FEMA's Role in Tsunami Mitigation

NEHRP ACEHR Meeting

April 12-13, 2021

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FEMA's Role in Tsunami Mitigation

- FEMA addresses tsunami risk, through:
  - National Tsunami Hazard Mitigation Program (NTHMP),
  - National Earthquake Hazards Reduction Program (NEHRP),
  - National Flood Insurance Program (NFIP), including the Community Rating System (CRS),
  - Hazard Mitigation Grant Programs (BRIC and HMGP),
  - FEMA response and recovery planning.

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FEMA's Role in NTHMP

- FEMA is a partner agency in the National Tsunami Hazard Mitigation Program (NTHMP)
  - Along with the USGS and coastal State and Territory agencies.
- We work within the NTHMP Coordinating Committee and co-chair the Mitigation and Education Subcommittee to help improve planning, awareness and mitigation.
  - CC members: HQ: Mike Mahoney; R10: Amanda Siok
  - MES FEMA co-chair: Tamara Biasco
- FEMA also works with SLTT agencies to use their NOAA tsunami inundation evacuation mapping as the basis for planning and to improve public awareness.

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State and Local Planning Actions

- Several coastal States have developed required State Mitigation Plans that include addressing tsunami.
- Many communities have recognized their tsunami risk and are addressing it along with other hazards:
  - Several coastal counties have FEMA approved multi-hazard mitigation plans that include tsunami.
  - Some plans include tsunami mitigation actions to protect public and critical facilities.
  - Several communities have completed mitigation activities using state and local funding.

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FEMA's Role in Reducing Risk

- Some tsunami-related planning and mitigation projects can be funded under FEMA all-hazard grant programs.
- FEMA's post-disaster Hazard Mitigation Grant Program (HMGP) can fund tsunami mitigation pilot projects.
  - FEMA supported development of a Tsunami Hazard Mitigation Program in Puerto Rico with Hurricane Georges HMGP funds.
- FEMA's Pre-Disaster Mitigation Program (PDM) has been replaced by the new Building Resilient Infrastructure and Communities (BRIC) Program under DRRA Sec. 1234.
  - BRIC based on 6% of estimated disaster expenses funds.
  - PDM/BRIC now recognizes tsunami as a fundable hazard.

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HMGP Tsunami-Related Grants

- Washington (Total FEMA Funding Obligated for Tsunami Mitigation: $6,869,349.50)
  - Grays Harbor County, City of Ocean Shores Tsunami Vertical Evacuation Shelter- Federal Share Obligated $3,592,141.50 (PDM)
  - Grays Harbor County, Stevens Elementary Tsunami Vertical Evacuation Shelter- Federal Share Obligated-Pending (PDM)
  - Pacific County, Long Beach Safe Haven Program- Tsunami Vertical Evacuation Berm- Federal Share Obligated $362,020 (HMGP- DR-4056-0020)
  - Pacific County, Fire Protection District #1- Preliminary Studies and Design work for Vertical Evacuation Structure- Federal Share Obligated $90,000 (HMGP- DR-4249-0008)
  - Pacific County, Tokeland Vertical Evacuation Tower- Federal Share Obligated $2,825,188 (PDM)

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HMGP Tsunami-Related Grants

- Oregon (Total FEMA Funding Obligated for Tsunami Mitigation: $2,537,233)
  - Curry County, Port of Brookings Harbor- Floating Dock Reinforcement Mitigation for Tsunami- Federal Share Obligated: $123,500 (HMGP- DR-1764-0002)
  - Lincoln Co, Newport Tsunami Safe Haven Hill Retrofit, Hardening and Access Improvements- Federal Share Obligated: $680,478 (HMGP- DR-1764-0002)
  - Lincoln County, Seal Rock Water District- Water and Sanitary Sewer System Protective Measures- Federal Share Obligated: $571,667 (HMGP-DR-4055-0013)
  - Tillamook County, Bay City Water and Sewer Protective Measures- Federal Share Obligated $1,161,588 (HMGP)

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HMGP Tsunami-Related Grants

- American Samoa Legislative Building: Built to VE zone and tsunami inundation, using ASCE 24-05 and ASCE 7-10.
- California, Samoa Peninsula (Humboldt County) Fire Station remodeled with HMGP funding to address tsunami vertical evacuation.
- FEMA Region 9 is funding a Cooperating Technical Partner (CTP) grant with CGS (Rick Wilson) for the Port and Harbor Tsunami Playbooks and improved tsunami inundation mapping (USC).

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FEMA Tsunami Exercises

- Region 10 led the 2016 Cascadia Rising exercise.
- They are currently planning for the June 2022 Cascadia Rising exercise, using the same scenario.
- The exercises assume a Cascadia earthquake event with a main wave of 30-40 feet in height depending on local topography (both underwater and along the shore).
- The exercises are based a 20- to 30-minute warning time prior to initial wave arrival.

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National Flood Insurance Program

- FEMA identifies flood-prone areas and develops and distributes Flood Insurance Rate Maps (FIRM) to the over 20,000 participating communities.
- FEMA has included tsunami wave heights on FIRM's since the 1970's for areas of the West Coast, Hawaii, and other Pacific Islands where tsunami is the primary flood hazard.
- FEMA has modernized its FIRM's through its Risk Map Program.
  - Risk Map is intended to include other hazards including tsunami.

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NFIP Tsunami Flood Mapping

- NFIP FIRM's provide a 1% annual chance of flood risk information for flood insurance rating purposes.
- Tsunami wave heights normalized to a 1% annual chance event may not show the true potential threat since the maximum tsunami inundation could be much greater than at a 1% annual probability limitation.
- Except for areas like Hawaii where tsunami is the primary hazard, NFIP has elected to not provide tsunami inundation zones on recent FIRM's.
- However, our new digital FIRM's will allow a community to overlay their own tsunami inundation maps independent of recurrence frequency if they wish.

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Flood Loss Reduction Activities

- The NFIP Community Rating System (CRS) creates an incentive for communities to help minimize tsunami risk.
- Through CRS, the cost of flood insurance can be reduced in communities that exceed NFIP minimum requirements.
- CRS provides credit when local governments:
  - Map tsunami run-up areas
  - Acquire tsunami hazard areas for open space uses.
  - Zone tsunami hazard areas for open space uses.
  - Adopt land use planning measures to control development.
  - Require new structures be built at or above the tsunami elevation.
  - Prohibit new critical facilities in tsunami hazard areas and adopt tsunami construction requirements.
  - Develop local public information and education programs.
  - Receive the NOAA *TsunamiReady* designation.

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FEMA's Tsunami Risk Assessment

- Hazus MH, is FEMA's nationally applicable GIS-based loss estimation software for earthquakes, wind, and flood.
- Hazus seeing widespread use for local/regional planning for mitigation as well as post-event assessment.
- FEMA completed development of the Hazus tsunami module in 2017 in response to a GAO tsunami report.
  - The Hazus tsunami module was funded by FIMA NFIP and DHS Flood Apex Program.
- More information on FEMA website:
  www.fema.gov/plan/prevent/hazus/index.shtm

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HAZUS MH
EARTHQUAKE • WIND • FLOOD

Tsunami Evacuation Issues

- Tsunami warning is based on being able to evacuate at-risk population to high ground.
- Current warning systems focus on far-source events; for near source, the earthquake itself is the warning.
- For near-source event, warning time is can be as little as 15 to 30 minutes.
- For many coastal communities, this is not sufficient time for evacuation to high ground.
- In those cases, the best solution is vertical evacuation to specially designed refuge structures.

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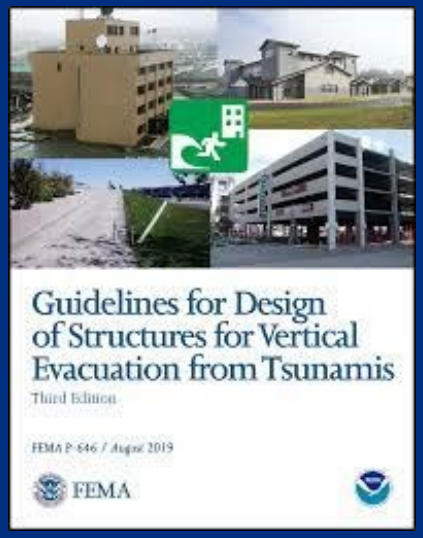
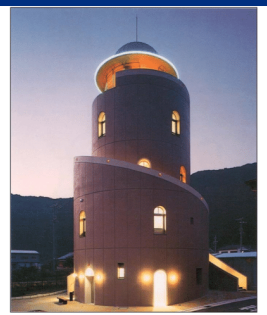
Refuge Design Guide Document

- Technical design guidance for special facilities for vertical evacuation.
  - Refuge must be able to withstand loads from both earthquake ground shaking and multiple tsunami waves and debris and still remain functional.
- First edition was a joint FEMA/NOAA project.
  - Co-funded by FEMA NEHRP and NOAA NTHMP.
  - Publication distributed by FEMA as FEMA P-646.
  - Third Edition includes lessons from Tohoku tsunami and new criteria from ASCE/SEI 7-16 Chapter 6.
  - Encourages multiple use structures such as parking garages, community centers, hotels, etc.
  - Includes design criteria for artificial high ground.
  - Also includes operational guidance for refuge.





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First US Tsunami Evacuation Refuge

- Under its Project Safe Haven, the State of Washington worked with Grays Harbor County and the Ocosta School District to get local funding to build a tsunami vertical evacuation refuge as part of a new/replacement elementary school.
- The roof of the gymnasium serves as the refuge, which is sized for students and local population.
- Total project cost: $ 14,600,000
  - Local share: $ 11,800,000
  - State share: $ 2,800,000
  - **Tsunami safe refuge (a local cost): $ 2,000,000**

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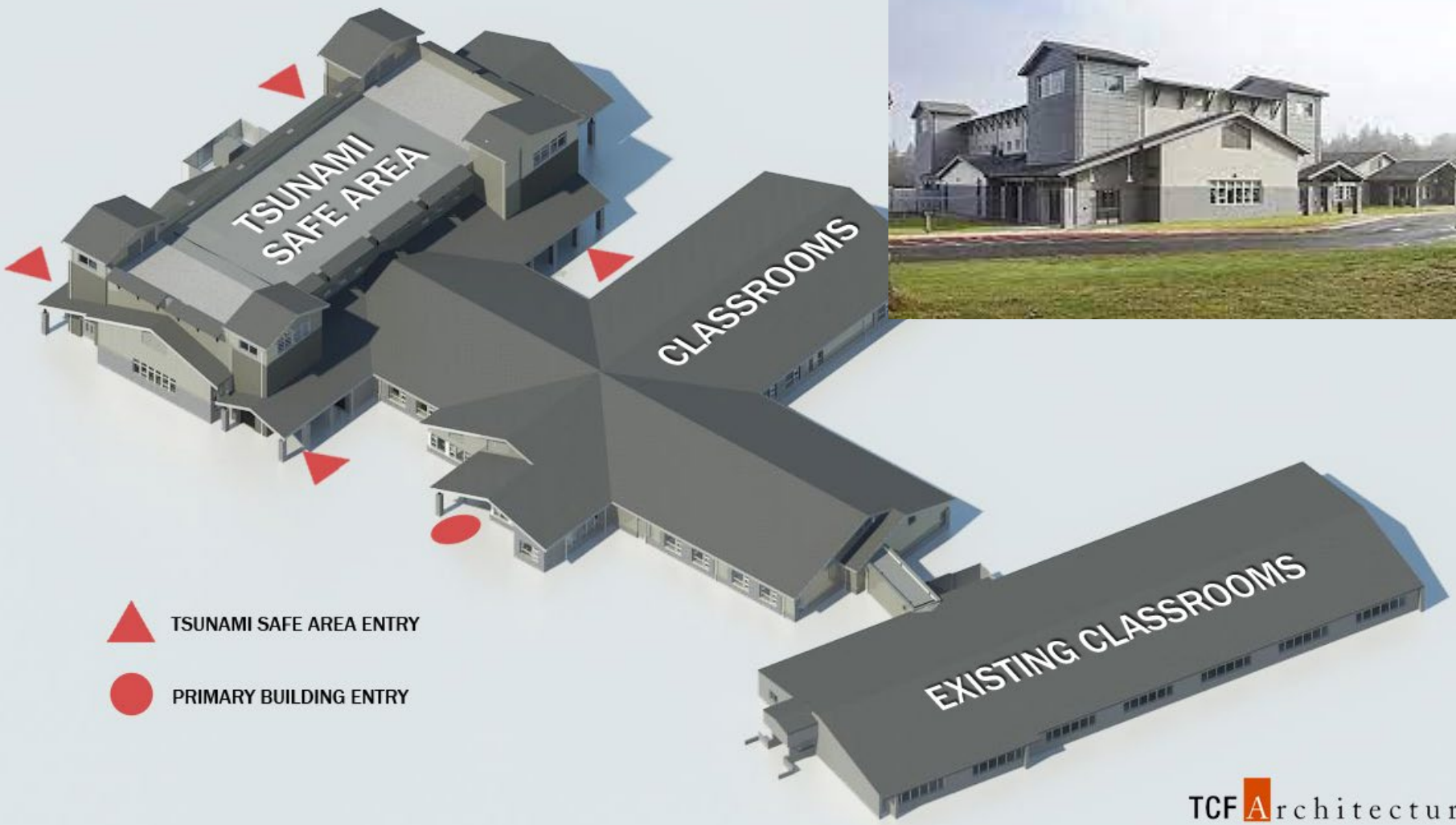
First US Tsunami Evacuation Refuge



Second US Vertical Evac. Refuge

- Shoalwater Bay Indian Reservation, located in Tokeland, WA on the Cascadia coastline.
- With the closest high ground 2 miles away, there would not be enough time to evacuate.
- Sized to fit over 400 evacuees.
- Funding:
  - FEMA funded - $2.2 million,
  - Shoalwater Tribe - $1 million
- FEMA NEHRP provided SME assistance with the design, which used FEMA P-646 design criteria.

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Tsunami in the Building Codes

- FEMA NEHRP staff, with NOAA support, prepared and successfully submitted a code change for the 2012 IBC:
  - This change added a new Appendix M Tsunami. If the Appendix is adopted by a State or community, it restricts the construction of high occupancy, high risk, or critical facilities within a community's tsunami inundation zone, unless it is a vertical evacuation refuge built according to FEMA P-646.
- Based on lessons learned in the 2011 Tohoku tsunami, the American Society of Civil Engineers ASCE 7-16 Design Load Standard developed and added a new Chapter 6 – Tsunami Loads and Effects.
  - This chapter added new tsunami hazard maps and design load and construction criteria.

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Chapter 6: Tsunami Loads and Effects

- ASCE/SEI 7 is the consensus design standard used to determine design loads for US building design for natural hazards.
- ASCE/SEI 7 is adopted by reference by the International Building Code, which in turn is adopted by most US jurisdictions.
- The 2016 edition of ASCE/SEI 7 includes a new Chapter 6 on Tsunami Loads and Effects.
- ASCE/SEI 7-16 adopted by reference into the 2018 IBC.
- Design criteria based on 2500-year Maximum Considered Tsunami.

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Chapter 6: Tsunami Loads and Effects

- Only applies to the five US Western States – Washington, Oregon, California, Alaska and Hawaii
- Only applies to Risk Category IV (Essential Facilities) and III (High Occupancy Buildings).
- Will only apply to Risk Category II (General Building Stock) if adopted by the local jurisdiction, and then only for buildings over a particular height.
- Will not apply to all other Risk Category II, including light framed residential or commercial buildings.
  - Based on the assumption that communities have access to the NOAA tsunami warning system and an effective evacuation plan.

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Conclusion

- Tsunamis are very rare events but ones with very high consequences, as shown in the Indian Ocean and Japan.
- As rare events, they tend to fall below the attention level of the American public. However, we need to encourage actions that will improve their protection.
- We need to be able to provide the tools that states and local communities need to be able to address their risk from this rare but potentially catastrophic hazard.
- Because of the large numbers of people that are at risk, FEMA continues to work to improve preparedness and awareness, and reduce the risk from future tsunamis.

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