Field Investigation Report on Damage from the March 2025 Myanmar Earthquake

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Key Facts
- Hazard Type: Earthquake
- Date of the disaster: March 28, 2025
- Location of the survey: Sagaing, Mandalay, Myanmar
- Date of the field survey: August 15, 2025
- Survey tools: Digital camera, GPS
- Key findings

1) For the Yadanarpon Bridge investigated in this study, comparisons between the observed damage and analytical findings confirmed that the transverse bracing between the bearings is a particularly critical structural component. In addition, the overall structure was found to be inclined toward the downstream side; interviews with local engineers further indicated that how to address this inclination will be a key issue in future repair works.
2) At Sagaing Technological University, extensive damage was identified inside the buildings, including buckling of longitudinal reinforcing bars in columns and widespread shear failure of walls. Surface ground offsets associated with fault slip were also observed in the vicinity of the university.

Key Words : *2025 Myanmar Earthquake, Sagaing Fault, damage to bridges, damage to buildings, repair*

1. INTRODUCTION

At 12:50 local time on March 28, 2025, an Mw 7.7 earthquake struck central Myanmar. Strong shaking was observed in urban areas such as Mandalay, Sagaing, and Naypyidaw, causing damage to a wide range of structures, including infrastructure facilities, residential buildings, government facilities, and religious structures. As a consequence, severe impacts were reported, with more than 4,900 fatalities and more than 6,000 injuries[1),2)].

Although several reports and papers have been published on this earthquake, many of them focus on the damage in urban areas, particularly Mandalay and the capital city of Naypyidaw. In contrast, relatively few studies have specifically documented damage in the Sagaing region, located to the west of the source area and close to the epicentral vicinity. Furthermore, to the best of the authors' knowledge, there are almost no academic reports that not only investigated, by finite element analysis, the damage mechanisms of a long-span steel arch bridge that sustained damage in the vicinity of its bearings but also described the subsequent repair works.

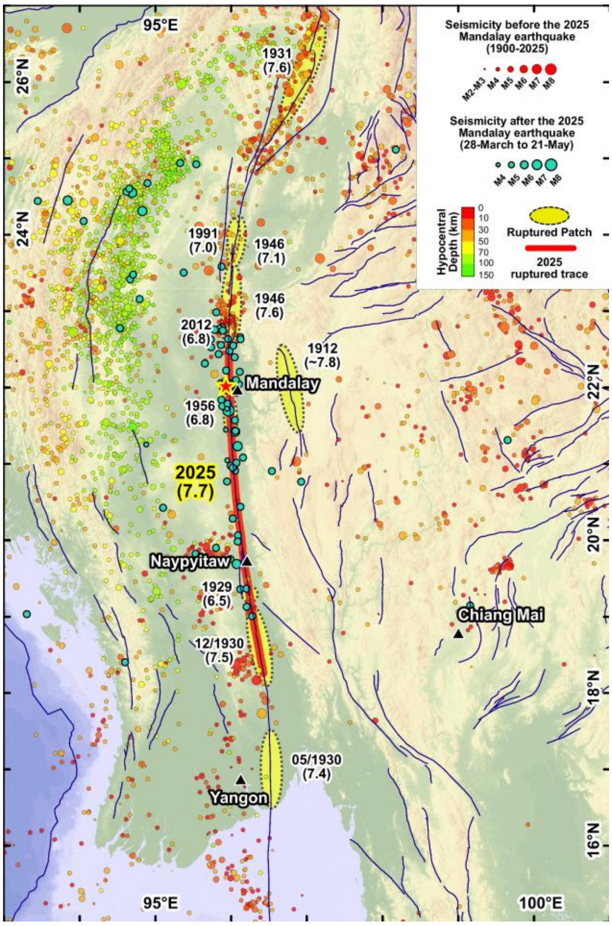


Fig.1 Locations of major earthquakes that have occurred since 1900 along the Sagaing Fault, as compiled by Lindsey et al.[3], reproduced from Ref. 4).

Therefore, this report compiles and presents the building damage in the Sagaing region and the damage to bridges spanning the Mandalay-Sagaing corridor caused by the 2025 Myanmar earthquake.

2. OVERVIEW OF THE 2025 MYANMAR EARTHQUAKE

Fig.1 shows the locations of major earthquakes that have occurred since 1900 along the Sagaing Fault, as compiled by Lindsey et al.[3], together with the location of the 2025 Myanmar earthquake. The Sagaing Fault is an active fault that runs north-south through central Myanmar for more than approximately 1,400 km. **Fig.1** also includes the aftershocks following the mainshock as well as the ruptured patch and ruptured trace. The fault trace indicated by the blue line, together with the ruptured patch and ruptured trace, is reproduced from Ref. 4). **Fig.1** indicates that magnitude-7-class earthquakes have repeatedly occurred along the Sagaing Fault from the past to the present.

The 2025 earthquake was caused by strike-slip motion on the Sagaing Fault, and the rupture is reported to have propagated approximately 60 km to the north and more than 400 km to the south from the hypocenter. In addition, because the focal depth was shallow (approximately 10 km), the effects of geometrical spreading and seismic attenuation were relatively small, which may have contributed to the strong ground shaking.

Table 1 Bridge specifications

Location	Mandalay, Myanmar	
Completion year	2008	
Bridge type	Steel truss, Steel arch	
Total length	1,126 m	
Span length	Main span (arch)	224 m
	Side span (truss)	112 m
Width	16.6 m	
Traffic lanes	4 lanes	

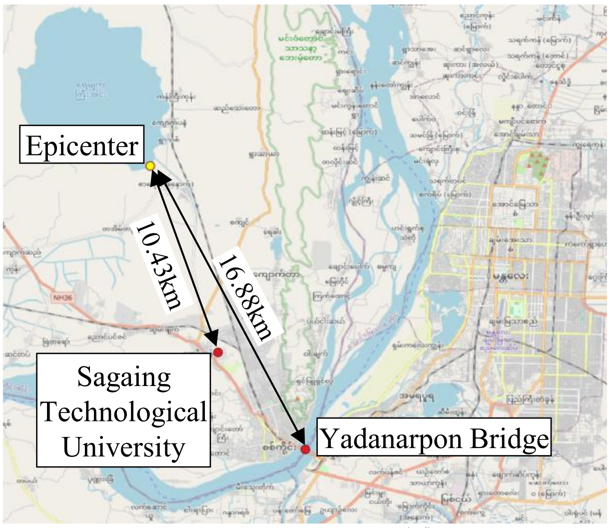


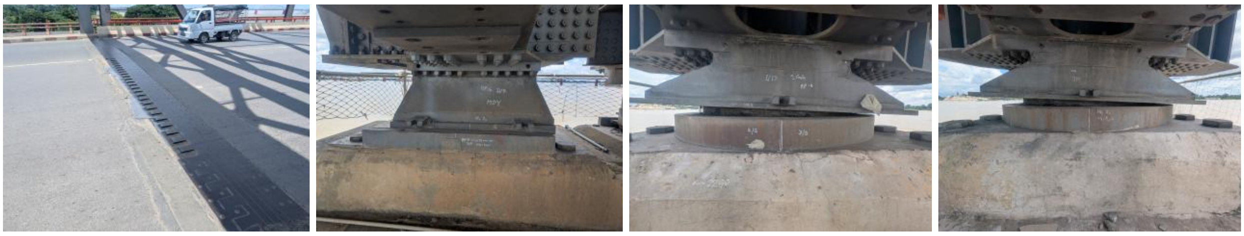
Fig.2 Location map[5),6)]

Fig.3 Yadanarpon Bridge

Fig.4 Ava Bridge

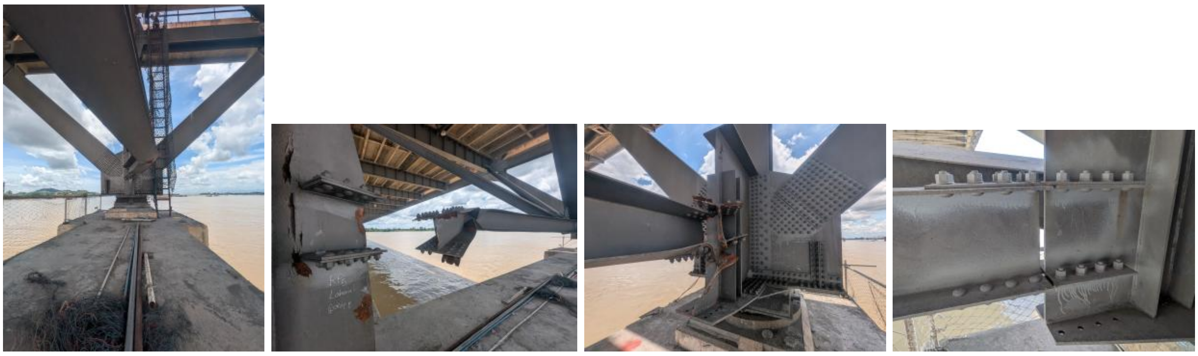
3. DAMAGE TO BRIDGES

A damage survey was conducted on Yadanarpon Bridge, a long-span steel arch bridge crossing the Ayeyarwady River, which flows in the north-south direction between the Mandalay and Sagaing areas in inland Myanmar. The bridge specifications are summarized in **Table 1**, the location map is shown in **Fig.2**[5),6)], and an overview of the bridge is presented in **Fig.3**. Yadanarpon Bridge is located 16.88 km from the epicenter, and it is in parallel with the Ava Bridge (**Fig.4**), which collapsed during this earth-

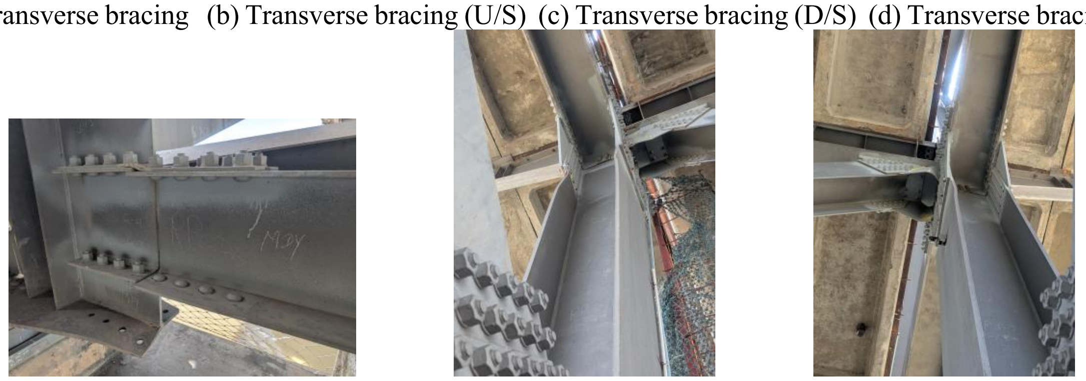


(a) Expansion joint (b) Bearing movement (c) Bearing rotation(U/S) (d) Bearing rotation(D/S)

Fig.5 Conditions of the expansion joint and bearings



(a) Transverse bracing (b) Transverse bracing (U/S) (c) Transverse bracing (D/S) (d) Transverse bracing (tension)



(e) Transverse bracing (compression) (f) Vertical member buckling (g) Gusset plate buckling

Fig.6 Conditions of the transverse bracing and vertical members

quake; therefore, substantial seismic forces are considered to have acted on the bridge.

Photographs taken during the survey are presented in **Figs.5-7**. Although the bridge did not collapse, clogging of the expansion joints associated with longitudinal displacement of the superstructure, as well as translation and rotation of the bearings, were observed. In addition, buckling and fracture were identified in members in the vicinity of the bearings.

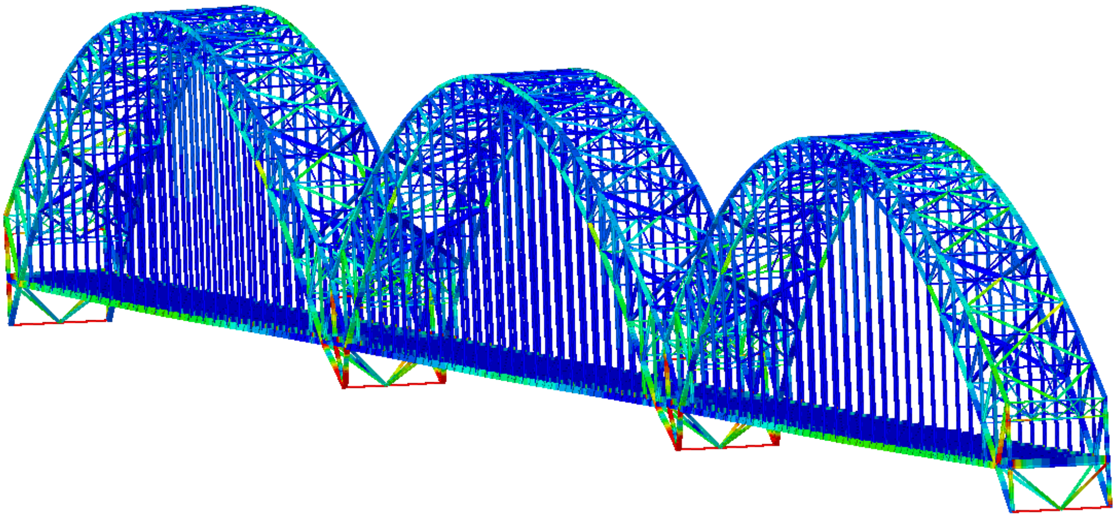
Fig.5(a) shows the expansion joint on the Mandalay side, where the river-span superstructure was found to ride up onto the approach-side component. **Fig.5**(b), taken from the transverse direction, indicates a 75 mm displacement in the longitudinal (bridge-axis) direction at the bearing region. **Figs. 5**(c) and **5**(d) are longitudinal views of the bearing region, with the upstream side on the left. These figures indicate that both the upstream and downstream bearings rotated toward the downstream side. This suggests that the arch ribs are in equilibrium while the overall bridge structure is inclined to the downstream side.

Fig.6(a) shows the transverse bracing between the bearings (cross-frame) viewed from the transverse direction, where global deformation and buckling are observed. **Fig.6**(b) shows the upstream side of the same member, confirming buckling and fracture near the connection. **Fig.6**(c) shows the downstream side, where torsional-type failure near the connection is observed. **Figs.6**(d) and **6**(e) present the connection region of the transverse bracing on another pier. Although the bracing did not fracture, slip marks associated with tensile force at the upstream connection are observed (**Fig.6**(d)), whereas buckling of the connecting plate due to compressive force is observed at the downstream side (**Fig.6**(e)). **Figs.6**(f) and **6**(g) show members directly above the bearings, where buckling of vertical members and gusset plates is confirmed.

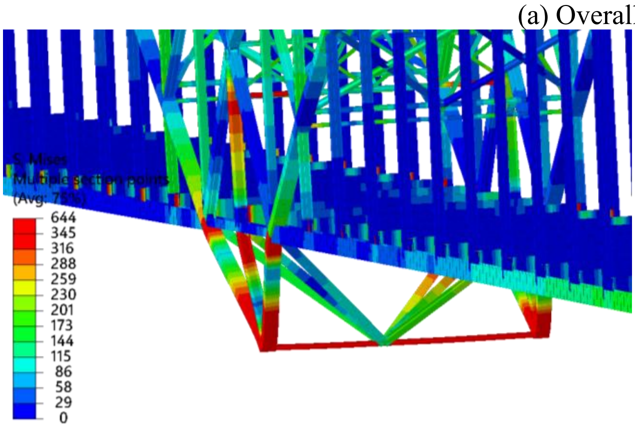
Fig.7 shows repair works that were underway at the time of the survey. During the repairs, members were lifted by a crane from the river while the work was performed, and deformed members were cut and replaced.

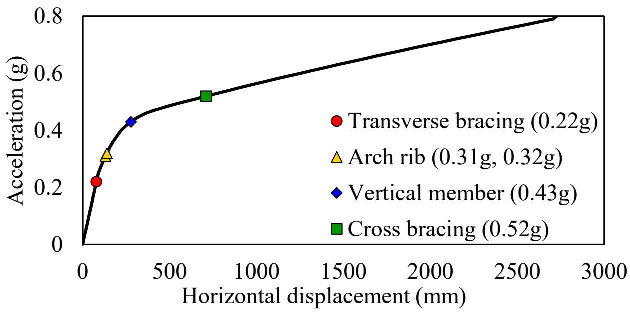
(a) Use of a crane from the river (b) Replacement of the gusset plate

Fig.7 Repair works



(a) Overall stress state





(b) Stress stare near the bearing (c) Acceleration-horaizontal displacement relationship

Fig.8 Results of a FEA

Notable damage was observed in the transverse bracing between the bearings. **Fig.8** presents the results of a transverse-direction pushover analysis conducted for the bridge. The FE model geometry is based on the design drawings. The deck slab was modeled as an elastic shell, while the other steel members were modeled as bilinear elastoplastic beam elements with a post-yield stiffness of E/100. The analysis confirms that the transverse bracing yields first, which is consistent with the observed damage pattern. Furthermore, when seismic forces act in the transverse direction, excessive stresses develop near the connections of the members directly above the bearings, which is in line with the damage shown in **Figs.6**(f) and **6**(g).

4. DAMAGE TO BUILDINGS

(a) Overall exterior (b) Entrance (c) Wall shear damage1 (d) Wall shear damage2

(e) Wall shear damage3 (f) Column damage1 (g) Column damage2 (h) Collapse of the ceiling

Fig.9 Conditions of the Sagaing Technological University buildings and ground offset around the university

(a) A square pond at a temple (b) Road condition (before EQ) (c) Road cndition (after EQ)

Fig.10 Ground offset near the Sagaing Technological University

(a) Before EQ (b) After EQ

Fig.11 Damage to the Pagoda

(a) Pier collapse damage (b) Concrete pier cracks

Fig.12 Damage to the U Bein Bridge

A damage survey was conducted for buildings on the campus of Sagaing Technological University, located 10.43 km from the epicenter (**Fig.2**). The Sagaing area was one of the regions most severely affected by the earthquake. Photographs of the investigated buildings are shown in **Fig.9**. **Fig.9**(a) shows the overall exterior, where damage to the exterior walls and roof can be identified. **Fig.9**(b) shows the entrance area, confirming shear failure of walls and cracking near the bases of columns. **Figs. 9**(c)–(e) present details of wall shear damage; diagonal shear cracks oriented at approximately 45° are observed in concrete-based walls incorporating brick masonry. **Figs.9**(f) and **9**(g) show column damage, where concrete crushing and buckling of the internal reinforcing bars are confirmed. **Fig.9**(h) shows the collapse of the ceiling.

In addition, surface ground offsets associated with fault slip were observed in the vicinity of the university. As shown in **Fig.10**(a), a square pond within a nearby temple compound was damaged due to the ground offset. As shown in **Figs.10**(b) and **10**(c), a road located along the Ayeyarwady River exhibited a large lane misalignment attributable to the ground offset.

5. DAMAGE TO HISTORIC STRUCTURES

A damage survey was conducted on historic structures in Myanmar. **Fig.11** shows a pagoda located in the Sagaing area. The earthquake caused the collapse of the upper spire and the mid-level dome, leaving only the lower structural portion remaining. **Fig.12** shows the U Bein Bridge crossing Taungthaman Lake in Mandalay. As shown in **Fig.12**(a), the collapse of one side of a pier due to the earthquake led to the fall of the railing and a significant tilt of the deck. In addition, **Fig.12**(b) indicates that cracks developed in the concrete pier.

6. SUMMARY

This report presents the results of field surveys on damage to bridges and buildings caused by the earthquake that struck central Myanmar on March 28, 2025, together with observations of bridge repair works and a comparison with finite element analysis results. For the Yadanarpon Bridge investigated in this study, comparisons between the observed damage and analytical findings confirmed that the transverse bracing between the bearings is a particularly critical structural component. In addition, the overall structure was found to be inclined toward the downstream side; interviews with local engineers further indicated that how to address this inclination will be a key issue in future repair works.

At Sagaing Technological University, extensive damage was identified in the buildings, including buckling of longitudinal reinforcing bars in columns and widespread shear failure of walls. Surface ground offsets associated with fault slip were also observed in the vicinity of the university.

In the historic structures in and around Mandalay and the Sagaing area, multiple types of damage were observed, including severe damage to pagodas and damage to the piers of the U Bein Bridge.

Although neither the investigated bridge nor the buildings collapsed, they sustained severe damage. These findings highlight persistent safety challenges for future infrastructure development and maintenance practices in Myanmar.

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