

# Joint System of Traditional Houses in Littoral, Highland, and Lowland Region of West Java

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**Abstract** — Traditional building in West Java has a unique characteristic that can be observed in its joint system. These joint system is divided into lower system, middle system, and upper system. Moreover, the variety of topographies in West Java should represent different characteristics between these buildings: houses in littoral region has a distinction to be compared to houses in lowland region and highland region.

This research will emphasize the characteristic of buildings located in those regions through observation and measurement of traditional houses in littoral, highland, and lowland of West Java. Survey has been conducted in Kampong Panjalin of Kabupaten Majalengka (represents littoral region), Kampong Cikondang of Kabupaten Bandung (represents highland region), and Kampong Mahmud of Kabupaten Bandung (represents lowland region). The observation is focused on three building aspects: form and configuration, material and dimension, and detail of joint system.

**Keywords** — Joint System of Construction, Traditional House, West Java.

## I. INTRODUCTION

### 1.1. Background

Traditional buildings find their way through a trial and error process that is done repeatedly and has been tested by time. This can be seen from regular ornaments (representing custom or tradition symbols), the use of natural materials and built with appropriate technology tailored to the community's capabilities through a long period of trials (Triyadi & Harapan, 2007).

In general, traditional buildings in Indonesia consist of 3 (three) kinds of systems: lower system, middle system, and upper system (Triyadi & Harapan, 2008). These three systems are reinforced by a joint system that results a rigid and strong building. Materials in traditional building, either as architectural, structural, or joint elements, are natural materials that easily obtainable in the surrounding environment, such as bamboo, wood, palm fiber, sagoo leaf, natural stone, and others. One example of Indonesian traditional buildings that have these character is traditional houses in West Java (Triyadi & Harapan, 2007).

This paper will discuss the West Javan traditional house construction systems in 3 (three) locations: (i) Kampong Panjalin in Kabupaten Majalengka, (ii) Kampong Cikondang and (iii) Kampong Mahmud in Kabupaten Bandung. In this paper, traditional house in each location will be studied, which focus on three aspects: form and configuration, material and dimension, and the detail of joint system.

### 1.2. Scope and Limitation

In this study, houses are divided into 3 (three) systems

where each system has a subsystem and each subsystem also has sub-subsystem (component). Three main systems in the house are the upper system (roof subsystem and ceiling subsystem), the middle system (wall subsystem, column subsystem, and beam subsystem), and the lower system (floor subsystem and foundation subsystem) (Triyadi & Harapan, 2007). The research parameters used in this paper are form and configuration; material and dimensions, to understand the proportion of each element and building component; and detail of joint system, to understand existing construction knowledge that can be an inspiration for new construction design (Gutierrez, 2004; Triyadi & Harapan, 2007).

## II. LITERATURE REVIEW

### II.1. Traditional Houses in West Java

Typical traditional houses in West Java is a stilt house where the level of floor ranging from 40 to 80 cm above the ground. The shady space under the house can be used for farming tools storage and chicken coop; it also functioned as an air ventilation (Muanas, 1984; Triyadi & Harapan, 2008). The typical shapes of West Javan traditional house is based on, and can be observed, through the differences of roof. There are five shapes, namely: (a) suhunan jolopong ("suhunan" means "ridge"), two nearly identical roof plans separated by a ridge in the middle of the house; (b) tagog anjing (means "sitting dog"), two different-sized roof plans separated by a ridge in front of the house; (c) badak heuay (means "gaping rhinoceros"), similar to tagog anjing, but one roof plan straddles a shorter roof plan, so no ridge in the roof; (d) parahu kumureb (means "inverted boat"), similar to a hipped roof; and (e) julang ngapak (hornbill stretching wings), similar to suhunan jalopong, but the plans bend resulting the angled plan in each side of roof.

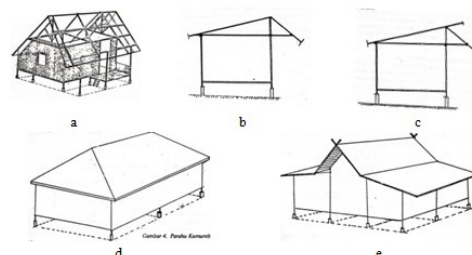


Fig. 1. Typical shapes of traditional houses in West Java: a. Suhunan jolopong, b. Tagog anjing, c. Badak heuay, d. Parahu kumureb, e. Julang ngapak

Source : Muanas, 1984

## II.2. Construction Joint System of West Java Traditional House

West Java traditional house uses a joint system that similar to the mortice and tenon used for wood construction, locally known as a pupurus joint system. This joint system can be found in three main systems of house. In the upper system, pupurus used to join truss and column, truss and ridge beam, tiang adeg and tatapakan adeg, and column, balok pangeret, and bearing beam. In the middle system, it used to join palang dada. Meanwhile, in the lower system, pupurus used to join main beams (pananggeuy and paneer) and columns. In some cases, pupurus joint system is reinforced with wooden peg or nails.

## III. METHODOLOGY

### III.1. Method

This research is conducted through measurement and documentation of the traditional houses and its system. The measured and documented aspects of the house are building form and configuration, material, dimensions, and details of the joint system, either on the upper system, the middle system, or the lower system. Interviews were also carried out to the building owners to find out the construction and renovation history of the house.

### III.2. Research Stages

The steps taken in this research process are: 1) literature study about traditional building and traditional houses of West Java, 2) selection of research object and its sample, 3) Site survey to three selected locations, 4) Grouping of data, analyzed by using comparison method.

## IV. DESCRIPTION OF TRADITIONAL HOUSES IN THREE LOCUS AREA

The three kampongs selected as locus area represented a variety of topography in West Java. Kampong Panjalin represents a littoral region; Kampong Cikondang represents a highland region; while Kampong Mahmud represents a lowland region;

### IV.1. Kampong Panjalin (Littoral Land)

Kampong Panjalin located in northern part of Kecamatan (district) Sumberjaya, part of Kabupaten Majalengka and a direct border to Kabupaten Cirebon.



Fig. 2. Traditional House in Kampong Cikondang

Traditional house in Kampong Panjalin has a size of 7.1 x 9.55 m. It consists of two rooms: front room with size of 4.3 x 7.1 m and back room with size of 5.25 x 7.1 m. In some houses, the back room is used as a meditation room for pilgrims who pay visit to the Kampong.

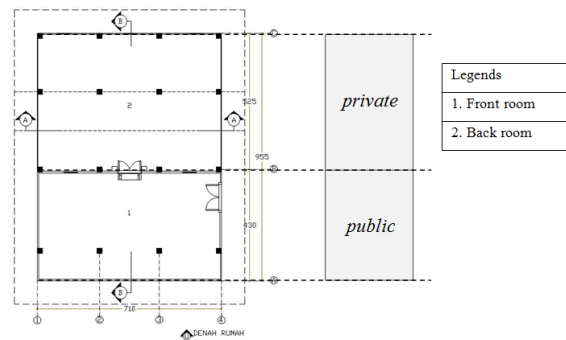


Fig. 3. Plan of Traditional House in Kampong Panjalin

### Systems of Traditional House in Kampong Panjalin

#### 1. Lower System

##### • Floor

The level of front room floor is lower 30 cm than the back room's. While the back room floor level is 1.3 m above the ground. The material used as a floor is bamboo slats, locally known as palupuh.

##### • Foundation

The foundation, called by locals as tatapakan, is made of solid stone with a flat surface. The shape of tatapakan is cylinder with a diameter of 30 cm.



Fig. 4. Foundation of Traditional House in Kampong Panjalin

#### 2. Middle System

##### • Column

Traditional house of Kampong Panajalin has sixteen main columns made of solid teak wood with size of approximately 19x19 cm.

##### • Wall

The wall of this traditional house is made of teak wood board and bamboo weaves with sasag (crossing) motif.

##### • Door and Window

This traditional house only has one opening: a door with a size of 1.00 x 1.60 m and has two leaf doors. Material of this door is solid teak wood.

#### 3. Upper System

##### • Roof

The roof form of traditional house in Kampong Panjalin is julang ngapak. While original roof material is wood shingle, the current roof material is clay roof tile. The original joint at trusses using papurus system, reinforced with wooden peg and a knot made of fiber rope. Now, in some parts, joint is reinforced with nails.



Fig. 5. Roof and truss of Traditional House in Kampong Panjalin

#### IV.2. Kampong Cikondang (Highland)

Administratively, Kampong Cikondang located in Kecamatan Pangalengan of Kabupaten Bandung. It lies in a mountains of Southern Bandung.



Fig. 6. Traditional House in Kampong Cikondang

Traditional house in Kampong Cikondang has a size of 6.00 x 8.00 m and consists of four rooms: two bedrooms, living room (known as tengah imah), and tepas. Each bedrooms has a size of 3.00 x 2.00 m. In the front of the house, there are steps that made of bamboo slats, named golodog. Golodog also functioned as transition space before entering the house.

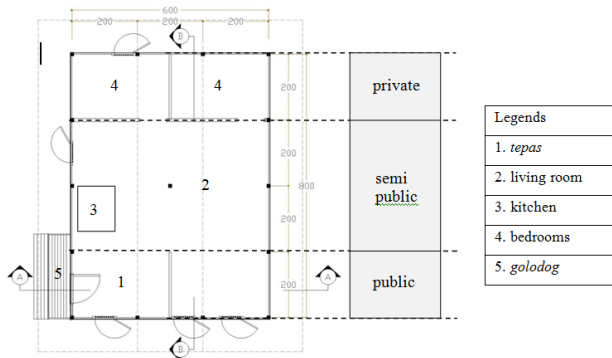


Fig. 7. Plan of Traditional House in Kampong Cikondang

#### Systems of Traditional House in Kampong Cikondang

##### 1. Lower System

###### • Floor

Traditional house of Kampong Cikondang is a stilt house with height app. 45 cm above the ground. Similar with traditional house in Kampong Panjali, the floor is made of palupuh. Palupuh is arranged above the whole bamboo stem, named darurung. Meanwhile, darurung is supported by a solid wooden beam, named panenggeuy.

###### • Foundation

The foundation of this house is a solid box-shaped stone. It has a flat upper surface, but other surface remained natural (unpolished).



Fig. 8. Foundation of Traditional House in Kampong Cikondang

##### 2. Middle System

###### • Column

Traditional house of Kampong Cikondang has fifteen main columns with size of approximately 15x15cm. Fourteen columns located in outer wall, while one columns located inside the house. Columns that functioned as outer wall also the functioned as supporter of walls with wooden joist, named sisiku.



Fig. 9. Columns of Traditional House in Kampong Cikondang

###### • Wall

The wall of this traditional house is made of bamboo weaves with keping (fishbone) motif. The wall is attached to columns; its lower part is clamped by board, named papan linear, and its higher part is attached into beam.



Fig. 10. Wall of Traditional House in Kampong Cikondang

###### • Door and Window

This traditional house only has one door with a size of 0.98 x 1.94 m and has two leaf doors. It has five windows: three windows located in living rooms, one window located in back side of the house, and one window located in western side of the house.



Fig. 11. Window of Traditional House in Kampong Cikondang

### 3. Upper System

- Roof

The roof form of traditional house in Kampong Cikondang is suhunan jolopong with additional roof plan in its western side, named “leang-leang”. The roof is made of fiber knotted with bamboo straps in the rafter. The joint at trusses using papurus system, reinforced with wood peg.

- Ceiling

Ceiling of this house is made of bamboo weaving that clamped by bamboo slats. The ceiling is supported by proportionally-distributed bamboo stems. This type of ceiling is called locally as “darurung atap” or “dolos”.

#### IV.3. Kampong Mahmud (Lowland)

Administratively, Kampong Mahmud located in Kecamatan Margaasih of Kabupaten Bandung. This kampong has a unique costum, which bars houses to use brick wall and glass as its material. The costum also forbid to dig a well, later found that this kampong located in swamp area.



Fig. 12. Traditional House in Kampong Cikondang

Traditional house in Kampong Mahmud has a size of 5.00 x 15.50 m and consists of four rooms: two bedrooms, living room (known as tengah imah), and tepas.

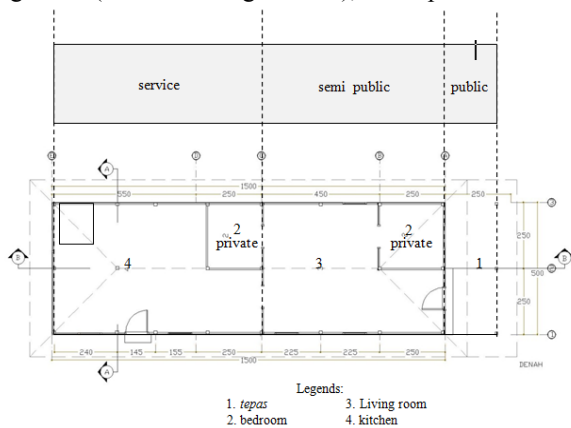


Fig. 13. Plans of Traditional House in Kampong Cikondang

#### Systems of Traditional House in Kampong Mahmud

##### 1. Lower System

- Floor

There are two types of floor in traditional house in Kampong Mahmud; one type is made of wood board, used in living room; another type is made of bamboo slats that supported by bamboo beams, named “darurung”.

- Foundation

Foundation of this traditional house is made of stone with various shape: a rectangle; a trapesium, or even natural shape. However, every foundation has a flat surface in its upper side.

##### 2. Middle System

- Column

There are twenty columns in traditional house in Kampong Mahmud. Each column has a size of 11x12 cm. Nineteen columns located in outer wall of house and one located in the kitchen.

- Wall

The wall in this house is made of bamboo weaving with kepong (fishbone) motif. The wall is attached to columes and supported by smaller columes (named “palang dada”) with size of 5x10 cm.



Fig. 14. Wall of Traditional House in Kampong Mahmud

- Door and Window

This traditional house has two doors with size of 0.75 x 1.90 m. One door located in front of the house (main entrance) and another one is located in kitchen (service door). Both doors is made of wood.

### 3. Upper System

- Roof

The roof form of traditional house in Kampong Mahmud is parahu kumureb with additional roof plan for tepas area. The roof material is clay rooftile, while rafter and batten are made of wood.

- Ceiling

Ceiling of this house is made of bamboo weaving that clamped by bamboo slats. The ceiling is supported by proportionally-distributed bamboo stems. This type of ceiling is called locally as “darurung atap” or “dolos”.

## V. ANALYSIS ON CONSTRUCTION JOINT SYSTEM

### V.1. Lower System of Traditional House

#### 5.1.1. Form and configuration

##### 1. Littoral land (Kampong Panjalın)

- Floor

The floor of traditional house in this area (northern West Java) has a height approximately 1.00-1.30 m above the ground. The shady space is used, not only for chicken coop, but also to prevent water entering the house, when flood is coming.

- Foundation

The foundation used in the observed houses are made of stone that obtained from nearby river.

##### 2. Highland (Kampong Cikondang)

- Floor

The floor of traditional house in this area (central West Java) has a height approximately 45-60 cm above the ground.

- Foundation

The foundation used in this traditional house is made of stone with form of box or trapesium.

##### 3. Lowland (Kampong Mahmud)

- Floor

The floor of traditional house in this area (southern West Java) has a height approximately 60 cm above the ground.

- Foundation

The foundation used in this traditional house is made of stone with form of box.

#### 5.1.2. Material and dimension

##### 1. Littoral land (Kampong Panjalin)

- Floor

Floor is made of bamboo slats, named palupuh. All of palupuh clamped with bamboo straps every 1 meter.

- Foundation

Located above foundation is main column, named “tiang adeg” that transfer all loads of house into the ground. The foundation observed in the field has a dimension of  $\pm 30$  cm with a flat surface.

##### 2. Highland (Kampong Cikondang)

- Floor

Floor is made of wood board or bamboo slats, named palupuh.

- Foundation

The foundation used in this traditional house is made of stone with form of box or trapesium and has a flat surface.

##### 3. Lowland (Kampong Mahmud)

- Floor

Floor is made of bamboo slats, named palupuh. All of palupuh clamped with bamboo stem with diameter of 7 cm every 30-40 cm.

- Foundation

The foundation observed in this research is made of stone with form of 20-21cm-sized box and has a flat surface. The distance between upper surface of foundation to the ground is approximately 25 cm.

#### 5.1.3. Detail of joint system

##### 1. Littoral Land (Kampong Panjalin)

- Floor

Joint system between column and main beam (panenggeuy) with size of 8x17 cm is pupurus system without any knot, only by wooden peg. Joint system between main beam (panenggeuy) and smaller beams (darurung) is originally reinforced with knot of bamboo fiber. Later, it is reinforced with nail.

- Foundation

The main column is placed on the foundation without any joint. Columns are connected with main beam.

##### 2. Highland (Kampong Cikondang)

- Floor

Joint system between column and main beam (panenggeuy) is pupurus system reinforced with knot of bamboo fiber, wooden peg, or nail.

- Foundation

The main column is placed on the foundation without any joint. Columns are connected with main beam.

##### 3. Lowland (Kampong Mahmud)

- Floor

Joint system between column and main beam (panenggeuy) is pupurus system reinforced with wooden peg or nail.

- Foundation

The main column is placed on the foundation without any joint.

## V.2. Middle System of Traditional House

### 5.2.1. Form and configuration

#### 1. Littoral land (Kampong Panjalin)

- Column and Wall

The form of house's structural plan observed in this research is rectangle. Both long and short side of house has four columns with gap between 2.35-3 m. The comparison between length, width, and height of each side is proportional enough to make the structure rigid and stable.

Unlike in other observed houses, bamboo weaving wall in this traditional house is not supported with wall-frame. The bamboo weaving is only attached into main structural elements (column, upper beam, and lower beam)

- Door and Window

Door and window in this house is rectangle. The leaf doors is quite heavy since it is made of solid teak wood. Window type is jalousie window with leaf windows.

#### 2. Highland (Kampong Cikondang)

- Column and Wall

The form of house's structural plan observed in this research is rectangle. The plan is symmetrical with harmonious distance between columns.

- Door and Window

The door is rectangle. The window has jalousie and four leaf windows.

#### 3. Lowland (Kampong Mahmud)

- Column and Wall

The form of house's structural plan observed in this research is rectangle. The plan is symmetrical with harmonious distance between columns. Both long and short side of house has four columns with gap between 2.52-2.92 m. To make the structure rigid, there is additional smaller column (palang dada iga-iga) that resulted that every side of structure be a framebox-like.

- Door and Window

Door and window in this house is rectangle. Window has jalousie and leaf windows.

### 5.2.2. Material dan dimension

#### 1. Littoral land (Kampong Panjalin)

- Column and Wall

The material used as structural elements of this house is solid teak wood and material used as wall is bamboo weaving with sasag (crossing) motif and teak wood board with length between 50-160 cm and width 20-40 cm.

- Door and Window

The material used for every door and jalousie window in this traditional house is teak wood. Dimension of doors in observed house are 1 x 1.6 m and 0.8 x 1.8 m. Dimension of first jalousie windows is 50 x 73 cm, consists of 5 jalousies with dimension of 3.5 x 3.5 cm. Dimension of second jalousie window is 25 x 50 cm, consists of 4 jalousies with dimension 3.5 x 3.5 cm.

#### 2. Highland (Kampong Cikondang)

- Column and Wall

The material used as structural elements of this house is wood (any kind found nearby forest, such as albasia or

teak wood) and material used as wall is bamboo weaving with kepong (fishbone) motif.

- Door and Window

The material used as door and window in this house is wood. The dimension of doors are 0.98 x 1.94 m and 0.75 x 1.90 m. The dimension of windows are 1.15 x 0.73 m, 0.8 x 1 m, and 0.6 x 1 m with jalousie size is 3 x 3 cm. Every window has 8 jalousie that has gap between 3.5-6.5 cm.

### 3. Lowland (Kampong Mahmud)

- Column and Wall

The material used as structural elements of this house is wood (any kind found nearby forest, such as albasia or teak wood) and material used as wall is bamboo weaving with kepong (fishbone) motif.

- Door and Window

The material used as door and window in this house is wood. The dimension of door is 0.73 x 1.80 m and 0.75 x 1.90 m. The dimension of window is 0.675 x 1 m with jalousie size is 2.5 x 2.5 cm. Every window has 5 jalousie that has gap around 7.5 cm.

#### 5.2.3. Detail of joint system

##### 1. Littoral land (Kampong Panjalin)

- Column and Wall

Joint system for house frame is pupurus system. It can be found in the joint of column and lower beams (panenggeuy, paneer, and galugur beam).

- Door and Window

Joint system of door and window is pupurus system without any reinforcement. The door and window frames are attached to both upper beam (pangeret beam) and lower beam (paneer beam).

##### 2. Highland (Kampong Cikondang)

- Column and Wall

Joint system for house frame is pupurus system. It can be found in the joint of column and lower beams (panenggeuy, paneer, and galugur beam).

- Door and Window

The leaf door and leaf window use hinge, locally named "simeut meuting". It shows that there is an adaptation of technology in the house. However, jalousie windows still use pupurus system.

##### 3. Lowland (Kampong Mahmud)

- Column and Wall

Joint system for house frame is pupurus system. It can be found in the joint of column and lower beams (panenggeuy, paneer, and galugur beam). However, the joint between wall and its supporting frame is reinforced with nail.

- Door and Window

The leaf door and leaf window use hinge, locally named "simeut meuting". It shows that there is an adaptation of technology in the house. However, jalousie windows still use pupurus system.

### V.3. Upper System of Traditional House

#### 5.3.1. Form and configuration

##### 1. Littoral land (Kampong Panjalin)

The form of the roof is julang ngapak. The truss is triangle and has additional leaning beams (leang-leang) in front and back of the house. The truss consists of tihang

adeg, a standing beam in the center of truss, and two leaning beams that connect tihang adeg and pangeret beam. The width of truss is approximately 3 m.

##### 2. Highland (Kampong Cikondang)

Same with Kampong Panjalin, the form of the roof is julang ngapak. The truss is triangle and has additional leaning beams (leang-leang) in front and back of the house. The truss consists of tihang adeg, a standing beam in the center of truss, and two leaning beams that connect tihang adeg and pangeret beam. The width of truss is approximately 2.5 m.

##### 3. Lowland (Kampong Mahmud)

The form of the roof is different with the others, a half of julang ngapak. The truss is triangle and no additional leaning beams (leang-leang) as the other houses. The width of truss is approximately 3.5 m.

#### 5.3.2. Material dan dimension

##### 1. Littoral land (Kampong Panjalin)

While original roof material is wood shingle, the current roof material is clay roof tile. Roof tile is arranged on bamboo batten for every line of roof tiles. While the raft is placed every 30-40 cm. The material of truss is wood with dimension of 7 x 12 cm. While ridge is made of wood with dimension of 7 x 15 cm.

##### 2. Highland (Kampong Cikondang)

The roof material is bamboo fiber and sago leaves. The dried sago leaves placed in the most inner part of roof so the roof is thick and water resistant. The sago leaf are clamped with bamboo slats and tied with bamboo fiber.

##### 3. Lowland (Kampong Mahmud)

The roof material is bamboo fiber clamped with bamboo slats and attached to bamboo rift with another bamboo fiber.

#### 5.3.3. Detail of joint system

##### 1. Littoral land (Kampong Panjalin)

The observed house has an entirely pupusan system without any reinforcement in its roof joint system, whether in its truss, ridge, and pangeret beam.

##### 2. Highland (Kampong Cikondang)

The pupusan system in truss joint is reinforced with wooden peg and later with nail. This kind of reinforcement is also found in the joint of ridge and pangeret beam.

##### 3. Lowland (Kampong Mahmud)

The pupusan system in truss joint is reinforced with wooden peg and later with nail. This kind of reinforcement is also found in the joint of ridge.

## VI. CONCLUSION

Joint system in three observed location has a principally same system: pupusan system, a joint that similar with mortice and tenon joint. Other similarities between three traditional houses is using of bamboo slates (palupuh) as floor. Palupuh os also used as wall in every house so the temperature inside the house relatively breezy in day. However, in Kampong Panjalin house, the wall also made of wooden board and the palupuh has different motif (sasag motif). While in two other location, the motif is kepong motif.

In, center and southern part of West Java, to support

palupuh as floor, there are darurung (made of bamboo stems with diameter of 7 cm and placed every 20-30 cm) and main beam with dimension of 5 x 7 cm.

Foundation material in every observed house is natural stone. The height of floor level in these houses is around 45-60 cm and used as air ventilation.

The span of truss in the observed houses is relatively short: 3-5 m. The structural frame is reinforced with wooden joist with varied dimension. The configuration of truss in every house is similar and can be seen from inside of the house.

## REFERENCES

- [1] Ekadjati, S. Edi. (1980): Society and Cultural of Sunda People. Pusat Ilmiah dan Pembangunan Regional – PIPR, Bandung – West Java.
- [2] Gutierrez, Jorge, 2004: Notes on the Seismic Adequacy of Vernacular Buildings, 13th World Conference on Earthquake Engineering. Vancouver. B.C. Canada August 1-6.2004. Paper No.5011.
- [3] Muanas, Dasum (1984): Traditional Architecture of West Java. Education and Culture Department of West Java, Indonesia.
- [4] Sucipto T., (2002): Traditional Kampong and Verbacular Houses in West Java Department of Culture and History of West Java.
- [5] Triyadi, Sugeng & Harapan, Andi (2007): Study of Local-Indigenous of structure and construction in West Java. Building Technology Department, Institute Technology of Bandung.
- [6] Triyadi, Sugeng & Harapan, Andi (2008): Study of Traditional Housing Systemic of Sunda. Building Technology Department, Institute Technology of Bandung.

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Dr. Andi Harapan is the Lecturer in Architecture Department at University of Computer Indonesia, Bandung an also and an Architect by education graduated from Architecture Department of the Bandung Institute of Technology in 2004. Andi is also a Post Graduated in Architecture from Bandung Institute of Technology (ITB) and holds a Doctoral degree from Bandung Institute of Technology. Andi was also taken the post doctoral at Toyohashi Institute of Technology, Japan in 2011. Andi has more than 10 (eight) years professional experiences in Architecture consultancy activities, and has developed a strong analytical, design and management skills through years of professional stints and experiences in Design's Project.