

Building Structure Housing: Case Study of Community Housing in Kendari City

M Z Umar¹, A Faslih¹, M Arsyad¹, A S Sjamsu¹, I Kadir¹

¹ Department of Architecture, Vocational Education Program, Halu Oleo University Jl. H.E.A Mokodompit, Andounouhou-Kendari 93232

Email: muzakum.uho@gmail.com

Abstract. Housing development has been pioneered through a simple home construction program to reduce the production cost. Simple housing program was developed in Kendari City. The purpose of this study is to show the principles of reducing the cost production for the type 36 homes, in Kendari City. The selected architectural objects are the lower, middle and the upper structure of type 36 house. The data collection was done by observation and in-depth discussion with construction workers. The analysis technique used in this research was a descriptive narrative analysis technique in the form of tabulation data. This study concluded that there are several principles of price reduction in the structure of public housing buildings. Quick principles exist in constructing techniques such as using cigarette packs as a foundation pad, mortar usage for rapid wall standing, and the spacing of mortars could be done manually by using two fingers on a human hand. Economic principles could be used for material matters, such as eliminating the use of gravel for concrete, the use of sand material to contain the soil, the foundation does not use sand and empty stone, and the shape of the ring beam was made using triangle reinforcement.

Keywords: Housing structure

1. Introduction

Nowadays, the housing ownership has become the national problem in Indonesia, especially in urban areas [1]. Kendari city community for instance, has difficulty to own home residence due to the high price of land, cost of materials, and the price of building components. Therefore, the government began to introduce the concept of Small Housing construction (RS) and Simple Healthy House (RSS) with the support from the national bank BTN under the government loan subsidy program (KPR) [2]. The housing construction has been initiated through a simple home program to reduce the price of production. The program was planned to accommodate the house with one bedroom, living room, dining room, kitchen, bathroom, with the total space area of 36 m² to 72 m² [4]. The purpose of this study is to figure out the principles used in the production of BTN housing program structure type 36 in Kendari.



2. Literature Review

2.1 The Principles of Building

Today, it is very essential to implement a good, reliable and fast work to construct a house, especially in foundation work [5]. Precast concrete structural system is one of the alternative way which supports time and energy efficiency [6]. Baduy tribe for instance, has been using this technology long time ago before high technology was known. the components of the house had been prepared to assembly later on by the homeowner so it takes a short time to construct a house. Generally, Baduy tribe took 5-10 days to construct home [7]. Considering the time issue in house construction, thus it is important to develop the idea of rapid house construction for a large scale community.

2.2 Principles of Economics in Buildings

A sufficient financial is a basic need for every household. If basic income of a family increases, the physical condition of the house will increase as well [9]. The building structure must meet the requirements of stability, balance, strength, aesthetics, and economical. In general, the construction of buildings must be economically viable. Based on the above it can be concluded that economic principles are needed in the building.

2.3 Simple Principles of Building

Architecture is not a matter of a luxury high-technology materials or the location of its building. Simple materials are even more capable to reflect the art of the building itself. A good architecture could also come from a simplicity [11]. The house is like a beautiful woman. No women from their appearance looks simple, but it has a very broad meaning of life. Thus, these women can be viewed as the beauty of the deeper value than just cosmetic [12]. Based on the above it can be concluded that these simple principles are needed in architecture.

3. Research Methods

This research was conducted in Kendari City. This research was done in qualitative method with case study approach to house type 36 in Kendari City. The selected architectural objects are the lower, middle and the upper structure of the type 36 house. The data collection method was done by observation and in-depth discussion with building workers. The analytical technique which used in this research was descriptive narrative analysis technique in the form of tabulation data on the structure of house type 36.

4. Results and Discussion

This research was conducted in public housing located in Wuawua Village, Wuawua District, Kendari. Houses in this housing there are two types. The first type is type 45 with total 57 units. The second type is type 36 with total of 139 units. The production cost of type 36 per unit is Rp. 50.000.000, - (Fifty million rupiah) with the cost of construction workers Rp. 14.000.000, - (Fourteen million rupiah) and development cost Rp. 36.000.000, - (Thirty-six million rupiah). The lower structure, the middle structure, and the upper structure of the house of type 36 are, as follows:

4.1. Bottom Structure

Bow plank was installed before digging the foundation hole. The tools which used in this work including hose, axe, and hammer. The materials which used in this work were are stacked wood, unused wooden boards, nails, and artisan rope. After the bow plank wood and rope has been installed, the next process was digging the foundation hole. There were two forms of foundation based on excavation pit in this housing. The first form of the foundation is the foundation located in the hole. The second form of the foundation is a partial foundation in the hole and partly above the ground. The height of the foundation in this housing may varies, as it adjusted the shape of the contours of the soil. The height of the foundation was about 20-80 cm. The width of the foundation head was 20-30 cm. The thickness of the

foundation mortar head was 3 cm. The factors which affect the shape of the foundation head were the stirrup, thickness of plaster, and thickness board. The width of the best foundation head was 20 cm. The foundation formula was determined by the width of the foundation head, e.g. the width of the foundation head 25 cm, then the height of the foundation $25 \times 2 = 50$ cm, so the base foundation width would be equal to the height of the foundation. The foundation of the elbow was known by using an elbow tool, a cigarette pack (shown in figure 1), paper money, or using the formula $80:60 = 100$ by forming an elbow plane.

The foundation in this housing did not use sand dunes and empty stone pairs. The composition of the plaster ratio was 1: 4 for sloof and foundation. That means the top foundation was equipped with sloof, except foundation of terrace. The terrace foundation is made by using mountain rocks. The composition of the concrete mixture is 1: 4 or 1: 5 with sand material from the Pohara area and sand material from the Nambo area. The sand material which use for concrete mix design was material sand from Pohara area. This sand has the characteristic of coarse texture, solid and gray. The price for one truck was Rp. 550,000, - (five hundred fifty thousand rupiah). The other material which use was sand material from the Nambo area. The characteristics of this sand were white (if dried), red (when excavated), pebbly, and full of soil. The price of one truck was Rp. 350,000, - (three hundred fifty thousand rupiah). The composition of the mixture for the sloof concrete was 3 lorry of sand material from Pohara area, 1 lorry of sand material from Nambo area, 1 sack of cement, and water. The mix design for the ring balk is 1: 3; 1: 4; And 1: 5. The composition of the concrete mixture for the column is 1: 4. The cast thickness for sloof, column, and ring balk was 2 cm. The mixture composition for carport floor rebates was 1: 4 using sand material from the Nambo area and Pohara area, one cement sack. The floor rebate thickness was 8 cm.

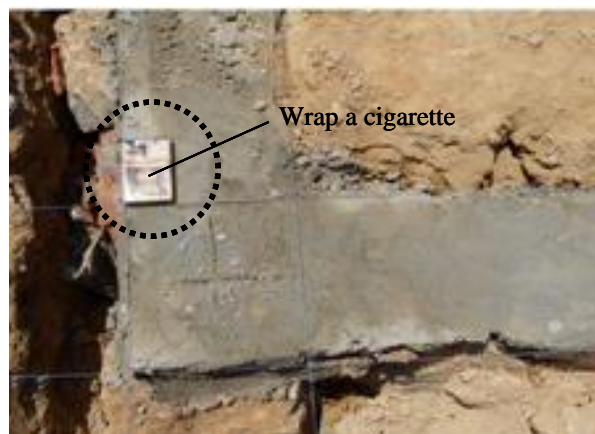


Figure 1. Cigarette pack as the tool of the foundation elbow (Source: author's collections, 2016)

The size of the iron stirrup for sloof was 8-12 cm high, 8-9 cm wide, 8 mm reinforcement steel, and 6 m long. The distance on each stirrup on the sloof refinery was 25-40 cm. The length of concrete binding wire was 35 cm. The length of the stirrup iron was cut by 42-45 cm. The amount of reinforcing steel in iron stirrup was four bars with an iron size of 8 mm. The reinforcing steel was bent over at the end of 3-5 cm long. After sloof was casted, the size becomes 9 x 10 cm and 12 x 15 cm. The tools which used for arranging iron sloof stirrup were including iron arches, iron fabricators, iron scissors, gauges, and iron locks. The materials were concrete binding wire, 8mm reinforcement steel, and iron for stirrup 6 mm. The dimensions of sloof stirrup needed to be taken into account with the dimensions of the brick. The brick dimensions which used in this housing was 19 cm long, 10 cm wide, and 5 cm high. The dimensions of sloof stirrup should be smaller than the width of the brick, so that the sloof and wall surfaces were flat.

Septic tank was located under the carport. Septic tank hole was dug as deep as one meter. Septic tanks were made into two wells. There were two types of sewer pipes in this housing, sewerage pipes from latrines and sewage pipes from the bathroom. Drainage was made as part of the foundation. Ground

drainage was made from stack of rock mountain rocks and plastered. The soil type at this residential project location was waxy ground, this soil type is easy to melt when exposed to water and easily harden when exposed to the sun and has small swelling number.

4.2. Central Structure

Dimensions of stirrup for columns were 6-10 cm long and 6-10 cm wide. And it increased double in size as the concrete were casted. The distance between each column stirrup was 30-40 cm. Materials which used to make iron stirrup was a steel reinforcement with a size of 6 mm. The shape of the stirrup column should be smaller than the dimension of the brick. If the columns arouse between the brick, the concrete would get easily porous and broken. After the brick wall had been installed with a distance of one meter, then the casting of the column could be done. The columns were casted using sand material from the Nambo area and not sifted. The iron length for the column was 3.20 m. After floor installation, the column height becomes 2.70 m. The principle of steel casting was to make the stirrup distance on sloof, column, and ring balk is closer to the column and vice versa. The closest stirrup distance is 17-20 cm and the next distance 30-50 cm.

The composition of the mix ratio for wall plaster was 1: 4 with 1 cement sack, 3 pohara sand trays, and 1 Nambo sand tray. The sand material from the Pohara area was used as material for floor rebates and wall plaster. The sand material from the Nambo area tend to have less swelling number which were good material for plaster walls. This type of sand material was often used in public housing projects because of its economic price. The construction workers tend not to spray water on the walls before plastered and patched with mortar. The process of walls plastering started from 10 cm of the sloof head. Then, the plaster process was continued to the surface of the ring balk head. The walls were given skim coat to soften the walls with the composition of one bucket of skim coat mixed with half bucket of water or eight handfuls of skim coat mixed with half bucket of water. The process of skim coating was done after the wall has been completed plastered. The walls were cleaned using the unused cement bag then drawn the skim coat from the bottom by using two cape tools. Then applied the same process for the rest of the project.

The height of the walls in this housing varied from 3.00 m and 3.20 m. The wall height was measured from the sloof head to the ring balk head. The process of installing brick wall by weighing. The base of the yarn weigh was placed at the edges of the brick above the sloof. The position of the thread should be straight referring the reference point to erect the wall. If the wall was not weighed, then the wall could be potentially curved and collapsed. During the brick preparation, it is important to check its stability by touching the wall. if the brick wall was easy to shake when touched, the process should be stopped and wait until the mortar was dried. The wall might get collapsed if the span distance between them was too short and the wall height was more than 3 m. The wall stability was also determined by the sand material. Building workers prefer to put thick mortar in the installation of the brick, because the thicker the mortar, the faster the wall stands. The type of wood which used for the frame in this housing was the wood class type II.

6 mm iron was used for iron reinforcement and stirrup. The iron stirrup shape of the ring beam was a triangle (shown in figure 2). Distance between stirrup was 30-55 cm. Iron stirrup for ring beam were cut in 30 cm long, 7-8 cm height, and 7-8 cm width. The thickness of the cast beam ring was 1-2 cm. The reinforcement steel for ring beams fabrication shall be done in accordance with building area. The Nambo sand material was spread over a heap. The tiled floor was installed from the back corner of the door in the second row. The following floor installation follows the floor pattern. The tile floor needed to be soaked in water to permeate the mortar. Ceramic immersion was carried out in the lorry for 5-10 minutes. The mortar composition for the tile floor was 1: 4. The floor layers were made from ground embankment using Nambo san material, mortar 1: 4 with 5 cm thick.



Figure 2. The triangular stirring shape for the beam ring (Source: author's collections, 2016)

4.3. Top Structure

Ampig is a roof frame made of red stone. The height of ampig on the right side was 0.40 m. The height of the ampig on the left side was 0.20 m. The height of ampig was vary, due to the shape of the terraced roof. Mounted column was located at the center of the ampig to avoid instability. The steel reinforcement for ampig column was planted into a beam ring 0.10 m. The hand block on the ampig was not fitted with steel reinforcement rather be plastered. The concrete deck was printed on a terrace with the size of 0.80 x 2.00 m and a cast thickness of 0.10 m. The concrete deck used 6 mm steel woven reinforcement like a mat. Woven iron stirrup made of two layers and casted together with ring beam.

Working tools which used for assembling the lightweight steel roof truss were including hammer, waist bag, screw driver, self-drilling screw, steel scissors, meter, contacts stock, roll wire, and ladder. The materials which used for assembling the lightweight steel roof truss were light steel 72.35 mm with hat sections of 25.65 mm, screw, blue spandex roof, roof top camel, and lisplang. The details of the lightweight steel roof truss construction were including light steel stretched at its bottom which usually called the bottom chord with a span length of 3.40 m, triangle light steel as top chord (hand beam) with span length of 4.20 m, light steel which connected bottom and top chord (web or inner light steel). The next process was to cover the batten and spandex roof above ampig with red stone and mortar. Then, we arranged one layer of red stones on top of the hat sections then have it covered with mortar and plastered.

5. Conclusions and Recommendations

5.1. Conclusion

This study concluded that there are several principles of cost reduction which could be done in constructing public housing. Quick principles exist in constructing techniques such as using cigarette packs as a foundation pad, mortar usage for rapid wall standing, and the spacing of mortars could be done manually by using two fingers on a human hand. Economic principles could be used for material matters, such as eliminating the use of gravel for concrete, the use of sand material to contain the soil, the foundation does not use sand and empty stone, and the shape of the ring beam was made using triangle reinforcement. In addition, the use of simple working tools like handy strap, gauge, water hose, hammer, iron fabricator, and waist bag could also be a consideration in this study.

5.2. Suggestion

This research can be continued to examine the principles of precise and secure infrastructure for public housing buildings.

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