2024

Panhala Fort Disaster Management Plan



District Disaster Management Authority



Government of Maharashtra Disaster Management, Relief and Rehabilitation Department

Panhala Fort Disaster Management Plan Kolhapur District 2024-2025

Disaster Management Authority District Collector's Office, Kolhapur District

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Collector and Chairman, District Disaster Management Authority, Kolhapur, Maharashtra

<u>Message</u>

India, with its rich cultural and historical legacy, faces a variety of natural and human-induced disasters. Over the years, the nation has significantly enhanced its disaster preparedness, response, and mitigation capabilities. With a strong emphasis on community participation and the involvement of all key stakeholders, we have developed frameworks that enable efficient disaster risk reduction. However, the protection of our heritage sites, such as forts and monuments, requires specific attention due to their historical significance, structural vulnerabilities, and the increasing footfall of tourists.

Forts like Panhala are not only symbols of our rich heritage but are also vulnerable to various hazards, including landslides, earthquakes, fires, and extreme weather events etc. Recognizing this, the NDMA has emphasized the development of disaster management plans that cater specifically to such heritage sites. A structured disaster management plan for Panhala Fort ensures that in the event of an emergency, there is a swift, coordinated, and effective response mechanism in place.

To adhere to the Disaster Management Act of 2005, regular consultations were held between the DDMO and PMU, Palladium. PMU, Palladium's experts spent several weeks on this project, engaging in detailed scientific research and comprehensive analysis. Their work culminated in the creation of this Panhala Fort Disaster Management Plan, aimed at reducing disaster risks and boosting the resilience of the Fort.

I sincerely thank all the government departments, local authorities, NGOs, and the local community for their continued cooperation in this initiative. Your collaboration is vital to the successful implementation of the Panhala Fort Disaster Management Plan.

I urge all stakeholders to remain vigilant, follow the guidelines laid out in the Panhala fort disaster management plan, and participate actively in awareness and training programs. Our collective efforts can significantly minimize the risk to life and property and ensure the continued protection of Panhala Fort, the pride of Kolhapur and the cherished monument of our history.

Let us work together to preserve both our people and our heritage.

District Collector, District Disaster Management Authority, Kolhapur, Maharashtra

Panhala Fort Disaster Management Plan Kolhapur District 2024 - 2025

Prepared By

District Disaster Management Authority, Office of the District Collector Kolhapur, Govt. Of Maharashtra

Knowledge partner

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The District Disaster Management Authority has taken all reasonable precautions to verify the information and ensure stakeholder consultation and input prior to its publication. The publisher welcomes suggestions for improving future editions.



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प्रति.

मा. प्रधान सचिव, आपत्ती व्यवस्थापन मदत व पुनर्वसन विभाग, मंत्रालय, मुंबई- ४०००३२

विषय :- कोल्हापूर जिल्हा आपत्ती व्यवस्थापन आराखडे सादर करणेबाबत.

महोदय,

सन २०२४-२५ या वर्षाचा कोल्हापूर जिल्हयातील आपत्ती व्यवस्थापन आराखडा अद्यावत करण्यात आलेला आहे, तो आपल्या अवलोकनार्थ सादर करत आहोत. त्याचबरोबर कोल्हापूर जिल्हयातील छत्रपती शिवाजी महाराजांच्या पदस्पर्शाने पावन झालेल्या 'पन्हाळा गडाचा' राज्यातील पहिला गडकोट आपत्ती व्यवस्थापन आराखडाही तयार करण्यात आलेला आहे. सदर आराखडाही अवलोकनार्थ सोबत सादर करत आहोत. कृपया, अवलोकनी यावे ही नम्र विनंती.

> (अमोल येडगे) जिल्हाधिकारी तथा अध्यक्ष, जिल्हा आपत्ती व्यवस्थापन प्राधिकरण,कोल्हापूर

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List of Abbreviations:

DC:	District Collector
DDMA:	District Disaster Management Authority
DEOC:	District Emergency Operation System
DRR:	Disaster Risk Reduction
DRT:	Dister Response Team
GSI:	Geological Survey of India
IDRN:	India Disaster Resource Network
IMD:	Indian Meteorological Department
IRS:	Incident Response System
NDMA:	National Disaster Management Authority
NDMIS:	National Disaster Management Information System
NGO:	Non-Government Organization
PA:	Public Address
PDNA:	Post Disaster Need Assessment
PFEOC:	Panhala Fort Emergency Operation System
PPE:	Personal Protective Equipment
PWD:	Public Work Department
RDC:	Resident Deputy Collector
SDM:	Sub Divisional Magistrate
SDMA:	State Disaster Management Authority
ZP:	Zilla Parishad

1. Introduction

1.1. Cultural Heritage Sites and Precincts in India

Heritage is categorized and designated in numerous ways by stakeholders at national and international levels. Heritage may be divided into two categories: natural and cultural. India has a tremendous treasury of culture. Heritage varies greatly in historicity, magnitude, affiliation, expression, and style. However, huge portions of this cultural treasure are still unrecognized and safeguarded. The heritage that has been formally acknowledged and is legally protected by different agencies are also continually exposed to a variety of natural and man-made hazards.

Tangible legacy refers to historical structures, monuments, and artifacts that should be preserved for future generations. According to UNESCO (1972), culturally important items include those related to archaeology, architecture, science, and technology. Tangible and intangible cultural treasures are inextricably intertwined.

The Archaeological Survey of India (ASI), under the Ministry of Culture, is responsible for identifying, protecting, and managing culturally significant sites and items in India. It works through State Circles, Museums, Excavation, Prehistory, Epigraphy, and Science Branch, Horticultural Branch, Building Survey Project, Temple Survey Projects, and Underwater Archeology Wing. It operates under the requirements of the AMASR Act of 1958. Over 3683 locations have been identified as Centrally Protected Monuments and Sites.

Each state has its own legislative acts, as well as monuments and landmarks. They may also have specially designated regions under State Acts. Several cities' masterplans specify heritage precincts and notify zones that are under management through city administration. Therefore, the legal scope of constructed cultural heritage in India varies substantially depending on the jurisdiction.

1.1.1. Heritage Values/ Cultural Significance

Heritage values can generate revenue for cultural heritage sites through tourism, education, recreation, and other means. Quantifying historic values based on economic capital is a complicated procedure. There are substantial ties between cultural sites and local economies all over the country. Thus, while evaluating catastrophe threats to cultural sites, it is critical to include the possible impact of a calamity on heritage contributors. Heritage value also adds to shared memories and local, regional, and national identities, which play an important role in Recovery following a calamity.

When planning for disaster risk reduction for cultural heritage sites, it is vital to address threats not only to the site's lives and livelihoods, whether directly or indirectly, but also to the heritage values represented in the site. These values can be reflected by the physical fabric of the place, such as architectural or artistic characteristics, or by its use. In any scenario, conventional methods to disaster risk reduction may clash with the protection of these values, making it critical to identify, analyze, and prioritize them.

Furthermore, because cultural heritage sites may contribute to disaster mitigation through their planning, construction technologies, association with local stakeholders, and so on, they may be viewed as potential assets in overall disaster risk management planning at the neighborhoods, precinct, or city scales. Furthermore, the scale of heritage value is a significant component in determining its contribution. Cultural heritage sites and precincts may have significant value at various sizes.

Global: Globally, UNESCO World Heritage Sites have Outstanding Universal Value based on criteria defined by the 1972 World Heritage Convention.

National: The ASI recognizes sites of national significance in India. The Ministry of Urban Development recognizes historic cities and urban areas.

Regional: Regional historical sites are identified by state archaeology departments, INTACH state chapters, and master plans. The Ministries of Tourism and Rural Development have also designated several regions and sites at the regional level.

Local: INTACH, non-governmental organizations, and local municipal governments may recognize heritage sites that are locally significant. Cultural heritage places can have overlapping importance, resulting in multiple types of cultural value for different stakeholders at different sizes.

1.2. Disasters and their Impact on Cultural Heritage Sites and Precincts

In recent years, there has been an unprecedented increase in the frequency of disasters and their impact on lives, property, and livelihoods (UNISDR 2009). Rapid urbanization, rising population, climate change, and other factors have made nations more vulnerable, particularly developing countries like India.

Disasters have had an especially devastating impact on our country's cultural heritage in recent years. For example, the Bhuj Earthquake in 2001 devastated both rural and urban areas, destroying many nationally and state-protected monuments as well as vernacular structures. The earthquake caused considerable damage to the Bhuj City Palace, including the memorial chatris (cenotaphs). Similarly, the 2011 Sikkim earthquake devastated several Buddhist monasteries and temples. Flash floods in the lower Himalayas in 2013 and the Kashmir Floods in 2014 caused widespread damage to temples, palaces, historic gardens, and museums.

Such disasters have become more frequent because of unsustainable human activity and its consequences for ecosystems and the environment. Armed warfare, terrorism, and vandalism are reported from across the world. During sieges, cities typically lose their cultural legacy. Examples of similar operations in India include the recent attack on a UNESCO World Heritage site in Darjeeling. Cultural heritage has only lately been identified as an important component of comprehensive catastrophe risk reduction strategies. One of the most significant issues in this field is a general lack of understanding and prioritizing heritage. Disaster risk management for constructed cultural assets includes the following important aspects:

- Because of the variation in age, scale, and physical aspects of architectural heritage, it is difficult to apply conventional measures to disaster risk reduction.
- Disasters endanger not only the lives of those living, visiting, or managing cultural heritage sites and precincts, but also the heritage values embodied in the physical fabric.
- Poor management, neglect, and lack of awareness complicate disaster risk reduction for built heritage, as the structural integrity of such buildings often deteriorate over time.
- Interventions to mitigate risk to such sites may occasionally represent a threat to its heritage value and beauty.
- Built heritage can serve as a refuge area or demonstrate structural resilience through old technologies, which can aid in creating risk reduction techniques on a broader scale.

Furthermore, in India, constructed cultural property presents unique issues in disaster risk management.

Table 1: Managing Risks at the cultural heritage sites in India: Key Issues and Challenges Aspect

Aspect	Key Issues and Challenges
Risk	Continuously updated information regarding cultural heritage sites and precincts available in a streamlined manner, specifically with respect to hazard mapping and identifying vulnerabilities
Assessment	Identification of stakeholders and local communities, and including them in the decision- making process
Risk Mitigation	Multiple agencies dealing with different aspects of the same site or precinct, leading to inter-agency coordination issues

Aspect	Key Issues and Challenges
	Historic cities, settlements and precincts have high densities of built fabric and infrastructure that has grown and transformed in an ad-hoc manner with little or no documentation
	Poor management, neglect and lack of awareness further complicate disaster risk reduction for built heritage since often the structural integrity of such buildings gets compromised over time
	Interventions that would reduce risk to such sites may sometimes pose a threat to the heritage value and aesthetics
	Complex contextual scenarios in terms of accessibility and connectivity
Emergency Preparedness	Many "Living" heritage sites or sites that are actively in use are at greater risk because of high levels of visitor footfall
Response	Most 'standard' preparedness and response procedures are impossible to implement in cultural heritage sites without significantly impacting the values of the heritage site
	Normative ideas of 'authenticity' of material fabric often conflict with ideas of reconstruction within the Indian (and South Asian) context
Post-Disaster Recovery and	Since a large percentage of built heritage is not identified in official lists, assessment of damage and losses in a disaster scenario is extremely problematic
Rehabilitation	There is a close relationship between traditional arts, crafts and cultural practices and built heritage, but much of it is unaccounted for. With the loss of built heritage, intangible aspects of cultural heritage are also put at risk

1.3. Existing Legislative Frameworks- An Overview

1.3.1. Framework for Heritage Sites in India

- Any section of the citizens residing in the territory of India or any part thereof having a distinct language, script or culture of its own shall have the right to conserve the same" (Article 29 of the Constitution)
- It shall be the obligation of the State to protect every monument or place or subject of artistic or historical interest, declared by or under law made by parliament, to be of national importance from spoliation, disfigurement, destruction, removal, disposal or export, as the case may be" (Article 49 of the Constitution)
- "It shall be the duty of every citizen of India to value and preserve the rich heritage of our composite culture" (Article 51 A (F) of the Constitution)

The Indian Constitution sets out the primary framework for identifying, valuing and conserving various tangible and intangible aspects of culture. The Apex Body for the implementation of this Framework with respect to cultural heritage is the **Ministry of Culture**, which acts through the **Archaeological Survey of India**. Under the aegis of the ASI and MoC, national legislations that apply to cultural heritage in India include the following:

- ✤ AMASR ACT 2010
- The Ancient Monuments and Archaeological Sites and Remains Act, 1958 and The Ancient Monuments and Archaeological Sites and Remains Rules, 1959
- The Antiquities and Art Treasures Act, 1972 and The Antiquities and Art Treasures Rules, 1973

Several states also have State legislations that apply to State Archaeology Monuments and Sites.

1.4. Framework for Disaster Management in India

In India, disaster management is overseen by the National Disaster Management Authority, which was established under the National Disaster Management Act (2005). The National Disaster Management Act of 2005 establishes the institutional, legal, financial, and coordinating frameworks for Disaster Management (DM) on the national, state, district, and local levels.

The second instrument is the National Policy on Disaster Management (NPDM) 2009, which states:

"Indigenous knowledge on disaster and coping mechanisms adopted by various States will be given due weightage with special focus on protection of heritage structures."

In May 2016, the NDMA released the National Disaster Management Plan (NDMP), which outlines methods to strengthen disaster resilience at the national level via continuous action, prioritizing short-term, medium-term, and long-term objectives. The NDMP operates under the Sendai framework for Disaster Risk Reduction, to which India has signed, and aims to provide a structure and guidance to government entities throughout the disaster management cycle. The NDMP mandates that ministries and public entities establish disaster risk management plans and integrate them into their overall planning and administration. The NDMA is primarily responsible for developing disaster management policies, strategies, and recommendations for Central Ministries, Departments, and States. These recommendations serve as a framework for ministries and institutions to establish their own DM plans, which must be approved and reviewed by the NDMA (NDMA 2009). This comprises the sites and precincts controlled by the MoC and ASI.

1.5. Rationale for Panhala Fort Disaster Management Plan

Panhala Fort, a historically significant monument in Kolhapur, Maharashtra, faces a variety of potential disasters such as landslides, earthquakes, fires, and human-induced damage. These risks threaten not only the structural integrity of the fort but also the safety of the visitors and residents in the nearby areas. The increasing impact of climate change, rapid urbanization, and human activities near the fort magnify the risks. Therefore, the development of a comprehensive disaster management plan is crucial to protect the fort's heritage, minimize potential damage, and ensure the safety of all stakeholders.

1.6. Vision

To develop a disaster-resilient Panhala Fort by implementing sustainable management strategies, preserving its historical and cultural heritage, and ensuring the safety of both visitors and nearby residents through proactive disaster risk reduction, response, and recovery measures.

1.7. Aim

To minimize the risk and impact of natural and man-made disasters on Panhala Fort and its surrounding areas by developing a systematic disaster management framework that incorporates prevention, preparedness, mitigation, response, and recovery strategies.

1.8. Objectives

1.8.1. Risk Assessment and Vulnerability Mapping

- Conduct a detailed hazard assessment of the fort and its surrounding environment to identify potential risks such as landslides, earthquakes, floods, and fires.
- Map vulnerable areas within and around the fort, including structural weaknesses, visitor-prone areas, and nearby human settlements.

1.8.2. Strengthening Structural Resilience

- Implement structural reinforcement measures to enhance the fort's resilience against earthquakes, erosion, and other environmental stresses.
- Regularly monitor and maintain the fort's walls, gates, and infrastructure to address signs of deterioration or vulnerabilities.

1.8.3. Early Warning and Communication Systems

- Establish a robust early warning system that alerts authorities and visitors in case of impending natural disasters.
- Create clear communication protocols to ensure timely dissemination of information before, during, and after a disaster event.

1.8.4. Capacity Building and Training

- Conduct disaster preparedness and response training for local authorities, fort management, and residents.
- Form disaster response teams composed of local volunteers, staff, and emergency responders to act swiftly in the event of a disaster.

1.8.5. Emergency Response Plan

- Develop a comprehensive emergency response plan that outlines evacuation routes, medical assistance, firefighting measures, and crowd control protocols.
- Set up designated safe zones and shelters for evacuation in case of emergency.

1.8.6. Cultural Heritage Preservation

- Collaborate with archaeological experts to ensure that disaster mitigation efforts do not compromise the historical and cultural value of the fort.
- Develop post-disaster recovery plans to restore damaged areas while preserving the integrity of the monument.

1.8.7. Sustainable Tourism Management

- Implement visitor management strategies, such as limiting access to high-risk areas and improving tourism infrastructure, to reduce the strain on the fort's structural integrity.
- Educate tourists about the importance of disaster preparedness and safe behavior within the fort premises.

1.8.8. Community Engagement and Public Awareness

- Increase community participation in disaster risk management through education, workshops, and collaboration with local groups.
- Launch awareness campaigns to inform locals and visitors about the fort's disaster risks and safety protocols.

1.8.9. Coordination with Government Agencies and Experts

- Partner with disaster management authorities, heritage conservation experts, and environmental agencies to ensure a coordinated and multi-disciplinary approach.
- Regularly update and revise the disaster management plan based on new research, technology, and disaster occurrences.

By implementing this disaster management plan, Panhala Fort will be better equipped to withstand natural and man-made disasters, thereby safeguarding its heritage and ensuring the safety and well-being of future generations.

1.9. Terminology of Disaster Management

Disaster: A severe 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.

Disaster Risk: The potential loss of life, injury, or destroyed or damaged assets that could occur to a system, society, or a community in a specific period, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity.

Disaster Risk Reduction (DRR): Disaster risk reduction is aimed at preventing new and reducing existing disaster risks and managing residual risk, all of which contribute to strengthening resilience and, therefore, achieving sustainable development.

Early warning system: An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities, systems and processes that enable individuals, communities, governments, businesses, and others to take timely action to reduce disaster risks in advance of hazardous events.

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.

Mitigation: Measures taken to reduce or prevent the adverse effects of hazards, including structural and non-structural interventions.

Preparedness: Refers to the level of readiness to manage an impending disaster situation or disaster and its associated effects.

Response: The activities and measures are taken to address the immediate impacts of a disaster, including search and rescue, emergency medical care, shelter provision, and humanitarian assistance.

Recovery: The restoring or improving 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.

Resilience: The ability of individuals, communities, and systems to withstand, adapt to, and recover from the impacts of disasters while maintaining essential functions and minimizing disruption and loss.

Rehabilitation: It refers to restoring or regaining the physical, mental, social, or economic well-being of individuals or communities affected by a disaster or other adverse event.

Vulnerability: The conditions determined by physical, social, economic, and environmental factors or processes that increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

2. Panhala Fort Profile

Panhala Fort, also known as Panhalgad and Panhalla (literally "the home of serpents"), holds a prominent place in the history of Maharashtra. Locally, it was known as the abode of serpents and was traditionally associated with the sage Parashar. The fort occupies a significant position in the history of the state and is also a favored destination as a hill station. Panhala Fort offers a panoramic view of the surrounding forts and hills in the Sahyadri mountain range. It is a magnificent sight, bearing witness to many mythological and historical events and legends. The fort was built by the Shilahara dynasty in the twelfth century and later passed through various rulers, including the Yadavas, Bahamani, Adilshahi, Mughals, and Marathas. It was constructed by King Bhoja II of the Shilahara dynasty between 1178 and 1209 CE to ensure proper administration of his empire. After King Bhoja II, the Yadava ruler Singhan Dev Yadav took control of the fort. In 1347, it was taken over by the Bahamani Sultanate of Gulbarga as one of their strongholds.

The Adilshahi Sultanate rulers of Bijapur made significant fortifications and constructed major building complexes, bastions, and ramparts, which lasted over 150 years. Many inscriptions on the fort's walls refer to the Adilshahi rulers. Panhala Fort has seen numerous battles and sieges, particularly during the Maratha Empire. The fort is notably linked with Chhatrapati Shivaji Maharaj, the founder of the Maratha Empire, who spent over seven months there before escaping the siege of Siddhi Johar in 1660. Today, Panhala Fort is a popular destination for tourists seeking to experience the rich heritage and culture of Maharashtra.

Mughal emperor Aurangzeb attacked and laid siege to the fort from 1691 to 1700. The fort was successfully defended under the able leadership of Tararani for nine long years. At that time, Panhala Fort was under the rule of Chhatrapati Rajaram. Afterward, Rajaram's second son, Sambhaji, took charge of the fort in 1714 and established autonomous rule, creating a separate state of Kolhapur with Panhala as its capital.

The fort was finally handed over to the British in 1827, but in 1844, British General Dela Motte was seized and held hostage inside the fort by some rebels. This led to British forces storming the fort and keeping it under guard until India's independence in 1947.

2.1. Location

Panhala Fort is part of the foothill region of the Sahyadri escarpment (Latitude:16° 48′ 32″ N and Longitude :74° 6′ 33″ E) in southern Maharashtra (Fig. 1). The area is primarily composed of compact basalt and amygdaloidal basalt flows, with some vesicular traps. These are separated by thin, ribbon-like red and green tachylitic bands, which are more extensive. Compact basalt flows dominate over the amygdaloidal basalt flows, and the surface exposure reveals moderately to deeply weathered rock in the form of a section.



Fig. 1: Geographical Location of Panhala Fort

Located approximately 20 km from Kolhapur, Panhala Fort has excellent connectivity through road infrastructure linking it to nearby towns. It is built on an outlying spur of the Sahyadri range, rising more than 400 meters above the surrounding plain.

2.2. Transportation Network

Panhala Fort can be reached by road from major cities in Maharashtra and neighboring states (Fig. 2). It is located on the NH 4 highway, which connects it to cities like Mumbai, Pune, and Bangalore. Visitors can hire a taxi or take a bus from these cities to reach the fort. The distance and time taken to reach the fort by road from some nearby cities are:

- Mumbai to Panhala Fort: 375 km (6 hours)
- Pune to Panhala Fort: 230 km (4 hours)
- Bangalore to Panhala Fort: 610 km (10 hours)



Fig. 2: Transportation Network of Panhala Fort; Source: Google Map

The fort can also be reached by rail from various parts of India. The nearest railway station to the fort is Kolhapur, which is about 25 km away. Kolhapur railway station is well-connected to other major railway stations in India, such as Mumbai, Pune, Delhi, Hyderabad, Chennai, and Kolkata. Visitors can take a train to Kolhapur railway station and then travel further by car or bus to Panhala Fort. Panhala Fort can also be reached by air from different cities in India. The nearest airport is Kolhapur Airport, about 30 km away. Kolhapur Airport has flights to and from Mumbai, Hyderabad, Bangalore, and Tirupati. Visitors can fly to Kolhapur Airport and then hire a cab or take a bus to the fort.

2.3. Geomorphology

On both sides of Panhala's fortification wall, steep cliffs form a huge complex of columnar joints with vertical and slightly inclined angles, which rise to great heights. These joints are interconnected, and their contact points create a continuous structure. The northern extension of Panhala, known as the Masai Plateau, is primarily used for plantation activity (Fig. 3). Both sides of the ridgeline are covered with beautiful, well-developed, highly elevated blocks of hexagonal, pentagonal, octagonal, and square-shaped columnar joints. These natural features add to the fort's natural beauty and enhance the importance of the plateau's natural

heritage. Along the east-west ridgeline, a steep slope is observed, and Panhala Fort was constructed along this parallel direction.



Fig. 3: Geomorphological Map of Panhala Fort

Panhala Fort is aligned along an east-west stretch, with offshoots of the Sahyadri running in the same direction. In a microtopography study, highlands of 9.60 and 9.30 meters are observed on the Panhala plateau, which stands 900 meters above mean sea level. Due to this ridgeline, the development of depressed land ranging from 780 to 600 meters takes place to the north and south of Panhala in an east-west direction. Along the highest elevated portion, a steep slope is observed, while in the lower elevated areas, a gentler slope is noticed. The slope along the east-west trend of the Panhala ridgeline controls the drainage characteristics of the region. The Panhala plateau acts as a source for the formation of radiating patterns of high-density drainage systems in the surrounding areas.

Most of the surface within the upper plateau region is exposed to atmospheric weathering conditions. As a result, the upper rock is highly dissected, with some micro and mega cracks developing in the rock bodies, creating channels for the movement of surface water into the deeper zones. This condition is highly conducive to groundwater recharge, as the area receives substantial rainfall during the rainy season. Consequently, the upper, highly dissected cap of the Panhala plateau serves as a source for the formation of springs in these areas. Due to the deep weathering, the upper part of the rock is transformed into fertile soil with high moisture content. Therefore, most of the land on the plateau is covered with evergreen forests, plantations, and grass.

The surrounding depressed areas consist of thick black cotton soil deposited by erosion from the highland source region of Panhala. This soil is widely used for agriculture. As a result, the geomorphology of Panhala features a highly dissected plateau in the top portion and a middle region with a sloping terrain.

According to the suitability of the landscape on the Panhala plateau, as well as along the sloping region and in the valley basement, different settlements have been established. The largest settlements were situated based on the availability of natural resources. In the study area, the largest settlement is Panhala town, located at the top of the plateau in the form of a fortified settlement. The second largest is Ambavade, situated in the northeastern extension of Panhala in the valley region. Settlements in the sloping region are comparatively less suitable, and therefore the population density in this area is relatively lower.

3. Hazard Risk Assessment and Vulnerability Analysis

3.1. Identifying Hazard and Hazard History

Panhala Fort has a rich history but also faces various hazards due to its geographical and environmental conditions. One of the most recurrent natural hazards in the area is the frequent occurrence of wildfires (Table 1), especially during the summer months. These fires, often fueled by dry trees and grass, pose a significant threat to the biodiversity and structural integrity of the fort, leading to the cracking of its ancient walls. In addition, the fort, like much of the world, was impacted by the COVID-19 pandemic, which brought about widespread health and social challenges. Human-induced hazards, particularly accidental fires, are also common, exacerbated by the dry landscape surrounding the fort. These events highlight the vulnerability of Panhala Fort, a historic monument, to both natural and human-caused hazards.

Hazard	Frequency (Years)	Probability Rank	Probability Level
Natural Hazard			
Flood	0	0	Rare
Cyclone	5	2	Possible
Landslide	2	2	
Earthquake	34	1	Rare
Heatwave	0	0	Rare
Drought	50	1	Rare
Wildfire	1	3	Almost Certain
Epidemic	5	2	
Cloud Brust	6	2	
Lightning	3	2	
Pest Attack	0	0	Rare
Hailstorm	7	2	
Wild Animal Attack	0	0	Rare
Technological Hazard			
Electrical Failure	2	2	
Transportation Failure	2	2	Possible
Communications Failure	0	0	Rare
Information Systems Failure	0	0	Rare
Fire	1	3	Almost Certain
Structural Damage	1	3	Almost Certain
Human Hazard			
Stampede	0	0	Rare
Drowning	0	0	Rare
Mass Casualty Incident (trauma)	0	0	Rare
Terrorism	0	0	Rare
VIP Situation	0	0	Rare
Hostage Situation	0	0	Rare
Civil Disturbance	0	0	Rare
Missing Resident	0	0	Rare
Bomb Threat	0	0	Rare

Table 2: Hazard frequency and probability ranking of Panhala Fort

3.2. Hazard Profile

Panhala Fort is one of the largest forts in the Deccan region. Its historical significance is intertwined with strategic military use, but today it faces several natural and anthropogenic hazards. Here's a Hazard calendar (Table 2) and detailed profile of hazards that affect Panhala Fort.

Disaster	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Earthquake	 	 	 	~	 	 	~	 	 	~	 	~
Floods						~	~	~	~			
Cyclones	 	~			 	~	~	 		~	 	
Landslide						v	~	 Image: A second s	 Image: A second s			
Heatwave			~	~	 							
Epidemics	v	v	~	~	~	v	~	~	 	~	 	~
Wildfire			~	~	 							
Fires	v	v	~	~	~	v	~	~	 	~	 	~
Road accidents	 	~	~	~	 	~	~	 	 Image: A second s	~	 Image: A second s	
Lightning					~	v	~	~		v	v	
Drought			~	 	~							

Table 3: Hazard Calendar of Panhala Fort

3.2.1. Geological Hazards

Landslides and Rockfalls: The fort is situated on a hill that has steep cliffs and slopes Lead towards high landslide susceptibility (Fi. 4 and Fig. 5). During the monsoon season, heavy rainfall increases the risk of landslides and rockfalls. The basaltic rock formation is vulnerable to weathering, leading to small-scale rockfalls.



Fig. 4:Landslide Susceptibility Map of Panhala Fort as per IIT, Delhi



Fig. 5: Landslide Susceptibility Map of Panhala Fort as per GSI

Seismic Activity: Panhala Fort is located in a region that is categorized as Seismic Zone III, which is a moderate risk zone (Fig. 6). Although there is no significant history of earthquakes, the structures on the fort could be susceptible to tremors due to the age of the buildings and their current state of deterioration.



Fig. 6: Earthquake Zonation Map of Panhala Fort

3.2.2. Climatic Hazards

Heavy Rainfall and Flooding: The region experiences significant rainfall during the monsoon season (June to September) and lead to moderate flood susceptibility (Fig. 7). The combination of heavy rains and poor drainage systems around the fort leads to waterlogging in certain sections of the fort, causing structural erosion and weakening.



Fig. 7: Flood Susceptibility Map of Panhala Fort

Erosion: Continuous exposure to rain and winds has led to erosion of the fort walls and surrounding area. Rain-induced erosion is most prominent during the monsoon, and long-term impacts can weaken the fort's foundational strength.

3.2.3. Human-Induced Hazards

Tourism Pressure: Panhala Fort is a popular tourist destination. The footfall during peak tourism seasons can increase the load on the infrastructure, potentially leading to structural damage due to overcrowding, littering, and vandalism.

Unauthorized Construction: There has been unregulated development around the fort in recent years, with some structures being built illegally near heritage sections. This increases the risk of foundational instability and changes the water drainage patterns, exacerbating erosion.

3.2.4. Vegetation Hazards

Overgrowth and Root Penetration: Over time, uncontrolled vegetation growth has led to the penetration of tree roots into the walls of the fort. This can cause cracks in the masonry and weaken the fortifications. Monsoon seasons further enhance plant growth, which accelerates the deterioration process.

3.2.5. Conservation Challenges

Lack of Maintenance: The fort's heritage value is high, but the lack of systematic conservation efforts and preventive maintenance programs means the fort faces a high risk of deterioration. Proper restoration and preservation plans are needed to mitigate these risks.



Climate Change: Increasing temperatures and unpredictable weather patterns, including stronger monsoons and erratic rainfall, are also contributing to the accelerated deterioration of the fort.

Fig. 8: Hazard impact distribution on Panhala Fort

Panhala Fort's hazard profile includes geological, climatic, and anthropogenic factors (Fig. 8). Landslides, seismic activity, heavy rainfall, erosion, tourism pressures, and vegetation overgrowth present considerable challenges to the fort's preservation. To ensure the longevity of this historical monument, detailed risk mitigation strategies and regular maintenance programs need to be implemented.

3.3. Risk Assessment

Table 3 provides a comprehensive risk assessment matrix categorized into Natural Hazards, Technological Hazards, and Human Hazards. The matrix evaluates risks based on several factors: probability, human impact, property impact, business impact, preparedness, internal response, and external response. The overall risk category for each event (ranging from low to high) offers insight into how these factors interplay in assessing the fort's vulnerability.

Natural hazard									
	Severity = (magnitude - mitigation)								
Event	Probability	Human impact	Property impact	Business impact	Prepared ness	Internal response	External response		
	Likelihood this will occur	Possibility of death or injury	Physical losses and damages	Interruption of services	Preplanning	Time, effectiveness, resources	Community/ mutual aid staff and supplies	Risk category	
Score	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = high 2 = moderate 3 = low or none	0 = n/a 1 = high 2 = moderate 3 = low or none	0 = n/a 1 = high 2 = moderate 3 = low or none		
Flood	0	2	2	3	1	1	2	Low	
Cyclone	2	0	2	2	2	2	2		
Landslide	2	1	2	2	2	2	3	High	
Earthquake	1	0	0	0	0	0	0	Low	
Heatwave	0	0	0	0	0	0	0	Low	
Drought	1	0	0	0	0	0	0	Low	

	Table 4: Ri	isk assessme	ent matrix of	Panhala I	Fort
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Natural hazard										
				Severity = (mag	gnitude - mitigat	tion)				
Event	Probability	Human	Property	Business	Prepared	Internal	External	1		
	Likelihood this will occur	Impact Possibility of death or injury	Impact Physical losses and damages	Impact Interruption of services	ness Preplanning	response Time, effectiveness, resources	response Community/ mutual aid staff and supplies	Risk category		
Score	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = low 2 = moderate 3 = high	0 = n/a 1 = high 2 = moderate 3 = low or none	0 = n/a 1 = high 2 = moderate 3 = low or none	0 = n/a 1 = high 2 = moderate 3 = low or none			
Wildfire	3	1	1	1	0	0	0	Low		
Epidemic	2	2	1	1	1	1	2			
Cloud burst	2	2	2	1	2	2	1	Medium		
Lightning	2	1	1	1	2	2	1			
Pest attack	0	0	0	0	0	0	0	Low		
Hailstorm	2	2	3	0	0	0	0	Low		
Wild animal attack	0	3	3	3	2	2	1	Low		
			Techno	oqical haza	rd					
Electrical Failure	2	3	0	1	1	1	1	Medium		
Transportation Failure	2	0	0	0	1	1	1	Low		
Communications Failure	0	0	0	0	1	1	1	Low		
Information Systems Failure	0	0	0	0	1	1	1	Low		
Fire	3	2	2	1	1	1	2	High		
Structural Damage	3	1	1	2	1	1	1	Medium		
2 4			Hum	an hazard						
Stampede	0	1	1	1	1	1	1	Low		
Drowning	0	3	0	1	1	1	1	Low		
Mass Casualty Incident (trauma)	0	2	2	2	1	1	1	Low		
Terrorism	0	0	0	0	0	0	0	Low		
VIP Situation	0	1	1	1	0	0	0	Low		
Hostage Situation	0	0	0	0	0	0	0	Low		
Civil Disturbance	0	1	1	1	1	1	1	Low		
Missing Resident	0	0	0	0	0	0	0	Low		
Bomb Threat	0	0	0	0	0	0	0	Low		

3.3.1. Natural Hazards

Landslides: Landslides are marked as high risk. Given the fort's hilltop location, landslides are a likely hazard, particularly during heavy rains. These hazards pose significant threats to human life, property, and business operations. It has moderate to high impact scores in human and property impact, suggesting that the fort's location or regional weather patterns make it susceptible to landslides. Preparedness and internal response are also rated moderately, indicating that response mechanisms may not be fully developed or effective.

Lightning, Cloud burst and Cyclone: With a moderate score, Lightning, Cloud burst, and Cyclone are a medium risk. Preparedness seems moderate, but the external response capacity is low, possibly due to geographical isolation.

Low-Risk Hazards: Hazards such as heatwaves, droughts, wildfires, and pest attacks are categorized as low risk. These events are less likely to affect the fort, given its geographical and environmental context, but preparedness and response measures for these risks should still be in place for potential worst-case scenarios.

3.3.2. Technological Hazards

Electrical Failures: Electrical failure is marked as medium risk, primarily due to the moderate preparedness and internal response scores. In historical sites like Panhala Fort, technological infrastructure, especially power lines and internal wiring, may not be up to modern standards, which increases vulnerability to electrical issues.

Fire: It stands out as a high-risk hazard, reflecting the absence or insufficiency of fire suppression and detection systems. This suggests an urgent need to upgrade fire safety systems, given the fort's historical value and vulnerability to fire outbreaks, which could cause significant damage.

Structural Damage: This hazard also carries a medium risk and is of particular concern for Panhala Fort due to the aging structure of the fortifications. A moderate score in property impact and preparedness points to the need for regular assessments and restoration work to prevent structural failures.

3.3.3. Human Hazards

Most human hazards, such as stampede, drowning, mass casualty, terrorism, hostage situations, and others, are marked as low risk. However, this does not eliminate their potential threat, especially during high tourist seasons or special events. The probability of incidents like mass casualties and trauma is low, but a moderate score in preparedness and response systems indicates a need for the fort to maintain well-trained personnel and emergency procedures in place.

Bomb Threat and Terrorism: These are marked with the lowest scores in probability, but given the fort's historical and cultural significance, a proactive security system (including surveillance and threat assessment protocols) should be in place.

3.3.4. Key Observations

- The most pressing risks are Landslide, fire, and structural damage. These high and medium risks highlight gaps in both preparedness and internal/external response.
- Across various hazards, the preparedness scores are generally in the moderate to low range. This shows that while some initial safety protocols might be in place, they are either outdated or insufficient to fully protect against certain risks, particularly fire and structural damage.
- The external response score is consistently low across all hazards, especially in technological and human hazards. This suggests the fort's reliance on external agencies (municipalities, fire services, etc.) might be delayed or inadequate during emergencies. Strengthening partnerships with emergency services could improve this.
- The fort's internal response mechanisms (such as manual security backups or emergency response teams) need strengthening, as the response to natural and human-induced hazards shows room for improvement.

3.4. Vulnerability Assessment

The vulnerability assessment of Panhala Fort, as depicted in Table 4 and Table 5, outlines various critical areas requiring attention to mitigate risks. Structural elements are highlighted as being susceptible to damage, particularly during emergencies, which necessitates regular inspections and reinforcement. The fort's layout and high-risk areas, such as those prone to overcrowding or difficult evacuation, need clear signage and designated evacuation routes. Electrical systems and drainage are noted as vulnerable, with recommendations for maintenance and upgrading to prevent failure during emergencies. Other issues, such as inadequate emergency lighting, insufficient access policies for restricted areas, and the lack of emergency supplies, further emphasize the need for improvements in infrastructure. Effective pest control, maintaining appropriate humidity levels, and managing vegetation are also critical to preserving the fort's structural integrity and preventing further deterioration. Collectively, these findings call for a comprehensive planning to enhance preparedness, ensure visitor safety, and protect the fort's historical value.

Category	Issue	Details	Action Needed
Structural Distress	Old heritage buildings showing distress	Examples include Naukhinicha Sajja and some bastions.	Structural repairs needed
Building Layout	Accessibility during emergencies is difficult	Populated regions like Machli Galli have poor accessibility during emergencies.	Improve emergency access
	Monitoring of all areas not an issue	Height regulations minimize monitoring difficulties.	No action required
High-Risk Areas	Buildings near fortification wall at risk	Landslides pose a danger to buildings near fort walls.	Reinforce and protect vulnerable buildings
Low-lying Areas	Soil saturation at Panhala	Mainly during the rainy season, the soil at Panhala is prone to saturation.	Monitor and improve drainage systems
Electrical Systems	Outdated and exposed systems	30-40% of the Distribution Panels (DPs) are outdated and need to be replaced.	Upgrade electrical systems
	Poor roof and terrace drainage	Inadequate maintenance of drainage from roofs and terraces.	Improve drainage maintenance
Drainage	Historical drainage outlets not functioning	Non-functioning drainage systems across the fort contribute to landslides.	Research and restore historical drainage
Sewage Systems	Outdated and not implemented	Development plans are ready, but land issues prevent implementation.	Resolve land issues and implement sewage plan
Ventilation	Adequate natural and mechanical ventilation	Both natural and mechanical ventilation systems are adequate.	No action required
Humidity & Temperature	Excessive humidity in the museum	Humidity is a problem in all areas of the museum.	Implement humidity control
Pest Control	Pest control procedures not implemented	Pest control is not consistently implemented in certain areas.	Regular pest control procedures needed
Lighting	Adequate lighting arrester is not installed	Lighting arresters are considered as not sufficient.	Identification of vulnerable buildings and installed adequate lightning arresters
Signage	Adequate signage for visitors	Signage is considered sufficient for visitors.	No action required

Table 5: Buildings	, surroundings and	infrastructure	vulnerability
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Category	Issue	Details	Action Needed
Access Points	Compliant with codes	Access points adhere to building codes.	No action required
Emergency Access	No blocked or unreachable exits	Access and exits are not blocked or unreachable.	No action required
Security of Restricted Areas	No risk of tampering with restricted areas	Access to restricted areas is not a concern.	No action required
Security Staff	Insufficient security systems in place	A dedicated security system is needed, though current staff is adequate.	Implement a dedicated security system
Managerial Staff	Adequate managerial staffing	The current level of managerial staff is deemed sufficient.	No action required

Table 6: Visitor management, security system and infrastructure vulnerability

Category	Issues	Details	Action Needed
	Security Staff	Inadequate training and no dedicated security system	Implement dedicated security system and train staff
	Managerial Staff	Sufficient staff from local municipal council are available	No action needed
Visitor Management and Security System	Automated Security System	Lack of automated security systems	Install modern security mechanisms (CCTVs, Public Addressing System, Siren)
	Chain of Command for Fort Operations	There is no chain of command exist at Panhala fort	Established a systematic chain of command mechanism
	Backup Systems	No manual backup for security in emergencies	Establish manual backup system
	Emergency Protocol	No established emergency response protocol	Create and document emergency protocol
Critical Infrastructure	Emergency Contacts	Emergency contacts list exists but not regularly updated	Ensure list is updated and easily accessible
	Staff Verification	No database for staff background verification	Implement staff background verification system
	Fire Detection and Suppression Systems	No fire detection or suppression systems available in most of the buildings	Install fire detection and suppression systems at critical buildings

Category	Issues	Details	Action Needed
	Evacuation Plan and Routes	No evacuation plan or displayed evacuation routes	Develop and display evacuation routes generally at most crowed areas
	Emergency Elevators and Fire Stairways	Emergency elevators and fire stairways don't meet codes	Upgrade stairways and elevators to meet safety standards
	Emergency Supplies	No emergency supplies available	Provide necessary emergency supplies
	Infrastructure Monitoring	Critical infrastructure not regularly checked or monitored	Appoint dedicated officials for regularly monitor and maintain infrastructure

3.4.1. Key Suggestions:

- Detect early signs of structural weakness or damage.
- Strengthen the fort's structure against mild earthquakes.
- Reduce the impact of human activity in the fort.
- Prevent damage from roots weakening the structure.
- Establish protocols for landslides and floods.
- Implement a dedicated and automated security system and ensure security staff are properly trained.
- Establish a clear emergency response protocol and manual security backups.
- Create a database for staff verification and maintain a regularly updated list of emergency contacts.
- Install fire detection and suppression systems across all required buildings.
- Develop a formal evacuation plan and ensure evacuation routes are clearly displayed.
- Upgrade fire stairways, doors, and emergency elevators to meet code standards.
- Regularly check and monitor critical infrastructure to prevent safety lapses.

3.5. Capacity

The fort is equipped with basic search and rescue tools to manage disasters (Table 6), but these are inadequate to establish strong disaster resilience. Developing advanced disaster monitoring and early warning systems, along with effective warning dissemination and preparedness drills, would significantly improve its overall disaster resilience.

Sr. No	Item	Qty
1.	Fire Water Tender Truck	1
2.	Water Mist Motor Bike (Bullet Bike)	1

Table 7: List of search and rescue equipment at Panhala Fort

Sr. No	Item	Qty
3.	Fire Rescue Cylinder Mounted Motor Bike (Bullet Bike)	1
4.	Backpack Extinguishing Device	1
5.	Automatic Fire RID	5
6.	Emergency Tower Light	1
7.	Smoke Exhauster	1
8.	Fire Extinguisher- Water CO2- 9 Itr	6
9.	Fire Extinguisher- Mechanical Foam- 9 Itr	6
10.	Fire Extinguisher- ABC Type -9 ltr	6
11.	Snake Catcher Stick and Carrying Bag	2
12.	Conical Traffic Cone 3 Feet height	10
13.	Hydraulic Wedge Jack	1
14.	Helmet Sikandar Type	10
15.	Rubber Knee and Ankle (Gum) Boots	10
16.	Carbide tipped blade Chain Saw	1
17.	Hand Torch - 2 Km Range	5
18.	Fire Hand Gloves - Basic	10
19.	Electric Spanner Gun - 220 V	1
20.	Spanner Set	1
21.	Fire Ball	10
22.	Portable Fire Pump (Petrol)	1
23.	Vehicle Search Light	1
24.	Tower Ladder 2 Section	1
25.	Fire Blanket	2
26.	Life Ring	4
27.	Scoop Stretcher	1
28.	Safeguard	4
29.	Bobster as per BSF Ballistic Goggles	2
30.	Life Jacket	4

4. Measures for Disaster Risk Prevention, Reduction and Mitigation

4.1. Building and environment stabilization

- Disaster Response Team (DRT) will coordinate with facility services and maintenance staff to assess the damage caused by any disaster (fire, flood, landslide or other disaster).
- Professional restoration services, especially those provided through insurance, should be involved under the supervision of the DRT. Insurance adjusters should also be a part of the review process.
- Designated staff from the fort conservation team will be responsible for documenting damage to the fort's structures.
- Documentation will include thorough photographic and video evidence, with written records detailing the impact on walls, gates, pathways, artifacts, and other structural elements.
- Use standard forms to record damages, such as a Post Disaster Need Assessment form.
- After controlling the disaster, prompt action should be taken to limit environmental damage.
- Water or moisture damage (from heavy rains or floods) should be addressed by:
 - Removing any standing water through mopping or pumping.
 - Removing wet debris or carpets.
 - Placing dehumidifiers and fans in affected areas to stabilize humidity.
- Aim to restore conditions to normal seasonal levels for humidity and temperature. If this is not possible due to the disaster's scale, focus on lowering humidity and temperature to slow down the development of mold, wood distortion, and corrosion.
- If the fort's security system is compromised, especially electronic systems, temporary increased security may be necessary. This is crucial to protect the fort from theft, vandalism, or unauthorized access.
- Coordination with disaster response team (DRT) will help ensure the fort's artifacts and structure are protected.
- Consider sealing off damaged areas or installing temporary surveillance cameras as necessary.
- Access to the damaged areas will be limited to authorized personnel, including fort staff, volunteers, restoration experts, and service providers.
- The Facility lead will monitor and control site access to avoid unnecessary disturbance or further damage.
- All entry points should be sealed to prevent biological infestations, especially in areas weakened by structural damage.
- Staff and workers should be trained to identify and report any signs of mold, insect infestations, or rodent activity. Immediate steps should be taken to quarantine affected areas or objects to prevent contamination.

4.2. Other Prevention Measure

- Continuous update and conduct micro level risk assessments and hazard mapping specific to Panhala Fort to identify vulnerable areas within the fort, such as weak walls, gates, and areas prone to landslides, flood, earthquake, erosion, etc.
- Update and Map out natural disaster risks like earthquakes, landslides, and flooding that could impact the fort's structure and surrounding environment.
- Establish an effective early warning system for potential natural disasters, such as landslides, floods or cyclones, to alert local authorities, fort staff, and visitors in advance.
- Coordinate with DDMA, SDMA, MAHAVED, MAHARAIN, IMD and GSI to receive timely warnings/updates on possible disasters.
- Review and implement strict building regulations specifically designed for the conservation of heritage structures like Panhala Fort.
- Regularly assess the fort's structural integrity and carry out necessary retrofitting, repairs, and reinforcements to prevent collapse during natural disasters.
- Invest in resilient infrastructure around the fort, including stormwater drainage systems, retaining walls, and flood barriers to protect against water damage.
- Ensure that walking paths, access roads, and visitor facilities are constructed with disaster resilience in mind.
- Implement sustainable land management practices around the fort to reduce risks like landslides and soil erosion.
- Conduct reforestation activities and promote vegetation in the surrounding areas to stabilize soil and reduce the risk of landslides.
- Prevent illegal activities, such as deforestation, which could weaken the fort's surrounding ecosystem.
- Organize regular awareness campaigns, drills and exercises for local residents, visitors, and staff on the risks of natural disasters and how to respond during emergencies.
- Provide capacity-building programs for local authorities, fort staff, and nearby communities to ensure they are trained in disaster preparedness, response, and evacuation protocols.
- Update fort disaster management plan every two years, and if necessary, modify roles and responsibilities for fort staff, local authorities, emergency services, and other stakeholders.
- Establish clear evacuation routes and safe zones for visitors in case of an emergency with the consultation of Archology department, Tourism Department, Fire Department, and PWD.
- Ensure communication protocols are followed to coordinate disaster responses efficiently.
- Strengthen vulnerable sections of the fort through retrofitting and reinforcement, particularly the walls, gates, and older structures prone to collapse.
- Facilitate partnerships and collaborations between government agencies, heritage conservation organizations, non-governmental organizations (NGOs), and local communities to ensure a unified disaster prevention approach.
- Engage with private sector entities for funding and support in implementing disaster prevention infrastructure.

- Regularly monitor and evaluate the effectiveness of the fort's disaster prevention measures, including structural health, early warning systems, and community preparedness.
- Update risk assessments and disaster management strategies based on new research, lessons learned from disaster or drills, and changing environmental conditions.

4.3. Disaster Specific Mitigation measure

4.3.1. Landslide

Panhala Fort, situated in the hilly terrains of Maharashtra, is prone to landslides due to its geographical location and seasonal heavy rainfall. To mitigate the risk of landslides and protect the fort's historical structures and surrounding areas, the following measures should be implemented:

Structural Measure

- Stabilize vulnerable slopes using engineering solutions such as retaining walls, terracing, and gabions to prevent soil erosion and landslides.
- Promote the growth of deep-rooted vegetation on slopes to enhance soil stability. Native plants and trees can help reduce soil erosion and improve slope resistance to rainfall.
- Install or improve drainage systems around the fort to ensure proper water management during heavy rains. Proper drainage channels will prevent water accumulation on slopes and reduce the chances of landslides caused by soil saturation.
- In areas where there is a high risk of rockfalls, install protective nets or fences to prevent falling debris from damaging the fort's structures or endangering visitors.
- Retrofit and reinforce walls, gates, and other key structures of the fort that could be affected by landslides. Ensure that the foundations of these structures are stable and able to withstand ground movement.
- Construct protective barriers or buffer zones in critical areas where landslides or debris flows could impact the fort's structures or pathways.

Non-Structural Measure

- Conduct detailed geotechnical studies to assess soil stability, slope angle, and geological conditions around the fort. Identify areas with weak soil, rock formations, and high-risk zones for landslides.
- Develop a micro level landslide hazard map for Panhala Fort, highlighting vulnerable areas, potential landslide-prone slopes, and critical zones for intervention.
- Implement a real-time landslide monitoring and early warning system using sensors and remote monitoring techniques. These systems can detect ground movements, soil moisture levels, and other indicators of an impending landslide.
- Work with local meteorological agencies (MAHAVED, MAHARAIN, IMD) to receive timely weather updates, allowing authorities to take precautionary actions during periods of heavy rainfall or storm activity.
- Enforce strict land use regulations to restrict construction or development in landslide-prone areas around the fort. Discourage any activities that may destabilize slopes, such as deforestation.
- Update and enforce building codes that include landslide-resistant construction practices, particularly for new buildings, roads, and other infrastructure near the fort.

- Conduct awareness campaigns for fort staff, local residents, and visitors to educate them about the risks of landslides and the importance of maintaining natural landscapes.
- Train local authorities, fort staff, and community members in landslide preparedness, emergency response, and evacuation procedures to ensure timely and effective action in case of a landslide.
- Identify and maintain safe evacuation routes from the fort and surrounding areas in case of a landslide.
 Clearly mark these routes and ensure they are accessible during emergencies.
- Conduct regular inspections of slopes, retaining walls, and drainage systems to ensure they are functioning effectively. Identify any new areas of concern and address them promptly to prevent landslide-triggering conditions.
- Monitor environmental changes, including deforestation, soil erosion, and changes in land use that may increase landslide risks. Take proactive measures to address these concerns.
- Collaborate with geologists, civil engineers, environmental scientists, and local government authorities to design and implement effective landslide mitigation strategies.
- Engage non-governmental organizations (NGOs) and local communities in the implementation of landslide mitigation measures, such as reforestation projects and slope monitoring programs.

4.3.2. Wildfire

Wildfires pose a significant risk to heritage sites like Panhala Fort, especially during dry seasons. Given the historical and cultural value of the fort, it is essential to implement comprehensive wildfire mitigation measures to protect the site, its surrounding environment, and visitors.

Structural Measure

- Establish firebreaks (clear zones) around the fort to act as a barrier against approaching wildfires.
 These can be strips of land cleared of vegetation that prevent the fire from spreading toward the fort.
- Where feasible, build fire-resistant barriers, walls, or fences around critical sections of the fort to shield it from fire or flying embers.
- Retrofit existing fort structures using fire-resistant materials. Apply fire-retardant coatings to wooden elements and ensure that roofs and gates are made of non-combustible materials such as metal or stone.
- Use fireproof storage for valuable historical artifacts or documents kept within the fort premises. Ensure that critical heritage elements are protected against both direct fire and smoke damage.

Non-Structural Measure

- Regularly clear dry grass, brush, and dead vegetation around the fort to reduce the risk of fire spread.
 Create a defensible space of at least 30-50 meters around the fort by removing potential fuel.
- Plant fire-resistant native species around the fort. These species should be less prone to ignition and help slow the spread of fire.
- Install wildfire detection and monitoring systems, such as infrared cameras, sensors, or drones, to detect heat, smoke, or flames in the surrounding forests or hills.
- Implement weather stations to monitor dry and windy conditions that can increase fire risk. Coordinate with local meteorological agencies to receive timely alerts on wildfire risks during dry seasons.
- Set up water storage tanks or reservoirs within and around the fort. Install an automated sprinkler system for fire suppression, particularly near vulnerable structures.

- Ensure that firefighting equipment, such as hoses, extinguishers, and water pumps, are available at key points around the fort. Train fort staff in using this equipment for emergency response.
- Establish a designated area for aerial firefighting support, such as a helipad or water source that can be used by helicopters for aerial water drops.
- Clearly mark and maintain safe evacuation routes for fort staff, visitors, and nearby communities.
 Ensure that these routes are free of vegetation and can be accessed quickly during an emergency.
- Conduct regular wildfire response drills for fort staff, local authorities, and visitors to ensure that all parties are aware of evacuation procedures and fire safety protocols.
- Set up an emergency communication system (e.g., loudspeakers, sirens, or mobile alerts) to quickly notify visitors and staff of a wildfire threat.
- Establish partnerships with local fire departments, forest services, and disaster management authorities for rapid response and resource sharing during wildfire events.
- Collaborate with wildfire experts and environmental agencies to conduct regular wildfire risk assessments. Use these assessments to refine and update the fort's wildfire mitigation and emergency plans.
- Raise awareness among local communities, visitors, and fort staff about wildfire risks, prevention, and response protocols. Conduct educational programs on how to avoid fire hazards (e.g., no smoking, no open flames) and report fires.
- Engage local communities in Firewatch programs, particularly during high-risk seasons. Volunteers can assist with fire lookout duties and report potential fire threats early.
- Ensure that access roads to and from the fort are fire-resistant and well-maintained. Clear flammable debris from these roads and create buffer zones along access routes.
- Ensure that any power lines running through the area are well-maintained, free from encroaching vegetation, and fire-resistant to reduce the risk of electrical sparks causing wildfires.
- Implement sustainable land use practices in surrounding areas, including afforestation with fireresistant trees and controlled grazing to reduce the accumulation of dry grass.
- After a fire, implement erosion control measures to prevent soil erosion, which could compromise the fort's structural stability in the long term. This can be achieved through replanting trees and installing barriers.

4.3.3. Flood

Flooding poses a significant risk to the structural integrity and cultural heritage of Panhala Fort. To effectively manage and mitigate this risk, the following comprehensive mitigation measures should be implemented:

Structural Measures

- Strengthen existing structures, including walls and gates, to withstand floodwaters. This may involve reinforcing foundations and using water-resistant materials for repairs.
- Invest in efficient water drainage systems around the fort to facilitate the quick removal of excess water during heavy rains. This includes regular maintenance of existing drainage to prevent blockages.
- Construct temporary or permanent flood barriers or levees around the fort to redirect or block floodwaters, particularly in areas prone to heavy rainfall or runoff.

Non-Structural Measures

- Conduct detailed flood risk assessments to identify areas of the fort and its surroundings that are most vulnerable to flooding.
- Develop a flood hazard map that highlights potential flood zones based on historical data and future projections.
- Implement strict land use planning regulations in and around the fort to prevent construction in floodprone areas. Encourage the preservation of natural landscapes that can absorb rainwater.
- Establish and enforce building codes that require flood-resistant construction techniques for any new structures or renovations in the fort and surrounding areas.
- Provide guidelines for local communities regarding flood preparedness and the importance of maintaining green spaces that can help absorb rainwater.
- Set up an early warning system to provide timely alerts about potential flooding, utilizing local meteorological data and community input to predict extreme weather events.
- Ensure that alerts are communicated effectively to fort staff, local community, and visitors to facilitate timely evacuations and preparations.
- Conduct awareness campaigns for fort staff, local community, and visitors about flood risks and preparedness measures. Provide training on evacuation procedures and emergency response.
- Establish clear evacuation routes and safe zones within the fort and nearby areas for visitors and staff in case of flooding.
- Facilitate partnerships between government agencies, NGOs, community groups, and academic institutions to collaboratively address flood risks and improve resilience.

4.3.4. Earthquake

Given the historical and cultural significance of Panhala Fort, it is critical to protect it from the potential impact of earthquakes. The following earthquake mitigation measures can help preserve the fort's structure and ensure the safety of visitors and staff:

Structural Measures

- Conduct micro-zonation study and create seismic map in earthquake prone location.
- Identify the vulnerable structure
- Adopt the building code and suggestion given by the micro- zonation study and properly designed, engineered and constructed structures — residential, service or infrastructure — built on well tested soil for adapting to suitable adjustments in design.
- Retrofitting old structures so that shortcomings in construction could be externally strengthened to a considerable extent to withstand the convulsions caused by earthquake.

Non-Structural Measures

- For getting the structural measures implemented with due earnestness, honesty of purpose and sense of compulsion host of non-structural measures in the form of policies guidelines and training have to be provided.
- Policy decisions about construction of structures with due approval from specified authorities have to be taken. The building codes etc have to be suitably formulated/amended and appropriately detailed and legal implications properly stated.

- Guidelines both for earthquake-resistant constructions as well as for retrofitting have to be formulated with specifications about site selection, foundation, construction, materials and workmanship making involvement of specialist architects, trained engineer and masons mandatory.
- The guidelines have to be formulated for the concerned authorities about land use planning, monitoring of construction work and controlling of settlements in hazard prone areas to avoid fatalities and loss of property.

Mitigation Strategy

- The desired implementation of mitigation measures requires a well-thought-out strategy. Implementation of mitigation measures, therefore, has to be multi-pronged: adoption wise attractive and cost wise comfortable.
- The Strategy for mitigation measures for the typical effects of earthquake involves.
- Awareness generation among the fort staff, visitors and local community about what details to look for or insist upon about the building, household fittings and equipment, in the houses they own or intend to purchase.
- Awareness among the stakeholders about the need to build/rebuild earthquake resistant houses/structures and keeping safe neighborhood.
- Capacity building of Architects/Engineers/Builders and even masons for construction of earthquake resistant houses/structures.
- Formulation of suitable building bye laws in fort or nearby areas and enforcement thereof.

4.3.5. Fire

Panhala Fort is an important historical monument that needs protection from the risk of fire, whether caused by natural factors or human activity. Given the fort's cultural and architectural significance, fire mitigation measures must be both preventive and responsive, aiming to protect the structure and ensure visitor safety.

Structural Measure

- Retrofit historic structures with fire-resistant materials where possible, without compromising the fort's heritage value. This includes using fire-retardant coatings on wooden elements, roofs, and doors.
- Store important historical artifacts and documents in fire-resistant storage areas or containers to protect them from fire damage.
- Install fire dampers in chimneys, vent systems, and other openings to prevent the spread of fire between different areas of the fort.
- Install water storage tanks and fire hydrants around the fort to ensure an adequate water supply for firefighting. Ensure that the water pressure is sufficient for fire suppression activities.
- Deploy closed-circuit cameras with fire-detection capabilities around the fort to monitor high-risk areas continuously.
- Place fire extinguishers at easily accessible locations throughout the fort, especially near wooden structures and entry points.
- Where feasible, install automated fire sprinkler systems in vulnerable areas of the fort to extinguish fires at an early stage.

Non-Structural Measure

- Conduct a detailed fire risk assessment to identify vulnerable areas within the fort, such as wooden structures, storage areas for artifacts, and places with dense vegetation.
- Create a fire hazard map of the fort and surrounding areas, identifying high-risk zones where the likelihood of fire ignition or spread is greater. This map will guide preventive actions.
- Regularly clear dry leaves, grass, and other flammable debris from around the fort, particularly near fort walls and gates. Maintain a defensible space around the fort to act as a firebreak.
- Install smoke detectors and heat sensors in key areas/buildings of the fort to detect fires early. These systems should be linked to a Fort Disaster Management plan to alert authorities and staff.
- Develop detailed evacuation plans for fort staff, visitors, and local communities. These should include clearly marked escape routes and safe assembly points away from potential fire hazards.
- Conduct regular fire drills to ensure staff and visitors are familiar with evacuation procedures. Include scenarios where access points are blocked to test the effectiveness of alternate routes.
- Set up well-equipped first-aid stations within the fort and train staff in basic fire emergency medical care.
- Conduct fire safety awareness campaigns for local communities, fort staff, and visitors. Educate them about the risks of fire and the importance of not engaging in hazardous activities like smoking or starting campfires near the fort.
- Train all fort staff in fire prevention, detection, and emergency response procedures. Ensure that they know how to operate firefighting equipment and how to safely evacuate visitors.
- Maintain clear, accessible roads leading to and from the fort for fire trucks and emergency vehicles. Ensure that these routes are wide enough for emergency services to access quickly during a fire.
- If feasible, establish a helipad or an area accessible to aerial firefighting units to facilitate rapid water drops or fire suppressant releases.
- Prohibit the use of open flames (e.g., bonfires, candles, cooking fires) within and around the fort unless in designated, controlled areas.
- Designate the entire fort and its surrounding areas as a no-smoking zone. Place clear signage to inform visitors of the fire risk associated with smoking.
- Implement strict controls or bans on fireworks and celebratory events involving fire near the fort, particularly during dry seasons.

5. **Planning for Emergency Preparedness and Disaster Response**

5.1. Planning for Evacuation and Emergency Response

In the case of a fire or other imminent threat to human safety, begin evacuation procedures as outlined in the Fire and Evacuation manual immediately. Follow instructions provided by the Chief Fire Officer.

In the case of a fire, activate the nearest fire alarm and evacuate the building. Gather at an outdoor Muster Point. Do not use elevators. Close doors and windows as you go. Do not open doors that are hot to the touch or take an alternate route if you encounter smoke. Stay low to the ground if there is smoke present. Use fire extinguishers only if the fire is small and it is safe to do so, or if it is required to clear a route out of the area. Call 101. Alert authorities of

- the nature of fire.
- the location of the fire.

- your name.
- any other relevant information

In all other situations, an evacuation can be ordered by PFEOC or the DRT.

Means of egress and Muster Points are clearly marked and should be used as learned in training and indicated on maps and signs.

In the case of a smaller scale emergency, where it is safe for staff to stay and initiate an emergency response, the DRT should determine if the public only should be evacuated from all or part of the fort.

The DRT should consider

- the possibility of a situation becoming dangerous for the public.
- the need for staff to focus on an emergency.
- the safety of visitors, and especially minors or disable person, if they were evacuated from the building

5.1.1. Evacuation

A well-structured disaster evacuation plan is essential for ensuring the safety of visitors, staff, and the local community at Panhala Fort during an emergency such as a fire, landslide, flood, or earthquake. This plan outlines the steps to safely evacuate people while minimizing confusion and panic, ensuring clear communication, and providing a safe and secure evacuation route.

5.1.2. Key Roles and Responsibilities

Facility lead: Coordinates all evacuation activities, including communication, crowd control, and liaison with local authorities.

Security Personnel: Assist in guiding visitors along safe evacuation routes, ensuring crowd control, and securing exits.

Staff Members: Assist in directing visitors to evacuation routes, providing first aid, and helping individuals with special needs.

Chief Medical Officer: Provide medical assistance and handle any injuries that may occur during the evacuation process.

5.1.3. Evacuation Routes and Safe Zones

- Clearly marked paths leading to designated safe zones outside the fort. These routes will be highlighted on maps available at entry points, information booths, and strategic locations throughout the fort.
- Open areas away from potential hazards such as steep cliffs, historical structures, or dense forests. These areas should be capable of accommodating large groups of people and providing basic shelter and first aid.
- Alternate routes in case primary exits are blocked or unsafe due to the nature of the disaster. These routes will be identified and regularly updated based on disaster risk assessments.

5.1.4. Evacuation Communication Systems

Facility lead will install a loudspeaker system throughout the fort to communicate evacuation instructions in multiple languages (Marathi, Hindi, English). Regularly maintained and tested.

- Audible alarms to signal evacuation, with different alarm tones for different types of disasters.
- DEOC will prepare an SMS-based alert system to send real-time notifications to visitors and staff regarding the evacuation process.
- The facility lead will ensure the availability of walkie-talkies and handheld radios and distribution to key staff to ensure seamless communication during the evacuation process.

5.1.5. Visitor and Staff Evacuation Procedures

- Upon arrival, all visitors should be informed about evacuation procedures through signage, digital displays, and brochures.
- Visitors should follow the instructions of staff and security personnel during the evacuation.
- Individuals with mobility issues, elderly, and children will be given priority assistance.
- Staff members will be assigned specific roles, including guiding visitors to exits, assisting people with disabilities, and maintaining order.
- Staff should be familiar with all evacuation routes and designated safe zones.

5.1.6. Evacuation Protocols

- Once everyone has been evacuated, conduct a final headcount at the safe zones to ensure all visitors, staff, and personnel have safely exited the fort.
- After the disaster has been resolved, the fort should only be re-opened once authorities have deemed it safe. This includes conducting safety inspections and repairs where necessary.
- After the evacuation, provide counseling and support services for those affected, especially if the disaster has resulted in injuries or emotional trauma.
- The Facility lead will collaborate with local DEOC, fire services, police, and medical teams to ensure a coordinated response.
- Ensure emergency vehicles have clear access to the fort through pre-designated routes.
- Keep the local community informed of evacuation plans, especially if the fort's evacuation could affect nearby villages or settlements.

5.1.7. Others

- Regular evacuation drills should be conducted for staff and visitors to familiarize everyone with evacuation routes and procedures.
- Staff should be trained to handle emergencies, administer first aid, and guide individuals with special needs.
- Staff and security personnel should be trained to assist individuals with mobility impairments, ensuring they are evacuated quickly and safely.
- Assign specific staff members or volunteers to assist the elderly, children, or other vulnerable visitors who may require additional assistance.
- Facility lead/ alternate should keep a record of all individuals (staff and visitors) who have been safely evacuated and those who may still be inside.
- Conduct headcounts at safe zones to ensure everyone has safely exited the fort. This will be crossreferenced with the visitor tracking system.

- Restrict access to evacuated areas during a disaster. Only authorized personnel (DRT, Police, Fire man, and medical teams) should be allowed to enter high-risk zones.
- Security personnel should guide people away from disaster-prone areas and ensure that evacuation routes are not overcrowded, preventing stampedes or panic.
- Deploy additional security personnel at entry and exit points to manage traffic and prevent unauthorized access during an evacuation.
- Ensure first-aid stations are well-stocked with medical supplies such as bandages, antiseptics, and oxygen tanks. First-aid kits should be located at safe zones and with key personnel.
- Establish medical response teams to provide immediate assistance during the evacuation. These teams should be stationed at safe zones and along evacuation routes.
- Coordinate with local health center or call 101 to provide transport for seriously injured individuals to nearby hospitals.
- If the disaster occurs during adverse weather conditions (e.g., heavy rain or strong winds), evacuation routes may need to be adjusted accordingly. Ensure that safe zones provide adequate shelter from the elements.
- Panhala Fort has steep slopes and uneven pathways. In such areas, extra staff and resources (e.g., portable lighting, ropes, stretchers) should be available to help navigate these terrains safely.

5.2. Monitoring and Early Warning Systems

- If warning of an oncoming disaster can be obtained, the Fort should take all possible measures to prepare for the expected emergency. Potential situations where warning might be available include wildfires, heavy rainfall, flooding, cyclone, landslide or any other event which allows for some preemptive measures to prepare facilities and collections for an emergency. The following steps should be taken if there is any chance of facilities being affected:
- Put all DRT members and related staff on alert and warn them that their assistance may be required if an emergency should endanger the building or the infrastructure.
- Call in all DRT members to direct efforts to prepare the Fort for an emergency event and ensure that preventive measures are taken.
- Evacuate the building if the emergency will pose a threat to human life or safety.
- Assemble emergency supplies as needed.
- If it is safe to move inside the Fort, set up a schedule of frequent and thorough inspections. This should include a comprehensive survey of the whole Fort to ensure that all systems continue to function properly, and no leakage or damage occurs. Use the Post Disaster Need Assessment (PDNA) form to record any damage.

5.3. Emergency Response Mechanism

In a disaster situation requiring evacuation, follow the Fire and Evacuation Plan developed by the Chief Fire Officer. If it is safe for staff to remain on-site or to return to the site following an evacuation, proceed as below. If at any time the building becomes unsafe, people should be evacuated immediately. At no point should the safety of people be compromised. In the case of a smaller scale emergency, where it is safe for staff to stay and initiate an emergency response, the DRT should determine if the public should be evacuated from all or part of the Fort.

5.3.1. Flood/ Heavy Rain/ Cyclone

In the case of a flood/ heavy rain or cyclone

- Alert the facilities services and maintenance staff.
- Contact all DRT members.
- Monitor emergency alert services on Sachet App, Maharain, Mahaved, Indian Meteorological Department (IMD) portal and the radio.
- Prepare to evacuate; plan the route based on information available and initiate an evacuation if required. If you can, use the PA system to advise people where to gather and what to do.
- Staff should not walk through areas where water has accumulated until it has been deemed safe to do so by a qualified individual. Be aware of electrocution risks.
- Assume flood water contains contaminants and use appropriate Personal Protective Equipment (PPE).
- Locate the source of water and alert facilities services to stop or mitigate the flow of water if possible.
- Move computers and other electronic equipment off the floor and unplug electronic equipment and appliances in susceptible areas.
- Move vital records and archival collections out of low drawers and off of low shelves.
- Move all objects that can be moved off the floor and off of lower shelves.
- If flooding on lower levels is anticipated, move objects and records to a higher level.
- If it is safe to move about the building, initiate regular and thorough building inspection for leaks or damage. Use the PDNA form to record any damage.
- Prepare emergency supplies, Emergency Kits, Search and rescue equipment.

5.3.2. Wildfire

If a wildfire warning is issued,

- Contact all DRT members and establish communication with DEOC and PFEOC.
- Monitor emergency alert services on Sachet App, Indian Meteorological Department (IMD) portal and the radio.
- Notify staff and visitors regarding what action is required. If you are able to, use the PA system to advise people what to do.
- Prepare to evacuate and plan the route based on information available. Initiate an evacuation if required and assemble at Muster Point away from the danger where emergency responders can access evacuees.
- Release staff to secure vulnerable family members if they are under an evacuation alert.
- Close windows and doors.
- If it is safe to do so, evacuate vital records and high priority collection objects.
- Check readiness of battery-powered equipment and backup power sources.
- Turn on interior and exterior lights.

- Turn off exterior air intake.
- Move vulnerable outdoor objects inside if possible.
- Move combustibles away from the building. Consider furniture, landscaping such as woodchips or brushes, fallen leaves or branches, awnings, and banners.
- In a large-scale disaster, only use landlines and cell phones for emergency calls. Text messaging uses less space on the network than voice calls.
- Contact facility services / maintenance staff of Fort.
- Turn off gas.
- Immediately upon an evacuation order being issued, evacuate following directions from emergency authorities.

If you are trapped and unable to evacuate,

- If you can, contact the authorities or call 101 or 1077 so they know where you are and who is with you.
- Stay inside.
- Close but do not lock all windows and doors, and block gaps with damp towels.
- Remove flammable items like blinds, curtains, and awnings from windows, and move furniture that is near windows.
- Keep the lights on.
- Turn on exterior sprinklers to wet roofs, buildings, and grounds.
- Fill buckets and sinks to fight small interior fires.

5.3.3. Cyclone

- Monitor emergency alert services on Sachet App, Maharain, Mahaved, Indian Meteorological Department (IMD) portal and the radio for update and warnings.
- Contact all DERT members.
- Notify staff and visitors if / what action is required.
- If it is unsafe for people to leave the building, initiate shelter-in-place procedures and gather people in a safe interior space, away from windows and other hazards. Advise people to protect themselves beneath stairs or heavy furniture and by covering their neck and head with their arms.
- If it is safe to do so, alert facilities services / maintenance staff for assistance in preventing water pooling on the building and grounds.
- If safe to do so, initiate regular and thorough building inspection for leaks or damage. Use PDNA format to record any damage.
- If the cyclone involves severe winds, particular attention should be paid to trees and structures or furniture surrounding the building to ensure that they are stable and are not in a position to damage the building. If it is safe to do so, list items that should be moved indoors or secured. Close and seal all doors and windows. Monitor all windows for breakage. Windows may need to be boarded. Move valuable objects and people away from areas that might be impacted by falling or flying objects or debris.

If it is safe to do so, locate Emergency Supplies Kits. Prepare additional emergency supplies, including buckets, polyethylene sheeting, mops and towels, Coroplast boxes for relocating affected objects or those which could potentially be harmed.

5.3.4. Landslide

If a landslide warning is issued

- Notify the facilities services, maintenance staff, and the Disaster Response Team (DRT).
- Ensure all DRT members are immediately informed and engaged in the response effort.
- Continuously monitor emergency alert services, including the Sachet App, Indian Meteorological Department (IMD) portal, Maharain, Mahaved, and radio updates for any relevant warnings or advisories.
- Based on the severity of the landslide or the threat of one, prepare to evacuate affected areas.
- Plan the evacuation route considering the terrain and possible hazards.
- Use the PA system to advise visitors and staff on where to gather and what safety protocols to follow.
- Staff and volunteers should avoid walking through areas impacted by landslides or debris until it has been declared safe by a qualified individual.
- Ensure everyone is aware of the risks associated with unstable ground, falling debris, and possible electrocution from damaged infrastructure.
- Use Personal Protective Equipment (PPE) when necessary.
- If possible, work with facilities services to mitigate any further hazards, such as stopping water flows that may contribute to landslides or clearing minor debris to prevent escalation.
- Move vital records, valuable instruments, and electronic equipment away from low-lying areas and off of lower shelves to minimize damage.
- Unplug and move electronic devices to safe areas and secure any valuable equipment.
- If it is safe to move through the building, initiate regular inspections to check for leaks, structural damage, or further risks.
- Use the Post-Disaster Needs Assessment (PDNA) form to record any damage.
- Prepare and distribute emergency supplies, including Emergency Kits and search and rescue equipment.
- Ensure that staff and volunteers have access to first aid supplies and set up a communication center to coordinate the response.
- Continue to monitor weather conditions and geological reports for any signs of further landslide activity.
- Update response and evacuation plans as necessary based on new information and risk assessments.

5.3.5. Explosion / Earthquake

Drop, take cover under large stable furniture, supported door or archways or against an interior wall, cover your head and torso, and hold on. Do not move around. Stay away from windows and shelves.

- If shaking is severe or continuous, and you are able to do so, use the PA system to advise people to drop to their knees, cover their neck and head, take cover under large stable furniture, supported door or archways or against an interior wall, lock wheelchair wheels, and hold on.
- If you smell gas, get out of the building. Otherwise, do not go outside until the shaking or incident has stopped.
- Earthquakes often have secondary effects including aftershocks, fires resulting from gas leaks (also a risk after an explosion), landslides or rock fall. Listen to emergency authorities, get to safety.
- When the shaking has subsided, contact the DRT members to coordinate efforts to ensure human safety and prevent further object damage.
- Put on sturdy shoes and protective clothing to help prevent injury from debris, especially broken glass.
- When the building has been declared safe by authorities, thoroughly inspect all systems and building functions with qualified maintenance personnel to ensure that no damage was incurred or to address any damage that is found. Use the Post-Disaster Needs Assessment (PDNA) form to record any damage.

5.3.6. Bomb threat / Suspicious package

- The person who receives a phone call with a bomb threat should stay calm, be polite, and listen. Try to get as much information about the bomb as possible. Do not interrupt the caller and listen for details in the person's voice or in the background. If possible, initiate a call trace action and signal for a co-worker to call 100. If the call display displays any information, write it down.
- Use the Bomb Threat Telephone Procedures and Checklist and write down as much information as you can remember. Store a copy of this form with reception or anyone who answers general calls from the public.
- If you find a suspicious package, leave the area, take others with you, close the door, and call 100; immediately follow the directions provided by emergency service authorities.
- Do not shake, handle, smell, or taste a suspicious package or letter. If you have handled a suspicious package, wash your hands or shower with soap and water immediately after leaving the area as above. Carefully remove any clothing with powders or liquids on it and seal them in a plastic bag.
- If instructed to do so by emergency service authorities, evacuate the building as per the Fire and Evacuation Plan developed by Chief Fire Officer.

5.3.7. Medical emergency

- If a person is found to be in medical distress, including extreme emotional distress,
- Call 100/1077 and follow directions provided by emergency service authorities.
- Call first aid certified staff / security and alert the DRT.
- Clear the area of the public and, if it is safe to do so, assist first responders or first aid providers as requested. Be respectful of the individual's privacy and the needs of their family members or companions.
- In the case of a pandemic or community-wide outbreak of an infectious disease, contact medical authorities and proceed as instructed. The DRT and / or the Chief Medical Officer may be asked to provide advice to human resources staff regarding instructions to staff about reporting to work. Individuals who know they are contagious or that they have been exposed to an infectious disease should not come to the work site.

 If the incident requires a public statement, initiate procedures as described in Disaster Management Plan.

5.4. Emergency Team / Disaster Response Team (DRT)

All staff are familiar with emergency/disaster planning and their role in its execution, and have the resources, training, and authority to undertake their duties and responsibilities. There is a designated Disaster Response Team (DRT) established to guide the Panhala Fort's actions and response (Fig.9). In the event of an emergency, the key decision maker will be the Response Lead or their designate who will lead the DRT. All staff may be called on to assist in the preparedness, response and recovery effort, often in roles outside of their usual responsibilities.

To facilitate an efficient, organized, and prompt response in the event of an emergency/disaster, individuals have been designated with specific duties and responsibilities for which they will be trained in advance and prepared to undertake. The DRT includes staff in the following roles:



Fig. 9: Structure of Disaster Response Team

5.4.1. Responsibilities

Response lead: [DDMA/DC]

Alternate: [RDC]

Primary area of responsibility: [Management / Response]

The Response Lead

- Takes charge and coordinates emergency response and recovery.
- Declares emergency and implements the [Emergency and Disaster Plan] and evacuation procedures as per the [Fire and Evacuation Procedure].
- Contacts emergency services first responders (fire / police / ambulance).
- Works closely with first responders, team members and third-party contractors, and relays decisions to team members.
- Summons members of the DRT.
- With the Facilities Lead, works to ensure the safety of people and the security and integrity of the building.
- With the Infrastructure Lead and Assistant, works to ensures the safety of the infrastructural damage and vital records.
- With the Staffing Assistant, works to ensure the safety of staff and volunteers who are undertaking to restore operations and protect the infrastructure and assets.
- With the Communications Lead, responds to requests for information and media requests.
- With the Recording Assistant, ensures internal staff and volunteer communication is quick and effective and that records critical to the response are maintained.
- Makes and authorizes all decisions related to administrative and financial matters, in alignment with policy and procedure and in consultation with the [Executive Director and Board, or the appropriate authority] when required (i.e., personnel and administrative records, insurance claims, purchase of emergency supplies, equipment, and services).

Infrastructure Lead: [PWD]

Alternate: [Nagar Parishad]

Primary area of responsibility: [Infrastructure / Insurance / External Resources and Supplies]

The Infrastructure Lead

- Takes charge of structural audit in an advance warning situation.
- Takes charge of all aspects of structural damage.
- Evaluates the Fort environment and, in consultation with the Facilities Lead, determines measures to stabilize it;
- Evaluates damage to the structure and liaises with insurance adjusters.
- liaises with external conservation expertise.

Facilities lead: [District Archaeology]

Alternate: [Tourism Department]

Primary area of responsibility: [Facilities / External Services / Environmental Controls]

The Facilities Lead

- Takes charge of evacuating and securing the building.
- Takes charge of stabilizing and restoring the building.

- Controls access and movement of all personnel in and out of the building.
- Together with the Infrastructure Lead, arranges for safe shelter and work facilities where required.
- Arranges for transportation of tourist for evacuation
- Arranges security services for the response.
- Is knowledgeable about all aspects of building utilities and systems and works with the Infrastructure Lead to manage environmental conditions.
- Obtains and supervises building recovery services and contractors in consultation with the Infrastructure Lead with respect to building safety and environmental controls.
- Maintains copies of detailed and current blueprints and floor plans.

Communications lead: [DEOC]

Alternate: [Police Control Room]

Primary area of responsibility: [External and Internal Communications / Emergency Operations Centre / Media Relations]

The Communications Lead

- Takes charge of communications for the team, the staff, and external support during response / recovery operations.
- liaises with information technology staff to restore and maintain communications technologies and systems as well as access to vital records needed for response and recovery.
- Provides information to relevant levels of stakeholders to aid in the emergency response and recovery.
- Distributes information and responds to media, and if the disaster is large-scale, coordinates media response.
- Monitors news, weather and public services messages, including alert systems and social media notifications to collect information on pending and occurring disasters.
- Coordinates social media messages.
- Handles incoming and outgoing public messages, including calls for volunteers, supplies, and equipment as well as messaging when these needs have been filled.
- With Staffing Assistant, maintains communications among Volunteer Support Team.

Infrastructure assistant: [ZP]

Alternate: [Tehsildar]

Primary area of responsibility: [Infrastructure Stabilization and repair]

The Collections Assistant

- Coordinates the structural assessment, stabilization, and restoration.
- Is responsible for visual (photographic, video recording) and written documentation of damage and records recovery efforts for insurance and evaluation purposes.
- Works with the Infrastructure Lead to ensure safety and precaution related to structural damage.
- Prepares Post Disaster Need Assessment (PDNA) reports.

Staffing assistant: [SDM]

Alternate: [Tehsildar]

Primary area of responsibility: [Human Safety / Emergency Staffing]

The Staffing Assistant

- Always ensures the safety of staff and volunteers during an emergency.
- Ensures appropriate health and safety equipment is available and utilized.
- Attends wellness considerations such as fatigue, mental health, breaks, food, music, rest, and lengths of shifts.
- Liaises with human resources staff on Human Resources Policy and administration matters.
- Ensures staff and volunteers have access to psychological first aid, crisis counselling, or other mental health supports
- In a community-wide disaster, coordinates the dissemination of disaster response information and resources for employees and volunteers whose homes or families have been affected
- Contacts Volunteer Support Team, coordinating with the Communications Lead and the Infrastructure Lead for skilled volunteer services from the fort and archives community.
- Accepts or declines offers of volunteer support based on the fort's needs, each volunteer's skills and training, and health and safety considerations.
- Works with Infrastructure Lead to provide human resources needed for recovery/reconstruction effort.

Recording assistant: [Tourism Department]

Alternate: [Nagar Parishad]

Primary area of responsibility: [Documentation and Internal Communications]

The Recording Assistant

- Attends meetings of the DRT and all other response meetings—including staff and volunteer updates—and records decisions and action items.
- With the Communications Lead, is responsible for internal communication and disseminates information as required to the DRT and staff and volunteers.
- Ensures a photograph and video record of all response efforts is created and maintained and works with the infrastructure Assistant to coordinate the documentation of structural damage.
- Records meetings of the DRT.
- Maintains a document management system to secure and make accessible to the DRT the records associated with the response.

Other responsibilities

The DRT will hold regular meetings to coordinate efforts and make decisions regarding the Fort's disaster preparedness and response. When possible, the key decision points and action items from these meetings will be recorded by the Recording Assistant. In an emergency situation, meetings will be held at least daily. DRT members will serve as team leads for disasters requiring a large-scale response. It is their responsibility to communicate decisions and action planning to their work groups.

- DRT members should be provided with the materials and equipment needed to facilitate communication and emergency responses. In particular, cell phones or walkie talkie should be made available and used. If required, additional fort cell phones or walkie talkie will be secured. DRT members with a Fort issued cell phone should ensure that contacts, alert systems, emergency response apps, and other information that is important in an emergency is stored on the device and, when possible, available without a cellular or Wi-Fi connection.
- In the case of a smaller scale emergency or an emergency localized to a particular area, the DRT may decide to operate with a modified team. This modified team will still ensure that the relevant position functions and plan objectives.

Volunteer support team

- A list of trained volunteers who may be called on in the event of an emergency to assist in recovery and cleanup operations. These volunteers should be included in the appropriate aspects of the Fort's disaster preparedness training/Mock drill.
- Volunteers, along with staff members without assigned duties, will provide assistance in areas determined by the DRT. The Volunteer Support Team will report to the Staffing Assistant.
- Unsolicited volunteer help will be accepted or assigned when their support is both needed and appropriate, and when it is safe to do so according to the direction of the DRT.
- Skilled volunteers from the fort and nearby community will be sought as required to undertake certain aspects of the response and recovery efforts.

5.5. Chain of command

All members of the Disaster Response Team will observe the Chain of Command as follows:

- All staff and volunteers will respond to any instructions or directions given by emergency/disaster service authorities including police, fire, and ambulance personnel.
- In the event of an evacuation, all staff and volunteers will respond to the directions provided by the Chief Fire officer and Fire officer.
- The DRT members (Infrastructure Lead, Facilities Lead, Communications Lead, Infrastructure Assistant, Staffing Assistant, and Recording Assistant) will report to the Response Lead.
- Volunteers and other staff not assigned specific duties will report to the Staffing Assistant, or once specified, their work team Leads.
- In the case of a community-wide disaster, the Response Lead will liaise with the district's Disaster response force as per the district disaster management plan.

5.6. Communicating an emergency / disaster

- A situation is declared an emergency or a disaster by the Response Lead in consultation with the relevant stakeholders. In the absence of the stakeholders, or if they cannot be reached, the Response Lead (or when unavailable, their Alternate) is authorized to declare an emergency and assemble the DRT.
- When a disaster or possible emergency is encountered by any member of the fort's paid or volunteer staff, the Response Lead should be contacted immediately. If the Response Lead is unavailable, any member of the DRT can be notified. If human safety is a concern, call 1077 first.
- When an emergency/disaster requiring full or partial evacuation is encountered, fire alarm and public address (PA) system protocols will be initiated according to the Fire and Evacuation Procedure. All

staff and volunteers will be trained to understand the PA system codes and the procedures that they trigger.

- In the case of a disaster/emergency declared after hours, especially one that causes the Fort to be closed to staff or where staff may be assigned different locations to work or a different role than usual, the following protocol will be initiated:
 - Internal messages will be developed according to the procedure described in the Communications Plan. This may involve the use of holding messages when more details are not available.
 - All staff will be contacted by WhatsApp / video conference / text message / phone / email.
 Staff will be asked to check in with their supervisor by WhatsApp / video conference / text message / phone / email by a specified time. Staff who have not checked in by that time will be contacted directly by their supervisor.
 - Once the emergency response has begun, and depending on their work function, supervisors may be assigned to another member of the DRT for communication purposes and work assignments.
 - If servers are non-functional or internet communication has been disrupted, phone calls will be used instead, and the organizational chart will act as a phone tree to facilitate a prompt process.

5.7. Emergency operations center

The District Emergency Operations Center (DEOC) plays a crucial role in coordinating disaster response and recovery efforts during emergencies at Panhala Fort. When a disaster requires a long-term response or evacuation, the DEOC can be activated to support the Panhala Fort Emergency Operations Center (PFEOC). Key responsibilities of the DEOC include:

- The DEOC serves as a command center, directing response and recovery efforts. It provides a space for meetings and acts as a hub for communication, ensuring all actions are well-coordinated.
- The DEOC stores and distributes necessary supplies and equipment for disaster response, such as search and rescue tools and safety gear.
- The PFEOC ensures the basic needs of response teams, including sanitation, food, rest, and first aid, are met to maintain effective operations.
- DEOC facilitates the use of advanced communication technologies and systems like the Incident Response System (IRS), India Disaster Resource Network (IDRN), and National Disaster Management Information System (NDMIS) to provide timely information and suggestions to the response lead for effective decision-making.
- The DEOC connects various line departments to ensure coordinated efforts across different sectors. It also disseminates warnings and alerts, ensuring all stakeholders are informed about ongoing situations and actions.
- The DEOC provides suggestions and guidance to the response lead to support the implementation of appropriate response and recovery actions based on real-time data and coordination efforts.

5.8. Emergency Response Systems within the Site/Precinct: Automated and Manual

Cultural heritage sites and precincts should be equipped with the following emergency response systems:

- Fire suppression systems that respond to the specific needs of the site or precinct. Fire suppression systems can be automated or manually operated or a combination of both depending on the typology of the site. However, it should be considered that in the case of many cultural heritage sites and precincts, standardized systems of fire suppression may not be compatible with the historic fabric and their installation/ and use may impact the heritage values of the site. Therefore, it is important to understand the material, construction and aesthetic value of the site as well as assess possible ignition sources before setting up a fire suppression system. All staff and management should be regularly trained in the usage of these systems, and these should be easily accessible and regularly serviced and replaced when needed
- Public address systems and provision for wireless communication in case of loss of telephonic networks and communication. This could include walkie-talkies, hand-held radios and intercom systems. Public address systems are particularly useful for large scale sites and heritage precincts with inhabitants.
- Security systems like automated door locking, cut-off for elevators systems and access to potentially hazardous areas within the building, cut-off for electrical supply and water supply systems. Basic physical barriers at entrances and exits, locking systems should be provided in every heritage site in both public spaces as well as storage and archive areas. These should be monitored regularly.
- Emergency lighting and electrical back-up systems that provide public areas with enough lighting in the scenario of a power failure, as well as protection of electrical equipment from power surges and fluctuations other response systems that respond to the specific hazards identified during the risk assessment stage should be incorporated as well. It is important to take the site requirements and limitations into consideration while implementing such systems.

5.9. Emergency Supplies and Equipment

An indicative (not comprehensive) list of emergency supplies and equipment is listed. Temporary salvage of sites may only be undertaken once the emergency has been declared as stabilized and the site is declared safe for re-entry. An assessment of stabilization equipment may be needed for complex sites. Potential suppliers and storehouses for such material can be arranged for, while creating the emergency plan.

For Evacuation of people

- Emergency lights, flashlights
- First aid kits
- Masks
- Wheelchairs and stretchers as needed

For temporary stabilization or salvage of building/site

- Hard hat or helmet
- Safety goggles
- Masks
- Flashlights and Emergency Lamps
- Assorted gloves including standard rubber gloves, acid resistant gloves, heat resistant
- gloves or mitts
- Assessment forms and clipboards with stationery
- Cameras with spare battery packs and spare memory cards
- Caution tape
- Labels and stick-on tags
- Duct tape
- String and Rope
- Basic toolbox
- Basic storage boxes and packing material including water-proof sheeting for temporary
- covering of exposed areas
- Sasic hardware including timber battens, nails, screws, etc. for emergency stabilization

6. Post-disaster Assessment, Planning and Recovery Processes

6.1. Post-Disaster Damage and Needs Assessment (PDNA)

Post-disaster needs assessment is a crucial process conducted in the aftermath of a disaster to evaluate the impact on affected aspects and determine their immediate and long-term needs. This assessment involves gathering comprehensive information about the extent of damage caused by the disaster, including damage to infrastructure, local homes, livelihoods, and social services. Additionally, it identifies the vulnerabilities of the affected population and assesses their capacity to cope with the aftermath of the disaster. The needs assessment findings guide the development of response and recovery strategies, ensuring that assistance is targeted effectively to address the most pressing needs of the affected communities. Moreover, the assessment helps coordinate efforts among various stakeholders, including government agencies, humanitarian organizations, and local communities, to facilitate a comprehensive and coordinated response to the disaster.

6.1.1. Standardized procedures and methodologies

The post-disaster documentation and evaluation process varies based on the disaster's nature and effect on the vicinity. In general, a visual survey of the site/precinct is conducted in the initial stage to inform the subsequent comprehensive surveys and assessments. The visual survey can be a basic checklist to establish that the site/precinct is safe for re-entry and evaluation, or it can be used to determine whether immediate stabilization actions, such as shoring up structural components on the site and creating access through debris clearance, are required.

6.1.2. Key Timeline

The recent advancement in disaster assessment, particularly the adoption of the National Disaster Management Plan, 2016, by the Government of India, in line with the Sendai Framework for DRR (2015-2030), puts greater emphasis on resilient recovery. For resilient recovery, the critical factor is assessing post-disaster damage and needs. The PDNA steps are explained in the PDNA Manual in more detail, but the key steps are presented below (Fig. 10).



Fig. 10: Steps of PDNA as per NDMA

For each of the steps, the critical factor is the timeline. The agreed international methodology based on UN-ECLAC by the UN, EU and WB proposed the following timeline for a comprehensive assessment.

6.1.3. PDNA Timeline

Tumos		Week							
Types	1	2	3	4	4 5 6 7		8		
Estimation of disaster effects									
Baseline data collection									
Field visit and survey									
Estimation of damage and production losses									
Aggregation of damage and production losses									
Estimation of disaster impact									
Micro-economic impact analysis									
Macro-social impact analysis									
Personal/household impact analysis									
Recovery needs									
Reconstruction needs									
Assessment report preparation									

Table 8: survey timeline for PDNA

6.1.4. Mobilizing resources for assessment

In cases of L2 and L3 category disasters, the damage to Fort may be extensive, making it impossible to conduct an evaluation using internal resources. To increase efficiency, consider using new technologies like crowd-based maps and ICT platforms that allow volunteers to exchange information. Trained volunteer teams can do fast visual assessments with specified tasks. Teams of trained volunteers can be assigned specific tasks to conduct rapid visual assessment.

6.1.5. Compiling the data in a meaningful way to inform the process of post-disaster recovery planning and action

Damage assessment and overall disaster losses should be communicated clearly and effectively to local stakeholders, management, and potential financing or donor organizations, allowing for efficient and transparent recovery planning. When conducting a post-disaster needs assessment, prioritize activities based on the highest risk elements of the location.

- I. Elements of the site which are at highest risk due to the disaster
- II. Elements which are of the highest significance and are the most vulnerable
- III. Elements that have suffered the greatest damage but are retrievable
- IV. Relatively stable aspects
- V. Irretrievably damaged elements

The basic procedures involved in post-disaster assessment are as follows:

Table 9: Post disaster assessment process

Processes	Descriptions
Assessment of the context	It is essential to ensure that the site/precinct and surroundings are safe for entering and working and that it is secure and that basic services are available
Evaluating initial assessment	An overall picture of the site damage will enable the rescue team to list out immediate needs and resources, gather permissions and assistance, set out criteria for salvage procedures and develop the initial plan
Secure and stabilize	Depending upon the scale of the disaster, it may be necessary to secure the location before undertaking any type of salvage operation

Processes	Descriptions
Salvage or transfer of collections based on initial assessment	Based on initial assessment, it may be deemed urgent to remove certain elements from their location and shift them to a secure temporary location
Detailed assessment	This should be undertaken by qualified professionals only. Detailed assessment should be accompanied with documentation, visual as well as descriptive to keep a detailed record of the condition of the object prior to any treatment

6.1.6. PDNA Committee members

The PDNA should be a well-coordinated inter-agency mechanism. Agreement on the management structure of the PDNA is essential. The management structure shall comprise of the following:

PDNA management team: depending on the DRT decision, the Facility Lead (Archaeology department) typically leads the management and assessment team. The management team shall meet regularly with DRT to oversee the assessment process, provide strategic guidance, take decisions, and ensure that the necessary resources are available for undertaking the evaluation.

Coordination team: the PDNA management team will agree to assign a few staff to provide coordination between the fort and logistics. The members can be from the Infrastructure Lead (PWD) or Staffing Assistant (SDM). The team shall be responsible for managing day-to-day planning, coordinating with the sector team members and DRT and donors in conducting the assessment, analyzing the data, preparing the reports, and developing the recovery and reconstruction framework under the guidance of the PDNA management team. The Coordination team shall be responsible for organizing the assessment's conduct and ensuring all logistical arrangements are in place.

Sector teams: The sector teams shall comprise designated technical representatives from PWD, ZP, or Nagar Parishad. The Staffing Assistant will assist during the visit to the affected area. The sector team will collect baseline data, damage, and loss data, undertake field visits to validate the data collected, analyses the data, and write the sectorial assessment report on damage and loss and proposed sector priorities for recovery and reconstruction.

Report Preparation Secretariat: the coordination team, with technical support from development partners (if required), shall coordinate with the sectorial team members for the report. The coordination team will then summaries the individual report into a consolidated report and share it with the management team.

6.2. Emergency Stabilization- Approaches

Before long-term repairs, recovery, and reconstruction can begin, interim measures to stabilize the Fort may be required to provide safe access and decrease disaster risks. A structural or conservation specialist (PWD/Archology expert) should be engaged to determine the least invasive technique to stability that guarantees the site/precinct's values are not endangered by such interventions.

Some temporary stabilization steps are outlined below:

- Installing a temporary shelter/roof for the structure to protect it from environmental harm, secure the internal areas, and stabilize working conditions for any interior spaces.
- Shoring, propping, anchoring, or bracing to provide temporary structural support to a building that has sustained impact or structural damage. Qualified experts are needed for these activities since improper support systems might cause further damage.
- Drying out structures or interiors with mechanical ventilations, fans, and dehumidifiers, depending on the level of water or moisture damage, to prevent biological assaults, extended humidity, and so on.
- Surfaces of high value and high risk can be cleaned dry or wet, depending on the materials.

Structure dismantling may be a viable option if the system allows for re-assembling and there is comprehensive documentation.

Stabilization processes should be carried out only after the assessment step has been completed and stakeholders have agreed on action priorities.

Interim stabilization of the Fort is also important since it offers the site managers, local stakeholders and authorities time to get organized, raise funds and take considered decisions regarding post-disaster repairs and recovery exercises. Haste should be avoided at all costs since it can result in further adding to the loss of heritage value in the process of recovery and cause further damage.

6.3. **Post Disaster Repairs and Reconstruction**

Post-disaster repairs and reconstruction of damaged sites/precincts should be carried out only with proper documentation and evaluation processes. Poor reconstructing procedures create additional physical harm to heritage fabric while increasing its structural fragility.

In general, the following principles should be applied:

- For the Fort, a limited intervention approach should be followed, with any intervention being based on good documentation and study. Any endeavor at reconstruction, restoration, or retrofitting should begin with considerations of authenticity and visual integrity.
- Traditional skills and methods, if available, should be used to repair and restore damaged structures. This ensures the continuity of building and crafting traditions.
- Restoring cultural heritage sites/Fort can help restore a feeling of normalcy in disaster-affected areas. These factors should help with heritage conservation and rebuilding as part of the broader recovery strategy.
- Principles of 'build back better' form a central component of international frameworks such as the Sendai Framework. However, the notion of 'better' with respect to cultural heritage is yet not clearly defined. This means that retro fitting measures, which may increase the structural stability of cultural heritage sites, should be undertaken with caution and only after carrying out community consultation among stakeholders discussing clearly on the benefits as well as limitations of such an approach. Retrofitting may have a significant impact on integrity and value and this potential impact should be discussed and evaluated against the benefits.

6.4. Funding, Partnerships and Business Planning

Generating resources for post-disaster rehabilitation and recovery requires the contribution of local, regional, national as well as international partners and institutions, which often makes the task of fund raising as well as the task of effectively utilizing the funds a complex process.

A sound business plan of the Fort with clear objectives and timelines should be prepared by the Archology department, considering the views of local stakeholders, and used for raising funds. Funds are typically financed and disbursed through the State exchequer, in coordination with the Centre and/or international funding agencies. The usage of funds will be determined through the Ministry of Culture.

6.5. Linking Recovery to Risk Reduction

Recovery, rehabilitation, and reconstruction activities should be connected to risk reduction and mitigating the effect of future disasters. The concept of 'building back better' supports this approach. Post-disaster recovery operations may often give insight into risk and emergency management while also highlighting shortcomings in the prior disaster risk management method. Risks that were previously unaddressed can be integrated, and detected vulnerabilities can be removed or mitigated by proper rebuilding, restoration, or even reassignment

of usage. The recovery phase should also be used as an opportunity for building capacity among professionals and local stakeholders for better risk reduction.

7. Training, Capacity Building and Raising Awareness

Training, fostering capacity, and increasing awareness are critical components of disaster risk management and must be carried out at numerous levels. To effectively manage disaster risk at Panhala Fort, institutions and government agencies should collaborate to design effective training modules that address several strategic norms. Training and capacity building should have the following primary objectives:

- Highlight the need for holistic approach towards disaster risk management that responds to the specific needs of Fort
- Enable Facility lead and site staff to carry out basic risk assessment for the Fort independently and build systems for management, through risk reduction measures, emergency response protocols and recovery processes
- Stakeholders including Facility lead and local communities should be equipped to implement, monitor and update disaster risk management plans in their assigned capacity
- Networks between different agencies responsible for the management and administration of Fort should be established to build institutional capacity and cooperation
- Highlight specific issues that deal with a hazard that emerges due to specific geographical and cultural context

The mandate for training and capacity building for disaster risk management is primarily with the Kolhapur DDMA.

7.1. Capacity Building for Disaster Risk Management Professionals/ Emergency Responders

Program	Description	Duration
Introduction to Panhala Fort: Concerns and Issues	This module introduces the specific concerns and scope of cultural heritage and challenges of disaster risk reduction involved	2-3 days
Disaster Risk Management for Panhala Fort	This type of course will provide interdisciplinary training for participants to equip them to undertake integrated disaster risk assessment of Panhala fort, build comprehensive systems for disaster risk management incorporating various measures aimed at reducing risks, respond to disasters and recovering from them to be able to formulate disaster risk management plans for cultural heritage sites and precincts	1-2 weeks
Emergency Response and Stabilization Fort	This module will train emergency responders in the appropriate emergency response procedures applicable for Panhala Fort, highlight the processes for retrieval of artefacts and collections, illustrate measures for temporary stabilization that will not adversely affect cultural heritage sites and so on	3 d a y s - 1 week
Disaster Risk Assessment Methodologies	This module will explore the basic relationships between hazards, vulnerabilities and disaster risks, illustrating each	2 -3 days

Table 10: Training of Disaster Response Team (DRT) members

Program	Description	Duration
	stage in the disaster risk management process. Building upon this base, approaches and methods for risk assessment will be introduced	
Post Disaster Assessment	This module will focus on post-disaster assessment methodologies for Panhala Fort, and equip Fort staff with the tools needed for carrying out assessments at various scales and in various scenarios of disaster	2-3 days
Planning for Disaster Risk Recovery	This module explores actions that are involved in post disaster recovery and rehabilitation of cultural heritage sites and precincts	2-3 days
Role of recent Technology in DRR	This module will explain the benefit of using the advance technology for HRVA, Recovery and Reconstructions	1-2 days

7.2. Training of Site Staff and Management

The following programs should be integrated within the annual/monthly calendars for sites with pre-existing management plans or systems:

Program	Description	Duration	Frequency	Participants
Basic Security Protocol Delivery	Basic training to security and staff about critical infrastructure, security and standard responses	1 Hour	Once in a month	Particularly security staff, managers
Risk Assessment Training	Participant should be able to undertake basic risk assessment of the building, infrastructure, management, etc.	2-3 days	Once in a Year	Site manager and staff members. May be in coordination with the heritage practitioners involved in the conservation/management of the site
Tabletop Exercise	A Tabletop Exercise is a paper drill intended to demonstrate the working and communication relationships of functions found within the disaster management organizational plan	½ Day	Once in 3 months	The exercise is intended primarily for the administrators, managers and personnel who could conceivably be placed into an officer's position upon activation of the disaster management plan
Emergency Drill or Workshop	A drill that engages the entire staff and management and prepares the site or precinct for likely disaster scenarios and the appropriate responses	1 day	Once in 6 months	Ideally visitors should also be participants in this drill to raise awareness but also provide a realistic scenario to staff and management

Table 11: Training programs for staff and management

7.3. Raising Awareness among Local Communities, Residents and Visitors

Due to the specialized concerns and challenges of addressing disaster risk management for cultural heritage sites and precincts, it is important to tailor activities for raising awareness for disaster risk management for local communities that reside within and around these sites as well as visitors and tourists. Local communities can also be mobilized as volunteers during and after a disaster, so prior training will ensure a robust response and also streamline coordination.

Awareness can be raised through the following actions:

Program	Description	Duration	Frequency	Participants
Off-site Interpretation/ Orientation/ Fixed Literature	Online or Printed literature that highlights the emergency plan for the Panhala fort. This can be interactive or in the form of brochures and maps	N/A	N/A	All local stakeholders, visitors to the site should be able to access this information freely and widely
Basic Emergency Protocol Delivery	Basic training to engage security and emergency responder in the area about acceptable routes, procedures	½ day	Once in 3 months	All stakeholders that spend extended periods of time on the site
Emergency Drill or Workshop	A drill that engages the entire staff and management and prepares the site or precinct for likely disaster scenarios and the appropriate responses	1 Day	Once in 6 months	Residents, visitors and other stakeholders should be participants in this drill to raise awareness but also provide a realistic scenario to staff and management

Table 12: Awareness generation programs

8. Conclusion and Action Plan

The Panhala Fort Disaster Management Plan establishes a comprehensive framework aimed at safeguarding the fort's structural integrity and protecting lives in the event of a disaster. By identifying and addressing potential risks such as landslides, earthquakes, fires, and floods, the plan provides a multi-layered approach to disaster preparedness. It ensures resilience through structural reinforcement, early warning systems, and regular training for staff and local communities. Sustainable tourism management is also integrated to maintain a balance between heritage preservation and visitor safety. Overall, the plan empowers local authorities, stakeholders, and the community to collectively respond to emergencies, thereby preserving Panhala Fort's historical significance for future generations.

8.1. Implementation and Revising the Plan

Some of the provisions for Panhala Fort have been detailed in this plan need to be undertaken with immediate effect, while the implementation of longer-term strategies and changes may require time and resources. The implementation of the of this Plan requires coordinated efforts from various stakeholders, including local authorities, government agencies, and community members. It involves regular training programs, mock drills, and establishing response protocols that ensure preparedness at all levels. Additionally, specific disaster response teams are tasked with managing emergencies and conducting real-time evaluations.

8.2. Revising and Updating the Guidelines

This document is a dynamic document and will be updated periodically based on new technological advancements, research, and post-disaster assessments. Regular audits and feedback from disaster response drills will guide these revisions. Incorporating lessons learned from real-world disaster events will enable the continuous enhancement of the plan, thereby maintaining the fort's resilience against evolving threats.

9. Annexure

9.1. Important contact number

SI.no	Organization Name	Contact Details
1.	Nagar Parishad	(02328) 235027.235047
2	Panhala Police Station	(02328) 235024
2	Archaeological Survey of India, Sub circle Banhala	(02228) 225247
J .		(02326) 233247
4.	Rural Hospital, Panhala	(02328) 235049
5.	Water Supply	(02328) 235330, 235331
6.	Maharashtra State Electricity Board, Panhala Branch	(02328) 235053
7.	President, Hotel Association	(02328) 235072

9.2. Office staff contact number

SI.no	Name	Contact Details
1.	Mr. Chetan Kumar Dhanappa Mali, Administrator and Principal	9960186646
2.	Mr. Amit HinduraoMane, Administrative Officer and Tax Inspector	9518968582
3.	Mr. Tanaji Nanavare, Accounts	7387943382
4.	Smt. Snehal Ramesh Panhalkar, Water supply and Sanitation supervisor	9156020880
5.	Smt. Jayashree Balaso Devkule, Civil Engineer	8329325534
6.	Mr. Biswas B Ramane, Clerk	9763917607
7.	Mrs. Madhura Maruti Gawli, Tax Inspector	7499590943
8.	Smt. Surekha Ashok Vadar, Tax Inspector	7768931225
9.	Mr. Asuman Gaikwad, Assistant Town Planner	7083981095
10.	Mr. Mukul B Chavan, Junior Engineer	9503649879
11.	Mr. Gurunath B Kamble, Barnishi	9923112071
12.	Mr. Aiit D Choury. City Coordinator	8888449036

9.3. Panhala town office

Sl.no	Organization Name	Contact Details
1.	Tehsildar Office	(02328) 235026
2.	Medicine (Rural Hospital)	(02328) 235049
3.	PWD (Circuit House)	(02328) 235038
4	Panhala Police Station	(02328) 235024
5	Archeological Accountant	(02328) 235247
6	Water Supply Department	(02320) 235230, 225231
-		(02328) 233330, 235331
7.	Maharashtra State Electricity Board, Panhala	(02328) 235053, 235043
8.	Telecom Corporation, Panhala	(02328) 235001, 235100, 235400

9.4. Other Offices

SI.no	Organization Name	Contact Details
1.	Kolhapur Collector Office	2665814, 2665813
2.	DEOC, Collector Office	2665812
3.	Subdivisional Officer, Panhala Subdivision	(02328) 235023
4.	Assistant Director, Town Planning Kolhapur	2342565
5.	Deputy Engineer, Kolhapur	2537019

9.5. PDNA Format

Name of Officer:

Type of Disaster:

Date of Disaster:

Duration of Disaster:

a) Electrical Facilities

Item/Services	No. of unit damage	Population affected	Recovery measure
Feeder			
Transformer			
HT lines			
LT line			
Electric poles			

b) Human lives

Items	Particulars	Total
Human lives lost	Male	
	Female	
A person who suffered	Male	
grievous injurious	Female	
A person who suffered	Male	
minor	Female	
injuries		

c) Water Facilities

Туре	No. of units affected	Population affected	Recovery measure
Well			
Bore Well			
Water Supply Disrupted			
Contamination			
ESR damaged			
GLR			
Damaged			
Sump Damaged			
Pipelines damaged			
Stand Post damaged			
Hand Pump			

d) Structural facilities

Location of the Structure: Lat-

Long-

Element	Extent of Damage				Reference/C
	Extensive (>75%)	Major (50- 75 %)	Moderate (25 – 50%)	Minor (<25%)	omment
Foundation					
Vertical supports columns, walls, etc.					
Horizontal supports beams, lintels, etc.					
Partitions, nonstructural walls					
Openings-windows, doors, etc.					
Floors, ceilings, etc.					
Decorative elements					
Others					

Items	Particulars	Total
Fully Damage structure	Number	
	Estimated Loss in Rs.	
Partly damaged structure	Number	
	Estimated Loss in Rs.	
No. of nearby house damaged	Number of Houses	
	Estimated Loss in Rs.	
Roads (All)	Number	
	Estimated Loss in Rs.	
State Roads	Number	
	Estimated Loss in Rs.	
District Roads	Number	
	Estimated Loss in Rs.	
Local Roads	Number	
	Estimated Loss in Rs.	
Bridges	Number	
	Estimated Loss in Rs.	
Culvert	Number	
	Estimated Loss in Rs.	
Office Buildings	Number	
	Estimated Loss in Rs.	
Shops	Number	
	Estimated Loss in Rs.	

Items	Particulars	Total
Others	Number	
	Estimated Loss in Rs.	

e) Animal lives

Items	Particulars	Total
Milch animal lost (Buffalo/Cow)	No	
	Estimate loss (Rs.)	
Milch Animal lost (Sheep/Goat)	No	
	Estimate loss (Rs.)	
Draught animal lost (Horse/Bullock)	No	
	Estimate loss (Rs.)	
Draught animal lost (Calf/Donkey/Pony/Mule)	t No	
	Estimate loss (Rs.)	
Poultry Lost (Chick/Duck)	No	
	Estimate loss (Rs.)	
Others	No	
	Estimate loss (Rs.)	