transitional shelter : displaced populations

ABSTRACT

'Displaced persons' of which there are currently approximately 20 million of concern to the United Nations High Commission for Refugees [1] have significant impact on host populations, local and regional economies and environments, and political security.
Displacement of a population can be a result of aggression within the country, occupation or domination from a foreign country, natural or man made disaster, armed or internal conflict or a mass violation of human rights, resulting in populations forced to flee their homes suddenly or unexpectedly in large quantities. The resulting 'displaced persons' could be classified as either 'international refugees' or 'internally displaced'. Displaced populations can be accommodated in a number of ways through host families, rural self settlement, urban self settlement, collective centres, self settled camps or planned camps. This report seeks to discuss 'planned camps' only and in regard to 'medium term' shelter solutions. [2]

This research seeks to investigate digital technology with regard to mass customization, and the opportunities of its application to the manufacture of shelter for displaced communities. The research will be undertaken in three primary sections. Section one will examine digital technology and mass customization fabrication as an alternative to pre-fabrication of the repetitive module. Section two will outline requirements for medium term shelter and provide a preliminary evaluation of the effectiveness and appropriateness of current responses to physical and psychological sheltering needs of the "displaced". Section three will evaluate the opportunity of mass customization to provide an architectural solution, not of forced conformity and homogeny, but one which embraces social and cultural diversity, and on a practical level is customized to suit different terrains and climactic conditions. Case studies of the application of mass customisation to architectural proposals will be examined as a means to assess the feasibility of this proposal.

INTRODUCTION

On April 28, 1994 200,000 people passed through a single border post from Rwanda to Tanzania within 24 hours to escape the genocide in Rwanda. In the early 1990s there were approximately 3 million refugees from Afghanistan living in Pakistan. In early 1992 a repatriation programme commenced that saw 1.2 million returning to Afghanistan during that year, with over a hundred thousand passing across the border in a single week in July. [1]

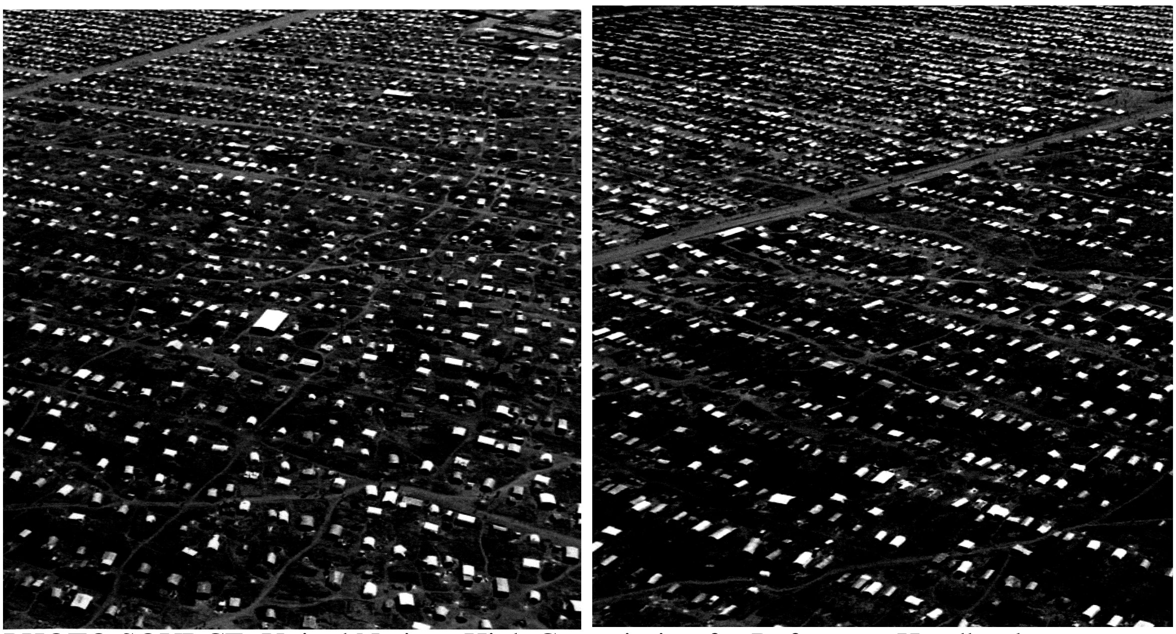

PHOTO SOURCE: United Nations High Commission for Refugees - Handbook

MASS CUSTOMISATION

'Mass customisation' is a strategy to provide customized products or services to the market place on an individual or large scale basis, without a reduction in the effects of 'mass production' which include efficiency of time, production, economy of cost and high quality. Mass production can be viewed as a single stage process with pre-determined product specifications available. [3]
The technologies of digital design and fabrication allow for mass customisation of unique building structures and components through 'digitally controlled numerical variations' - providing for a range of consumer preferences. Mass customisation is a two phase process "the initial build-to-stock phase and the final customize-to-order phase" [3] Previously confined to the automotive, aerospace and ship building industries, it is a technology that select international architects are now embracing as a practice of producing non-standard architecture.

To gain an improved understanding of digital fabrication and mass customization, thereby allowing an evaluation relative to cost, complexity, and material consideration, and, with regard to shelter, an assessment of the capacity to with stand structural, seismic, tsunami and hurricane forces, an investigation into the applications of mass customisation techniques is required.

"Traditionally, mass customisation production techniques have been implemented in industries such as ship building where, for example, differing parameters result in a form of design that satisfies the general function of the ship while providing advantageous and differing aspects to the design, all as a modification to the base design and technological features".[04]

Within the automobile industry the majority of elements are standardised across the complete product line, for example the chassis and engine components. An introduction of "integrated component assemblies" replaces assembly of thousands of individual components reducing not only design and labour costs but a reduction in material cost. Mass customisation of body elements, accessories and finishes, however, allow a solution that meets individual customer based preference. The principle of note here is the concept of being able to "manufacture a family of objects or products which have a common foundation in their design, structure and functionality, but are each unique in their individual manifestation" [04]

The aerospace industry again typically provides variants of an existing design. Economic considerations prevent production of a "different aircraft for different requirement". "The speed at which markets developed meant that it was faster and cheaper to derive variants of an existing design, modified to fulfill new needs. (e.g.: Boeing 367-80 ® Boeing 707 passenger jet, KC-135 tanker, E-3A AWACS sentry). This has become even more evident in the latest designs, in which not individual models, but whole families of aircraft are launched. These consist of an array of related models, which share parts, manufacturing, and flight-training commonality while containing enough 'room' for growth within the root design (e.g. Boeing 777 family) " [04]

New manufacturing techniques [CNC machining and CAM] allow creative rule based design systems to combine with production to manufacture product that is free from predetermined constraints and form thus producing interrelated but unique product. Industrial design and clothing industries have also historically adopted this technology. Adidas now provides a customised "miAdidas" product range. Companies including Procter & Gamble, Lego, Nike, Land's End and Levi Strauss have also started large-scale mass customization programs. [05]

"Basic Mass-Customization is achieved by modifying the definition parameters within a design framework. A basic design is established in its morphology, which does not change during the customization process. In this sense, there is no one 'root design', but rather many variations of it, each of which is instantiated by its individual, unique parametric values." [04]

Steps taken to realize mass customization can be said to lie in two areas: Product Design For Mass Customization (DFMC) and Mass Customization Manufacturing (MCM) system.

"MCM implementation strategies can be divided into three different categories according to the different stages when customization is introduced in the value-chain: (1) form MCM, (2) optional MCM, and (3) core MCM (Alford/ Sackett/ Nelder, 2000). Form customization is the simplest MCM implementation strategy, where customization is introduced at the delivery stage. Optional customization allows customization to take place at the manufacturing stage. The essential point of this implementation strategy is to provide a large number of pre-designed, standard options to customers. It produces the configured products. Customers can only select options from a predetermined list and request them to be assembled. Core customization integrates customers with the design process. Accordingly, manufacturing processes and delivery services must be customized too. Core customization is the final goal and the perfect condition of mass customization manufacturing." [06]

"The revolutionary MCM system is characterized by four challenging characteristics: degrees of flexibility, production capability adjustments, modularization methods, and dynamic network-control system structure. Thus, an MCM system must possess sufficient flexibility and rapid response capability to deal with complex manufacturing situations. The concept of flexibility in traditional FMS has four major components: volume flexibility, manufacturing flexibility, mix ratio flexibility, and delivery flexibility (Koste/Malhotra, 1998). The MCM system demands a higher degree of flexibility than traditional FMS." [06]

Due to the commonality (similarity) over product lines or among specific customized products, the product family suggests itself as a natural technique to facilitate increasingly efficient and cost-effective product development (Meyer et al., 1997) A strategy of implementing mass customization has been proposed by Tseng and Jiao (1996) through developing product family architecture (PFA). Essentially, a PFA aims at presenting a generic architecture to identify and use common elements, within which each new product extends so as to tie future designs to a common product line structure. [06]

In summary of the assessment of current mass customisation applications, commonality within a product family appears to be the primary factor in achieving the economies of cost and scale experienced by mass production.

MEDIUM TERM TRANSITIONAL SHELTER

The second stage of research seeks to gain an understanding of the nature and needs of 'shelter for displaced communities'. The development of settlements requires complex assessment encompassing functional, social, and emotional needs of both the users, both individually and collectively. Construction can not only represent but structure the way that people interact socially, and the way in which they perceive their world. The challenge for an architectural solution lies in finding a strategy that respects individual culture and tradition while enabling individual determination of the shelter, embracing the possibilities of architectural creation and with consideration to local conditions.

This research involves analysis of current architectural responses for shelter both locally and internationally, gaining a preliminary understanding of the social and psychological implications of shelter for displaced communities, and discussion with UNHCR, RedR and Sphere Project.

In accordance with the **United Nations High Commission for Refugees** [UNHCR]
"Shelter must, at a minimum, provide protection from the elements, space to live and store belongings, privacy and emotional security. Shelter is likely to be one of the most important determinants of general living conditions and is often one of the largest items of non-recurring expenditure. While the basic need for shelter is similar in most emergencies, such considerations as the kind of housing needed, what materials and design are used, who constructs the housing and how long it must last will differ significantly in each situation" [8]

As an immediate solution for the need to shelter, the UNHCR had stockpiled approximately 100,000 tents in preparation for a post-conflict Iraq. The immediate response required for this potential scale of shelter requires a fast, easy, readily available and adaptable solution. At times, often no more than blue tarp and sticks will be provided in the first instance. However the psychological implications of ongoing habitat in a transitional settlement requires a more considered and sensitive approach to accommodation, with consideration to both the social and physical needs of the displaced population [9] and the financial and practical needs of the 'provider' of shelter.

The **Sphere Project** also discusses 'the importance of shelter settlement and non-food items in disasters'. In both hot and cold climates, beyond survival, shelter is essential not only to provide security and personal safety, protection from the climate, and increased resistance to poor health and disease but is essential to retain human dignity and to sustain family and community life to the extent possible in difficult circumstances. [10] [11]

"Key aspects of the right to housing include the availability of services, facilities, materials and infrastructure; affordability; habitability; accessibility; location; and cultural appropriateness. The right to housing also extends to goods and services, such as sustainable access to natural and common resources; safe drinking water; energy for cooking, heating and lighting; sanitation and washing facilities; means of food storage; refuse disposal; site drainage; and emergency services. People should have adequate space and protection from cold, damp, heat, rain, wind or other threats to health, structural hazards and disease vectors. The appropriate siting of settlements and housing should provide access to health-care services, schools, child-care centres and other social facilities and to livelihood opportunities. The way housing is constructed, the building materials used and the policies supporting these must appropriately enable the expression of cultural identity and diversity of housing. The importance of shelter, settlement and non-food items in disasters Shelter is a critical determinant for survival in the initial stages of a disaster. Beyond survival, shelter is necessary to provide security and personal safety, protection from the climate and enhanced resistance to ill health and disease. It is also important for human dignity and to sustain family and community life as far as possible in difficult circumstances." [7]

It can be suggested that many current approaches to accommodate dispossessed refugees, with emergency shelter brought in fully assembled and towns created overnight - which both vary considerably from earlier traditions and ignore lifestyles [often by eliminating the space and soil for gardens that are so frequently pivotal to traditional life] reflect 'post modern' qualities. They contribute to the sense of alienation amongst the displaced and fail to recognise that self organisation can assist with creating a sense of order and structure among chaos.

By designing to facilitate human events and response rather than merely function, architects can shape the way that people exist and interact, and in the process, "facilitate balance and harmony in society". [Tschumi] With consideration of this, in emergency housing applications, architecture must also respect and cultivate continued cultural tradition of the affected populations. To provide a successful architectural response for displaced populations, the architect must first engage the coexisting cultures, political systems, and the environment - it is essential that we begin to understand human society and in this particular application, the affected populations, as an 'organism'. The development of settlements requires complex assessment encompassing the functional, social, and emotional needs of the users, both individually and collectively. It must be acknowledged that construction can not only represent but structure the way that people interact socially, and the way in which they will perceive their world. The challenge therefore lies in finding a strategy for collaboration that respects individual culture and tradition and enables individual determination of the shelter, potentially through flexibility and individual modification.

Current solutions available are often soft skinned, expensive, provide inadequate protection and are difficult to transport. In summary what is required by medium term shelter is an inexpensive and easily constructed assembly by local community requiring no special tools or skills. The shelter must be easily transportable and provide protection against extreme weather conditions. Shelter needs to provide security and privacy to its occupants both externally and internally – thus internal subdivision should be an option. Shelter however should not surpass the standard generally experienced by the occupant and should be recyclable. [07]

The construction should accommodate household activities: "space should be provided for sleeping, washing and dressing; care of infants, children and the ill or infirm; the storage of food, water, household possessions and other key assets; cooking and eating indoors when required; and the common gathering of the household.

The design of the shelter and the materials used are familiar where possible and culturally and socially acceptable. Alternative materials required to provide temporary shelter are durable, practical and acceptable to the affected population. The type of construction, materials used and the sizing and positioning of openings provides optimal thermal comfort and ventilation". [07]

"Disaster prevention and mitigation: the design should be consistent with known climatic conditions, be capable of withstanding appropriate wind-loading, and accommodate snow-loading in cold climates. Earthquake resistance and ground bearing conditions should be assessed. Recommended or actual changes to building standards or common building practices as a result of the disaster should be applied in consultation with local authorities and the disaster-affected population". [07]

With regard to varying climate conditions in warm, humid climates: "shelters must be oriented and designed to maximise ventilation and minimise entry of direct sunlight. The roof should have a reasonable slope for rainwater drainage and have large overhangs. The construction of the shelter should be lightweight, as low thermal capacity is required. Seasonal rains should be taken into account and consideration should be given to adequate surface water drainage around the shelter and to raised floors to minimise water ingress.

In hot, dry climates: construction should be heavy to ensure high thermal capacity, allowing changes in night and day temperatures to alternately cool and heat the interior, or lightweight with adequate insulation. Adequate care should be taken in the structural design of heavy construction in areas with seismic risks. Door and window openings positioned away from the direction of the prevailing wind will help to minimise heating by hot winds and radiation from the surrounding ground. Shade and protection from hot winds can also be gained from adjacent shelters and surrounding natural land forms or trees. Flooring contiguous with the external walling should be provided to minimise sand penetration.

In cold climates: heavy construction with high thermal capacity is required for shelters that are occupied throughout the day. Lightweight construction with low thermal capacity and high insulation is more appropriate for shelters that are occupied only at night. Air flow through the shelter should be kept to the minimum necessary to ensure personal comfort whilst also providing adequate ventilation for space heaters or cooking stoves." [07]

"Bad planning has allowed settlements to destabilise countries or entire regions. Good planning has supported displaced people in maximising internal and external protection and security, in reaching durable solutions, in avoiding natural hazards, in minimising disease spread, in maintaining their relations with their hosts, in managing natural resources sustainably, and in contributing to local livelihoods. Good settlement planning has also determined the success of aid operations, and of other sectoral programmes within those operations." [07]

In summary, it can be concluded that medium term transitional shelter has a common base requirement of certain physical and psychological needs that need to be met with a range of variables that arise from cultural and climatic differences. On this assessment it would appear that there is an application for mass customisation for production of this shelter.

CASE STUDIES

In response to the increased need for emergency shelter a number of architects have sought to develop solutions incorporating materials and techniques such as the use of bombed-out rubble bound within wire as a construction material, formation of a dome through inflating a large hemp tarp and spraying with a liquid concrete, and the experimentation of lycra and spandex based materials to form a tarpaulin. Rarely are the prefabricated solutions adopted as they do not successfully meet the needs of the populations and tend to be inappropriate in terms of culture, climate and cost.

Ban first explored emergency housing in response to the refugee crisis in Rwanda in 1994, where genocidal conflict resulted in approximately two million refugees. The initial UN response was provision of tarpaulins to the refugees, who were then responsible for scavenging wooden logs to erect them. This, however, contributed to rapid deforestation in refugee areas, which required refugees to wander ever further in search of wood, exacerbating both the environmental and the humanitarian crisis. When the UN began distributing aluminium support rods with the tarps, refugees sold the valuable aluminium, and returned to foraging for wood. Bans' design solution for Rwanda was a four panel tent supported by a framework of easily assembled paper tubes. Approximately a hundred of Ban's tent structures were deployed in a program in Rwanda in 1998. Ban designed more substantial relief housing for the victims of earthquakes in Kobe, Japan in 1995, and Western Turkey in 1999. The criteria required a cheap structure that could be easily and quickly assembled. His solution was to use a foundation of sand-filled beer crates (selecting 'Kirin' beer crates over those of a rival company, because their yellow colour harmonized better with the brown of the cardboard tubes), walls of paper tubes (diameter 108mm, 4 mm thick), which were stuffed with crumpled paper for insulation, and the ceiling and roof of tent material. The tubes could be constructed on site. The floor area of 16m2 equalling that of the UNHCR basic shelter size for Africa. The houses are deemed successful in that they cost less than $2000 for a 16sq.m. unit, can house four people, take only 6 hours to build and are easy to store. Another advantage is that the paper tube machine could be brought into the disaster area rather than transporting bulk materials, which is difficult in a crisis. Afterwards the huts are easily dismantled and the materials cheap to recycle.

SOURCE: www.shigerubanarchitects.com
PAPER EMERGENCY SHELTERS FOR UNHCR - Byumba Refugee Camp, Rwanda, 1999

In assessment, Shigeru ban's structures provide successful shelter for displaced populations satisfying both physical and social considerations [9]. The cardboard structure achieves the fine balance of both 'permanent impermanence' and 'impermanent permanence' [Ban] - the structure must be perceived as equally impermanent to the standard issue tent while providing a psychological sense of shelter. The construction material used satisfies requirements of durability, strength, fire and water proofing. The material cost is low, readily available, easily constructed with unskilled labour, easily disassembled and easily maintained. With respect to environmental issues shelters can be constructed from recycled material and are fully recyclable once disassembled.

Although not a criticism as such, the irony of Ban's cardboard structures is they are potentially "too good". If structures improve too greatly on what refugees have previously experienced, there is less incentive to leave a host country and return to place of origin - consideration must be given for what is culturally appropriate.

PHOTO SOURCE: www.shigerubanarchitects.com
PAPER LOG HOUSES - Kobe, Japan, 1994 / Kaynasli, Turkey, 2000 / Bhuj, India, 2001

ARCHITECTURE & MASS CUSTOMISATION

The third section and conclusion will provide an assessment of the possible application of digital fabrication technologies and 'mass customisation' to the manufacture of medium term transitional shelter for displaced communities. In order to assess the application of this technology it is necessary first to analyse current applications to architectural proposals and secondly to determine the criteria for the basis of assessment for the use with transitional shelter.

"For mass housing to be an attractive option, it is essential to provide architectural flexibility wherein each new dwelling complex can be of different design, thereby avoiding architectural monotony." [12]

Flexible manufacturing systems require that production allows 'flexibility' not only in output but in process, mix, volume and routing.(Browne 1984, Singh and Talavage 1991). While this discussion will not examine these production issues in more detail it is also important to note that these systems should also avoid waste while reducing "resource idleness, waiting time, delivery time and production costs". [12]

The "MIT House_n research group" explored the application of mass customization to architecture, originally implemented by the ship building, electronics and automobile industry, by separating the building into a "chassis (providing structure, power, communication, etc.), and mass-customized modules (for interior fit-out, exterior facades, electronics, communication, etc.)...This allows building designers to concentrate primarily on the unique programmatic and environmental context of a building, and allows individual occupants to focus on tailoring their environment according to needs and values." [MIT House_n researchers Thomas McLeish (Masters candidate, MIT Media Lab) and Tyson Lawrence (Masters candidate, MIT Department of Mechanical Engineering)] [13]

Alvaro Siza developed an interactive internet system to explore the possibilities of mass customization within housing for his project at Malagueira. The system utilized a modeling tool 'discursive grammar'. "A discursive grammar consists of a programming grammar and a designing grammar. The programming grammar generates design briefs based on user data; the designing grammar provides the rules for generating designs in a particular style, and a set of heuristics guides the generation of designs towards a solution that matches the design brief." [14]

This research identified three primary problems to be addressed in providing a satisfactory architectural solution. "1. the translation of client data into design requirements 2. to verify whether a design satisfies these requirements [simulation] 3. a mechanism to translate the design requirements into a housing solution [optimization]" [14]

The research undertaken for this paper revealed that the application of mass customisation to emergency medium term disaster relief has in fact been explored in a preliminary manner at Massachusetts Institute of Technology. Their research considered that mass customization could provide a readily available solution which still allowed individuality within the community. Their process sought to give control to the end user through the use of "generative computational methods and Computer Numerically Controlled (CNC) fabrication techniques to accommodate for design customization in this previously monotonous genre" [15]

"A direct instantaneous (Pine, 1993b) link can be established between generative design and fabrication and evaluation system. The end user can participate in this decision process, without incurring cost beyond the initial technological infrastructure. A generative system that mechanizes the interaction between user, designer and fabrication, attempts to effectively deploy customized dwellings without incurring a cost premium. It is not intended that the process proliferates cosmetic change (Chin, 2005), but more importantly structural and spatial variation." [15]

Their research resulted in a plywood structure that could be manually assembled with simple tools and could be customized for client and site variations and requirements. However, the results also stated that as this process involves a complex computational system there could be variations and conflict with tolerance in the final structure.

CONCLUSION

To assess whether mass customization has in fact a beneficial application to medium term transitional shelter it is first necessary to clarify the criteria on which this assessment can be made. Current mass customization applications to architectural proposals are still in experimental stage. On that basis it can be assumed that the cost effectiveness of this technology may make it unfeasible at this time and the length of the manufacturing process is difficult to determine. If shelter is to be produced on demand as required to suit varying environmental and cultural conditions, the production time may not meet demand at this stage. If the potential need for shelter was to be anticipated and manufactured in advance there would be issues with the cost of storage.

In regard to the physical requirements of displaced populations it has been determined that shelter must be durable, secure and provide resistance to fire, moisture and local environmental conditions. It should be easily transported to remote sites, constructed and deconstructed simply with no special skill requirement and with the ability to recycle it at the end of its use. Psychological requirements demand privacy, cultural and political sensitivity. Mass customization indeed allows the variation required to provide the solution to all these requirements. The control of the varying factors I believe, however, should occur through a central facility and be based on generic climate and cultural conditions rather than 'end user' personal input.

In conclusion, with assessment first experiments of applying the technology of mass customisation to housing it would appear that it does have a feasible application to medium term emergency shelter once cost effective criteria can also be achieved.

FOOTNOTES

1. UNHCR handbook for emergencies, UNHCR, 1999 (united nation high commission refugees)

2. Note: Individual household shelter solutions may be short or long term subject to the level of assistance provided, land use rights or ownership, the availability of essential services and social infrastructure, and the opportunities for upgrading and expanding the dwellings.

3. MIT Open Source Building Alliance Mass Customization Trends in Other Industries - 1990s to Present

4. Mass-Customization in Design Using Evolutionary and Parametric Methods

5. Qualification of Small and Medium-sized Car Suppliers for Mass Customization due to Suitable Factory, Production, and Logistics Structures Peter Nyhuis, University of Hanover, Germany Marius Müller-Seegers, University of Hanover, Germany

6. Flexible Manufacturing System for Mass Customization Manufacturing Guixiu Qiao, Roberto Lu, and Charles McLean

7. The Sphere project, (2004) Humanitarian Charter and Minimum standards in disaster response

8. UNHCR (1999) para 71, p 144 UNHCR handbook for emergencies

9. The physical & social requirements of shelter can be summarises as follows. Refer to the UNHCR handbook, Sphere Project & Shelter Project for emergencies for a more detailed explanation.

Physical specifications

- Usable area - 3.5 m2 per person - recommended minimum surface area is 45m2 per person including garden space, with capacity for expansion. Modular planning should address – family = 4-6 people, community = 16 families, block = 16 communities, sector =4 blocks, camp = 4 sectors (= 20,000 people)
- A grid system is to be avoided if possible in preference to area or cluster planning by family, neighbourhood or village groups as appropriate to support existing social networks, and to contribute to security and self management by the affected populations.
- Cluster planning is to maintain the privacy and dignity of the separate households by offsetting door openings and ensuring that each household shelter opens onto common space. Shaded external space adjacent to the shelter is to be provided for food preparation, cooking and sleeping. Internal subdivision within shelters provide for privacy and cultural aspects
- The internal volume is to have a 33% total floor area with minimum head height 1.8m,
- The operating climate should allow for temperatures of -25 to +45 with ventilation (reducable to control heat loss but not sealable) and be adaptable by users according to climatic demands (component changes)
- The structure must be durable with structural integrity - must not fail in wind speeds up to 85-100km/h, wind damage through uplift of roofing
- The structure must reduce the risk of fire and minimise spread of flame (risk is high in dry areas where forest fires or wildfires are common, and in cold or temperate climates where cooking and heating stoves are used inside shelters) Fireproofing of structures and buildings twice as far apart as they are tall. Fire breaks should be provided between blocks and can be used for vegetables or recreation.
- The structure is to be waterproofed to prevent penetration of moisture ingress and internal condensation
- covering and colour – reflection / heat absorption must be considered with use of non toxic materials.

social specifications

- the structures should be adaptable with minimum components, and enable repair with non specialist skills and equipment
  provide the capacity for modification by the occupants to suit their individual needs including subdivision of the internal volume for privacy.
- materials should be environmentally sustainable, suitable for later reuse, upgrading, modification or reconstruction on return

cultural and political sensitivities should be taken into account with colour and design with adequate daylight penetration. Materials used should be familiar where possible and culturally and socially acceptable. Durable, practical and acceptable to the affected population.

- manufacturing and disposing of the shelters should take place without significant negative environmental impact. It should consider the extent of natural resources available and that they are managed to meet the ongoing needs of the displaced and host populations. The production and supply of construction material and the building process must minimise the long term depletion of natural resources. Trees and other vegetation should be retained where possible to increase water retention, minimise soil erosion and to provide shade. Locations of mass shelters or temporary planned camps are returned to their original condition once they are no longer needed for emergency shelter use. SPHERE

During construction locally sourced materials and labour used should not adversely affect the local economy or environment. Locally derived standards of workmanship and materials should be achieved, SPHERE

10.. The Sphere project, Humanitarian Charter and Minimum standards in disaster response, 2004 ch 4, p 208

11. The 'Shelter Project' is a proposal that seeks to develop a practical assessment tool to enable better understanding of roles and responses to the emergency and reconstruction phases of transitional settlement addressing both the beneficiaries and the donors. It expands discussion of transitional settlement assessment from the quantification of basic shelter needs of individuals to vulnerability and risk assessment of individual, family and community livelihoods.

12. High-Turnaround and Flexibility in Design and Construction of Mass Housing Amarjit Singh1, Rick Barnes2, and Ali Yousefpour3 - "FLEXIBILITY IN HOUSING"

13. MIT Open Source Building Alliance

14. The case of Siza´s houses at Malagueira José P. Duarte

15. Design and digital fabrication of housing for developing environments.

Marcel Botha, Lawrence D. Sass - Massachusetts Institute of Technology, Department of Architecture

BIBLIOGRAPHY

UNHCR handbook for emergencies, UNHCR, 1999 (united nation's high commission refugees)

The Sphere project, (2004) Humanitarian Charter and Minimum standards in disaster response

The 'Shelter Project' is a proposal that seeks to develop a practical assessment tool to enable better understanding of roles and responses to the emergency and reconstruction phases of transitional settlement addressing both the beneficiaries and the donors. It expands discussion of transitional settlement assessment from the quantification of basic shelter needs of individuals to vulnerability and risk assessment of individual, family and community livelihoods.

Corsellis et. Al (2004) Transitional Shelter, Shelter project

Lindset, B. "Digital Gehry – Material Resistance Digital Construction"

Kolarevic, B. "Digital Production"

"Competitive Advantage Through Customer Interaction"
Leading Mass Customization and Personalization from the Emerging State to a Mainstream Business Model edited by Frank T. Piller, Ralf Reichwald and Mitchell Tseng with an introduction by B. Joseph Pine II Munich, 6-8 October 2003 Technische Universität München (TUM)

Dittmer, J (2004) The Soufiere Hills Volcano and the Post Modern Landscapes of Montserrat, Focus on Geography, New York

Luscombe, B (2000) "he Builds with really tough material – paper" ASIANOW, time, magazine

Nadar Khalili interview, (2002) National Geographic Today, 03/04/2002

Helsel, S (2001) Sean Godsell FUTURE SHACK Architecture Australia 200109

Bell, E (2001) Shigeru Ban Princeton Architectural Press

Duarte J. P.: 2005, "A discursive grammar for customized mass housing: the case of Siza's houses at Malagueira, Automation in construction" volume14: pp 265-275.

Willis, D., Woodward, T. "Diminishing Difficulty: Mass Customisation and the Digital Production of Architecture" Harvard Design Review, Fall 2005/Winter 2006: pp 70-83.

Joseph Chuen-huei Huang, Robert Krawczyk "Customizing Prefabricated Houses by Internet-Aided Design" **,** Illinois Institute of Technology, College of Architecture, USA

Crayton T.: 2001, "The Design Implications of Mass Customization, Design Intelligence" 7(5), pp. 95.

Huang J.C.: 2005, "Integrating Mass Customization with Prefabricated Housing", Ph.D. Thesis Proposal (unpublished), Illinois Institute of Technology.

Duarte, J. P.: 1999, "Democratized Architecture: Grammars and Computers for Siza's Mass Housing", in Proceedings of the International Conference on Enhancement of Computational Methods in Engineering and Science. Macau: Elsevier Press.

Duarte, J. P.: 2002, "A Descriptive Grammar for Generating Housing Briefs on Line, in Concurrent Engineering – Research and Applications", Proceedings of the.9th ISPE International Conference on Concurrent Engineering 2002, Cranfield, United Kingdom.

Pine, Joseph / Victor, Bart / Boynton, Andrew (1993): "Making Mass Customization Work", Harvard Business Review, No. 9, pp. 108-119.

Qiao, Guixiu / Lu, Roberto / Riddick, Frank (2003): "Flexible Modeling and Simulation for Mass Customization Manufacturing", Proceedings of the 2003 IIE Annual Conference, Portland, OR, May 2003.

Silveira, Giovani / Borenstein, Denis / Fogliatto, Flavio (2001): "Mass Customization: Literature Review and Research Directions", International Journal of Production Economics, Vol. 72, pp. 1-13.