# RESEARCH REPORT

## DISTRIK MELINGKAR

CIRCULAR HOUSING
IN INDONESIA

ABSTRACT

Indonesia is currently facing a housing deficit of 15 million units. In order to try and resolve this problem, 800.000 units of formal housing are being build every year and the most popular typology in this fast growing housing market is the Indonesian housing cluster. The goal within this project is to do a redesign of the housing cluster typology and create a sustainable neighbourhood using building principles derived from the learnings of circular economy.

KEYWORDS;
Housing Cluster, Indonesia, Bandung, Circular Economy, Sustainability, Housing, Bamboo, modular construction

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# PREFACE

Growing up in the Netherlands with an Indonesian mother meant spending almost every other summer in Indonesia with just one goal: visiting each and every relative in six weeks. Hopping from one island to the other to do so. Most of my relatives live in one single street, in a harbour city on the island called Sulawesi. Rows of houses on a crowded street. It is hot and noisy. The smell of food mixes with that of gasoline, but nothing seemed different or out of the ordinary with what I was used to at home. It was when I visited aunts and uncles on the other islands however, when living conditions caught me by surprise. Not because they were poor, no quite the opposite. It was because they lived in large luxurious houses in neighbourhoods situated behind guarded fences and concrete walls. Each time we would drive up to the gate, show identification to the guard, who I as a child always mistook for a police officer, and drive right up to the house. There we would greet the aunts and uncles who's name I would always forget before I could finally play outside with my ball. I would walk onto these empty streets where no one walks, where cars are either driven or parked and walk right op to the fence. On the other side I would see busy roads, crowded food stalls and people walking and talking with each other. On this side of the fence, there was me holding my ball. This was my first experiences with the residential typology of the gated community. Also known in Indonesia as, the housing clusters.

Fast forward 20 years and I am a soon to be graduate student at the faculty of Architecture in Delft. At the same time my parents ask me to create a first draft for their future house in Indonesia, in the home town of my mother. I agree under one condition, that we collectively have the ambition to lower the use of embodied and operational energy, by using mostly local materials and applying passive climate strategies. Even when this might raise the costs. As you can tell, I am too, as any other TU Delft student, firmly indoctrinated in the search for a more sustainable future. My parents agree and that's when it hits me. I should try to make this my graduation project and not just do a redesign for one home, but do it one a much larger scale. Indonesia is currently facing a housing deficit of 15 million units. In order to try and resolve this problem, 800.000 units of formal housing are being build every year and the most popular typology in this fast growing housing market is, you have guessed it, the Indonesian housing cluster.

The goal within this project is to do a redesign of this typology and create not just a sustainable home, but a sustainable neighbourhood. Explore Lab provided me with the opportunity to create my own framework for this ambition. Which was as challenging as it was fun.

- Steffan Wi-Tak Hegeman

*(Voor het uiteindelijke P5 verslag waarin het ontwerp wordt opgenomen ook in het voorwoord, de docenten natuurlijk volledig bedanken voor alles)*

# CONTENT

# INTRODUCTION

Indonesia already has a backlog of around 13.5 million residential units. With the fast growing economy causing the middle social class to grow with it, it now demands around 400.000 new homes each and every year. Even with the many government programmes and incentives to increase the development of low and middle income housing, the Indonesian housing sector is still not able to keep up with this growing demand (“Indonesia’s Mass Housing Sector,” 2017). The fear is that the Indonesian millennial is not able to afford to buy property in and around large cities. This is a large scale issue for Indonesia who is trying to harness the economic capacity of the young and productive population. To secure the sustainability of the growth of the young middle-class and their long term economic viability, property ownership by them is required.
Large international corporations such as Lippo Group and Summarecon jump at the chance to do what the government is not able to. Provide housing for this up and coming middle-class and create huge revenues by doing so. Two residential typologies are being built by these large corporations. High rise in existing city centres and the in popularity growing gated community, also known as the housing cluster. These housing clusters can be up to 500 units large They are being built near large cities such as Jakarta. Allowing their residents to live at driving distance from their work in the city. The housing clusters grouped together can actually be seen as newly built cities of their own that suddenly sprouted out of the ground. The rise in popularity of this residential typology made me question, if the housing sector is building that many clusters, how harmful are they to the environment? Also, how great of a living environment are these clusters? Finally, perhaps the most important question of the project, how can we redesign the Indonesian housing cluster with the goal to minimize its impact on the environment, providing sustainable and healthy neighbourhood for the up and coming middle-class of Indonesia to live in?

This has led to my research question:
*What design principles are used when designing sustainable neighbourhoods and which ones would contribute towards a redesign of the Indonesian housing cluster, to minimize its environmental impact?*

The method used in order to provide an answer to this given research question can be divided into three parts:

First, a trip is made to Indonesia, more precisely Bandung. With excursions made to multiple housing clusters of different social classes, a visit to a traditional Indonesian village and an exchange of knowledge with students of the university of Bandung ITB. This trip and all of the observations provided the necessary information and insights.

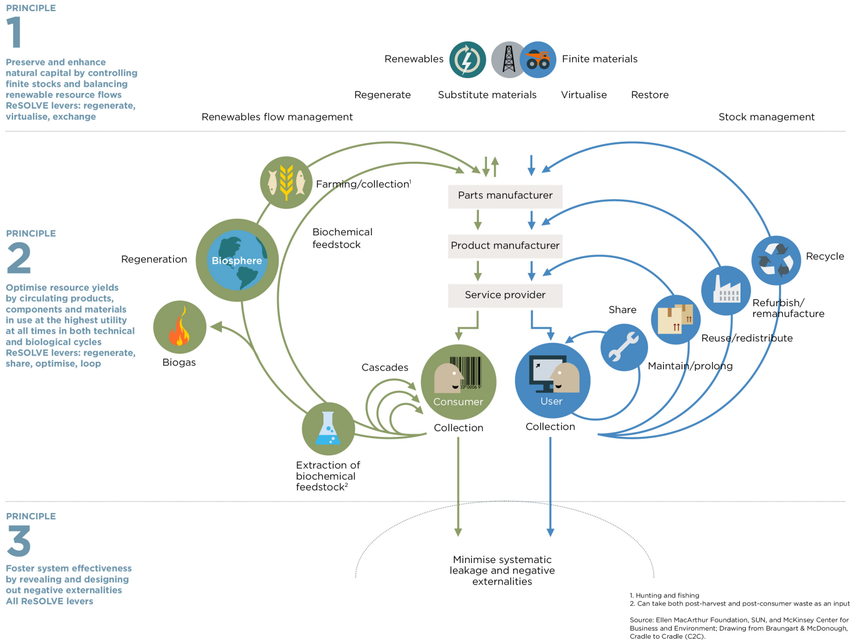
In order to design a sustainable neighbourhood, it is chosen to do an assessment of two other existing sustainable neighbourhoods and also the currently built housing clusters. Three case studies in total. To make an assessment of the level of sustainability of these case studies, an assessment tool for sustainability has to be made first. The second part of the research method is a literature study done on the circular economic model and its application in the built environment. This provides a framework of 15 key aspect when designing a sustainable, in this case circular-neighbourhood. This framework is used for the assessment of the three case studies.

The third part of the research is assessing the case studies using the circular economic framework. Each case study is assessed on each of the 15 key-principles and given eather a
green - many circular principles applied
yellow- some circular principles are applied
red - no circular principles applied

The three case studies chosen are;
1.Cosmo Estate, a housing cluster currently being built. This analysis leads to findings on the qualities of the typology and more importantly, where to improve upon. Showing that the housing clusters currently built, have a large impact on the environment.
2. Kampung Naga, a traditional Javanese village. The village is known to have a very low carbon footprint per person and even though they knowingly live in a modern society, they choose to live according to traditional customs and beliefs. Leading them to become part of the ecosystem of their environment. Therefore having very low impact on their surrounding. Using the framework to assess this case studies from the past, provides the necessary low tech design principles that have been used for ages.
3. The third case study is an eco-village called EVA-Lanxmeer in Culemborg, the Netherlands. It is a neighbourhood founded on the school of thoughts of permaculture. Which is very in line with the philosophy of circular economy. EVA-Lanxmeer is also known for having a low environmental impact. Showcasing not only more modern design principles but also the social and organizational aspects of developing a modern sustainable neighbourhood.

These three case studies are compared with each other in the following chapter. Comparing the three cases shows not only on which key-principles the neighbourhoods are or are not sustainable, but more importantly why. The comparative study should paint a full picture on which key principle would not only contribute on its own towards a sustainable neighbourhood, but in combination with other design principles.

The closing chapter concludes the study and summarizes the insights that the chapter before and all of the assessments provided.






# CIRCULAR ECONOMY

## CE IN THE BUILT ENVIRONMENT.

The concept of circular economy is in no way new. Several school of thoughts lay at the foundation: cradle to cradle, industrial symbioses and biomimicry. It takes a lot of inspiration from biological cycles. Ecosystems in the nature around us. Look at the ecosystem of a forest. A leaf drops from the tree, deteriorates and becomes food for the plants below. Nothing is wasted and waste is food.

This principles, where nothing is wasted and waste is food specifies our use of our precious resources. They cannot simply be wasted after it has been consumed. The have to be preserved if future generations want to be able to enjoy them as well. A recent interpretation of the circular model is done by the Ellen MacArthur foundation. They have created the diagram on the previous page that summarizes the principles of CE in the build environment. The diagrams separate two material streams. The biological materials and technical materials.

Biological materials are renewable materials such as wood that is used in building products without contamination. That allows them to be returned into the biosphere. Ideally you would cascade structural wood into a non-structural building product which then can be formed into fibreboard and so on. Technical materials, such as plastic and metal are products that should be maintained in the 'technosphere' for as long as possible.

Products should be made to adapt, making it possible to be reused. They should be durable and able to be upgraded or reengineered. The last cycle within the technical material stream is recycling of the raw material. Technical materials should not be returned. That would be waste. The Danish publication 'Building a Circular Future' showcases multiple circular projects and highlights key principles that ought to be considered when designing a circular building. They can be sorted into two categories: Building level where it mainly discusses the way materials ought to be used and Circular Economy Organizational level how to structure such a project from a development perspective.

1. Housing level – design and material bank
1.1. Materials
1.2. Disassembly
1.3. Material passport/bank
1.4. Maintenance and Interim strategy
1.5. Standardization

2. Circular Economy
2.1. Organizational structure

2.2. Circular models
2.3. Circulation
2.4. Businesses and Partnerships

Books and publications such as ‘Building Revolutions’ by David Cheshire and the Danish publication ‘Building a Circular Future’ when talking about applying circular economy to the built environment, often solely focus on the circular economy of the building. Singular. They discuss circular principles and strategies for buildings as if they are mostly autonomous objects, disclosed from their surroundings. This is of course, not entirely true. Circular economy in its simplest form means waste from one process becomes food for another organism. So the building, by definition, becomes part of the life-cycle of its surrounding. What I mean however, is that most case studies of circular economy, are about one building. Such as an office building, or maybe a school, or one villa or again another office building. This is not to accuse them of not being thorough enough when choosing their case studies. It shows that the use of this relatively new economic model of circularity, has mainly found its start within our built environment when developing a singular building. This has many reason, three of them are;

1. The existing building stock up until now has been developed according to the ‘linear model’. The entire building industry has evolved into using and optimizing this model. To develop entire circular neighbourhoods would require a lot of participants within the industry to simultaneously make a shift towards a circular future. This will not happen overnight. Change towards a circular economy will most likely be a slow one. One where each and every participant, from brick supplier to house owner, will need to be convinced.

2. Many case studies focus on the reuse of an existing building since that is one of the bedrock principles of circular design. This of course, does limit the scope of circular strategies towards a singular building.

3. Third reason is the shear complexity of designing a circular neighbourhood or village when designing circular at all is still so new. In the future, more municipalities, corporations, project developers, designers and consumers will be accustomed to it and more case studies of larger scale projects will be around.

Our research question however, does not only focusses on the building, but on the principles needed to design a sustainable and environmentally friendly neighbourhood. In the graduation thesis by Judith Bosch called ‘Towards circular villages?’ multiple sustainable neighbourhoods are taken as case study and assessed using the six principles energy use, water and sewage, waste, food, transportation and the social aspect of organizing such a village/neighbourhood. To have a fully holistic approach towards assessing the case studies of three neighbourhoods in this report, I have included the key aspects of Judith Bosch. Creating the complete framework that is shown on the next (green) page.
Each case study will be dissected into these 15 key-principles. Within each principle an assessment will be made whether the project used many, some or no circular principles. This will be shown with the corresponding colours green, yellow or red. This is a bit of a subjective approach. What counts as a strong circular strategy or approach and what does not? I will try to include the reasoning through my findings and argue why a case scores as high or low as it does and most importantly. How they do it and which design principles and strategies are applied.



## CLUSTER LEVEL

### ENERGY
Does the neighbourhood provide renewable energy for all of their own housing units?

### WATER & SEWAGE
Are circular options for water and sewage systems such as rainwater harvesting and plain reuse or filtering of grey water for non potable purposes in place?

### WASTE
Waste should be diminished as much as possible, and waste that can not be prevented should be reused.

### FOOD
Are foods produced locally by inhabitants? Is food production part of the social activities of the community? Or is the neighbourhood part of regional food chain?

### TRANSPORTATION
Are cars shared between neighbours to minimize the use of cars? Or are cars electric? Is the neighbourhood car free? How is parking resolved?

## HOUSING LEVEL

### MATERIALS
Are building materials chosen with properties that ensure they can either be reused or returned to the biosphere?

### DESIGN FOR DISASSEMBLY
Is the building designed in layers with different lifespans, with connections that can tolerate repeated assembly and disassembly? And is there besides a plan for construction also a plan for deconstruction?

### MATERIAL PASSPORT & BANK
Materials should be documented throughout all the phases to ensure quality and value of the materials and resources. Did the building products receive a ‘passport’?

### MAINTENANCE
Is the value of the materials secured by providing correct maintenance?

### STANDARDIZATION
Are the buildings standardized to make is easier to fit into a larger context system? Is it scalable? Are building plans, systems and construction methods standardized and or expandable for flexibility?

## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURE
Has the development of the project been a bottom-up initiative or top-down? And was the project organized to have a clear vision towards sustainable living?

### CIRCULAR MODELS
Rather than creating products, businesses need to provide the user with a service.

### CIRCULATION
The value of the products in the technical and biological cycle as needs to be maintained as long as possible.

### BUSINESSES & PARTNERSHIPS
To complete circle in the circular economy, new businesses and partnerships agreements need to emerge.

### SOCIAL STRUCTURE
What is the social structure within the neighbourhood? How are initiatives and events organized? And how is the social cohesion within the neighbourhood, are strong social bonds formed?


FIG. 1 THE ENTRANCE SIGN OF COSMO ESTATE, CLEARLY IDENTIFYING ITSELF AS PRIVATE PROPERTY (2017)

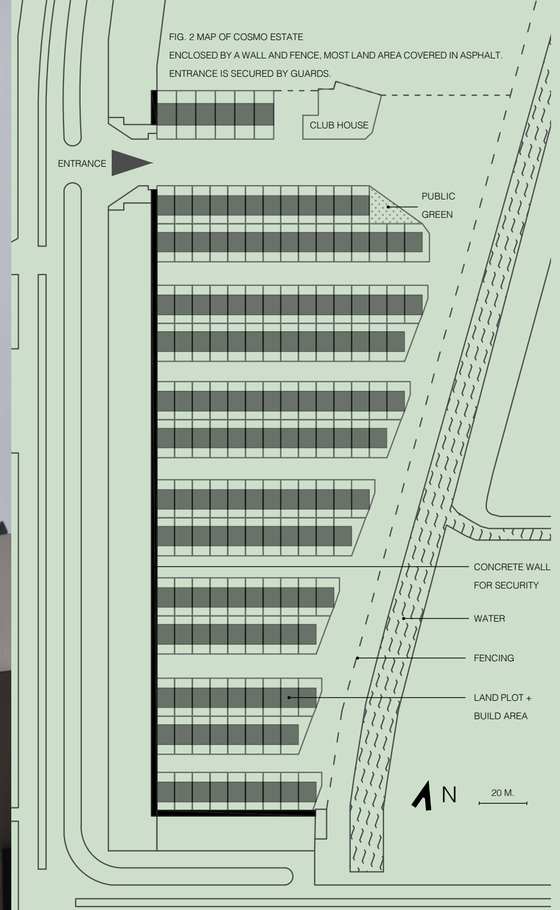



FIG. 2 MAP OF COSMO ESTATE
ENCLOSED BY A WALL AND FENCE, MOST LAND AREA COVERED IN ASPHALT.
ENTRANCE IS SECURED BY GUARDS.

# CASE STUDY 1

## COSMO ESTATE , CIKARANG
## THE MODERN DAY CLUSTER

### INTRODUCTION

Cosmo estate is a gated community, also known as a housing cluster, located in Cikarang City. A newly built non-autonomous city in the Bekasi regency, West Java, Indonesia. Kota Jababeka, the biggest industrial estate in Southeast Asia is situated here. Cikarang City and other new non-autonomous cities in the area are growing rapidly, to accommodate all the workers and employees in the Bekasi regency. These rapidly built housing clusters and their goals are comparable to that of the Dutch VINEX-wijk typology. They are built to limit the car-travel-distance between home and work, situated around or near larger cities and accommodate the newly growing middle class affordable house, by trying to offer the existing richer middle class who lives in those houses newer houses in these clusters.

Cosmo Estate is a perfect example of the archetypical middle to upper class housing cluster. A large concrete wall, a steel fence and a guarded entrance where identification is needed secures the perimeter of the cluster. It exists of 3 hectares of land and 156 houses that are all built in the same immensely popular architectural style: rumah minimalis, design for this cluster is done by PT PP Urban.

## CLUSTER LEVEL

### ENERGY

Cosmo Estate is connected to an electric grid. Power is supplied by the use of fossil fuels, a coal driven energy plant. Transformers, attached on poles in the neighbourhood, guide power through cables to the homes. Electricity is used for lighting and household appliances. The largest energy consumption annually is cooling. All houses use air conditioning. Actively cooling accounts for almost 30% of the energy use. Cooking is done on gas which is supplied in gas tanks. Which are bought or delivered. Empty tanks are returned and reused. Cooking with the use of gas, is also a large consumer with 27% respectively (T. K. Usep Surahman, Osamu Higashi, 2015).

The houses have no source of renewable energy and the design does not facilitate cross ventilation or other passive cooling strategies.
- no circular principles applied.

### WATER & SEWAGE

Tap water in Indonesia can come in two ways. The first is ground water from a deep well. The depth of those wells is on average 20m and water comes in through a jet pump. This is regarded as poor quality of water since ground water is polluted. The second method is city water (also known as PAM) and provides for a more sanitary, better quality of water. Major cities and modern clusters such as Cosmo Estate are connected to the PAM water treatment facilities. Water comes through pipes and is collected in barrels situated in the yards of people's homes. Note that this water is often still polluted, because of the poor quality and maintenance of water lines. Bacteria from ground water seeps in. Tap water is therefore used for showering, doing the dishes, flushing the toilet, but it is not drinking water. (UNDP, 2012)

Bottled water, also known as 'aqua mineral', is bought and is the only source for clean drinking water.
Cosmo Estate like almost any part of Indonesia, uses sceptic tanks to collect grey and black water. Often located in the ground underneath the front lawn (see highlighted photo on the next page). These are cleaned every so often by workers and cleaned at water treatment plants. There are three problems with this system.
1. There is little to no oversight on to who is responsible for actually cleaning the collected water. To save money, it is often dumped in rivers.
2. Tanks can be made of low quality materials and start to leak over the years, polluting the ground water. A saying in some Indonesian communities is: "a leaking tank is a great one". Since it requires no cleaning (Yuki, 2016).
3. Grey and black water are not separated, making it impossible to filter and reuse grey water locally.

It is clear that - no circular principles are applied.

However, it must be said that for Indonesian standards, Cosmo Estate is doing well. Only 4% of all sewage waste in Indonesia is being treated at all. The other 96% spills into the ground water and rivers (Soedjono, 2018).



### WASTE

The exact management of waste in Cosmo Estate is unclear. However, 35% of household waste in Indonesia is burned, 15,4% is thrown in nature, 8% is buried, only 1,6% is recycled and 40% is thrown in a landfill (Meidiana, 2010). It is very likely that a modern cluster such as Cosmo Estate, collects its waste through a service, is not sorted and ends up in a landfill.
– no circular principles applied.

### FOOD

Food is not locally grown nor is there any space in or around the cluster to do so. There are no rice fields nearby or farming with livestock. Habitants of Cosmo Estate can buy their food at the supermarkets around the corner of the cluster. - no circular principles applied.

PHOTOS ON THE RIGHT
FIG. 3 WATER BARREL CONNECTED TO THE PAM SYSTEM
FIG. 4 ENTRANCE TO THE SCEPTIC TANKS UNDERNEATH THE LAWN

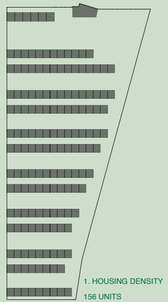


## TRANSPORTATION / INFRASTRUCTURE

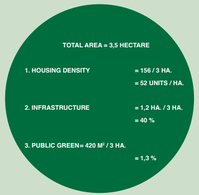
Like many modern clusters, Cosmo Estate is designed to maximize its profits by having a high housing density, 52 houses per hectare. This also means that there are 52 parking spots per hectare. The spatial design of the cluster is mainly focussed on the usage of the car. A stunning 40% of the surface area of Cosmo Estate is designated to the car, excluding parking spots. Even more surprising is the complete lack of walkways. The people of Cosmo Estate enter in their car through the guarded gates and drive straight to their homes. Walking or biking is not advocated by the urban plan itself. There is some green near the sides of houses and streets and streets, there is a club house with a playground and there is one public playground. Public green and playground account for 1,3% of the cluster.

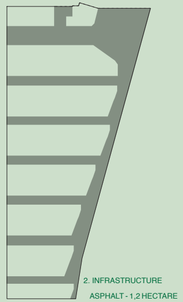
To conclude, the infrastructure of Cosmo Estate advocates the use of car and mobility through any other means is not included in its design.
- no circular principles applied.

PHOTOS ON THE NEXT PAGE (STARTING TOP LEFT, CLOCKWISE)
FIG. 5 THE ONE PUBLIC PLAYGROUND ON ALL OF THE 3 HECTARES OF LAND
FIG. 6 ENTRANCE TO THE SCEPTIC TANKS UNDERNEATH THE LAWN
FIG. 7 FAÇADES OF THE TYPE 90 HOUSES
FIG. 8 GUARDED ENTRANCE TO THE CLUSTER

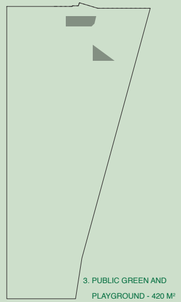


1. HOUSING DENSITY
156 UNITS



2. INFRASTRUCTURE
ASPHALT - 1,2 HECTARE



3. PUBLIC GREEN AND
PLAYGROUND - 420 M²



## HOUSING LEVEL

### MATERIALS

Materials used in the cluster house of Cosmo Estate are shown in table-1. Including the amount and their potential rate to be reused or recycled. These number are not exact. A study in Jakarta and Bandung was done on nearly 600 landed houses, of which a third was comparable to the homes in Cosmo Estate (T. K. Usep Surahman, Osamu Higashi, 2015). The data given by the study provides a material inventory with amount of materials used per square meter of house. This was then used to create a clear and trustworthy overview of the house in Cosmo Estate in table 1.

| MATERIAL INVENTORY | | AMOUNT (KG) | POTENTIAL RATE (%) | |
|---|---|---|---|---|
| | | | REUSING | RECYCLE |
| 1. | STONE | 61.380 | 0 | 0 |
| 2. | SAND | 60.660 | 0 | 0 |
| 3. | CLAY BRICK | 27.828 | 96 | 96 |
| 4. | CEMENT | 15.813 | 90 | 90 |
| 5. | WOOD | 11.790 | 96 | 96 |
| 6. | CERAMIC TILES | 3.051 | 100 | 100 |
| 7. | STEEL | 3.294 | 0 | 0 |
| 8. | CLAY ROOF | 3.681 | 100 | 100 |
| 9. | CONCRETE ROOF | 0 | 38 | 38 |
| 10. | PAINT | 486 | 100 | 100 |
| 11. | GYPSUM | 630 | 0 | 0 |
| 12. | ASBESTOS ROOF | 189 | 100 | 100 |
| 13. | CLEAR GLASS | 72 | 96 | 96 |
| 14. | CONCRETE BRICK | 0 | 100 | 100 |
| 15. | ZINC ROOF | 9 | 90 | 90 |

TABLE 1 : SHOWCASING THE AMOUNT OF BUILDING MATERIALS EXISTING IN A LANDED HOUSE OF 90 $M^2$ AND THEIR POTENTIAL TO BE REUSED OR RECYCLED.

Noticeable is the predominant use of industrial building materials. Stone and sand can be seen as natural materials, but are used to create concrete. Biological renewable materials such as wood is only 5% of the entire building stock. It needs to be noted that this is also because wood had less density then concrete. Skewing the number. However, it is clear cluster houses are mainly built using industrial materials that cannot be returned to the biosphere. Therefore, needing to be kept in the economic cycle for as long as possible. By ‘maintaining’, ‘repairing’ and in the end ‘reusing’ or ‘recycling’ them.

Table 1 shows their potential to be reused and recycled but unfortunately, the current rate of reusing and recycling is very little to none. The countries lack of promotion for recycling and reusing of building materials, creates a constant flow of industrial waste into Indonesian landfills (T. K. Usep Surahman, Osamu Higashi, 2015).
Surahman’s study does describes a scenario in which the reuse and recycle rates of the materials are maximized. Claiming that 40% of the embodied energy of a landed house can be saved. 15% is reused, 15% recycled and both kept within the building cycle, 65% is used for reclamation for infrastructure and 5% becomes waste to landfill. Even though this results in a far better outcome then 100% landfill, turning 65% of building materials into roads is far from applying circular strategies. What needs to be remembered is that this study was done on minimizing the impact of the existing residential building stock and therefore, promoting reusing and recycling the materials becomes the number one priority. It confirms that if we want to create a circular future within our housing, different building materials need to be chosen. – no circular principles applied.



(STARTING TOP LEFT, CLOCKWISE)

FIG. 9 TWO KINDS OF BRICK DISPLAYED ON THE CONSTRUCTION SITE
FIG. 10 CONSTRUCTION WORKER MIXING CONCRETE BY HAND, ON THE FLOOR
FIG. 11 SHOWCASING CONCRETE CAST BEAM WITH BRICKS ON TOP. THIS WILL ALL BE FINISHED WITH A LAYER OF GYPSUM PLASTER

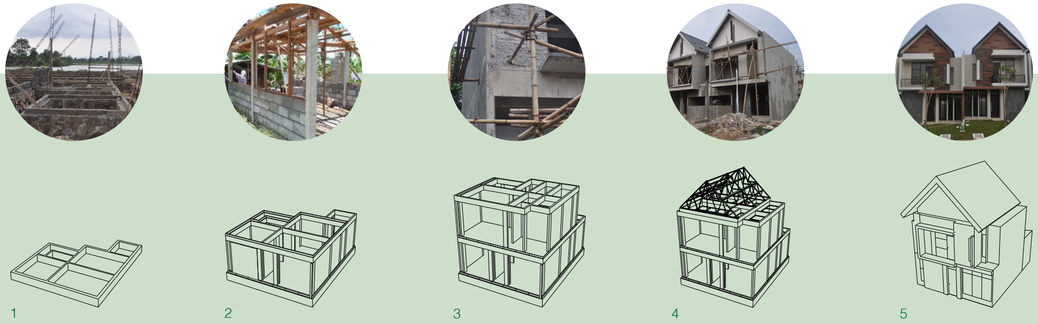
Last paragraph showed that mostly industrial building materials are used in the houses of Cosmo Estate. These are not biodegradable and are hard to reuse or recycle. The materials do have the potential to be reused or recycled but this is barely ever done, because the building industry of residential housing in Indonesia is not promoting to do so (T. K. Usep Surahman, Osamu Higashi, 2015) and therefore, houses are not designed to do so either.

The illustration on the bottom of the page is a simplified description of the step-by-step construction plan. Not only showing the way houses are build, but also illustrating why it is so hard to regain building materials from the cluster houses after or during demolition.

Step 1; A first team of workers does the construction. Their salary is the lowest. A foundation is placed using river or mountain stones or concrete. Sometimes a combination of both is used.

Step 2; A concrete floor is cast over the foundation. On top of the the floor, the frame for the ground floor is built. A reinforced concrete skeleton frame is cast of columns and beams. Then bricks are between the columns to fill the frame and create walls.

Step 3; A concrete floor is cast over the first frame and the second concrete skeleton frame is cast on top. It often occurs that the ground floor skeleton and the first floor skeleton use a different grid.






Step 4; The aluminium or steel or timber structure of the roof is put in placed. Pipes for the water system are also placed, often after the structure is done. Sometimes breaking the floor open again to place pipes. A second team is responsible for the electricity services. These workers are the most expensive for a contractor and are often trained in the West of Java (Joppie, 2017). The first team covers all the piping in the wall, the electricity and all of the brick and concrete structure is plastered with a gypsum finish. Creating a smooth service that could be mistaken with fine concrete finish. The and second team of workers are now done.
Step 5; A third team of workers is responsible for the finishing of the exterior and interior. Cladding, laying tiles, placing window and door frames and finishing with paint.

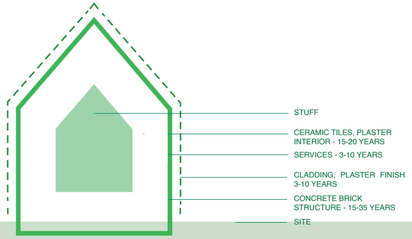



FIG. 21 BUILDING LAYERS OF CLUSTER HOUSE WITH TECHNICAL LIFESPAN

Figure 12, above showcases the layers according to Steward Brand's model. Noticeable is that the interior, service and structure layer are placed in one layer. Even though they have very different technical lifespans. Making it hard to maintain or extract one layer without damaging the other.



Noticeable is not only the use of materials but the connection that are made between building products and more importantly, building layers. Everything is connected through cement. Even the services, who often have a different lifespan then the structure, are placed within the structure. Gypsum is used to cover everything. Creating a 'out of sight, out of mind' mantra within the housing cluster industry. When maintenance or repairmen needs to be done, parts of the house need to be demolished and remade. Trying to disassemble the house and recover materials for reuse purposes when covered in cement, concrete and plaster is nearly impossible.

Therefore, design for disassembly is seen as - no circular principles applied.


PHOTOS ON THE PREVIOUS PAGE (STARTING TOP LEFT GOING CLOCKWISE)
FIG. 13 COSMO ESTATE HOUSING UNDER CONSTRUCTION
FIG. 14 COSMO ESTATE HOUSING FINISHED
FIG. 15 ROOFING DETAIL, FINISHED
FIG. 16 ROOFING DETAIL, UNDER CONSTRUCTION

PHOTOS ON THIS PAGE (STARTING TOP LEFT GOING CLOCKWISE)
FIG. 17 SHOWCASING MOSTLY ASPHALT AND LITTLE BITS OF PUBLIC GREEN ON THE SIDE OF THE ROAD
FIG. 18 TYPE 90 HOUSING, FINISHED

## MATERIAL PASSPORT & BANK

Developers and home owners have a severe lack of knowledge of materials used within the houses. It is caused by the organizational structure of the project developers. You can read more on this in the ‘Organizational structure’ of Cosmo Estate.

This has led to the use of many different contractors for the same project. Each trying to outbid other contractors by claiming they can build a house for less money. This leads to contractors cutting cost by using inferior materials without letting it be known. Thinner reinforcement within the concrete, less quality bricks and so on. The less costs the contractors have, the more profit they make. So they corrupt the system by cheating on materials. This is common practice in Indonesia (Dewi, 2011). So besides the contractors themselves, no one knows what materials are used within the houses. All that is important for developers is the finishing image, which is covered in plaster. Once the house is sold, it becomes the responsibility of the home owner.

I asked Joppie, a contractor with whom I visited multiple cluster, why there are two types of bricks in front of the house. But I can only see the grey ones being used? He told me, many contractors leave a pallet of quality brick in front of the house. To show when the developers or future home owners visit. Making them belief that it is a quality home that is being built. This is – no circular principles applied.

## MAINTENANCE

Maintenance is often required soon after the house is sold. The plaster finish of the home can crack as soon as 6 months after it is built. It is hard to maintain the services when needed because the building layers are connected through plaster, cement and concrete. House of Cosmo Estate’s type have a lifespan of around 15-25 years before it is demolished by a new owner or the developer. - no circular principles applied.

FIG. 19 THE GREY BRICK ARE CHEAPER AND MORE OFTEN USED, WHILE THE RED BRICKS ARE DISPLAYED ON SITE FOR THE DEVELOPERS AND FUTURE RESIDENTS TO SEE.



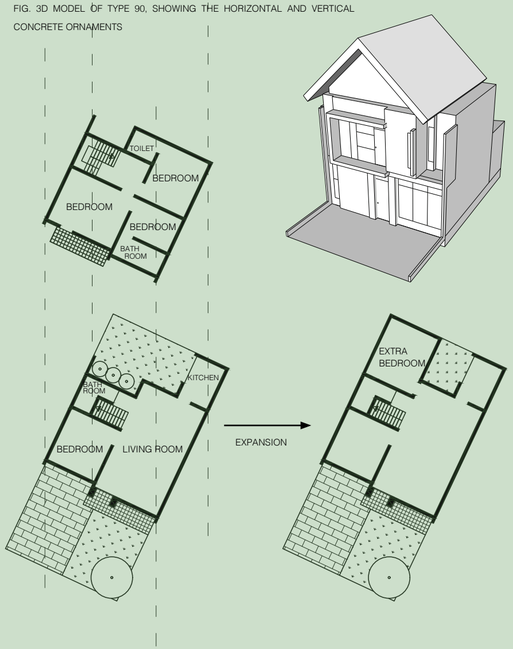
## STANDARDIZATION

Formal houses in Indonesia are standardized under a popular modern architectural style called: Rumah Minimalis. Cosmo Estate is a perfect example of this style. The façade of the house is often covered in horizontal and vertical concrete ornaments. Creating a Bauhaus-like effect. The Rumah Minimalis have in front a lawn with parking spot and a yard in the back. The front lawn is often not used. The yard in the back is for cooking, drying clothes and has room to expand the house in the future. Creating an extra bedroom for instance. This is common practice according to the contractor I spoke.
Houses are simply categorized in types such as type 36, type 45, type 60, type 70, type 90 and so on. The number equates to the liveable surface are of the house. Starting from type 60 the houses are two stories high, but almost never higher. Type 36 is the most common. It is one of the more affordable homes, that are often bought by young couples who are starting their families. Cosmo Estate mainly sells type 90 houses and a few type 120. Many of these types are standardized and there a many books/ catalogues filled with designs for the types of Rumah Minimalis.

By mainly building one type of house, Cosmo Estate is standardizing on a larger scale. Unfortunately, it is not used to standardized prefabricated building components and construction methods. This would speed up the building process and make it easier to identify all the building materials in the houses. Because of the large scale standardization but not taking advantage of it, it is seen as – some circular principles applied.



FIG. PLANS OF COSMO ESTATE INCLUDING POSSIBLE EXPANSION
FIG. 3D MODEL OF TYPE 90, SHOWING THE HORIZONTAL AND VERTICAL CONCRETE ORNAMENTS



## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURES

The organizational structure of housing clusters is top-down and a perfect example of the linear economical model. The complete opposite of circular economy.

1; Lippo group is a conglomerate company that is defined by prof. Ismet Harun of ITB Bandung as a 'Network Extender' (Harun, 2017). Network Extenders are large international corporations, often having many different businesses. They obtain large amounts of land in Indonesia on which they develop housing clusters for large profits. Cosmo Estate is one of those clusters. 3 hectares of land is bought.

2; A marketing, financial and strategy team is used to determine how many housing units are needed, which types of housing and what the exploitation will be.

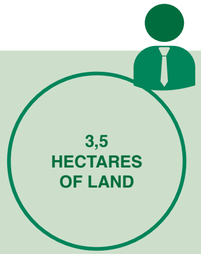
3; Housing design is either done by an architectural team or picked from one of the rumah minimalis books that are filled with designs for all types of housing. The architect is not always involved in the design process. For Cosmo Estate and other clusters in Cikarang, PT PP Urban is involved in the design phase.

4; With the design for the cluster and the house chosen, the developer lets multiple contractors bid to see who can develop the houses for the lowest price. With large project like Cosmo Estate, there is not often a single contractor who can build all the house, because the contractor has to pay for the cost before hand. So the land is divided by the amount of contractors needed. All of them building the same house, with a slightly different method and materials. All the contractor needs to do is make sure the house suffices to the image of the house made by the strategy team. Then the contractor is paid his money and the house is essentially sold to the developer.

5; The marketing team will in the meantime promote the cluster with brochures in shopping malls and online. Selling the owner an image of quality.

6; The owner buys the house and the land from the developer, without actually knowing which contractors actually built it and what the quality of the house is.
When the house is sold, the developer is free from responsibility over the house and the built quality. Lippo group still provides services such as waste pick up and security, for which owners pay a fee.

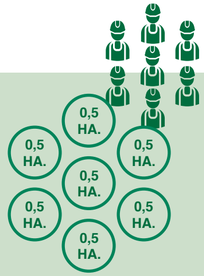
A very linear process, from development to house owner. - no circular principles applied.




1. ACQUIRING LAND / LAND OWNERSHIP

2. MARKETING: STRATEGY DEVELOPMENT


3. HOUSING DESIGN




4. MULTIPLE CONTRACTORS


5. FABRICATING IMAGE OF QUALITY

6. MARKETING: SELLING THE 'IMAGE OF QUALITY'

START — FINISH

## CIRCULAR MODELS
+
## BUSINESSES & PARTNERSHIPS
+
## CIRCULATION

No circular models are created. Rather conventional businesses are used to develop Cosmo Estate.
Materials and the quality of life would ideally be maintained for as long as possible. In order to do so, the organization should stay responsible in some way during its lifespan. This is not the case. The entire development of Cosmo Estate is based on the linear economical model. - no circular principles applied.

## SOCIAL STRUCTURES

There is a lack of social cohesion within the cluster. People might know their neighbours but social activities are not taken place. This has a few reasons:

1; People buy a house individually. There is no collective process in developing the cluster or collective vision for the cluster since its built by the developer. You will know who your neighbours are the moment you move in.
2; There is barely any space for social events. Cosmo Estate shares a community house/club house, but initiatives in such club houses are rare. There is only one playground for children to meet and play and there is a clear absence of any public park.
3; The infrastructure of the cluster is completely designed for the car. You drive through the gate, straight towards your parking spot, after which you directly enter your house. There is no walking about through the cluster, since there are no sidewalks. And there are no sidewalks, because there is barely any public space to walk to.

The cluster does not facilitate any form of social cohesion between the inhabitants, but this is not the only problem housing clusters create.
Jakarta is forming a lack of social interaction between different neighbourhoods as well. Clusters are build next to each other with on the borders concrete walls, fences and guarded gates. With no infrastructure to walk from one cluster to another. The housing clusters literally separate people from each other. Creating urban scars within their city (Yandri, 2015). Examplery of – no circular principles applied.



FIG. 20 THE SALES PITCH IMAGE FROM THE BROCHURE, FABRICATED BY THE MARKETING TEAM OF THE DEVELOPER. THIS IS USED IN SHOPPING MALLS TO SELL HOUSES IN COSMO ESTATE

## CLUSTER LEVEL

### ENERGY
Electricity is used for household appliances. Cooling is done actively and accounts for nearly 30% of the energy use. Gas is used for cooking, this accounts for nearly 27% of the energy use. No passive cooling strategies are applied.

### WATER & SEWAGE
Drinking water is bought bottled. Grey and black water are collected in the same tank and it is unclear if this water is treated when collected. No rainwater is collected.

### WASTE
Waste is collected, not sorted and goes straight to the landfills in Indonesia.

### FOOD
Food is bought by the local supermarket, but food is not locally produced or grown.

### TRANSPORTATION
There are no walk ways and 40% of the cluster exists out of asphalt roads that accommodate the car. Parking is done right in front of the car. There are not even walk ways that lead to the cluster. These are all roads.

## HOUSING LEVEL

### MATERIALS
Building materials that are used are mainly industrial materials that should be kept in the building cycle for as long as possible. This is however, almost never done.

### DESIGN FOR DISASSEMBLY
The building layers construction, services and interior are interconnected. Even though they have different lifespans. Everything is connected with mortar and there is no plan for disassembly. After the lifespan of the house, the entire house is demolished without extraction of building materials.

### MATERIAL PASSPORT & BANK
It is unknown for the developer and house owner which materials and at what quality are used within the house. Making it impossible to use the house as a material bank.

### MAINTENANCE
There is no strategy in place for maintenance.

### STANDARDIZATION
The houses themselves, their typologies and the building method is standardized. However, there are barely any signs of prefabrication or efficient mass production with building components. So there is potential, it is just not taken advantage of.

## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURE
The process of development of Cosmo Estate is very linear. The company develops land with homes, sells it as a product and bares no responsibility afterwards.

### CIRCULAR MODELS
Cosmo Estate is sold as a product, not as a service.

### CIRCULATION
There is no incentive from the developer to maintain the quality of the houses of Cosmo Estate for as long as possible. This responsibility is for the owner.

### BUSINESSES & PARTNERSHIPS
New businesses and partnerships are not created because the development of Cosmo Estate has been based on the incentives of the linear economical model.

### SOCIAL STRUCTURE
There is a lack of social cohesion in the modern housing clusters. There are very few ways and places to interacts with your neighbours. To make matters even worse, modern clusters create a serious segregation problem between neighbourhoods, within their cities themselves.

# CASE STUDY 1 CONCLUDES

## CONCLUSION TO COSMO ESTATE, CIKARANG, JAVA

It becomes clear that Cosmo Estate has not been build according to principles and strategies that are in line with circular economy. This was to be expected. The main objective for developer of housing clusters such as Lippo Cikarang is to offer housing to the growing regency and make money. As much as possible. There are no strategies in place to minimize their impact on the environment or create a more green and natural place to live. It is designed to efficiently build houses and accommodate to the general needs of the Indonesian middle class.
And this has to be emphasized. The cluster typology is popular and ever growing. Large corporations such as Lippo do spend lots of money to do research on the general needs of the Indonesian middle class so they know what and how to sell it. This means the clusters do offer qualities that people search for. Such as a sense of security, an idea of a neighbourhood, the idea of a quality house in which they can invest their money and an architectural style that is popular among middle class Indonesia.

However, if we want to keep building these clusters without destroying the environment. We need to radically redesign these clusters. Offering no only the ideas but actually all the qualities the Indonesian middle class is looking for while minimizing the impact on the environment.

FIG. 1 VIEW OF KAMPUNG NAGA FROM THE HILL WHEN YOU WALK THE 300 STEPS DOWN INTO THE VALLEY (2017)

FIG. 2 MAP OF KAMPUNG NAGA, 1,5 HECTARES OF THE 11 HECTARES OF LAND THE OWNED IS ZONED FOR HOUSING.

N

20 M.

# CASE STUDY 2

## CASE STUDY 2: KAMPUNG NAGA
### THE VERNACULAR ARCHITECTURE IN TASIKMALAYA

### INTRODUCTION

Kampung Naga and its villagers are a culturally unique case study. It is an Indonesian, Sundanese traditional community of 110 households occupying an area of 100 hectares. Their houses are build from local materials, in vernacular architectural style like they have for hundreds of years. The village sits on a hill, resting between a forest south on top of the hill and the river down in the valley. They are mostly surrounded by forest which is regarded as sacred, believed to keep the spirits of their ancestors. They are a village that strongly follows traditional Sundanese beliefs, a philosophy that proclaims that every person in Kampung Naga should not own more than that the ancestors gave them in the beginning (Brenda Vale, 2013). Their beliefs have restricted them from building more houses after growing to a population of 110 households. They have increased their building density in the past but refuse to expand. They are acutely aware of the limits of the land and water resources that their ancestors left them. The solution was to let new community members build houses outside of Kampung Naga and to not change their land zoning that has been part of their sustainable lifestyle.

Kampung Naga is only 30 km removed from modern cities. Some leaders have cell phones and on the outskirts they have a tourist office as part of the village financial income. Their spiritual beliefs give them an amazing understanding of the capacity of their land, it has created their sustainable lifestyle while still interacting with modern society. This makes them such a valuable case towards understanding circular communities.

## CLUSTER LEVEL

### ENERGY

Use of modern energy sources like renewable energy, gas and electricity in Kampung Naga is prohibited (Nasrudin, 2018). There is a black and white TV that runs on a rechargeable car battery in one of the houses on the outskirts of the village and the tourist office is connected to the electric grid. Tourism is a source of income for the village and for that purpose only do the leaders use cell phones. They do use oil and fire as energy sources. Stoves made out of river stones allow them to cook on fire and oil lamps provide the necessary needed light at night. Those are all the resources the village needs. They do not use energy for household appliances in their daily life. By almost not using any energy at all, they strongly apply the first strategy of circular economy: 'refuse' to use resources (RVO, 2018). Not using and therefore retaining resources naturally coincides with minimizing the impact someone has on the environment.

The question therefore is not, where does the village get their energy from and is it renewable, but what design strategies are applied in order for them to create a comfortable living environment without the use of modern energy?

The first thing to note is that the accepted indoor climate of the traditional house differs from that of the modern Indonesian house. Where the people of Kampung Naga accept that the temperature indoors fluctuate with the outside climate. The indoor climate of the modern house is often kept at an average temperature of 22 degrees Celsius, maintained via the use of the air conditioner (Nasrudin, 2018). The Indonesian household appliance that on average has the highest energy usage of all household appliances (Usep Surahman, 2013). So the question about circular strategies of energy use in Kampung Naga is actually a question about how to passively cool the village and its homes. What design strategies are in place?

According to my own observations and the findings documented by Brenda Vale (2013), Nasrudin (2018) and Sudarwani (2016) Kampung Naga uses six design principles effectively:

1. *Spatial design, housing orientation and patterns, ventilation*
The village intelligently uses its geographical advantage, the natural air flow between the hill and the river. Hot air flows up and when air cools it flows downhill towards the river in the valley. This linear movement of the air flow between the hill and the river dictates the spatial design of the village. Houses are orientated in one direction, sitting behind each other and creating these unobstructed paths for the wind. Forming an urban ventilation system.

2. *Spatial design, housing orientation and patterns, shading*
The houses are built near to each other, distances between the end walls average 1,5 m. and the porches are often only 2 meters apart. This allows for neighbouring houses to provide shading for each other sun rise and sun down. Sundanese beliefs and customs are said to be the reasoning behind the appropriate distances between the houses but they often overlap with strategies to improve indoor climate conditions.

3. *Spatial design, 'roofscape', shading*
Combined with the high density of the village, the cantilevering roofs create this remarkable landscape made out of palm leaves that shade the narrow alleys and porches in front of the houses. It makes sure that no one has to walk in the sun when moving around the village when the sun is at its highest. It also creates a recognisable aesthetic that makes Kampung Naga so unique.

4. *Housing design, raised living floor, cooling underneath by wind*
The houses are built upon foundation blocks made of river stones, raising the house of the floor. This has multiple advantages; 1. it protects against moisture entering through the floor, 2. it minimizes impact on the ground, 3. it allows them to coop with the height differences when building on a hill, 4. it protects against floods during heavy rainfall and 5. it allows the wind ventilation underneath the house. Cooling their homes on all sides through natural air flow.

5. *Housing design, natural cross ventilation*
Window openings on both sides combined with designated ventilation elements placed underneath the roof pitch on the end walls allow for cross ventilation. One of the first design strategies when passively cooling a home.

6. *Housing design, green roof, palm leaves and fibers*
The roofs of all houses in Kampung Naga are made out of palm leaves and fibers. It is one of the few building materials that is not cultivated on their own land. It comes from land nearby. The roofs works as a green roof. Capturing moisture and releasing it when heated. It provides perfect insulation against the sun.

The village has lived without modern resources of energy for the past 100 years. It therefore applies the first strategy of circular thinking; refusing to use resources. Kampung Naga's energy use, or lack thereof, will therefore be seen as - many circular principles applied.

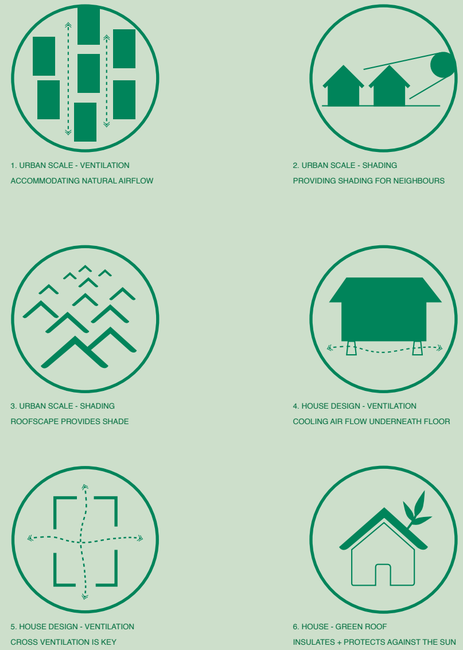


FIG. 3-7
(LEFT TO RIGHT, 2017)

3. ROOFSCAPE OF KAMPUNG NAGA, DOWN HILL VIEW
4. ROOF MADE OF PALM LEAVES
5. FOUNDATIONS BLOCKS MADE OUT OF RIVER STONES, RAISING THE HOMES OF THE GROUND.
6. VENTILATION ELEMENTS UNDERNEATH THE ROOF PITCH, ABOVE THE WINDOWS AND UNDERNEATH THE CEILINGS.
7. SHADED ALLY BETWEEN THE NEIGHBOURING HOUSES.

* The three aspects water, waste and food are in Kampung Naga interconnected and can not be described and valued on their circularity separately.

## WATER & SEWAGE

Kampung Naga's complex system of collecting water, growing food and reusing waste is both a technical solution to the needs of the village as is it part of their spiritual beliefs. A story of heartbreak between two sacred ancestors Dewi Sri and Dewa Antasari. The pain of lost love turns Dewi into a rice crop and Dewa into a fish. Sundanese believes that the plate with their daily meal of rice and fish is where the two forever meet. (Brenda Vale, 2013)

## WASTE

1. Spring water of the hill near the sacred forest, forms an important source of drinking water. The water is guided from the hills into the pond through bamboo pipes. The villagers carry the water to their homes for. Each house has their own drum with water in the kitchen. There is a washing platform above the spring. Waste from washing becomes food for the fish. (Adipurnomo, 2017)

2.& 3. Through an irrigation system the water then is used for the growth of rice crops. The water gets filtered and flows together with rainwater through the gutters in the village.

4. That water is collected in a fish ponds. The village has built toilets, huts to wash themselves and to wash their dishes above the fish ponds. They share these facilities. All biological waste drop into the ponds and is used as food for the growth of fish.

5. - 8. That water cascades into other rice fields. Growing food and eventually cleaning the water by filtering it through the rice fields before it

## FOOD

flows into the Ciwulan River to become part of the biosphere and natural cycles of the forest around them. Water evaporates, clouds form, rain falls into the Sacred forest, fills the water springs of the village and the cycle repeats itself.

The small amount of industrial waste they produce such as plastic is burned like in the rest of Indonesia. The burning of non-biological waste has no direct effect on the environment of their village and there is no Sundanese believe to tell them otherwise. There is room for improvement in their waste cycle. Besides rice and fish, the village eats chicken, eggs, goat, nuts and fruits locally sources. Chickens either roam free or are kept underneath the houses to eat the termites out of the wood.

The origins of circular thinking are founded on the inspiration of biological cycles in nature, where nothing is wasted and waste is food. Kampung Naga is exemplary in mimicking the biological cycles in nature and it would not be unfair to say that they have created their own perfectly balanced symbioses between them and the nature surrounding them.
Water, waste and food will be seen as - many circular principles applied.

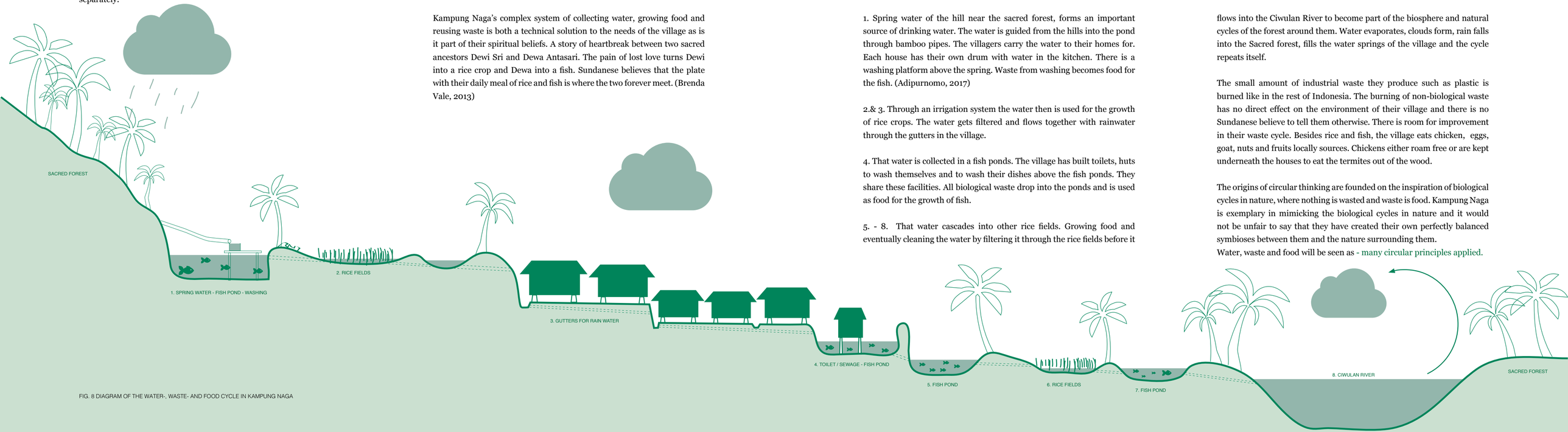



FIG. 8 DIAGRAM OF THE WATER-, WASTE- AND FOOD CYCLE IN KAMPUNG NAGA

## TRANSPORTATION

The village owns and shares a few vehicles for tourist purposes and public transportation for schooling outside the village for their children. No vehicles are used within the village itself and most things they need; food, water and building supplies are available in and around the village on walking distance.

- They use central parking. Visitors can drive to the tourist office where there is parking. From there, every single person has to walk to the village. This is problematic however, in case there is an emergency in the village.

- They share vehicles used for tourism.

- They reduce the use of cars and scooter by sourcing most of what they need locally.

Because of their traditional means of living, they have not been adepted to the usage of cars and scooters. They have refused/reduced the use of transportation and this is therefore seen as - many circular principles applied.

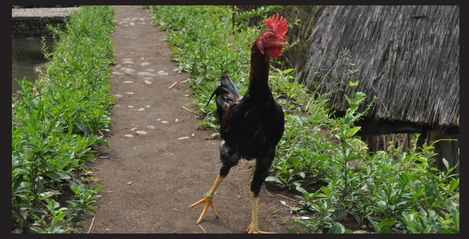


FIG. 9-13 (LEFT TO RIGHT CLOCKWISE, 2017)

9. FISH PONDS ABOVE IN THE HILLS
10. SAWA'S (RICE FIELDS)
11. LOCALLY PRODUCED FOOD, CHICKEN, RICE AND VEGETABLES GIVEN TO US DURING THE TOUR
12. TOILETS AND WASHING FACILITIES ABOVE THE FISH PONDS, NEAR THE VILLAGE
13. CHICKEN ROAMING FREE (TASTING DELICIOUS)

## HOUSING LEVEL

### MATERIALS

The circular model distinct two strategies when choosing building materials.
1. Technical materials. Building components are to be maintained in the industrial cycle for as long as possible and should be designed for easy reuse, maintenance and repair.
2. Biological materials. Materials ought to be able to safely return to the biosphere, at the end of the building lifespan.
(Cheshire, 2016)

The villagers of Kampung Naga source their building materials locally and have clearly chosen for the second strategy.
Construction materials are bamboo, mahogany wood and balsa wood. Sourced from the forest zones designated for growing building materials. Foundation blocks are made from river stones. Walls are made from wood or plaited bamboo. The same materials are chosen for the floors (Sudarwani, 2016). Treatment of bamboo building components is done with lime stone, which is gathered from a mountain in West Java. The roofs are constructed with bamboo and cladded with reeds, palm leaves and fibres.
The villagers create building components with biological materials and treat them with biological materials. At the end of the lifespan of a house, almost every building element will therefore be able to safely return to the forests biosphere or act as fuel for the fires to cook on and feed the villagers. Nothing is wasted. Building materials is also seen as
- many circular principles applied.

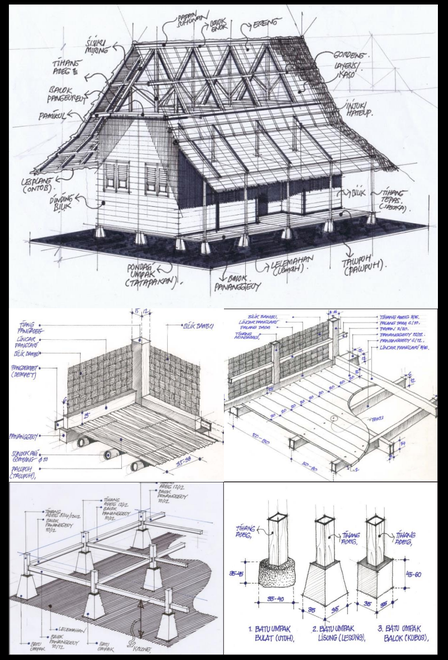



FIG. 14-18 (LEFT TO RIGHT CLOCKWISE, 2017)
14. A SMALL HOME, FIRE WOOD AND CHICKEN CAGES STOCKED UNDERNEATH
15. REED AND PALM LEAVES AND FIBRES AS ROOF CLADDING
16. BAMBOO AND WOOD WINDOW HATCH
17. INTERIOR OF A BIG HOUSE, WOODEN FLOOR, PLAITED BAMBOO WALLS
18. WOODEN BRANCH AS COLUMN, HELD IN PLACE ON RIVER STONE BY PRESSURE
FIG. 19. (PREVIOUS PAGE) DRAWING OF HOUSE + FLOOR AND FOUNDATION ELEMENTS

## DESIGN FOR DISASSEMBLY

Is the building designed in layers with different lifespans, with connections that can tolerate repeated assembly and disassembly? And is there besides a plan for construction also a plan for deconstruction?

The architectural style of the houses in Kampung Naga is rumah panggung. Rumah means house, panggung means on a stage or platform. The vertical section of a house is divides into three parts and represents the Sundanese cosmological beliefs. The space underneath the house represents the underworld, functioning as storage for firewood and chickens. The middle section is earth, where daily activities take place. The top part is the upper-world. The architectural style in Kampung Naga is very similar to that of other Kampung Adat, traditional villages, in the area. (Nasrudin, 2018)

The people of Kampung Naga build their own houses. It takes around 30 to 40 people to help a family with the construction of their new home. Most building components can be prefabricated (see fig. 20). When those are ready, the house can be built in 5 to 7 days (Interview during a tour in Kampung Naga, 2017). Connections between building components exist mostly out of holes and pens, and rope made out of coconut and palm fibres. Some nails are used in the newer homes when nailing down timber floor boards.

When analysing the rumah panggung according to the building-layer principles of Steward Brand, the house consists out of 5 of the 6 building-layers (See fig. 21on the next page). Each layer has a different estimated lifespan. According to the villagers, building components are easy to repair and replace when needed, because no connections are glued or fixed to

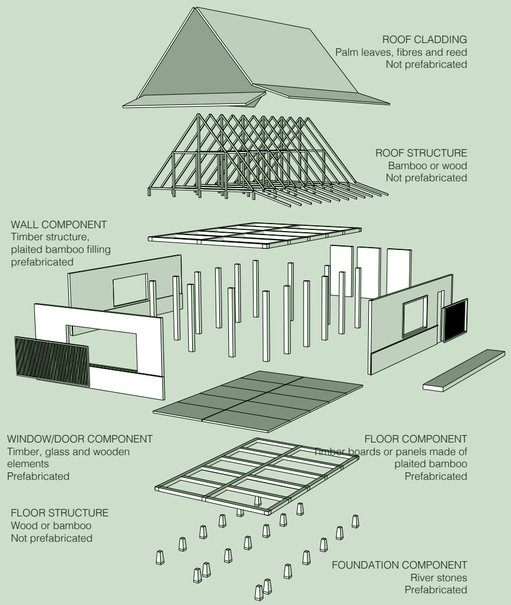



FIG. 20 EXPLODED VIEW OF BUILDING COMPONENTS AND MATERIALS OF RUMAH PANGGUNG



the point that disassembly means damaging both building components. The rumah panggung is clearly built in layers according to their different lifespan and connections are made for easy repair and replacement. The villagers themselves have all the knowledge not only to build their homes, but also how to safely disassemble them at the end of their lifespan. They have a workshop filled with damaged building components such as

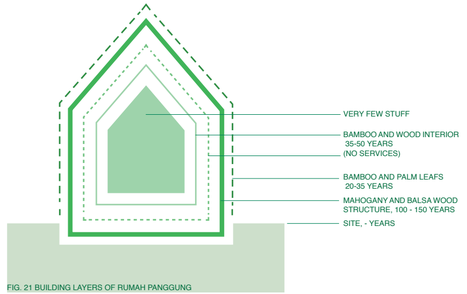



FIG. 21 BUILDING LAYERS OF RUMAH PANGGUNG

window frames and floor boards that were taken out of the house, ready to be repaired and used for a new home (Observed during a tour through kampung Naga, 2017). Design for Disassembly is seen as - many circular principles applied.



## MATERIAL PASSPORT & BANK

The knowledge of construction, materials, maintenance and what to do with the materials at the end of their lifespan is kept within the village and its peoples. They may not use a digital BIM-model to establish al that information, but they are well aware of all the materials and building components in their homes. They have a workshop filled with damaged building components such as window frames and floor boards that were taken out of the house, ready to be repaired and used for a new home (Observed during a tour through kampung Naga, 2017). This also is rated as - many circular principles applied.

## MAINTENANCE

Maintenance is done collectively, once a year by all the villagers. They will retreat the bamboo plaited walls with lime stone, repair and replace palm leaves on roofs and will also do the required maintenance on the water and irrigation systems of the kampung. They will do all the work necessary to expand the lifespan of their homes and the other systems within the village, together. A social activity to improve the well-being of the kampung.
- many circular principles applied.

## STANDARDIZATION

Standardized building typologies, dimensions, systems and construction methods make it often easier to reuse, repair and if need replace a building components. It also allows a building to expand easier or to repeat the same structure is needed. Therefore, making it easier to keep a building and it parts in the industrial or biological cycle for a longer period of time. (Cheshire, 2016)

At first glance it may look like the houses in Kampung Naga are standardized, but this is not entirely true. According to the beliefs in Kampung Naga, every day in the year has a different value. The birth-dates of the couple that builds a new home roughly determine the size of the house. They have two sizing types, see fig. 22 and 23 on the right. The sizes of these types ranges from 5 x 6 meters to the largest in the village of 12 x 12 meters (Nasrudin, 2018; Sudarwani, 2016).

The dimensions of building parts however, such as doors and window frames are standardized and follow the dimensions of the Javanese man (Sudarwani, 2016). This makes these parts highly repeatable and easy to reuse.

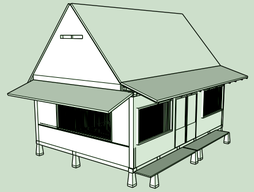
The houses in Kampung Naga are not expandable and building new homes in the village is not allowed. They do have an internal development within the house. Allowing for more bedrooms when needed (see fig. 24 on the next page). (Sudarwani, 2016)

Internal development is possible and building parts are reused. But the dimensions of each house differ because of Sundanes beliefs. Making it impossible for structural elements such as beams and columns, and wall and floor elements to be easily reused without customization. Therefore standardization is seen as - some circular principles applied.

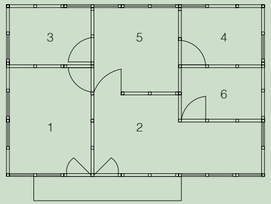


LARGE UNIT
household;

4 - 10 family members



1) living room
2) kitchen
3) bedroom
4) bedroom
5) family room
6) rice granery




SMALL UNIT
household;

2 - 5 family members

1) living room
2) kitchen
3) bedroom
4) bedroom

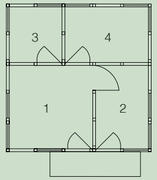



FIG. 22 (PREVIOUS PAGE) DESIGN OF A LARGE UNIT

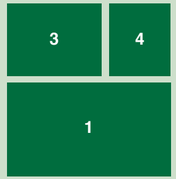
FIG 23 & 24 (LEFT TO RIGHT) DESIGN OF A SMALL UNIT & THE INTERNAL DEVELOPMENT OF THE PLANS OF A SMALL HOUSE



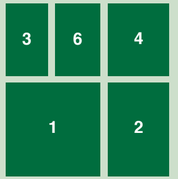
SMALL UNIT - INTERNAL DEVELOPMENT

Interior flexibility;
internal expansion of a
family household.

Basic form




1st development




2nd development


1) living room (+ kitchen)
2) kitchen
3) bedroom
4) bedroom
5) family room
6) rice granery
7) bedroom

## CIRCULAR ECONOMY

ORGANIZATIONAL STRUCTURES
+
SOCIAL STRUCTURES

Kampung Naga is self-organized with little to no government involvement, the village has not been constructed as part of a regional masterplan and is not owned by anyone person or group. The village has a stewardship instead of an ownership; it is held in trust by those living in it for their children and the succeeding generations (Brenda Vale, 2013). They do not own their houses. It is their house for the time being because they live in it. This is in stark contrast with the Western world where ownership not only implies the right of tenure, but also allows you to do with your property whatever you like. That is not the case in Kampung Naga. The way the people of Kampung Naga see property has much to do with their understanding of their place as humanity within the natural world. Kampung Naga not only illustrates the physical model with 'technical' solutions to live a satisfying life, in harmony with the natural world, but perhaps even more important. It shows that sustainability is mostly a social model with a collective clear understanding of what the land can constantly support and organize a way of living within these limits.
Kampung Naga can therefore be seen as a bottom-up approach towards sustainable living created by their social and organizational structures.
- many circular principles applied.

CIRCULAR MODELS
+
BUSINESSES & PARTNERSHIPS
+
CIRCULATION

Kampung Naga is not based on a structure of capitalism. Within the village, money is obsolete. Instead, the people provide services for each other. They trade goods and collectively provide food for the entire village. Houses are built together, needing 30 - 40 people to do so. This also means that everything, is built, produced and made to last. To be durable. Because there is no incentive to sell new goods in order to make money. The only money made is with the tourist business. That money is used for the few products and services not provided by the villagers themselves. Such as gas or palm leaves and fibres to make the cladding for the roofs. Circular business models are not in place, because of the unique way services are provided within the village. This does provide a structure where many circular principles are applied. Clothing of children is shared when they grow out of it. Everything is made to last to be easily reused or recycled. Value of products, materials and goods are made to be retained. Durability is key. Simply because it makes the most sense when money does not play a role. This is therefore seen as - many circular principles applied.

FIG. 25 (ON THE NEXT PAGE) SHOWS THE WORKSHOP OF THE VILLAGE. HERE ARE BUILDING COMPONENTS, FURNITURE AND OTHER PRODUCTS MADE FOR THE ENTIRE COMMUNITY.



## CLUSTER LEVEL

### ENERGY

The village doesn't use modern sources of power and by doing so it is applying the first design principle of Circular Economy; refusing to use resources. Therefore, it is its design principles to passively create a comfortable climate within the village and their homes that is the real genius behind the energy-use, or lack there of in Kampung Naga.

### WATER & SEWAGE + WASTE + FOOD

The origins of circular thinking are founded on the inspiration of biological cycles in nature, where nothing is wasted and waste is food. Kampung Naga is exemplary in mimicking the biological cycles in nature. They have remained to do so for hundreds of years and it would not be unfair to say that they have created their own perfectly balanced symbioses between them and the nature surrounding them.

Short example; Clean drinking water enters from the mountains, afterwards this becomes water to wash themselves and grow vegetables and rice. That water then cascades into ponds filled with fish. Goats also walk around the fish ponds for drinking, their dropping becoming part of the fishes food chain and fertilization for the vegetables. Chickens whom are raised for meat and eggs roam free underneath the kitchens of the raised houses and feed themselves with rice and other food that drops down the open kitchen floor when being prepared. The villagers are being fed on a diet of rice, vegetables, goat, chicken-meat and -eggs and fruit. Human waste is dropped in on of the fish pond which acts as their sewage and also provides food. This water fis filtered by rice fields. Afterwards it flows into the Ciwulan river and becomes part of the biosphere of the nature around them.

Circularity at its finest.

### TRANSPORTATION

The village owns and shares a few vehicles for tourist purposes and schooling outside the village for their children. No vehicles are used within the village itself and most things they need; food, water and building supplies are available in and around the village on walking distance. Minimizing use of vehicles and fossil fuels fits the bill of 'Circularity'.

## HOUSING LEVEL

### MATERIALS

Buildings materials such as bamboo, palm leaves and wood are chosen from the forest around the village. After their lifespan they can be returned into the forest and its biosphere. Building waste becomes nutrition for the soil to grow new wood and bamboo. Or the waste becomes firewood to cook their meals with.

### DESIGN FOR DISASSEMBLY

The houses have naturally been build in 'building-layers' and are easy to disassemble. The structure can have a lifespan up to 30 years, surviving earthquakes and floods. While the floorboards, walls and roof cladding can easily be removed and replaced. Connections are made holes and pens or roped together with palm fibres. Making it easy to disassemble.

### MATERIAL PASSPORT & BANK

The houses and its building method has been standardized over the years. The knowledge of how to construct them and what materials to use is passed on from generation to generation. A modern version of the material bank is therefore not used but the villagers know what materials to reuse and what to return to the forest.

### MAINTENANCE

Maintenance is collectively done by the entire community. In order to lengthen the lifespan of the houses. They will replace or repair the walls, floor and roof cladding of houses. They provide a new layer of lime wash onto the woven bamboo walls to protect them from moisture. And if needed will replace/repair wooden beams and columns.

### STANDARDIZATION

There are two types of houses with both standardized measurements and building methods. The villagers of Kampung Naga have been building this way for hundred of years and remain building this way till this day. This makes it easy to maintain, disassemble and rebuild when needed. Again applying circular strategies.

## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURE

Organizational structure is inherited from the customs of original Sundanese tribes. Their values towards nature are in strides with the school of thought of the circular model. Their structure is similar to that of a bottom-up approach.

### CIRCULAR MODELS

Kampung Naga is not based on capitalism and therefore no linear economic model is in place. It is based on inhabitants providing services for each other. Such as collectively building a house for a family. Or growing and providing each other of food.

### CIRCULATION

Materials and products are made to be kept in the cycle of Kampung Naga for a as long as possible.

### BUSINESSES & PARTNERSHIPS

There is no business in Kampung Naga, besides the tourist business.

### SOCIAL STRUCTURE

Kampung Naga is based on having the villagers having the same Sundanes beliefs, following the same traditions and participating in the same activities. The entire village is constructed on the social structure between its people.

# CASE STUDY 2 CONCLUDES

## CONCLUSION TO KAMPUNG NAGA

The way of living in Kampung Naga is completely in line with the principles of a circular economy. Even though the village is hundreds of years old and the term circular economy quit new. The strong collective beliefs of the people in Kampung Naga, living in nature with their surrounding, knowing the limits of their land and not willing to exceed those create a community with a very low carbon foot print. Circular economy speaks of mimicking the cycles in nature. The people of Kampung Naga are actually part of the cycles of the nature around them. Their water, sewage and food system is ingenious and nothing new. Humans have been doing so for ages. We have stepped away from it because our comfort wishes and needs have changed.

There lays also the crux of this case study. The wishes of the villagers are vastly different then those of the Indonesian middle class. Living conditions can not be directly copied when designing modern residential housing. So the question is, how can residential design meet the needs and wishes of middle class Indonesians while learning and applying the principles and strategies used in Kampung Naga? I belief the answer lays in the collective thinking of the villagers of Kampung Naga and their social structure.

FIG. 1 BIRDS EYE VIEW ON A FEW COURTYARDS. NOTICEABLE ARE THE GREEN PUBLIC CENTRES AND THE PONDS IN FRONT OF THE COURTYARDS WITH HELOPHYTE FILTERS.


FIG. 2 AREAL SHOT OF EVA-LANXMEER. SHOWCASING 12 COURTYARDS, OFFICES, SCHOOL AND FARM.

# CASE STUDY 3

## CASE STUDY 3: EVA-LANXMEER, CULEMBORGH THE ECO-VILLAGE

### INTRODUCTION

EVA-Lanxmeer started as a private initiative in the early nineties, by Marleen Kaptein. She wanted to offer an environmentally friendly urban plan as alternative to that of the newly proposed ‘VINEX-wijken’. She was inspired by the design principles of permaculture and saw VINEX neighbourhoods as mono-cultures. She argued that instead, people should live in ecosystems. A living environment that takes social cohesion, quality of life, the environment, employment, food production and the landscape into account (Bosch, 2017).

This led to EVA-Lanxmeer in Culemborg. A neighbourhood existing of 300 households, built around 12 open courtyards whom are all car-free. It has offices, schools, businesses and a city farm. Kaptein wanted to facilitate not just living, but recreation, employment and education. Enabling people to work and play near their homes, decreasing their ecological footprint and improving their quality of life. This vision translated into the five EVA principles. (“EVA-Lanxmeer,” 2019)

1. Incorporating the genius loci (local spirit): existing qualities should be preserved and enhanced
2. Closing material and energy cycles
3. Bring local food production back into people’s everyday lives
4. Connect architecture to elements of the landscape
5 Embed sustainable water and energy systems into the urban plan

## CLUSTER LEVEL

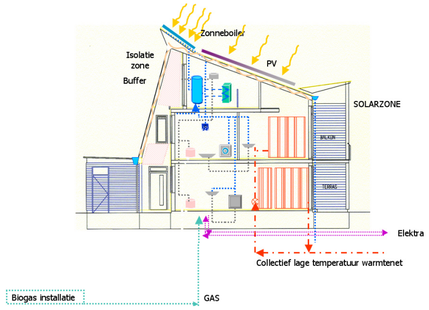
### ENERGY

The energy ambition of EVA-Lanxmeer is one of the first circular strategies to minimize the impact one has on the environment: it is to *reduce* fossil energy use. Therefore, the main focus for energy use was to reduce heat loss, heat the houses as efficient as possible and mainly use renewable energy (“Integrale aanpak ecologische wijk Culemborg,” 2001).

Two passive strategies are used by all houses in the neighbourhood:
1. All main windows and living quarters are orientated to the south.
2. All houses are extremely well insulated.

One active heating and cooling strategy used throughout EVA-Lanxmeer is done by the company Thermo Bello which was founded specifically for this project. Stored drinking water is cooled during the winter. The extracted heat during this process is pumped through the drinking-water-network, reaching the walls and floors of all the homes. In the summer, the process is reversed and houses are comfortably cooled. This, is relatively speaking a very efficient, low energy heating and cooling system (Bosch, 2017).

Furthermore, each of the twelve courtyard provides their own strategy to reduce their use of fossil fuel. Solar panels on roofs create electricity, solar water heaters heat water, the use of bio-gas (was intended but not realized), air-heating through adjacent greenhouses and the use of ground-coupled heat exchangers (“EVA-Lanxmeer,” 2019).
- many circular principles applied.



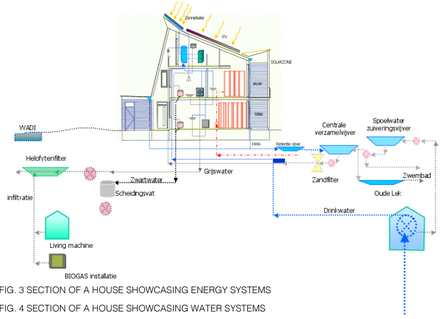




FIG. 3 SECTION OF A HOUSE SHOWCASING ENERGY SYSTEMS
FIG. 4 SECTION OF A HOUSE SHOWCASING WATER SYSTEMS





FIG. 5 DIAGRAM OF RAINWATER COLLECTION PLAN
FIG. 6 DIAGRAM OF GREYWATER SYSTEM PLAN



### WATER & SEWAGE

The water-concept of EVA-Lanxmeer is based on managing rainwater, wastewater and drinking water.

Rainwater that falls on the roofs is collected in retention ponds. Some retention ponds are used to create drinking water. Rainwater that falls on the streets is guides to ground soil ditches. Allowing the water to seep through the ground, replenishing the ground water buffer in the area.

Waste water is divided into two systems, a grey water and black water system. Grey water is wastewater coming from the sinks, showers and washing machines. Black water is toilet water. The grey water is guided to the ponds in the neighbourhood with helophyte filters. The water is filtered, cleaned, flows into a stream and ends up into the rivers. Black water goes into the public sewage system.

The water company Vitens, extracts drinking water at four sources in EVA-Lanxmeer. This water is used as drinking water for not only the neighbourhood but the entire municipality Culemborg.

The original intent was to use the retention ponds as a water source for flushing the toilet in EVA-Lanxmeer. Most toilets even have a double piping system, one connected to the drinking water and on to the rainwater system. However, this system has not been active yet due to Dutch building codes becoming stricter. Drinking water is now used to flush the toilets (“Integrale aanpak ecologische wijk Culemborg,” 2001).
- many circular principles applied.

## WASTE

The people of Lanxmeer sort their waste into paper, glass, biodegradable and general waste. All waste is collected by the company Avri and processed by them. What can be recycled, is recycled. It was intended to combine the biodegradable waste flow with the black water system, to create bio-gas. This has not been realized, in part because of building code regulations. Some biodegradable waste is used in the communal gardens, but that is not much. They also discussed letting the farm collect the biodegradable waste to use as fertilizer, but because of trust issues they have collectively voted not to do so. The people of Lanxmeer do recycle and show the intent to turn waste into food, but this has unfortunately much to improve upon and real progress can still be made. - some circular principles applied.

## FOOD

EVA-lanxmeer produces food locally via its city farm Caetshage. The farm does not produce all food needed to sustain the entire neighbourhood but it is a vital part of EVA-Lanxmeer (Bosch, 2017). It has four main purposes (“EVA-Lanxmeer,” 2019):

1. Organic food production. Cityfarmes Todd and Boudien produce vegetable food packages that are sold to the people in the neighbourhood. Families can subscribe to these food package services. Some is sold in the shop on the farm and some is sold in other supermarkets in Culemborg.

2. Day activity. For the elderly and for people in assisted living. They help create the food packages as part of their daily activities.

3. Education. One of the main focusses of Marleen Kaptein was to educate children on how the food on their plates is produced. To make them grow up knowing, where their dinner comes from. Class trips from the school ‘De Werfklas’ are taken to the farm.

4. Recreation. Harvesting workshops and cooking classes are organized. People can also walk freely on the paths throughout the farming grounds.

It may not produce all the food needed by EVA-anxmeer, but growing vegetables and fruits locally already reduces energy used to otherwise travel to buy food. Growing food contributes heavily towards creating an ecosystem within the neighbourhood. - many circular principles applied.



## TRANSPORTATION

There has always been the ambition of a car free living environment . This was and is one of the main pillars within its urban plan (“Integrale aanpak ecologische wijk Culemborg,” 2001).
The parking spots are situated all on the edges of the project. Houses are accessible but mainly for emergency vehicles. There is a maximum of 1 parking spot per household. The few streets in and around the courtyards are mostly dead-end and narrow. Leaving more space to walk, bike and create social interaction between neighbours. It also leaves more green for natural filtration of rainwater. The infrastructure consists of a network of walk&play routes and bike lanes. There is also a system in place for car sharing and a charging roof with solar panels for electric cars will be added to the parking spots (“EVA-Lanxmeer,” 2019).
Trying to reduce the use of fossil fuels, by discouraging the use of cars through the design principles described above, speaks of - many circular principles applied.

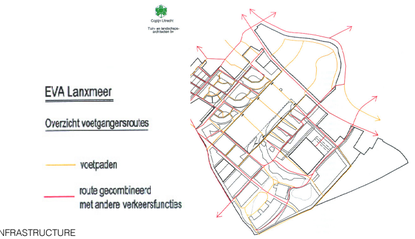



FIG. 7 INFRASTRUCTURE



FIG. 8 HARVESTING THE CITY FARM

FIG. 9 FARMERS TODD & BOUDIEN + TODD ON A TRACTOR

FIG. 10-13 (LEFT TO RIGHT CLOCKWISE)

10. LODEWIJK VAN DEIJSELHOF COURTYARD, WITH RAINWATER RETENTION POND
11. LODEWIJK VAN DEIJSELHOF COURTYARD, HOUSES WITH SOLAR PANELS
12. KASWONINGEN COURTYARD, HOUSES WITH ADJACENT GREENHOUSE
13. DRINKING WATER FACILITY

## HOUSING LEVEL

MATERIALS
+
DESIGN FOR DISASSEMBLY
+
MATERIAL PASSPORT & BANK

EVA-Lanxmeer has 12 courtyards and several detached homes spread throughout the neighbourhood. Each courtyard consisting of around 20 houses and each courtyard is different from each other. Most courtyards not only had input from their future residents, they also had different developers, investors, designers, constructors, sizes, costs and use of building materials.

They do however, share the same EVA vision that led to the five principles:
*1. Existing qualities should be preserved and enhanced*
*2. Closing material and energy cycles*
*3. Bring local food production back into people's everyday lives*
*4. Connect architecture to elements of the landscape*
*5 Embed sustainable water and energy systems into the urban plan*

These principles are completely in line with circular thinking in the built environment. However, these houses were not specifically designed according to circular principles. Circular economy was a still unknown phrase during construction of EVA-Lanxmeer. They all have been designed to lessen their impact on the environment in one way or another, but there is not much information on what is done with the building at the end of its life time. So material cycles are on paper not actually closed. What is done right however, is that the houses are logically build in layers and often use prefabricated building components. Making it easier to disassemble and reuse. Therefore - some circular principles are applied.

The same goes for the question whether there is a material bank in place with the use of material passports. Contractors and architects are all aware of the materials used and it has been documented. Even the home owners have a clear understanding of the material used, because of their involvement in the design process. Though this information is not shared with the public, it is used when maintenance or replacement is required. So - some circular principles are applied.

The building materials used is different in each courtyard, but there is a general preference for the use of renewable materials that could eventually be returned to the biosphere. Timber frame construction, timber cladding, reed cladding, green roofs and one courtyard even uses an artificial hill as insulation. Industrial building products are also well chosen when used. Triple glazing, double insulated sandwich panels, prefab concrete floor components with floor heating systems and the list goes on. All chosen to minimize heat loss and therefore reduce the energy required for heat gain. - many circular principles applied.

It is clear that great effort was made during the design process to create environmentally friendly homes, but in terms of a circular future there are still some things to improve upon. These have mainly to do with defining and creating a clear strategy on what to do with the building materials when the building has served its purpose. Closing the material cycle after its lifespan, which is what the second principle of the EVA-vision states.



## STANDARDIZATION

At first glance it may seem as if standardization only takes place within each courtyard and architecturally speaking it does. Most different courtyards do not share the same building methods or contractors. Nor do they share the same building materials and components. What is truly standardized in EVA-Lanxmeer, is the collective heating and cooling system, done by energy company Thermo Bello. It uses the drinking water system to heat almost every house. Two things needed to be standardized in the homes in order to make this work:
1. The minimum required insulation thickness, to minimize heat loss, making it possible to heat a house with low temperature drinking water.
2. The homes, mainly their floors and walls needed to be connected to this system. Allowing large scale efficient heating and cooling throughout the entire neighbourhood, by standardizing two aspects in all the homes (Bosch, 2017; "EVA-Lanxmeer," 2019).

Another strategy used by some courtyards such as 'Achterberghof', is standardization in floor plan in combination with a hybrid building method originally used when designing hospitals ("EVA-Lanxmeer" 2019). This gives the residents the capacity to change their floor plans when their changing needs require to do so. The flexibility of these homes help extend their lifespan. - many circular principles applied.

## MAINTENANCE

EVA-Lanxmeer and its houses are designed on longevity. Proper maintenance is therefore needed. For maintenance of the technical installations the task force WEI was created, consisting of residents with a technical background. They work together with the energy company Thermo Bello to solve small technical issues and maintenance. When technical maintenance becomes to complicated, Thermo Bello will do it themselves.
Housing maintenance is the responsibility of the residents. Most residents within their courtyard work together and are able to ask each other for help. For more technical advice, they can go to the WEI task force.
An organizational and social structure is in place to ensure proper maintenance within EVA-Lanxmeer ("EVA-Lanxmeer, energie en installaties" 2019).
- many circular principles applied.

FIG. 14-17 (LEFT TO RIGHT CLOCKWISE)

14. HET HOUTEN HUIS

15. 'RIETWONINGEN', FACADES MADE OF REED

16. ACHTERBERGHOF WITH FLEXIBLE FLOOR PLAN

17. 'KASWONINGEN' - GREENHOUSE HOUSES, USING SOLAR HEATED AIR TO HEAT HOUSES

## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURES

In contrast to most other eco-villages in the Netherlands, EVA-Lanxmeer has been founded as a private initiative with a top-down structure, that at its beginning was solely led by Marleen Kaptein and her strong vision for a large scale sustainable neighbourhood. Now fast forward 25 years and EVA-Lanxmeer shows more resemblance to that of a grassroots organization (Bosch, 2017). So how did EVA-Lanxmeer manage to transform from a top-down organization into bottom-up community with strong social bonds?

Organizational steps:
1. From the start Kaptein was able to create a network of experts from different field such as urban planning, permaculture, sustainability, housing, finances and so on. They supplied knowledge and supported the project. A team was created, consisting of five disciplines: Energy, water, green, living & working and residents & consumers.

2. The team finalised a proposal in 1993 and in 1994 they established the foundation 'EVA Stichting'. The foundation safeguarded the vision of EVA. This vision was threefold ; creating a living environment in which people engage with their direct environment, create solutions for environmental problems & develop healthy ecosystems and finally to facilitate a conscious lifestyle.

*The team was also responsible for managing contacts with the constituency. The EVA-Stichting foundation eventually formed the link between the top-down organization and the future bottom-up elements of the project.*

3. In 1995 Kaptein spread through her own network, a brochure to attract potential stakeholders and residents. The project was able to gain 80 residential applications without even having a location.

4. A location was finally found in Culemborg. The foundation created the urban plans in 1996. The municipality funded the study & research phase of the project and sold the land located for communal courtyards at low prices.

*During the making of the urban master plan, the future residents were merely informed and not involved, as expected of a top-down organization. It was at the next design phase of the urban plan however, that this organizational structure transformed.*

5. It was during the design phase of the twelve courtyards, that residents participated and got the freedom to design for themselves. This was mainly done through workshops with experts. It gave the residents an opportunity to create their own courtyard together, their own living environment within the larger scale. It also gave them their first opportunity to bond as a group. This has proven to be vital for the social structure and future organizational structure of the neighbourhood.



The current organizational structure of EVA-Lanxmeer exists of four main pillars ("EVA-Lanxmeer," 2019).

1. The original residential association BEL (Bewoners of EVA-Lanxmeer). Created in 1997 to manage the waiting list for aspiring residents, they still have formal control on the making of bigger decisions within the neighbourhood. BEL consists of four to five residents of EVA-Lanxmeer and is the foundation for many events, sub-organizations and task forces such as WEI or the City Farm workshop group.
2. A neighbourhood council which exists of appointed leaders of the courtyards. An informal organ within the structure of EVA-Lanxmeer that discusses content between the different courtyards.
3. Are the courtyards themselves. These act more as a body that initiates social activities within their own courtyard and are vital for the strong social cohesion.
4. Is the latest addition, BEL 2.0. This body explores the possibilities to improve the neighbourhood through new innovations with regard to climate change.

Even though EVA-Lanxmeer has been initiated as an expert led, top-down organization through the vision of Marleen Kaptein. It has evolved into a community with bottom-up organizational structures in place. The master plan was designed by experts and through the design of the courtyards residents were allowed to participate, which proved vital for this transformation. Now, the residents are involved in every organizational body within the neighbourhood. Allowing them to collectively make decisions to improve their living environment. Such as exploring new and innovative ways to improve their sustainability vision by creating BEL 2.0.
Organizational structures is therefore seen as
- many circular principles applied.

### SOCIAL STRUCTURES

There is a general sense of community within the entire neighbourhood, despite its size of 300 households. It is noticeable however, that social cohesion is strongest at courtyard level. Every courtyard has a different level of social interaction, but most have strong social bonds. This is where people interact, socialize and organize events. Some have parties, others created a courtyard music band and most maintain their courtyards together as social activities. Having these strong social bonds allow the neighbours to openly express their frustration and have an honest conversation about it (Bosch, 2017). Which then brings them more together. As any healthy relationship would.
The strong social cohesion partly stems from their collective participation during the design of the courtyards. It allowed them to bond and feel as if they designed their living environment together. Which they did. The downside is that it sometimes makes it harder for newer families to integrate within these existing social structures.
In the end, these courtyards facilitate strong relationships between neighbours, that is proven to be vital for the organization of the entire neighbourhood and its vision towards sustainable living ("Integrale aanpak ecologische wijk Culemborg," 2001).
- many circular principles applied.

## CIRCULAR MODELS

No circular economical models are applied throughout the housing development of EVA-Lanxmeer. Houses are built and sold as finished products instead of services and developers are not responsible for their product after their lifespan. - no circular principles applied.

## BUSINESSES & PARTNERSHIPS

Al though no circular economical models were used for the development of EVA-Lanxmeer, new businesses and partnerships have been formed to develop this neighbourhood into a diverse ecosystem. Thermo Bello is the energy company created to provide EVA-Lanxmeer of heating and cooling. It has a partnership with drinking water company Vitens and together they designed the system to supply heating, cooling and drinking water. The city farm Caetshage was initiated to locally produce food. A school was placed in EVA-Lanxmeer, allowing children to walk to school. Offices in the neighbourhood create a healthy live-and-work lifestyle for its residents and a partnership with the energy supplier is formed to sell excess electricity, produced by the solar panels, back to the grid.
All these businesses and partnerships are formed to create a balanced and diverse neighbourhood, an ecosystem. - many circular principles applied.

## CIRCULATION

The grey-water and rainwater systems allows for water to be retained within the cycles of the neighbourhoods for as long as possible. Most houses and all of the technical installations are designed keeping longevity and durability in mind (“EVA-Lanxmeer,” 2019). Houses are designed with flexible floorplans to help extend their lifespan. A team of residents formed the taskforce WEI to properly maintain the installations in the neighbourhood and assist with housing maintenance. EVA-Lanxmeer is built to last and maintain its value for as long as possible. – many circular principles applied.



FIG. 18 MARLEEN KAPTEIN IN A COURTYARD IN EVA-LANXMEER 2014

## CLUSTER LEVEL

### ENERGY
All houses main façades face south for passive heating. Solar energy is used to create warm water and electricity. An efficient low-energy heating and cooling system uses drinking water to warm and cool the neighbourhood. Many other strategies are in place to reduce the use of fossil fuel.

### WATER & SEWAGE
Rainwater is collected in retention ponds. The water in some ponds is cleaned and used as drinking water. Sewage is sorted into a grey and a black water system. The black water flows into the public sewage. The grey water flows to ponds with helophyte filters. That water eventually flows into the natural biosphere.

### WASTE
Waste is sorted, collected an picked up by a waste company. Most will be recycled, but biodegradable waste is not used as fertilizer. This should be improved upon.

### FOOD
A city farm in EVA-Lanxmeer locally produces vegetables and fruits. Vegetable packages are sold to the neighbourhood and other supermarkets in Culemborg.

### TRANSPORTATION
There are no cars allowed within the courtyards or the inner parts of the neighbourhood. Parking is done at the edges of the vicinity. The use of cars is discouraged by the design. Houses do have accessibility to emergency vehicles and people with a disability.

## HOUSING LEVEL

### MATERIALS
Most houses us a combination of renewable materials and industrial materials. Renewable materials such as timber, reed and green roofs can be returned to the biosphere after the lifespan of a house. The industrial materials all contribute towards houses that minimize their heat loss and therefore reduce the energy needed during the cold seasons.

### DESIGN FOR DISASSEMBLY
Houses are not specifically designed for disassembly. They are built however in clear and distinct building layers making disassembly easy.

### MATERIAL PASSPORT & BANK
Information about the used building products and materials is on hand with the designers, constructors and residents. It is not being just as a material bank.

### MAINTENANCE
The task force WEI is responsible for proper maintenance in the neighbourhood.

### STANDARDIZATION
Almost all houses us the same heating system within its walls and floors. Some houses also use standardized floor plans in combination with hybrid building methods to create a flexible home. Able to adapt to the changing needs of residents in order to extend the durability of the house.

## CIRCULAR ECONOMY

### ORGANIZATIONAL STRUCTURE
EVA-LANXMEER started as a private, topp-down initiative and has successfully transitioned its organizational structure into a more bottom-up like organization, enjoying the benefits such as strong social cohesion.

### CIRCULAR MODELS
Houses and their building materials are developed and sold as products and not as services.

### CIRCULATION
EVA-LANXMEER was designed to last. Durability was one of its key ambitions. This has been accomplished through build quality, smart design and proper maintenance.

### BUSINESSES & PARTNERSHIPS
New businesses specifically for EVA-Lanxmeer were formed to create a diverse neighbourhood that would function as a complete ecosystem. Energy company Thermo Bello was created for heating, partnership with Vitens for drinking water, a city farm was founded for local production of food and a school and offices were build for a healthy live-and-work environment.

### SOCIAL STRUCTURE
There is a general sense of community throughout the entire neighbourhood, but the strong social bonds are formed within the courtyards. It is in the courtyards where people interact, organize events and get together. The courtyards and their social cohesion are vital for the entire organizational structure of EVA-Lanxmeer.

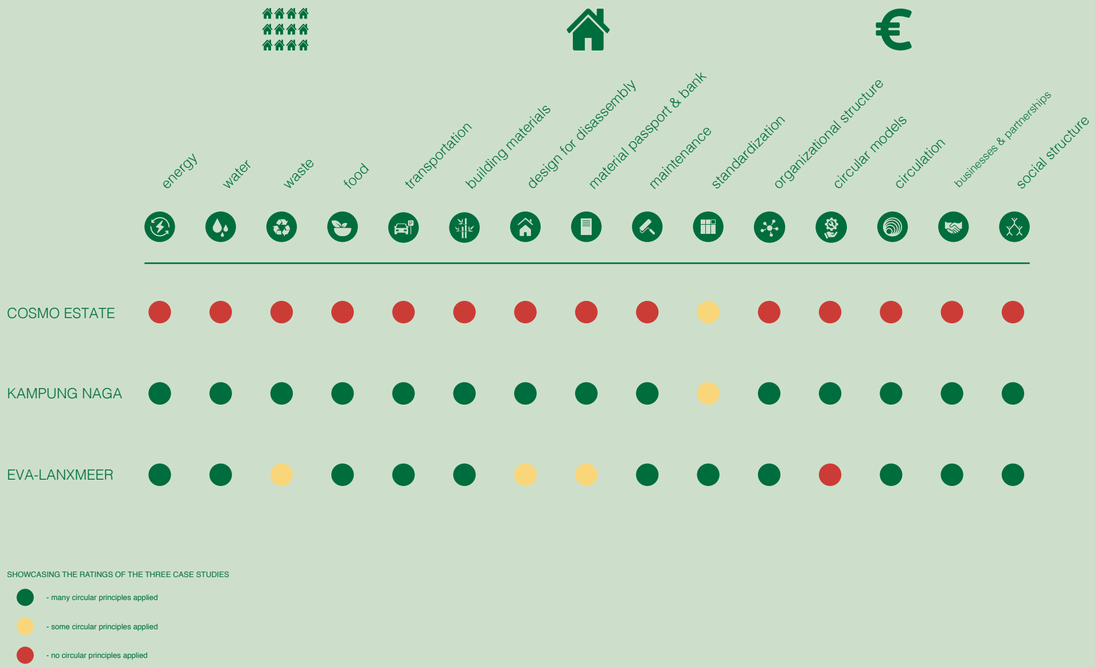
# CASE STUDY 3 CONCLUDES

## CONCLUSION TO EVA-LANXMEER

Marleen Kaptein truly had a vision. An ambition to create a sustainable and healthy living environment in which people engage with each other and their direct surrounding. A neighbourhood where people lead conscious lifestyles and a place where solutions to environmental issues are created. A complete and healthy ecosystem for people to live in.

Kaptein's vision shows many similarities to that of the origins of circular thinking. So it may not come as a surprise when it is said that EVA-Lanxmeer as a whole has preformed well when evaluated through the scope of the 15 key circular principles. Aspects that could be improved upon mainly have to do with an end of life strategy. EVA-Lanxmeer is designed for durability, but it is equally important to develop a strategy on how to use or handle building materials after they expire, in order to prevent them from becoming waste. In circular thinking, nothing is wasted and waste is food. For this practice, new circular models need to be created. It is this and their waste management where EVA-Lanxmeer could potentially improve upon.

The neighbourhood began as a sustainable healthy living environment and it has successfully remained to be this way. The social and organizational structures has proven to be vital for its success. It allows the people of EVA-Lanxmeer to make decisions as a community, to explore new ecological innovations and to safeguard the vision of Kaptein with which it once began. Social structure, is key.




# COMPARATIVE CHAPTER

## THE CASE STUDIES SIDE-BY-SIDE

Now that the three case studies are done, an image appears of the typologies, their characteristics and how they score when studied through the scope of circular design principles. This chapter will provide us with the opportunity to view the three types of neighbourhoods side-by-side and perhaps show us not only that they score differently within this study, but also why they come to do so. What are their common characteristics and what are their differences?

### CLUSTER LEVEL

It becomes clear during the studies that Cosmo Estate, the case study representing the Indonesian housing cluster, does not preform well on cluster level. Energy and water loops are not closed nor are strategies in place to reduce its usage and the use of the car is clearly advocated. Waste is not sorted and at best ends up in a landfill. Food production plays no role. Also noticed is that none of these ‘cluster level aspects’, are actually connected with each other on cluster level. Their use of individual sceptic tanks is a perfect example of this. Each house within Cosmo Estate acts on its own, individually, instead of forming a network or system.

This is in stark contrast with the second case study: Kampung Naga. Their water system, food production, waste management and sewage is all interconnected and compliments each other. The people of Kampung Naga have not just created their own ecosystem. They have become part of the ecosystem of the nature around them. Closing cycles within their village with strategies such as using fish ponds as sewage systems which also acts as the productions of their food and using rice fields to filter their wastewater before its returned into the river. Kampung Naga scores really well as seen in the diagram on the previous page, because the village is part of an ecosystem.

This is similar to the urban plan development of EVA-Lanxmeer, which was based on the principles of permaculture. Which implies system based thinking, simulating the occurring principles in natural ecosystems. This is evident with EVA-Lanxmeer’s low-energy, heating and cooling system, which uses the drinking water system to reach the houses. The eco-village does not perform as well as Kampung Naga. This has mainly to do with their waste management. There is great potential to close cycles by connecting their waste flow with their food production. This could lessen their impact on the environment even more.

The differences between the two cases that score well and the case that does not, is that the two cases of Kampung Naga en EVA-Lanxmeer try to close their cycles by connecting them. Instead of using separate systems and individual houses, they have created an ecosystem that works as one.

## HOUSING LEVEL

Cosmo Estate does not perform well on housing level either. This has not just to do with the choices of building materials. This is mainly because of the construction method and the way connections are made between different building layers. For instance, a concrete cast structure with brick filling, is connected with the building services and covered in plaster. Almost every connection is made with cement and finished with plaster. This makes it nearly impossible to extract any building material or product for reuse and very hard to extract anything to properly recycle. Making the entire house after its lifespan, industrial waste.
Unlike in Kampung Naga, where the people themselves are responsible for the building through all of its phases. From construction to disassembly. Not only do they mostly use renewable materials, they also build the house in clear layers. Making it possible to properly extract building components. This allows them to repair and reuse building elements and lengthen the buildings lifespan.
Lifespan and durability was one of the key themes during the design phase of the houses in EVA-Lanxmeer. Building quality, floor plan flexibility and maintenance strategies all contribute. Therefore, the case study of EVA-Lanxmeer does score reasonably well. Where it could have improved upon was an end of life strategy to actually prevent the buildings from becoming waste.
The case studies of Kampung Naga and EVA-Lanxmeer show similarities in design for durability. An important principle within circular thinking. What becomes clear when studying the Indonesian housing cluster typology is the importance of building the house in separable layers, so that it can be properly disassembled when needed. Enabling our building industry to first repair, replace and otherwise reuse building materials and therefore, reducing the need for the usage of new materials.

## CIRCULAR ECONOMY

None of the three case studies has been developed according to the principles of circular economy. This shows when studying the cases, looking for new circular models used or businesses and partnerships made. Cosmo Estates has benefited using the linear economical model. Producing houses and selling them as product. Eva-Lanxmeer has mostly done the same and Kampung Naga does not sell products nor houses, but trades and provides free services to each other. There is therefore not much to compare on these circular principles.
The key-principles that are comparable and of importance towards, are their organizational and social structures within these neighbourhoods. Cosmo Estate had a top-down organizational development. An investor group bought the land, designed the master plan, built houses using multiple contractors and sold the homes as finished products to its future residents. This has led to low build quality housing and a severe lack of social cohesion within the cluster.
The organizational structure and social structure within Kampung Naga is hard to tell apart. They are so interconnected. The village's organizational structure shows many similarities to that of a bottom-up approached development. The people all share the same traditional Sundanese beliefs of balanced living in nature, knowing the limits of their land and not willing to exceed those, inheriting the land from their ancestors and knowing they are responsible to pass the same land on to their children. It acts as a shared vision that guides them into a life in which they minimize their impact on their environment.
These traditions and beliefs within Kampung Naga that show respect towards their living environment, are very similar to the ambitions and vision of Marleen Kaptein. It was her vision of living in a healthy ecosystem that made Kaptein initiate: EVA-Lanxmeer.
In the case of EVA-Lanxmeer, the project started as a top-down structured private initiative, that developed over time in a bottom-up culture. This transformation happened during the design phase. The urban master plan was at first, completely designed by experts without the influence of its residents. A top-down design phase. This made it possible for Kaptein and her experts to implement their vision of creating an entire ecosystem within this plan. During the second design phase, the design of the courtyards. They started to involve the future residents. This had two positive outcomes. 1. This was a way to share the EVA vision of a sustainable and healthy lifestyle with its residents, and 2. This was the starting point for a strong social bond between the residents, which has proven to be vital for its bottom-up structure that the neighbourhood enjoys today. It is this social structure that allows EVA-Lanxmeer to make decisions as a community, to explore new ecological innovations and to safeguard the vision of Kaptein with which it once began.

This shows not only the importance of social cohesion within a neighbourhood, but it also shows that a project development does not need to start out as a bottom-up initiative such as a traditional Kampung. As longs as the residents eventually become part of the organizational and social structure within its neighbourhood. Something that is lacking in the housing cluster typology of today.

## TO CONCLUDE

After comparing the three case studies with each other through the scope of the 15 key-circular-principles, we arrive at the conclusion. This chapter will be a moment to reflect upon the three neighbourhoods, their characteristics and what answers they provide to the research question:

*"What design principles and strategies are discovered to be the main contributors, when preforming a circular-economy-assessment on the three case studies: the Indonesian housing cluster of today, the traditional Indonesian village of the past and the Dutch modern day eco-village, in order to redesign the Indonesian housing cluster typology and reduce its environmental impact?"*

As a recap of the discussed case studies , the first one describes the housing cluster Cosmo Estate. Representing the typology of the Indonesian housing cluster, which has seen a rise in popularity among the growing middle class in Indonesia. Cosmo Estate is a so called gated community, harbouring 156 households on 3 hectares of land. Its public space mostly consists of asphalt and the whole perimeter is guarded by either a manned gate, concrete wall or steel fence. This case study lacks almost every application of circular principles and showcases all the areas on which future housing clusters can improve upon.
The second case study describes the Indonesian, Javanese village of Kampung Naga. This community has lived as a traditional village for hundred of years and remain to do so, whilst still interacting with modern society. The people practice traditional Sundanese beliefs, which have been passed on to for generations. These beliefs call for the people of Kampung Naga to live in harmony with nature, to know the limits of their inherited land and to not exceed it and its resources. Knowing that their children will inherit the same land. Kampung Naga has literally become part of nature's ecosystem and through that, unknowingly applied many circular strategies and principles.
The third but not least case study, is the story of Marleen Kaptein and her vision on a healthy and sustainable neighbourhood. This led to the creation of EVA-Lanxmeer. A Dutch eco-village in Culemborg, existing of 16 hectares of land with 300 households. The neighbourhoods ambitions and plans were based on the design principles of permaculture, which has many similarities to that of the origins of circular thinking. This became noticeable during the study and EVA-Lanxmeer has come to apply many circular principles.
So what answers did the case studies provide in our search towards design principles that could help redesign the Indonesian housing cluster and reduce its environmental impact? The key takeaways will be described in the same three categories that they have been studied in, to keep everything organized and clear. Cluster level, housing level and circular economy.

### CLUSTER LEVEL

Close the energy, water, waste and food cycles by connecting them into one system. Mimicking the biological workings of an ecosystem. Waste becomes food for fish. Rice fields and fish ponds can act as your sewage system. Drinking water can be used to heat or cool your homes when designed properly. Do not create a collection of individual houses each with their own individual systems. Create an ecosystem in which every house finds it place.

# CONCLUDING CHAPTER

### HOUSING LEVEL

Design houses in clear distinct building layers. Design a building on durability. Use flexible floor plans and create access for maintenance when needed or allow building components to be removed whilst the rest of the building remains intact. Do not treat renewable building materials with chemicals for they will not be able to be returned to the biosphere.
Document every used building material and component, this leads to a material bank which can be used for future project. Reducing the need for new materials.

### CIRCULAR ECONOMY

In order to create a sustainable living environment such as EVA-Lanxmeer and to safeguard its vision, strong organizational and social structures within the neighbourhood are vital. Healthy social bonds between people are key to a healthy community.

The housing cluster typology as it is designed today, fails in regard to almost every circular design principle. A complete redesign would be required in order to reduce the environmental impact of future Indonesian housing clusters. Stop developing the cluster as a collection of individual houses and start seeing them as a collective, an ecosystem that creates a healthy and sustainable living environment for all of its people.

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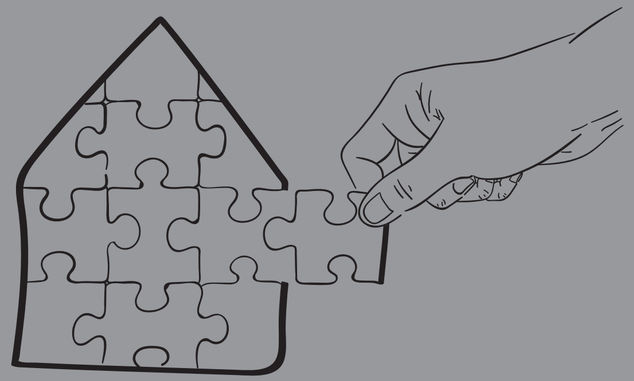
Photo above is contractor Joppie, with whom I have visited the housing cluster for my research and his wife. Who also owns the bed&breakfast 'the attic' at which we stayed. (2017)

# A perfect fit

creating supportive housing for the autistic



reflection report

# REFLECTION REPORT

**DISTRIK MELINGKAR**

A CIRCULAR NEIGHBOURHOOD
IN INDONESIA

Steffan Wi-Tak Hegeman
4092015

Reflection report, graduation Explore Lab
May, 2019

Delft University of Technology
Master Architecture, Urbanism and Building Sciences

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| Board of examiners | Inge Bobbink |

## ME, MY PROJECT AND WHY I CHOSE EXPLORE LAB

Growing up in the Netherlands with an Indonesian mother meant spending almost every other summer in Indonesia with just one goal: visiting each and every relative in six weeks. Hopping from one island to the other to do so. Most of my family lives in one single street in a harbour city on the island called Sulawesi. Rows of houses on a crowded street. It is hot, noisy, the smell of food mixes with that of gasoline, but nothing was out of the ordinary. No, it was when I visited aunts and uncles on the other islands when living conditions caught me by surprise. Not because they were poor, no quite the opposite. It was because they lived in large houses situated behind a guarded fence on empty streets. Each time we would drive up to the gate, show identification to the guard, who I as a child always mistook for a police officer, and drive right up to the house. There we would greet the aunts and uncles who's name I would always forget before I could finally play outside with my ball. I would walk onto these empty streets where cars are either driven or parked and walk right op to the fence. Looking outside I would see crowded streets, food stalls and people walking. The fence gave me a feeling of isolation. These moments were my first experiences with the residential typology of the gated community. Also known in Indonesia as, housing clusters.

Fast forward 20 years and I am a soon to be graduate student at the faculty of Architecture in Delft. At the same time my parents ask me to create a first draft for their house in Indonesia, the home town of my mother. I agree under one condition, that we have the ambition to lower the use of embodied and operational energy, by using mostly local materials and applying passive climate strategies. They agree. Then it hits me, I should try to make this my graduation project and not just do a redesign for one home, but do it one a much larger scale. Indonesia is currently facing a housing deficit of 15 million units. In order to try and resolve this problem, 800.000 units of formal housing are being build every year and the most popular typology in this fast growing housing market is, you have guessed it, the Indonesian housing cluster.

My goal was to do a redesign of this typology and create not just a sustainable home, but a sustainable neighbourhood. Explore Lab provided me with the opportunity to create my own framework for this ambition. Which was as challenging as it was fun.

## RESEARCH & METHODOLOGY

My research question is

What design principles are used when designing sustainable neighbourhoods and which ones would contribute towards a redesign of the Indonesian housing cluster, to minimize its environmental impact?

I visited Indonesia shortly after my P1. My tutor Mo Smit, via the Architectural Engineering Bandung studio provided me with the opportunity to join their team for two weeks in Bandung. This was very insightful but I had not yet created my eventual research methodology and framework. Making it hard to be precise with my observations in Bandung.

Then I started with a literature study into the circular economy model used in the built environment. This provided the knowledge with which I created a framework of 15 key design principles for neighbourhoods. These are divided into the three categories: Cluster level, housing level and Circular Economy.
I analysed and assessed three neighbourhoods using this framework. The three case studies were Cosmo Estate, Kampung Naga and EVA-Lanxmeer. The first is a traditional Indonesian village representing past communities, the second is a modern housing cluster currently built and the third is a successful Dutch sustainable neighbourhood.

Assessing and comparing these three case studies provided a lot of insight into the design principles and strategies needed when developing a healthy and sustainable neighbourhood.

The result was my creation of a framework with design principles needed to design my own housing cluster in the North of Bandung that would have far less impact on the environment then other currently build clusters.

The framework for my research was created after I had visited Indonesian and the case studies. In hindsight it would have been better to have changed the order within this process, but then I would not have had the opportunity to join my tutor and her team to the university and the many excursions and experts we got to meet.

## THE RELATIONSHIP BETWEEN RESEARCH AND DESIGN.

As mentioned above, the result of my research gave me the necessary insights and information to create my own framework with 15 key design strategies to help me fulfil my ambition of designing a healthy and sustainable neighbourhood in Bandung. These design strategies guided me through my design process, starting with the urban plan for 300 homes on a hill side all the way down to the design of the structural connections 1:5 that allow me to use bamboo as building material.

## THE RELATIONSHIP BETWEEN YOUR GRADUATION TOPIC, YOUR MASTER TRACK AND YOUR MASTER PROGRAMME.

Shaping my own project was challenging but allowed me to explore my own fascinations and interests. I always thought that I had this pure fascination for architecture and especially the building technical side of it. I am doing the Architectural Engineering master track in the master program Architecture. So it is no surprise that I am doing a design of stacked housing in Indonesia where a big part of my interest lay in the building method of my design. However, this project showed me that my interests go beyond merely architectural on the 1:100 to 1:5 scale. I enjoyed the process of attempting to theoretically creating a healthy neighbourhood in a country such as Indonesia. The sociological aspects, the ecological structure, infrastructure, the way a neighbourhood could work as an ecosystem by studying permaculture.
In the end I designed a residential area that ought to be a healthy and sustainable neighbourhood. Including a design for six residential units in a stacked housing typology. Which is a clear architectural assignment that fits within my master studies.

## ELABORATION ON RESEARCH METHOD AND APPROACH CHOSEN BY THE STUDENT IN RELATION TO THE GRADUATION STUDIO METHODICAL LINE OF INQUIRY, REFLECTING THEREBY UPON THE SCIENTIFIC RELEVANCE OF THE WORK.

The process of my research was bumpy from start to finish. Mainly because of personal reasons. This influenced my research methodology and the limited time in which I wrote my research. I am very happy with the insights my research gave me and it provided me with a lot of knowledge for my design process. However, I think it still needs a lot of work in order for it to be of proper scientific relevance.

# ELABORATION ON THE RELATIONSHIP BETWEEN THE GRADUATION PROJECT AND THE WIDER SOCIAL, PROFESSIONAL AND SCIENTIFIC FRAMEWORK, TOUCHING UPON THE TRANSFERABILITY OF THE PROJECT RESULTS.

The graduation project and its result as  a whole can be seen as a proposal for change within the mass housing developments of residential areas in Indonesia. With a main focus on the gated community. These developments scar the cities their in and are built with little to no regard for the environment. Even though change could easily be done through the application of smart and intelligent design strategies.

I am fully aware that my academic theoretical project is taking those changes to the extreme. And not every aspect of my proposal has been fully tested. For instance, the development process of my neighbourhood and the business models behind it are not backed through calculations at all. In all honesty, I have no idea if my proposal would be financially feasible for a real estate developer. However, what is transferable  on the wider social and professional framework are the proposed strategies that have been used within my project to create my version of a healthy and sustainable housing cluster. Allowing the next person with a similar ambition to take inspiration, ideas, strategies and evaluation out of my project and designing their improved version of a neighbourhood in Indonesia.