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The Significance of Traditional Materials and Their Substitution with Newly Available Materials

The Effects on House Form of the Atoni Building Culture

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Abstract – This article focuses on the region of Central Timor, settled by the Atoni Meto people, who live in round houses built on the ground. There seem to have developed local peculiarities in vernacular architecture, which require the use of wooden materials of different size, shape and state of processing. Changes in local vernacular architecture were also induced by the recent availability of modern materials such as bricks, concrete and corrugated iron. The aim of this article is to explore how such building materials are used and whether they are/ can be integrated into local vernacular building traditions. Fieldwork conatining architectural survey was conducted in Timor in May 2004 in Maubesi, and in June 2011 near Soe and Nikiniki (villages None, Supul and Boti) and Kefamenanu (among others the villages of Fafenesu, Maslete and Tamkessi). Some of the materials seem to have a strong effect on the layout or design of the buildings, whereas in other cases, such effects are far more subtle. In some cases, the new materials are used to imitate the more traditional ones, with astonishing results, and often incorporating structural details from the older technology and traditional materials which are copied. New materials already influence the building due to their different, new properties, and designs are devised to adapt to these changes, which in the end result in an altered building. In other cases, there is no compatibility at all, and old forms and designs are abandoned in favour of a new concept supported by new materials.

Keywords: *Atoni, Timor, vernacular architecture, wood.*

I. INTRODUCTION

The focus of this article is material and structural change in architecture and the use of different materials in a specific Indonesian region, Central Timor. In this case study, the buildings of the Atoni Meto in Central Timor will be examined in more detail. The Atoni Meto live in West Timor and Central Timor, which was historically divided into ten princedoms (Amarasi, Fatu Leu, Amfoan, Mollo, Amanuban, Amanatun, Miomafu, Insana, Beboki and Kupang), but the author´s field of study is focused on the areas near the towns of Soe and Nikiniki, which are situated relatively far from the coast, at a

somewhat higher altitude (about 800m above sea level), and the area around Kefamenanu, which is more to the North-East and situated at a somewhat lower altitude (about 400m), but still in a region dominated by hills and small mountains (see Fig. 1). Historically, Nikiniki was the seat of the Raja of Amanuban. Today the King´s family still resides there and is involved in public affairs (the last raja, Nesi Nope, was mayor of Nikiniki before being crowned raja). Kefamenanu was founded as a Portuguese trading post, but lies within the boundaries of the historical domain of Miomafo. The historical rajadoms (princedoms) were recognised by the Dutch after administrative colonial takeover and called "landschap". The Dutch occupied the interior of the island from 1910 to 1915 (see Cunningham, 1967, p. 64). After independence, in 1950, Indonesia took over these Dutch administrative units without much alteration, but renamed them "swapraja". Today, West Timor is divided into four larger units known as "kabupaten": Kupang, Timor Tengah Selatan (TTS, South Central Timor), Timor Tengah Utara (TTU, North Central Timor) and Belu. The historical princedoms have been kept as sub-units of these larger entities, and although the influence of the rajas has been weakened, the importance of the traditional structures is still significant (see also MC William, 2002, pp.27-31). The author carried out field research in the region in May 2004 and in June 2011. This corresponded with the dry season, which is usually also the time for house building. The climate can be described as follows:

"The monsoonal climatic pattern is one of the principal influences on the environment in Timor, and is characterised by a short intense wet season followed by an extended period of seasonal drought. During the wet season the western monsoon brings heavy rains, generally of short duration and often associated with severe soil erosion and flooding. By contrast in the wet season from May to December, there is little or no rain except in a few topographically favourable locations. Dry winds from the Australian continent blow continuously, rivers slow to a trickle and ay even dry up completely, and the landscape, bleached by the sun, becomes increasingly sparse and dusty " (Mc William, 2002, p. 25).

So far, the most definitive study of the Atoni Meto house was written by Cunningham (Cunningham, 1964), who worked in the Princedom of Amarasi, which is to the South-West of the author's research areas. Although houses there seem to share many of the characteristics of houses in the region of research, there also seem to be certain local peculiarities and differences. Probably the most marked difference is that the Amarasi houses are rectangular and have a distinct wall zone, although these characteristics (at least the rectangular ground plan) are apparently caused by external influences, and the overall nomenclature of building elements and structure of the buildings is still in alignment with the round houses built in Amanuban and Miomafo. In 1987, the Japanese researcher Koji Sato visited the Atoni region and surveyed several buildings: an account of his work can be found on his homepage (Koji, 2021). McWilliam (2002, p. 225-243) gives a very good account of the houses found in South-West Ammanuban, while also comparing his findings to Cunningham´s. The findings of the author's field research fitted well with both accounts, although there also seem to be smaller local peculiarities, such as differences in the nomenclature of building parts and the shape of the buildings. Whether there are larger differences regarding the symbolic system or the use of space within the house could not be determined, as field research was too short to be able to gain such in-depth views. Work was mostly focused on the structure of the buildings as such. A recent study worth mentioning is the account of Christoph Müller (Müller, 2013) whose research was conducted in roughly the same region as the author. In 2013 another study was published, on houses in Kaenbaun village (domain of Miomafo, somewhat northeast of Kefamenanu), with plans and analysis of the use of interior space (Kurniawan et al.), also in 2020 and 2021 studies where published about the settlements of Tamkessi (Lake, 2020) and Maslete (Sitindjak et al., 2021), both locations, where the author also did field research.

The houses of the Atoni Meto near Nikiniki and Soe have round, domical roofs, no walls, and are built directly on the ground, while houses around Kefamenanu are also round, but have a conical roof and a short roof ridge. The latter houses also incorporate walls. Additionally, the Atoni have a granary and community building, a "lopo", which has four large pillars and a round roof, the exact shape of the roof depending on the area where the lopo is found. In fact, like the houses, the roofs of lopos near Soe and Nikiniki are domical, whereas near Kefamenanu, they are conical. Interestingly, the four-pillar internal support structure of the lopo can also be found in many (although not all) dwelling houses, which led Domenig (Domenig, 2008, pp. 493 -497) to believe that the houses are in fact converted granaries. Müller (1839-1844) also published descriptions of Atoni buildings, where one house was a converted lopo with a distinct wall zone and rat guards on its pillars.

In the author's opinion, although the phenomenon of granary-to-dwelling house conversion is very common in the wider geographical area of the Lesser Sunda Islands, in Atoni architecture, it is probably not a conversion as such, but rather an adaptation of the system developed in the lopo. The attic structure of the dwelling house seems to be a smaller, but almost identical copy of the four-post structure of a lopo. Usually, when people moved into granaries in other neighbouring regions, they did so in order to dwell aboveground (usually inhabiting the roof area used for storing the harvest; as is the case e.g., on Alor (Zámolyi, 2013) and probably in the case of the Donggo houses on Sumbawa (Just, 1984). It makes perhaps no big difference how this phenomenon is addressed: the fact is that most Atoni Meto houses and lopos share a very similar inner structure. Koji Sato (Koji 1991) believes that ordinary people copied or adopted the structure because they were not allowed to have a lopo of their own. And in fact, near Nikiniki, lopos are linked to clans (meaning there is only one lopo per clan), which meant that not everybody was allowed to erect a lopo. On the other hand, this seems to have changed recently, and probably was also not handled with the same strictness in each region.

Another type of building, sacred buildings known as "ume leu" seems never to have adopted the four-post inner structure, as it has only one central post, whereas in the greater region of Kefamenanu, ordinary dwelling houses also seem not to have adapted the four-post structure, and have only one or two main posts. Some larger buildings which have a short roof ridge have two posts. Historical records on the area near Nikiniki and Soe also suggest the presence of a former house-type without the four-post inner structure, but rather only a central post supporting the roof (Müller, 1857:239).

From the structural point of view, all regional building forms are connected through their round ground plan and the special solution developed for holding together the rafters: a ring or cable made of lianas, which runs around the inner side of the roof. All the rafters are lashed to this cable-ring, and there are three such cable-rings at different heights: one at the bottom of the roof, one in the middle and one near the top.

Interestingly, many differences between buildings found near Soe and Nikiniki, and buildings found near Kefamenanu – differences in roof shape, supporting structure and the presence or absence of walls – can be explained by the choice of material used, which in this case spans a range of different types and differently-sized wooden elements, as will be explained in more detail later. A discussion of whether the choice of material and the resulting form was deliberate, involuntary, or influenced by factors such as the availability of resources or other issues would go beyond the scope of this article, but it might be an interesting topic for further research – requiring longer and more in-depth field work.

II. METHODOLOGY

The aim of the research was to obtain source material for the author´s work on structural aspects of Indonesian wooden architecture (for other research areas see also Doubrawa & Zámolyi, 2007, Zámolyi, 2013). The most important goal was to provide an overview on the state of vernacular architecture in the region. A few objects were selected for more detailed investigation. These objects were selected either because they were typical (representing features shared by many other buildings) or seeming to be old, or because they were unusual for some reason (new architectural solutions, use of new materials). Of all villages visited a general photo-documentation was done, which meant that almost all buildings were photographed from the outside. The further research concentrated on architecturally important features, especially the structural system of the buildings. This article presents a more general approach, which tries to show trends in the change of vernacular architecture in the region.

Fieldwork was conducted in May 2004 in Maubesi, and in June 2011 near Soe and Nikiniki (villages None, Supul and Boti) and Kefamenanu (among others the villages of Fafenesu, Maslete and Tamkessi). Overall time spent in the area was in 2004 four days, in 2011 approximately ten days.

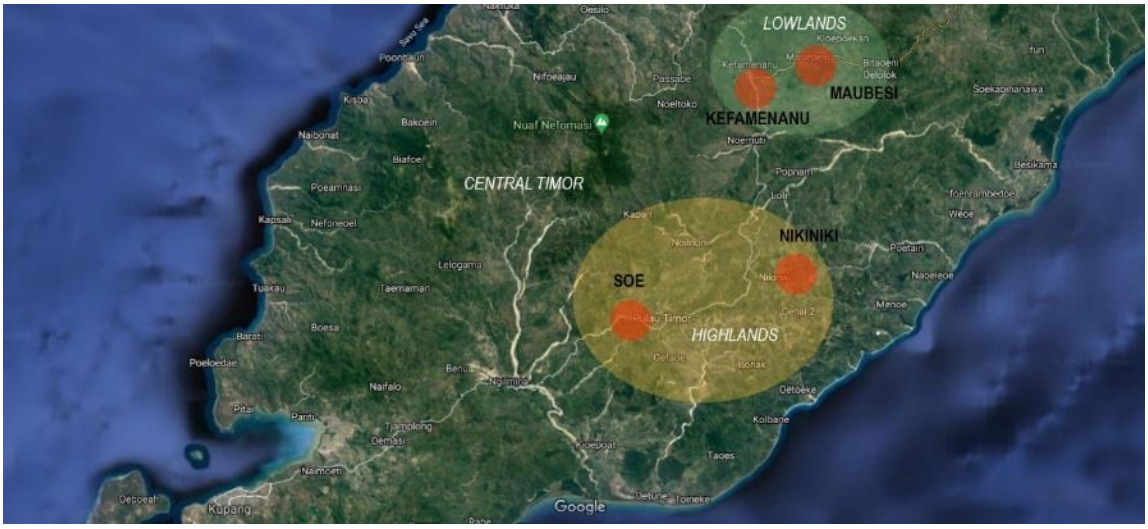

Fig. 1. Map of Central Timor With Main Fieldwork Areas, and Also the Higher Areas ("Highlands") and the Comparably Lower Areas ("Lowland") Marked
Source: Author (2021)

Focus of the fieldwork was architectural survey, photo-survey fit for photogrammetric analysis[1] and general photo-documentation. The results of the classic architectural survey, which was conducted manually on a house and a lopo in Maubesi village is presented in this article. The survey was conducted by measuring the building with the help of a handheld distometer, measuring tape and levelling staff and documenting the results on paper. Plans were drawn 2D in a CAD programme. Apart from this object approximately 5 other buildings where recorded for photogrammetric analysis.

In case of those buildings of special interest recorded for later photogrammetric analysis a semi-structured interview was done with a set of questions prepared on the construction process, materials – –and building tools. Questions about ceremonies conducted during the building process and the use of the building were asked, but did not constitute a focus of research. The reason for not concentrating on them was their complexity and the difficulty to interpret these answers without the possibility of a longer observation period in the field.

In 2004 the author was aided by a translator from Atambua, who was Bunaq, while in 2011 the guide and translator was a relative of the Raja of Nikiniki, and thus of Atoni Meto descent. He seemed to be recognized by the local communities as a person of respect and was known to them. On both trips the author was the only foreigner. Access to the villages was in 2004 by a rented car, in 2011 on moped.

The interviews were done after documenting the building, usually in the time of an hour, which was spent with the inhabitants before moving to the next object, or resuming the walk through the village. The persons answering the questions were usually either the head of the family or senior persons within the household and typically men. Usually the questions were asked in a situation where most inhabitants of a house (and often also neighbours) were sitting together and sometimes contributing to answers as well. The time was also used to explain the purpose of the visit and to socialize. On these occasions usually men, women and children residing in the household took part.

Although quite a lot of information was obtained with the help of the interviews, the statements could not be always fully counter-checked or set in a wider context, as the time spent with the villagers was always short, and sometimes also the translation of the guide slow or vague. The data extracted from the interviews was meant to aid architectural survey, but not as a research in its own right. Mainly it was used to be able to provide a base for technical description of the buildings, but not as a source of anthropological data proper. However, the informants often sidetracked in their narratives. This revealed

[1] With the help of photogrammetric analysis a subsequent production of point clouds and a 3D – model is possible. This model has a higher precision than manually conducted architectural survey.

aspects of vernacular architecture in close interrelation with many other aspects of life and local spiritualism. This information was noted down, but the author was unable to follow up on these aspects properly, as time was very limited. Where such additional information seemed coherent it was used in this article although much of it still has to be re-evaluated in a future field research.

In all villages visited a walk through the entire villages was conducted, in which almost all buildings of the settlement were photographed to be able to judge typical features or special and unique buildings. Sometimes buildings under construction could be observed, which provided opportunity to document construction process and tools used, albeit only in that current state of work, as almost every day a different village was visited. Mostly new vernacular buildings were under construction, no work on old style vernacular buildings could be witnessed.

III. MATERIALS IN INDONESIAN VERNACULAR ARCHITECTURE, WITH SPECIAL REFERENCE TO CENTRAL TIMOR

The use of wood as building material in Indonesia in general, and among the Atoni in Central Timor in particular, defines vernacular architecture. It must be emphasized that the state of processing of the wood makes a big difference to both the built structure and the knowledge and tools required for construction. Also, the use of different species of trees is highly significant, although this article deals more with the questions connected to shaping the wood than with the material´s physical properties as such. The most simple and archaic way to use wood is to integrate it into the structure of a building in its near-natural state: the branches of the tree are cut after felling and its bark is removed. In some places, trees are placed in a pond for some time (as seen during the author's field research in Central Java in 2011). The water removes nutrients which would make the wood attractive for insects. In Europe, wood is traditionally cut in winter, when the sap is not circulating, and is usually stored for some time in a dry place to remove the water content. The traditional European method of transporting logs by raft from the mountains to larger settlement centres also had a beneficial effect on durability. While water storage is known in Indonesia, as the Central Javanese example shows, the author knows of no equivalent of cutting wood at a specific time because of climatic reasons. Also, drying as a form of preparation seems not to be practised in Indonesia. This is not surprising, as most regions within Indonesia have no definite non-vegetational season comparable to our winters, and also, air humidity is usually quite high. Even in parts of the Lesser Sunda-Islands, which do have a marked dry season (Timor is no exception here), there seems to be no prescription for cutting trees in the dry season and also no drying of logs seems to be necessary. However, construction usually takes place in the dry season, although the main reason for this seems to be that the rains would disturb building activity, and also that house building should not overlap with crucial agricultural activities in the fields.

The logs which have been cut are used as soon after felling as they can be transported to the building site; a very exhausting and challenging task, as Timor is a mountainous area which makes dragging large logs a difficult endeavour. Among the Atoni, ordinary houses require no large logs: only the community buildings, the lopo, are erected on four large piles, and the houses of tribal leaders or chiefs sometimes have somewhat larger posts (see Fig. 2). Vertical elements (piles) are usually left in their natural round state and only sometimes, in the case of important buildings (among the Atoni, usually in case of the four main piles of a lopo) are they carved with specific designs or parts of them shaped to a specific decorative form.

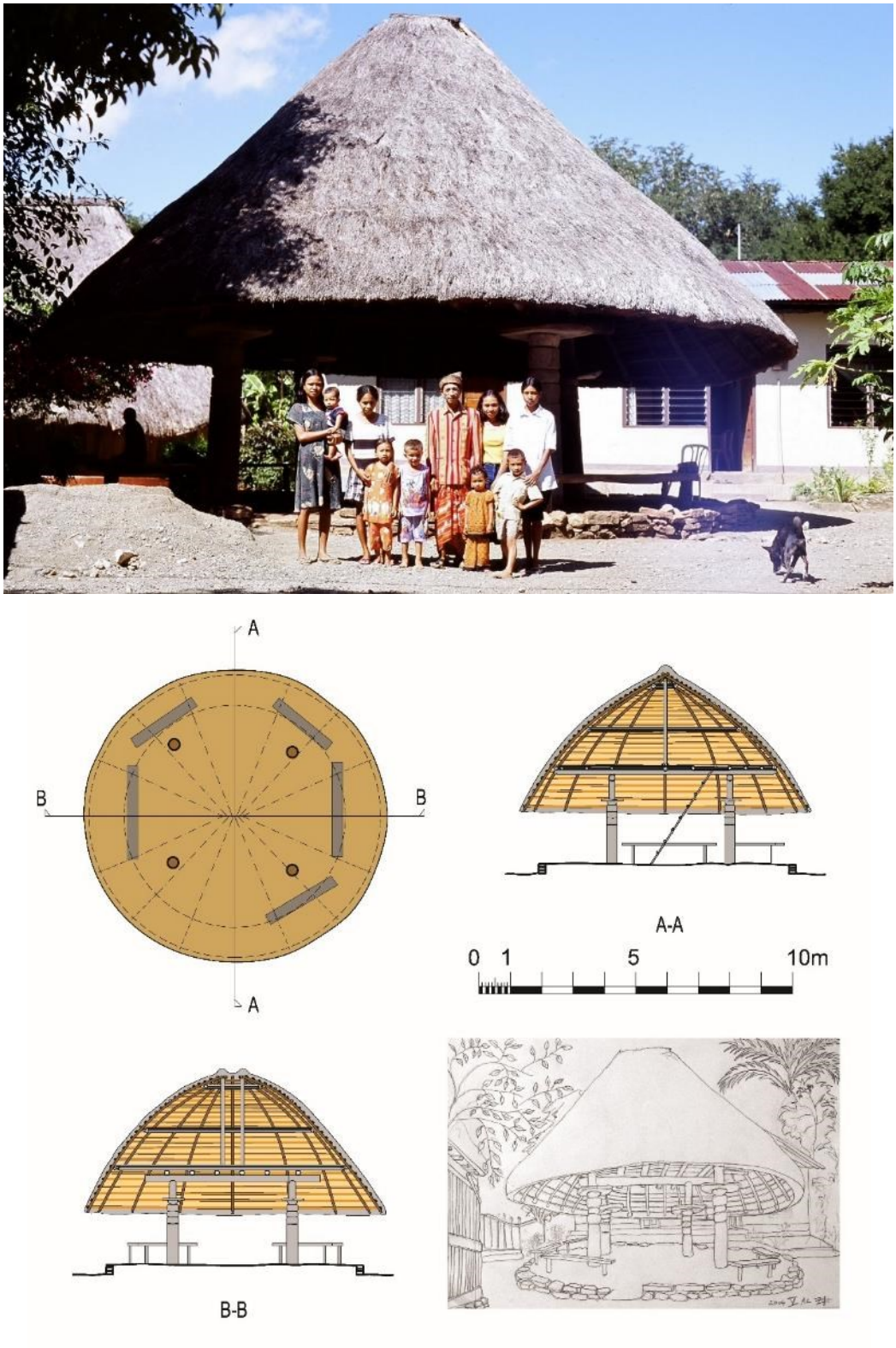

Fig. 2. Community Building and Granary (Lopo) in Maubesi, Eastwards of Kefamenanu, Central Timor, a Structure Having Its Main Posts (Piles) Buried in the Ground, 2004, Image and Plans.
Source: Author (2021)

Fig. 3. Main Pile (1 of Four) of a Ruinous Lopo in Nikiniki (Near the Rajas Residence). The various different carvings and decorations can be seen very well.
Source: Central Timor (2011); Zámolyi

Among the Atoni, and in most other parts of Timor, the vertical elements of a building are buried in the ground. The architectural term for these elements is "piles"[2]. Thus, as is the case in Atoni architecture, a building can have piles, but does not have to have a raised floor. Although "pile building" is commonly synonymous with "building on stilts" or "raised floor building", in the context of this article, this is not what the term will imply (if a house type has a raised floor, this will be pointed out separately). Driving piles into the ground anchors them in a stable way, but brings with it the disadvantage that they will rot over time and will have to be exchanged when the elements lose their strength. In certain cultures, the ends of such piles are charred by holding them over a fire, so that a layer of burned wood (coal, in effect) conserves the end of the element. Although the author has not heard of such practices in Indonesia, this does not mean that they do not exist. Generally, it seems that rather hard and durable species of wood such as teak (or ironwood, e.g., in Borneo) are chosen, and it is the durability of the given species which makes the piles last for a long time. Among the Atoni, the favoured species for posts is the matani (called "kayu merah", which means "red wood" in Indonesian), but during field research, the author also saw, in Nikiniki, one new lopo made with teak (jati) piles. In that case, it was pointed out that the wood was not local but came from plantations, and probably did not even come from Timor. Fieldwork done by the author among the Buna of Central Timor/Belu in 2004 showed that introduced species of wood, such as eucalyptus are also being used now, and probably this practice is also followed by other peoples of Central Timor. Eucalyptus grows now locally on Timor, as it has been used for re-forestation purposes. Nowadays, the base of wooden piles is often encased in concrete. That means that the hole dug when installing the element is not re-filled with earth (as used to be done), but rather with concrete. This measure probably also protects the wood to a certain extent, although it of course makes exchanging a rotten post much more difficult.

[2] Vertical wooden elements of a house frame, which are not buried into the ground, but stand on foundations of some sort (e.g. stones) or other wooden elements are called "posts", even if they support a raised floor.

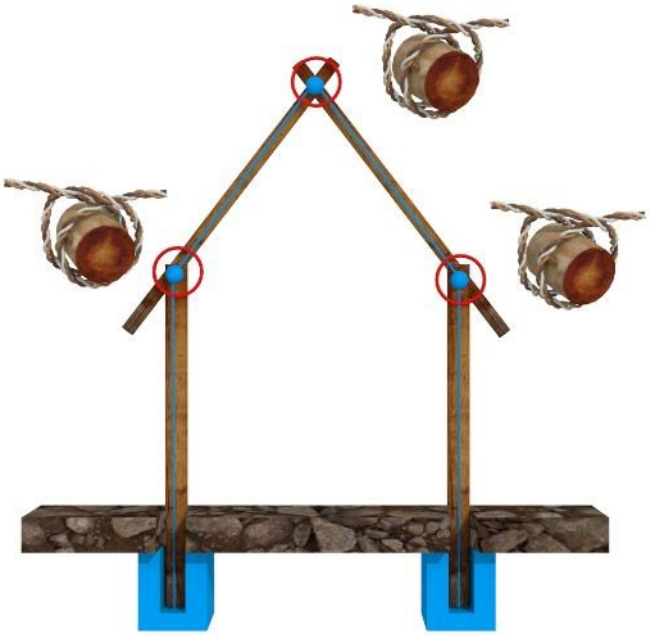

Fig. 4. Principle of a Pile Building: The vertical elements of the house (piles) are dug into the ground, which gives the house frame its stability. Other joints are usually lashed, building elements left naturally round.
Source: Author (2021)

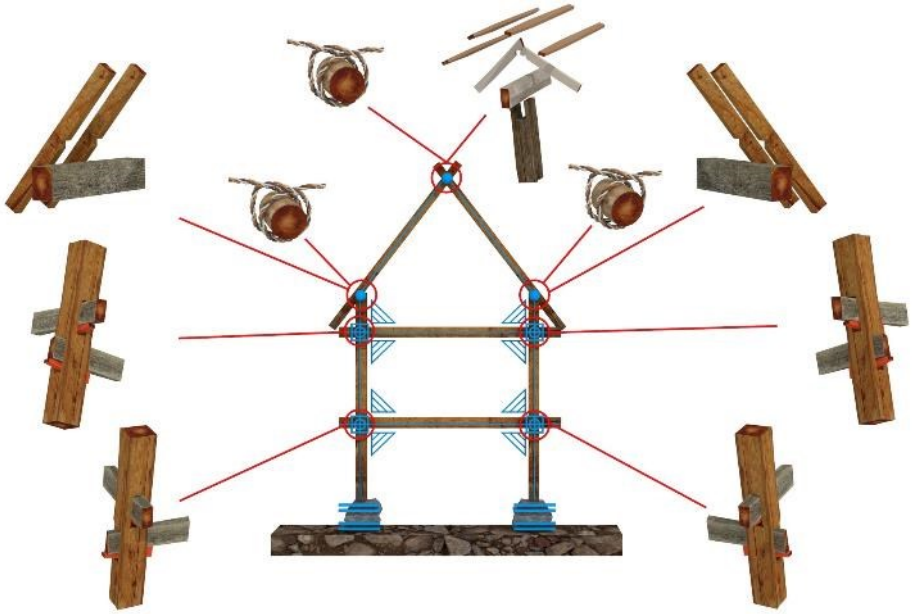

Fig. 5. Principle of a Post-and-Beam Building: The vertical elements of the house (posts) are placed above the ground, usually on stones. The frame of the building is made of rectangular posts and beams connected with carpenter´s joints. These are rigid enough (or have to be rigid enough) to give stability to the building. Diagonal frame elements (not found in every design) may lend additional stability to the frame. Only some joints of the roof remain lashed.
Source: Author (2021)

Buildings which have main vertical elements (piles) buried into the ground can be found on Sumba, Flores, Sawu, Roti, Adonara, Solor, Lembata, Alor, Timor and probably on Pantar and Wetar in the Lesser Sunda islands (for vernacular buildings on Sumba see Doubrawa, 2009; and on Flores, Doubrawa, 2013). Formerly, the technology seems to have been more widespread in Indonesia, but currently, apart from those regions already mentioned, only examples from parts of Kalimantan and

Sulawesi and from Papua are known. Buildings which have piles dug into the ground very often use joints which are connected by lashing, which is a convenient method for binding round elements. The more carpenter's joints a building has, the less natural, unprocessed wood has been used. Houses which have a frame completely made of square processed timber, like those on Nias (Viaro, 1980), South-Sulawesi (see Doubrawa & Zámolyi, 2007), in Toraja (Kis-Jovak, 1988), Sasak, Sumbawan (Just 1984 and Hitchcock 1983), and Javanese (Ismunandar, 1997; Tjahjono, 2015) or Balinese houses, sometimes still have lashed joints and round wooden elements in their roof area. However, it seems that the transition from round elements and lashings, to square elements and carpenter's joints took over 200 years or longer.

The process described above, of embedding vertical wooden elements of the frame into the earth found in large parts of the Lesser Sunda Islands can probably be termed "archaic" for several reasons. Firstly, it is possible to construct such buildings with very few and not very specialized tools: even stone tools can be used, as a study on the use of stone implements among the Dani of Papua has shown (Hampton, 1999). The piles buried in the ground will stabilise the structure, and also make the construction process easier – even larger buildings need only very limited scaffolding, which can be fixed to the buried piles, without having to take stability into consideration. A larger number of lianas, ropes and similar lashing materials is required, but these are usually available in the forest. The wooden elements connected by lashing have to be prepared only very superficially (probably only notched), if at all. Binding requires no geometric precision, no special tools and can be learnt comparatively easily by everybody in the community. Natural advantages of the building material, such as forks created by branches, can often be used to place beams in them. If such forks are not present, the end of the piles will receive notches, which can be easily made with a bushknife or an axe. And by combining a larger number of elements, complicated structures can be created with this simple, but energy-efficient technique.

However, the stability of the whole structure depends on the main piles being buried in the ground, and if they do have to be exchanged, this requires a major effort. Although it is not clear at which intervals such exchange or renovation needs to take place, we do have some statements collected during field research. A respondent from a clan residing in None village near Soe, with an apparently quite old lopo told me in 2011 that their lopo was nine generations old and that its main piles had never been exchanged. If we calculate a generation as being 25 years, then the lopo would be around 225 years old. And in fact, it is not impossible for the building to be that age, as in Europe, wooden or partly wooden vernacular buildings over 500 years of age have been preserved, e.g. one of the oldest Fachwerk-houses in Germany in Gelnhausen is dated 1351 AD, (see Binding et al, 1975), and there are other houses with a wooden frame dating from the 14th century relocated within German open-air museums (see Bedal & Heidrich, 1997)3. The climate in Timor is actually quite dry, which would support the long survival even of a structure embedded within the earth. In the village of Supul very near NikiNiki, a lopo was shown to the author, which was claimed to be seven generations old (that would be around 175 years). No information was provided as to whether the piles had been exchanged or not during its history; it was only stated that the thatch of the lopo had last been renewed in 1976. Both None and Supul had been fortified villages in the past, located in strategic positions on hilltops or outcrops, with low stone walls and remains of a thorny thicket-fence still visible. In Fafenesu village (princedom of Insana) a local also stated that the present lopo was from the 1940s, but its posts were recycled, having been incorporated into that renovation, and were in fact much older, probably "hundreds of years old" as the old man put it. As lopos are important to their clans (and thus they would be probably remembered in oral history), and their posts of quite large diameter (in a case surveyed in Maubesi the diameter of one post was 35cm, see Fig. 6), we should consider taking these statements seriously. A life-span of up to 200 years for main parts like piles could be realistic. Smaller parts, like rafters, battens and smaller beams of course would probably be exchanged several times during the building's existence. Further research would be needed in this field to confirm the accuracy of the data.

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3 The oldest known wooden house in Europe at present is the house Nideröst in Schwyz, Swiss, which has wooden parts which are 830 years old (dating from 1176 AD), see Descoeudres (2003).

In a 2004, field research at a house of the Sonaf Usfinit in Maubesi (princedom of Insana, to the East of Kefamenanu) yielded the following information: although there was no indication of how old the house was, renovation activities had taken place in 1938, 1954, 1974, 1988 and 1993. In 1974, the building had been relocated from its original site to a site nearer to the main road. How many original elements were exchanged at each renovation is not clear, but we can assume that not all elements were renewed. At the same time, it seemed that the latest renovation had left the building with little original substance: sawn wooden boards as walls and a new roof structure had been introduced. It was not clear whether the main posts were original or if and when they had been exchanged.

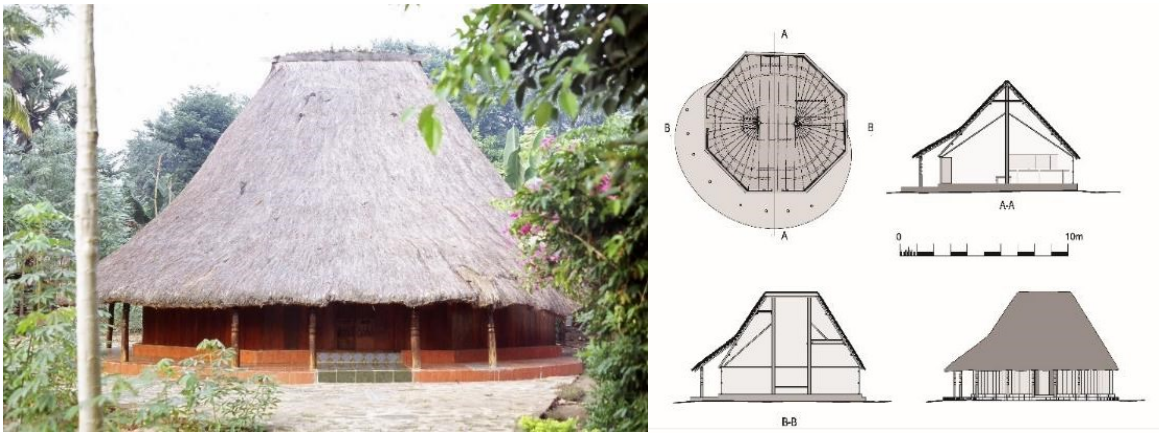

Fig. 6. Image and Plans of House in Maubesi, Eastwards of Kefamenanu,
Source: Central Timor (2004); Survey: Ferenc Zámolyi. Plans: Annamária Koncz.

Smaller local houses such as the roundhouse (called ume kbubu´), which also have piles and other wooden parts buried in the ground are said by locals to last 20-30 years.

For comparative data from other regions of Indonesia, it is worth mentioning the old houses at Karampuang, Kabupaten Sinjai, South Sulawesi which the author's field studies show were very probably built in 1950, and are still intact, probably with original elements. So far, the oldest individual vernacular building on one of the outlying islands of Indonesia, whose age has been historically confirmed, is the chief´s house in Bawamatolö village on Nias, which was erected in the 1860s, and whose construction was mentioned in contemporary Dutch sources. However, both of the latter examples have posts which are not buried in the ground, and thus differ structurally from houses erected on Timor. To bring a comparison from Europe, let us look at the case of a reconstructed Neolithic house, which was erected in 1964 in the open-air Museum in Asparn, Austria (now known as Museum MAMUZ) and which was pulled down in 2011, after 47 years. The building was in effect built using a similar technology as that of buildings on Timor and the Lesser Sunda Islands, with oak piles dug into the ground. In the Austrian case, by 2011, the underground parts of the piles had completely rotted and had lost their strength to support the building (Lenneis & Trebsche, 2013, p. 89) which was the reason the structure had to be rebuilt. However, it must be said that the ground on which the open-air museum was situated was somewhat wet – probably, in a real settlement, a drier place would have been chosen, and also, Indonesian hardwoods are probably more rot-resistant than oak. Also, it's likely that no special care was taken in 1964 in terms of obtaining the wood: it was probably not felled in winter and not naturally dried (if it was dried at all) or soaked in water for longer durability. Lenneis & Trebsche (2013, p. 94) come to the conclusion that such buildings in Europe would have stood for approximately 100 years before the main piles would need to be exchanged because of structural damage (however, the figure of 100 years seems to be an educated guess rather than the product of any sort of real experience or experiment). As the climate in Timor is drier than in Central Europe (with regard to the amount and frequency of humidity change within the soil at the house site), and local woods are probably more rot-resistant than oak, as mentioned, it is probably safe to assume that large main piles would have longer lifespans than 100 years.

Apart from the grander specimens of Atoni architecture, such as the large lopos or chief´s houses, the ordinary dwelling house, or ume kbubu´ (roundhouse) is a very light, small structure, which was

probably abandoned every one or two generations, or even shorter timespans (see also Mc William, 2002, p. 227), as hamlets had to be moved because of shifting agriculture. The ume kbubu´ is built with a framework of very small sticks. These sticks can easily be bent, which is not possible with logs. We will see that the material used is essential for the Atoni round house, but that its domical appearance probably also limits its size.

Whereas in Atoni architecture, only certain specific elements within the buildings have square or rectangular cross sections (e.g. in most lopos, only the principal beams, each connecting two of the four piles), and therefore have to be trimmed to this shape with a cutting implement such as an adze, axe or bushknife), in other part of Indonesia, vernacular buildings are often built mostly of such rectangular cross section elements. Probably, the latter buildings are the outcome of a longer evolutionary process, which led from an initial system using naturally-round elements, to the designs using squared timber found today. Although there are definitive hints of such processes (see also Doubrawa & Zámolyi, 2007 for the South Sulawesi region) they cannot (yet) be reconstructed in detail in their entirety. Also, it seems that in some areas these developments happened a longer time ago, while in other areas, they only happened more recently, and probably, in Timor, they did not happen at all – although it is worth mentioning that even within the Timor area, there are vernacular buildings which have started out on this process, featuring relatively many squared-timber elements connected by carpenter's joints. However, the final step in this evolutionary process – abandoning the concept of piles embedded within the earth, and building houses with posts placed on a foundation of stones – was never reached, at least not in West Timor.

At some point during the evolutionary process described above, almost all the elements of a building were replaced by squared elements, and usually fewer and fewer lashings were used, and were replaced by carpenter's joints. Thus, the building would at some point be rigid enough to stand without having its piles dug into the ground, at which point the piles, which were now technically posts, would be placed on stones to protect their ends from water and from rotting away. This building technology is called post-and-beam (Fig. 7). Of course, there are also intermediate types, and often, more archaic and more "modern" versions of the same traditional building type can be found side by side.

As we have already said, most of Indonesia's vernacular architecture consists of wooden buildings. Materials such as stone, bricks and concrete have been introduced comparatively recently, maybe in the last 100-150 years. An exception to this rule of thumb can be seen in certain urban areas, and of course certain types of sacred architecture, where stone and brick were used as building materials for at least 1300 years (see Miksic, 2004; Miksic & Geok Yian Goh, 2017; Chihara, 1996). The use of ceramic tiles on a larger scale (for secular buildings, too) is documented from Java from around 1400 AD (Miksic & Geok Yian Goh, 2017, p. 469-471; Karow, 1987; Soedarmadji, 2012), but on more outlying Indonesian islands, ceramics, brick and stone were not used as building materials until comparatively recently. Temples and sanctuaries made of stone or bricks have been documented in certain places within the archipelago, especially Java, from the 7th century AD onwards, although there were also early temples in Sumatra and other islands as well (see Miksic & al, 2010; Tjoa-Bonatz & Reinecke, 2015; Dumarcay, 1978 and 1986; Kinney, 2003; Chihara, 1996). But again, it was rare that such monuments were erected in peripherial areas, as they were associated with a stronger state-like internal organisation and central power within the region. The Timor region did not have any such centres, so no stone or brick architecture was erected during the Hindu period. The Hindu period lasted until the 15th century, and Islam never reached the Timor region. The Portuguese then introduced stone fortifications (on fortifications in Indonesia and materials used for building them see: Anonymous, 2012), ruins of which can still be seen in several locations in the region. It is very probable that stone or brick houses were built by the Europeans, too, but no definitive account, study exploring such building activities in the West Timor region, or indeed ruin of such a building, is known to the author. And if indeed there were any, there were probably very few examples in the interior of the islands. In Oekussi region, not far away from Kefamenanu, the Dominican friars built a church in Noemuti village as early as the beginning of the 18th century. However, as the catholic influence began to wane soon after, it seems not to have had a larger influence in the region (Steenbrink, 2007, p.170). Catholicism reached further inland only in 1925, when Noemuti was turned into a permanent mission post, with several settlements following in the next few years: Hiupukan in 1929, Kefamenanu and Maubesi in 1937. This also meant presence of a resident priest in these places, and that more influence was exerted on local

people (Steenbrink, 2007, p.171). Several churches were subsequently built in Kefamenanu. However, it seems that stone or brick architecture did not have influence on vernacular buildings in Timor until the recent increased availability and affordability of such modern materials.

Nowadays, materials such as bricks and stone (or, more recently, concrete) are sometimes incorporated into traditional, wooden vernacular designs, as such materials have in many places only become widely available in the past few decades. In the case of buildings on Timor, such hybridization is difficult, as rounded forms (which in many cases are the dominant form) cannot easily be combined with the rectangular concepts of modern buildings. In other Indonesian regions, e.g., South Sulawesi, vernacular building types are much more suited to such experiments. Thus, concrete and brick walls are erected, usually to wall up areas between the building posts, or extensions in the form of rooms made of these new materials are added to existing wooden structures (Doubrawa & Zámolyi, 2007). Similar concepts can be found on Nias in western Indonesia (see Aahs, 2014). In West Timor, field research among the Tetum in 2004 and 2011 showed that even though their buildings are rectangular, no additions to the buildings are made from brick or concrete. If new materials are used, they are used to build a house in contemporary design, not connected to older buildings. In the case of wooden buildings, only the piles are replaced with concrete piles, but the rest of the house is still made from wood. A similar pattern can be observed among the Atoni Meto: new, rectangular concrete houses are built in front of the roundhouses, and both building types are kept. In case of the ume kbubu´, the new house is also built to a new design and using new materials because of a campaign by the Indonesian government (and before independence, by the Dutch government) asserting that the small roundhouses are unhealthy. In the case of lopos, as will be described in more detail later on in the article, the four main piles are nowadays often cast in concrete.

"These days, although the ume kbubu´remains the key house structure for Meto families and is the first structure erected when new households are formed, Meto families will also typically develop a second house in front of the "round house" which is rectangular in shape. The development of these houses has been an emergent feature in Amanuban for the last twenty years or so in large part due to the promotional efforts of local government policy. Round houses with their lack of ventilation are considered unhealthy and primitive in the collective view of government. Current development policies, a hangover from earlier colonial concerns pursued under the so-called "ethical policy" (Waterson, 1990:29), favour the construction of rectangular framed houses which are considered "healthy houses" (rumah sehat)." (Mc William 2002, p. 228).

In these cases, the old house is used for cooking and sleeping, and the new house for receiving guests. The experiences of the author are consistent with Mc William´s description. The locals seem quite attached to their old vernacular style, which they regard as warmer (by local standards, the nights in most mountain regions are cold) than the modern buildings and they feel more at home in them, and according to Mc William:

"For them the house is a warm and secure place and the hearth smoke a comforting blanket which has curing properties and keeps biting insects and vermin at bay." (Mc William 2002, p. 227)

In None village, a man who was asked about this by the author in 2011 answered the author's question with prosaic simplicity: "The modern house has to be, the old house we don´t want to lose."

Nowadays, new houses are usually made of concrete bricks, or with a concrete frame, a construction approach widespread within the archipelago. Concrete is used in Indonesia in several ways: most usually in the form of concrete bricks (cast locally) or as a frame. Concrete bricks are cast in wooden models made on site, and usually have hollow sections, into which iron bars can be inserted as reinforcement. Then the cavities within the walls are filled with additional concrete to connect the individual elements. To make the frame, posts and beams are cast in wooden formwork which has been reinforced with iron caging or iron bars. Concrete can be weaker or stronger, depending on its composition, and with some effort, it can be moulded into almost any form. Among the Minangkabau on Sumatra, for example, concrete is now used to build an exact reproduction of the timber frame of vernacular buildings, and then covered by carved wooden panels, to give the appearance of a traditional building. Although there are similar cases in other regions, concrete is mainly used for buildings with designs other than traditional vernacular forms (see Fig. 7).

Fig. 7. Traditional House Behind a New House Made of Concrete Blocks
Source: Soe (2011)

At the production stage, concrete requires quite a lot of skill to get the ingredient mix (cement, sand, gravel and water) and consistency right, and also to know how many steel rods have to be inserted and where to place these rebars. Although it has advantages, concrete can also be a treacherous material, especially in earthquake-prone areas (which almost all islands within the archipelago are, and if the structure is not properly planned and executed, the probability of it collapsing during a natural disaster is much higher than for wooden buildings, as concrete is much heavier, and it is more brittle than wood. Whereas wooden buildings are comparatively light and flexible, concrete buildings are heavy and can collapse without warning under strong forces; the heavy elements striking burying people under them or striking people dead if they collapse. Only if they are specially designed and built especially strongly can concrete buildings withstand the force of major earthquakes. Unfortunately, these special design skills are often lacking in Indonesia, or the buildings are not built strongly enough, in order to save money.

The problems with bricks, which can be used to build entire walls or as an infill for a concrete frame are similar: they are heavy, often not very hard, as they are fired in the open field by the people who make them (at relatively low temperatures), and often, the brick-mortar bond is not very strong. On the plus side, they are easy to carve and shape, as decorations in Bali show, which essentially can be carved from wood, but also out of brick in a similar form.

Corrugated iron is another modern material that is now widely used as an alternative to thatch roof-covering (see Fig. 8). Its advantage is its longer durability – it doesn't need to be replaced or repaired as often as a roof made of grass or palm-leaf. However, it has very poor insulating qualities, causing the area below it to heat up a lot – and also, rain falling on such a roof makes very loud sounds, which can be a problem in places where there is lots of rain, as is the case with certain Indonesian regions.

Also, the use of corrugated iron sheets often leads to a transformation in the shape of the building: whereas thatch can be applied in and to any form, corrugated iron has to be applied in rectangles or triangles, as any other form would be too complicated to achieve with simple tools. Thus, roofs which were originally round, oval, or spherical turn into an angular shape and have mostly straight ridge lines when they are re-created in corrugated iron. Of course, there are also exceptions to this rule: for example, in the Minangkabau regions of Sumatra, where nicely upswung ridgelines are considered essential, and thus extra effort is put into making even corrugated iron roofs resemble their thatched predecessors as closely as possible. Similar cases can be sometimes observed among the Toraja in Sulawesi, where a nicely curved roof is one of the hallmarks of a well-executed building, and where the new material is also worked with special skills and effort to resemble such a shape.

Fig. 8. Modern Lopo in Front of a Modern House Near Kefamenanu, As Seen From the Main Road.
Source: Central Timor (2011)

IV. CONCLUSION

The Atoni in Timor employ a quite archaic building technology in erecting their vernacular buildings. They are made of wooden elements left naturally round. These elements are lashed together with lianas, very few or no carpenter´s joints are used. This technology is simple but effective, as most people of a village community can learn it easily and help in the construction process. The durability of such houses is not so good as the durability of houses made with carpenter´s joints and placed on foundation stones (which is another very common technology in Indonesia´s vernacular architecture), as wooden parts have to be dug into the ground, and therefore they will rot over time. However, it seems that at least the large granaries and community buildings, the lopos, can be comparably old, if the data collected is correct: even with main piles buried in the ground, it seems realistic, that they can endure 100-150 years in some cases with smaller repairs only.

New building materials such as concrete are used more and more in the areas of the field research. Houses of modern, rectangular design are built in front or beside the traditional round houses. Also, new materials are more and more used in the old vernacular designs. How this happens and how they change the old building style in detail will be examined in the second part of the article, which will be published in the next issue of this journal.

REFERENCES

Aahs, A. (2014). *The Progress of the Architecture Concerning the Influence of the Cultural and Social Aspects in South-Nias: On the Example of Hiliamaetaniha and Sondregeasi* [Unpublished Diploma Thesis]. University of Technology Vienna.

Anonymous (2012). *Forts in Indonesia, (result of the Project "Inventory and Identification of Forts in Indonesia", 2007-2010, Indonesian Architecture Documentation Centre)*. Ministry of Education and Culture, Republic of Indonesia.

Bedal, K., & Heidrich, H. (1997). *Bauernhäuser aus dem Mittelalter.* Fränkisches Freilandmuseum.

Binding, G., Mainzer, U., & Wiedenau, A. (1975). *Kleine Kunstgeschichte des deutschen Fachwerksbaus [Short Art History of German Fachwerk-building]*. Wissenschaftliche Buchgesellschaft.

Chihara, D. (1996). *Hindu-Buddhist Architecture in Southeast Asia.* Brill.

Cunningham, C. E. (1964). Order in the Atoni House. *Bijdragen tot de Taal-, Land- en Volkenkunde 120*(1), 34-68.

Cunningham, C. E. (1967). *Soba: An Atoni Village of West Timor* in Koentjaraningrat (ed): *Villages in Indonesia*. Cornell University Press.

Descoeudres, G. (2003). *Das Haus Nideröst in Schwyz und das Problem der Versetzung von Häusern*, in: Furrer B. (ed.). *Kulturaustausch im ländlichen Hausbau. Inneralpin und transalpin. Berichte über die Tagung der Regionalgruppe Alpen in Schwyz 29. Juni – 1. Juli 2002 Beiträge zur historischen Hausforschung in den Alpen 1).* Sobernheim. 29-38.

Domenig, G. (2008). *Round Houses of Indonesia – A Comparative Study*, In Schefold, R., Domenig, G., Nas, P., Wessing, R. (eds.) (2008). *Indonesian Houses, Volume 2, Survey of Vernacular Architecture in Western Indonesia*. KITLV Press. 487-522.

Doubrawa, I. (2009). *Sumba Baut* (Unpublished Diploma Thesis). University of Technology Vienna.

Doubrawa, I. (2013). The Formation of Vernacular Architecture – an Approach to the Development Factors of Two House Types in Flores, Indonesia. in E. Lehner, I. Doubrawa, & Ikaputra (eds). *Insular Diversity, Architecture-Culture-Identity in Indonesia*. IVA-ICRA.

Doubrawa, I., & Zámolyi F. G. (2007). *Documenting the Past – Transformation and Change in South Sulawesi Architecture.* In: *Living in Memory: Houses, History and Environment in Southeast Asia. Archiv des Museums der Völkerkunde Wien 57/58*, Verein "Freunde der Völkerkunde"/Lit Verlag.

Dumarçay, J. (1978). *Borobudur.* Oxford University Press.

Dumarçay, J. (1986). *The Temples of Java*. Oxford University Press.

Hampton, O.W. (1999). *Culture of Stone – Sacred and Profane Use of Stone Among the Dani*. A&M University Press.

Hitchcock, M. (1983). *Technology and Society in Bima, With Special Reference to House Building and Textile Manufacture*. D. Phil Thesis, University of Oxford.

Ismunandar, R. K. (1997). *Joglo – Arsitektur Rumah Tradisional Jawa*. Dahara Prize.

Just, P. (1984). Houses and House Building in Donggo. in: *"Expedition", periodical of the University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia, 26*(4), 30-46.

Karow, O. (1987). *Terrakottakunst des Reiches Majapahit in Ostjava*. Katalog zur Ausstellung: Das Sparschwein unter dem Reisfeld, Musem für Völkerkunde, Frankfurt am Main.

Kinney, A. R., Klokke, J. M., & Kieven, L. (2003). *Worshipping Siva and Buddha – The Temple Art of East Java*. University of Hawaií Press.

Kis-Jovak, J. I. (1988). *Banua Toraja: Changing Patterns in Architecture and Symbolism among the Sa'Dan Toraja, Sulawesi, Indonesia*. Royal Tropical Institute Amsterdam.

Koji, S. (2021, August 30). http://www.sumai.org. National Museum of Ethnology (Minpaku), Osaka.

Koji, S., (1991). *Menghuni Lumbung: Beberapa Pertimbangan mengenai Asal-Usul Konstruksi Rumah Panggung di Kepulauan Pasifik* [Dwelling in Granaries – The Origin of Pile Building in the Pacific]. "Antropologi Indonesia" (49), 31-47, Jurusan Antropologi FISIP Universitas Indonesia.

Kurniawan D. Th., Antariksa, & Agung Murti, N. (2013). Konsep Ruang Ume Kbubu Desa Kaenbaun Kabupaten Timor Tengah Utara. *Jurnal RUAS, 11*(1), 28-36.

Lake, R. Ch. (2021). Tata Spasial Arsitektur Tradisional Suku Atoni Di Kampung Tamkesi Pulau Timor. *ATRIUM - Jurnal Arsitektur, 2*(1), 31-41.

Lenneis, E., & Trebsche, P. (2013). *Die Dokumentation des nachgebauten linearbandkeramischen Langhauses von 1964 – Ein Beitrag zur Diskussion der möglichen Lebensdauer.* in: Lauermann, E., Lenneis, E., Lobisser, W. F.A., Pacher, M. W.; Trebsche, P.: *Das „jungsteinzeitliche" Langhaus in Asparn an der Zaya– Urgeschichte zwischen Befund und Experiment*. Urgeschichtsmuseum Niederösterreich in Asparn a.d. Zaya, NÖ Institut für Landeskunde. 87-97.

McWilliam, A. (2002). *Paths of Origin, Gates of Life – A Study of Place and Precedence in Southwest Timor*. KITLV Press.

Miksic, J. N. (2004). *The Classical Cultures of Indonesia*, In: Glover, I., Bellwood, P. (eds.), (2004). *Southeast Asia – From Prehistory to History.* Routledge Curzon. 234-257.

Miksic, J. N., & Geok Yian Goh (2017). *Ancient Southeast Asia*. Routledge.

Miksic, J. N., Magetsari, N., Fontein, J., Haryono, T., & Setiadi, I. B. (2010). *Borobudur*, Taman Wisata Borobudur, Prambanan & Ratu Boko.

Müller, Ch. (2013). *Architecture of the dry land – Atoni Meto* in: Lehner, E.; Doubrawa, I.; Ikaputra (eds), (2013). *Insular Diversity, Architecture-Culture-Identity in Indonesia*, IVA-ICRA. 187-194.

Müller, S. (1839). *Bijdragen tot de kennis van Timor en eenige andere naburige eilanden* in: Temminck, C.J. (ed.), *Verhandelingen over de natuurlijke geschiedenis der Nederlandsche overzeesche bezittingen. Deel I: Land- en volkenkunde*. Luchtmans en Van der Hoek.129-320.

Müller, S. (1857). *Reizen en onderzoekingen in den Indischen Archipel, gedaan op last der Nederlandsche Indische Regering, tusschen de jaren 1828 en 1836*. Vol II. Muller.

Sitindjak, R., Kusuma, W. L., & Poppy, N. F.(2020). The Iconography of Sonaf Nis None Traditional House in East Nusa Tenggara, Indonesia. *SHS Web of Conferences 76*(3):01046.

Soedarmadji, Damais, J.H. (2012). *Majapahit Terracotta – The Soedarmadji Jean Henry Damais Collection*. BAB Publishing Indonesia.

Steenbrink, K. (2007). *Catholics in Indonesia, 1808 -1942 – A Documented History, Vol. 2 – The Spectacular Growth of a Self-Confident Minority 1903 -1942*, KITLV.

Tjoa-Bonatz, M. L., & Reinecke, A. (eds.) (2015). *Im Schatten von Angkor – Archäologie und Geschichte Südostasiens*. Verlag Philipp von Zabern.

Viaro, A. (1980). *Architecture et urbanisme du sud de Nias*. Unesco.

Waterson, R. (1990). *The Living House*. Oxford University Press.

Zámolyi, F. G. (2004). *Traditionelle fidschianische Architektur- Konstruktion, Funktion, Symbolik* (Unpublished Diploma Thesis). Vienna Technical University.

Zámolyi, F. G. (2013). *Developments and Change in Eastern Indonesian Vernacular Architecture: Living between Tradition and Modernization* in: Lehner, E., Doubrawa, I., Ikaputra (eds) (2013). *Insular Diversity, Architecture-Culture-Identity in Indonesia*. IVA-ICRA.

Zámolyi, F. G. (2015). *Architecture of Fiji* in: Selin, H. (Ed.) (2015). *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, Springer.

Zámolyi, F. G. (2017). *New and Old Styles of Vernacular Buildings Among the Tetum – An Architectural Field Research Report From Central Timor, Indonesia*, in: ISVS e-Journal, 5(1).