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New vernacular construction: Environmental awareness and territorial inclusivity

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Abstract. Studies on vernacular architecture document the built heritage; discuss its preservation; and sometimes focus on its sustainability, expressing admiration for the wisdom it embodies. Traditional buildings are exemplary in terms of embodied environmental impact, but can hardly be transformed into 'sustainable' buildings in the contemporary sense, for legal, cost, technical, or cultural reasons. Today's lifestyles and expectations of comfort are very different from the original ones. Much appreciation of vernacular buildings derives from an aestheticising approach that emphasises appearance and craftsmanship. Such appreciation is tied to the perpetuation of 'traditional' forms but can lead to gentrify heritage and to design buildings that are unaffordable to local individuals and communities. We present not a literature review, but a theoretical proposal of a new vernacular, rooted in locality (origin of materials, socio-economic system, skills, etc., drawing inspiration from food self-sufficiency policies) and affordable by everyone – as it was the case with 'traditional' vernacular – but also able to respond to contemporary priorities such as counteracting climate change by opting for negative-embodied carbon materials, and meeting present expectations of comfort. Each of these criteria is discussed in detail. Within such constraints, we claim there would still much scope for creativity and innovation in terms of architectural design, behavioural choices, and policy adoption. The analysis of four recent buildings designed by outstanding contemporary architects in three continents completes the paper, substantiating very different examples in tune with the proposed approach. Open questions – including regarding the possibility of future identification of quantitative thresholds to describe 'new vernacular' buildings – are discussed in the conclusion.

1. Introduction: the essence of vernacular architecture, and its present condition

For a long time, architecture has meant exceptional buildings (temples, palaces...) for exceptional functions or for dominant groups, and the art/technique of their design and construction. The 'histories of architecture' have consistently devoted their attention to such buildings. Only during the course of the 20th century did interest and then also the qualification of architecture gradually extend to ordinary and popular buildings, often not designed or constructed by professional architects.

A pivotal change in consideration by both architects and the public occurred with Bernard Rudofsky's *Architecture without Architects* exhibition [1], which was shown in 84 different locations over a period of about twelve years from 1964 and whose catalogue sold over 100,000 copies in the USA alone [2]. In his work, many found visual and conceptual reasons for a counterpoint to standardisation and modernist orthodoxy. Not without reason, Rudofsky has been criticised for not

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letting people talk for themselves, for his exoticism that smacked of neo-colonialism, in short, for an approach that was insufficiently contextualised [3-4]. Nevertheless, his work – together with that of Turner [5], Alexander [6], and many others – contributed to change the course of architecture towards social engagement, environmental responsibility, cultural relativism and anthropological awareness, as it was observed by Josep María Montaner [7].

On the contrary, Paul Oliver was the single researcher who not only dedicated his life to the study of vernacular architecture but also arguably achieved the most consistent insights [8-9]. According to his definition, "vernacular architecture comprises the dwellings and all other buildings of the people. Related to their environmental contexts and available resources, they are customarily owner- and community-built, utilising traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies, and ways of living of the cultures that produce them" [10].

A whole body of literature exists on the topic of vernacular architecture, at the highest level of scholarly competence included. In most cases these are monographic studies of specific areas, cultures, typologies, or individual buildings. An exhaustive overview is provided by the *Encyclopaedia* edited by Oliver [10] of which Marcel Vellinga is now publishing a fully revised, updated and expanded version [11].



Figure 1. Different building technologies for same function and typology at Österreichisches Freilichtmuseum Stübing, Austria. Photo: A Bocco Guarneri, 2011.



Figure 2. Rural house mostly built with agricultural material at Écomusée d'Alsace, Ungersheim, France. Photo: A Bocco Guarneri, 2020.

Vernacular architecture has been described as the "native science of building" [9:4] (figure 1), the outcome of a totally different process from formal architecture [9:6], as it was built for oneself, and for living in. In contrast to contemporary buildings, which are more financially motivated than functional, vernacular buildings were conceived without an 'expiration date,' and could serve for several generations (with continuous maintenance and modifications). Their close 'fitness for purpose' stems on the one hand from the fact that they were "never unnecessary, not erected on a whim and not intended to impress" [9:28], and on the other because 'needs' and expectations were, in times of relative scarcity, more frugal than today [12]. Their relative simplicity (compared to the complexity of today's buildings, the parts of which are typically made up of many functionally specialised layers) makes the legibility of the parts and construction solutions evident, and thus traditional buildings are very suitable for educational use in demonstrating structural principles and recognising the functional role of construction elements [13].

Vernacular buildings were the result of local know-how, and their mode of functioning had been tested over time. They were constructed from available materials, and everything needed to construct them had been produced locally, with rare exceptions. Indeed, the material could often be waste or a by-product of agricultural activity (figure 2) [14]. The traditional techniques employed were dynamic, as they were the result of innovations, imports, adaptations. Compared to modern and industrial design, the sets of rules in action in vernacular design appear much more obvious, precisely because the limitations within which the artisans worked were usually much tighter. The sustainability of the socio-economic systems within which they developed was achieved through non-dependency: more by necessity than by choice, before fossil fuels, they were systems that tended towards a steady state, not growth [15-16]. Their primary goal was to maintain the equilibrium of life-support systems. Hence the low environmental impact of traditional construction. Given its vastness and variety, vernacular architecture constitutes "an unequalled laboratory with a vast range of responses to problems" [17:181] "such as climate change and resource depletion" [18:14]. Oliver has affirmed that "vernacular architecture is the time-honoured, truly sustainable architecture that has evolved over the centuries, changing or adapting when necessary" [18:265]. In recent decades, a strand of studies has focused on the intrinsic sustainability of traditional buildings, expressing admiration for the wisdom they embody [19-22]. Not that all traditional societies behaved in a sustainable way; simply, those who failed to do this disappeared in the long run [23].

However, as Vellinga stated, often "representations of vernacular traditions (...) are frozen in time (...) and (...) romanticized" [24:83]. Much of the discourse still tends to regard them as homogeneous, passive and rather static entities. Such conception denies the fact that "a tradition is instead a continuous creative process through which people (...) negotiate, interpret and adapt knowledge and experiences (...) within the context of the challenges, wishes and requirements of the present". As he concludes, "the vernacular (...) has been denied both a history and, indeed, a future" [24:88-89].

Vernacular heritage is a subject for conservation and preservation policies. Under ICOMOS's *Charter on the built vernacular heritage* [25], vernacular architecture represents a cultural value, an identity to be preserved. But for whom? There is a widespread conviction that the vernacular belongs to the past: as much because of the rejection of it by the poorer classes themselves (as continuing traditions would connote them as backward) as because of the active discrimination against traditional building methods perpetrated by the regulations in force in many countries. It is paradoxical that as a result of this situation, it is instead the socio-economically advantaged groups that often appropriate the vernacular heritage, which in many countries is restored to contemporary technical and aesthetic standards and transformed into luxury second homes. In mature industrialised countries it is the more educated and wealthy part of the population who value traditional heritage. The rural population of the West as well as the majority of global South population as soon as they had the chance, left their traditional homes to live in new 'modern' houses. Meanwhile, the old ones either fell into disrepair or were bought by exogenous groups. The latter's ability to spend has led in many places to gentrify traditional heritage, whose users are not anymore those who live there permanently and have living ties with local traditions [26].

Vernacular architecture, although adapted to the site, made by and for the people, using local materials and techniques and somehow possessing all the characteristics which would help solve tremendous challenges of our time such as rising inequalities and climate change, fail to deliver such image of future solution. Such constructions are perceived as anchored in the past and are not attractive to the majority. They might be attractive to some of the wealthy, but through a romanticised and aesthetic angle which removes all other social aspects of it. In this paper, we want to explore how to define a new vernacular architecture grounded in our time.

2. Our theoretical proposal: a 'vernacular architecture of the 21st century'

The set of principles which may identify what we would like to define as a "vernacular architecture of the 21st century" is founded on the earlier concept of "vegetarian architecture" proposed by Bocco Guarneri, which is in itself inspired from ecologically oriented agriculture and nutrition [27]. The principles are driven by ethical and ecological values, and have nothing to do with an aesthetic preference:

- Natural, renewable, locally available construction materials, free of toxic chemicals, and as little processed as possible;
- Passive solar design (this means that the bulk of thermal performance is achieved through passive building measures, and any active systems – if the case makes them necessary – play only a supplementary/auxiliary role);
- High-tech components may be used to achieve otherwise unattainable performance, but care must be taken to minimise them to keep the embodied impact as low as possible. The application of Peter Harper's concept of "low carbon + industrial vitamin" expresses a viable approach to contemporary construction where the bulk of the mass is local, natural, low-processed, and possibly bio-based materials, while some advanced products boost its performance [28];
- Labour-intensive, small-scale production processes, simple construction technologies.

The concept of 'vernacular architecture of the 21st century' we propose is an outcome of the research quoted above but takes a more explicit reference to the socio-economic territorial system and the popular character it would embody. In drafting this proposal, we also drew on current trends towards the identification of the vernacular as a source of inspiration for the design of a sustainable future [29-30], and an increase of the rate of food self-sufficiency and food sovereignty [31-33] which are aimed at reactivating trusted, fair and organic supply chains, and appear consistent with the systemic goals we aspire to contribute achieving.

We propose to call 'vernacular for the 21st century', a building that:

i) is mainly made of/with locally available resources;
ii) has a very low environmental footprint;
iii) meets real, contemporary expectations of the users; and
iv) is intended to be used by ordinary, local people.

A contemporary, future-oriented vernacular would therefore draw on the principles of traditional vernacular but be ready to address its potential from an unfettered perspective. This means that in no way we are suggesting that 'traditional' forms must be repeated in new constructions expected to accommodate very different ways of living, nor that we consider the way the buildings will look like to be a relevant issue: something we gladly leave to the choices of designers and clients.

Instead, our theoretical proposal suggests a research direction: a challenge for designers, builders, and clients to make with what is local; an appeal to decision-makers to promote policies to relocate production; an invitation to creatively develop technical solutions and social arrangements [34].

In this paper we have not proposed quantitative thresholds for measuring whether a building meets the criteria we are proposing. This is beyond the scope of the paper as a proper quantification should change from case to case and context to context [35]. This is not to say that such criteria could not ultimately be described also quantitatively based on, e.g., LCA impacts, money fluxes, but there should be first an agreement on values and objectives a certain society wants to achieve before defining indicators and quantifying them [36].

3. A discussion of the four criteria proposed

Past and future vernacular share the value of being grounded in a territory through materials and people. Materials are locally sourced to a large extent and labour and know-how are also usually very much localised. However, it is difficult to define what would be appropriate ratio between local and global and even if there should actually be one. In the following section, we elaborate in more detail how we could define more specifically the criteria for a new vernacular and how they differ from traditional vernacular as well as from current conventional construction.

3.1. Localness of resources: a grounded architecture for a fair and circular economy

By definition, traditional vernacular mostly used local material. Imports (of goods, skills and capital) were not completely ruled out, but certainly limited to extraordinary elements or occasions. The first basic criterion we propose is that a new vernacular should also focus on the use of local resources. However, the drivers might be different. Vernacular construction used local materials mainly because of strict transport constraints. In pre-fossil fuel times, that was a need, not a choice. However, such need was not seen as a hindrance. Building traditions were able to thrive in spite of sometimes very narrow constraints. In the 15th century, Leon Battista Alberti had already clearly expressed this principle: “Better than knowing which should be the most performing materials for his job, a good builder knows how to make the best use of those he has at hand” [37]. Within such limited set of materials available, there was still much room for creativity and innovation – indeed, it stimulated artisans and the ingenuity of past and present vernacular techniques sometimes admirably demonstrates it [38-39].

Today, there is no reason to take the principle of locality too literally, and completely rule out the use of materials transported from outside the local system. First, because transport today is much cheaper and easier. Second, because in comparison to the environmental impact of the production of industrial materials, the emissions related with transport are negligible. For instance, the carbon emissions related with the production of a window are equivalent to transporting the same window by truck across Eurasia from Lisbon to Vladivostok [40]. Which means that, in terms of embodied impacts, reusing a window from wherever in the continent is always better than producing a new one. This also shows the importance of minimising the use of such industrialised materials. (Of course the transportation impact depends on the mass transported: the greater the mass and the lower the embodied impacts, the shorter should be the distance travelled). Finally, today’s definition of local cannot be as geographically narrow, and as strict as in the past, since some products we use and want to continue to use cannot be produced in a totally decentralised way. How could PV panels, wires, glass be locally manufactured?

If from an economic, environmental and technical perspective, the size of the appropriate territory is paradoxically an entire continent, what would be the reason to commit to localness? Here, a comparison with food self-sufficiency might be helpful if not taken too literally: “Food self-sufficiency is focused on the supply, or availability component of food security, and is concerned with ensuring that a country has the capacity to produce food in sufficient quantities to meet its domestic needs” [41]. Labour-intensive methods that are adapted to small-scale agricultural production are linked with the ‘agroecology’ proposed by Miguel Altieri [42] and the definition of good farming offered by Wendell Berry [43].

But not all products can be produced anywhere. Fair trade is then usually seen as an approach to what cannot be grown or is unrealistic to grow locally. The point is not about harvesting coffee beans at any site where you want to be able to drink coffee, but arguably about considering first reducing the needs and drinking herb teas sometimes, and secondly, when drinking coffee, to drink imported organic, fair-trade coffee. On the other hand, all what could be reasonably obtained locally, should be valued. In rich countries, this requires a shift in priorities (and attached status) from exotic, high-performance, maybe low-cost to beneficial-to-the-local-economy and low-tech at the political and cultural level [44].

Our position on the size of the territory is that distance per se is not a criterion; the point is the intention in the choice of resources. In particular, one should pay attention to the social and economic consequences of such choice. Indeed, as Sebastian Moffat and Niklaus Kohler presented it [45], the built environment is the interface between natural and human capital and interacts with both at different space-time scales. Physical resources are extracted from the surrounding territory. Local knowledge is used to transform such matter into a building. And once the building is erected, it in return interacts with the surrounding material and immaterial capital. It interacts with nature by providing shelter for different living beings and by affecting local wind and temperature patterns. It interacts with human society by embedding the values and knowledge of the people who built it, and by accommodating meaningful social functions.

Modern construction is often disconnected from both local material and immaterial capital. Materials are oil-based and knowledge is embedded within the cement bag or steel beam as much as it seems that even a child would be able to build a concrete block-based house. One just needs to add water to a 'ready-mix' construction material. This is considerably removed from recipes and skills that used to be transmitted from generation to generation [46].

The scrupulous control of supply chains and the design of synergies between rural and urban territories could enable the re-invention of local economies. For such a re-invention to take place, there must be a critical questioning of where the money linked to the construction and management of buildings flows to [47]. Indeed, relocalisation of materials and know-how is linked with a relocalisation of financial flows. Buying energy-intensive and fossil-based materials manufactured by a multi-national company induces by definition a flow of money towards oil-producing countries and the shareholders of the multi-national. The degree of dependence on fossil fuels is different for each country and each material and would require specific quantitative measures [47], but it is clear that an appropriate choice of materials and technology [48] will allow to maintain the majority of the financial investment for construction in the territory [49].

Therefore, material choice and the prioritisation of local materials is not fundamentally driven by the aim to minimise carbon emissions, but most importantly to relocalise economic flows and trigger positive connexions between the social and economic actors of a given territory. Agricultural by-products such as straw can be valorised as insulation materials and can then be sold with a much higher added value than if used as animal bedding. Such local economic flows are clearly in line with the ambitions of 'circular economy' and would be fostered in a new vernacular construction. A stimulating application of this approach is shown by the 'Economic nutrition chart' initiative [50].

As a side note, we remark that consistently with a 'circular economy' approach, the reuse of existing buildings is one of the most obvious ways of using local resources.

Moreover, it should be emphasised that local resources ought to be understood not only as those materials, finished products, skills and knowledge which are immediately available but also as those which may be obtained in the future as an effect of public policies and private investment (e.g. [re]activation of production chains, introduction of novel activities, hybridisation of products and/or technologies) [51]. The availability of local financial capital is also relevant, since some production chains may be more labour-intensive and others more capital-intensive.

3.2. Minimisation of embodied carbon

Low environmental impact was given *a priori* in vernacular architecture, due to the limitations of means available, the non-availability of fossil fuels being the most obvious one. Environmental impact was not quantified, nor considered, but traditional buildings are in most cases (very) low carbon architecture [52-53]. There is also historic evidence of vernacular architecture using local material unsustainably; among the examples, the collapse of a North American civilisation that overcut trees [54]. Without going

to such an extreme case, it is now widely accepted that even indigenous civilisations profoundly transformed their territory [55-56]. The localness of materials is therefore not enough to ensure an environment-friendly construction.

In the 'new vernacular' approach, a low environmental impact (over the whole life cycle) is a constraint for material choice. A local, scarce material should not be included in such 'new vernacular' buildings while a (relatively) distant, abundant, and possibly low-embodied carbon material might be considered if emissions linked with transport can be minimised (e.g. by train or barge).

Bio-based materials should be given preference because of their capacity to store carbon within the built environment [57] but at the same time should be carefully constrained within the sustainable production capacity of such materials [58]. To do so, it is important not to shift from one-material-fits-all-purposes (concrete) to another (timber). Not enough trees can be made available for all applications [59]. However, inspired by vernacular architecture and its diversity, the ingenuity to use a multiplicity of fast-growing bio-based materials should be learnt once again [60]. Embracing diversity, it is possible to achieve both low carbon construction and sufficient resource production.

As long as use-phase emissions are concerned ('operational carbon'), our proposal does not discuss them, since national and supra-national directives have long existed; indeed, in some countries, carbon budgets are being introduced as legal requirements, that include both the embedded and operational components [61-64].

3.3. Users' expectations of comfort in a changing climate

Another focus in our definition of 'new vernacular' is the question of comfort. We consider that fulfilling the demands of the present generation is difficult to ignore, while this was secondary in vernacular mind-set. Comfort questions the needs of the present generation, what is 'sufficient' and what would be an acceptable level of comfort in a building. Current conventional buildings claim to offer what in the rich countries is understood as the highest standard of comfort – a 'new vernacular' building will offer comfort of a different kind. Conventional buildings provide comfort through control and automation. 'New vernacular' buildings will provide comfort through robustness and multifunctionality of materials (as opposed to assemblage of mono-functional, highly specialised layers) and appropriate building techniques. For instance, a rammed earth wall can provide acoustic, thermal, hygroscopic and structural performance at once [65] (although it may show weaknesses in terms of seismic resistance in some contexts).

In vernacular buildings, function and use were the goals to be achieved, and these could result in a certain level of comfort (sometimes quite remarkable as such and easily improvable further, as shown e.g. in [66]); comfort was not much the intention: it was rather the result of the function. In conventional buildings of today, comfort is calculated and maintained through automation and machinery. In the vernacular for the future, comfort will also be designed, but with less automation and smart controls.

But the ultimate difference between these three conceptions in terms of comfort might in fine be with respect to the climate. Vernacular constructions were adapted to local climate (without necessarily providing a high level of comfort); conventional constructions provide comfort through reliance on numerous and complex of technical systems. 'New vernacular' constructions will passively provide comfort through the ingenious use of multifunctional materials. This approach can respond to the future climate without adding complexity and costs, and therefore provide more resilient buildings.

Indeed, climate change will affect the built environment as buildings are long-lasting structures while the climate is unfortunately changing at a pace that is out of control. In an age of rapid climate change, designing for current local climate is not resilient. A new vernacular should therefore also reflect the need for a sustained comfort under a changing climate. Relying on a material like earth – which, among other properties, shows a good moisture buffering capacity – may allow such robustness of the system

[67]; while relying on a technical system that has been optimised for the current climate necessarily suggests that such system will not be optimal in a different context.

However, designing for changing climate cannot rely on local know-how and skills alone (even less on traditional ones), and will probably need to involve a part of engineering and environmental sciences to model how the territory might change and how a given design strategy will react to these changes.

Along with this, the expectations of comfort now taken for granted and often induced by marketing and status issues will have to be questioned: simple behavioural measures (such as wearing a jumper in the cold season) can have a strong impact on reducing energy consumption without significantly reducing comfort [68].

3.4. Affordability

Finally, it is essential that the people of a given region are allowed to use and live in 'new vernacular' constructions. Climate neutrality and materials circularity should not go hand in hand with gentrification of heritage buildings and high construction costs. Authors who, as Friedman, have highlighted the constituent poverty of vernacular building are those who most clearly understood its nature [69].

We have nothing but admiration for extremely refined levels of craftsmanship (for instance that of Japanese 'living national treasures,' *ningen kokuhō*) [70], but our proposal is about the everyday, the ordinary, the non-elitarian, the non-virtuosic (as for instance, in the work of Japanese designer Shirotani Kosei) [71]. The disdain of traditional buildings by local people was often associated with status issues: they were the tangible sign of a past of poverty from which they wanted to free themselves, while much of the outsiders' appreciation (including real estate value) of traditional built heritage derives from an aestheticising approach that emphasises its appearance and perhaps its craftsmanship quality, but appears unaffordable for most people, and is strongly tied to the continuity of past forms over time [72].

The decrease of demand, the distraction of skilled workforce towards jobs consisting in the simplified assemblage of industrialised materials, and the gradual phasing out of the traditional methods of production or extraction of natural materials led in recent decades to an impressive increase of the cost of traditional techniques due to the shortage of expertise. What used to be by and for the poor can now be afforded by the rich alone. Outcomes should be fair and inclusive: a luxury house that is negative-carbon, and incorporates handsomely handcrafted details obtained from local, natural materials is not vernacular [73].

4. Four examples

A quantitative analysis of a few built cases can be found elsewhere [74-75]. Here, we would like to briefly introduce examples that were not, as yet, fully quantified. Perhaps none of them completely satisfies the criteria we have enunciated at §2 and discussed at §3, nevertheless it seems to us that each contributes to representing some of them, and that their variety expresses how very different individual realisations can be consistent with the principles of a vernacular architecture for the future. Independently of their appearance – sometimes closer to traditional vernacular, sometimes far removed from it –, most of their mass comes from within a radius of less than 100 km and their initial embodied carbon (A1-A3) is negative (except in the Maison de la maternité which, being located in south Morocco, cannot make use of much plant-based material). Natural, bio-based materials were deemed appropriate by their designers and users and are consistent with the criteria proposed in this paper, particularly at §§3.1-2, as extensively supported by the literature on the subject [76-81]. Each of the projects was realised activating economic resources and local knowledge, plays a role in local development, and provides an exemplary piece of architecture.

Pat Borer and David Lea's Autonomous Environmental Information Centre (AtEIC) at the Centre for Alternative Technology (Machynlleth, Powys) was UK's first rammed earth building open to the

public, in 2000 [82-83]. The AtEIC was conceived as a manifesto building: a radical architecture using renewable and natural materials, and avoiding PVC, chemical surface finishes and cement (figure 3). For some years its 450 m^2 were used as a shop and information/visitor reception centre; they were later converted into exhibition space. Foundations are limecrete, that is, concrete where slate shatters are bound by hydrated lime. Rammed earth was used for interior columns and walls to take advantage of its structural and thermal properties; a specialised company supervised the execution and instructed the site workers. 180 tonnes earth were imported from the Llynclys quarry, near Oswestry, as it was not possible to extract it from the local sub-soil. 8~10% (dry weight) powdered clay was added to the mix; in some places it was stabilised with lime. Compressed earth blocks, some of which stabilised, were employed too. Plasters are also earth, while renders are hydraulic lime based. Local larch laminated timber was used for the roof trusses and the frames' structure. Pine window frames are from decommissioned buildings. The central column of the staircase is a pine log cut from the nearby forest. Green oak planking was used in the roof, while the flooring is larch laminate. Cellulose fibre was used as insulation in the roof and in the ground floor slab. Recycled sheep's wool from Bradford is the main insulation material and was employed in wall cavities.



Figure 3. Inner view of the AtEIC, Machynlleth, Wales, UK. Photo: M Bocci, 2017.



Figure 4. Exterior view of the Maison de la maternité, Tissint, Morocco, 2017. Credit: S Naji www.salimanaji.org/salima_naji/2017/08/

The Maison de la maternité de Tissint (Tata province) was built in 2016. It was designed by Salima Naji, an architect known for her battle in favour of traditional heritage and materials and her engagement with the development of rural communities in south Morocco [84-86]. It is a single-storey maternity ward in a rural commune that makes the largest allowed use of natural materials and re-interprets traditional forms and motifs in an uncompromising contemporary way (figure 4). Being this a public building, to comply with local regulations, the architect had to incorporate a reinforced concrete frame in the design, but a reinforced concrete-free version would have been technically feasible. Foundations are reinforced concrete trench fill; reinforced concrete columns are embedded in the walls and the free-standing columns of the arcade. The wall basements are exposed local stone, upon which are lime-rendered cavity walls of mud-mortared adobes. They are thick enough to passively achieve good thermal resistance in spite of the lack of insulation: indoor temperature is reported to be an agreeable 27°C when outside it is 45°C, without air-conditioning. Walls are earth-plastered and their corners are rounded, lending a soothing and protective feeling to a place with such delicate a function. The roof is flat albeit set at different heights from one area to another: one is a conventional reinforced concrete slab, another a traditional palm timber joist construction; both are waterproofed with bituminous membranes. False

ceilings are traditional *tataoui* made of palm laths; floors are local slate, *tadelakt*, ceramic tiles, stained cement screed. 70% of the material is local.

Since the Pakistan great earthquake of 2005, Yasmeen Lari has been designing several solutions for simple dwellings capable of withstanding disasters such as floods and quakes, among which Lari Octa Green (LOG) [87-88]. 1,000 LOGs were constructed in the aftermath of the floods of 2022 in Sindh province alone. LOGs can be juxtaposed to form larger houses; their modular design allows for flexibility, customisation and ornamentation. All main building materials of Lari's shelters are locally available at low if any cost, including good quality clay and bamboo, which is being cultivated locally, albeit not traditional. Plinth walls are made of lime-sand bricks bound with lime-mud mortar, sun-dried bricks facing a core of lime-mud, or limecrete possibly reinforced with split bamboo. Foundations form a slightly raised platform that maintains the building above the latest flood level. Walls are braced bamboo frames, infilled with mud-plastered date palm mats (in the temporary versions) or clay and small stones (in more permanent ones); they may be built on site or provided as prefabricated frames. Another option is loadbearing adobe walls, whose mud render may be reinforced with an embedded bamboo lattice. Both flat and conical roofs have a bamboo structure, covered by reed thatch or by straw mats, mud-lime plaster, and a lime and cocciopesto mix for improved water resistance (figure 5). Lari's projects are based on and take advantage of widespread local knowledge of working with fast-growing plants. The low-tech construction process is meant to promote community co-operation and self-confidence. Designs and tutorials available on her website [89]. Thanks to its practical approach, Lari's is the only emergency project that was effectively 'scaled up to thousands' in Pakistan, however most professionals and government agencies are still biased against earth and bamboo's properties.



Figure 5. Flood response shelter designed by Yasmeen Lari, 2010. Credit: the Heritage Foundation of Pakistan.



Figure 6. The Akeno Raised Floor house in Hokuto, Japan, 2021. Credit: Fuminori Nōsaku Architects.

The Akeno Raised Floor is a private house built in 2020-21 in Hokuto, Yamanashi prefecture, Japan. It was designed by Fuminori Nōsaku Architects for a couple who can remote work from this mountain city [90]. The floor surface is about 77 m^2 roughly half of which are the central living-dining-kitchen area. The plan is a simple rectangle whose north, east and west walls have a few small openings, while the south elevation is generously glazed and opens onto a large terrace running the full length (figure 6). Loadbearing wooden frames are filled with locally produced bales of wheat straw; the walls are clad with traditional *yaki-sugi* on the outside and earth plaster on the inside. The roof is single-pitched, and extends to protect the entire depth of the terrace; the covering is galvanised sheet metal. Both roof and floor are insulated with wood fibre. The wall layout and the insulation materials (and the transmittance values they allow to attain) would be quite ordinary in a European 'ecological' building, but are very unusual in Japan, where no energy regulations are in force. Even more unusual is that the building is off-grid and does not resort to the usual massive reinforced concrete foundation to meet earthquake

regulations, but rather to ten prefabricated steel supports, which detach the floor from the ground, which is left largely undisturbed: whence the name of the building. This house is part of a research path undertaken by the architects, that questions well-rooted assumptions and advocates the reuse of existing buildings, their relationship with the soil and its fertility, the biocompatibility of building materials, and unconventional patterns of use and sharing of space [91].

5. Conclusion

In this paper we discussed the possibility of defining a new vernacular construction which would be urgently needed to face the challenges of climate change and social tensions arising from globalised economy. A new vernacular construction should be climate neutral, be built with local materials and trigger local supply chains. We argued that this new vernacular is different from traditional vernacular architecture in that environmental concerns are clearly part of constructional choices, and that meeting the users' expectations of comfort is part of design intention (but also that these expectations will have to be critically re-examined). However, comfort in a new vernacular building is not handled in the same way as contemporary conventional construction in the sense that it is not achieved through automation and control but rather through appropriate use of multifunctional materials.

Since transport does not contribute massively to overall embodied carbon emissions, we also argued that strict localness of materials is not required to reach climate neutrality. However, constraints to the amount and/or distance of transported materials would be justified by social and economic goals. What is then the appropriate distance within which to source materials, and which spatial scale might be considered as 'local'? We have not stipulated a fixed limit as it probably depends on the local conditions as well as potentially available alternatives. In the same way, we haven't defined what is the appropriate percentage of local bulk materials vs. the imported 'vitamins' which would considerably increase the performance of the local/non-local mix, nor the percentage of expenditure that should be kept circulating in the local economic system. Such quantifications might perhaps be obtained by evaluating a broad database of buildings that we would consider as representative of the 'new vernacular' strategy we have proposed. A good start are the case studies in the *Vegetarian architecture* book [27].

At the end of the day, whatever building is built with whatever materials, it is important to remember that its main impact is not related with the building itself, but with the people who decided to build it and who will use it afterwards. Even if we can consider what buildings do, it is ultimately what people do with buildings which counts. In this sense, the identification of a strong user and comfort component in the definition of a new vernacular raises the problematic question of the appropriate balance between individual demands and environmental constraints [92]. There cannot not be a universal definition of comfort, since it is a cultural construct and it greatly varies from one individual to another; moreover, it can be achieved by very different means. However, combining the satisfaction of decent housing needs [93] with the enforcement of a carbon budget per household [94-95] might perhaps be used as a first definition of a 'new vernacular' way of life?

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