No. 15017/37/2019-P&M(Mon)-DMP

Government of India

Ministry of Road Transport & Highways

(P&M Section)

Transport Bhawan, 1, Parliament Street, New Delhi - 110001

Dated, the 19th August, 2025

To

1. Chief Secretaries of all the State Governments/ UTs.
2. Additional Chief Secretaries/ Principal Secretaries/ Secretaries of all States/ UTs Public Works Department/ Road Construction Department/ Highways Department (dealing with National Highways and other Centrally Sponsored Schemes)
3. Chairman, NHAI
4. Managing Director, NHIDCL
5. Director General (Border Roads)
6. All Engineers-in-Chief / Chief Engineers of Public Works Department of States/ UTs/ Road Construction Department/ Highways Departments (dealing with National Highways and other Centrally Sponsored Schemes)
7. Secretary General, Indian Roads Congress
8. Director, Indian Academy of Highway Engineers
9. All CE-ROs & SE-ROs of MoRT&H

Sub: Final Version of Disaster Management Plan of Ministry of Road Transport & Highways - reg.

Sir,

I am directed to refer to NDMA's OM no. 1-113/2015-PP(Part-1) E:116187, dated 26.05.2025 (copy enclosed) communicating therewith conditional approval of Disaster Management Plan (DMP) of Ministry of Road Transport & Highways (MoR&TH) with the stipulation that MoRT&H is to prepare Final Version of the DMP incorporating the suggestions and recommendations of NDMA, and say that MoRT&H has prepared the Final Version of the DMP, duly incorporating the suggestions and recommendations of NDMA.

2. The Final Version of the Disaster Management Plan of MoRT&H, consisting of two volumes (Volume-I: Overview and Disaster Management Sub-Plan for Highways and Volume-II: Disaster Management Sub-Plan for Road Accidents) is being forwarded herewith for adoption and implementation.

3. This content of this circular may be brought to the notice of all concerned for information an d necessary compliance.

Yours faithfully,

Encl: 1. Disaster Management Plan of MoRTH (Vol-I & Vol-II).
2. OM dated 26.05.2025 of NDMA

(Shoba Basil)
Under Secretary to the Government of India
(Tel) - 011-23714001

Copy for information and necessary action to:

1. AS(Road Safety/Transport)/ AS(H/LA/EAP/Logistics/Establishment/IT)/ AS&FA
2. All ADGs/CEs at Headquarter
3. All Technical Officers at Headquarter
4. NIC - for uploading on Ministry's website under "Publication" with heading "Disaster Management Plan"

Copy for kind information to:

1. PS to Hon'ble Minister (RT&H)
2. PS to Hon'ble MoS (RT&H)
3. PS to Hon'ble MoS (Corporate Affairs and RT&H)
4. PSO to Secretary (RT&H)
5. PSO to DG (RD)&SS
6. PPS to ADG(Mon.)

मृणालिनी श्रीवास्तव, भारतीय पुलिस सेवा
निदेशक
Mrinalini Shrivastava. IPS
Director

सत्यमेव जयते

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गृह मंत्रालय, भारत सरकार
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File No: 1-113/2015-PP(Part-1) E: 116187

Dated: 26.05.2025

Office Memorandum

Subject: Minutes of the Meeting held on 02.05.2025 under the chairmanship of Shri Rajendra Singh, Member & Head of the Department, NDMA with regard to Ministry of Road Transport & Highway MoRTH.reg.

This refers to the Disaster Management (DM) Plan of the Ministry of Road Transport & Highways (MoRTH), presented before the National Disaster Management Authority (NDMA) during the meeting chaired by Shri Rajendra Singh, Member & Head of the Department, NDMA, on 2nd May 2025. The minutes of the meeting is attached at Annexes I

2. The Chair has conditionally approved the DM Plan, subject to the incorporation of the suggestions made by NDMA during the meeting. Additionally, NDMA recommended restructuring the DMP chapters as outlined in Annex 1.

3. A final version of the plan, incorporating the required changes, may be submitted to NDMA for record-keeping.

(Mrinalini Shrivastava)
Director (Policy & Plan)
Tel: 011-26701712
e-mail: policyplan@ndma.gov.in

To

Shri Kaushik Basu
ADG
MoRTH
Delhi 110011

Copy to:

1. PPS/PS to Member & HoD / Member (SAH) /Member (KSV)
2. PS to Advisor (Mitigation)

Minutes of the Meeting
Disaster Management Plan (DMP) Presentation of the Ministry of Road Transport and Highways (MoRTH)
Date: 2nd May 2025
Venue: National Disaster Management Authority, New Delhi
Chairperson: Shri Rajendra Singh, Member & Head of the Department

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1. Opening Remarks

The meeting commenced with a welcome address by Shri Rajendra Singh, who emphasized the critical importance of the Disaster Management Plan (DMP) for ensuring resilience and swift response in the highway and road transport sectors. The DMP's alignment with the National Disaster Management Authority (NDMA) mandate was highlighted as a key priority.

Part I: Volume I (Disaster Management Sub-Plan for Highways)

Presented by: Sh. Vikram Mittu, Executive Engineer (EE), MoRTH

Volume I: Overview and Disaster Management Sub-Plan for Highways

Chapter 1: Executive Summary

- **Comments**: Provides a clear overview of the purpose, scope, key strategies, and responsibilities.
- **Improvements**:
    - Include specific examples or case studies to illustrate how the strategies have been or will be implemented. {Para 1.3 (i) to (iv)}
    - Add a section on the expected outcomes and measurable goals to clarify the plan's success metrics. (Add Para 1.5)

Chapter 2: Introduction

- **Comments**: Well-articulated rationale and background, including legal mandates and alignment with national and international policies.
- **Improvements**:
    - Expand on the specific challenges faced by the road sector in disaster management. (Add Para 2.6 on Challenges)

- Include a section on the historical context of major road-related disasters in India to highlight the necessity of the plan. (Add Para 2.2.1 Historical Perspective and change the numbering of subsequent para accordingly)

Chapter 3: Institutional Framework for Disaster Management

- **Comments**: Detailed and structured framework with clear roles and responsibilities at different levels.
- **Improvements**:
  - Include a section on the coordination mechanisms between different levels of government and agencies. (Add Para 3.9 (iv) on Coordination with Stakeholders)
  - Add a subsection on the role of non-governmental organizations (NGOs) and community-based organizations (CBOs) in disaster management. (Add Para 3.5.3 on NGOs and CBOs)

Chapter 4: Concept of Hazard & Disaster

- **Comments**: Comprehensive overview of hazards and disaster risks in the road sector.
- **Improvements**:
  - Include more detailed case studies or examples of past disasters to illustrate the impact on road infrastructure. (Add examples in Sub Para 4.2.1 to 4.2.6 for impact of respective disasters on road infrastructure)
  - Add a section on emerging risks, such as climate change impacts and technological hazards. (Add Para 4.2.7 & 4.2.8 for Climate Change and Technological Hazars respectively and also give relevant examples of each)

Chapter 5: Disaster Risk Reduction and Building Resilience

- **Comments**: Good coverage of disaster-specific mitigation strategies.
- **Improvements**:
  - Include specific examples of successful risk reduction measures implemented in other countries. (Add Para 5.3 on Risk Reduction Practices in other countries)
  - Add a section on the integration of traditional knowledge and local practices in disaster risk reduction. (Add Para 5.4 on Indigenous Knowledge and Traditional Practices in Risk Reduction)

Chapter 6: Preparedness

- **Comments**: Detailed preparedness strategies, including digital resource mapping and project-specific preparedness.
- **Improvements**:
    - Include a section on the use of technology, such as AI and IoT, for real-time monitoring and early warning systems. (Add Para 6.3 on Use of Technology for Monitoring and Early Warning)
    - Add a subsection on the importance of community engagement and public awareness programs. (Add Para 6.4 on Community Engagement and Public Awareness)

Chapter 7: Response Strategies

- **Comments**: Comprehensive response strategies for various disaster types.
- **Improvements**:
    - Include specific protocols for coordination with international aid organizations in case of large-scale disasters. (Add Para 7.3 on Coordination with International Aid Organisations)
    - Add a section on the role of media and communication in disaster response. (Add Para 7.4 on Role of Media and Communication in Disaster Response)

Chapter 8: Recovery and Reconstruction

- **Comments**: Good emphasis on building back better and detailed steps for recovery.
- **Improvements**:
    - Include specific examples of successful recovery and reconstruction efforts from other countries. (Add Para 8.2 on Recovery and Reconstruction in other Countries)
    - Add a section on the importance of environmental sustainability in reconstruction efforts. (Add Para 8.3 on Environmental Sustainability in Reconstruction)

Chapter 9: Resource Inventory

- **Comments**: Comprehensive list of human and material resources.
- **Improvements**:
    - Include a section on the maintenance and regular updating of resource inventories. (Add Para 9.1 – 6 on Maintenance and Updation of Resource Inventories)

- Add a subsection on the role of private sector partnerships in resource mobilization. (Add one bullet point on Private Sector Partnership in Para 9.1 – 5)

Chapter 10: Plan Maintenance

- **Comments**: Good emphasis on regular review and update schedules.
- **Improvements**:
  - Include specific examples of how feedback from drills and actual events has led to improvements. (Add specific examples in Para 10.2.1 to 10.2.3)
  - Add a section on the role of continuous learning and adaptation in disaster management planning. (Add Para 10.5.4 on Continuous Learning and Adaptation)

Chapter 11: Capacity Building

- **Comments**: Strong focus on capacity building and training.
- **Improvements**:
  - Include specific examples of successful capacity-building initiatives. (Add Para 11.4 on Capacity Building Initiatives and include examples)
  - Add a section on the role of international cooperation in capacity building. (Add Para 11.5 on International Cooperation in Capacity Building)

Volume II: Disaster Management Sub-Plan for Road Accidents (Each chapter should start from a fresh page)

Presented by: Sh. R.R. Meena, Deputy Secretary (Road Safety), MoRTH

Chapter 1: Introduction

- **Comments**: Good overview of the rationale and global perspective on road safety.
- **Improvements**:
  - Include specific data on the economic impact of road accidents in India. (Include data in Para 1.4 or provide as annexure giving its reference in Para 1.4)
  - Add a section on the role of technology in improving road safety. (Add Para 1.5.1 on Technological Intervention for Road Safety)

Chapter 2: Objective

- **Comments**: Clear objectives outlined.
- **Improvements**:
    - Include specific targets and timelines for achieving these objectives. (Provide timelines in front of each objective) (Make the existing para as Para 2.1)
    - Add a section on the role of public-private partnerships in achieving these objectives. (Add Para 2.2 on Public Private Partnership)

Chapter 4: Concept of Disaster for Road Accidents

- **Comments**: Good definition and understanding of road accidents as disasters.
- **Improvements**:
    - Include specific examples of major road accidents and their impacts. (Add Para 4.5 on Major Road Accidents and share details)
    - Add a section on the role of behavioural science in preventing road accidents. (Add Para 4.6 on Behavioural Approach to Prevention of Road Accidents)

Chapter 5: Understanding Road Accident Risk

- **Comments**: Comprehensive analysis of contributing factors.
- **Improvements**:
    - Include specific data on the most common types of road accidents and their causes. (Add Para 5.2 on Types & Causes of Road Accidents)
    - Add a section on the role of urban planning in reducing road accident risks. (Add Para 5.3 on Urban Planning for Prevention of Road Accidents)
    - Change the numbering of existing para 5.2 & 5.3 as Para 5.4 & 5.5 respectively)

Chapter 6: Institutional Framework

- **Comments**: Clear roles and responsibilities outlined.
- **Improvements**:
    - Include a section on the coordination mechanisms between different agencies. (Add Para 6.2 on Inter Agency Coordination)
    - Add a subsection on the role of NGOs and CBOs in road safety. (Add Para 6.2.1 on Role of NGOs and CBOs)

Chapter 7: Road Accident Disaster Risk Reduction

- **Comments**: Good coverage of prevention and preparedness measures.
- **Improvements**:
    - Include specific examples of successful risk reduction measures. (Make the existing Para as Para 7.1 and add examples in it)
    - Add a section on the role of public awareness campaigns in reducing road accidents. (Add Para 7.2 on Public Awareness Campaigns)

Chapter 9: Detailed Protocols (Number the existing Para as Para 9.1 and add subsequent Paras as suggested below)

- **Comments**: Comprehensive protocols for response and recovery.
- **Improvements**:
    - Include specific examples of successful response and recovery efforts. (Add Para 9.3 on Success Stories)
    - Add a section on the role of technology in improving response times. (Add Para 9.2 on Role of Technology in Response)

Chapter 10: Capacity Building to Handling Disasters (Number the existing Para as 10.1 and add subsequent Paras as suggested below)

- **Comments**: Strong focus on capacity building and training.
- **Improvements**:
    - Include specific examples of successful capacity-building initiatives. (Add Para 10.2 on Examples of Successful Capacity Building Initiatives)
    - Add a section on the role of international cooperation in capacity building. (Add Para 10.3 on International Cooperation in Capacity Building)

General Improvements

1. **Incorporate Feedback Mechanisms**: Ensure that there are robust mechanisms for gathering and incorporating feedback from stakeholders, including local communities, NGOs, and private sector partners.
2. **Enhance Technological Integration**: Emphasize the use of advanced technologies such as AI, IoT, and GIS for better disaster prediction, preparedness, and response.

3. **Strengthen International Collaboration**: Highlight the importance of international cooperation and the sharing of best practices in disaster management.
4. **Focus on Community Engagement**: Emphasize the role of community engagement and public awareness in disaster management, including the importance of local knowledge and traditional practices.
5. **Regular Updates and Reviews**: Ensure that the plan is regularly updated to reflect new technologies, emerging risks, and lessons learned from recent disasters.

Additional Key Decision Point:

- **Cross-Agency Coordination:** Chairperson stressed seamless collaboration between NHAI, NHIDCL, and state agencies.
- **Technology Integration:** Early warning systems and GIS-based resource mapping should be prioritized. For example, 112 and the IDRN portal need to be integrated.
- **Public Awareness:** Proposal to involve NGOs/communities in disaster preparedness campaigns, roadside signage.
- **Sachet App:** Sachet App: Sachet is an integrated early warning application designed to alert travellers and drivers in real-time. It is proposed to be integrated with NHAI display boards and platforms, such as the eDAR portal, to enhance road safety and the timely dissemination of hazard-related information.
- **Emergency Helpline 112**: Dial 112 for all emergency services. The helpline has now been extended to cover disaster-related emergencies as well. It is highly recommended to promote and display the emergency number 112 prominently on NHAI boards, signage, and public transport such as buses to ensure quick access during crises.
- Mandatory annual updates of the sub-plan.
- Capacity building for stakeholders in life support and evacuation procedures.
- Integration of Emergency Services: The emergency helpline number 112, traditionally used for general emergencies, has now been extended to cover disaster-related incidents as well. It is highly recommended that the promotion of dialing 112 be prominently displayed on NHAI display boards, signage, and public transport such as buses to ensure widespread public awareness and quick access during emergencies.

Closing Remarks

- The chairperson appreciated the presenters and urged all stakeholders to treat the DMP as a "living document" adaptable to emerging challenges.
- The DMP was conditionally approved.
- Meeting concluded with a vote of thanks.

Overall, the DMP provides a solid foundation for disaster management in the road and highway sector. With these suggested improvements, it can become even more effective in ensuring the safety and resilience of India's road infrastructure.

सड़क और राजमार्ग क्षेत्र के लिए
आपदा प्रबंधन योजना

Disaster Management Plan
for Road & Highway Sector

सड़क परिवहन और राजमार्ग मंत्रालय

भारत सरकार

अगस्त 2025

Ministry of Road Transport & Highway

Government of India

August 2025

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Volume-I

Overview and Disaster Management Sub-Plan for Highways

1. Executive Summary

The Disaster Management Plan (DMP) of the Ministry of Road Transport and Highways (MoRT&H) provides a comprehensive framework for managing disasters with a focus on maintaining and restoring traffic connectivity on roads and highways. The plan aims to align the Ministry's Disaster Management activities with its core mission of enhancing the mobility and efficiency of the road transport system in India.

1.1. Purpose

The primary purpose of the DMP is to outline the strategies and actions necessary to prepare for, respond to, and recover from disaster events affecting the road and highway sector. It ensures that the infrastructure remains functional and safe for users during and after disasters, contributing to the overall resilience of the transport system.

1.2. Scope

The scope of the Disaster Management Plan (DMP) for the Ministry of Road Transport and Highways (MoRT&H) includes a comprehensive approach to disaster management across all phases of the disaster management cycle, specifically tailored to the road and highway sector. As the nodal ministry, MoRT&H places special emphasis on road accidents and infrastructure issues such as collapsed, damaged, or washed-out roads caused by disasters like floods, urban floods, earthquakes, landslides, snow avalanches, cyclones, tsunamis and so on. The DMP provides streamline of activities to be undertaken by various agencies of MoRT&H under the umbrella of Ministry is clearly brought out. MoRT&H shall make appropriate provisions for financing the implementation plan. It also collaborates closely with other departments to provide support in these situations.

The Disaster Management Plan (DMP) for the road sector shall include:

a) Measures to be taken for prevention of disasters or the mitigation of their effects on road infrastructure.

b) Measures to be taken for the integration of mitigation measures in the development plans of the road sector.

c) Measures to be taken for preparedness and capacity building of road sector to effectively respond to any threatening disaster situations or disaster.

d) Roles and responsibilities of different Ministries or Departments of the Government of India in respect of measures of the three aspects mentioned above.

1.3. Key Strategies

i. **Prevention and Mitigation:** Implementing structural and non-structural measures to reduce the vulnerability of road infrastructure to disasters, across its life cycle. This includes updating design standards, incorporating disaster risk reduction measures in planning and construction, and maintaining an inventory of resources for quick mobilization.

   Example/Case Study: Landslide Mitigation on NH-44 NH-05 in Himachal Pradesh

   NH-05 in Himachal Pradesh, prone to landslides during the monsoon due to its hilly terrain and unstable slopes, saw significant mitigation efforts by the MoRT&H through the NHAI in 2022, including structural measures like installing retaining walls and geotextile-based soil reinforcement along a 5-km stretch near Shimla, as per IRC: SP: 106-2015 guidelines, and non-structural measures such as collaborating with the Geological Survey of India for a Hazard Risk and Vulnerability

Assessment to create a digital resource map for targeted interventions. This led to a reduction in road blockages in the NH section during the 2023 monsoon season.

ii. **Preparedness:** Developing emergency plans, conducting risk and vulnerability assessments, and organizing public awareness programs. Ensuring all stakeholders, including government agencies and local communities, are trained and equipped to handle disaster situations effectively.

Example/Case Study: Cyclone Preparedness in Odisha

Coastal National Highways in Odisha are highly vulnerable to cyclones. Advance preparedness before Cyclone YAAS in May 2021 in the form of mobilization of Quick Response Teams (QRTs) equipped with necessary equipments (Cranes/Recovery Vehicles/ other equipment for clearance of road) and materials, setting up of Control Rooms at MoRT&H HQ and its Regional Offices, close coordination with District Administration, SDRF/NDRF, enabled successful action in promptly restoring the affected NH network to traffic-worthy conditions.

iii. **Response:** Establishing clear protocols for immediate response to disasters, including coordination with State Disaster Response Forces (SDRF), the National Disaster Response Force (NDRF), and other first responders. Ensuring rapid mobilization of resources to restore traffic and provide aid.

Example/Case Study: Response to 2021 Uttarakhand Flash Floods (NH-7)

In February 2021, a glacial lake outburst flood in Chamoli, Uttarakhand, severely damaged NH-7, disrupting connectivity to border areas and relief operations, prompting the MoRT&H's Regional Officer in Dehradun to activate the Incident Response System (IRS) as per NDMA Guidelines (July 2010), establishing a control room within 4 hours to coordinate efforts, liaising with SDRF and NDRF to deploy rescue teams with inflatable boats and cranes for debris clearance and commuter rescue, and mobilizing bulldozers and excavators from nearby contractors within 6 hours using the resource inventory, which enabled temporary diversions to restore traffic flow within 12 hours, resulting in partial connectivity restoration within 24 hours, timely delivery of relief materials, minimized economic losses, and effective inter-agency coordination.

iv. **Recovery and Reconstruction:** Planning for the rapid restoration of road infrastructure post-disaster and implementing "Build Back Better" principles to enhance resilience. This includes assessing damage, prioritizing repairs, and leveraging advanced technologies and materials for reconstruction.

Example/Case Study: Reconstruction Post-2018 Kerala Floods (NH-66)

The 2018 Kerala floods severely damaged NH-66 in Alappuzha and Ernakulam districts, prompting the MoRT&H's Roads Wing, in coordination with the State Public Works Department, to conduct a detailed damage assessment within one month, prioritizing critical stretches for relief transport and completing temporary restoration works like gravel filling and temporary bridges within two weeks using funds delegated to the Regional Officer. Permanent reconstruction followed IRC: SP: 113-2018 guidelines, incorporating flood-Resilient designs with elevated road sections, wider drainage systems, and durable polymer-modified asphalt, while Geographic Information Systems (GIS) ensured precise mapping of flood-prone areas to account for local topography, resulting in the completion of resilient NH-66 sections by mid-2019, which withstood heavy rainfall in 2020 without major disruptions, exemplifying the "Build Back Better" approach.

Note: - Some additional Case Studies are given in APPENDIX-IX.

1.4. Responsibilities:

The DMP serves as a quick reference for senior officials and stakeholders of road sector, providing a concise yet comprehensive overview of the Ministry's approach to disaster management. It aligns with national policies and international frameworks, such as the Sendai Framework for Disaster Risk Reduction, to ensure a coordinated and effective disaster management response. Further, the Disaster Management Plan (DMP) outlines specific roles and responsibilities for various stakeholders, ensuring a coordinated and effective response to disasters. These responsibilities are defined under the DM Act of 2005 and involve multiple layers of government and related agencies.

1.4.1 National Level Responsibilities:

i. National Disaster Management Authority (NDMA):

- Formulates policies, plans, and guidelines for disaster management.
- Ensures their enforcement and implementation across the country.
- Approves the National Disaster Management Plan (NDMP) and plans of various ministries and departments.

ii. National Executive Committee (NEC):

- Assists NDMA in discharging its functions.
- Prepares the National Plan and coordinates its implementation.
- Monitors the compliance of directives issued by the Central Government.
- Coordinates responses to disasters, involving relevant ministries, state governments, and specialized agencies like IMD, Armed Forces, CAPFs, and NDRF.

iii. National Disaster Response Force (NDRF):

- A specially trained force for rapid deployment.
- Provides assistance to state governments and district administrations in imminent hazard events or their aftermath.

iv. National Institute of Disaster Management (NIDM):

- Develops human resources and capacity for disaster management.
- Designs, Develop and implements training programs.
- Undertakes research and assists in national policy formulation on Disaster Management.
- Promotes awareness generation and develops educational materials.

1.4.2 State Level Responsibilities:

i. State Disaster Management Authority (SDMA):

- Headed by the Chief Minister, it lays down policies and plans for disaster management in the state.
- Approves the State Plan and coordinates its implementation.

- Recommends funding for mitigation and preparedness measures.
- Reviews developmental plans to integrate prevention, preparedness, and mitigation measures.

ii. State Executive Committee (SEC):

- Headed by the Chief Secretary to the State Government.
- Coordinates and monitors the implementation of national and state disaster management policies and plans.
- Provides information to NDMA on various aspects of disaster management.

iii. State Disaster Response Force (SDRF):

- Provides immediate support and response in disaster situations.
- Works in coordination with NDRF and other national agencies.

1.4.3 District Level Responsibilities:

i. District Disaster Management Authority (DDMA):

- Led by the District Collector or equivalent, with an elected representative as the co-chairperson.
- Acts as the planning, coordinating, and implementing body for disaster management at the district level.
- Prepares the district disaster management plan and ensures its implementation.
- Ensures guidelines from NDMA and SDMA are followed by district-level offices.

ii. Local Authorities and First Responders:

- Local authorities, Panchayati Raj Institutions (PRIs), and Urban Local Bodies (ULBs) are crucial for community-level disaster response.
- Supported by police, State Disaster Response Force (SDRF), fire services, and medical services.
- National Disaster Response Force (NDRF) provides specialist training and response when required.

iii. Civil Defence, Home Guards, and Youth Organizations:

- Play significant roles in immediate response and relief operations.
- Coordinated by relevant administrative departments of state governments.

This structure ensures a comprehensive and layered approach to disaster management, involving coordinated efforts from national to local levels, ensuring preparedness, rapid response, and effective recovery from disasters.

1.5. Expected Outcomes and Measurable Goals

To ensure the effectiveness of the DMP for the road and highway sector, the following expected outcomes and measurable goals are established to evaluate the plan's success and impact:

1.5.1 Expected Outcomes

a) **Enhanced Infrastructure Resilience:** National highways and road infrastructure are designed and maintained to withstand various natural and man-made disasters, reducing the frequency and severity of disruptions.
b) **Rapid Response and Recovery:** Timely and coordinated response mechanisms are in place to restore traffic connectivity and ensure safe evacuation and relief operations during disasters.
c) **Reduced Socio-Economic Impact:** Minimized economic losses and social disruptions due to disasters through effective mitigation, preparedness, and recovery strategies.
d) **Improved Stakeholder Coordination:** Strengthened collaboration among MoRT&H agencies, State Governments, NDMA, NDRF, and other stakeholders to ensure a unified and efficient disaster management approach.
e) **Increased Public Awareness and Safety:** Enhanced community awareness and preparedness for disaster scenarios, leading to safer road usage and better compliance with disaster response protocols.
f) **Sustainable Reconstruction:** Post-disaster reconstruction incorporates "Build Back Better" principles, resulting in more resilient infrastructure that reduces future vulnerabilities.

1.5.2 Measurable Goals:

a) Progressive reduction of 10% each year in number of complete road closures on National Highways exceeding 48 hours due to disaster.
b) Progressive reduction of 10% each year in number of partial road closures on National Highways (traffic plying in only one direction at a time or bi-directional traffic plying on carriageway on which uni-directional traffic is supposed to ply under normal conditions) exceeding 96 hours due to disaster.
c) Progressive reduction of 10% each year in number of landslide locations on National Highways.
d) No collapse of major bridge or long tunnel due to disaster event.
e) Reduction in the number of road fatalities and injuries by at least 50% by 2030.

2. Introduction

2.1 Profile of Ministry of Road Transport & Highways

Ministry of Road Transport & Highways, Government of India is entrusted with the task of formulating and administering, in consultation with other Central Ministries/Departments, State Governments/UT Administrations, organizations and individuals, policies for Road Transport, National Highways and Transport Research with a view to increasing the mobility and efficiency of the road transport system in the country.

2.2 Rationale

The Disaster Management Plan (DMP) of Ministry of Road Transport & Highways provides an outline and direction to the transportation & communication system for all phases of the disaster management cycle. Keeping in view the responsibility of MoRT&H to develop & maintain infrastructure at an acceptable level of service with adequate safety for road users, and the fact that MoRT&H has been made the Nodal Ministry for the road accidents. The Disaster Management Plan of MORT&H to undertake disaster management activities shall be laid down under two sub- plans, one for "Road Accidents" as Nodal Ministry and the other for all other disaster events (eg. Landslide, Flood, Earthquake, etc.) in supporting role. The role of Ministry for other disaster events is mostly acting in the supporting capacity and aid Nodal Ministries & State Governments to ensure connectivity in worst scenario. It is in accordance with the provisions of the Disaster Management Act 2005. It is a dynamic document which can adopt periodic updates in accordance with the global best practices and input from executing agencies of MoRT&H and knowledge base in disaster management.

2.2.1 Historical Perspective

The road and highway sector in India has faced significant challenges due to disasters, both natural and man-made, underscoring the critical need for a robust Disaster Management Plan (DMP). Over the years, several major incidents have highlighted the vulnerabilities of road infrastructure and the devastating consequences of inadequate preparedness and response mechanisms.

- **2004 Indian Ocean Tsunami:** The tsunami severely impacted coastal roads in Tamil Nadu, Andhra Pradesh, and Andaman & Nicobar Islands, washing away critical highway stretches and bridges. This disrupted connectivity, delayed relief operations, and highlighted the need for tsunami-resilient infrastructure design, such as elevated roads and robust drainage systems, to mitigate future risks.
- **2013 Uttarakhand Floods:** Unprecedented rainfall and cloudbursts triggered massive floods and landslides, damaging over 2,000 km of roads, including National Highways, and destroying numerous bridges. The disaster stranded thousands of pilgrims and locals, emphasizing the importance of landslide mitigation measures, early warning systems, and rapid response mechanisms to restore connectivity.
- **2015 Chennai Floods:** Urban flooding in Chennai submerged major roads and highways, disrupting transport and emergency services. Poor drainage systems and inadequate urban planning exacerbated the situation, underscoring the need for flood-Resilient infrastructure, including elevated roads and effective drainage designs, in urban areas.
- **2020 Cyclone Amphan:** The cyclone caused extensive damage to road infrastructure in West Bengal and Odisha, with storm surges and high winds uprooting trees and blocking highways. The event highlighted the necessity for cyclone-Resilient designs, such as strengthened bridges and seawalls, and the importance of pre-disaster preparedness to ensure rapid clearance of debris and restoration of traffic.

- **Recurring Landslides in Hilly Regions:** Landslides in states like Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and the Northeast have repeatedly disrupted National Highways, particularly during monsoons. For instance, the 2021 Kinnaur landslide in Himachal Pradesh blocked NH-5, isolating communities and delaying rescue efforts. These incidents emphasize the need for slope stabilization, retaining walls, and real-time monitoring systems in landslide-prone zones.

2.2.2 Legal Mandate

Hon'ble Prime Minister's Ten-Point Agenda on Disaster Risk Reduction draws integrated approach towards implementing the Sendai Framework for Disaster Risk Reduction, Paris Agreement on climate change and the SDGs, through its Agenda 1, i.e., all sectors to imbibe the principles of disaster risk management and utilize the legal mandate under the Disaster Management Act 2005 (DM Act) and the National DM Policy 2009.

2.2.2.1 As per the provisions of Section 11 of DM Act 2005, a National Plan shall be prepared for Disaster Management by the National Executive Committee (NEC) having regard to National Policy and in consultation with State Governments and expert bodies or organizations in the field of Disaster Management to be approved by National Disaster Management Authority (NDMA).

2.2.2.2 Section 35 of DM Act 2005 calls for the measures for disaster prevention through risk mitigation, mainstreaming into developmental plans and projects, preparedness, and financial resources, at the level of Ministries of Central Government.s

2.2.2.3 Section 36 of DM Act 2005 fixes responsibility on the Ministries or Departments of the Government of India to:

a) take measures necessary for prevention of disasters, mitigation, preparedness, and capacity building in accordance with the guidelines laid down by the National Authority.
b) integrate into its development plans and projects, the measures for prevention or mitigation of disasters in accordance with the guidelines laid down by the National Authority.
c) respond effectively and promptly to any threatening disaster situation or disaster in accordance with the guidelines of the National Authority or the directions of the National Executive Committee in this behalf.
d) review the enactments administered by it, its policies, rules, and regulations, with a view to incorporate therein the provisions necessary for prevention of disasters, mitigation, or preparedness.
e) allocate funds for measures for prevention of disaster, mitigation, capacity-building, and preparedness.
f) provide assistance to the National Authority and State Governments for:
    (i) drawing up mitigation, preparedness and response plans, capacity-building, data collection and identification and training of personnel in relation to disaster management:
    (ii) carrying out rescue and relief operations in the affected area.
    (iii) assessing the damage from any disaster.
    (iv) carrying out rehabilitation and reconstruction.
g) make available its resources to the National Executive Committee or a State Executive Committee for the purposes of responding promptly and effectively to any threatening disaster situation or disaster, including measures for:

(i) providing emergency communication in a vulnerable or affected area.
(ii) transporting personnel and relief goods to and from the affected area.
(iii) providing evacuation, rescue, temporary shelter, or other immediate relief.
(iv) setting up temporary bridges, jetties, and landing places.
(v) providing, drinking water, essential provisions, healthcare, and services in an affected area.

h) take such other actions as it may consider necessary for disaster management.

2.2.2.4 As per provisions of Section 37 of the DM Act, 2005

(1) Every Ministry or Department of the Government of India shall:

a) prepare a disaster management plan specifying the following particulars, namely:

(i) the measures to be taken by it for prevention and mitigation of disasters in accordance with the National Plan.

(ii) the specifications regarding integration of mitigation measures in its development plans in accordance with the guidelines of the National Authority and the National Executive Committee.

(iii) its roles and responsibilities in relation to preparedness and capacity-building to deal with any threatening disaster situation or disaster.

(iv) its roles and responsibilities regarding promptly and effectively responding to any threatening disaster situation or disaster.

(v) the present status of its preparedness to perform the roles and responsibilities specified in sub-clauses (iii) and (iv).

(vi) the measures required to be taken in order to enable it to perform its responsibilities specified in sub-clauses (iii) and (iv).

b) review and update annually the plan referred to in clause (a).

c) forward a copy of the plan referred to in clause (a) or clause (b), as the case may be, to the Central Government which Government shall forward a copy thereof to the National Authority for its approval.

(2) Every Ministry or Department of the Government of India shall:

a) make, while preparing disaster management plan under clause (a) of sub-section (1), provisions for financing the activities specified therein.

b) furnish a status report regarding the implementation of the plan referred to in clause (a) of sub-section (1) to the National Authority, as and when required by it.

National Institute of Disaster Management (NIDM) is mandated under the DM Act 2005 to support Government/Ministries and related agencies in developing their policies, plans, capacity building and research, etc.

2.2.3. Hon'ble Prime Minister's Ten-Point Agenda on Disaster Risk Reduction

1. All development sectors must imbibe the principles of disaster risk management
2. Work towards risk coverage for all - starting from poor households to small and medium enterprises to multi-national corporations to nation states

3. Encourage greater involvement and leadership of women in disaster risk management
4. Invest in risk mapping globally
5. Leverage technology to enhance the efficiency of our disaster risk management efforts
6. Develop a network of universities to work on disaster issues
7. Utilize the opportunities provided by social media and mobile technologies
8. Build on local capacity and initiatives
9. Ensure that the opportunity to learn from a disaster is not wasted.
10. Bring about greater cohesion in international response to disasters

2.2.4. Coherence with National and International Policy/Agenda Sendai Framework

The emphasis of Sendai Framework is on preventing new and reducing existing disaster risk and strengthening overall disaster resilience through the implementation of integrated measures. UNDRR is the agency that implements the Sendai Framework. In addition, the scope of ORR (Operational Research and Recovery) has been broadened significantly to focus on both natural and human-induced hazards including various related environmental, technological, and biological hazards and risks. The framework acknowledges the interlinkages between climate change and disaster risks.

The salient features of the Sendai Framework are:

a) **Outcome -** To achieve substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries globally over a span of 15 years i.e., by 2030.

b) **Goal -** Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political, and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.

c) **Four Priorities -** The four priorities for action are:

- Understanding disaster risk
- Strengthening disaster risk governance to manage disaster risk
- Investing in disaster risk reduction for resilience &
- Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

d) **Seven Targets -**

- Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rates in the decade 2020-2030 compared to the period 2005- 2015.
- Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020-2030 compared to the period 2005-2015.
- Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
- Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

- Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030.
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

2.3. Vision

To have a sustainable, disaster resilient, efficient, safe, and internationally comparable quality of road infrastructure in general and National Highways infrastructure in particular, to achieve enhanced connectivity, quick mobility to a level which accelerate socio-economic development.

2.4. Objective

The objective of Disaster Management Plan (DMP) of Ministry of Road Transport & Highways is as follows:

a) Identifying risks specific to MoRT&H;

b) Undertake measures for mitigating such risks of disasters.

c) Prevention of new risks of disasters.

d) Undertake preparedness & response measures as well as system level resilience measures.

e) Defining the role & responsibilities of various agencies/divisions of MoRT&H at each level of disaster management.

f) Undertake measures proposed for strengthening capacity-building on prevention, preparedness, mitigation, response and recovery and inter-ministerial/ State coordination.

g) Facilitate coordinated response at various levels.

2.5. Scope

The Disaster Management Plan (DMP) for the **road sector** shall include:

a) Measures to be taken for prevention of disasters or the mitigation of their effects on road infrastructure.

b) Measures to be taken for the integration of mitigation measures in the development plans of the road sector.

c) Measures to be taken for preparedness and capacity building of road sector to effectively respond to any threatening disaster situations or disaster.

d) Roles and responsibilities of different Ministries or Departments of the Government of India in respect of measures of the three aspects mentioned above.

The DMP of MoRT&H provides an integrated, holistic action-oriented planning framework for DM and resilience of asset portfolio for the whole Department, which must be reviewed and updated periodically. The DMP provide streamline of activities to be undertaken by various agencies of MoRT&H under the umbrella of Ministry is clearly brought out. MoRT&H shall make appropriate provisions for financing the implementation plan.

The DMP provides the framework for mobilization and coordination of the central ministries, departments and other agencies among themselves and the devolution of responsibilities between central, state government. Responding to any specific disaster is assigned to designated Officers of agencies.

The DMP of MoRT&H specially provides framework for reducing the risk of disaster due to any hazard on roads and highways and provide supporting role to other Ministries and State Governments by ensuring the traffic connectivity during disasters.

2.6 Challenges in Disaster Management for the Road Sector

The road and highway sector, faces a multitude of challenges in effectively implementing disaster management strategies. These challenges stem from the sector's critical role in ensuring connectivity, the diverse nature of disasters impacting road infrastructure, and the complexities of coordinating across multiple stakeholders and regions. Below are the key challenges faced by the road sector in disaster management:

a) **Diverse and Region-Specific Hazards:** India's varied topography and climate expose the road network to a wide range of natural disasters, including floods, landslides, earthquakes, cyclones, tsunamis, and snow avalanches. Each disaster type presents unique challenges, such as washed-out roads during floods, blocked highways due to landslides, or structural damage from earthquakes. The diverse hazard profile necessitates region-specific mitigation measures, which are often resource-intensive and require tailored engineering solutions. For instance, coastal roads face tsunami and cyclone risks, while hilly regions are prone to landslides and snow avalanches, complicating standardized disaster management approaches.

b) **Aging and Vulnerable Infrastructure:** A significant portion of India's road and highway network, particularly older stretches of National Highways, was not designed with modern disaster-resilient standards. Retrofitting existing infrastructure to withstand natural disasters, such as earthquakes or floods, is both costly and technically challenging. Additionally, many bridges and culverts lack adequate capacity to handle extreme weather events, leading to frequent disruptions and the need for extensive repairs.

c) **Resource Constraints:** Effective disaster management requires substantial financial, human, and material resources. Limited budgetary allocations for disaster preparedness and mitigation, coupled with competing developmental priorities, often restrict the implementation of proactive measures like hazard-Resilient construction or regular maintenance of vulnerable stretches. Furthermore, the availability of specialized equipment (e.g., cranes, excavators, and hydraulic rescue tools) and trained personnel for rapid response is often inadequate, particularly in remote or disaster-prone areas.

d) **Coordination and Inter-Agency Collaboration:** Disaster management in the road sector involves coordination among multiple agencies, including MoRT&H, NHAI, NHIDCL, BRO, State PWDs, SDRF, NDRF, and local administrations. This multi-layered institutional framework can lead to challenges such as delays in decision-making, communication gaps, and unclear delineation of responsibilities. For instance, during a disaster, ensuring seamless coordination between central and state agencies to mobilize resources and restore connectivity is often hampered by bureaucratic processes or jurisdictional overlaps.

e) **Rapid Urbanization and Urban Flooding:** The rapid urbanization of India has increased the vulnerability of urban road networks to disasters, particularly urban flooding. Poorly planned urban infrastructure, inadequate drainage systems, and encroachments on natural watercourses exacerbate flooding, leading to prolonged road closures and traffic disruptions. Managing urban flooding requires integrated urban planning, which is often outside the direct purview of MoRT&H, posing a challenge in aligning road sector strategies with broader urban development goals.

f) **Data and Information Gaps:** Accurate and timely data on hazard-prone zones, infrastructure vulnerabilities, and real-time disaster impacts are critical for effective disaster management. However, the road sector faces challenges in maintaining comprehensive digital resource mapping and real-time monitoring systems. Historical data on disaster impacts, such as flooding or landslide incidents, is often incomplete or not centrally

maintained, hindering post-event analysis and long-term planning. Additionally, the lack of integration with early warning systems (e.g., from IMD or CWC) limits proactive preparedness.

g) **Community Engagement and Awareness:** Effective disaster management relies on community participation, particularly in vulnerable areas. However, limited public awareness about disaster risks, evacuation routes, and safety protocols along highways poses a significant challenge. Engaging local communities and integrating their knowledge into early warning systems or response plans is often underdeveloped, reducing the effectiveness of community-based disaster risk reduction (CBDRR) initiatives.

h) **Climate Change and Emerging Risks:** Climate change is intensifying the frequency and severity of disasters such as floods, cyclones, and cloudbursts, posing new challenges for the road sector. Existing design standards and mitigation measures may not account for these emerging risks, necessitating frequent updates to guidelines and increased investment in climate-resilient infrastructure. Adapting to these evolving risks requires predictive modeling and long-term planning, which are resource-intensive and complex.

i) **Capacity Building and Training Gaps:** While the DMP emphasizes capacity building, the road sector faces challenges in implementing regular training programs and mock drills for disaster management. The lack of specialized training modules tailored to highway engineers, contractors, and first responders limits their ability to respond effectively to disasters. Additionally, the absence of a robust mechanism for knowledge sharing and documentation of lessons learned from past events hinders continuous improvement.

j) **Financial and Procurement Delays:** Timely funding and procurement of resources are critical for immediate disaster response and long-term reconstruction.

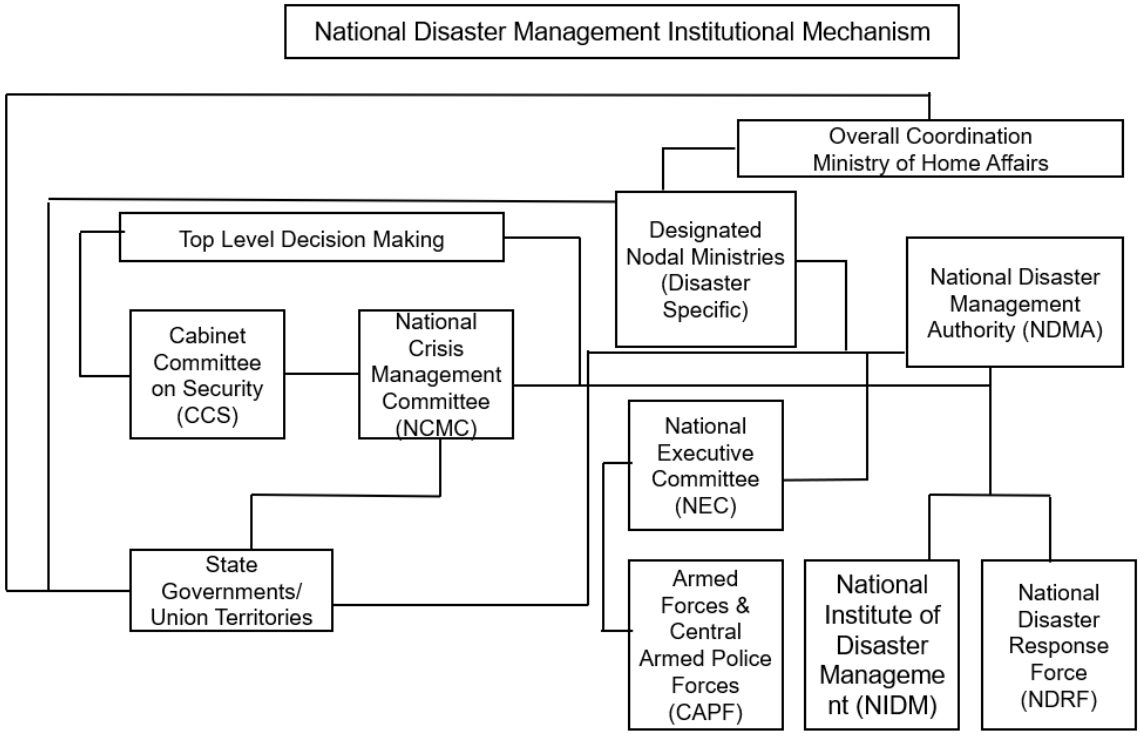
k) **Maintenance of Resource Inventories:** Maintaining an up-to-date inventory of resources, including equipment, manpower, and relief supplies, is a logistical challenge, particularly in remote or border areas where NHIDCL and BRO operate. Ensuring the availability and accessibility of resources like cranes, ambulances, and communication devices during disasters requires continuous coordination with contractors, state administrations, and other agencies, which is often hampered by logistical constraints.

3. Institutional Framework for Disaster Management

3.1. Institutional Framework for Disaster Management at Centre

The overall coordination of disaster management vests with the Ministry of Home Affairs (MHA). The Cabinet Committee on Security (CCS) and the National Crisis Management Committee (NCMC) are the key committees involved in the top-level decision-making about disaster management.

The NDMA is the lead agency responsible for the preparation DM plans and the execution of DM functions at the national level. Figure 1-1 provides a schematic view of the basic institutional structure for DM at national level. The figure represents merely the institutional pathways for coordination, decision-making and communication for disaster management and does not imply any chain of command.



In most cases, state governments will be carrying out disaster management with the central government playing a supporting role. The central agencies will participate only on the request from the state government. Within each state, there is a separate institutional framework for disaster management at the state-level. The DM Act of 2005 provides for the setting up of NDMA at national level, and the SDMA at the state level. The role, composition, and the role of the key decision-making bodies for disaster management at national level are briefly described in the Table 1-1.

Table 1-1: Key National-level Decision-Making Bodies for Disaster Management

#	Name	Composition	Vital Role
1.	**Cabinet Committee on Security (CCS)**	Prime Minister, Minister of Defence, Minister of Finance, Minister of Home Affairs, and Minister of External Affairs	● Evaluation from a national security perspective if an incident has potentially security implications ● Oversee all aspects of preparedness, mitigation, and management of Chemical, Biological, Radiological and Nuclear (CBRN) emergencies and of disasters with security implications ● Review risks of CBRN emergencies from time to time, giving directions for measures considered necessary for disaster prevention, mitigation, preparedness, and effective response
2.	**National Crisis Management Committee (NCMC)**	Cabinet Secretary (Chairperson) ● Secretaries of Ministries/Departments and agencies with specific DM responsibilities	● Oversee the Command, Control and Coordination of the disaster response ● Give direction to the Crisis Management Group as deemed necessary ● Give direction for specific actions to face crisis situations
3.	**National Disaster Management Authority (NDMA)**	● Prime Minister (Chairperson) ● Members (not exceeding nine, nominated by the Chairperson)	● Lay down policies, plans and guidelines for disaster management ● Coordinate their enforcement and implementation throughout the country ● Approve the NDMP and the DM plans of the respective Ministries and Departments of Government of India ● Lay down guidelines for disaster management to be followed by the different Central Ministries, Departments, and the State Governments
4.	**National Executive Committee (NEC)**	Union Home Secretary (Chairperson) ● Secretaries to the GOI in the Ministries/Departments of Agriculture, Atomic Energy, Defence, Drinking Water and sanitation, Environment, Forests and Climate Change Finance (Expenditure), Health and Family Welfare, Power, Rural Development, Science and Technology, Space, Telecommunications, Urban Development, Water Resources, River Development and Ganga Rejuvenation, The Chief of the Integrated Defence	● To assist the NDMA in the discharge of its functions ● Preparation of the National Plan ● Coordinate and monitor the implementation of the National Policy ● Monitor the implementation of the National Plan and the plans prepared by the Ministries or Departments of the Government of India ● Direct any department or agency of the Govt. to make available to the NDMA or SDMAs such men, material or resources as are available with it for the purpose of emergency response, rescue and relief ● Ensure compliance of the directions issued by the Central Government ● Coordinate response in the event of any threatening disaster situation or disaster ● Direct the relevant ministries/ Departments of the GoI, the State Governments and the SDMAs regarding measures to be taken in response to any specific threatening disaster situation or disaster ● Coordinate with relevant Central Ministries/Departments/Agencies which are expected to provide assistance to the affected State as per standard Operating Procedures

		Staff of the Chiefs of Staff Committee, ex officio as members. ● Secretaries in the Ministry of External Affairs, Earth Sciences, Human Resource Development, Mines, Shipping, Road Transport and Highways and Secretary, NDMA are special invitees to the meetings of the NEC.	(SOPs) Coordinate with the Armed Forces, Central Armed Police Forces (CAPF), the National Disaster Response Force (NDRF) and other uniformed services which comprise the GoI's response to aid the State authorities ● Coordinate with India Meteorological Department (IMD) and several other specialized scientific institutions which constitute key early warning and monitoring agencies ● Coordinate with Civil Defence volunteers, home guards and fire services, through the relevant administrative departments of the State Governments
5.	**National Disaster Response Force (NDRF)**	Specially trained force headed by a Director General Structured like paramilitary forces for rapid deployment	Provide assistance to the relevant State Government District Administration in the event of an imminent hazard event or in its aftermath
6.	**National Institute of Disaster Management (NIDM)**	Union Home Minister; Vice Chairman, NDMA; Members including Secretaries of various nodal Ministries and Departments of Government of India and State Governments and heads of national levels scientific, research and technical organizations, besides eminent scholars, scientists and practitioners.	● Human resource development and capacity building for disaster management within the broad policies and guidelines laid down by the NDMA ● Design, develop and implement training programmes ● Undertake research ● Formulate and implement a comprehensive human resource development plan ● Provide assistance in national policy formulation, assist other research and training institutes, state governments and other organizations for successfully discharging their responsibilities ● Develop educational materials for dissemination ● Promote awareness generation

From time to time, the central government notifies hazard-specific nodal ministries to function as the lead agency in managing types of disasters (see Table 1-2 for current list of disasters specific nodal ministries notified by GoI)

Table 1-2: Nodal Ministry for Management/ Mitigation of Different Disasters

SI. No.	Disaster	Nodal Ministry/ Department
1	Accident - Air (Aviation)	Min. of Civil Aviation (MOCA)
2	Accidents - Rail	Min. of Railways (MOR)
3	Accidents - Road	Min. of Road Transport and Highways (MORT&H)
4	Avalanche	Min. of Defence (MOD) - Border Road Organization (BRO)
5	Biological Emergencies	Min. of Health and Family Welfare (MHFW)
6	Cold-Wave	Min. of Agriculture and Farmers Welfare (MAFW)
7	Cyclone/ Tornado	Min. of Earth Sciences (MOES)
8	Drought	Min. of Agriculture and Farmers Welfare (MAFW)
9	Earthquake	Min. of Earth Sciences (MOES)
10	Flood	Min. of Jal Shak (MOJS)
11	Floods - Urban	Min. of Housing and Urban Affairs (MHUA)
12	Forest Fire	Min. of Environment, Forests, and Climate Change (MEFCC)

13	Frost	Min. of Agriculture and Farmers Welfare (MAFW)
14	Hailstorm	Min. of Agriculture and Farmers Welfare (MAFW)
15	Industrial and Chemical	Min. of Environment, Forests and Climate Change (MEFCC)
16	Landslides	Min. of Mines (MOM)
17	Nuclear and Radiological	Dept. of Atomic Energy (DAE)
18	Oil Spills	Min. of Defence (MOD) - Indian Coast Guard (ICG)
19	Pest Attack	Min. of Agriculture and Farmers Welfare (MAFW)
20	Tsunami	Min. of Earth Sciences (MOES)

3.2. National Disaster Management Authority (NDMA)

The Government of India established the NDMA in 2005, headed by the Prime Minister. Under the DM Act 2005, the NDMA, as the apex body for disaster management, shall have the responsibility for laying down the policies, plans, and guidelines for disaster management for ensuring timely and effective response to disaster. The guidelines of NDMA will assist the Central Ministries, Departments, and States to formulate their respective DM plans. It will approve the National Disaster Management Plans and DM plans of the Central Ministries / Departments. It will take such other measures, as it may consider necessary, for the prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Central Ministries / Departments and State Governments will extend necessary cooperation and assistance to NDMA for carrying out its mandate. It will oversee the provision and application of funds for mitigation and preparedness measures.

NDMA has the power to authorize the Departments or authorities concerned, to make emergency procurement of provisions or materials for rescue and relief in a threatening disaster situation or disaster. The general superintendence, direction, and control of the National Disaster Response Force (NDRF) is vested in and will be exercised by the NDMA. The National Institute of Disaster Management (NIDM) works within the framework of broad policies and guidelines laid down by the NDMA. The NDMA has the mandate to deal with all types of disasters - natural or human-induced. However, other emergencies such as terrorism (counterinsurgency), law and order situations, hijacking, air accidents, CBRN weapon systems, which require the close involvement of the security forces and/or intelligence agencies, and other incidents such as mine disasters, port and harbor emergencies, forest fires, oilfield fires and oil spills will be handled by the National Crisis Management Committee (NCMC). Nevertheless, NDMA may formulate guidelines and facilitate training and preparedness activities in respect of CBRN emergencies.

3.3 National Disaster Response Force (NDRF)

The NDRF has been constituted as per the Chapter VIII of the DM Act 2005 as a specialist response force that can be deployed in a threatening disaster situation or disaster. As per the DM Act, the general superintendence, direction, and control of the NDRF shall be vested and exercised by the NDMA. The command and supervision of the NDRF shall vest with the Director General appointed by the Government of India. The NDRF will position its battalions at different locations as required for effective response. NDRF units will maintain close liaison with the designated State Governments and will be available to them in the event of any serious threatening disaster situation. The NDRF is equipped and trained to respond to situations arising out of natural disasters and CBRN emergencies. The NDRF units will also impart basic training to all the stakeholders identified by the State Governments in their respective locations. Further, a National Academy will be set up to provide training for trainers in disaster management and to meet related National and International commitments. Experience in major

disasters has clearly shown the need for pre-positioning of some response forces to augment the resources at the State level at crucial locations including some in high altitude regions.

A) General - First and Key Responders:

The role and importance of community, under the leadership of the local authorities, Panchayati Raj Institutions (PRls) and Urban Local Bodies (ULBs), being the bedrock of the process of disaster response, is well recognized. For their immediate support, there are other important first responders like the police, State Disaster Response Force (SDRFs), Fire and Medical Services. The NDRF will provide specialist response training whenever required. In serious situations, the resources of all NDRF battalions, on an as required basis, will be concentrated in the shortest possible time in the disaster affected areas. Other important responders will be the Civil Defense, Home Guards and youth organizations such as NCC, NSS and NYKS. The deployment of the armed forces will also be organized on as required basis.

B) Location, Constitution and Functions:

These have been formed under the Disaster Management Act at 12 selected locations in the country for dealing with relief and rescue operations related to all types of disasters. The NDRF consists of battalions of Central paramilitary forces drawn from the Border Security Force (BSF), lndo-Tibetan Border Police (ITBP), Central Industrial Security Force (CISF)and Central Reserve Police Force (CRPF) for the purpose of specialist response in disaster situations. Each Battalion has 6 Companies comprising of 3 teams each. Team comprises of 45 men out of which 24 are for Search & Rescue and balance 21 for support functions. Short-listed & trained staff are on deputation in NDRF.

As per the Disaster Management Act, various ministries and departments under Government of India should join hands for mutual assistance in case of a disaster. Coordination amongst the affected agencies (many departments of the Central Government and the States) is very important and MoRT&H shall develop the channel of communication open to get help from NDRF, as same play important role in rescues and responses.

3.4. National Institute of Disaster Management (NIDM)

As per the provisions of the Chapter VII of the DM Act, 2005 Government of India constituted the National Institute of Disaster Management (NIDM) under an Act of Parliament with the goal of being the premier institute for capacity development for disaster management in India and the region. The vision of NIDM is to create a Disaster Resilient India by building the capacity at all levels for disaster prevention and preparedness. NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation, and policy advocacy in the field of disaster management. The NIDM has built strategic partnerships with various ministries and departments of the central, state, and local governments, academic, research and technical organizations in India and abroad and other bi-lateral and multi-lateral international agencies. It provides technical support to the state governments through the Disaster Management Centers (DMCs) in the Administrative Training Institutes (ATls) of the States and Union Territories. Presently it is supporting as many as 30 such centers. Six of them are being developed as Centers of Excellence in the specialised areas of risk management - flood, earthquake, cyclone, drought, landslides, and industrial disasters.

3.5. Institutional Framework for Disaster Management at State and District Level

As per the DM Act of 2005, each state in India shall have its own institutional framework for disaster management. Among other things, the DM Act, 2005 mandates that each State Government shall take necessary steps for the preparation of state DM plans, integration of measures for prevention of disasters or mitigation into state development plans, allocation of funds, and establish EWS. Depending on specific situations and needs, the State

Government shall also assist the Central Government and central agencies in various aspects of DM. Each state shall prepare its own State Disaster Management Plan.

The DM Act, 2005 mandates the setting of a State Disaster Management Authority with the Chief Minister as the ex officio Chairperson. Similar system will function in each Union Territory with Lieutenant Governor as the Chairperson. At the district level, District Disaster Management Authority (DDMA), the District Collector or District Magistrate or the Deputy Commissioner, as applicable, will be responsible for overall coordination of the disaster management efforts and planning. Figure- 1-2 provides schematic view of the typical state-level institutional framework does not imply any chain of command.

Based on the National Disaster Management Plan for Road Sector, the state and district disaster management authorities and relevant departments for road sector shall together develop DMP at State and District levels. This shall be based on this DMP for the road sector as well as informing the Central Ministry on future revisions/ Updation of this DMP.

The Role and Responsibility of the road departments/agencies pre- and during disasters are as per **Appendix-II (Responsibility Matrix)**.

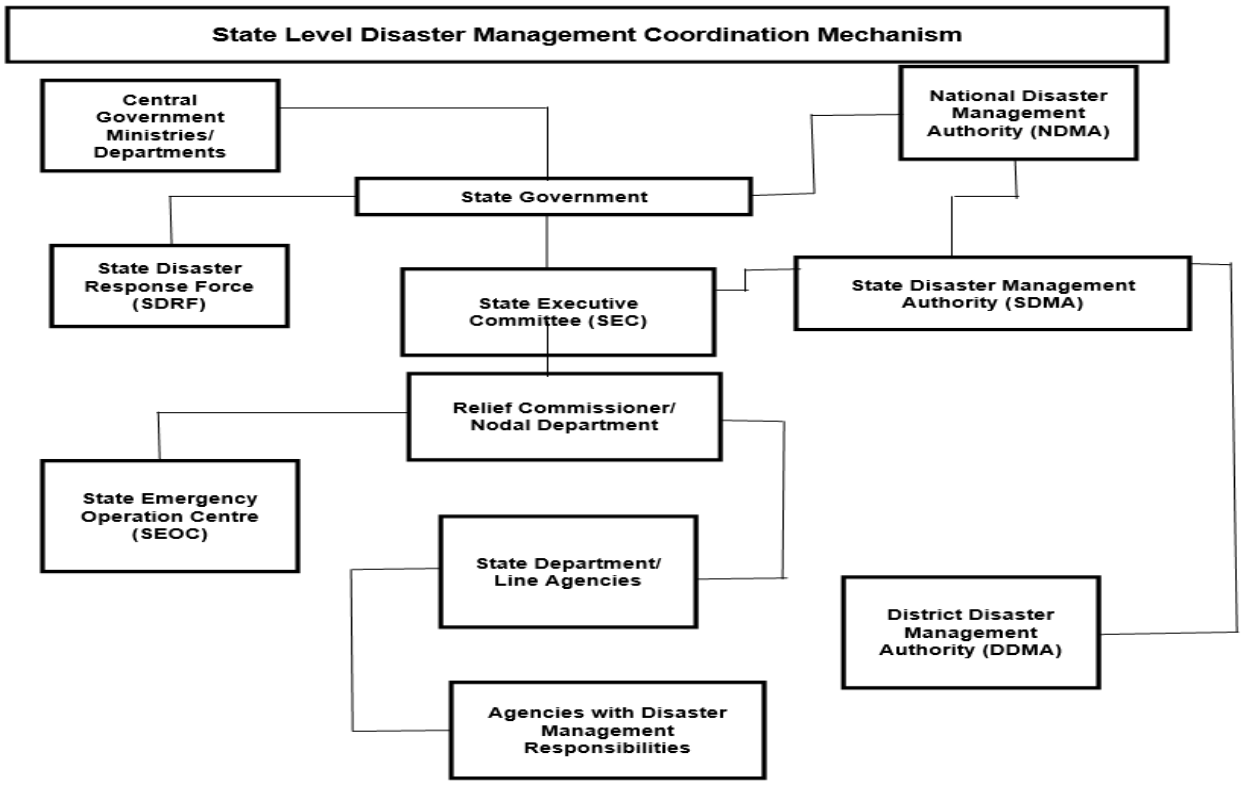


Figure: State level Disaster Management - Basic Institutional framework

3.5.1 State Disaster Management Authority (SDMA)

As per provisions in Chapter III of the DM Act, 2005 each State Government shall establish a State Disaster Management Authority (SDMA) or its equivalent under a different name with the Chief Minister as the Chairperson. In case of other UTs, the Lieutenant Governor or the Administrator shall be the Chairperson of that Authority. For the UT of Delhi, the Lieutenant Governor and the Chief Minister shall be the Chairperson and Vice-

Chairperson respectively of the State Authority. In the case of a UT having Legislative Assembly, except the UT of Delhi, the Chief Minister shall be the Chairperson of the Authority established under this section. The SDMA will lay down policies and plans for DM in the State. It will, inter alia approve the State Plan in accordance with the guidelines laid down by the NDMA, coordinate the implementation of the State Plan, recommend provision of funds for mitigation and preparedness measures, and review the developmental plans of the different Departments of the State to ensure the integration of prevention, preparedness, and mitigation measures. The State Government shall constitute a State Executive Committee (SEC) to assist the SDMA in the performance of its functions. The SEC will be headed by the Chief Secretary to the State Government. The SEC will coordinate and monitor the implementation of the National Policy, the National Plan, and the State Plan. The SEC will also provide information to the NDMA relating to different aspects of DM.

3.5.2 District Disaster Management Authority (DDMA)

As per provisions in Chapter IV of the DM Act, 2005 each State Government shall establish a District Disaster Management Authority for every district in the State with such name as may be specified in that notification. The DDMA will be headed by the District Collector, Deputy Commissioner, or District Magistrate as the case may be, with the elected representative of the local authority as the Co-Chairperson. The State Government shall appoint an officer not below the rank of Additional Collector or Additional District Magistrate or Additional Deputy Commissioner of the district to be the Chief Executive Officer of the District Authority. The DDMA will act as the planning, coordinating, and implementing body for DM at the District level and take all necessary measures for the purposes of DM in accordance with the guidelines laid down by the NDMA and SDMA. It will, inter alia, prepare the DM plan for the district and monitor the implementation of all relevant national, state, and district policies and plans. The DDMA will also ensure that the guidelines for prevention, mitigation, preparedness, and response measures laid down by the NDMA and the SDMA are followed by all the district-level offices of the various departments of the State Government.

3.5.3 Role of Non-Government Organizations (NGOs) and Community-Based Organizations (CBOs)

Involvement of Non-Government Organizations (NGOs) and Community-Based Organizations (CBOs) enhances community resilience, facilitates grassroots-level preparedness, and supports effective response and recovery operations. The key roles and responsibilities of NGOs and CBOs in the context of disaster management for the road and highway sector are as follows:

A. Community Awareness and Education:

- NGOs and CBOs conduct awareness campaigns to educate communities living near highways about disaster risks, safety measures, and evacuation protocols.
- They organize workshops and training sessions to build local capacity for recognizing early warning signs of disasters such as landslides, floods, or cyclones, particularly in vulnerable road stretches.

B. Support in Preparedness:

- Collaborate with State Disaster Management Authorities (SDMAs) and District Disaster Management Authorities (DDMAs) to develop community-based disaster preparedness plans.
- Assist in identifying vulnerable road stretches and bridges, sharing local knowledge to support hazard risk and vulnerability assessments.

- Facilitate the formation of local disaster response teams, including volunteers trained in basic rescue and first aid, to assist during emergencies on highways.

C. Response and Relief Operations:

- Provide immediate assistance during disasters, such as distributing relief supplies (food, water, clothing, and hygiene kits) to affected communities and stranded commuters on highways.
- Support rescue operations by mobilizing volunteers to assist the National Disaster Response Force (NDRF), State Disaster Response Force (SDRF), and other first responders in clearing road blockages or aiding stranded individuals.
- Act as a liaison between affected communities and government agencies to ensure timely communication of needs and resource allocation.

D. Recovery and Rehabilitation:

- Participate in post-disaster damage assessments by providing local insights into the impact on communities and road infrastructure.
- Support the "Build Back Better" approach by advocating for disaster-resilient infrastructure and facilitating community input in reconstruction planning.
- Assist in livelihood restoration programs for communities affected by disrupted connectivity due to damaged roads or highways.

E. Coordination and Advocacy:

- Work closely with the MoRT&H, its executing agencies and their Regional Offices, and local authorities to ensure alignment with the Disaster Management Act, 2005
- Advocate for the integration of community-based disaster risk reduction (DRR) measures in road sector planning, such as planting vegetation for slope stabilization or improving drainage systems.
- Facilitate coordination between government agencies, local authorities, and communities to ensure inclusive and effective disaster management strategies.

3.6. Institutional Framework of MoRT&H for Disaster Management

3.6.1. Keeping in view the responsibility of MoRT&H to develop & maintain infrastructure in traffic worthy condition with adequate safety for road users, and the fact that MoRT&H has been made the Nodal Ministry for the road accidents, the institutional framework of MoRT&H to undertake disaster management activities shall be laid down under two sub-plans, one for "Road Accidents" as Nodal Ministry (Volume-II: Disaster Management Sub-Plan for Road Accidents) and the other for all other disaster events (eg. Landslide, Flood, Earthquake, etc.) in supporting role (Volume-I: Overview and Disaster Management Sub-Plan for Highways).

3.6.2. The Road Safety Division of MoRT&H shall be the Nodal Division for preparing, monitoring & implementing the sub-plan for Road Accident Disasters dealt under **Volume-II** of this document.

3.6.3. The sub-plan for Road Accident Disasters shall be prepared by the Road Safety Division of MoRT&H, in consultation with the Roads Safety Engineering Zone and other stakeholders, following the stipulated framework for Nodal Ministries.

3.6.4. The Disaster Management Plan hereinafter shall apply to disaster events other than "Road Accident", where MoRT&H is supposed to act in supporting role.

3.6.5. A comprehensive, and integrated approach of managing disasters and reduce risk of disaster, with a clear-cut hierarchy and well assigned roles & responsibilities of officers of various agencies of MoRT&H are covered in this section. Flow chart of Institutional hierarchy and details in tabular form are given in **Appendix-I.**

3.7. MoRT&H:

The Ministry of Road Transport and Highways (MoRT&H) is responsible for the development and maintenance of the National Highways network in India. It plays a critical role in formulating policies related to road transport and ensuring the implementation of road safety measures including disaster management.

The Development & Maintenance of NH is looked after by the following:

i. **Roads Wing of MoRT&H:** Responsible for the technical aspects related to road development. It formulates standards and specifications, ensures the implementation of policies, and monitors the construction and maintenance of national highways. The Road Wing plays a crucial role in the assessment and management of road infrastructure, especially during and after disasters.

   The encadred Officers of CES(Roads) are posted at Ministry's HQ, at Regional Offices and at PIUs of MoRT&H for implementation of works assigned as per broad role & responsibilities. The head quarter is manned by officers placed in Roads Wing, Highways Division, Toll Division, BP&SP Cell. The Officers of Roads Wing are even now posted in Safety Cell, Transport Wing also. The Roads Wing is headed by DG(RD)&SS who in turn is assisted by ADGs for the States grouped into various Project Zones. Road Safety Zone is functional at HQ level under Roads Wing.

   The jurisdiction of Roads Wing (RW), MoRT&H extends to the NH stretches/works of State PWDs (or any other Authority/ Agency subordinate to the State Government), MoRT&H PIUs and BRO, with the only exception of Financial Delegation of Powers for immediate restoration/ repair of NH works, conferred under Appendix-VI of this document, where BRO has been delegated independent financial powers.

   Further, the Regional Officers (RO) of the Ministry who closely supervises the projects, liaison between the State Govt., local authorities, contractors, State PWD (or any other Authority/ Agency subordinate to the State Government), BRO and Central Government.

   The Road Wing of the MoRT&H focuses on enhancing the resilience of road infrastructure against natural disasters through comprehensive risk assessments and robust design standards. It integrates disaster-resilient features into road construction, ensuring infrastructure can withstand events like floods and earthquakes. The Road Wing also plays a crucial role in emergency response by coordinating with local authorities to quickly assess and repair damaged roads, and it provides training to personnel to improve disaster management capabilities. These efforts aim to safeguard road networks, ensuring their functionality and safety even during and after natural calamities.

ii. **National Highways and Infrastructure Development Corporation Limited (NHIDCL):** The organisation has its presence in 08 North Eastern States and Uttarakhand, UT of Ladakh, Jammu & Kashmir and Andaman Island. It has its Head Quarter situated at Delhi and operates from 13 Regional

Offices (ROs) located in various states. Each RO, headed by an Executive Director (Project), has several Project Monitoring Units (PMUs) under it. NHIDCL has a total of 48 PMUs.

NHIDCL is responsible for promoting, surveying, establishing, designing, constructing, operating, maintaining, and upgrading National Highways and Strategic Roads, including those connecting regions along international borders. This enhanced regional connectivity fosters cross-border trade and commerce, strengthens India's international borders, and contributes to a more integrated and economically consolidated South and Southeast Asia. Additionally, the improved infrastructure brings significant economic benefits to local communities and strengthens the integration of peripheral areas with the mainstream.

At HQ NHIDCL, Highway Administration Cell headed by an Executive Director (Tech.), is responsible for coordination and formulation of polices for Disaster Management/Relief.

NHIDCL operates through its various Contractors, EPC works for development of road, Short Term Maintenance Contracts (STMC), Maintenance Contractors for regular maintenance of roads. In addition, process to undertaking Emergent Repair (ER) works have been vested with each RO.

iii. **National Highways Authority of India (NHAI):** NHAI plays a crucial role in enhancing India's road infrastructure, contributing significantly to the country's economic growth and connectivity. It is an autonomous agency of the Indian government responsible for the development, maintenance, and management of national highways in India. It has 25 Regional Offices across the country, which oversee the execution and monitoring of highway projects in their respective regions and over 191 PIUs, which are responsible for the day-to-day implementation of highway projects, ensuring they are completed on time and within budget. NHAI is responsible for the development and maintenance of National Highways entrusted to them.

NHAI incorporates disaster management into its operations to enhance the resilience of national highways. This involves conducting risk assessments to identify vulnerabilities to natural disasters like floods and landslides and incorporating disaster-Resilient design features into highway construction. NHAI ensures that highways are built with robust materials, effective drainage systems, and other protective measures to mitigate disaster impact.

In addition, NHAI is actively involved in emergency response and recovery efforts, coordinating with local authorities to quickly restore damaged infrastructure. Regular maintenance and timely upgrades further bolster highway resilience. By integrating disaster management practices into its operations, NHAI aims to safeguard road infrastructure, ensuring its durability and functionality even in the face of natural calamities.

iv. **Border Road Organisation (BRO):** The BRO established in 1960, develops and maintains road networks in India's border areas and friendly neighboring countries. This includes infrastructure operations in 19 states and three union territories (including Andaman and Nicobar Islands) and neighboring countries such as Afghanistan, Bhutan, Myanmar, Tajikistan and Sri Lanka. BRO is also tasked with maintaining this infrastructure including operations such as snow clearance. BRO is instrumental in significantly upgrading and building new India-China Border Roads. By improving road access to remote areas, BRO facilitates not only military logistics but also boosts local economies and access to essential services in these geographically isolated regions.

BRO has 18 Projects, each headed by a Brigadier/ Chief Engineer, located at different strategic locations to maintain and construct road. It has 47 Border Road Task Force (BRTF), each headed by a Colonel/Superintending Engineer (SE) that works under respective projects.

BRO is primarily a departmental organisation with inherent capability in terms of earthmoving equipment, vehicle and plants to undertake various works. It has delegated financial powers to facilitate the works.

Together, these entities work towards enhancing the road infrastructure in India, ensuring safety, and improving connectivity across the country. **The institutional hierarchy as well as assigned roles and responsibilities of various agencies of MoRT&H on disaster management is tabulated in Appendix-I.**

3.8. Core Functions:

The Ministry of Road Transport & Highways (MoRT&H) is a pivotal entity in India responsible for the development, maintenance, and management of the National Highways network. Its core functions include:

i. **Policy Formulation:** Developing policies for road transport, national highways, and road safety including disaster management.

ii. **Infrastructure Development:** Planning, constructing, and maintaining national highways and expressways.

iii. **Regulation and Standards:** Setting standards for road construction, vehicle regulations, and traffic management.

iv. **Funding and Financing:** Allocating budgetary resources, securing funding, and managing financial aspects of road transport projects.

v. **Road Safety and Traffic Management:** Implementing measures to enhance road safety and disaster management, reduce accidents, and manage traffic flow.

3.9 Role in National Disaster Management Framework

MoRT&H plays a significant role in the National Disaster Management Framework, particularly in ensuring the resilience and reliability of transportation infrastructure during and after disasters. Key responsibilities include:

i. **Preparedness and Mitigation:**

- Ensuring that national highways are designed and constructed to withstand natural hazards such as floods, earthquakes, and landslides.
- Implementing road safety measures to minimize the impact of accidents and emergencies.

ii. **Response and Relief:**

- Facilitating swift and efficient transportation routes for emergency services and relief materials during disasters.
- Collaborating with other ministries and agencies to coordinate disaster response efforts.

iii. **Rehabilitation and Reconstruction:**

- Leading the reconstruction of damaged road infrastructure post-disaster.
- Incorporating disaster-Resilient designs and materials in rebuilding efforts to enhance future resilience.

iv. Coordination with Stakeholders:

A Disaster Management Division (DM div.) to be headed by Chief Engineer/Joint Secretary level officer has been envisaged under this DMP, which shall act as Nodal Division of MoRT&H to coordinate with Ministries/Departments of the Central Government, State Government/ District Administration as well as executing agencies of MoRT&H (refer Appendix I). Further Regional Offices (RO) and Project Implementing Units (PIU) of MoRT&H and its Executing Agencies shall also coordinate at field level with State Government/ District Administration. MoRT&H & its Agencies and their field offices shall make efforts towards the following:

- **Inter-Ministerial Coordination:** To collaborates with other central ministries, such as the Ministry of Home Affairs (MHA), Ministry of Jal Shakti (MoJS), and Ministry of Earth Sciences (MoES), to align disaster management efforts. This includes sharing data, resources, and expertise for effective disaster response and mitigation, as mandated under the Disaster Management Act, 2005.
- **State and District-Level Coordination:** To coordinates with State Disaster Management Authorities (SDMAs) and District Disaster Management Authorities (DDMAs) to ensure seamless integration of disaster management plans. This includes joint planning, resource mobilization, and execution of response strategies during disasters.
- **Engagement with Local Authorities and Communities:** To engage with Panchayati Raj Institutions (PRIs), Urban Local Bodies (ULBs), and community-based organizations to enhance local-level preparedness and response. This involves public awareness campaigns, training programs, and incorporating local knowledge into disaster risk reduction strategies.
- **Coordination with NDRF and SDRF:** To maintains close liaison with the National Disaster Response Force (NDRF) and State Disaster Response Force (SDRF) to facilitate rapid deployment of resources and personnel during disaster events, ensuring quick restoration of traffic connectivity and support for rescue operations.
- **Private Sector and NGO Collaboration:** To works with contractors, engineering firms, and non-governmental organizations (NGOs) to leverage additional resources, expertise, and manpower for disaster response and recovery, particularly in the maintenance and restoration of road infrastructure.
- **Information Sharing and Communication:** To ensures effective communication channels with all stakeholders, including real-time updates on road conditions, resource availability, and disaster response activities, using digital platforms and coordination with agencies like the India Meteorological Department (IMD).

3.10. Relevance to Specific Types of Disasters

MoRT&H's functions are particularly relevant to the following types of disasters:

i. Natural Hazards or Disasters:

- **Floods/ Urban Flood:** Ensuring highways have adequate drainage systems and are elevated in flood-prone areas to prevent submersion.

- **Earthquakes:** Constructing roads and bridges with earthquake-Resilient designs to maintain connectivity during and post seismic event.
- **Landslides:** Implementing slope stabilization techniques and constructing retaining walls to prevent landslides along highways.
- **Snow Avalanches:** Ensuring roads in avalanche-prone areas have protective structures like snow galleries and implementing avalanche monitoring and warning systems.
- **Cyclone:** Constructing cyclone-Resilient infrastructure and ensuring quick clearance and restoration of roads for relief operations post-cyclone.
- **Tsunami:** Designing coastal roads with elevated structures and effective drainage systems to mitigate flooding and ensuring rapid road repairs to support evacuation and relief efforts.

ii. Man-Made Disasters:

- **Industrial Accidents:** Facilitating quick access routes for emergency response teams to industrial disaster sites.
- **Road Accidents:** Enhancing road safety measures to prevent and manage accidents effectively.

iii. Other Emergencies:

- **Pandemics:** Ensuring the uninterrupted movement of essential goods and medical supplies through well-maintained transport networks.

3.11. Alignment with Ministry's Mission and Responsibilities

MoRT&H through Disaster Management Plan (DMP) endeavors that the Ministry's efforts in disaster preparedness, response, and recovery are integrated with its overarching mission to develop and maintain a safe, efficient, and sustainable road transport network. By incorporating disaster management into its core responsibilities, MoRT&H endeavors to contribute to national resilience and public safety, ensuring that the road transport system remains operational and effective in times of crisis.

4. Concept of Hazard & Disaster

As per the definition adopted by UNISDR,

"Hazard is a dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage".

Hazard, natural as well as humanly induced, can result in disaster. The occurrence of a given hazard becomes disaster risk when human stakes (e.g., assets, lives, and socioeconomic or environmental values) are exposed and vulnerable to the hazard. Definition of Disaster as given by the Government of India was legislated for the first time in the Disaster Management Act, 2005. As per DM Act, 2005,

"Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which result in substantial loss of life or human suffering or damage to and destruction of property or damage to, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area".

The natural disasters or hazards, which the country has experienced in the past, not only caused huge loss to the affected states/ country in terms of human lives, property, revenue, but also caused huge losses to the road sector in terms of damage of road infrastructures causing severe connectivity issues.

India has a highly diversified range of natural features. Its unique geo-climatic conditions make the country among the most vulnerable to natural disasters in the world. Disasters occur with very high frequency in India and while the society at large has adapted itself to these regular occurrences, the economic and societal costs continue to rise.

Hazard identification is the first activity to be performed by thoroughly analyzing all the previous records (historic data) as well as anticipated occurrence of any phenomena which may have negative consequences on the road and related assets. The goal of hazard identification is to find out potential risks associated with the hazards. The hazards inventoried during this stage is to be categorized based on their nature, likelihood, severity and risk level. The list of identified hazards needs to be updated and reviewed in regular intervals.

Hazard Exposure indicates the susceptibility of assets (roads and other related) which may be negatively impacted due to hazards.

Risk Assessment for effective Disaster Management: Risk assessment is the starting point for planning effective actions along six aspects of DM cycle which are prevention, mitigations, preparedness, response, rehabilitation and reconstruction.

4.1. Hazard Risk and Vulnerability Assessment

The HRV Assessment will assist the authorities in making risk-based decisions to address vulnerabilities, mitigate hazards, and prepare for response to and recover from disaster events. It enables the authorities for better preparedness towards risk reduction strategies based on acceptable consequences and the frequency of events.

Vulnerability reductions measures should encompass across the life cycle of the project namely planning, engineering design, maintenance management, institutional capacity building, and contingency planning.

i. **Risks identification during Planning:** Transport development policy and planning to address identification of risks; shifting development away from disaster-prone areas when possible; consideration

of integration and redundancy on critical infrastructure. Develop response and recovery strategies for disaster identified.

ii. **Engineering design:** Improving design standards of transport infrastructure to maintain connectivity and reduce disaster risk; use of innovative materials and design specifications that enhance robustness and flexibility of infrastructure.

iii. **Operational Maintenance:** Developing asset management systems with mapping of transport assets, improving institutional and financial arrangements; integration of climate and disaster risks in the prioritization of infrastructure investments.

iv. **Institutional Capacity:** Centralizing disaster risk information and data comprehensively; upstream planning of transport systems to reduce the hazard exposure; manage institutional and regulatory challenges.

v. **Contingency Planning:** Developing policy frameworks, communication protocols, and investments in emergency preparedness and response; alignment of transport systems and flows with local and regional evacuation, and recovery needs.

India has a highly diversified range of natural features. Its unique geo-climatic conditions make the country among the most vulnerable to natural hazards in the world. Disasters occur with very high frequency in India and while the society at large has adapted itself to these regular occurrences, the economic and societal costs continue to rise. These disasters have caused huge losses to the road sector in terms of damage of road infrastructures causing severe connectivity issues.

4.2. Disaster Risks in Road Sector (Infrastructure)

Disaster in the road sector can occur mainly due to the following identified hazards

a) Cyclones

b) Floods/cloud burst/urban flood

c) Earthquakes

d) Tsunamis

e) Landslides

f) Snow Avalanches

4.2.1. Cyclones

When a cyclone approaches the coast, a risk of serious loss or damage arises from severe winds, heavy rainfall, storm surges and river floods. A severe cyclone / cyclonic storm disrupts the Transportation Systems of the affected areas as it often destroys critical bridges, overpasses, roads, road signages, avenue plantation, and roadside furniture complicating efforts to transport food, clean water, and medicine to the areas that need it.

Case Study: Cyclone Amphan (May 2020) – West Bengal and Odisha, India

Impact on Road Infrastructure:

- Cyclone Amphan, a super cyclonic storm, struck the eastern coast of India, severely affecting West Bengal and Odisha. High winds exceeding 180 km/h and storm surges up to 5 meters caused widespread damage to road infrastructure.
- Coastal roads and national highways, such as NH-116B in West Bengal, were inundated due to storm surges, leading to temporary closures and disrupted connectivity.
- Debris from fallen trees and damaged structures blocked major highways, including NH-16, delaying relief operations.
- Bridges and culverts faced structural damage due to high-velocity winds and flooding, particularly in low-lying areas of the Sundarbans.

Response Measures:

- NHAI and State Public Works Departments (PWDs) mobilized teams to clear debris and restore traffic on NH-16 within 48 hours.
- Temporary repairs were made to damaged culverts, and sandbags were used to stabilize washed-out road sections.
- MoRT&H coordinated with NDRF to provide heavy machinery for debris clearance.
- Emergency funds were allocated to Regional Officers for immediate restoration works.

Lessons Learned:

- Inadequate drainage systems exacerbated flooding; wider and deeper drains are now prioritized in cyclone-prone zones (as per IRC: SP:113-2018).
- Pre-disaster identification of vulnerable stretches and regular maintenance of drainage systems could have reduced the extent of damage.
- The need for cyclone-Resilient bridge designs was highlighted, leading to updated guidelines for structural reinforcement.

4.2.2. Floods/cloud burst/urban flood

The main causes of floods are heavy rainfall, inadequate capacity of rivers to carry the high flood discharge, inadequate drainage to carry away the rainwater quickly to streams/ rivers, ice jams or landslides blocking streams. Cyclones also cause floods. Flash floods occur with high rate of water flow due to high intensity rain/ storm/ cloud burst and due to poor permeability of the soil. Areas with hardpan just below the surface of the soil are more prone to floods as water fails to seep down to the deeper layers.

Case Study: Kerala Floods (August 2018) – Impact on NH-66 and Other Highways

Impact on Road Infrastructure:

- The unprecedented floods in Kerala, triggered by heavy monsoon rains and cloudbursts, severely impacted NH-66, a critical coastal highway connecting major cities like Kochi and Thiruvananthapuram.
- Over 200 km of national and state highways were submerged or washed away, with NH-66 facing multiple breaches due to overflowing rivers and inadequate drainage.
- Urban flooding in Kochi led to waterlogging on arterial roads, disrupting access to relief centers and hospitals.
- Landslides triggered by heavy rains blocked hill roads, including sections of NH-183, isolating communities in Idukki and Wayanad districts.

Response Measures:

- MoRT&H deployed Regional Officers to coordinate with State PWD and NDRF for rapid debris clearance and temporary road restoration.
- Inflatable boats and heavy machinery (e.g., excavators) were mobilized to clear blocked sections and restore connectivity within 72 hours in critical areas.
- Emergency funding was utilized by Executive Engineers for immediate repairs, such as filling breaches with gravel and sandbags.
- The Indian Army and BRO assisted in constructing temporary Bailey bridges to restore connectivity in isolated areas.

Lessons Learned:

- Poor drainage systems in urban and rural road networks exacerbated flooding, emphasizing the need for wider drains and regular desilting (IRC: 34-2011).
- Pre-flood mapping of vulnerable stretches and bridges could have enabled proactive reinforcement.
- Community-based early warning systems were underutilized, highlighting the need for better integration with local authorities.

4.2.3. Earthquakes

Wide-spread human and material losses, collapse of infrastructure and services may be the major consequences of the earthquake. Earthquakes over 5.5 magnitudes on the Richter scale are progressively damaging to property and human life. Globally, earthquakes result in a loss of about 50,000 lives every year.

Case Study: Bhuj Earthquake (January 2001) – Gujarat, India

Impact on Road Infrastructure:

- The Bhuj earthquake (magnitude 7.7) caused extensive damage to road infrastructure in Gujarat, particularly NH-8A (now NH-41), connecting Ahmedabad to Kandla.
- Cracks and surface ruptures appeared on road pavements, rendering several stretches of NH-8A impassable.
- Bridges and overpasses suffered structural damage, with some experiencing partial collapse due to inadequate seismic-Resilient design.
- Debris from collapsed buildings blocked access roads, delaying rescue and relief operations in rural areas.

Response Measures:

- MoRT&H coordinated with the BRO and State PWD to clear debris and restore connectivity on NH-8A within 96 hours.
- Temporary diversions were created using gravel and sand to bypass damaged sections.
- Structural engineers were deployed to assess bridge stability, and emergency repairs were prioritized based on damage assessments.
- The National Earthquake Engineering Simulation Consortium (NEESC) provided technical support for retrofitting damaged structures.

Lessons Learned:

- Following the 2001 Bhuj earthquake, significant revisions were made to India's bridge seismic design guidelines, culminating in IRC: SP:114-2018.
- Initial Reforms & Force-Based Design (2003): Interim seismic provisions in IRC:6 introduced a force-based approach. This included spectral acceleration (by soil type), importance factors, response reduction factors, mandatory dislodgement prevention, and ductile pier detailing (as per IS:13920), especially for Zones IV and V.
- Seismic Device Recommendations: Special seismic devices like base isolation bearings and Shock Transmission Units (STUs), acting as seismic arresters, were recommended to mitigate earthquake forces.
- Enhanced Seismic Force Considerations (2008 & SP:114-2018): Later revisions, reflected in IRC: SP:114-2018, included simultaneous action of forces in three directions, dynamic earth pressure, and hydrodynamic forces during earthquakes.
- Shift to Limit State & Capacity Design (SP:114-2018): IRC: SP:114-2018 adopted a limit state design approach (from IS 1893 methodology), emphasizing capacity design principles, expanded analysis methods, and detailed ductile detailing requirements for controlled seismic response.

4.2.4. Tsunamis

A tsunami is a series of water waves caused by the displacement of a large volume of a body of water, usually in an ocean and it happens after centuries of energy build-up within the earth. Seismically generated tsunamis are the result of abrupt deformation of sea floor resulting in vertical displacement of the overlying water. It may be caused by non-seismic events such as a landslide or impact of a meteor. The release of energy produces tsunami waves that have small amplitude but a very long wavelength (often hundreds of kilometers long). At deep sea, the waves travel at about 800 km per hour, having an amplitude of only about 1 m and therefore, remains undetected by ships in the deep sea. However, when it approaches the coast, its wavelength diminishes but amplitude grows enormously, and it takes very little time to reach its full height. Tsunamis have the potential of causing significant casualties, widespread property damage, massive infrastructure loss and long-term negative economic impacts.

Case Study: Indian Ocean Tsunami (December 2004) – Tamil Nadu and Andaman & Nicobar Islands

Impact on Road Infrastructure:

- The 2004 Indian Ocean Tsunami caused massive destruction to coastal roads in Tamil Nadu, particularly NH-45A (now NH-32) along the Chennai-Puducherry corridor.
- Storm surges with run-up elevations up to 10 meters washed away road embankments and inundated low-lying sections, disrupting connectivity to coastal communities.
- In the Andaman & Nicobar Islands, NH-223 (now NH-4) was severely damaged, with sections submerged or eroded by waves.
- Bridges and culverts along coastal highways collapsed due to hydrodynamic forces, isolating towns and delaying relief efforts.

Response Measures:

- MoRT&H collaborated with NDRF to deploy inflatable boats and helicopters for relief operations.
- Temporary access routes were created using sand and gravel to restore connectivity within 72 hours in critical areas.
- Regional Officers submitted damage assessment reports, enabling rapid allocation of emergency funds.

- Mangrove restoration was initiated post-event to mitigate future tsunami impacts.

Lessons Learned:

- Coastal roads lacked elevation planning, highlighting the need for run-up elevation data in design.
- The absence of tsunami-Resilient building codes for highways increased vulnerability.
- Community awareness and signage for evacuation routes were insufficient.

4.2.5. Landslides

Landslides have been a major and widely spread natural hazard that often affect life and property, leading to a major concern. Landslides are a significant natural hazard involving the movement of rock, earth, or debris down a slope. They can be triggered by various factors, including heavy rainfall, earthquakes, volcanic activity, and human activities such as deforestation and construction. Landslides can cause severe damage to infrastructure, homes, and agricultural land, leading to substantial economic losses and sometimes loss of life. The risk of landslides increases in areas with steep terrain, loose or eroded soil, and lack of vegetation. Early warning systems, proper land-use planning, and slope stabilization techniques are essential measures to mitigate the impact of landslides. Understanding the geological and environmental conditions that lead to landslides is crucial for developing effective prevention and response strategies.

Case Study: Uttarakhand Landslides (June 2013) – NH-58 (now NH-7)

Impact on Road Infrastructure:

- Heavy rainfall triggered massive landslides along NH-58 in Uttarakhand, particularly in the Rudraprayag and Chamoli districts, during the 2013 monsoon.
- Multiple sections of NH-58 were blocked by debris and boulders, isolating pilgrimage sites like Kedarnath and Badrinath.
- Slope failures damaged road embankments, and several culverts were clogged, exacerbating flooding.
- The landslides disrupted access to relief and rescue operations, stranding thousands of pilgrims and tourists.

Response Measures:

- BRO deployed heavy machinery, including excavators and bulldozers, to clear debris and restore traffic within 48 hours on critical stretches.
- MoRT&H coordinated with the State Disaster Response Force (SDRF) to prioritize rescue operations and temporary road restoration.
- Regional Officers conducted rapid damage assessments and mobilized contractors for emergency repairs.
- Temporary retaining walls were constructed to stabilize slopes and prevent further slides.

Lessons Learned:

- Inadequate slope stabilization and drainage management contributed to landslide severity (IRC: SP:106-2015).
- The lack of real-time monitoring systems for landslide-prone zones delayed response.
- Community-based early warning systems could have mitigated risks.

4.2.6 Snow Avalanche:

Avalanches are block of snow or ice descending from the mountain tops at a river like speedy flow. They are extremely damaging and cause huge loss to life and property. In Himalayas, avalanches are common in Drass, Pir

Panijal, Lahaul-Spiti and Badrinath areas. As per Snow and Avalanche Study Establishment (SASE), of Defence Research and Development Organisation (DRDO), on an average, around 30 people are killed every year, due to this disaster in various zones of the Himalayan range. Beside killing people, avalanches also damage the roads, bridges, entry and exits of tunnels, other road assets, properties, and settlements falling in its way. Traffic blockage, structural damages of roads, and retaining wall damages occur most frequently due to avalanches.

Case Study: Himachal Pradesh Avalanche (February 2019) – NH-5 (Kinnaur District)

Impact on Road Infrastructure:

- A massive snow avalanche struck NH-5 in Kinnaur, Himachal Pradesh, blocking a 5-km stretch and isolating remote villages.
- Snow accumulation and debris damaged road surfaces and guardrails, rendering the highway impassable for over a week.
- The avalanche disrupted supply chains for essential goods, affecting local communities and military outposts.
- Icy conditions and secondary avalanches complicated clearance efforts.

Response Measures:

- BRO mobilized snow-clearing equipment, including snowplows and bulldozers, to restore connectivity within 72 hours for critical sections.
- MoRT&H coordinated with the Indian Army and NDRF to airlift stranded individuals and deliver relief supplies.
- Regional Officers used delegated financial powers to procure additional snow-clearing equipment.
- Temporary snow galleries were installed to protect vulnerable stretches.

Lessons Learned:

- The absence of permanent snow galleries in avalanche-prone areas increased vulnerability (NDMA Guidelines on Landslides and Snow Avalanches, 2009).
- Delayed early warning systems hindered timely evacuation and road clearance.
- Regular maintenance of snow-clearing equipment was critical but under-resourced.

Note: - Some additional Case Studies are given in APPENDIX-IX.

4.2.7 Climate Change

Climate change poses significant emerging risks to the road and highway sector, exacerbating existing vulnerabilities and introducing new challenges to infrastructure resilience. Rising global temperatures, changing precipitation patterns, and increasing frequency of extreme weather events directly impact the design, construction, maintenance, and operation of road networks. These changes necessitate adaptive measures to ensure the long-term functionality and safety of road infrastructure.

Examples of Climate Change Impacts:

1. **Increased Flooding and Erosion**: Heavier and more frequent rainfall events, driven by climate change, lead to flooding that can wash out roads, damage bridges, and erode embankments. For instance, the 2018 Kerala floods caused extensive damage to National Highways, disrupting connectivity and requiring significant reconstruction efforts.

2. **Heatwaves and Thermal Expansion**: Prolonged heatwaves can cause asphalt pavements to soften and deform, leading to rutting and cracking. In 2022, extreme heat in northern India led to pavement deterioration on several National Highways, increasing maintenance costs and safety risks.
3. **Sea Level Rise**: Coastal highways are increasingly at risk due to rising sea levels and storm surges. For example, sections of NH-66 along the Konkan coast have faced recurrent inundation, necessitating elevation and protective measures like seawalls.
4. **Glacial Lake Outburst Floods (GLOFs)**: In Himalayan regions, melting glaciers due to rising temperatures increase the risk of GLOFs, which can devastate roads and bridges. The 2021 Chamoli disaster in Uttarakhand, triggered by a glacial breach, washed away sections of NH-58, isolating communities and requiring emergency restoration.

Mitigation Strategies:

- Incorporate climate-resilient design standards, such as elevated road structures and improved drainage systems, to mitigate flooding risks.
- Use heat-Resilient materials like polymer-modified bitumen to enhance pavement durability under high temperatures.
- Conduct climate risk assessments during the planning phase to identify vulnerable road stretches and integrate adaptive measures.
- Promote afforestation and bioengineering techniques to stabilize slopes and reduce erosion in climate-sensitive areas.

4.2.8 Technological Hazards

Words into Action Guidelines: Implementation Guide for Man-made and Technological Hazards published by the **United Nations Office for Disaster Risk Reduction (UNISDRR) in 2018** in support of the Sendai Framework for Disaster Risk Reduction 2015-2030 lists different types of **Technological Hazards,** out of which only **Transportation Hazard** namely, **transport accidents involving dangerous goods and hazardous substances** (e.g. *explosives and gases, flammable and oxidizing substances, toxic and infectious substances and articles, radioactive and corrosive, environmentally hazardous and miscellaneous dangerous substances and articles.*) which occur during transport by road, pertains to MoRT&H.

MoRT&H has laid down the regulatory framework for the transportation of dangerous goods and hazardous substances under the Central Motor Vehicles Rules, 1989.

The detailed operational guidelines for transportation of dangerous goods and hazardous substances shall be prepared by the Road Safety Division of MoRT&H, in consultation with all stakeholders, and incorporated in subsequent update of Volume-II: Disaster Management Sub-Plan for Road Accidents or a separate standalone volume.

Table 4-1: Overview of impacts of different identified hazards on road infrastructure

Hazard	Impacts
Landslide	● Failure/slippage of embankments, roadside slopes ● Loss of avenue plantation ● Reduced shoulders width ● Reduced / washout of lane(s) ● Partial to complete damage to carriageway ● Obstruction to traffic and supply chain network. ● Damage to roadside features, drainage structures, protection works, and signages. ● Impact on road safety and visibility of road ● Damage to roadside properties (public and private)
Avalanche	● Disruption to transport network ● Overturning of protection structures ● Damage to road structure ● Damage to roadside properties (public and private)
Earthquake	● Can trigger landslides, avalanches and Tsunami. ● Damage to culverts and cross drainage assets ● Damage of roadside properties (public and private) ● Develop cracks and destabilize the carriageway and off-carriageway features. ● May cause sinkholes as result of damage to underground utilities along road alignment. ● May create instability in slopes along the alignment. ● Disruption of road network
Tsunami	● Washout/ severe damage to roads and bridges ● Failure of protection works ● Large volume of debris on road ● Disconnected road network requiring major reconstruction.
Flooding	● Roads with limited foundations and poor or no drainage can be washed away or scoured. ● More rapid degradation of subgrade material underneath roads or pavements, leading to loss of strength and bearing capacity. ● Submergence of roads and bridges ● Failure of drainage structures ● Erosion of embankments and can cause subsidence
Cyclones	● Can cause storm surge, flooding and landslides. ● Damage to bridges, flyovers, street lighting, signs and other assets. ● Uprooting of avenue plantation and damage to road side features obstructing the traffic. ● Huge waste and debris deposition on carriageway. ● Increased erosion of coastal areas destabilizing coastal roads

S&R Zone to further study and identify the disaster which have adverse effect on highway/ road sector. Accordingly, this section shall be periodically updated/finalized by S&R Zone.

4.3 Disaster Zoning

The concept of disaster zoning identifies the areas having similar parameters on average particularly with respect to disaster caused by natural hazards. The impacts of the disasters and their multiplier effects on the economy, national development and severity of affected infrastructures are well known and need to be adequately quantified. Natural calamities like earthquakes, cyclones /cyclonic storm /hurricanes, floods, tsunamis etc. have been scientifically and statistically studied based on data collected the world over. It has become possible to predict their intensities with a certain degree of confidence so that structures/equipment machinery etc. can be designed to withstand the effect of these forces. Seismic loads as well as wind loads have been measured/instrumented in the country by various organizations like India Meteorological Department (IMD), Geological Survey of India (GSI) etc. As regard to floods, Central Water Commission (CWC) has established a network of Gauge & Discharge (G&D) sites for the measurement of various parameters of discharge of major rivers and forecasting the floods.

In every disaster, highway infrastructure including buildings, tall structures, etc. are vulnerable to damage. Therefore, suitable margins and factors of safety are to be considered in the design of highway infrastructure to sustain the severity according to the zone characteristics. However, the intensity, suddenness and extent of any natural calamity are beyond any perfect assessment and have to be effectively managed in the event of its occurrence.

Disaster zoning can refer to the hazard maps available with various climatic and research institutes namely BIS, BMTPC, NDMA, Bhuvan portal etc., The zonation reference may be made to State specific Risk Zonation, IMD hazard atlas for cyclone, heat, Sea Level Rise (SLR), Wind, Fog, Storm Surge, Snow Avalanche, Rockfall prone areas, flood hazard and other climate change/ extreme events.

4.3.1. Cyclone Prone Zone (IMD)

The major natural hazard that affects the coastal regions of India is cyclone. India has a coastline of about 7516 kms and about 71 percent of this area is in ten states (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Odisha and West Bengal). The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones. The effect of a storm surge is most pronounced in wide and shallow bays exposed to cyclones such as in the northern part of Bay of Bengal. On average, five or six tropical cyclones occur every year, of which two or three could be severe. Most cyclones occur in the Bay of Bengal followed by the Arabian Sea and the ratio is approximately 4:1. India is exposed to nearly 10 percent of the world's tropical cyclones.

IMD has been working in predicting cyclonic events with the help of satellites and numerical weather prediction tools and it can be done accurately up-to 12 hours' validity. Cyclonic events and their damage as defined by IMD is below:

SI.	Cyclone Type	Wind Speed (km/h)	Inundation distance from cost	Damage
1	Severe	88-107	Upto 5 km	Moderate
2	Very severe	108-167	Upto 10 km	Large
3	Extra severe	168-221	Upto 10-15 km	Extensive
4	Super	222 & above	Upto 40 km	Catastrophic

In India, cyclones of catastrophic nature have been witnessed. Cyclonic winds due to Phailin, Nilam, Hud-Hud and other events in Bay of Bengal belt had 3-minute sustained maximum wind speed of about 260 km/h. Thus, an adequate factor of safety needs to be considered while designing highway infrastructure.

4.3.2. Flood Zone (CWC)

India is one of the most flood prone countries in the world. The principal reasons for flood lie in the very nature of natural ecological systems in this country, namely, the monsoon, the highly silted river systems, and the steep and highly erodible mountains, particularly those in the Himalayan ranges. The average rainfall in India is 1150 mm with significant variation across the country. The annual rainfall along the western coast and the Western Ghats, Khasi hills and over most of the Brahmaputra valley amounts to more than 2500 mm. Most of the floods occur during the monsoon period and are usually associated with tropical storms or depressions, active monsoon conditions and break monsoon situations.

23 of the 37 states and union territories in the country are subject to floods and 40 million hectares of land, roughly one-eighth of the country's geographical area, are prone to floods. Floods occur in almost all river basins in India. Areas liable to Floods in India are Punjab, Uttar Pradesh, Northern Bihar, West Bengal, Assam, Arunachal Pradesh, Odisha, Coastal Andhra Pradesh, Telangana, Kerala, Karnataka, Parts of Gujarat, Kashmir Valley.

Flood Plain Zoning:

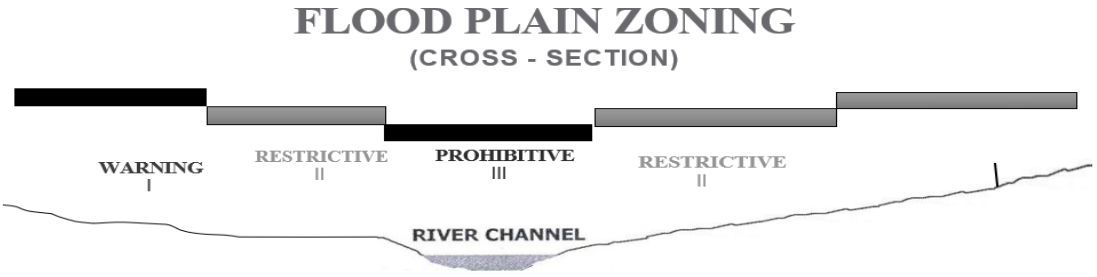
The basic concept of flood plain zoning is to regulate land in the flood plains in order to restrict the damage by floods, which are likely to occur from time to time. It aims at determining the locations and the extent of areas likely to be affected by floods of different magnitudes/ frequency and to develop these areas in such a way that reduces damage to a minimum. CWC has carried out flood plain zoning in some of the river basins in the country. The flood zones have been classified in the following three categories as shown in Figure:

a. Prohibitive zone

b. Restricted zone

c. Warning zone

The relevant IRC code namely IRC: SP:113-2018 on flood disaster mitigation for highways engineers may be followed.



4.3.3. Earthquake Zone: The Indian subcontinent is very prone to earthquakes and some of the most intense earthquakes of the world have occurred in India. The entire Himalayan region is considered to be vulnerable to

high intensity earthquakes of a magnitude exceeding 8.0 on the Richter Scale. Scientific publications have warned that very severe earthquakes are likely to occur anytime in the Himalayan Region, which could adversely affect the lives of several million people in India.

The extent of the impact of an earthquake depends on its magnitude, location and time of occurrence. Bureau of Indian Standard {BIS) code IS: 1893 deals with the earthquake resistance design of various structures. As per the code, the country has been demarcated from the point of view of the intensity of seismic loads in four Zones i.e., Zone-II to Zone-V.

SI.	Zone	Region/ States
1	Zone V	Kashmir, the western and central Himalayas, North Bihar, the North-East Indian region and the Rann of Kutch
2	Zone IV	lndo-Gangetic basin including Delhi, Jammu and Kashmir, Parts of Maharashtra, Gujarat
3	Zone Ill	Coastal Areas, Andaman and Nicobar Islands, Parts of Kashmir, Western Himalayas
4	Zone II	Most of Deccan & Chota Nagpur Plateau, Rajasthan

4.3.4. Tsunami Genic Zone

Not all the major earthquakes are tsunami genie and according to Indian National Centre for Ocean Information Services (INCOIS), for tsunami to hit the Indian coast, it is necessary that earthquake of magnitude more than 7.0 on Richter scale should normally occur. The possible zones for such an event to occur are Andaman - Sumatra or Makran (Pakistan).

4.3.5. Landslide Zone (GSI)

Landslides mainly affect the Himalayan region, the Western Ghats of India and also in the Nilgiri Range. It is estimated that 30 percent of the world's landslides occur in the Himalayas. The unprecedented rains in the Nilgiris region in 1978 alone had triggered about one hundred landslides which caused severe damage to communication lines, tea gardens and other cultivated crops.

There have been marked improvements in the quality, timeliness and lead time of hazard warnings, mainly driven by scientific and technological advances. For landslide monitoring, identifying the incipient instability of slopes and early warning of ensuing landslides is possible through systematic mapping, slope instrumentation, monitoring and real-time data analysis. Modern technology offers several high-resolution instruments that can capture, monitor and transmit data for real-time analysis and forecasting. Simple devices commonly used for early warning against landslides in the recent past are wire or special switches, actuated by the pressure of moving debris to give signal, electrical switch poles which turn to an upright position upon displacement, photo-electrical barriers especially for rapidly moving debris flows or earth flows and pulsed radar for snow avalanches.

The relevant documents namely IRC: SP:106-2015 Engineering Guidelines on Landslide Mitigation Measures for Indian Roads may be followed.

4.3.6. In addition to above, the exercise of preparing/ updating the detailed maps to delineate the region/NH Network vis-a-vis the available disaster zones shall be undertaken as per **Appendix-II.**

5. Disaster Risk Reduction and Building resilience

As per UNDRR, Disaster risk reduction consists of a framework of elements aimed at preventing new and reducing existing disaster risk (i.e., disaster mitigation) and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. Disaster risk reduction includes disciplines like disaster management, disaster mitigation and disaster preparedness.

5.1. Disaster Specific Mitigation Strategies for the Road Sector

The disaster specific mitigation strategies for the road sector including National Highways, as laid down in relevant guidelines, manuals, circulars of MoRT&H, IRC shall be updated from time to time by the S&R Zone to align the road sector specific Disaster Specific Mitigation Strategies with the extant National Disaster Management Plan. Representative from NDMA shall be included as a Member of the Apex Committees and other Technical Committees of IRC dealing with disaster mitigation guidelines.

The updated list of such guidelines, manuals, circulars applicable for the road sector (National Highways), shall be maintained by the S&R Zone and hosted on the MoRT&H website. The current list is placed at **Appendix-III** (as provided by the S&R Zone).

All implementing agencies of MoRT&H shall follow the Disaster Specific Mitigation Strategies as laid down in relevant guidelines, manuals, circulars of MoRT&H, IRC.

The S&R Zone shall issue Abstract Technical Advisory from time to time, laying down the disaster specific basic mitigation measures, in abstract form, to serve as a ready reckoner for field officials. For the avoidance of doubt, it is clarified that the Abstract Technical Advisory shall be used by the field officials for basic understanding, and the respective guidelines, manuals, circulars of MoRT&H, IRC shall be followed for implementation purpose. The current ready reckoner is placed at **Appendix-IV**.

5.2 Disaster Risk Reduction and Building resilience - The Responsibility Matrix

The chapter presents responsibility matrix for the six Thematic Areas (TA) and related Sub- Thematic Areas for Operational Risk Management (ORM) as envisaged under Sendai Framework: viz. Understanding Risk, Inter-Agency Coordination, Investing in Operational Risk Reduction (ORR) - Structural Measures, Investing in ORR - Non- Structural Measures, Capacity Development & Climate Change Risk Management for each hazard in the succeeding sub-sections. The responsibility matrix for Inter-Agency Coordination, investing in ORR - Non-Structural Measures & Capacity Development are common and applicable to all types of hazards. The responsibility matrix for the same is given at **Appendix- II.**

5.3 Risk Reduction Practices in Other Countries

To enhance the resilience of India's road and highway sector against disasters, MoRT&H can draw inspiration from successful risk reduction measures implemented in other countries. These international practices demonstrate effective strategies for mitigating disaster risks, improving preparedness, and ensuring rapid recovery. Below are specific examples of successful risk reduction measures adopted globally, tailored to the context of the road and highway sector:

i. Japan: Earthquake-Resilient Road Infrastructure

Practice: Japan, a country prone to frequent earthquakes, has implemented advanced seismic design standards for its road and highway infrastructure. For instance, the Hanshin Expressway, severely damaged during the 1995 Kobe earthquake, was retrofitted with seismic isolation bearings and dampers to absorb seismic energy. New

highways, such as the Tokyo Bay Aqua-Line, incorporate flexible joints and reinforced materials to withstand seismic forces.

Implementation: Japan uses real-time earthquake monitoring systems integrated with traffic management to halt traffic on vulnerable bridges and highways during seismic events, preventing accidents and enabling rapid inspections. Post-disaster, Japan employs prefabricated modular bridges for quick restoration of connectivity, as seen after the 2011 Tohoku earthquake.

Relevance to India: MoRT&H can adopt seismic-Resilient design standards for bridges and highways in earthquake-prone zones (e.g., Zone IV and V as per India's seismic zoning). Collaborating with the Indian Meteorological Department (IMD) for real-time monitoring and integrating automated traffic control systems can enhance preparedness. The use of modular bridges could expedite recovery in states like Himachal Pradesh and Uttarakhand, prone to earthquakes and landslides.

ii. Netherlands: Flood-Resilient Road Design

Practice: The Netherlands, with much of its land below sea level, has developed flood-resilient road infrastructure. The A4 motorway near Rotterdam includes elevated sections and advanced drainage systems to prevent flooding during heavy rainfall or storm surges. The country also employs "floodable roads" designed to temporarily store water during extreme events, reducing damage to critical infrastructure.

Implementation: The Netherlands uses permeable pavements and large-scale retention basins alongside highways to manage excess water. The Delta Works program integrates roads with flood barriers, such as movable gates, to protect coastal highways from storm surges.

Relevance to India: In flood-prone regions like Assam, Bihar, and Uttar Pradesh, MoRT&H can incorporate elevated road designs and advanced drainage systems, as outlined in IRC:SP:113-2018 (Guidelines on Flood Disaster Mitigation for Highway Engineers). Retention basins and permeable pavements can be piloted in urban flood-prone areas like Mumbai and Chennai to manage cloudbursts and urban flooding effectively.

iii. United States: Hurricane-Resilient Coastal Highways

Practice: In hurricane-prone states like Florida, the U.S. has implemented resilient design measures for coastal highways. For example, the Overseas Highway in the Florida Keys is elevated and reinforced to withstand storm surges and high winds. Post-Hurricane Katrina, Louisiana upgraded its highway infrastructure with stronger embankments and improved drainage systems.

Implementation: The U.S. employs early warning systems linked to the National Hurricane Center, enabling preemptive road closures and evacuations. Vegetation buffers, such as mangrove plantations, are used to reduce wind and wave impact along coastal roads.

Relevance to India: For cyclone-prone states like Odisha, Andhra Pradesh, and Tamil Nadu, MoRT&H can adopt elevated road designs and reinforce embankments, as recommended in IRC:34-2011 (Guidelines for Road Construction in Areas Affected by Water Logging, Flooding). Planting mangroves along coastal highways, as suggested in Appendix IV, can mitigate cyclone and tsunami impacts, drawing from successful U.S. practices.

iv. New Zealand: Landslide Mitigation on Highways

Practice: New Zealand, with its mountainous terrain, has implemented advanced landslide mitigation measures on highways like State Highway 1. Techniques include slope stabilization using soil nailing, rock bolting, and retaining walls, combined with real-time monitoring systems to detect ground movement.

Implementation: After the 2016 Kaikoura earthquake, New Zealand deployed drones and satellite imagery for rapid damage assessment and prioritized repairs using geosynthetic reinforcements. Community-based early warning systems involve local stakeholders to monitor landslide-prone areas.

Relevance to India: In landslide-prone regions like Himachal Pradesh and Sikkim, MoRT&H can implement slope stabilization techniques as per IRC:SP:106-2015 (Engineering Guidelines on Landslide Mitigation Measures for Indian Roads). Deploying drones for rapid damage assessment and engaging local communities for early warning, as outlined in Appendix IV, can enhance preparedness and response.

v. Australia: Bushfire-Resilient Road Networks

Practice: Australia has developed bushfire-resilient road networks to ensure connectivity during wildfires. For example, the Hume Highway in New South Wales incorporates firebreaks, widened road shoulders, and heat-Resilient materials to maintain accessibility for emergency services during bushfires.

Implementation: Australia uses predictive fire modelling to identify at-risk road sections and deploys mobile fire suppression units along highways. Post-fire recovery includes rapid debris clearance and temporary road repairs to restore connectivity.

Relevance to India: While bushfires are less common in India, similar principles can be applied to manage forest fires in states like Uttarakhand and Madhya Pradesh. MoRT&H can integrate firebreaks and heat-Resilient materials in road design and collaborate with forest departments for predictive modelling and rapid response strategies.

5.4. Indigenous Knowledge and Traditional Practices in Risk Reduction

The integration of indigenous knowledge and traditional practices into disaster risk reduction (DRR) strategies is crucial for enhancing the resilience of road and highway infrastructure, particularly in regions prone to natural disasters. Indigenous communities and local populations often possess a deep understanding of their environment, developed over generations, which can complement modern engineering and disaster management approaches. Indigenous knowledge and traditional practices shall also be leveraged for better outcomes.

5.4.1 Use cases for Indigenous Knowledge and Traditional Practices

- **Environmental Understanding:** Indigenous communities often have detailed knowledge of local topography, weather patterns, and ecological indicators, which can inform the identification of vulnerable road stretches and disaster-prone areas.
- **Early Warning Systems:** Traditional practices, such as observing animal behavior, plant cycles, or weather signs, can serve as effective early warning systems for disasters like floods, landslides, or cyclones.
- **Sustainable Practices:** Indigenous methods, such as the use of local materials for construction or natural barriers like vegetation for slope stabilization, can enhance the durability and resilience of infrastructure.
- **Community Engagement:** Leveraging local knowledge fosters community participation, ensuring that disaster management strategies are culturally appropriate and widely accepted.

5.4.2 Case Examples

- **Landslide Mitigation in Hilly Regions:** In the Himalayan region, local communities have traditionally used bamboo and stone barriers to stabilize slopes. These practices can be integrated into modern landslide mitigation strategies, such as those outlined in IRC: SP: 106-2015, to enhance slope stability along national highways.
- **Flood Management in Coastal Areas:** Indigenous communities in coastal regions often plant mangroves to reduce the impact of storm surges and tsunamis. MoRT&H can adopt this practice by promoting mangrove plantations along coastal highways, as suggested in Appendix-IV, to mitigate flooding and erosion.
- **Traditional Weather Forecasting:** In certain rural areas, communities rely on traditional indicators, such as bird migration patterns or cloud formations, to predict heavy rainfall or cyclones. These can be combined with meteorological data to improve early warning systems for road users and maintenance teams.

6. Preparedness

6.1. Preparedness

The United Nations Office for Disaster Risk Reduction (UNDRR) defines preparedness as:

"The knowledge and capacities developed by governments, professional response and recovery organizations, communities, and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent, or current hazard events or conditions."

Preparedness ensures an effective response to hazards, through the anticipation and timely evacuation of people and property from threatened areas. It encompasses activities such as early warnings, contingency planning, and resource mobilization. A sound disaster risk analysis, early warning systems, and coordination between all stakeholders (government agencies, communities, NGOs, and the private sector) are vital for effective preparedness.

6.1.1 Digital Resource Mapping for Road Stretches

Mapping of Resources: All NH/road stretches, including contractor resources (human and machinery), should be mapped on a digital database. Relevant stakeholders should have access to this data for effective resource mobilization during disaster events.

Real-Time Resource Allocation: Enable quick identification of available resources, including machinery and manpower, in disaster-prone areas for immediate mobilization.

6.1.2 Project Specific Preparedness: In view of the natural hazards or disasters occurring every year, all agencies (NHAI/NHIDCL/BRO/PWD/CPWD etc.) are instructed to proactively implement preventive/ precautionary measure and be in state of preparedness to meet eventually arising out of natural hazards and disaster. It is imperative that all roads and highways which have been entrusted to respective agencies for widening, strengthening or completed corridors, remain in a condition suitable for traffic under all circumstances.

i. The civil contractor holds responsibility for maintenance works in sections where widening and strengthening activities are underway.

ii. Each RO should direct its concerned PIUs/PMUs to identify the specific locations where disasters are occurring regularly and inventory of all equipment and machinery which are required during disaster should be available along with their availability in advance and kept handy in each SO/PIU/PMU.

iii. Necessary liaison and co-ordination with district administration/ state government should be maintained by RO/PMU of each state/district.

iv. A comprehensive directory of officers involved in natural hazards or disaster management at various levels will be prepared by all agencies and State levels giving their names, addresses, telephone numbers, mobile numbers, email address. Such directory will be widely circulated and updated annually.

v. The key personnel of Contractor/ consultant and Site Officials should maintain a comprehensive list of service provider of ambulance, hospitals and trauma care centers which have the facilities to take care of the accident victims. Such details should also be readily available at the camp site of the contractor, office of the consultant and Site Officials and displayed at hazard locations.

vi. Each RO will designate one officer in charge for liaison and monitoring of the disaster related activities. Further, each Site Office shall maintain liaison and co-ordination with adjoining PMU to meet any emergency.

vii. All PDs/GM(P)s are required to provide a certificate within a period of one month from occurrence of disaster of completing measures.

viii. Provision of installation of Bailey bridge: Bailey bridges are suitable for hilly areas due to their modular design and versatility. They can be quickly assembled to span gorges, ravines, or uneven terrain, providing temporary crossings in emergency situations. Their strength and durability make them capable of supporting the weight of vehicles on slopes and rugged landscapes. Additionally, their portability allows for rapid deployment to remote or inaccessible locations, facilitating emergency road repairs in hilly terrain. As per the site constraints and impact of natural calamity, the provisions for installation of Bailey bridge through experts may be adopted as per standard & specification of MoRT&H.

ix. All cross drainages must be inspected pre-monsoon, and it may be ensured that there is no debris/ dismantled material/ any other obstruction in the water way.

x. All pucca drains, kaccha drains, median drains, sub-surface drains, drainage spouts on bridges and drainage pipes in the kerb between the main road and service road etc. are properly cleaned and maintained so that there is no ponding of water on the carriageway or service road.

xi. Embankment protection and stone pitching etc. at all Cross Drainage Works may be checked in advance and rectified if required.

xii. Special attention/ vigilance needs to be given to cross drainage structure and embankment at the location of major rivers and canals where there is a history/ precedent of flood damages.

xiii. Contact telephone no. of ambulance services should be displayed at regular intervals specially near the accident/ flood prone locations to provide immediate help in case of any emergency.

xiv. For the bridge/ C.D works which are under construction, adequate arrangements for drainage by providing suitable numbers of pipes at the time of staging/ shuttering be ensured at site.

xv. No construction material/ debris/loose soil should be dumped on road surface.

xvi. The placements of construction material/ earth in median/ carriageway should be checked and ensured that there is no spillage of such materials or mud due to flow of water on the carriageway under use to avoid any slippery surface causing accidents.

xvii. Advance-warning signs regarding portions of any of the highways closed/ damaged or diversion or any other information which needs to be advised to the road users should be prepared in advance.

xviii. All contractors working on the roads and highway projects must be advised to take all necessary safety measures, precautions during construction to protect the work and ensure safety of the road users during heavy rains and floods. Further, the area under excavation/ trenching should be properly cordoned off by providing suitable barricading and arrangement for providing lighting, retro-reflective tapes, sign boards should be made at such hazardous locations.

6.1.3 Bailey Bridges: Application in Disaster Management for the Road Sector

A **Bailey Bridge** is a portable, prefabricated, truss bridge designed for rapid deployment in emergency situations, such as during natural disasters or military operations. Developed during World War II by British engineer Sir Donald Bailey, it is renowned for its simplicity, modularity, and ability to be quickly assembled without heavy machinery. These characteristics make Bailey Bridges an essential tool in the disaster management framework of the MoRTH, particularly for restoring connectivity in areas affected by floods, landslides, or other disasters that damage National Highways (NHs).

Bailey Bridge Preparedness for Floods and Landslides

Pursuant to MoRT&H Circular No. NH-15017/17/2016-P&M dated 15.04.2025, NHIDCL is designated as the nodal agency for planning, procurement, and custody of Bailey Bridges for immediate restoration works under the Maintenance & Repair (M&R) head. A separate fund will be allocated to NHIDCL, which shall submit a proposal for fund requirements after assessing demand from various agencies. NHIDCL is tasked with pre-positioning Bailey Bridges at vulnerable locations in mountainous terrain for emergency deployment.

Table: Consolidated Proposition of Bailey Bridge Locations (State/UT-wise)

Sl. No.	State/UT	Location	Length & Width (Load Class-70R)	Remarks
1	Jammu & Kashmir	Jammu	L=200 ft, W=4.25m	01 Bailey Bridge
2	Jammu & Kashmir	Srinagar	L=200 ft, W=4.25m	01 Bailey Bridge
3	Ladakh	Leh	L=200 ft, W=4.25m	01 Bailey Bridge
4	Assam	Guwahati	L=120 ft, W=4.25m	01 Bailey Bridge
5	Assam	Silchar	L=140 ft, W=4.25m	01 Bailey Bridge
6	Arunachal Pradesh	Tawang	L=120 ft, W=4.25m	01 Bailey Bridge
7	Arunachal Pradesh	Roing	L=200 ft, W=4.25m	01 Bailey Bridge
8	Sikkim	-	L=200 ft, W=4.25m	02 Bailey Bridges
9	Uttarakhand	-	L=200 ft, W=4.25m	02 Bailey Bridges
10	Himachal Pradesh	-	L=200 ft, W=4.25m	01 Bailey Bridge (Stored by BRO)
11	Nagaland	Silchar	L=200 ft, W=4.25m	01 Bailey Bridge (Stored at Silchar)
12	Mizoram			
13	Tripura			
14	Manipur			
15	Meghalaya	-	L=200 ft, W=4.25m	01 Bailey Bridge
Total				**14 Bailey Bridges**

MoU Details (between NHIDCL and GRSE, dated 29.08.2024):

a) **Delivery:** Dispatch within 30 days of order placement.
b) **Erection/Launching:** Site shall be handed over to GRSE after abutment construction and complete erection of Bailey Bridges be done by GRSE as per requirement. GRSE to undertake minor repairs at installation without cost to agency.
c) **Transportation:** Actual costs plus 5% handling charges, reimbursable by NHIDCL.
d) **Storage:** NHIDCL/agencies provide secure storage, with costs met from project contingencies or M&R funds, reimbursable by MoRT&H. Storage in all states except Himachal Pradesh by NHIDCL; Himachal Pradesh storage by BRO.
e) **Taxation:** GST @ 18% included additional tax changes borne by NHIDCL.

f) **Costing:** Based on GRSE quotations (e.g., Rs. 127.98/kg for 140 ft EWBB 70R, Rs. 158.15/kg for 200 ft SL MSB 70R).

6.2. Disaster-Specific Preparedness Strategies

6.2.1 Cyclones

a) Monitoring and Early Warning

- Continuously monitor updates from IMD, Meghdoot, and INCOIS for cyclone alerts.
- Implement automated systems to issue early alerts for pre-emptive action, both for workers and nearby communities.
- Use satellite data from ISRO to track cyclone developments.

b) Site and Equipment Preparation

- Anchor construction materials, machinery, and temporary structures or store them indoors to prevent wind damage.
- Pre-monsoon drainage system inspections to clear debris and prevent flooding. Retrofit critical infrastructure like power lines and communication towers.
- Follow Ministry guidelines for coastal highway embankments and tree plantation, accounting for sea level rise and storm surge risks.

c) Communication Plan

- Establish reliable communication lines for alerts and evacuation instructions to workers, supervisors, and local residents.
- Provide updated contact lists of emergency services and display them in high-risk areas.

d) Safety Protocols and Contingency Planning

- Outline specific response actions based on the severity of the cyclone, including site securing, drainage checks, and evacuation protocols.
- Develop cyclone response manuals based on IRC: 6-2017 guidelines for cyclone-Resilient structures.

6.2.2 Tsunamis

a) **Early Warning Systems**

- Use data from the National Centre for Seismology (NCS) to detect undersea earthquakes.
- Implement tsunami detection systems along coastal roads, with automated alerts for local residents and highway users.
- Install signage along highways in coastal zones, indicating evacuation routes and risk zones.

b) **Evacuation Plans**

- Develop tsunami response manuals based on NDMA guidelines.
- Clearly mark evacuation routes and safe zones for workers and local communities.
- Conduct regular drills for community and site personnel to ensure effective evacuation during a tsunami event.

c) **Public Awareness**

- Agencies should conduct educational campaigns to raise awareness about tsunamis, their risks, and appropriate responses
- Engage with local groups to spread information and improve response times in case of a tsunami warning.

d) **Infrastructure Resilience**

- Strengthen coastal embankments to protect infrastructure from water surges.
- Design and retrofit infrastructure (roads, bridges) in coastal zones using nature-based and engineered solutions to withstand tsunami impacts.

e) **Coordination**

- Work with local and state disaster management agencies to synchronize responses and resources.
- Collaborate with international experts to adopt best practices for tsunami preparedness and response.

6.2.3 Floods / Cloudbursts / Urban Floods

a) Project Site Selection and Design

- Conduct a thorough floodplain assessment to identify areas at high risk of flooding. Where possible, avoid construction in floodplains.
- If construction in a floodplain is unavoidable, embankments shall be designed, adequate number of cross drainage structures and bridges are to be designed with proper hydraulic and hydrological studies considering projected flood levels and potential future climate change impacts.
- Regular pre-monsoon inspections of drainage systems and culverts to ensure they are clear of debris and capable of managing rainfall.

b) Early Warning Systems & Monitoring

- Use advanced hydrological models like HEC-RAS or Doppler radar systems to monitor and predict intense rainfall events, to simulate flood scenarios.
- Conduct detailed flood risk mapping using GIS tools in collaboration with the Central Water Commission (CWC).
- Develop detailed flood response manuals based on IRC:34-2011 guidelines for flood management.
- Monitor on-site water levels and drainage systems to identify potential issues early.

c) Communication & Evacuation Plan

- Develop a communication plan to quickly inform workers and stakeholders of potential floods.
- Clearly define and mark evacuation routes for flood-prone areas and conduct regular drills to practice evacuation protocols.
- Conduct regular emergency drills to ensure everyone understands their roles and responsibilities during a flood.

d) Flood Barriers and Temporary Crossings

- Pre-purchase and store sandbags for potential use in creating temporary flood barriers around critical infrastructure like causeways, bridges, roads or equipment.
- Consider acquiring water barriers or deployable flood walls for additional protection in high-risk areas.
- Install modular Bailey bridges in flood-prone areas for continued access during emergencies.
- Regularly inspect and maintain levees, dams, and drainage systems and vulnerable infrastructure like bridges and roads with the help of the CWC.

6.2.4 Earthquakes

a) Site Selection and Seismic Design

- Conduct seismic risk assessments to identify earthquake-prone zones and avoid new construction in these areas.
- Ensure infrastructure is designed to withstand seismic forces, following IRC and national building codes.

b) Early Warning Systems and Monitoring

- Implement real-time seismic monitoring to provide timely alerts.
- Install advance signage in earthquake-prone areas, indicating safe evacuation routes and emergency shelters.
- Ensure the availability of search and rescue equipment such as thermal imaging cameras and cutting tools.

c) Emergency Communication and Evacuation Plans

- Developing and updating plans for immediate response post-earthquake, including clearing debris and restoring access.
- Define evacuation routes and assembly points, ensuring accessibility during an earthquake.

d) Public Awareness and Education

- Educate communities on earthquake risks, evacuation routes, and safety protocols through public programs and distributed materials.
- Engage local authorities and organizations to ensure widespread understanding of earthquake safety.

e) Emergency Response and Coordination

- Develop detailed earthquake response plans, including debris removal, access restoration, and damage assessment.
- Coordinate closely with local emergency services and government authorities to streamline the response process.
- Develop earthquake response manuals based on IRC:6-2017 guidelines for earthquake-Resilient structures.

6.2.5 Landslides

a) Site Selection, Slope Management, and Stabilization

- Conduct geological surveys to identify landslide-prone areas and avoid construction in these zones. Use data from the Geological Survey of India (GSI) to identify landslide-prone areas.
- Implement stabilization techniques, such as retaining walls and vegetation, in high-risk areas.
- Perpetual landslide sites should be recorded, mapped and avoided in future projects. Suitable protection measures during design stage including consideration to alternate alignment may be adopted in future projects.

b) Drainage Systems and Machinery Readiness

- Ensure efficient drainage systems to prevent slope saturation.
- Position excavation and rescue machinery near landslide-prone areas for quick deployment.

c) Monitoring and Early Warning Systems

- Set up monitoring systems to track slope movements and detect early signs of instability.
- Establish early warning systems to provide timely alerts for landslide risks.
- Coordinate with geological and environmental agencies for monitoring and response.
- Ensure the availability of excavation and rescue equipment.

d) Public Awareness and Emergency Preparedness

- Conduct regular programs to educate communities on landslide risks and safety measures.
- Develop and practice evacuation plans for landslide-prone areas.
- Conduct annual landslide drills with local communities.
- Develop landslide response manuals based on NDMA guidelines.

e) Infrastructure Maintenance

- Inspect and maintain roads, embankments, and retaining walls in landslide-prone areas to ensure their integrity.
- Collaborate with geologists and engineers to improve landslide risk assessment and management strategies.

6.2.6 Snow Avalanches

a) Site Selection, Mapping, and Infrastructure Protection

- Avoid constructing roads or infrastructure in avalanche-prone areas.
- Identify and map avalanche-prone areas for future project planning.
- Use snow fences, deflection dikes, and diversion channels to control avalanche impacts.

b) Early Warning Systems and Communication Networks

- Establish weather stations and ground-based sensors to detect avalanche conditions early.
- Set up communication systems to quickly alert local residents, travelers, and emergency responders.

c) Community Awareness, Training, and Emergency Equipment

- Educate local communities and tourists about avalanche risks and safety practices.
- Train residents, tourists, and first responders on avalanche rescue techniques.

- Ensure availability of avalanche safety equipment, including transceivers, probes, shovels, and airbag backpacks.

d) Emergency Planning, Drills, and Coordination

- Develop avalanche-specific response plans with clear roles for stakeholders.
- Regularly conduct drills and safety audits to evaluate and improve the preparedness and response plan.

6.3 Use of Technology for Monitoring and Early Warning

The integration of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Geographic Information Systems (GIS), and remote sensing enables real-time monitoring, predictive analytics, and rapid dissemination of alerts, thereby enhancing preparedness and response capabilities.

a) Artificial Intelligence (AI)

AI algorithms can analyze vast datasets from weather stations, satellite imagery, and traffic sensors to:

- Predict hazard events such as floods, landslides, and infrastructure failures.
- Detect anomalies in structural health monitoring systems (e.g., cracks in bridges).
- Optimize evacuation routes using real-time traffic and hazard data.
- Automate decision-making for resource allocation and emergency response.

b) Internet of Things (IoT)

IoT devices such as sensors, cameras, and smart meters can be deployed across road networks to:

- Monitor bridge vibrations, road surface conditions, and water levels near culverts.
- Enable real-time alerts for flooding, structural stress, or traffic congestion.
- Support remote diagnostics and maintenance scheduling.

c) Geographic Information Systems (GIS) and Remote Sensing

GIS platforms integrate spatial data for:

- Hazard mapping and vulnerability assessment.
- Overlaying infrastructure data with disaster zones for risk-informed planning.
- Tracking disaster progression and coordinating response.

d) Early Warning Systems (EWS)

Technology-enabled EWS combine data from multiple sources to:

- Issue multi-hazard alerts via SMS, sirens, mobile apps, and highway Variable Message Signs (VMS).
- Disseminate localized warnings to contractors, field officers, and communities.
- Integrate with state and district emergency operation centers for coordinated response.

e) Sachet App – Disaster Alert & Preparedness Tool

The Sachet App, developed by NDMA, is a real-time disaster alert system designed to enhance public safety and preparedness. It provides geo-targeted alerts for natural disasters such as floods, cyclones, earthquakes, and landslides, sourced from verified government agencies like IMD and CWC. It is an integrated early warning application designed to alert travelers and drivers in real-time. It is proposed to be integrated with NHAI display boards and platforms, such as the eDAR portal, to enhance road safety and the timely dissemination of hazard-related information.

Link: https://sachet.ndma.gov.in/

Key features include:

1. Instant alerts based on user location.
2. Disaster-specific guidance (Do's and Don'ts).
3. Satellite connectivity for alerts during network outages.
4. Multi-language support for wider accessibility.
5. Daily weather forecasts and emergency contact info.

f) National Database for Emergency Management (NDEM)

The National Database for Emergency Management (NDEM), developed by ISRO's NRSC, is a GIS-based decision support system that enhances disaster preparedness and response across India.

Link: https://ndem.nrsc.gov.in/#/

Key Features:

- Real-time satellite data for monitoring floods, landslides, and other hazards affecting road infrastructure.
- Multi-layered GIS maps showing vulnerable zones, critical transport assets, and population clusters.
- Custom dashboards for assessing highway and bridge vulnerability, planning evacuation routes, and prioritizing restoration.
- Integration with IMD, CWC, and NDMA for synchronized alerts and forecasts.
- Web and mobile access for field teams and control rooms.

NDEM would enable MoRT&H to make data-driven decisions during emergencies, ensuring faster response, safer transport corridors, and resilient infrastructure planning under the preparedness plan.

g) NHAI One Mobile App (Formerly Tatpar)

The NHAI One App, previously known as Tatpar, is an internal mobile platform designed to streamline highway maintenance, inspections, and complaint resolution. It is primarily used by contractors, field engineers, and NHAI officials.

Key Functions:

- ✓ Document defects in road infrastructure.
- ✓ Conduct inspections and upload geo-tagged reports.
- ✓ Submit action taken reports and request approvals.
- ✓ Track maintenance activities and project timelines.

- ✓ Facilitate communication between field teams and Project Implementation Units (PIUs).

This app complements public-facing platforms like:

- ✓ RajmargYatra App – for citizen complaints and travel info.
- ✓ 1033 Helpline – for emergencies and toll issues.
- ✓ CPGRAMS Portal – for structured grievance filing.
- ✓ Drone Analytics System – for AI-based defect detection.
- ✓ Toll Information System (TIS) – for toll and route data

Early warning systems and GIS-based resource mapping will be prioritized. For example, 112 and the IDRN portal integration.

6.4 Community Engagement and Public Awareness

Community engagement and public awareness form the bedrock of effective disaster preparedness and response. The GOI-UNDP Disaster Risk Management Programme (2002–2009) showcased the power of a multi-stakeholder approach by actively involving local communities, volunteers, civil society, and NGOs in building grassroots capacity for disaster resilience.

Innovative outreach methods—such as folk performances, puppet shows, street plays, school-based safety programs, and disaster preparedness fairs—proved especially effective in engaging rural and low-literacy populations. These culturally relevant strategies enabled critical safety information to reach the most vulnerable groups, fostering widespread awareness and behavioral change.

Key pillars of community-driven preparedness include:

- Citizen Leaders and Youth Volunteers (NSS, NYKS, NCC), who act as frontline communicators and responders in disaster situations.
- Women's participation in Disaster Management Teams (DMTs), including roles in first aid, evacuation, shelter management, and search & rescue—helping challenge traditional gender norms and enhance community preparedness.
- Self Help Groups (SHGs), Anganwadi, and ASHA workers, who serve as trusted messengers and local resource persons for risk communication and basic emergency support.

Efforts shall be made at local levels to engage with the highway-side communities, construction laborers, transport unions, local bodies and leverage the community knowledge and potential for an integrated approach to disaster management.

7. Response Strategies

Response measures are those taken immediately after receiving an early warning from the relevant authority or in anticipation of an impending disaster, or immediately after the occurrence of an event without any warning. Response activities react safely and adequately to an emergency caused by a disastrous event and keep or quickly recover the road function necessary for emergency activities.

Response refers to the activities that take preparedness into action; to save lives in an emergency, to immediately recover road functions necessary for emergency operations, and to prevent secondary impacts on the road. Response is time sensitive. It is very important for the organizations and agencies responsible for road management, in coordination with national, regional, and local agencies, to work to restore road functions based on latest and accurate information about the emergency and damage caused to the road. Response activities take place after an emergency occurs.

Response optimizes the execution of planned preparedness immediately after the disaster, under conditions of limited human and material resources, to secure the life of people and to recover the road function, depending on the circumstances of the emergency. In other words, in the response phase, it is important to understand the emergency and set appropriate timeline targets and implement preparedness activities. For this purpose, it is important to collect up-to-date information on disasters and their effects on roads, to restore road functions based on this information, and to disseminate such information to the road users. At the same time, it is important to "coordinate and work together" to secure the human and physical resources to do so.

The institutional elements of response often include the provision of emergency services and assistance by public/ private sectors and community sectors, as well as community and volunteer participation. Response is considered as the most visible among various phases of disaster management. The response process begins as soon as it becomes apparent that a disastrous event is imminent and lasts until the disaster is declared to be over. For effective response, all the stakeholders need to have a clear vision about hazards, its consequences, clarity on plans of action and must be well versed with their roles and responsibilities. The commonly associated measures involved in the response stages of road sector are outlined below and explained in succeeding paragraphs in a Checklist form for prompt response.

a) First Information / perceive the threat / assess the hazard.
b) Identification of evacuation routes
c) Identification of human resources needs and their deployment.
d) Identification & deployment of other essential resources such as material & equipment.
e) Communication management.

7.1 Disaster specific response strategies

In addition to the general action plans discussed above, additional action plan needed during the occurrence of specific crisis/disaster situation has been explained in following paragraphs. Refer **Appendix-V**: Immediate Response during/ after Disaster for roles and responsibility assigned to respective authorities in the given time frame.

7.1.1 Road accidents

The separate sub-Plan for Road Accident Disasters, for which MoRT&H is Nodal Ministry, is given under **Volume-II** of this document.

7.1.2 Landslides & Avalanches

a) First information / perceive the threat / assess the hazard.

- Inform the nodal Ministry for Landslides (Ministry of Mines) and nodal Ministry for Avalanches (Ministry of Defense and BRO) and coordinate in the response plan.
- Evaluate the extent of the landslide & avalanche, including the area affected and the potential impact on infrastructure and communities. Assess the potential disruption to road networks, bridges, and other critical transport infrastructure.

b) Identification of evacuation routes

- Develop detailed evacuation plans in collaboration with the Nodal Ministry, local authorities and communities. Identify the access roads required and mark safe zones away from landslide & avalanche prone areas using hazard maps and local knowledge.
- Ensure clear signage and communication of these safe zones to the public.
- Ensure construction of emergency (temporary) access roads to the affected areas for rescue operations.
- Communicate these plans effectively to residents through community meetings, leaflets, and digital platforms.

c) Identification of human resource needs and their deployment

- Coordinate with the Nodal Ministry's in identifying specialized search and rescue teams including geologists and engineers, to assess and manage the situation.
- Mobilize the Site office & Regional Office officials, respective contractors and the local volunteers to assist with evacuation, first aid, and other support activities.
- Coordinate volunteer efforts through local disaster management committees.

d) Identification & deployment of other essential resources

- Mobilize excavators, bulldozers, winter service vehicles and cranes for debris or snow removal and road clearance through contractors.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Stock emergency shelters with essential supplies such as food, water, medical supplies, and blankets as per requirement.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management

- Maintain continuous communication with the agencies of the nodal Ministry, emergency services, local authorities, and the public.
- Provide regular updates on the situation through Variable Message Signs (VMS), media channels, social media, and community networks.
- Issue warnings through sirens, SMS alerts, and media broadcasts to inform the public of imminent landslide and avalanche risks.

- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.1.3 Cyclones

a) First Information / perceive the threat / assess the hazard.

- Inform the Nodal Ministry for Cyclones (Ministry of Earth Sciences) its agencies and coordinate in the response plan.
- Utilize weather forecasts and cyclone tracking systems provided by the Indian Meteorological Department (IMD) to monitor cyclone development and movement.
- Assess the cyclone's severity, potential impact areas, and the likely extent of flooding and wind damage. Keep continuous vigil on the movement of the cyclone and update plans accordingly.
- Evaluate the potential impact on road networks, bridges, and other critical infrastructure to prioritize response efforts.
- Implement river level monitoring systems to anticipate flooding due to heavy rainfall associated with cyclones & the impact on roads.

b) Identification of evacuation routes.

- Develop detailed evacuation plans in collaboration with the Nodal Ministry, local authorities and communities. Identify and mark routes to higher ground and safe zones away from coastal and low-lying areas prone to flooding. Ensure these routes are accessible and free from obstructions, with clear signage indicating directions to safe zones.
- Ensure clear signage and communication of these safe zones to the public.
- Ensure construction of emergency (temporary) access roads to the affected areas for rescue operations.
- Communicate these plans effectively to residents through community meetings, leaflets, and digital platforms.

c) Identification of human resources needs and their deployment.

- Coordinate with the Nodal Ministry's in identifying specialized search and rescue teams including geologists and engineers, to assess and manage the situation.
- Mobilize the Site office & Regional Office officials, respective contractors and the local volunteers to assist with evacuation, first aid, and other support activities.
- Coordinate volunteer efforts through local disaster management committees.

d) Identification & deployment of other essential resources.

- Mobilize excavators, bulldozers and cranes for debris removal and road clearance through contractors.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Stock emergency shelters with essential supplies such as food, water, medical supplies, and blankets as per requirement.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management.

- Maintain continuous communication with the agencies of the nodal Ministry, emergency services, local authorities, and the public.
- Provide regular updates on the situation through Variable Message Signs (VMS), media channels, social media, and community networks.
- Issue warnings through sirens, SMS alerts, and media broadcasts to inform the public of imminent cyclone risk.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.1.4 Floods

a) First information / perceive the threat / assess the hazard.

- Inform the nodal Ministry for Floods (Ministry of Jal Shakti) its agencies and coordinate in the response plan.
- Evaluate the flood's severity, affected areas, and potential impact on infrastructure and communities.
- Maintain a constant vigil along vulnerable sections of the road during floods to monitor water levels and signs of weakness in embankments. Ensure rapid mobilization of resources based on the lead time available from the first information of the likely event.
- Observe high flood level, discharge, velocity of flow, obliquity of flow, erosion of banks, functioning of the bridge waterway and changes in flow pattern.
- In case where such records reveal that scour as observed has a tendency to exceed the earlier anticipated design scour depth, appropriate steps like dumping of boulders around the foundation locations or extending to fully fledged garlanding of foundations laid at suitable levels which will not cause adverse or deteriorating flow condition of the river around piers may be restored to after obtaining the approval of competent authority.
- In some cases, it may be found necessary to train the river and guide the flow more uniformly through the various opening by means of proper training work such as guide bund spurs etc.
- Suitable concrete blocks/wooden packing may be provided under the beams near the bearing to ensure that in the event the superstructure being dislodged from bearings it would ultimately rest on such concrete/wooden blocks avoiding the risk of total collapse.

b) Identification of evacuation routes.

- Develop detailed evacuation plans in collaboration with the Nodal Ministry, local authorities and communities. Identify and mark routes to higher ground and safe zones away from low-lying areas prone to flooding. Ensure these routes are accessible and free from obstructions, with clear signage indicating directions to safe zones.
- Identify diversion roads required in the event of breaches in advance to ensure traffic can be diverted at short notice.
- Install clear and durable road signs indicating evacuation routes and potential hazards. Allow traffic again only when flood waters have receded sufficiently, and no danger is expected.
- Ensure construction of emergency (temporary) access roads to the affected areas for rescue operations.

- Communicate these plans effectively to residents through community meetings, leaflets, and digital platforms.

c) Identification of human resources needs and their deployment.

- Coordinate with the Nodal Ministry's in identifying specialized search and rescue teams including geologists and engineers, to assess and manage the situation.
- Mobilize the Site office & Regional Office officials, respective contractors and the local volunteers to assist with evacuation, first aid, and other support activities.
- Coordinate volunteer efforts through local disaster management committees.

d) Identification & deployment of other essential resources.

- Mobilize excavators, bulldozers and cranes for debris removal and road clearance through contractors.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Keep sandbags, boulders, empty bitumen drums, Hume pipes, and other materials readily available at vulnerable points for quick use. Store adequate collections of aggregates and bitumen emulsion near vulnerable sections for prompt repairs to potholes and depressions during and after floods.
- Coordinate in arranging boats, life jackets, and first aid kits to facilitate rescue operations in flooded areas.
- Stock emergency shelters with essential supplies such as food, water, medical supplies, and blankets as per requirement.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management.

- Maintain continuous communication with the agencies of the nodal Ministry, emergency services, local authorities, and the public.
- Provide regular updates on the situation through Variable Message Signs (VMS), media channels, social media, and community networks.
- Issue warnings through sirens, SMS alerts, and media broadcasts to inform the public of imminent flood risks. Display suitable advance warning signs well ahead of breach points to avoid traffic heading up at the breach point.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.1.5 Earthquake

a) First information / perceive the threat / assess the hazard.

- Inform the nodal Ministry for Earthquakes (Ministry of Earth Sciences) its agencies and coordinate in the response plan.
- Assess the earthquake's magnitude, epicenter, and affected areas using data from seismic monitoring systems.
- Evaluate the potential impact on road networks, bridges, and other critical infrastructure.

b) Identification of evacuation routes.

- Develop detailed evacuation plans in collaboration with the Nodal Ministry, local authorities and communities.
- Identify diversion roads required in the event of breaches in advance to ensure traffic can be diverted at short notice.
- Install clear and durable road signs indicating evacuation routes and potential hazards. Allow traffic again only when flood waters have receded sufficiently, and no danger is expected.
- Identify and mark safe zones away from buildings and infrastructure using hazard maps and local knowledge. Ensure clear signage and communication of these safe zones to the public.
- Ensure construction of emergency (temporary) access roads to the affected areas for rescue operations.
- Communicate these plans effectively to residents through community meetings, leaflets, and digital platforms. Allow traffic again only when earthquake debris has been cleared sufficiently and no danger is expected.

c) Identification of human resources needs and their deployment.

- Coordinate with the Nodal Ministry's in identifying specialized search and rescue teams including geologists and engineers, to assess and manage the situation.
- Mobilize the Site office & Regional Office officials, respective contractors and the local volunteers to assist with evacuation, first aid, and other support activities.
- Coordinate volunteer efforts through local disaster management committees.

d) Identification & deployment of other essential resources.

- Mobilize excavators, bulldozers and cranes for debris removal and road clearance through contractors.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Keep sandbags, boulders, empty bitumen drums, Hume pipes, and other materials readily available at vulnerable points for quick use. Store adequate collections of aggregates and bitumen emulsion near vulnerable sections for prompt repairs to potholes and depressions during and after floods.
- Coordinate in arranging boats, life jackets, and first aid kits to facilitate rescue operations in flooded areas.
- Stock emergency shelters with essential supplies such as food, water, medical supplies, and blankets as per requirement.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management.

- Maintain continuous communication with the agencies of the nodal Ministry, emergency services, local authorities, and the public.
- Provide regular updates on the situation through Variable Message Signs (VMS), media channels, social media, and community networks. Advise people to avoid windows and stay away from areas prone to structural damage.

- Issue warnings through sirens, SMS alerts, and media broadcasts to inform the public of imminent earthquake risks. Display suitable advance warning signs well ahead of breach points to avoid traffic heading up at the breach point.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.1.6.1 Infrastructure Failures: Tunnel Collapse

a) First Information /Perceive the Threat /Assess the Hazard

- **Immediate Detection:**
  - Trigger emergency alarm systems upon detection of imminent or actual collapse or cave-in.
  - Use loudspeakers to alert all personnel across the tunnel site.
  - Use two-way radios to communicate with all personnel and initiate the emergency response protocol.
- **Reporting & Initial Response:**
  - Utilize emergency numbers like 1033 (24x7 highway helpline) to report the incident.
  - Dispatch first responders (route patrolling officers, ambulance, crane, etc.) to the site.
  - Assess the number of personnel affected and severity of injuries.
  - Mobilize trained experts to evaluate the extent of the damage. Determine the potential impact on nearby infrastructure, traffic, and communities. Use drone/satellite imagery and ground surveys to assess the damage.
- **Initial Hazard Assessment**
  - Assess the location, size, and potential risks due to imminent or actual collapse.
  - Prioritize locating trapped workers using Sound Detection/ Radar System, Thermal Imaging, Exploratory Drilling, Specialized Robots, Sniffer Dogs etc.
  - Gather information on the number and condition of trapped individuals.

b) Identification of Evacuation Routes

- Develop detailed evacuation plans tailored to the layout of the tunnel. Communicate these plans to residents and commuters through multiple channels, including local authorities and digital platforms.
- Identify and clearly mark alternative routes to divert traffic away from the accident site & spillage area (if any) using road signs and digital boards to guide drivers.
- Follow traffic diversion plans as per IRC: SP 43-2022 (Guidelines on Traffic Management Technique).
- Ensure emergency vehicles have clear and unobstructed access to the site.
- Coordinate with State traffic police to manage the flow of vehicles, set up roadblocks, and ensure smooth diversion of traffic.
- Clear the accident site of debris and damaged vehicles to restore traffic flow.

c) Immediate Evacuation

- Begin evacuation for trapped personnel. Ensures that everyone follows pre-established evacuation plans and exits the area safely. Personnel should stop all activities and proceed to designated safe exits.

d) Assistance to Trapped Individuals

- Provide medical supplies, packaged food, drinking water, and sanitation (e.g.. portable toilet bags) to trapped individuals until rescue begins.

e) Identification of Human Resources Needs and Their Deployment

- Deploy emergency responders, route patrolling officers, ambulances, and medical personnel for immediate assistance.
- Mobilize specialized scorch and rescue teams including engineers, medical personnel, and structural experts. Ensure they are equipped with the necessary tools and protective gear.
- Mobilize the Site office & Regional Office officials and respective contractors to assist with evacuation, first aid, and other support activities depending on the severity of the accident.
- Before any rescue attempts, the collapse zone must be stabilized. This may involve using shoring timbers, erecting barricades, or diversion of water.
- Identify and mark accessible points within the tunnel for potential rescue operations. These access points should be easily identifiable.
- Coordinate with State traffic police to manage the flow of vehicles, set up roadblocks, and ensure smooth diversion of traffic.
- Identify & mobilize trained community volunteers if required to assist in managing the situation and providing first aid.

Risk Assessment for safe rescue operation:
Conduct thorough risk analysis of the collapsed area to ensure safety of rescue personnel.

Search and Extraction:
Utilize specialized equipment such as hydraulic spreaders, concrete cutters, and lifting devices to extricate trapped individuals safely. Implement safe extraction techniques to minimize further collapse or injury.

f) Identification & Deployment of Other Essential Resources

- Ensure a sufficient number of ambulances & route patrolling vehicles are available and equip ambulances and emergency response units with first aid kits, stretchers, and other medical supplies.
- Provide tow trucks or cranes to remove damaged vehicles and clear the road of any debris. Deploy fire trucks equipped with firefighting and rescue equipment in coordination with the state fire brigade. Ensure fire extinguishers are available at the site to handle small fires.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Provide support items, viz., packaged food, drinking water, and portable sanitation facilities for trapped individuals until rescue operations commence.
- Identify backup equipment in advance to be mobilized in case of failure of primary resources.

g) Communication Management

- First responders shall inform the Site office & Regional Office officials about the accident as soon as possible & in no case later than 1 hour.
- Use Variable Message Signs (VMS) on highways and urban roads for real-time driver updates. Use television, radio, and social media platforms to inform the public about the accident, its location, and alternative routes.
- Maintain continuous communication between police, fire brigade, medical teams, and traffic management personnel to coordinate efforts effectively.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

h) Medical Assistance

- **Triage and Treatment**
  - Establish triage near the collapse site to assess and prioritize injured individuals based on the severity of their injuries.
  - Administer necessary first aid and medical treatment on-site to stabilize patients. This step prepares them for safe transportation to medical facilities for more advanced care.

- **Transportation to Medical Facilities**
  - Coordinate with emergency medical services for hospital transfers of injured individuals

i) Post-Emergency Procedures

- **Debriefing and Evaluation**
  - Conduct debriefs with Emergency Response Team and stakeholders to review response and lessons learned.
- **Documentation and Reporting**
  - Document all actions taken, resources used, and outcomes.
  - Submit incident reports to regulatory authorities and Ministry.
- **Recovery and Rehabilitation**
  - Implement measures to stabilize the tunnel structure and mitigate the risk of further collapse or instability.
  - Provide support and counselling services to affected personnel and their families to address any emotional or psychological trauma.

7.1.6.2 Infrastructure Failures: Bridge Collapse

a) First information / perceive the threat / assess the hazard.

- Utilize emergency numbers like 1033 (24x7 emergency highway helpline number) to report accidents immediately.
- Dispatch first responders (Route patrolling officers, ambulance, crane etc.) to accident site and assess the number of personnel affected.
- Immediately mobilize trained experts to evaluate the extent of the damage. Determine the potential impact on nearby infrastructure, traffic, and communities. Use drone / satellite imagery and ground surveys to assess the damage.
- Provide first aid to the injured & transport severely injured to the hospital.
- In case of bridges over rivers, observe high flood level, discharge, velocity of flow, obliquity of flow, erosion of banks, functioning of the bridge waterway and changes in flow pattern.
- In case where such records reveal that scour as observed tends to exceed the earlier anticipated design scour depth, appropriate steps like dumping of boulders around the foundation locations or extending to fully fledged garlanding of foundations laid at suitable levels which will not cause adverse or deteriorating flow condition of the river around piers may be restored to after obtaining the approval of competent authority.

b) Identification of evacuation routes.

- Develop detailed evacuation plans tailored to the specific layout of the bridge. Communicate these plans to residents and commuters through multiple channels, including local authorities and digital platforms.
- Identify and clearly mark alternative routes to divert traffic away from the accident site & spillage area (if any) using road signs and digital boards to guide drivers.
- Follow traffic diversion plans as mentioned in IRC: SP 43-2020 the IRC code for Traffic Management Plan for different types of roads (highways, urban roads, rural roads).
- Ensure that emergency vehicles have clear and unobstructed access to the accident site. This includes coordinating with traffic police to manage and clear traffic quickly.
- Coordinate with State traffic police to manage the flow of vehicles, set up roadblocks, and ensure smooth diversion of traffic.

- Clear the accident site of all debris & damaged vehicles to ensure smooth flow of traffic.

c) Identification of human resources needs and their deployment.

- Emergency responders, route patrolling officers, ambulances and medical personnel are to be sent to the location to provide immediate medical assistance to the injured.
- Deploy specialized search and rescue teams, including engineers, medical personnel, and structural experts. Ensure they are equipped with the necessary tools and protective gear.
- Mobilize the Site office & Regional Office officials and respective contractors to assist with evacuation, first aid, and other support activities depending on the severity of the accident.
- Coordinate with State traffic police to manage the flow of vehicles, set up roadblocks, and ensure smooth diversion of traffic.
- Identify & mobilize trained community volunteers if required to assist in managing the situation and providing first aid.

d) Identification & deployment of other essential resources.

- Ensure a sufficient number of ambulances & route patrolling vehicles are available and equip ambulances and emergency response units with first aid kits, stretchers, and other medical supplies.
- Provide tow trucks or cranes to remove damaged vehicles and clear the road of any debris. Deploy fire trucks equipped with firefighting and rescue equipment in coordination with the state fire brigade. Ensure fire extinguishers are available at the site to handle small fires.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management

- First responders shall inform the Site office & Regional Office officials about the accident as soon as possible & in no case later than 1 hour.
- Utilize Variable Message Signs (VMS) on highways and urban roads to provide real-time updates and guidance to drivers. Use television, radio, and social media platforms to inform the public about the accident, its location, and alternative routes.
- Maintain continuous communication between police, fire brigade, medical teams, and traffic management personnel to coordinate efforts effectively.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.1.7 Tsunami

a) First information / perceive the threat / assess the hazard.

- Inform the Nodal Ministry for Tsunami (Ministry of Earth Sciences) its agencies and coordinate in the response plan.
- Utilize weather forecasts and Tsunami tracking systems provided by the Indian Meteorological Department (IMD) to monitor cyclone development and movement.
- Assess the Tsunami's severity, potential impact areas, and the likely extent of flooding and wind damage. Keep continuous vigil on the movement of the Tsunami and update plans accordingly.
- Evaluate the potential impact on road networks, bridges, and other critical infrastructure to prioritize response efforts.

b) Identification of evacuation routes.

- Develop detailed evacuation plans in collaboration with the Nodal Ministry, local authorities and communities. Identify and mark routes to higher ground and safe zones away from coastal and low-lying areas prone to flooding. Ensure these routes are accessible and free from obstructions, with clear signage indicating directions to safe zones.
- Ensure clear signage and communication of these safe zones to the public.
- Ensure construction of emergency (temporary) access roads to the affected areas for rescue operations.
- Communicate these plans effectively to residents through community meetings, leaflets, and digital platforms.

c) Identification of human resource needs and their deployment.

- Coordinate with the Nodal Ministry's in identifying specialized search and rescue teams including geologists and engineers, to assess and manage the situation.
- Mobilize the Site office & Regional Office officials, respective contractors and the local volunteers to assist with evacuation, first aid, and other support activities.
- Coordinate volunteer efforts through local disaster management committees.

d) Identification & deployment of other essential resources.

- Mobilize excavators, bulldozers, rescue boats and cranes for debris removal and road clearance through contractors.
- Identify backup equipment's in advance, to be mobilized in case of failure of the former.
- Stock emergency shelters with essential supplies such as food, water, medical supplies, and blankets as per requirement.
- In case of necessity of a Bailey bridge, effort should be made to arrange the same from the State itself, if available, otherwise local Army authorities may be contacted.

e) Communication management.

- Maintain continuous communication with the agencies of the nodal Ministry, emergency services, local authorities, and the public.

- Provide regular updates on the situation through Variable Message Signs (VMS), media channels, social media, and community networks.
- Issue warnings through sirens, SMS alerts, and media broadcasts to inform the public of imminent Tsunami risks.
- Inform the Ministry and the public about the reopening of traffic through newspapers, social media, television, radio, and pamphlets. Use official channels to prevent the spread of misinformation and keep the public informed.

7.2. Incident Response System (IRS)

The National Disaster Management Guidelines on Incident Response System (IRS) provide directions and guidance to central ministries, state government departments, and state & district administrations for effective and well-coordinated response. The IRS is a participatory, well-structured, fail-safe, multi-disciplinary, multi-departmental, and systematic approach to guide administrative mechanisms at all levels of the government. It is flexible and is implemented irrespective of the size, location, type, and complexity of the disaster. The IRS architecture and methodology are applicable for the management of all incidents (natural or man-made).

The Ministry of Road Transport & Highways (MoRT&H) emphasizes on the IRS approach as part of the Disaster Management Plan (Response) for the Road and Highway Sector and will draw upon an implementation plan to streamline early adoption, implementation of IRS, and training of the Incident Response Team (IRT) across the responsible authority and agency indicated in **Appendix VI and VII** of the DM Plan. The IRS organization for MoRT&H, when fully developed, will lay down clear tasks that need to be performed by the administrative machinery at various levels. The IRS for the Ministry will identify and notify officers for the performance of different tasks, get them trained in their respective roles, and provide a structure under which all designated staff will function in tandem with the responsible authority, agencies, and the State or District Disaster Management Authority/Administration where the incident has occurred. The Incident Response Teams will be pre-designated at all levels and notified. On receipt of early warning or reported incident, the Responsible Officer (RO) may activate them as per the Standard Operating Procedure (SOP).

7.3 Coordination with International aid Organizations

MoRT&H shall coordinate with the Nodal Ministry that is the Ministry of Home Affairs for seeking support from international aid organizations, as and when such need arises.

7.4 Role of Media and Communication in Disaster Response

Effective communication and media engagement are critical components of disaster response and MoRT&H have a dedicated portal as Media Attention Group

The Media Attention Portal, developed by MoRT&H, is a centralized system designed to track, verify, and resolve media-reported incidents related to national highways and road infrastructure. It plays a key role in disaster communication and public accountability.

Link- https://media.MoRT&H.gov.in/ncomplaint/login

Key Features:

- Real-time tracking of media reports concerning road damage, accidents, or disaster impacts.
- Integration with 535+ PIUs/PMUs/Divisions under MoRT&H, NHAI, NHIDCL, and BRO.
- Escalation and resolution workflows to ensure timely action and reporting.
- Training programs conducted for field units to use the upgraded portal effectively

8. Recovery and Reconstruction

UNDRR defines recovery as:

"The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural, and environmental assets, systems, and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better': to avoid or reduce future disaster risk."

The recovery task begins soon after the emergency phase ends, and it should be based on pre- existing strategies and policies that facilitate clear institutional responsibilities for recovery action. The focus of recovery is on restoring livelihoods, shifting to a path of sustainable development that reduces disaster risk. The plan for recovery should be designed keeping in view the worst-case scenarios.

The recovery stage covers immediate restoration to long-term betterment reconstruction. It tends to be difficult and long-drawn-out process. The reconstruction will vary depending on the actual disaster, location, pre-disaster conditions, and the potentialities that emerge at that point of time.

8.1. Steps of Recovery Process

Broadly three stages are involved in the recovery process - Damage Assessment, Post-event investigation & analysis and strategy for the future & building back disaster resilient infrastructure (i.e., reconstruction). The entire process is rarely a set of orderly actions, and it consists of several related activities. The major steps/ processes of the recovery process and the processes involved are as below.

8.1.1 Detailed Damage Assessment

Immediately following a disaster, an initial damage assessment must be performed to assess the impact of the disaster on the road infrastructure. The assessment should provide a rough estimate of the type and the extent of damages, including probable cost and the need for financial assistance. Ministry has adopted standard procedure where Senior Officers from Ministry visits site, accompanying officers from various executive agencies and State Governments and submit report to Ministry HQ. Disaster specific roles and responsibilities of MoRT&H officers for Damage Assessment shall be prepared/ updated by the Ministry from time to time. However, the current delegation and responsibilities shall be as per **Appendix-VII.**

8.1.2 Post-event Investigation & Analysis and Strategy for the future

It is very important that analysis and identification of lessons learnt are carried out and everything has been restored to normal after a disaster has occurred. The purpose is to take stock of what worked and what did not work and identify gaps in the current system. Post-disaster investigation report shall include details on the event, its damage, response adopted during disaster event and risk mitigation measures proposed post disaster, in addition to detailed damage assessment. The delegation of role and responsibilities shall be as per **Appendix-VII**. This report shall be reviewed periodically at Ministry HQ level to identify the common challenges, pattern of events, success and failure cases of measures adopted during and post disaster event. These assessment reports will serve as cases of Best Practices and Lesson Learnt to be disseminated for improving disaster preparedness. This shall also be used for updating of Disaster preparedness plans.

8.1.3 Building Back Disaster Resilient Infrastructure

Globally, the approach towards post-disaster restoration and rehabilitation has shifted to one of betterment reconstruction. While disasters result in considerable disruption of normal life, enormous suffering, loss of lives and property, global efforts consider the recovery, rehabilitation, and reconstruction phase as an opportunity to

“Build Back Better’’ (BBB) integrating disaster risk reduction into development measures and making communities resilient to disasters. Para 9.1.1 of the National Policy of Disaster Management (NPDM) also acknowledges this and states that “the approach to the reconstruction process must be comprehensive to convert adversity into opportunity. Incorporating disaster resilient features to ‘build back better’ will be the guiding principle”. Building back better envisages seizing the opportunity to rebuild to reduce development deficits of the affected areas going beyond restoration to the pre-disaster ‘normal’.

It is best practice to encourage resilient recovery with optimal incentives. The optimal combination of regulation and incentives (both financial and non-financial) can stimulate a resilient recovery. Effective government incentives can be localized depending on the characteristics of each region’s infrastructure and private sector capacity. Leading practices for rebuilding resilient infrastructure are as follow:

a) Formulate long-term vision, guided by community and regional growth strategies.

b) Prioritize projects based on strategic importance, potential value, and available resources.

c) Assess land-use impacts and construction regulations.

d) Incorporate economic, sustainability, and livability goals.

e) Evaluate financing alternatives; capitalize on private-sector financing and experience.

f) Provide transparency and close control over funds and capital projects.

g) Establish centralized capital project management and risk oversight.

The plans for reconstruction in highly disaster-prone areas need to be drawn out during the period of normalcy. Central Ministries / Departments concerned, the State Governments and the power utility should create dedicated project teams to speed up the reconstruction process.

8.2 Recovery and Reconstruction in other Countries

To enhance the resilience of India's road and highway infrastructure, MoRT&H can draw inspiration from successful recovery and reconstruction efforts in other countries. The following examples highlight effective strategies that can be adapted to the Indian context:

1. **Japan – Post-2011** Tohoku Earthquake and Tsunami Reconstruction

   Context: The 2011 Tohoku earthquake and tsunami caused extensive damage to Japan's coastal infrastructure, including roads and bridges, with losses estimated at USD 210 billion.

   Recovery Strategy:

   - Rapid damage assessments were conducted using satellite imagery and drones to prioritize restoration of critical highways, such as the Tohoku Expressway.
   - Reconstruction incorporated elevated road designs and tsunami-Resilient barriers to mitigate future risks in coastal areas.
   - Japan implemented a "Build Back Better" approach, using advanced seismic-Resilient materials and retrofitting techniques for bridges and tunnels.
   - Community engagement ensured local input in rebuilding efforts, enhancing social resilience.

   Outcome: Key highways were restored within months, and long-term reconstruction efforts resulted in infrastructure capable of withstanding similar disasters. By 2015, over 90% of damaged roads were fully reconstructed with enhanced resilience.

Relevance to India: MoRT&H can adopt Japan's use of technology for rapid damage assessments and explore the option to incorporate elevated designs in tsunami-prone coastal regions like Tamil Nadu and Andhra Pradesh.

2. **New Zealand – Post-2016 Kaikoura Earthquake Recovery**

Context: The 2016 Kaikoura earthquake severely damaged State Highway 1, a critical transport link, due to landslides and fault ruptures, costing approximately NZD 1.2 billion in damages.

Recovery Strategy:

- The New Zealand Transport Agency (NZTA) established a dedicated recovery alliance with contractors, engineers, and local authorities to expedite repairs.
- Slope stabilization techniques, such as rock bolting and retaining walls, were employed to prevent future landslides.
- Temporary bypass routes were created to maintain connectivity while permanent repairs were underway.
- Advanced monitoring systems, including real-time seismic sensors, were installed to enhance early warning capabilities.

Outcome: State Highway 1 was fully reopened within 13 months, with reconstructed sections featuring improved resilience against earthquakes and landslides.

Relevance to India: MoRT&H can explore New Zealand's alliance model as a case study to enhance inter-agency coordination. Additionally, adopting proven slope stabilization techniques from international best practices could help mitigate landslide risks in vulnerable regions such as Himachal Pradesh and Uttarakhand.

3. **United States – Post-Hurricane Katrina Reconstruction (2005)**

Context: Hurricane Katrina caused widespread flooding and damage to road infrastructure in Louisiana, particularly affecting Interstate 10 and coastal highways.

Recovery Strategy:

- The Federal Highway Administration (FHWA) collaborated with state agencies to conduct rapid damage assessments and prioritize restoration of key transport routes.
- Reconstruction efforts focused on elevating roads and bridges in flood-prone areas and improving drainage systems to prevent waterlogging.
- The use of resilient materials, such as high-performance asphalt and concrete, enhanced the durability of rebuilt infrastructure.
- Public-private partnerships (PPPs) were leveraged to secure funding and expedite reconstruction.

Outcome: Major highways were restored within two years, with improved flood resistance and enhanced emergency access routes.

Relevance to India: MoRT&H can explore the option of PPP models to fund disaster recovery and implement elevated road designs in flood-prone regions like Bihar and Assam.

4. **Indonesia – Post-2004 Aceh Tsunami Reconstruction**

Context: The 2004 Indian Ocean tsunami devastated coastal roads in Aceh, disrupting connectivity and economic activities.

Recovery Strategy:

- The Indonesian government, with international support, prioritized rebuilding coastal highways with elevated designs and improved drainage systems.
- Mangrove restoration and vegetation planting were integrated to reduce the impact of future tsunamis and erosion.

- Community-based reconstruction programs trained local workers, fostering economic recovery and skill development.

Outcome: Over 2,000 km of roads were rebuilt by 2009, with enhanced resilience to tsunamis and floods, significantly improving connectivity and disaster preparedness.

8.3 Environmental Sustainability in Reconstruction

Environmental sustainability is a critical consideration in the reconstruction of road infrastructure post-disaster to ensure long-term ecological balance and resilience. MoRT&H integrates environmentally sustainable practices into its recovery and reconstruction efforts to minimize environmental impact, promote resource efficiency, and align with national and international commitments such as the Paris Agreement on climate change and the Sendai Framework for Disaster Risk Reduction. The following measures are adopted to ensure environmental sustainability in reconstruction:

- **Use of Eco-Friendly Materials:** Prioritize the use of sustainable, low-carbon, and recycled materials (e.g., fly ash, recycled asphalt, and geopolymer concrete) in road and bridge reconstruction to reduce the environmental footprint and conserve natural resources.
- **Energy-Efficient Construction Practices:** Employ energy-efficient construction techniques, such as using solar-powered equipment and low-energy construction processes, to minimize greenhouse gas emissions during reconstruction.
- **Restoration of Natural Ecosystems:** Ensure that reconstruction activities avoid further degradation of local ecosystems. This includes replanting native vegetation, restoring wetlands, and protecting water bodies affected by construction activities.
- **Water Management and Conservation:** Incorporate advanced drainage systems and water harvesting techniques in reconstructed infrastructure to manage runoff effectively, prevent soil erosion, and conserve water resources.
- **Biodiversity Protection:** Conduct environmental impact assessments (EIAs) prior to reconstruction to identify and mitigate impacts on local flora and fauna. Implement measures such as wildlife corridors and eco-ducts to maintain biodiversity in areas affected by disasters.
- **Climate-Resilient Design:** Design reconstructed infrastructure to withstand future climate-related hazards, such as floods and cyclones, by integrating climate-adaptive features like elevated roads, permeable pavements, and robust drainage systems.
- **Waste Management:** Implement proper waste management practices during reconstruction, including recycling construction debris and minimizing waste generation to reduce environmental pollution.
- **Community Engagement and Local Resource Utilization:** Engage local communities in reconstruction efforts to promote sustainable practices and utilize locally available materials and labor, reducing transportation-related emissions and supporting local economies.
- **Alignment with National and International Frameworks:** Ensure that reconstruction efforts align with the National Policy on Disaster Management (NPDM) 2009, the Paris Agreement, and the Sendai Framework by prioritizing low-carbon, climate-resilient, and sustainable development practices.
- **Monitoring and Evaluation:** Establish mechanisms to monitor the environmental impact of reconstruction projects, ensuring compliance with environmental standards and continuous improvement in sustainability practices.

9. Resource Inventory

Creating a comprehensive resource inventory for disaster response and recovery is essential for effective disaster management. This inventory should include human resources, equipment, facilities, and other assets that can be mobilized rapidly during a natural hazard and disaster.

Each of the field offices coming under the purview of Ministry of Road Transport and Highways shall appoint a "Regional Nodal Officer" (See **Appendix VIII**) for management of Resource Inventory.

The following are some of the suggestive key resources to be inventoried with concerned department/ agencies in DM activities:

9.1 Human Resources

1. Disaster Response Teams:

- Emergency Response Teams (ERT): A team comprising of officers from field offices, Authority engineers and contractors shall be constituted by Regional Nodal Officer and updated on yearly basis. The ERT team shall comprise of following officials:
  - Regional Nodal Officer
  - Authority Engineer nominated by Regional Nodal Officer
  - Two Representative from Contractor/ vendors nominated by Regional Nodal Officer
- Medical Teams (doctors, nurses, paramedics): Concerned district administration where the projects of MoRT&H are currently on-going or completed shall maintain the list of team members of such medical teams for DM activities. Regional Nodal Officer in the field offices to coordinate with the same to obtain such list for reference.
- Search and Rescue Teams (including specialized units like canine teams): Concerned district administration where the projects of MoRT&H are currently on-going or completed shall maintain the list of team members of such rescue teams for DM activities. Regional Nodal Officer in the field to coordinate with the State Administration or any such authority to obtain such list for reference.

2. A comprehensive list of human resources (including engineers, technicians, volunteers) and equipment checklist to be maintained in the resource inventory is enlisted in **Appendix VIII**.

3. The Regional Nodal Officer shall also be responsible for taking annual review meetings to ensure the necessary human resources and equipment are available and checklist is updated.

4. Rapid Mobilization and Utilization –

- **Resource Mapping -** Regional Nodal Officer shall be responsible to maintain real-time location of resources and ensure their timely arrival for DM activities.
- **Inter-Agency Coordination –** Regional Nodal Officer shall be responsible to establish protocols for coordination between various agencies and organization. Regional Nodal Officer shall also be responsible to regularly update contact list and communication channels.
- **Training and Drills –** Regional Nodal Officer shall also be responsible to conduct yearly training sessions and mock drills. The aim of such exercises to familiarize teams with the inventory and mobilization procedures.
- **Monitoring and Evaluation –** DG(RD)&SS, MoRT&H shall be responsible to implement systems for continuous monitoring of resource usage for DM activities. DG(RD)&SS, MoRT&H shall take an annual

review meeting with all the Regional Nodal Officers and also conduct post-disaster evaluations to improve future response.

- **Private Sector Partnership:**

Private Sector Partnerships: Engage private sector entities, such as construction firms and logistics providers, to augment resource mobilization by leveraging their expertise, equipment, and manpower for rapid disaster response and recovery operations.

5. Regional Nodal Officer shall be responsible to maintain the above stated checklist with the help of contractors/ vendors, district administration, National Disaster Response Force or any other stakeholder from Government or Private Sector which can provide such human resources and equipment for DM activities.

6. Maintenance and Updation of Resource Inventories

To ensure effective disaster management, a comprehensive and regularly updated resource inventory is critical. The maintenance and updating of resource inventories involve the following actions:

- **Regular Updates:** The Regional Nodal Officer, appointed by DG(RD) & SS, shall ensure that the resource inventory is reviewed and updated annually or as needed based on changes in available resources, new acquisitions, or obsolescence. This includes updating lists of human resources (engineers, technicians, volunteers) and equipment (search and rescue, medical, communication, heavy machinery, transportation, and facilities) as outlined in Appendix-VIII.
- **Digital Inventory System:** Maintain a digital inventory system for real-time tracking and accessibility of resources. This system should include details of equipment availability, location, condition, and responsible personnel. The Regional Nodal Officer is responsible for ensuring the digital inventory is updated yearly and accessible to relevant stakeholders. Going forward digital resource inventory would be linked with Indian Disaster Resource Network (IDRN) through API.
- **Coordination with Stakeholders:** Collaborate with contractors, vendors, state/district administrations, NDRF, and other relevant entities to ensure the availability and readiness of resources. The Regional Nodal Officer shall verify that equipment and personnel listed in the inventory are operational and can be mobilized promptly during disasters.
- **Periodic Audits:** Conduct regular audits to verify the accuracy of the resource inventory, ensuring that listed resources are physically available and in working condition. Any discrepancies or shortages should be addressed immediately, with updates reported to the Disaster Management Division (DM Div.) of MoRT&H.
- **Integration with Disaster Preparedness:** Ensure that resource inventories are aligned with disaster-specific preparedness strategies (Section 6.2) and are readily available for deployment during emergencies. This includes pre-positioning critical equipment in vulnerable areas identified through hazard zoning (Section 4.3).
- **Documentation and Reporting:** Maintain detailed documentation of inventory updates, including changes in resource availability, new acquisitions, or retirements. Quarterly reports on inventory status shall be submitted by Regional Nodal Officers to the respective Zonal Heads/Members for submission to MoRT&H.
- **Training and Capacity Building:** Provide training to personnel responsible for maintaining and updating the resource inventory to ensure proficiency in using digital systems and coordinating with external agencies for resource mobilization.

10.Plan Maintenance

Maintaining a Disaster Management Plan (DMP) is essential for its continued relevance and effectiveness. This process involves regular reviews, updates and the incorporation of new information, technologies and lessons learned from drills and actual disaster events.

10.1 Regular Review and Update Schedule

10.1.1 Review of DMP

- Conduct a comprehensive review of the DMP annually to assess current resources, contacts, and protocols, updating as necessary to reflect any organizational, logistical, or regulatory changes.
- Maintain readily accessible, updated copies of the DMP at the contractor's site office, PIU/PMU, and Regional Offices to enable rapid response during emergencies.
- Regularly verify and update contact information for key personnel, suppliers, and emergency agencies to prevent communication gaps.
- Annually conduct a drill or tabletop exercise to evaluate the DMP's effectiveness and identify areas for improvement.

10.1.2 Post-Event Review

- Following any disaster or drill, thorough review of the DMP will be conducted, but not limited to documenting successes, challenges, and areas for enhancement. Record specific obstacles such as communication gaps, resource shortages, or procedural inefficiencies.
- Assign roles, responsibilities, and deadlines to ensure timely updates, with team leads overseeing and reporting on progress.
- Identify opportunities for strengthening the DMP, particularly in areas such as resource allocation, agency coordination, training, and technological support.

10.1.3 Technology and New Information Update

- Regularly assess and integrate emerging technologies that improve disaster response, including advanced communication platforms, data analytics tools, and real-time monitoring systems.
- Update communication systems as necessary to ensure dependable connectivity (e.g., radios, satellite phones, or emergency apps) for effective crisis management.
- Enhance data management systems for better tracking, storage, and analysis of incident data, enabling informed decision-making.
- Keep response equipment up-to-date (e.g., drones, GPS devices, supply tracking systems) to maintain efficient field operations.
- Offer continuous training on new technologies to ensure smooth integration during emergencies.
- Update hazard and risk assessments based on current data and newly identified vulnerabilities.

10.1.4 Resource Inventory

- Maintain an accurate and current resource inventory, incorporating new equipment and personnel and removing obsolete or unavailable resources (refer to Chapter 9 for more details).

10.2 Lessons Learned from Drills and Events

10.2.1 After-Action Reports (AARs)

- Develop AARs after each drill or actual event to evaluate incident response, including planning, preparation, response, and recovery.
- Document specific successful practices to reinforce them for future events.
- Identify and address areas needing improvement, such as training, equipment, and response protocols.

Example:
Example 1: Mock Drill for Landslide Response (Himachal Pradesh, 2024)

During a mock drill conducted in a landslide-prone section of NH-5 in Himachal Pradesh, the AAR revealed that the response time for deploying heavy machinery (excavators and bulldozers) was delayed due to inadequate pre-positioning of equipment near vulnerable stretches. The drill highlighted a lack of real-time communication between the Regional Officer (RO) and the National Disaster Response Force (NDRF).

Example 2: Flood Response in Assam (2023 Monsoon)

Following severe flooding on NH-37 in Assam, the AAR identified that blocked drainage systems exacerbated road submersion, delaying relief operations. The report noted insufficient pre-monsoon drain clearance and a lack of real-time flood monitoring.

10.2.2 Continuous Improvement

- Formulate action plans based on AAR findings to address gaps, with specific objectives, timelines, and designated responsible personnel.
- Implement identified improvements to the DMP, refining processes, resources, or roles to enhance readiness.
- Regularly monitor action item progress to ensure effective integration into the DMP.

Example:
Example 1: Upgrading Response Protocols Post-Cyclone Drill (Odisha, 2024)

A cyclone response drill in Odisha revealed that the coordination between the Regional Officer (NHAI) and local authorities was hampered by unclear roles during the evacuation phase. The action plan post-drill led to the development of a standardized Incident Response System (IRS) checklist, specifying roles for each agency.

Example 2: Post-Earthquake Reconstruction (Uttarakhand, 2023)

After a minor earthquake damaged a section of NH-58 in Uttarakhand, the AAR noted that the reconstruction process lacked seismic-Resilient design specifications for retrofitting bridges.

10.2.3 Stakeholder Feedback

- Gather feedback from stakeholders, including internal teams, partner agencies, and community representatives, to uncover potential issues and gain diverse perspectives.
- Integrate stakeholder feedback to improve the DMP's communication, coordination, and logistical aspects.
- Maintain open communication channels with stakeholders to support adaptive, effective disaster response strategies.

Example 1: Community Feedback from Flood-Prone Areas (Bihar, 2024)

During a community outreach program in Bihar, residents near NH-31 reported that road signage for flood evacuation routes was inadequate, causing confusion during evacuation drills. Additionally, social media platforms were leveraged to disseminate real-time updates on road conditions during floods, improving community preparedness.

10.3 Training and Capacity Building

10.3.1 Regular Training

- Conduct routine training for all disaster management personnel, including updates on procedures, technologies, and DMP modifications.

10.3.2 Mock Drills and Simulations

- Regularly conduct mock drills and simulations to assess and enhance the DMP.

10.3.3 Documentation and Knowledge Sharing

- Maintain documentation of all training and drill activities, sharing insights and best practices with other agencies and stakeholders.

10.4 Coordination and Communication

10.4.1 Inter-Agency Collaboration

- Facilitate ongoing collaboration among agencies to ensure the DMP aligns with regional and national disaster management frameworks.

10.4.2 Public Awareness

- Keep the public informed on the DMP and its updates through community outreach and disaster preparedness programs.

10.5 Monitoring and Evaluation

10.5.1 Performance Metrics

- Develop and monitor performance metrics to assess the effectiveness of disaster response and recovery efforts.

10.5.2 Regular Audits

- Conduct regular audits to identify areas of non-compliance and potential improvements within the DMP.

10.5.3 Continuous Feedback Loop

Establish a feedback loop for ongoing DMP improvements, documenting and communicating all updates to relevant stakeholders.

10.5.4 Continuous Learning and Adaptation

Continuous learning and adaptation are critical for ensuring the Disaster Management Plan (DMP) remains relevant, effective, and responsive to evolving risks and challenges in the road and highway sector. This process involves systematically integrating lessons learned from past disasters, drills, and emerging best practices to enhance the DMP's robustness and adaptability. Key components include:

- **Knowledge Integration:** Regularly incorporate findings from After-Action Reports (AARs), stakeholder feedback, and post-event analyses into the DMP to address identified gaps and improve response strategies.
- **Emerging Trends and Technologies:** Stay updated on advancements in disaster management technologies, such as AI-driven predictive analytics, remote sensing, and real-time data monitoring, to enhance early warning systems and response efficiency.
- **Adaptive Planning:** Periodically revise the DMP to reflect changes in hazard profiles, climate patterns, and infrastructure vulnerabilities, ensuring alignment with national and international frameworks like the Sendai Framework.
- **Stakeholder Engagement:** Foster a culture of continuous learning by engaging with local communities, regional authorities, and other ministries to share knowledge and adapt strategies based on collective experiences.
- **Training and Knowledge Sharing:** Conduct regular workshops and knowledge-sharing sessions with MoRT&H agencies, NDRF, SDMA, and other stakeholders to disseminate lessons learned and promote adaptive practices.
- **Feedback Mechanisms:** Establish robust feedback loops to capture real-time insights from field operations, enabling rapid adjustments to plans and protocols during disaster response and recovery phases.

11.Capacity Building

UNDRR defines "Capacity Development" for DRR as:

"Capacity development is the process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals. It is a concept that extends the term of capacity-building to encompass all aspects of creating and sustaining capacity growth over time. It involves learning and various types of training, but also continuous efforts to develop institutions, political awareness, financial resources, technology systems and the wider enabling environment."

Investing in capacity development for ORR is a continuing process of enhancing the capability of individuals, agencies, and communities to improve the performance of their DM functions. It is a cost-effective way to save lives, prevent or reduce losses and ensure effective recovery and rehabilitation.

The process of capacity building will include elements of human resource development, i.e., individual training, organizational development such as improving the functioning of groups, and the strengthening of organizations, regulations, and institutions. It also includes curriculum development, large-scale awareness and carrying out regular mock drills and disaster response exercises.

The National Policy on Disaster Management (NPDM) provides for development of the Disaster Management handling capability by each Ministry/Department of the Central Government as also by the State Government. The Policy also lays down that all Central Ministries and Departments will prepare their DM Plans and where funds are being asked for to improve Disaster Management capability including the financial projections to support these plans. The necessary budgetary allocations will be made as part of the Five Year and Annual Plans.

The NPDM 2009 envisages a pivotal role for the National Institute of Disaster Management in capacity development. Similarly, the State Disaster Management Institutes and ATIs should play a lead role in the States/ UTs. The NPDM envisages capacity development in the domain of DM at all levels of government including ministries, line departments and across various autonomous institutions. It also stresses the importance of capacity development efforts to promote community-based DM efforts. The policy notes that to sustain ORR, it is necessary to undertake capacity development across the education sector covering schools to professional institutions. It recognizes that skill development in all sectors to incorporate multi-hazard Resilient features along with strengthening of relevant licensing, certification, and standards.

11.1 National Institute of Disaster Management and other Institutions

The NIDM in partnership with other research institutions, has capacity development as one of its major responsibilities, along with training, research, documentation and development of a national level information base. It will network with other knowledge-based institutions and function within the broad policies and guidelines laid down by the NDMA. It will organize training of trainers, DM officials and other stakeholders. The NIDM will play an important role in developing and facilitating the implementation of a national training schedule for DM. It will also be the nodal institution for Regional and International cooperation for training. There are several renowned institutes in various States, which are imparting training in DM. These will be strengthened with skilled resource persons and financial assistance and such efforts will be replicated by other States/UTs. Also, the DM cells in all Administrative Training Institutes, Police Academies, State Institutes of Rural Development, Training centers of five CAPFs from where NDRF is drawn up (BSF, CRPF, CISF, ITBP, and SSB) and the National Training Academy will contribute most significantly to developing DM. related skills. The capacity of existing institutes needs to be upgraded in accordance with regional and local requirements.

11.2 Capacity Building Areas of Road Sector

Capacity development is applicable to all aspects of disaster management. The Central Ministries, departments, and agencies as well as the State/UT Governments are required to take actions for capacity development of different stakeholders.

Development of capacity building/ training modules on preparedness, response and recovery as well as build back disaster resilient infrastructure and early warning systems is required for enhancing capacity at institutional and individual levels. This will also ensure the investment planning is included towards preparedness measures. The trainings based on these modules to be imparted to relevant stakeholders including contractors' engineers/ human resources and consultants.

Presently, Ministry has issued several specifications/guidelines to foster the knowledge/ideas to tackle disasters specific to Highway sector. However, there is no such training/skilling mechanism to provide handholding approach or mock drills which may help further in disaster management. Accordingly, following mechanism has been adopted:

Institute/Office	Role/Responsibility
IAHE	IAHE, the training institute of MORT&H, which mainly imparts training to officials of Highway sectors across the Central Government, State Govts, PSU's etc, shall collaborate with NIDM (National Institute of Disaster Management, apex training institute on Disaster management) & Capacity Building Commission (CBC) to set up training calendar/modules etc, to impart disaster specific training for policy/ guidelines as well as other measures to effectively mitigate/ tackle various disasters during pre-disaster & during disaster stage and to effectively build back better the infrastructure after the damage caused by disaster.

11.3 Mock Drill Exercises

To be prepared for any eventuality, periodic mock drill exercises are to be undertaken in the various areas of construction and operation of road sector by considering various disaster situations like an earthquake, flood etc. Depending on the vulnerability, mock drills to handle such situations need to be undertaken. The Regions are also required to ensure that at least one mock drill exercise for every disaster situation to which the area is vulnerable is undertaken in each quarter. The adverse observations made on each event of Mock drill should be considered and it should be ensured to prevent the occurrence of such undesirable events in the future.

A quarterly report on the mock drill exercises undertaken indicating the outline of disaster situation, response of the various teams, observations, and effectiveness for handling the emergency and scope for improvements etc. are to be sent by each Regional Officer to respective Zones/Members for submission to Ministry of Road Transport & Highways.

11.4 Capacity Building Initiatives and examples

To strengthen disaster management capabilities within the road and highway sector, MoRT&H, in collaboration with the National Institute of Disaster Management (NIDM) and other institutions, has implemented several successful capacity-building initiatives. These initiatives focus on enhancing the skills, knowledge, and preparedness of personnel, integrating disaster-resilient practices into infrastructure development, and fostering

inter-agency coordination. Below are specific examples of successful capacity-building initiatives that have been undertaken to improve disaster management in the road sector:

1) Training Programs by Indian Academy of Highway Engineers (IAHE) in Collaboration with NIDM:

IAHE, as the primary training institute of MoRT&H, has partnered with NIDM to develop and deliver specialized training modules on disaster risk reduction (DRR) and response for highway sector professionals. These programs target engineers, contractors, and regional officers, focusing on disaster-specific preparedness, mitigation, and recovery strategies.

Example: In 2023, IAHE conducted a series of workshops titled "Disaster-Resilient Highway Infrastructure" across five regional zones, training over 500 engineers and project managers. The workshops covered seismic-Resilient design principles, flood mitigation techniques, and emergency response protocols. Participants engaged in case studies, such as the reconstruction of National Highway stretches in Uttarakhand post-2021 floods, to learn practical applications of DRR measures. Feedback from participants highlighted improved understanding of integrating disaster resilience into project planning and execution.

2) Integration of Technology in Training and Preparedness

MoRT&H has leveraged advanced technologies, such as Geographic Information Systems (GIS) and real-time monitoring systems, to enhance disaster management training and preparedness. These tools are used to train personnel in mapping vulnerable road stretches and simulating disaster scenarios.

Example: NHAI implemented a GIS-based training module in 2023 for its Regional Officers to map flood- and landslide-prone sections of National Highways in Assam. The training enabled officers to use GIS tools to assess vulnerabilities and plan mitigation measures, such as improved drainage systems. This initiative contributed to a 30% reduction in flood-related disruptions on NH-37 during the 2024 monsoon season, as reported by NHAI's regional office.

11.5 International Cooperation in Capacity Building

International cooperation will play a vital role in enhancing the capacity of the MoRT&H for disaster management by facilitating knowledge exchange, technology transfer, and collaborative training initiatives. Aligning with global frameworks such as the Sendai Framework for Disaster Risk Reduction, MoRT&H collaborates with international organizations, foreign governments, and multilateral agencies to strengthen disaster resilience in the road sector. Key aspects of international cooperation include:

- **Knowledge Sharing and Best Practices:** Engaging with international bodies like the United Nations Office for Disaster Risk Reduction (UNDRR) and the World Road Association (PIARC) to adopt global best practices in disaster-resilient road infrastructure design, construction, and maintenance. This includes learning from case studies on cyclone-Resilient roads, seismic retrofitting techniques, and flood mitigation strategies implemented in other countries.
- **Training and Capacity Development:** Partnering with international institutions to conduct joint training programs and workshops for MoRT&H personnel, contractors, and consultants. These programs focus on advanced disaster management techniques, including the use of innovative materials, early warning systems, and post-disaster recovery strategies. Collaboration with agencies like the Asian Disaster Preparedness Center (ADPC) enhances technical expertise and preparedness.
- **Technology Transfer:** Leveraging international expertise to integrate cutting-edge technologies, such as satellite-based monitoring, GIS mapping, and drone-based damage assessments, into MoRT&H's disaster

management framework. Partnerships with countries experienced in disaster-resilient infrastructure, such as Japan and Australia, facilitate the adoption of advanced engineering solutions.

- **Joint Research and Development:** Collaborating with global research institutions to conduct studies on disaster risk reduction specific to the road sector. This includes joint projects on climate-resilient infrastructure, landslide mitigation, and sustainable reconstruction practices, funded through international grants or bilateral agreements.
- **International Funding and Support:** Accessing financial and technical support from multilateral organizations like the World Bank, Asian Development Bank (ADB), and United Nations agencies for capacity-building initiatives, infrastructure upgrades, and post-disaster reconstruction. These partnerships help MoRT&H implement large-scale disaster resilience projects.
- **Regional Cooperation:** Strengthening ties with neighboring countries, particularly in South Asia, through forums like the South Asian Association for Regional Cooperation (SAARC) to develop cross-border disaster management strategies. This is critical for ensuring connectivity during transboundary disasters like tsunamis, cyclones, or floods affecting shared road networks.
- **Participation in Global Forums:** Actively participating in international conferences, such as the World Conference on Disaster Risk Reduction, to align MoRT&H's policies with global standards and contribute to the global discourse on disaster risk reduction in the transport sector.

The Indian Academy of Highway Engineers (IAHE), in collaboration with the National Institute of Disaster Management (NIDM), will coordinate with international partners to develop training modules and exchange programs. These initiatives will ensure that MoRT&H personnel are equipped with global knowledge and skills to enhance disaster preparedness, response, and recovery in the road sector.

12. Financial Arrangements

Ministry has different financial arrangement/mechanism/schemes for different executing agencies to carry out development/restoration/rehabilitation/re-construction works of NH assets, damaged on account of disaster.

Funds requirement have been broadly categorized for carrying out immediate restoration and long-term rehabilitation/reconstruction. The Financial Delegations & responsibilities for Immediate / Permanent Restoration shall be prepared/ updated by the Ministry from time to time. However, the current delegation and responsibilities shall be as per Appendix-VI.

Under the financial delegation, the power of the competent authority mentioned under Rule 136 (1) of GFR 2017 will stand delegated to the concerned as per Appendix-VI to enable immediate disaster response in compliance with the provision of Rule 136 (2) of GFR 2017.

APPENDIX

APPENDIX-I

(Cl. 3.6.5: Institutional Framework of MoRT&H)

Sl. No.	Committee	Composition	Role & Responsibility
1.	Standing Committee	Secretary (RT&H), DG(RD) & SS, Chairman NHAI, MD NHIDCL, AS/JS(H), AS/JS(NHIDCL), AS/JS(Transport), ADG/CE(Planning), ADG/CE(Mon), CE S&R, Nodal Officer (DM Div.)	i. To approve policy/ guideline formulated by DM Div. in coordination with other Zones and review & update yearly based on the input from Agencies/Zonal Heads. ii. Nodal Officer (DM Div.) to report Secretary (RT&H) and apprise committee during and just post disaster.

Disaster Management Division (DM Div): DM Div. shall be headed by CE/JS level officer who shall act as nodal officer for the Ministry. DM Div. shall coordinate with various Division/Zones on various tasks as under:

Sl. No.	Task	Responsible Division
1	To provide technical input to formulate & regularly update disaster related policy to DM Div.	S&R Zone
2	IAHE, the training institute of MoRT&H, which mainly imparts training to officials of Highway sectors across the Central Government, State Govts. PSUs etc, shall collaborate with NIDM (National Institute of Disaster Management, apex training institute on Disaster Management) & Capacity Building Commission (CBC) to set up training calendar/modules etc, to impart disaster specific training for policy/guidelines formulation as well as other measures to effectively mitigate/tackle various disasters during pre-disaster & during disaster stage and to effectively build back better the infrastructure after the damage caused by disaster.	IAHE
3	**Pre-Disaster:** 1. SE (Project Zone) to ensure all pre-disaster preparedness are followed by Regional Officers as per Ministry's standard.	Project Zone (Roads Wing)

	During Disaster: 1. DM Div. to circulate proforma, collate information on temporary blockages and seek report at regular intervals from respective SE (Project Zone). 2. SE (Project Zone) in coordination with Regional Officer (Roads Wing) to report the data at regular intervals to DM Div. during and up to 24 hrs. post occurrence to disaster. Nodal officer (DM Div.) to apprise data to Secretary (RT&H). **Post Disaster:** 1. SE (Project Zone) to coordinate with Regional Officer (Roads Wing), & inspect the site, if need be, and submit detailed report about damages occurred, repair/restoration measures (immediate/temporary) undertaken as per the format of DM Div.	

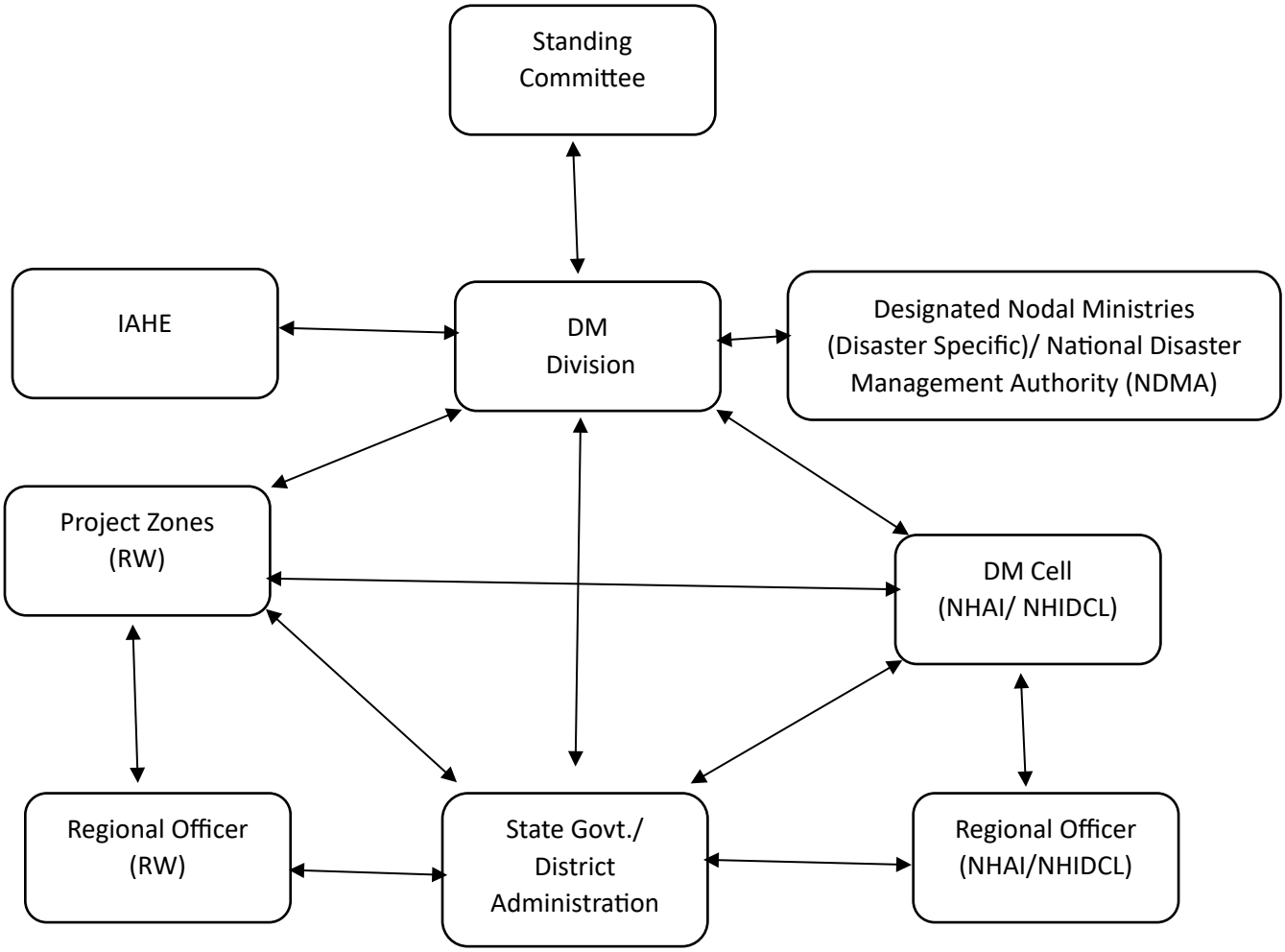
Disaster Management Cell (DM Cell): NHAI/NHIDCL shall create Disaster Management Cell headed by CGM/Director level officer who shall act as Nodal Officer for the agency to coordinate with Disaster Management Div. of MoRT&H. DM Cell of the agency (NHAI/NHIDCL) shall work under the overall framework of DM Div. of MoRT&H and shall provide requisite information as and when required/sought. Further, it shall submit proposals for policy /guidelines regarding Disaster Management for the approval of DM Div. of MoRT&H. Detailed task mentioned below:

SI. No.	Task	Responsible Division
1	**Pre-Disaster:** 1. Identify the hazard specific zone and recommend the disaster risk reduction (DRR) measures. 2. Nodal Officer (DM Cell) to ensure all pre-disaster preparedness are followed by Regional Officers. **During Disaster:** 1. DM Div. to circulate proforma, collate information on temporary blockages and seek hourly report from Nodal Officer (DM Cell). 2. Nodal Officer (DM Cell) in coordination with Regional Officer to report the data at regular intervals to DM Div. during and up to 24 hrs. post occurrence to disaster. Nodal Officer (DM Div.) to apprise data to Secretary (RT&H).	DM Cell (NHAI/NHIDCL)

	Post-Disaster: 1. Nodal Officer (DM Cell) to coordinate with Regional Officer, & inspect the site, if need be, and submit detailed report with regard to damages occurred, repair/restoration measures (immediate/temporary) undertaken as per the format of DM Div.	

Regional Officers (RW/NHAI/NHIDCL): Regional Officers for the agency shall perform following tasks:

Sl. No.	**Roles & Responsibility**
1.	**Pre-Disaster** i. Identify the Hazard specific zone and recommend DRR measures to be adopted in new construction. ii. Frequent site visit to check the quality of construction at vulnerable areas. iii. Mobilize PDs/ EE(NH)/ OC-RCC (BRO) to coordinate with DM/SDRF team and prepare disaster management plan line with Ministry guideline and in compatibility with District Disaster Management Plan. iv. Building Community awareness on the vulnerable areas using social media. v. Review the disaster specific response plan of all PDs/EE(NH)/ OC-RCC(BRO)
2	**During -Disaster** i. RO's shall be present to site once EWS is disseminated. ii. Liaison with State Government/District Administration and provide all assistance of Central Government iii. Coordinate with PDs/EE/(NH)/OC-RCC(BRO)/State Government to extend support and ensuring restoration of traffic connectivity.
3	**Post-Disaster** i. Assist Central Team in assessment and evaluation. ii. Prepare damage & loss assessment in coordination with Central Team & State PWD. iii. Send recommendation on DRR measures both structural and policy measures to respective Zonal Heads/Members/Dir(T).



***It is to mention that jurisdiction of Roads Wing (RW) shall extend to the NH stretches/works of State PWDs (or any other Authority/ Agency subordinate to the State Government), MoRT&H PIUs and BRO, with the only exception of Financial Delegation of Powers for immediate restoration/ repair of NH works, conferred under Appendix-VI of this document, where BRO has been delegated independent Financial powers.**

****The contact details of all the concerned officers as per the above institutional framework are given at below mentioned links:**

i. **For MoRT&H:** **https://MoRT&H.nic.in/who-is-who**
ii. **For NHAI:**
    - (a) **For HQ - https://nhai.gov.in/#/official/officers-hq**
    - (b) **For Field - https://nhai.gov.in/#/official/officers-fields**
iii. **For NHIDCL:**
    - (a) **For HQ - https://nhidcl.com/corporate-office/**
    - (b) **For Field - https://nhidcl.com/field-offices/**

APPENDIX-II

(CI. 3.5: Responsibility Matrix)

Pre-Disaster Understanding Risk:

Major Area	Responsibility of Centre & State Agencies	MoRT&H Head Quarter	Project Zone/DM cell (NHAI/ NHIDCL)	Regional Office
Observation Networks, Information System, Research, Forecasting. Early Warning	Promote research and studies- both in- house and extra-mural by providing research grants to researchers and Institutions Study on ecosystem and terrain/shoreline changes. Promote availability in public domain database and promote studies on socio-economic impacts of disaster.	DM Div.	Support & Coordination	Support & Coordination
Zoning/ Mapping	Preparation of detailed maps to delineate the region/NH Network vis-à- vis the available zoning maps.	DM Div.	Support & Coordination	Preparation of detailed map indicating vulnerable locations
Hazard Risk Vulnerability & Capacity Assessment (HRVCA)	1. Promote studies, documentation, and research 2. Studies on vulnerabilities and capacities covering social, physical, economic, ecological, gender, social inclusion, and equity aspects 3. Provide technical support and guidance for comprehensive HRVCA	DM Div.	Support & Coordination	Preparation of detailed map indicating vulnerable locations
Overall Disaster Governance	1. Preparation and implementation of DM plans and ensure the functioning of agencies with DM tasks 2. All aspects of disaster risk management and mainstreaming DRR 3. Ensuring coherence and mutual reinforcement of DRR, CCA and development	DM Div.	Support & Coordination	Implementation of DM plans

Non-Structural Measures	Coordination among center and state agencies for a) revised/updated rules, norms b) adoption of new/updated standards, c) enact/amend laws, regulations and d) adopt/review policies e) implementation, enforcement, and monitoring	DM Div.	Support & Coordination	Adapting the norms/ codes
Structural Measures Hazard Resilient Construction, strengthening & retrofitting	1) Technical Support & Studies 2) Formulation of the guidelines/norms/standards 3) Monitoring of adherence to the guidelines / norms/ standards	DM Div.	Support & Coordination	Support & Coordination

During Disaster:

Major Area	**Responsibility of Centre & State Agencies**	**MoRT&H Head Quarter**	**Project Zone/DM cell (NHAI/NHIDCL)**	**Regional Office**
Dissemination of Warnings	1. Quick, clear, effective dissemination of warning to all, down to the last mile- remote, rural, or urban; Regular updates to people in areas at risk 2. Deployment of communication Equipment Warnings using all types of options, types of	DM Div.	Support & Coordination	Regional Officer shall nominate an officer not below the rank of EE/PD for the following: 1. To Coordinate with local authorities DM/DC as per Disaster Management Act 2005, and emergency responders to assess the disaster situation and respond accordingly 2. Facilitating the deployment of National Disaster Response Force (NDRF) teams as per the Disaster Management Act 2005, and other specialized resources as needed

	technologies, and media 3. Providing needful information online and offline and interface with mobile network service Providing warnings on radio, TV, and cell phones			3. Mobilizing resources, including personnel, equipment, to support search and rescue operations, medical aid, and relief efforts 4. Establishing and managing emergency operations centers/ control rooms to coordinate response efforts 5. Conducting regular situation assessments and providing updates to higher authorities 6. Implementing disaster mitigation and preparedness measures to minimize the impact of future disasters 7. Ensuring compliance with disaster management plans, policies, and guidelines.
Response	1. Organizing and coordinating central assistance 2. Organizing and coordinating the immediate response 3. Coordinate with central agencies	DM Div.	Support & Coordination	1) Implementation of DM plans 2) Continuous vigil shall be kept on movement of cyclone/ tsunami. 3) The incidental report and investigation analysis shall be informed to higher authority.

APPENDIX-III

(Cl. 5.1: Disaster Specific Mitigation Strategies for the Road Sector)

The updated list of such guidelines, manuals, circulars applicable for the road sector (National Highways), shall be maintained by the S&R Zone

1. IRC: 34-2011 Guidelines for Road Construction in Areas Affected by Water Logging, Flooding and/or Salts Infestation
2. IRC: SP: 106-2015- Engineering Guidelines on Landslide Mitigation Measures for Indian Roads
3. IRC: SP:113-2018- Guidelines on Flood Disaster Mitigation for Highway Engineers
4. IRC:138-2023 Guidelines for Highway Engineers on Disaster Resilient Green Highways in Multi-Hazard Ecosystem
5. Disaster Management Act 2005 (DM Act)
6. NDMA Guidelines on Incident Response System (IRS)- July, 2010
7. NDMA Guidelines on Management of Urban Flooding- Aug 2010
8. NDMA Guidelines on Management of Tsunamis- Aug 2010
9. NDMA Guidelines on Management of Landslides and Snow Avalanches- June 2009
10. NDMA Guidelines on Management of Cyclones- April 2008
11. NDMA Guidelines on Management of Floods- Jan 2008
12. NDMA Guidelines on Management of Earthquakes- April 2007
13. NDMA Guidelines on Disability-Inclusive Disaster Risk Reduction- 2019
14. National DM Policy 2009.
15. National Guidelines on Disaster Management Exercises (DMEx)-October 2024
16. National Guidelines on Community – Based Disaster Risk Reduction (CBDRR) -October 2024
17. Paris Agreement on climate change
18. World Road Association (PIARC) – Road Infrastructure Resilience: An International Perspective
19. UNDRR (United Nations Office for Disaster Risk Reduction) & UNISDR (United Nations International Strategy for Disaster Reduction)–Guidelines for Disaster Risk Reduction in Transport Infrastructure

APPENDIX-IV

(Cl. 5.1: Disaster Specific Mitigation Strategies for the Road Sector)

The following is a list of emergent actions to be taken by Regional Officer/PD/ the officer in- charge of a road section when the same is seriously affected by floods/landslide partial or total disruption of traffic. The machinery and manpower available on the nearby project site may be utilized in case of exigency.

The Ministry has been emphasizing the emergent measures to be taken for mitigation of adverse effect of natural disasters e.g. floods, earthquakes, landslides, and cyclones. Certain amount of advance preparedness is essential before floods/cyclones to face any emergent situation. Adverse effects, however, could be mitigated to a great extent by taking timely action based upon monitoring of vulnerable road stretches and bridges, which would be well known to the field officers. In this connection, the following advance actions are considered necessary.

i. Identification of vulnerable bridges and stretches of roads likely to be washed away/breached/blocked due to Natural Disaster.

ii. Special inspection of the vulnerable location to be out before floods/ cyclones.

iii. Identification of relief equipment and material required for immediate restoration of traffic in case of damages due to Natural Disaster

iv. Identification of available equipment and material in the area by the concerned field officers and intimating the same to the Nodal Officer

v. Occurrence of Natural Disaster should be intimated to the Administration and to the Nodal Officer who will inform the Ministry.

vi. Nodal officer should have direct liaison with Meteorological Department of Government of India for immediate advance warning of natural calamities.

1. Cyclone:

Mentioned below are the Mitigation Strategies for cyclone:

a) **Improved drainage:** Proper drainage systems help to remove water from the road surface and prevent flooding. This can be achieved by installing wider and deeper drains, clearing debris from existing drains, and grading the road surface to promote proper water flow.
b) **Elevation:** Elevating important roads in flood-prone areas can help to keep them above the water level during cyclones. This can be a costly measure, but it can be very effective in protecting critical infrastructure and reducing transportation disruptions.
c) **Strengthening Bridges:** Strengthen bridges using cyclone-Resilient design principles to withstand high winds and debris impact.
d) **Seawalls and dikes:** Seawalls and dikes can be used to protect coastal roads from storm surges and waves. These structures act as barriers, absorbing the energy of the waves and preventing them from reaching the road.
e) **Vegetation planting:** Planting trees and shrubs along roadsides can help to reduce windblown debris and soil erosion. This can help to protect the road surface and keep it clear of debris after a cyclone
f) **Mangrove Plantation:** The ecologically efficient mangroves should be planted more. India has 3 per cent of the world's mangroves cover. The root systems of mangroves help in mitigating tsunamis, soil

erosion etc.

g) **Use of resilient materials:** Using strong and durable materials for road construction can help to improve the road's resistance to damage from cyclones. This may include using concrete or asphalt pavements that are designed to withstand high winds and flooding.
h) **Regular maintenance:** Regularly inspecting and maintaining roads is essential to identify and repair any damage that could make them more vulnerable to cyclones. This includes filling potholes, repairing cracks, and clearing debris from drains.

2. Flood/Cloud Burst/Urban Flood:

There have been several incidences of flooding of National Highways which might not have been reported and *in* ther *cases* even if reported, information and data may have lost due to the passage of time. Therefore, there is a need to issue guidelines/instructions and prescribing a format for reporting the incidents of flooding and then this information and data should be maintained at a central location and updated from time to time. In case of incidents involving loss of human or animal life, electricity rules have made it mandatory for all installation to report such incidents. Mentioned below are a few Mitigation Strategies for flood:

a) **Improved drainage:** Proper drainage systems help to remove water from the road surface and prevent flooding. This can be achieved by installing wider and deeper drains, clearing debris from existing drains, and grading the road surface to promote proper water flow.
b) **Elevation:** Elevating important roads in flood-prone areas can help to keep them above the water level during cyclones. This can be a costly measure, but it can be very effective in protecting critical infrastructure and reducing transportation disruptions.
c) **Strengthening Bridges:** Strengthen bridges using cyclone-Resilient design principles to withstand high winds and debris impact.
d) **Vegetation planting:** Planting trees and shrubs along roadsides can help to reduce windblown debris and soil erosion. This can help to protect the road surface and keep it clear of debris after a flood.
e) **Use of resilient** materials: Using strong and durable materials for road construction can help to improve the road's resistance to damage from cyclones. This may include using concrete or asphalt pavements that are designed to withstand high winds and flooding.
f) **Regular maintenance:** Regularly inspecting and maintaining roads is essential to identify and repair any damage that could make them more vulnerable to flooding. This includes filling potholes, repairing cracks, and clearing debris from drains.

3. Earthquake:

Mentioned below are a few Mitigation Strategies for earthquake:

a) **Seismic design of new highway structures:** new highway structures should be designed and constructed to withstand the expected seismic forces in the region. This involves using seismic-Resilient materials and construction techniques. For proper design the mapping of National Highways needs to be done with respect to various earthquake zones.
b) **Seismic retrofitting of existing highway structures:** Existing highways structures that are not designed to withstand strong earthquakes can be retrofitted to improve their seismic resistance.

4. Tsunami:

The elevation above the tide level (at the time of the tsunami) reached by water is called the run-up elevation. It varies considerably from point to point along the coast and is very sensitive to the shape of the coastline as it relates to the direction of the source mechanism for the wave. Data on run-up elevations for the whole coastline should be collated and used as a reference for designing structures. Mentioned below are a few Mitigation Strategies for Tsunami:

a) **Building codes:** Implementing and enforcing stricter building codes that incorporate tsunami-Resilient design principles for bridges, tunnels, and other highway infrastructure.
b) Elevation planning: When building new highways in tsunami-prone zones, consider elevating them above the projected inundation level. This can be achieved through earthworks, bridges, or elevated viaducts.
c) **Vegetation barriers:** Planting dense vegetation along coastal stretches can help dissipate the energy of tsunami waves before reaching the highway.
d) **Signage and public awareness:** Installing clear signage along highways in tsunami- prone areas to warn travelers and educate the public on evacuation routes and safe havens

5. Landslide and Snow Avalanche:

The disaster management network must harness the local knowledge-based warning systems for landslide hazards. The monitoring of hazardous locales by educated aware, and sensitized communities is the most valuable and reliable information base for developing an effective early warning system. Local committees or groups must be identified and trained to discern early warning signs, gather information, and disseminate them to the appropriate O&M cells. Mentioned below are a few Mitigation Strategies for Landslide:

a) **Drainage management:** Proper drainage systems are crucial to prevent water from saturating the soil, which can trigger landslides. This includes installing surface and subsurface drains, French drains, and berms to redirect water away from slopes.
b) Vegetation management: Planting trees, shrubs, and grasses with deep root systems helps to bind the soil together, reduce erosion, and absorb excess water, contributing to slope stability.
c) **Slope stabilization:** This can involve various techniques like:
    - **Grading:** Reducing the steepness of slopes can significantly decrease the risk of landslides.
    - **Retaining** walls: These structures act as barriers to hold back soil and debris on slopes.
    - **Soil reinforcement:** Techniques like geotextiles and soil nails can increase the shear strength of the soil and prevent it from slipping.
    - **Shotcrete:** Applying a layer of sprayed concrete onto slopes can provide additional support and prevent erosion.

APPENDIX-V

(Cl. 7.1: Immediate Response during/ after Disaster)

Responsibility Authority	Role & Responsibility	Time Frame
EE(PWD-NH)/ PD(NHAI)/ GM(P/NHIDCL) / OC-RCC (BRO)	i. To regularly monitor the impact of Disaster on NH network in their Jurisdiction in close coordination with District Administration, and timely inform the Regional Officer (along with photographs) about any serious impact of the disaster. ii. To timely inspect the site, assess the severity of damage, prepare technical plan for restoration/ repair and estimate the rough cost for restoration of damaged infrastructure requiring immediate attention. iii. If the estimated cost of restoration/ repair is within Rs. 25 lacs per spot and within Rs.1Cr for all spots affected by the disaster event, exercise delegated power to sanction and carry out the work.	Within 6 hours of the occurrence of the damage event
Regional Officer (MoRT&H)/ Regional Officer (NHAI) / ED(P), (NHIDCL)/ BRTF Commander (BRO)	i. To timely inspect the site, either based on the information received from EE(NH)/PD/OC-RCC (BRO) or through other sources, along with EE(NH)/PD/OC-RCC(BRO), and assess the severity of damage, and requirement of immediate restoration, if any. ii. The tentative technical plan for repair/ restoration would be prepared by RO(MoRT&H/NHAI)/ED (P- NHIDCL)/ BRTF Commander (BRO) during site inspection. iii. The rough cost for restoration of the damaged infrastructure requiring immediate attention for repair/ restoration, would be estimated with the assistance of Team of Executing Agency within 3-4 hours. iv. Based on the estimated cost of repair/ restoration, the Technical Plan would either be approved on the site itself by RO(MoRT&H/NHAI)/ED (P-NHIDCL)/ BRTF Commander (BRO), if falling within its delegation of powers as mentioned under Section no. 12 of this document. Otherwise, the	Within 12 hours of the occurrence of the damage event

	damage report along with restoration scheme/ cost must be sent to Zonal Head (MoRT&H)/ Member (NHAI)/ Director(T), (NHIDCL)/ Project CE (BRO), for site inspection and approval of technical plan for repair/restoration of the infrastructure.	
Zonal Head (MoRT&H)/ Member (NHAI)/ Director(T), (NHIDCL)/ Project CE (BRO)	i. To study the Technical Plan of repair/ restoration shared by RO(MoRT&H/NHAI)/ED(P- NHIDCL)/ BRTF Commander (BRO), for disaster events with estimated cost of repair/ restoration beyond the delegated power of RO(MoRT&H/NHAI)/ED(P-NHIDCL)/ BRTF Commander (BRO) (Section 12), and to Visit the site along with RO(MoRT&H/NHAI)/ED(P- NHIDCL)/ BRTF Commander (BRO). ii. To finalize and approve the Technical Plan for the Immediate Restoration/ repair on site, approve the cost estimate if the same is within delegated powers (Section 12), and get the work started on the same. Otherwise, the damage report along with restoration scheme/ cost must be sent to DG(RD) & SS/ Chairman (NHAI)/ MD(NHIDCL)/DGBR(BRO) for approval within their delegated powers (Section 12) or for seeking the approval of Competent Authority if it is beyond their delegated powers (Section 12)	Site Visit within 24 hours of the occurrence of the damage event. Approval of Restoration/ Repair Plan within 30 hours occurrence of the damage event.

APPENDIX-VI

(Cl. 12: Financial Arrangements)

Agency/ Wing	Financial Delegation & Responsibilities	Action by
MoRT&H (RW/EAP)/ NHAI/ NHIDCL/ BRO	EE(PWD-NH)/ PD(NHAI)/ GM(P/NHIDCL)/ OC-RCC (BRO), shall have power to sanction estimates for immediate restoration/ repair work, up to Rs. 25 lacs. For short term per spot subject to max of Rs.1 Cr. Per disaster event	EE(PWD-NH)/PD(NHAI)/GM(P/NHIDCL)/ OC-RCC (BRO)
	Regional Officer (MoRT&H)/ Regional Officer (NHAI) / ED(P), (NHIDCL)/ BRTF Commander (BRO), shall have power to sanction estimates for immediate restoration/ repair work, up to Rs. 1 Cr. Per spot subject to max of Rs. 25 Cr. Per disaster event	Regional Officer (MoRT&H)/ Regional Officer (NHAI) / ED(P), (NHIDCL)/ BRTF Commander (BRO)
	Zonal Head (MoRT&H)/ Member (NHAI)/ Director(T), (NHIDCL) / Project CE (BRO), shall have power to sanction estimates for immediate restoration/ repair work, up to Rs. 5 Cr. Per spot subject to max of Rs. 50 Cr. Per disaster event	Zonal Head (MoRT&H)/ Member (NHAI)/ Director(T), (NHIDCL)/ Project CE (BRO)
	DG(RD) & SS / Chairman (NHAI)/ MD (NHIDCL)/ DGBR (BRO), shall have power to sanction estimates for immediate restoration/ repair work, up to Rs. 10 Cr. Per spot subject to max of Rs. 100 Cr per disaster event	DG(RD) & SS / Chairman (NHAI)/ MD(NHIDCL)/ DGBR (BRO)

*Note:

i. Allocation of funds shall be done by Planning Zone in accordance with clause no. 49 of Disaster Management Act, 2005

ii. Respective Officers to whom financial power is delegated as per Appendix-VI may first explore the possibility for execution of works for immediate repair/restoration through contractor already engaged in work of construction or maintenance (STMC/PBMC etc.) in the affected stretch or any nearby stretch, failing which carry out procurement of works through short term tenders/ single tender enquiry/nomination following the provisions of Rule 166 of GFR 2017 and Clause 3.5.11 of Manual for Procurement of Works, 2022 published by Dept. of Expenditure (Ministry of Finance).

Permanent restoration:

Agency	Financial Delegation & Responsibilities
RW	As per extant guidelines for delegation of power for original nature of work
NHAI	As per extant guidelines for delegation of power for original nature of work
NHIDCL	As per extant guidelines for delegation of power for original nature of work

Capacity Building:

DM Div. to identify and finalize Capacity Building measures required in coordination with IAHE. Needful funds shall be provided by the Ministry.

APPENDIX-VII

(Cl. 8.1.1 & 8.1.2: Detailed Damage Assessment)

Sl. No.	Agency	Role & Responsibilities	Time Frame
1.	Roads Wing (State PWD, BRO & EAP)	**Zonal Heads/JS(EAP):** i. **Initial Damage Assessment immediately following disaster event:** To submit damage assessment report specifying the damage requiring temporary solutions and permanent solutions to DG(RD) & SS. ii. **Post-event Investigation & Analysis and Strategy for the future:** To submit assessment report clearly specifying root cause of disaster, highlighting design specific problems, scope of improvement and possible solutions both structural and legal measures to DG(RD) & SS. DG(RD) & SS to evaluate report and submit final recommendation to Standing Committee.	Within 1 month
2.	NHAI	**Member NHAI:** i. **Initial Damage Assessment immediately following disaster event:** To submit damage assessment report specifying the damage requiring temporary solutions and permanent solutions to Chairman (NHAI). ii. **Post-event Investigation & Analysis and Strategy for the future:** To submit assessment report clearly specifying root cause of disaster, highlighting design specific problems, scope of improvement and possible solutions both structural and legal measures to Chairman (NHAI). Chairman (NHAI) to evaluate report and submit final recommendation to Standing Committee through AS(H), MoRT&H.	Within 1 month
3.	NHIDCL	**Dir(T), NHIDCL:** i. **Initial Damage Assessment immediately following disaster event:** To submit damage assessment report specifying the damage	

		requiring temporary solutions and permanent solutions to MD (NHIDCL). ii. **Post-event Investigation & Analysis and Strategy for the future:** To submit assessment report clearly specifying root cause of disaster, highlighting design specific problems, scope of improvement and possible solutions both structural and legal measures to MD (NHIDCL). MD (NHIDCL) to evaluate report and submit final recommendations to Standing Committee through AS (NHIDCL), MoRT&H.	Within 1 month

APPENDIX-VIII

(Ch. 9: –Regional Nodal Officer: Checklist for Resources)

For each state where MoRT&H, NHAI and NHIDCL are having regional offices, a Regional Nodal Officer shall be appointed by DG (RD) & SS based on following criteria –

- For each state where the MoRT&H RO is present, the head of the RO shall be the Regional Nodal Officer
- In case, the states where MoRT&H RO is not present, then DG (RD) & SS shall appoint the head of either NHAI – RO or NHIDCL – RO, as the Regional Nodal Officer

Following are checklist of Human Resources and Equipment to be maintained by Regional Nodal Officer.

Engineers and Technicians:

• Structural Engineers: Regional Nodal Officer in field offices to maintain a list of engineers with the help of existing manpower of contractors/ authority engineers etc. Review of such list shall be done yearly and necessary updation shall be carried out.

• Civil Engineers: Regional Nodal Officer in field offices to maintain a list of engineers with the help of existing manpower of contractors/ authority engineers etc. Review of such list shall be done yearly and necessary updation shall be carried out.

• Electrical and Mechanical Technicians: Regional Nodal Officer in field offices shall maintain a list of such professionals with the help of state administration or any such authority and obtain such list for reference.

Volunteers:

• District Administrations have been mandated to keep a ready compilation of the data related to trained Aapda Mitra Volunteers, Civil Defence Volunteers, volunteers of Nehru Yuva Kendra (NYKS), NCC, NSS, NGOs, Community Based Organizations (CBOs), etc. Nodal Officers in field offices shall maintain a list with the help of state administration and obtain such list for reference.

Equipment:

For ensuring the adequate availability of equipment to carry out DM activities, Regional Nodal Officer shall appoint an Officer in the regional office who will be responsible to maintain a checklist of equipment and update the same in a digital inventory system on yearly basis.

To ensure the availability, transportation, deployment and operation of such equipment(s) for carrying out DM activities, existing contractors/ vendors with the field offices shall be lopped in.

Following is the tentative check list of equipment under distinct categories which shall be maintained in field offices and updated on yearly basis based on requirements:

1. **Search and Rescue Equipment:**

   - Cranes and Excavators: From contractors/ vendors
   - Jaws of Life (hydraulic rescue tools): From contractors/ vendors

- Rope and Harnesses: From NDRF or state/ district administration or any such authority
- Inflatable Boats and Life Jackets: From NDRF

2. **Medical Equipment:**
   - Ambulances: From state/ district administration
   - Mobile Medical Units: From state/ district administration
   - First Aid Kits: From state/ district administration
   - Portable Oxygen Cylinders: From state/ district administration
   - Defibrillators: From state/ district administration
3. **Communication Equipment:**
   - Satellite Phones: From NDRF
   - Two-way Radios: From NDRF
   - Public Address Systems: From state/ district administration
4. **Heavy Machinery and Tools:**
   - Bulldozers: From contractors/ vendors
   - Backhoes: From contractors/ vendors
   - Chainsaws: From contractors/ vendors
   - Generators: From contractors/ vendors
   - Water Pumps: From state/ district administration
5. **Transportation:**
   - Trucks and Lorries: From contractors/ vendors
   - Helicopters: From NDRF or state/ district administration or any such authority
   - Boats: From NDRF or state/ district administration or any such authority
   - Buses and Vans: From NDRF or state/ district administration or any such authority

Facilities

1. **Emergency Shelters and Camps:**
   - Tents and Temporary Housing Units: From NDRF or state/ district administration or any such authority
   - Community Centers: From state/ district administration
   - School Buildings: From state/ district administration
   - Sports Complexes: From state/ district administration

2. Medical Facilities:

- Field Hospitals: From state/ district administration
- Triage Centers: From state/ district administration
- Blood Donation Centers: From state/ district administration
- Clinics and Health Posts: From state/ district administration

3. Storage Facilities:

- Warehouses for relief supplies: From state/ district administration
- Cold Storage for perishable items: From state/ district administration
- Fuel Storage: From state/ district administration

Other Assets:

Following is the list of assets which shall be maintained by Officer appointed by Regional Nodal Officer in field offices with the help of NDRF or state/ district administration or any such authority and shall be made available for DM activities in coordination with identified entities. It will be responsibility of Nodal Officers-RI to apprise such authority about the maintenance of such lists in field offices and ensure their availability for DM activities.

1. Relief Supplies:

- Food and Water Supplies: From state/ district administration
- Clothing and Blankets: From state/ district administration
- Hygiene Kits: From state/ district administration
- Cooking Utensils: From state/ district administration

2. Logistics Support:

- Fuel and Energy Supplies: From state/ district administration
- Transportation Logistics (routes and schedules): From state/ district administration

3. Information and Data Systems:

- Geographic Information Systems (GIS): From NDRF or state/ district administration or any such authority
- Disaster Management Software: From NDRF or state/ district administration or any such authority
- Real-time Monitoring Systems: From NDRF or state/ district administration or any such authority
- Databases of Critical Infrastructure: From NDRF or state/ district administration or any such authority

APPENDIX-IX

(Cl. 1.3 - Key Strategies, and Cl. 4.2 – Disaster Risks in Road sector (Infrastructure))

Case Study 1: Flood/GLOF Disaster impact on road infrastructure

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Flood	4th October 2023	

State	District	Affected NH
Sikkim	South Lhonak	NH-10 & NH-510

Description of Damage (photographs):

Between 3rd and 4th October,2023 alone, Sikkim received five times the usual precipitation. The South Lhonak lake burst its shores, causing a flash flood. Water levels downstream in the River Teesta subsequently rose by 15 to 20 feet (4.6 to 6.1 m), flooding many areas in Mangan, Gangtok, Pakyong, and Namchi districts in Sikkim, and Kalimpong, Cooch Behar, Jalpaiguri and Darjeeling districts in West Bengal.

Road and Bridge Infrastructure Damage

1. **NH-10 (Rangpo to Ranipool)**
   Location: Km 62+950
   Damage: Approximately 50 meters of road washed away (half-width).
   Status: Restored and traffic-worthy as of the report date.
2. **NH-510 (Singtam to Tarku)**
   Location: Km 0+070
   Damage: Central Pier (P1) and superstructure of a 125m major bridge washed away. Abutment A1 is overhanging and inaccessible. Further damage to A2 and P2 pending detailed investigation.
   Action: IIT proposed to conduct feasibility study for reconstruction.
3. **LD Kazi Bridge (Sherwani)**
   Location: Upstream of Teesta-VI NHPC project.
   Damage: Entire bridge washed away.

Impact of disaster on NH connectivity:

1. **Details regarding Blockage in connectivity of NH:**

   Nature of Blockage: Partially blocked [✓]/ Completely blocked [ ]

   Impacted/blocked length: ~175 m

2. **Whether connectivity through alternate route available or not? (Yes/ No)**

   If yes, **additional length:** ___N.A.__ km and,

   Travel time: __N.A.___hrs. required for detour.

3. Duration for which connectivity remained partially/ completely blocked until **temporary / Permanent restoration was done:** 13 days for temporary restoration

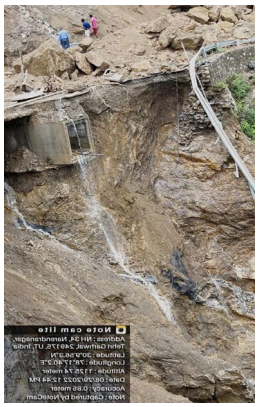
Case Study – 2: Landslide in Tehri Garhwal, Uttarakhand

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Landslide	14.08.2022	24.08.2022

State	District	Affected NH
Uttarakhand	Tehri Garhwal	NH-34 (Old NH-94)

Description of Damage (photographs):

During the monsoon season of 2022, the valley side slope collapsed on night of the 29.07.2022 at km 18+000 due to heavy rainfall causing landslide & the Highway at km 18 has been blocked repeatedly during the rains multiple times. Further the valley side has been eroded which may further extended leading to damage to causing the risk of Highway closure at any instant of time.



Impact of disaster on NH connectivity:

1. **Details regarding Blockagein connectivity of NH:**

   Nature of Blockage : Completely blocked

   Impacted/blocked length: 50 Mtr.

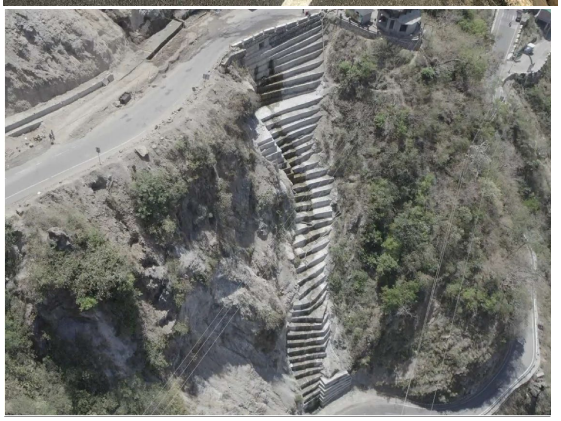
2. **Whether connectivity through alternate route available or not? (Yes/ No)- Yes**

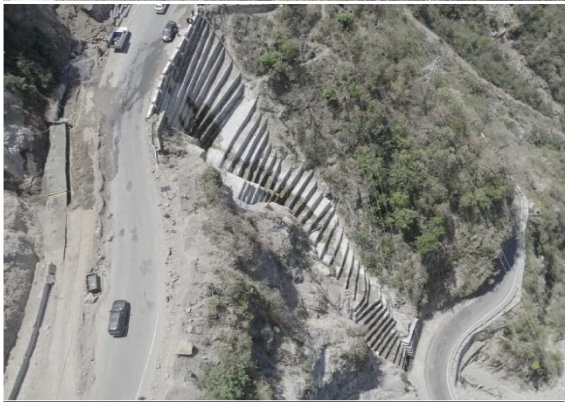
   If yes, **additional length:** 30 km and,

   Travel time: 2 hrs. required for detour.

3. Duration for which connectivity remained completely blocked until **temporary/ Permanent restoration Temporary restoration work was completed on with in 30 days and restoration of Road at km 18.00 was completed before May 2023**

Restoration of Road at km 18.00 was completed before May- June 2023





Case Study – 3: Snow Avalanche

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Snow Avalanche	27 Feb 2025	28 Feb 2025

State	District	Affected NH
Uttarakhand	Chamoli	NH-07

Description of Damage (photographs):

During the intervening night of 27 Feb and 28 Feb 2025, heavy snowfall was reported in the upper reaches of Chamoli District, triggering a series of mino and major avalanches. A major avalanche struck near Mana Village on the Mana Pass Road at Km 0+100.

Staff and labour camp belonging to the EPC contractor, M/s S&P - VCIPL JV engaged in the i provement/ construction of road Mana–Mana Pass under the BRO, Bharatmala Pariyojana was

situated along this stretch of the road.

At approximately 0730 hrs, initial reports from the EPC contractor indicated that around 54 EPC Contractor workers and temporary accommodation were trapp d/buried under the avalanche. In response, Joint rescue operations were promptly launched by BRO teams and Army personnel. The details of the rescue outcomes are as follows :-

a) Rescued alive fro
b) Fatalities - 08 Nos

Impact of disaster on NH connectivity: Details **regarding Blockage in connectivity of NH:** NH-07

Nature of Blockage: Completely blocked

Impacted/blocked length: 50.987 km

Whether connectivity through alternate route available or not? No

If yes, additional length: Nil

Travel time: Nil .

Duration for which connectivity remained partially/ completely blocked until temporary / Permanent restoration was done: 72 Hours / 03 Days

Avalanche Site - 46 Nos

Case Study – 4: Flood

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Flood	31.07.2024	05.08.2024

State	District	Affected NH
Uttarakhand	Rudraprayag	107

Description of Damage (photographs):

During the ongoing monsoon of 2024 road section at various location from km 70 – km 74 has been damaged/ washed out due to cloudburst (in July 2024) & very heavy rain led to flash flood in the Mandakini river as well as in Songanga river.

Chainage 70.500

Chainage 70.475

Chainage 70.360

Chainage 70.570

Chainage 70.63

Chainage 71.20

Impact of disaster on NH connectivity:

1. **Details regarding Blockage in connectivity of NH:**

   Nature of Blockage : Partially blocked/Completely blocked :- **Completely blocked/Washout**

   Impacted/blocked length: 365. Mtr.

2. **Whether connectivity through alternate route available or not? (Yes/ No)- No**

   If yes, **additional length:** NA km and,

   Travel time: NA hrs. required for detour.

3. Duration for which connectivity remained completely blocked until **temporary/ Permanent restoration Temporary restoration work was completed on 31.08.2024** in 31 days

Case Study – 5: Land slide

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood	Period of Disaster Event	
	Start	End
Land slide	Km 99.00	Km 131.00
State	District	Affected NH
Arunachal Pradesh	West Kameng	NH-13

Description of damage: -

(a) Due to "Sitrang" Cyclone,heavy intensity rainfall occurred from afternoon of 25 Oct 2022 to 27 Oct 2022 due to which several formations were breached and numerous slides occurred along Balipara-Charduar-Tawang(BCT) road. Heavy intensity rainfall occurred in and around Tenga valley due to which most of the damages occurred on BCT road from Km 99.00 to Km 131.00,Bomdila Bye Pass from Km 10.570 to Km 10.577 road.

(b) Due to heavy intensity rainfall that occurred on 27 & 28 Aug 2023 during the monsoon season in this region of West Kameng district of Arunachal Pradesh, several Landslide occurred. Due to these Landslide Formation, Pmt structure, BT surface got damaged along BCT road.

(c) Due to heavy intensity rainfall that occurred on 04&05Jul 2024 in this region of West Kameng district of Arunachal Pradesh, several Landslide occurred from Km 98.600 and Km 102.200 at various location on BCT road.

(d) Due to heavy intensity rainfall that occurred on 13 Aug 2024 in this region of West Kameng district of Arunachal Pradesh, several Landslide occurred from Km 98.000 and Km 100.000 at various locations on BCT road.

(e) Due to heavy intensity rainfall that occurred on 30 & 31 May 2025 in this region of West Kameng district of Arunachal Pradesh, several Landslide occurred from Km 96.900 to Km 131.000 at various location on BCT road.

Details of Repair/Restoration works:-

(a) Immediately resources were mobilized on the ground to clear the slide as early as possible for double lane and restored road to its original condition. Repair/Restoration Workis in progress as T/Wall, B/Wall and R/Wall by this RCC under Job no-103/699 for Rs 111.55 lakh, Job No-103/712 Cost 299.94 Lakh, Job No-103/718 Cost Rs. 245.48 lakh, and Job no-103/716 for Rs 140.81 Lakh.

Lead Agency for temporary & permanent restoration:- Border Roads Organisation (BRO)

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:-Border Roads Organisation

Challenges faced during temporary & permanent restoration:-

- ✓ Continuous Heavy Rainfall: Persistent adverse weather slowed down clearing operations.
- ✓ Multiple Landslide Points: Several breaches needed concurrent attention, stretching resources.
- ✓ Difficult Terrain: The mountainous and remote landscape hindered access to damaged sites.
- ✓ Limited Connectivity: Damaged communication lines made coordination challenging.
- ✓ Resource Mobilization: Rapid mobilization of heavy machinery and skilled personnel were required under hazardous conditions.

Details of relief & rescue operations, if any:-

- ✓ Immediate deployment of BRO teams for clearing debris and landslide material.
- ✓ Priority given to rescue any stranded travelers and ensure safe passage once basic clearance was achieved.
- ✓ Close coordination with district administration for emergency support and essential supplies.

Key Learnings: -

a) Pre-positioning of resources before known monsoon period significantly enhances response time
b) Importance of real-time communication networks for coordination in inaccessible regions.
c) Regular maintenance and early warning systems reduce long-term disruption and damage.

New Technology/Innovative techniques used, if any:-

- ✓ Slope Restoration Work (SRW) proposed at various location Km 91.42, Km 105.995, Km 114.200 and Km 120.500 on NH-13.
- ✓ Slope Restoration Work (SRW) is under progress at location Km 102.400 on BCTroad NH-13 andBomdila Bye pass at Km 0.300 and Km 9.200 was completed on ground.
- ✓ Slope Restoration Work (SRW) was completed at location Km 96.000 and Km 95.600 on BCT road NH-13.

Remarks:-

BRO teams swiftly mobilized available resources and manpower to restore connectivity in record time. Effective coordination and dedication ensured timely clearance of debris and relief to affected areas. Efforts of 91 RCC/14 BRTF/ VARTAK (P) have been appreciated by various Army formations, Civil Administration, VVIP/VIP dignitaries, Locals and Print Media.

d) Inter-agency collaboration (when applicable) accelerates infrastructure restoration.

Case Study – 6: Land slide

Type of Disaster Event (Lanslides/Snow Avalanche/Earthquake/Flood	Period of Disaster Event	
	Start	**End**
Land slide	Km 99.00	Km 131.00
State	**District**	**Affected NH**
Arunachal Pradesh	West Kameng	NH-13

Description of damage:-

(a) Due to "Sitrang" Cyclone,heavy intensity rainfall occurred from afternoon of 25 Oct 2022 to 27 Oct 2022 due to which several formations were breached and numerous slides occurred along Balipara-Charduar-Tawang(BCT) road. Heavy intensity rainfall occurred in and around Tenga valley due to which most of the damages occurred on BCT road from Km 99.00 to Km 131.00,Bomdila Bye Pass from Km 10.570 to Km 10.577 road.
(b) Due to heavy intensity rainfall that occurred on 27 & 28 Aug 2023 during the monsoon season in this region of West Kameng district of Arunachal Pradesh, several landslides occurred. Due to these landslides Formation, Pmt structure, BT surface got damaged along BCT road.
(c) Due to heavy intensity rainfall that occurred on 04&05Jul 2024 in this region of West Kameng district of Arunachal Pradesh, several landslides occurred from Km 98.600 and Km 102.200 at various location on BCT road.
(d) Due to heavy intensity rainfall that occurred on 13 Aug 2024 in this region of West Kameng district of Arunachal Pradesh, several landslides occurred from Km 98.000 and Km 100.000 at various locations on BCT road.
(e) Due to heavy intensity rainfall that occurred on 30 & 31 May 2025 in this region of West Kameng district of Arunachal Pradesh, several landslides occurred from Km 96.900 to Km 131.000 at various location on BCT road.

Details of Repair/Restoration works:-

(a) Immediately resources were mobilized on the ground to clear the slide as early as possible for double lane and restored road to its original condition. Repair/Restoration Work is in progress as T/Wall, B/Wall and R/Wall by this RCC under Job no-103/699 for Rs 111.55 lakh, Job No-103/712 Cost 299.94 Lakh, Job No-103/718 Cost Rs. 245.48 lakh, and Job no-103/716 for Rs 140.81 Lakh.

<u>Lead Agency for temporary & permanent restoration</u>:- Border Roads Organisation (BRO)

<u>Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure</u>:-Border Roads Organisation

Case Study – 7: Land slide

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood	Period of Disaster Event	
	Start	**End**
Land slide	Km2.69	Km 2.71
State	**District**	**Affected NH**
J&K	Ganderbal	New NH-501

Description of damage:-
Size of Land slide - 20X12X4 Mtr
Damage of structure - Edge beam 14 Mtr
V/E/P Deployed - JS-205

Details of Repair/Restoration works:-
Slide clearance was carried out promptly after occurance of land slide. The edge beam was reconstructed/repaired and made ready before the Shri Amarnathji Yatra commenced

Lead Agency for temporary & permanent restoration:- 122 RCC/32 BRTF

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:- BRO

Challenges faced during temporary & permanent restoration:- It was a very challenging task to complete the work in extremely cold conditions without delay and it was finished before the Shri Amarnathji Yatra commenced.

Key Learnings:-
During the completion of this challenging task, it was necessary to take care of both the manpower and the equipment.

Case Study – 8: Landslide

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood	Period of Disaster Event	
	Start	**End**
Land slide	Km 4.900	Km 4.930
State	**District**	**Affected NH**
J&K	Ganderbal	New NH-501

Description of damage:-
Size of Land slide - 26X7.5X4 Mtr.
V/E/P Deployed - JS-205

Details of Repair/Restoration works:-
Slide clearance was carried out promptly after occurance of land slide.

Lead Agency for temporary & permanent restoration:- 122 RCC/32 BRTF

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:- BRO

Challenges faced during temporary & permanent restoration:- It was a very challenging task to complete the work in extremely cold conditions without delay and it was finished before the Shri Amarnathji Yatra commenced.

Key Learnings:-
During the completion of this challenging task, it was necessary to take care of both the manpower and the equipment.

Case Study – 9: Snow Avalanche

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood	Period of Disaster Event	
	Start	**End**
Snow Avalanche	Km 4.700	Km 4.760
State	**District**	**Affected NH**
J&K	Ganderbal	New NH-501

Description of damage :-

Size of Snow Avalanche - 24X5X5.3 Mtr & 20X4.3X4 (Multiple Avalanches) V/E/P Deployed -JS-205

Details of Repair/Restoration works:-

Snow removal was carried out promptly after the snowfall ceased.

Lead Agency for temporary & permanent restoration:-122 RCC/32 BRTF

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:- BRO

Challenges faced during temporary & permanent restoration:-

Snow clearance work was carried out in extremely cold and freezing conditions.

Key Learnings:-

When clearing snow, take great care. A sudden, large avalanche could occur, ensure the protection of both workers and machinery.

Case Study – 10: Landslide

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood)	Period of Disaster Event	
	Start	**End**
Land slide	Km 3.770	Km 3.785
State	**District**	**Affected NH**
J&K	Ganderbal	New NH-501

Description of damage:-
Size of Land slide - 13X5X4 Mtr. V/E/P Deployed - JS-205

Details of Repair/Restoration works:- Slide clearance was carried out promptly after occurrence of land slide.

Lead Agency for temporary & permanent restoration:- 122 RCC/32 BRTF

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:- BRO

Challenges faced during temporary & permanent restoration:- It was a very challenging task to complete the work in extremely cold conditions without delay and it was finished before the Shri Amarnathji Yatra commenced.

Key Learnings:-
During the completion of this challenging task, it was necessary to take care of both the manpower and the equipment.

New Techology/Innnovative techniques used, if any:- NA

Remarks:- NA

Case Study – 11: Landslide

Type of Disaster Event (Landslide/Snow Avalanche/Earthquake/Flood)	**Period of Disaster Event**	
	Start	**End**
Land slide	Km 3.690	Km 3.715
State	**District**	**Affected NH**
J&K	Ganderbal	New NH-501

Description of damage:-
Size of Land slide - 23X6X7 Mtr. V/E/P Deployed
- JS-205

Details of Repair/Restoration works:-
Slide clearance was carried out promptly after occurance of land slide.

Lead Agency for temporary & permanent restoration:- 122 RCC/32 BRTF

Details of Road Authorities & details of NGO of local community involved in temporary & permanent restoration of infrastructure:- BRO

Challenges faced during temporary & permanent restoration:- It was a very challenging task to complete the work in extremely cold conditions without delay and it was finished before the Shri Amarnathji Yatra commenced.
Details of relief & rescue operations, if any:- NA
Key Learnings:- During the completion of this challenging task, it was necessary to take care of both the manpower and the equipment.
New Techology/Innnovative techniques used, if any:- NA

Case Study – 12: Landslide

Type of Disaster Event	**Period of Disaster Event**	
	Start	**End**
Landslide at Km 9.50 on JNM Road	02 May 2022	02 May 2022
State	**District**	**Affected NH**
Sikkim	JNM Road	NH 310

1. **Description of Damage:-**

Landslide at Km 9.50 on JNM road: Due to incessant rainfall on 02 May 2022 and subsequent days, damages occurred on road Old JNM at Km 9.50, which were further aggravated. Formation washed out (Size 40X6X6 mtr) due to weak toe on valley side about 50 mtr deep.

2. **Details of Repair/Restoration Works:-** In order to avoid impending danger of disruption to the line of communication, to avoid any further damages to life and property, following restoration works taken up:-
   (a) Fmn cutting of size 40X2X3 mtr.
   (b) Sausage B/Walling of size 40X1 mtr(in 02 steps)
   (c) L Shaped lined drain 50 mtr.
   (d) PCC (1:2:4) T/Wall 16 mtr X2 mtr
   (e) PCC (1:3:6) T/Wall 16 mtr X2 mtr
   (f) PCC (1:3:6) R/Wall 16 mtr X2 mtr
   (g) Sausage R/Wall size 24mX6m (06 steps in 1 mtr height)

3. Lead Agency for temporary & permanent restoration:-

758BRTF/Swastik/BRO

4. Details of Road Authorities' & details of NGO or local community involved in temporary & Permanent restoration of Infrastructure:-

Road Authorities –129 RCC

5. Challenges faced during temporary & permanent restoration :-

Roads are disrupted and blocked due to intense rains And snowfall.

6. Details of relief & rescue operations:-

Due to department quick response and tireless effort 15 tourists were rescued from the avalanche site alive. One lady buried under the snow was also rescued after toiling for about 90 minutes. After massive search operation 06 Nos of tourist buried under snow were evacuated and send to STNM Hospital, Gangtok (Sikkim) but unfortunately their life could not be saved. The rescue operation continued till 05th Apr 2023 with machine and personnels. Apart from above more than 350 stranded tourists and 80 vehicles which were stuck at the avalanche site evacuated by his skill and efforts. Department has displayed his great skill and wisdom to save the valuable life of tourists.

7. Key learning :-

(a) Lack of Redundancy in Communication
(b) Lack of Logistic Sustenance Support for Labours

8. New Technology/ Innovative techniques used:-

No comments

9. Remarks:-

Many dignitaries Officials visited the spot and appreciated BRO Team efforts to save human lives.

Case Study – 13: Snow Avalanche on JNM Road

Type of Disaster Event	Period of Disaster Event	
	Start	**End**
Snow Avalanche on JNM Road	04 Apr 2023	04 Apr 2023
State	**District**	**Affected NH**
Sikkim	JNM	NH 310

1. **Description of Damage:-**

Snow Avalanche on JNM Road: On 04th Apr 2023 at about 1130 Hrs a sudden avalanche has buried/swept away a number of tourists who were enjoying photography near 15th Mile on JNM road.

2. **Details of Repair/Restoration Works:-**On 04th Apr 2023 at about 1130 Hrs a sudden avalanche has buried/swept away a number of tourists who were enjoying photography near 15th Mile on JNM road. On hearing about this incident BRO team and a wheel loader and immediately started rescue operation for victim of avalanche.

3. **Lead Agency for temporary & permanent restoration:-**
759BRTF/Swastik/BRO

4. **Details of Road Authorities' & details of NGO or local community involved in temporary & Permanent restoration of Infrastructure:-**
Road Authorities –129 RCC

5. **Challenges faced during temporary & permanent restoration :-**
Roads are disrupted and blocked due to intense rains and snowfall.

6. Details of relief & rescue operations:-

Due to department quick response and tireless effort 15 tourists were rescued from the avalanche site alive. One lady buried under the snow was also rescued after toiling for about 90 minutes. After massive search operation 06 Nos of tourist buried under snow were evacuated and send to STNM Hospital, Gangtok (Sikkim) but unfortunately their life could not be saved. The rescue operation continued till 05th Apr 2023 with machine and personnels. Apart from above more than 350 stranded tourists and 80 vehicles which were stuck at the avalanche site evacuated by his skill and efforts. Department has displayed his great skill and wisdom to save the valuable life of tourists.

7. Key learning :-

(a) Lack of Disaster Management plan.

8. New Technology/ Innovative techniques used:-

No comments

9. Remarks:-

Many dignitaries Officials visited the spot and appreciated BRO Team efforts to save human lives..

Case Study – 14: Flood/Cloud Burst/GLOF

Type of Disaster Event	**Period of Disaster Event**	
	Start	**End**
Flood/Cloud Burst/GLOF	3rd Oct 2023	04th Oct 2023
State	**District**	**Affected NH**
Sikkim	Mangan	NH 310 A & 310 AG

1. Description of Damage:-

Glacial Lake Outburst Flood (GLOF). On intervening night of 03rd and 04th Oct 2023, North Sikkim experienced massive cloud burst due to heavy torrential rainfall resulting in bursting of Lhonak glacier, ravaging the entire region of North Sikkim. Thus, causing extensive damages to roads, bridges and permanent structures in North Sikkim and causing loss to human lives and properties. The lake outburst also resulted in the breach of the Chungthang dam, which is the largest hydropower project in the state of Sikkim and massive damage to Dikchu dam.Due to flash flood in river Teesta, a total of 20 bridges and approx. 30 Km of road network in stretches got washed away/severely damaged between Silliguri to North Sikkim. Ferocity of flood due to GLOF was so severe that all vehicular crossing over river Teesta between Singtam to Zeema washed away. Connectivity to North Sikkim was completely severed. Civil population of Chungthang town, Lachen valley and Lachung valley as well as numerous detachments of Army and BRO deployed in North Sikkim were completely cut off. As per rough estimation, approx. 25000 crores worth assets and infrastructure got lost due to flash flood. Due to severe damage to road networks and bridges, supply lines of armed forces were completely jeopardise. Thereby, making security of the nation vulnerable. In addition thousands of tourist got stranded in North Sikkim. Primary and shortest route of induction from Silliguri to Gangtok i.e. NH-10 experienced massive damages and formation breaches at multiple locations, which made induction of any heavy machineries and construction/rescue stores very challenging, as other alternate routes to Gangtok were of lower specifications having weak bridges. Unprecedented destruction caused due to GLOF, attracted massive national as well as international media attention.

Washed Away Chungthang Dam

Washed Away Approach Road to Theng Tunnel

Damaged Gangtok-Chungthang Road

Washed Away Chungthang-Lachen road

2. <u>Details of Repair/Restoration Works:-</u>

Mangan-Chungthangrd (Km 89.70 to Km 95.50)
Chungthang-Lachen road (Km 2.50-10.00 & Km 17.00 to Km 20.00) Lachen-Kalep road (Km 0.200 to Km 5.600 & Km 5.600 to Km 7.00) Chungthang Br at Km 95.600 on G-C Road
Zeema Br at Km 41.00 on C-Ln-Z Road

FMN CUTTING AT KM 3.30 OF SUSTAINE

R/WALL AT KM 87.600 NEAR THENG TUNNEL

3. Lead Agency for temporary & permanent restoration:-

758BRTF/Swastik/BRO

4. Details of Road Authorities' & details of NGO or local community involved in temporary & Permanent restoration of Infrastructure:-

Road Authorities –86 RCC&107 RCC

5. Challenges faced during temporary & permanent restoration :-

Roads were inaccessible due to disrupted line of communication.

6. Details of relief & rescue operations:-

Border Roads Organisation in close coordination with Army undertook challenging task of construction of foot tracks in Lachen valley to reconnect isolated villages and BRO detachment. Foot tracks enabled successful evolution of hundreds of stranded tourists/locals to safer locations.

7. Key learning :-

(a) Proper Communication facility with high resolution of Wi Fi sets to be established.

(b) Logistic Sustenance Support for Labours to be provided.

8. New Technology/ Innovative techniques used:-

No comments

9. Remarks:-

Many VIP's visited the spot and appreciated BRO Team efforts to save human livesand to establish road connectivity.

Case Study – 15: Cyclone Remal

Type of Disaster Event	**Period of Disaster Event**	
	Start	**End**
Cyclone Remal	11th Jun 2024	12 Jun 2024
State	**District**	**Affected NH**
Sikkim	Mangan	NH 310 A & 310 AG

1. Description of Damage:-

Cloud Burst. On 11th/12thJune 2024, incessant heavy rains, caused by a cloudburst in Sikkim's Mangan district - measuring over 220.10 mm created havoc in Mangan. All the roads leading towards North Sikkim experienced multiple heavy Landslide and formation breaches, resulting in complete breakdown of connectivity to North Sikkim. 400 feet Bailey Suspension bridge constructed post GLOF collapsed, resulting in severing of connectivity between Mangan and Dzongu region. Due to breakdown in connectivity, more than 2000 tourists got stranded in the North Sikkim.

(i) Existing 90 ft TSEWBB at Km 4.10 on Rd Lachen-Kalep, which was launched on 27 Nov 2023, was damaged and buried under boulders with a tributary of River Teesta flowing over it.

(ii) Stores of 400 Ft BSB planned to be launched on 01 Jun 2024 onwards, dumped at Zeema Chu bridge site at Km 4.1 on Rd Lachen-Kalep have been washed away, with heavy damages to abutments and anchor blocks of BSB under construction.

(iii) 100 Ft TSEWBB (Zeema-I) at Km 1.5 on Lachen-Kalep sustained damge already on 26 Mar 2024 due to flash flooding in the seasonal nallah. The recovered parts of the bridge stored at site were also washed away by muck/huge boulders on 28/29 May 2024.

(iv) Site of 400 Ft BSB at Sanklang suffered heavy scouring resulting in collapse of spur walls of River Training Works (RTW) and the river flowing in three channels vis-Avis two channels earlier, threatening heavy damages in case of further change of course.

(v) Collapse of recently constructed 400 ft BSB on Rd Mangan- Sanklang due to collapse of concrete pillars of old suspension bridge.

(vi) Approx two kilometres (in stretches) have been breached/washed away.

(vii) Approx four running kilometres (in stretches) have been affected by triggering of Landslide.

(vii) Approx 650 running meters of fmn (in stretches) has affected by sinking of fmn.

(viii) Approx 750 running meters of retaining walls (in stretches) has been damaged.

(ix) 10 culverts have been severely damaged.

Fmn Breach at Lanthakhola

Fmn Breach at Rafangkhola

Log Bridge at RitchuNala

Log Bridge at Rafangkhola

Details of Repair/Restoration Works:-

(viii) **Recce**. Physical recce and damage assessment of Road stretch between Mangan and Chungthang was carried out by Cdr 758 BRTF, OC 107 and 86 RCC and OICs on 14 June 2024 and subsequent days.

(ix) **Task**. To provide connectivity between Mangan to Chungathang for induction of rescue teams/stores/resources V/E/P and evacuation of stranded tourists from North Sikkim.

(x) **Equipment Deployed**. Seven Ex-200 excavators beside other machinery and 120 CPLs were deployed between Mangan to Chungthnag for restoration works.

(xi) **Immediate Restoration**.

(aa) **Slide Clearance**. Four Ex-200 excavators and 140 CPLs were deployed to for slide clearance between Mangan and MayanchuKhola. Two Ex 200 excavators were deployed for restoration of formation along F/bkappch of Toong bridge. One Ex-200 excavator was deployed along H/Bk appch of Theng tunnel.

(ab) **Crossing of Nalas**. To facilitate immediate connectivity across fast flowing

Log Bridge at RitchuNala & Rafangkhola

streams, modified log bridges were constructed for establishing urgent foot connectivity for move of locals and tourists. Later, for immediate connectivity for vehicles, Hume pipe culverts are being planned under Flood Damage Restoration works (FDR) and work started.

2. **Lead Agency for temporary & permanent restoration:-**
758BRTF/Swastik/BRO

3. **Details of Road Authorities' & details of NGO or local community involved in temporary & Permanent restoration of Infrastructure:-**
Road Authorities –86 RCC&107 RCC

4. **Challenges faced during temporary & permanent restoration :-** Transportation of stores was badly affected in order to restore the line of communications.

5. **Details of relief & rescue operations:-**
Due to heavy incessant rains, various roads leading to North Sikkim suffered multiple slides, formation breaches, washing away of culverts etc. Panic and chaos spread in the region as recently constructed 400 ft BSB connecting Mangan to North Sikkim and Dzongu region collapsed as concrete pillars of old suspension bridge, collapsed on it. Because of severing in road connectivity approx. 1500 tourists got stranded in North Sikkim. 758 BRTF launched deliberate rescue efforts and successfully rescued all the stranded tourists from North Sikkim.

6. **Key learning :-**
   (a) Local hiring of V/E/P to be promoted.
   (b) Centralised Reserve Stores
   (c) Transportation of Reserve Stores

7. **New Technology/ Innovative techniques used:-**
No comments

Case Study – 16: Flood, Landslide OP Teesta III

Type of Disaster Event	**Period of Disaster Event**	
	Start	**End**
OP Teesta III	30 May 2025	02 Jun 2025
State	**District**	**Affected NH**
Sikkim	Mangan	NH 310 A & 310 AG

1. Description of Damage:-

Incessant heavy rain fall:-Due to heavy rainfall and cloud burstin AOR of 86 RCC, 115 RCC& 107 RCC from 30and 31 May 2025 and 01and 02Jun 2025, formation breached at several location, Multiple Land Slides and Culverts are damages also 09 Nos of Bridges has been washed out/damaged, resulting in complete breakdown of connectivity between Mangan to North Sikkim.

(i) Km 67.800 to Km 78.600 on Road Gangtok-Chungthang

(ii) Km 3.50 to Km 7.60 (Sustained alignment) on Gangtok-Chungthang road.

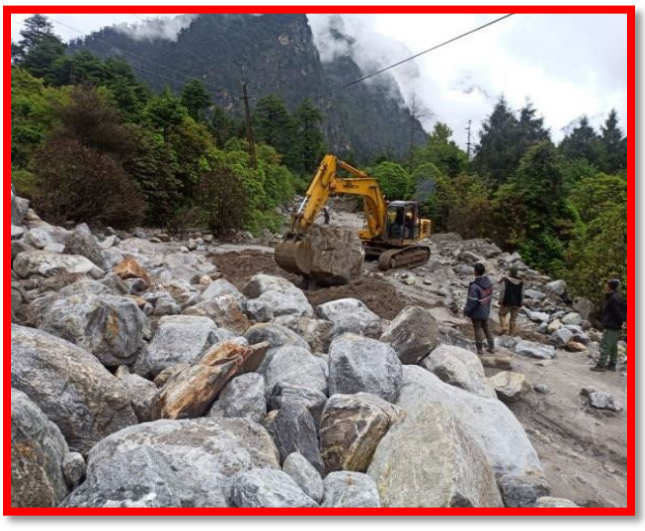
(iii) Km 89.700 to Km 93.06 on Road Gangtok-Chungthang

(iv) Km 0.00 to Km 23.400 on Chungthang-Lachen Road

(v) Km 0.00 to Km 13.600 on Lachen-Kalep Road

(vi) Km 0.650 to Km 0.750 on Road LachungZakuphyakKatao.

(vii) Km 3.00 to Km 19.00 on Lachung-Zedong Road.



FMN BREACHED ALOGWITH PMT STR DAMAGED @ KM 0.400 ON TOONG- BR APPROACHES ON G-C RD

LANDSLIDE @ KM 2.30 and Km 2.35 ON SUSTAINED ALIGNMENT OF G-C RD

2. Details of Repair/Restoration Works:-

Gangtok-Chungthang Road

(i) **Recce**. Physical recce and damage assessment of Gangtok and Chungthang road between Km 3.50 to Km 7.60 was carried out by OC 107 RCC and OICs on 15 May 2025 and subsequent days.

(ii) **Task**. To provide sustained connectivity between Gangtok to Chungthang for all types of vehicles.

(iii) **Equipment Deployed**. Two Ex-200 excavators beside other machinery and 100 CPLs are deployed between Km 3.50 to Km 7.60 for restoration works. One Ex-200 excavator and one W/loader and 40 CPLs were deployed between Km 89.700 to Km 93.06 for restoration works.

(iv) **Restoration**. IRMD 2025-26 has already been invoked on 06 Jun 2025 on Gangtok-chungthang Road and same is under progress to restore line of communication. Slide clearance has already been carried out under normal maintenance grant/running job and damage on sustained alignment of Gangtok-Chungthang Road.

Chungthang-Lachen Road

(i) **Recce**. Physical recce and damage assessment of Road Chungthang-Lachen (C-Ln) between Km 00.00 to Km 23.400 was carried out by OC 86 RCC and OIC on 01 Jun 2025 and subsequent days.

(ii) **Task**. To prevent further damage to formation breach.

(iii) **Resources Deployed**. 01x Ex-200, 01x Ex 70, 01x MUT and 90 x labors are deployed for slide clearance and restoration works

(iv) **Restoration**. Foundation work for new 180 feet TDREWBB at Km 9.950 is under progress. Repair works will be under taken under Immediate Restoration of Monsoon Damage works for restoration of formation. Land slide cleared between Km 9.950 (Rabum Chu) to Km 15.900 (Taram Chu) but both bridge location connected only from foot bridge. A new 400 feet BSB proposed at Km 15.900 and hydraulic data for same is under progress.02 No BB proposed for De-launching & Re- launching (90' DDREWBB, Mauzis Br & 60' TS EWBB, Chatten Br) and a new 100 feet DDREWBB proposed at Km 18.620 .

Lachen-Kalep Road

(i) **Recce**. Physical recce and damage assessment of Road Lachen-Kalep (Ln-K) between

Km 0.00 to Km 13.600 was carried out by OC 86 RCC and OIC on 08 Jun 2025 and subsequent days.

(ii) **Task**. To prevent further damage to formation breach.

(iii) **Resources Deployed**. 01x Ex 70,01x Ex 200, 01x MUT, 01x W/L, 01x JCB & 200 x labours are deployed for slide clearance and restoration works..

(iv) **Restoration**. Slide clearance are under progress to prevent further breach to formation. De-launching & Re-launching works will be under taken under Immediate Restoration of Monsoon Damage works for restoration of formation. Land slide clear between Km 1.500 (Zeema-I) to Km 4.00 but road breached in several location between Km 3.350 to 4.100. 02 Nos BB proposed for De-launching & Re-launching (100' TDREWBB, Zeema-I Br & 130' DD EWBB, Zeema-II Br).

LachungZakuphyakKatao Road

(i) **Recce**. Physical recce and damage assessment of LachungZakuphyakKatao road between Km 0.650 to Km 0.750 was carried out by OC 115 RCC and OICs on 01 Jun 2025 and subsequent days.

(ii) **Task**. To provide sustained connectivity between LachungZakuphyakKatao for all types of vehicles.

(iii) **Equipment Deployed**. One BD-50, W/L-01 nos and 20 CPLs are deployed between Km 0.650 to Km 0.750 for restoration works.

(iv) **Restoration**. In order to maintain smooth flow of traffic as well as to facilitate restoration of monsoon damages has been considered unavoidable. Hence, IRMD has been invoked at this location under the provision of P-560 of BR Regulations.

Lachung-Zadong Road

(i) **Recce**. Physical recce and damage assessment of Road Lachung-Zedong (Lg-Z) between Km 3.00 to Km 19.00 was carried out by OC 115 RCC and OIC on 01 Jun 2025 and subsequent days.

(ii) **Task**.To provide sustained connectivity between Lachung- Zedong for all types of vehicles.

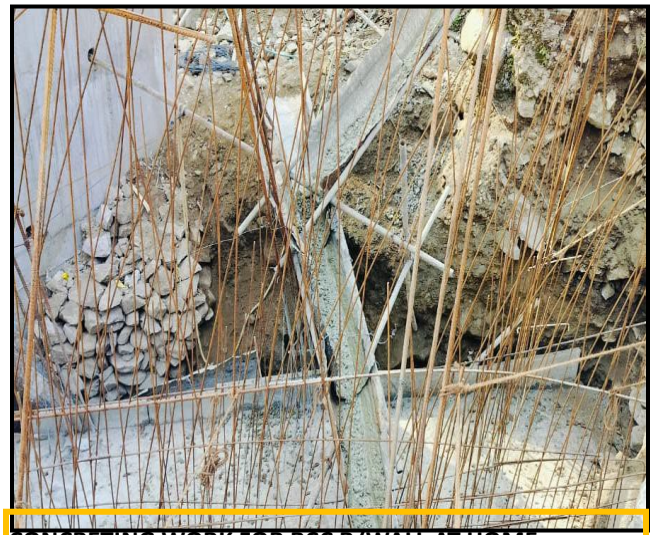
(iii) **Resources Deployed**. BD-80 01 nos, Ex-200 01 nos, T/TPR 03 nos, Dumper 02 nos and 25 CPLs are deployed between Km 3.00 to Km 19.00 for restoration works.

(iv) **Restoration**.Temporary retaining structures are under progress to prevent further breach to formation. Repair works will be under taken under Immediate Restoration of Monsoon Damage (IRMD) works for restoration of formation.

CONSTRUCTION OF R/S/WALL AT KM 7.552 TO KM 7.560 on Ln-K road

CONSTRUCTION OF R/S/WALL AT KM 7.544 TO KM 7.552 on Ln-K road

CONCRETING WORK FOR RCC R/WALL AT HOME BANK OF CHUNGTHANG BRIDGEON G-C



CONCRETING WORK FOR RCC R/WALL AT HOME BANK OF CHUNGTHANG BRIDGE ON G-C Rd

3. Lead Agency for temporary & permanent restoration:-

758TF/Swastik/BRO

4. Details of Road Authorities' & details of NGO or local community involved in temporary & Permanent restoration of Infrastructure:-

Road Authorities-86 RCC & 107 RCC

NGO – NA

5. Challenges faced during temporary & permanent restoration :-

(a) Lack of Redundancy in Communication.

(b)Lack of Logistic Sustenance Support for Labors.

(c) Lack of Disaster Bricks.

6. Details of relief & rescue operations:-

Thousands of tourists were affected due to this natural calamity and it was difficult to evict the stranded tourist to safe place. Due to disturbance of roads, it was very difficult to deliver the resources, Vehicle/Equipment/Plants to the place of damage/restoration.

7. Key learning :-

Prepositioning of stores to the landslide/cloud burst prone areas.

8. New Technology/ Innovative techniques used:-

No comments

9. Remarks:-

Several Jobs under IRMD works undertaken to restore the disrupted line of communication.

Case Study – 17: Cyclone YAAS

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	End
Cyclone	26th May 2021	28th May 2021

State	District	Affected NH
Odisha and West Bengal	-	Multiple NHs (Mentioned below)

Description of damage:

Cyclonic Storm "Yaas" made landfall near Dhamra Port, Odisha on 26th May 2021, severely impacting the National Highway network in Odisha and West Bengal. A total of 50 stretches across 26 NHs (3,778 km) were affected due to flooding, tree felling, and structural damage.

Major damage occurred on NH-520 (Belipada to Rimuli section) with 96 km affected. Minor damages were reported across 10 stretches totaling 394 km. Traffic disruptions were promptly addressed by Quick Response Teams (QRTs), and all highways were reopened by 28th May 2021. No casualties were reported.

Details of Repair/Restoration works (with good quality-colored photographs)

1. NH-16 traffic was halted temporarily and restored the same day after conditions improved.
2. Quick Response Teams (QRTs) provided food and water to stranded passengers at toll plazas.
3. NH-520 (Belipada to Rimuli): Diversion Road washed away; traffic rerouted via Nuamundi. Repaired and reopened by 28th May.
4. NH-49 (Keonjhar to Tangabilla): Water overflowed low-level bridge; reopened within 9 hours after water receded.
5. NH-20 (Kuakhia to Satabhaya): Blocked due to fallen trees; cleared and reopened within 3 hours.
6. 10 stretches totaling 394 km across Odisha and West Bengal required minor restoration (tree clearance, surface repairs, etc.).
7. By 28th May 2021, all affected NH stretches were reopened to traffic.
8. No casualties reported.

Lead Agency for temporary & permanent restoration: Ministry of Road Transport & Highways (MoRT&H)

Challenges faced during temporary & permanent restoration.:

1. Major washout of diversion roads (e.g., NH-520 near Belipada to Rimuli) due to heavy rainfall.
2. Structural damage to bridges and road surfaces, requiring urgent repair.
3. Rising water levels over low-level bridges (e.g., NH-49) delayed traffic restoration and required monitoring before repairs.
4. Blocked highways (e.g., NH-20) due to fallen trees needed rapid deployment of QRTs for clearance.
5. Temporary halts in traffic (e.g., NH-16) led to stranded vehicles; alternate routes increased travel distance (e.g., Champua road detour added 28 km).
6. Mobilization of equipment (cranes, recovery vehicles) and personnel across 209 locations in 7 States/UTs.

Details of relief & rescue operations, if any (also provide good quality-colored photographs, if any): N/A

Key Learnings:

- ✓ **Advance Preparedness Is Crucial:** Early mobilization of Quick Response Teams (QRTs) and setup of control rooms enabled swift action and minimized disruption.
- ✓ **Inter-agency Coordination Enhances Efficiency:** Effective collaboration between MoRT&H, NHAI, NHIDCL, district/state authorities, SDRF, and NDRF ensured timely restoration.
- ✓ **Rapid Response Minimizes Impact:** Prompt clearance of debris and repair of damaged stretches helped reopen highways quickly, reducing economic and logistical strain.
- ✓ **Strategic Placement of Resources Matters:** Positioning QRTs at toll plazas and key structures facilitated faster deployment of recovery equipment and support services.

Remarks: Please refer below table 1, 2, 3, and 4 for more detail

Table – 1: Impact on National Highway network and mitigation response (Status as on 30th May 2021)

Sl. No.	Name of State/UT	Number of NHs Impacted	Number of Districts Impacted	Traffic Situation on Impacted Stretches			Condition of Impacted Stretches (Km)				Quick Response Teams Mobilized (No.)	Casualties on Road (No.)
				Open Stretches (No.)	Closed Stretches (No.)	Total (No.)	Fair	Minor damage	Major damage	Total		
1	Odisha	16	16	23	0	23	2090	294	96	2479	77	0
2	West Bengal	11	14	27	0	27	1199	100	0	1299	62	0
	Total	**26 (Unique)**	**30**	**50**	**0**	**50**	**3289**	**394**	**96**	**3778**	**139**	**0**

Table – 2: Agency-wise break-up of National Highways impacted in the 2 States (Status as on 30th May 2021)

Sl. No.	Name of State/UT	NHs Impacted (NH No)	Total Length under Impact (km)			Minor damage (km)			Major Damage (km)		
			NHAI	State PWD	Total	NHAI	State PWD	Total	NHAI	State PWD	Total
1	Odisha	16,53,316,55,18,20,49,143,520,220,59,516,157,57,326A,326	1543	936	2479	0	294	294	96	0	96
2	West Bengal	116,116B,12,16,112,14,19,6*,32*,2E*,114	738	561	1299	0	100	100	0	0	0
	Total		**2281**	**1497**	**3778**	**0**	**394**	**394**	**96**	**0**	**96**

Table – 3: Preparedness Summary of impending Cyclone YAAS (Status as on 30th May 2021)

Name of State / UT	Agency	NHs likely to be affected			Quick Response Teams for the NH length likely to be affected	
		Number of NHs	NH Nos. (in case old no. * is mentioned)	Length of NHs (km)	Number of locations	Number of teams mobilized
A&N Islands	**NHIDCL**	1	4	330	7	7
Puducherry	**State PWD**	2	45A*, 66*	65	4	4
	NHAI	1	45A*	18	1	1
	Subtotal	**2 (unique)**		**83**	**5**	**5**
Tamil Nadu	**State PWD**	3	45A*, 532, 234*	250	8	8
	NHAI	5	5, 44, 45, 45A, 45B, 45C	1050	18	18
	Subtotal	**7 (unique)**		**1300**	**26**	**26**
Andhra Pradesh	**State PWD**	10	326A, 26, 516E, 165, 216, 167A,167B, 167BG, 67, 716A	1267	26	26
	NHAI	1	16	270	3	3
	Subtotal	**11 (unique)**		**1537**	**29**	**29**
Odisha	**State PWD**	10	220, 316, 326, 326A, 55, 57, 157, 59, 516.	936	46	46
	NHAI	9	16,18,55,53,316,20,520, 143, 49	1544	28	28
	Subtotal	**16 (unique)**		**2480**	**74**	**74**
West Bengal	**State PWD**	**9**	12,14,31,112,114,116B,133A,512	**915**	**35**	35
	NHAI	7	2*, 2E*, 6*, 12, 41*, 32* & 60*	684	15	15
	Subtotal	**15 (unique)**		**1599**	**50**	**50**
Jharkhand	**State PWD**	**5**	23*, 78*, 75E*, 220 & 320G	**352**	**5**	5
	NHAI	**6**	80*, 2*, 33* & 6*, 75*	359	**13**	15
	Subtotal	**10 (unique)**		**711**	**18**	**20**
Grand Total (5 States, 2 UTs)		**62 (unique)**		**8040**	**209**	**211**

Table – 4: Districts likely to be affected by impending Cyclone YAAS (Status as on 30th May 2021):

Name of State / UT	Agency	Districts likely to be affected	
		No.	Names
A&N Islands	NHIDCL	2	South Andaman, North & Middle Andaman
Puducherry	State PWD	2	Puducherry, Karaikal
	NHAI	2	Puducherry, Karaikal
	Subtotal	**2 (unique)**	
Tamil Nadu	State PWD	3	Cuddlore, Nagapattinam, Villupuram
	NHAI	14	Chennai, Tiruvallur, Kanchipuram, Villupuram, Cudallore, Ariyalur, Thanjavur, Tiruvarur, Ramathanapuram, Tuticorin, Madurai, Tirunelveli, Kanyakumari, Napattinam
	Subtotal	**14 (unique)**	
Andhra Pradesh	State PWD	10	Srikakulam, Vizianagram, Vishakhapatnam,East Godavari, West Godavari,Krishna , Guntur, Prakasam, Nellore, Chittoor
	NHAI	3	Srikakulam, Vizianagram, Vishakhapatnam
	Subtotal	**10 (unique)**	
Odisha	State PWD	13	Bhadrak, Cuttack, Dhenkanal, Gajapati, Ganjam, Jagatsinghpur, Jajpur, Kendrapara, Khordha, Keonjhar, Mayurbhanj, Nayagarh&Puri
	NHAI	14	Ganjam,Khordha,Cuttack,Bhadrak,Balasore,Puri,Jajpur,Kendrapara,Jagatsinghpur,Dhenkanal,Mayurbhanj, Keonjhar, Sundargarh, Deogarh
	Subtotal	**16 (unique)**	
West Bengal	State PWD	13	North 24 pargana, South 24 pargana, Howrah, Purba Medinipur, Paschim Medinipur, PurbaBardman, Paschim Bardman, Birbhum, Bankura, Purulia,Murshidabad, Malda,Dakshin Dinajpur
	NHAI	11	Nadia, North 24 Parganas, Purba Medinipur, Paschim Medinipur, Howrah, Paschim Bardhaman, PurbaBardhaman, Hooghly, Purulia &Jhargram in West bengal and Balsore in Odisha
	Subtotal	**16(unique)**	
Jharkhand	State PWD	4	Simdega, Gumla, East Singhbhum& West Singhbhum
	NHAI	6	Saraikela Kharsawan, East Singhbhum, Sahibganj, Dhanbad, Ranchi & Lohardaga
	Subtotal	9 **(unique)**	
Grand Total (5 States, 2 UTs)		**69 (unique)**	

Case Study – 18: Landslides triggered by earthquakes

Type of disaster Event *(landslides/Snow Avalanche/Earthquake/Flood)*	**Period of Disaster Event**	
	Start	**End**
Landslides triggered by earthquakes in addition the heavy rainfall, Poor drainage & also due to fragile geological condition of the existing slope	18.09.2011	08.01.2021 (restoration work completed)

State	**District**	**Affected NH**
West Bengal	Darjeeling	NH-110(Old NH-55)

Description of Damage (also provide good quality-colored photographs)

The carriageway width between chainage Km 50.150 (Darjeeling Side) and Km 53.475 (Siliguri Side) in and around ***"Tindharia"*** area along the NH 55 was partially to severely damaged at the following 3 numbers of locations due to occurrence of landslide on 18.09.2011 on the valley side of the existing Road (Km 50.155 to Km 50.187 (Tindharia I say S1) , Km 52.650 to Km 52.750 (Tindharia II say S2) ,Km 53.452 to Km 53.485 (Tindharia III say S3). The total height of valley side slope varies from 36 to 64 m from the existing road bench and the maximum height of valley side slope affected due to landslide was around 30 m at the ***"Tindharia I (Km 50.155 to Km 50.187)"*** location. The maximum height of the landslide-affected valley slope was about 90 m, with the total slope height between 165 and 185 m. The slope angle ranged from 55 to 70 degrees at the ***"Tindharia II" location***. Highly weathered fractured rock was exposed on the slope. A major landslide affected the nearby narrow gauge railway line, which was later restored with an RCC retaining wall after several months. At the ***"Tindharia III (Km 53.452 to Km 53.485)"*** location, the total height of existing valley side slope is in between 39 and 49 m from the existing road bench and the maximum height of valley side slope affected due to land-slide was around 25 m.

Conditions of landslide affected valley slope at "Tindharia I" (Km 50.155 to Km 50.187)"

Conditions of landslide affected valley slope at "Tindharia II" (Km 52.650 to Km 52.750)

Conditions of landslide affected valley slope at "Tindharia III (Km 53.452 to Km 53.485)

Details of Repair/Restoration works(also provide good quality colored photographs)

A detailed investigation program covering the topographical, geological cum geotechnical aspects of the affected area and also on the proposed construction materials were undertaken to formulate the suitable rehabilitations measures of the failed valley slopes. The detailed engineering design by analyzing the stability of proposed rebuilding of valley slopes corresponding to widening of the affected road bench were done as per the available standards and guidelines for ensuring the adequate safety under static and seismic conditions. The proposed restoration measures consisted of composite reinforced earth technology by strengthening the existing exposed valley slope surface with adequate steel nailing at first and then rebuilding of the road bench by newly added steep reinforced soil slope using layers of designed polymeric reinforcement in multi-tiered manner covering the entire affected heights. The nailing of the existing slope was proposed to connect suitably with the soil reinforcement of the newly added valley side steep slope. Adequate surface and subsurface drainage measures including the erosion protection schemes were provided for the restored valley slope. The surface cracks generated due to landslide at the existing road bench and also on the hill slope portion were sealed with suitable filling material. Details of investigation, design analysis and actual construction works done for the restoration of one of the landslide affected valley slopes of moderate height of 30-34 m in ***"Tindharia"*** area was done.

Activity of surface cleaning, drilling, fixing of welded wire back mesh simultaneously with soil nailing of existing valley slope at "Tindharia I"

Activity of surface cleaning, drilling, fixing of welded wire back mesh simultaneously with soil nailing of existing valley slope at "Tindharia I"

Pull-out Test on the steel nailing of existing valley slope

Base level of TerraLink® structure before start of filling and compaction

Lead Agency for temporary & permanent restoration GPT SSPL,(Contractor) ,LEA Associates South Asia Pvt. Ltd. (DPR Consultant)

Details of Road Authorities & details of NGO or local community involved in temporary & permanent restoration of infrastructure.

Ministry of Road Transport & Highways, State PWD.

Challenges faced during temporary & permanent restoration

There were several challenges faced during construction stage which includes surface and sub-surface drainage, safety and traffic management during construction, space constrain, absence of any access road, difficulties in drilling through challenging completely to highly weathered rocky strata and presence of seasonal water table. Suitable construction method has been adopted to overcome all these challenges.

Details of relief & rescue operations, if any(also provide good quality colored photographs, if any)

N.A

Key Learnings

All the relevant quality control laboratory tests for various engineering parameters like gradation, Atterberg's limits (LL, PL, PI), compaction tests, relative density tests and shear strength tests parameters (i.e. cohesion, c and angle of shearing resistance i.e. for the selected borrow fill (RBM) material were conducted as per the relevant BIS guidelines and satisfying the frequency of tests as specified in the "MORT&H Technical Specification, Fifth Revision, 2013". The density of compacted reinforced fill was also checked in required frequency so that it meets the requirement as per the project specifications. The load testing of the steel nails were conducted as per guidelines given under "Clause no 3210 of MORT&H Technical Specification, Fifth Revision, 2013" after installation of the designed grade and length of nails. Based on the above findings, Hybrid Reinforced Soil Structure" by using polymeric reinforcement in the newly added steep multi-tiered valley fill and connecting the fill slope reinforcements with designed grade and length of steel nails were adopted for restoration of the slope. This has been proved to be an effective mitigation methodology for slope restoration in hilly terrain.

New Technology/ Innovative techniques used, if any

The items of Stabilization of Existing Slope using Nails by Top Down Construction, Installation of Semi-perforated Drainage Pipes inside of Existing Slope, Pull-out Test of Nails, Widening of Valley Slope by Reinforced Earth® Composite Technology (TerraLink®) were taken up.

Remarks

The detailed engineering investigations and design of valley slope restoration works in the form of "Hybrid Reinforced Soil Structure" by using polymeric reinforcement in the newly added steep multi-tiered valley fill and connecting the fill slope reinforcements with designed grade and length of steel nails which were proposed to be drilled and grouted inside the existing valley slope, were carried out by following the available guidelines of FHWA, BS, IRC and "MORT&H Technical Specifications". It is to be mentioned that a detailed recommendation on monitoring the behavior of the valley slope structure during its construction and also in post construction say serviceability period of minimum 3 years by installing various geotechnical instrumentation namely "Slope Inclinometer", "Strain Gauges", "Earth Pressure / Load Cells", "Piezometers" and "Settlement Gauges" were planned in DPR. In reality, the physical monitoring of valley slope during the restoration work and after its completion was undertaken by using the normal survey equipment at "Tindharia I". However, till date no deformation of the restored valley slope at "Tindharia I" is observed and the widened road bench as made in rehabilitation works are serving well for the local inhabitants and plying traffic along NH 55 in West Bengal. A picture of completed Restoration work of Valley slope is attached below.

Completed Restoration Work for Valley Slope at "Tindharia I" on NH55

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Case Study – 19: Earthquake, Kachchh, Gujarat

State	District	NH
Gujarat	Kachchh	8A (Old NH)

Type of Structures (Bridge/Tunnel/ROB/VUP/LVUP/Culvert/Slope protection/Retaining structure):

Surajbari Bridge

Location of structure

For Crossing Gulf of Kutch

Type of disaster (Landslides/Snow Avalanche/Earthquake/Flood)

Earthquake

Details of impact due to disaster

Surajbari Old Bridge: Pier 12 tilted longitudinally and had to be strengthened before re-opening to traffic

Surajbari Old Bridge: pounding at joint caused spalling of concrete coating and cover. Note severely corroded reinforcement. [Photo courtesy of Mahesh Tandon].

Surajbari Old Bridge: deck displaced vertically and horizontally; horizontal displacement was a maximum of about 1.5m at Pier P15. [Photo courtesy of Mahesh Tandon].

Surajbari New Bridge: many shear stopper blocks were badly damaged. [Photo courtesy of Mahesh Tandon].

Surajbari New Bridge: damage to shear stopper block. [Photo courtesy of Mahesh Tandon].

Surajbari New Bridge: deck joints were moved beyond their capacity and some rubber seals were torn out. [Photo courtesy of Mahesh Tandon].

Suraj Bari New Bridge: liquefaction of the underlying soil caused settlement and cracks in the approach embankments

Photo in next row same chronology

Good quality-colored photographs

Remarks

The old Suraj Bari bridge, which had been constructed in the 1960s, suffered significant damage during the earthquake. The bridge was closed to traffic for the first two days. It was temporarily restored for slow and single-lane traffic. Five weeks after the earthquake, the New Suraj Bari bridge was commissioned.

Case Study – 20: Cyclone (Tauktae)

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Tauktae Cyclone	18th May 2021	19th May 2021

State	District	Affected NH
Multiple states	-	Multiple NHs (Mentioned below)

Description of damage:

Cyclonic Storm "Tauktae" impacted the National Highway network across 7 States and 1 Union Territory—Tamil Nadu, Kerala, Karnataka, Maharashtra, Goa, Gujarat, Rajasthan, and Daman & Diu. The cyclone made landfall on the Gujarat coast between 17th and 18th May 2021 as a Very Severe Cyclonic Storm.

- A total of 88 National Highways spanning approximately 5,650 km across 99 districts were affected.
- 200 stretches of highways were impacted, with 4 stretches (255 km) in Gujarat (Gir-Somnath, Bhavnagar, Amreli, Rajkot, and Botad) being the most severely affected due to felling of trees and electric poles.
- Despite heavy rainfall and high wind speeds, Quick Response Teams (QRTs) managed to reopen all affected stretches within 2–12 hours.
- No major structural damage or casualties were reported on the National Highway network.

Details of Repair/Restoration works (with good quality-colored photographs)

- A total of 200 stretches (~5,650 km) across 88 National Highways in 99 districts were affected.
- 185 QRTs were mobilized across the 7 States and 1 UT:
  - Tamil Nadu (32), Kerala (7), Karnataka (8), Maharashtra (19), Goa (1), Gujarat (85), Daman & Diu (1), Rajasthan (32)
  - Positioned at toll plazas, key structures, and vulnerable locations for rapid response.
- All stretches were kept open except 4 stretches (255 km) in Gujarat (Gir-Somnath, Bhavnagar, Amreli, Rajkot, and Botad) which were severely affected.
- These were reopened within 2–12 hours despite heavy rain and high winds.

Lead Agency for temporary & permanent restoration: Ministry of Road Transport & Highways (MoRT&H) & NHAI

Challenges faced during temporary & permanent restoration.:

- The cyclone affected 88 National Highways across 99 districts in 7 States and 1 UT, making coordination and response logistically complex.
- Restoration efforts had to be carried out amid heavy rainfall and high wind speeds, especially in Gujarat, which faced the brunt of the storm.
- Ensuring real-time updates and coordination between MoRTH, NHAI, district/state authorities, and control rooms was critical and challenging.

Details of relief & rescue operations, if any (also provide good quality-colored photographs, if any): N/A

Key Learnings:

- ✓ Early mobilization of Quick Response Teams (QRTs) and setup of control rooms ensured swift action during and after the cyclone.
- ✓ Seamless collaboration between MoRTH, NHAI, state/district authorities, and emergency services helped minimize disruption and accelerate restoration.
- ✓ Positioning QRTs at toll plazas and key structures allowed for faster clearance and repair operations.
- ✓ Control rooms at the Ministry and NHAI headquarters played a vital role in receiving public complaints and coordinating timely responses.
- ✓ Despite the cyclone's severity, no major structural damage was reported, indicating the robustness of the National Highway infrastructure.

Remarks: Please refer below tables for more detail

Table – 1: Impact on National Highway network and mitigation response (Status as on 19th May 2021)

Sl. No.	Name of State/UT	Number of NHs Impacted	Number of Districts Impacted	Traffic Situation on Impacted Stretches			Condition of Impacted Stretches (Km)				Quick Response Teams Mobilized (No.)	Casualties on Road (No.)
				Open Stretches (No.)	Closed Stretches (No.)	Total (No.)	Fair	Minor damage	Major damage	Total		
1	Tamil Nadu	19	28	36	0	36	705	108	0	813	32	0
2	Kerala	4	5	7	0	7	4	0	0	4	7	0
3	Karnataka	10	7	8	0	8	0	0	0	0	8	0
4	Maharashtra	17	10	19	0	19	758	112	0	870	19	0
5	Goa	1	1	1	0	1	0	13	0	13	1	0
6	Gujarat	33	14	85	0	85	3720	175	41	3936	85	0
7	Daman & Diu	1	1	1	0	1	10	0	0	10	1	0
8	Rajasthan	19	33	43	0	43	0	0	0	0	32	0
	Total	**88 (unique)**	**99**	**200**	**0**	**200**	**5198**	**408**	**41**	**5646**	**185**	**0**

Table – 2: National Highways impacted in the 7 States and 1 UT (Status as on 19th May 2021)

Sl. No.	Name of State/UT	NHs Impacted (NH No)
1	Tamil Nadu	181, 66, 85, 44, 38, 138, 183, 36, 87, 336, 536, 83, 81, 32, 79, 544, 179A, 7, 48
2	Kerala	85, 183, 66 &213
3	Karnataka	66, 748, 766 E, 766 EE, 73, 75, 275, 169A, 169, 766C
4	Maharashtra	166, 66, 348, 348A, 548, 348BB, 848, 166A, 166E, 166G, 566, 965 DD, 166F, 166D, 753F, 548A, 61
5	Goa	17B
6	Gujarat	53, 48, 41, 27, 51, 151-A, 27, 64, 56, 756, 953, 848, 848-A, 848-B, 351, 927D, 47, 351, 251, 51(Extn), 47, 147, 58, 68, 141, 341, 41, 754K, 168, 168A, 927C, 48 (Old NH), NE1 (Old NH)
7	Daman & Diu	251
8	Rajasthan	68, 70, 925, 52, 27, 148 C, 62, 54, 148D, 448, 58, 48, 458, 752, 116, 11, 709 Ext., 311, 325

Case Study – 21: Cyclone (AMPHAN)

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Cyclone AMPHAN	20 May 2020	21 May 2020

State	District	Affected NH
West Bengal	Parganas	Multiple NHs

Description of damage:

- Temporary traffic blockages occurred due to:
  - Uprooted trees on NH-116B, NH-117, and NH-35.
  - Fallen electric poles and wires, especially on NH-117 (Joka–Namkhana section).
- NH-35 experienced:
  - Damage to shoulders/flanks and parts of the carriageway.
  - One lane near km 57 (Barasat–Petrapole stretch) remained blocked by large, uprooted trees, though traffic continued on the other lane.
- NH-117 (km 114–133) showed surface damage and damaged toll plaza at Hatania–Doania Bridge.
- Other NHs (e.g., NH-2, NH-34, NH-512) had minor tree falls but no traffic disruption.

Details of Repair/Restoration works (with good quality-colored photographs)

Immediate Response & Clearance:

- Quick Response Teams (QRTs) were mobilized in all affected districts.
- Traffic blockages due to uprooted trees and fallen electric poles were cleared within 24 hours:
- NH-116B: Cleared by 04:30 AM on 21st May 2020.
- NH-117 (Kona Expressway): Cleared by 11:30 AM.
- NH-117 (Joka–Namkhana) and NH-35: Cleared by 5:00 PM.
- NH-35: One lane near km 57 remained blocked, but traffic was diverted to the other lane.

Lead Agency for temporary & permanent restoration: State Public Works Department (PWD) & National Highways Authority of India (NHAI)

Challenges faced during temporary & permanent restoration.:

- Blockages due to uprooted trees and fallen electric poles needed immediate clearance to restore traffic.
- Some stretches were difficult to access due to extreme weather conditions and debris.
- Damage to shoulders, flanks, and parts of carriageways (especially on NH-35) required detailed inspection and planning.
- Repairs had to be aligned with existing sanctioned or ongoing projects, requiring scope adjustments or cost overruns (e.g., variation/COS).
- Permanent restoration had to consider future resilience against similar cyclones, possibly requiring design upgrades.

Details of relief & rescue operations, if any (also provide good quality-colored photographs, if any): N/A

Key Learnings:

- ✓ Early mobilization of Quick Response Teams (QRTs) in vulnerable districts helped minimizes disruption.
- ✓ Pre-positioning resources and coordination among agencies ensured swift action.
- ✓ Temporary blockages were cleared within hours, restoring traffic flow quickly.
- ✓ Efficient deployment of manpower and machinery enabled timely clearance of debris.
- ✓ Most NHs withstood the cyclone with minimal structural damage, indicating robust design and maintenance.
- ✓ Damage was largely limited to shoulders and flanks, not main carriageways.

Photos:

International case studies 1 – Temporary and Permanent repair work after disaster

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	Period of Disaster Event	
	Start	**End**
Landslide	Feb 2020	Sept 2020

Country	Location	Affected Road/Highways
United States of America	Alabama	US 231 (SR 53)

Description of Damage (photographs):

From Feb' 11 to 13, 2020, northern Alabama received over 10 inches of rain, triggering a landslide underneath U.S. Highway 231. The landslide occurred 1.6 miles south of Lacey Springs, Morgan County. The event **affected about 400 feet** of the heavily used corridor that serves much of the traffic between the cities of Arab and Huntsville. Both roadways experienced **extensive cracking**; The southbound roadway **experienced pavement bulging and a 4-foot drop**, necessitating full closure. The detour **added 30 to 60 minutes to travel times**, severely impacting local communities and logistics.

Details of Repair/Restoration works (photographs):

Resilient Design Approach

Solution Chosen: Construction of two bridges instead of repairing the slope or using retaining walls.

Why: Allowed the slope to move naturally beneath the bridges, reducing future risk.

Lead Agency for temporary & permanent restoration: Alabama Department of Transportation (ALDOT)

Details of Road Authorities & details of NGO or local community involved in temporary & permanent restoration of infrastructure.

1. Federal Highway Administration (FHWA),
2. Alabama Division Office

Challenges faced during temporary & permanent restoration:

Multiple options were considered, each with its own challenges:

- ✓ **Repairing in place:** Required retaining walls, extensive right-of-way (ROW) acquisition, and project extension 3–4 times the slide length.
- ✓ **Soil-nail walls:** Topography raised concerns about their effectiveness.
- ✓ **Single bridge:** Needed elevation adjustments between north and southbound lanes.
- ✓ **Shifting alignment:** Required ROW acquisition and risked archaeological delays.

Details of relief & rescue operations, if any: N.A.

Key Learnings:

The two-bridge option provided the State of Alabama with a cost effective and lasting solution to a location prone to damage with each rain event. The two-bridge option bridging the slide area effectively adapts to the site location by allowing movement of the slope below the bridges. Additionally, through the instrumentation plan, ALDOT was able to monitor the bridges and surrounding area to mitigate future damage and potentially avoid a similar event.

New Technology/ Innovative techniques used, if any:

Tools Used: Inclinometers, piezometers, and deformation sensors installed in drilled shafts and surrounding soil.
Purpose: Real-time monitoring of slope movement and structural load to prevent future failures.
Procurement Strategy: ALDOT pre-purchased bridge girders and shaft casings to reduce delays.

Remarks:

Performance: Bridges withstood three major storms post-construction.
Ongoing Monitoring: Slight movement detected; ALDOT plans to reinstall sensors for long-term resilience insights.

Source: https://www.fhwa.dot.gov/programadmin/er/casestudies.cfm

International case studies 2 – Mitigation from Rockfall in hill areas

Type of Disaster Event *(Landslide/Snow Avalanche/Earthquake/Flood)*	**Period of Disaster Event**	
	Start	**End**
Rockfall Mitigation	August 2020	-

Country	**Location**	**Affected Road/Highways**
United State of America	Glenwood Canyon, Colorado	I-70 roadway and bridges

Description of Damage (photographs):

Interstate 70 (I-70), the main east-west interstate in the State, provides a critical connection for both people and freight through Colorado and across the Rocky Mountains. Over 32,000 acres burned. Damage to I-70 roadway, bridges, fiber optics, signage, rockfall fencing, guardrails, and drainage structures. Closure of I-70 for two weeks; Motorists who needed to travel through the canyon faced a several hundred-mile, 4-hour detour. The damage from the original fire and the subsequent debris flows required over $11 million in repairs.

Details of Repair/Restoration/ Mitigation Measures works (photographs):

- ✓ Conducted emergency repair immediately after the wildfire in August 2020.
- ✓ Installed temporary 7-foot rockfall fence in Spring 2021.
- ✓ Installed 1-kj and 3-kj energy-rated rockfall fences at key mileposts to absorb small and medium rockfall impacts.
- ✓ Used debris flow modeling and risk analysis tools to guide fence placement and design.

Lead Agency for temporary & permanent restoration: Colorado Department of Transportation (CDOT)

Details of Road Authorities & details of NGO or local community involved in temporary & permanent restoration of infrastructure.

1. Federal Highway Administration (FHWA),
2. Colorado Division Office

Challenges faced during temporary & permanent restoration:

The wildfire caused extensive damage and forced closure of I-70 for two weeks. CDOT had to quickly conduct emergency repairs to allow emergency vehicles access and stabilize damaged infrastructure. The fire triggered significant rockfall activity, damaging fencing, guardrails, and other assets. Emergency crews had to work in unstable terrain with ongoing debris flows and rockfall risks. CDOT had to assess damage and determine immediate stabilization needs while the fire was still active. Emergency repairs were constrained by safety concerns and limited access to the canyon. Shortly after installing new rockfall fences in Spring 2021, intense rainfall caused mudslides and debris flows.

Details of relief & rescue operations, if any: N.A.

Key Learnings:

- ✓ Rockfall fencing significantly reduced minor closures and disruptions.
- ✓ July 2021 flooding caused damage to some fencing due to extreme debris flows.
- ✓ CDOT plans to repair damaged fencing and continue monitoring.
- ✓ The project serves as a model for integrating resilience into transportation infrastructure.

New Technology/ Innovative techniques used, if any:

- ✓ CDOT conducted debris flow modeling to simulate how sediment and water would travel down slopes post-fire. The modeling helped determine the likelihood and impact of small, medium, and large rockfall events.
- ✓ Temporary 7-Foot Rockfall Barrier
- ✓ Energy-Rated Rockfall Fencing

Source: https://www.fhwa.dot.gov/programadmin/er/casestudies.cfm

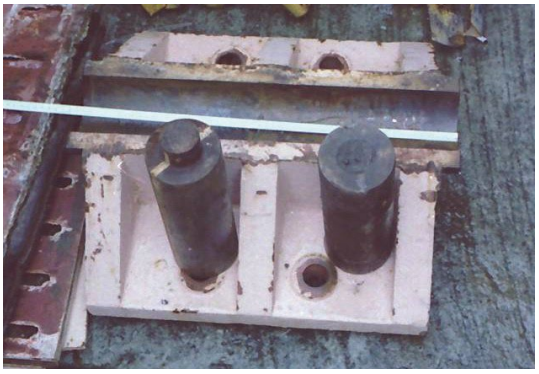
International case studies 3 – Japan Earthquake

Type of Disaster Event (Landslides/Snow Avalanche/Earthquake/Flood)	**Period of Disaster Event**
Earthquake (1978 Miyagi-ken-oki earthquake)	1978

Country	**Affected Road**
Japan	National Road 4 (Sendai Bridge), National Road 45 (Shin-Iino Bridge)

Description of Damage (also provide good quality-colored photographs)

Suffered extensive damage at reinforced concrete piers and steel bearings



Rupture of a pin in a pin bearing

Pull-out of anchor bolts due to rocking response of a lower bearing

Details of Repair/Restoration works (also provide good quality-colored photographs) Reinforced concrete piers were retrofitted by steel jacketing, 2) nonlinear viscous dampers were installed between a superstructure and a substructure, and 3) steel bearings were replaced with elastomeric beatings	 
Lead Agency for temporary & permanent restoration	Ministry of Land, Infrastructure and Transportation
Remarks	As a result, the bridge suffered no damage during the 2011 Great East Japan earthquake.

Disaster Management Sub-Plan
on Road Accidents

Disaster Management Plan for Road & Highway Sector

Government of India
Ministry of Road Transport & Highways

Table of Contents for the Disaster Management Plan:

Volume-I: Overview and Disaster Management Sub-Plan for Highways

1. **Table of Contents**

Volume-II: Disaster Management Sub-Plan for Road Accidents

Table of Contents

Abbreviations

AASHTO	American Association of State Highways and Transportation Officials
AB PM-JAY	Ayushman Bharat Pradhan Mantri Jan Arogya Yojana
ABS	Anti-Lock Braking System
AIS	Automotive Industry Standards
ALS	Advanced Life Support
ATMS	Advance Traffic Management System
BLS	Basic Life Support
CCS	Cabinet Committee on Security
CCTNS	Crime and Criminal Tracking Network and Systems
CPR	Cardiopulmonary resuscitation
DM	Disaster Management
DMP	Disaster Management Plan
DRSC	District Road Safety Committee
eDAR	Electronic Detailed Accident Report
GDP	Gross Domestic Product
GM	General Manager
IAHE	Indian Academy of Highway Engineers
IIT	Indian Institute of Technology
IMS	Incident Management System
IRC	Indian Roads Congress
ITS	Intelligent Transport System
MHA	Ministry of Home Affairs
MoRT&H	Ministry of Road Transport and Highways
NCMC	National Crisis Management Committee
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NDRF	National Disaster Response Force
NHA	National Health Authority
NHAI	National Highways Authority of India

NHIDCL	National Highways and Infrastructure Development Corporation
NGO	Non-Governmental Organizations
NIC	National Informatics Centre
NICSI	National Informatics Centre Services Inc.
PIU	Project Implementation Unit
RO	Regional Office
RSA	Road Safety Audit
SCCORS	Supreme Court Committee on Road Safety
SDG	Sustainable Development Goal
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SHA	State Health Authority
TMS	Transaction Management System
TRW	Transport Research Wing
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UT	Union Territory
VRU	Vulnerable Road Users
WHO	World Health Organization
WVSCoP	Whole Vehicle Safety Conformity of Production

2. Introduction

2.1. About National Disaster Management Plan (NDMP)

The National Disaster Management Plan (NDMP) provides a framework and direction to the government agencies for all phases of a disaster management cycle. The NDMP recognises the need to minimize, if not eliminate, any ambiguity in the responsibility framework. It, therefore, specifies who is responsible for what activity at different stages of managing disasters. The NDMP is envisaged as ready for activation at all times in response to an emergency in any part of the country. It is designed in such a way that it can be implemented as needed on a flexible and scalable manner in all the phases of disaster management including:

- Mitigation (prevention and risk reduction),
- Preparedness,
- Response, and
- Recovery

The NDMP is consistent with the approaches promoted globally by the United Nations, in particular the Sendai Framework for Disaster Risk Reduction 2015-2030. It is a non-binding agreement, which the signatory nations would attempt to comply with on a voluntary basis. India is committed to making all efforts to contributing to the realization of the global target by improving the entire disaster management cycle in India by following the recommendations in the Sendai Framework and by adopting globally accepted best practices. The four priorities for action under the Sendai Framework include:

1. Understanding disaster risk,
2. Strengthening disaster risk governance to managing disaster risk,
3. Investing in disaster risk reduction for resilience,
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation, and reconstruction.

The NDMP incorporates substantively the approach enunciated in the Sendai Framework and will help the country to meet the goals set in the framework. By 2030, the Sendai Framework aims to achieve substantial reduction of disaster risk and loss to lives, livelihoods, health, and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries.

2.2. Rationale for Sub-Plan on Road Accidents

The Disaster Management Plan (DMP) of Ministry of Road Transport & Highways provides an outline and direction to the transportation & communication system for all phases of the disaster management cycle. Keeping in view the responsibility of MoRT&H to develop & maintain infrastructure in traffic worthy condition with adequate safety for road users, the Road Safety Division of MoRT&H has prepared this sub-plan on road accidents.

2.3. Road Safety – A Global Perspective

"Global Status Report on Road Safety" by the World Health Organization estimates that about 1.19 million people are killed on an annual basis because of road accidents globally. In the recent past, road accidents have emerged as a major health concern and the leading cause of death for children and young adults aged between 5 to 29 years. Approximately 90% of the burden of road traffic fatalities emerge in low- and middle-income countries, including India. Countries that have performed better in improving road accidents have shown that policies driven by scientifically sound crash data are powerful in helping better understand consequences of crashes and thus facilitate targeted strategies. Such detailed data on crashes is lacking in the emerging economies making it a challenging endeavour to address the problem of traffic safety in a holistic manner.

2.4. Social and Economic Impact of Road Accidents

The loss of one person is often a loss of a family as the social fabric is greatly impacted for the family following an untimely demise of a member. Further, the World Health Organization (WHO) states that road traffic injuries cause considerable economic losses to individuals, their families, and nations. These losses arise from the cost of treatment as well as lost productivity for those killed or disabled by their injuries, and for family members who need to take time off work or school to care for the injured. For most countries, road accidents lead to a loss of approximately 3% of their Gross Domestic Product (GDP) and are the leading cause of death for children and young adults aged between 5 to 29 years. As per report "Socio-Economic cost of

Road Accidents in India" by DIMTS in association with TRIPP-IIT Delhi, the socio-economic costs of road crashes is around 3.14% of Nation's GDP.[1]

2.5. Road Accidents – A Bigger Concern for India

Globally, India accounts for almost 11% of the road crash-related deaths consistently over the years, as highlighted in the WHO reports. India lost about 1.68 lakh people to road traffic crashes in 2022, the highest ever recorded till date. Of these, the Vulnerable Road Users (VRU) accounted for more than 50% of the fatalities, with pedestrians at about 19%, cyclists at 3%, and two-wheeler riders at 45%.

Road crashes are an inter-play of multi-factor reasons and hence require a multi-pronged approach with concerted efforts of all agencies, to mitigate the burden of traffic fatalities. As a first step in this direction, scientific investigation of road accidents help identify failures in human, infrastructure, and vehicles and the benefits of such efforts have been well established through the successes of the countries that have a better safety record presently. Research fuelled by such scientific data points has the potential to improve our understanding of crashes at a very fundamental level. This can facilitate concerned stakeholder agencies across the various pillars of road safety such as road safety management, safer road users, safer roads, safe speeds, safer vehicles, and post-crash care to develop innovative and targeted solutions. There is immense potential to improve the way crash data is collected, recorded, and evidenced. This not only helps the engineering and enforcement stakeholders but also provides for a well-informed communication to generate awareness and educate the general public. Across these pillars, the responsibilities are spread across stakeholder agencies including Police, Roads, Health, Education, Transport, and the other downstream departments.

2.5.1. Technical Intervention for Road Safety

The integration of technology is pivotal in advancing the standards of road safety and augmenting the effectiveness of existing measures. Technological innovations offer substantial

[1] Source: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1941052

potential in mitigating road accidents and enhancing the response mechanisms. The Intelligent Transportation Systems (ITS), Electronic Detailed Accident Reporting (eDAR), Advanced Vehicle Safety Technologies, Geographic Information Systems (GIS) for Road Safety Audit, etc have significantly impacted the scenario of road safety. Further, the innovations like Connected and Autonomous Vehicles (CAV) Mobile Applications for Driver Safety, telematics and location-based emergency services, etc. have potential to further improve the safety of road users.

To ensure effective disaster management in road safety, the integration of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and Geographic Information Systems (GIS) is essential. AI can be employed to analyze large datasets, enabling the prediction of potential accident hotspots and the implementation of proactive measures to prevent accidents before they occur. IoT devices support real-time monitoring by providing vital data on road conditions, traffic patterns, and environmental factors, thereby improving situational awareness and enabling timely interventions. Meanwhile, GIS tools offer powerful spatial analysis capabilities, helping to identify high-risk areas, optimize emergency response routes, and ensure efficient allocation of resources during disaster events. By leveraging these technologies, road safety initiatives can be significantly improved—enhancing predictive accuracy, bolstering preparedness strategies, and enabling rapid, data-driven responses to road accidents and related emergencies.

2.6. Global Road Safety Commitments

The global fraternity has convened dialogues at multiple levels and the various global commitments have been reached that re-iterate the importance and required contribution from the stakeholder states to reduce the burden of traffic fatalities.

- United Nation's **"Decade of Action for Road Safety"** aligning with the Stockholm Declaration on Road Safety (2020).
    - Targets to reducing road traffic deaths and injuries by at least 50% by 2030.
- United Nation's **"Sustainable Development Goals (SDG)"**
    - SDG Goal 3: Ensure healthy lives and promote well-being for all at all ages. Target 3.6 specifies that *"by 2020, halve the number of global deaths and injuries from road traffic accidents.*

- SDG Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable. Target 11.2 specifies that *"by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons".*

- Voluntary global performance targets for road safety risk factors[2]
  - Target 1: By 2020, all countries establish a comprehensive multisectoral national road safety action plan with time-bound targets.
  - Target 2: By 2030, all countries accede to one or more of the core road safety related UN legal instruments.
  - Target 3: By 2030, all new roads achieve technical standards for all road users that consider road safety or meet a three-star rating or better.
  - Target 4: By 2030, more than 75% of travel on existing roads is on roads that meet technical standards for all road users that consider road safety.
  - Target 5: By 2030, 100% of new (defined as produced, sold, or imported) and used vehicles meet high quality safety standards, such as the recommended priority UN Regulations, Global Technical Regulations, or equivalent recognized national performance requirements.
  - Target 6: By 2030, halve the proportion of vehicles travelling over the posted speed limit and achieve a reduction in speed-related injuries and fatalities.
  - Target 7: By 2030, increase the proportion of motorcycle riders correctly using standard helmets to close to 100%.
  - Target 8: By 2030, increase the proportion of motor vehicle occupants using safety belts or standard child restraint systems to close to 100%.

[2]https://cdn.who.int/media/docs/default-source/documents/health-topics/road-traffic-injuries/12globalroadsafetytargets.pdf

- Target 9: By 2030, halve the number of road traffic injuries and fatalities related to drivers using alcohol, and/or achieve a reduction in those related to other psychoactive substances.
- Target 10: By 2030, all countries have national laws to restrict or prohibit the use of mobile phones while driving.
- Target 11: By 2030, all countries to enact regulation for driving time and rest periods for professional drivers, and/or accede to international/regional regulation in this area.
- Target 12: By 2030, all countries establish and achieve national targets in order to minimize the time interval between a road traffic crash and the provision of first professional emergency care.

2.7. Stockholm Declaration on Road Safety

Recognizing that SDG target 3.6 will not be met by 2020 and that significant progress can only be achieved through stronger national leadership, global cooperation, implementation of evidence-based strategies, and engagement with all relevant actors including the private sector, as well as additional innovative approaches.

During this conference held in Stockholm in February 2020, India reaffirmed its commitment to the United Nation's goal set under the UN Decade of Action for Road Safety 2021-2030 to reduce road fatalities and injuries by at least 50% by 2030. Accordingly, MoRT&H has been proactively working on all the 4Es (vis-à-vis Engineering, Enforcement, Education, and Emergency Care) of road safety.

3. Objective

3.1. Objective and Timelines

The objective of the Disaster Management Sub-Plan for road accidents is as following:

- Identifying risks of road accidents.
- Undertaking measures for mitigating such risks of road accidents.
- Prevention of new risks of road accidents.
- Undertaking preparedness & response measures.
- Defining the role & responsibilities of various agencies/divisions of MoRT&H.
- Undertaking measures proposed for strengthening capacity-building on prevention, preparedness, mitigation, response and recovery and inter-ministerial/State coordination.
- Facilitating coordinated response at various levels.

The objectives outlined above are integral components of the continuous activities undertaken by various stakeholders affiliated with MoRT&H. These initiatives are systematically monitored to ensure effectiveness and alignment with strategic goals. The identification of road accident risks is accomplished through comprehensive audits conducted on a regular basis. These audits provide essential insights into potential hazards, enabling stakeholders to proactively address safety concerns. To effectively mitigate identified risks and enhance preparedness for responsive measures, a significant focus is placed on the rectification of black spots and accident-prone areas. This involves implementing corrective actions to improve road infrastructure, signage, and visibility, thereby reducing the likelihood of accidents.

Role of Public-Private Partnerships in Achieving Road Safety Objectives

Public-private partnerships (PPPs) significantly contribute to advancing road safety by combining public oversight with private sector innovation and resources. Aligned with the objectives outlined in Chapter 2, PPPs support safer infrastructure development, data-driven risk analysis, public awareness campaigns, and the integration of advanced technologies. They also enhance emergency response capabilities, mobilize funding for sustained impact, and aid in policy formulation. Through these collaborative efforts, PPPs strengthen the overall road safety ecosystem, ensuring a more efficient and effective response to key challenges.

4. Scope

The Disaster Management Sub-Plan for road accidents shall include:

- Measures to be taken for prevention of road accident disasters or the mitigation of their effects.
- Measures to be taken for the integration of mitigation measures in the development plans of the road sector.
- Measures to be taken for preparedness and capacity building of road sector to effectively respond to any threatening road accident situations.

The sub-plan on road accidents provides an integrated, holistic planning framework for DM of road accident disasters for the department, which must be reviewed and updated periodically. The sub-plan provide streamline of activities to be undertaken by various agencies of MoRT&H under the umbrella of Ministry is clearly brought out.

This sub-plan of MoRT&H specially provides framework for reducing the risk of disaster due to any road accidents on National Highways and provide supporting role to other Ministries and State Governments by ensuring the traffic connectivity at the worst scenario.

5. Concept of Disaster for Road Accidents

5.1. Definition for Disaster

The United Nations Office for Disaster Risk Reduction (UNDRR) defines a disaster as a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic, and environmental losses and impacts.

The National Institute of Disaster Management, Ministry of Home Affairs, Govt. of India defines a disaster as an event or series of events, which gives rise to casualties and damage or loss of properties, infrastructure, environment, essential services or means of livelihood on such a scale which is beyond the normal capacity of the affected community to cope with. Disaster is also sometimes described as a catastrophic situation in which the normal pattern of life or ecosystem has been disrupted and extraordinary emergency interventions are required to save and preserve lives and or the environment.

5.2. Man-Made Hazard

UNDRR defines man-made hazards as those induced entirely or predominantly by human activities and choices. Technological hazards are normally considered a subset of man-made hazards.

Chemical, nuclear, and radiological hazards, as well as transport hazards, are defined as those that originate from technological or industrial conditions, dangerous procedures, infrastructure failures, or specific human activities. Examples include industrial pollution, ionizing radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills.

5.3. Concept of Road Accident as Disaster

Going by the definition of “disaster” by the National Institute of Disaster Management, since road crashes impact the victim and their immediate families and do not necessarily affect a community at large at all instances, all road accidents may not be considered a disaster. However, certain accidents which may have a catastrophic damage of vehicle or mass casualties, may need to be considered as disaster and accordingly need to be handled. Based on the

definition of the Disaster Management Act 2005, MoRT&H has adopted the following definition of Road Accident Disaster:

"Road Accident Disaster is a serious road accident or an untoward event of grave nature, either on roadway or arising out of road activities, due to natural or man-made causes, that may lead to loss of many lives and/or grievous injuries to a large number of people, and/or severe disruption of traffic, involvement of mass casualties[3], etc,, necessitating large scale help from other Government/Non-Government and Private Organizations."

5.4. Authority to Declare a Disaster Related to Road Accidents

MoRT&H has approved to nominate ROs, GMs (when ROs are not available) for declaring an untoward incident as a road accident disaster. With the adoption of the above definition of road accident disaster, it needs to be appreciated that not only a serious road accident may turn into a road accident disaster, if not handled and managed properly, there may be many more road related events which may turn into disasters for which necessary prevention and mitigation measures are to be taken beforehand. Regional offices would ensure that prevention, mitigation, preparedness, rescue and relief related issues covering road accident disasters affecting road operations system are addressed.

5.5. Major Road Accidents

India continues to face a severe road safety crisis, with 2024 witnessing some of the highest numbers of road fatalities and injuries globally.

Key National Statistics for 2024

- Around 180,000 people died in road accidents in India in 2024[4].
- Two-wheeler riders without helmets accounted for 30,000 deaths[5].

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[3] For the purpose, the definition of mass casualty would be as per the circulars/notifications/guidelines issued by the Central Government from time to time

[4] https://english.news.cn/20250108/f94df62be62e4a699cc1b2c9c3fc1e23/c.html

[5] https://english.news.cn/20250108/f94df62be62e4a699cc1b2c9c3fc1e23/c.html

- 66% of fatalities were in the 18-34 age group, highlighting the loss of young, productive citizens[6].
- Nearly 10,000 school students died, often due to poor traffic management near educational institutions[7].
- Major states with the highest fatalities: Uttar Pradesh (23,652), Tamil Nadu (18,347), Maharashtra (15,366), Madhya Pradesh (13,798)[8].

Specific Examples and Regional Impact

1. Maharashtra[9]

- In 2024, two-wheeler riders and pedestrians made up 70% of road fatalities on state and national highways.
- The state saw 36,084 accidents and 15,335 deaths, with speeding and helmetless riding as leading causes.
- Mumbai, Pune rural, and Nashik rural reported the highest accident numbers, while Pune rural had the most deaths.

2. Bihar[10]

- The state registered an average of 20 road deaths daily, with 8,452 accidents and 6,690 deaths between January and September 2024.
- Patna alone reported 1,063 accidents and 750 deaths
- Speeding was identified as the major cause.

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[6] https://indianexpress.com/article/trending/top-10-listing/parliament-winter-session-2024-nitin-gadkari-reveals-the-top-indian-states-with-highest-number-of-road-accidents-9722989/
[7] https://www.bbc.com/news/articles/c4g49pgx6d0o
[8] https://indianexpress.com/article/trending/top-10-listing/parliament-winter-session-2024-nitin-gadkari-reveals-the-top-indian-states-with-highest-number-of-road-accidents-9722989/
[9] https://www.hindustantimes.com/cities/mumbai-news/70-of-accident-victims-in-2024-were-pedestrians-two-wheeler-riders-data-101736881254456.html
[10] https://timesofindia.indiatimes.com/city/patna/more-road-accidents-in-2024-than-2023-in-state-but-fatalities-injuries-decline-govt/articleshow/117177759.cms

The high number of fatalities among young adults and school children has a profound socio-economic impact, depriving families of breadwinners and affecting future generations.

5.6. Behavioural Approach to Prevention of Road Accidents

Behavioural science plays a vital role in road accident prevention by offering insights into road user behaviour and guiding interventions to promote safer conduct. It supports the development of targeted awareness campaigns, educational initiatives, and incentive-based programs that discourage risky behaviours like speeding and distracted driving. Through data-driven analysis, high-risk behaviours can be identified and addressed with tailored strategies. Behavioural insights also aid in shaping policies that influence safer decision-making and risk perception. Overall, integrating behavioural science into road safety efforts fosters a culture of responsibility and enhances proactive accident prevention measures.

6. Understanding Road Accident Risk

6.1. Phase-wise Road Accident Contributing Factors

For identifying risk factors before a crash, during a crash, and after a crash, in relation to the person, vehicle, and the environment, a matrix has been developed as illustrated below. Each phase of the problem (pre-crash, crash, and post-crash) can be analysed in a systematic manner for human, vehicle, and infrastructure related parameters. This would help in identifying all the factors associated with a road accident. The objectives of the three phases are as illustrated below:

- **Pre-crash phase:** Factors contributing to the occurrence of a crash. It is necessary that all countermeasures developed for each of the factors is selected such that the occurrence of the crash can be prevented.
- **Crash phase:** Factors contributing to occurrence of injuries. Associated countermeasures help prevent injuries from occurring or reduce the severity of injuries if they do occur.
- **Post-crash phase:** Factors that aggravate the severity of injuries. Associated countermeasures help mitigate the adverse outcome of crashes after they have occurred.

Contributing Factors (Illustrative Matrix)			
Crash Phases	**Human**	**Vehicle**	**Infrastructure**

Pre-Crash (Crash Prevention)	• Over-speeding • Drink and drive • Violation of traffic signals • Improper usage of lane/Wrong-side driving	• Road worthiness • Tyre defect • Loss of control • Steering failure • Overloaded cargo	• Lack of standard road markings and relevant traffic signages • Sharp curvature • Lack of pedestrian facilities
Crash (Injury Prevention)	• Non usage of helmets/seatbelts	• Crashworthiness • Availability of safety system • Occupant ejection • Occupant entrapment	• Roadside hazardous furniture • Roadside deep slope
Post-Crash (Life Sustaining)	• Lack of skilled staff in BLS, extrication process • Acceptability of victim • Stabilization of involved vehicle • Lack of skills in traffic management and coordination with other stakeholder agencies	• Ease of evacuation • Stabilization of involved vehicle • Risk of fire	• Availability of extrication equipment • Availability of post-trauma care centre and adequate deployment of ambulances • Availability of rehabilitation centre

Apart from tackling the above factors, various other tools, institutions, enforcement, and monitoring activities are needed from stakeholder departments such as Police, Health, Transport, Road, and Education. Further, coordination with the National and State Disaster Management Forces would be required for tackling the situation.

Below is the list of responsibilities accounted across different phases of occurrence of a road accident:

Sl. No.	Responsibilities Accounted Across Different Phases of a Road Accident
1	Pre-Crash – before occurrence of the disaster (prevention & preparedness) • Identifying high-risk and high-density road corridors for implementation of electronic monitoring. • Undertaking road safety audits to proactively identify the road engineering deficiencies through the Regional Offices of NHAI, NHIDCL, and Road Wing, and through State Governments. • Utilization of the eDAR data and deployment of resources accordingly. • Building capacity of stakeholder agencies on areas such as crash investigation, road safety audit, incident management, Basic Life Support, Advance Life Support, extrication process, rescue operation, etc. • Undertaking mock drills of the response team along with multiagency drills. • Review and updates to the road safety action plan on an annual basis by January of each year. • Undertaking design stage audits to ensure safety at the development level.
2	Crash – immediately after receiving notification on the road accident disaster • Sending the response team to the crash spot. • Liaising with stakeholder agencies and providing immediate medical support, traffic management, evacuation/extrication of accident victims, etc. • Coordinating with stakeholder agencies/State Governments/SDRF/NDRF to extending support and ensuring restoration of traffic connectivity.
3	Post-Crash • Assessing and evaluating the accident spot for potential engineering deficiencies and rectification of the same. • Sending the recommendations on road safety measures (both engineering and non-engineering) along with the policy measures. • Conducting a site visit of the road accident spot by staffs of the RO, detailed investigation and information recording of the crash spot, and identification of crash causation factors and lessons learnt in the management operations.

6.2. Types & Causes of Road Accidents

Key Statistics (2022)[11]

Total Road Accidents	4,61,312
Total Fatalities	1,68,491
Total Injuries	4,43,366

Accident and fatalities by Road User (2022):

Sl.	Road User Type	Fatalities	Proportion of Total Deaths
1	Two-wheeler Users	74,897	~44%
2	Pedestrians	32,825	~19%
3	Car Occupants	lower than above categories	lower than above categories

Accident and fatalities by Road Type (2022):

Sl.	Road Type	Accidents (%)	Fatalities (%)
1	National Highways	32.9	36.2
2	State Highways	23.1	24.3
3	Other Roads	43.9	39.4

Major Causes of Road Accidents

Road accidents are multi-causal and are often the result of interplay of various factors like (i) human error, (ii) road environment and (iii) vehicular condition. In 2022, under the category of Traffic Rule Violations, over speeding is a major killer, accounting for 71.2 percent of the persons killed followed by driving on the wrong side (5.4 %).

[11] https://morth.nic.in/sites/default/files/RA_2022_30_Oct.pdf

6.3. Urban Planning for Prevention of Road Accidents

Urban planning plays a key role in reducing road accident risks by creating safer, more accessible environments for all road users. Key strategies include efficient traffic flow design, robust pedestrian and cycling infrastructure, and zoning regulations that minimize vehicle-pedestrian conflict. Enhancing public transport reduces vehicle dependency, while smart city technologies enable real-time traffic management and faster emergency responses. Together, these planning measures contribute to a safer, more sustainable urban mobility system.

6.4. Strengths in Handling Road Accident Disasters

The strengths of MoRT&H in handling road accident disasters include:

- Robust institutional framework for management of road network of the National Highways (regional offices and field offices).
- Dedicated road safety engineers nominated for NHAI, NHIDCL, and the Road Wing.
- National level crash database (eDAR) rolled out in all States/UTs. Further, ongoing integration of eDAR with other databases for utilization of the following objectives:
  - Identification of accident-prone stretches,
  - Deployment of ambulances, and so on.

6.5. Challenges in Handling Road Accident Disasters

There are a few possible inadequacies which are very essential in handling specific type of road accidents as under:

- Limited resources dedicated to road accidents and their response.
- Absence of robust extrication equipment deployed to the first responders/response teams.
- Non-availability of trained staffs for extrication of passengers and/or casualties/or drowned/fallen from involved vehicles down in sea, river, lake, etc.
- Non-availability of cranes.
- Non-ability in handling major fires.

7. Institutional Framework

7.1. For Road Safety at MoRT&H

The roles and responsibilities of the various agencies of MoRT&H in the management of road accidents are briefly described as below:

Stakeholder	Roles and Responsibilities
Ministry of Road Transport and Highways (MoRT&H)	• Administering policies for road transport, National Highways, and transport research with a view to increasing the mobility and efficiency of the road transport system in the country. • The ministry operates under two wings: Road Wing and Transport Wing.
Road Safety Division, MoRT&H	• The ministry has a dedicated "Road Safety Division" which oversees all matters pertaining to road accidents.
Road Safety Engineering Zone, MoRT&H	• Monitoring the safety related activities of Regional Offices.
Regions Offices for NHAI, NHIDCL, & Road Wing	• The Regional Offices and the Project Implementation Units (PIUs) under them oversee the National Highway network. • Nominating dedicated road safety officers.
Road Operator/ Concessionaire	• A response team is proposed to be included along with the incident management team as a part of the road operator/concessionaire. • Roles and responsibilities of the road operator/concessionaire would be as per the circulars/notifications/guidelines issued by the Central Government from time to time.

7.2. Inter-Agency Coordination

Effective inter-agency coordination is vital for managing road safety challenges, and MoRTH employs a structured approach to ensure collaboration among key stakeholders. District Road Safety Committees (DRSCs) facilitate seamless communication between police, health, transport, and emergency services. Regular training sessions, mock drills, and task forces strengthen preparedness and unified action. Centralized data platforms and real-time technology tools

enhance information sharing and emergency coordination. Continuous review meetings help refine strategies, ensuring a cohesive and effective road safety framework.

7.2.1. Role of NGOs and CBOs

NGOs and Community-Based Organizations (CBOs) play a vital role in advancing road safety through grassroots engagement, advocacy, and support services. They conduct community-focused awareness campaigns, influence policy, and promote safe road behaviours. These organizations also assist in data collection and collaborate on research to inform evidence-based strategies. Many provide rehabilitation, counselling, and legal aid to accident victims. MoRTH, through implementing agencies like DRSC, actively partners with NGOs and CBOs to enhance community outreach, road safety education, and localized interventions, ensuring a people-centric approach to road safety.

7.3. Feedback Mechanisms

Continuous improvement in road safety requires strong feedback mechanisms that incorporate insights from stakeholders, including communities, NGOs, and the private sector. MoRTH promotes transparency and adaptability through regular consultations, public feedback platforms, and collaborative workshops. Structured processes ensure stakeholder input is analyzed and integrated into policy decisions. Periodic evaluations help refine strategies based on feedback effectiveness. Additionally, MoRTH has introduced a direct public feedback channel via email (rscmorth@gmail.com), reinforcing its commitment to inclusive, user-informed road safety planning and implementation.

8. Road Accident Disaster Risk Reduction

8.1. Road Accidents and Risk Reduction Measures

The road accident specific mitigation strategies for the road sector (National Highways), as laid down in relevant guidelines, manuals, circulars of MoRT&H, and IRC shall be updated from time to time by the S&R Zone to align the road accident specific mitigation strategies.

The updated list of such guidelines, manuals, circulars applicable for the road safety (National Highways), shall be maintained by the S&R Zone and Road Safety Engineering Division and hosted on the MoRT&H website.

All implementing agencies of MoRT&H follow road accident mitigation strategies outlined in official policies and guidelines. Successful measures in India include targeted infrastructure improvements like black spot rectification and better signage, which have reduced accidents. Strict enforcement of laws such as the highway alcohol ban, helmet and seatbelt mandates, along

with speed cameras and digital penalties, has improved compliance. Advances in vehicle safety through features like airbags and ABS, stronger trauma care facilities, and ongoing public awareness campaigns have further enhanced road safety. Data-driven approaches enable focused interventions, while special provisions for vulnerable road users—like dedicated pedestrian and cycling lanes—help reduce risks. Together, these coordinated efforts have significantly lowered road accident rates and fatalities nationwide.

8.2. Public Awareness Campaigns

Public awareness campaigns play a vital role in reducing road accidents by promoting responsible driving and increasing knowledge of road safety across diverse populations. These campaigns use targeted messaging to address unsafe behaviours like distracted driving, speeding, and ignoring traffic laws, encouraging positive change. By leveraging various media platforms, engaging local communities, and partnering with schools, NGOs, and CBOs, they effectively reach and educate road users, especially young people. Digital and social media further amplify their impact by spreading information quickly to wider audiences. Additionally, community engagement is crucial in disaster management and road safety, as local knowledge of cultural and traffic dynamics helps develop tailored, effective strategies. Involving communities fosters ownership, cooperation, and resilience, which strengthens adherence to safety measures. Establishing platforms for dialogue, incorporating community feedback into policies, and empowering local advocates ensures sustained success in road safety initiatives.

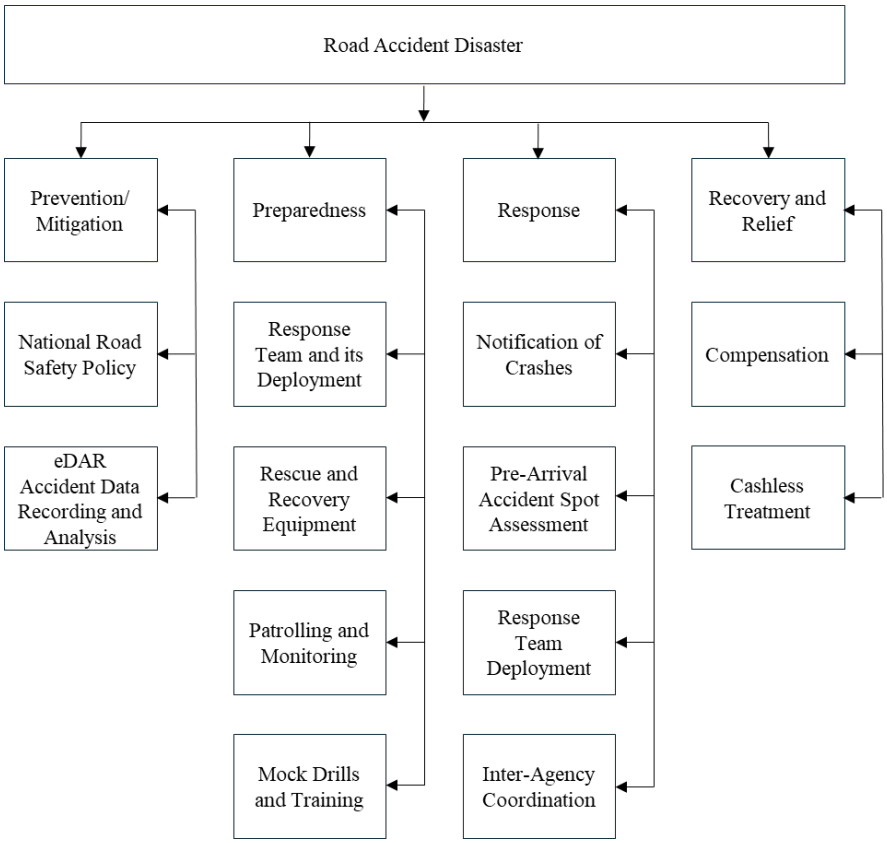
Case Example: The mandatory front seat belt Rule in India, backed by strong awareness campaigns by stakeholder like Police and some vehicle manufacturers, has increased seat belt use and saved lives.

9. Road Accident Disaster Specific Preparedness and Response

9.1. Guiding Principles

The following are the guiding principles to be followed for road accident response and rescue:

- To ensure well-being of the victims with timely and appropriate medical care.
- To ensure safety at the crash scene and ensure safety of bystanders and rescue personnel.
- To ensure seamless communication and coordination between responding agencies.
- To preserving the site for forensic investigation and handing over to the concerned agencies.



9.2. Prevention

9.2.1. Electronic Detailed Accident Report (eDAR)

eDAR (Electronic Detailed Accident Report) is a central repository for reporting, management, claim processing, and analysis of road accident data for enhancing road safety in the country. The application has been developed and implemented by NIC/NICSI and the required data analytics is being carried out by the Indian Institute of Technology (IIT) Madras under the aegis of Ministry of Road Transport and Highways (MoRT&H). It is being integrated with other databases such as CCTNS, VAHAN, SARATHI, and insurance database, etc. The application has been rolled out in all the 36 States/UTs for live entry of road accidents data.

The objectives of the eDAR project include:

- Providing data-based insights to MoRT&H and State agencies for formulation of policy measures and strategic decision making.
- Enabling authorities to identifying accident spots/blackspots through analytics and take preventive measures.
- Enabling efficient processing of road accident claims, reducing the time taken in settlement of such cases and elimination of fake claims.

9.3. Preparedness

9.3.1. Response Team

A dedicated response team who would be undertaking the necessary response and rescue activities along with the other stakeholder agencies would be included. The requisites of the response team include the following:

- Appointment of a nodal officer for each highway corridor to ensure preparedness.
- Permanent and well-equipped staffs to be formed as dedicated accident disaster response team stationed at toll plazas.
- Display of details of response team at toll plazas as well as at regular road intervals especially around high fatality zones/blackspots.
- Rescue teams to mandatorily be trained at minimum in the following four skills 1) crash scene safety and traffic management, 2) safe extrication, 3) basic trauma life support, and 4) fire management.

The key functions of the response team include:

- Maintain and regularly update the list of names and contacts of potential rescue stakeholders in the vicinity.
- Maintain and update the list of doctors/medical practitioners/examiners.
- Maintain a list of ambulance providers (private hospitals, government hospitals, private ambulances) for aggregation or requisition in hours of need.
- Identify the low lying areas and areas near water bodies and keep updated weather data (extreme rainfall data) of the area.
- Undertake patrolling of accidents on National Highways.
- Report and coordinate with stakeholder agencies.
- Maintain and ensure that all rescue equipment are available in patrol/rescue vehicles at toll plazas in usable condition at any point of time.
- Effective utilization of e-DAR (e-Detailed Accident Report) in deployment of response team and support other agencies as required.
- Timely arrival to accident spot and providing response to the situation including traffic cordoning off making the scene safer during the rescue operations, evacuation of accident

victims, towing the vehicle from carriageway to a safe spot, coordinating with medical agencies to ensure first response to accident victim and recording of accident evidence.

- Support in handover of victims to nearest appropriate medical facility.

9.3.2. Deployment of Rescue Teams and Ambulances

The Highway Concessionaire/Road Owning Agency shall map the existing ambulance locations and identify appropriate base locations for ambulances, police, and patrol vehicles, response teams along the highway such that:

- Response time from identified high fatality zones and blackspot locations is under 10 minutes.
- Response team shall have access to vehicle maintenance, phone charging, and sanitation facilities.
- Positioning of Rescue Teams and ambulances based on crash data & fatality data for optimization of resources.
- There is an equitable distribution of rescue equipment in each patrol vehicle.
- Additional ready-to-use equipment from the nearest toll plazas can be accessed in the minimum time possible.

9.3.3. Rescue and Recovery Equipment

- All equipment in the response team vehicle shall be readily accessible, preferably in the visible areas.
- All heavy tools in the response team vehicle shall be stored in a position that requires minimum reaching and lifting.
- Each response team vehicle shall carry or have emergency access to upon calling at least the following items
    - Seatbelt cutters,
    - Lifting, cutting, breaking, pulling, pushing gears, oxy-acetylene cutting equipment,
    - Portable electrical repair toolkit,
    - Hydraulic rescue tools (jaws of life),
    - Power driven winch,
    - Flashing arrow boards and variable message sign boards (VMS),
    - Portable signage, traffic cones or tubes, and barricades,

- First aid kit with appropriate equipment,
- Lighting systems,
- Fire extinguishers,
- Small quantities of fuel,
- Lighting systems,
- Fire extinguishers,
- Small quantities of fuel,
- Towing or pushing equipment to remove vehicles from lanes of traffic,
- Cordoning radium type rope,
- Rechargeable light for search,
- Vehicle stabilisation kit

9.3.4. Patrolling and Monitoring

Considerations to follow while patrolling on high-speed roads:

- Wearing of reflective clothing by all personnel at all times.
- All crash report documentation at minimum shall include the following:
  - Patrol unit number,
  - Exact crash location,
  - An estimate of the extent and nature of vehicle damage,
  - Approximate number of injured victims and nature of injuries,
  - Assessment of need for additional medical assistance,
- Considerations to follow at the crash scene:
  - The first team to reach at scene to act as First Responder,
  - Provide appropriate first aid to victims,
  - Initiate scene safety protocols in coordination with the control rooms and response team,
  - Obtain witness names and contact information

9.3.5. Mock Drills and Trainings

The nodal officer (person-in-charge) for the rescue team shall:

- Undertake multi-agency mock drills regularly.
- Undertake quarterly drills at crash-prone locations or in the vicinity every quarter.

- Ensure all potential first responder agencies receive BLS training. Specific training for women (house wives in particular) as well as Anganwadi & ASHA workers of villages falling in high fatality corridor should be done.
- Submit a detailed report on each drill and training to the road operators.

Multi-agency drills shall include:

- Re-enactment of crash at crash prone locations or nearby locations.
- Real-time mock calls.
- Demonstration of roles of first responder and each of the stakeholders.
- Multi-agency coordination at scene.
- Ambulance response time.
- Scene safety and traffic flow coordination.
- Different methods of triaging at scene.
- First aid provided to victims.
- Safe extrication/extraction of victims.
- Transport of victims to the nearest medical facilities.

9.4. Response

9.4.1. Notification of Incident/Road Accident Disasters

- On receiving call for emergency response, the control room shall gather the following details:
    - Crash location (including the exact direction and lane).
    - Brief description and nature of the crash, to the extent possible without straining the caller.
    - Estimated number of injured persons and number of suspected casualties, if any - to ascertain the number & type of ambulances required.
    - In the case the call is received from a bystander, the Helpline Control Room, at any point during the call, shall not force the caller to provide their name if they are unwilling to do so.
    - Provide guidance to the caller on securing the victim and on providing first aid.
- Upon receiving the call, the control room shall:
    - Notify the response team nearest to the scene.
    - Notify the nearest police station to dispatch a team.

- Notify the nearest rescue/patrol vehicle (equipped with necessary equipment).
- Track the arrival of ambulances.

- The rescue team shall notify the district authorities for deployment of State or National Disaster Response Force. All agencies shall assist the SDRF team until the rescue operations are closed and terminated. The response team shall arrive at scenes and commence the rescue operation including assisting and coordinating with other agencies

9.4.2. Pre-Arrival Crash Scene Assessment

- The following details can be collected:
  - Exact location of the incident.
  - Lane direction (where the crash vehicles are present).
  - GPS coordinates (live location sharing if possible).
  - Number of vehicles involved.
  - Number of victims and nature of injuries.
  - Involvement of heavy vehicles.
  - Involvement of hazardous material.
  - Involvement of fire.
- The control room shall guide the victim/ commuter/caller to move to a safe edge of the road while the rescue team arrives.
- Based on the information the rescue team shall do the following:
  - Dispatch needed medical assistance immediately.
  - Notify District Disaster Management Force, fire services, police, hospital, as required.
  - Assess tentative list of equipment required for rescue.
  - Assess if a medical practitioner/examiner is required at the crash location and facilitate accordingly.

9.4.3. Rescue Team Dispatch

- Travelling to scene: If a clear vision of the travel path is not available, one or more personnel will act as spotter guides to:
  - Guide the driver.
  - Navigate GPS.
  - Keep track of lanes, exits and entries on the highway corridor

- Ensure that any potential hazards are avoided

- Driving rescue vehicles in opposing traffic lanes is highly hazardous and shall only be considered under exceptional circumstances (i.e., if there is no alternate travel route). Vehicle drivers must proceed slowly and with extreme caution in these situations.
- Arriving at scene:
  - Drivers arriving at the scene shall exercise extreme caution while manoeuvring vehicles; to ensure safety of rescue personnel and pedestrians present and also be mindful of the hazards such as downed or low-hanging wires, hazardous materials, limited visibility, etc.
  - When operating at a crash scene where the road is closed to regular traffic, the Police shall guide the positioning, parking and staging of the ambulances and patrol vehicles in a manner that ensures safety for all.
  - Place appropriate warning signs and traffic channelling devices at nearest exit/entry ramps for upstream traffic to be alerted regarding an ongoing rescue operation ahead.
  - Use adequate warning lights and scene lighting at the scene in case of dim lighting.
  - Personal protective gear shall be worn during all training and operational incidents (like helmet, reflective jackets, gloves, boots, respiratory protection, etc.,).
  - If required, the response team can call for second team for assistance
  - The response team, in collaboration with all the medical facilities in the jurisdiction, shall prepare the list of doctors and nurses in the vicinity who may be called to the scene in extraordinary circumstances.

9.4.4. Inter-Agency Coordination

The response team should notify other stakeholder agencies such as Police, Hospital, Ambulances, District/State authorities, SDRF/NDRF (as required). Regional offices of MoRT&H (NHAI, NHIDCL, and Road Wing) should get in touch with NDRF/SDRF offices at the nearby locations to have the first-hand knowledge of the resources available with them and also to familiarize them with road accident-related disaster situations and expose them to the issues relevant to the rescue and relief of passengers during road accidents. It is also advised that NDRF/SDRF should be associated in full scale exercises that is held once every year.

9.5. Recovery and Relief

9.5.1. Scheme for Compensation to Victims of Hit and Run Motor Accidents, 2022

Section 161(3) of the Motor Vehicle Act, 1988, as amended vide Motor Vehicle (Amendment) Act, 2019 states that the Central Government shall provide compensation in respect of the death of, or grievous hurt to, persons due to hit and run motor accidents and may formulate a scheme for the same. Section 161(2) mandates the following compensation amounts:

- In case of death – Rs. 2,00,000 (increased from Rs. 25,000).
- In case of grievous injury – Rs. 50,000 (increased from Rs. 12,500).

Subsequently, 'Scheme for Compensation to Victims of Hit and Run Motor Accidents, 2022' has been notified by the Central Government vide GSR 163(E) dt 25.02.2022. For the same, a hit and run compensation account under the Motor Vehicle Accident Fund has been created. This account has been credited with the transfer of funds remaining in the erstwhile Solatium Fund under the Solatium Scheme, 1989. An additional source of funding for this account shall be a percentage of total third-party premium collected by insurance companies carrying on the business of motor insurance in India, considering the actual disbursements from the hit and run compensation account in the preceding year.

9.5.2. Cashless Treatment of Road Accident Victims

The Government of India, in line with its commitment to reduce fatalities due to road accidents and the legal mandate under section 162 of the Motor Vehicle Act, 1988, has notified a scheme to provide cashless treatment to the victims of road accidents caused by the use of motor vehicles. The program is aimed at establishing an ecosystem for providing timely medical care to the victims of road accidents, including during the golden hour.

The National Health Authority (NHA) shall be the implementing agency for the pilot program, in coordination with the Police, hospitals, State Health Agency (SHA), etc.

The broad contours of the pilot program are as follows:

- Victims entitled to cashless treatment up to a maximum of Rs. 1.5 lakh per accident per person for a maximum period of 7 days from date of accident.
- Applicable to all road accidents caused by use of motor vehicle on any category of road.
- AB PM-JAY packages for trauma and polytrauma cases being co-opted.
- Claims raised by hospitals for providing treatment to be reimbursed from the Motor Vehicle Accident Fund.

The program will be implemented through an IT platform combining the functionalities of eDAR application of MoRT&H and Transaction Management System (TMS) of NHA.

10.Detailed Protocols

10.1. Key Practices

Following are some of the key practices to be followed upon notification of a road accident disaster:

- Coordination with the police to close carriageways and dissemination of information to the road users through messaging/signages/notifications at toll plazas/traffic diversions, etc.,
- Ensuring scene safety and placement of cones and barriers.
- Deployment of cranes/extrication equipment as required.
- Ensuring proper safe parking of rescue and emergency team vehicles.
- Ensuring safe extraction/extrication processes during evacuation of the entrapped crash victims from the damaged vehicles using equipment such as jaws-of-life, gas cutters, hydraulic cutters, etc.
- Tracking of arrival of emergency care vehicle and transfer of victims from the crash spot to the hospital.
- In case of fire
    - Ensuring safe evacuation of victims.
    - Extinguishing fire or negate plug gas leak/oil leak and making the scene safe as early as possible.
    - Containing the spread of hazardous substances.
- Extrication of victims from entrapments.

Detailed protocols for scene safety (including traffic diversion and hazard checks to be followed), stationing of vehicles at the scene, victim extrication, emergency care at accident spot (including victim care, patient stabilisation, lifting and moving the casualty, triaging at scene, and dispatch to the nearest appropriate medical facility), and scene termination (including scene preservation and cordoning off, resuming regular flow of traffic, and initiation of crash investigation) would be as per the circulars/notifications/guidelines issued by the Central Government from time to time.

10.2. Role of Technology in Response

Technology plays a vital role in speeding up emergency response during road accidents. Systems like automatic incident detection and advanced traffic management enable real-time accident monitoring and quick reporting, allowing faster dispatch of emergency services. GPS and geo-location help emergency vehicles navigate efficiently to the site, while integrated communication ensures smooth coordination among responders. Digital dispatch automates resource allocation for quicker action, and smart traffic lights can clear routes for emergency vehicles. Together, these technologies reduce response times and improve outcomes for accident victims.

10.3. Success Stories on response and recovery efforts

Success stories in India's road accident response and recovery highlight impactful initiatives across multiple areas. First responder and Good Samaritan programs focus on the crucial "Platinum 10 Minutes" after a crash, training bystanders to provide lifesaving aid, improving survival rates. The "Golden Hour" trauma care strategy ensures victims receive emergency treatment within 60 minutes. The National Ambulance Code standardizes ambulance services, enhancing emergency response quality nationwide. Financial support through the Motor Vehicle Accident Fund offers cashless treatment and compensation, easing the burden on victims and families. Black spot remediation projects have successfully transformed high-risk accident zones into safer areas. , such as Godrej Junction and Kasara Ghat. The National Injury Surveillance Centre aids data-driven trauma care improvements, while policies from the Ministry of Health ensure no victim is denied emergency treatment due to legal concerns. Together, these coordinated efforts have significantly improved road accident survival and recovery outcomes in India.

11.Capacity Building to Handling Disasters

11.1. Key aspects for capacity building

The key aspects and broad thematic areas for capacity building applicable to the dimensions of road accident disasters are summarized below:

Key Aspect	Thematic Areas
Scientific Crash Investigation	• Understanding crash forces ➢ Vehicle dynamics

Key Aspect	Thematic Areas
	➢ Direct and indirect damages ➢ Evidence identification ➢ Sequence of events • Evidence documentation ➢ Key variables of importance ➢ Recording redundancy ➢ Photography ➢ Image analysis • Crash data analysis and reporting • Personnel safety during investigations • Incident management protocols **<u>Application of Crash Investigations</u>** • Safe systems approach • Causal factor determination • Collision diagrams • Blackspot identification and rectification • Monitoring and evaluation • Before and after studies • Effectiveness measures • International best practices
Road Safety Audit	• Road inspection checklist • Evaluation of road attributes • Gap assessment in comparison with IRC standards • Understanding the causation factors • Identifying road engineering deficiencies • Devising suitable short term and long-term measures
Road Safety Management	• Administration of projects/programs • Fund management • Monitoring of road safety activities • Evaluation of project/program performances
Basic Life	• Step by step CPR process and demonstration/practice

Key Aspect	Thematic Areas
Support	• Repository arrest and rescue breaths/demonstrations • Recovery position/demonstration
Extrication, Rescue, and Evacuation Procedures	• Usage of extrication tools • Handling of damaged vehicles • Handling of crash victims while performing extrication processes

11.2. Successful Capacity Building Initiatives on Road Safety

Capacity building initiatives in road safety have played a vital role in enhancing the skills and coordination of key stakeholders across India. The successful capacity building initiatives in road safety include RADHEE's first responder training, which equips police and volunteers with emergency care skills to improve accident survival rates. District Road Safety Committees (DRSCs) conduct regular multi-agency training to enhance coordination among key stakeholders. NGOs like SaveLife Foundation run school programs promoting safe road behaviors among children. The Ministry of Road Transport and Highways (MoRTH) also provides requisite trainings to officers of State Governments through institutions like NIC, NICSI, IHAE, CoERS, Driving Training Institutions etc. in various fields related to safety of road users.

11.3. International Cooperation in Capacity Building

International cooperation is crucial for strengthening disaster management capacity, particularly in developing and disaster-prone countries. Through frameworks like the Sendai Framework, countries collaborate to share expertise, resources, and best practices, supported by organizations such as the United Nations and World Bank, which provide technical assistance, funding, and training. These partnerships focus on building early warning systems, conducting risk assessments, and developing resilient infrastructure to reduce vulnerabilities. Capacity-building efforts empower local communities and governments by bridging gaps between national and local levels through joint exercises and knowledge sharing platforms like those organized with BRICS, BIMSTEC, and the UN. Beyond emergency response, international cooperation promotes long-term strategies for disaster prevention, mitigation, and recovery, leveraging global expertise and technology to help resource-limited countries effectively prepare for, respond to, and recover from disasters, thereby protecting development and saving lives.

12.Plan Maintenance

This Road Accidents Sub-Plan of the Ministry of Road Transport and Highways should be reviewed and updated on an annual basis. The plan update process should begin in the month of January in each year and should be completed by the month of April the same year, based on inputs received from the following:

- Lessons learnt during implementation of the plan the preceding year.
- Lessons learnt from other countries.
- Directions from concerned stakeholders including the Ministry of Home Affairs, National Disaster Management Authority, Government of India, etc.

Appendix I: Road Safety Initiatives by MoRT&H

Some of the key initiatives taken up by the Ministry of Road Transport and Highways to reduce instances of road crashes are as below:

- **Road Engineering**
  - Indian roads and highways are designed and constructed as per the recommendations and guidelines laid out by the Indian Roads Congress, AASHTO, and similar standards used worldwide.
  - Road safety has been made an integral part of road design at the planning stage.
  - Road Safety Audit (RSA) of all National Highways has been made mandatory in all stages of highway construction.
  - Ministry has notified guidelines for the provision of road signages and markings on National Highways and Expressways.
  - Ministry has issued guidelines for pedestrian facilities on National Highways to all States/UTs.
  - Quarterly inspection of roads are carried out under the jurisdiction of respective RO's for a check on the road worthiness.
  - Ministry has prioritized the identification and rectification of black spots on National Highways through the adoption of temporary and permanent rectification measures.
  - Ministry has delegated powers to the RO's for technical approval to the detailed estimates for rectification of identified accident blackspots.

- **Vehicle Engineering**
  - Improvements in safety standards for automobiles including airbags, Anti-Breaking Systems (ABS), tyres, crash tests, Whole Vehicle Safety Conformity of Production (WVSCoP), etc.
  - Ministry has notified the fitment of speed-limiting devices on all transport vehicles.
  - Ministry has rolled out a scheme for setting up one model Inspection & Certification Centre in each of the States/UTs for testing the fitness of vehicles through an automated system.
  - Ambulances have been upgraded to Basic Life Support as per AIS 125.

- **Education**
  - Ministry has implemented a scheme for undertaking publicity measures and awareness campaigns for creating awareness on road safety amongst road users through the use of electronic/print media, etc.
  - National Road Safety Week/Month is organized every year for spreading awareness and strengthening road safety.
  - A certification course for Road Safety Auditors has been commenced at the Indian Academy of Highway Engineers (IAHE).
  - Ministry has ordered States to set up state-of-the-art driver training institutes for proper training and effective licensing of drivers.
  - Display of emergency rescue numbers on notice boards within the Central and State level offices.
  - Training of the staff and bystanders on basic first aid such that they can respond to save lives during the event of an accident.
- **Enforcement**
  - Motor Vehicle (Amendment) Act, 2019 provides for strict enforcement through the use of technology and further provides for strict penalties for ensuring compliance to road safety rules.
  - Ministry has notified guidelines for protection of Good Samaritans.

- Ministry has issued notification for the functional and technical specifications of Advance Traffic Management System (ATMS) for implementation on National Highways and Expressways.

- **Emergency and Trauma Care**
  - Motor Vehicle (Amendment) Act, 2019 provides for a scheme for the cashless treatment of accident victims during the golden hour.
  - Integration of National Highway helpline number 1033 with emergency ambulance service number 108 for ease of access to post-crash care.
  - Integration of National Highway helpline number 1033 with 112 for all emergency services is under process to provide seamless and ease of services to public.
  - Provision of ambulances with paramedical staff/emergency medical technicians/nurses at toll plazas on various National Highway corridors.
  - Ministry has mandated implementation of Incident Management Services (IMS) comprising of rescue ambulances, route patrol vehicles, and tow away vehicles/cranes, during operation and maintenance of National Highways.
    - Contractors have been mandated to deploy tow away cranes for removal of breakdown/damaged vehicles in the aftermath of accidents.
    - Rescue ambulances are to facilitate immediate first aid during the golden hour to the accident victims and subsequently transfer the accident victims to the nearest hospital/trauma care centre.
    - Route patrol vehicles are to check unauthorized activities, guide road users, and provide assistance to traffic management during incidents of crashes.