



The 3rd
Thailand Symposium on
Earthquake Research

TSER2025

VENUE: CHULALONGKORN UNIVERSITY, BANGKOK

14-15 AUGUST 2025

*"Lessons Learned from the March 28, 2025,
Earthquake: Multidisciplinary Reflections for Future Preparedness"*

M7.7 2025 Mandalay Earthquake

Response of Myanmar Earthquake Clinics

Saw htwe zaw

Myanmar Earthquake Clinics

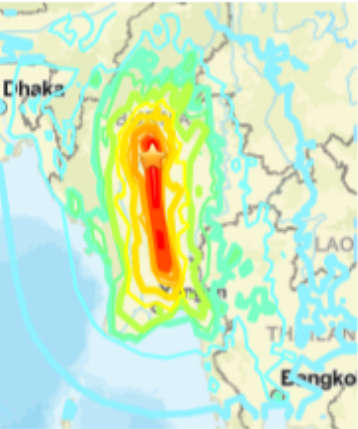
Myanmar Earthquake Committee

Bangkok, 250815

M 7.7 - 2025 Mandalay, Burma (Myanmar) Earthquake

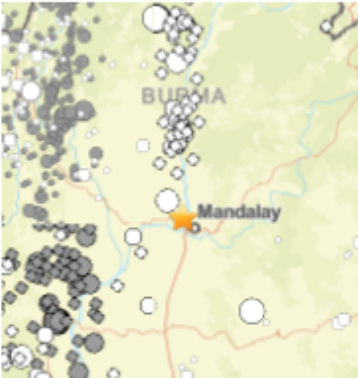
2025-03-28 06:20:52 (UTC) | 22.011°N 95.936°E | 10.0 km depth

Interactive Map



Contributed by [US](#)

Regional Information



Felt Report - Tell Us!

0

0

2

5

3

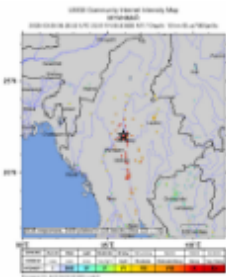
5

Responses

Contribute to citizen science.
Please [tell us](#) about your experience.

Did You Feel It?

IX

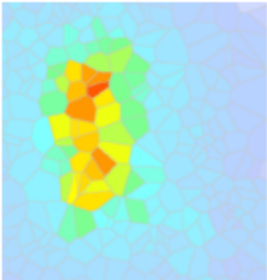


Community Internet Intensity Map

Contributed by [US](#)

ShakeMap

X

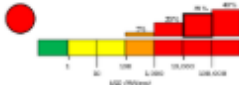


Estimated Intensity Map

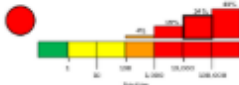
Contributed by [US](#)

PAGER

RED



Estimated Economic Losses

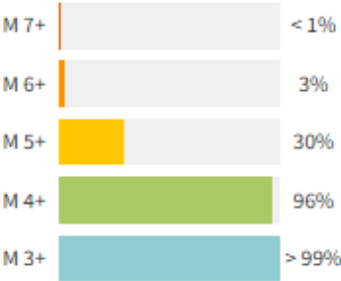


Estimated Fatalities

Contributed by [US](#)

Aftershock Forecast

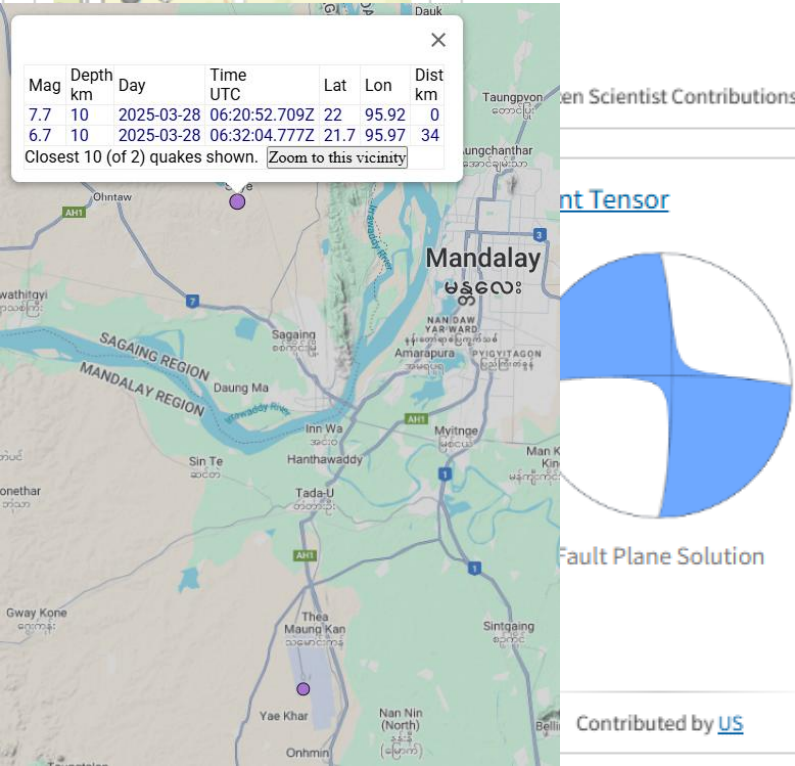
According to our forecast, the chance of at least one aftershock within the next **month**:



Contributed by [US](#)

Mag	Depth km	Day	Time UTC	Lat	Lon	Dist km
7.7	10	2025-03-28	06:20:52.709Z	22	95.92	0
6.7	10	2025-03-28	06:32:04.777Z	21.7	95.97	34

Closest 10 (of 2) quakes shown. [Zoom to this vicinity](#)



Finite Fault



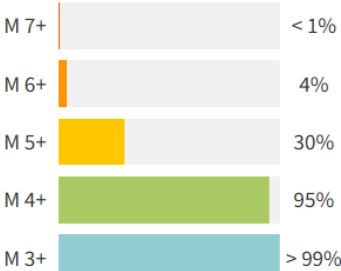
Fault Plane Solution

Contributed by [US](#)

View Nearby Seismicity

Aftershock Forecast

According to our forecast, the chance of at least one aftershock within the next **week**:



Contributed by [US](#)

Contributors



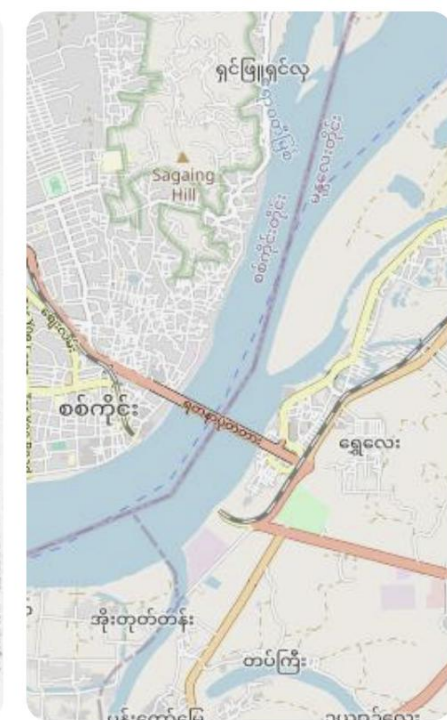
USGS National Earthquake Information Center, PDE

Authoritative Network

Comparative Historical Perspective: 1855 Henery Yule visit to Innwa

1839 Innwa Earthquake

- March 23, 1839
- Magnitude 8.3
- Similar characters
 - North-south fault movement
 - Surface ruptures
 - Widespread destruction
 - Primary and secondary wave effects
- Recurrent- 186 years



The **1839 Ava earthquake**, also known as the **Amarapura earthquake** or **Inwa earthquake**, was a disastrous seismic event that struck present-day central Myanmar on March 23.^[1] This earthquake with an estimated moment magnitude as high as 8.3, was one of the largest in the country, since 1762. It was assigned a maximum of XI (*Extreme*) on the Modified Mercalli intensity scale, and was felt in Rangoon and Bhamo.^[2] Damage was enormous in Ava, resulting in the death of hundreds of people.



မြန်မာ့လျင်များ အကြောင်း ကောက်နုတ်ချက်

ပူးလ်၏ "၁၈၅၅ ခုနှစ်တွင် အင်းဝနန်းတော်သို့ သွားရောက် တာဝန်ထမ်းဆောင်ခြင်း" မှ မြန်မာ့လျင်များ အကြောင်း ကောက်နုတ်ချက် (စာမျက်နှာ ၃၄၉-၃၅၁) ကို မြန်မာနိုင်ငံ လျှင်ကော်မတီမှ ဘာသာပြန်ဆိုသည်။



"On Saturday morning, 23rd March 1839, at about 4 o'clock a.m., Amarapura was visited by an earthquake, that surprised the oldest inhabitants by its strength — Burman history mentions nothing of the kind having taken place before. I was in bed and asleep at the time, but was soon awoken by a tremendous roar, and the tiles from the roof of the house coming down about my ears; the motion so great that I had some difficulty in finding the door, but whether vertical or horizontal, I had not presence of mind sufficient to judge at the time. I did not even know it was an earthquake until it was finished. The shock may have taken up about thirty seconds in all."

"When I did get into the open air, I found the heavens without a cloud, and although there was not a breath of wind, the trees shook as if it were blowing a gale. The dust rising all round from the destroyed houses gave the sky a peculiar appearance, not easily to be forgotten."

"From the appearance the ruins presented in the morning, I have little doubt that the motion was from north to south. The river did rise a little, as if its bed had been obstructed, but did no damage to the boats, even to those that were deep-laden. I never heard of a wave, but the banks of the river, between Amarapura and Ava, were rent in many places, presenting chasms of from five to ten feet deep."

Earthquake Clinics Response

Federation of Myanmar Engineering Societies (Fed.MES)

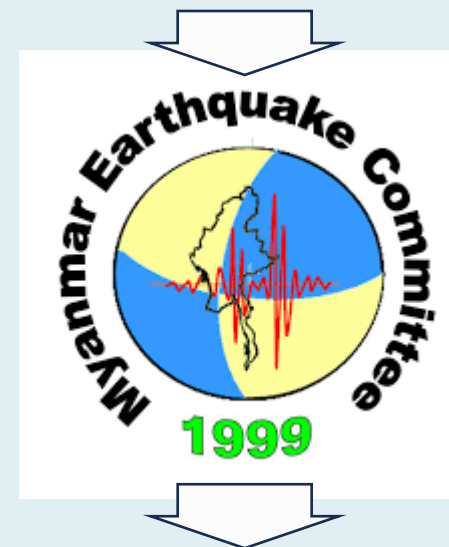
- 68,000+ members, 360+ corporate members
- Nation-wide networks

Myanmar Earthquake Committee

- Established in 1999 under Fed. MES
- Seismologists + Geologist + Engineers

Earthquake Clinics

- Volunteer engineer network
- Independent
- Opensource



Earthquake Clinics Response

Clinics Response

1. PDRA (Post Disaster Rapid Assessment)

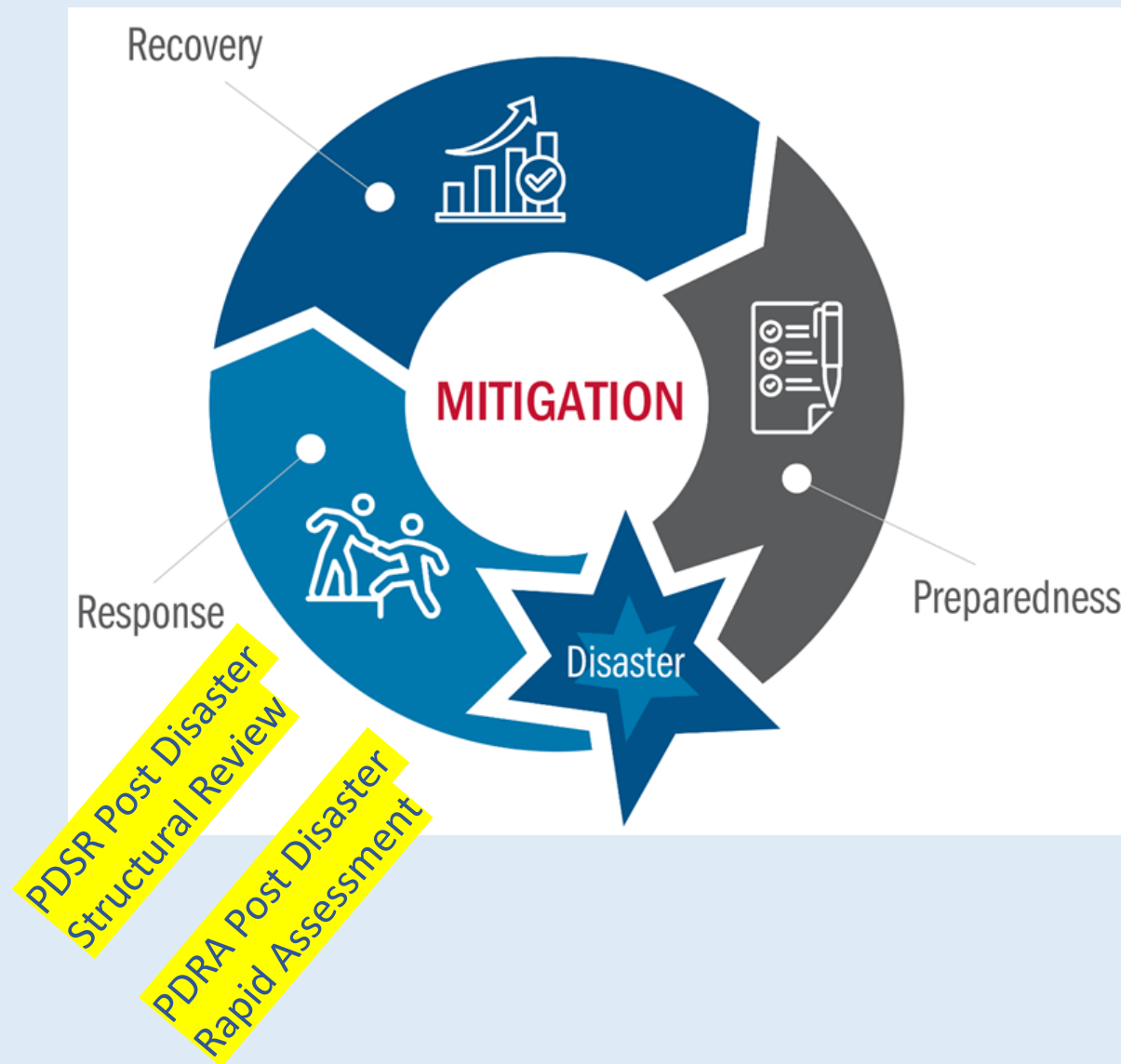
- Ref: ATC20, FEMA P2055
- Prioritize Buildings (Green/Yellow/Red)
- Build Database

2. PDSR (Post Disaster Structural Review)

- Ref: ASCE41, FEMA P2335
- Training and Retrofit Design

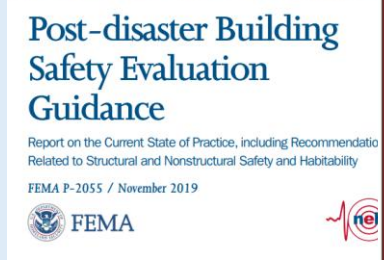
3. Mapping

- Damage Zone Map
- Fault Zone Map



Part 1: Post Disaster Rapid Assessment

- FEMA P-2055
 - Post-Disaster Building Safety Evaluation Guidance
- Green (Blue)
 - Few Repair
 - Owner and Engineers (RE)
- Yellow (Orange)
 - Minor Repair
 - Owner and Engineers (RSE)
 - Major Repair
 - Owner, Engineers (PE), Authority (City Councils)
- Red
 - Retrofit
 - Owner, Engineers (PE), Authority (City Councils)
 - Demolish
 - Owner, Engineers (PE), Authority (City Councils)



RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

Entry, occupancy, and lawful use are restricted as indicated below:

Facility Name and Address:

Date: _____
Time: _____
(Caution: Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for: _____
(Jurisdiction) _____
Inspector ID / Agency: _____

UNSAFE

DO NOT ENTER OR OCCUPY (THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

Date: _____
Time: _____
This facility was inspected under emergency conditions for: _____
(Jurisdiction) _____
Inspector ID / Agency: _____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as required) and no apparent structural damage was found.

Inspected Exterior Only

Inspected Exterior and Interior

Inspected condition to local inspection may be required.

Inspector Comments:

Facility Name and Address:

Date: _____
Time: _____
(Caution: Aftershocks since inspection may increase damage and risk.)

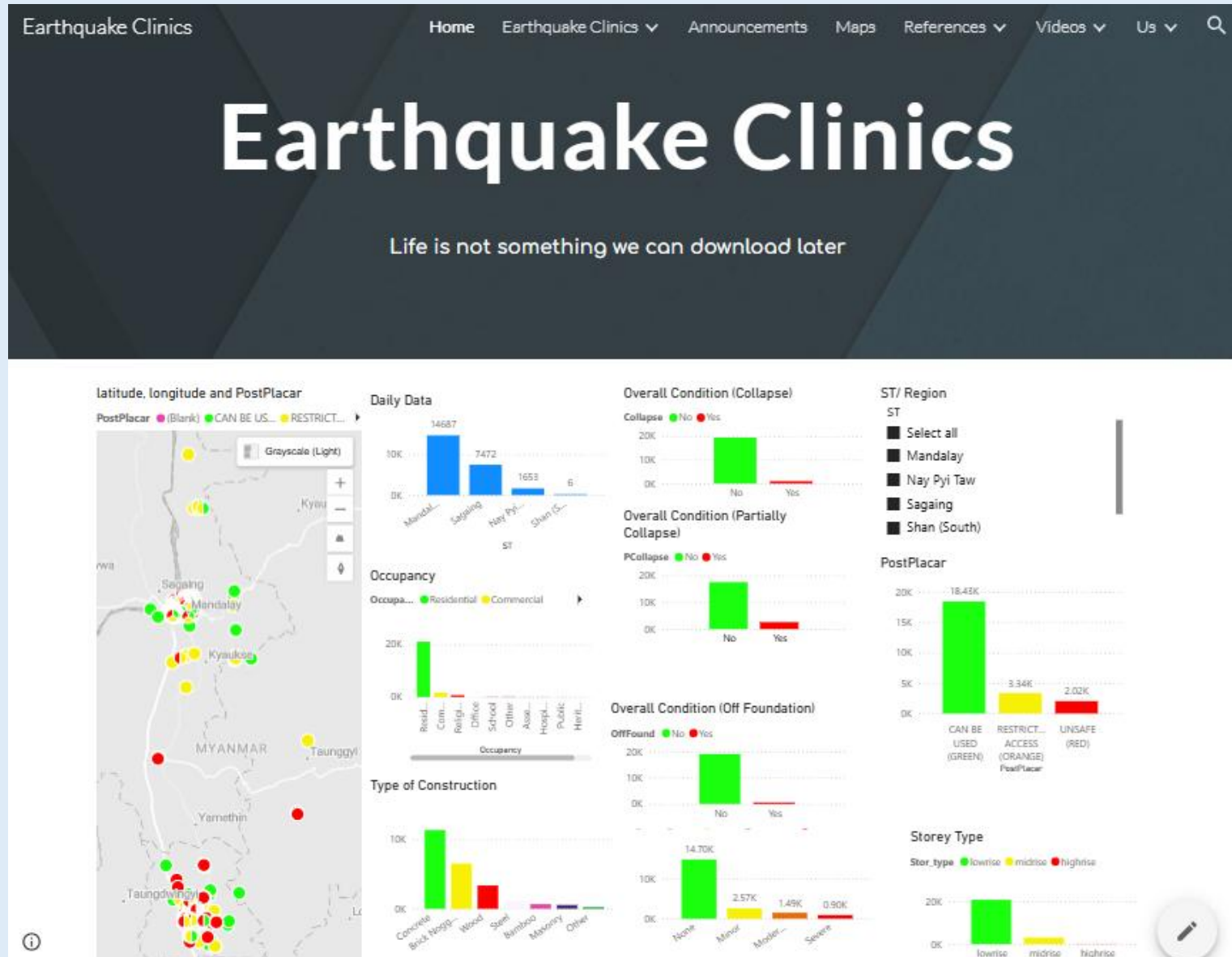
This facility was inspected under emergency conditions for: _____
(Jurisdiction) _____
Inspector ID / Agency: _____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

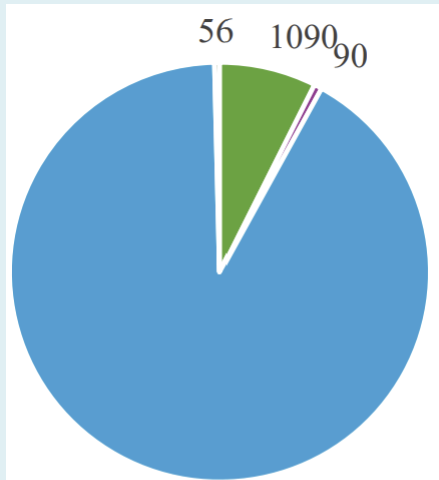
PDRA	Damage State	Owner	Authority	Engineer		
				RE	RSE	PE
Blue/ Green	Few Repair	☐	☐	☐	☐	☐
Orange/ Yellow	Minor Repair	☐	☐	☐	☐	☐
	Major Repair	☐	☐	☒	☐	☐
Red	Retrofit	☐	☐	☒	☒	☐
	Demolish	☐	☐	☒	☒	☐

Earthquake Clinics Web site

<https://sites.google.com/view/earthquakeclinics>



PDRA Survey

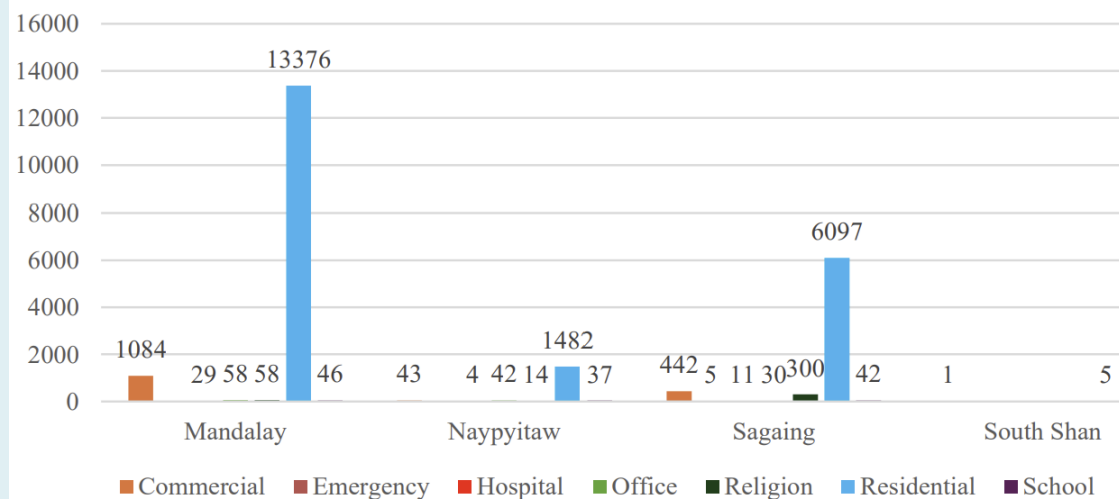


■ Commercial ■ Hospital
 ■ Residential ■ School



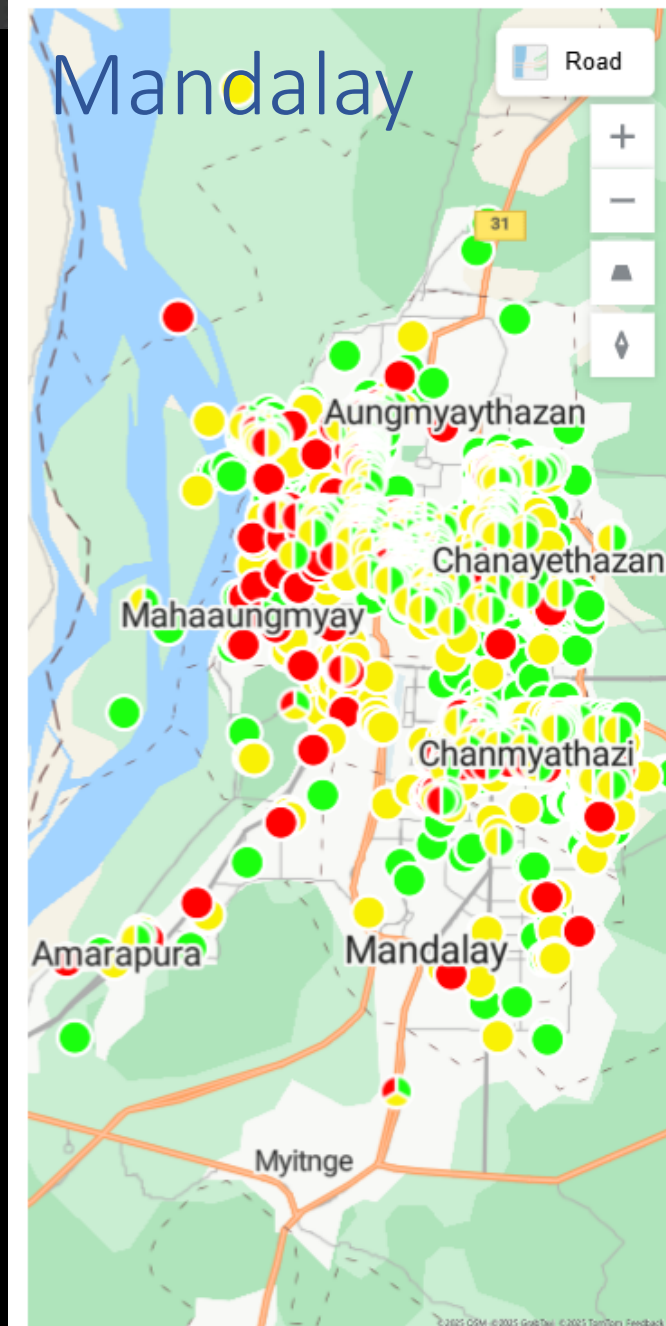
PDRA Dataset

Building Usability Classification by Township (Apr 8 – June 30)

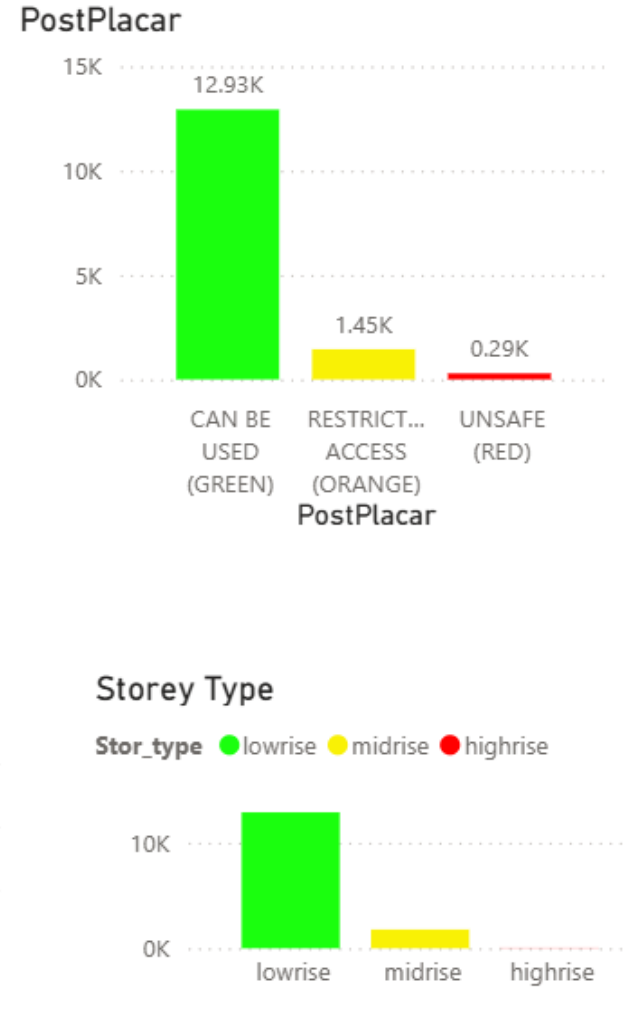
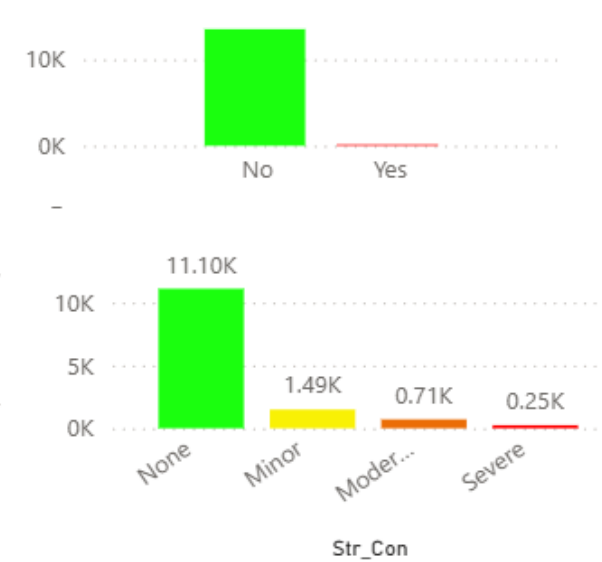
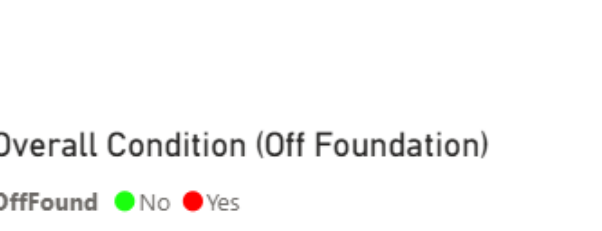
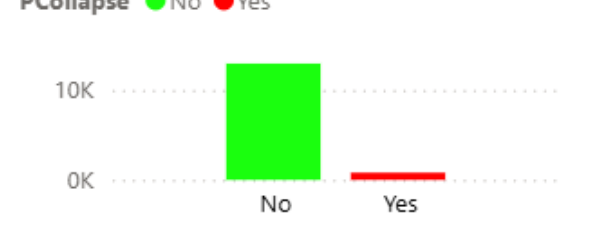
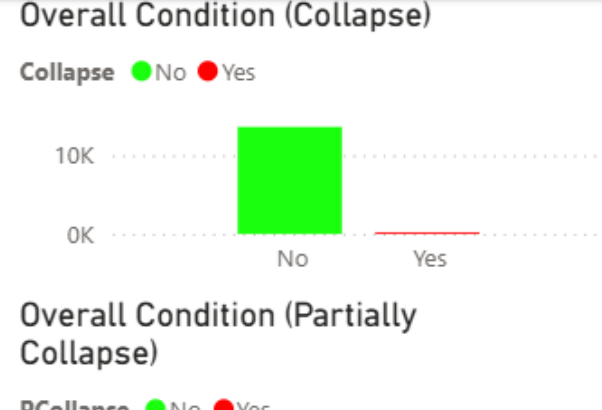
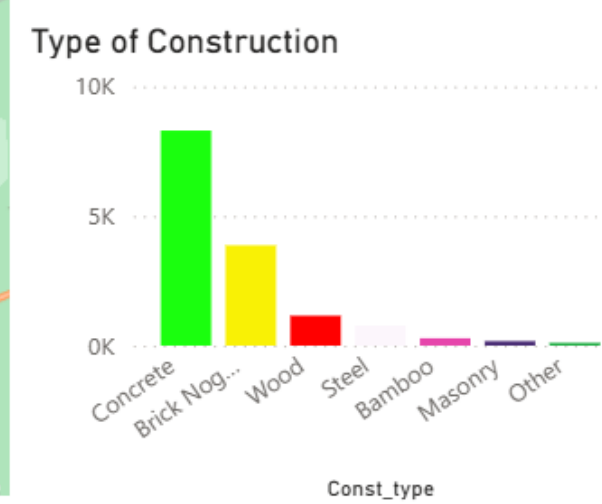
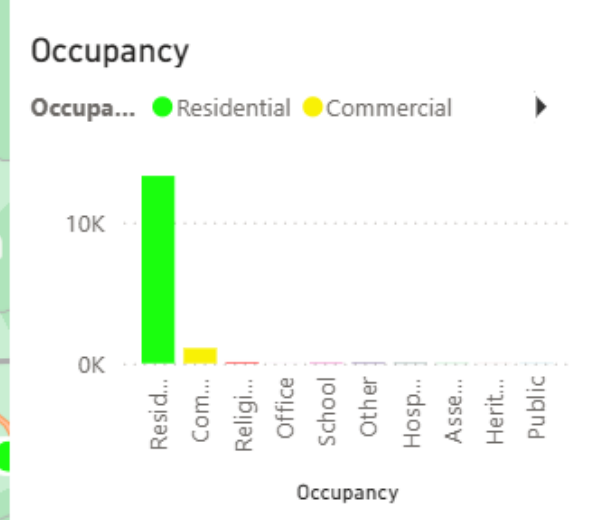
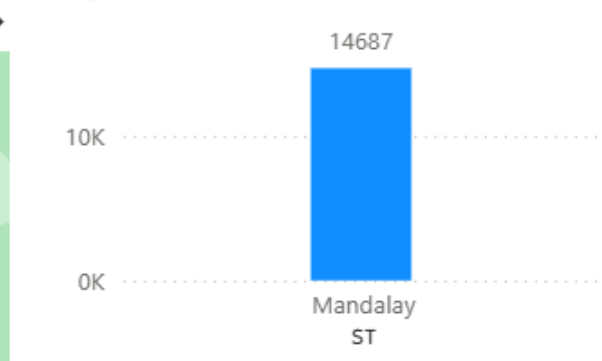


latitude, longitude and PostPlacar

PostPlacar (Blank) CAN BE US... RESTRICT...



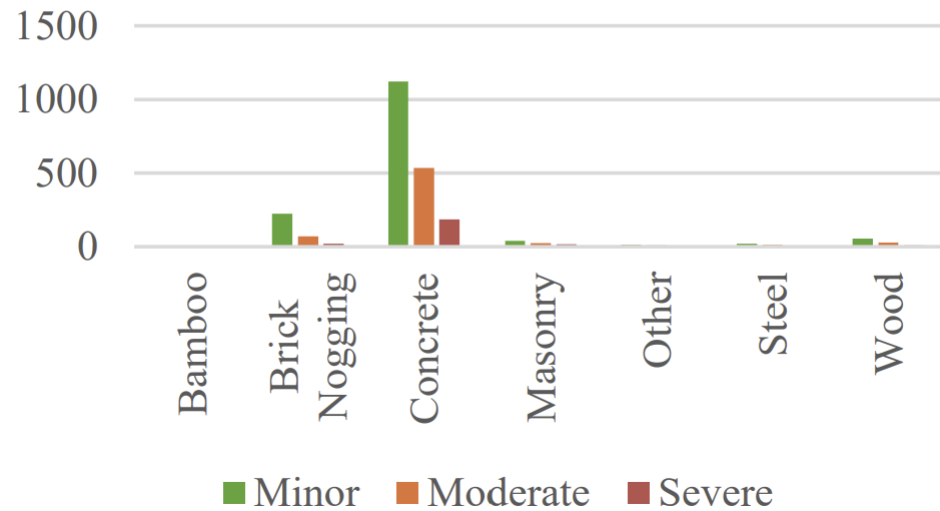
Daily Data



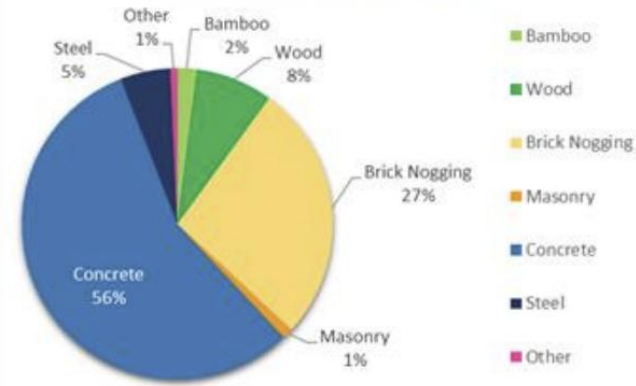
Mandalay Building Typology

Field surveys

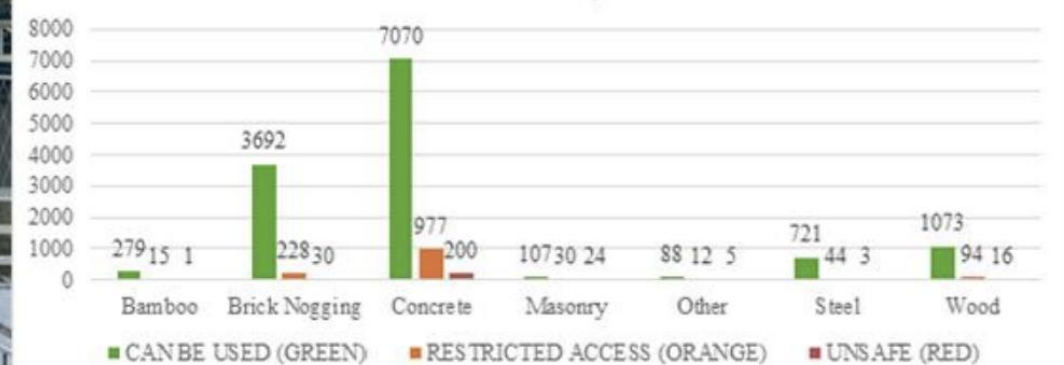
Mandalay Structural Condition



Building Typology of Mandalay

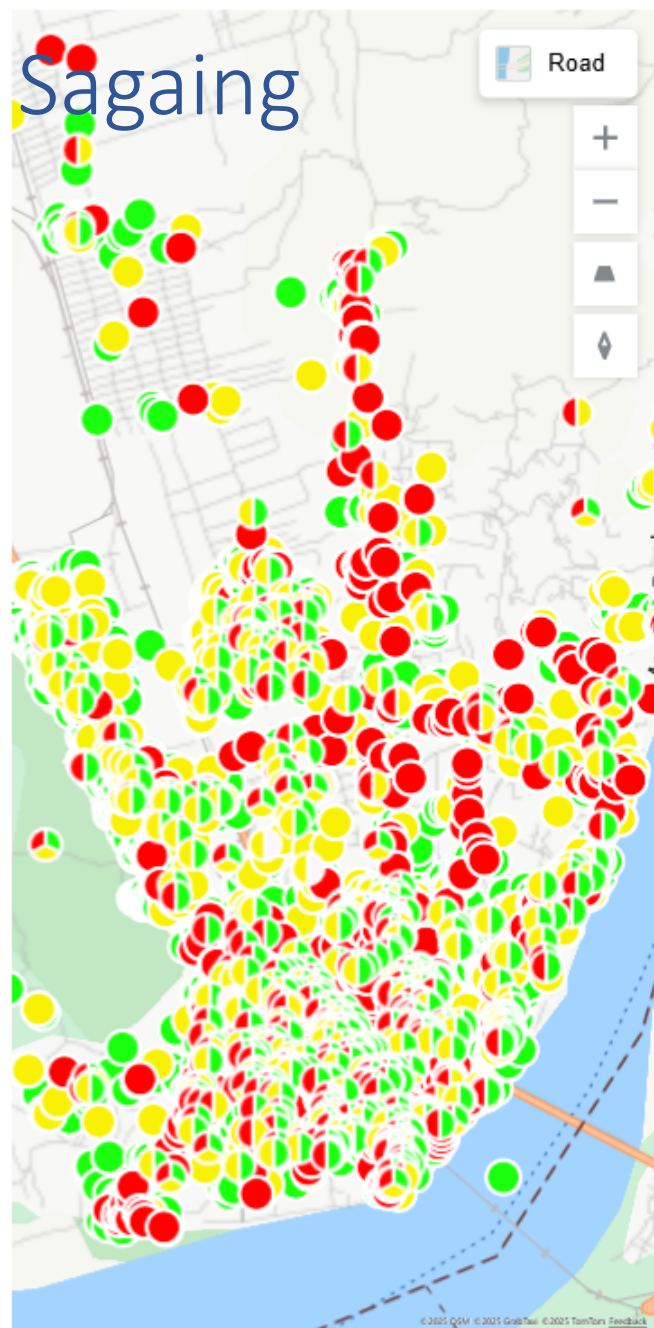


Mandalay

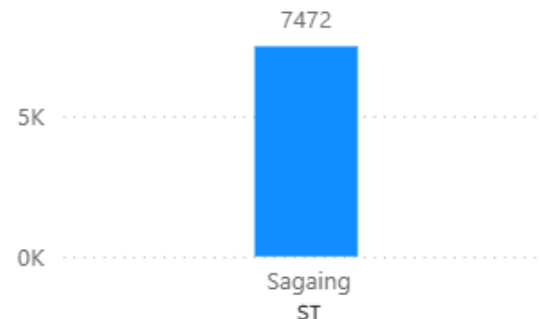


latitude, longitude and PostPlacar

PostPlacar (Blank) CAN BE US... RESTRICT...

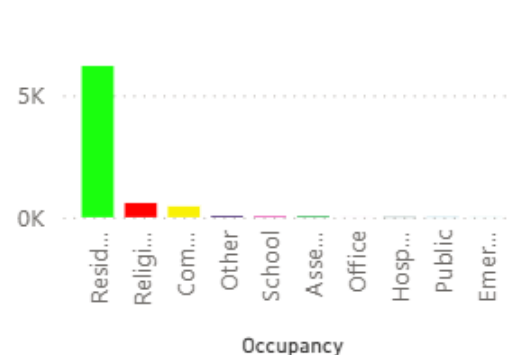


Daily Data

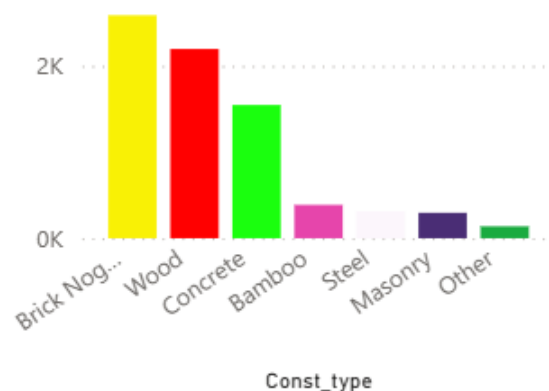


Occupancy

Occupancy: Residential (Green), Religion (Red)



Type of Construction



Overall Condition (Collapse)

Collapse: No (Green), Yes (Red)



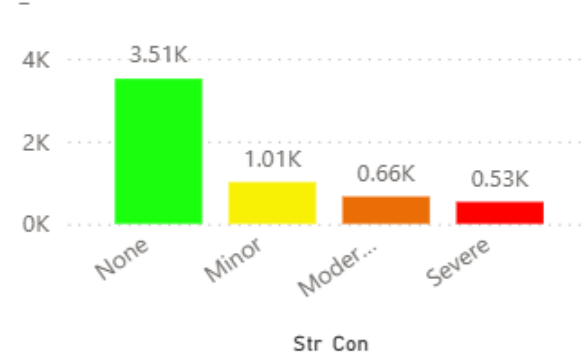
Overall Condition (Partially Collapse)

PCollapse: No (Green), Yes (Red)



Overall Condition (Off Foundation)

OffFound: No (Green), Yes (Red)

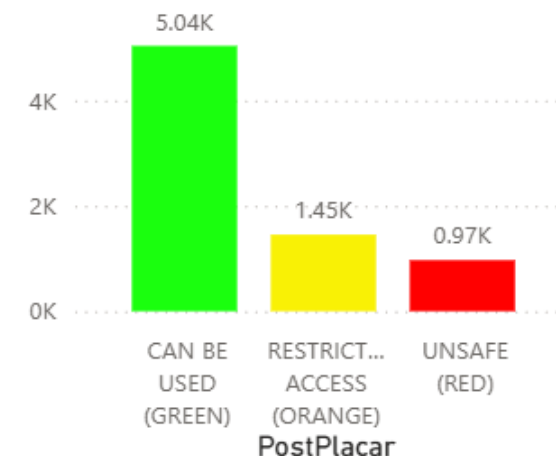


ST/ Region

ST

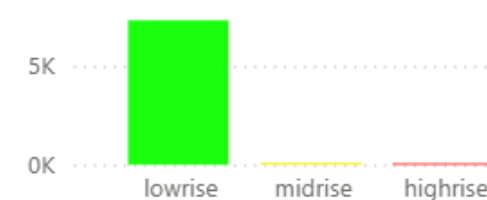
- Select all
- Mandalay
- Nay Pyi Taw
- Sagaing
- Shan (South)

PostPlacar



Storey Type

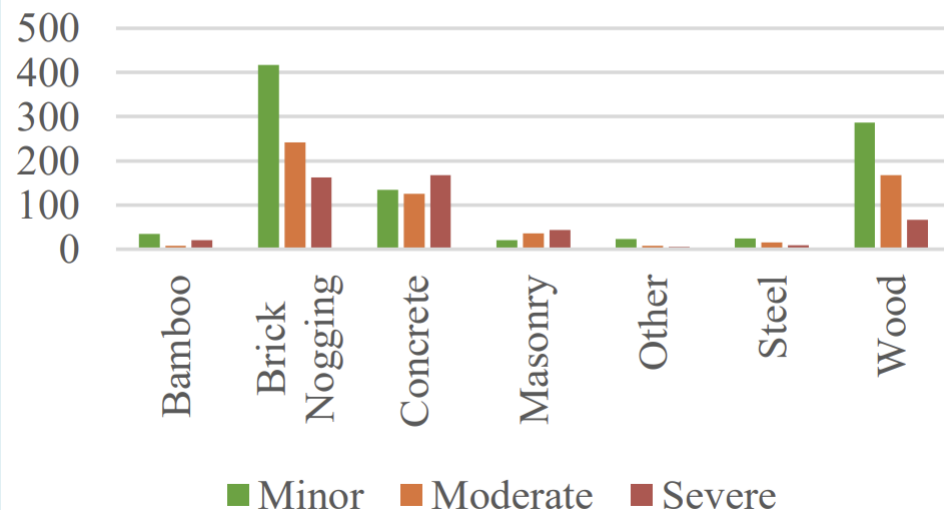
Stor_type: lowrise (Green), midrise (Yellow), highrise (Red)



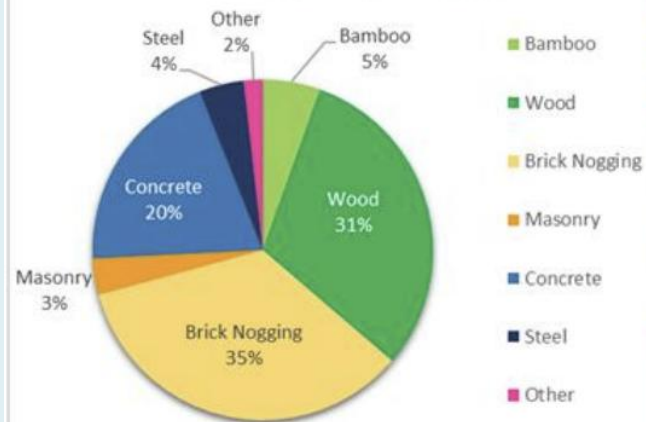
Sagaing Building Typology

Field surveys

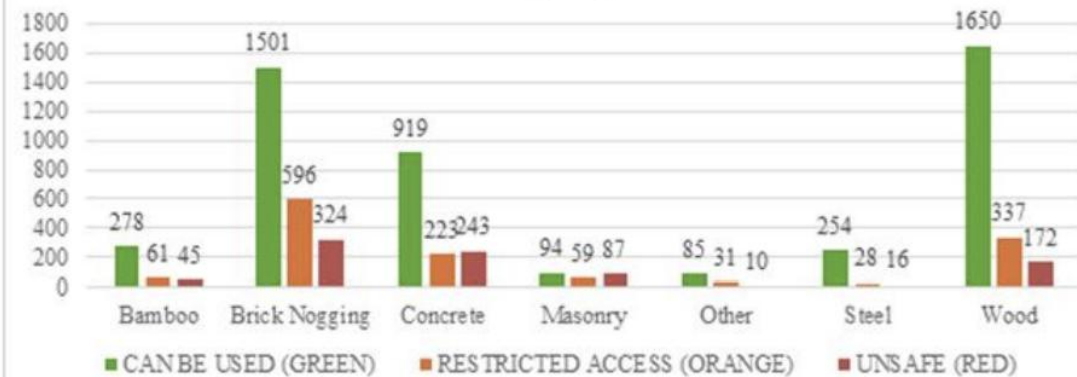
Sagaing Structural Condition



Building Typology of Sagaing

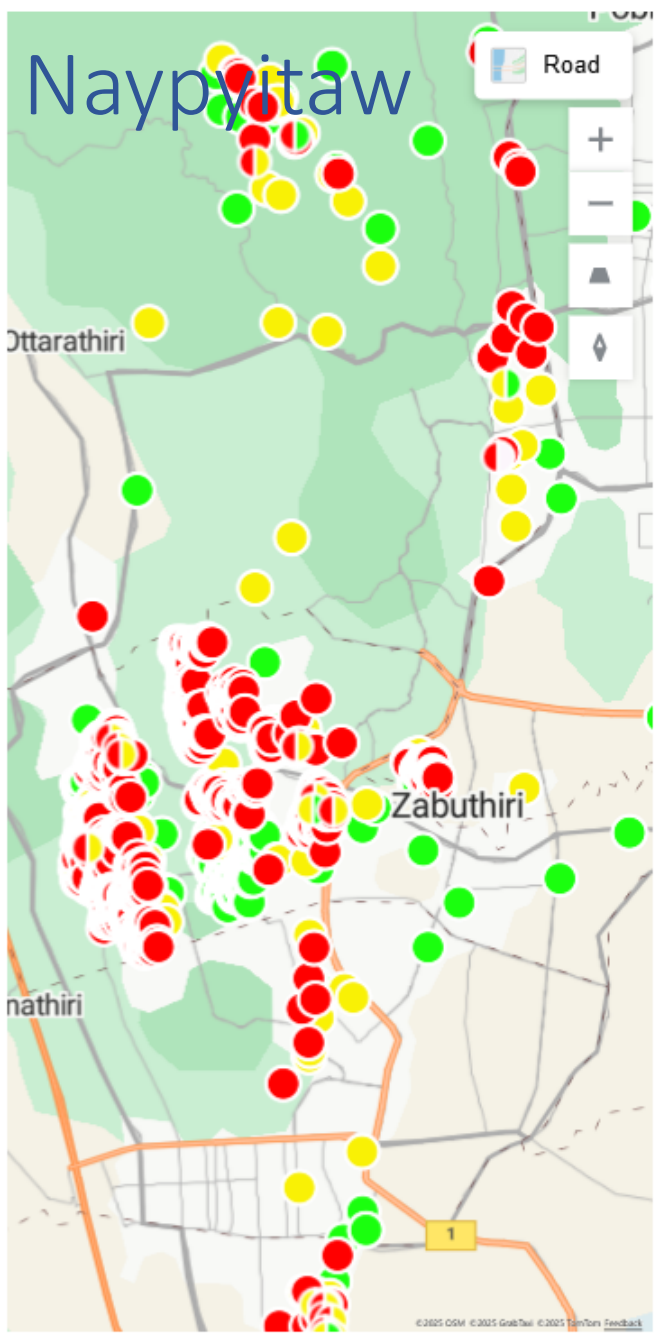


Sagaing

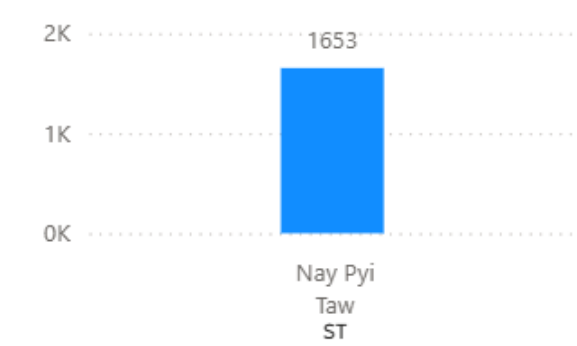


latitude, longitude and PostPlacar

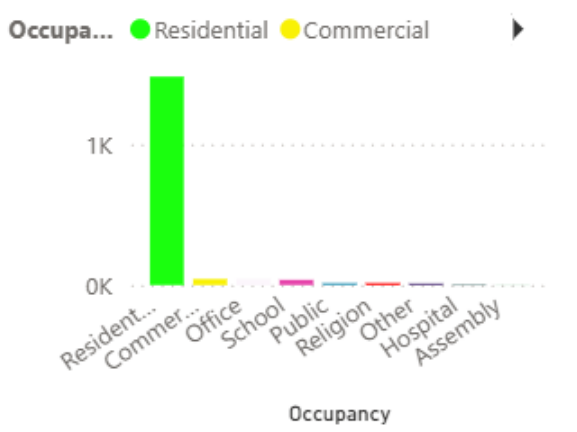
PostPlacar (Blank) CAN BE US... RESTRICT...



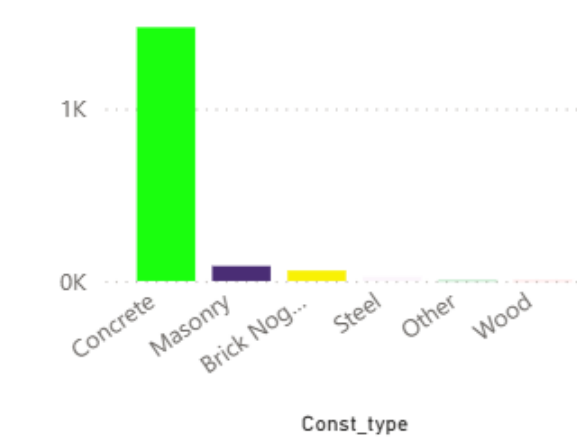
Daily Data



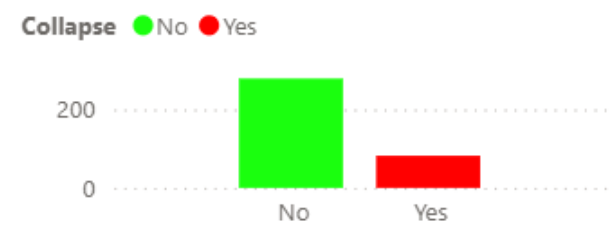
Occupancy



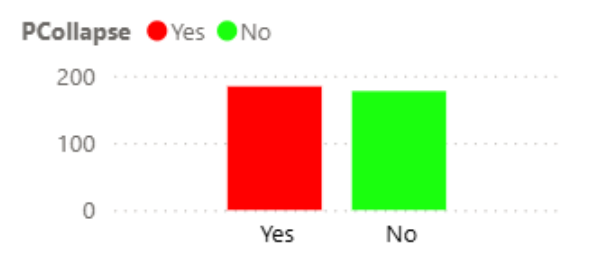
Type of Construction



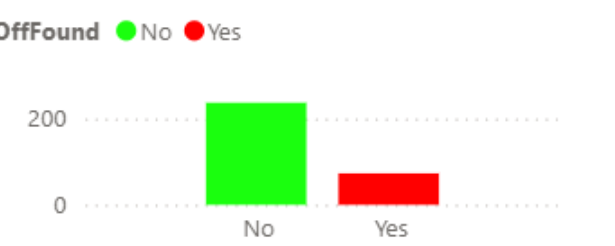
Overall Condition (Collapse)



Overall Condition (Partially Collapse)



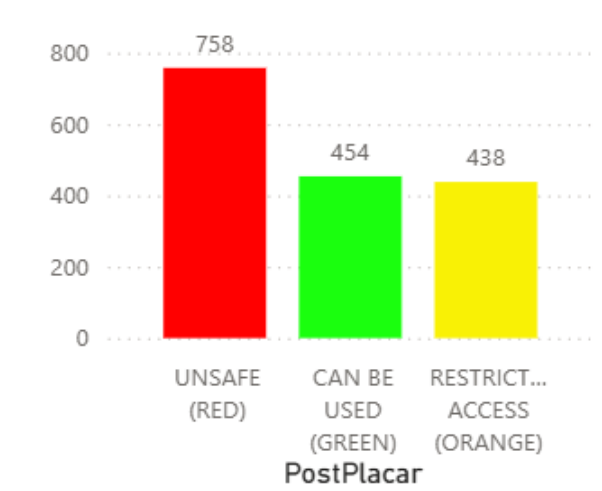
Overall Condition (Off Foundation)



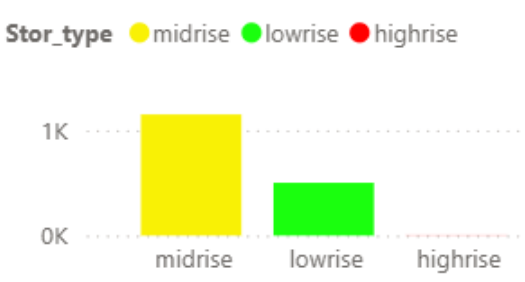
ST/ Region

- ST
- ☒ Select all
 - ☐ Mandalay
 - ☒ Nay Pyi Taw
 - ☐ Sagaing
 - ☐ Shan (South)

PostPlacar

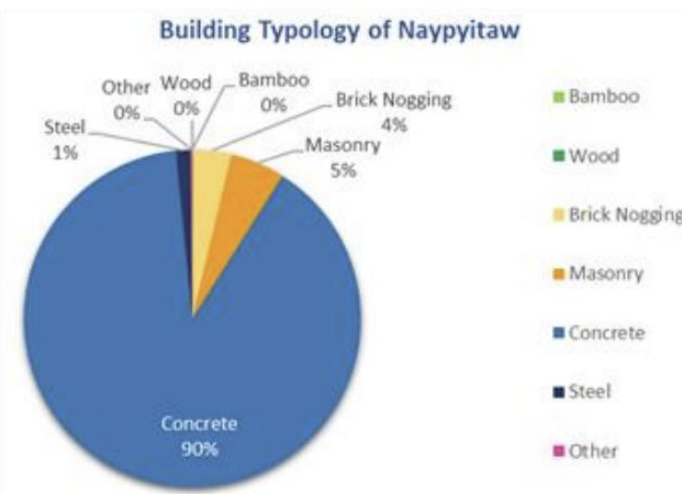


Storey Type



Naypyitaw Building Typology

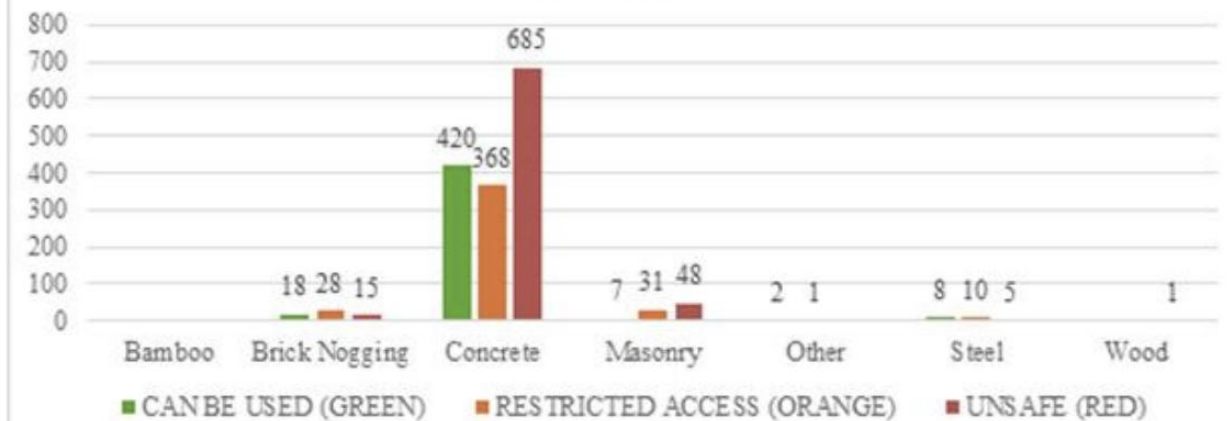
Field surveys



Nay Pyi Taw Structural Condition

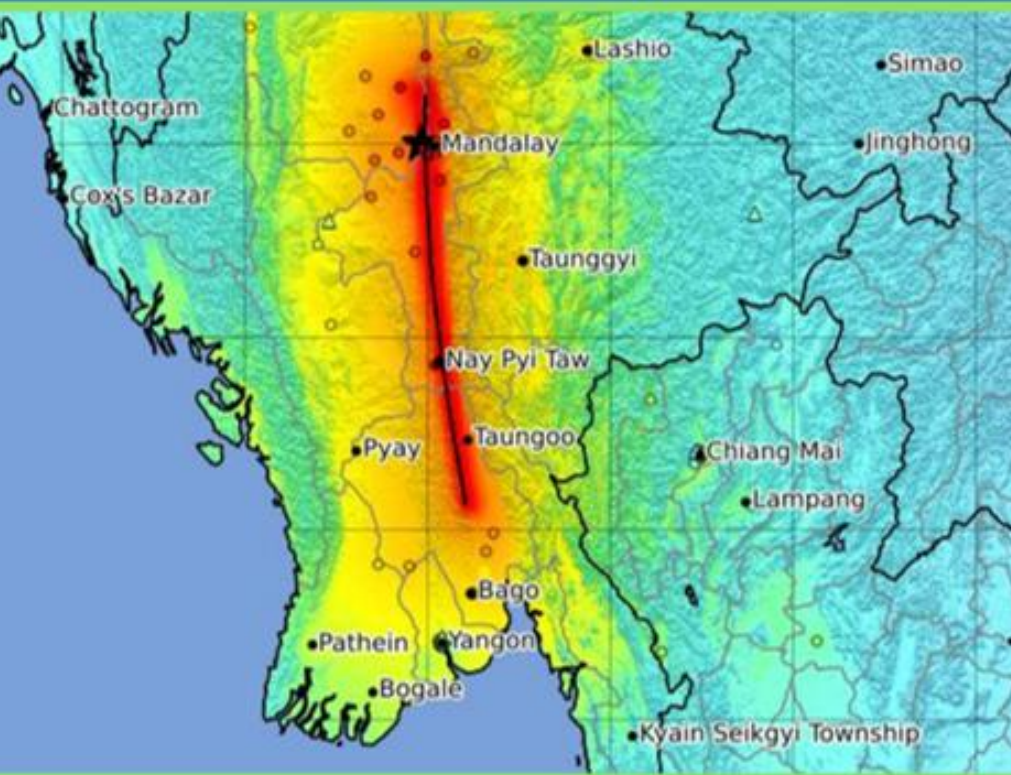


Nay Pyi Taw



Post Disaster Rapid Damage Assessment (PDRA) Report

7.7 Mandalay Earthquake 2025 Engineering Response & Recovery



PDRA Report

- PDRA report has been published in June 2025.

- End of Part 1



Part 2: Post-Disaster Structural Review (PDSR)

PDRA

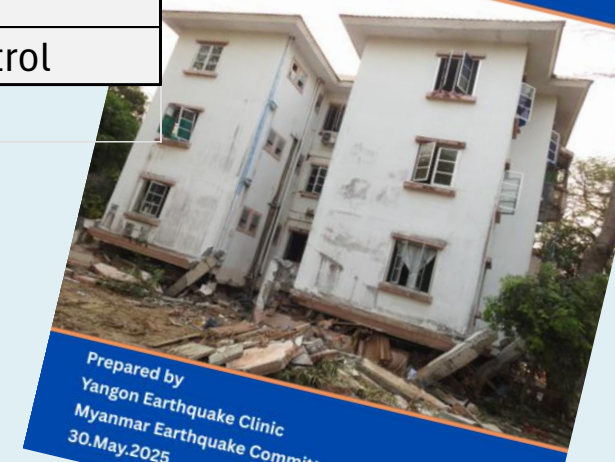


PDRA	Damage State	Owner	Authority	Engineer			Repair Strategy
				RE	RSE	PE	
Blue/ Green	Few Repair	○	◐	○	○	○	Repair with general guidelines, SOPs
Orange/ Yellow	Minor Repair	○	◐	○	○	○	Retrofit Design and Repair
	Major Repair	○	○	●	○	○	
Red	Retrofit	○	○	●	●	○	
	Demolish	○	○	●	●	○	Demolishing with Damage Control
Major Repair + Retrofit							



PDSR

GUIDELINE FOR SEISMIC
EVALUATION AND
RETROFITTING OF EARTHQUAKE
DAMAGE BUILDINGS FOR
MANDALAY EARTHQUAKE



Prepared by
Yangon Earthquake Clinic
Myanmar Earthquake Committee
30.May.2025



Structural Review Training and Retrofit Design Training

- Training every Wednesday since the first week of May.
- The structural assessment and retrofit guidelines has been prepared based on **ASCE 41-17** and **FEMA P-2335**



Guidelines for Post-Earthquake Repair and Retrofit of Buildings Based on Assessment of Performance-Critical Damage

FEMA P-2335 / May 2025



ASCE/SEI
41-17

Seismic Evaluation and Retrofit of Existing Buildings

PDSR Scheme

ASCE41-17

- Existing buildings
- Before Earthquake
- Deficiency based
- All building types

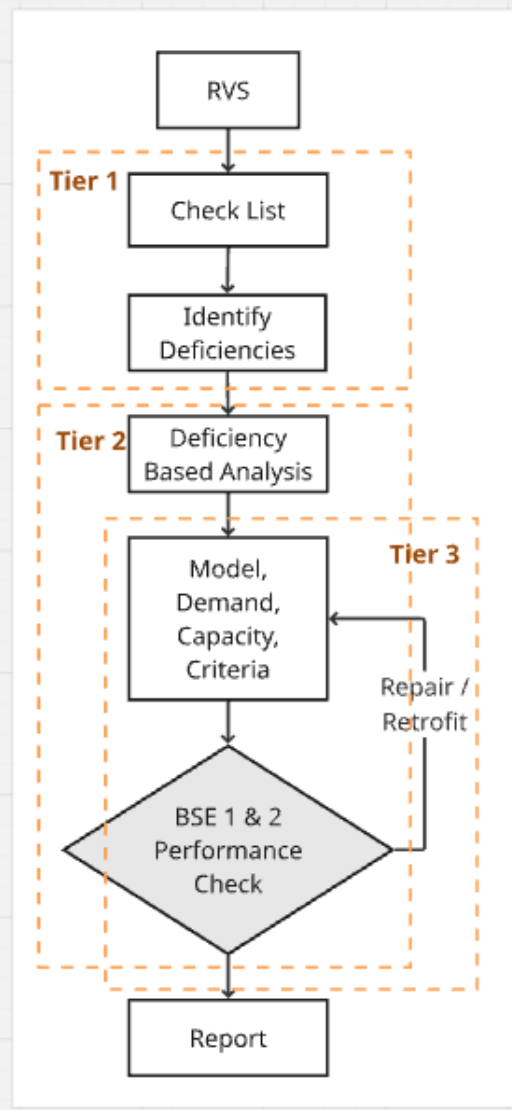
FEMA P2335-25

- Damaged buildings
- After Earthquake
- Damage based
- Concrete buildings only

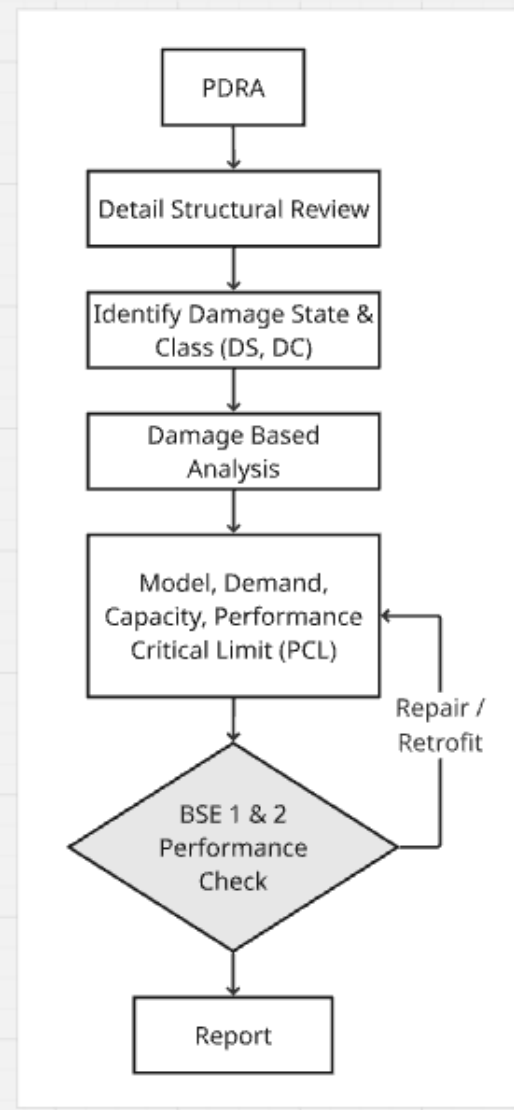
PDSR

- PDRA base
- Apply to all building types

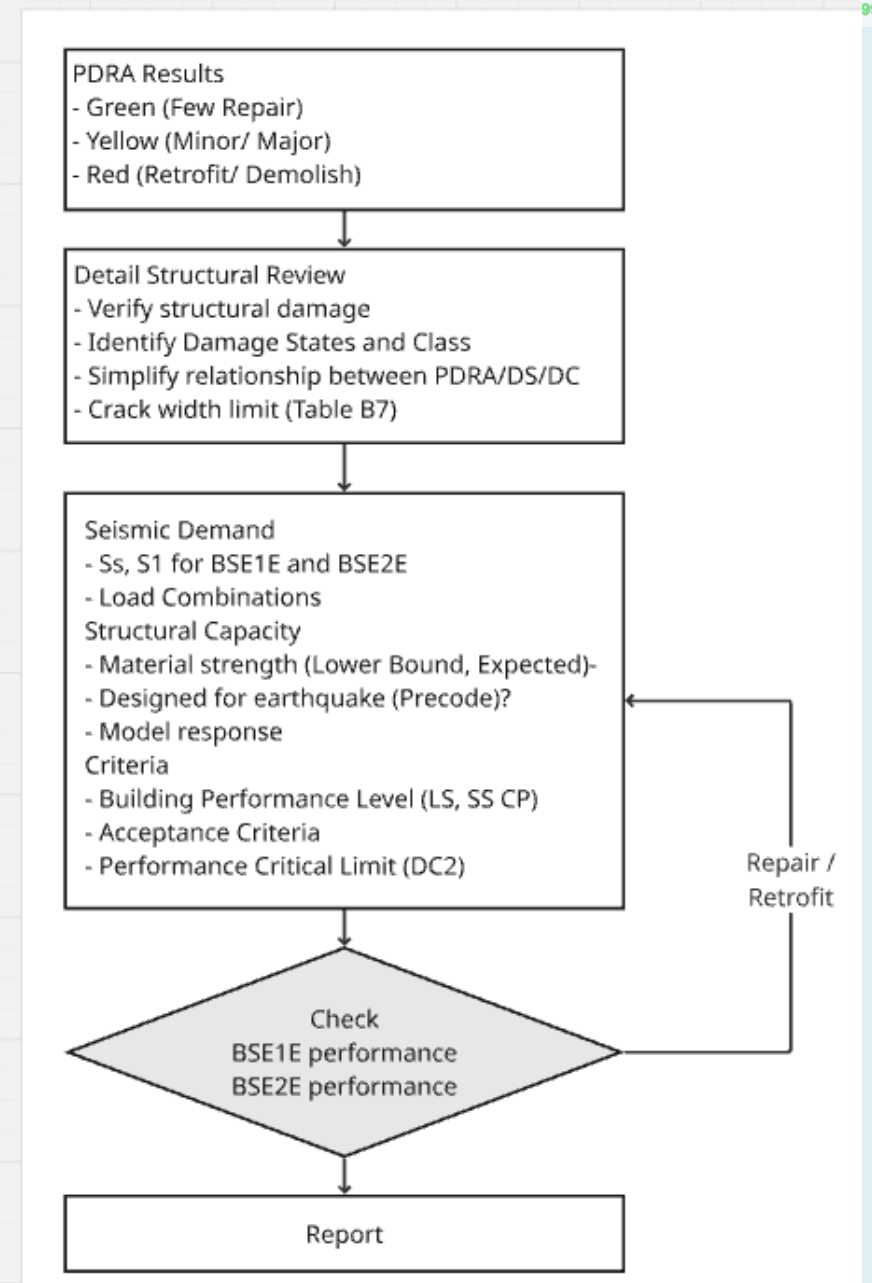
Deficiency Based Evaluation- ASCE41-17



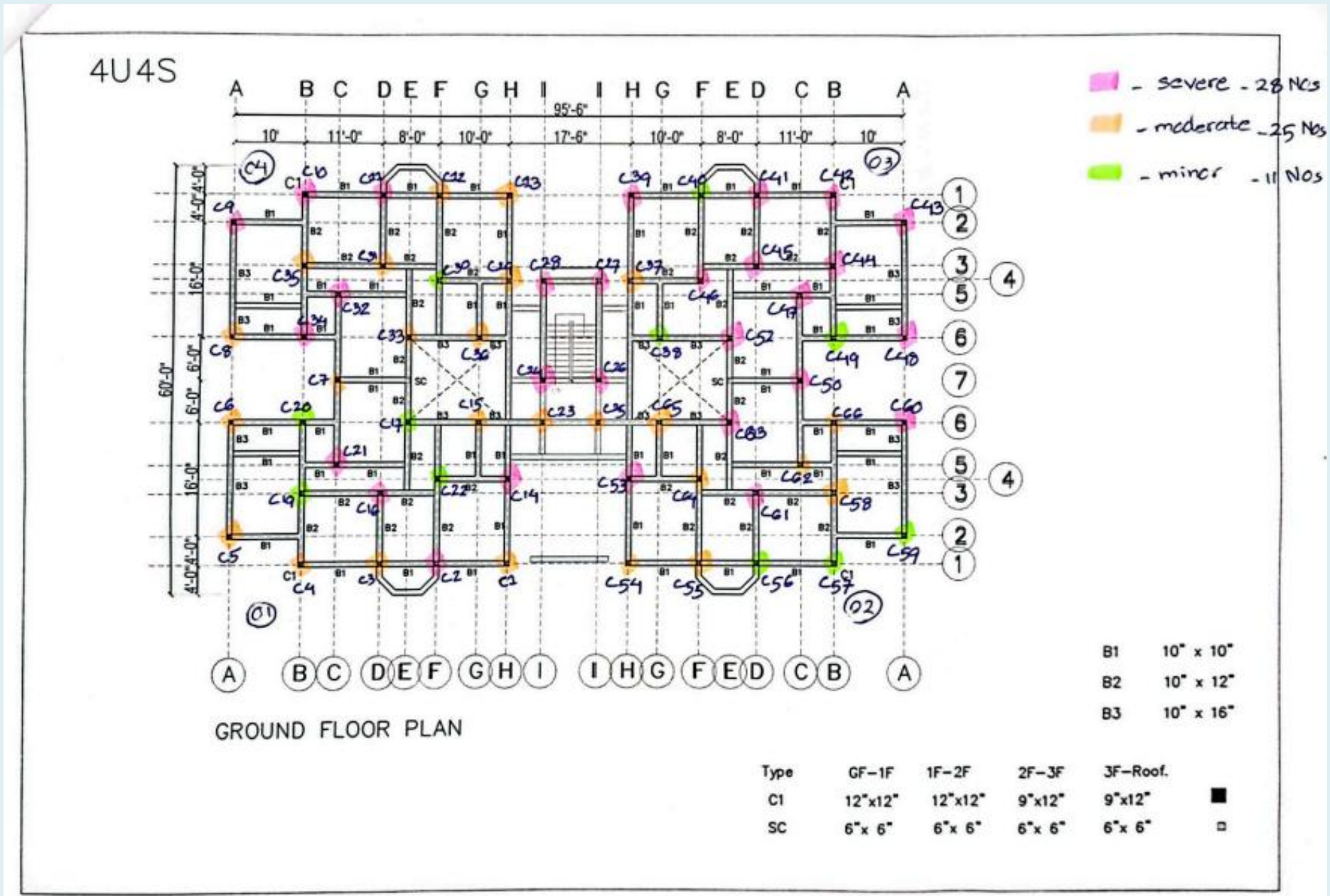
Damage Based Evaluation- FEMA P2335



Post Disaster Structural Review (PDSR)



Field Observation: PDRA Summary



Field Observation: PDRA Damages



GF - C10 (Severe)



GF - C13 (Severe)



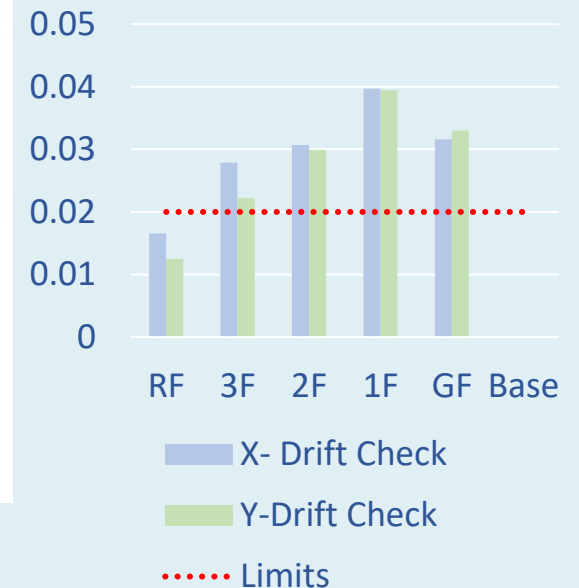
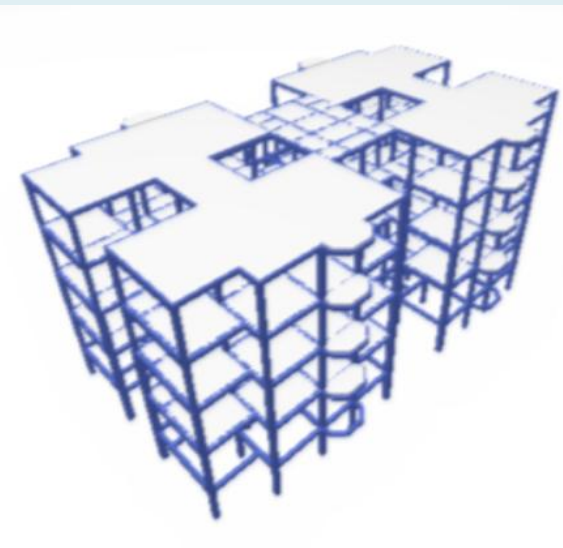
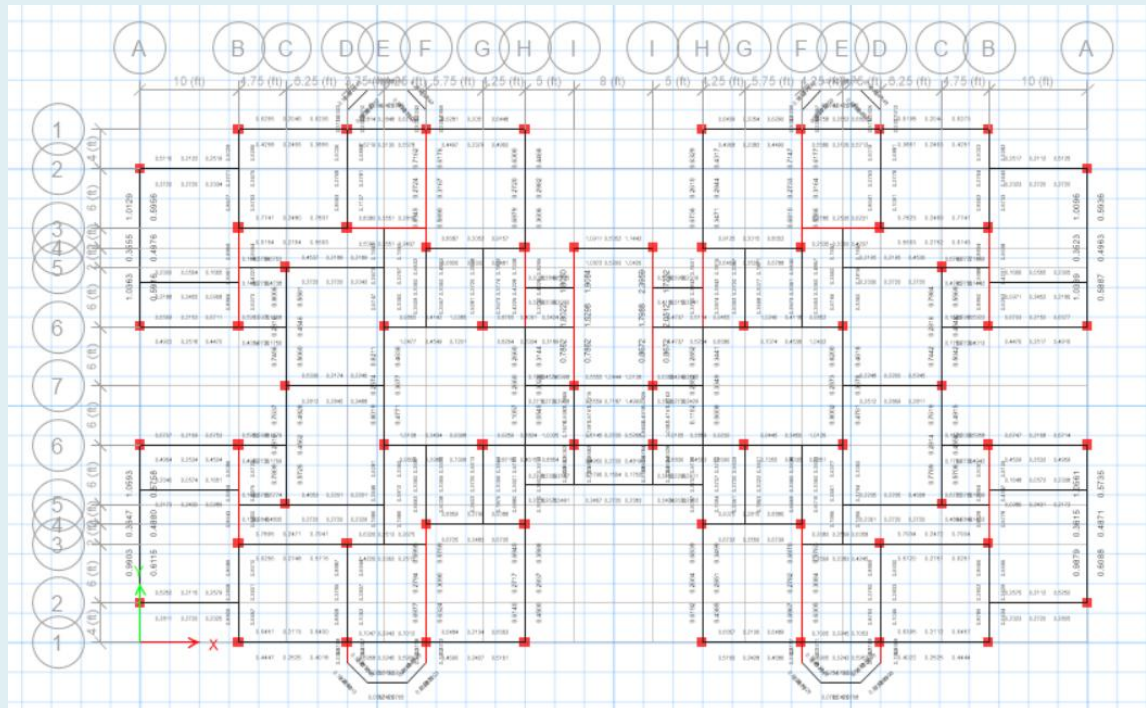
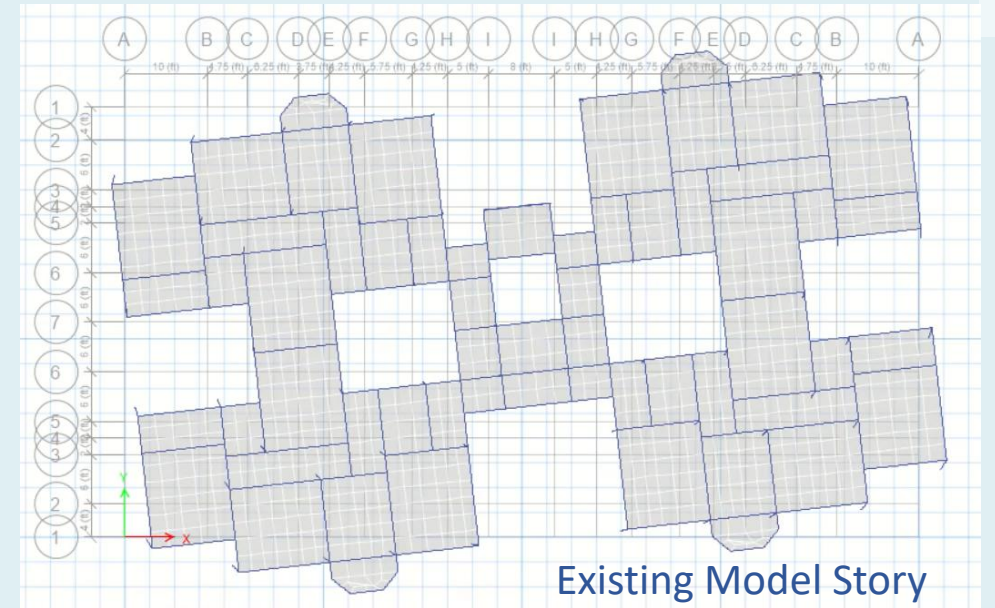
GF - C2 (Moderate)



GF - C3 (Moderate)

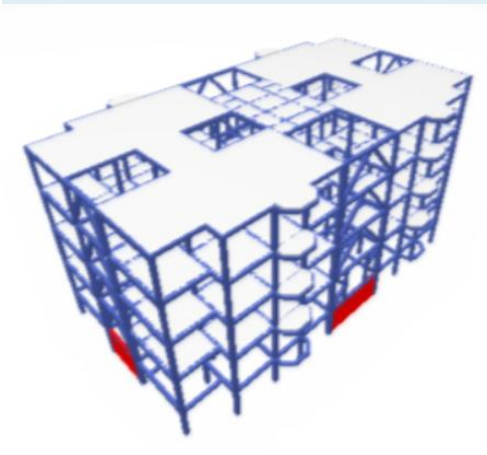
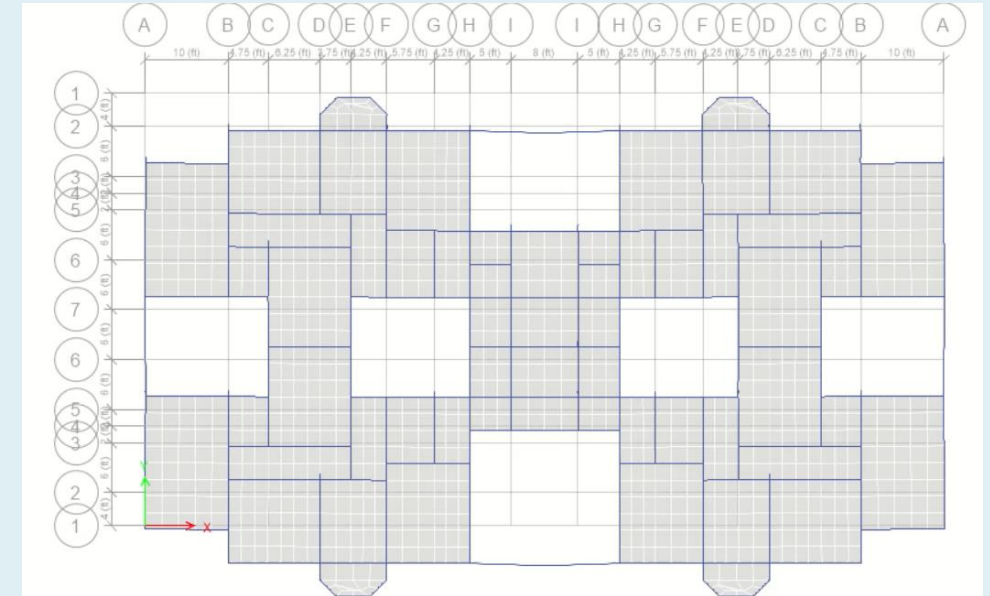
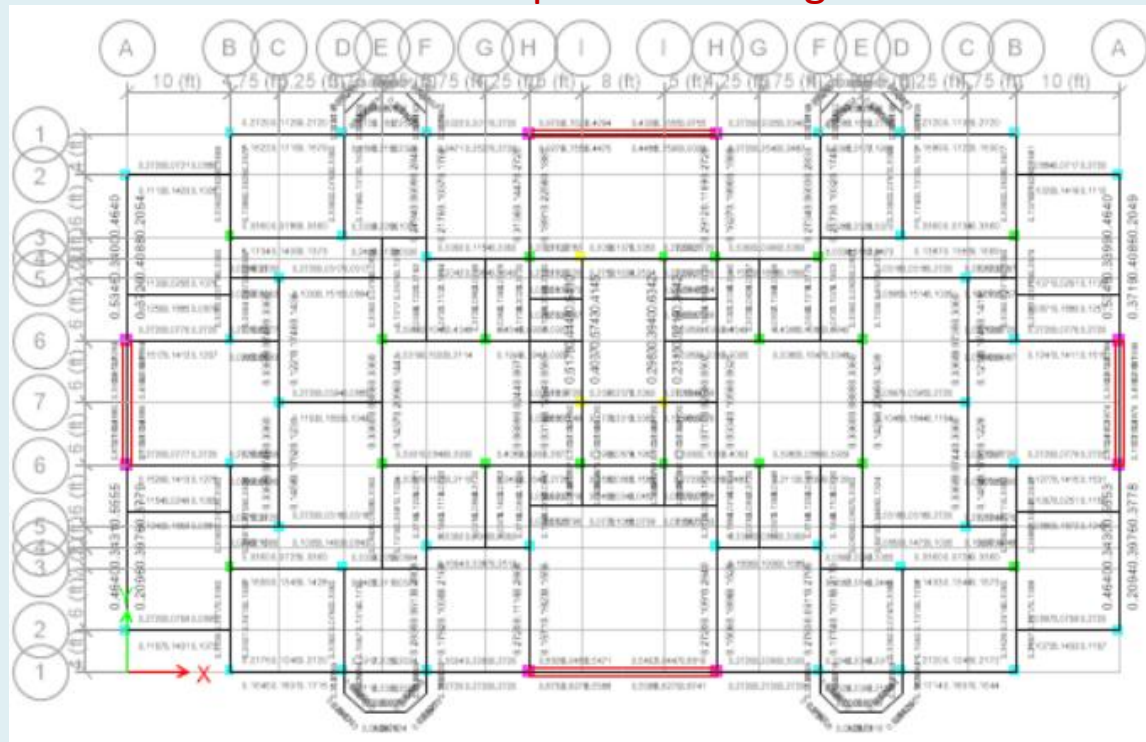
Existing Model Performances

- No Lateral Force Resisting System
- First mode in rotation
- Drift limit exceed
- Many concrete columns are failed in design check.

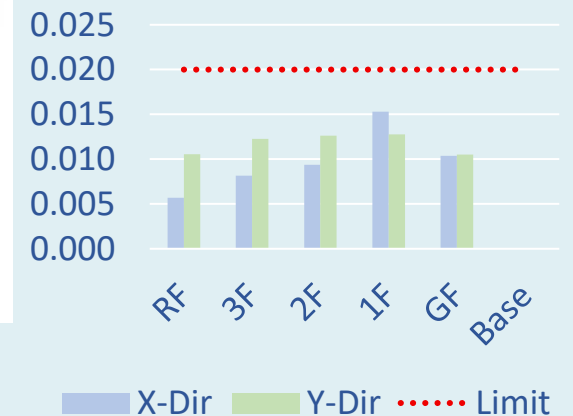


Retrofit Model Performances

- System Improvement:
 - Add Lateral Force Resisting Frames in re-entrant corners
- First and second modes in translation
- Drift within limit
- All structural members passed in design check.



Retrofit Model Story Drift



GUIDELINE FOR SEISMIC EVALUATION AND RETROFITTING OF EARTHQUAKE DAMAGE BUILDINGS FOR MANDALAY EARTHQUAKE



Prepared by
Yangon Earthquake Clinic
Myanmar Earthquake Committee
30.May.2025

Summary of PDSR Guideline

- Check performance in **Two Earthquake Levels** with respected **Performance Objectives**.
 - Structural components **failed more than 25%** of total in a story, system improvement is recommended.
 - Identify **system deficiencies** and improve if necessary.
 - **Repair all damages.**
-
- End of Part 2

Damage Zone and Fault Zone Maps

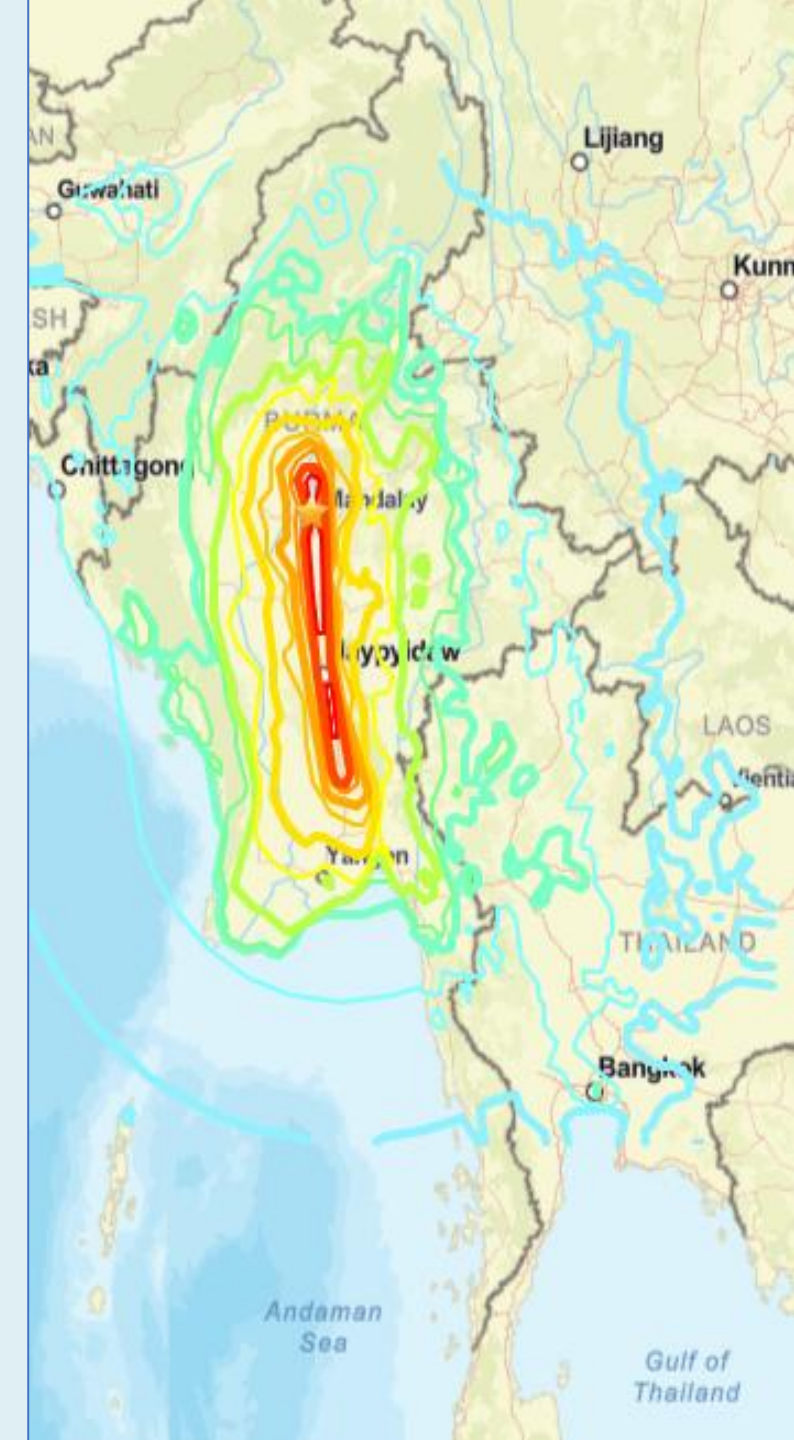
Structural Assessments

- Post Disaster Rapid Assessment (PDRA)
- Post Disaster Structural Review (PDSR)

Damage and Fault Zone Maps

Based on damage assessment data and ground studies from field collaborations and other on-line sources, following maps were prepared.

- Damage Zone Map
 - To prioritize areas and reconstruction activities
 - Efficient resource allocation and coordination
- Fault Zone Map
 - To develop risk base land use planning
 - To setup regulatory compliance system
 - To enhance mitigation, early warning and monitoring system



Damage Zone Map

Based Maps

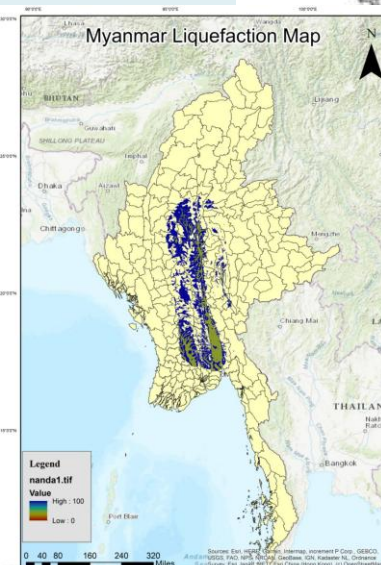
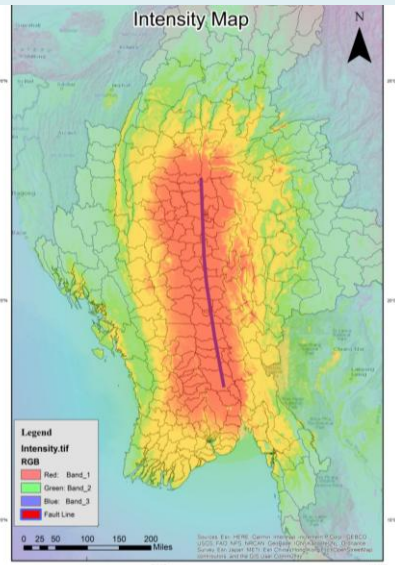
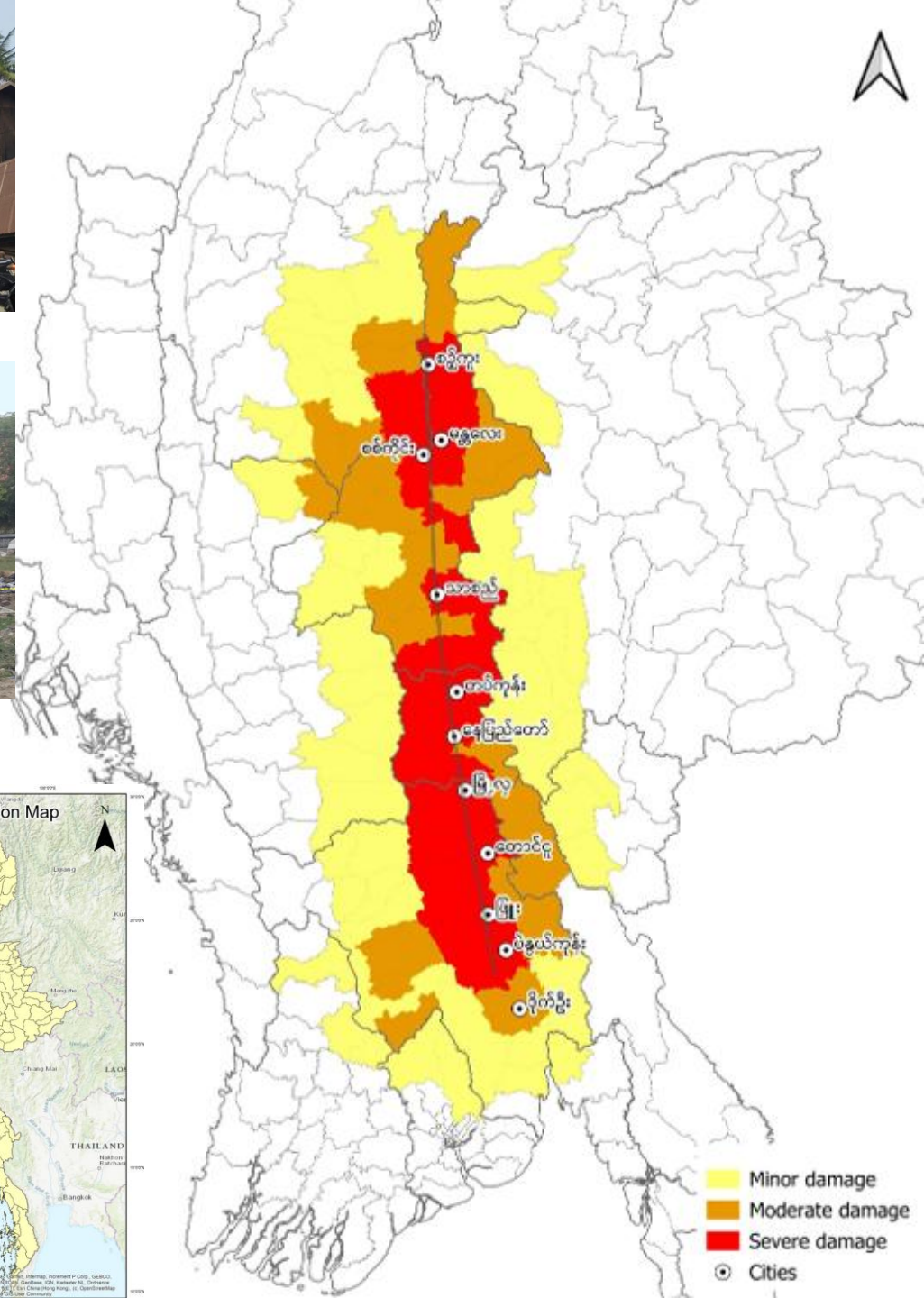
- Fault Model Rupture Line Map
- Intensity Map
- Landslide Risk Map
- Liquefaction Risk Map

Damaged Zone Map

- Field ground verifications
- Based on Township boundary
- Classified into Severe (Red), Moderate (Brown), Minor (Yellow) zones.



Sagaing Buddha Museum Road



- Minor damage
- Moderate damage
- Severe damage
- Cities

Proposed Fault Zone Mapping and Urban Planning Controls

■ Red, Fault Zone – High-Risk

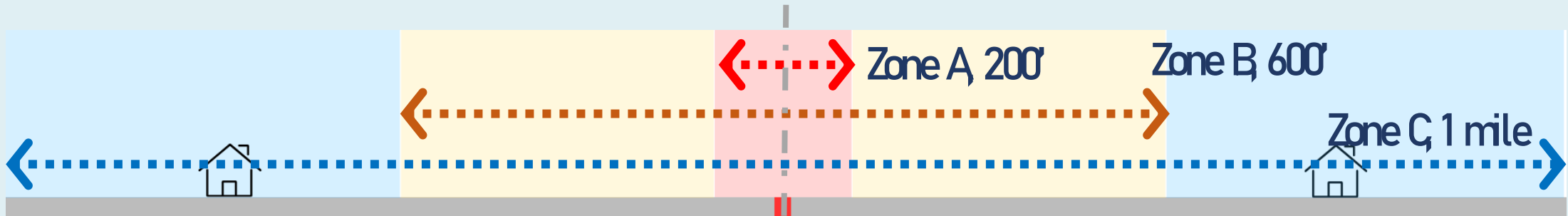
Location: 100 ft (30m) each side

■ Yellow, Buffer Zone – Moderate-Risk

Location: 300 ft (100 m) each side

■ Blue, Observe Zone – Low-Risk

Location: 0.5 miles (0.8 km) each side



- **Zone A: 200 feet wide**—immediately adjacent to the fault, representing the highest danger of surface rupture and ground displacement.
- **Zone B: 600 feet wide**—buffer zone with elevated risk, where existing buildings and infrastructure require stringent review and retrofitting.
- **Zone C: 1 mile wide**—wider area for controlled urban development, where new construction must adhere to enhanced seismic safety standards.

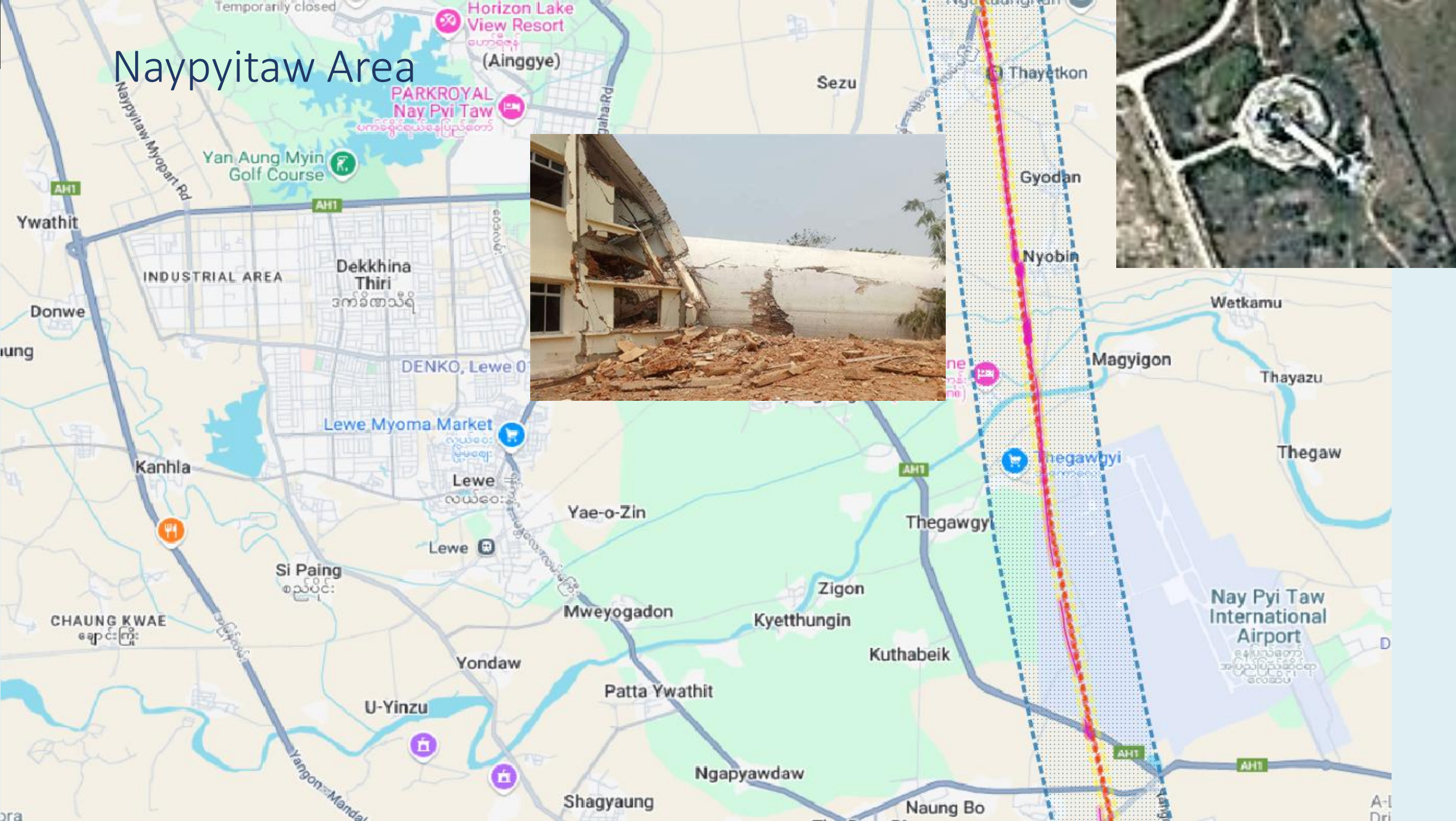
Destruction of Infrastructure and Urban Impact

Key infrastructures

- Sagaing market
- Sagaing bridge
- Myitnge bridge
- Mandalay International Airport
- Naypyitaw Ottarathiri Hospital
- Naypyitaw Airport
- Etc.



Naypyitaw Area

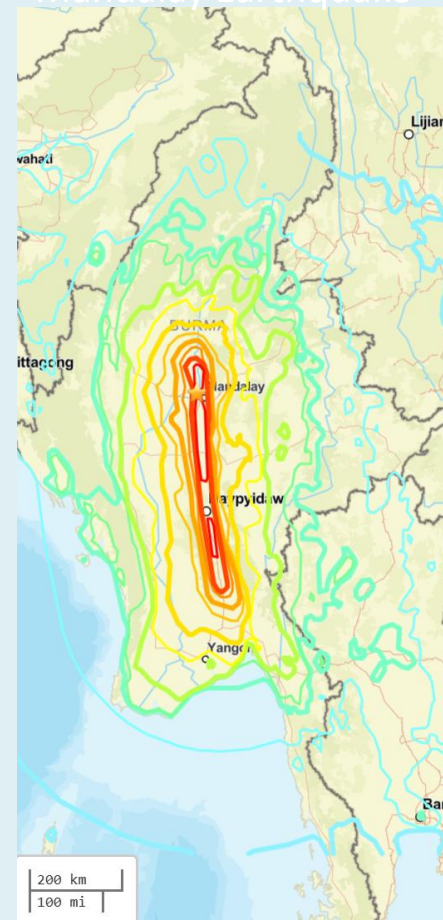


MNBC 2025 updates

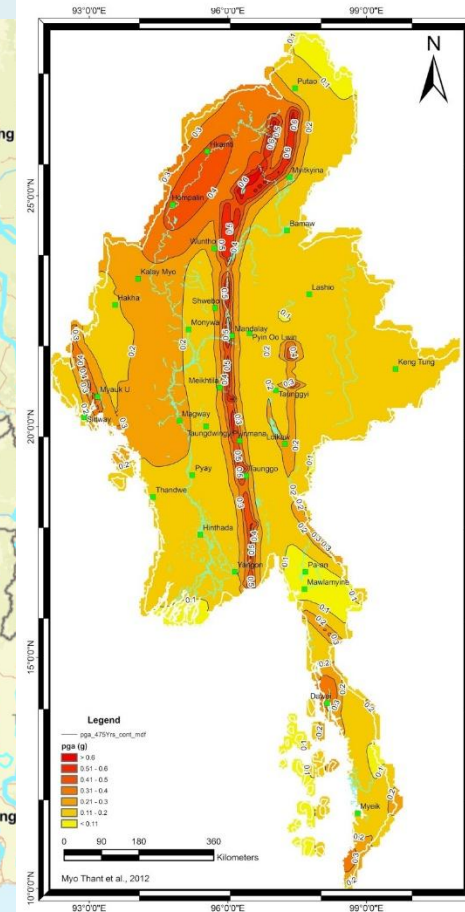


- Tall buildings (12+ stories with code review process) do not damage much.
- Mandalay Earthquake Intensity is relevant to MNBC2020 and MNBC2025 intensity map data.
- In MNBC2025 update, seismic safety has been enhanced by-
 - Seismic Force Increment (1.3) to all Ground Floor Columns for high seismic area unless rho is already applied.
 - Compulsory Ductile Detailing for all buildings

Mandalay Earthquake

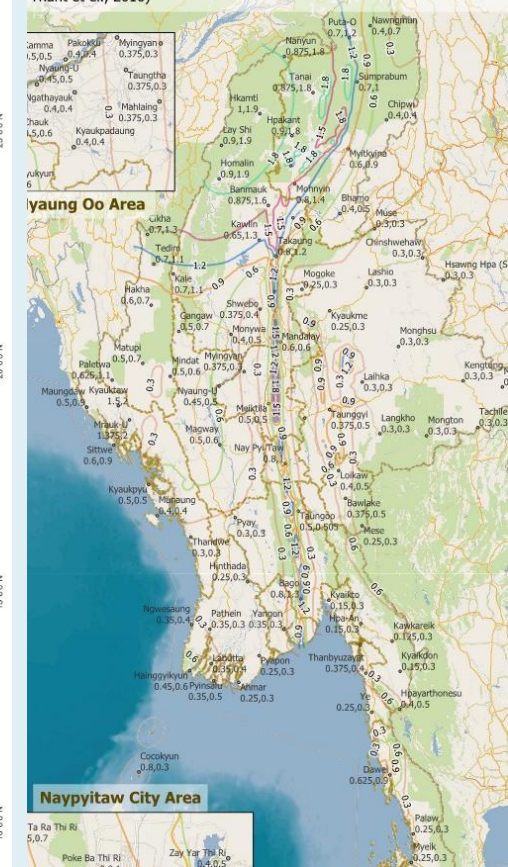


MNBC2020



MNBC2025

num Considered Earthquake Ground Motion for 1.0 Sec Spectral Response
 eration at 2% in 50 Years with 5% Critical Damping for Site Class B
 Thant et al., 2016)



Thank you

Myanmar Earthquake Clinics