

# Chapter 3: Disaster Mitigation

## I. Core Idea:

- Living things are inherently resilient and have survived countless disasters. (Quote: Wolfdyke)

## II. Learning Objectives Summary:

- Understand the concept of disaster mitigation.
- Explain structural mitigation strategies:
  - Site selection for buildings (residential & industrial).
  - Structural stability: concerns and issues.
  - Fire escape planning in buildings.
- Describe non-structural mitigation strategies:
  - Land use regulations.
  - Hazard zoning.
  - Building codes and construction practices.
- Explain emerging trends in disaster mitigation and its link to sustainable development.

## 1. Core Concepts of Disaster Mitigation

•**Definition:** Disaster mitigation is the process of taking measures to remove or decrease the impacts of hazards by reducing risks in advance. It focuses on reducing loss of life and property. As one source states, "Disaster mitigation is the first phase of disaster management cycle. It entails measures that seek to remove or decrease the impacts and risks of hazards through proactive and predetermined measures."

**Proactive Approach:** Mitigation is a proactive measure aimed at reducing human losses. It emphasizes preparing in advance, rather than reacting after a disaster occurs. The document describes mitigation as "a proactive step, taken to reduce human loss and financial costs that may arise as an aftermath of a disaster."

**Focus Areas:** Mitigation efforts are generally organized into three areas: risk analysis, risk reduction, and risk management.

**Aim:** The essence of the term mitigation is prevention. In this sense, it is a means to prevent the severity of the human and material damage caused by calamity.

- Its objective is to guarantee that any human action or natural occurrence does not lead to disaster. Thus, the key to mitigation lies in reduction-aversion-avoidance of the risk from an event by taking pre-emptive action.
- Moreover, it is a known fact that hazards cannot be removed altogether but surely the vulnerability can be decreased substantially.

The main aim of any disaster management activity is to prevent disasters wherever possible and to mitigate those that are unavoidable.

There are four sets of tools that could be used to mitigate disasters:

- 1.Hazard management and vulnerability reduction
- 2.Economic diversification
- 3.Political intervention and commitment
- 4.Public awareness.

## **2. Types of Mitigation Strategies**

**There are two broad categories of mitigation: structural and non-structural.**

**•Structural Mitigation:** This includes physical construction projects that aim to reduce the impact of disasters by involving robust construction programmes

Examples include

- (i) constructing dams,**
- (ii) hazard-resistant buildings, and**
- (iii) building codes that focus on safety.**

**Structural measures focus on enhancing the physical resilience of structures.**

**•Non-Structural Mitigation:** These are measures that don't involve physical construction but rather aim at modifying human behavior and practices.

Examples include:

- (i) land-use regulations,
- (ii) hazard zoning,
- (iii) building codes,
- (iv) community awareness programs,
- (v) public education, and
- (vi) regulatory measures.

### **Integrated Approach:**

The documents emphasize that mitigation is most effective when approached as a part of medium to long-term development strategies and should incorporate both structural and non-structural measures

## **Key Structural Mitigation Elements**

Structural mitigation, options must be identified, and a cost-and-benefit analysis of each of the option must be performed. Based on this evaluation, mitigation strategies can be defined.

Various long- and short-term mitigation measures may be thought of when planning infrastructure development.

These measures are aimed at minimising the destructive and disruptive effects of disasters on the built environment. These interventions help in substantial reduction of disasters.

Examples:

1. Selection of Sites for Industries and Residential Buildings: The unplanned and unsustainable urban development has led to severe environmental pressures. In construction of modern buildings, security, health, environment and equity issues should be considered. Selection of site for industries and residential buildings the following should be considered:

(i) Site Planning: Ideally, the site selection should be done after the design phase to assess the appropriateness of the site relative to the proposed development. An investigation and evaluation of the site quality, in terms of availability of light, air and water, without damaging the natural environment should be carried out for selecting the site.

(ii) Land use pattern: It should be ensured that the proposed development project conforms to the development pattern for that area. Location of site should not affect (a) the existing biodiversity and ecosystem, (b) upset sites of historical value, (c) the aesthetics and scenic beauty of a location.

**(iii) Other factors:** Issues such as connectivity, availability of public transport systems, power requirement and power source, water requirement and its source, disposal of garbage and sewage should be suitably addressed.

**2. Minimum Distances from Sea: Orientation of Buildings:** There are five factors that have to be considered to increase resistance of a home from cyclonic winds: roof coverings, windows and doors, and roof sheathing attachment, walls and foundations

**3. Stability of Structures: Issues and Concerns:** (i) To provide safe and healthy habitat, careful considerations need to be made to the building construction activity. Building planning, designing and construction activities have developed over the centuries.

(ii) The design of high-rising buildings should be architecturally sound.

(iii) Interlinking of fire alarm system, fire protection system, security system, ventilation and electrical system should be done, and an analysis of emergency power, standby power requirement and captive power systems should also be done.

**4. Fire Escapes in Buildings:** Plan: The sole purpose of this plan is to provide a guideline to the occupants of the building regarding the action they should take in case fire breaks in the building. These are

- (i) automatic sprinkler systems
- (ii) automatically detect fire
- (iii) automatically releasing water in specific patterns and quantities
- (iv) Fire fighting arrangements are should also be fitted with inlet connections at ground level for charging with water by pumping from fire services and air release valve at roof level to release trapped air inside.

### **3. Key Non-Structural Mitigation Elements:**

- (i) Land-Use Regulations:** These are crucial for ensuring orderly development, and often include measures such as:
- (ii) Floor Area Ratio (FAR):** The document notes that "Floor area ratio regulations are intended to prevent haphazard development and avert congestion around human settlements."
- (iii) Urban Land Ceiling Act (ULCRA):** This act aimed to prevent individuals from hoarding land.
- (iv) Hazard Zoning:** This involves identifying areas prone to specific hazards and using the information to regulate development.
  - (a)** The documents highlight areas with varying seismic risk across India and assign zone factors from 0.10 to 0.36. Zone 5 is the highest risk with the strongest factor.
  - (b)** "Zone 5 covers the areas with the highest risk that suffer earthquakes of intensity MSK IX or greater. The zone factor of 0.36 is assigned to Zone 5 and civil engineers use this factor for building earthquake-resistant design of structures in Zone 5."
  - (c) Building Codes and Construction:** Establishing and enforcing strict building codes to ensure structures can withstand various hazards.

- (d) "Building codes and construction are an integral aspect of non-structural mitigation."
- (e) "The National Building Code of India clearly prescribes the minimum standards of fire protection and fire safety of buildings. It is necessary for all concerned to comply with all requirements of fire safety as prescribed in fire-related legislative provisions."

#### **4. Importance of Communication**

- **Essential Component:**
- Communication is essential for successful disaster management. Without communication, even the best mitigation strategies can be ineffective.
- The source mentions that "Communication is an indispensable aspect of disaster management. To deal with disasters to our satisfaction, efficient communication at all levels is necessary."
- **Key Functions:** Communication facilitates:
  - Disseminating early warning information.
  - Educating the public on safety procedures.
  - Highlighting risks and vulnerabilities.
  - The document stresses that the "goal of communication is to ensure that the hazard does not become a disaster."

## 5. Disaster Mitigation and Development

- **Interconnectedness:** The documents emphasize that **disasters and development are closely linked.** Development can exacerbate the impact of disasters and vice-versa.
  - "Disasters and development are closely linked. Disasters can undo development, and development can prevent disasters. In fact, development initiatives can both be created and destroyed by disasters."
- **Sustainable Development:** Development should be planned and carried out in a way that reduces vulnerability to disasters, emphasizing sustainable practices. Mitigation is considered a part of integrated structural development.
  - "The need is to highlight and reinforce the importance of sustainable development in disaster mitigation."
- **Risk Assessment:** Proper risk assessment must be conducted before any development projects are initiated to avoid increasing risk in the areas.
  - "Before embarking on any development project a thorough risk assessment should be done."

## **6. Emerging Trends and Capacity Building**

- Shifting Focus:** There's a shift from focusing on response to emphasizing prevention and risk reduction. Mitigation is now considered an essential part of effective disaster management.
- “...emphasis has shifted to mitigation as it now understood that mitigation plays a vital role in proper management of disaster. Disaster mitigation involves activities aimed at **minimising the destructive effects of disasters.**”

- “Community participation and capacity building are being considered central to the identity of disaster mitigation.”
- Capacity Development:** Essential for enabling individuals, communities, and organizations to actively participate in disaster mitigation. This involves:
  - \* Assessment of current capacity.
  - \* Formulation of development strategies.
  - \* Implementation and evaluation of programs to increase their strength.
- Teamwork and Coordination:** The importance of coordination among different stakeholders and within teams for effective disaster management.
  - “Coordination helps in integrating the activities related to disaster management. Coordination is the essence of management and it helps in achieving goals effectively and efficiently.”

## **7. Specific Construction Considerations**

**The sources highlight various specific building and site considerations related to disaster resilience:**

- Site Planning:** The importance of careful site selection, considering aspects such as soil conditions, hydrology, landscape, and existing vegetation.
- The documents emphasize the “...need to integrate an architecturally sustainable design with the natural environment, with least damage to the nature and at best improving it by restoring its balance.”
- Orientation of Buildings:** Proper building orientation to minimize heat gain, maximize natural light and airflow.
  - “The proposed building orientation should respect the climatic conditions by minimising the heat gain and considering the impact of shade on adjacent land uses and areas.”
- Minimum Distances from Sea:** Specific setbacks from the coast are required for structures in coastal areas to provide protection from tsunami.
- "The distance from the edge of a coastal bank to a building is called as setback distance."**

- **Structural Integrity:**

Structures should be constructed using *quality materials*, with a focus on *proper foundations*, walls, and roof designs for stability and resistance to different forces.

- "Roofs must be designed and constructed to remain intact and attached to the rest of the structure during cyclones. Roofs have to stand wind forces from many directions."

- **Fire Safety:**

Fire escapes and fire protection systems, such as automatic sprinklers, are essential elements in buildings.

- The plan should also "specify the materials used in construction and the quantum of damage that can be caused if there are instances of fire."

**Cyclone Shelters:** Need to be located on high ground, be accessible, and constructed to withstand wind speeds and storm surges, including specific requirements for walls, windows, doors, and ventilation.

## **Sustainable Development for Disaster Mitigation:**

**Disasters can undo development, and development can prevent disasters. development initiatives can both be created and destroyed by disasters.** The intricate relationship between disasters and development is now recognised and revolves around four basic themes:

- 1. First, it is believed that disasters are detrimental to development since they destroy years of development initiatives at one go.**
- 2. The second belief is about rebuilding after a disaster.**
- 3. Third is that the development programme can increase an area's susceptibility to disasters.**
- 4. The fourth notion says that development programme can be designed to decrease the susceptibility to disasters and their negative consequences.**

**Sustainable development goals can be achieved only when communities and government work in tandem with each other.**

## 8. Case Study: Home Cheat Home

The included case study in one of the sources presents a case of a **building collapsing due to poor construction**, highlighting the importance of adhering to building codes and regulations.

**It emphasizes the dangers of illegal construction practices and corruption.**

**It points out the dangers of shoddy construction, lack of compliance, and how the corruption of “police-politicians nexus” allows it to continue and places lower income individuals at disproportionate risk.**

## Conclusion

**Disaster mitigation is a vital aspect of ensuring the safety and resilience of communities. It requires a multi-faceted approach that integrates structural and non-structural measures, effective communication, and active engagement from all stakeholders. A focus on sustainable development and capacity building is also vital for reducing vulnerability to disasters. The sources emphasize that disaster mitigation is a continuous process, needing adaptation, and not just a one-time project. By focusing on the various factors discussed, societies can better mitigate the potential losses caused by hazards and continue to grow in safer and more sustainable ways.**

# Questions

- 1.What is hazard zoning and why is it important for disaster mitigation?
- 2.What are the five earthquake risk zones in India, and what characteristics define the zone with the highest risk?
- 3.What are the key aspects of site planning that need to be considered when building, especially in terms of minimizing environmental damage?
- 4.How do the building codes, as described in the National Building Code of India (NBC), aid in mitigating disasters, specifically regarding fire safety?
- 5.What is the concept of a setback distance from the coast, and why is it important in coastal construction?
- 6.Differentiate between structural and non-structural mitigation measures in disaster mitigation. Give one example for each.
- 7.What is the role of communication in disaster mitigation and how does it contribute to more successful mitigation strategies?
- 8.Briefly describe the concept of "capacity development" in the context of disaster risk reduction.
- 9.According to the provided material, how can a focus on sustainable development help mitigate disasters?
- 10.What are some of the major concerns addressed when developing fire safety and escape plans in buildings?

## **Answer Key**

- 1.Hazard zoning is a non-structural mitigation measure that helps in increasing acceptance among communities. It defines areas based on their vulnerability to natural disasters like earthquakes, thereby helping communities and disaster management authorities make informed decisions.
- 2.The earthquake zoning map of India is divided into five zones, ranging from Zone 2 to Zone 5. Zone 5, with the highest level of seismicity, is characterized by the highest risk, where earthquakes of intensity MSK IX or greater can occur, and structures must be earthquake-resistant.
- 3.Key aspects include site selection based on environmental impact, land-use patterns and sustainability. These must consider availability of resources, conservation of natural features, and minimizing disruption to existing ecosystems and biodiversity during construction.
- 4.The NBC provides guidance on fire safety, including escape routes, fire detection, suppression systems, and building materials to mitigate the impact of fires. This helps in making a building a safer place for its inhabitants, especially during a fire.
- 5.A setback distance is the space between a building and the high water mark (OHWM) of a water body, especially near the coast. It's important because it helps to protect structures from natural disasters, and is an important measure to minimize environmental degradation.

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6. Structural mitigation measures involve construction projects like dams and earthquake-resistant buildings. Non-structural measures include things like land-use planning and building codes, which aim to reduce the impact of a disaster without altering infrastructure.
7. Communication is crucial in disaster mitigation because it provides warnings, facilitates risk assessment, and ensures community awareness. By sharing information promptly and clearly, people are able to make informed decisions to protect themselves and property, thus improving the success of mitigation strategies.
8. Capacity development is the process of strengthening the skills, resources, and mechanisms of communities, organizations, and individuals to reduce risk and manage disasters. It is the ability of a community to better respond to and recover from disasters through enhanced preparedness and planning.
9. Sustainable development can help mitigate disasters by incorporating resilience into development projects and reducing vulnerability to disasters. It focuses on reducing negative human impact on the environment, and promotes equitable use of resources, thereby making communities less vulnerable to disasters.
10. Fire safety plans focus on creating safe escape routes, using appropriate materials for fire safety, and installing fire detection and suppression systems. They must also account for accessibility and egress for all people in the building during an emergency, and address the challenges of smoke and panic.

## Long Questions

1. Discuss the importance of integrating both structural and non-structural mitigation measures in a comprehensive disaster mitigation strategy. Use examples from the text to support your argument.
2. Evaluate the role of communication and information dissemination in the context of disaster mitigation. Why is it essential and what are its limitations in mitigating disasters?
3. Analyze the relationship between sustainable development and disaster mitigation. How can development projects be designed to contribute to both goals simultaneously?
4. Critically assess the current building practices and regulatory mechanisms for mitigating building collapses, such as those mentioned in the "Home Cheat Home" case study. What steps can be taken to ensure structural integrity and safety in construction projects?
5. Examine the concept of community participation in disaster risk reduction, focusing on "capacity development" as it is presented in the materials. How can communities be empowered to contribute effectively to disaster preparedness and resilience?

## **1. What is the primary goal of disaster mitigation, and what are the two main categories of mitigation strategies?**

Disaster mitigation aims to reduce the loss of life and property by minimizing the impacts of disasters. The two main categories of mitigation strategies are **structural mitigation** and **non-structural mitigation**. Structural mitigation involves physical construction projects to enhance the built environment's ability to withstand disasters, while non-structural mitigation uses measures such as land-use regulations, hazard zoning, and public awareness campaigns.

## **2. What is hazard zoning, and how does it contribute to disaster mitigation efforts?**

Hazard zoning is a non-structural mitigation measure that involves classifying areas based on their risk level for specific hazards such as earthquakes. It aims to manage development by restricting construction in high-risk areas, to reduce the potential for damage. Hazard zoning assigns specific risk levels, such as Zone 5 which is considered a very high risk zone. These zones are then used by civil engineers and builders to design and construct buildings that conform to certain standards and safety requirements.

## **3. How do building codes and construction practices contribute to disaster mitigation?**

Building codes are an integral part of non-structural mitigation. They provide guidelines for various construction aspects, such as the strength of materials, the orientation of buildings, the distance between buildings and overall structural design. Adherence to proper building codes and construction standards can significantly reduce the impact of disasters by enhancing the stability and resilience of structures. Proper fire safety measures, adequate fire escapes, and effective materials further minimize structural vulnerabilities.

#### **4. What role does communication play in effective disaster mitigation?**

Communication is an essential aspect of disaster mitigation. It helps in ensuring that relevant policies and information are effectively disseminated to the public so individuals can adopt proper safety measures and precautions. Effective communication helps in early warning systems, risk assessment, and informing vulnerable populations on what actions to take. It also plays a crucial role in public education and raising awareness of hazards so members of a community can respond to disasters in an appropriate manner.

#### **5. What is meant by “capacity development” for reducing risk, and what are some key steps involved?**

Capacity development for reducing risk refers to a process that involves enhancing the ability of individuals, communities, and organizations to manage risks. It involves assessing current capacity, formulating development strategies, implementing development programs, and evaluating effectiveness. Key steps in capacity development include: soliciting active participation from stakeholders; assessing current capacity to identify weaknesses; formulating strategies to enhance strengths; implementing the developed strategies, and constantly evaluating the progress of each of these steps.

#### **6. How are disasters and sustainable development related, and why is it important to consider this relationship in disaster mitigation efforts?**

Disasters and sustainable development are closely linked. Disasters can disrupt and destroy development efforts, and unchecked and disorganized development can exacerbate vulnerability to disasters. Integrating disaster mitigation measures in long-term development plans is key to building resilient communities. Development projects should be designed to reduce susceptibility to hazards while promoting sustainability. This approach acknowledges that disasters are not solely natural events and are often worsened by human activities and development choices.

## **7. What are some important considerations for site selection when planning for industries and residential buildings?**

Site selection for both industries and residential buildings should prioritize environmental concerns, land use, and access to necessary utilities. Site analysis should evaluate the suitability of the site with respect to things like soil conditions, existing vegetation, solar access, hydrology, wind patterns, and proximity to existing natural and man-made infrastructure. The goal of site selection is to integrate development sustainably and with minimal damage to the natural environment and its resources. Additionally, the location should be chosen in a way that ensures the safety of the inhabitants and workers and access to emergency services and escape routes.

## **8. What is the importance of non-structural mitigation measures in reducing risk, and can you provide a few examples?**

Non-structural mitigation measures are crucial for minimizing the likelihood and consequences of risks. These measures are less costly than structural changes and often target modifying human behavior and awareness. Examples of non-structural measures include: land-use regulations to control development in high risk areas; reviewing building codes to ensure safe construction practices; community awareness programs to educate residents on safety measures; and preventive health programs. Compliance and commitment to these measures are essential for building disaster resilient communities.