To what extent can architects future-proof the space, systems and structure of a building?

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Introduction

To what extent can architects future-proof the space, systems and structure of a building?

“As an architect you design for the present, with an awareness of the past, for a future which is essentially unknown.” (Foster, 2007)

This essay looks at the architectural issue of future-proofing, a complex issue that architects have always encountered and will continue to face towards the future. Architects are employed as the designers of tomorrows world, but no one can definitively predict anything from the present moment in time. To future-proof is to anticipate and design for changes occurring at any time from the present. There is not a universally accepted longevity of future-proofing as this design issue varies greatly between components and projects. It can be any amount of time into the future; a second, minute, hour, day, month, year or longer.

Susanna Hagan begins her presentation at The Architecture Foundation event; *Future-Proofing the City*, 2009, by saying: “well to begin, I’m not sure that one can future-proof cities, apart from their built-in inertia, the only prediction we can comfortably rely on, is the unpredictability of cities, climate, economies, societies.” After all, telling the future is impossible. However the idea of future proofing is not actually telling the future, it is about designing a flexible building which can cater for changes within its lifespan and even allow for its end of life.

The Topical Focus

Due to the issues the building industry is currently facing, the connotation of the term ‘sustainability’ is related to the environmental impact of architecture. However, this essay sets out to draw attention towards other, equally important issues within the topic of sustainability. To sustain is to ‘continue for an extended period of time’ and architecturally this requires support from more than just the environment. People support architecture just as much as architecture supports people. A building has no use without the people that use it and in order to be used, architecture must remain relevant, being functional, economical and technologically up-to-date to name but a few.

Future proofing a building can potentially save resources and increase the length of time that a building is relevant. This view is shared by Kronenburg: “Adaptability, therefore, has the additional advantage of being a key strategy in providing a sustainable building solution as well as an appropriate one.” (Kronenburg, 2007, p142)

The Applicational Focus

This essay will primarily focus on offices and houses, as Brand points out, these types of buildings are where the highest rates of change are found.

“You don’t have to look far to see it. ... The majority of workers work in offices (over 50 percent and still rising). Apart from high-turnover retail spaces, where do you find the highest rates of change within contemporary buildings? In owner-occupied houses and in office buildings.” (Brand, 1997, p156)

It is likely that this statement remains true in todays modern world and illustrates the importance of future-proofing offices and houses above all others.

Throughout this essay I will be discussing case studies from classics such as the Rietveld Schröder House for its adaptable walls and the Willis Faber & Dumas Headquarters for its immunity to the effects of the IT boom as well as more recent examples such as the Seattle Public Library for its balanced combination of spaces.

This essay is set out in accordance to the layers of change within architecture, from space to systems to structure.

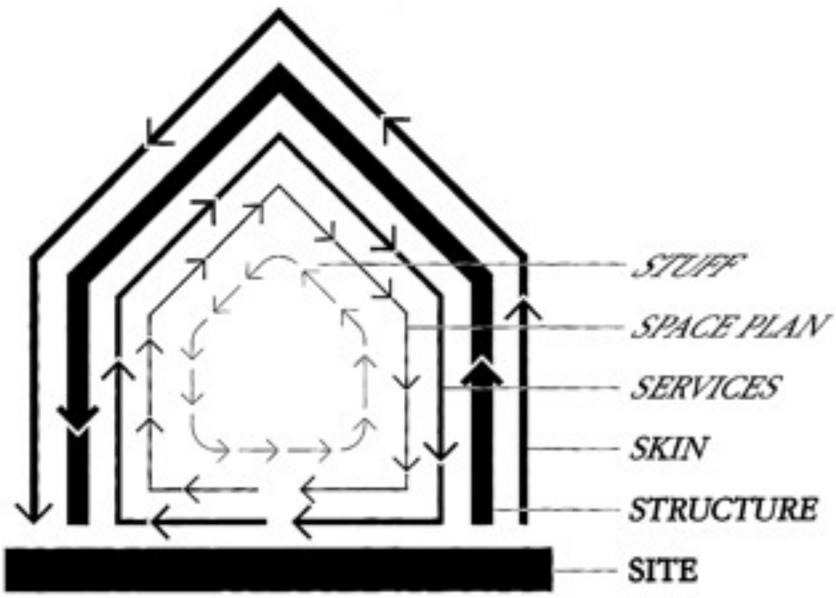


Figure 1. Shearing Layers of Change

Design for Mitigation and Adaptation

To predict change we usually take into account past trends to estimate a projected course towards the future. As Hagan notes: “There are two strategies; mitigation and adaptation. Mitigation deals with what we can predict, or are already facing. For instance rising global temperatures are leading us to design buildings that produce less atmosphere warming $C0^2$... Adaptation on the other hand, responds to what we can’t predict” (2009) such as wild fluctuations in the environment or the use of a house after an unpredictable change within the family such as divorce, death or unscheduled children. These examples are not definitive and changes can occur from any direction such as social, economic and environmental.

Design for Mitigation

The aim of designing for mitigation is to minimise the impact that future changes could have on the building. This is difficult as it essentially works from past trends and predictions. For example designing an energy efficient building would minimise the impact of increasing energy costs, therefore tolerating the potential economic and environmental issues. Another example would be fitting a wireless network to allow for changes within an office. This would untether computers enabling them to be freely moved around, easily added or removed from a network and reduce the need for rewiring.

This method is about being aware of what is happening and what is expected to happen in the world. By making the most out of what we are already aware of, the need to adapt or renovate is reduced, resulting in a building which continues to function correctly, extending the useful life of a building.

Design for Adaptation

The aim of designing for adaptation is to create flexible spaces with the ability to be reshaped to accommodate unforeseen circumstances. Designing more dynamic spaces which tolerate and expect change rather than remaining static and functionally degenerating until its next redevelopment. In *Flexible Architecture*, Kronenburg writes how flexible spaces are beneficial to architecture:

“Flexible architecture consists of buildings that are designed to respond easily to change throughout their lifetime. The benefits of this form of design can be considerable: it remains in use longer; fits its purpose better; accommodates users’ experience and intervention; takes advantage of technical innovation more readily; and is economically and ecologically more viable. It also has greater potential to remain relevant to cultural and social trends.” (Kronenburg, 2007, p7)

This shows that the concept of future proofing has great potential to generally improve architecture in practically every way.

Although there are many advantages to adaptable designs, the general concept can have its issues. In some cases it is unable to provide a close fit to the functions it must support, it could be bulky, excessively complex and methods are often limited by technology. However, there are ways to get the correct balance and constant advances in technology support this vision by offering improved materials, smaller components and better resources. For example permanent concrete structures can be replaced by more recent steel structures which in theory could be altered after construction, offering improved adaptability.

Context

"Human beings are flexible creatures. We move about at will, manipulate objects and operate in a wide range of environments. There was a time, not too long ago in evolutionary terms, when our existence was based on our capacity for movement and adaptability; Indeed it is to this that we owe our survival as a species. most cultures now lead a more or less sedentary life, but it could be that flexibility is once again becoming a priority in human development and that technological, social and economic changes are forcing, or at least encouraging, a new form of nomadic existence based on global markets, the world wide web and cheap, fast transportation." (Kronenburg, 2007, p10)

Kronenburg sets out a strong contextual backdrop here, stating how human society and industry has developed from a temporary nomadic lifestyle, to a more permanent, site specific species. In modern history many elements of our lifestyle have shifted back to nomadic fundamentals but in a modern way. In response to this shift in dynamics, architecture requires constant adjusting, so to what extent can architects now future-proof buildings from spacial configurations to services and systems, down to the core structure.

Space

Introduction and Development of Space

The term 'space', refers to the spacial planning of a building which can include the size, function and layout.

Before the 1960's, interiors were closed, static places. Office floors were divided up into cellular rooms for workers and houses had individual uses for each room. These rooms were very limited to the physical capacity and became very restrictive and unsuitable as businesses and families developed. Floor layouts would then require changes and it was a relatively expensive job which resulted in wasted resources such as materials, energy, money and time.

After the 1960's, open plan spaces became the standard as a result of "the brothers Eberhard and Wolfgang Schnelle" (Brand, 1997, p168), creating the 'office landscape' which was later americanised to 'open office'. Floors were opened up and layouts were defined with furnishings which could be continuously moved around and altered with absolute minimal waste. The change to dynamic spaces affected more than just floor plans, it changed the way people, and therefore businesses and families, behaved. "The new designs are not just about changes to the physical landscape however, they also offer an opportunity to modify or change the organisation's culture and the ways in which people work and relate." (BCO, 2010, p4). Supported by open plan spaces, workers were assigned to specific teams for each project rather than focusing on a confined section of a project. Also, families were more connected as they could talk and see other members whilst doing different things.

After this turning point the majority of spaces in most buildings remained open plan, allowing flexibility and creating more desirable spaces due to more abundant and evenly dispersed lighting, improved ventilation and the perception of larger spaces. However, it can be said that an issue with open plan spaces is that they cannot always support the required function and may struggle to control distractions such as sounds, smells or sights. Some of todays more successful spaces are a cocktail of different configurations creating a balance between flexibility and suitability.

Future-Proofing Space

Open plan is clearly an improvement over closed plan but what can the next stage in architectural development be, and in particular, how can this further future proof spaces? In other words how can we satisfy unknown future requirements to extend the useful life of a space.

Adaptable Space

Adaptable spaces have existed for a very long time, the Japanese 'Shugakuin Rikyu Imperial Villa', completed in 1659, displayed "formal simplicity coupled with ultimate flexibility in use of space and integration with the external environment". The interior walls were light so they could be moved around and the space was generic, being adapted throughout the day to suit multiple uses. (Kronenburg, 2007, p14)

Following on in 1925, the Rietveld Schröder House located in the Netherlands, is a basic example of adaptable space which reminded society that spaces require flexibility, especially in changing environments such as the home. It used a similar method to the traditional Japanese Villa with configurable walls hung from the ceiling which ran along paths dictated by a runner system. (Kronenburg, 2007, p27)

Figure 2. Rietveld Schröder House

“The only fixed volumes are the bathroom and stairwell: the rest is one continuous space, made flexibly habitable by sliding panels and built-in furniture, including fold-away beds and tables. There was much talk in the 1920s of time as the ‘fourth dimension’ of architecture.” (Weston and Mondrian 1996, p97)

The Schröder House is essentially an open plan space but with the ability to add dividing walls into set places. Each panel is independent so the user is able to easily utilise different configurations of the room and floor. This concept maintains the advantages of open plan but also adds a layer of control, improving its suitability for flexible living and partially accommodates unpredictable future use of the space. For example if a member of a family requires visual privacy, the walls can be moved around to divide up the floor into separate rooms to accommodate this. The same concept can also be applied to office spaces which would work in a similar way.

The idea of adaptable volumes is reasonably successful but it is not without its faults. One main disadvantage of the system used in the Schröder House, is that the walls have set configurations therefore still restricting the spacial volumes to that which the architect deemed most suitable at the time is was designed. As the architect, or anyone else for that matter, cannot foresee changes in the way the space is used, adaptable spaces such as this soon become unsuitable.

Multifunctional Space

Designing spaces for more than one use allows it to accommodate functional changes later on whilst remaining suitable. Multifunctional architecture is more universal than bespoke and generally speaking, this allows for all sorts of changes within the society, economy and environment, depending on the building. If one use becomes obsolete the space still remains suitable for other uses, thus, keeping the building useful and relevant for much longer.

Multifunctional spaces have advantages such as improved spacial efficiency and versatility. Spacial efficiency is how well a space is utilised to make the most use from what is available. In houses and offices, this would reduce the need for expensive extensions into additional land and allows for maximum return on property investments. Versatility is how well the space can withstand and adapt to changes.

These ideas of adaptable and multifunctional spaces are vast improvements over traditional fixed, single use spaces, however in some instances there are still possible refinements to be made as Kronenburg explains:

“A valid criticism of adaptable space is that it cannot provide a close fit to the functions that it must support. It is a solution that must, by necessity, be able to accommodate other uses and these may be compromised. A strategy that deals with this issue is the idea of fluctuating space. In essence this approach to design is to incorporate in a building dedicated, functional spaces that address specific functions that need to be carried out there, but are also directly linked with more ambiguous territory - a sort of buffer zone in which many things can happen. This allows the dedicated space to be appropriately serviced, decorated and furnished, but also allows unplanned, ad-hoc activities to expand out from it as required.” (Kronenburg, 2007, p127)

Fluctuating Space

Kronenburg brings to light the main issue of flexible spaces; their inability to properly serve the required function. On one hand you can design for a precise use and get it to function perfectly with that specific need, the issue here is that its particular use will change rendering the space inadequate. On the other hand you can design something that is totally flexible, for example a simple open space, the issue here is that since the space is so universal, it can no longer serve the requirements of all the specific applications it was made for.

Fluctuating space is a comparatively new method and is one possible solution to future proofing in spacial planning. Essentially the idea is a balanced mix of design methods integrating both the previously explored methods into one, therefore designing spaces throughout the building which can perfectly cater for current uses as well as providing adaptable and multiuse elements for the buildings unpredictable future.

“Different spaces within the office, such as breakout areas and private pods, are appreciated as offering a positive contribution to communication and the ability to work quietly and privately. Refresh areas, atriums and outdoor spaces are seen to offer particular benefits in terms of both organisational communication and well-being.” (BCO, 2010, p5)

Figure 3. Seattle Public Library

This idea was applied by Rem Koolhaas and the Office for Metropolitan Architecture in their design for the Seattle Public Library, located in the USA and completed in 2004. The library is a response to the increasing demand on libraries to incorporate much more dynamic media and information into a building type previously assigned for just printed information. Each floor has a different character and dedicated role with “tailored flexibility” (Kronenburg, 2007, p128) allowing each space to respond to changes which affect that particular floor and function. Between each floor there are multifunctional spaces which combined “a variety of work, relaxation and entertainment” (Kronenburg, 2007, p128). Information technology is having an increasing impact on the way information is consumed and the popularity of printed media is decreasing; take the recent decline in magazine and newspaper purchases as an example. The Seattle Public Library integrates this technological and sociological change into its ecosystem, but the multifunctional spaces in between each floor allow the building to remain in use and relevant. This balanced method creates a well rounded building with the capacity to adapt and remain suitable, even if the library is affected by changes further in the future.

The Seattle Public Library has another future proofing element called the ‘book spiral’. It is a continuous area stretching between four floors and contains the ever growing collection of the library’s non-fictional books. It allows the size of the collection to fluctuate freely “rather than breaking it up for restacking as it exceeds its allotted space”. Although this is a specific design feature, it shows that with careful attention to the way a building functions through time, rather than just at the time its was designed for, it can cope with changes whilst also minimising inconveniences for the users.

Future Space

Realistically there is no easy answer to creating a future proofed space but by ensuring there is a balance between adaptability and suitability, and between dedicated and multifunctional space, the useful life of space could be dramatically extended, until it requires drastic change much later in its life. This is what architects should build upon and develop in order to extend the useful life of the houses and office spaces they design.

Spaces could be dedicated to demanding or very specific uses. Dedicated spaces for the demanding functions and multifunctional spaces for the constantly changing, dynamic functions. For example, in a home the bathroom would be dedicated and unlikely to change whilst the living spaces would be multifunctional and dynamic.

In some instances we can anticipate and mitigate the effects of the future requirements of specific functions, such as the constantly changing size of the book spiral in The Seattle Public Library. In other instances anticipation is difficult, this calls for a more adaptable approach with the intention to accommodate unknown alterations.

“Office space will have to adapt to suit these new ways of working, whilst not inhibiting the more traditional workstyles.” (BCO, 2004. p7)

Architects should try to ensure that it is not obsolete functions or spacial inadequacy which forces renovation but instead it is the natural decay of materials which can then be renovated, replaced, repaired or upgraded.

Systems

Introduction and Development of Systems

In this digital age systems have a massive impact on architecture and have done for years. Architects realise this and treat technology as an integral part of their work. The term 'systems', includes services such as ventilation, heating, lighting, mains electricity, networks, IT systems, security and fire alarms.

With the information technology boom in the early 1980's, architecture faced its next big obstacle. Starting in offices to boost commercial value and later spreading into nearly every building, the initial wave of bulky PC's multiplied the loads and requirements; more wires, networks, cooling loads and energy to name a few. Buildings were wired to the hilt and had been designed too tightly around current technology. "When trends moved on, the buildings were left standing, good at something that no one wanted any more." (Brand, 1997, p171). This did not allow for any changes in layouts or system upgrades and as a result they had to be constantly refitted.

"The temptation to customize a building round a new technology is always enormous, and it is nearly always unnecessary. Technology is relatively lightweight and flexible - more so every decade. Let the technology adapt to the building rather than vice versa, and then you're not pushed around when the next technology comes along." (Brand, 1997, p192)

Brand makes an important point here, showing that fully integrating systems into architecture is just as bad as not integrating them at all. When something is fully integrated and treated in a bespoke manor, it is unlikely to accommodate upgrades or make other changes without major disruptions. This is also the case for not integrating systems enough.

The answer was to allow some flexibility for changes within those systems which led to suspended ceilings and soon after, accompanied by raised floors. These systems gave a dedicated space for cabling and services whilst being accessible and adaptable. Suspended ceilings were mainly used for general services such as ventilation and lighting, raised floors were introduced for actively changing services such as mains electricity points, network cables and other interconnections. Of course this method requires larger gaps between floors and ceilings and since these cannot be easily modified after construction, they caused what were then up-to-date buildings to be classed as obsolete.

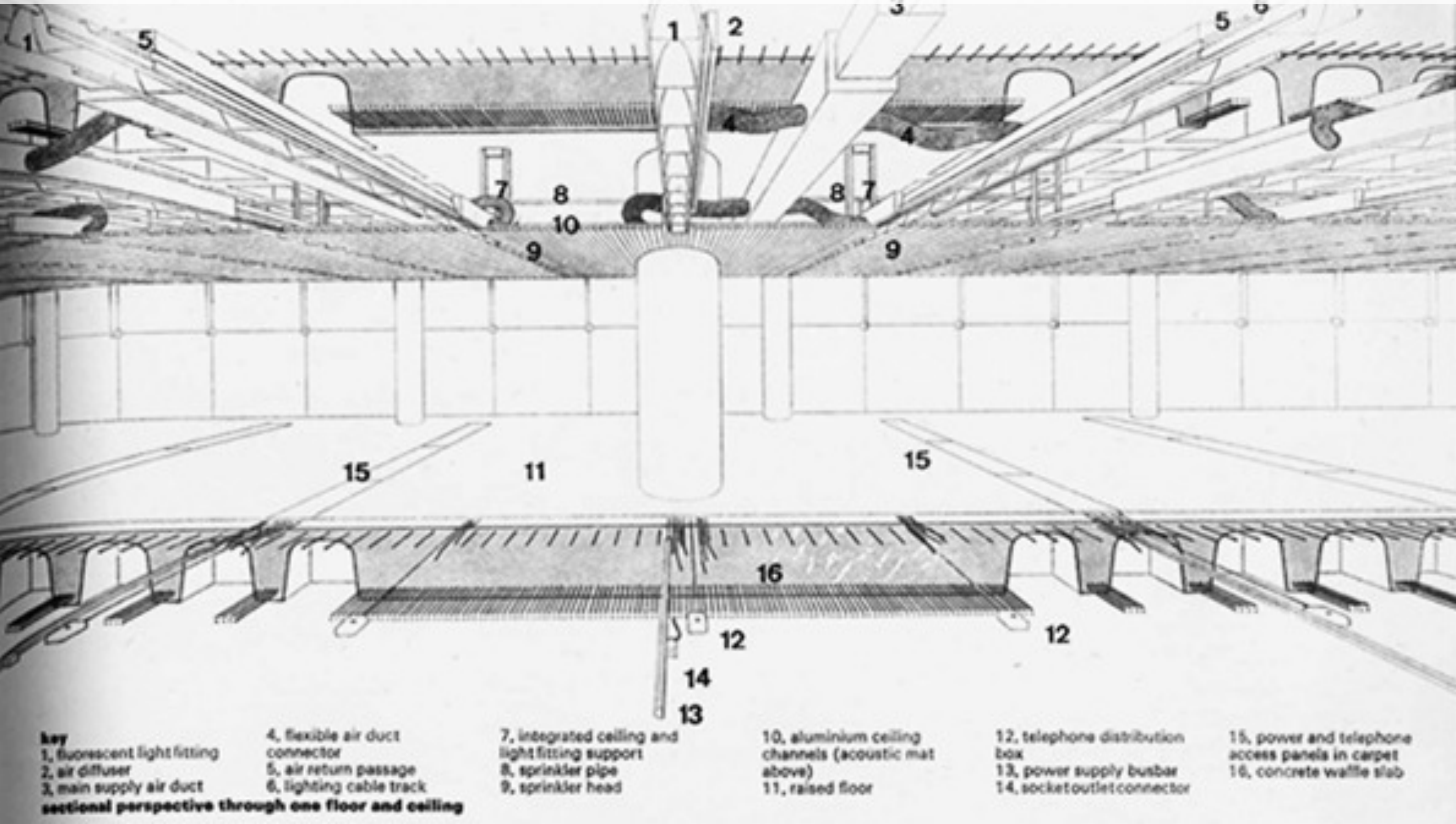
Current Future-Proofing Systems

Foster and Partners designed a prime example of the idea of future proofing for future systems with their Willis Faber and Dumas Headquarters, located in Ipswich, UK and built between 1971 to 1975. In particular the use of raised floors and suspended ceilings throughout the office areas prepared it for future developments in information technology. The practice notes on their website the following text:

“It also pioneered the use of raised office floors, anticipating the revolution in information technology. When Willis Faber introduced extensive computerization, it was able to do so with minimal disruption.” (Foster and Partners, n.d.)

Foster and Partners apparent forward thinking saved their client a huge amount of money, time and materials as the they were able to integrate new systems into their existing building with minimal change. Foster notes that other competing companies had no choice but to build new buildings to enable the use of new systems: “Our competitors had to build new buildings for the new technology. We were fortunate, because in a way our building was future-proofed. It anticipated change, even though those changes were not known.” (2007, 15:30)

Figure 4. Sectional perspective through one floor and ceiling



The aim of future proofing is not to predict the future, but to cater for the possibilities is might bring by the two methods discussed earlier; mitigation and adaptation. This example shows that it is possible to get both these methods right and that when it is successful there are substantial benefits. The mitigating part of the design was what Foster described as "wired for change" (2007, 16:50), a self descriptive term stating extensive wiring was fitted including redundant wires for future use. This minimised the disruption for the company through the following years as the wiring was adequate for supporting their IT systems. The adaptive method was using both raised floors and suspended ceilings, in hindsight these may seem obvious techniques but it is the flexible nature of the buildings design as well as the systems it embraces that made it successful. It allowed for an unpredictable future to merge into existing property.

In houses, very little has been done to allow flexibility within the systems used. Perhaps this is due to the fact that housing demands on services are much less than offices and when they are changed it is normally to keep up with fashion and current technological trends. This disguises these changes as necessary steps in the redecoration process, compared to offices which require the latest systems in order to be profitable.

There are some fairly recent adaptable housing solutions which show belief for the need to accommodate changing services in residential buildings. Dutch architect Frans van der Werf's, Pelgromhof project, built 1997 to 2001, has a 'projected' lifespan of 75 years (Kronenburg, 2007, p138) compared to the usual 50 years.

"The individual apartments are built using a flexible servicing system that allows residents to design their own apartments according to their needs and tastes." (Kronenburg, 2007, p139)

An admirable effort to bring more flexible services to residential developments, this is another story when compared to residential houses. However, there is an important point here; the architect is allowing each flat to be tailored by the residents instead of delivering a finished building.


Figure 5. Pelgromhof

The shift towards wireless technology allows certain aspects of services to be more relaxed. Most commercial systems are more dynamic with a mixture of laptops and other systems and residential IT systems are now laptops and wireless networks. This has a distinct impact on the way people both live and work, a significant step towards untethered lifestyles and behaviour.

Wireless technologies are allowing offices and houses to continuously keep up to date by upgrading with little disruption and it seems embedded, adaptable spaces have allowed services to change freely from the office. Lately there is great emphasis on the efficiency of buildings with the green agenda. Services such as ventilation, heating, cooling and artificial lighting are now being reduced due to the rising cost of energy making it more financially beneficial to use passive systems over even the most efficient active ones.

It seems that the heavy technology phase is passing by, making way for wireless, lightweight and passive services, so how can architects anticipate the future requirements to ensure the long life of new builds?

Future Systems

The shift towards, or back to, passive systems in many ways makes it easier to future proof a building. This is because they require very little 'upgrades', if any at all. However this must not be mistaken to mean it makes it easier to design a successful passive building. Architects are now even more responsible for the future performance of a building as they cannot rely on active systems after construction is completed. Passive design must be properly integrated into the design right from the start, from the physical form to the materials used. For example floor plans should be shallow to allow a better connection to the external environment. This improves the penetration of light as well as providing a well ventilated space. Another example is that buildings and cities should be kept compact since this has been proven (Foster, 2007, 9:50) to be more efficient than unnecessarily larger and more spread out developments.

“The next decade promises the wider take up of ‘cloud computing’, which will enable servers and company files to be stored remotely, removing the need for large power sources and on-site technical capability.” (BCO, 2011, p6)

Emerging wireless and lightweight technological systems should shift demands towards networks and off site equipment, whilst their visible physical presence will be reduced due to smaller devices and fewer accessible cables. “The investment in cabling will be questioned, and some users will try and live without it.” (BCO, 2005, p8). As technology advances quicker and quicker it is getting more difficult to predict what impact these changes could have on architecture. “The number of internet connected devices is set to explode in the next four years to over 15 billion - twice the world's population by 2015.” (BBC News, 2011). Architects should think carefully before tightly integrating current technology and they must remember that everything within the systems they specify will eventually change.

“Let the technology adapt to the building rather than vice versa, and then you’re not pushed around when the next technology comes along.” (Brand, 1997, p192)

The suspended ceiling and raised floor methods are successful because they separate the technological layer into its own space where it can be altered freely with minimal disruption. These principles should be built upon when future proofing property to systems.

Structure

Introduction and Development of Structure

The term ‘structure’ refers to the primary framework of a building which keeps it standing. Naturally these are substantial, heavy and fairly permanent in order to resist the massive amount of forces applied to them.

Structures are the most permanent layer of a building and do not go out of date like systems would, or be as dynamic as spaces. However they need to be able to accommodate the changes within these other layers. For example, Brand notes in the following quote that failure to future-proof the structure of a building can quickly lead to demolition.

“When Information technology took off in the early 1980’s, many of the high rise office buildings of the previous two decades were found to be absolutely incapable of adapting. Their floor-to-ceiling height was too low. There was no room for both a dropped ceiling and a raised floor, and no way to fix the problem. Blocks of new buildings in London’s data-intense financial district were suddenly obsolete, and since the problem was structural the only cure was demolition.” (Brand, 1997, p170)

These buildings were around 20 years old when they reached the end of their lives but they were capable of lasting a lot longer. Brand suggests that even basic structural methods can last fifteen times longer than this example. “Timber frame assures a 300-year structure because of its massiveness and because the buildings endoskeleton is well protected from the weather outside and exposed for inspection inside. It is adaptable, recyclable, and beautiful.” (Brand, 1997, p195). It seems that the life of a structure is limited more to its adaptability rather than the decay of a material. “We begin to understand why site-built, platform-frame houses have persisted so long in America. ... is an amateur medium. You can build and rebuild an entire house with a power saw and a hammer”. (Brand, 1997, p193).

If structures can become less restrictive and allow other layers to adapt, the buildings useful life would be extended.

Current Methods of Future-Proofing Structure

To extend the useful life of a building the structure must be able to accommodate changes from its other layers and there are a few ways this can be done. The first and most commonly used are basic passive methods such as Le Corbusier's open plan "Maison Dom-ino" housing system from 1914 (Figure 6). Another method is to use active, adaptive structures but these seem less likely to hit mainstream any time soon as they are very expensive and complex.

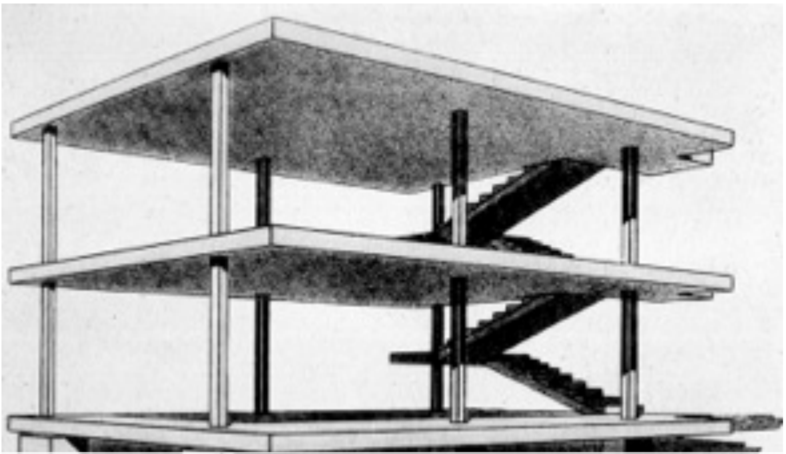


Figure 6. Maison Dom-ino

Today the "Maison Dom-ino" concrete housing structure is more often applied to offices more than houses. It is a very simple but effective method of future proofing architecture from the structure as it keeps the structure as unobtrusive as possible to allow the rest of the building to fluctuate around it. For example it opens up the floor for dynamic internal spaces and separates the external facade.

One problem with the "Maison Dom-ino" is that it is static and difficult to alter so if the ceiling heights are too low it can only be demolished, an example I have previously noted (Brand, 1997, p170). This calls for an even less restrictive structure or an adaptable one.

Creating adaptable structures 'can' be done and can work very well in specific applications such as an opening and closing roof for a theatre. These active, or more recently emerging under the term 'smart' structures, can respond to many changes such as weather conditions or spacial requirements. However they are incredibly expensive and as a result, are only viable for special instances such as venues. Active structures are also mechanical so it is more than likely that mechanical failure would occur at some time and that they would require regular maintenance.

Figure 7: Starlight Theatre by Studio Gang Architects shows that active and adaptive structures can work well in specific applications. The roof can open and close, adapting to internal and external climates as well as lighting requirements. The example is far from future proof but it does have an adaptive structure capable of accommodating a wider range of requirements.

Figure 7. Starlight Theatre

Future Structures

Anticipating the future requirements of structures is a mixture of all the other layers within a building, this is because the structure is the biggest barrier they face. By designing a structure to be as unrestrictive and adaptable as possible, the effects of future requirements are mitigated and adapted to.

If significant changes occur in other layers such as the systems or space and structures haven't become less restrictive and more adaptable, most of our buildings could need substantial renovation or even demolition.

Perhaps design for disassembly can provide some adaptability to structures. This method of design ensures that things can be taken apart just as they were constructed.

Design For Deconstruction

Apart from a few exceptions such as protected buildings and heritage sites, it is very unlikely that a building can last forever. Therefore even with a great amount of attention to the design of flexible spaces, systems and structures, architects should acknowledge that buildings have a finite lifespan. Designing for deconstruction and disassembly addresses the end of life issues of buildings by recognising this need right from the start of the development instead of passing the problem onto another generation. It is time to get the right balance between permanence and versatility.

“Timber frame was the original design-for-disassembly building material - just knock out the pegs. Throughout medieval northern Europe, timbers were handed on from building to building for centuries.” (Brand, 1997, p194)

Product designers are now taking on much more responsibility for the end of life of their designs and design for disassembly is a key part of this as seen in the Herman Miller, Mirra office chair (Figure 8). Architecture should acknowledge the success of this movement and push DfD towards mainstream. “Indeed, there are important lessons to be learned from experience in other industries that are already further down the road towards full producer responsibility than the construction industry.” (Addis and Schouten, 2004, p84)

By taking this into consideration early on, resources can be saved, components reused and the impacts of deconstruction or demolition can be reduced. The immediate responsibility for pushing DfD falls to the clients and possibly the architects. The distant responsibility would fall to planning regulators, it is expected that they will make DfD compulsory, or at least push more responsibility to the industry.

“Ultimately the most significant progress towards achieving more effective deconstruction for reuse and recycling will be in the hands of enlightened building clients and their design and construction teams who find ways of turning it to their benefit before legislation makes it compulsory” (Addis and Schouten, 2004, p84)

However the discussion of DfD leads to other topics more focussed on sustainability.

Figure 8. Disassembled Herman Miller, Mirra Office Chair

Conclusion

Each method and idea discussed throughout this essay pushes for a longer useful life, improved fit to current behaviour and more responsibility for the end of a buildings life. There is a lot of movement in the industry which is related to building efficiency and the way the buildings change and adapt through time should be seen as an import part of this. Future proofing architecture should be a significant part of the integrated and comprehensive design process of buildings and is an imperative step towards a more sustainable future.

To make it clear, architects can future proof but by no means does that require foretelling the future. This is achieved by designing with a layer to mitigate the impacts from expected changes and a layer of adaptability to tolerate unpredictable changes.

As much as one could hope, the building industry is conventionally slow to respond to such changes within its practice, however the recent push towards more sustainable architecture is forcing change. It is everyones responsibility and the government has made its move by producing targets for zero carbon. Professional bodies such as The Royal Institute of British Architects (RIBA), building regulators, architects, other professionals and clients need to tackle the effects that future changes can have on architecture.

“Everything points towards the requirement to produce simple, flexible and long-lasting space which can be readily adapted in the future to meet the ever changing needs of occupiers, while also meeting environmental regulations, which will continue to get more stringent as the years go on.” (BCO, 2011, p6)

Spaces need to have a balance between adaptability and suitability, and between dedicated and multifunctional space. This creates an ecosystem within the building with the capacity to respond to external change. Systems themselves are becoming more lightweight, flexible and versatile with each advancement such as wireless and passive design. Structures must be unrestrictive and adaptable to support the changes in other layers of the building. All of a buildings elements should be disassemblable to extend their life and to allow for the end of the buildings life.

Towards an architecture of

"long life, loose fit, low energy"

(Alex Gordon,1972)

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