

NEW MACHINE VERNACULAR: REMOTE BUILDING DEVICES, DIGITAL/CULTURAL ACCOMMODATION AND TECHNOLOGY'S RENEWED HUMANITARIAN AGENDA

Marcus Shaffer

Abstract

Contemporary advancements in mobile technologies and computer-aided fabrication systems have signaled the plausibility of remote construction devices in our near future. Semi-autonomous building-making machines capable of quickly (and continuously) erecting housing, architecturally dependent micro economies, and emergency urbanisms, represent our enormous technological potential to better the lives of an estimated 33 million people currently living in I.D.P. status around the world. In addition to homes and livelihoods, Tectonic Machines, as digital-mechanical extensions of our human sensibilities with regards to building, might also address the cultural and communal alienation of camp-bound I.D.P.s through extreme accommodation in producing vernacular forms and building types. In fact, the success of these humanitarian-centric machines will not be measured through an accounting of their industrial efficiency, but by their variable capabilities towards recreating aesthetically relevant replacement communities to carry functioning cultural systems and temporary economies, rather than mere logistics-based holding camps. These new machine's sensing, "informed", communicative, and freed from subjugation to the assembly line, must be devised to

communally design and deliver a great variety of architectural forms that are environmentally fit, culturally accommodating, and spontaneously familiar (not necessarily new), in their appropriateness. In this scenario of techno-environmental mediation, a whole range of future vernaculars might evolve and develop as a comingling of old traditions and state-of-the-art machineries, local materials and global technologies, community-generated instinct and experienced formal practices.

In addition to these topics, this paper will report on the development of a specific Tectonic Machine currently being designed for use in humanitarian relief situations and of the essential role vernacular accommodation plays in that development. This project has evolved from a digitally controlled casting system into something with the character and capabilities of a robotic collaborator or construction probe that learns, informs, and evolves design and construction in dialogue/partnership with architects and displaced communities.

Keywords: *Tectonic Machines, Technology transfer, Remote construction devices, Mechanical vernacular*

Introduction

Current advancements in mobile technologies and computer-aided fabrication systems have signaled the plausibility of remotely operated construction devices in the near future. Semi-autonomous building-making machines capable of quickly erecting and modifying resettlement housing, architecturally dependent micro economies, and perhaps even “emergency cities”, represent our enormous technological potential to better the lives of millions of people living in Internally Displaced Person status around the world. In addition to erecting semi permanent housing and the architectural infrastructure of livelihoods, Tectonic Machines, as digital-mechanical extensions of our human sensibilities with regards to building, might also address the cultural and communal alienation of camp-bound IDPs through extreme accommodation in producing vernacular forms and culturally familiar building types. As “humanitarian aid” or SSTR (stability, security, transition, and reconstruction) missions increasingly involve more technologically-capable proponents servicing more technologically adept populations, the success of the architecture machines we design should not be gauged by the standards of old--through an accounting of their efficiency in producing mere logistics-based holding camps. The success and use of these “new machines” should be measured by their variable capabilities towards recreating aesthetically relevant forms and culturally accommodating replacement communities capable of supporting functioning social systems and economies. These new humanitarian machines will take

advantage of Information Age technologies—sensing, “informed”, and digitally equipped to “remember”, transmit and reproduce building information and traditions. They would ideally be devised to communally design and deliver a great variety of vernacular forms that are environmentally resourceful, and spontaneously familiar (not necessarily new) in their appropriateness. In this future scenario of techno-environmental mediation, a whole range of new vernacular developments might evolve as a comingling of old traditions and communal machineries, local materials and global architectural technologies, community-generated building instincts and professionally experienced formal practices.

In addition to these topics, this paper will briefly report on the development of a hypothetical Tectonic Machine currently being designed as a construction process for use in humanitarian relief situations—and of the essential role vernacular accommodation plays in that development. This project has evolved from a digitally controlled form work/false work system into something with the potential of a robotic construction probe that transmits, informs, and evolves design and construction in dialogue with architects and displaced communities.

An Urgent Need for New Mobile/Remote Architectural Technologies

“The only way the new can be created is from deep with precise conditions existing in the

present. The architect must become, more than ever before, a creature of the present, fusing all that is remembered and all that is dreamt within it, as though existence itself were hanging in the balance (Woods, 1997).” During the Industrial Age, the field of architecture was culturally responsible for making connections between modern society’s technology use, and the potential impact of these technologies on/in the built environment (Banham, 1960). In the post-industrialized Information Age, we now live in a heightened techno-cultural climate where the digital dialogue between intelligent human, computational, and mechanical systems provides the basis of routine living and makes extraordinary achievement possible—from the connectivity of the World Wide Web to our extended exploration of distant planets. Even for those living in the so-called “developing world”, common handheld technologies—the ubiquitous mobile telephone—can easily transmit and accommodate extended audio and visual experiences that are technologically gathered and beamed home via satellite from the farthest reaches of our planet. Technologically, extreme virtual presence and physical mobility on a global scale through means both digital and mechanical are very advanced and reliable, readily available, and increasingly inexpensive (Tech Mission, 2009). In contrast with the Machine Age, the Information Age is producing smaller, highly sophisticated “personal” technologies that are finding their way home into mud brick and adobe houses throughout the developing world. These devices in turn, are creating cross-cultural generations of globally connected and digitally inventive technology users who are less restricted by former

economic, political, and social barriers. Professional architecture as practiced in the West is taking advantage of this barrier-free digital know-how in developing nations like India and China, by “outsourcing” drafting, estimations, structural engineering, and 3D modeling responsibilities (O21, 2010). The “remote architects” who provide these services/skills are often returning home to traditionally built houses at the end of the working day. If future scenarios permit us some degree of speculation, perhaps the architectural opportunities of the age lay somewhere in the potent mix of new form-making technologies/hardware, increasingly sophisticated technological skills carried by developing world workers, and the correspondingly “primitive” shelter technologies that constitute their familiar living/working environments?

One manner in which we might take advantage of this shifting technological landscape is in confronting the increasing displacement of people around the world due to wars and natural disasters. Despite our technological sophistication, we also live in a world where an estimated 26 million people (according to the IDCM: The Internal Displacement Monitoring Centre) exist in a desperate state of forced physical, cultural, and political instability as refugees or Internally Displaced Persons. One need only imagine a dispersed and/or homeless population greater than that of present day Metro-Tokyo living without the physical provisions (protection, storage, intimacy, privacy, etc.) and cultural benefits of architecture (public safety, addresses for social/economic functions) in order to understand the severity of this situation. This growing population, in both developed and

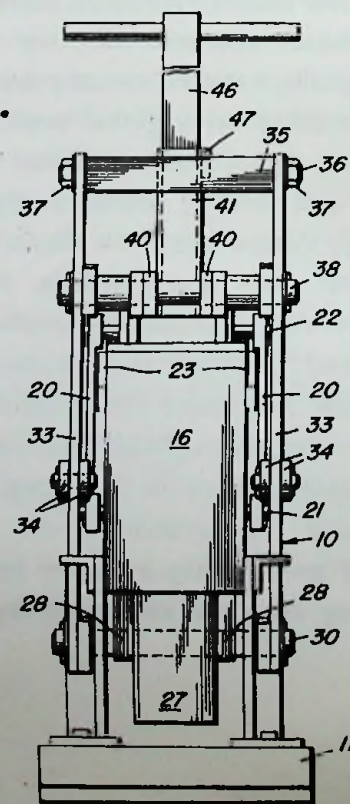
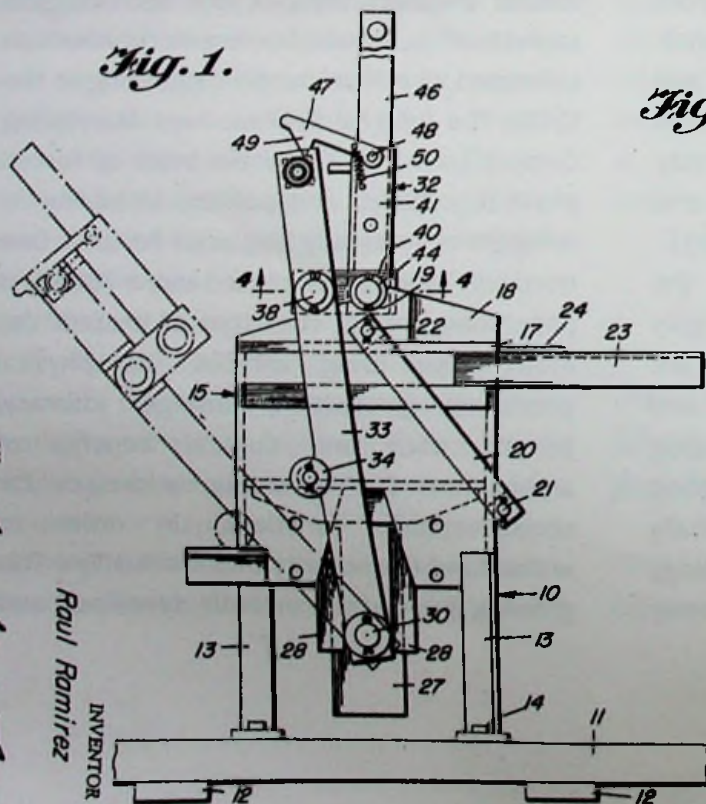
developing nations (think educated professionals, not farmers), and the unacceptable nature of their living conditions demands our attention... their displacement is a global humanitarian emergency that will easily employ a multitude of new/improved methods of intervention working towards a variety of solutions.

Addressing the complexities of post-disaster relief and/or forced mass migration with user-friendly, cross-cultural, "high" technologies can be critiqued as a lofty, expensive, and time-consuming goal—but generations of people born, raised, and "confined" in deplorable permanent/temporary conditions literally constructed of half-measures truly deserve a greater variety of attempted solutions (the average length of stay for IDP camp residents is 17 years—roughly the same amount of time it took industries to make cell phones and

personal computers ubiquitous around the world). Presently, one thing is certain—neither the sheltering methods and efficiency-related technologies associated with Government or N.G.O. (Non-government Organization) relief, nor the relatively slow pace of conventionally practiced "professional" architecture can adequately respond to an urgent need for architecture on the scale of city-making (Lewis, 2008).

If we are to offer IDPs sustainable lives and livelihoods through sensitive resettlement rather than logistical holding and external organizational dependency, potential solutions to "well articulated needs" lay in taking advantage of both new technologies and familiar traditions/vernacular (Davis, 2006). The reality of creating the required "Exigent Cities" for these IDP populations practically exists in novel hybrids of the best forms of organizational deployment

Figure.1: US Patent drawings for CINVA RAM Block Press.



Dec. 6, 1960

Filed June 26, 1957

R. RAMIREZ
BRICK MAKING APPARATUS

2,962,788

3 Sheets-Sheet 1

BY
Raul Ramirez
INVENTOR

capabilities and hardware, information age construction processes, and local building traditions and material employment (Lewis, 2008). Perhaps one way of placing this discussion (and expectations) on a more fundamental level is to begin by talking about Industrial Age Tectonic Machines and form-making processes already in use in resettlement environments, in order to learn how they might better inform the Tectonic Machines of the Information Age.

New Architecture Machines for the People

A critical factor in devising deployable construction technologies that are capable of re/creating vernacular forms lies in engaging and serving the “recipient” of these machines/technologies. In his 2003 essay entitled “Technology Transfer: A Vernacular View”, Paul Oliver advises,

Technology transfer that facilitates the solution of a problem confronting a culture could be undertaken, but not with the intention of achieving an objective that satisfies, favours, or benefits the transmitting technologists rather than the recipients. The need for technological change or modification must be recognized and preferably expressed by the recipient culture with whom, and with whose indigenous knowledge, any changes may be introduced.

The fact that these technologies must be developed with IDPs in mind, and then given over to the populations who will use them is

critical to their success, with autonomy and control being especially important in evolving camps into resettlement communities (Hailey 2009). In his 2006 article, *Sheltering from Extreme Hazards*, Ian Davis suggests that designers focus on process-based strategies for rebuilding that involve and employ recipient’s skills/traditions/desires, rather than product-based solutions (instant houses, pods, etc.). One example of a technological transfer success from the Industrial Age that is of particular interest to me is the manual block press. Attributed to Francois Cointeraux in the 18th Century, this Tectonic Machine and its various incarnations, including the CINVA RAM Press (Fig. 01), is still being used, adapted/alterd, and manufactured in developing nations today. What is noteworthy about this technology is that these presses have truly become of and for the people. They are easy to fabricate, relatively mobile, widely available (employed in Asia, Africa, and the Americas), and they can be used at various economies to make both earthen and concrete block. Additionally, the block, as a basic construction unit, allows for all manner of construction—practical and expressive, new, emulative and/or traditional. This packaged/deliverable process, with construction quality block rather than finished structures/shelters as the end product, relies upon user needs, input, and work ethic to realize actual constructions. In this manner, these Tectonic Machines engage the recipient and are capable of all variety of architectures based upon the user’s manual skills and desires. On a recent trip through northern Sri Lanka, I met a tuk-tuk driver who was using a communally owned block press to build a house for his family (Fig. 02). When I asked

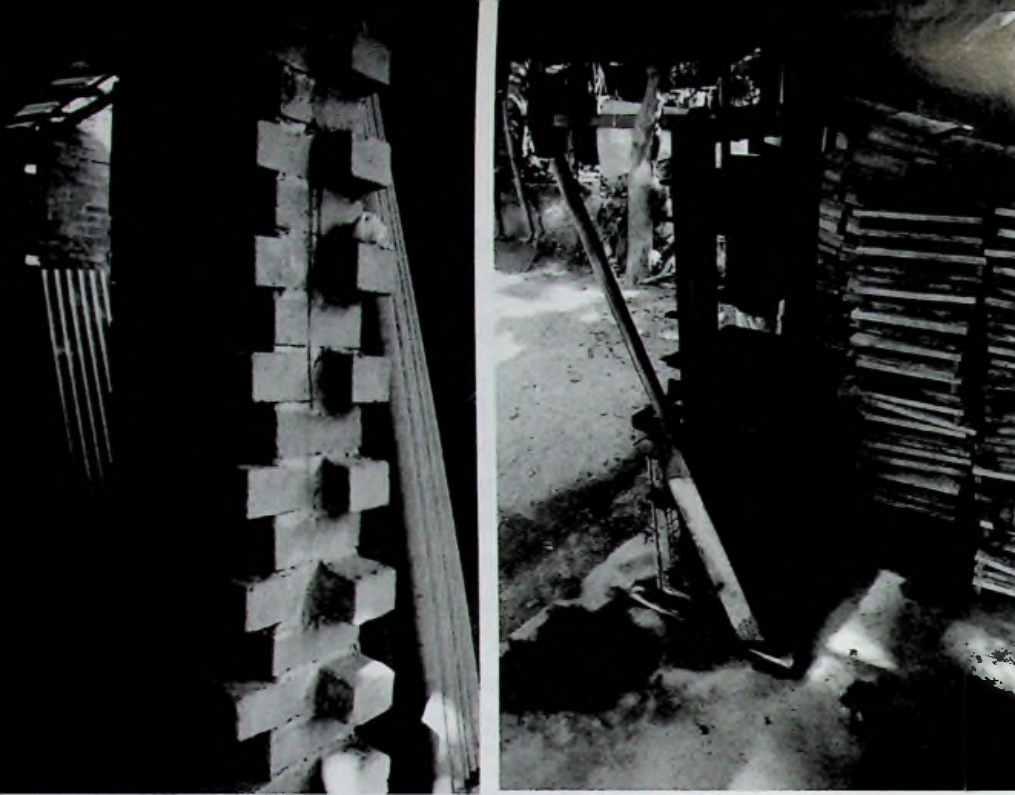


Figure 2: Manual concrete block press communally used in Puttalam, Sri Lanka, and resultant construction. Photographs by the author.

why he had chosen this material (concrete) and technology (the block press) from the wide variety of traditions common to this area—including cadjan, mud brick, wattle and daub—he replied that his social status would be effected by employing “Westernized” technologies and materials, and adopting a “Westernized” house type/plan. In fact my acquaintance, Mr. Kumar, had rejected local low-tech traditions in favor of Western emulation and machine technology related to his three years of experience in Dubai working in a high-rise modernist hotel. What I consider to be most informative with regards to my research is his acceptance and inventive use of the block press as a piece of interventionist architectural technology, and the fact that the press was communally owned, housed, and maintained by the population who used it. As far as shortcomings are concerned, this Tectonic Machine has several that might be improved upon with Information Age enhancements or alternatives. While all types and shape of block have been developed using the manual block press: interlocking

blocks, hollow-core blocks, gutter blocks, pavers, etc., it is less obvious that the block press automatically or intuitively contributes to the sustenance of vernacular traditions (especially those that do not employ block). Extending this critique, there is very little that is automatic about the press—one needs to employ oneself physically at making many blocks before building a structure, and neither machine/press nor the blocks themselves transmit specific buildings or building traditions to the next or future user. In addition to being laborious, the process of making houses using the press-made blocks is also relatively slow, requiring significant time commitment and material investment. In conclusion, speed, automation, and transmittable “memory” are all qualities that might better adapt Tectonic Machines of the Information Age to the task of constructing culturally sensitive resettlement communities. Transmittable “memory” connected to the workings of the machine might also giving recipients who are ill, weak, hurt, or unskilled a means of choice in rebuilding.

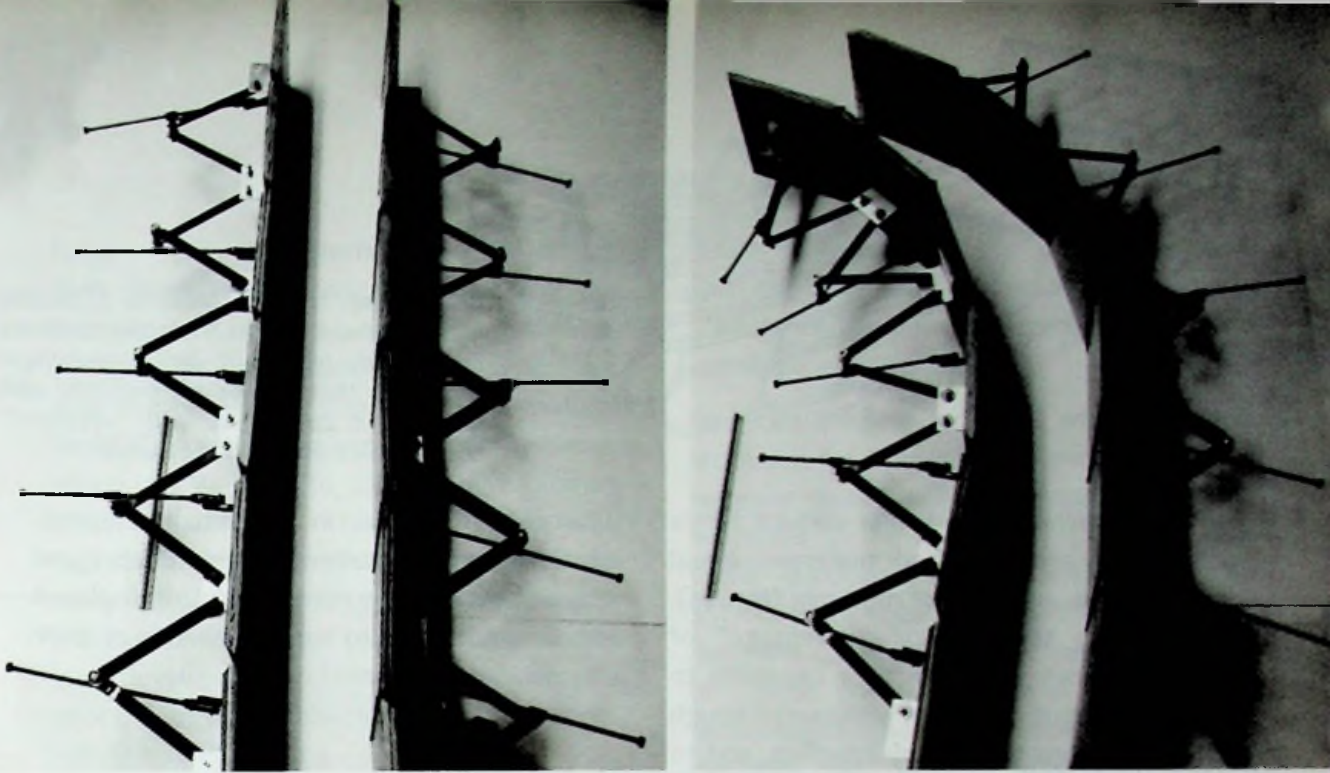


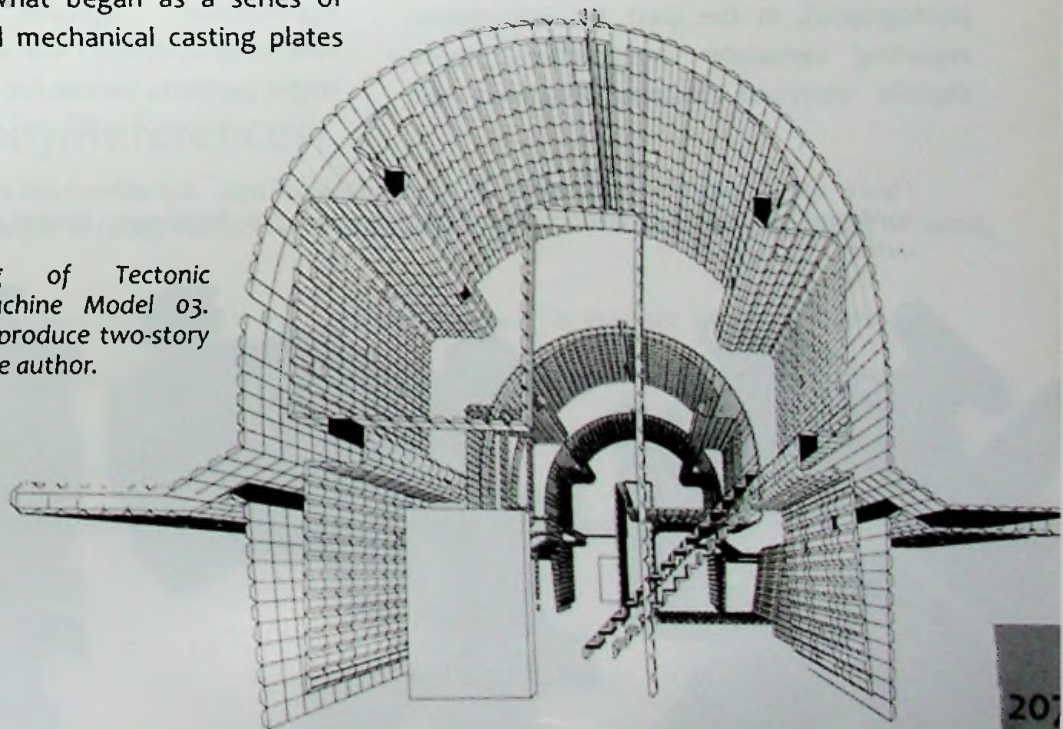
Figure 3: Full-scale prototype of a mechanically adjustable form work/false work. Prototype and photographs by the author.

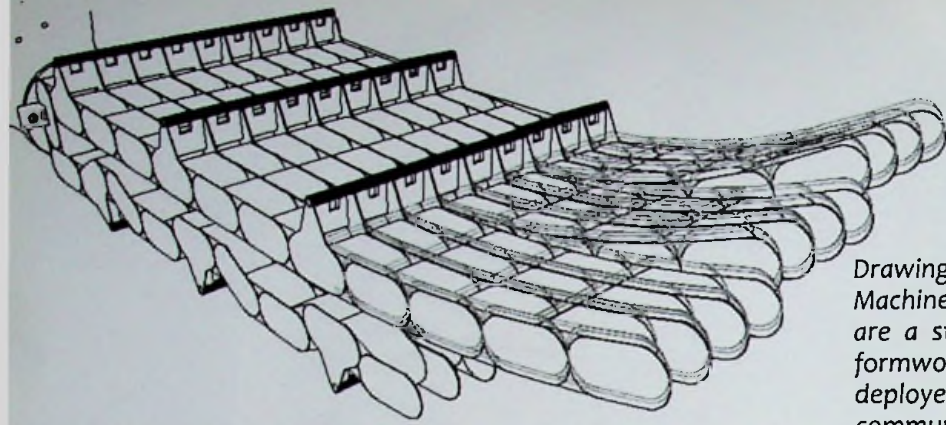
Vernacular Machines: Digital/Mechanical Formwork

In 2007 I began working on a mechanically adjustable formwork for low-fire ceramic constructions as a graduate student at Virginia Polytechnic Institute and State University (Shaffer, 2008). What began as a series of digitally controlled mechanical casting plates

(Fig. 03) that could be reconfigured to create structures (Fig. 04) has evolved into a type of semi-autonomous robotic form work/false work to be developed and programmed in concert with N.G.O.s and the displaced populations they serve (Fig. 05). The principle mechanical “advantage” these Tectonic Machines will offer their IDP recipients is the ability to construct a greater

Figure 4: Drawing of Tectonic Machine--Shokushu Machine Model 03. Machine configured to produce two-story house shell. Image by the author.





Drawing of Tectonic Machine--Shokushu Machine Model 05. The Shokushu Machines are a study in robotic digital/mechanical formwork that can be programmed and deployed in partnership with "recipient" communities. Image by the author.

variety of architectural and/or cultural forms using readily available plastic materials—liquid earth, adobe, and cement-mud mix (Fig. 05). The primary technological “advantage” of these machines will be in their capability to digitally dialogue or engage with users through communications technology interface, and to remember/reconstruct previous works employing computational memory. Rather than maintaining an overreliance on the changing priorities of the distractible human artisan, the “informed” transmissive tool/machine/technology itself has the capacity to become a repository for the history and traditions of its past use/users (as tools have always done to a certain degree). Just as one might have looked to forms of communal transmission (oral and tactile) and ethnographic recording (drawings and photographs), in the past for information regarding vernacular constructions, these digitally equipped Tectonic Machines will

carry like information in their virtual memories. In this manner digitally equipped tools become instrumental to the resettlement of displaced communities and to the sustenance of their vernacular traditions.

Conclusions

As this work progresses and my research has begun to include scholarship regarding the complexities surrounding resettlement camps (logistical, political, social) and the great breadth of issues related to vernacular construction, the solidity of these Tectonic Machines shift between projects that can/might actually be realized, and hypothetical “agendas” or lists of functions/capabilities that a Tectonic Machine might perform. Vernacular traditions certainly

Figure 05: A quarter-scale model of the Shok-Mod 05S, digital/mechanical formwork. Right-angle configuration (right), radius/curvilinear (middle), and free-form/open. Models and photographs by the author.



have an important role in their development, and in humanizing the momentous forces of globalization, Information Age technologies, and our ever-shifting relationship with the natural world. They also represent a critical familiarity, which can be used to counter humanitarian crisis situations that are too often the byproducts of these disruptive forces. On the other hand, Crembil & Lynch (2009) suggest that we have a unique opportunity in turning our developing architectural technologies (along with our architectural values) towards reinvigorating the vernacular, in adopting/recording, employing and evolving various construction arts, crafts, and traditions to house and comfort displaced people in the Information Age.

No one can deny the realities of global trade, digital tools, capital-intensive fabrication methods, or mass markets. Just the opposite: we suspect that these economic forces might be capable of bringing craft forward in a new way. The spread of the

Internet and cellular communication, global sourcing networks, appropriate technology, and intellectual property rights may lead to a resurgence of craft.

One can imagine a future where Tectonic Machines for humanitarian purposes are as common to IDP relief and assistance as the helicopter or cargo plane are today—particularly as militaries have given SSTR missions equal footing with invasions and defensive campaigns. The technical capabilities of these new vernacular construction technologies should extend to designing machines that function semi-autonomously and that are highly mobile so that they might be “assigned” to move with and continuously provide for targeted or seasonally displaced populations (Shaffer, 2009). As tempting as it is to regulate or preserve architectural traditions and technologies within specific geographic places and historical periods, the principle benefits of a vernacular are in sustaining, uniting, and ultimately distinguishing people.

Bibliography/References

Asquith, L & Vellinga, M (eds) *Vernacular Architecture in the Twenty-first Century*, Taylor & Francis, London.

Banham, R. 1960, *Theory and Design in the First Machine Age*, F. A. Praeger, Inc., New York.

Crebil, G & Lynch, P 2009, 'No Resistance', *Journal of Architectural Education*, vol.62, no. 4, pp 49 – 55.

Hailey, C 2009, *Camps* The MIT Press, Cambridge.

Lewis, J 2008, 'The Exigent City', *The New York Times Sunday Magazine*, 8 June

Oliver, P 2006, *Built to Meet Needs*, Architectural Press/Elsevier, Oxford.

O2I (Outsource to India) 2010, Outsource2india.com, viewed 10 April, 2010,
< http://www.outsource2india.com/services/architectural_design.asp

Shaffer, M 2008, 'Rise Tectonic Machines', Masters Thesis, Virginia Polytechnic institute and State University

Shaffer, M 'Mobile, Immediate, and Adaptable for the People' Proceedings of Chang[e]ing Identities, Fall 2009 ACSA Regional Conference, Albuquerque New Mexico, p. 172 – 180.

Tech Mission, 2009, UrbanMinistry.org, viewed 22 April 2010,
<<http://www.urbanministry.org/wiki/international-digital-divide-statistics>

Internet use in the Asia/Pacific, Africa, and Middle East regions accounts for approximately 40% of internet usage worldwide, with India representing the largest growing population of internet users according to 2008 International Digital Divide statistics. Similar statistics for cell phone usage from 2007 record nearly 8 million cell phones used in Sri Lanka, and nearly 600 million in China.

Woods, R. 1997, *Radical Reconstruction*, Princeton Architectural Press, New York