The Arrangement of Model Instrument (Tentative) for Campus Evaluation with Earthquake and Tsunami Disaster Mitigation Insight

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Abstract. Padang is one of the big cities on the West Coast of Sumatra which is at risk of earthquakes and tsunamis. Meanwhile, campus should be a model that is able to play an important role in disaster mitigation. The study aims to identify and develop tentative model instrument for the evaluation of campuses with the earthquake and tsunami disaster mitigation insight. The method used in this research is literature study such as decisions or policies, results of studies, technical guidelines, books, and publications, both covering earthquakes and tsunamis. The structured instrument model is expected to be a tentative model that will continue to be tested and developed through expert validation and testing both limited and extensive trials. In this study, only tentative model instruments will be presented. This instrument is useful for assessing and recommending earthquake and tsunami disaster mitigation actions for campuses, especially in the city of Padang.

Keywords: campus, mitigation, model instrument, tentative

1. Introduction

The city of Padang is one of the areas at risk of earthquakes and tsunamis in Indonesia, which is located right on the West Coast of Sumatra, West Sumatra Province, the Pacific node of the Ring of Fire. Located on a world seismic node, the west coast of Sumatra is a source of subduction, one of the sources of the earthquake and the risk of a tsunami. Kerry Sieh, California Institute of Technology geologist said that the subduction zone region has a long history of earthquakes and tsunamis, including 1381, 1608, 1797, 1883 and 2004. Megathrust, the mention of the fault, is a contact area of a shallow subduction zone, and is estimated a source of earthquakes off Sumatra's west coast. Its strength is estimated at 8.9 magnitude which could trigger a larger tsunami in the next 50 years. The time prediction is based on the history of the previous tsunami, with a 200-year cycle distance [1].

As an educational institution, the campus should take part in disaster mitigation as early as possible. In line with that, the Head of BNPB said that "The university environment must understand how disaster management efforts from pre-disaster, during disasters and post-disaster [2]. Not only in disaster management directly on site, universities can play a role by conducting studies according to their fields concerning pre-disaster such as disaster risk reduction, prevention and preparedness, spatial planning, rehabilitation and reconstruction processes and also training". However, the development of models for earthquake and tsunami disaster mitigation campuses has not been widely developed today.

Therefore, the objective of the study are identifying variations in model instruments for the evaluation of existing earthquake and tsunami disaster mitigation campuses, developing instrumental models (tentative) for evaluating earthquake and tsunami disaster mitigation campuses.
2. Research Method
The method used in this study is literature study. The data analyzed are sources in the form of policies (policies), results of studies, technical guidelines, books, and published journals, both covering earthquakes and tsunamis. The instrument of the model is based on the results of the study of existing sources. After that, the analysis is carried out by sorting out parameters, indicators and sub-indicators that are appropriate for the evaluation of earthquake and tsunami disaster mitigation campuses.

3. Results And Discussions
3.1 Identification of Basis for Determining Parameters, Indicators and Sub-indicators
From the results of the study, researchers managed to identify various technical guidelines, policies and regulations, provisions, books and published journals that can be used as references in the preparation of parameters, indicators and sub-indicators for insightful campus evaluation earthquake and tsunami disaster mitigation as follows:

- Regulation of the Head of the National Disaster Management Agency Number 4 of 2008 concerning Guidelines for Preparing Disaster Management Plans [3]
- Disaster Preparedness School Framework prepared jointly by the Indonesian Disaster Education Consortium
- Regulation of the Head of BNPB Number 04 of 2012 concerning Guidelines for Implementing Safe Schools/Madrasas from Disasters [2]
- Minister of Public Works Regulation Number 29/PRT/M/2006 concerning Technical Guidelines for Building Requirements [4]
- Minister of Public Works Regulation No.21/PRT/M/2007 concerning Guidelines for Spatial Planning of Volcanic Eruption and Earthquake-Prone Areas [5]
- Geotechnology Research Center of the Indonesian Institute of Sciences (LIPI) 2013 concerning Guidelines for Implementing Disaster Mitigation Schools[6]
- Federal Emergency Management Agency (FEMA) : Guidelines for Design of Structures for Vertical Evacuation from Tsunamis (2008)[7]
- Federal Emergency Management Agency (FEMA) : Building A Disaster-Resistant University, (2003) [8]
- Federal Emergency Management Agency (FEMA) : Handbook of Tsunami Evacuation Planning (2011) [9]
- The Identification of Parameter Arrangement for Hypothetical Model of Campus with Earthquake Disaster Mitigation Insight. MATEC Web of Conferences [10]
- Guide and Checklist for Nonstructural Earthquake Hazards in California Schools [11]
- Urban Local Earthquake Disaster Risk Index : 12WCEE Journal Volume 11510 [12]
3.2 Analysis of Parameter, Indicators and Sub-indicators Used

Not all parameters are suitable to be applied to assess campus. Therefore, it is necessary to identify and analyze parameters, indicators and sub-indicators considered for campus scale. In addition, based on the identification above, there are several similarities in parameters and indicators that can be used. Therefore, the researcher summarizes the parameters, indicators and sub-indicators to assess earthquake and tsunami disaster mitigation-based campuses. The components used to develop the model instrument consist of the following 3 parameters.

- Hazard, consisting of indicators: location of the source of the earthquake and tsunami hazard, record of earthquakes and tsunamis that have occurred, and topography
- Vulnerability, consisting of indicators: foundation systems, shape and structure of buildings, roofing material, walls, columns, doors and windows, minimum ratios of land area and class, evacuation routes and access, minimum floor height
- Capacity, consisting of indicators: campus community’s knowledge and responses, campus policies, emergency response plans, disaster warning systems and resource mobilization

3.3 Model Instrument (Tentative) for Campus Evaluation with Earthquake and Tsunami Disaster Mitigation Insight

An earthquake disaster mitigation campus is assessed by how much vulnerability the campus has to disasters and the capacity of the campus to overcome these vulnerabilities. Based on the formula from BNPB, 

\[ \text{Risk} = f (\text{Hazard} \times \text{Vulnerability} / \text{Capability}) \]

It means the higher the vulnerability, the higher the risk of the campus to disasters, on the contrary the higher the capacity the lower the risk. The following assessment forms are adopted from various sources.

Table 1. Assessment form for existing conditions with the ideal conditions of earthquake and tsunami disaster mitigation campuses (vulnerability and capacity)
12 The building is designed with the height of the evacuation floor that cannot be reached by tsunami inundation, which must be 30% + 3 meters higher than the maximum wave height
(The maximum wave height data source refers to the tsunami model / sloping map of BNPB)
13 Minimum university area of 10,000 m²
14 The ratio of class area is at least 1.5 m² / student
15 Luas ruang kuliah tidak kurang dari 20 m²
16 The building is designed by providing adequate evacuation routes and is not blocked, as anticipation of emergencies
17 The walls of the building are made of lightweight material and are free from cracks
18 Providing safe evacuation and access routes that can be easily achieved and equipped with clear directions and well known by the campus community, including campus communities who have special needs, especially in the event of a disaster
19 Buildings must be designed by providing infrastructure for easy access (accessibility) for those with special needs and the elderly
20 The building is designed to provide infrastructure for easy access (accessibility) for those with special needs upstairs
21 There is a building that is large enough or a spare place so that it can accommodate as many people as possible who are displaced in a short time (for example there is an alternative function in the form of halls and classrooms to evacuate)

| CAPACITY INDICATOR |
|---------------------|
| Parameter | Indicator | Sub-indicator | Assessment Number |
| Campuses Community Knowledge and Responses | Knowledge of natural events and disasters (type, source, magnitude, location) | The campus community is able to explain the types, sources, causes and insensities of earthquake and tsunami disasters | 3 |
| | Knowledge of secondary hazards caused by earthquakes | Campus community can mention the types of disasters that occur after the earthquake | 2 |
| | Physical vulnerability (location and condition of the building) | The campus community can explain the vulnerability of the environment and the physical building of the campus | 3 |
| | Respond to disaster risk | Knowledge of the efforts made to reduce the risk of earthquakes and tsunamis and the motivation of the campus community in anticipating the occurrence of natural disasters | 4 |
| Campuses Policy | There are policies, agreements and / or campus regulations that support efforts to implement the campus safe from earthquake | There are policies and guidelines for disaster mitigation on campus | 5 |
| | Availability of access for all campus components to knowledge and training information to increase capacity in terms of Disaster Risk Reduction (reference material, participating in training, etc.) | Implementation of socialization regarding earthquake disaster mitigation knowledge | 7 |
| | The implementation of earthquake disaster drill simulation is held regularly on campus | 8 |
| Emergency Response Plan | Plan to respond to emergencies | Availability of earthquake and tsunami disaster risk assessment documents | 9 |
| | Availability of campus plans for emergencies | 10 |
| | Availability of campus preparedness procedures that are agreed upon and implemented by all campus communities | 11 |
| | Availability of plans, places, maps and campus evacuation routes with signs that are easily understood by all campus communities including members with special needs | 12 |
Then, the assessment guidelines were adopted from the 2013 Geotechnology Research Center of the Indonesian Institute of Sciences (LIPI) on the Guidelines for Implementing Disaster Mitigation Schools [6].

\[
\text{Index of earthquake and tsunami disaster mitigation campuses} = \frac{\text{number of existing vulnerability indicators}}{53} + \frac{\text{number of existing capacity indicators}}{53} \times 100\%
\]

| Index value (%) | Category | Explanation |
|-----------------|----------|-------------|
| 80-100          | Campus with high-level mitigation insight | The ideal condition campus with disaster mitigation insight |
| 60-79           | Campus with medium-level mitigation insight | Improvement is needed by the campus from several aspects |
| <60             | Campus with less mitigation insight | Serious efforts need to be made regarding aspects that must be addressed towards the campus with disaster mitigation insight |

4. Conclusions and Recommendations
The instrument model for evaluating campus with earthquake and tsunami mitigation insight is very important. The structured instrument model is expected to be a tentative model that will continue to be implemented and developed through expert validation and testing both limited and extensive trials. In this study, only tentative model instruments has been presented. This instrument is useful for assessing and recommending earthquake and tsunami disaster mitigation actions for campuses, especially in the city of Padang.
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