

SETTLEMENTS AND HOUSING ON NIAS ISLAND ADAPTATION AND DEVELOPMENT

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ABSTRACT: On December 26th 2004 a major earthquake caused a Tsunami in the region of the Indian Ocean. The epicentre of the quake lay offshore the Indonesian Island of Sumatra close to its neighbouring island Nias. 3 months later Nias was again hit by a series of earthquakes causing death of 900 people.

Besides the human tragedy the earthquake the natural disasters showed that outstanding resilience of the vernacular buildings: whereas 80 percent of the modern style houses collapsed few old buildings were damaged, causing less harm to the inhabitants.

The traditional architecture of the Island of Nias is an outstanding example of the adaptation to specific environmental conditions. The design and the location of the settlements, used materials, building construction and techniques result from development over centuries.

Even though, the knowledge and application of these techniques is endangered due to different reasons.

The authors undertook an interdisciplinary excursion to Nias in summer 2005. The building surveys and results of ongoing interdisciplinary research shall finally lead to the development of earth quake resistant architecture in Nias for the 21st century considering indigenous principles, knowledge and techniques.

1. INTRODUCTION

Nias is a small island 120 kilometres west offshore the Indonesian archipelago of Sumatra. Until recently it has been renowned as a perfect surf spot only to a small group of people. In the aftermath of the Tsunami, on the 28th of March 2005 Nias was struck by a severe earthquake, which destroyed numerous buildings. About 900 people lost their lives in the collapsing houses. Only these recent natural disasters made the island known to the general public.

Significantly most of the destroyed buildings have been built out of concrete within the recent decades following western influence, but not meeting western standards concerning foundation and safety. In contrast comparatively few vernacular houses collapsed or were damaged by the quake. In the indigenous architecture of Nias special constructions have been developed over many generations to make buildings resistant to earthquakes. Particularly interesting are the foundations and the elevation with unique and complex arrangement of vertical and diagonal columns. If the buildings are well maintained they can last over generations and withstand even strong seismic shocks. Even if damage occurs the threat to life is not as dangerous due to the relative lightness of the wooden constructions.

Although the vernacular architectural of Nias has undoubted advantages the people prefer to build bungalow style buildings made of concrete following modern influences. The recent catastrophe may start a process of reconsideration of the traditional ways of building. Research of the indigenous building types has to be carried out in order to apply the findings to the design of new forms, constructions and typologies.

The Viennese Institute for Comparative Research in Architecture started to work on a documentation of the traditional building methods in Indonesia in 2003. A first outcome of the research has been published in a documentary

film, which was finished by the time the Tsunami hit the region. Our first reaction was to use the presentation of the preview to collect donations for the victims.

Furthermore the building surveys will provide a basis for comprehensive analysis of the traditional buildings in Nias. In interdisciplinary cooperation with Indonesian scientists and considering the indigenous construction principles, knowledge and techniques, proposals for future earthquake resistant architecture will be worked out.

2. ABOUT NIAS

“Tano Niha”, the island of men, is about 150 km long and 50 km wide. This part of the Indonesian archipelago includes also smaller islands in the south and north which sum up to a total area of 5625 km². The topography of the main island of Nias is characterised by big rivers, valleys and mountains up to 887 meters high. The climate is tropic, warm with a humidity of 80-90% and an average of 250 days of rain per year with frequent storms and heavy rains.

Due to the rough topography Nias is not densely populated. In the region of the capital is Gunung Sitoli live 65.000 people. The largest town in the south is the port Teluk Dalam. Two more towns to mention are Lahewa in the North and Sirombu on the west coast. Especially Sirombu was badly hit by the tsunami.

Traditionally villages were built inland. Coastal settlements were founded as base for trade with the Netherlands and later as missions in the 18th and 19th century. They have grown significantly and accommodate the majority of Nias population nowadays.

The infrastructure in Nias is in general very bad. Only the main roads from the capital are paved. Heavy rains, landslides and big rivers make it difficult to maintain the traffic routes. The street along the east coast is relatively new and now in a good

condition. Smaller routes inland are still gravel roads or just footpaths connecting the villages. Electricity is only available along the bigger roads. Water supply is still a problem in most regions.

In former times Nias has been densely forested with primeval forest rich of species. Today only few of the original forest is left and good building timber is scarce. Unlike the neighbouring Sumatra Nias has no fertile volcanic soil. The land along the rivers and the coastal plains are agriculturally used. Extensive plantations of rubber and patchouli cover the island, its export are the main sources of income. Besides banana, coconut, cacao, and rice are harvested. In agriculture also animal husbandry is important. Pig breeding has special significance as pigs are needed for all sorts of feasts and rituals. Fishing is also usual but only on a small scale.

3. TECTONIC SITUATION

In the aftermath of the Tsunami in December 2004, on the 28th of March 2005 a severe earthquake struck Nias. The epicentre of the earthquake lay just 100km north of the capital Gunung Sitoli. The massive shocks destroyed 80% of all modern buildings. 900 people lost their lives in collapsing houses.

Nias is part of a very active tectonic area. Lying on the fracture zone of the so called Eurasian and Indo-Australian tectonic plates it is shaken by earthquakes regularly causing the inhabitants to call Nias "the dancing island". There is no volcanism, but very unstable ground condition with big regional differences.

4. POPULATION

The history of settlements in North Sumatra and Nias is still unclear, but historians assume that the island has been continuously settled for at least 1500 years. Settlers came from Southeast Asia and imported a culture cultivating rice, processing metal and erecting megaliths. As the natural resources on Nias always have been limited people are depending on economic exchanges with neighbouring Sumatra, trade was and still is of high significance. An Arab trader who mentioned an island off shore of Sumatra in 851 made so first records about Nias. Nias was known by then not only because of its richness of swine, but also the light-skinned slaves of the island. Especially the people of South Nias have been dreaded for their martial behaviour of head hunting and enslaving people.

In the second part of the 19th century the Netherlands colonised Nias and Missionaries followed also from Germany. At that time the written recording and research of the so far oral history of the island started.

After a short period under Japanese rule Indonesia claimed independence 1945 under Soekarno, later Soeharto. Today Nias belongs to the district of North Sumatra, and is divided into Kecamatan Nias and Nias Selatan.

Population census: 1900	estimated 150.000 (Schröder)
1961	300.000 (Government figures)
1996	633.630 (Government figures)
2003	760.000 (UN figures)

The number of inhabitants of Nias is still rising although many people left the island in the last two years. The population growth is the reason for many big problems.

5. SOCIETY AND CULTURE

Although the island of Nias is not big the culture of the various regions is differs significantly. Due to the rough topography the development of society and culture took place independently. In

the South society was hierarchically structured and based on kinship. On top of the social pyramid of a village stood the king. His house symbolised the outstanding position of the owner in dimension and design. Nobles and commoners shared the villages. The lowest hierarchical step built by the slaves with no rights. The slavetrade brought wealth to the South nias villages and was common already before European influence. Even today everyone on Nias belongs to a clan that can be wide spread but is still held together by the joint forefather. The affiliation to a clan is passed by the father in the patrilineal system. There is a very complex system of crosslinear marriage. In North Nias the structure also based kinship but the hierarchy has never been so strict. Still, each village is headed by a chief whose house can be recognised by the number and size of megaliths in its front.

The traditional law, the "Adat", regulates every day life of the people. The unwritten rules regulate any part of life and demand a specific rhythm of rituals and feasts, for which Nias was famous. (Hämmerle 1999, Beatty 1992) The Adat is still very important, even if society is about to change radically.



Gathering in the Village of Bawomatalou, Schröder 1917

6. EARTHQUAKE MARCH 2005

A major earthquake occurred in the night of Monday, March 28, 2005. The magnitude was 8.7 on the Richter scale and the epicentre located 90 km south of Sinabang with in a depth of 30 km. No Tsunami was triggered, but the earthquake was also felt in Thailand, Singapore, Malaysia and Cocos Island and Australia. Major effects were noted in the areas of Nias and Simeulue Island.

The biggest damage through the earthquake happened in the populated coastal areas especially in Gunung Sitoli, enhanced by the bad alluvial soils and the cheap concrete structures. These were responsible for 758 casualties, 705 persons badly hurt and 781 people hurt. 84,388 persons are still internally displaced (IDP), living in camps or with host families.

Reports from local authorities stated that 70% of buildings collapsed in Gunung Sitoli town. Telecommunication facilities were totally destroyed. 50% of all bridges were destroyed and land transportation blocked. Also electricity was cut partially.

About 50% of all public buildings were destroyed. Out of 122.652 housing units about 71.000 were damaged or destroyed. (IOM 2005)



Centre of Capital Gunung Sitoli, August 2005

Significant differences could be observed considering building materials. Most casualties were victims of collapsing concrete structures. The benevolence of wood, not only in the traditional, but also in the Malayan style buildings saved lives.

The (usually bad) economic situation of the island was boosted by the recovery efforts of the government and international help. But this upswing comes together with high inflation and a serious shortage of raw material.

7. CULTURE ZONES

Original traditional settlements never were by the sea. Indigenous inhabitants of Nias agree that the culture began in Central Nias in an area called Gomo. (Feldman 1984)

Due to the rough topography most of the settlements were erected inland, in the most southern and most northern parts of the island. The territories were isolated and developed independently. Differences in social organisation and village formation divide Nias into at least three distinct regions: north, central and south. The west of Nias is recently referred to as a fourth and modern cultural zone. (Hämmerle 1999)

Between the regions there are linguistic, social and cultural differences, as well as diversities in architecture. Each cultural zone developed a particular house typology.

8. TYPOLOGY OF TRADITIONAL NIAS HOUSES

North Nias houses have an oval floor plan, rows of diagonal bracings (X form) in the substructure and a huge hat like roof. Central pillars lead from basement to ridge pole. The façade is all around the house.

In Middle Nias houses have a rectangular floor plan, slanting sidewalls and an oblique front façade, which is often decorated with carvings and/or colour. In the substructure v-shaped diagonal bracings are significant. Layouts of Central Nias houses can vary from rectangular to cross-shaped. The hybrid typology of these houses has not yet been fully examined. Research on its origin and influences on North- and South Nias types will form an important part of our project.

Houses of South Nias have a rectangular floor plan, straight load bearing sidewalls and a slanting front façade. Significant is the v-shaped diagonal bracing in the front façade and the very high steeply pitched roof. Houses are built side by side in a row. So the house has just one front façade with open louvers and decoration.

All house types are entered from the side, the entrances sometimes being very creative annexes. In former times the houses were entered from below through bottom flaps. In the core of the house used to be the fireplace. Under the colonial rule of the Netherlands a decree ordered that kitchens had to be

placed in an annex outside the house. Nowadays all kitchen and sanitary facilities are situated in these annexes. For the oval shaped North Nias houses the annex construction is quite difficult. No typology has yet evolved for these recent building parts.

Very significant for all Nias houses are the window flaps in the roofs. This kind of opening is peculiar to the island of Nias and cannot be found elsewhere in the Archipelago of Indonesia.



North Nias house, Sihare'ō Siwahili

9. TRIPARTITE STRUCTURE

The construction of the buildings has evolved reflecting the tectonic situation under the steady threat of seismic shocks.

As in many other types of houses in Indonesia, we also find in all Nias house types a vertical zoning of three different levels, each level having its own structural system and serving a different function. The tripartite structure refers to a spiritual differentiation: the underworld, the present world and the upper world of the ancestors.

The ground floor represents the underworld. This originally open space is only used for storage and for animals. The living area allegorises the present world, the place where every day life takes place. Ancestors and gods have their space in the roof as the place of the over world.

Besides the spiritual meaning of the tripartite zoning this construction idea is responsible for the earthquake resistance of the buildings.



South Nias houses, Bawomatalou

The houses rest on a structure of vertical and oblique posts which are placed on slabs of stones. Vertical posts and X and V bracings are the elements of this substructure. The three-dimensional structure offers great resistance and has the required elasticity because it does not settle in the ground. The

separation of the house from the ground is the most important concept for earthquake resistant building in traditional form.

The first floor - the living floor - is in itself a very stable boxlike structure. Even if the substructure collapsed, the box persists. In the 11 villages we visited, nobody was killed during the earthquake of 28th March 2005 due to the breakdown of a traditional house.

The living floor is separated into public, private and transitional spaces either by wooden walls or changes in the height of the floor. This element to organise space is most elaborate in South Nias houses and will show up also on the village level.

Large openings over whole front facades provide good ventilation. They enable the inhabitants to overview the neighbourhood. Depending on the distance to the opening a good control of contact and visibility is possible.

Houses are hardly furnished, the inhabitants belongings stored in chests. The most important piece of furniture is a long plank below the louvers, which the tenants use as a bench.



Interior of the front room of a South Nias house

The steeply pitched roofs are a notable feature of Nias houses. The roofs of the chief's houses, called "Omo Sebua" can reach up to 20m. Still most roofs are covered with palm leaves, although the use of tin is getting more popular.

The light multi-storey roof-construction is resting on 2 main pillars in the North and Middle Nias type, and on sidewalls in South Nias. The steep sloping roof zone is a very light 3d structure. Minimising material is the most important issue of this intelligent construction. Furthermore, the large overhangs protect the wooden connections from rain and provide additional space outside.

10. MATERIALS AND DETAILS

For the traditional house only local grown plant material was used. Even nowadays the use of metal even for the renovation of traditional houses is avoided. The wooden beams are jointed using elaborate mortise and tenon connections. They are very flexible and don't break in case of earthquakes. Loosened connections can be fixed easily.

Different kinds of wood are used according to the position within the construction. Noticeable are the posts of a very slow growing hardwood called "Manawa Danö" which is used in the North Nias houses. As this wood is very hard and trunks are built in the construction as they are grown, the posts of the substructure have very different shapes and give the substructures very interesting designs.

For the interior of South Nias kings houses huge plates of ebony have been used being most impressive. With the beginning of extensive cultivation of land for plantation the growth of building timber declined.

Ebony was grown on the island of Telo but also here it is getting scarce. Apart from wood, palm leaves and bamboo are still used for the roofs and coconut fibres are used for binding.

Natural stones are used for the base underneath the posts in the substructure of the houses. For the pavement of the roads especially in South Nias slab stones are laid very exactly.

Similar techniques and designs of carving are applied to wood.

South Nias houses have the fine decoration inside the house. The wooden carvings show the status of the owner. Especially the Omo Sebua have numerous fine carvings.



Omo Sebua in Hilinawalö Mazinö, South Nias

11. SETTLEMENTS

The structure of the settlements in the three regions reflects directly the different typologies.

11.1 North Nias Villages

Traditional villages in the northern part of Nias consist either of groups of 6 to 12 oval houses, which are being oriented longitudinal-side towards the street, or single cottages far away from each other, also in oval shape.

In former times the settlements were fortified with fences of bamboo or with an earth walls overgrown with trees. In front of the houses traditionally megaliths are placed. These stones symbolize the connection between the living and the dead. They reflect the social status of the house owner. Nias is famous for its megalith culture, culminating in the elaborate pieces of South Nias. The houses were entered from the village square, through a bottom flap underneath the house. A staircase has replaced this entrance or a front porch as this defensive preparation is not needed any longer.

The situation of the settlements was very well adapted to the environmental conditions. Some villages in Middle Nias are situated in valleys along rivers. The villages in South Nias are

on high ground, mostly on top of a hill, with excellent views and easy to protect. The orientation of the main axis depends on the main direction of the surrounding topography, as is clearly visible on the satellite image.



North Nias settlement, Onolimbu

11.2 Central Nias Villages

Settlements in Central Nias are with scattered single buildings or combined houses. Although the settlement history of Nias has its roots in Central Nias nowadays the architecture of this region appears as a hybrid of northern and southern styles. Like in the villages of North Nias the settlements are a collective of single buildings. But different from the North the houses can be combined and are situated with their eaves facing the village square. This orientation and the rectangular floor plan are also found in the South Nias villages. The space in front of the houses is paved with stones and is used for drying agricultural products or laundry. Stairs and steps are used to define spatial relations. Interestingly the combination of two Middle Nias houses can happen in two variations: sharing a common entrance-space in between (South Nias variation), or standing closely together and thus having two separate entrances on the sides.



Middle Nias house, Gomo area

Characteristic features of the architecture in Central Nias are decoration and ornamental art. At the fronts samples and animal representations serve as protection for the house and its inhabitants. Other symbols inform about the conditions of the family regarding fertility, for example the number of women living in the house.

11.3 South Nias Villages

South Nias is famous for the traditional rowhouse - settlements. Villages in South Nias are situated on hills and are named after their location. In the past, when warfare and headhunting raids were endemic, an outer palisade of sharpened bamboo stakes fortified the village with a deep ditch behind. The settlements can consist of several hundred dwellings arranged on either side of paved street, which may be up to 100 meters long. The basic linear street pattern can be enlarged to T- or L shaped configuration.



Village of Orahili, South Nias

The layout of these villages reflects the structure of the nias society. One village was the settlement of one clan. People lived together on a very narrow space, under constant social control. Due to the elevated sites of the villages they have to be entered by grand stone staircases forming the beginnings of the streets. The entrance situation is always accentuated, impressive stair cases are flanked by symbolic protective animals, lizards. The stability of the site is required for any earthquake proof building. On our field trip we found that all of the old village cores are built on exceptional good ground. The stability can vary locally to a high degree. Just in very few cases topographic situations were not considered thoughtfully like in the village of Siwalawa, where the earthquake has triggered a big landslide, breaking away the new village extension just beside the staircase of the old settlement entrance.



Hiliamaeta, South Nias

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the structure of the Nias society. One village was the settlement of one clan. People lived together on a very narrow space, under constant control.

Between two coupled houses covered entrance terraces are shared by pairs of adjacent households. Neighbouring houses are also connected with doors to provide escape routes, which were needed in the past.

The houses have a public room in front and sleeping rooms in the back. The front room is lighted by an opening, which is stretching over the whole street facade and is secured by a wooden grid. Like in the north the furniture is sparse. Constructive elements of the cantilevered front façade create different floor levels in the interior space, being used as benches and for storage purposes.

The standard typology of the South Nias house is a rectangular shaped elevated row house construction oriented with the eaves towards the street. The substructure is made of 4 rows of strong pillars (Ehomo), reaching from ground to first level. Diagonal posts like in North-Nias houses support them. But on the contrary to this typology here the v-shaped columns are situated at the very front, acting as support and as representative element. Again, all house posts rest on foundation stones on one hand to prevent them from rotting and on the other hand to make the construction as a whole more flexible. The space created beneath the house is used for storage and as a stable.

In contrast to the "normal" houses the houses of the chief are entered from below over a staircase. The house of the chief was usually the largest structure and is located at the centre of the village. Beside it there used to be a meeting house, called bale. In some cases more than one Omo Sebua existed.

Due to the change in society only four Omo Sebua still exist in Nias. The loss of these structures is usually followed by a fast decline of the traditional architecture of the village. To keep the structures alive, a new function would have to be found.

Meeting places are still very important in the villages and are frequently used for village gatherings. The traditional building type of the meetinghouses (*Osal*) has not survived (Schröder 1917), but modern meetinghouses are common and situated in the centre of the village. The traditional stone benches in front of the Omo Sebua are still used for village meetings.



Centre of Hilinawalö Fau, South Nias

All parts of the settlement spaces form a hierarchy that refers to the transition from private to public. The most private part is on the backside of the house. The living room is in front. Between two coupled houses covered entrance terraces are shared by pairs of adjacent households. Neighbouring houses are also connected with doors to provide escape routes, which were needed in the past. In the covered area in front of the houses

along the street semi-public space is used for working, socialising and for transition. A drainage gutter defines the border. The following area towards the street is reserved for the megaliths as representation space. This zone is called "wall of stones" (*öli batu*) and indicates the rank of the householders. The megaliths are a kind of petrified model of the social hierarchy and feasts of merit. The stones are classified by gender, and come in a variety of forms, which include menhirs, benches and circular seats.

The space between the *öli batu* and the public walkway in the middle belongs to the respective house and has to be maintained by the owner. It can be used for drying agricultural products or laundry. In the case of the catastrophe, which caused heavy damage to the houses, the space is used for temporary shelters. The only real public space is the narrow walkway.

Because of the remoteness of the villages in the south help has not yet reached most places. The lack of building material prolongates the situation. People don't have the resources for the maintenance of the houses any longer. Bad maintenance is the main reason for damage of traditional houses.



Hilinawalö Mazinö, South Nias

12. OUTLOOK AND CONCLUSION

Our research project serves as a documentation of the present situation and we hope to stimulate the support of the reconstruction efforts. The traditional knowledge and the qualities should not be lost but find a new and modern interpretation. Modern settlements lack the spatial qualities of the traditional villages. Common places do not exist (with rare exceptions), even markets happen to be just beside any street. The existing building regulation obviously couldn't provide reasonable guidelines for settlements.

Traditional shapes are influencing modern buildings. But what is learned from tradition until now is pure form. The diagonal bracing of the South Nias house became a characteristic emblem for Nias, which is used on many public buildings. But also private house owner make use of a formal reinterpretation of these elements. Although they lack their former constructive function, they stand for a stability, which could have been provided much easier using concrete as a building material.

The book and the film documentary, which are in the course of production, will be shown to public audiences in Nias. All research material will serve as a basis for future projects. We hope that it will be used for the enhancement of the situation of the Nias people.

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In the winter term 2005 a design program was carried out at department of HB2 of the Vienna University of Technology to apply the knowledge of the traditional architecture on future designs.

REFERENCES

Beatty, Warren: Society and Exchange in Nias, Clarendon Press, Oxford, 1992

Brenner-Felsach, Joachim; Mittersakschmöller, Reinhold (Hg.): Eine Reise nach Nias, Böhlau Verlag, Wien Köln Weimar 1998

Feldman, Jerome: Fragile Traditions, Indonesian Art in Jeopardy, University of Hawaii Press Honolulu 1994

Hämmerle, Johannes Maria: Nias - eine eigene Welt, Academia Verlag Sankt Augustin 1999

IOM: Post Disaster Damage Assessment on Nias and Simeulue Island, June 20, 2005, The International Organisation for Migration

Schröder, E.E.W.Gs.: Nias., Brill E.J. Leiden 1917

Tjahjono, G. (Ed.): Indonesian Heritage: "Architecture" Archipelago Press, Editions Didier Millet, 1998

Viaro, Alain M.: Urbanisme et architecture traditionnels du sud de l'île de Nias, Etablissements humains et environnement socio-culturel UNESCO 1980

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