THE STRUCTURAL FORMS AND CONSTRUCTION OF INFORMAL HOUSING : A CASE STUDY OF EAST JAVA

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Abstract

Informal or spontaneous settlements can be legal or illegal. The legal informal settlements in East Java for example, are kampungs or villages and the illegal are those on illegal lands, such as along the river banks, along the train tracks or at the steep lands; which are prone to disasters. The livelihoods of poor people occupying informal houses on such settlements can be endangered by environmental hazards: floods and landslides.

The discussions about the structural forms and construction of Informal housing include the structure of houses in the legal and illegal settlements, and how people construct their houses.

The Habitat agenda 21 dictates that every one deserved adequate housing. Even the poor and the homeless, who often dwell in houses at the illegal lands, should be addressed, and should be guided to help themselves to obtain adequate housing on legal lands. Guidances for sturdy house structure and sustainable construction are very important for improving the house quality. Since the informal houses are frequently hit by floods and landslides, it is important that the structure of the houses are improved. This is to prevent the poor people from disaster and homelessness.

The structural forms and construction improvement of informal houses can be guided by the government, the practitioners, the academes, and the NGO's and it is hoped that the house construction can be done by the dwellers themselves. The case study shows how the authority involved in the plan, relocation, and construction of houses, to help the poor at the illegal settlements mitigate disasters and hazards. The study also shows how people in the legal informal settlements such as kampung and villages improved the structural forms and construction of their houses to avoid future hazards. The sustainable construction discussed in the paper implies environmentally oriented construction designs, and environmentally friendly operation and maintenance procedures.

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1. INTRODUCTION

Informal settlements, both legal and illegal, spread in East Java. The informal settlements are built by the dwellers without any assistance from others. The legal informal settlements in the city are named “Kampungs” and in the villages are named “ Village Settlements”

Characteristics of the legal and illegal informal settlements are as follows (Silas 1983; Gilbert and Gugler 1992) :

- The houses in the informal settlements were built by the dwellers.
- Infrastructure were lacking.
- The houses were built with temporary materials.
- The informal settlements were built without any formal planning.
- Most of the dwellers are low income, work at the informal sectors.
- The illegal settlements are often sited on land prone to hazard or disaster.

The illegal informal settlements exist in the city and in the villages ; are built on illegal lands, such as along the river banks, at the slope of hilly land, and along the train tracks. The houses have no title to the land on which they stand and the house dwellers pay no rent (UNCHS 1997).

Hardoy and Satterthwaite (1989) also mentioned about the houses in informal settlements. The houses or shack built in squatter settlement, invading empty land, empty houses, and in a temporary camp for victims of disasters or those evicted from other forms of housing.

The informal settlements built on sites inappropriate for construction, such as at the slope of hilly land and along the riverbanks are prone to environmental hazards i.e. landslides and floods. The hazards may cause damage or loss (Jay Moor 2001). Such damage and loss are threat to humans and what they value, and thus should be avoided.

The form of the structure of informal houses is usually very simple frame structure, with stone foundations; brick, plank or bamboo walls; timber or bamboo columns and beams; galvanized iron or ceramic tiles roof. Since the houses are built by the dwellers themselves, very often do not follow the appropriate house structure and construction.

The conditions of the illegal houses are worse than the legal informal houses. Due to the houses being constructed by the dwellers, there is often no understanding of the necessary relationships of the house component parts. The foundations are often not sunk deeply enough to maintain the strength of the structure. The wall thickness is not up to standard; and the absence of beams and columns can reduce the stability of the structure. The materials of the houses are second hand or recycled materials with low durability. These are cartons, plastics, zinc, plywood or organic materials.

The discussion in this paper covers the solution to the informal settlements’ problems as stated above and the improvement of structural forms and construction done by the government and by the dwellers themselves; both at the illegal and at the legal informal settlements.

As dictated by the Habitat Agenda 21, every one deserves adequate housing . Problems of damage to the houses in the informal settlements as the impact of disaster , which may cause homelessness should be addressed and solved.

The case study were informal settlements in East Java, i.e. the illegal settlements at the slope of hilly land and the legal informal settlements at the river sides in the village.

2. STRUCTURAL FORMS AND CONSTRUCTION OF INFORMAL HOUSING IN EAST JAVA

The structural forms and construction of informal housing discussed here are based on the case study of the illegal informal settlement at the slope of hilly land and the legal informal settlements at the riversides at the village.

2.1 The Research Design

The research on both informal settlements were conducted during the year 2002 and 2003. The method used in the research was survey at the location of informal settlements to study the environmental hazards which may hit the settlements; the structural forms of the houses and the construction system used in constructing the houses. The house sample were 10% of the total homogeneous houses available in the settlements and were randomly chosen.

2.2 Assessment to the Informal Houses

Assessment to the informal houses are based on the standard of decent housing and the theory of simple house structure and sustainable construction. The standard of decent housing as stated by the Department of Public Works (1980) are as follows :

1. The house minimum area is 7m^2 per person.
2. Enough light penetrates into the house, with openings about ¼ th of the floor area of the house.
3. Enough air movement in the house by providing openings at the walls for cross ventilations.
4. The floor should be plastered or covered with building materials such as ceramic tiles, planks, or other floor cover materials.
5. The house should have clean water, toilet and bathing facilities.

The structural forms of the house should follow the normal structure, with binding beams and columns in correct proportions. The structural columns and the foundation should maintain the structural integrity ; and the foundation should be sunk deeply enough, depends on the load bears by the foundation and the type of the land on which the house built.

In providing suitable houses, the construction should follows the house construction procedures and techniques. This can be done by the construction labours or by the dwellers as long as the house are up to standard and sturdy enough. Permanent building materials are preferable than the organic materials, since the permanent materials will last longer. The construction labours are more skilled then the house dwellers. However, the poor dwellers do not have enough money to hire constructions labours, and thus should construct their own houses.

2.3 The Structural Forms and Construction of Housing at the Hilly Land

The poor people invade the slope of hilly land because land suitable for settlements is expensive and the people can not afford to buy the legal land. Even the people aware of the danger of living in the hazardous location, they still build their houses at the slope of the hilly land at the Situbondo regency. From the survey it was proved that their houses were not up to standard. No house has toilet and bathing facilities; the people bath and wash their clothes at the river below the hilly land. The floors were stamped earth and air movement in the houses were inadequate because there were no cross ventilation. Light penetrates into the houses through openings which sizes were only about 1/10 th of the floor area of the room. The space area for one person was about 5 m^2. (Table 2.1)

Table 2.1 Inadequate Housing Conditions in the Informal Settlements at Hilly Land

Standard	Housing in Compliance with Standard
1. House area $7m^2$ / person	• 15 % up to standard. Average house area about 5 m^2 / person
2. Opening size for light penetration ¼ th of floor area	• 12% up to standard. Average opening size about 1/10 th of floor area
3. Cross ventilation openings	• 20% up to standard, 80% houses have no openings for cross ventilations
4. Plastered or covered floor	• 10% covered floor, 90% stamped earth
5. Has clean water, toilet and bathing facility	• 12% have toilet and bathing facilities • 100% have no clean water from the pipe, water was obtained from the river or purchased.

The structural forms of the houses were poor. Generally houses were not constructed with adequate foundations for a hillside house. The log columns were standing on big stones or on timber beams. The construction of the houses were done by the dwellers, who had no experience in building houses. Hence the houses were easily hit by the landslides. When the landslides and flood hit the settlements in the year 2002, 860 houses were broken (Human Settlements Division- East Java 2002).

2.4 The Structural Forms and Construction of Housing at the Riversides

The informal settlements discussed here is the legal settlement at the Solo riversides in the village, namely Tulungrejo at Bojonegoro regency. This village hit by the flood every year. In 2001 about 160 hectares of farming areas were hit by the flood and the water inundation was 7 to 10 days. 3500 m road and 385 houses were also flooded. Such flooding caused loss to the inhabitants (2802 persons) each year, particularly when they are farmers (Human Settlements Division – East Java 2002a).

The structural forms of the houses in this village is better than those in the illegal houses in Situbondo. This is because the households have the right over the housing and land they occupy. Hence they have willingness to improve their houses. About 18% of the houses are permanent, 48% semi permanent and 34% are non permanent. The permanent house is constructed with the brick walls, the semi permanent is constructed half with brick and half with planks or bamboo walls, and the non permanent house is constructed with planks or bamboo walls. Usually the houses are simple frame structures; with concrete, wood or bamboo columns. Beams and trusses can be of timber or bamboo. Most of the houses followed the appropriate construction procedures. The dwellers were able to hire construction workers available in the village and at the neighbouring villages. Table 2.2 shows the housing conditions in the legal informal settlements at the riversides.

Table 2.2. Housing Conditions in the Legal Informal Settlements at the Riversides

Standard	Housing in Compliance with Standard
1. House area 7m^2/ person	▪ 90% have floor areas more than 7m^2/ person.
2. Opening size for light penetration ¼ th of floor area	▪ 65% have openings for enough light penetration.
3. Cross ventilation opening	▪ 50% have openings for cross ventilations.
4. Plastered or covered floor	▪ 70% have covered floors.
5. Has clean water, toilet and bathing facilities	▪ 100% obtain water from river or wells. ▪ 80% have toilet and bathing facilities.

From tables 2.1 and 2.2 the conditions of legal and illegal housings in the informal settlements can be compared. It is clear that the houses in the legal informal settlement at the riverside are better than the houses at the illegal informal settlements.

The house materials can be found easily in the village. After the flood, the people collect the mud and process it into bricks for building houses. There are about 10 villages in the region that produce bricks for selling. Sand is obtained from the Solo river. The readily available building materials in the village affect the better conditions of houses.

3. SUSTAINABLE CONSTRUCTION AND INFORMAL HOUSING IMPROVEMENT

Sustainable construction is important in supporting sustainable development of human settlements. A special Agenda 21 for Sustainable Construction in Developing Countries was commissioned as part of the action plan for the implementation of Agenda 21 on Sustainable Construction. The CIB, UNEP – IETC and CSIR Building and Construction Industry Development Board of South Africa, created the Agenda 21 for Sustainable Construction in Developing Countries. (Agenda 21 for Sustainable Construction in Developing Countries 2002).

To discuss the structural forms and construction of informal housing, it is necessary to bear in mind the sustainable construction, which implies environmentally oriented construction designs and environmentally friendly operation and maintenance procedures (Agenda 21 for Sustainable Construction in Developing Countries 2002).

3.1. Improvement to Ilegal Informal Housing

As indicated in section 2.3 the ilegal informal housing in the hilly land of Situbondo was not up to Standard. The houses were not serviced, no clean water supply and electricity. Toilets and bathing facilities were not available. Landslides often hit the houses and the dwellers. On the other hand the illegal settlements may cause erosion, since trees which can hold the rain-water are cut down to obtain land for the houses.

Improvement to the unfavourable conditions of the settlement have been done by the local, central and East Java governments, with financial aids from OECF. In 2002 the peole who were the victims of landslides, were resettled in other areas suitable for settlements. About 800 houses were built for the resettlement, in Situbondo areas. Table 3.1 shows the improvement of settlements which were hit by landslides and floods.

Table 3.1. Improvement of Settlements in Situbondo Region

Settlements' component	Quantity
1. Simple house	▪ 799 units
2. Toilet and bathing facilities	▪ 80 units
3. Clean water facility	▪ 2 units
4. Village roads	▪ 4900 m
5. Foothpaths	▪ 4750 m
6. Rain water gutters	▪ 8000 m

Source: Report on Solutions to Environmental Hazards:
Landslides and Floods – East Java
(Human Settlements Divisions- East Java 2002a)

3.2 Sustainable Construction Application for Improving the Illegal Informal Housing

Sustainable construction is a holistic process aiming to restore and maintain harmony between the natural and built environments, and create settlements that affirm human dignity and encourage economic equity (Agenda 21 for Sustainable Construction in Developing Countries 2002). Based on the above statement, the forms and construction of housing to replace the illegal housing are discussed, covering the following aspects:

1. Environmentally oriented construction design
2. Environmentally friendly operation procedures
3. Environmentally friendly maintenance procedures

The houses built by the government, to replace the illegal houses, were built on land owned by the Situbondo regency. The house plan was adopted from the general house plan in the village with terraces at the front and back of the house. The minimum size of one unit house is 30 m^2. The structural forms of the houses were very simple timber frame structures, in the form of row houses. There were 94 houses built in one hectare area. The walls were constructed with bricks (bataco) up till 1.00 m high from the floor and the rest were constructed with board. The foundations about 40 cm deep, were constructed with bricks and the roof were covered with asbestos cement. Table 3.2 shows the sustainable construction application of the houses built by the Government.

Table 3.2 Sustainable Construction Application of the Houses Built by the Government

Aspects	Application
1. Environmentally oriented construction design	▪ The house plan was adopted from the general house plan in the village. ▪ The house materials were available locally, and effort was made to limit the material wastes. ▪ The houses were constructed on stable land and safe areas to avoid disasters. ▪ The construction followed the correct procedures and techniques and guided by the engineers.
2. Environmentally friendly operation procedures	▪ The house construction operation was done following the Standard Operating Procedures. ▪ The materials for construction were obtain locally. The bricks (bataco), the particle boards and the asbestos cement were produced by local industries. The red bricks for foundation were produced by small industries. ▪ Since the construction was on a vacant land, thus no neighbours were disturbed during the construction operation.
3. Environmentally friendly maintenance procedures	▪ No special maintenance for asbestos cement roof and board wall, except painting when the materials deteriorated. However, the use of asbestos cement roof cover is still in disputes, that may affected the dwellers's health. ▪ The timber frame structure does not requires intensive maintenance.

3.3 Sustainable Construction Application for the Renovation of Houses Built by the Dwellers

As indicates in section 2.4 the legal informal settlements were much better than the illegal settlements. Houses were built according to the people's culture and needs. Many traditional design style of houses were still available and most houses were in compliances with the standard. The structural forms of the houses were timber frame structures and some houses were built permanently. People hired construction labours for building their houses. Building materials commonly used were timber, bricks, tiled, bamboo, timber board and ceramic. However, since the settlement areas are surrounded by the river, the houses and the dwellers regularly hit by the floods.

To avoid the flood water coming into the house the dwellers built new houses or renovated their houses. The houses were elevated, by constructing the floor up to 1.00 m or 1.50 m high from the ground. The sustainable construction application of the houses built by the dwellers are shown in table 3.3.

Table 3.3 Sustainable Construction Application of Houses Built by the Dwellers

Aspects	Application
1. Environmentally oriented construction design	▪ The house plan followed the dwellers' requirements and needs. ▪ The house materials were available locally; bricks were made by the people in the village and at the neighbours' villages. Sands was easily obtained from the river. ▪ To avoid flooding in the house, the house floor was constructed 1.00 m to 1.50 m high from the ground. ▪ The construction of houses followed the correct procedures and techniques and done by the construction labours, so that no flooding disturbed the construction.
2. Environmentally friendly operation procedures	▪ The house construction operation or renovation was done after obtaining permissions from neighbours. ▪ Using locally available materials from natural resources except cement, galvanised iron. ▪ The construction or renovation was done during the dry seasons.
3. Environmentally friendly maintenance procedures	▪ The building materials used were maintenance free, such as tiled for roof, timber or red bricks, and planks for walls, and ceramic for floors. ▪ The house structure, timber frame or concrete frame, were maintenance free.

Tables 3.2 and 3.3 shows that the sustainable construction was applied in the construction or renovation of the houses built by the government and the dwellers.

4. CONCLUSION

The results of the study were as follows:

1.a. The illegal informal settlements at the slope of hilly land were unsuitable for living. People suffered from disaster, and therefore, to comply with Agenda 21, people were relocated to other safe areas.

b. The legal informal settlements at the riversides were still suitable for living, eventhough floods were regularly hit the settlements and houses. The dwellers managed to renovate their houses to combat the floods.

2.a. The structural forms of the illegal houses were generally very poor, hence the government built new houses for the dwellers.

b. The structural forms of the legal houses were generally good and followed the proper house structure. The construction or renovation of houses were done by the dwellers with the help from construction labours.

3.a. The sustainable construction aspects were applied in the construction of new houses to replace the illegal houses. Except that the use of asbestos cement for the roof was still in doubt for the affirmation of the dwellers' health.

b. The sustainable construction aspects were followed by the people at the riversides village. Such construction system has been applied for generations in the village.

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APPENDIX A

Figure A.1: Floods hit the Village in Situbondo

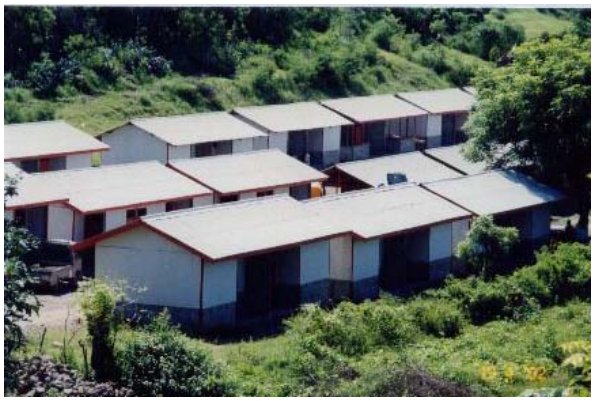

Figure A.2 : Row of simple houses at Situbondo

Figure A.3 : Toilet and water hydrant facilities

Figure A.4 : The street in the village and the houses with toilet facilities

APPENDIX B

Figure B.1: The Solo river surrounds the village

Figure B.2 : The common traditional house in the village at the riverside

Figure B.3 : An elevated house to avoid flood water coming into the house

Figure B.4 : A very simple house ready for renovation . Building materials were collected at the garden until enough for renovation.