Indigenous Housing, Australia

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Msc 4, Explore Lab
Graduation Project
Indigenous Housing, Australia

Foreword

This project is a collaboration between the Aborigines of Ramingining, the Technical University of Delft, The Netherlands and the University of Technology Sydney, Australia.

Designing architecture in line with the traditions and identity of the Yolngu Aborigines.

I would like to thank the Yolngu Aboriginals of Ramingining for sharing their knowledge and patience. They learned me to understand their Dreamtime, identity and environment.

Also many thanks to the TU Delft, The Netherlands, and in particular Nimish Biloria, Chris Kievid, Robert Notrott and Ype Cuperus for making it possible to work on this Australia project.

Last but not least, the people of UTS, Kees Dorst and Bert Bongers in particular, for providing a place to help, explore and develop the architecture in Australia.

A life of thoughts become a life of being,

René-Paul van Leeuwen
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Introduction

The project started in September 2009 during a 1-month research visit with the Yolngu Aboriginals in Arnhem Land. After the research the Yolngu asked me to design buildings in line with their identity.

Because of the collaboration between TU Delft and the University of Technology of Sydney (UTS) also a visit of 1 week with them was arranged. The huge questions and problems in architecture, with most Yolngu Aboriginals in common, interest was shown by UTS and this made it possible to work for my graduation in Australia. Also TU Delft was very helpful and supported me during the last 2 years.

Now one year later the first design proposal is finished in the form of my graduation project. But also for the Australian Government in the form of funding and UTS in the form of becoming a promovendi in August 2012.

The location which is chosen as pilot is Ramingining, in the north of Australia. It has a sub-tropical climate with temperatures from 25-35 degrees annually. A strong collaboration and several visits gave the input and inspiration to know what can be a first solution towards respect and recognition towards Australians and the Aboriginals (worldwide).

The main influences in the design are: climate, cyclone proof, environmental materials, cultural behavior, traditional building techniques, traditional shaping, outside living - inside comfort.

The culture shows that the shelters from the past are made out of bendable materials (organic shapes) and layered structures (strength). This is the essence of the design translated into the present, in the form of laminated wood (local cypress timber). Research in the constraints and possibilities of the material where constantly the main ruleset for the design.

Wing-simulations defined the outside shape of the building. The walls inside are designed and positioned in way that the building is always open towards nature (depending on the position of the user) but still closed for a poetic route, discovering new elements all the time.

The roof is a louver system which can be open and closed according to the need of: sun, shade, sun + rain shelter or ventilation.

Most uncommon in the design, for most people, is that it is open. No privacy what we, as western people, are used to. For the Yolngu family, sharing and connected to nature at all time is a major part of their living in the past, present and the future.
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Location

Ramingining is a small, remote mainland community in the state Northern Territory, Central Arnhem Land located some 550 kms East of Darwin, nearly 30 km from the Arafura Sea and about 30 km south east of Milingimbi island. Arnhem Land got his name because of the expedition by Matthew Flinders and gave the land the same name as his Dutch ship, which was named by the dutch city Arnhem.

Ramingining is a traditional Aboriginal community with restricted access. Permission to visit is required by law and can be made through the Northern Land Council directly. Total alcohol restrictions apply, named as one of the Dryzones of Arnhem Land were the Yolngu live. The peoples’ language (Yolnu Matha) is primarily Djambarrpuynyu and Gupapuyngu however Ganalbingu and others are also spoken. In Ramingining are 828 people living. In total 517,200 Aboriginals live in Australia which is 2.5% of the total population of Australia. 80% Of the Aboriginals live in big cities.

Arnhem Land nowadays is lead by the Aboriginals called the Northern Land Council located in Darwin and have a dependance in Ramingining. The Council was established in 1973 to represent traditional Aboriginal landowners and other Aboriginals with interest in the land. By the Council the Aboriginals control the actions on their land and have written rights to communicate between the western society.

The Homeland Research Centre is a corporation made up about 265 members to who are residents of the 10 main homelands surrounding in Ramingining. A homeland is a region of an Aboriginal tribe which belongs to a family. The Homeland Resource Centre activities are becoming focused on enterprise development and the promotion of economic independence.

1 Aboriginal people of Arnhem Land
2 ‘Aboriginal and Torres Strait Islander Population’, Australian Bureau of Statistics, 1301.0 - Year Book Australia, 2008
3 Northern Land Council
Indigenous Housing, Australia Present, Functions

In Ramingining there is a school, clinic, a store and an Art Centre (Bula Bula Arts) that are all accessed by the Homeland Residents. ¹

In this mapping you see the build up of the functions in the village. Although its quite western build up, there is a strong connection towards nature and the universe. The reason of this is that there is no attachment to it and the many hours spend outside and in the bush. ⁴

¹ Ramingining Homelands Resource Centre Aboriginal Corporation
The housing of the Aboriginals are all given by the government and there is a small payment every month to use the houses. The reason for the rent is to keep the Aboriginals connected to their house and that they take care of it. Although, all the Aboriginals tell that they don’t want to pay for a house which is made for “Balanda”.

The identity of a “Balanda” house is different then of an Aboriginal. Out of research came up that all the Yolnu would like to have a house build in line with their own identity, traditions and environment.

By tradition two families can’t live together in one house. Because of this one house is almost empty and the other is overloaded. Some houses have such big families that they even sleep in the kitchen and bathroom. Houses can be separately build next to each other according to the amount of families.

Overcrowding is a common problem in Aboriginal communities and camps. Houses and tin sheds in Alice Springs' town camp are home to 10 people on average, sometimes to 17 people, in Mowanjum, an Aboriginal community in Western Australia, about 350 people share 42 houses, most of which have only three bedrooms. The housing problem has affect on the behavior in the form of fighting and learning problems. 5

To make clear how Aboriginals would like to have their house, the first step will be made by looking at the family size, particular needs of the area and the square meters. The second step will be the construction depended on climate, natural environment and available resources.

In western houses you have the main entrance linked to the living room. Attached to the living room is the kitchen, toilet and bathroom. Already two things are missing namely: the house is not build to have an open fire with a meeting room. Yolnu are originally nature people and they would like to have connection to their environment. A half open kitchen is more likely. Because fire can be integrated into it for cooking, heating and driving away mosquitoes, snakes and other insects.

5 "Report blasts housing "inaction", Koori Mail 447 p.7
6 *Aboriginal term for white people
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Present, Families Divided

As a result of the present housing status the families are living divided in the village. There is no family control, no passing on of the bloodline stories and therefore a growing problem of alcohol- and drugs abuse, young mothers, child rape and fighting.

Yolngu people used to be nomads in the past. Now, most of them live in remote areas together with their families. The reason for this change is the integration with the western culture and the change of climate.

The nomadic live was there because of the constant change of weather, circulation of food and water. Now the nomadic live is more localized into communities. Ramingining is one of the bigger communities in Arnhem Land, together with Milingimbi Island. Ramingining is the main centre with all the facilities (see Homeland Resource Centre) and have 10 outstations. The Yolngu tribe is divided into different families with their own hierarchy, which means that everybody has their own task and behavior into the family.

According to Paul Memmott, many of the houses the Aborigines built were dome structures. In the rainforest area around Cairns, in Queensland, where there was heavy rain for much of the year, people would occupy such villages for up to a year. Some of the houses had triple layers of cladding and insulation. In western Victoria, Aboriginal people built circular stone walls more than a meter high, constructing dome roofs over the top with earth or sod cladding.  

6 P. Memmott, the Aboriginal Architecture Of Australia  

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Past, Families Connected

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6 P. Memmott, the Aboriginal Architecture Of Australia  

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Fig. 7) Divided Family Positioning

Fig. 8) Nomadic Scheme

Fig. 9) Traditional Shelter
Bringing back the families is the foremost important implementation to strengthen the identity again. The 50,000 years old traditional living system will be used for this. It brings back the responsibilities and tribe bond, and also there will be lived again on the family homeland.

Take for example the North Line in the first diagram below: the father (M1), son (M2) and grandson (M3) stay in the same family line for his whole life to strengthen and guard his traditions, stories and responsibilities (protecting the bloodline). The woman who are born in a particularly wind-direction will leave (Gray Arrows) the family to another tribe / family. Therefore you only see man who are responsible for their housing or bloodline.

In the diagram, far below you see a family represented of 16 people. Its built up out of 3 generations:
- The elder, wife and son;
- The elder’s 3 sons and their wife’s living in the houses situated in the next layer;
- The elder’s 3 grand-sons living in the outer ring.

The son stays in the same family line for his whole life to strengthen and guard his traditions, stories and responsibilities (protecting the bloodline). The woman who are born will leave the family to another tribe / family. Or in other words, the wives in this scenario are coming from another family. Therefore you only see man who are responsible for their housing.
Neidji: “Our story is in the land. It is written in those sacred places. My children will look after those places. That’s the law.”

Because of this belief, their sacred, the positions of the houses will be picked by the Aboriginals themselves. Only the Aboriginals themselves know where their exact place to live is. Some would like to stay in the community Ramingining. Others would like to live on their own land, given by the traditions of their ancestors. The percentage is about 50-50.

To make houses in line with the environment most of the materials being used are cypress timber, clay, grass etc. Nowadays the houses are build up out of steel which costs a lot of money because of transportation, different companies to share their market and the high costs of machine equipment. By using local timber the material prices can be reduced. Also the chance to have local employment will grow. The local timber (Cypress) will be collected from the east side of Ramingining, across the river (marked with red eclipse). The rest materials such as paperback (bark) for the inside of the houses and rest materials will be used for making fire.

The climate of the Northern Territory is a tropical monsoon with two seasons: the wet- and the dry season. The wet season is from October to March and the dry season from April to September.

The temperature fluctuates from 18 degrees by night and 33 degrees by day. Sometimes the area has cyclones which is a value input for the designing process.

In Arnhem Land the average amount of cyclones is 1 in 5 years. A Category 1 cyclone’s strongest winds are GALEs with typical gusts over open flat land of 90 - 125 km/h. These winds correspond to Beaufort 8 and 9 (Gales and strong gales).

7 Bill Neidjie, Kakadu elder.
The building needs a high thermal mass with night cooling, direct evaporative cooling and indirect evaporative cooling.

There must be taken into account that these standards are made for western people. Aboriginal people are used to higher climate changes than normal.

The average solar radiation of Ramingining is 21 Megajoules/m² or 210 W/m². This will be used as the parameter for the production of electricity in the form of solar panels. Common solar panels have the constrain for organic designs that they have a plain surface. Nowadays techniques makes it possible to make flexible solar panels named: Thin Filmed Solar Cells (TFSC).

There has to be found a balance between creating constructions in line with the identity of the Aboriginals and the constraints the government has given for houses. Constraints are:
- the usage of building techniques which are present in Australia and used in remote areas;
- simple building structures;
- termite proof.

The diagram below shows the effect bio-climate chart for Ramingining. It shows what is needed to create a comfort zone for designs. From april till october the comfort zone, for most of the present architecture, can only be reached with air-conditioning.

Fig. 15) Bio Climate Chart

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Climate Responsive Design
Indigenous Housing, Australia
Design Influences

Tropical Climate, hot-humid:
- Elevated floors: airflow, animals away, wet season;
- Double layered roof construction, creates cold break;
- Shading, from the landscape / trees;
- Cooling strategies, through dehumidification, evaporation, airflow, and mass;
- Windows open to the microclimate of the site for ventilation;
- Site planning for the right positioning of ventilation;
- Veranda, creates shade outside.

Round shapes:
- representation of tree;
- Infinity;
- Meetings are held in a circle;
- Nature is organic, plain surfaces are human made.

Functions:
Yoingi would like to have a house in traditional style only when there is also western influence in it. The houses will have the following functions:
- Meeting room;
- Sleeping rooms;
- Kitchen;
- Toilet;
- Shower;
- Laundry.

Power connections for:
- Television and cellphone;
- Internet;
- Water and electra.

Wind-research will be used to design and shape the building for the cyclone periods.
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Wind Shaped Construction

Every two years there is a cyclone coming from the sea on land. The speed is about 90 km/h and the direction is always North-West. The building has to be elevated 1 meter for the wet-season and dangerous animals and insects.

To create a building which is streamlined for this situation, a wing simulation is used (Design Foil). Several simulations are made because of the measurements needed for a living according to the Australian standards. The parameters are: 1 meter of the ground, cyclone speed of 90 km/h and a height of 4 meters. The result is a construction with a length of 19 meters.

Round shapes are important for the Aboriginal. Representing trees and meeting, the wing then is modified to strengthen this feeling. In the picture below you see the modified wing as a structure for the building.

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Fig. 16) Simulation Wingshape Outcome

Fig. 17) Modification, Based on Program

Fig. 18) Structural Element, Roof + Floor
Indigenous Housing, Australia

One Main Material

The materials are mostly used by its environment. Only a small percentages of steel is used for the Louver System.

The culture shows that the shelters from the past are made out of bendable materials (organic shapes) and layered structures (strength). This is the essence of the design translated into the present, in the form of laminated wood (local cypress timber).

One Structural System

By using local Cypress Timber the parameters can be defined for a structural system. The chosen system is to laminate the Cypress. Qualities of GluLam compared to normal timber beams are:
- More bendable
- Stronger
- Stiffer
- Curved engineering structure

The government demands for laminated Cypress is Grade 10. Knowing the density a calculation can be made for the fire resistance and the rate of bending. The building system will be beams of 140x38mm with a variable in length.

Local GluLam (Grade 10)
Cypress Density 700 kg/m$^3$

Fire Resistant Level:
\[ C = 0.4 + (280/d)^2 \]
\[ C = 0.4 + (280/700)^2 \]
\[ C = 0.57 \text{ mm/min.} \]

Clarring Rate:
\[ Dc = C \cdot T + 7.5 \]
\[ Dc = 0.57 \cdot 60 + 7.5 \]
\[ Dc = 41.1 \text{ mm} \]

> 50mm after 1 hour:
50 + 41.1 + 41.1 = 132.2 mm$^2$

Min. Glulam size: 140 x 38mm
Max. Hight 5m
Indigenous Housing, Australia
Design
Indigenous Housing, Australia
Design Location

Fig. 21) Building Location 2D

Fig. 22) Building Location 3D
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Positioning Functions

Fig. 23) Housing Logic
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Applying “Wing” Structure

Every two year there is a cyclone coming from sea on land. The speed is about 90 km/h and the direction is always North-West. The building has to be elevated 1 meter for the wet-season and dangerous animals and insects.

Fig. 24) Section Logic

Northline Divided by 1300mm

1) Northline Points Divided by 1300mm
2) Middle Points Generations Outdoor
3) Rotation Point 1+2
4) Connecting Points 1+2+Northline Points
5) Apply Section (19m)
6) Loft Sections
7) Boundary
**Indigenous Housing, Australia**

**Walls**

The walls are pointing towards one centre-point. This way the users from two wings have contact with each other. In the pictures below it is the connection between North and West.

Also the wind direction is an input, where the walls function as a windbreak.

The walls are designed in a way that there is always the connection with nature, outside.
The roof is simulated with Rhino + Grasshopper. The angle of opening is 90 degrees. The behavior of the blinds is simulated realtime with the measurements and behavior of the real building.

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Roof

Fig. 28) Line Divided by 138mm

Fig. 29) Divided Points Connected by Lines

Fig. 30) Solid Components

Fig. 31) Perspective View Roof

Fig. 32) Perspective View Louver
Every unit inside the building has a bed made out of pandanus leaves. The leaves are used by the woman of the Yolngu to weave mats out of it.

Every individual unit has its entrance towards the alley in the middle. The beams, which creates the walls, are rotated around their axes for a continuous connection towards nature and surrounded family members who live around.

Power plugs are situated in the laminated beams for recharging cellphones and to be able to plug in other devices.

Art can be hanged at the walls.
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Design Renders

Fig. 35) Outside Location View

Fig. 36) Inside View Alley
Indigenous Housing, Australia
Technical
Indigenous Housing, Australia
Prefab Built

The building know 3 building stages:
1) The walls are positioned.
2) The “wing” construction is hanged in it. Build up out of 6 elements.
3) The roof will be made.

Fig. 37) Walls Positioned

Fig. 38) 6 Elements Structure

Fig. 39) Louver Close-up
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Situation Building

The building’s position is located next to the main road of the village. The two separate wings of the building are “connected” by a meeting space.

Fig. 40) Situation Building 2D
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Floorplan

Fig. 41) Floorplan 2D

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