Comparisons of coastal recovery following tsunami

Professor Alison Raby,
Head of the COAST Engineering Research Group

Tsunami research:
Modelling and Impacts on Built Environment

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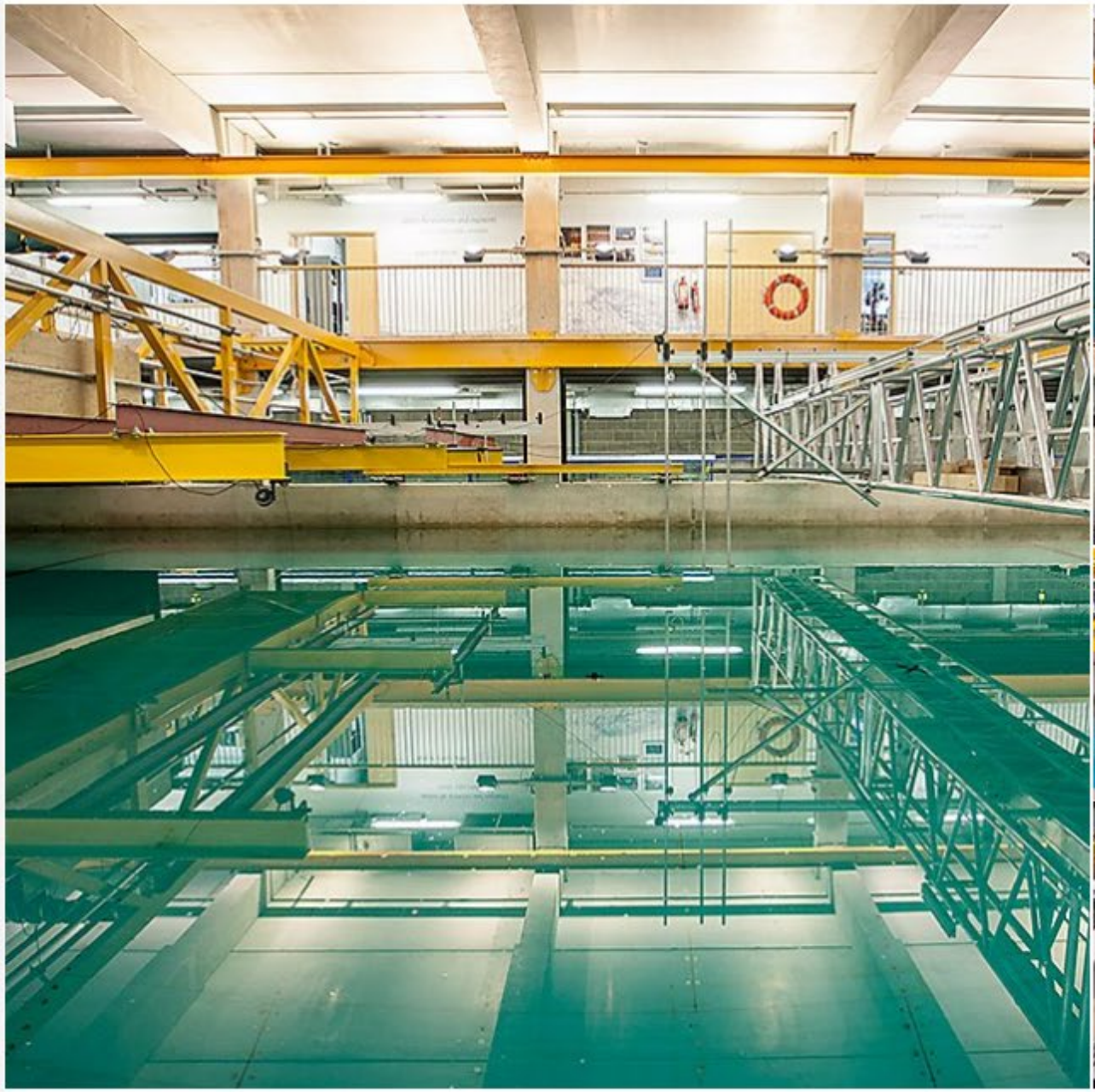
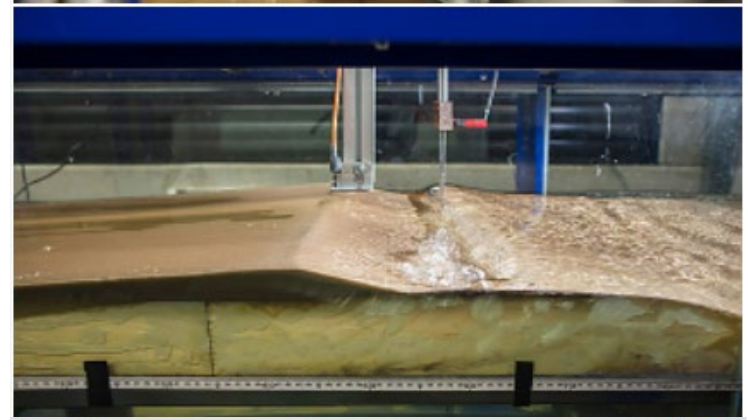
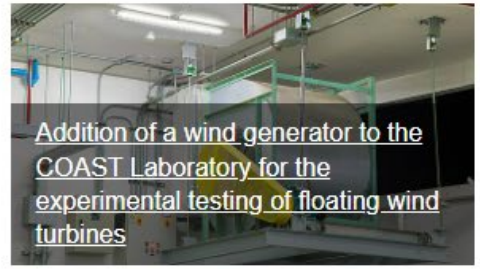
University of Bath - 20 November 2023





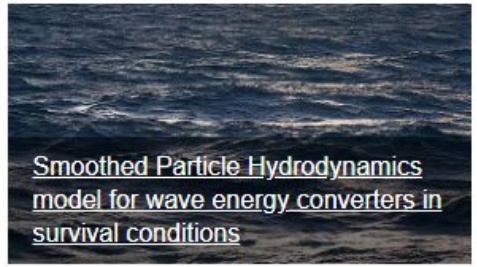


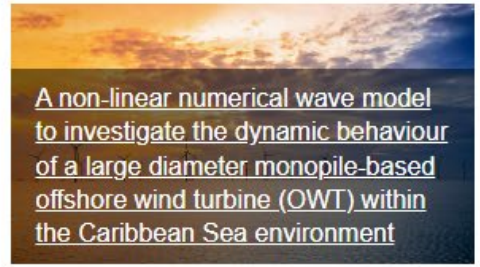

The Intelligent Community Energy Project (ICE)


Addition of a wind generator to the COAST Laboratory for the experimental testing of floating wind turbines

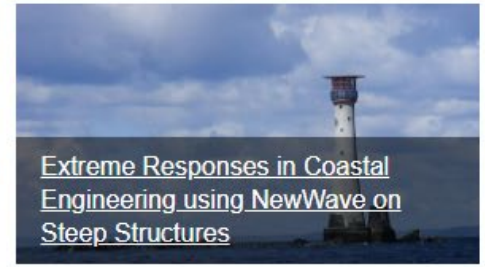

MaRINET 2


ORE Supergen Hub

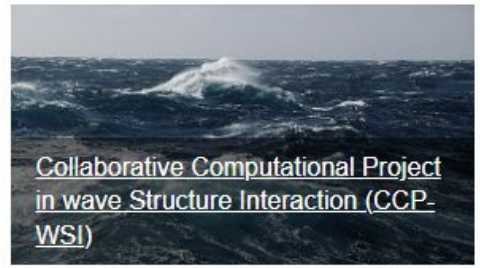

Smoothed Particle Hydrodynamics model for wave energy converters in survival conditions


A non-linear numerical wave model to investigate the dynamic behaviour of a large diameter monopile-based offshore wind turbine (OWT) within the Caribbean Sea environment

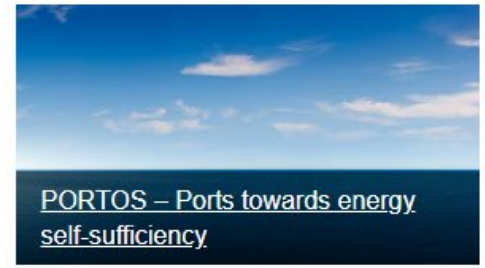

Structural performance of floating marine energy devices


Extreme Responses in Coastal Engineering using NewWave on Steep Structures


Compound flooding from tropical cyclone-induced sea surge and precipitation in Sri Lanka (C-FLOOD)


Collaborative Computational Project in wave Structure Interaction (CCP-WSI)


Marine-i


PORTOS – Ports towards energy self-sufficiency

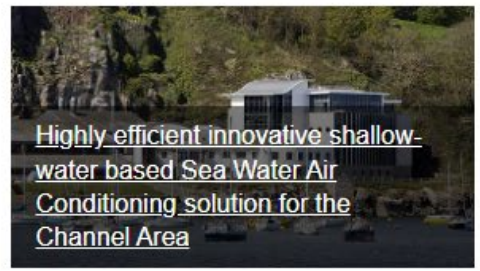

TIGER (Tidal Stream Industry Energiser)


Extreme Loading on Floating Offshore Wind Turbine under Complex Environmental Conditions


Cornwall Floating Offshore Wind Accelerator


FlexWave


Hydrogen supporting ORE Integration (New)


Highly efficient innovative shallow-water based Sea Water Air Conditioning solution for the Channel Area


SENSUM


Learning from Earthquakes

Contents

- Background to EEFIT recovery missions
- Comparisons between recovery from different events
  - Spatial planning
  - Design codes
  - Education / training
  - Evacuation structures
  - Morphological response
  - Coastal defences
  - Summary

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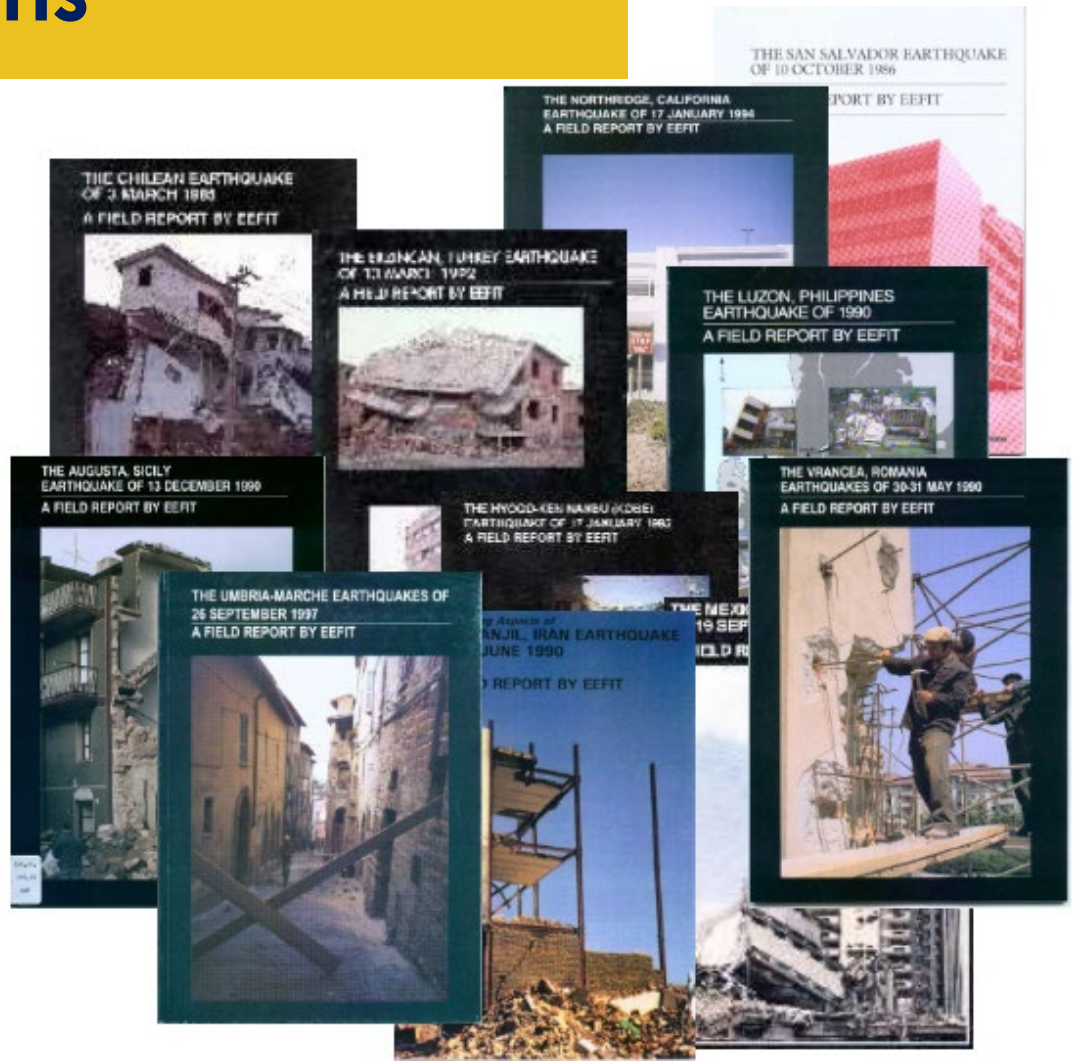
Past missions

1. Turkey (1983)
2. North Yemen (1983)
3. Liege, Belgium (1983)
4. Chile (1985)
5. Mexico (1985) 6
6. Kalamata, Greece (1986)
7. San Salvador (1986)
8. Loma Prieta, USA (1989)
9. Newcastle, Australia (1989)
10. Romania (1990)
11. Iran (1990)
12. Philippines (1990)
13. Erzincan, Turkey (1992)
14. Northridge, USA (1994)
15. Kobe, Japan (1995)
16. Umbria-Marche, Italy (1998)
17. Colombia (1999)
18. Kocaeli and Duzce, Turkey (1999)
19. ChiChi, Taiwan (1999)
20. Bhuj, India (2001)
21. Sri Lanka and Thailand (2005)
22. Pakistan (2005)
23. Folkestone, UK (2007)
24. Peru (2007)
25. Wenchuan, China (2008)
26. L'Aquila, Italy (2009)
27. South Pacific Tsunami (2009)
28. Padang, Indonesia (2009)
29. Haiti (2010)
30. Chile (2010)
31. Christchurch (2011)
32. Tohoku, Japan (2011, 2013)
33. Nepal (2015, 2022)
34. Kumamoto, Japan (2016)
35. Ecuador (2016)
36. Amatrice, Italy (2016)
37. Sulawesi, Indonesia (2018)
38. Albania (2019)
39. Zagreb, Croatia (2020)
40. Aegean (2020)
41. Haiti (2021)



EEFIT
Earthquake Engineering Field Investigation Team

EEFIT Recovery

History of recovery missions

- 2009 L'Aquila, Italy earthquake (2012)
- 2011 Tohoku earthquake and tsunami (2013)
- 2015 Gorkha, Nepal earthquake (2022)

Importance

- What has been learned?
- Build back better?
- Training

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EEFIT Indonesia-Thailand Recovery Missions

Sanriku coastline, Japan (2011 GEJE)

Phuket and Khao Lak, Thailand (2004 IOT)

Banda Aceh, Indonesia (2004 IOT)

Palu Bay, Indonesia (2018 Sulawesi earthquake/ tsunami/ landslide)

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EEFIT
Earthquake Engineering Field Investigation Team

EEFIT Indonesia-Thailand Recovery Missions

Field teams

1. Professor Alison Raby, University of Plymouth (Banda Aceh and Thailand mission lead)
2. Mr Antonios Pomonis, World Bank (Palu mission lead)
3. Dr Ella Meilianda, TDMRC USK, Banda Aceh
4. Dr Yunita Idris, TDMRC USK, Banda Aceh
5. Mr Dedy Alfian TDMRC USK, Banda Aceh
6. Dr Marco Baiguera, University of Southampton, UK
7. Dr David McGovern, London South Bank University, UK
8. Dr Keith Adams, London South Bank University, UK
9. Mr Yudha Adi, Mott McDonald, Indonesia
10. Dr Muhammad Marzuki, Tadulako University, Palu
11. Dr Sukiman Nurdin, Tadulako University, Palu
12. Dr Eyitayo Opabola, UCL, UK
13. Dr Teraphan Ornthammarath, Mahidol University, Thailand
14. Dr Panon Latcharote, Mahidol University, Thailand
15. Mr Nattapon Trumikaborworn, AIT, Thailand

EEFIT Earthquake Engineering Field Investigation Team

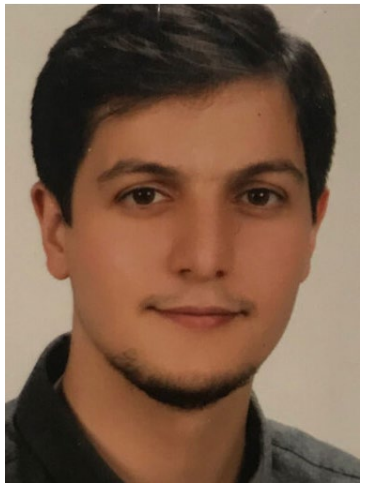
TDMRC TSUNAMI AND DISASTER MITIGATION RESEARCH CENTER

EEFIT Indonesia-Thailand Recovery Missions

- Remote teams

1. Professor Tiziana Rossetto, UCL
2. Ms Francesca Marafini, Florence University
3. Mr Harsh Mistry, University of Manchester
4. Mr Nurullah, Açikgőz, Boğaziçi University



- Japanese perspective

1. Dr Anawat Suppasri, IRIDeS, Tohoku University,

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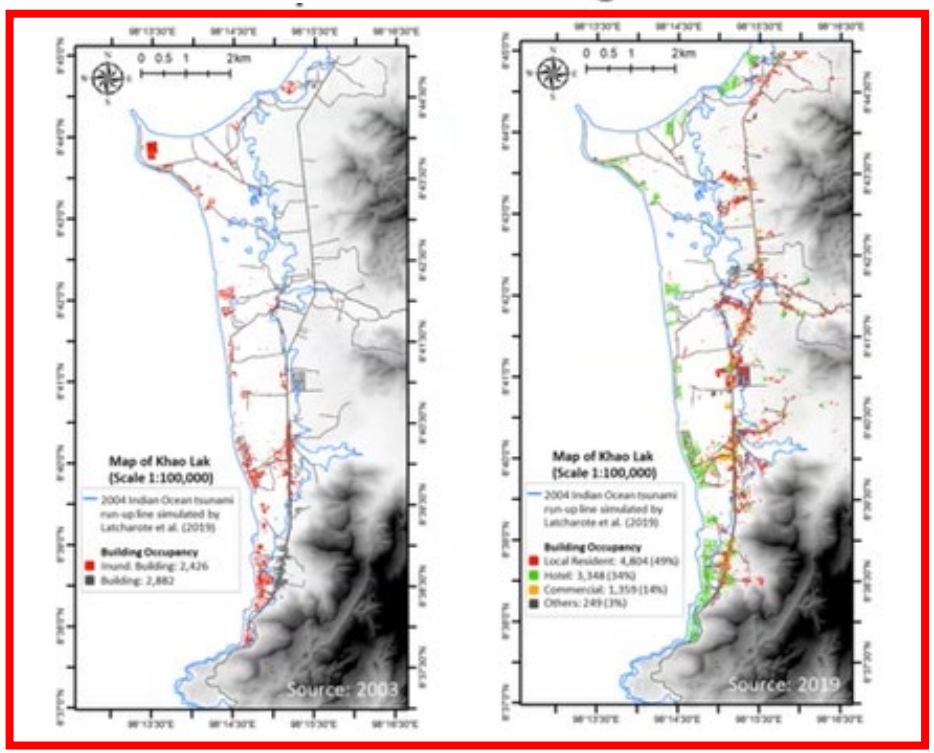
災害科学国際研究所 IRIDeS

Spatial planning and development

THAILAND



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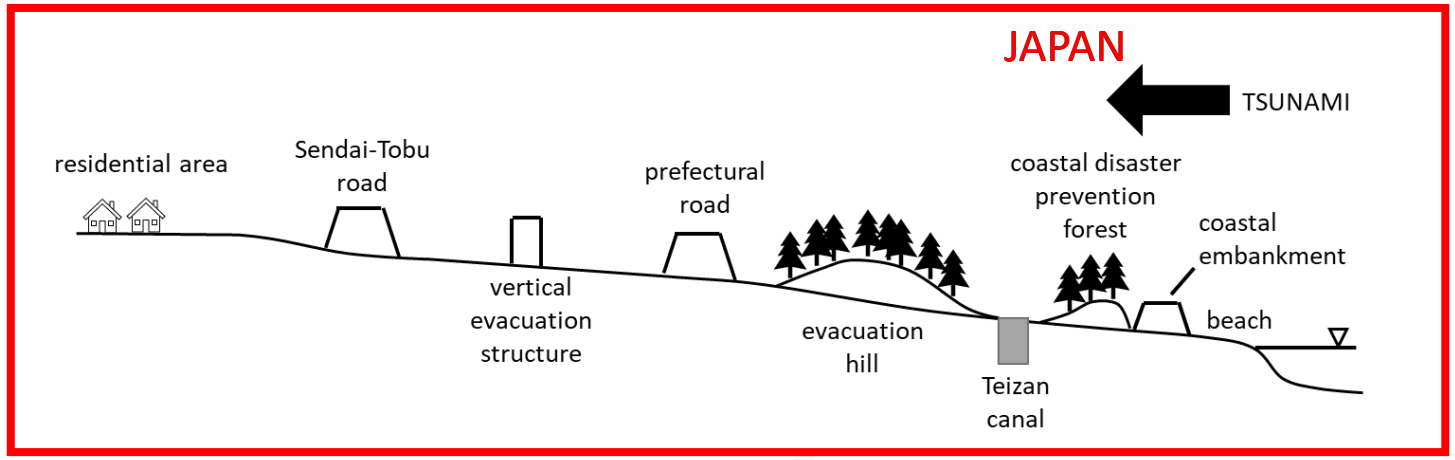

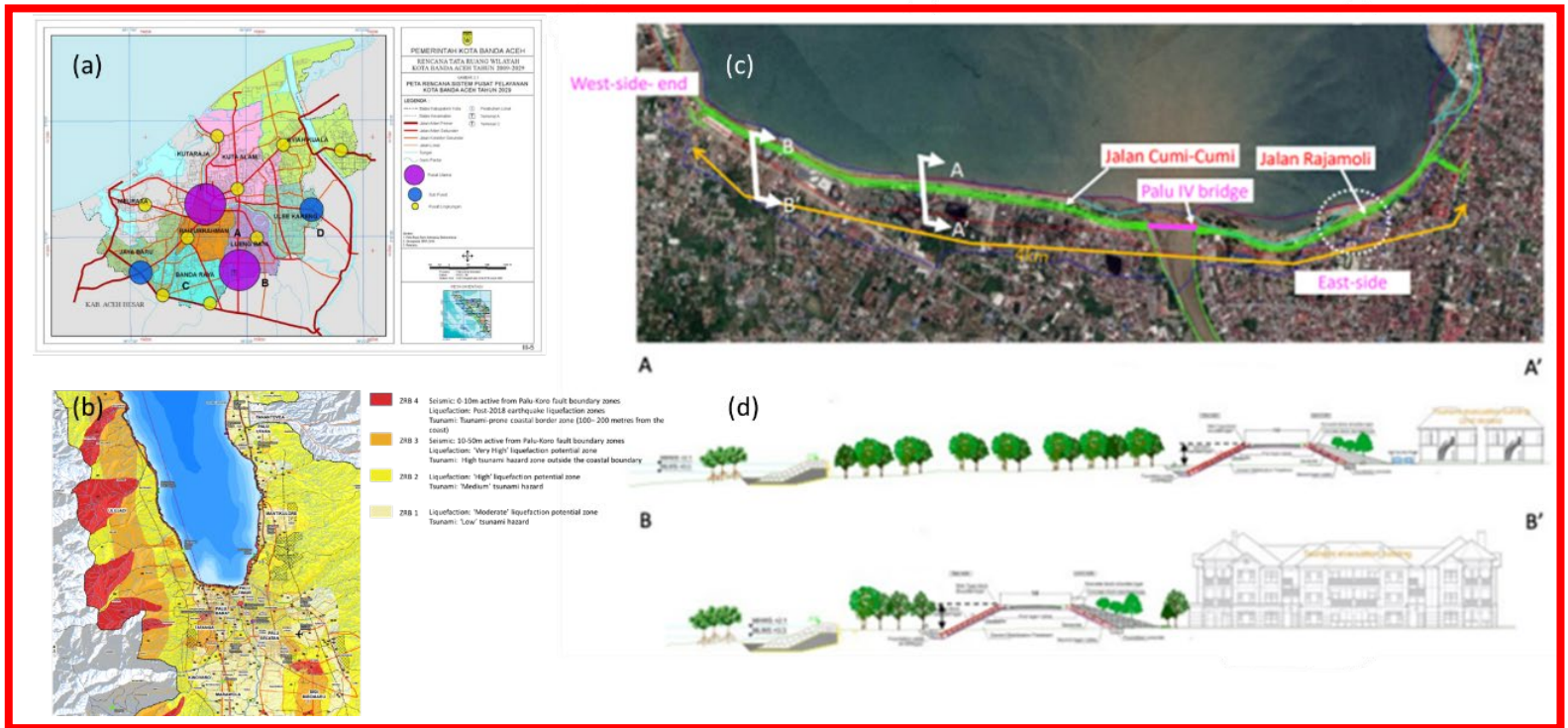

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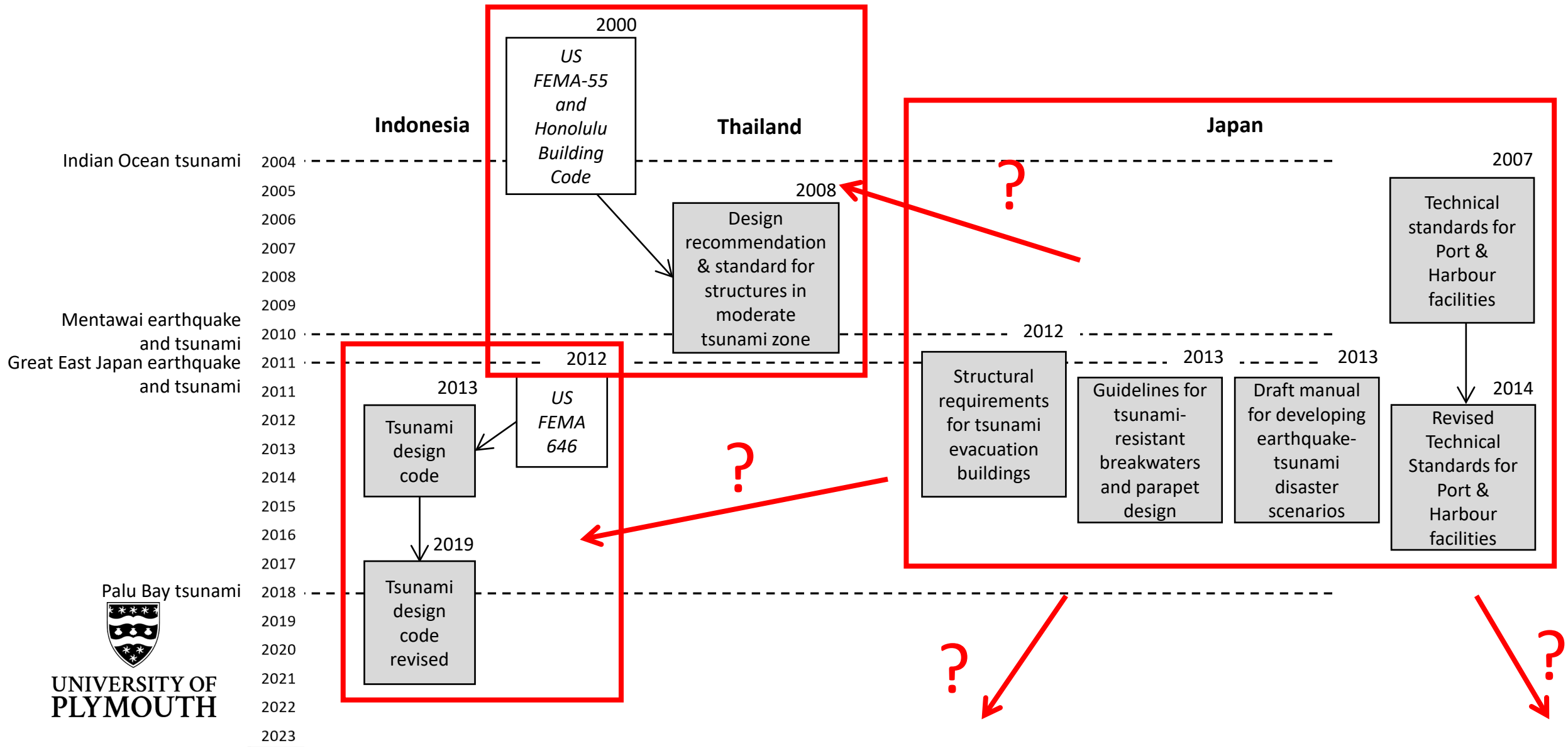
Development of tsunami design codes



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Warning systems

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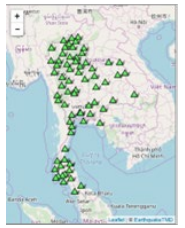

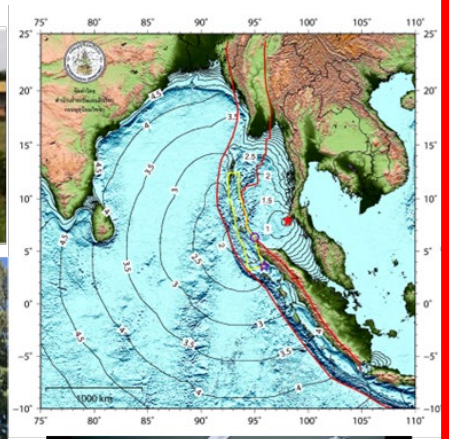



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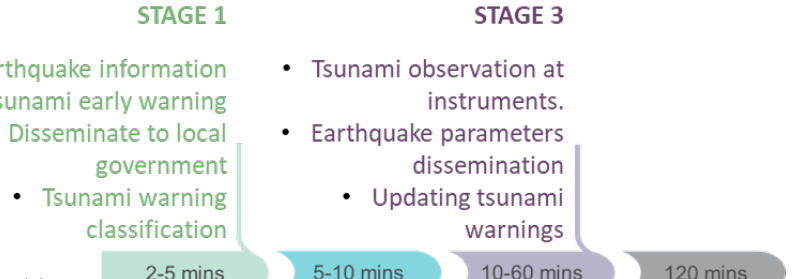

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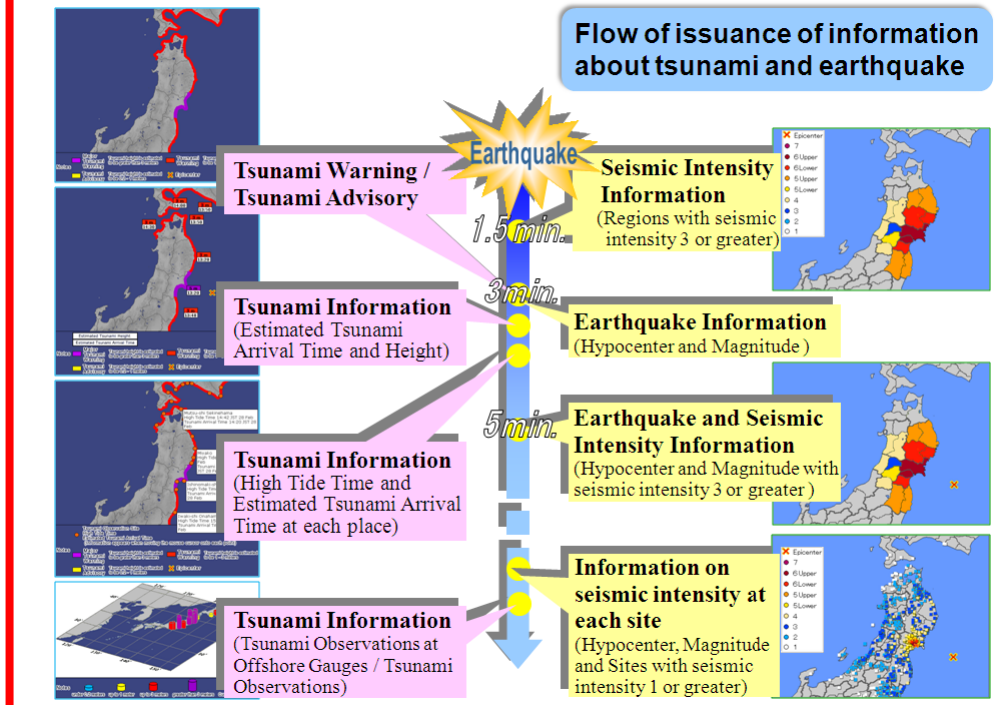

Evacuation training

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Sendai Tobu Road evacuation stairs

https://sendai-resilience.jp/en/efforts/government/development/evacuation_facilities.html

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Evacuation structures

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Dedicated vs multi-purpose

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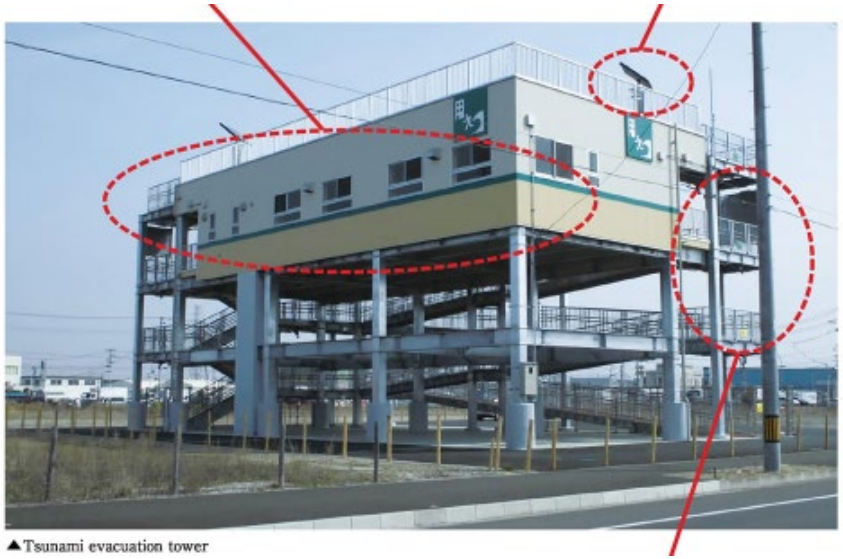
Protection from cold and wind (plus blankets and heaters

Power from PV, gas cartridges, LED flood lights



▲Tsunami evacuation tower

Consideration for people requiring assistance

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Based upon: https://sendai-resilience.jp/en/efforts/practice/practice_01.html

Morphological response

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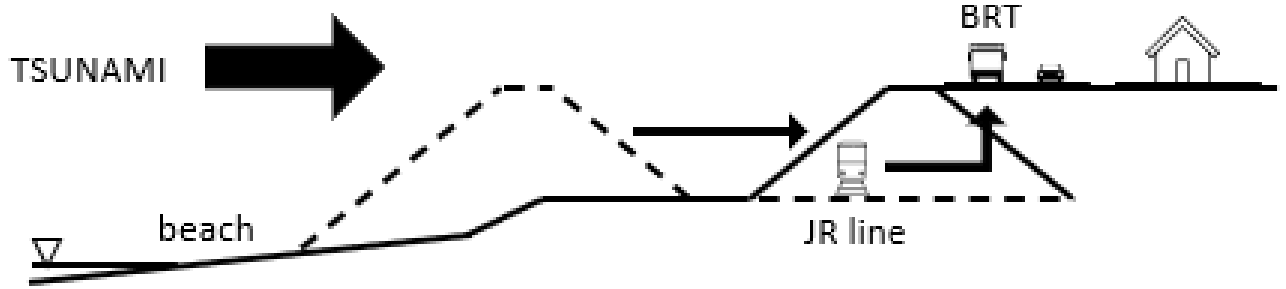
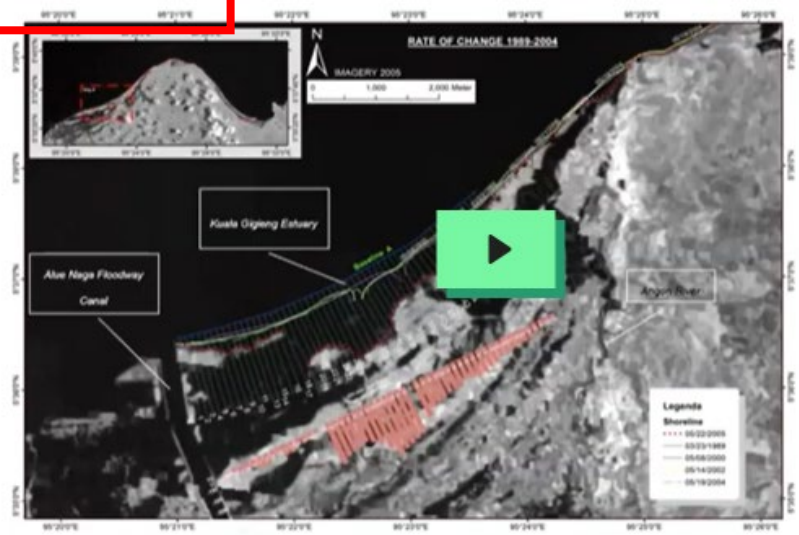


Post-tsunami at Segment A

- Villages: Alue Naga, Kajhu, Lambada Lhok Krueng Meuria and Baro
- Morfology: low-lying lagoonal coast with barrier island, small creek
- Pre-tsunami 2004: protected by barrier island, lagoon inlet used for traditional fisherman navigation.
- Post-tsunami 2004: lagoon exposure to sea, 65% barrier island disappeared, lagoon sedimentation (Meilianda et al., 2021)



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Coastal defences

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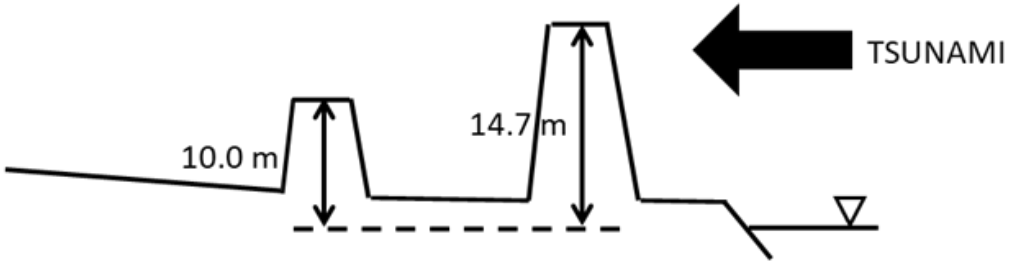

JAPAN

INDONESIA

SUMMARY

- Relatively high exposure levels for Thailand visitors *c.f.* permanent residents and visitors elsewhere
- Importance of appropriate training
- Lessons learned and contained in Japanese design codes not necessarily being conveyed more widely
- Different cultural response to evacuation structures
- Ubiquitous Japanese tsunami defences – necessary or desirable elsewhere?

THANK YOU

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