

The Taman Petanu Sustainable Buildings Review By Ben Walters

Conclusions and Recommendations

Based on the perceived aesthetic for the project and the importance of combining local architectural traditions, with modern design, green concerns and appropriate technology, the following recommendations are made about the selection of materials for the Alam Santi eco-neighbourhood project.

A total of 67 different items (or uses for items) were found that were considered to be viable for inclusion on the database. Items studied were divided into the following categories:

A Walls and structures	G Water recycling materials
B Foundations, floors	H Irrigation fittings
C Flooring	I Water efficiency fittings
D Roof framing	J Energy efficiency fittings
E Roofing	K Renewable energy production fittings
F Rainwater harvesting efficiency materials	L Coatings etc

The selected materials were graded using the following criteria. Then the sum of all aspects of sustainability was combined to produce a final rating per item.

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Full details and analysis for each item can be found on the main database which is stored on:
<https://spreadsheets2.google.com/ccc?hl=en&key=tSVJb8qZQ-5xOfobPoYjweQ&hl=en#gid=0>

Materials that take into account as many of the listed concerns and criteria as possible (i.e. given the highest rating) include following.

Walls and structures

- Locally available and economic options such as local red and brown clay soils in cob (total), rating 93% and brick form (photo code A02, rating 84%).
- Local concrete and local clay slip to disguise it is an alternative and cost effective form (rating 84%)
- Rendered ferro-cement over woven bamboo panels with local timber or layered coco-lumber (rating 81%)



clay soils in cob (total)



Local concrete w local clay slip



Rendered ferro-cement

- Local timber for structural strength can include compressed bamboo wood or laminated coco lumber (rating 94%).
- Also petung bamboo is strong enough in its original form (rating 82%). These can even be strong enough to be used as building supports, but due to their laminated nature they have to be protected from rain splash with wide building eaves, and high waterproof footings which have to be designed to aid runoff and prevent insect infestation. This gives rise to some quite specific building knowledge, but provides a tremendously useful source of large timbers from a renewable resource base (rating 94%)
- Local river stone (photo/ codeC04, rating 80%) is also available, as is black sand and gravel for cement mixing.



laminated coco lumber



petung bamboo



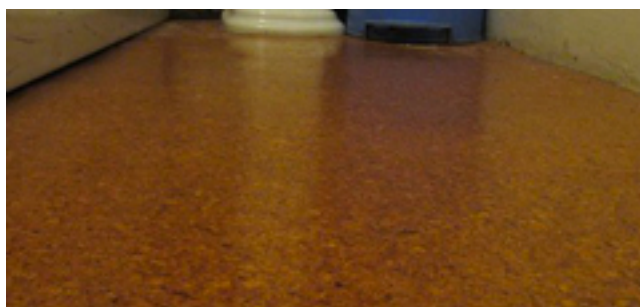
renewable resource base

Flooring

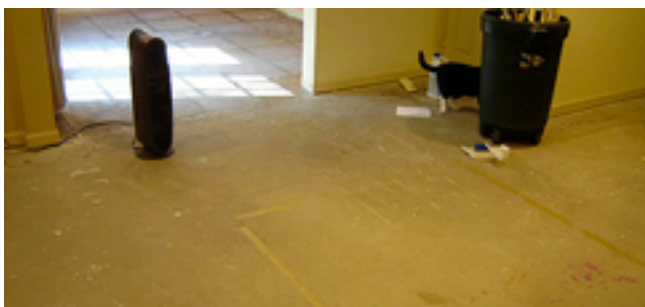
- Local glazed and unglazed floor tiles are available. One outlet is the Little Tree sustainable building Center in Kuta.
- The packed and varnished clay soil flooring would be very useful to develop as it is beautiful, long lasting and non polluting, but requires training as mentioned later.
- Although not completely local, cement powder is widely available, and is useful for the walling also, and can be used to hold river stone together, with local sand.
- Local bamboos, and cocolumber can also be used for the flooring, but as with their use for supports they have to be used with clearance to reduce water splash or insect infestation risk.



Local glazed and unglazed floor tiles



packed and varnished clay soil



cement powder



Coco-lumber

Roofing and roof framing

Local bamboo and cocolumber can be used here for roof framing (rating 92%) also, as can palpalan roofing (photo / code E06 rating 91%).



cocolumber



Local bamboo

Local ijuk (photo /codeE08 rating 85%) and regionally available vetiver are also useful alternatives (photo/ codeE05 rating 83%).



Local ijuk



vetiver

In terms of sourcing, local unglazed roof tiles (73%) are available, as are glazed ones (68%) from Java. Note the glazed tiles certainly should be considered due to their longer life span.



Local unglazed roof tiles



Local glazed roof tiles

Galvanised iron sheeting (rating 58%) and aluminium framing (rating 63%) can be used for roofing too, especially if they are “disguised”, and are available, highly durable, and quite cheap. Their relatively lower ratings reflect that they are derived from industrial, mined sources, and so, score lower on the more environmental indices of the rating system.

Despite its local and organic nature, alang-alang (rating 66%) scored comparatively low due to its increasing price, decreasing quality and also, being softer than other fibres, with a greater ability to rot too quickly and produce a mould type health risk. Being so soft, it is also more colonizable by insects and can become much more flammable than the harder fibres.



Galvanised iron sheeting



aluminium framing



alang-alang

Energy needs

- Pico scale hydro-power would be more appropriate than microscale which could leave expensive unusable capacity and possibly damage appliances with a power surge. Also, its manufacture produces some pollutant effect, but is limited as its installation relies on manpower and building supplies with relatively little needed in the way of “components”.
- Chinese solar panels are available, last a long time, and are getting better.
- DC equipment is getting more economical, and works well with efficient LED bulbs and fridges to reduce electricity use drastically.



Pico scale hydro-power



Chinese solar panels



DC equipment

A lot of electronic gear such as photo-voltaic solar cells and low wattage light bulbs is getting cheaper with popularity, but a lot of more basic supplies like cement powder are getting more expensive.

Note: In the study, a lot of the electrical and instrumentation materials seem to have low ratings, despite utilizing renewable sources of energy. This is because the compiler attempted to quantify the impact of manufacturing and import if any components had to be shipped into Bali before being re assembled. The actual functioning of the equipment might be quite “clean”, but its manufacturing can still produce an effect, even though that effect has been counteracted by the use of renewable.

Plastic use and Miscellaneous

The examination of d2w technology and its use for making HDPE piping greener in order to render it oxy-biodegradable and non poisonous and to use a side product of the oil industry that is normally flared off would also be of importance to this project.

Natural versions of piping can lack the durability of plastic, and until the present plastic has been a major pollutant. This important innovation based on usually burned off parts of the hydrocarbon molecule can render degrading plastic non poisonous as it will be able to break down into carbon, hydrogen and humus rather than longer chain by- products that are more persistent. Bear in mind that this is used with PE and PP rather than PVC.

PVC of course is cheaper, but then again d2w is also cheap as it is produced anyway by the oil industry and would normally be wasted, and it enables us to use the durability of plastic in a much less poisonous way. A full life cycle analysis would show pollution by the oil industry engineering process and infra structure, but it is already established, and the d2w technology would help it be less wasteful and safer, to an extent.

A lot of the water capture and use equipment can be built in house, with little resources, including the excellent waste water garden system to recycle nutrients and produce clean water to fulfil other site needs.

Examples of locally implements (on Bali) styles and techniques



Wooden walls & glazed tile floor



Ferro cement walls and countertops



Woven bamboo walls & varnished floor



Colour cement floor

Building and Resource Considerations

Some clay or soil resources may be created onsite by earth moving, creating opportunities for water features at the same time.

Some of the woodier, or greener materials needed could be grown onsite to offset transportation needs. Apparently an adjacent piece of land is being made available for the group to use. Possibly a version of agro-forestry or tumpang sari, based on local indigenous traditions but with updated management and design could be used here. Norm Vant Hoff, a local green building and environmental design consultant made the observation that many coconut trees are high enough to be dangerous to harvest, and that they can still produce enough materials if shorter. This could lead to harvesting of high trees and their replacement by younger ones, producing a good supply of coco-lumber for the laminated timber process.

Some practical “skilling up” is needed for at least some of the people in the project, and other interested parties, to handle on site resource use and home development properly. The indigenous building knowledge, as well as newly learned uses for particular innovations in use of local resources is wide and deep, and more than enough to justify creation of locally inspired tropical sustainable building and home design courses as well as courses in related subjects such as Balinese geomancy. These courses could become a source of information and expertise for other projects, and any course participants could become a valuable source of help, particularly for the shared facilities of the project. In turn, they could gain valuable practical experience and become a knowledge base in their own right.

Total is known as cob in the west and is taught in many sustainable building courses there. Modern ways of using compressed bamboo and even layered coco-lumber to even become replacements for now rare large timbers, plus the specialized knowledge needed for their use is more than enough to justify courses, even at several levels.

The Thickly rendered ferro-cement /bamboo panel- walling technique is also particularly valuable. These materials feature low costs, and are durable and can look great if the skills base is in place. They are available locally, as is the expertise, so transportation is minimized. They are also very natural and can be treated in various ways that are not too toxic, even in various stages of production.



Total is known as cob in the west



rendered ferro-cement

Since humanity has become recently more than 50% urban, and a good share of the rest are in highly populated rural areas, it can be said that apart from agriculture, another real test of humanity’s ability to achieve sustainability lies within the realm of building and related infrastructure development activities.

Recent research in America up to 2006 bears this out with about 3000 million metric tones of material and resources being used for this type of activity every year (Sibley, U.S.G.S.2006), far outstripping other non-agricultural resource uses by about 4 to 1. Not all countries exactly share the American profile, but nonetheless, the ramifications are obvious. For the now rapidly developing and urbanizing tropical zone countries such as Brazil and Indonesia, this kind of knowledge will become increasingly valuable.

Pak Swastika, a local community representative that advises Alam Santi, made the excellent point that in order to have a real idea of building costs, **an average size and quality dwelling needs to be built soon as a prototype**, and the full experience of material gathering, costing, man-hours required for building, maintaining etc needs to be recorded from that experience and used to extrapolate to different sizes and quality of homes. Therefore a master plan needs to be completed beforehand, with adequate consultation from the members of the project as to minimum requirements within the local planning constraints, to help form an acceptable vision for the prototype.

Some of the prices supplied on the accompanying spreadsheet exhibit a wide range as they were based on previous experience, but on different projects to this one, under different macro economic and inflation conditions, and that figures like those mentioned, can change. **At the moment an annual inflation rate of 6-7% per year for building materials can be assumed according to PBM**, a local quantity surveying company, and due to demand, even this could rise.

Waste Management

A local green waste management company Temessi Recycling, is based in nearby Gianyar and is run on a non-profit basis. They take separated garbage, and can process organic waste into excellent quality aerobic compost at a price of Rp. 400 a kilo or \$40 a tone.

The non-organic recyclables such as plastics can also be taken care of as Temessi has agents that can buy it and ship it to Surabaya for recycling. They also mentioned recycling companies that pay for waste such as PPLH in Denpasar (paper, plastic), Saraswati in Kerobokan (paper), and EcoBali who take plastics, tetrapak and many others as long as they are separated.

Temessi also offered to send some information about how to produce smaller scale aerobic composting systems on site.

Next Steps

Completion of masterplan and home prototype(s). This can help with project costing, facilitation of modern, tropical sustainable building course creation opportunities and to test some of the lesser known building innovations such as compressed coco-lumber as well as test the viability of lesser known power sources such as pico-hydro. Study of site investigation soil survey results particularly with respect to service ducting, shared facility impact, irrigation and drainage requirements as the site is on a slope above the Petanu river gorge and rainfall can be heavy. Interviews with older generations to see if any local land use resource or building traditions specific to the Kemenuh region that might be useful have been missed.

With possibly slightly later priority, but of nevertheless great importance, **greater coordination with all the other sustainability NGO'S, information sources and projects and experts and relevant government and funding agents as well.**

Also it could also be useful to feature suppliers and contractors in Bali and neighbouring areas such as Lombok to network, pool knowledge and efforts, attract volunteers, mutually improve and expand courses, publish funding information etc.

An early start may involve creating a web portal with access to the various websites in an easily accessible and publicized part of the web. This was suggested by Nino of Temessi and the tutors on the GEDS (on-line eco-village design course) course being undertaken by the compiler of this report.