

Dysfunctional design + construction: a cohesive frame to advance agility in the 21st century

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ABSTRACT: Architecture is routinely recognized as being a valuable vehicle to improve our living spaces and enhance the quality of life. The notion of quality of life covers domains such as the interpersonal, psychological, spiritual and financial. In many ways, and in many jurisdictions, the connection between contemporary design & delivery systems for buildings, qualities of life and promotion of our community are broken. Quality of life is dynamic; people and the environment change over time. Hence, the role that agile architecture plays in this process, and in particular, what place it occupies in the unique social, political, environmental and economic setting is vital to promote the concept of quality living. Agility in buildings establishes the capacity to respond to evolving demands with regard to function, space, parameters and performance. However, for a plethora of reasons, robust solutions able to adapt to future changes are infrequent in present design practices and products. Additionally, worldwide population growth, scarcity of resources, and climate change warrant a dramatic shift in architectural practices to embrace concepts of agility – thereby realizing more dynamic and adaptive design solutions that can respond to an increasingly fluid, volatile and uncertain milieu. The present research critically assesses the status quo and in response synthesizes a conceptual framework for agility in architecture. Methods incorporated include meta-analysis, logical argumentation and case studies. Key deficiencies in the marketplace and contextual barriers against formulating/implementing such a framework are delineated. The seminal historic precedents of agile projects are drawn from numerous global cities, illustrating agility concepts in design, construction, legislative, and financial ethos. Case studies, in tandem with a strategic literature review, highlights leading themes, ideas and practices of agile architecture worldwide. This paper advocates the concept of agility as an indicator of the quality of life amongst architects, by adopting a more familiar language to them and by moving towards the development of a cohesive framework aimed at integrating interlocking distinct processes, better interlacing design phases to construction, operation, occupancy, disassembly and reuse. The forthcoming frame is viewed as a medium to aid developers, designers, builders and policymakers in applying and realizing greater project agility. Agility in this context must be the result of meaningful and productive relations between all layers, agents, facets and forces affecting the project – in essence migrating away from the static architectural practices and staid architectural outcomes that define modern building design. In the view of the researchers, “*change*” must be the new constant.

KEYWORDS: Quality of life, agility, holism, integration, design, innovation, open building, sustainability

INTRODUCTION

One of the most discussed issues in the design community is the capacity of the built environment to adapt over time to cope with ever-changing uses and preferences (Kendall, 1999). The physical form of our cities is radically changing and as Richard Rogers highlighted in his book: *Cities For a Small Planet*, “it is a commonplace to anticipate that a building will outlive the purpose for which it is built in a matter of a few years. Buildings no longer symbolize a static hierarchical order: instead, they have become flexible containers for use by a dynamic society” (Rogers, 1998). The challenge is to design buildings that can incessantly accommodate new technologies, allow for changes in the living patterns of occupants, and in the shape of households those occupants form. Only when buildings are designed to cope with both present and future challenges, will real estate decisions indeed characterize the holistic approach of worthwhile investments and transcend as sustainable architecture.

This agile perspective of the built environment is fully aligned with the persistent issues of environmental ethics, recycling and cradle-to-cradle concepts, the use of sustainable building materials and other vital concerns in the sustainability agenda worldwide (Kendall, 1999; Anupa Manewa et al., 2013). Hence, implementing sustainability and agile concepts will immensely depend on adjusting investment and regulatory rules as well as incentives related to the design, construction, and management of such buildings with built-in capacity for change. Challenges in the built fabric are present in areas of environmental considerations (Kincaid, 2000; Geraedts, 2008), technological novelties (Nutt, 2000), planning and policy, social necessities, political constraints (David M. Gann & James Barlow, 1996) and economic situations (Arge, 2005; Douglas, 2006). To cope with these macro-level challenges, the industry must shift from traditional static architecture

that lacks the requisite flexibility to accommodate potential changes in users' needs and functional demands (Slaughter, 2001). Additionally, worldwide population growth, scarcity of resources and climate change warrant a dramatic shift in architectural practices to embrace concepts of agility (Kendall, 1999) – thereby realizing more dynamic and adaptive design solutions that can respond to an increasingly fluid, volatile and uncertain milieu. However, for a plethora of reasons, there is a disconnect between the current state of design practices and the market's need for agile architecture. This is fueled, in part, by a lack of advanced research in the field of agility. Currently, uninformed design approaches, conservative legislation and entrenched policies operate in concert to neglect social necessities and discount future environmental, spatial and functional mutability, while concurrently dismissing affordability concerns (Kendall, 1999; Kronenburg, 2007).

1.0 BACKGROUND

1.1. Flexible, adaptable and agile

It can be argued that flexibility and adaptability have overlapping meanings and includes different approaches. According to Rabenek, Sheppard and Town (1974), “flexibility is proposed against tight-fit functionalism.” They argue that the inefficient design attempts at flexibility might lead to “fallacy of freedom through control,” while adaptability relates to units and spaces “that can be easily altered adjusting to changing circumstances.” In 1991, Herman Herzberger claimed that “in flexible design, no single solution is preferable to all others.” He continues to criticize the flexibility approach uttering that the belief that neutral designs could make the building adapt to changing situations created a lack of identity. Consequently, he introduced a new concept, “polyvalence,” which supports minimal flexibility so that the design could adapt to different uses without undergoing any changes. Steven Groak (1992) – in his book *The idea of Building* – referred to buildings as “unstable systems in the dynamic environments.” He defined a fine line between flexibility and adaptability, where flexible design is “capable of different physical arrangements,” while the adaptable design is “capable of different social uses.” Gerard Maccreeanor (1998) viewed flexibility as a “design idea that leads to the collapse of traditional layout,” while adaptability – in his words – is a “different way of interpreting flexibility and it refers to multifunctionality.” Maccreeanor further noted that “most adaptable buildings were those not originally planned for flexibility.” Schneider and Till (2007) characterized flexibility – in the context of housing – to be attained by “altering the physical fabric of the building,” while adaptability is achieved “through designing units or spaces so that they can be used for various purposes.”

While there are many ways one might define flexibility and adaptability with respect to building design, the authors are after a measure which is more independent, responsive and holistic; a measure that unifies the scattered facets of contemporary sustainable designs; that introduces all layers of physical, social, environmental and financial factors in the form of continuously evolving and dynamic framework; a measure better interlacing design phases to construction, operation, occupancy, disassembly and reuse; a measure that we call “agile”.

1.2. Societies' challenges and potentials towards agility

Our societies are in fact agile, dynamic and resilient. They possess the ability to pass on knowledge from one generation to the other, to embrace and resolve different levels of challenges; they have the curiosity to explore and desire to succeed. However, societies are usually organized into certain living patterns and framed by a set of laws and rules. Also, habits and traditions can be another rival to a more dynamic milieu. They can control a person's beliefs, and regulate the way s/he thinks and acts in a particular social and cultural paradigm (e.g. moveable walls can oppose with the strict privacy concerns of some Islamic cultures). Such bounded societies might struggle to accept any kind of innovation or progress. But today, it could be argued that the fast lifestyle and technologies lead people to cope with the speed and scale of an ever-changing environment. Consequently, modern architecture must better match and serve these contemporary societies, it must respond to the qualities manifest by such movement.

Many buildings that were constructed since the 1920s – relying on the ‘functionalist’ design approach – are now obsolete (Kendall, 1999). These buildings were ‘statically’ designed to meet the standards and functions at that time and hence are not destined for occupants’ evolving uses and require costly refurbishment due to their tight value-engineered specifications and incapability of being adjusted to meet shifting needs. This problem of static misguided attitude within the design community led us to falsely believe that our cities are rigid artifacts comprised of finished and single-use buildings and infrastructure. This argument posits that when scientific research is aligned with professional know-how early in the design stage, buildings would not require many alterations over the years, except perhaps cosmetically (Kendall, 1999). In the last few decades, technology has ushered in immense transformations in our living patterns and arguably increased consciousness of our world – An effect that we refer to as ‘globalization’ (Hubert-Jan Henket & Hilde Heynen, 2002). Although global mobility and consumerism secured freedom and allowed a much higher level of innovation, the consequences of climate change and global warming prove to be dramatic (Kendall, 1999;

Hubert-Jan Henket & Hilde Heynen, 2002). The reality seems complicated and worrying and urges immediate action. As our communities continue to expand, relocate, merge and eventually vanish, the need for agility is growing. The globalized living and working patterns of our cities necessitate novel architectural concepts that can sustain such contemporary societies (Hubert-Jan Henket & Hilde Heynen, 2002; Kronenburg, 2007). Perhaps a holistic design approach that is transformable, movable, adaptable and agile could efficiently allow for multiple uses in one space, better sustain the economic factor and adequately manage the over-use of energy resources.

2.0 EARLY APPLICATIONS OF AGILE ARCHITECTURE

It is insightful to consider several seminal historical design projects in order to better grasp concepts of mutability and the need for adaptation and change. The following precedents illustrate early approaches to environments that provide 'give & take' around shifting users and usage.

2.1. The traditional Japanese house

In Europe over the last three centuries spaces and places have increasingly been designed for fixed functions. However, in Japan, a multi-functional design approach continues to the present day (Kronenburg, 2002, p. 22). Japan is a country that has successfully approached extreme demands on space in unique and innovative ways (Sinclair, 2015). Traditional Japanese houses have unique interior and architectural features that reflect Japan's history and culture. Family homes were lifestyle-based and functional adaptability was the core of design concepts (Jeremy Till & Tatjana Schneider, 2007). The layout was designed according to the involvement of the inhabitants; where the sitting or dining room can be transformed into a bedroom by pulling out futons from a storage cupboard. Moveable partitions, a Japanese design feature known as 'shoji' (a sliding panel made of translucent paper in a timber frame), perhaps interiors to readily transform. When used for exterior skin, such walls give Japanese homes many possibilities as spaces between building and landscape can be dynamically reconfigured (Figure 1). Additionally, the traditional Japanese house used flexible construction techniques where wooden joints were tied with ropes known as 'Wagoya.' Overall, the flexible construction materials, interior and exterior architectural features, the modular approach to design and the indeterminacy of function of the traditional Japanese house established its uniqueness and efficiency, vital innovations and design approaches that are still included in modern homes.



Figure 1. Interior 'Shoji' panels and 'Tatami' floors which are made of rice straw, featuring the multifunctional use of space by integrating sliding walls. Exterior 'Shoji' panels perfectly integrate indoors and outdoors. The tatami-mat layout and the use of plain wood express sensitivity to natural materials. (photograph: Brian Sinclair)

2.2. Rietveld Schroeder House, Utrecht, the Netherlands. (1924)

The De Stijl architectural movement was the first to introduce and encourage the utopian vision of simplicity and functionalism of the design forms (e.g. all the unreasonable decorative features were abandoned) (Paul Overy et al., 1988). Flexibility was introduced by designing interiors that visually blur the boundaries between the space and furniture, having movable walls and designing furniture elements to slide from the walls so that space can be transformable. Such design approaches provided an instant response to individuals by creating spaces that can accommodate different functions. The Rietveld Schröder House (Figure 2), is perhaps one of the most effective examples of De Stijl movement where open space plan liberated the interior and created a flexible domestic environment (Weston, 1996; Paul Overy et al., 1988). This two-storey house has an open plan space which is grouped around a central core. The large living space is transformable for the ability to respond to the individual needs and privacy by introducing partition walls. Each panel is independent, and thus, users can accommodate any desired configuration of the space by leaving the partitions open or closed

or half closed. The built-in furniture also complements the transformable upper floor (Paul Overy et al., 1988, p. 29). Nearly 60 years of living in the house, Mrs Schroeder expressed that:

For me, this house exudes a strong sense of real joy. That is absolutely a question of proportions, but here in this house, it's stimulated. I find it very important that a house has an invigorating atmosphere; that it inspires and supports the joy of living (Paul Overy et al., 1988).



Figure 2. The Schroeder house elevation accentuates the relationship between vertical and horizontal planar forms (left). The upper floor interior with open partitions showing the full extent of the space (right). Source: (Moritz, digitalized in 2010)

2.3. Fun Palace, UK. (1964)

The late British architect, Cedric Price believed that designers must recognize the potential needs of a building structure to allow for uncertainties throughout the lifespan of a building. He also stressed that in any case if a building has outlived its anticipated purposes, it should be dismantled and not retrofitted (Mathews, 2005). It all started in October 1961, when the renowned theatre director Joan Littlewood told her friend Cedric Price about her lifelong dream:

“She envisioned an alternative kind of social space, an experimental space where the public can freely interact in new ways, endlessly stimulating their creativity and broadening their knowledge. she wonders whether architecture might play a role” (Joan Littlewood & Peter Rankin, 2003, p. 702; Mathews, 2005).

Fun Palace is a proposition for an alternative educational leisure centre that is designed to facilitate various programmatic and spatial reconfigurations initiated by its users (Figure 4). Price reasoned that by accurately using the new technology, the public could have control over their environment thereby making the building responsive to the individual's needs (Anstey, 2007). The idea was to facilitate social experience and awareness through fun. Hence the Fun Palace program would need to be carefully designed to stimulate activity among individuals, leading them to recognize their potential and thus providing a more positive self-motivation (Joan Littlewood & Peter Rankin, 2003, p. 640). Consequently, Price eventually acknowledged that “Littlewood's idea would require a radically new kind of interactive architecture, highly adaptable to the rapidly shifting cultural landscape of England now – the 1960s – and in the future” (Mathews, 2005). Hence, the idea of a continuously self-reconfiguring program inspired Price to devise an anticipatory architecture, which harmoniously reconfigured itself to respond to users' shifting demands.

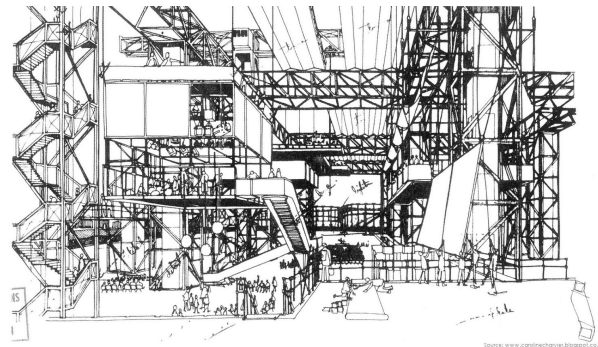


Figure 3. Cedric Price's Fun Palace, section. The concept was to make the design constantly under construction: Users can rearrange wall panels to create new spaces as the program change and evolve, creating endless variation forms and flexibility **Source:** (Price, C. Archives, Canadian Centre for Architecture [CCA])

2.4. The Nakagin Capsule Tower, Tokyo, Japan. (1972)

Among many, the Japanese Metabolism movement – established by Noboru Kawazoe and others – was rendered as one of the most influential in the emerging open building approach. This great architectural movement envisioned a whole new path for architecture in the 20th century and beyond. The vision was to synthesise a harmony between technology, tradition, nature and humans. The concept expanded to manifest the idea that the built environment should develop organically in parallel with the dynamic needs of the inhabitants (Lin, 2010). Such an original vision – in the 1960s – resulted in various iconic architectural and planning developments in Japan, setting a trajectory for the future of flexible structures. One of the unique and distinguishing designs that became an architectural icon of that era is The Nakagin Capsule Tower by architect Kisho Kurokawa. The Capsule Tower design precisely signifies the Metabolism theory:

The philosophy of metabolic design is based on modular buildings, exchangeability, prefabricated parts and capsules. The units move, change or expand according to the needs of the individual, thereby creating organic growth (Echavarria, 2005, p. 24).

3.0 AGILITY AND SUSTAINABILITY

The current state of worldwide population growth, scarcity of resources and climate change challenges explains the popularity and profile of the low carbon agenda in developed countries. This led to a surge in research and development, making the technical and operational facets of low carbon buildings well understood (Loms, 2010). Sustainable built environment to be one in which our use of resources is minimized while the utility of our buildings is maximized, as defined by Murakami (2011): “the achievement of high quality within a target-built environment while emitting low environmental load beyond the target-built environment.” It is tempting to outline agility concepts as an agenda solely in the frame of the energy/carbon reduction. However, this approach results in an overly-narrow focus of the agile agenda and prevents consideration of the broader benefits agile design could present (e.g. economic sustainability of continuously adaptable developments). Evidently, the agile agenda has interfaces with other pursuits beyond low carbon. Therefore, in our contemporary context, the pursuit of synergies between agility and sustainability concepts demands us to look intensely at the big picture – looking from above through an integrative lens is a necessary precursor to more detailed evidence-based intervention (Sinclair, 2009). In 1972, Sir Alex Gordon – former president of the Royal Institute of British Architects (RIBA) – argued that ‘good architecture’ should be designed for long life, loose fit and low energy (Gordon, 1972). The idea of integrating flexibility to accommodate future needs as well as minimizing energy footprint throughout the physical life of the building is undoubtedly the ultimate holistic objective for architecture in our modern society (Langston, 2014). Today, Gordon’s objectives can be interpreted as ‘durable, flexible and sustainable.’

- **DURABILITY**

Obsolescence can be defined as “the inability to satisfy increasing requirements or expectations” (Donald Iselin & Andrew Lemer, 1993; James Pinder & Sara Wilkinson, 2001). This is an area that poses considerable stress due to varying social demands (Kintrea, 2007). Obsolescence does not mean poor performance. Most available resources on building durability are more applicable to building components and systems rather than entire buildings. Factors affecting components durability can be: (a) quality of components, (b) Execution level, (c) indoor and outdoor environment, (d) usage settings and (e) maintenance level (Kincaid, 2000; Langston, 2014). While a building is a sum of parts, such parts can be replaced and hence renewed, leaving the primary structure to determine overall life expectancy. Other literature on service life discusses the effect of external and internal actions on building durability and identifies location, usage and design as the main parameters. Few researchers have included regulatory changes to zoning as a form of obsolescence (e.g. Austin, 1988; Campbell, 1996; Kincaid, 2000).

- **FLEXIBILITY**

For an array of reasons, buildings can become functionally obsolete long before their physical life has come to an end. Developing long-standing structures may be inefficient if their useful-life ends prior to their physical-life. Future designs need to be flexible enough to support alternative functional uses. The development of an integrative holistic framework for agility enables building designers to understand the long-term impacts of their decisions early in the design stage. As flexibility approach already embodies financial, social and environmental criteria, the framework would extend traditional operational considerations such as energy performance to include refurbishment, disassembly and reuse.

- **SUSTAINABILITY**

There are many comprehensive environmental rating systems for buildings worldwide (e.g. LEED, BREAM, Green Star, etc.), all of which are established for evaluating the environmental design and green attributes of projects. Most rating schemes are organized into a set of impact categories which usually cover issues of indoor environmental quality (IEQ), energy, transport, water, materials, land use and

emissions. Fundamentally carbon reduction can be framed as a problem of energy reduction, which is further decomposable into separate issues of operational and embodied (or process) energy reduction. The low carbon agenda indeed provides powerful leverage through the provision of ancillary benefits (beyond emissions reduction) such as reductions in energy bills and a reduced dependency on external energy sources. The resonance flexibility has with ideas on the minimization of embodied energy (through a reduction in material wastage resulting from demolition and rebuilding) is also apparent (Gorgolewski, 2005). The present researchers highlight the importance of, yet insufficiency in, considering energy as part of any equation for sustainability.

In the view of the researchers, durability, flexibility and sustainability are interesting concepts for exploring agility's collision with sustainability. It is helpful to use such constructs in assessing key contemporary case studies, with an end goal of determining the overall 'agility' of each project. The authors argue that such assessment but be multifaceted and robust, moving beyond simply a consideration of energy use and low carbon. The sustainable design movement emerged more than a decade after Gordon's 3L Principle, leading to a somewhat aggressive push towards low carbon targets at municipal and national levels in the developed world. Although progress on the delivery of such objectives has been gaining momentum, the focus has been on green building, with less consideration being given to durability and flexibility. Sinclair (2009) has previously delineated a Holistic Integrated Framework for Design + Planning. This theory considers the symbiotic interplay of Agility, Fitness, Diversity and Delight, understanding all hold equal value and significance. It considers energy and low carbon as components of a much greater system. The diverse action areas underlying the four core qualities are seen as having high flexibility, and subject to change and modification as conditions suggest and context dictates (Figure 4). Furthermore, Sinclair (2012) explored the matter of agility in depth and proposed a synergistic model for amplified agility in architecture to encompass four main areas, namely: Psychological (individual), sociological (group), legal (regulatory) and physical (constructional). This approach complements Gordon's 3L principle in our present context. Looking at the suggested quadrant of agility, we can easily link into long life (recycling, design for disassembly and reassembly), loose fit (open building, user-controlled design, skeleton infill) and low energy (reduced embodied energy, lowered life-cycle cost). The present research aims to craft a new model that creatively and potently links agility and sustainability through exploring a spectrum of modern developments and emergent concepts.

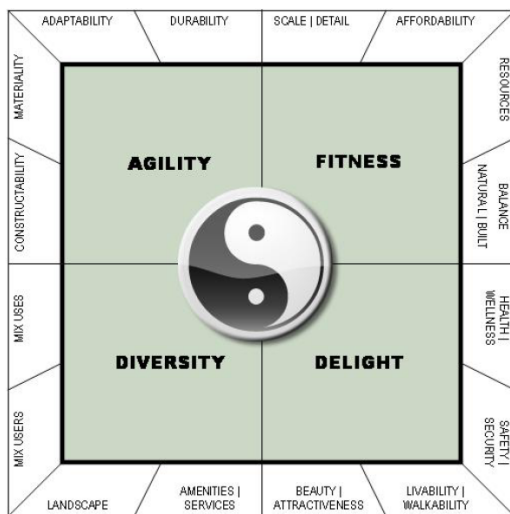


Figure 4. Sinclair's Holistic Integrated Framework for Design + Planning (Sinclair, 2009)

4.0 CASE STUDIES

The researchers are investigating the unifying principles of agile architecture throughout both early (historical) and contemporary applications in an attempt to understand the unique factors required to develop much more sustainable environments. Case studies introduced in the present paper can be seen as pragmatic and strategic examples with which to investigate modern agile concepts. We draw attention to six contemporary designs drawn from the flexible/adaptable building movement. Blundell-Jones – in his book *Modern Architecture Through Case Studies* – views the case studies approach as a unique dialogue and considers investigating the cultural and physical context of each case to be “a better way to disclose general set of principles and laws rather than bending the work to fit the rules” (Blundell-Jones, 2002, p. 5).

The selected case studies, which are vital components to this ongoing research, are drawn from six global cities -- they represent different building types while showcasing different responses to various contexts and conditions: Sendai Mediatheque (Japan), Loftcube (Germany), Sliding House (UK), Sharifi-ha House (Iran), Galaxy Soho (China) and Shotgun Chameleon (USA). All cases were constructed during the 21st century and had been recognized for national, state or regional recognition for architectural distinction. The present paper introduces these intriguing projects as subjects for the next phase of study – namely and in-depth field-based analysis with agility and sustainability front-of-mind. Our theoretic posturing avoids any set position or assumptions and instead innovatively evaluates and interoperates each project objectively in the context of durability, flexibility and sustainability. Case studies data, in tandem with the strategic literature review, aim to highlight leading themes, ideas and practices of agile architecture. The ongoing research will connect the analysis of these contemporary projects with historical precedents and an understanding of the literature. The next stage of the research, beyond conducting the case studies, will synthesize a framework that connects agility and sustainability – equipping architects and builders with the theory, tools and techniques needed to develop and realize more mutable, adaptable, responsive and responsible buildings.

CONCLUSION

The architecture of the 21st Century should possess the fundamentals of durability, flexibility and sustainability. Such principles are not mutually exclusive, nor incompatible with values of delight and performance, but rather hold equal significance. A zero-carbon structure with no robust functional flexibility will still become obsolete long before its physical life has come to an end. While such design demonstrates technological advancement, it is merely a prototype for concepts that need integration into a balanced and broader framework that should be more commonly practised. However, a standard theoretical framework for setting such agile concepts is not yet established, rather only generalized methods and guidelines are found in the literature. Hence, the long-term objectives of the present research are to: • Identify all layers, agents, facets and forces affecting the integrative design process, • Understand the failure and success of past attempts (technological, social, political, environmental and economic) and • Develop a novel framework and associated methods of analysis to provide the requisite levels of agility. The authors understand that whether our designs are partially or entirely adaptable – or even somewhere in between – there can be no ‘one-size-fits-all’ approach to pursuing agility in our modern society. Appreciating that, – listening and truly responding to users’ needs – is the optimal way to achieve strategic, successful and necessary outcomes.

The present paper critically presented historical precedents, explored prevailing thinking, observed emerging trends, and pointed to contemporary building designs in an effort to bring agility into the spotlight. The ongoing research intends to synthesize a conceptual framework for heightened agility and sustainability, thereby realizing more responsible, responsive and appropriate architecture for the 21st Century. Advancing from the established foundation of Gordon’s 3L principle, Open Building (OB) practices and drawing upon Sinclair’s recent Holistic Framework for Design + Planning, the aspired integrative model aims to introduce continuously evolving and dynamic solutions – in essence migrating away from the static architectural practices and staid architectural outcomes that define modern architecture. The authors are presently pursuing better clarity and applicability of facets and concepts of agility in contemporary building design – using case study methods to illuminate best practices and identify future potential. Given the growth of population, scarcity of resources and the emerging society expectations due to the modern world technological advancements, our research pursuit into Agile Architecture seems significant, timely and necessary. In our proposition for reconsidered and more appropriate Architecture, people must reside centrally, and the dynamic, responsive and meaningful must eclipse the static, staid and stale. Ingenuity, creativity, imagination + open-mindedness prove valuable and vital.

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