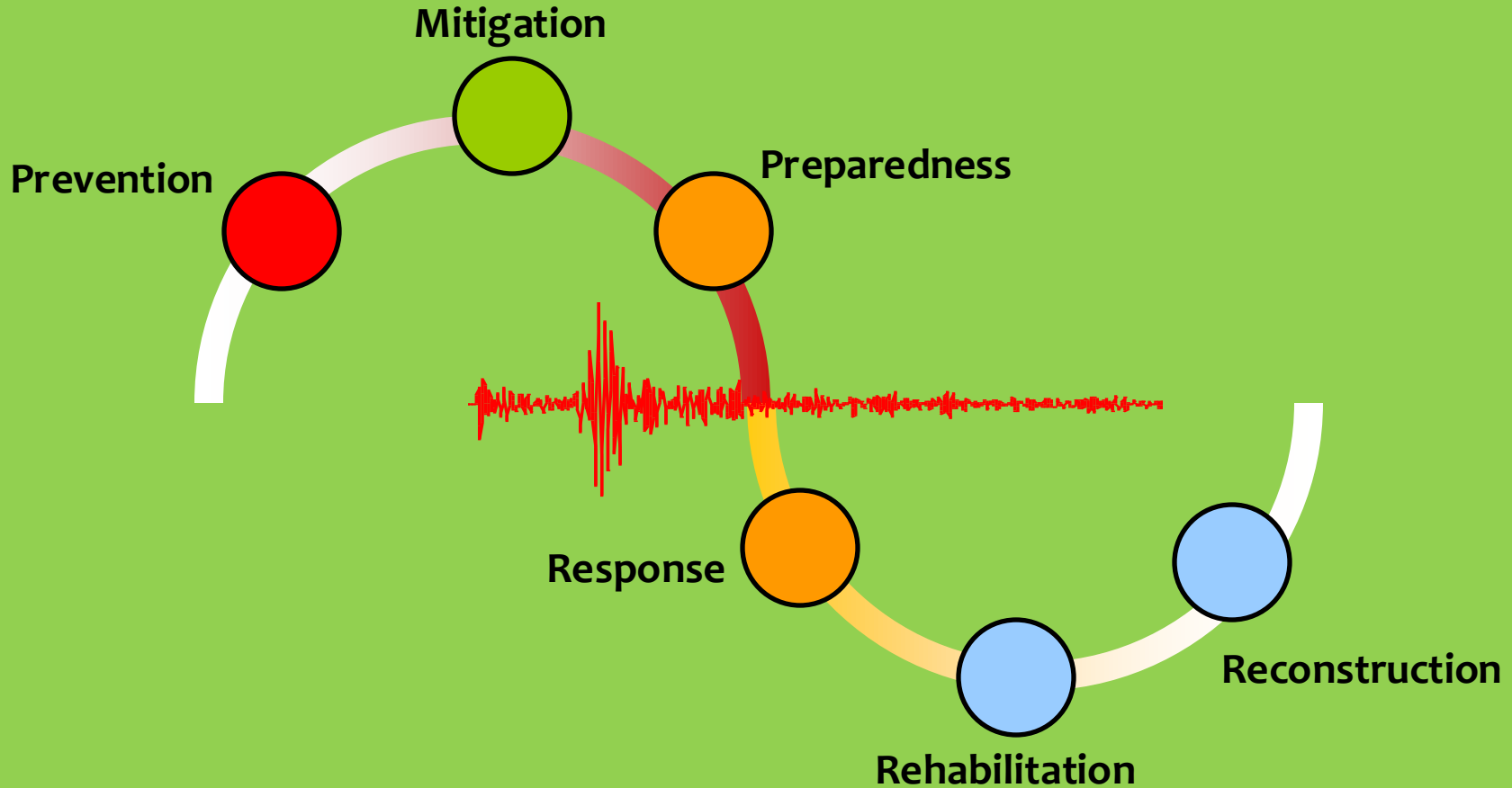
Implementation Challenges



C&D Waste

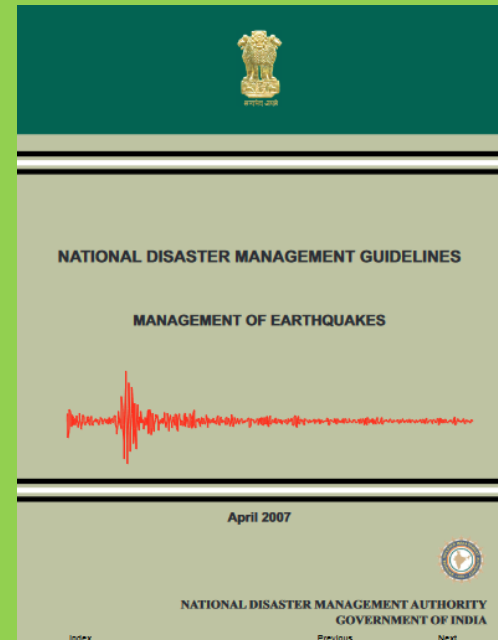
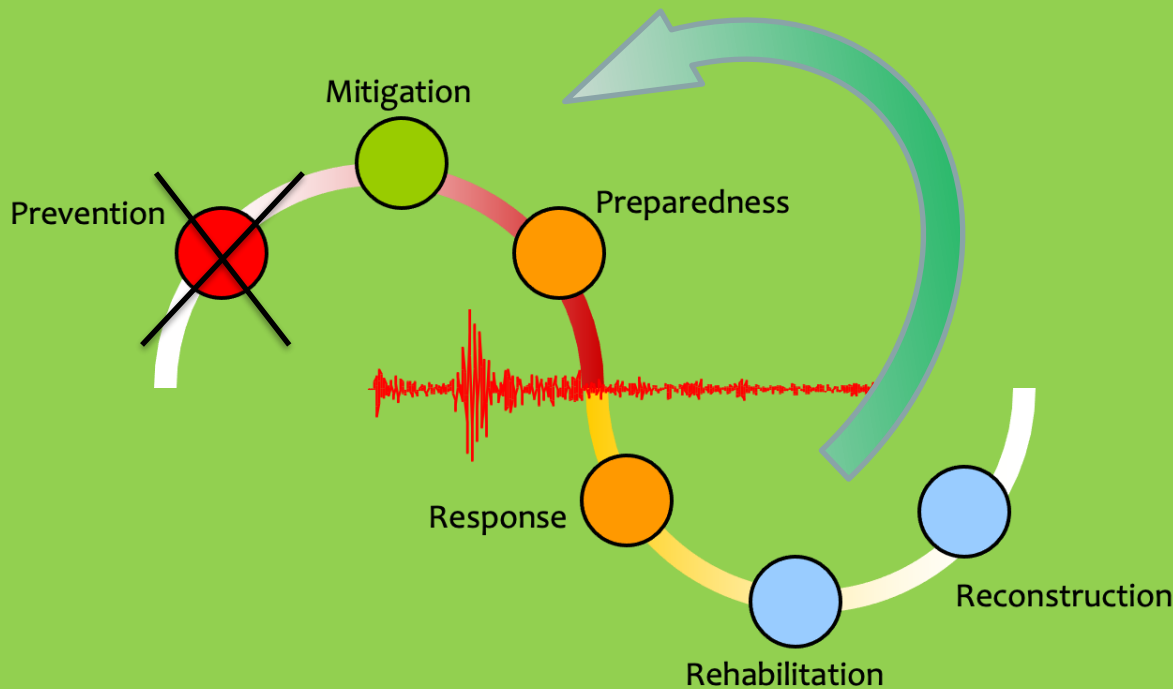
Decarbonization

Disaster Safety



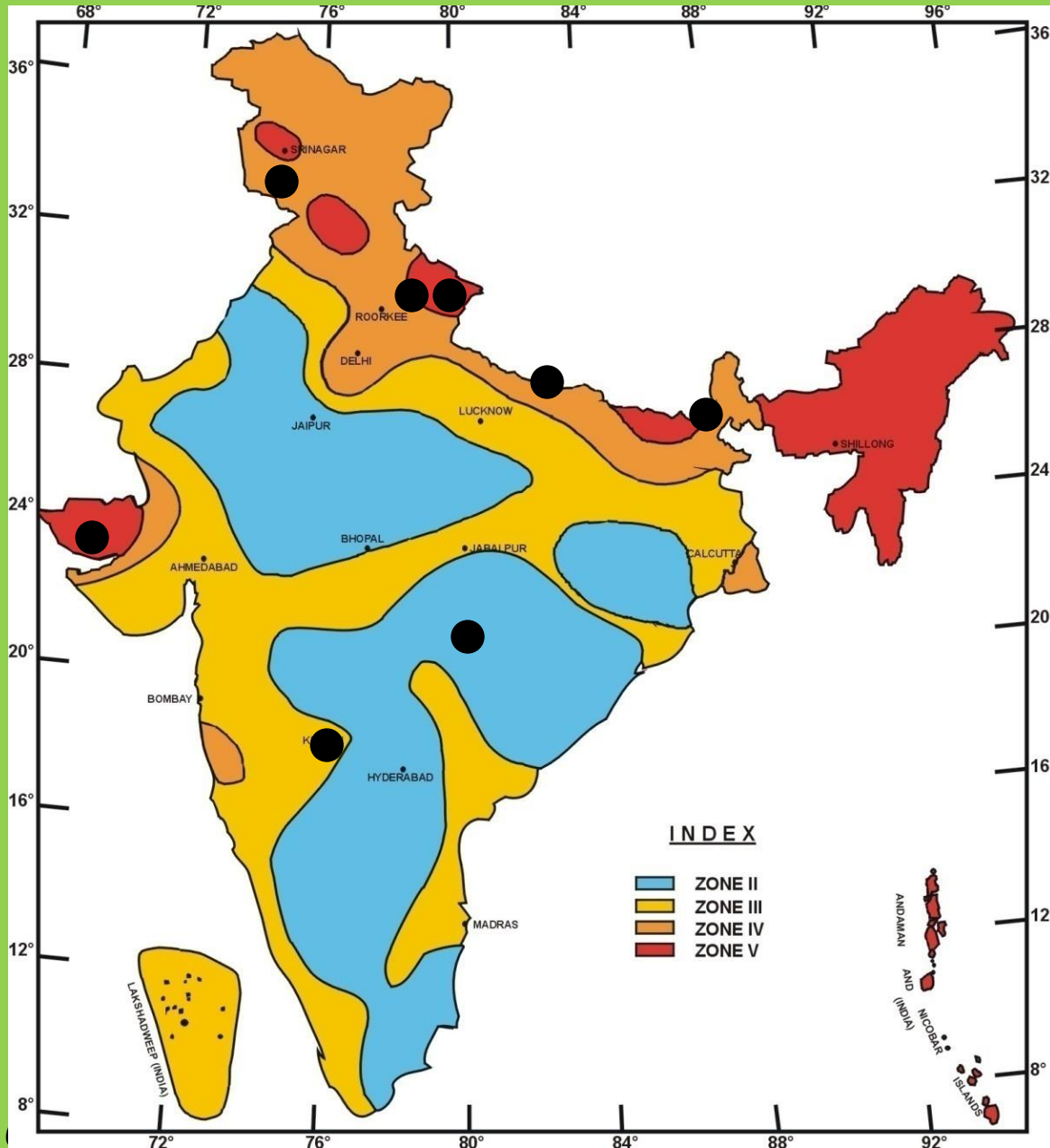
Earthquake Disaster Management

- The Disaster Management Act, 2005 seeks a paradigm shift



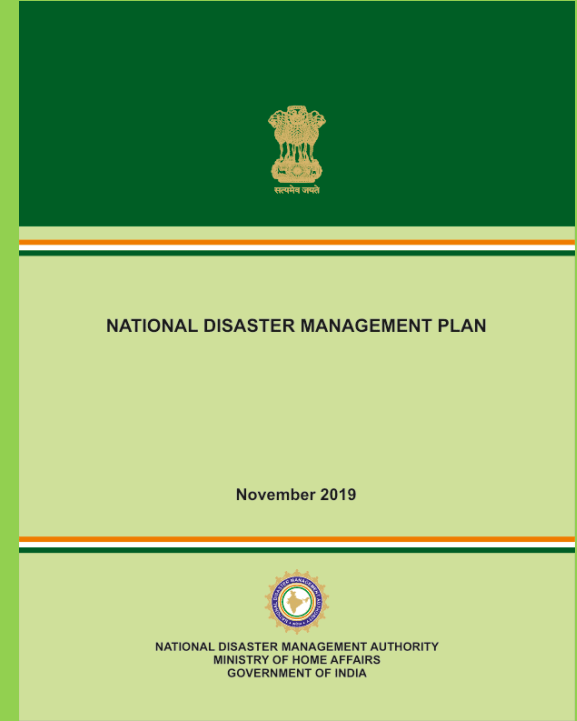
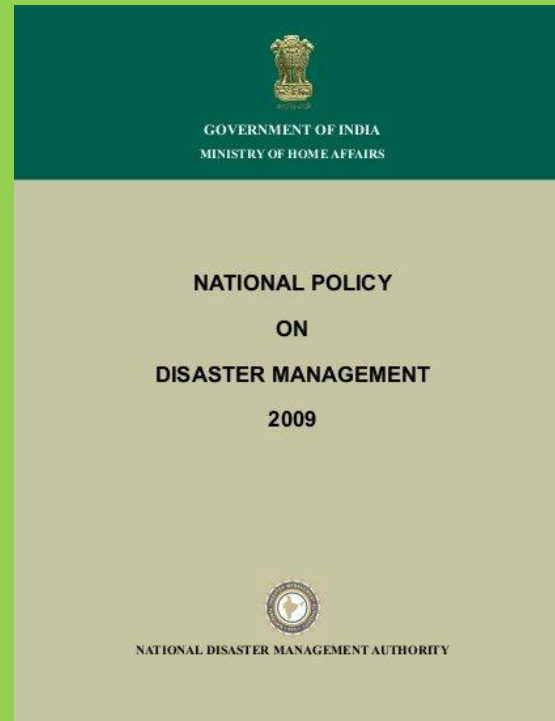
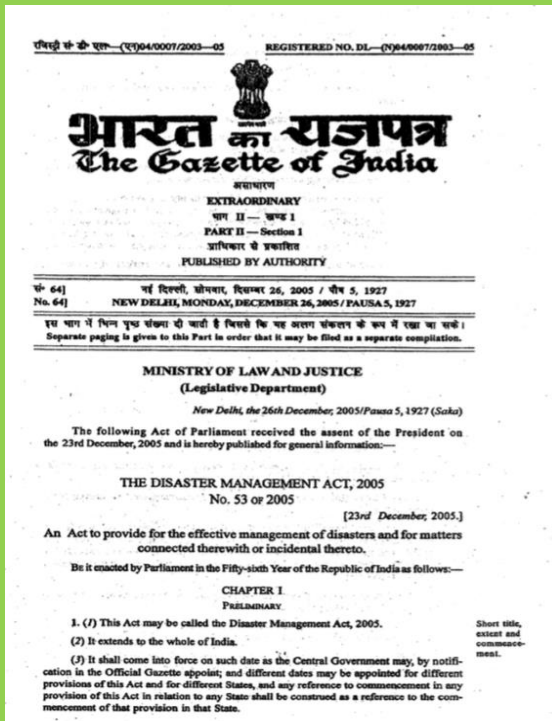
ZERO TOLERANCE
to AVOIDABLE Deaths
due to Earthquakes

Notable Events



Earthquake Disaster Management

- In addition to the Disaster Management Act, 2005
 - Disaster Management Policy released 2009
 - Disaster Management Plan released in 2019

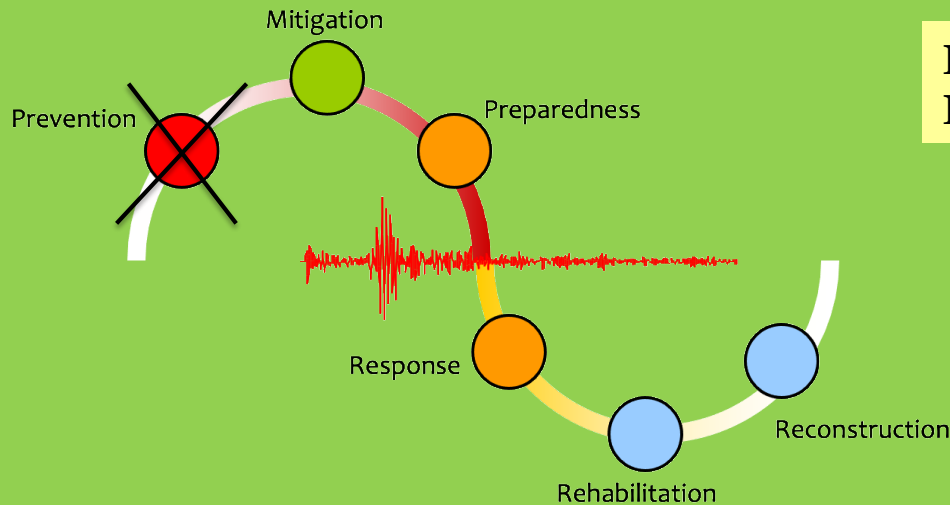


Earthquake Disaster Management

- **Guidelines for banks and lending institutions in 2010**
 - *to make loans contingent on compliance of Disaster Resilience Standards*
- **Guidelines for Seismic Retrofitting of Deficient Buildings and Structures in 2014**
 - *to make structures to earthquake forces*
- **Guidelines for Hospital Safety in 2016**
 - *to make all hospitals in India to be structurally and functionally safer from disasters;*
- **Guidelines for School Safety in 2016**
 - *to make all children and their teachers, and other stakeholders in the school community safe from any kind of preventable risks due to natural hazards*

Disaster Safety

	Mitigation	Prepared.	Response	Rehabilit.	Reconstr.
Mitigation	Safe Built Environ.	Technical Education	Damage Assessment	Temporary Shelters	Permanent Shelters
Prepared.		DM Plans	Active EOCs & Mock Drills	Community Engagement	Owner Dr. Recons.
Response			Search & Rescue	Trauma Counseling	Insitu or Relocate
Rehabilit.				Livelihood Restoration	Loss Compensation
Reconstr.					Built Environment Restoration



Sustainability

- **Three choices to make**
 - *Material*
 - *Technology*
 - *Artisans*

Local



Geo-Climatic Sensitivity
People-Centric
Vernacular Typologies

Energy Efficiency

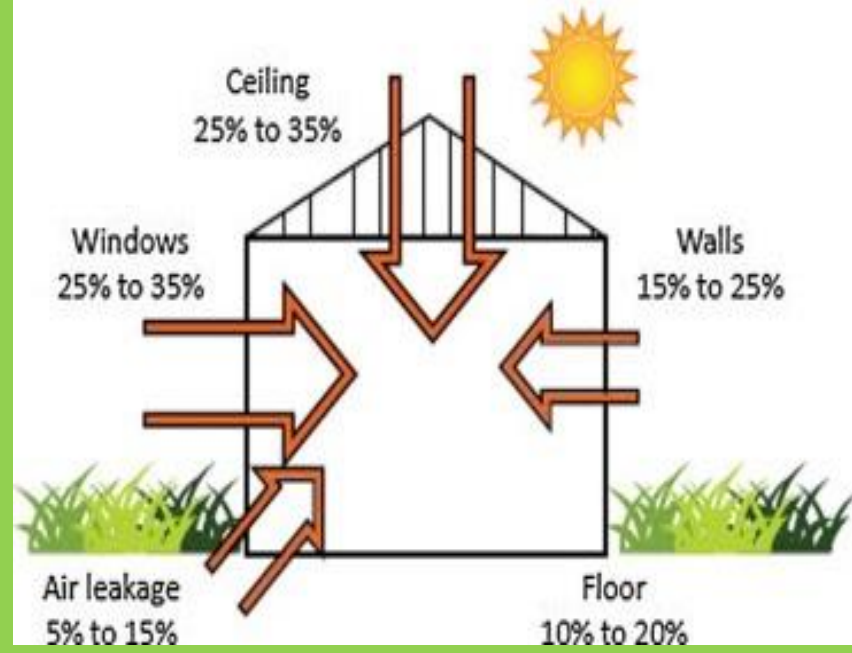
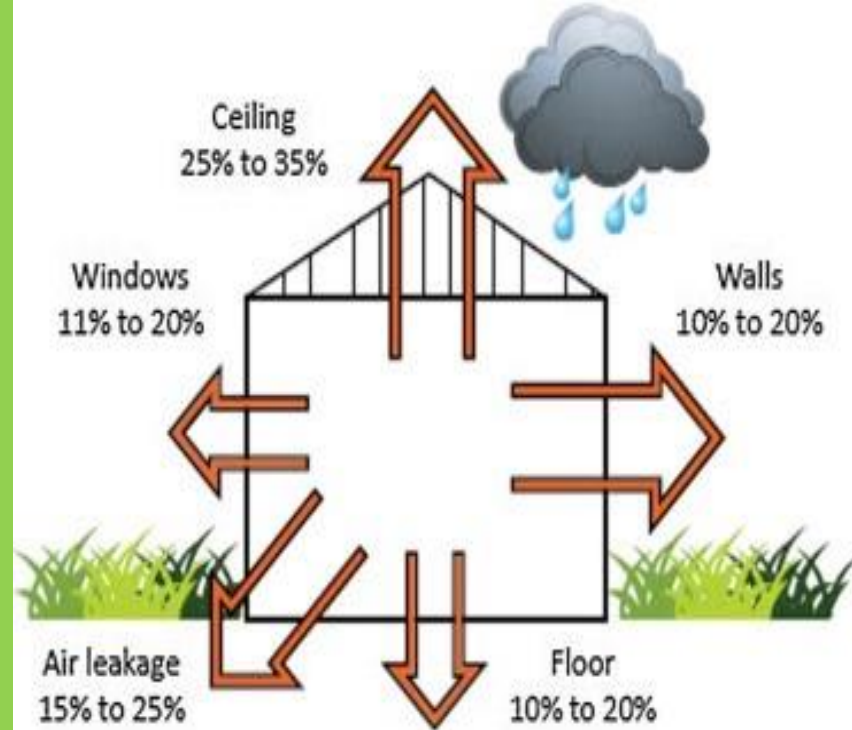
Buildings account for 30% of global energy consumption

1. Envelope Optimization

- Insulation and air-tightness
- Double-glazed windows
- Thermal mass and shading

2. Efficient Systems

- LED lighting and controls
- HVAC and water heating
- Smart building automation



Energy Efficiency

3. Renewable Energy Integration

- Solar PV and thermal systems
- Wind power and geothermal energy

4. Smart Technologies

- Energy management systems
- IoT sensors and automation
- Energy storage and grid resilience



Energy Efficiency

Benefits:

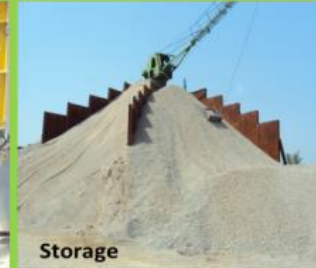
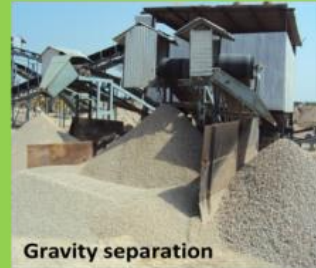
- Reduced energy consumption (20-50%)
- Lower operating costs
- Enhanced occupant comfort and productivity
- Increased property value and resilience

Certifications and Standards:

- LEED (Leadership in Energy and Environmental Design)
- ENERGY STAR
- Passive House
- Net Zero Energy

C&D Waste Utilization

- Construction and Demolition (C&D) waste is a major environmental concern.
- Scenario of C&D waste generation
 - World 2100 million tonnes
 - India 350 million tonnes
- Sources of waste in kg/sqm
 - 40-60 New construction
 - 300-500 Demolition/Renovation
 - 40-50 Repairs



Collection

Separation

Crushing

Gravity separation

Fine separation

Storage

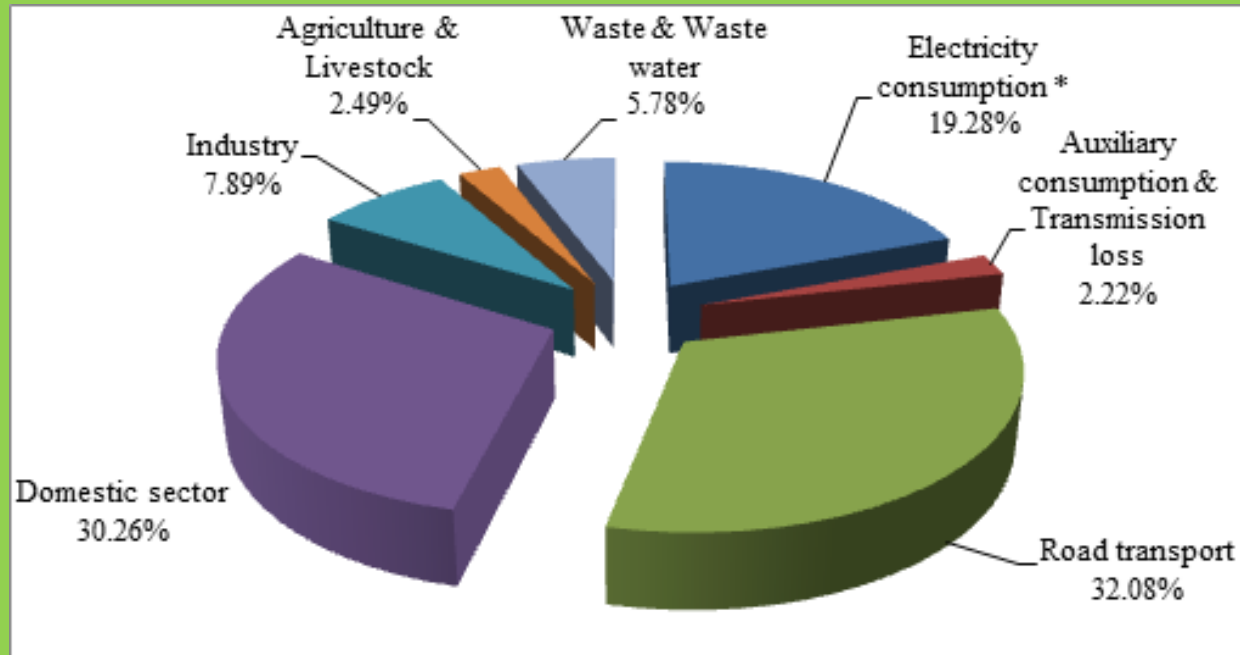
C&D Waste Utilization

- **Swachh Bharat Mission**
 - Launched in 2016, this is India's primary initiative for waste management
- **On-site crushing and screening**
 - MB attachments with equipment can be used to crush and screen C&D waste on-site, reducing the need for transport
- **Recycled products**
 - Products made from recycled C&D waste have been tested and found to be suitable for various purposes



Decarbonization of Buildings

- 39% of global energy-related CO₂ emissions come from buildings
- Benefits:
 - Reduced energy consumption and emissions
 - Improved indoor air quality and occupant health
 - Enhanced property value and resilience
 - Compliance with climate policies and regulations



Implementation Challenges

- High upfront costs
- Technical and skills gaps
- R&D Support
- Awareness and Acceptance
- Policy and regulatory frameworks



सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India



केन्द्रीय भवन अनुसंधान संस्थान, रुड़की
Central Building Research Institute, Roorkee
सुरक्षित और विनाश साक्षर
Safe & Sustainable Habitat

Let us work towards Urban Resilience