



1. Introduction to Disaster Management

- **Disaster:** A sudden, calamitous event causing significant damage to life, property, and the environment.
 - **Disaster Management:** A systematic process of preparing for, responding to, and recovering from disasters. It involves planning, coordination, and implementation of measures to mitigate the effects of disasters.
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2. Types of Disasters

A. NATURAL DISASTERS

- Earthquakes
- Floods
- Cyclones
- Tsunamis
- Landslides



- Droughts

B. MAN-MADE DISASTERS

- Industrial accidents (e.g., gas leaks, explosions)
 - Structural failures (e.g., dam bursts, bridge collapses)
 - Fires
 - Chemical, biological, radiological, and nuclear (CBRN) hazards
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3. Phases of Disaster Management

1. Mitigation

- Minimizing risks and vulnerability (e.g., earthquake-resistant designs).
- Examples: Land-use planning, building codes, environmental regulations.

2. Preparedness

- Planning how to respond.
- Includes: Drills, training, emergency kits, evacuation plans.



3. Response

- Immediate actions during/after a disaster.
- Includes: Rescue, medical aid, firefighting, damage control.

4. Recovery

- Long-term rehabilitation and rebuilding.
- Includes: Restoration of infrastructure, psychological support, insurance processing.

4. Institutional Framework in India

- **National Disaster Management Authority (NDMA):** Apex body headed by the Prime Minister.
- **State Disaster Management Authorities (SDMAs):** Headed by Chief Ministers.
- **District Disaster Management Authorities (DDMAs):** Headed by District Collectors.



5. Legal Framework

- **Disaster Management Act, 2005:**

- Establishes NDMA, SDMAs, and DDMAAs.
 - Lays down responsibilities of government agencies.
 - Encourages public-private participation and community-based disaster preparedness.
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6. Role of Engineers in Disaster Management

Especially relevant to **mechanical engineers**:

- **Design and Safety:**

- Earthquake-resistant HVAC systems, pressure vessels, and pipelines.
- Fire suppression systems in industrial units.

- **Inspection and Maintenance:**

- Regular checks of boilers, cranes, lifts, and pressure systems.



- Preventive maintenance to avoid mechanical failures.
 - **Emergency Planning:**
 - Designing emergency shutdown systems.
 - Developing evacuation plans and safety drills.
 - **Post-Disaster Response:**
 - Restoring essential mechanical services (e.g., water pumps, generators).
 - Assisting in reconstruction with machinery and equipment.
 - **Risk Assessment:**
 - Hazard identification (e.g., gas leak, fire risk) and mitigation strategies.
 - **Industrial Safety Standards:**
 - Adhering to BIS, OSHA, and ISO standards.
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7. Important Concepts

- **Vulnerability:** Conditions increasing the susceptibility of a community to the impact of hazards.
- **Capacity Building:** Enhancing human, institutional, and infrastructure



capabilities.

- **Resilience:** Ability to recover quickly from disasters.
 - **Early Warning System:** Technology-based alerts to predict and warn about impending disasters.
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8. Case Studies

- **Bhopal Gas Tragedy (1984):** Importance of safety systems in chemical plants.
 - **Uttarakhand Floods (2013):** Role of poor construction practices and lack of planning.
 - **COVID-19 Pandemic (2020):** Engineering support in oxygen supply systems and hospital equipment.
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9. Disaster Risk Reduction (DRR)

- **Sendai Framework for DRR (2015-2030):**
 - International agreement emphasizing risk understanding,



strengthening governance, and investing in resilience.

▪ **India's Initiatives:**

- National Cyclone Risk Mitigation Project (NCRMP)
 - School safety programs and community awareness
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10. Technology in Disaster Management

- **Drones:** Surveillance and rescue operations.
 - **GIS and Remote Sensing:** Hazard mapping and planning.
 - **IoT and Sensors:** Monitoring critical systems (e.g., boiler pressure, structural strain).
 - **Mobile Apps:** Alert systems (e.g., NDMA's app, Aarogya Setu during COVID).
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11. Best Practices for Engineers

- Regular training and mock drills.
- Compliance with safety norms and audits.



- Record-keeping of maintenance and inspections.
 - Coordination with local authorities and disaster response teams.
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12. Mechanical Engineering-Specific Hazards

- **Boiler Explosion**
 - **Mechanical Failures in Elevators/Hoists**
 - **Fire due to overheating or lubrication failure**
 - **Gas leakages in HVAC or refrigeration systems**
 - **Collapse of mechanical structures (tanks, silos)**
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