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Rumah Panggung in Kampung Naga, West Java, Indonesia and *Minka Gassho Zukuri* in Shirakawa-go, Japan: The Local Wisdom of Traditional Houses in Mitigating Earthquake

ABSTRACT: *The objectives of this research is to explore the geological conditions and tales about earthquake narrated by local people in Indonesia and Japan; and the local wisdoms contained in traditional houses in Kampung Naga, West Java, Indonesia and in Shirakawa-go, Japan in relation to seismic resistant. This research employed qualitative approach, an approach that tends to have a subjective perspective. Sources of data were obtained from literature review, interviews, and a FGD (Focus Group Discussion). The results showed that although the traditional houses in Kampung Naga, Indonesia and in Shirakawa-go, Japan have many differences, but both architectural models have in common purpose to reduce the damage to the building in case of earthquake. Building resilience in both traditional houses has similarities to the foundation and the materials used. "Rumah Panggung" in Kampung Naga and "Minka Gassho Zukuri" in Shirakawa-go do not have a rigid structure for their foundations, floors, and buildings. In the event of an earthquake, the houses just shifted their positions following the horizontal force of the earthquake. The buildings will move freely and return to their original positions after the quake without causing any serious damage. Difference between the two are house in Kampung Naga only uses materials that are lightweight and thin, while house in Shirakawa-go uses thick roof to adjust to the local climatic conditions. The people in Kampung Naga and Shirakawa-go are considered successful in building seismic resistant houses.*
KEY WORDS*: Rumah Panggung in Kampung Naga, local wisdom, Minka Gassho Zukuri in Shirakawa-go, mitigation earthquake, and local natural conditions.*

INTRODUCTION

The term *mitigation* derived from the Latin language, *mitigare*. *Mitigare* derived from a combination of two root words, *mythic* meaning soft, gentle, and docile; and *agare* means to do or to make (cited in Fadillah, 2011). Thus, mitigation means making benign or tamed. Natural disaster mitigation means "to tame" a disaster. Nevertheless, natural disasters, particularly earthquake, actually cannot be tamed. Therefore, mitigation is more appropriate to be interpreted as an attempt to

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reduce the risk of a natural disaster.

The Law of the Republic of Indonesia Number 24 Year 2007 on Disaster Management, Article 1 (9), said that disaster mitigation is a series of efforts to reduce disaster risk, either through physical development and awareness or increase ability to deal with disasters. The notion of natural disasters, in the law, is a disaster caused by an event or series of events caused by nature, such as earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides (BNPB, 2007).

In Indonesia, disaster mitigation activities are coordinated by the National Disaster Management Institution or called *Badan Nasional Penanggulangan Bencana* in Indonesian language, which usually abbreviated BNPB. This institution is a non-department government institution, which has a duty to help the President do the planning and integrated implementation of disaster management and emergency responses before, during, and after disaster. Form of its activities includes prevention, preparedness, emergency response, and recovery (BNPB, 2007; and Yansen, 2010).

BNPB was established under Presidential Decree No.8 of 2008 on the National Disaster Management Institution. Several important duties of BNPB are: (1) to guide and direct the disaster relief effort that includes disaster prevention, emergency response, rehabilitation, and reconstruction fairly and equitably; (2) to establish the standardization and the need for implementing disaster management based on the law; (3) to distribute information about disaster prevention activities to the community; (4) to report disaster management implementation to the President once a month in normal conditions and at all times in a state of emergency; (5) to use and account the national and international aids; and (6) to account for the use of the budget received from the State Budget (BNPB, 2007).

In Japan, the disaster management system has been highly developed. Based on the record, it was formed in the 1940s. At the time, disaster management grouping by type had already existed like *Disaster Relief Act, Fire Services Act,* and *Flood Control Act*. In 1961, there was an institutional improvement by establishing the DCBA (Disaster Countermeasures Basic Act), after *Ise*-wan typhoons which claimed more than 5,000 lives. DCBA is defined as an institution of national protection for national territory and lives, livelihoods, and property from natural disasters (Gimpelson *et al*., 2016).

DCBA is a national-level organization coordinating CDMC (Central Disaster Management Council) for national institution level; LDMC (Local Disaster Management Council) for province or prefectures level; and MDMC (Municipal Disaster Management Councils) for lower level. At national level, DCBA is coordinated by a Special Ministry called the Ministry of Disaster Management, with members of all the Ministers and experts. At national level, a number of institutions and relevant Ministries do the coordination to mitigate all types of natural disasters, such as FDMA (Fire and Disaster Management Agency), Ministry of Health, Ministry of Labour and Welfare, MLITT (Ministry of Land, Infrastructue, Transport, and Tourism). MILTT has also the function of coordinating with JMA (Japan Meteorolocical Agency), JCG (Japan Coast Guard), and MDPC or Maritime Disaster Prevention Center (Nazarov, 2011).

In addition to government institutions, Japan has a number of voluntary organizations in mitigating disasters, such as VFC (Voluntary Firefighting Corps), *Suibo-dan* (Voluntary Flood Fighting Teams), and *BOKOMI* (Community Based Disaster Risk Management). Although *BOKOMI* is voluntary, but the organization is involving local government, the head of the station, firefighters, leaders of local associations, women's associations, parents' associations, and others. When disaster occurs, *BOKOMI* will help local authorities to evacuate people. Under normal conditions, *BOKOMI* also conduct various training programs, such as training to use firefighting equipment, evacuation drills, transmission of information drills, flood control training, and others (Nazarov, 2011).

The objectives of disaster management institution, both in Indonesia and in

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Japan, have in common to try to carry out disaster prevention, emergency response, rehabilitation, and reconstruction. Disaster management institution performed its every step in modern way with a budget that has been prepared. Along with it, the research and mapping of disaster-prone areas are also carried, such as cartography to landslides prone, volcanic disaster area maps, and maps of earthquake-prone regions. It includes research on aspects of buildings and houses.[1]

For example, in Indonesia, is the task forces in structure and building construction in technical committee for settlement affairs standardization, the Directorate-General of Settlement, Public Works Departement, in which they arrange a technical guidebook of seismic resistant houses and buildings complete with methods and ways to repair the damage. Even the Directorate of High School at the Ministry of Education and Culture of the Republic of Indonesia also compiled a book about technical guidelines of seismic resistant school buildings.[2]

In Japan, almost all the buildings have applied the seismic resistant standards. Standardization of seismic resistant buildings has been conducted since 1924. The research and study on seismic resistant building construction intensified after the 1923 Kanto earthquake. Standards of the buildings, at that time, were focused on the minimum thickness of wooden beams, reinforced concrete, and installation of wire construction. In 1950, it was improved to *kyu-Taishin* standard. The enforcement of *kyu-Taishin* standard was expanded not only in urban areas, but also in rural areas by adding other provisions concerning the use of wooden structures.[3]

After 20 years, the provisions of buildings were renewed again. In 1971, provisions on strengthening the foundation of shear and concrete foundation were added. The next change was in 1981, known as *shin-Taishin* standard. In 2000, the standard was also revised with the provisions on soil stability test for certain type of building. In 2006, provisions and system in seismic resistant building certification were tightened to expect more security and more people can be saved in the case of earthquake (JPC, 2016).

Long before Japan and Indonesia develop innovative building, traditional society in both countries have innovated ways to build and structured their neighborhood areas, in order to reduce victims when natural disasters occur. Those innovation and customary provisions are known as "local wisdom" (*cf* Diarta, 2007; Gaillard, 2007; and Ochiai, 2014).

Wisdom comes from the word "wise" which is defined as intelligence, smart, clever, intelligent, knowledgeable, understand, or able to put things in place. While the *local* word means somewhere limited, applying only to a certain place, and contains elements that are typical or unique. Thus, the *local wisdom* is also known as "indigenous wisdom", "traditional wisdom", "indigenous inventions", or "local genius" (Diarta, 2007).

Local wisdom includes customs, knowledge, perceptions, norms, and cultures, which are adhered by the people live in a certain area, and they linger hereditary. The forms of local wisdom are knowledge systems, social systems, and cultural systems, which are reflected in the way of environmental management, customs in social relations, land use, the use and selection of materials as well as residential architecture, the style of clothing, etc.

This research tried to explore the local wisdom of traditional houses in Kampung Naga, Indonesia and Shirakawa-go, Japan from the aspect of seismic resistance. Kampung Naga is located in Tasikmalaya Regency, West Java Province, Indonesia, while Shirakawa-go is located in Gifu Perfecture, Japan. Both are seperated very far, but their similarities and differences will be described, so that the meaning of all humans have a universal culture value is obtained.

[1]News on "Japanese Goods Help People Around the World Prepare for Disasters: From Manga to Card Games, Educational Creations Leverage the Experience of the Earthquake-Prone Nation". Available online also at: http://www.jica.go.jp/english/low/news/field/2014/150313_02.html [accessed in Bandung, Indonesia: March 2, 2016].

[2]See "Reducing Vulnerability of School Children to Earthquakes: A Project of School Earthquake Safety Initiative (SESI)". Available online also at: http://www.preventionweb.net/files/2951_SESIOutcomeallfinal.pdf [accessed in Bandung, Indonesia: March 2, 2016].

[3]News on "Earthquake building codes in Japan". Available online also at: http://japanpropertycentral.com/real-estate-faq/earthquake-building-codes-in-japan/ [accessed in Bandung, Indonesia: March 2, 2016].

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Based on above background, the proposed research questions are: (1) how are the geological conditions and tales about earthquake narrated by local people in Indonesia and Japan?; and (2) how are the local wisdoms of traditional houses in Kampung Naga in West Java Province, Indonesia and Shirakawa-go in Gifu Perfecture, Japan in relation to seismic resistance?

The objectives of this research were to find out information about geological conditions and tales narrated by the local people in Indonesia and Japan; and local wisdom inherent in traditional houses in Kampung Naga in West Java Province, Indonesia and Shirakawa-go in Gifu Perfecture, Japan in relation to seismic resistance.

Findings of this research are useful both theoretically and practically in three ways. *First*, to provide inspiration and awareness to architects and civil engineers of the importance of considering the environmental conditions for building houses. Environmental factors that influence the resilience of a building is geological and climatic factors. In theory, the geologic data such as morphology and topography, the structure of the soil and rocks, geologic structure, which includes stance and the tilt rock layers, stocky, fractures, faults, folds, dissonance, and everything related to geological hazards should be considered by civil engineers in construct a building. Climatic data required is the intensity of rainfall, humidity, and climatologic hazards such as hurricanes and storms.

Second, to use it as study materials of traditional culture by cultural observers. In the process of cultural interaction understanding is needed. The process of globalization cannot be avoided. Cultural interaction between nations will go stronger in intensity, and the probability of conflict is also very large. Understanding between cultures is expected to reduce the potential conflict. For example, in Japanese culture, there is a tradition called *ojigi* that is the way saluting with bow when saying thank you, apology, give a diploma at graduation, and others (Nugroho, 2006). Indonesian students studying in Japan must have an understanding of the above culture, or otherwise social interaction will be disrupted.

Third, to use it as learning materials which enrich insight to learners by practitioners of education. This article can enrich the content of the book written by the researchers as the diversification of the research findings entitled *Rumah Panggung in Kampung Naga and Minka Gassho Zukuri in Shirakawa-go*, published by Rizqi Press in Bandung, West Java, Indonesia, with ISBN (International Standard Book Number) 978-602-6971-20-3, in 2016; and enrich the proceeding article that has been published by the Atlantis Press in the ICIEVE (International Conference on Innovation in Engineering and Vocational Education) in 2015.

LITERATURE REVIEW

The literature review is aimed at providing understanding about the characteristics of the earthquake and architecture of houses in Indonesia and Japan.

Earthquake Disaster Characteristics. Theory about the tectonic earthquake, acknowledged by the experts, is caused by the movement of tectonic plates. According to this tectonic plate theory, the planet earth is consisting of at least four layers. They are inner core, outer core, mantle, and crust. In the outer core layer connected with mantle, convection process just like boiling water occurs. These two layers are often called *asthenosphere*. This asthenosphere fluid flows from the center of the earth towards the earth's surface. On the uppermost layer, there are plates called *lithosphere* that are rigid, frozen, and frangible (*cf* Condie, 1997; Sumita & Bergman, 2007; and Foulger, 2010).

The lithospheric plates consisted of 12 fractions. In certain parts, the edges between lithospheric plates move apart. It is the result from the convection process occurs underneath. By the time the plates move apart from one another, the fracture paths are opened followed by liquid magma from the asthenosphere. Fracture zone of the plates, which move apart from one another, is known as divergent plate margin. The process lasted hundreds to thousands of years that tectonic plates move in opposite directions. On the edge of another plate, fractional tectonic plates are moving toward each other, so that one of

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them pierced down, and the other pressed curved upward. The margin of the shoving plates are called convergent plate margin. At the time of the plates move toward each other and shove against each other, that is when an earthquake occurs (Schellart & Rawlinson, 2009).

Earthquake occurs because of the release of pent-up energy, due to the strain of two plates. The broken plates (fault) or the bend ones (folding) may cause vibration. Generally, there are three types of faults, namely thrust fault or reverse fault, horizontal fault or strike-slip, and normal fault. The fracture due to the elasticity of rocks has already on the threshold, then, the rock will fracture to release energy from the pressure and the pulling. With the above assumptions, the earthquake frequently occurs in the sub-duction zone. If the position of the release of energy is slight then shallow or intermediate earthquake occurred. But, if the position was deep, then, deep earthquake occurred (Condie, 1997; Foulger, 2010; and Anonymous, 2016).

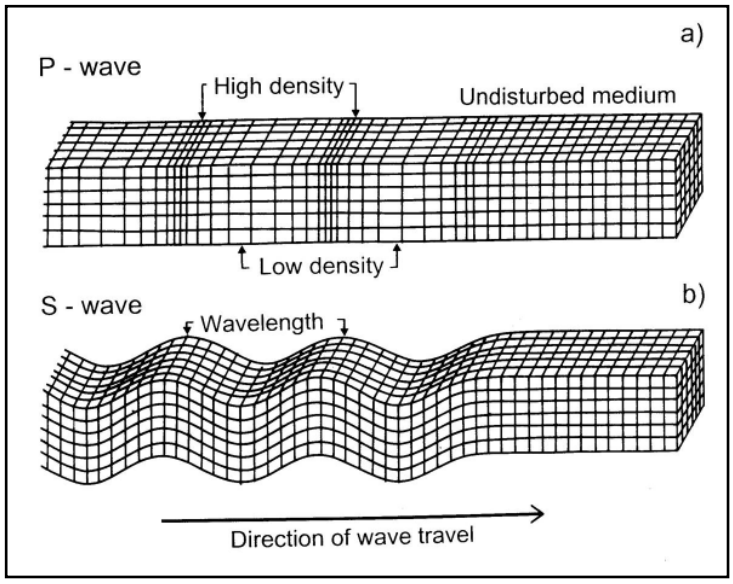

Figure1:
"Primary and Secondary Waves"
(Source: https://esgsolutions.com/technical-resources/microseismic-knowledgebase/understanding-the-waveform, 2/3/2016)

Earthquake waves can be divided into two types. *First*, body wave. It is spreading and move away from the hiposentrum. Body wave can be recognized from its compressional wave, which is moving closer and apart. Compressional wave can propagate either in solid, liquid, or gas matter. When the compressional wave propagates through a substance, the wave shoves atoms to get closer and away from each other repeatedly. Particles contained within the substance move back and forth in the same direction with the wave's motion, so it is called longitudinal wave. Compressional wave's speed can reach 6 km per second. Therefore, it is called the P wave or Primary wave (Ross & Ben-Zion, 2014).

In addition to the compressional wave, the body wave also underwent the shear wave, which can propagate in a solid matter. The pattern of the shear wave is its snaking motion, which perpendicular to the direction of the wave; therefore, it is called transverse wave. Its propagation velocity is lower at only 3.5 km per second. That is why it can be recorded by the seismic stations after the primary wave, so it is called S waves or Secondary wave (Ross & Ben-Zion, 2014). The shock of Primary and Secondary waves will continue to spread to the earth's surface and it is called the surface wave. See figure1.

Second, surface wave. It is very similar to the P (Primary) and S (Secondary) waves, but it moves or propagates on the earth's surface not the inside. Its speed is lower and recorded in seismograph as vertical and horizontal motion. Surface wave divided into two that are love wave and rayleigh wave that move in circular orbit. Love wave is transverse wave on the surface, which its direction is perpendicular to propagation direction from the center of epicenter. Its speed is about 70% of the S wave. The first wave is perceived and highly damaging. Rayleigh wave is a wave motion similar to water wave on the ocean. Its motion is elliptical retrograde, where soil particles rotate backward while the wave move forward. Its speed is faster than the love wave and almost 90% of the S wave (Ross & Ben-Zion, 2014).

Reaction of every building will vary, due to the type and the strength of the earthquake shock. In the case of Primary wave, the

building is like being squeezed between and stretched out that causing several cracks. In the contrary, the Secondary wave case, the building is like being lifted up and then suddenly dropped repeatedly until it collapsed (*cf* Shearer, 1999; and Ross & Ben-Zion, 2014).

The strength of an earthquake can be measured based on the magnitude recorded in seismograph or based on the degree of damage to buildings. The first measurement scale is known as Richter scale, and the second one is called Mercalli scale. Mercalli scale is using Roman numerals from I to XII. An earthquake, which capable of destroying buildings, is from VI to XII (Fowler, 1990; Shearer, 1999; and Ross & Ben-Zion, 2014).

History of Architecture in Indonesia and Japan. The architecture of houses and buildings in Indonesia is heavily influenced by the cultural development. According to E. Karnadi (2013b), there are at least six architectural styles, which are traditional, religious, palaces, colonial, post-independence, and contemporary architectures. Several of them, which have been regarded as the cultural heritage, are only four, namely: traditional, religious, palaces, and colonial architectures (Karnadi, 2013b).

First, traditional architecture. Many traditional architecture are based on its functions as a shelter, social relation, parenting, and meet the customary law prevailing in society. With the function of which is influenced by customary law and local community beliefs, the traditional houses in Indonesia are very diverse, especially in the building process. It has always been "controlled" by the customs system and under the guidance of carpenter master. Based on cultural history, the architecture of traditional houses in Indonesia are using natural materials, such as leaves, bamboo, wood, and stone, because it affected by animism and dynamism beliefs (Lombard, 2005; and Karnadi, 2013b).

Traditional house, or also known as vernacular house, is taking into account the harmony with the surrounding natural environment conditions. The architecture of traditional houses in Indonesia generally follow the architectural style of the Austronesian which is long form, communal, using wood materials, on stilts, and the slope of the roof is quite steep. House on stilts allegedly intended to prevent attacks by wild animals, keep it dry from soil moisture, slow the weathering of wood and prevent it from termites. With a quite steep shape, the roof can quickly drain from the pouring rain; and when it is heat, the roof can provide coolness due to the large space of air circulation (Nas, 2009; and Karnadi, 2013b).

Second, architecture with religious influences. The shape is very easily identified, because they are built in accordance purpose of worship, such as temple, mosque, and church. However, not all forms of religious architecture adopt all origin architectural styles. Religious architecture in Indonesia has had many interfaith blends. For example is an ancient mosque in Java, it took a lot of inspiration from the design of the architecture of Hindu and Buddhist temple from China. Another example is the Great Mosque of Demak in Central Java and the Great Mosque in Yogyakarta. Both do not have the dome as many mosques have in a number of countries. The Great Mosque of Demak, which was built in 1474, and the Tower of Kudus Mosque, which was built in 1549, is similar to the Hindu temple (Lombard, 2005; Nas, 2009; and Karnadi, 2013b).

Third, architecture of the palace. This architecture style spread in a number of areas that used to be the centers of an empire. Numbers of palace architectures are pavilion at the Royal Palace in Java; Puri Agung Gianyar Palace in Bali; Pagaruyung Palace in Minangkabau, West Sumatera; and Maimun Palace in North Sumatra (Nas, 2009; and Karnadi, 2013b).

Fourth, Colonial architecture or the Dutch heritage. Dutch colonial architecture buildings are the Ceremonial Hall at the ITB (*Institut Teknologi Bandung* or Bandung Institute of Technology); *Villa Isola* or *Partere* Building at the UPI (*Universitas Pendidikan Indonesia* or Indonesia University of Education) in Bandung; and many other buildings, such as railway stations, hotels, hospitals, sugar factories, and educational institutions. The Dutch colonial era buildings are spread in

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major cities on the island of Java, such as Jakarta, Bandung in West Java, Semarang in Central Java, and Surabaya in East Java (Lombard, 2005; Nas, 2009; and Karnadi, 2013b).

Meanwhile, traditional Japanese architecture has also similarities with the traditional architecture in Indonesia, which is characterized by wooden structure and on stilts house. In its development, the Japanese architecture was influenced by Chinese architecture that came in through Korea (Karnadi, 2013a).

Buddhism has also influenced Japanese architecture. The general structure of the Japanese architecture is its large and curved roof and wood frame walls covered by thin paper called *washi*. For the interior design, the walls are flexible, which can be shifted as required. Visually, the roof of Japanese architecture is very prominent. The size is almost half the size of the entire building and the shape of the building is set in a symmetrical pattern (Young, 2004; and Karnadi, 2013a).

Historically, architecture in Japan is tracked since Jomon period of around 8000 BC (Before Christ). After Jomon period, continued to Yayoi period in 300 BC, and at the same time also grows that is so called Tomb era. Those relics of the ancient tradition have given pattern to Japanese civilization. After those three periods, a new belief called Shinto was born. The influence of Shinto shrine attached to the shape of the building, which is still visible until now. The structure and construction of the building is still very simple, without any detail and ornament or color (Young, 2004; and Karnadi, 2013a).

In 552 AD (*Anno Domini*), Buddhism came into Japan from Korea through the kingdom of Paekche. Pattern and shape of the shrines in Japan were influenced by China architecture and culture. The period of the triumph of Buddhism in Japan was the Asuka period (552-645 AD) and Nara period (646-793 AD). From those two periods, the Japanese temple architecture was growing rapidly with *wayou* style (Coaldrake, 1996; and Karnadi, 2013a).

In the Heian period (794-1185 AD), two major sects was appear: Shingon sect and Tendai sect. Both sects have developed a doctrine of esoteric Buddhism of *Mahayana* (Great Civilization). Shingon sect had activities center which located on Mount Koya in Wakayama province. While the Tendai sect centered on Hie mountain located on the border between the Kyoto and Shiga (Coaldrake, 1996; Young, 2004; and Karnadi, 2013a).

In the period 1186-1333 AD, new sects in Buddhism called Zen was born. Zen sect divided into two other sects that are Rinzai and Soutou sects. Both of these sects were brought by monks from Japan, who went to study to China. In Japanese architecture, Zen inheritance can be seen in garden arrangement that developed until the Muromachi period in 1134-1573 AD and the Momoyama period in 1574-1614 AD (Coaldrake, 1996; Young, 2004; and Karnadi, 2013a).

It was in the Edo period (1574-1868 AD), traditional Japanese buildings were starting to show their design and details of the building, color, and engraving, both in temples architecture and residential houses. The next period was the period of the Meiji Restoration (1687-1911 AD) and Taisho period (1912-1926 AD). The architectural style of this periods have been much influenced by Western architectural style and developed for university buildings, museums, and offices (Coaldrake, 1996; Young, 2004; and Karnadi, 2013a).

Basic Principles of Seismic Resistant Houses. Technically, seismic resistant building is determined by many factors. Four of them are: good location of the building, building foundation, building plans, and sawhorse (Yani, Widaningsih & Rosita, 2015).

Firstly, a good location to build seismic resistant building is the flat one, the soil condition is not mushy, and the soil type is not a clay type which is sensitive to the soil's expanding and contracting. Soil that expands in rainy season and contracts in dry season can affect the building construction. If the relief of the land surface is sloping, then, it would be better to find stable hillside that is not prone to landslides during the earthquake (Bozorgnia & Bertero, 2004).

Secondly is a building foundation. Criteria

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for a good building foundation are: (1) the surface of the soil must be hard; (2) cross section foundation must be symmetrical; (3) hardness of the ground for the foundation must be all the same, it is not allowed if one part is hard and another part is soft; (4) it is suggested to use the "continuous" foundation along the length of the building plan and it is not allowed to use the stair foundation; (5) when using pedestal, then each foundation must be tied to each other with rigidly binding beams; (6) for the foundation on soft soil, concrete slab foundation or other alternatives foundation can be used; and (7) for the house on stilts build on the hard ground by using piles, then each of the pole should be attached in, such a way to each other with cross stiffeners (Merritt & Ricketts, 2001; and Yani, Widaningsih & Rosita, 2015).

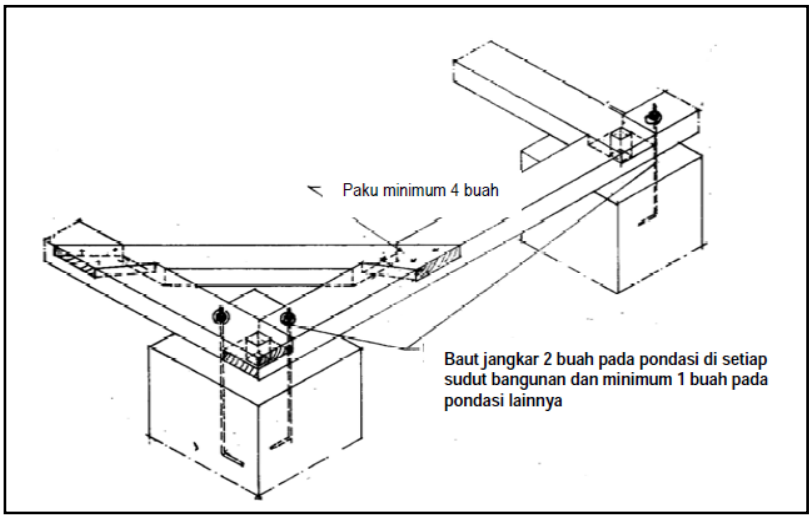

Figure 2:
Pedestal Foundation with the Binding Beams
(Source: Widaningsih & Cahyani, 2014)

The bottom of the pole that touching the ground is given soles from stone, so that it can carry the load on it evenly. The stone size is around 25 x 25 cm, 20 cm thick. See figure 2.

Thirdly, attempted house building plan is as possible in the simple form, symmetrical, and the axis of the building is not too long. The long axis of the building will reduce the power, if there is an earthquake shock. Comparison between the width and the length of the building is 1:2. If the development plan is not symmetrical, it is conceptually should be made to be separated and each part is considered as a unit that must be symmetrical (Merritt & Ricketts, 2001).

To obtain a solid building plan, it is suggested that the placement of insulating walls and opening doors or windows must be made symmetrical with the axis of the building plan. The building structure should be designed well, so that it will have a good ductility. Ductility is the ability of a material or structure to withstand pressure, flexibility, and resilient to damage (Merritt & Ricketts, 2001).

Fourthly is timbering for the roof as sawhorse. The good one is nails plank timber. This type of timber is quite mild and simple. Generally, timbers are made of wood, bamboo, steel, and reinforced concrete. The function of the timber is to support the roof structure (Merritt & Ricketts, 2001; and Yani, Widaningsih & Rosita, 2015).

RESEARCH METHODS

Research Approach. This research employed a qualitative approach, an approach that tends to have the subjective perspective (Somantri, 2005). Many theoretical literatures in a research are used as research guide, so that findings will be close to the real facts. However, it is also used to guide data searching, data analysis, and discussion of the findings (Djaelani, 2013). Accuracy of this research will be determined by the sources of references or literature study, and information obtained from interviews and focus discussion.

Data Sources and Research Procedures. This research obtained data from three sources: the literature study, interview with resource person, and FGD (Focus Group Discussion). The literature study was done by selecting the relevant literatures on traditional house, architecture, local culture in research sites, and the characteristics of the earthquake and the impact it caused (Skovdal & Cornish, 2015).

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Interviews with resource people at the sites. In Kampung Naga, the resource people are villagers and traditional leader (*kuncen*). The informations obtained were about customary in building and home functions. Meanwhile, informations about the architecture of Minka Gassho-Zukuri were gathered from the traditional house museum Nihon Minkaen Open Air Museum in Kawasaki City, Japan.

Finally, the FGD (Focus Group Discussion) is to do in-depth review by discussing method with the researchers team and architecture experts at the UPI (*Universitas Pendidikan Indonesia* or Indonesia University of Education) in Bandung, West Java, Indonesia.

Research procedures include the following steps: (1) the study of literature or desk research by collecting and making the description of the architecture of traditional houses in Kampung Naga, West Java, Indonesia and in Shirakawa-go, Japan; (2) preparing research instruments needed, such as interview guideline, questionnaires, and observation guideline; (3) preliminary study through FGD to discuss the preliminary findings on the characteristics of traditional houses in Kampung Naga, West Java, Indonesia and in Shirakawa-go, Japan; (4) the data collection by conducting interviews and field observations; (5) data tabulation and analysis through second FGD; and (6) report writing in the form of paper, proceeding article, book, and scientific journal article. See picture 1.

***Instruments and Data Collection*.** As in the tradition in qualitative research, the instrument or tool used for collecting and analyzing the data is the researcher him or herself. Researcher in qualitative research is known as human instrument, whose roles are to set up the focus of the research, selecting informants as source of data, collecting data, assessing data quality, data analysis, interpret the data, and make conclusions on findings (Creswell, 1998; and Skovdal & Cornish, 2015).

Picture 1:
One of the Researchers Team and the Resource Person Inside the *Gassho Zukuri* House at the Nihon Minkaen Open Air Museum in Kawasaki City, Japan
(Source: Researchers' Documentation)

Methods of data collection are literature study, observation, interview, and FGD (Focus Group Discussion). Obtained data are tabulated by elaborating and compiling them to produce a description as expected for the research (*cf* Creswell, 1998; Somantri, 2005; Djaelani, 2013; and Skovdal & Cornish, 2015).

RESULTS AND DISCUSSIONS

***Geological Conditions and Tales of Earthquake*.** Many areas of the earth are often hit by earthquake. In Indonesia, areas frequently hit by earthquake are the islands of Sumatra, Java, Bali, Nusa Tenggara (Little Sundanese islands), Sulawesi, Maluku, and Papua (West Irian). Borneo island is an exception for it is rarely hit by earthquake. Sumatra, Java, Bali and Nusa Tenggara islands are prone to earthquake, because they are shoved up by the Indo-Australian tectonic plates. While the islands of Sulawesi, Maluku, Papua, and the surroundings are shoved up by the Philippine and the Pacific Plates (Heys, 2015).

Every year, thousands of weak earthquakes that shock Indonesia are recorded. In 2015, around 4,394 earthquakes were recorded and over the last 100 years, four biggest earthquakes, which killed thousands of people shocked Indonesia, were: (1) Aceh earthquake shocked the island of Sumtera,

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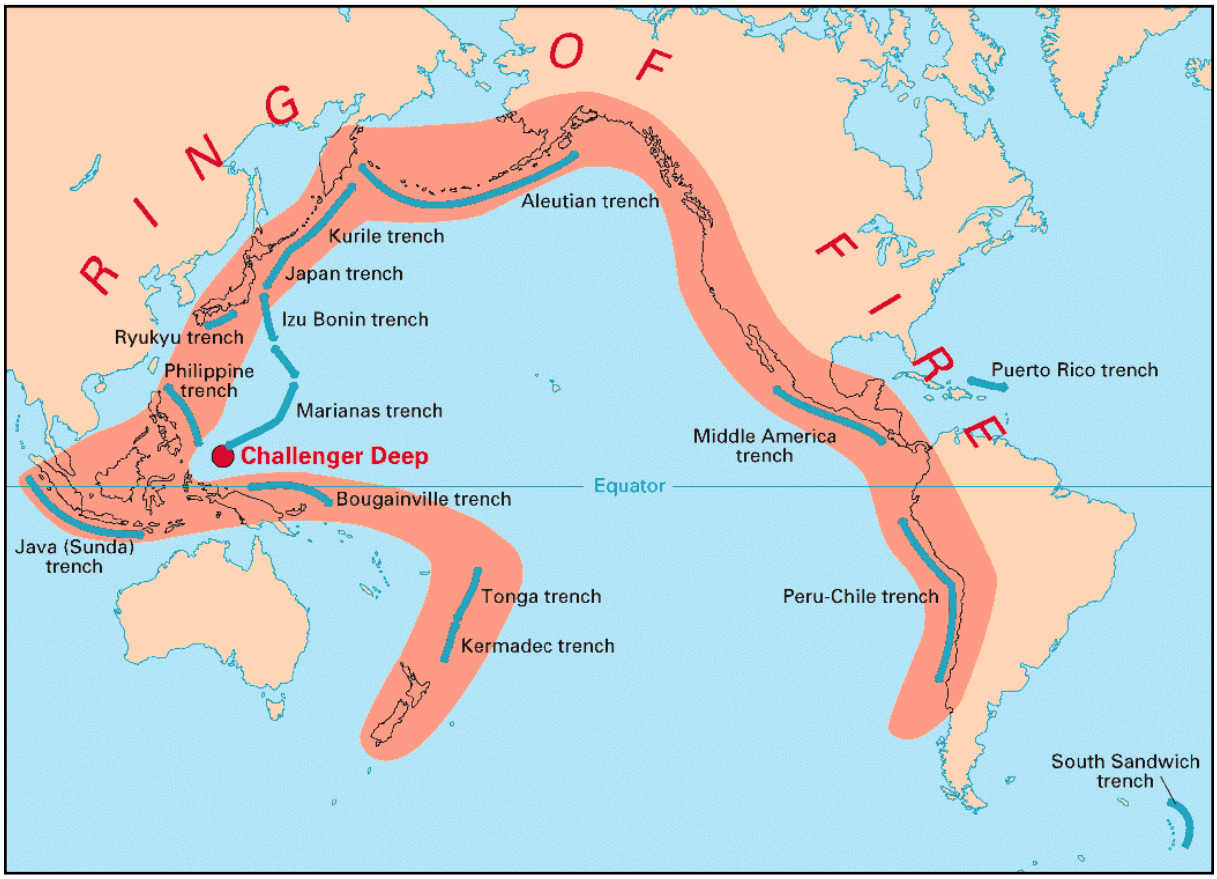

Figure 3:
"Ring of Fire"
(Source: http://pubs.usgs.gov, 2/3/2016)

on 26 December 2004, with a strength of 9.3 on the Richter scale and was accompanied by the Tsunami that caused heavy loss of more than 283,106 people; (2) Nias earthquake shocked North Sumatra, on 28 March 2005, with a strength of 8.6 on the Richter scale and claimed 1,346 victims; (3) Earthquake that shocked Yogyakarta, on 26 May 2006, with a strength of 6.3 on the Richter scale and claimed 6,234 victims; and (4) Earthquakes that shocked West Sumatra, on 30 September 2009, with a strength of 7.9 on the Richter scale and claimed 1,117 lives, about 1,214 seriously injured and 1,688 slightly injured (*cf* Mat Tahir & Ahmad, 2014; and Heys, 2015).

Japanese island is also frequently hit by earthquake. Japan is surrounded by four plates: the Pacific, the Philippines, North Americas, and Eurasias plates. In Japan, earthquake occurs almost every day. The most powerful earthquakes recorded are: (1) the earthquake and Tsunami on the island of Okushiri in 1993, and claimed more than 200 lives and missing person; (2) the Kobe earthquake in 1995, which is known as the *Great Hanshin-Awaji* earthquake, that caused massive damage and killed more than 6,400 people; and (3) Kanto earthquake or *Kanto daishinsai,* on 1 September 1923, which killed thousands of people and destroying hundred thousands of homes (*cf* Borland, 2006; and Clancey, 2006).

Indonesia and Japan will not be free from earthquakes, because they are both in the ring of fire area that extends from America, Bering Strait, Japan, Philippines, Indonesia, and continued to New Zealand. Ring of Fire is area where two or more tectonic plates bump into each other. Along this path are found mountain folds and active volcanoes. See figure 3.

The Indonesian people, especially the Sundanese people, who occupy the Provinces of West Java and Banten, have a unique tale

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about the earthquake. Ancient Sundanese used to believe that earthquake occurs, due to the movement of a stone that live in the bowels of the earth. He will move when he fells stiff on his body. However, the stone will not move carelessly, because he knows that there are still humans live on the earth's surface. Why does the stone eventually make a move? It is caused by a demon, who disguised as a black ant. The demon came to the stone and reported that there was no longer human being live on the surface. Hearing the report, the stone was writhing to relax his stiff muscles. At that moment an earthquake was occuring (Maulia, 2009; and Anggraeni, 2013).

Men live on the earth's surface was shocked. They know it was because the act of the demon who incited the stone. With a sense of panic, all men then shouted trying to tell the stone that there are still humans being live on the surface. The hope was that the stone heard and immediately stop his movement. Therefore, everyone is encouraged to shout out loud by saying: "*Aya … aya … aya!!!",* which means "We are here ... we are here … we are here!!!". Sundanese call earthquake disaster in their language as *lini* (cited in Anggraeni, 2013).

Another tale comes from the island of Simeulue in Nanggroe Aceh Darussalam, Northern Sumatera, Indonesia. The province is located at the Western tip of the Indonesian archipelago. At the time Aceh earthquake and Tsunami occur in December 2004, hundred thousands of people were killed, buildings and houses were destroyed, and almost nothing were remain (Mat Tahir & Ahmad, 2014). But, there was one little island in Aceh, located in the middle of the Indian Ocean, that survived from the Tsunami disaster. Although buildings was destroyed, but there were only six victims found dead. People live on Simeulue island spared from the Tsunami, because they have local knowledge stored. They have stories told for generations (Foster *et al*., 2005; and Suhandono, 2010).

The legend said that in 1907, the Tsunami ever hit Simeulue island and killed many people. Houses and buildings were destroyed. The Simeulue people wanted no more lives being the victims of earthquake and Tsunami again. The traditional leaders ultimately create a song that taught his descendants from generation to generation. They call the Tsunami as *Smong*. Song tells about the *Smong,* as cited by S. Suhandono (2010), is as follows:

Enggel mon sao curito
(Listen to a story)
Inang maso semonan
(In the ancient times)
Manoknop sao fano
(A village were underwater)
Uwi lah da sesewan
(That's what they tell me)
Unen ne alek linon
(Preceded by an earthquake)
Fesang bakat ne mali
(Followed by a big wave)
Manoknop sao hampong
(Then the whole place were underwater)
Tibo-tibo mawi
(In a sudden)
Anga linon ne mali
(So if you feel a strong earthquake)
Uwek suruik sahuli
(Followed by the receding water)
Maheya mihawali
(Go and seek)
Fano me singa tenggi
(A higher place)
Ede Smong kahanne
(That is Smong)
Turiang da nenekta
(The history of our ancestors)
Miredem teher ere
(Keep this in your mind)
Pesan dan navi da.
(The message and its advice).

Meanwhile, tale about the earthquake in Japan is much different. This story is quoted from the site at: http://noretz-area.blogspot.co.id that we cited in Bandung, Indonesia, on 19 December 2015. The ancient Japanese believed that the earthquake and Tsunami were caused by the act of a giant catfish called *Namazu*. This fish lived in the mud beneath the earth. *Namazu* was very powerful and could only be conquered by *Kashima*, the God who protects the the Japanese from earthquake. *Kashima*'s weapon was a magical stone that has magical powers. *Namazu* never stands still, he was always looking for opportunities to move and make a riot that cause earthquake. *Namazu* would make a move, when the guard started to become complacent and slack (http://noretz-area.blogspot.co.id, 19/12/2015).

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Figure 4:
"Illustration of Kashima Crippling Namazu: The Giant Catfish Monster"
(Source: http://noretz-area.blogspot.co.id, 19/12/2015)

After the Edo earthquake in 1855, Japanese made a cult of *Kashima*, the God, as *Yonaoshi Daimyojin* or God of the earth's healer. *Namazu* was a legend depicted on ancient paintings called *Ukiyo-e* (Smits, 2006). The paintings show that *Namazu* is controlled by *Kashima,* the God. To add strength to *Kashima* and weaken *Namazu*, the God demanded that rich people multiply their alms to the poor. See figure 4.

Stories of how an earthquake occurs now have changed a lot in Japan. Although the Japanese government has not been able to reduce the earthquake yet, but the government has been trying to reduce disaster victims by applying disaster mitigation, as follows: *first*, the government recommends that all Japanese people always remain vigilant. Near the door of the house, must always be prepared a variety of emergency equipment that is put into a backpack like bottled water, dry food, medicines, cash, clothes drier, radio, flashlight and some replacement batteries, glasses, and things are considered needed by each family. Furthermore, it is recommended to put the shoes under the bed and bicycles in the yard. Shoes are put on immediately for securing feet from broken glass.

Second, the government also advocate schools, offices, and shops (supermarkets) for conducting routine disaster simulations, including conducting quick evacuation drills. *Third*, the government set standards for seismic resistant houses and building. Experts in construction and architecture strive to meet all those standards. *Fourth*, the government helped by volunteers from the community socialize to perform emergency actions when earthquake occurs, such as protecting the head, sheltering under the table to protect the head from hard objects, immediately shut off the gas flow, and make sure the door remains open to reduce the risk of trapped among the rubble.

Fifth, officers will activate an earthquake warning via mobile phone networks to all citizens and sirens. And finally, *sixth*, the Japanese government has been designing center of nuclear energy and electric trains will turn off automatically in case of earthquake (*cf* Usami, 2002; and Smits, 2006).

The Environments of Kampung Naga and Shirakawa-go. Kampung Naga is located in Neglasari Village, Salawu District, Tasikmalaya Regency, West Java Province, Indonesia. It is not far from the highway that connects two Sundanese cities: Garut and Tasikmalaya. Kampung Naga is one of the traditional villages that is protected and conserved on

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the criteria of cultural heritage, architecture, and environment (Fitri, Yani & Ahmad, 2015). Kampung Naga is bounded by the sacred forests (rainforest), in which there are several ancestral graves on the West, vilagers' rice fields on the South, Ciwulan river on the North and East (Widaningsih & Cahyani, 2014).

Kampung Naga can be reached by public transportation or private vehicles. Since it has become a tourist destination, there is a parking lot on the edge of the highway for visitors. From the parking lot, visitors must descend the ladder, called *sengkedan,* to Ciwulan river swale. The mileage is pretty close which is about 500 meters away, but the relief is very steep hill with a slope of more than 45 degrees. There are no special facilities for disable to go into this village. The trip can only be taken by those who are able to walk way up or down the hillside.

The division of land use in Kampung Naga consists of *leuweung larangan* (forbidden forest), sacred forests, garden, rice field, and settlements. In managing the land, the community has two types of land ownership: (1) customary land that are forbidden forest and sacred forests; and (2) yard that are land for private property, such as rice field, garden, and pond. Forbidden forest and sacred forest should not be disturbed by the villagers, because it is considered *pamali* or taboo (Yani, Widaningsih & Rosita, 2015).

Kampung Naga has two leadership systems, formal leadership is led by a neighborhood head, or called *Ketua RT (Rukun Tetangga);* and traditional leadership is led by an indigenous leader, or called *Kuncen*. *Ketua RT* is governing the administration of villagers, their roles, rights, and obligations as Indonesian integrated with the government above him or her. *Kuncen* serves as the guardian of the traditions, customs rules, and regulations applied in Kampung Naga. Leadership of a *Kuncen* considered sacred by the villagers, so that adherence to the rules are very binding on all villagers (Iryana, 2014).

The settlement consists of 110 houses, a meeting hall called *Bale Patemon*, a mosque, a traditional house called *Bumi Ageung,* which built on 1.5 hectares of customary land. Customary land is a land that cannot be owned by individuals, the indigenous villagers are only allowed to build their homes if vacant land is still available. The building footprint area is adapted to each person's ability to develop and provide its materials, so that the large of every house is different (Widaningsih & Cahyani, 2014).

Kampung Naga villagers believe that all areas around the village dominated by certain powers, especially at every edge of an area, such as river bank, yard boundary, rice field boundary, place where the water comes out or called *huluwotan*, hillsides, edge of the forest, and many others. The boundary areas are believed inhabited by spirits and considered haunted. Therefore, the tradition is to keep *sasajen* (offerings) as a form of homage to the spirits, so that they do not interfere with the lives of the villagers (Iryana, 2014).

If the traditional practices are abandoned by the villagers, natural disasters such as earthquake, volcanic eruption, flood, landslide, and other accident are believed will occur. The prohibition in the traditions is known as taboo or called *pamali*. *Pamali* is an unwritten law, but obeyed by every villager (Iryana, 2014; and Yani, Widaningsih & Rosita, 2015).

The annual ritual held in Kampung Naga is *hajat sasih* ceremony. It is a ritual pilgrimage of visiting ancestral graves and clean them of grass grows. Before the ceremony began, men villagers should wash their body in Ciwulan river. After washing, they should perform an ablution according to the ordinances of Islam and wear special clothing with the color of white. Then, they take a broom stored in a corner of the mosque to clean the ancestral graves. After cleaning the graves, they regrouped at the mosque and pray for the safety and welfare of the villagers. See picture 2.

Meanwhile, Shirakawa-go is located on Hida plateau, Gifu prefecture, Japan. It can be reached by bus or train from all major cities in Japan. Shirakawa-go is relatively isolated mountain village with the very well known on Gassho style houses. Since 1995, Shirakawa-go is listed as a site of world cultural heritage by UNESCO (United Nations of Educational, Scientific, and Cultural Organization). Shirakawa-go is one of a very old village for it has been inhabited since 8000 BC to 200 BC

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Picture 2:
"*Hajat Sasih* or Annual Ceremony"
(Source: www.inddit.com, 2/3/2016)

(Before Christ). At the beginning of the 16th century, around Ogicho area was estimated there were about 50 houses; in Edo period, the number had grown to 80 houses; and in Meiji period, it doubled to more than 100 houses (Ochiai, 2014).

Just like many farm village, the landscape of Shirakawa-go area is very beautiful and peaceful. It is very close to Shogawa river valley. The form of almost every house is relatively the same with Gassho style (a steep roof in a shape of two hands put together in pray) and facing East and West in order to receive direct sunlight. The roof direction also has a purpose in order to let the mountain wind flow and put it to good use. The distance between houses is set in such a way, in case of fire the flames do not spread to other houses. To keep non-flammable, every morning around 8:00 AM (*Ante Meridiem*) at local time, the roof of the house sprayed with water automatically. In December and March, Shirakawa-go is usually covered by heavy snow. Among the Gassho trandisional houses, there is a very large Gassho's house called *wadake,* which open to the public. *Wadake* building is house belong to prominent clan in Shirakawa-go built in the Edo era (Miyazawa, 2005).

Villagers of Shirakawa-go are belief in Shinto teachings. Shinto means "the Gods way", which is based on the idea that the creator and controller of the universe are the Gods. Beside believing in many Gods, the Japanese also believe the forces of nature, such as the power of the sun, moon, wind, sea, mountains, lightning, and others. Shinto is heavily influenced by the Buddhism from China and Korea. Buddhism is belief in life after death and the existence of heaven and hell. A mix of Shinto and Buddhism rise the concept of dualism in Japanese belief and both are together in a harmony (Miyazawa, 2005; and Ochiai, 2014).

The annual festival celebrated by the villagers of Shirakawa-go is called *Doburoku* ceremony. It is a ceremony held in late autumn to express gratitude to the Gods on a good harvest and pray for the peace and health for the whole villagers. The festival is held in the temple to pray to the God of the mountain. *Doburoku* is a kind of food in a form of watery porridge made of Japanese sake and it taste sweet. Although the production of alcoholic beverages is forbidden, but for villagers of Shirakawa-go, they are given a special permission to produce *Doburoku* in limited quantities during the festival. Each visitor will be offered *Doburoku* and requested for a

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donation. *Doburoku* is taken out of the temple by using a large bucket with a diameter of one meter. The festival is filled with dances, jokes or *niwaka*, singing songs, and others (*cf* Kim, 1994; and Miyazawa, 2005). See picture 3.

Picture 3:
"*Doburoku* Festival: Photo by Sightseeing Navigation in Shirakawa-go Shirakawa Village Office"
(Source: http://shirakawa-go.org/en/sightseeing/50/, 19/12/2015)

The Lightweight Seismic Resistant Kampung Naga's House on Stilts.
Kampung Naga's house on stilts is composed of three parts: the front, middle, and back. The front is a porch called *golodog*, its function is a room to receive guests. The middle is a large living room, where family and also guests are gathering together to have dinner. Beside it, there are two to three bedrooms. At the back, there is a kitchen and a rice storage room called *goah* located side to side with living room. It is a room exclusively to women's activities. The size of the house is relatively small, only 5 x 8 meters (Hermawan, 2012 and 2014). See figure 5.

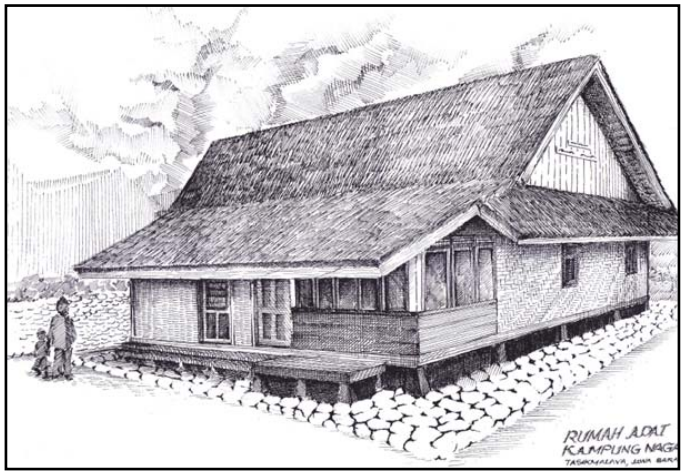

Figure 5:
House on Stilts in Kampung Naga
(Source: Researchers' Documentation)

The foundation of the house is in pedestal shaped with stone as its base. There are two ways of installing this pedestal foundation. First is by using stone that chiseled in elongated rectangular shape about 50 cm height. It is mounted vertically to refute the wooden poles, so that the poles do not appear below the stilts. Second is by using wooden pole with a single stone as its base. The stone has a purpose to avoid wood to be moistened and eaten by termites, so it can sustain longer. Wooden pole is the main structural element of the house made of *Albasiah* tree, or *Albizia Falcataria*, that cut into 10 x 10 cm. To maintain its durability and strength, woods are soaked in mud for at least 40 days, and then cleaned and dried (Nuryadin, 2015). See figure 6.

House's materials composed of wood and bamboo. Wood and bamboo are materials that are widely used in Indonesian traditional architecture as part of the national cultural heritage, which have a high value (Wibowo, 2015). Roof of the house uses palm fiber from the sugar palm. *Tepus* leaves are laced up one another and stretched forming a large sheet then stacked with palm fibers. Floor is made of bamboo or wood. The wall is made of woven bamboo with woven braid pattern. The wall is not painted, except using chalk or called *meni*. Construction and roof of the house are adapted to local climatic conditions. Pole structure and foundation make the house adaptive to earthquake and land contour. Ventilation is set to make the houses remain dry and cool, compensate to tropical climate conditions. Beside its water-resistant character, the roof

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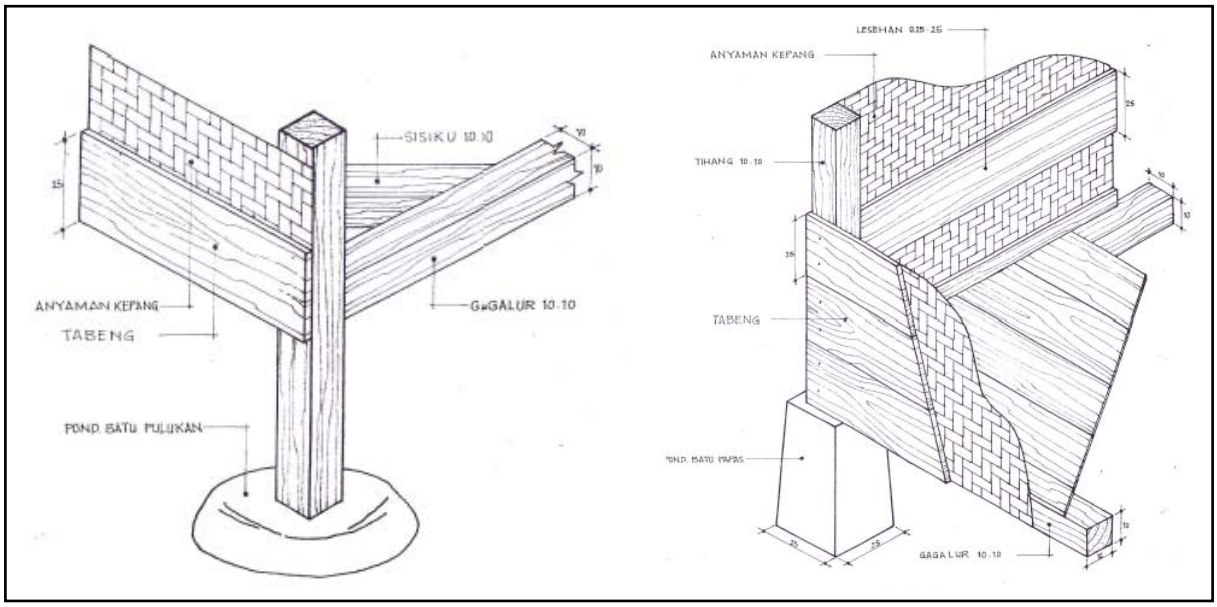

Figure 6:
Two Foundation Installation Systems of House on Stilts in Kampung Naga
(Source: Researchers' Documentation)

also keeps the house warm during the night (Widaningsih & Cahyani, 2014).

The house is facing the North or the South with elongated towards the West-East. It has no doors in two opposite directions, because according to their beliefs, if there were two doors in a house, good fortune would enter the front door, but it will come out again through the back door (interview with Informant A, 9/10/2015). The entrance always consists of two doors: the living room door and the kitchen door. Both are adjacent to and facing forward. To distinguish them, the kitchen door is always characterized by the use of rougher woven bamboo. The house does not have a bathroom for the purposes of bathing and defecating. This is because, according to their beliefs, bathroom is dirty, so that it is not allowed to be part of the house. For the purposes of bathing and defecating villagers must go outside the customary land. The fish pond and cattle also considered dirty and they must be placed outside the customary land (Nuryadin, 2015; and interview with Informant A, 9/10/2015).

Floor of the house use bamboo called *Palupuh*. It is tanned, opened, trimmed, and arranged lengthwise on top of the stilts' frame, which is made of wood. Bamboo used to make *Palupuh* is bamboo with diameter of 20 cm. Besides *Palupuh*, 15-20 cm lengthwise planks are also used for flooring, which is laid on top of wooden stilts' frame. *Palupuh* floor is still being used in the kitchen. It is because if water were spilled, it could spill immediately to the ground through the hollow cavity of the *Palupuh*. Besides, cast-offs can fall through the cavity to the ground and feed the chickens under the house (Hermawan, 2012 and 2014).

The walls of the house are the wall of the skeletal system. Wall frame structure is made of *Albasiah* tree, or *Albizia Falcataria*, in size of 7 x 10 cm, whereas for walls lining wicker booths woven with a pattern of braids are used. The type of bamboo used for the walls is type of bamboo called *awi tali*. It previously dried to make it more durable. Materials for doors are *suren* wood or *mangrid,* which is similar to flooring planks with a thickness of about 4 cm. Special to the kitchen door, it is required to use *sasag*. *Sasag* woven door in the kitchen is more transparent, so that the level of privacy is less, but in terms of security it is very effective, because people from the outside will easily find out if there is a fire in the kitchen (Hermawan, 2012 and 2014).

Based on the results of FGD (Focus Group Discussion), a house on stilts in Kampung

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Naga is a seismic resistant house, because: *first*, structure of the floor is just put on top of the stone pedestal foundation. If an earthquake occurs, the house would only shift or change its position. *Second*, the connection among the foundation, the floor structure, and the body of the house are not rigid. *Third*, the body frame of the house can move freely and return to its original position. Almost all parts of the house are using light and elastic natural materials, so that the house is not burdened by a heavy load, and when any earthquake occurs, the house will not collapse. Finally, *fourth*, woods frame of the house are connected by pins and pegs, when they are shocked, they will not crack like concrete walls. Kampung Naga villagers feel safer to be inside of the house at the time of the earthquake. If an earthquake occurred and they were outdoors, they would hurry to get into the house.

Picture 4:
A *Gassho Zukuri* House in Ogimachi Village, Shirakawa-go, Japan
(Source: Researchers' Documentation)

***The Solid Seismic Resistant Gassho Zukuri Traditional House*.** Traditional Japanese house for common people called *Minka*. *Minka* has already existed before 1800 AD (*Anno Domini*). *Minka* architecture varies depending on the climate, the relief of the earth's surface, and its function. *Minka* in the northern part of Japan is designed to be able to adapt to the long winter and snow. The roof is a steep roof made of straw, so that the air inside the house is warm enough. The windows are small to avoid the cold wind to get into the house. The second and the third floor are usually designed for the purposes of rearing silkworms. While, *Minka* in the southern part of Japan is consisted of group of houses that are relatively small. It is optimally ventilated to avoid the lunge of the typhoon.[4]

In the repertoire of Japanese architecture, *Minka* divided into two types: the farmhouse type is called *Nouka*; and the urban house is called *Machiya Minka Gassho Zukuri*, which will be discussed in this paper is the farmhouse type or *Nouka* of northern Japan. *Gassho Zukuri* traditional houses can be found in the historic village of Shirakawa-go and Gokayama. These two sites were registered as world cultural heritage by UNESCO (United Nations of Educational, Scientific, and Cultural Organization). In Shirakawa-go area, there are four villages, but Ogimachi is the one that registered and become a popular tourist site. There are about 114 *Gassho Zukuri* houses in Ogimachi and all the houses are inhabited. However, there is also an open air museum near the village for tourists to visit and look around (Ochiai, 2014). See picture 4.

Gassho Zukuri house has a very steep roof. It is about 60 degrees in a form of isosceles triangle. It resembles the *Gassho,* which means two hands put together in pray. Inside the house, there is a fireplace called *Irori*. It is located in a large room called *Oe* and *Daidoko.* It is a place to cook, to get body warm in the winter and also to dried clothes. It is the center of the house's activities, especially at night. The thatched roof is made of hay or called *Kaya* in Japanese language. There is no scientific name for this plant. This roof can last for 30 to 40 years. However, its durability is getting shorter now since *Irori* is no longer used. The everyday use of *Irori* can dry the

[4]See news on "Getting to Know the Style of Traditional Japanese Architecture House (*Minka*)". Available online also at: http://international-face.blogspot.co.id/2015/09/ [ccessed in Bandung, Indonesia: March 2, 2016].

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hays and avoiding it from getting humid (Miyazawa, 2005).

This *Gassho Zukuri* house can last hundreds of years, built with cedar wood that grew big and tall. Renovation of the house is simply by replace the roof every 20 or 30 years done in a tradition called *Yui,* which means community self-help or mutual cooperation with all villagers. The process of replacing the roof is in great demand by foreign travelers and sometimes they are willing to help the process. *Gassho Zukuri* thatched roof has a thickness of about 40-50 cm. The cedar wood used to build the house can last up to 200 to 300 years, and therefore it is very valuable. *Gassho Zukuri* house is a very large house. The size of the building is about 18 meters long and 10 meters wide. It consists of 3 to 4 floors and can be occupied by 70 people (Miyazawa, 2005; and interview with Informant B, 10/11/2015).

The plan of *Gassho Zukuri* house can be divided into four by giving intention to the backmost room seen from the entrance: (1) the main Japanese room is *butsuma* with family Buddhist altar inside and there is no room with the alcove; (2) the main Japanese room is *butsuma* with the alcove inside; (3) the main Japanese room is *butsuma* with family Buddhist altar and the alcove inside; and (4) the main Japanese room is *shoin* or study room. However there are several details that varied in every house, such as the number of rooms, and the location of *Oe* or the room with fireplace inside (Miyazawa, 2005).

Gassho Zukuri house generally has three floors. The first floor is used for all family activities. Second and third floor is not used for living. It was used for rearing silkworms. There are two parts of the attic used to rear silkworms, the below one is called *ama* and the above one is called *sora-ama*. To add strength to the roof of the house, especially in the case of an earthquake, strong wind, or heavy snow wood frame of the roof called *ohagai* (the large one) and *kohagai* (the small one) are bond together (interview with Informant B, 10/11/2015).

Picture 5:
Pedestal Foundation of *Gassho Zukuri* House and Roof Truss System which Can Move Back and Forth When an Earthquake Occurs or Blown by Strong Wind
(Source: Researchers' Documentation)

Foundation of the house is in the form of pedestal that is installed on a large stone embedded into the ground. Besides being able to maintain the wood from weathering, the pedestal form foundation can be one of earthquake disaster mitigation efforts. If an earthquake shocked, the house will not collapse, but only shifted its position (Ochiai, 2014).

There are three key factors that make *Gassho Zukuri* house resistant to the earthquake. They are: *first*, the floor structure is placed on top of the pedestal stone foundation, which is prepared well before the house is built. In the case of an earthquake,

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Table 1:
Comparison betwen *Rumah Panggung* in Kampung Naga, Indonesia
and *Minka Gassho Zukuri* in Shirakawa-go, Japan

No	Comparison of Both Traditional Houses		
	Components	***Rumah Panggung* in Kampung Naga**	***Minka Gassho Zukuri* in Shirakawa-go**
1	Shape of the house	Stilts house with triangle roof	Stilts house with triangle roof
2	Size	Around 5 m wide, 8 m long	Around 10 m wide, 20 m long
3	Direction	From south to north	Facing on the same direction where the river flows
4	House frame	Rectangular	Rectangular
5	Roof shape	*Julang ngapak* (soar up to the sky)	*Gassho* (hands praying)
6	Materials	Bamboo and woods	Woods and cedar
7	Roof materials	*Ijuk* (palm fiber)	*Kaya* (hay)
8	Foundation	Pedestal	Pedestal
9	Wall	Woven bamboo	Woods plank

(Source: Yani, Widaningsih & Rosita, 2015)

the house will only shift or change its position. *Second*, the woods used for the house which are large and sturdy with the joints between the columns, which are tied with string. If any earthquake shocked, it would only move and easily return to its original position. Finally, *third*, the body frame of the house can move freely and return to its original position, because the connection between the timbers are not locked by using nails. Almost all parts of the house are using woods, so there will be no debris crushed if it collapsed (*cf* Miyazawa, 2005; and Ochiai, 2014). See picture 5.

Although the traditional houses of Kampung Naga, West Java, Indonesia and Shirakawa-go, Japan are different, but both architectures have similar purpose to reduce the damage to the building in the case of earthquake. Both traditional houses do not have a rigid structure among the foundation, the structure of the floor, and the body of the house. See table 1.

In the event of an earthquake, the body of the houses will only shift their position following the horizontal force of the earthquake. The houses will move freely and return to its original position after the shocks. Both traditional houses are using only natural materials for all parts of the houses. The difference is that *Rumah Panggung* in Kampung Naga, West Java, Indonesia is simply using lightweight materials, so it will not be a burden to the house. While *Gassho Zukuri* house in Shirakawa-go, Japan is using thick roof to adjust to the local climatic conditions. When it's snowing, the roof will be capable of holding a pile of snow. Another important thing is the highly elastic ties system using special kind of plants, so that the houses are not easy to collapse (*cf* Miyazawa, 2005; Ochiai, 2014; and Yani, Widaningsih & Rosita, 2015).

CONCLUSION [5]

Geological conditions of Indonesia and Japan, that have in common, are their frequent earthquakes. Long before the term disaster mitigation in both countries are known, they both already have local wisdoms in mitigating earthquake disasters. Based on the above results, the villagers of Kampung Naga in West Java, Indonesia and Shirakawa-go in Japan have already had the awareness that earthquakes can happen anytime. Information about their local wisdom provides us insights and new perspectives on how humans during their long journey have been trying to overcome the difficulties caused by local natural conditions.

Traditional humans with technological limitations have been able to protect themselves from the threat of natural disaster by studying the characteristics of nature and maintain a harmonious relationship with them. It is suggested that humans still need to

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adapt to local natural conditions for the nature still holds and has the power over human's ability to cope. It is also suggested that humans should keep their relationship with nature well remain. Although humans have mastered the technology, but they still must adapt to nature. Even if humans had been able to overcome the forces of nature, they must maintain the natural resources for human life still comes from the nature on this planet of earth.

To enhance the harmonious relationship between nature and humans, presumably the next generation must study harder to understand the forces of nature and the natural resources it contains. In that way, people will continue to have the opportunity to be able to live in the world, although the threat of natural disasters will continue to lurk human safety. Findings of this research are expected to give inspiration and awareness about the importance of considering the condition of natural environment to build a house. It also useful for culture observers, who study about local wisdom; and for education practitioners, it can be used as teaching materials at the schools.[6]

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[6]***Statement***: We, hereby, declare that this article is our own scholarly work; so, it is not a product of plagiarism due to all sources that are cited in this article, we have shown in the References. This article is also not submitted, reviewed, or published in other scholarly journals yet.

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