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# Earthquake-Induced Collapse of Nawabi Heritage and Geotourism Prospects at Kella Nizamat, Murshidabad, West Bengal, India

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**Abstract**

Murshidabad is situated on the banks of the Bhagirathi River in West Bengal and is a major historical and cultural area in eastern India. In the 18th century, it became the capital of the Bengal Subah and was a major centre of political, commercial and architectural activity. This paper examines the possible connection between ancient earthquakes and the structural deterioration observed in several Nawabi heritage buildings in and around Kella Nizamat, focusing on the earthquakes of 1764 and 1897. The study uses a range of sources including historical accounts, field observations, GPS-based spatial data, oral accounts and secondary geological and seismological data. Field observations reveal that many heritage structures (palaces, mosques, tombs and gateways) are in various states of decay. Structural damage results from a combination of seismic activity, riverbank erosion, weathering, material decay, neglect, and human interference. The study proposes an integrated approach that combines heritage tourism and geotourism to link earthquakes, structural collapse, the Bengal Basin, heritage tourism, geotourism and geoconservation sustainably for heritage management.

**Keywords:** Earthquake; Structural collapse; Bengal Basin; Heritage tourism; Geotourism; Geoconservation.

## 1. Introduction

Murshidabad is one of the most significant cultural landscapes of West Bengal, situated on the eastern bank of the Bhagirathi. It was a major administrative and political centre in the 18th century. The city grew as a result of the revenue headquarters being shifted from Dhaka to Murshidabad in the early 18th century and Murshid Quli Khan making Murshidabad the capital of Bengal. As the capital of the Nawab expanded, there was a proliferation of palaces, mosques, gardens, gateways, tombs, administrative buildings and all sorts of other royal buildings. Kella Nizamat and the surrounding area thus became a major centre of architectural heritage. The present day heritage landscape is very different from what it was in the past. Some sites have gone completely; others are merely ruins, just a gateway or a wall or a series of foundations or fragments of a building. There are also many buildings which have simply decayed over the years as per the historical records. The decline of these heritage resources is not the result of one thing.

It's a combination of earthquakes, riverbank erosion, flooding, climatic weathering, poor maintenance, changes in the course of the river, material decay and human intervention. In this wider context, earthquakes are especially interesting. The Bengal Basin is structurally complex and has several mapped features. For example, the Eocene Hinge Zone (EHZ), extending from the Kolkata–Ranaghat area to Mymensingh, is an important structural and depositional boundary. GPS studies have shown modern crustal deformation and earthquake activity linked to the EHZ and other structures within and around the basin. Therefore, this study suggests historical seismic activity should be regarded as one of several causes contributing to the deterioration of the Nawabi heritage at Kella Nizamat. It also explores viewing these earthquake-related heritage landscapes as geotouristic resources alongside current heritage tourism.

## 2. Literature Review

### 2.1 Historical and Heritage Studies

The historical writings on Murshidabad cover the city's growth, the Nawabi administration, and its architectural features. Roy's Murshidabad Kahini is an account of the historic city, including its palaces, mosques, gardens and changes in its physical appearance. Majumdar's The Musnud of Murshidabad similarly discusses important buildings associated with the royal family and their historical importance. Maitra's History of Murshidabad provides useful information on Murshidabad's development as the capital and describes several important Nawabi structures, such as Chehel Sutun, Kuleria, and other palace complexes. Recent studies have examined Murshidabad from the perspectives of heritage tourism, tourism potential, and conservation. For example, Paul and Roy discussed tourism-based heritage conservation in Murshidabad (Govindaraju, L., & Bhattacharya, S. 2011), and Day and Biswas examined the role of the Hazarduari Palace Museum in cultural and heritage tourism (Haldar, S., & Sarda, R. 2021). Although these studies stress the significance of Murshidabad's architectural heritage for tourism, they discuss little about the link between seismic processes and the physical deterioration of individual heritage structures.

### 2.2 Geotectonic Research

The geological setting of the Bengal Basin has been studied through seismic reflection, geological analyses and GPS measurements. Major structural divisions of the West Bengal Basin identified by deep seismic studies include a western scarp zone, a relatively stable shelf and a significantly deeper basin east of the hinge zone. Mullick and Mukhopadhyay (GPS study) have shown that the Eocene Hinge Zone is an active low angle fault dipping eastwards and earthquakes have been recorded near the EHZ along the Garh Moyna Khandaghosh fault and the Pingla fault. Other seismotectonic studies have identified a number of significant tectonic structures in the area: the Eocene Hinge Zone, the Garh-Moyna-Khandaghosh Fault, the Jangipur-Gaibandha Fault, the Pingla Fault, the Debagram-Bogra Fault, the Rajmahal Fault and the Malda-Kishanganj Fault.

### 2.3 Geotourism and Heritage Protection

Geotourism now sees the geological and geomorphological features as tourism resources and is concerned with their interpretation, their conservation and the involvement of the local communities. There have been studies into the geoheritage of West Bengal which have demonstrated the tourism potential of the geological and geomorphological resources as well as their value for geoconservation. This study expands the conceptual approach by treating earthquake-affected cultural heritage as a possible form of geoheritage. The remains of earthquake-damaged structures are not just signs of deterioration but indicate the interaction between earth science processes and the history of civilisation.

## 3. Research Gap

The literature on Murshidabad can broadly be divided into three categories:

1. historical study of the nawabi period;
2. heritage and architectural studies; and
3. studies into tourism potential and heritage conservation.

Geological investigations have also examined the tectonic and seismic characteristics of the Bengal Basin, yet relatively little research explicitly looks at the spatial relationship between:
earthquake occurrence → direction and intensity of the seismic impact → structural damage → present state of ruin → heritage interpretation → geotourism potential.

This paper looks at the royal buildings in the Kella Nizamat area from a historical, geographical, structural and tourist point of view.

## 4. Objectives of the Research

The primary objectives are:

1. A study should be undertaken into the correlation between historical seismic activity and the degree of structural deterioration in certain Nawabi period buildings.
2. To look at the possible spatial effects of the great historic earthquakes on Kella Nizamat and the surrounding areas.
3. To record certain heritage structures which have been affected by earthquakes through field observations and by means of GPS to record their positions.
4. To assess the potential of earthquake damaged ruins for use in geoheritage interpretation. 5. To look at the possibility of integrating geotourism into the existing heritage tourism system of Murshidabad.

## 5. Database and Methods

### 5.1. Sources of data

The study makes use of both primary and secondary data. The primary data was collected via fieldwork in the form of observations, GPS coordinates, photographs, structural surveys and interviews with local people. The study looked at the cracks, the collapsed sections, the surviving architecture, the riverbank erosion and all the other sorts of environmental impact. The secondary data was drawn from ethnographic books, archaeological literature, research papers, geological and seismotectonic studies, the Census, tourist material, maps and the archives.

### 5.2 Methodology Approaches

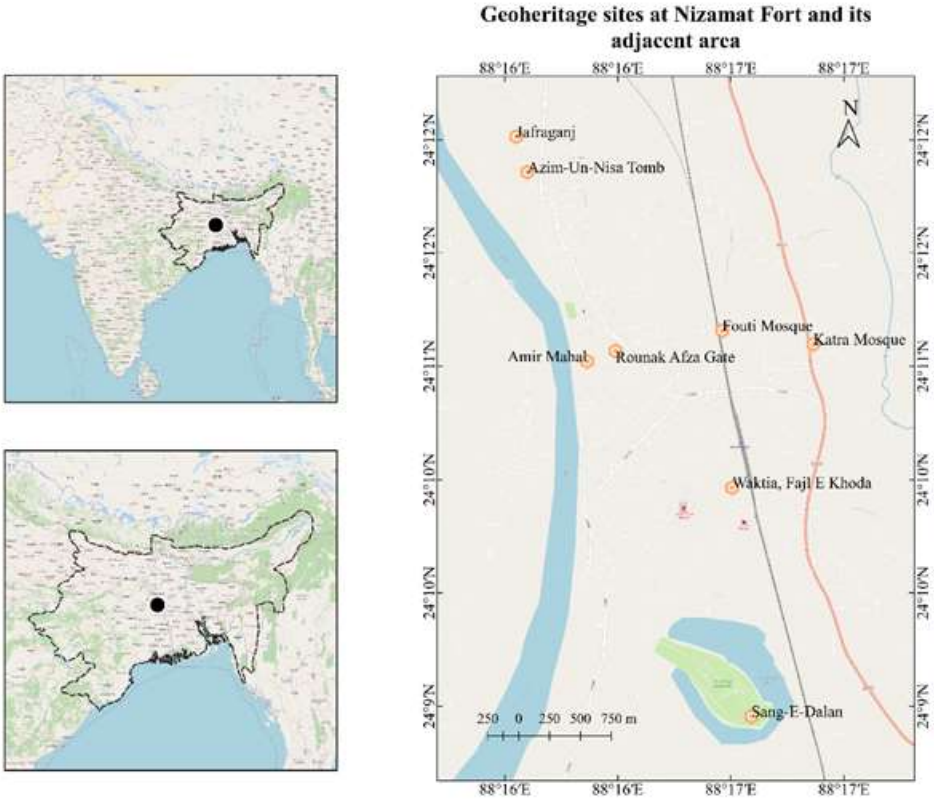
The study was in three stages: the pre-field stage, the field stage and the post-field stage.
Prior to the fieldwork: a literature review, identification of the heritage structures and historical earthquakes, production of base maps and selection of the sites to study. The fieldwork itself consists of a GPS survey, photographic documentation, visual assessment of the structural damage, interviews with the local people and recording of river erosion and other environmental effects.
Do the spatial analysis, categorise the heritage structures by their present condition, compare the earthquake epicentres with the heritage site epicentres, produce the thematic maps and assess the heritage and geotourism potential.

### 5.3 GIS-Based Analysis

We've integrated the locations of the heritage sites, earthquake epicentres, geological features, river channels, erosion zones and the network of access roads into a GIS. We've then used spatial overlay and proximity analysis to look for any possible links between seismicity, the environmental processes, the structural deterioration and the heritage-tourism potential.

## 6. Study Area

Murshidabad is in central-eastern West Bengal and is part of the vast Gangetic alluvial plain of eastern India. The district is essentially alluvial land having been formed over the years by the action of fluvial processes (sedimentation, channel migration, flooding, river bank erosion etc). Of the various features of the region the Bhagirathi river has been by far the most important in determining the spatial pattern of the settlements, routes of transport, areas of agriculture and the location of the historical centres.




**Map 1: Location Map of Study Area**

The Kella Nizamat area and the surrounding heritage landscape form a significant cultural and historical region from Bengal's Nawabi period. It includes many historical buildings such as palaces, mosques, gateways, tombs, ghats, residential buildings, and other architectural remains. These structures represent different stages of political, administrative, religious, and social development and together serve as evidence of Murshidabad's historical evolution as an important centre of Nawabi adminTo understand how the landscape of Kella Nizamat and its surroundings has changed, it is essential to examine the relationship between heritage buildings and geomorphological processes. In the past, the river and its landscape determined settlement locations, and later changes in the river and environment have affected the survival

of built heritage. This interaction shows that cultural heritage is not static but part of a continuously changing geographical environment.environment.

The heritage landscape of Murshidabad must be seen as a combined cultural-geomorphological system linking historical architecture, human activities, river processes, environmental change, and landscape transformation. An integrated approach is necessary to identify causes of heritage deterioration, determine vulnerable structures, develop conservation strategies, and assess potential for sustainable heritage and geotourism development in the area.

## 7. Geological Setting of the Bengal Basin

### 7.1 Tectonic environme

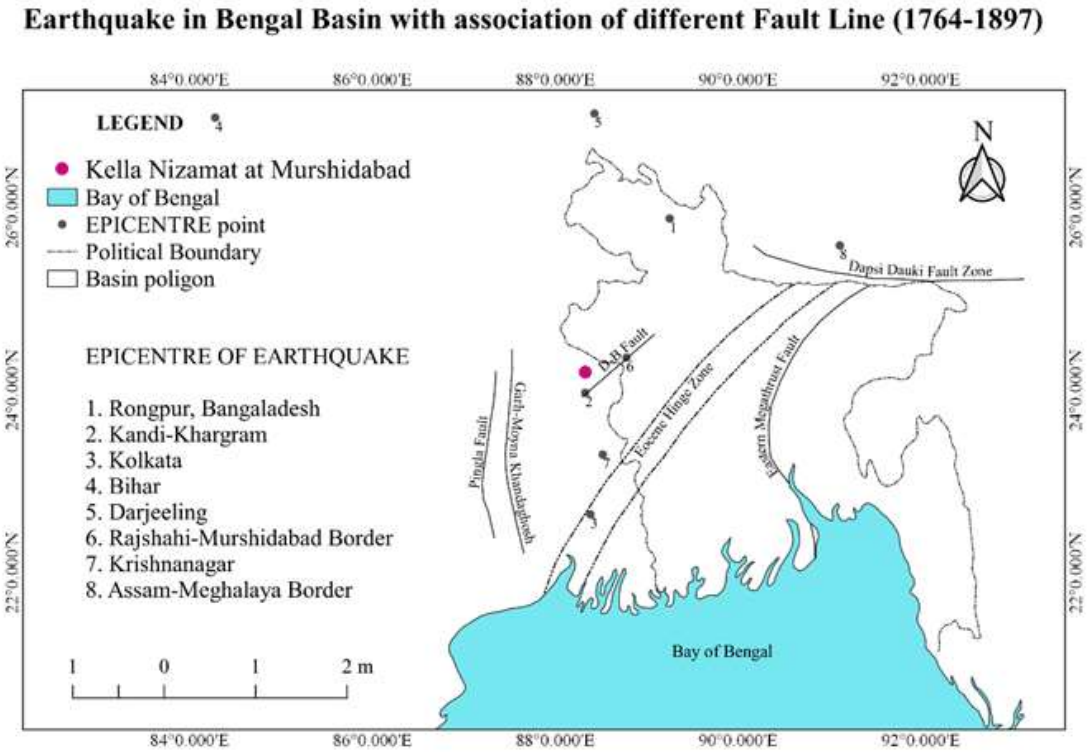
The Bengal Basin is a large sedimentary basin situated between the Indian Shield to the west and northwest and the tectonically active regions of the Himalayas, the Shillong Plateau, and the Indo-Burman system to the north and east.asThe basin has thick sedimentary sequences and several significant structural features, including the Eocene Hinge Zone. This zone marks the transition from the relatively stable western shelf to the deeper part of the eastern basin.sin.

Modern GPS work shows the EHZ is still tectonically active. Mullick and Mukhopadhyay have identified seismicity in the vicinity of the EHZ (on the Garh-Moyna-Khandaghosh and Pingla faults) and have measured crustal deformation across the hinge belt.

### 7.2 Main Structural Features

Major structural components related to the Bengal Basin include:

1. Hinge Zone (Eocene);
2. Debogram-Bogra Fault
3. Garh-Moyna-Khandaghosh Fault;
4. Pingla Fault;
5. Rajmahal Fault;
6. Malda–Kishanganj Fault;
7. Dapsi-Dauki Fault Zone;
8. The Himalayan Main Boundary and Main Central Thrust systemThe EHZ is noteworthy because it passes through the Kolkata-Ranaghat area into Bangladesh and represents a significant structural change in the basin.sin.




**Map 2: Main Structural Features**

**8. Earthquakes of Murshidabad (Historical)**

There are historical records of earthquakes in Bengal and the surrounding areas in the 18th and 19th centuries.

Two earthquakes are of particular interest for the present study:

**Earthquake, 1764**

The database links the earthquake of 4 June 1764 to the Kandi–Khargram area, and field interpretation suggests that southwestward to westward influence may have affected several structures around Kella Nizamat.izamat.

**Earthquake, 1897**

The Great Assam earthquake of 12th June 1897 was one of the big earthquakes to affect NE India and the effects were felt over a wide area, extending into Bengal.

The seismic influence in the northeast-to-east direction is important for interpreting damage patterns recorded in many structures in this study.

**Important Methodological Warning**

The original version assumes Mercalli intensity equals Richter magnitude, but these scales are not equivalent. Mercalli intensity refers to effects observed at a place, while Richter magnitude measures earthquake size. For large earthquakes, modern studies usually use moment magnitude (Mw).

In this paper, historical intensity and magnitude are treated as distinct parameters and are not directly converted into each other.

**9. Royal Heritage Seismicity and building collapse**

The survey found several heritage buildings in different states of deterioration.

| Heritage structure | Historical seismic association in field interpretation | Possible direction |
|---|---|---|
| **Azim-Un-Nisa Tomb** | 1764; later 1842 | SW and NW |
| **Jafraganj Palace** | 1764; later 1842 | SW and NW |
| **Rounak Afza Gate** | 1764 | SW |
| **Sang-e-Dalan** | 1764; later deterioration | SW |
| **Main entrance of Motijheel** | 1764 | SW |
| **Waktia Mosque** | 1764/1897 interpretation | SW and NE |
| **Fajl-e-Khoda Mosque** | 1764/1897 interpretation | SW and NE |
| **Katra Mosque** | 1897 | NE |
| **Fouti Mosque** | 1897 | NE |
| **Kuleria Mosque** | 1897 | NE |
| **Amir Mahal** | 1897 | NE |

**Source:** Field survey and an interpretation of the research data.

**10. Heritage Structures Selected**

**10.1 Tomb of Azim-Un-Nisa**

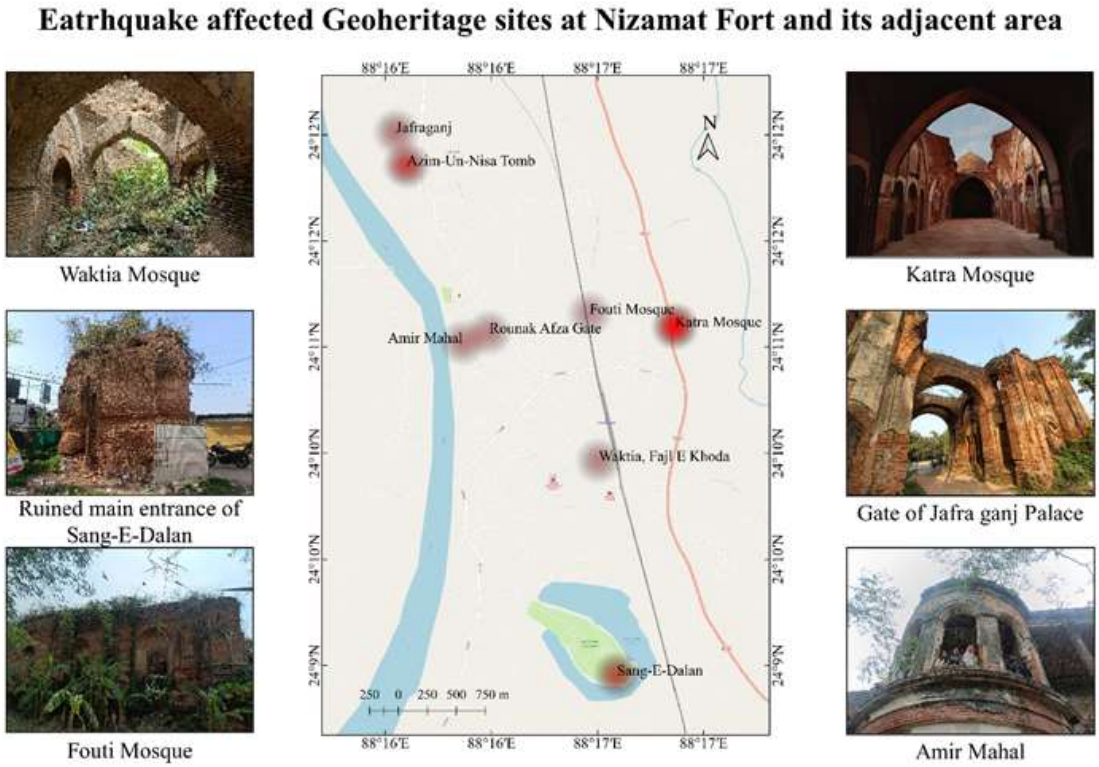
The database shows the Azim-Un-Nisa Tomb is located at about 24.1987° N and 88.2647° E; it is traditionally believed to have been built for Azim-Un-Nisa, daughter of Murshid Quli Khan. Field observations showed the building was deteriorating in various ways. The southwest-facing part may be linked to the 1764 earthquake, and later damage may be connected to subsequent seismic activity and river-related environmental processes. The structure shows the importance of considering multiple hazards since seismic damage and fluvial erosion can interact over long periods.

**10.2 Jafraganj Palace Images**

The Jafraganj Palace was constructed during the early Nawabi period and has a historical connection with Mir Jafar; its position in the field database is 24.2020° N and 88.2645° E. Only a small part of the original palace remains, and the remaining gateway, together with structural remains, is seen as proof of gradual deterioration due to seismic and other environmental processes.

**10.3. Gate Rounak Afza**

The gate known as Rounak Afza is one of the historical gates in the Nizamat Fort complex. The existing structure retains important architectural evidence, especially in the former Nahabat Khana. The western section has suffered considerable degradation attributed to the southwest-directed seismic effects of the 1764 earthquake.




**Map 2: Earthquake-affected Geo-heritage Sites**

**10.4 Access to Sang-e-Dalan**

The Sang-e-Dalan and the adjoining entrance building at Motijheel are significant features of the historic landscape surrounding the oxbow lake. Historical and field evidence indicate the structures have deteriorated considerably. Their disappearance should be attributed not only to seismic activity but also to river migration, erosion, weathering, and later human intervention. human intervention.

**10.5 Mosques of Waktia and Fajl-e-Khoda**

Because both mosque complexes are located in a small area, they provide a suitable basis for comparison. Field observations revealed different patterns of deterioration. The study suggests their present state may reflect different building histories and varying exposure to seismic and environmental forces.

**10.6 Katra Masjid**

The Katra Masjid is one of the major architectural monuments surviving from the Nawabi period in Murshidabad; some features were damaged by the 1897 earthquake in the northeastern part of the area. The mosque has fared better than several other Nawabi buildings and offers a valuable opportunity for comparative conservation research.

**10.7 Fouti and Kuleria Masjids**

The Fouti Mosque (Sarfaraz Khan) is a significant example of an unfinished architectural structure and, in poor condition, is valuable as a record of eighteenth-century building techniques. The Kuleria Mosque also survives as part of the historical urban landscape. Field examination found structural cracking and deterioration, calling for a thorough architectural and material evaluation.

**10.8 Amir Mahal**

Amir Mahal, known as Bala Khana in the field material, is a large residential area from the later Nawabi

period and has suffered extensive deterioration. The study states the 1897 earthquake is one reason for this but also points to poor maintenance, material ageing, and later socio-economic changes as other important contributing factors.uting to it.

## 11. Results & Conclusion

The study has a number of important findings.

**Finding 1: Multi-hazard nature of Murshidabad's heritage landscape**

Earthquakes are not the only cause of deterioration of Nawabi structures; seismic shaking, riverbank erosion, flooding, weathering, vegetation growth, human interference, and poor maintenance have all contributed over the years.

**Finding 2: The earthquakes of 1764 and 1897 deserve special attention**

Because the Kandi–Khargram area is near Murshidabad, the 1764 event is especially relevant to the southwest-facing structural remains identified during the field investigation. For northeast-facing damage in some structures, a plausible regional seismic setting is the 1897 earthquake, which began in the Assam–Meghalaya region.

**Finding 3: Direction of damage as possible interpretive evidence**

The uniform orientation of the structural damage matches the positions of historical earthquake foci. Direction alone cannot prove causation; detailed structural engineering, archaeo-seismological studies, and material research are required.

**Finding 4: Heritage value of ruins**

The ruined monuments have significant heritage value beyond their damaged state. They provide important evidence of historical architecture, traditional building techniques, seismic vulnerability, river dynamics, urban transformation, political history, and environmental change. Therefore, these ruins should be regarded as valuable cultural and geographical evidence of the area's historical development and environmental evolution. Tourism in Murshidabad mainly focuses on its historical and architectural heritage. However, another way to interpret the situation is to understand the geological and environmental processes that transformed the landscape.

## 12. Framework for geoheritage tourism

The study suggests that some of the ruined buildings should be included as part of an interpreted geoheritage trail. A possible field route would be: Kella Nizamat to Rounak Afza to Waktia/Fajl-e-Khoda to Katra Mosque to Fouti Mosque to Kuleria Mosque to Jafraganj to Azim-Un-Nisa to Motijheel/Sang-e-Dalan.

## 13. Implications for conservation and management

Conservation and management of ruined heritage should be an integrated process incorporating scientific recording, structural assessment, environmental monitoring, community involvement and digital interpretation.

### 13.1 Proper Documentation

Make systematic records of all existing ruined buildings using high-resolution photography, GPS recording, drone surveys where allowed, 3D photogrammetry, architectural measurement, and historical mapping. The documentation will establish a permanent record of the present state and aid future conservation planning.

### 13.2 Structural Evaluation

A professional structural engineer and conservation architect should assess physical stability. Special attention should be paid to crack patterns, foundation condition, masonry stability, material degradation, and potential vulnerability to seismic activity.

### 13.3 Archaeo-seismological Investigations

Where appropriate, archaeo-seismological investigations can be used to establish whether the cracks, displacements, tilts, etc. that are observed are in fact attributable to a known historical earthquake. That in turn may help in distinguishing between seismic damage and damage due to deterioration or other environmental factors.

### 13.4 Monitoring of Riverbank

Anything near the Bhagirathi River needs to be continuously monitored, as bank erosion and channel change could in fact lead to the demise of the structure. The monitoring should cover bank retreat, channel migration, flood exposure, toe erosion and sediment deposition.

### 13.5 Participation of the Community

Local communities should be involved in heritage conservation and in the development of tourism. They could be the guides, the cultural interpreters, the craft producers, the homestay operators and the small-scale tourism entrepreneurs. That would in itself raise the level of local awareness and provide livelihoods.

### 13.6 Interpreting Digital Heritage

Digital technology can enhance the public's understanding of the damaged heritage landscape by connecting individual structures to their historical, geological, and environmental contexts through QR codes, GIS-based maps, 3D models, and digital storytelling, promoting heritage education. The study has several limitations. Historical earthquake records for the 18th and 19th centuries are less complete than modern instrumental records, so epicentral locations and intensity estimates may be uncertain. Structural deterioration has multiple causes, and attributing a specific crack or collapse to an earthquake requires detailed engineering or archaeo-seismological investigation. Several structures have been entirely destroyed and cannot be inspected directly. Also, because some historical information is based on oral traditions, it must be checked against documentary evidence. The field survey provides a very important initial basis, but repeated monitoring and a multi-disciplinary investigation are required before any definite causal links can be established.

## 14. Conclusion

The Nawabi heritage landscape of Murshidabad is a confluence of history, architecture, geomorphology, and natural hazards. Many surviving, partially ruined, and disappeared structures in Kella Nizamat and its surroundings represent the historical evolution of the Nawabi capital. The evidence in this study suggests that historical earthquakes, particularly those of 1764 and 1897, should be considered among the factors contributing to the deterioration of selected royal structures. The study also emphasises that earthquake damage should not be viewed separately from riverbank erosion, flooding, weathering, poor maintenance, and human impact. The Bengal Basin sits on a complex tectonic structure. Earlier research on the Eocene Hinge Zone and its associated faults shows that crustal deformation and earthquakes still occur in the area. This geological setting provides a sound scientific basis for examining the relationship between seismic activity and heritage-site vulnerability. The key point of this study is that ruined heritage should be regarded as both cultural heritage and geoheritage. Structural collapse should be viewed not merely as a conservation issue but also as a way to include evidence of geological processes in heritage interpretation

and tourism planning. A well-planned geotourism program can link Murshidabad's historical narrative with the geological history of the Bengal Basin. The model should emphasise conservation and scientific interpretation rather than treating fragile ruins as mere tourist attractions. An integrated model of heritage conservation, geoconservation, community participation, and geotourism may provide a framework for sustainable interpretation of Murshidabad's disappearing Nawabi landscape.

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