

## **Design Research through Construction: Enabling a New Professional Culture**

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### **ABSTRACT**

*In conventional architectural practices the scope of academic engagement into design-research encounters a disjunction, as the processes tend to differ for distinct interest groups, students and clients, which ultimately expose the prevailing gap between architectural education and practice. In professional culture, the process of design and constructing a building mostly follows a linear structure that neglects the fact that the decision of a spatial design is highly project specific that demands a design-research based on physical making. This paper provokes the question, how a new professional culture based on design-research can be established where construction is incorporated as a design-tool rather than keeping it as a post design act yet acknowledged in today's architectural practices? Making prototypes can inform a design process much rationally which ultimately can lead a project towards an 'evidence-based' design-research. The paper will first evaluate evidences drawn from few experiments in academic context, examining the changes in architectural production, explored during visits in ETH Zurich and ICD Stuttgart. Next a comparison of such praxis shall be examined by critically viewing to the evidence-based work-process of Bijoy Jain/Studio Mumbai Architects. Through the comparative analyses on both the academic and practice models, the paper will attempt to argue that, in a proper architectural inquiry, making prototypes can play an essential role in informing a design process and eventually can encourage clients to participate in design investigations that allow construction stage to inform the design.*

**Keywords:-** *Design-research, practice, physical making, construction, evidence-based design*

### **INTRODUCTION**

Architecture has multiple dimensions and through its physical engagement, has the ability to create influence on man, place and on the society as a whole. The importance of physicality or tangibility of a product of architecture is intense as it actually gives character to a design concept and can reflect many aspects of a given context involving users, culture, time, economy, politics, and many more. Architect Renzo Piano once described architecture as *"a dangerous activity that is in constant limbo and has to deal with all sorts of resources, not only concrete or wood or metal, but also history and*

*geography, mathematics and natural sciences, anthropology and ecology, aesthetics and technology, climate and society."*[1]. However, its influences can only be realized when a project is physically built following a rigorous professional process. Every project in architecture is different on its own right, involving different user group, their need, site condition, context and budget. Conventionally the professional practice in architecture encouraged systematic and linear work flow that starts from concept generation then moves to design development and finally ends with construction. This process is less

informative as a design research, yet considered efficient in terms of time, cost and management. Due to many constraints, often posed by the clients' part, a project therefore cannot turn into a research inquiry, rather narrows down to mere intuitive design solution, where many questions embedded into that project remains unanswered. However, recently, a change into such practice has been observed. As Voyatzaki says:

*“Over the last decade, there seems to have been a reconsideration of the relationship of architectural design and construction. The perception that construction is a necessary and inseparable part of the design process is now generally accepted.”* [2].

In this discussion, the existing model of professional practice is questioned. By showing evidences, this paper argues that construction can be an essential tool for evidence based design research, enabling a new professional culture, where clients are encouraged to participate in the design process that allows construction stage to inform the design.



**Fig.1:-** A systematic building construction work on an apartment building in Orlando, Florida, USA. (Source: <https://dailyreporter.com/files/2019/07/apartment-construction.jpg>, date accessed: 03 Dec, 2019)

### **Convention of Design & Construction in Architecture Profession**

Both in academia and profession the act of designing seldom acknowledges the need for project specific investigation. In current practice the professional concentration is more into structuring design stages into division of works so that multiple projects can be handled in the least possible time. Most architects struggle in developing standardized systems, using contemporary technologies and techniques, generalized enough for efficient construction system, optimizing time, money and resources. As such the client is obliged to respect the authority of the architect and trust the provided design solution because there is merely any way to challenge that.

According to Donald Schön such relationship is *“a traditional contract, a set of shared norms governing the behaviour of each party.”* [3]. The client or the user plays a rather neglected role in this whole process of ‘designing and making’. Infact, the responsibility of an architect does not cater for post occupancy issues and therefore there is no learning from the difficulties of a previous project. Moreover, accountability of architects through peers pushes architects to incline towards image based architecture. In this sequence, construction of a project often remains as a post design attempt (Figure 1), controlled by ‘systematic’ technical conduct as part of a bigger project management process.

However, the process of designing a building and then managing the construction afterwards on site is unique every time, as it involves a different client, site, context, varying construction companies and sub-contractors. If seen broadly, “the tectonics, the poetic aspect of construction and its contribution to the formal expression of an idea.[4], during

conceptual stage, can establish an effective research platform to inform the design process. Besides, in architectural profession, as Sailer mentions:

*“...the whole industry may change from a project-centered one into a process-based one where the process of finding out what the client needs, of engaging the users, proposing a design solution, managing the project, and evaluating its use and appropriation in the end in order to learn from it, is nearly as important as aesthetics, form and function.”*[5].

### **Design through Research in Architecture**

Research is always an intrinsic attempt for progressive development. It opens out new and alternative avenues for innovation and proposition of act for betterment of human kind. Every profession has the opportunity for research to push their inquiry further and thereafter better understand the possibility embedded into yet unresolved solutions, e.g. medicine, health & nutrition, social science etc.

Architecture, being a service oriented endeavour also amends scope for a project to provoke questions in pursuing a design process, which should be answered through analytic experiments and informed by evidences (Figure 2). The design process has often been defined by different scholars, for example as *“a process of making”* [6] as *“experimental in nature and a trial-and-error approach”* [7] as *“learning by doing phenomenon where the problem and solution emerge together”* [8], as *“neither procedural nor systematic, but as a process where*

*multiple alternative solutions are simultaneously tested.”* [9].

However, in a recent proposition, the Research and Development Committee of Royal Institute of British Architects (RIBA) provoked the issue of architectural research for a wider discussion. Sailer narrated the intent saying:

*“...designing and researching are two different activities. They argue against the often stated myth that designing a building is a form of research in its own right by comparing the process of designing a building with Bruce Archer’s definition of research as ‘systematic inquiry’ whose goal is communicable knowledge.”* [10]

Their research referred to what Jermy Till stated, *“A ‘good’ building is not necessarily good research, and good research may lead to ‘bad’ buildings.”* [19] In his narration he also mentioned, *“[...] The building as building reduces architecture to mute objects. These in themselves are not sufficient as the stuff of research inquiry.”* [20].

As such, it is important to understand the potential of an architectural profession that can engage in a practice, based on proper design research, e.g. investigating material possibility, making prototypes during design development stage, and therefore critically inquiring the possibilities in a design that can address client’s specific interest.

### **A New Praxis - Evidence Based Design Research**

In the light of the new professional culture, praxis of ‘evidence-based design’ has potential to integrate the user in its process.



**Fig.2:-***Computer to Construction: Technique Enables Mass Production of Custom Concrete Building Components from Digital Designs. (Source: <https://precast.org/2013/04/liquid-walls/>, date accessed: 03 Dec, 2019)*

“Evidence-based design may emerge, a design that is based on evidence gathered previously and continuously rather than a design that is purely fed by the intuition and experience of the individual designer.” [10]. Hence an evidence-based practitioner has to affirm what information he/she needs to gather to implement the results of an inquiry process. And this stays true for both academic and professional conduct. To better compare the possibilities between them, few such relationships amongst design processes

and its material realisation is discussed, explored during visits to some universities, industrial fabricators and reference building projects.

In the Gramazio Kohler Research, ETH Zurich, they examine the changes in architectural production requirements that result from introducing digital manufacturing techniques, expanding not only the possibilities for construction, but, by the direct



**Fig.3:-***Gramazio Kohler Research, ETH Zurich, Smart Dynamic Casting, 2013. (Source:[http://gramaziokohler.arch.ethz.ch/web/includes/popup.php?projectId=223&Copyri ght=18&lang=e&BilderGezuegelt=1&image\\_count=4](http://gramaziokohler.arch.ethz.ch/web/includes/popup.php?projectId=223&Copyri ght=18&lang=e&BilderGezuegelt=1&image_count=4), date accessed: 03 Dec, 2019)*

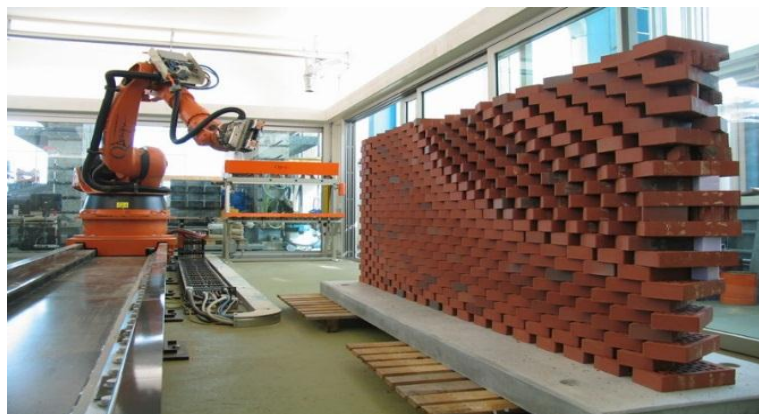
implementation of material and production logic into the design process, establishes a unique architectural expression and a new aesthetic. [14] For example, in the research, ‘Smart Dynamic Casting, 2012-15’, they explored possibilities of robotic fabrication of complex concrete structures (Figure 3), removing the need of individual made formwork and thereof effectively reducing the cost.[15] This innovative technique of casting concrete for developing a square spiral column in a lab environment can inform a design process and certainly can open a wider avenue for complex architectural form to take shape.

Previously, the research group launched an elective course, ‘The Programmed Wall, 2006’, where students investigated potential of brick walls to be fabricated by an industrial robot (Figure 4). “*The students defined not the geometry of the wall, but the constructive logic...and which thus produced an architectonic form.*” [16]

Even here the information acquired from academic experiments on brick walls, carry potential evidence that such arrangement can be applied in proper building design.



**Fig.4:-**Gramazio Kohler Research, ETH Zurich, *The Programmed Wall*, 2006. (Source: [http://gramaziokohler.arch.ethz.ch/web/includes/popup.php?projectId=81&Copyright=18&lang=e&BilderGezuegelt=1&image\\_count=3&closeText=click%20to%20close](http://gramaziokohler.arch.ethz.ch/web/includes/popup.php?projectId=81&Copyright=18&lang=e&BilderGezuegelt=1&image_count=3&closeText=click%20to%20close), date accessed: 03 Dec, 2019)



**Fig.5:-**Robotic fabrication of carbon and glass fibres in the ICD/ITEK Research Pavilion, 2012. (Source: <http://www.achimmenges.net/?p=5561>, date accessed: 03 Dec, 2019)

In the University of Stuttgart, the research of Prof. Achim Menges, founding director of the Institute for Computational Design (ICD), explores an alternative territory where machine and material computation potentially overlap in the design process. Amongst a series of constructed prototype buildings, includes ‘ICD/ITEK Research Pavilion 2012’, which was constructed by robotic carbon and glass fibre filament winding process (Figure 5).

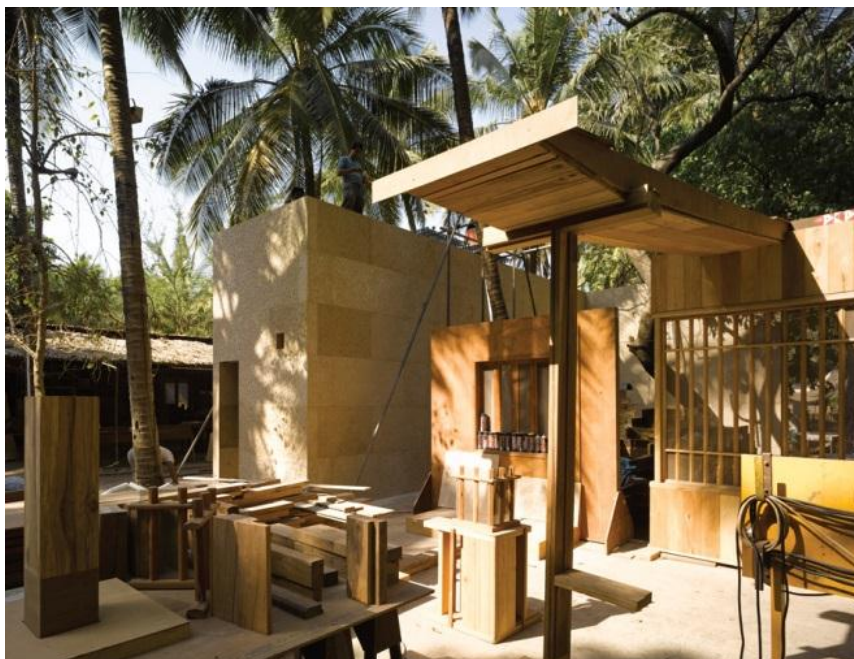
The research focused on the material and morphological principles of ‘arthropods exoskeletons’ as a source of exploration for a new composite construction paradigm in architecture. (Prof. Achim Menges Research, cited in: <http://icd.uni-stuttgart.de>).

Conceptualization and therefore physical realization of such a complex geometry was possible only through material investigation and physical making of the structure, which also gave confidence for constructing similar envelopes in larger scale.

All these examples ultimately establish the relationship between academia and profession, where academic experiments provide evidence to feed the design process of professional projects.

Amongst some contemporary design-research ‘praxis’, Bijoy Jain (Studio Mumbai Architects) [18] believes in an iterative process for design, where ideas are explored through the production of large-scale mock-ups, material studies, sketches and drawings to form an intrinsic part of mind and body [18]. To visualize spaces, they prefer a plywood model of a small part of the building (Figure 6), as it will be designed, rather than an exact design, unlike most of the firms who develop a concept well before making any prototypes.

Studio Mumbai’s involvement into material and construction experiments, have added depth and reasoning to the projects they execute, which are gradually developed based on their research inquiries.



**Fig.6:-** 1:1 prototype mockups by Studio Mumbai, Alibaug, India. (Source: <http://www.architectural-review.com/essays/workshop-by-studio-mumbai-alibaug-india/8604837.article>, date accessed: 03 Dec, 2019)

All these evidences, attempts to acknowledge the premise for a research based 'praxis', considering 'making' as a tool and therefore encourage to take conscious and knowledgeable decisions in a balanced and considerate way for the greater benefit of client and on the ongoing work process in professional practice.

### **'Making' in Professional Practice**

In contemporary culture, globally, academic research and professional practice seems to operate discretely, leaving minimum scope for collaboration and sharing of knowledge. This separation between research and practice leads to an inability to make practical use of evidence produced by research, resulting often in poor designs, that cannot make a difference to peoples' everyday lives and sense of place. According to Till:

*"[...] Both the academy and practice often do not meet this central test for research: the academy because of its inward looking processes, practice because of its lack of rigorous dissemination."* [19]

In order to bridge the gap between 'architectural research' and 'design practice' an alternative model of professional culture is necessary that considers design research as a platform to gather physical evidences for producing pragmatic design solutions. Infact, to integrate reasons and evidences into a design process, means to integrate the context and setting, hence, also to include the users, as they belongs to that same context.

As such, a culture can be established in architecture, which appreciates 'making' during design development stage. Making small and large scale mock-ups with varied alternative material application can inform a design process in much effective way than just developing an idea with paper drawings, based on preconceived notions. Making discloses a whole new set of material science, joining possibility and

construction techniques for advancing a design concept. And such information can then help to develop the ongoing design research, for ultimate production of a new built form. Certainly, this novel attempt has extra cost issue and depends on clients' interest. However, the process actually introduces the opportunity for clients' to actively negotiate with the results of prototype constructions and therefore a deeper relationship is established which can dissolve those associated issues, e.g. time, money.

In this process the client agrees to join the architect in inquiring into the situation for which he seeks help, confronts the practitioner when he doesn't agree and appreciates the competence demonstrated. The design process then changes into a form of negotiation addressing different sets of understanding, evolved through production of physical evidences, thus turning into a process of 'communication'. Though such strategy may prove to be time-consuming and require a new understanding of roles from both sides, yet this may set new direction and integrate relationship between professional culture and the construction industry.

Also from socio-cultural and philosophical perspective, by investigation through construction one can better understand culture as well as the 'state of the art' in the realm of architecture. Last but not the least; it can be argued that construction, as a vehicle for evidence-based design research, can allow us to gain insights into the iterations of form and space through the study of construction itself.

### **CONCLUSION**

This paper outlined aspects of the contemporary professional culture in architecture and tried to give insight on how this culture may turn towards a research based practice, catering for physically produced evidence. Also how it could integrate the users, their specific needs, and how it could become more

‘process-based’ by focusing more on constructively in design development stages, and evaluating the appropriateness of the information, obtained through physical investigations.

By acknowledging the critical position, expressed through statements of scholars, e.g. Schön, Sailer and Till, this paper tries to strengthen the argument that, in a proper architectural design, making prototypes can play an essential role in informing a design process and thereafter can encourage clients to participate in design investigations that allow construction stage to inform the design. A good architecture, hence, is a product of research. Till also supported the notion saying, “... ‘product’ refers to research into buildings as projected or completed objects and systems and might include for example issues of aesthetics, materials, constructional techniques and so on.” [20].

Architectural construction has gone through intense innovations regarding material, engineering and design throughout the 20th century, and drastically transformed the way buildings are conceived. These innovations opened up possibilities which challenged architects, engineers and constructors to build complex architectural spaces. And often such innovations are informed by some level of evidence-based investigations. To better relate, this paper therefore attempted to compare the differences in architectural research conducted in ETH Zurich and ICD Stuttgart, and also in the work-process of Studio Mumbai Architects, and came to the resolution that, whether in academia or profession, architecture is an endeavour of design research, where a problem is best addressed through physical construction.

The process of building through research can therefore create a new professional culture that is evidence-based, intelligent, social, user-oriented and procedural.

Hence, it is to be hoped that the new praxis based on design research can push the architectural practice in much positive direction and be able to state a true meaning for the purpose and intention of this profession.

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