special thanks to...

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I would like to thank all of these individuals for supporting me through the journey of my architectural thesis. Without their help this process would have been extremely difficult. I thank them for their time and energy they put into bringing me to a new level of understanding architecture.
CONTENTS

ABSTRACT 5

BACKGROUND, ISSUES, AND POSITIONS 6-7

RESEARCH AND EXPLORATIONS 8-9

SITE ANALYSIS AND PROGRAM 10-11

FLOOR PLAN DESIGN 12-13

RESIDENTIAL COMPONENT 14-19

COMMERCIAL COMPONENT 20-23

MEDICAL OFFICE COMPONENT 24-27

TRANSFORMATIONS 28-31

CONCLUSIONS 32-33

APPENDIX 34-40

BIBLIOGRAPHY 41
How can buildings adapt to change? What are the necessary elements to create an adaptable piece of architecture that will challenge the thinking of how buildings are designed? There are many factors that affect how a building will change including users, functions, technology, climate, quantity, processes. Knowing that a building will change before the design process even begins is a first big step for the building designers in creating a piece of architecture that can change. This thesis explores the means and methods of creating an adaptable building.

The program will have three components: commercial development, residential development, and medical office space. Each element will be designed in such a manner that change will be accounted for in the initial design. The change in this situation can be defined by the different elements that can change in a piece of architecture but limited to the users, function, quantity, climate, technology, processes. Each component will have its own identity, but each will be designed to accommodate change. This project will have a residential component which will increase the density of the area allowing small commercial businesses to thrive. The housing will be able to change to accommodate new styles of living, such as catering to the urban professional or young new couple looking to be close to the action of downtown. This component of the project will remain housing throughout the expected life cycle of the complex. And this is true for each part of the complex. The commercial development will also have constraints to what can be developed. The program for this component will be restaurants, cafés, small office space, retail, and service businesses. The same can be said for the medical offices of the complex. These spaces will be designed specifically for these medical offices. However in the future these can also become more traditional office spaces.

The chosen site is in downtown Indianapolis along the canal between 10th and 11th street and will become an urban complex that will serve the surrounding community. The site is currently zoned as a medical/research site. However, there is a strong need for more residential and commercial development along the canal, as well as more space for medical research centers and offices, cafés, restaurants, shops, small office space. The canal will be engaged by the architecture in a manner which creates a sense of place and life for the pedestrian using the canal. Across the canal is a commercial building for Indiana University Medical Information Sciences. Another advantage of the site is the ability to connect with the Clarion People Mover, which connects the Clarion Medical Campus. Across the street to the north side of the site is a very large Clarion Research Laboratory which also connects with the People Mover. To the west of the site is a very large vacant lot. The assumption must be made that these lots will also have dense urban development. Parking for the program can be provided for on the site.

The idea of change in architecture will be the theme of this thesis but within boundaries. It would be very unlikely a piece of architecture could be designed to fit all functions successfully. Therefore, these components have been formulated, and each of these will be designed within the limit of what can change within each component.
Throughout my life, I have been exposed to many different experiences all relating to healthcare architecture. Growing up, I experienced the ever-changing hospitals and healthcare buildings and with that experience, a seed of curiosity was planted with how architects and hospitals accommodate the changing needs of the building and its users. I wanted to explore how change can be accommodated through design. Through my thesis, I wanted to search for possible new ways in which change in architecture can be designed into the building. With this idea, I began my research into how architects and designers approach the idea of built-in change. Although my original curiosity for change was focused on healthcare architecture, I soon included into my project others areas of focus such as residential and commercial where I could investigate change in architecture.
The most intriguing and interesting characteristics of architecture to me is how do we, as designers, deal with change that comes about in architecture. Architecture is an ever evolving idea, and at any one point, there can be no point that is set as permanent. This thesis will look at the way in which designers can look at change and design for the future and an ever transforming built environment. Through a new design, in what ways can the design have built in aspects of change that can adapt, alter, flex, and modify the architecture to the present needs at the same time anticipating future needs? This question has emerged to me as a topic that I would like to investigate further. Learning about architecture, there is one idea in architecture and life in general that has been kept constant through time, and that is the idea that architecture and life are always changing.

My position on the matter of change is that there are many different issues that are to be considered when you are looking at a piece of architecture. I have researched and established which issues of change are significant to me and the idea of change. The first question that needs to be answered is, “why design for change in architecture?” This question can be answered by the issues that change: users, functions, quantity, processes, climate, culture, technology, economics, and organizations. These are the most important subject matter that I have found as to why design for change. The next question about change is “what changes in architecture, regarding the built design?” Having researched many different books and authors of this subject, I have broken down what changes in a piece of architecture down into the site, structure, skin, services, space plan, and stuff, (How Buildings Change, Stewart Brand) as well as the climate can change. Subsequently, one has to ask “what are the impediments to change?” I have broken this down into tangible obstacles: structure, services, and site design; and intangible obstacles: government, economy, and architectural theory.

Lastly and most importantly, how do we design for change in architecture? I have formulated five different approaches; some are generally accepted, and others have been formulated by a few different researchers. The first is “demolish/ (re)build” which is today’s generally accepted practice of change. The next is “assembly/disassembly/reassembly” which consists of designing with parts that can be reassembled in different configurations. The next two approaches are some what abstract and difficult to define. Using “economic choices” is a way of dealing with change by deciding to rent, leave vacant, or find a suitable tenant for a space that is changing. “Kinetic buildings” is the next approach which can be defined as using technology to bring about significant changes to the piece of architecture. On some levels, all architecture is kinetic.
RESEARCH AND EXPLORATIONS

The following questions are a result of my research into the topic of change in architecture. More of the research can be found in the appendix at the end of this report. The explorations for my thesis explored the different aspects of change in architecture.

Why design for change in architecture?
- Users
- Function
- Quantity
- Technology
- Process
- Cost analysis
- Organizations
- Cultural Shifts
- Climate

What changes in architecture?
These are the elements that I and others, such as Stewart Brand (How Buildings Learn), have researched and have found to be what changes in regard to architecture:
- site
- structure
- skin
- services
- space plan
- stuff

What are the obstacles to change in architecture?
- **Tangible Obstacles**
  - structure
  - services
  - site design
- **Intangible Obstacles**
  - government
  - economy
  - architectural theory

What approaches are the to change in architecture?
- Demolish/(re)Build
- Assembly/Disassembly/Reassembly
- Economic Choices
- Kinetic Buildings
- Open Building

EXPLORATION 1
This exploration explored designing a kit of parts for a medical center. The program for the medical center included nurses’ stations, patient rooms, laboratories, and office space. The concept behind this project was using Steward Brand’s layer diagram. There were to be modules that could be combined in order to produce the multiple functions of the medical center. The diagram to the right illustrates the different components that come together to form one of the complete modules of the medical center.
EXPLORATION 2
This project explores the technical aspect of “Open Building” theory. Open Building is explained in more detail in the appendix of this report. The diagrams above and below show the different systems of the building that will need to be coordinated. With this project, I took the role of the many professions that would need to used in order to coordinate such systems. The diagram to the left illustrates the curtain wall panel system of the building. This system allows for the skin of the building to change. The practice of open building has been in use for some time but has only recently been brought to light.

EXPLORATION 3
Looking at change in architecture, I explored taking an existing old building and transforming it into new uses. This project tried many different approaches to change. Open Building, assembly/disassembly, and demolish/rebuild. These illustrations show a few of the ideas explored. One idea is looking how the building floor plate can be cut through to create shafts for mechanical or circulation needs. Also the depth of the usable floor space was looked at and a depth was chosen that would satisfy a multitude of needs.
SITE ANALYSIS AND PROGRAM

The chosen site is in downtown Indianapolis along the canal between 10th and 11th street and will become an urban complex that will serve the surrounding community. The site is currently zoned as a medical/research site. However, there is a strong need for more residential and commercial development along the canal, as well as more space for medical research centers and offices, cafés, restaurants, shops, small office space. The canal will be engaged by the architecture in a manner which creates a sense of place and life for the pedestrian using the canal. Across the canal is a commercial building for Indiana University Medical Information Sciences. Another advantage of the site is the ability to connect with the Clarion People Mover, which connects the Clarion Medical Campus. Across the street to the north side of the site is a very large Clarion Research Laboratory which also connects with the People Mover. To the west of the site is a very large vacant lot. The assumption must be made that these lots will also have dense urban development. Parking for the program can be provided for on the site.
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<th>Quantity</th>
<th>NSF Each</th>
<th>Proposed NSF</th>
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Total Net Square Feet (NSF) | 152100
Net-to-Gross Factor | 1.35
Total Gross Square Feet | 205335
FLOOR PLAN DESIGN

Some of the circulation shall be shared which will possibly allow unforeseeable change to occur within the complex. The parking will be below street level with access points from 10th and 11th streets. The parking will serve all functions of the building, commercial, residential, and medical office building. However, the parking amount will be limited, and this is done to reduce the dependency on the automobile. The whole complex will be connected to the people mover which currently connects the Clarion Health Network buildings across Indianapolis. It is possible in the future that this people mover will expand to include public transportation to many destinations which can then serve the residents of the building and visitors such as medical patients and patrons of the commercial businesses.

Structure is one of the most influential aspects of design in architecture than can either hinder or help a design that has been designed to allow for change. Much thought was put towards resolving the structural system in order to keep the floor plate clear of columns. The floor plans show that the structure is very rigid and formal but the columns are placed in a dimension that will work well for many functions and allow for change to happen.
APARTMENT FLOOR PLANS
SCALE 1/16"=1'
The plan shows the layout of a one, two, and three bedroom, and each of these is placed within the structural bay of 20' wide. Each layout takes up 20' of exterior exposure per bedroom. Therefore is a tenant wanted to have a two bed room, they could expand this apartment relatively easily because the walls the layouts fall within the 20' bay easily.
The residential component has become a technical piece of architecture that explores how different assembly methods can be used in order to create a flexible building. The architecture of the residential component reflects the nature of living in a dense urban environment. Each apartment has the capability to individualize its own space. The interior and exterior each have flexibility that allows the tenant to customize their space. The following pages will illustrate further how this is done.
RESIDENTIAL ASSEMBLY
The model to the right and below shows how the building comes together. In order to allow for the plumbing and wiring to be changed within an apartment, the structure was handled in a non-traditional manner. The floor slab and beams have been turned upside down. This creates a situation in which you can construct a raised floor assembly which in turn then allows for the plumbing, electrical, and any other services to be re-routed to wherever the need arises. Waste water piping will not require a slope because small waste water pumps will be installed to push the water to the plumbing stacks. Having the capability to move these services underneath the floor allows the capability to have a limitless floor plan layout because the kitchen and bathrooms can be located virtually anywhere. The waste water stacks are placed adjacent to the columns in the corner where the beams meet the columns. An enclosure is built around these shafts which also carry the water supply, electrical, and data wiring. The flat ceiling then allows the HVAC ducts to run freely in any direction because there are no beams to maneuver around.
The diagrams above demonstrate the different exterior facade changes that could happen to the building facade. There are different materials, window assemblies, and walkway assemblies that can be used in order to alter the exterior wall of the apartments. The changes are dictated by the concrete structure and the walkway assembly. These changes are determined by the owner of the building and the renter or owner of the apartment unit.
INTERIOR ASSEMBLY
This series of renderings show the assembly from the interior of a typical apartment. The order in which this assembly occurs is not necessarily the order the construction would take place.

Raised floor assemblies, placement of vertical plumbing shafts, flexible wall partitions, changable exterior wall systems, and tall floor to floor height construction are all ways in which this component was designed for change. Each of these assemblies allow for change.

EXTERIOR ASSEMBLY
These illustrations demonstrate the assembly of the apartment from an exterior perspective. Different systems come together to create a piece of architecture that becomes flexible for the different users of the apartment.
The sections show how the services that run throughout the building will be handled. In order to allow for the plumbing and wiring to be changed within an apartment, the structure was handled in a non-traditional manner. The floor slab and beams have been turned upside down. This creates a situation in which you can construct a raised floor assembly which in turn then allows for the plumbing, electrical, and any other services to be re-routed to wherever the need arises. Waste water piping will not require a slope because small waste water pumps will be installed to push the water to the plumbing stacks. Having the capability to move these services underneath the floor allows the capability to have a limitless floor plan layout because the kitchen and bathrooms can be located virtually anywhere. The waste water stacks are placed adjacent to the columns in the corner where the beams meet the columns. An enclosure is built around these shafts which also carry the water supply, electrical, and data wiring. The flat ceiling then allows the HVAC ducts to run freely in any direction because there are no beams to maneuver around. The exterior air conditioning units are placed within the plenum space between the floor and ceiling. These can be placed wherever they are needed and will be screened by vegetation growth which will grow on panels attached to the exterior corridor assembly. High ceilings allow for the services to be changed with relative ease.
The approach that was taken for the commercial component was the typical manner in which most commercial spaces are built today. Most commercial spaces are constructed as shell space, and then individual tenants fit out their space. Through research, I have found that this is in my opinion the best manner in which to build commercial space. Most commercial spaces have a very quick turnover rate. Each tenant will have freedom over the design of their facade and interior space. As the illustrations that follow show, each facade will be specifically designed according to the tenant’s specifications. I have taken the liberty to design each of these spaces. However the reality of this project would be that many different designers would come together to create this piece of architecture. This can be said for the entirety of the building. Many different designers would come together with the owner and engineers to create this changeable piece of architecture.
The commercial shell space will allow for businesses to occupy the amount of space they need. Many commercial businesses will grow and shrink, and an approach of a typical office building construction was assumed in this situation. The base building will be constructed, and within this space, each business will have its own tenant build out. This practice has been done for many years and has proven to be a very good way in which to deal with change. The façade design of the commercial spaces will be entirely up to each tenant and their architect. However each façade design will have to have the approval of the building manager/owner. The manager/owner can have building guidelines written that architects of the build outs must follow.
INTERIOR SPACES
The photo to the left shows the empty shell space within the commercial component. This space illustrates the minimum bay width in which the structure creates. The HVAC system runs through the space from above branching from a service corridor. The illustrations to the right show a series of possible functions within the commercial shell space. The commercial space shown are bars and restaurants. However, these space could easily become any other type of commercial space such as retail or small office space.

COMMERCIAL SECTIONS
The sections show the commercial shell space which will allow for change in function to take place. The drawings also show how the plumbing and electrical shafts for the apartments and medical offices will connect down through the commercial space. The commercial space is served by a service corridor, highlighted in yellow that runs through the space in a north and south direction. The corridor divides the 34’ high space facing the canal and the 20’ high space on the opposite side. The corridor will connect with the loading dock and mechanical space at the north end of the building on 11th Street. A service elevator will connect the lower canal level to the street level. The plumbing needs for most commercial development will be small, but connection will be able to take place along the service corridor.
The structural bay will be laid out in a regular dimension. Because of the corridor links the mechanical space to the entirety of the commercial space, the HVAC ducts can be run through the corridor to supply the commercial space. Many interface connections to the main HVAC ducts will be able to be made which will allow for the infinite configurations for the various functions that will be in the space. It must be explained that there will be a limit to the type of functions that will be occupying the commercial space. The scope of the functions will be strictly limited to commercial businesses such as restaurants, cafés, retail shops, small groceries, and small businesses.
The medical office component will take an approach of the open building theory. This means that there is recognition that change will occur and that the parties involved will coordinate together to resolve the issues of change in the project. There has been five aspects of design and construction that will be implemented into the design of the medical office component. Each of the following will allow for change to take place with relative ease:

- service slots through floor plate
- flexible wall system
- shell space
- raised floor system
- high ceilings

The medical office building will operate and change to its fullest capacity. However, with all things medical, obsolescence will occur to much of the equipment and building. After much of the medical office building becomes obsolete for healthcare purposes, this part of the building may become typical office space and follow the pattern of traditional office buildings.
The purpose of this series of renderings is to demonstrate how a medical suite can be transformed from one type to another. The approach taken is very simple and comparable to that of the commercial shell space. The section of the building that is shown is the northwest corner of the medical office component. Medical Suite A is designed to be that of an internal medicine practitioner. The layout of the space is typical to what is needed functionally, and fundamentally the layout is very similar to that of Medical Suite B. However, the layout of Medical Suite B is for that of a dermatology practitioner. What the different between this design and what is typically done by today’s standards is the fact that the service for each of the suites can be changed relatively easily. A service wall runs adjacent to the space and allows for all of the services to be placed wherever they are needed. Each of these suites have examination rooms, small operating rooms, waiting areas, office area, and laboratory space. The requirements for the lab spaces and operating rooms are very extensive. The HVAC systems need to be upgraded often for these spaces and having the service wall adjacent to these spaces allows that upgrade to occur easily.
MEDICAL OFFICE WALL SECTION

The typical section through the medical office building shows how the circulation corridor will be parallel with a service corridor that will house the vertical shafts. The width of the usable floor area has been determined to be the average depth that is suitable for many of the clinics to be placed within the medical office building. The structure is similar to that of the residential structure which is the typical column and beam structure has been turned upside down. Having done this, there will be a raised floor assembly that will match with the top of the beams creating a plenum space that will house plumbing, electrical, and data runs. There will be virtually no need to have slopes for the waste water, because 0-slope pumps will be utilized. The flat side of the floor plate has been turned down to allow again for the HVAC to maneuver freely within the plan. The height of the medical office floors will also be 14', higher than that of the residential height which is 12'. Since the ceiling is the flat side of the floor plate, much of the medical equipment that will be needed can easily be mounted. Steel plates and angles can easily be anchored into the concrete floor slab for the equipment assemblies.

MEDICAL OFFICE EXTERIOR
The series of renderings to the right illustrate how the medical office building is constructed. However, the order which is shown is not necessarily the order in which it will actually be constructed. The rendering on the end shows the photovoltaic panels that can be added.

MEDICAL OFFICE INTERIOR
The sequence of renderings to the right show how the construction of the interior of the medical building comes together. Notice the slot cut into the floor plate to allow for services to run vertically through the building.

MEDICAL OFFICE SECTIONS
The typical section through the medical office building shows how the circulation corridor will be parallel with a service corridor that will house the vertical shafts. The width of the usable floor area has been determined to be the average depth that is suitable for many of the clinics to be placed within the medical office building. The structure is similar to that of the residential structure which is the typical column and beam structure has been turned upside down. Having done this, there will be a raised floor assembly that will match with the top of the beams creating a plenum space that will house plumbing, electrical, and data runs. There will be virtually no need to have slopes for the waste water, because 0-slope pumps will be utilized. The flat side of the floor plate has been turned down to allow again for the HVAC to maneuver freely within the plan. The height of the medical office floors will also be 14', higher than that of the residential height which is 12'. Since the ceiling is the flat side of the floor plate, much of the medical equipment that will be needed can easily be mounted. Steel plates and angles can easily be anchored into the concrete floor slab for the equipment assemblies.
2. HVAC and plumbing stacks
3. Medical suite A
4. Medical suite B
These renderings show what I propose to be the change that happens through time. The base building shows the beginning stage of the building. The proposed changes will take place over time. The renderings on this page show the east facade, and on the opposite page, the west facade.
proposed change

TRANSFORMATION
The illustrations here show the changes that could occur on the south facade, (this page) and the north facade (opposite page). These are only proposed changes that would take place under a one architect project. However, the reality of this project is that there would be many different architects working on this change.
proposed change

base building
There has been much input and feedback from many advisors to this project. Many of the issues with this project came about through what approach to take in designing for change. Originally, I had taken the approach that each component (medical office, commercial, residential) could be designed into the building, and each component could effectively be transformed into any of the other components. However, as the project progressed, I found that each component wanted to change different through time, and my approach changed to design each component in a manner in which change occurred within that component and typically stayed the same function. Another issue that I would revisit if I were to do the project again is to address the east and west facades in a different manner. The west facade should have been integrated into the canal much better, and that integration should have been pulled through the building to the east facade. The true test of this project would be to present this to a developer and/or contractor to get their feedback as to whether or not this project could be built and to sell them the idea of built-in change.
This project is far from complete. The main question asked was “how do we design for change?”. The very nature of this question make it impossible to have a definitive complete answer. Change is inevitable and constantly happening, therefore there can never be an explicit manner in which we design for change. One aspect is definite in the design process of architecture, and that is the fact that there will be change that will occur, foreseen and unforeseen. What we must do as designers is try to recognize as much of this change at the front end of any and all projects. This will allow us to create pieces of architecture that will become more sustainable and accommodate much more than today’s archetypical building design. I have learned much from this thesis process. I have learned that it is possible to design for change once there is recognition that change will occur. Throughout my career, I will be aware of this change and believe this will make be a stronger designer. I feel that as other designers become more conscience about this topic this will better the world in which we live.
APPENDIX

Why design for change in architecture?

Users – The rate at which users of a structure change today is much faster pace than they have been in the past. Our world is moving faster, and this is in part due to the technology revolution. Many structures change users daily, and other structures may change yearly, but the fact remains that typically the structure is designed to last longer than its occupants need for its use. Therefore, we must know this in the design process and know there will be different user groups that will be using the structure.

Function – This is the second of two most common reasons that we would think of when something changes in architecture. The function can change from one think to a completely non-related function, or it can change to a variation or similar function as the original. This is probably the most important aspect when designing for change. If the program of the building is very narrow, and the building is designed specifically for that program in all aspects, then it will lead to much difficulty in changing the program of that building. However, when you take into account that the function will change, you can plan for those accordingly in the program and design of the building.

Quantity – The quantity is probably one of the two most common reasons that we would think of when we think of change in architecture. Expansion, additions, and extensions are great for business in architecture, but on the other hand sometimes there are contractions. Businesses shrink and do not need as much space as before. This growth/shrinkage can come from booming economy, declining economy, or advent of new technologies into the business reducing the need for labor.

Process – This is a very important piece of the design if you are designing for change. The process of the manner in which we work, live, and play changes constantly. This should also be taken into account when designing for change. As designers we know that our way of living changes depending upon a number of unknown factors. One example is that of the proliferation of the internet and the computer revolution. These inventions changed how we shop and do business in our lives. Many of us shop online now compared to getting in the car and going to the store. The same can be said about business. More and more business is conducted online, and this can lead to a decrease in the amount of work space needed for any business.
**Climate** – This is probably one of the most common reasons why we design the way we do in architecture. The weather and natural environment can be a harsh landscape for humans. Cold winters and ice, and heat and blazing sunlight in the summer are the extremes of weather that we design our buildings to control. Our designs are meant to keep occupants warm in the winter and cool in the summer. Almost every building design takes the climate into account. As long as humans are occupying architecture, there will be the need to control our environment to keep us safe and comfortable.

**Technology** – This is an obvious reason to design for change in this day and age. We all know now that technology changes faster than we can blink our eyes. Technology has a very wide field that we could design for, but in most cases we limit in a design what technologies we use. We should look at the possibility that there may be a need for unknown technologies to be added later to a structure.

**Organizations** – Relating to users, organizations maybe change. They do not necessarily mean that a new group of users come in, but it might mean that the users may rearrange their organization. This might mean that their needs will change. One example may be that of a business organization. Businesses restructure their companies due to market conditions. They reorganize in order to stay competitive, and as designers, we must be aware of this and our clients’ need that might arise to reorganize.

**Cultural Shifts** – Our society and culture is continually evolving, and this also needs to be an area that needs to be thought about during the design process. This is a very elusive aspect in the regard that it is not easy to predict these future changes. A prime example is the design for Ball State’s Architecture Building; within the original building, there was only accommodation for a men’s restroom on each floor. There was no women’s restroom in the whole building. However, as we all know now, there has been a movement to make women equal in today’s society. There has to be some thought put into what the most up-to-date cultural standards are at the time of any design as well as hopefully being ahead of the curve and designing for the possible future.

**Cost analysis** – The cost of constructing buildings is always an issue. When we look at coming unforeseen changes, many times the cost can be prohibitive. It may be too expensive to demolish and change to what we need. The structure maybe unusable do to the fact that it was not designed for change and may become obsolete. Even when it is possible to demolish, it maybe cost ineffective to rebuild in the previous structure. It may not fit with what is needed.
APPENDIX
What changes in architecture?

One important question that must asked is: “what changes in architecture?” This hits on the essence of what I want to know which is how do we design for change knowing what we have to work with at this point. These elements are the elements that I and others (How Buildings Learn, Steward Brand) have researched and have found to be what changes in regard to architecture:

• In most cases, we know that the site will not change. Although there are cases in which we can design buildings that are mobile, and some that are usually not mobile but that can still be moved.

• The structure is the foundation and load-bearing elements which are prohibitively expensive to change, so in most cases, it is not changed nor designed to be changed. I believe that it might be possible to have this structure changed, and I say this because there might be a revolution of technology again.

• The skin of a building can change and does change, and it does so in a relatively short time line in regard to the structure of the building. The skin is change in order to keep up with style or technology, or for repair.

• Within the guts of most buildings, there are the services which supply the users with everything they need to function within the structure. The services include the electrical/telecommunication wiring, plumbing, sprinkler system, HVAC, and permanent equipment such as elevators and escalators. Services are very important in designing for change. If services are incapable of changing or incompatible with new technologies, they building as a whole may become obsolete and worthless.

• The function or space plan is the other area that architects work within in order to accommodate a client’s changing needs. The interior layout includes the walls, ceilings, floors, and doors. All in which can be changed relatively easy if they are designed in a way that allows them to be changed easily. This area is one that should be looked at more intently when designing for change.

• The last and easiest element of a building to change is the stuff inside of it. This includes everything from chairs, desks, phones, pictures, kitchen appliance, lamps; nearly everything that can be picked up and moved around easily daily or monthly. This is what people will change first when they want to bring about change.

• **Climate Changes** - The climate is a very important element of change. As designers, we design our buildings to control our climate around us. We use very technical ways in which to do this.

(How Buildings Change, Steward Brand)
What are the obstacles to change in architecture?

- **Tangible Obstacles** – This general heading can and does include countless reasons as to why change cannot be brought about within a building. Speaking in general terms, the **structure** is one element of a building that definitely inhibits change. Suppose a new function requires that the structure carry additional load that it was not designed for, the structure would keep that function(s) from happening. Another example might be that where a load bearing column or wall comes down and is incapable of not being moved. This will clearly hinder any new function that needs to have that space clear. The **services** of the building can be the worst of these problems. There are innumerable cases where services such as HVAC, plumbing, and electrical have gotten in the way of progress and change. Some of these are easier to deal with than others. Electrical wiring for example, can be re-routed to other locations, around elements, or in the case of data, it can be wireless. In regard to plumbing, the pipes are not very flexible however there are newer systems to deal with plumbing such as flexible plastic tubing for supply lines, and waste water pumps for zero slope piping for the water removal. However, in a large building dealing with the HVAC can be a cumbersome task. These systems take large volumes of space within a buildings infrastructure. These systems are large and sometimes placed in locations that make it impossible for them to be changed out. The ducts themselves require much thought and work to reorganize them to make for the best internal environment. This system is not touched unless it is necessary. Therefore it can be a hindrance to change. One last example of a physical obstacle may be the **site design**. Thought might not have been put to the idea that a project might expand on the site. This is a barrier to change. These are the physical hindrances to change that I have found to take place within a building.

- **Intangible Obstacles** – Again this heading leads to a list that is neither complete nor absolute, and these are all ways that keep change from coming about. There are again innumerable ways in which obstacles can manifest themselves, and all of these obstacles are speaking in general terms. **Government** regulation, “Red Tape”, and the law are all barriers when speaking in terms of change within architecture. The building may not be up to code and it could be deemed unusable by that governing body. Trying to get permits and contracts to go through the government slows down and sometimes stops the whole process of bringing about change in architecture. There may be local, state or federal ordinances or zoning codes that will have to be changed in order for a new function to come in, and this can all be an obstacle to change. The **economy** is a profound area that needs to be understood for projects to happen. From an economic point of view, there has to be sufficient financing of a project in order for it to take place. Financial analysis has to be done to prove that a new function will be a viable one as well as cost effective. Maybe the market conditions are right for the change to take place. This is simply explained by looking at the supply and demand for a new function or service. One of the most talked about areas of change in architectural education is that of the evolution of **architectural theory**. This can be an obstacle to change in that fact that current thinking is not progressive and change can be stymied by this. There might be a resistance to accept the new ideas in architecture. This can be from both the clients and the designer. Some clients and designers want to stay with a particular line of thinking, and this is definitely a barrier to new thinking and to change more importantly.
APPENDIX
How do we deal with change in architecture?

- **Assembly/Disassembly/Reassembly** - This approach takes on the design of a facility with the mind set that it will go through a process of assembly, disassembly, and reassembly according to what functions are called for in the program. The design process for this type of approach is to have a set of parts that one can design from with the knowledge that these parts will be assembled and then disassembled and reassembled into a new function using the same set of parts. In most cases, the designs are designed with prefabricated components off the shelf. Using a “kit of parts” can shorten the construction time there by making the building capable of changing in a relatively short period of time. This idea becomes very sustainable due to the fact that you re-use and recycle most of the materials. Today, the idea of constructing sustainable buildings is becoming more and more mainstream.

- **Demolish/(re)Build** – When looking at an existing building, the usual course of action is to demolish part of it and clear it out to make way for the new whether that be a new function or just updating the building. Once this is done, then the new construction takes place within the building shell. This method is one of the most traditional methods of dealing with changing functions in most buildings that require adaptive reuse, which includes demolition and rebuilding. In some cases, just bringing in new furniture and/or equipment can change the function. The key issues with this method that have to be dealt with include demolishing part of the permanent structure including electrical, HVAC, and plumbing. Adding new wall partitions, electrical wiring, plumbing, HVAC, and new equipment are all elements which need to be redesigned in order for the new function to work. These disciplines can be difficult to deal with, because in some cases, the interfaces between the old and new may not work in relationship to each other.
• **Kinetic Buildings** – These are buildings that move in order to bring about change. There are many different examples of this around the world, and for the most part, most of the buildings are kinetic due to the fact that they have HVAC, plumbing, and electrical wiring that make the building come alive. However, I believe the definition of a kinetic building is a building that dramatically changes according to its environment and/or users needs. These buildings use very advanced technologies to control light, views, and environmental changes a building might undergo. Examples might include mechanized sun shades that protect against heat gain as well as control daylighting.

• **Open Building** - Open building is a practice of design and construction according to analysis of both current requirements and provision for unknown future uses and technical upgrading. The basic elements of open building can be broken down into three systems. There is the primary system, secondary system, and tertiary system. The primary system is the first and base of the latter two systems. The primary system consists of the programmatic requirements such as the structure, cores for services, and main circulation such as elevators and stairs that will be fixed. The secondary system is to be adjustable which can include interior partition walls, flooring, ceiling, building technology such as HVAC, electrical, and plumbing. These systems should be designed in order to be replaced with updated and new systems with interfaces that are inter-connectable in the future. This secondary system should have a life span of nearly 20 years. Once the secondary system has reached an operable level, the tertiary systems are installed. This includes the building equipment that can be moved easily without change to the primary or secondary systems. The tertiary systems are to last for approximately five to ten years. Open building design method takes the approach that many different professions, consultants, and clients/owners will be making ongoing decisions in order to keep the design going. This approach works very well for a program that is very difficult to come to definite programmatic functions, such as a hospital with its ever-changing needs. Using the open building thinking, designers try to anticipate the future needs and plans for those accordingly and to think of a design as an ever-changing piece of architecture. The following is a list of the basic principles of open building:

  • The idea of distinct levels of intervention in the built environment, such as those represented by base building and fit-out, or by urban design and architecture.
  • The idea that users or inhabitants may make design decisions, as well as professionals.
  • The idea that, more generally, designing is a process with multiple participants including many kinds of professionals.
  • The idea that the interface between technical systems allows the replacement of one system with another performing the same function. (As with different fit-out systems applied in the same base building)
  • The idea that built environment is in constant transformation and change must be recognized and understood to enable professionals to be effective.
  • The idea that built environment is the product of an ongoing, never ending design process in which environment transforms part by part.
APPENDIX

Why design for change in architecture?

INO Hospital

INO is a major health care center in Bern, Switzerland. It is a hospital for intensive treatment, emergency care and major surgery. Almost a decade ago, the hospital administration of the INO Hospital decided to embark on a major expansion program adjacent to and connected with the existing center. For seven years, the hospital facilities team failed to settle on a sufficiently detailed program of requirements to enable an architecture team to begin the design process. Each year, a major component of the facility plan changed, because of forces outside the control of the hospital administration. Codes changed, the market for services shifted, new medical technology was introduced, new doctors required different facilities, and insurance standards and standards of care changed. When the decision was made to expand, the traditional idea for developing a program of requirements for hospitals assumed that it was more economical and easier to optimize construction if the “whole” was comprehended at once, with all its dependencies. But very complex buildings like hospitals appeared to be organized for optimal performance on other principles. The “whole” of such complex buildings always seem to come into existence over time, and are evolving rather than static. Facing the prospect of continued difficulties in accomplishing the expansion program following the traditional programming paradigm, the hospital administration accepted the advice of a consultant and completely changed its planning strategy. It ordered an “open building”, with specific and detailed “accommodation capacity” for a range of programmatic scenarios. Its aim was to construct a facility built in such a way as to balance stability and change.
BIBLIOGRAPHY


