A HEALTHY-PRODUCTIVE DWELLING MODEL BASED ON OPTIMIZING OF SPACE Case Study in Banjarmasin City, Kalimantan Selatan Province.

Bani Noor Muchamad [1], **Naimatul Aufa**[2], **Ira Mentayani**[3]
[1, 2, 3] Faculty of Engineering, Lambung Mangkurat University
Jl. A. Yani KM 35,5 Banjarbaru, Kalimantan Selatan
bani.noor.m@gmail.com

ABSTRACT

This research has a long-term aim to help the government's program in alleviating poverty and creating a healthy environment. The aim will be achieved by an implementation and trial of existing Optimizing of Space based on occupancy profiles. The trial and implementation were performed by using modeling techniques, both 3D graphic model and mock up model. The modeling techniques were performed through a design experiment process in a laboratory. It was selected based on the characteristics of the low economic, education and knowledge capacities, and the low level of awareness of the society in the slum areas. The result of the research is a healthy and productive dwelling model for the occupants. This innovation of a healthy and productive dwelling model can be a frame of reference for a mass dwelling establishment or construction done by the government, private companies (CSR), or NGOs in order to upgrade the slum areas and alleviate poverty.

Keywords*: poverty; slum area; modeling.*

ABSTRAK

Penelitian ini bertujuan jangka panjang untuk membantu program pemerintah dalam pengentasan kemiskinan sekaligus menciptakan permukiman dan lingkungan yang sehat dan berkelanjutan. Tujuan ini akan dicapai melalui pengimplementasian sekaligus pengujian Konsep Optimalisasi Ruang berbasis profil penghuni yang telah ada. Implementasi dan pengujian Konsep Optimalisasi Ruang dilakukan dengan menggunakan metode pemodelan, baik model 3D grafis maupun maket (mock up). Metode pemodelan dilaksanakan melalui proses eksperimentasi desain di laboratorium. Metode pemodelan dipilih berdasar karakteristik kemampuan ekonomi, pendidikan/pengetahuan, dan tingkat kesadaran masyarakat yang tinggal di kawasan permukiman kumuh yang masih rendah. Hasil penelitian adalah model hunian yang produktif dan sehat bagi penghuninya. Temuan inovasi model hunian produktif dan sehat ini dapat dijadikan acuan untuk pembangunan/pengadaan hunian massal yang dilaksanakan melalui program pemerintah, swasta (CSR), ataupun swadaya masyarakat untuk penataan permukiman kumuh dan pengentasan kemiskinan.

Keywords: kemiskinan; permukiman kumuh; pemodelan.

INTRODUCTION

This is a prospective research from the previous research conducted by Muchamad (2010) regarding the alleviation of poverty, especially by ordering the slum areas. From an architectural perspective, there are three serial indicators of poverty; (1) the low quality of dwelling, (2) the impact on the economy of the family, and (3) the health of the occupants. Low-quality dwellings make the occupants unproductive (unable to work at home or run a business), which leads to low income, the inability to meet the basic needs for food and clothing and good health.

This is the main thread of an architectural domain and poverty issue. The previous research has offered an alternative solution to the ordering of slum areas through Optimizing of Space based on occupancy profiles (Muchamad, 2010). The concept focuses on (1) the efficiency of space utilization, (2) the flexibility of space function for the dwelling to support the

productivity of its occupants, and (3) the establishment of dwellings that guarantee the health of the occupants. These three foci become an inseparable unit. Since the beginning of the research in 2009-2010, the slum area in *Kelurahan Gadang* (research location) has not shown much improvement. The environment of the slum area remains the same, or even shows degradation (see Picture 1). Moreover, there has been no program initiative by the local citizen or the government or any NGO to deal with the environment of the slum area. Based on this empirical evidence, this research intends to implement Optimizing of Space to support the government in the alleviation of poverty, especially through urban slum upgrading program with healthy-productive dwelling model.

Figure 1: Slum area in Banjarmasin
(Source: Author, 2016)

The implementation of Optimizing of Space is certainly not easy because it should do with the condition of the society where the social-economic status and academic background are relatively low. The core idea of this research is how architectural design could create a healthy-productive dwelling. By implementing the concept, we hope that the alleviation of poverty movement will work out. The research problem is on which healthy-productive dwelling design suits Optimizing of Space based on occupancy profiles for the poor in urban areas?

METHOD

In many literatures, model has different meanings. According to Tamin (1997), model is a media that can be used to measurably represent and simplify reality (the real world). Tamin also argues that every model is a simplified reality to achieve a certain goal, which is an in-depth explanation and definition and a prediction purpose. However, Reif (1973) states a model of a situation is simply a representation of our understanding of the corresponding real world situation. The situation can be an object, an event, a process or a system. Harris (via Reif, 1973, p.49) states “A model is an experimental design based on a theory”. From those definitions, we can say that a model is basically a tool to simplify a situation in the real world to make it easier for us to understand, to measure, and to realize the concept.

In architecture, modeling technique is one of the main techniques to express ideas, thoughts, concepts, and even to prove the truth of a theory. Of the three existing models (Reif, 1973), conceptual model is one of the modeling techniques that is widely used in operational research. As for operational research, Brooks and Robinson (2006, p.1) defined a conceptual model as “a software independent description of the model that is to be constructed”.

In developing conceptual model, we need to determine every element involved and the regulations of those elements. The simulation depends on the software that best suits the goal that the researcher wishes to achieve. Robinson (2006, p.2) defines conceptual model in relation to simulation model, “The conceptual model is a non-software specific description of the simulation model that is to be developed, describing the objectives, inputs, outputs, content, assumptions and simplifications of the model”.

It is important to understand that the whole modeling process is not a simple process. Trials should always take place until the best model is acquired (Brooks, 2006, p.1).

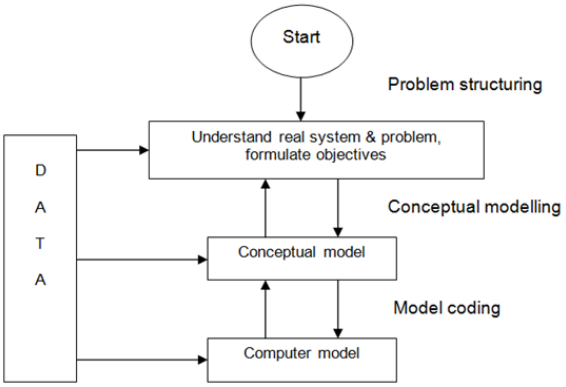


Figure 2: Modelling Process
(Source: Brooks, 2006)

In the context of this research, the model is a computer-based model (Egger & Carpi, 2008). Therefore, a computer is used to process, analyze, and present data. However, it is still the researcher's job to interpret the result provided by the computer. The following picture shows examples of successful modeling techniques in architecture.

Figure 3: 3D Computer Model
(Source: shutterstock.com)

LITERATURE REVIEW

Literature review is intended to find out three key questions regarding the research focus. The first question is, what do we mean by the slum areas (the definition, characteristics, and condition) and what has been done to upgrade them? The second question is what is the definition of an operational healthy-productive dwelling? The third question is how could the implementation of Optimizing of Space answer the research problem.

The slum areas and How to Deal.

Slum areas usually exist because of the construction of temporary dwellings by informal sectors. This construction results in the emergence of cluttered, disorganized, dense slum areas, with unhealthy, substandard environment (Yudohusodo, 1991, p.331). Generally, slum areas have no infrastructure, facility, and environmental utility. The buildings are disorganized and in poor conditions. The building materials are semi permanent. There is an extremely high density of building, with Floor Area Ratio exceeding the admissible ratio. They are also very densely populated that the function of urban environment gets mixed up and become messy (Yudohusodo, 1991, p.333). The buildings are generally very close to one another, where the size of the houses is not proportional to the number of occupants. The houses only function as shelters from the heat of the sun, the rain, and cold. The buildings are in a state of disorder because there is no planning nor are there facilities such as MCK (Mandi Cuci Kakus – access to shower, laundry, and toilet), clean water, and good waste disposal (Komaruddin, 1997, p.96).

People who live in the slums do not generally have a permanent job in an informal industry. They usually have a low education background. Most of them are from rural areas and many times they dropped out of school (Prajitno, 1990, p.2). The land upon which the houses are built is not of the occupant's property, but of the government, personal, legal, or an institute's property which has not yet been used. Despite that fact, they form a strong clan in the slums, always eager to help each other because they are on the same boat. They also have a high tolerance towards one another.

There are several types of slum areas: the slums, the squatter areas, and a certain type of slum depending on their typology. The slums are a slum area found in settlement areas. This area evolves into a slum area because of poor planning and abandonment. The squatter areas exist on lands that are not intended for settlement areas. The lands are usually unoccupied lots of a personal or legal property, or lands that are off limits such on a flood plain or near train tracks, etc.

The other type of slum areas (based on typology) is found in both urban and in rural

areas merely because of the characteristics and the life of the society, such as in an area where most of the people are fishermen (Respati, 2001). Based on the descriptions above, we can conclude that the slum areas are ones with dense population, low social-economic condition, too many houses, substandard dwelling sizes, substandard facilities and infrastructures, that are built illegally in the government's or a personal property. Such definition, characteristics, and condition of slum areas make this discussion of the research clear. These are several programs have been done to deal with slum areas (Yudohusodo, 1991 p.331):

1. Kampung Improvement Program which aims to improve the health condition and the facilities.
2. Slum areas environment renewal trial program, done by demolishing the buildings in slum areas and replacing them with tenements that qualify the standard.

There are also slum area renewal done by relevant parties like the local government, private sectors, financial institution, and the local citizens.

The Kampung Improvement Program generally works on structuring the area to upgrade the qualities of the physical environment of the area and the life of the occupants, and to provide job opportunities for the occupants. The dwellings in slum areas should be functional; as a place to live, to make a family, to work, and to increase the productivity of the family. The houses in the area need good treatments in order for them to meet the standard of a healthy house environment (Komaruddin, 1997 p.118).

An investigation reveals several attempts (such as: program, event, research, concept, etc.) dealing with slum areas. Some of those attempts are:

1. Kampung Improvement Program, and Slum Areas Environment Renewal Trial Program (Yudohusodo, 1991).
2. Slum Areas Relocation and Reorganization, Reorganizing slum areas by National Housing Authority and the old occupants get to rent the houses with cheap price, Simple Tenement Construction, land expropriation by engaging a private sector, and urban land consolidation (Komarudin, 1997, p.98).
3. Urban Settlement Quality Upgrading, Urban Renewal (Tenement Construction), Society-Based Settlement Infrastructure Service Upgrading (Pamsimas/Sanimas), Poverty Alleviation (PNPM Mandiri/P2KP), and Rural Settlement Quality Upgrading (Agropolitan and PPIP) (Ministry of Public Work, 2008).
4. The rising income in the society by legalizing the status of the house. Therefore, they can put up the house as collateral for business investment, providing job opportunities, and creating access to support the circulation on the flood plain (Tunreng, 2008).
5. An approach to fix the condition of the houses effectively by creating more space to accommodate the activities in the house, to earn more income, and to gain social status (Sueca, 2004).
6. Housing and settlement acquirement strategy for the poor through construction material engineering to get cheap standard houses, either by construction standardization system or modular coordination system (Putra and Yana, 2007).
7. The use of marginal group strategy in urban and district planning for communities that have enough to offer in the planning process. Supports from other parties as facilitators are also needed for those communities. Socializations on the people's rights and duties as citizens should be given (Rahayu, 2007).
8. Community development in upgrading the quality of the slums and engaging different sectors in the society, be it individuals, community group, rural society, or local leaders. The activities in this community development should be constructive ones involving physical work or non-physical work. They should also contribute in the upgrading of the quality of the settlement environment. The activities vary from initiating ideas, concept, and the realization of the ideas (Alit, 2005).

There seems to be two things missing in those attempts:

1. Micro-spatial scale of the space in organizing the slums has not been a priority. Most programs still emphasize on macro-spatial scale.
2. The condition of the occupants is not taken into consideration.

Based on the above analysis and recent development of handling the slum areas, we can conclude that a further research that considers micro scale planning and the occupant condition is needed.

Optimizing of Space.

According to Indonesian Dictionary, optimization is a process of achieving the best level or condition. Optimization is associated with things that are the best. Biologically, optimization can also mean the best condition of the environment most suitable for the whole growth and development of a creature. What about optimization in architecture (space and form)? In architecture context, space optimization can refer to an effort to utilize space well so it creates the best condition. As for dwelling, we need to understand the function of one of the forming elements in architectural design.

Space optimization is a process of utilizing space effectively and efficiently, according to the needs of the doer. Thus, the space has a better condition. Based on the data in the fields, 90% of the samples show that the houses in *Kelurahan Gadang* (the location of the research) do not have enough space to meet the minimum standard of a healthy house. A dwelling is qualified for Optimizing of Space when an occupant gets 20% of 9 m2 or at least 7.15 m2 (Kepmen No. 403/KPTS/M/2002).

To create a design for dwellings based on Space Utilization Optimization, the occupancy profiles are divided into three categories. This classification is based on these considerations:

1. Most respondents (68%) are families consisting of father, mother, and 2-3 children that the category of 3-5 people in a house should be prioritized.
2. Each family has the tendency to add the number of occupants in the house, either because they have newborns or because they let their relatives live with them. In this case, there could be up to 7 occupants. Therefore, another category needs to be created for this case.
3. In some cases, there are more than 7 people in a house. This happens because there are more than 2 families live together in one house. This is mostly because the children still live with their parents even though they are already married. This tendency occurs because it is in their culture to stay with their parents. In villages near the city of Banjarmasin, the children will usually occupy another part of the house or build their own house near their parents.

The aim of the categorization is to make it easy to analyze the quality of the alternative optimization design variations. The patterns of daily activities and their relation to space coverage are then studied through interviews and observations.

The result of the research is Optimizing of Space based on occupancy profiles and alternative design for each category proposed by Muchamad (2010). The concept summary is as follows:

1. A family group of less than 5 people. The space optimization for this group is by providing bedrooms, a living room, a kitchen, and a restroom. The living room functions as a dining room, a guest room, and a family room during the day, and a room for children to sleep in during the night. The kitchen is semi-outdoor. The rooms are not only multifunctional, but also spatially optimized.
2. A family group of 5-8 people. The space optimization for this group is by providing a master bedroom, a bedroom for the daughters, a living room, a kitchen, and a restroom. The master bedroom is for the parents, while the sons sleep in the living room. The living room has many functions: a family room, a dining room, and a guest room during the day, and a room to sleep in during the night.
3. A family group of more than 8 people or more than 2 patriarchs. The space optimization for this group is by providing several master bedrooms, a living room, a kitchen, and a restroom. The master bedroom is divided into several sections using fabric or a temporary partition, for the parents and the kids to sleep in. The living room has many functions, as a

family room, a dining room and a guest room during the day and a room to sleep in at night. Those standards are intender to fulfill the requirements of an ideal healthy house. It is not easy to make the people in the slums in *Kelurahan Gadang* understand and fulfill the minimum requirement of a healthy house as they have many constraints and they did not have any solutions. For example, with their financial problem, they tend to prioritize foods instead of house. The solution offered by this research is the most affective and rational way for them to have a healthy environment.

The 3D design for Optimizing of Space based on occupancy profiles needs to have categories that fulfill: (a) the standard range of facilities, (b) the standard room size, (c) the standard Optimizing of Space(space efficiency and flexibility), and (d) the inquiry of Optimizing of Space that matches the alternative design made based on the spatial and physical characteristics of the existing house.

Based on above considerations, we can conclude that this concept can be applied as a manual for architectural designs (both 2D and 3D) for a healthy-productive house.

RESULTS AND DISCUSSION

The result of this research is a design for a healthy-productive dwelling. The design is made according to Optimizing of Space which focuses on (1) the efficiency of space utilization, (2) the flexibility of the space function, so it becomes a proper house that supports the productivity of the occupants, and (3) creating a dwelling that guarantees the health of its occupants. The design of a healthy-productive dwelling can be explained through five design aspects: module, component, design, material, and construction.

Module

The design of a healthy-productive dwelling is made according to the industrial standard; 60 cm and its multiples. This module60 cm system is used as a basic design intended to achieve space utilization efficiency. Today, various kinds of construction materials, industrial and household goods use a measuring system that suits module 60 cm and its multiples, making it suitable for the existing dwelling design. Module aspect does not only help achieve space utilization efficiency, but also help achieve space function flexibility where productive activities take place. Eventually, a standard efficient and flexible space will support the health of its occupants.

With this modular system, the house design can be developed according to the needs of the occupant, based on their activity, the number of occupant, or the occupant taste.

There are at least four types of a healthy-productive house that can be made using modular system:

1. Type A. This is the basic type of 3m x 7.2m in size (21.6 m2) and is designed for small families (1 patriarch – 3-4 people). It has 1 guest room (3m x 3m), 1 master bedroom (3mx3m), and 1 service room (3m x 1.2m) divided into a kitchen (1.8m x 1.2m) and a restroom (1.2m x 1.2m). The guest room is designed to be multifunctional: as a guest room and as a business place during the day and a room for the kids to sleep in at night.
2. Type B is an upgraded version of Type A, where 1 room of 3m x 3m (9 m2) is added. This type is intended for families of 1 patriarch – 5-6 people. It considers the situation where elderlies live with their children-grandchildren or where a married member of the family brings his/her spouse to live together with the parents. The size of each room is the same as that in Type A.
3. Type C is an upgraded version of Type B where 1 room of 3m x 3m (9 m2) and 1 room of 3m x 1.2m (3.6 m2) are added. It is intended for big families with 2-3 patriarchs – 7-8 people. It considers the situation where elderlies live with their children-grandchildren or where a married member of the family brings his/her spouse to live together with the parents. Due to its large number of occupant, the service rooms (kitchen and restroom) are bigger. The total area of the house becomes 43.2 m2. The size of each room is the same as that in Type A.

4. Type D is an upgraded version of Type C, where 2 rooms of 3m x 3m (9 m2) each are added. It is intended for big families with 2-3 patriarchs – 9-10 people. The total area of the house becomes 61.2 m2. Type C and D provides more possibilities for productive work because there are more multifunctional rooms.

The followings are the illustrations for those four types of houses:

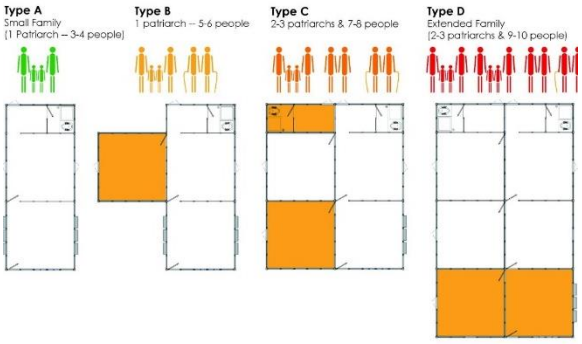


Figure 4: Types of healthy-productive dwelling (Source: Author)

Component

There are two key components of a healthy-productive, frame and panel components. Frame component is what shapes the room and the main structure of the building, while panel component fills or covers the structure. Panel component is made is various shapes and functions, like walks, windows, ventilation, doors, etc.

Component design variations are aimed at achieving three foci of a healthy-productive dwelling design. The dwelling components are designed to support space efficiency and are very functional. Moreover, they are standardized and off-site that they support space functional flexibility and they make construction easy. To get space functional flexibility (especially inside-wall components) the components are designed according to the needs of the productive business of the occupants. For example, the wall component can be distinguished depending on the kind of business.

Besides the above key components, there are a few other components that a healthy-productive dwelling, according to the standard set by the government, must have; The foundations, to give the building stability, and to link the building to the ground; unhuman waterproof floor, a minimum of 10 cm from the lawn and 25 cm from the road. It could be wooden or plaited bamboo for raised platforms: The windows and doors become ventilations with a minimum area of 10% of the floor area; Waterproof walls are to hold the ceiling, restrain winds, and rainfall, to protect the occupants from heat or dust outside, and to keep the privacy of the occupants; The ceilings are to absorb heat, a minimum of 2.4m above the floor. It could be board, plaited bamboo, triplex or gypsum; and the roof to restrain heat and to protect the occupants from dust, wind, and rain.

In a healthy-productive dwelling design, the components can be distinguished based on the forming components, which are (1) floor component, (2) wall component, and (3) roof component. Metal furring framing will be used for the floor component, forming an outside-wall pattern. Above the metal furring will be wall panels, either with module of 60 cm x 240 cm wall or wall panel combination with various openings (door, window, ventilation, etc.). The wall panel is designed to match the module (60 cm wide) to make it easier to build (off-site). It will also be flexible should there be a change in space size and function. Therefore, wall panel is an important component for space optimization. This panel component might use various kinds of material. The materials will be discussed in a separate section.

The roof component is the cover that protects the rooms from the climate. It is made above the frames of the building and the roof. Below is a picture of the components of a healthy-productive dwelling:

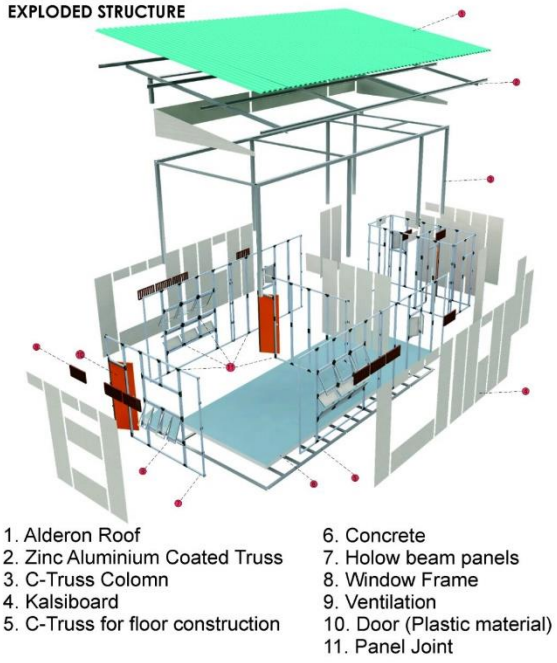


Figure 5: Component of healthy-productive dwelling
(Source: Author)

Design

To increase space and functional flexibility, a healthy-productive dwelling is designed with several alternatives concerning room organization and building orientation. This alternative design enables the occupants to choose one according to their taste. There are three alternatives adjustable according to needs. These alternatives enable the environment to develop dynamically. The ideal alternative design is chosen based on the number of occupants, the kind of work they do, and the condition of the land. Here are some pictures of alternative designs for each dwelling type.

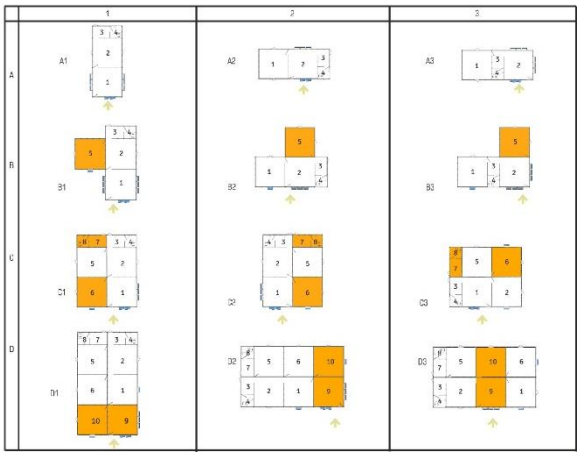


Figure 6: Alternative design of each type of dwelling
(Source: Author)

1. The A1 is as initially designed: type A2 design separates the bedroom with the service room; type A3 places the service room between the guest room and the bedroom.
2. Type B1 is as initially designed: types B2 and B3 place the guest rom as the main dwelling area.
3. Type C1 is as initially designed: Types C2 and C3 are developed with different space and building orientations.
4. Type D1 is as initially designed: types D2 and D3 are developed with different space and building orientations.

Based on the above descriptions, here is the typology of a healthy-productive dwelling:

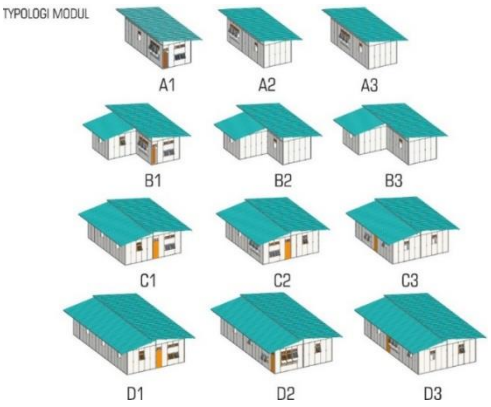


Figure 7: Typology of healthy-productive dwelling
(Source: Author)

Material

Just like the designing aspect, the material aspect is also developed with several alternatives. However, there are differences in the alternative materials. Principally, the materials are easy to get, easy to be processed (without the need of any tool, technology, or advanced skill), eligible to achieve space efficiency, functional flexibility, and health assuring.

Based on those considerations, the research recommends three kinds of main material, fabrication, organic, and recycled materials. The selected fabrication materials are iron frames and wall panels made of cement board. Organic materials are wood beams for frames and bamboo or plywood for panels. Recycled materials are composite plastic products for frames and panels. Even so, those three types of material could be combined. For example,

fabrication materials can be used for the outer part and recycled ones the inner part, etc. As for wall component, there are inner wall and outer wall components, depending on the strength and the durability.

Generally, the concept of materials for a healthy-productive dwelling is divided into three types. Type 1 is general home material. Type 2 is hollow iron and cement board panel materials, and Type 3 is plastic materials.

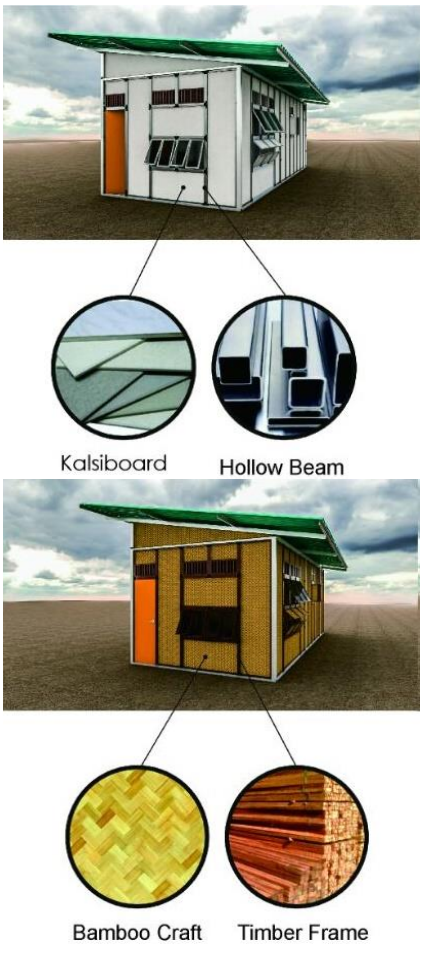
1. Type 1 is for relatively permanent houses where the ownership status is legal.
2. Type 2 is for the low-class society (subsidy) or temporary houses when natural disasters happen.
3. Type 3 is like type 2, only that it is suitable for wet lands.

Each type of material has their own advantages and disadvantages. Here is the table of comparisons among the types of materials.

Table 1: A comparison of healthy-productive dwelling materials

Material	strength	weaknesses
Hollow frame and Cement board panel	• High accuracy, because they are made in factories. • Good strength and durability.	• High cost. • Requires sophisticated technology to process.
Wood and plywood or bamboo	• Relatively cheap price. • Tools and the processing techniques are generally used.	• Limited number of materials. • Less strong and less durable. • Liable to break. • Less aesthetic. • Requires high maintenance.
Plastic	• Home industry. • Recycled material. • Replaceable. • Available in many colors. • Easy to maintain. • Waterproof.	• Less comfortable. • Less strong and less durable. • Liable to break when exposed to heat.

The followings are the descriptions of several types of material for a healthy-productive dwelling.



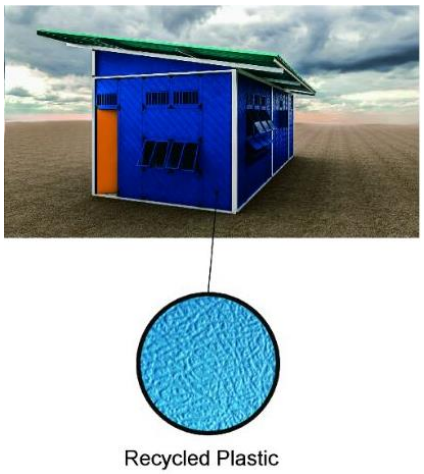


Figure 8:Alternative material
(Source: Author)

Construction

The construction of a healthy-productive dwelling is meant to be easy. Because the materials are easy to get and are made off-site, the construction is an assembling process.

Construction aspect explains the process and techniques of a healthy-productive dwelling construction. Process aspect demonstrates how the dwelling is developed from the simplest type to the most complex one. The technique aspect explains (1) joining technique (2) assembling technique, and (3) the working mechanism.

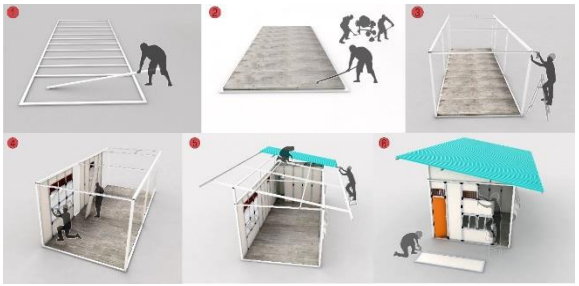


Figure 9:Illustration of the construction process
(Source: Author)

The general steps in construction are as follows:

1. Preparing the floor frames, especially the parts that will be filled with wall panel. The floor frames are either metal furring or wood). The floor should be strong and durable.
2. Filling in the spaces between the floor frames with sand or cement mix, evenly arranged and dense.
3. Setting up the wall frames and the ring beams. These frames are adjustable depending on the type of dwelling and the development of the building.
4. Setting up the components of wall panels, windows, pints, ventilation, etc. Joints are used to set up the wall panel.
5. Setting up the roof frames and the roof covering.
6. Finishing.

There are several types of frame and panel joints:

1. Vertical/horizontal joint between a frame and a panel
2. Vertical/horizontal panel-to-panel joint
3. Vertical/horizontal joint for three panels
4. Vertical/horizontal joint for four panels

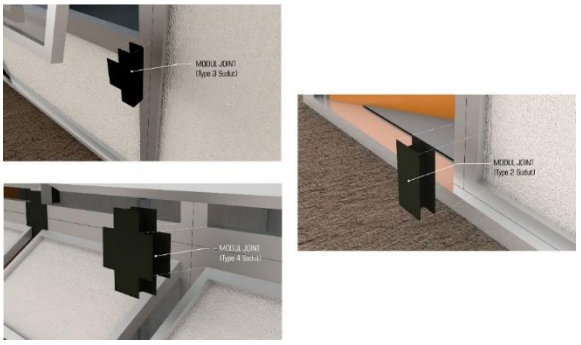


Figure 10: Model of connection between the frame and the panel
(Source: Author)

CONCLUSION

Poverty is a very complex multi dimensional problem that cannot be solved by only one discipline. Any discipline can contribute to the alleviation of poverty. From an architectural perspective, there are three serial indicators of poverty: (1) the low quality of dwelling, (2) the impact on the economy of the family, and (3) the health of the occupants. Based on those indicators, one way of alleviating poverty is by designing a healthy-productive dwelling that matches with Optimizing of Space based on occupancy profiles for the poor in urban areas. The concept focuses on (1) the efficiency of space utilization, (2) the flexibility of space function for the dwelling to support the productivity of its occupants, and (3) the establishment of dwellings that guarantee the health of the occupants.

The research has proven that a healthy-productive dwelling design can be realized and explained through five design aspects: module, component, design, material, and construction, which touch upon the three foci of Space Utilization Optimization.

Acknowledgment

The researcher thanks to the Ministry of Research, Technology, and Higher Education of Republic Indonesia c.q. University of Lambung Mangkurat through Penelitian Unggulan Perguruan Tinggi (PUPT) fund for supporting this research.

REFERENCES

Alit, I Ketut. (2005). Pemberdayaan Masyarakat Dalam Peningkatan Kualitas Lingkungan Permukiman Kumuh di Propinsi Bali. *Jurnal Permukiman NATAH*. Vol. 3 No.1 Pebruari 2005. 34-44.

Brooks, Roger J. (2006). Some Thoughts on Conceptual Modelling: Performance, Complexity and Simplification. *Proceedings of the 2006 OR Society Simulation Workshop*. S. Robinson, S. Taylor, S. Brailsford and J.Garnett, eds. United Kingdom.

Egger, Anne E and Carpi, Anthony. (2008). Research Methods: Modeling. *Vision learning* Vol. POS-1 (8), 2008. Tersedia di http:www.visionlearning.com / library / module_viewer.php. tanggal akses 5 Maret 2009.

Komarudin. (1997). *Menelusuri Pembangunan Perumahan Permukiman*. Jakarta: Yayasan Real estate Indonesia.

Muchamad, Bani Noor, dan Ira Mentayani, (2010). Konsep Optimalisasi Ruang Permukiman Kumuh berdasar Profil Jumlah Penghuni. *Jurnal TESA Arsitektur*. Vol. 8 No. 1 Juni 2010. Hal. 29-41..

Prajitno, Sakti. (1990). Mencari Momentum Pembenahan Permukiman Kumuh Kota Besar Di Indonesia, *Jurnal Penelitian Pemukiman*. Vol. VI, no 3-4.

Putra, I Dewa Gede Agung Diasana dan Anak Agung Gde Yana. (2007). Pemenuhan Atas Perumahan Salah Satu Upaya Penanggulangan Kemiskinan. *Jurnal Permukiman NATAH*. Vol. 5 no. 2 Agustus 2007 : 62 – 108.

Rahayu, Murtanti Jani dan Rutiana D. (2007). Strategi Perencanaan Pembangunan Permukiman Kumuh. Kasus Pemukiman Bantaran Sungai Bengawan Solo, Kelurahan Pucangsawit, Surakarta. *Jurnal GEMA TEKNIK*. No 1/Tahun X Januari 2007. Hal. 89-96.

Reif, Benjamin. (1973). *Models in Urban and Regional Planning.* London: Leonard Hills Book.

Respati, Niniek. (2001). Permukiman Kumuh: apakah itu?. *Buletin Perkim*. Jakarta

Robinson, Stewart. (2006). Issues Conceptual Modelling For Simulation: Setting A Research Agenda. *Proceedings of the 2006 OR Society Simulation Workshop*. S. Robinson, S. Taylor, S. Brailsford and J.Garnett, eds. United Kingdom.

Sueca, Ngakan Putu. (2004). Transformasi rumah: Prospeknya untuk memperbaiki keadaan rumah di Indonesia (Suatu Studi Pendahuluan). *Jurnal Permukiman NATAH*. Vol. 2 no.1 Pebruari 2004 : 1 – 55.

Tamin, Ofyar Z. (1997). Perencanaan dan Permodelan Transportasi. Bandung: Institut Teknologi Bandung.

Tunreng, Usman. (2008). Pola penataan lingkungan permukiman kumuh di sekitar kawasan bantaran Sungai Palu. Tesis Magister Teknik Pembangunan Wilayah & Kota. Program Pasca Sarjana Konsentrasi Perencanaan Pembangunan Wilayah & Kota, Universitas Diponegoro.

Yudohusodo, Siswono. (1991). *Rumah Untuk seluruh Rakyat*. Jakarta: Bharakerta.