

# **SOCIAL SUSTAINABILITY OF NEW-NGELEPEN DOME HOUSING AS POST-DISASTER HOUSING RECONSTRUCTION OF CENTRAL JAVA-YOGYAKARTA EARTHQUAKE 2006**

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**Abstract:** In May 27 2006 a 6,3 R earthquake struck Central Java and Yogyakarta of Indonesia, and took over 5,700 lives while injured more than 40,000 people. Although major infrastructure remains, housing and public building were heavily damage. It was estimated about 154,000 houses were completely destroyed, 260,000 houses slightly damage, and left 600,000 people homeless. This condition was recognized due to high population and building density area, poor building technique, and low quality of building material. Rehabilitating and rebuilding houses were considered to be central activities in reconstruction effort. New-Ngelepen dome housing is one of many reconstruction housing types, which took the form of resettlement due to insecure and unstable soil condition of former hamlet. Arranged in 6 clusters, 71 dome houses with circular ground floor plan of 38 m<sup>2</sup> and several facilities were provided in this housing. Because of its shape is different with the common house type in Indonesian villages, it is interesting to study its sustainability in the bionomic process. With a focus on social aspect of sustainable housing, qualitative method is use in the analysis based on field observation, interview, and questionnaire result. New-Ngelepen dome housing has adequate concern on principles of inclusive, participation, vitality, self-sufficient, accessibility, social cohesion, and integration with surrounding, whereas concerns toward character and adaptability principles were not adequate. Even though adaptation effort to local culture and technology transfer has been done, it is found that several discrepancies with the beneficiary's lifestyle and local characteristics still emerge. Guidance for development in bionomic process and adapting the next dome housing project with local architecture are suggestions that can be given.

**Keywords:** New-Ngelepen dome housing, post-disaster reconstruction housing, Central Java-Yogyakarta earthquake, social sustainability, sustainable housing

## **Introduction**

Central Java Province and Special Region of Yogyakarta were struck by an earthquake in May 27<sup>th</sup> 2006. According to the joint report from Bappenas (2006), the 6,3 on Richter scale earthquake took over about 5,700 lives and injured more than 40,000 people. The major damage affected area was occurred until 60 km Northern side of the epicenter which located 38 km offshore and 33 km below the Indian Ocean. Although major infrastructure remains, housing and public building were heavily damage. It was estimated about 154,000 houses were completely destroyed, 260,000 houses slightly damage, and left 600,000 people homeless. Housing damage and losses account for over 50% from the total of 3,1 million USD. This condition was recognized due to high population and building density area, poor building technique, and low quality of building material.

Currently the post-quake activity is already at the end of reconstruction phase which take 30 months, after the emergency relief efforts for the first 2 months and the rehabilitation phase for 12 months (State Ministry for National Development Planning, 2006). There are many support and assistance from local and international institution in doing the post-quake activities, whether as a stand alone effort or in coordination with Indonesia Government, which in handling disaster relief effort is coordinated by Bakornas Penanganan Bencana.

Housing sector reconstruction process has been started since rehabilitation phase because beside it had major damage and loss, it was also hope that the activity could support in recovering the economy condition of the community. There are many types of housing reconstruction effort, started from repairing assistance until donation of readily build starter house, and in-situ houses development until resettlement. One of the housing reconstruction activities is resettlement project of New-Ngelepen dome housing in

Sleman Region. This program was executed as a respond to former study which states that the hamlet was insecure and had unstable soil condition. Because of the provided houses and neighborhood have different shape and layout with common Indonesian villagers settlement, it makes this reconstruction effort is interesting to be studied about the sustainability condition in the bionomic process. The focus is in social sustainability of the dome housing, because there is a striking difference between current and former houses. Sustainability needs to be consider in post-disaster reconstruction housing projects, because it is hope that they can last for a long time while still preserving social, economy, and ecology aspects, whether for the beneficiaries or in the context of wider communities.

Qualitative method is use in the analysis, based on field observation and questionnaire, relating with principles which need to be concerned toward social sustainability of housing environment. There are 64 respondents data can be collected from the total 71 units of dome-house. Hearing also done to several head of household from the former hamlet.

### New-Ngelepen Dome Housing Project

New-Ngelepen dome housing is located in Sengir hamlet of Sumberhardjo village, Sleman Regency, Special Region of Yogyakarta. It is about 20 km Eastern side of Yogyakarta city. This housing was developed for the earthquake victims in Ngelepen hamlet and its surrounding, because the hamlet was devastated not only by the quake but also by landslides which followed. Considering the insecure and unstable soil condition on its hilly topography, resettlement was considered as a solution toward the problem. This project was developed by an international non-profit organization which has a task to resettling Ngelepen hamlet with donated fund. The development was started with feasibility study about the community, their customs, family unit, how they live, identifying suitable site, and other purposes. After discussion phase about location, planning and designing with several inputs from local institution, the construction phase was started in October 2006. The selected location is about 0,5 km under the former Ngelepen hamlet on a 1,5 ha flat topography paddies field which owned by the hamlet administration. Through employing about 370 local labors, the construction phase finished on March 2007, two months earlier than it was expected.

There are 71 dome houses build in 6 blocks (A to F). Each block contains 12 or 11 (B block only) dome houses with clustered layout surrounding an MCK facility (*mandi-cuci-kakus* or bath-wash-toilet) located in the middle of the block. Each MCK equipped with a septic tank and a well to supply each

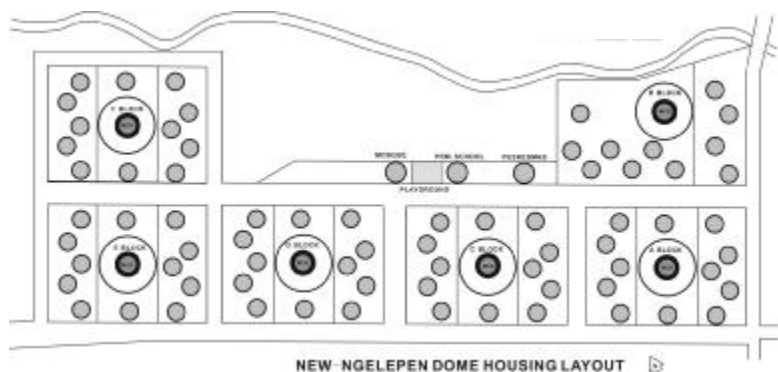


Figure 1. Location and layout of New-Ngelepen dome housing.  
Source: Developed from several sources.

cluster with clean water. Another 3 domes building are provided as public facilities, located almost in the middle of the housing site, that is: a Mosque, a primary school, and a *Puskesmas* (a small community health center). Playground also provided for the children next to the primary school. The dome house itself had a 38 m<sup>2</sup> ground floor plan which is meant to be an environmentally friendly homes that can withstand the severe effects of natural disasters (South and South, 2007). It is a two storied house, with one guest room, two bedrooms, and dining-kitchen room on the first floor, and a living room on the second floor above the bedrooms. Light fixtures, power outlets, and faucet in the kitchen are equipped in each dome house.

The beneficiaries started to live in their dome house in April 2007. Beside from Ngelepen hamlet (42%), they also came from surrounding hamlets, that is: Sengir (45%), Dayakan (5%), and Pantuk (5%) and Wunut (3%). Most of them have been living in their former villages for 35 years in average, with the longest stay duration of 80 years. The head of households employment are as: worker (42%), farmer with owned land (23%), self employed (14%), farmer without owned land (11%), government official (5%), and other (5%). The form of employment has not been changed before and after the earthquake, supposedly because they move only in a short distance from their former house.

### **Social Sustainability of New-Ngelepen Dome Housing**

Every notion about sustainability concept have a same objective, that is a long lasting continuance of existence on the earth along with the dynamic process, for human and other living creatures (Haughton, 1999). Implementing the sustainability concept in housing environment means creating a condition where a housing environment, as a physical container, can continue to support the dwellers' needs during the bionomic process, without reducing the ability of wider communities and the next generation to meet their own needs. Within this meaning, one of the challenge in a post-disaster housing reconstruction program is how we can recover, take care, and improve the remaining condition of social, economy, and ecology aspect which owned by the community, while still preserving the same aspects condition which owned by the wider communities. In ecology aspect, it is hope that the housing program could keep up the environmental quality and prevent from wasting up resources. In economy aspect, the housing program is expected could support the rehabilitation and creation of strong economy condition of the community to continue their life through availability of employment, better income, stable business, and implementation of appropriate technology. Whereas in social aspect, the concern is toward social cohesion, level of participation, crime, culture, behavior, and other local wisdom. Social sustainability in post-disaster housing reconstruction program is relating with how the developed housing project could keep and increase social aspect condition which owned by the community, rehabilitating if its broken, and making it happened if its not existed, while keep preserving the other aspects condition and also concern with the wider communities. In order to support creating housing sustainability in social aspect, there are several principles where attention needed to be given, that is: inclusive, participation, vitality, self-sufficient, accessibility, social cohesion, integration with surrounding, character, and adaptability (Pandelaki, 2003). These principles are connected and overlapped each other, thus concerning in one principle could support the other principles or the other way around.

#### Inclusive

Housing should be planned to accommodate inhabitants from varied group, whether based on age, employment, culture, race, etc, and not only from specific group of community. Thus it is expected that it can create a vibrant and dynamic community, while avoiding social segregation because of target group exclusiveness. New-Ngelepen dome housing basically have a respond toward this principle. Although the new hamlet name is using Ngelepen, but the beneficiaries also come from several surrounding hamlets. Through the selection process that was held by the local community, the 71 household beneficiaries who were proposed and agreed to receive the houses came from several hamlets, that is: Ngelepen (42%), Sengir (45%), Pantuk (5%), Dayakan (5%), and Wunut (3%).

#### Participation

This principle is relating with how the housing environment could generate participation, especially from the inhabitants. The inhabitants' or the prospective inhabitants' participation could be done as early as possible since planning, designing, and construction phase, as well as in maintaining and managing the housing environment in the bionomic process phase. The type and form of participation can be varied in each phase. For example, in the planning and designing phase they could participate through inviting them

to discuss about location, in the construction phase they could participate to join in supervising the construction process. Through this participation, it is hoped that it can create a sense of belonging, togetherness, and a suitable living environment for them.

The New-Ngelepen dome housing, directly and indirectly, has invited its occupant's participation in the development process. Since the planning through the bionomic process, several forms of occupant's participation were found. In the planning phase they were participate through giving their opinion regarding suitable housing location. In the construction phase, some of the prospective occupants involve in the activities as building labor, thus it can also provide employment that can generate income to ameliorate their economic condition. Participation and attention of the occupants also can be found in the bionomic process, although this is also support by the social cohesion condition among them, especially in the F Block. In this block it was found several community activities through *gotong royong* to make a better living environment as a response to the current condition, such as: making a new shallow well around the MCK that can manually pailed to provide water when the electricity went down, installing new waste water plumbing to prevent flood from MCK, and also they were *gotong royong* in building extension of their neighbor's dome. *Gotong royong* is mutual assistance among community members to solve problems which face by them, individually or as a group. Other participation in creating suitable living environment by the inhabitant that could be found are adding bench or sitting group for community gathering, and setting up sports field of volley ball and badminton. It is important to give guidance and supervision for them in order to give direction toward better housing condition and to prevent it from deterioration. Participation of the other actors in housing development, in this case the government, also very important. The provided land for resettlement, which is owned by the hamlet administration, is an important entry point in establishing the New-Ngelepen dome housing project, as well as other housing development form.



Figure 2. *Gotong royong* making house extension.  
Source: Field survey.



Figure 3. *Gotong royong* making plumbing & a new well around an MCK.  
Source: Field survey.



Figure 4. The dome, MCK & provided facilities.  
Source: Field survey.

### Vitality

The housing environment should provide necessary basic needs for the inhabitants to support their existence, such as: clean water supply; electricity; sanitation; garbage disposal; natural ventilation and lighting; adequate rooms; ensure security and safety of the inhabitants, whether from eradication, criminal action, illness, toxic chemical contamination, and from natural disasters such as earthquake, flood, landslide; also in keeping up condition of air, water, soil, noise, and odor in the housing environment.

Basically, vitality in New-Ngelepen dome housing has got an adequate attention. The provided house, as a basic shelter, have been well equipped and had a good specification. According to the inhabitant's opinion, they give a positive respond toward their dome house condition where they live in concern of: provided ventilation (91%), cleanliness (97%), strength (98%), and equipments (92%). Concerning with the provided infrastructure (clean water supply, drainage, garbage disposal, and roads), 100% of the inhabitants give a positive respond, meanwhile 91% give a positive respond about the provided social facilities (Mosque, primary school, playground, and *Puskesmas* or small health center).

Deficiencies which have been identified concerning with vitality are in the provided rooms wide and relating with tenure status of the plot. According to the survey, there are 84% of the inhabitant acknowledge that their dome house is smaller than their former house, 48% acknowledge had wider or better bedrooms, 45% acknowledge had wider or better kitchen, and 48% acknowledge had wider or better guest room. This condition is due to the difference between their current and former house. Formerly they had wider rooms in their houses, which in average were 76 m<sup>2</sup>, but on the other side the dome house has better quality or material specification than their former house. With the average family members of 3,14,

the dome house has comply with the Indonesia Government standard of adequate floor size per capita of 9 m<sup>2</sup> for a decent house. These conditions motivate the inhabitant to preempt through adaptation and or adjustments. One example which can be commonly found is in relation with kitchen and their cooking habit. The inhabitant has been used to cook their meal with materials such as charcoal and firewoods which can be gathered surround their former house, thus it's more economical for them. Cooking with these materials need a different kind of space, especially for cooking with firewoods, such as bigger stove and enough space which preferably separate with other rooms to prevent from the caused smoke. In the dome house this kind of style is difficult to be done. As responses to this condition, several of the inhabitants cook their meal outside of the dome house, creating extension shelter for cooking behind their dome house, and even several of them still cook their meal in their former house because it's more comfortable for them and since the distance is not so far. It seems like transition space which can accommodate adaptation activity between former and new lifestyle is needed.

The assurance of land tenure status is still an uncertain condition which is faced by the inhabitants of the New Ngelepen dome housing. According to the interview, the inhabitants were waiting for the decision from the government about the scheme in purchasing the land. It is hope that the amount which the inhabitants have to pay in purchasing the plot can be affordable for them. Otherwise it might be a burden for the inhabitants, which could lead to other conditions, such as decreasing of housing quality and changing in ownership.

#### Self-sufficient

This principle is relating with how a housing environment as could as it can be autonomously provide and support the inhabitants needs. Providing facilities is an effort toward concern with this principle, since creating a fully self-sufficient housing environment is arduous. Relating with this matter, New-Ngelepen dome housing has been tried to provide several social and public facilities which is intended to be use by the inhabitants. The provided facilities are Mosque, primary school, playground, and *Puskesmas* or small health care center, and open space around the MCK in each block. There are 91% inhabitants who give positive respond toward the provided facilities. From field observation, these facilities also can be use by wider communities.

#### Accessibility

Accessibility has a concern toward assuring the inhabitants and the wider community to have adequate access in the housing environment, in term of easiness in utilization, economy or community affordability, as well as it can be use by all kind of social group in the community or social equity.

In the New-Ngelepen dome housing, the arrangement of buildings and infrastructures have encourage in creating a good accessibility, in term of easiness in utilization and access by public community. Meanwhile, accessibility in term of economy affordability of land purchasing is still a question which faced by the inhabitants as it already mentioned above.

#### Social cohesion

Housing environment which could support and enhance togetherness and sense of belonging in the community is encouraging the creation of social cohesion. Housing design which can contrive the inhabitant to see and meet each other is one of solutions in creating social cohesion between the inhabitants. Availability of adequate social facilities which can be use by the inhabitant collectively also could encourage social cohesion.

In New-Ngelepen dome house, basically the social cohesion which came along from the inhabitant's former village is still preserve. Majority of them has been known each other well for quite a long time. Even several of them still have family relationship. According to the survey, 67% of the inhabitant is giving positive respond about whether the current social cohesion in the community is as same as or better than their former neighborhood. It is found that in A Block social cohesion is not in a good condition. Only less than 20% of the inhabitants in A block give positive respond about their current social cohesion condition. Supposedly most of them, who came from Sengir and Ngelepen hamlet, still attached with their former house. They are still commuting daily. In the day time they stay in the dome house and go back to their former house in the night time or the other way. They are doing this for several reasons, such as they still taking care of their cattle in their former house, cooking their meal in their former house, or they still feel comfortable to live in their former house because they already live there for a long time. Thus they are not or still have not been attached to the new environment. The condition is different with the F block which

had better social cohesion. More than 80% of the inhabitants in this block give positive respond about it. From field observation it is found that they are doing *gotong royong* to make a better living environment, through building public well, plumbing to prevent flood in MCK, and also together they were making an extension room for one of their neighbor.

New-Ngelepen dome housing with its limitation makes the inhabitant have to cope with the existing condition. Together, they were adding several facilities to support their social activities, such as benches for community gathering, field of volley ball and badminton to do sports. The use and placement of the MCK on the center of each cluster also can be a medium for the inhabitant to meet, greet, and socialize, such as for the house wives when they are washing clothes.

#### Integration with surrounding

Housing environment should establish a good interaction with their surrounding environment as well as the wider environment. There are many points where attention can be given in relation with this principle, such as: avoiding limitation of use and access, social discrepancy, and quality of life degradation of surrounding communities; helping to create a local climate and preserving existing ecosystem function; and becoming a place of economic growth. Thus the advantages and successfulness of the development could be felt by wider community and not only by a group of people.

Through accessible road design, river duct rehabilitation, and providing facilities which can be use by local community are several ways that can be found in New-Ngelepen dome housing that correlated with creating social sustainability through giving attention toward integration with surrounding. From the field observation, the provided facility also can be a place to start improving financial condition of the surrounding community. The BLK (*Balai Latihan Kerja* or Work Training Office) of Sleman Region held a short course in the primary school dome to teach embroidery for the house wives in the surrounding villages.

#### Character

In this principle, a housing environment should have aesthetics, identity, legibility, and functionality, with an attention toward the uniqueness of culture, tradition, history, and nature within a region. Giving attention toward local architecture in containing the behavior of local community is an easiest tool to understand the type of physical designs which necessary to be use in a housing development project.

A dissonant with local character which can be easily found in the dome house is in the absence of design solution to prevent the wall openings. With this unprevent wall openings, rain and sun shine could easily get into the house, and doors and windows which made from woods can easily became worn-out and broken. Concern toward character principle through feasibility study which has been taken seems like could not make the provided space appropriate enough for the beneficiaries with the local context. The first is, as it has been mention above, about the cooking style. Because of they can not cook inside of the dome house, they adapt with cooking outside of their dome house, or they make adjustment of extension room behind their dome house with whatever material available and according to their building construction capabilities. The second is their habit in taking care of domestic animals near their houses, such as cow, goat, duck, chicken, etc. In the dome housing it is difficult to carry out this kind of habit. This kind conditions lead to activities where several occupants still commute to their former house, because they still had their cattle in their former house, and they felt more comfortable with their former kitchen and it's much cheaper to do the cooking since gas stove is expensive. As a solution toward the habit of taking care domestic animal of cows and goats, the local government build a community's cattle shed on the Northern side area of the



Figure 5. The domes with their extensions and adjustments.  
Source: Field survey.

dome housing. There are 18 stalls of 2 m x 2 m provided. It is hope that the occupants do not have to commute anymore everyday, after they had their cattle moved from their old house to the new shed. The third one is about the way of the inhabitants, with all of their owned capabilities, doing adjustment of their dome house. The shape and form that appears and have been done by them are decent shapes that suitable with their technology and building method capability, material availability, and also financial capability. These kinds of form and shape that appeared are found quite difficult to be made in harmony with the dome house form which is different with the kind of form that they can build.

### Adaptability

The housing environment should have easiness and elasticity to accommodate the development and changing needs of the inhabitants, especially in the post-disaster reconstruction program housing provision which usually have accentuation in the fulfillment of basic needs. The adaptability need to be related with condition of the prospective beneficiaries. How they behave, how their capabilities, building method that they have, and building materials availability, are several consideration that need to be taken.

According to the field observation after six months the inhabitants started to dwell, there were 17% (12 of 17) of dome house which has been extended and adjusted, permanently (using bricks and concrete structure) and non permanently (using bamboo, wood, tarpaulin, former T-shelter, kiosk, iron sheet). The extensions and adjustments were connected directly to the house or build separately, with the functions of: cooking, storage, provide shading, sleeping room, domestic animal shed, and also in an effort to prevent rain water to get inside the house. Extension is done by the occupant's family themselves or with *gotong royong*. Physical adjustments of the private plots are found in the forms of: productive and aesthetic gardening, private shallow well, and providing hanger for drying cloth. Based on the form of adjustments which has been done by the inhabitants, it seems like they are difficult to be matched and in harmony with the dome house form. These conditions could lead to unharmonious condition which is basically unexpected.

Several adjustments also have been done by the inhabitant in public spaces. These adjustments were intended whether as private activities (corn field, small shop, chicken shed) or community activities (making new shallow well around MCK that can manually be pailed to provide water when the electricity went down, making new waste water plumbing to prevent flood from MCK, adding bench or sitting group for community gathering, sports field of volley ball). Relating with this condition, there is a need to give guidance and supervision in order to make the efforts they have made in the bionomic process can lead in creating a better living environment.

### **Conclusion**

Post-disaster housing reconstruction project will have a better function through giving a long term and balanced attention toward economy, ecology, and social aspects. The provided house and its surrounding environment should not only view as providing a basic shelter but also toward the other functions. New-Ngelepen dome housing has adequate concern toward principles of inclusive, participation, vitality, self-sufficient, accessibility, social cohesion, and integration with surrounding, whereas not adequate enough in character and adaptability principles. There are several discrepancies which found in the housing environment relating with the beneficiary's lifestyle and local characteristics, even though adaptation effort to local culture and technology transfer has been done. Suggestions which could be given are: the need of guidance and supervision for the New-Ngelepen dome housing inhabitants in the bionomic process to channeled their potentials for creating better living environment; and adapting the dome house with a more localized characteristics, such as climate, technology capability, and architecture, will make it more suitable for the local community beneficiaries.

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