Available online www.ejaet.com

European Journal of Advances in Engineering and Technology, 2018, 5(12): 1011-1016

Research Article ISSN: 2394 - 658X

Innovation in Modelling of Flood-Friendly Housing Design with Approaching of Sundanese Traditional Architecture (Case study: Baleendah Sub-district, Bandung District, West Java-Indonesia)

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ABSTRACT

The research locations are Cieunteung residence in Babakan Mekarsari village and Jambatan village in Andir, Baleendah sub-district, Bandung District-West Java Province in Indonesia. The prototype for flood-friendly houses in villages that will be proposed to the local government. The research gives two important formulas, there are: (1) Concept design of the flood-friendly house with Sundanese architecture approaches (imah panggung) (2) The design of a flood-friendly housing includes: the design of the floor plan, the design of house facade, the design of roof and the design of house structure and construction according to the local wisdom of Sundanese traditional architecture. Two important formulation results in the planning and designing the flood-friendly houses in the two villages will be submitted as the proposal to the local government as well as consideration to anticipate the wider impact of the flood.

Key words: Inovation, House design, flood-freindly, Sundanese traditional architecture

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INTRODUCTION

Until now, flood disaster still left unresolved problem and cannot be dealt permanently both by the central government, regional government or even city government. Disaster handling is always temporary and was done by the locals who lived in flood-prone areas independently. For examples, the rich people were designed two storey houses intended to prevent a flood on the first floor and the owner can move to the second floor when the flood comes. On the other hand for the poor people, were evacuated to another family house or keep staying in their flooded houses. In the past, there is no flood-friendly house design yet to anticipate submerging the main part of the house. Though architecturally, the design concept of the flood-friendly house can be made for the local residents. These all problems above become the background of this research about "Innovation In Modelling of Flood-Friendly Housing Design With Approaching of Sundanese Traditional Architecture *(Case Study in Baleendah Sub-district, Bandung Regency, West Java-Indonesia)".* The reason for chosen Baleendah sub-district become the study area in this research because this area was affected by the most severe flooding in the last five years since 2010. The house's design is inspired by the local wisdom of Sundanese traditional architecture, especially the house on stilts. The local wisdom of Sundanese traditional architecture as approachment in this research because of the value of richness and uniqueness locality. The results of this research are expected as a solution to solve the flood disaster problems.

METHOD OF RESEARCH

The method uses in this research is the descriptive-qualitative method by way of describing in writing from the results of a field survey about the real condition of the area that has tourism potential. While the research method uses in this research is secondary data analysis methods obtained from relevant agencies and survey method (observation) with research that focuses on surveys supported by field observations to get data about planning and designing flood-friendly houses. The location of this study is located in flood-prone area, among them is Cieunteung Village, Baleendah District, South Bandung Regency. The choice of location is based on several considerations, there are: (1) The area that was most affected by the floods in the past five years; (2) The location of the villages is very close to the Citarum and

Cisangkuy Rivers; (3) The village is included in the list of flood-prone area and flood alert areas in the provincial or in district of BNPB. While the reasons for chosen Naga village and Baduy village as objects of comparative studies because of their diversity and the richness of their unique and typical traditional architecture.

RESULT AND DISCUSSION

a. Description of Research Location

Babakan Mekarsari Village, Cieunteung residence and Jembatan village are part of the administrative area of Baleendah District which is astronomically located at the coordinates 7˚13'-7˚71 'LS and 107˚31'-107˚40' BT. While geographically located in the middle of Bandung Regency area which borders on 5 other sub-districts (*picture 3*). The altitude of the region is at 600 meters above sea level up to 715 meters above sea level, most of which are low land area and hills with temperatures ranging from 24˚-32˚ Celsius. The two villages were traversed by two large rivers, there are Citarum and Cisangkuy river. The climate in both villages is generally similar to other regions on the tropical island of Java, the rainy season and the dry season. During 2013-2014 the rainfall in Baleendah District was relatively low: 1,856 mm per year with an average of 10 rainy days per month. Baleendah District has an area of 34.18 km^2, administratively divided into 8 villages or residence-level regions.

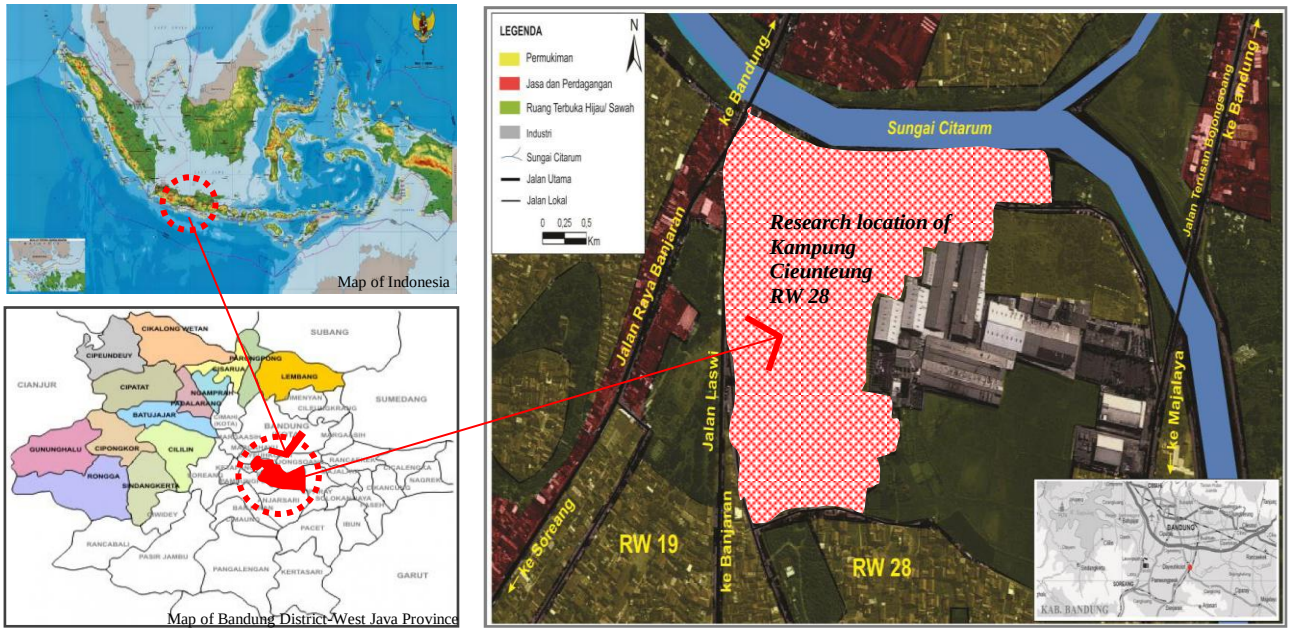

Fig. 1 Maps of location of research in Baleendah Disrict, Bandung-West Java Province

Fig. 2 The area affected by flooding in Cieunteung Village

Fig. 3 Houses destroyed by floods in Cieunteung village

In Baleendah District, especially in Cieunteung area of Babakan Mekarsari village and Jambatan village under the flooding area. These villages are the densest area, with a population of 450 people and 283 families. Houses lined up very closely with each other, almost without ideal distance. Residential houses are connected by small roads or even just an alley that with wide between 1-1.2 meters. Whereas citizen access is connected by a highway with a wide width, between 3.8-4.5 meters. Very dense inter-house distance has implications for the comfort and safety of residents, especially during a flood. Flood elevation plan of the Citarum River and Cisangkuy river in this area is +659,3 above the sea level, while land elevation in this area is +658 above the sea level, so that when the big flood in February 2010 reached an elevation of 660.3 above the sea level, this area experienced the puddle of water as high as 2.3 m. The residents in both villages were accustomed to being flooded by overflowing Citarum and Cisangkuy Rivers, which also affected other regions, such as Dayeuhkolot and its surroundings. In November 20th 2014 there was a major flood disaster in three sub-districts, in Baleendah, Dayeuhkolot, and Bojongsoang. The flood inundated as many as 3,000 houses in the three sub-districts. Many residents' houses were severely damaged. Hundreds of thousands of houses have been severely damaged by water (photo 6), and hundreds of thousands of people also fled to safer areas. These flood events continue to repeat from year to year, but always without any solutions.

b. Results and Discussion

General Concept

In general, the concept of a house model that is friendly to floods comes from the Sundanese community stage houses (*panggung*). The stage house is an inspiration to be developed as a house that is friendly to floods. Stage technology was chosen because it has advantages: (1) Good for air circulation, because it can provide a warm feeling at night, and cool during the day; (2) Ponds (empty space) under the floor can be used for water traffic during floods. In general, the house concept can be seen in Figure 4 below.

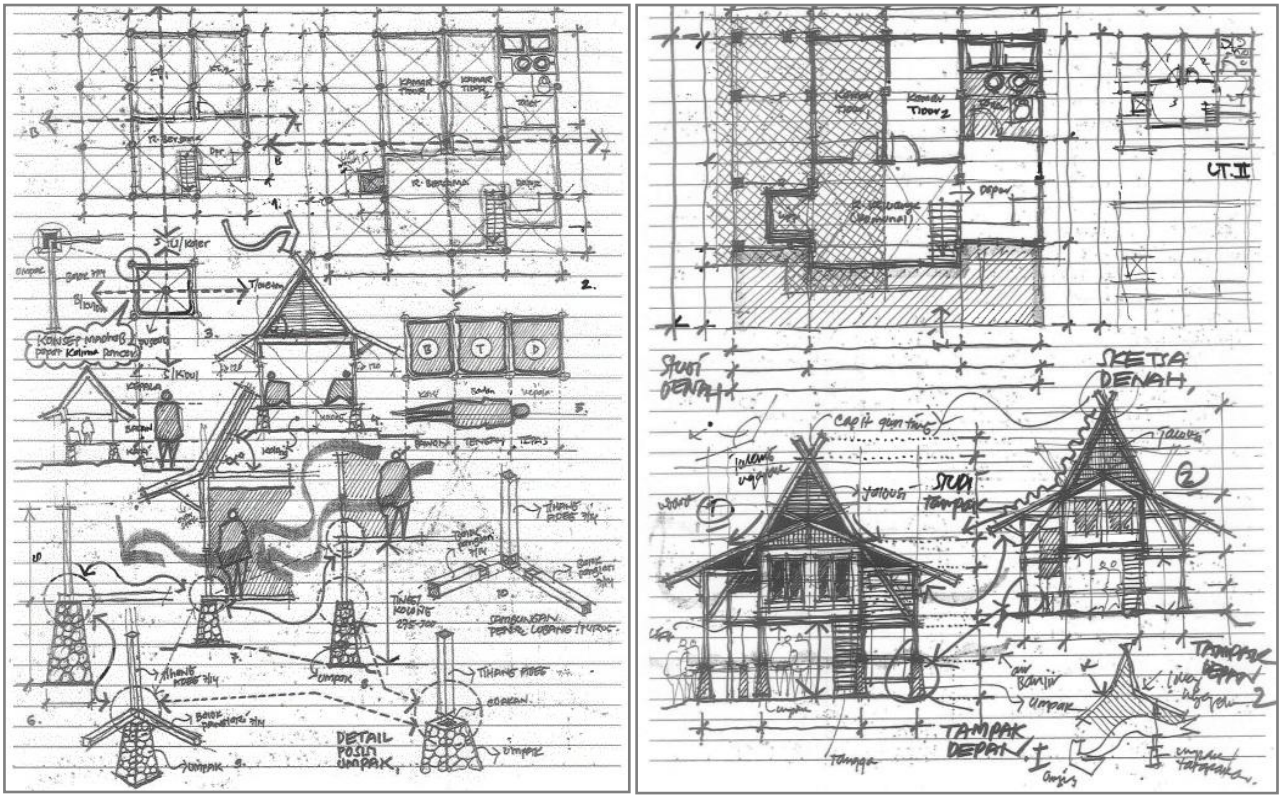

Fig. 4 Konsep umum rumah yang ramah terhadap bencana banjir

Plan Concept

The plan concept of a flood-friendly house (Drawing 4) is divided into two main floors, there are: (1) The first floor is the most basic part, not functioned as a living area but as a special empty space to provide space for water flow during the floods. The floor height is 350 cm, with an area for water to flow with a height 275 cm from the ground. On the first floor there is only one toilet or even no toilet, typically on the second floor, there are the stairs as a vertical circulation for residents of the house. On the first floor, it can also be used as a place for business (shop/service) with a knock-down wall concept or using a partition wall. During the dry season, the first-floor functions as a place of business, even residential, but when the rainy season arrives, all activities are centred to the second floor; (2) The second floor is the centre of occupants' activities, starting from sleeping, cooking and working. The rooms on the second floor include bedroom, toilet, living room, family room, and kitchen. Second-floor height between 350-400 cm with the top (ceiling)

can be opened or closed; (3) On the second floor, the ceiling can also function as a mezzanine floor which can be used as a view to the outside of the house.

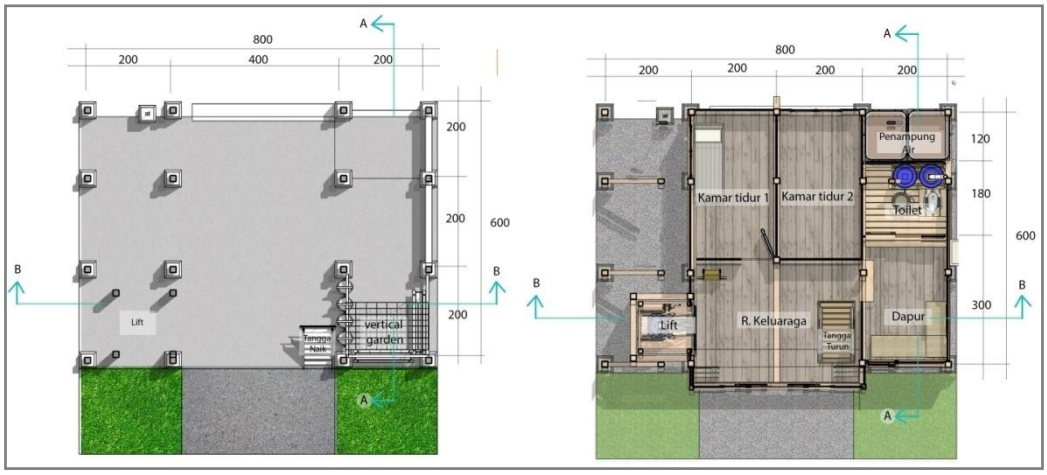

Fig. 5 Floor plan concept of a flood-friendly house

The plan is related to the placement of *umpak* foundation points based on the grid or module size of space. Looks related to the appearance of the house, to looks beautiful. The shape of the design roof relates to the roof models uses on the houses on stilts in Kampung Naga which is used as a comparative study for the planning and design of flood-friendly housing. The locals in the location of the study are free to determine the type of roof for their house according to the characteristic of Sundanese architecture.

Facade Concept and Shape of the Roof

The concept of a flood-friendly house facade adopts the Sundanese architectural design of the house on stilts, especially on roof design. This concept was chosen because the architecture of the house on stilts has a beautiful roof that can not be found in other regional architectures. Typical forms and name terms give a distinctive facade appearance. In addition, the concept of roof design is used because the research location is in the *Tatar Sunda* area, which makes its architecture as an inspiration for the concept design of a flood-friendly house. The locals of Cieunteung village are free to use roof design for their houses according to the tastes of the residents. In this research, the roof design that is used as an example is *julang ngapak* (*Drawing 5 and 6*). The facade concept of the house looks very simple, without excessive ornamentation. The Locals of Cieunteung in Babakan Mekarsari village and Jambatan village are free to choose the form of facades for their house according to their taste. These concepts are indirectly given the impression of simplicity in everyday life, to avoid the existence of social inequality among local residents. The majority of local people in both villages live at the level of the middle to lower economy, local residents also build houses according to their economic capabilities. The design of a flood-friendly house in Cieunteung village dapat dilihat pada gambar 6 di bawah ini.

Fig. 5 The concept of a facade of flood-friendly houses and the roof design

The form of structure and construction of houses on stilts which are arranged based on *umpak* (foundation), *pangadeg* (cubicle wall), and *suhunan* (roof) are a whole unity. These three things are the complexity of structure and construction. Includes the process of using building materials, from taking, preserving, processing to using it. All building materials come from nature and the processing is done manually, such as wood and bamboo *(Drawing 7 and 8).* However, it is possible that fabrication materials can be used as additional material. For joint techniques possibly to use nails, bolt nuts, or *paseuk* (wooden peg) and *beukeut* (rope bond) fibres or rattan which are very strong. In this research, for housing materials may use the fabrication materials, or a combination of nature and fabrication materials, for example, the installation of roofs using lightweight tile materials, GRC walls, and lightweight steel roof truss.

Fig. 6: Illustration of interior of a flood-friendly house (prototype) in Cieunteung Village

Construction of foundation can be also use reinforced concrete *(Drawing 6 and 7*) with certain techniques. On top of the foundation, wooden poles or columns are installed, or even from concrete as well as the main structure of the floor support. The columns are connected by the concrete beam at the bottom and the main beam at the top as the floor structure. Column structures are placed according to the module, which is 300x300 cm with column dimensions of 30x30 cm (cube shape), or diameter 30-40 cm (round shape). The column structures use *dolken* wood or reinforced concrete for the material, the local residents are free to determine it according to their taste and financial ability. In each column, the foot plate foundation will be installed as a base, or put on a *umpak* foundation (stone pedestal).

Fig. 7: Model of a flood-friendly house (prototype) in Cieunteung Village

CONCLUSIONS

1. The house on stilts in the Sundanese traditional architecture of the Sundanese Society is very relevant to be used as the concept design of the flood-friendly house. The advantages of house on stilts can be seen in four things, there are: (1) the bottom side or pit of the house with a height between 275-300 cm can be used to anticipate excess water that overflows during a flood, by raising the elevation of the house floor; (2) *Umpak* foundation or *tatapakan* at the base of the building as the main structure that forms *kolong* (pit). *Umpak* foundation can be replaced with *dolken* wood or concrete columns with a diameter of ± 30-40 cm; (3) The structure and construction can uses wood and bamboo or can be replaced by fabrication (truss), or according to the capabilities of the local residents; (4) Typical roof design of Sundanese architecture, such as *julang ngapak*, *jolopong*, and *capit gunting*;
2. The concept of designing a flood-friendly house, three main components include, such as (1) Rectangular floor plan with 300 cm wall module. The plan consists of two floors, the function of the first floor as a space that is emptied to anticipate the overflow of water during the flood with rising the elevation of the floor by 275-300 cm. While the residential area is on the second floor which consists of occupied rooms; (2) The house design uses the basic square shape on the facade, while the roof is designed in shape of *julang ngapak-capit gunting* or *perisai* in accordance with the character of Sundanese traditional architecture. There are no additional ornaments, the facade of the house appears simply but still unique and attractive; (3) Structural design and construction are included the *umpak* foundations made from stone, columns of houses made of dolken wood or round reinforced concrete 30-40 cm in diameter;

3. The concept of planning and designing a flood-friendly house can be proposed to the local government of Bandung Regency as a disaster mitigation tourism area, through several stages, including: (1) Submitted as part of the local government program, especially at the National Disaster Management Agency (BNPBD) of Bandung regency and West Java Provinces regarding of disaster mitigation and early warning system; (2) Make efforts to trace and explore the potential areas in West Java, especially about traditional Sundanese architecture that can be developed as a conceptual approach to disaster-friendly house design, especially flood; (3) Periodic socialization to local residents in prone flood areas about the importance of flood-friendly homes, especially in Cieunteung Village.

Acknowledgements

This research is the 2018 Superior Funding Research Scheme (PDUPT) funded by the Republic of Indonesia Ministry of Research, Technology and Higher Education. The research team expressed their gratitude to all those who contributed to this research. To the honor parties: (1) Ministry of Research, Technology and Higher Education Republic of Indonesia for PDUPT research opportunities; (2) LPPM Indonesian Education University; (3) Governors, Regents, and Sub-District Heads; (4) Head of BAPPEDA, BNPD, and BBWSC West Java; (5) Chairperson of RW, RT, community leaders, youth leaders, and communities in the research location; (6) Students participating in the Final Project Architecture: Indra Setiawan, Ridwan, and Lutfi.

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