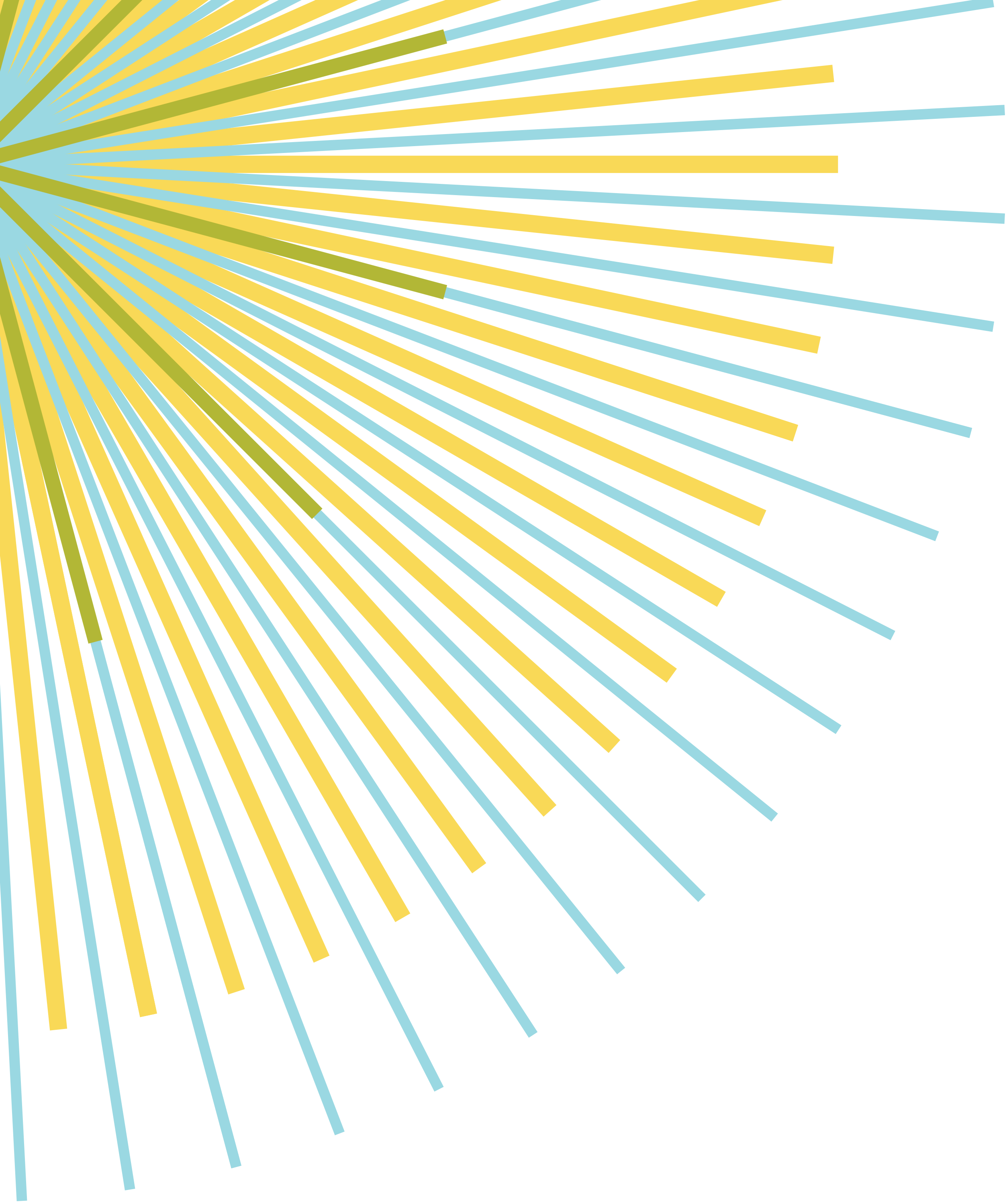

On the Clock

Architecture, Time, Materiality & Energy

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Architecture, Time, Materiality & Energy

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CONTENTS

ABSTRACT

On the Clock is a thesis about time, materiality, and energy. These elements are explored through the perception and understanding of time in relation to the way energy is expended. Time is an unrelenting element that is experienced and used every day; it ages the world around us, including the built environment.

Architects and designers are cognizant of time, but the implications of time are sometimes forgotten. The impact time has on the movement of energy, design, and society affects the way we learn, adapt, and demand from the built environment. Understanding the flow of energy in relation to buildings is vital.

On the Clock starts with an exploration into what time is and how it is perceived. The understanding of time and the way the world moves puts many environments into perspective. The relation of time with architecture shows how quickly the built environment changes. The mass of energy held in a building that exists today can be gone tomorrow because it does not meet the needs of contemporary society, despite the adaptability and ability to reuse the building.

How is time perceived through the built environment? How do we asses the essential parts of energy? What does globalization mean for the built environment and expenditure of energy? What does it mean to create a cycle for energy? Can architects and designers improve and create a new cycle that not only spends but preserves, reuses, and adapts the expenditure of energy?

STATEMENT

The movement of time is unchanging and regimented. The impact time has on the movement of energy, design, and society affects the way we learn, adapt for the future.

The fourth dimension (4D) is known as time; time is a linear element; once it is gone, it is gone. There is no way to re-live or get time back. Architecture is designed to move with time. Designing architecture to move with the linearity of time is unsustainable. As humans age, so do buildings and their functions. Time makes buildings temporary.

Time is an essential element in the process of how architects should think and design. We are taught to design for the future. However, no one can predict the future. As seen over and over, predictions of the future fail. Architects learn to design for function, functions become obsolete as society changes, and so does the building. Understanding the affect and effect time has on architecture is relevant because it changes the way material and energy are used in the built environment.

All around us are examples of circular movement. So why isn't architecture thought of in a circular way too? Are buildings designed as architectural palimpsest? Sure we preserve buildings, materials, sites, and memories. Preservation and adaptation give buildings new life and functions, but how would that change if we thought of buildings as more than just formed by their function. What if buildings were thought of as part of a larger, constantly changing cycle rather than a static thing built to meet the current societal demand?

The purpose of this thesis is to map, correlate, and dissect the history, preservation, and energy of architecture through time. By understanding the past and the decisions made in the present, designing in more energy sufficient and sustainable ways is possible. It moves architecture past the 3rd dimension and into the 4th. Learning and designing to create products and architecture that is adaptable for new functions and meanings is vital to moving forward. What good is a building or any object if the whole reason for existing (the function) becomes obsolete? Everything ages, if designed well and correctly architecture (or any good design really), can stand the test of time.

INTRO

01

- The Topic
- Relevance
- Methods
- Questions

"The world has not suddenly begun to change: it has always been changing, and perhaps no faster today than yesterday. But our attitude toward change is changing..."

- Kevin Lynch

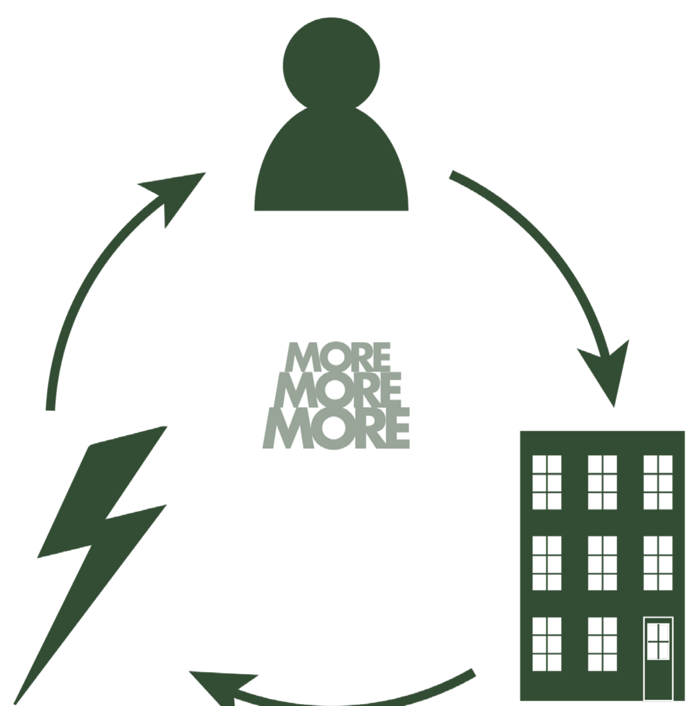


Figure 1.1
The Cycle of More, More People, More Buildings, More Energy

THE TOPIC

The unrelenting movement of time is visually embodied all around us, from the faded paint on the neighbors house to the growth of a tree in the front yard. My research started with understanding time, its dimensional qualities, and its relation to us as humans. I then started to think about how we quantify time in relation to architecture, which led me to materiality and energy. The way architecture has moved on in time is studied over and over again. Questions about where the built environment belongs in today's ever moving world and where architects fit in future society is always a debatable matter. As the population grows so does the demand for architecture and inhabitable space, which grows the industry requiring more moving parts, more moving parts means a higher energy demand. It is like the domino effect, but cyclical in some sense. The cycles we live in exists all around us; we can use time to inform those cycles. When we learn from decisions, it makes us analyze decisions made in the past that affect decisions made in the present which ultimately decide or design the future. Building and planning for the future usually requires an understanding of the potential expended energy and matter required to get us to the future.

RELEVANCE

The relevance of understanding the flow of energy through architecture and materiality today is vital because we need energy to move forward. Without energy, the world around us would quite literally stop, there would be no more physical movement of any machines or even human movement. We operate on energy; the world operates on energy. Energy is accumulated over time. The majority of the energy sources that are expended today take millions of years to accumulate and a matter of minutes to spend.[1] As designers and architects, it is essential to understand how energy is being used in day to day life. Keeping track of energy through architecture is not a new phenomenon, but it is a selective one, and at some point, we will no longer have the ability to be selective. Designing a system that is adaptable to time and the movement of time within a lifespan creates the opportunity for a more sustainable world. No longer spending energy that exceeds our ability to accumulate and replace in a lifespan, but creating energy in the process of spending energy, allows us to create a sustainable cycle.[2] The relationship between time and energy is a unique opportunity to balance the theoretical and the applied.

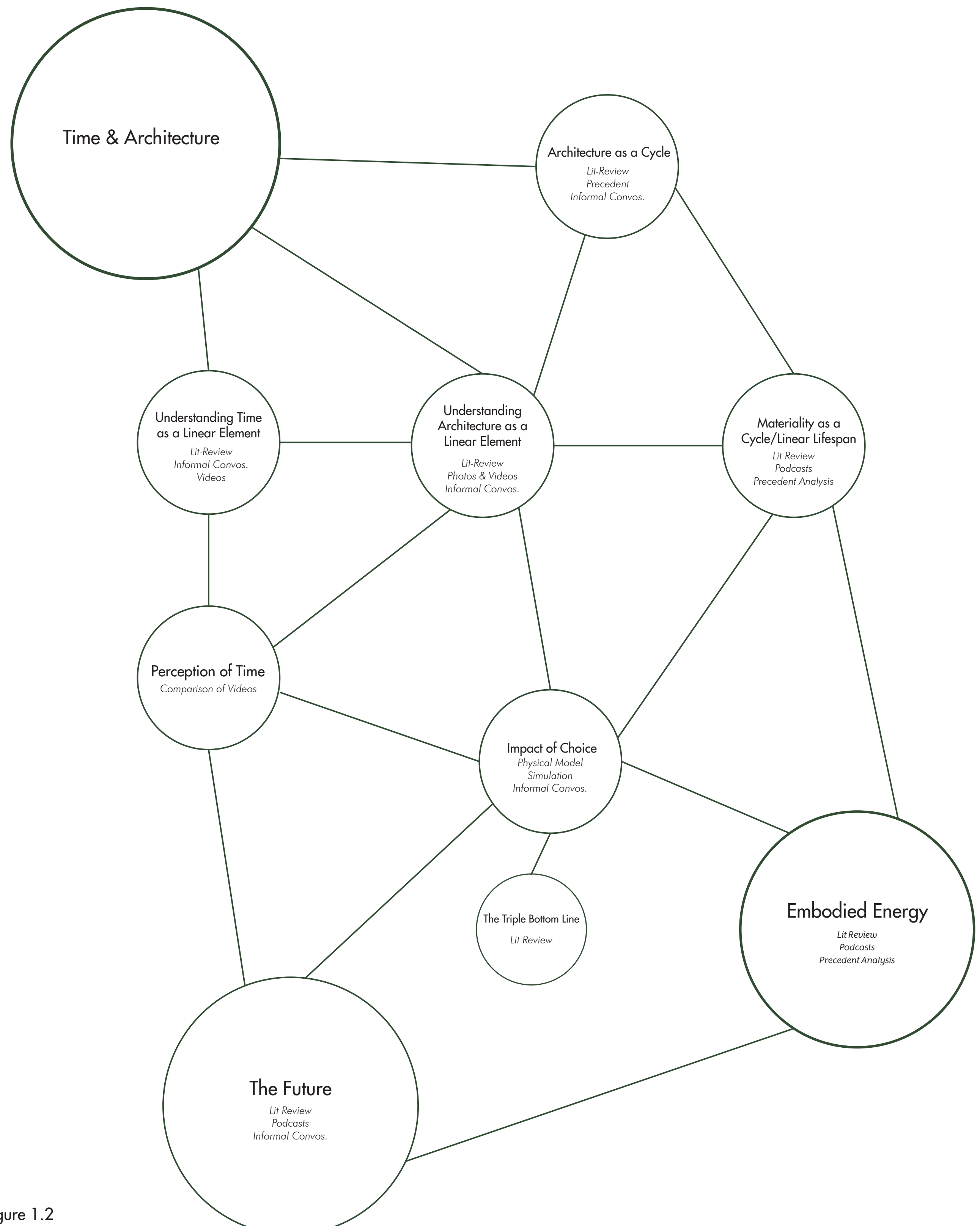


Figure 1.2
Mind Map of Methods

METHODS

Through this research, balancing the theoretical information with the statistical was difficult. The balance of time on an experiential level and an applied understanding was essential to understand how we move through it. Understanding the connection of energy through time needed to be theoretical and statistically based in order to understand the magnitude of it.

QUESTIONS

What does time mean in relation to architecture?

Why isn't architecture more obviously cyclical?

How do past and present decisions affect the future?

How can the linearity of time inform the way we design cyclical environments?

What defines something as "timeless"?

Does the practice of design and architecture progress in a way that accounts for the affect and effect of time?

TIME

02

"Time is free, but it's priceless. You can't own it, but you can use it. You can't keep it, but you can spend it. Once you've lost it you can never get it back."

- Harvey Mackay

DEFINED

Time *['tīm]* : Noun
The indefinite continued progress of existence and events organized by the past, present and future.[3]

> "To be realistic one must always admit the influence of those who have gone before."
>
> *- Charles Eames*

Time is a linear element. It only moves forward. There is no way to go back in time; the past is experienced through documentation and memory of events. The future is set up by the past and present. The present is fleeting; it is made up of the past and looking to the future. A psychological construct we use to help understand the here and now. Time is an element begging to be defined. Philosopher after philosopher has had their say about time and how it affects the world in which we live. We live through time based on our cyclical understanding. However, it is linear; it moves into the future consistently no matter how monotonous hours, days, or years seem.

The physical manifestation of time started centuries ago and has been planned way into the future. The counting of time has been designed and redesigned by societies that no longer exist. Time has been dissected by religion, physics, philosophy, and psychology. Leaders in all of those topics have tried to define the enigmatic element that is time. It is a dimension that has incomprehensible abilities. However, we find comfort in the measurement of it.[4] Architects and designers must learn to work with it and understand the events that have taken place within it.

As architects and designers, we need to learn from the past; it is a step closer to timeless design. When we learn from precedent and take inspiration from the existing, it only progresses design. To acknowledge what has happened before is to build upon the existing. Adding to the existing brings forward new knowledge and ideas. If we started designing and creating without any knowledge from the past (which is nearly impossible), we would never design anything new. Time is a way to acknowledge that which has come before us (figure 2.1).

To make time more understandable and the way our actions take place in time, we commonly break it down into the past, present, and future. As mentioned before, the present is a psychological construct. It is subjective to the topic. To further break down where the present begins and ends, figure 2.2 supports the idea that the present is made up of the near past (five years ago) and the near future (the next two years). Predictions of the near future usually are more accurate because we usually make choices and actions based on the idea of instant gratification; in reality, two years is never that far away. Time and time again, predictions of the future are usually incorrect. Take the 2030 challenge; for example, the net-zero carbon goal for every building built. Today the goal is at 2040; they added ten years because in 2006 when the challenge was introduced, net-zero seemed attainable by 2030.[5]

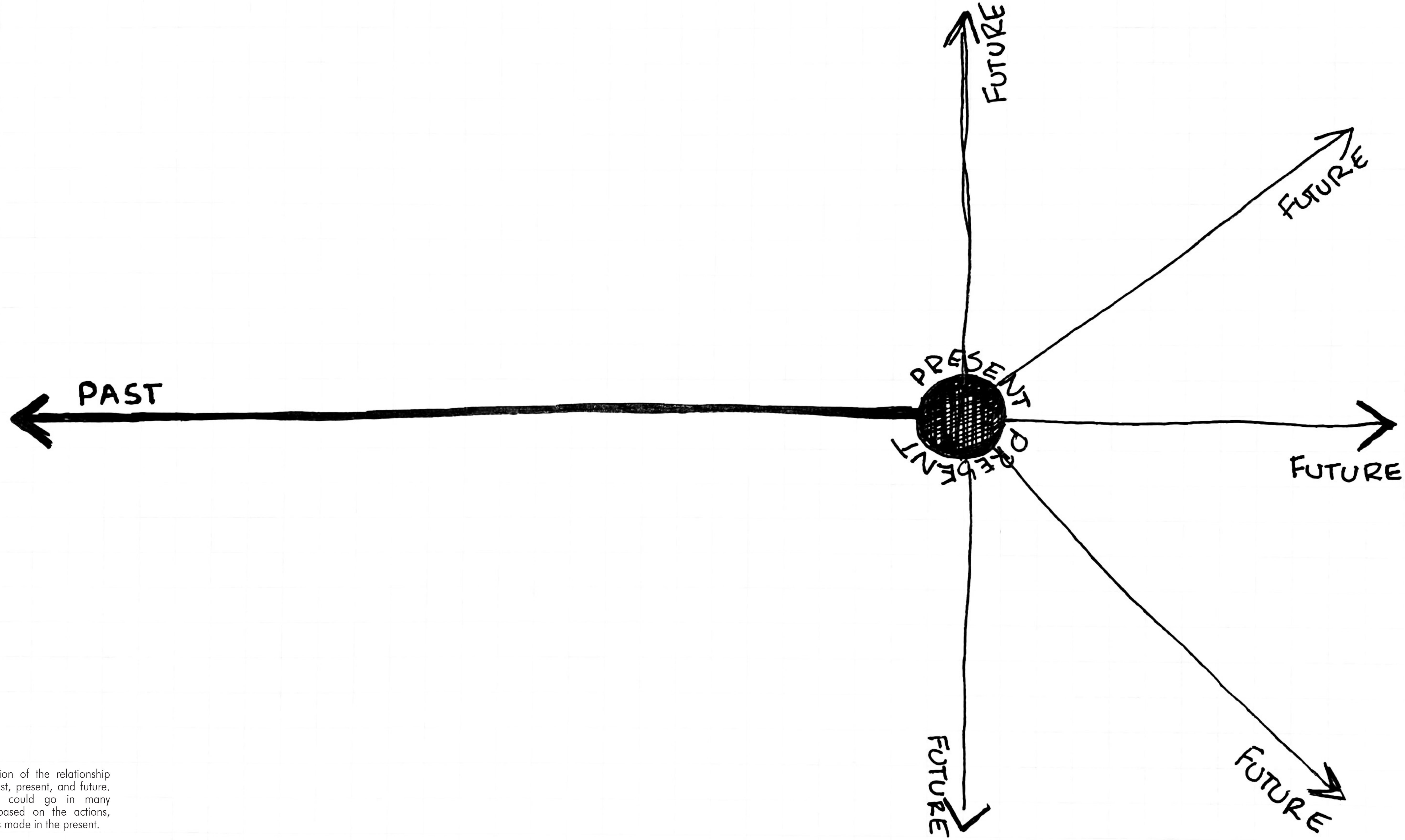


Figure 2.1
Representation of the relationship between past, present, and future. The future could go in many directions based on the actions, and choices made in the present.

Near Past | News Topics

2015
1. Apple to Join DJI
2. Supreme Court Rules Gay Marrage Is a Nationwide Right
3. EPA Accuses VW of Dodging Emission Rules
4. Hot Startup Theranos Has Struggled With Its Blood-Testing Tech.
5. Global Agreement on Climate Change

2016
1. Microsoft to Acquire LinkedIn
2. Britian Votes to Leave EU
3. DNC Hack Prompts Allegations of Russian Involvement
4. Donald Trump Elected President
5. Marijuana Gains at the Polls

2017
1. Dow Closes Above 20000
2. Trump Withdrawls From Climate Deal
3. Amazon to Buy Whole Foods
4. Hurricane Maria Hits Puerto Rico
5. Harvey Weinstein Takes Leave From Studio

2018
1. Xi Era to Continue in China
2. Trump to Impose Steel Aluminum and Steel Tariffs
3. Trump, Kim Begin New Phase of Dipolmacy
4. California Wildfires [largest in state history]
5. Oil Power [US becomes net exporter of oil & fuel for first time in decades]

2019
1. China Lands Probe on Moon's Far Side
2. First Image of Black Hole
3. Hong Kong Protests
4. Pelosi Announces Impeachment Inquiry
5. Google Co-Founders Step Aside

Present | Top Headlines

Iran Crisis
1. Iran Denies It Fired a Missile to Down Ukranian Jet
2. U.S. Announces New Iran Sanctions
3. Iraq Asks U.S. to Make Plans to Withdraw Troops
4. Amid GOP Pushback, Pence Says Sharing Intel with Congress Could 'Compromise' Sources
5. Misinformation Grows on Social Media After Iran's Attack on Iraqi Military Bases

Impeachment
1. Pelosi Prepares to Send Articles of Impeachment to Senate As Soon As Next Week
2. McConnell has the GOP Votes for Trump's Trial Now. That Doesn't Mean He'll Have Them Later.
3. Trump Would Support Witnesses Testifying in Senate Trial if Bidens Were Called

U.S. News
1. Puerto Rico Calls for Special Prosecuter in Ex-Governor's Chat Scandal
2. Protestors Form Flash Mob Outside Harvey Weinstein Rape Trial in New York
3. College Administrator Who Joked About U.S. Cultural Sites Iran Could Target is Fired

World
1. 'Green Revolutionaries': How Sweden Built a Generation of Greta Thurnburgs
2. Meghan Leaves U.K. for Canada after Dropping Bombshell That Has the Royals in Turmoil
3. Australia Races to Strengthen Fire Defenses Ahead of Heat, Wind Later This Week

Near Future | Predictions

Facebook Data
1. Flexitarians, Green Diets, and Green Rooms
2. The Milk Bath
3. POD People
4. Trust (and treat) Your Gut
5. It's Written in the Stars

Politics
1. The Election Will Be Close
2. Republicans Will Continue to Stick With Trump
3. The Democratic Presidential Race won't wrap up Quickly
4. The Fight for Senate Will be Expensive
5. Census Count Will Be A Challenge

Technology
1. 5G Applications
2. Quantum AI
3. Edge Computing
4. Treat Modeling
5. Human Augmentation

Biodiversity
1. Cellulose, for Better and Worse
2. Forests as Fuel
3. Better Buds for Bee?
4. Disappearing Kelp
5. Antartic Ice: a Dark Horse

Economic
1. Maxed Out Consumers
2. Foreign Trade and a Global Slowdown
3. General Business Uncertainty
4. Threat of Higher Interest Rates
5. Growth Still Probable Though

Figure 2.2
These images represent that the present is made up of the near past and the near future. In the near past image the top five headlines are listed along with the corresponding date. The headlines highlighted in black are headlines that we are still talking about or dealing with today. The present image is made up of the top news topics from January 2020. The near future is made up of predictions for the next two years, organized by topic and source.

> "Time is what prevents everything from happening at once."
> *- John Archibald Wheeler*

AS A DIMENSION

Our world exists in three dimensions but moves into the future with the fourth, the fourth dimension being time. We interact with these four dimensions on a daily bases. The first three dimensions determine the space we occupy. The first, second, and third dimensions are determined by the x, y, and z axes. Those axes define the geometry that designers and architects design within. We can manipulate, interact, control, change, and move freely within the space created by the first, second, and third dimensions.

Time is a dimension because it is one thing to know the location, but without the movement of time, there is no way to move through space or know when something happened. Time needs to be a dimension, not just because it can be proven mathematically and through physics but because we interact with it every day, and more importantly, it allows momentum and speed to exist.[6] In relation to the other dimensions, the faster we move through space, the slower we move through time and vice versa. It is a dimension with rules that apply to everyone no matter the speed they move through space.[7]

The fourth dimension gives us the same amount of information that the first three do. The difference is we cannot manipulate, control, or change it in the same way. Without time the way we understand and define the past would be a mess. History and events may have happened; things may be planned, but the critical question is always "When?". We interact with time on a daily bases, we schedule it, we keep track of it, we find comfort in it, but it is unrelenting, we have no way to control or change the movement of it.

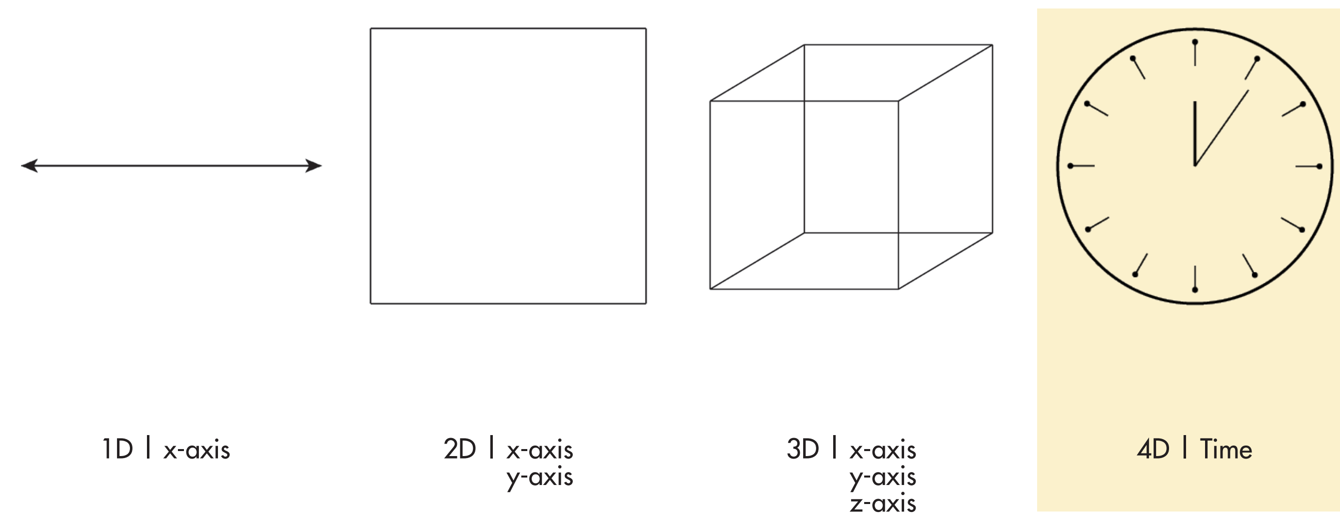


Figure 2.3
A visual representation of the first four dimensions with descriptions of the axes the use.

> "The future is something which everyone reaches at the rate of sixty minutes an hour, whatever he does, whoever he is."
> *- C.S. Lewis*

PERCEPTION

The perception of time changes from minute to minute, hour to hour, day to day, year to year and at some point once someone has lived for a decade, the perception of ten years changes too. The more time we have experienced, the faster it seems to move. How does our perception of time relate to the world around us? The built environment seems to change slowly and last forever, but at the same time, a street-scape can seem to have changed overnight. What does forever mean? The way time perceived and thought about is extremely subjective; it can quite literally change in a second. The feeling of time moving slowly to the notion of not feeling like we have enough of it is a common phenomenon that everyone experiences.[8]

Our perception of time in nature seems to be slowed down compared to the contemporary moving world around us. Psychologically we have an internal understanding of time passage. However, once our emotions are involved, they tend to distort our internal clock.[8] Figure 2.4, is a video of Lake Michigan that has been increased and decreased in speed by twenty-five percent increments. The perception of time changes when the subjectivity of our focus changes. The comparison of a video sped up or slowed down watched in unison shows how nature gives a different perception of time. At the beginning of the videos, there is no perception as to which video is playing in "real-time." The waves rolling in and out, in and out, at all different speeds, does not matter because it always looks natural. Faster or slower, it does not matter because the environments can change in an instant. Lake Michigan can go from being still, calm, and like a mirror to having riptides, murky sediment, and five-foot waves within an hour. Once the point of focus changes in the video, whether it is the camera movement (which is a human motion) or people enter the frame, the speed of the video is revealed. Time perception can be manipulated in some ways through our environments, but for the most part, it is exceptionally subjective to who someone is as a person.

Time perception in space can be altered very quickly by the way space is designed. A stair that has a lower rise but a longer run slows down the pace at which we climb and experience those stairs. If the stair has a higher rise and a shorter run, the way we climb and experience the stairs is at a much faster speed. The perception of time is related closely to our environment and the way we move through space.[7]

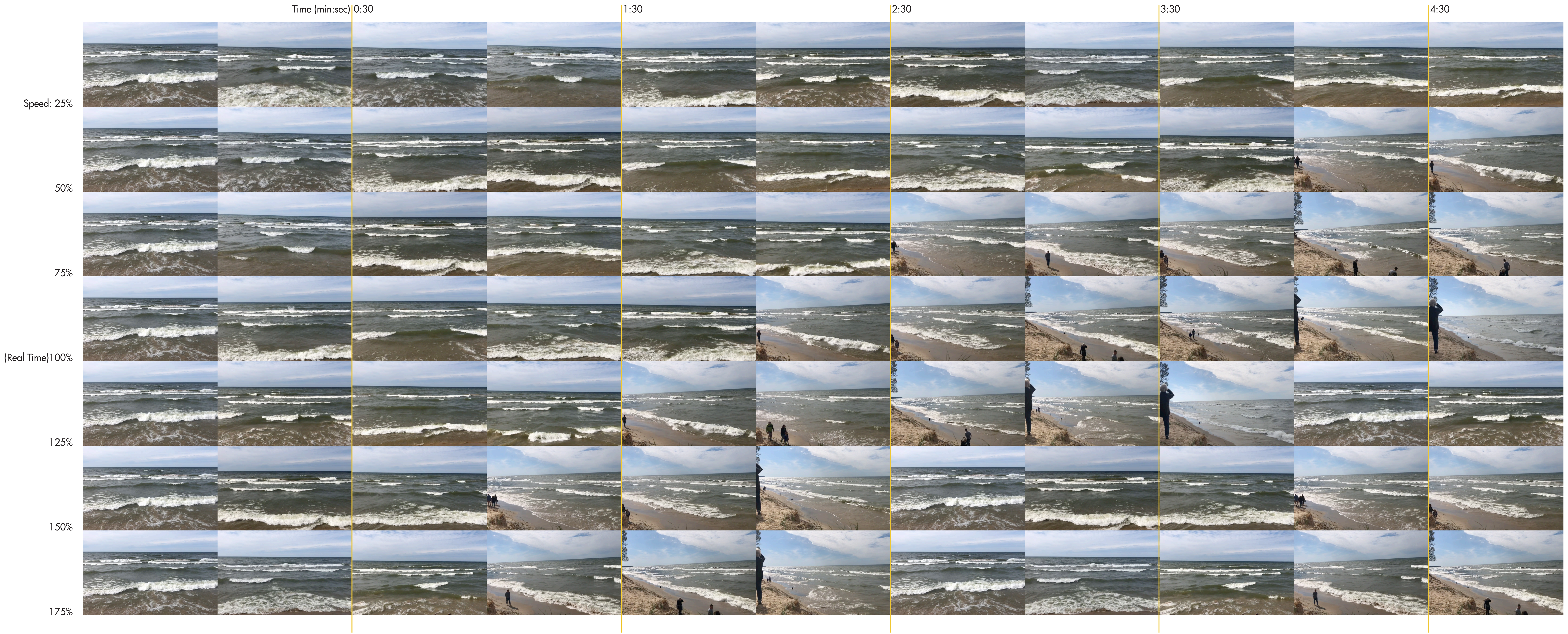


Figure 2.4

This is a static representation of a video that has been sped up and slowed down by 25% increments. The original video is of Lake MI. Every still frame represents the 30 second mark. The columns and rows of still frames show the comparison between time that has been sped up and slowed down. Below is the QR code to the live video.

"Time goes, you say? Ah, no! Alas, time stays we go."
- Henry Austin Dobson

LIFESPANS

Much of our perception of time has to do with the length of our lifespan. The built environment or architecture seems to change slowly and last forever, but it can also seem to change overnight. We all know that buildings do decay and cannot last forever, but if taken care of, they can outlast their expected lifespan. Our perception of architecture can seem elongated because the average lifespan of a building is very similar to that of the human lifespan. In reality, the lifespan of a building is quite short compared to the natural environments we inhabit and experience every day. Figure 2.6 shows that the average lifespan of all these buildings would barely last a quarter of the lifespan in comparison to the lifespan of a Sugar Maple Tree.

What do our generations look like in comparison to the life of a Sugar Maple Tree? Our built environments are nothing compared to the lifespan of the tree. In the process of the tree's lifespan, it is cycling through the ecosystem. Once it dies, it decomposes into the ground so that the next generation of trees can grow. Architecture, on the other hand,if not cared for decomposes, becomes uninhabitable and stays that way. If we are building for our generation, why aren't our buildings cycling through like the natural environments we inhabit?

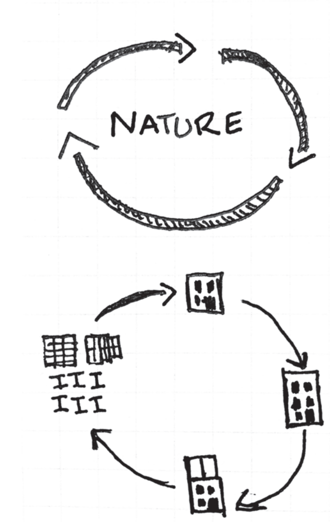


Figure 2.5

Sketch of buildings working in cycles like nature.

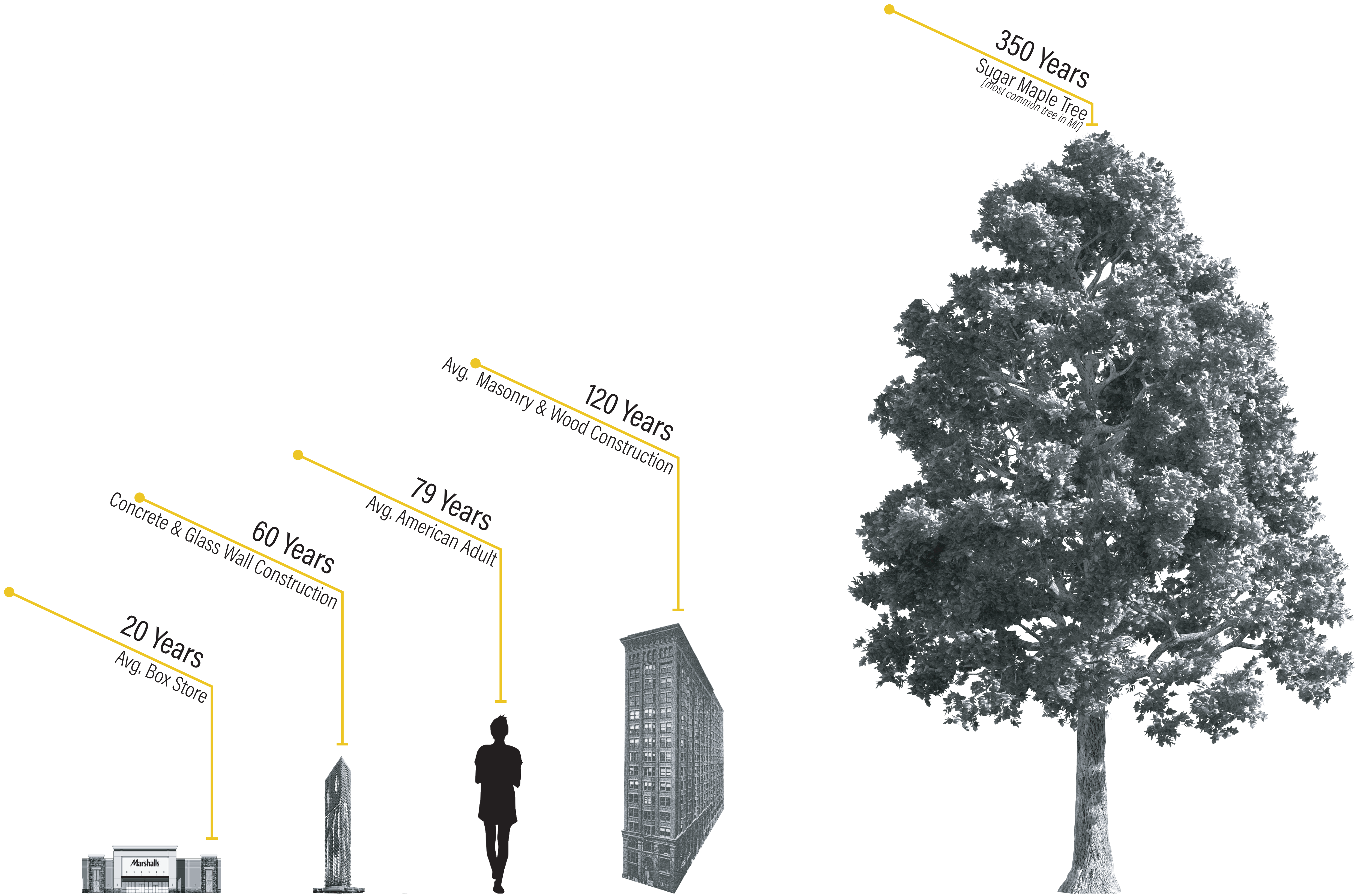


Figure 2.6

Average lifespan comparison between building types, the average American person and a Sugar Maple tree (the most common tree in Michigan).

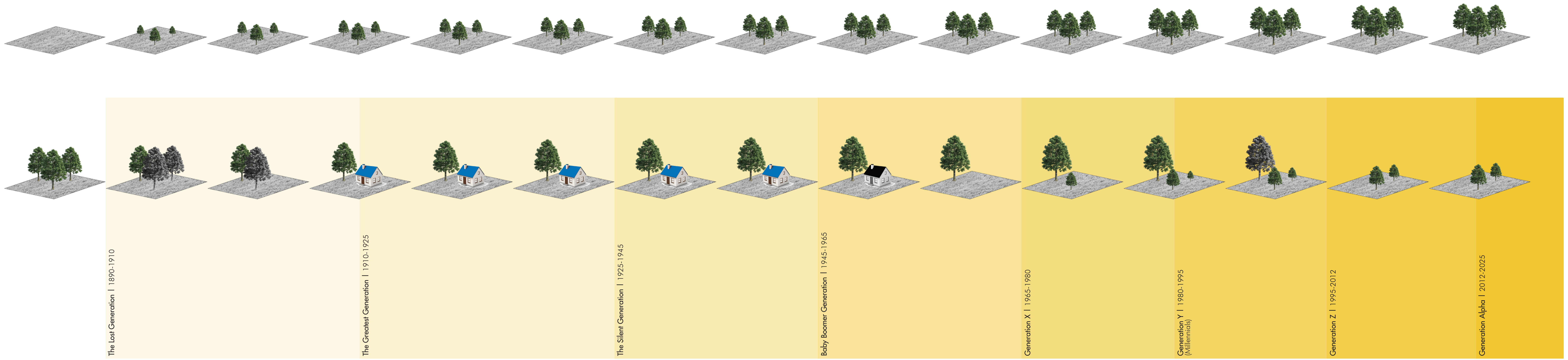


Figure 2.7

Sugar Maple Tree growth & lifespan in comparison to the past eight generations and the average lifespan of a house. Each image represents a decade, the whole chart represents three-hundred years of time.

> "Architecture exists, like cinema, in the dimension of time and movement."
>
> *- Jean Nouvel*

TIME & ARCHITECTURE

The relationship between architecture and time is never-ending. As mentioned before, the built environment is defined by the first three dimensions, and like us, it ages. As the population has grown and the world has advanced, the demand for the built environment has too. In figure 2.8, the number of architectural styles increases as the population increases. Current events influence many of the styles for the time. Like the 2030 Challenge has increased the need and interest in green and sustainable design. The way design and buildings are informed by the current day is marking societal and event history within the built environment. They move through time with us and show history through design. Daniel Libeskind once said, "Architecture is the biggest unwritten document in history."

The movement of time documents the different streets-capes we experience and shows how society has changed. As represented in figure 2.9, the changing street-scape of a small section on Woodward shows that as the city grew and businesses were booming, the buildings grew and changed multiple times within thirty years. Then in the thirties during the depression and unfortunate economic situations, there was very little change, little need for large business buildings too. The amount of information reflected in the changes made in that little section of Woodward is abundant. Architecture is a reflection of society and the times. Granted today, that section of Woodward has not changed much in terms of massing, but the interior and small changes on the exteriors are visually noticeable. As Detroit is starting to get back on its feet, the existing buildings have been adapted and updated to suit contemporary societal needs. Just because those buildings are changing their functional uses or the color of their walls does not mean the history or memory is lost. Traces of architectural palimpsest exist all around us.

Palimpsest is defined as something that was altered, adapted or reused but still bears visible traces of its earlier form. As an example, the School of Architecture at the University of Detroit Mercy shows how traces of palimpsest can be unique opportunities to mark different changes in time (figure 2.10). Some of these changes are so subtle and look like they were initially designed that way, like the interior window that was originally a door.

The physical qualities architecture represents in time is like no other type of documentation. Learning from these changes and how to design for the future can be found in the many little clues existing buildings leave for us today.

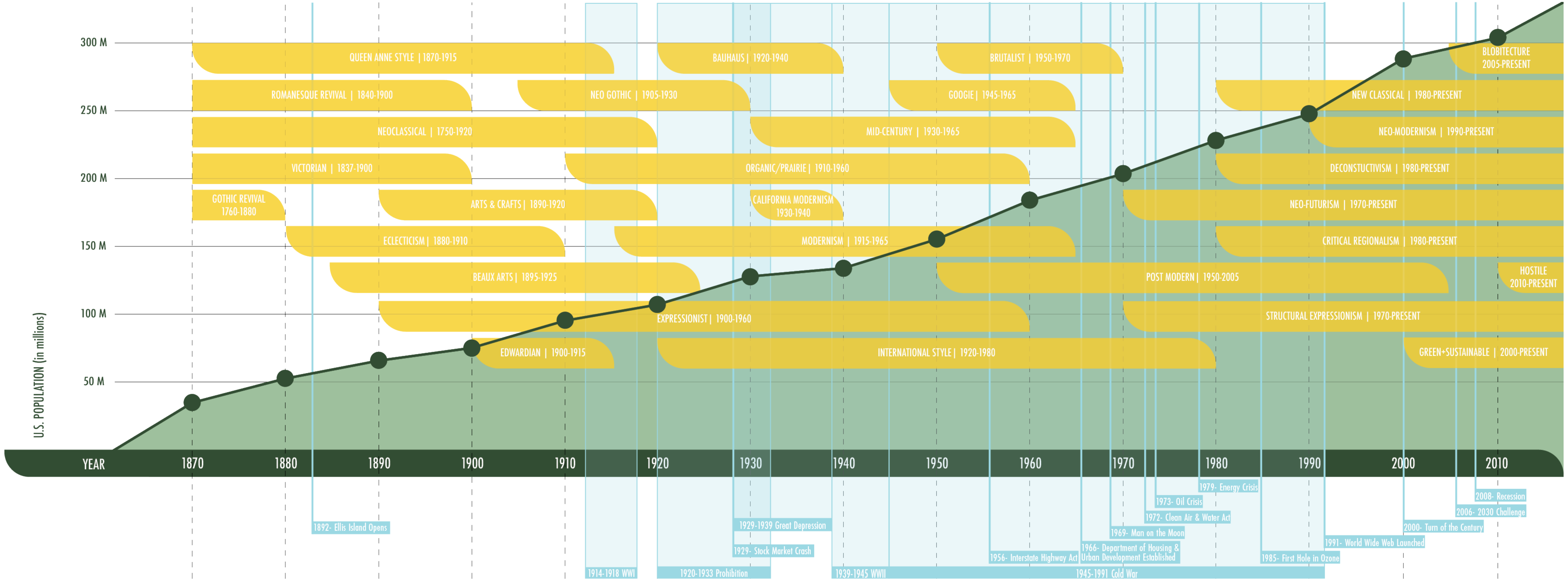
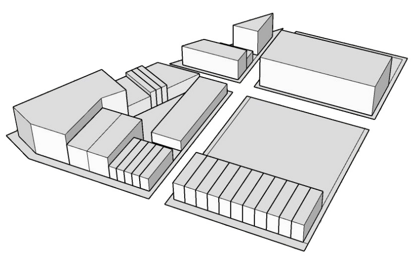
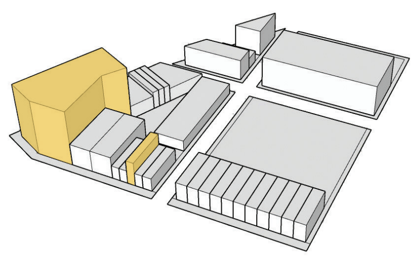


Figure 2.8

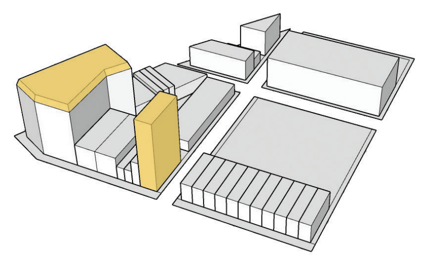
A population (dark green) timeline overlaid with architectural styles (yellow) and a handful of events (light blue. This figure is a representation of things that are happening simultaneously and the fact that they may effect each other.



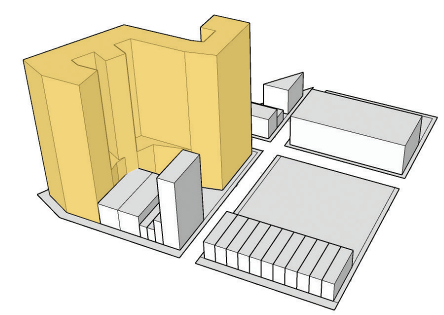
1880



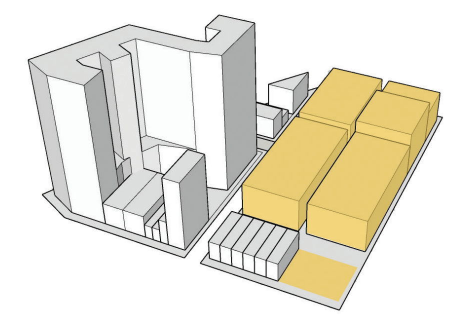
1910



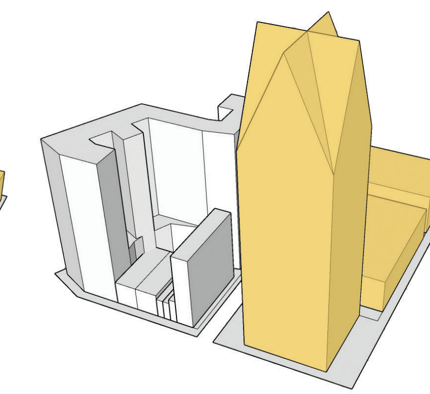
1920



1930



1950



2000

Figure 2.9

The massings of 662-500 Woodward Ave. From 1880 to 2000 the city block has evolved a minimum of six different times to reflect the changes in contemporary society.

ORIGINAL

EXISTING

Figure 2.10

Examples of Architectural Palimpsest through out The University of Detroit Mercy's School of Architecture building.

03

MATERIAL

"The strength of a good design lies in ourselves and our ability to perceive the world with both emotion and reason."

- Peter Zumthor

DEFINED

Material *[məˈtirēəl]* : Noun
The matter from which something is made.[3]

Material is an essential part to the dimensionality of Architecture. It is the smaller physical part that makes up the vertical and horizontal planes that define the space we inhabit. We experience material mainly through touch and sight, but our other senses interact with it too. The sound it makes when someone walks by, the smell it emits when it gets too hot are all ways we experience material, and it adds to the way we experience architecture. Material is what makes the foundation and structure of buildings exist. It is also what makes them visually pleasing and can denote the style of architecture a building is. We rationalize the choice of a material based on aesthetics, performance, availability, cost, etc. Materials are a way for us to balance the emotional and logical. The amount of information we can gain from materials is exponential.

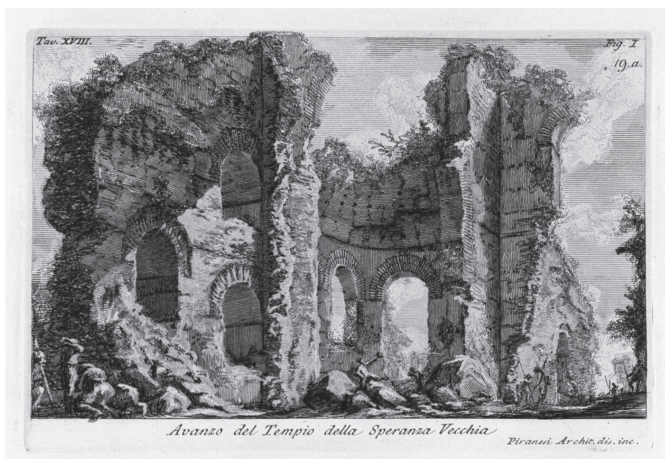


Figure 3.1 (left)

An etching by Giovanni Battista Piranesi of Temple of Venere and Cupido in Rome. Circa the 18th century, A.D.

Figure 3.2 (right)

A painting by John Armstrong depicting a cathedral in the Spanish war. Even though the church is decaying on the outside, it is still resilient on the inside. Circa 1940.

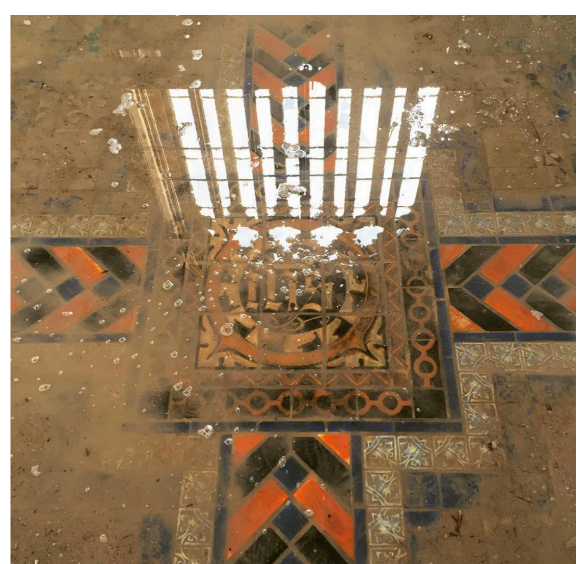


Figure 3.3 (left)

A watercolor by Joseph Mallord William Turner. The Tintern Abbey was painted to show the tension the ruins conveyed for the people at the time. Circa 1792.

Figure 3.4 (right)

A photo of St. Agnes Church in Detroit, MI. The floor is flooded reflecting the light through the cathedral windows. Taken in February 2016.

MANIPULATION OF TIME & PLACE

The manipulation of material through time and space is usually rooted in aesthetic choices and nostalgia. Materials reveal the effects of nature through time; this is commonly referred to as weathering or aging of a material. Naturally, the aging or weathering of material can take years or even lifespans to express visually. We have an obsession with looking at our buildings in decay, we romanticize and document it extensively.[9] This is not a new phenomenon either.

Although we cannot manipulate time in a literal way, that doesn't stop us from trying to manipulate the effects of it through materiality. Not only do we try to replicate the effects of time and weathering through photos, paintings, renderings, and preservation, we try to physically replicate the visual appearance of weathering and time through materiality. In some sense, material is the closest we get to the manipulation of time. Intended aging, synthetic coatings, and protective measures used to keep materials from aging or aging to a certain point is a common thing today. Choosing materials from non-local places is not a problem, but what does it mean to bring them from other places? The attempt to manipulate time and place through materiality has created the contemporary built environment we live in today. The connection of time, site, and architecture will always be a way to inform the future, whether it is from a scientific approach or a theoretical one.

The interest and quite honestly, the obsession with architectural ruins and the poetic historical stories they convey have created a hybrid architectural style of the contemporary and preserved.[9] Further expressing the idea of architectural palimpsest. The old juxtaposed with the new is a symbol of what has stood the test of time.[10] Through the appreciation for the past, the visual connection made with weathered material has increased the trend for it. "…the notion of aging as enhancement and the idea that the various markings and layers of a surface record and allow one to recollect earlier stages in the history of a building and the human life associated with it."[10] To achieve this effect, we age materials with purpose and try to pause that ideal moment of tarnish or history in time. Take copper oxidation for example, as seen in figure 3.5, there are many different colors, and visual textures copper gets through exposure to the atmosphere. The blackest of black taking up to seventy years to achieve, but in a lab, it takes only twenty-four hours. That is an example of time manipulation through materiality.

The manipulation of time through materiality is one thing

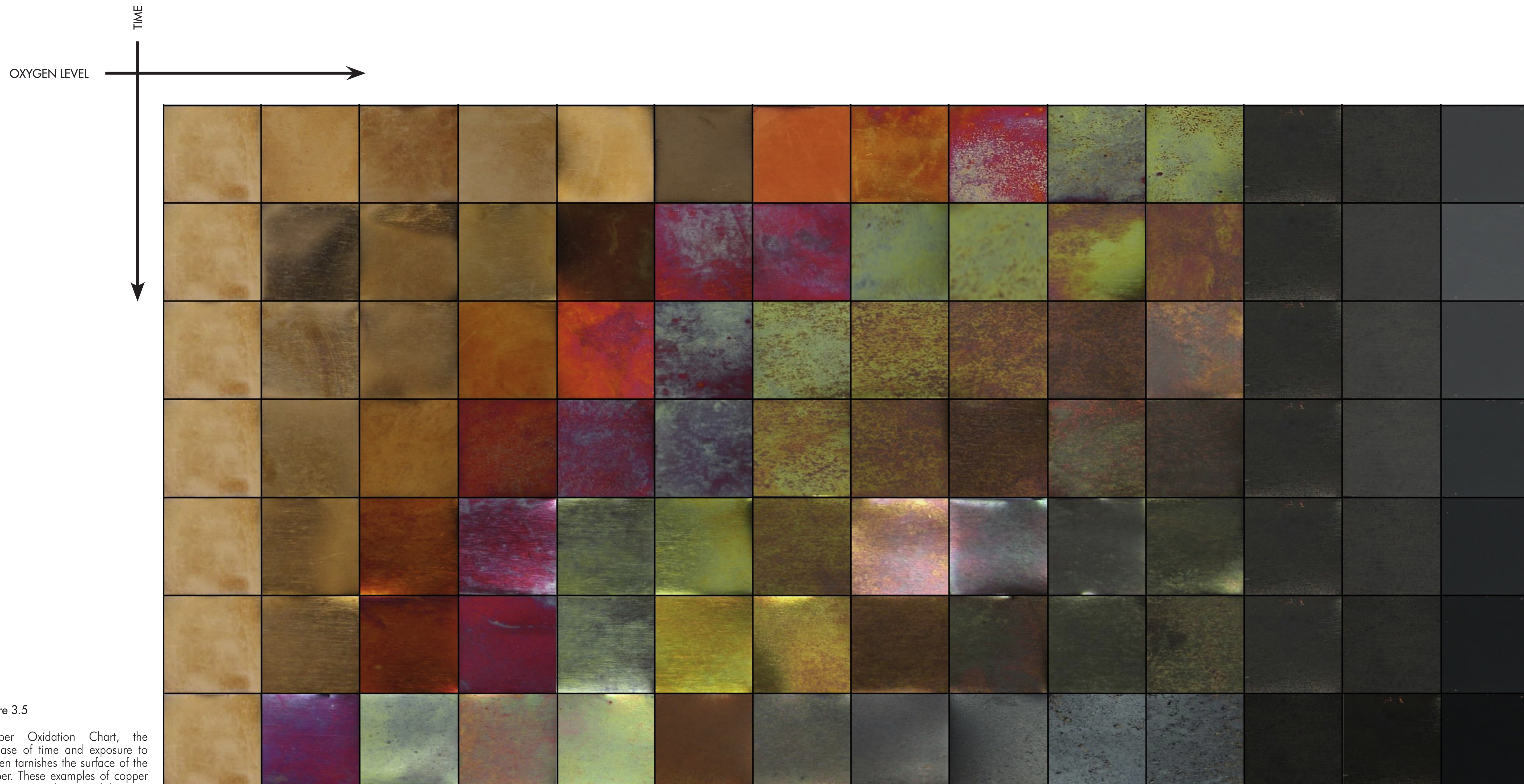


Figure 3.5

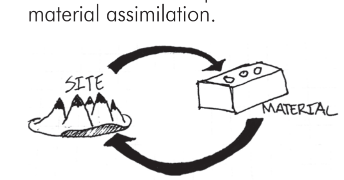
Copper Oxidation Chart, the increase of time and exposure to oxygen tarnishes the surface of the copper. These examples of copper oxidation were done in a lab.

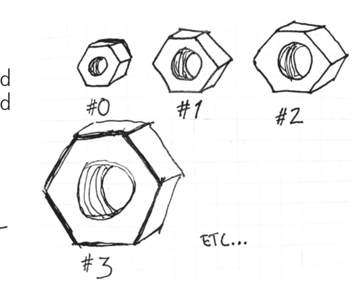
but the manipulation of place through time is another. Globalization has an impact on the way material is perceived today. The trendiness of material can lead to homogeneous built environments all over the world. Trends drive up the demand for that material even if the specialty of that material is locality. It is a cycle of local to global and vice versa. The mass production and globalization of material in some sense, removes the uniqueness of the material. "While mass production would eliminate the dominance of cabinetmaker's furniture, it would also result in the lamentable loss of good craftsmanship…"[10] The way we construct today is very controlled. There are specs for everything; it is like a factory. The building industry is operating through global supply chains, landscapes, machines, and logistics. It is not designed for the human scale anymore.[11] With the contemporary machined culture for the production of material today ages materials differently. The touch of the craftsman is no longer there, an element that added to the uniqueness in the age value of a material.

The weathering of material has to do with the location of the material. A material that makes up the facade of two buildings, one located in Arizona and one located Michigan will weather accordingly in different ways. Materials that are mass-produced for all sites and landscapes are not possible in reality. Wood cladding on a building where the weather is more humid with less heat does exponentially better than a building with the same cladding in a climate where the weather is dry and hot. The weathering of a material is directly correlated with its location; the cross-contamination between the two is material assimilation."The use of the same technologies throughout the world does not always take the uniqueness of places into account."[10]

Figures 3.6 & 3.7

Sketches representing "machined construction"/mass production and material assimilation.





MATERIAL LIFE CYCLES

Like us, materials age with the passage of time, and it can visually show. The aging or obsolescence (more importantly) of material usually leads to the end of a cycle. When the material reaches the end of one cycle, most often, it begins a new cycle. The new cycle depends on the location of the material and what matter it is comprised of. A material can go through a whole new cycle that is referred to as the second life, third life, etc. or it can end up as waste in a landfill and start a decomposing process, if it even has one. Materials can go through cycles of reuse, repair, and remanufacturing (recycling is a component of remanufacturing).

"In this sense, waste was seen for centuries as something specific that neither belonged to the family of natural resources nor to the one of finished products. Waste was a by-product, unable to be categorized in our dialectic understanding of raw vs. configured."[13]

Planned obsolescence is the idea that things are designed and produced with an end date. With the industrial revolution came our ever-quickening society, along with the mentality of "what's next?" The introduction of technology only quickened our society and made the demands for what's next more important. In order for us to keep up with this pace, we need a reason to buy new. Why not make sure the thing becomes obsolete and plan for that obsolescence, hence the idea of planned obsolescence.[12] That's when the next problem comes. What happens to all the things and materials that are no longer needed but have become obsolete? They become waste; it is not a newfound fact that humans create a lot of waste. "But as modern engineers and designers commonly create a product now, the item is designed only for its first use, not its potential next uses after it breaks, or grows threadbare or goes out of fashion, or crumbles." [12] Not all material becomes waste, and most times, with a little more effort, material can go through another cycle of use.

Waste is defined as the elimination or discard of a material, substance, or byproduct that is no longer useful or required after the completion of a process. Humans create, they create goods, and they create waste. The interesting thing about waste is that it has always been a thing societies have had to deal with.[13] It is also quite closely correlated with the growth of the population and cities. "As populations grew, people lived closer together in cities and towns and generated more waste."[14] The difference today is the amount of inorganic waste we create vastly outweighs the organic waste. Inorganic waste needs to be broken down again and

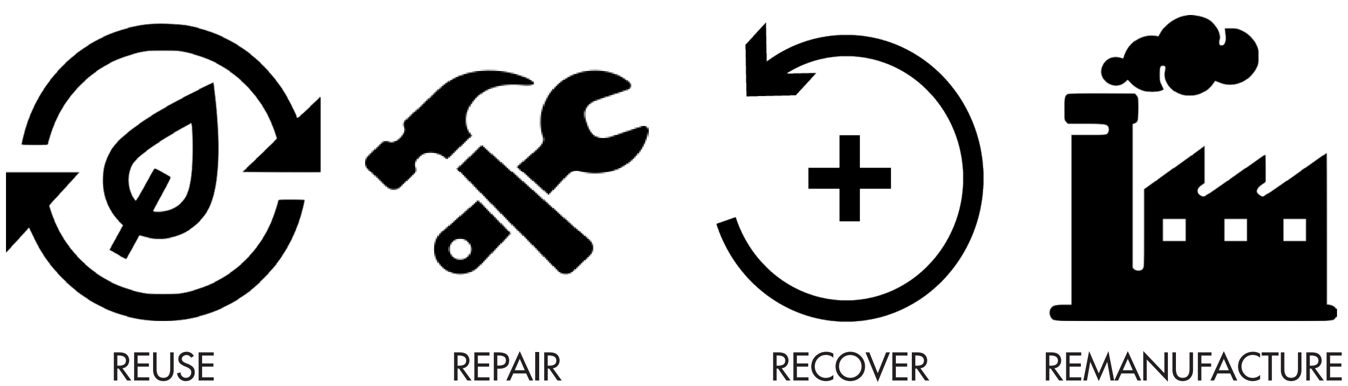


Figure 3.8

The four R's of product life cycles in relation to the idea of circular economies. The four R's of product life cycles were defined by Walter R. Stahel, a pioneer in sustainable thinking.

reused, repaired, or remanufactured; otherwise, it ends up in a landfill.[12] We have built whole systems around getting rid of waste. Much of the way we plan and design cities and architecture today is revolved around light, airy, healthy environments. Essentially out of sight out of mind mentality introduced with modernest design and architecture. "… following a strategy that uses architecture to form barriers or borders to separate human beings from their own waste." [13]

However, the more compelling fact about waste is that it is an integral part of society and has been since before Christ. Archaeologists have found evidence that the Minoan people (circa 1500 B.C.E.) had dump sites for their waste, they would dig large pits to throw their waste in and then cover it with Earth.[14] Sounds like a similar process we have today, except we fill our landfills with more inorganic material. Even more compelling is the fact that waste is a potential source of energy. It seems as though we are just realizing the potential waste can supply us. Starting to understanding how waste can be reused, repaired, recovered, or remanufactured is the first step in utilizing the energy wasted material holds.

Material life cycles are not all equal; it really depends on the matter a material is comprised of. Starting with recycling, it's not as great as we originally thought. However, it is a big step up from a landfill. Glass and Metals can be recycled over and over again. Materials that are fiber-based (plastics, fabrics, paper, etc.) can not be recycled over and over, which is why recycling is not the answer to sustainability.[15] The more times a fiber-based material is recycled, the more damaged and shorter the fibers become, at some point, the material can no longer be recycled again. The quality of a fiber-based material that is in its second life is not as high as it is in its first life. Recycling is great when materials can be remanufactured, but some materials have a limit to that recyclability. Not to mention, recycling requires energy, and not all places have strong recycling programs.[12] If a material can be reused or repaired before being recycled or remanufactured, that would be ideal. Recovering a material is interesting because it essentially means the material is being used for something else like creating energy (if it is combustible), or making compost. It is essentially when a material has been thrown away as garbage but is being used or processed in different ways. Many times it is the passing along of energy when a material is being recovered.[14]

Figure 3.9

Hannover Principles of Design, published in 1992. They provide a bases for thinking about sustainable design. They defined the three P's, People, Planet, and Profit. List distilled by the book The Upcycle.

HANNOVER PRINCIPLES OF DESIGN

1. insist on the right of humanity and nature to coexist
2. recognize interdependence
3. respect relationships between spirit & matter
4. accept responsibility for the consequences of design decisions
5. create safe objects with long term value
6. eliminate the concept of waste
7. rely on natural energy flows
8. understand the limitations of design
9. seek constant improvement by the sharing of knowledge

Figure 3.10

A map of combustible and non combustible materials from the book, Architecture and Waste: A (Re)Planned Obsolescence, page 61. WtE stands for Waste-to-Energy. This diagram represents all the materials where energy could be recovered from.

INVENTIONS

The built environment around us is adapted and updated to suit inventions of new tools and technology, produced, designed, and used over time. Creating an interesting tension between society and the way architecture responds to it. The need for more space, more wiring within walls, the way we design, or determine construction details is all rooted within the past and present. The mechanization of architecture is the production (or assembly) line of construction. The introduction of contemporary plumbing, electricity, etc. has really increased the demand and need for smaller and larger parts to be easily replaceable.[10]

Not only does society respond to new inventions, but it also inspires and pushes for innovation. Take the rise in sustainable architecture; the need to meet "net-zero" by 2030 has pushed the innovation and engineering of materials that perform better in terms of operational energy. More engineered materials means more cross-contamination of raw material. The cross-contamination of raw material is much harder to recycle and break apart or recover.[15] However, with new inventions come new opportunities, as a society, we can choose to buy and make better materiality choices. The way society and inventions influence each other is incredibly important to the way we choose to move into the future.

Figure 3.11

List of inventions that have effected the way we design and build architecture.

Figure 3.12

The light bulb changed the way we interact and experience a space. The invention of the airplane created the demand for an entirely new building and site plan. Aerated concrete gave us the opportunity to build lightweight concrete structures and inspired a new style of architecture. Optical fiber had no major use until recently. Today, it is buried underground in order to bring high speed internet to buildings. These are just some examples of the way we respond to new inventions and the demand for new inventions responds to society.

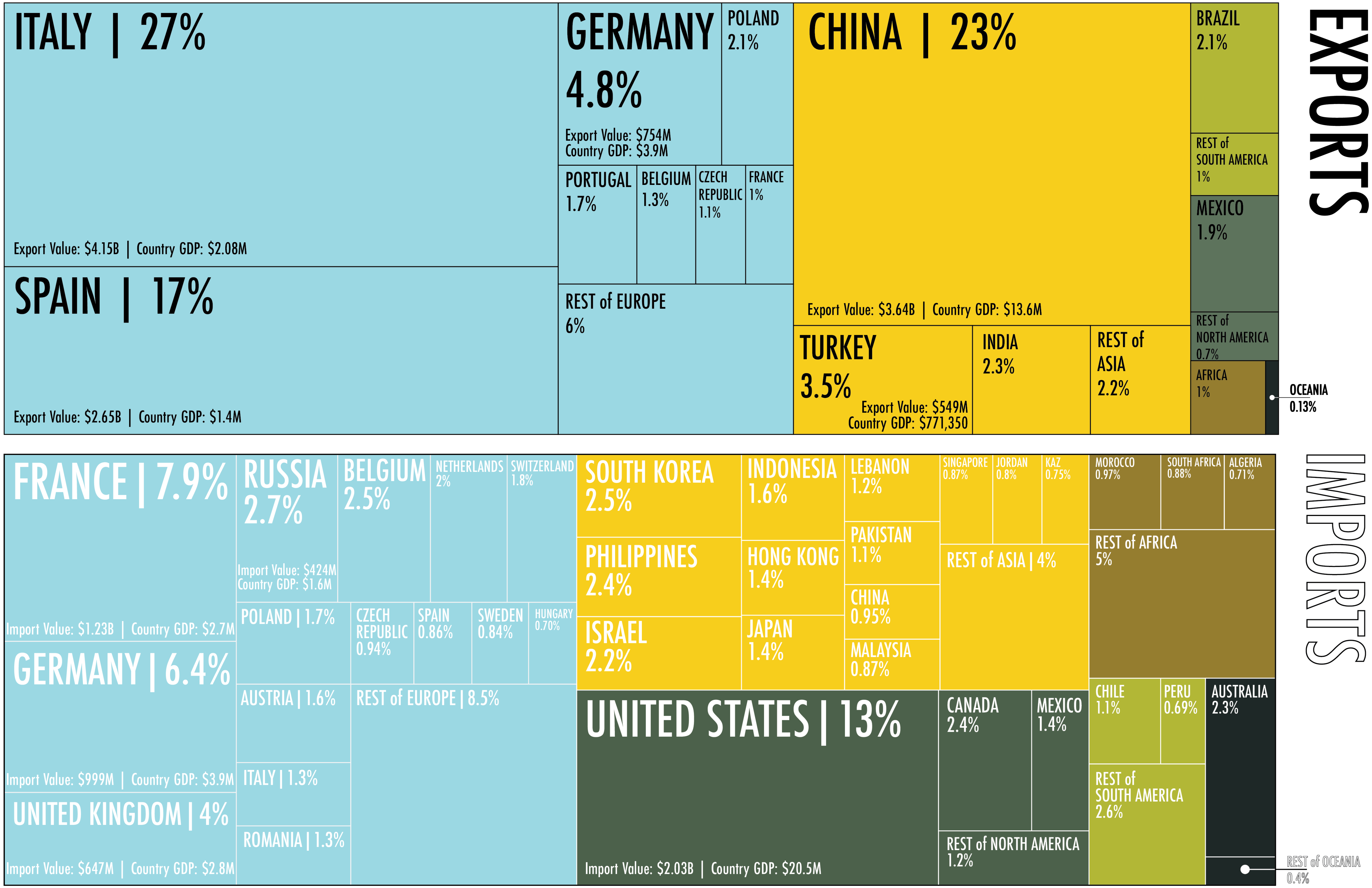
IMPORTS & EXPORTS

The introduction of new tools and technology into society has increased the need for globalization and the ability to access different materials. With the increase in demand on material, changing architectural styles, and globalization, the import and export industry of building materials is operating on an economic platform valued at 15.6 billion dollars.[16] 120 years ago, we wouldn't have had access to materials like we do today. The US is the number one importer of building materials and doesn't even rank annually in the top 15 exporters.[16] With the increase of globalization; we can get materials from the most remote spots. Whether engineered or natural, any material we please can be local with a little shipping. The rise of globalization, advanced technology, and the movement of building materials has increased the embodied energy of materials.

Figure 3.13

The current economic value of the import/export building material industry is $15.6 billion. Many of the highest importing countries don't even rank in the highest export countries. The top five export and import countries also have the import value and the country GDP to help understand the value of the percentages and how they relate to the overall GDP of that country.

The graphs are broken down by continent...
Yellow= Asia
Light Blue = Europe
Dark Green = North America
Light Green = South America
Light Brown = Africa
Dark Blue = Oceania



ENERGY

04

"Our jobs as custodians on this earth at this point in time is to keep moving energy forward. Without it life cannot exist."

- Unknown

"If you want to find the secrets of the universe, think in terms of energy, frequency and vibration."

- Nikola Tesla

DEFINED

Energy *['enrərjē]* : Noun
Power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines.[3]

Energy can be a simple thing, and it can be a very complicated thing, either way, it is very vital. Our fascination with energy is much like our fascination with time. The difference is that we can accumulate, transfer, and manipulate energy in a way time cannot be. We learn about energy in grade school and with it how the world works at an elementary level. Energy is how we have built the world around us; we have learned how to store it and use it to survive. It has created the advanced world we live in today and will continue to be an element of innovation and learning.

> “Energy cannot be created or destroyed, it can only be changed from one form to another.”
>
> *- Albert Einstein*

ACCUMULATION OF ENERGY

The accumulation of energy is closely related to time. Without time there would not be an opportunity for energy to accumulate. There are many different sources of energy, chemical-based, or natural-based; they all need time to accumulate, some more time than others. Energy can be accumulated in one source but then needs to be refined, or the form needs to be altered in order for the source to use the energy. The alteration of the energy form allows for the accumulation of energy in other sources, typically sources that will spend it.

Sources of energy are either renewable or non-renewable; non-renewable sources of energy power most of our energy demand today. Oil, in terms of fuel, is estimated to power eighty percent of the world’s energy needs.[17] The accumulation of potential energy in the fuel is the decomposition of prehistoric plants and animals. It has taken millions (more like hundreds of millions) of years for oil to be what it is today.[1] Coal is another source of energy that requires millions of years to form.[1] These sources are considered non-renewable because, in order to replace them, it would take lifespans into a future that we have not even been able to conceptualize yet.

Renewable sources of energy like solar, wind, or hydro can be accumulated in much, much, much shorter ranges of time compared to non-renewable sources.[2] Using renewable sources at a basic level has always been around. Wind is a common source that has been used to create rotational energy for a long time. The problem is, it is inconsistent, there has to be wind in order to get energy. It works great in some landscapes but not as consistently well in others. Hydro energy is another form of energy that has been around for centuries, powered by the movement of water. Solar power is a source of energy. We are just learning to harness for more than its heat. Just like our understanding of harnessing energy from non-renewable sources has grown, our understanding of how to harness more energy from renewable sources has grown too.

The knowledge we have gained about how to obtain, manipulate, and harness energy has radically grown and changed in the past twentieth and twenty-first centuries. It is not an uncommon thing to hear in the news today about the environmental impacts burning, drilling, and mining, non-renewable sources of energy. Those impacts are putting pressure on our ability to harness, store, and become more reliant on renewable sources. The biggest problem we have with using non-renewable sources is that by burning them,

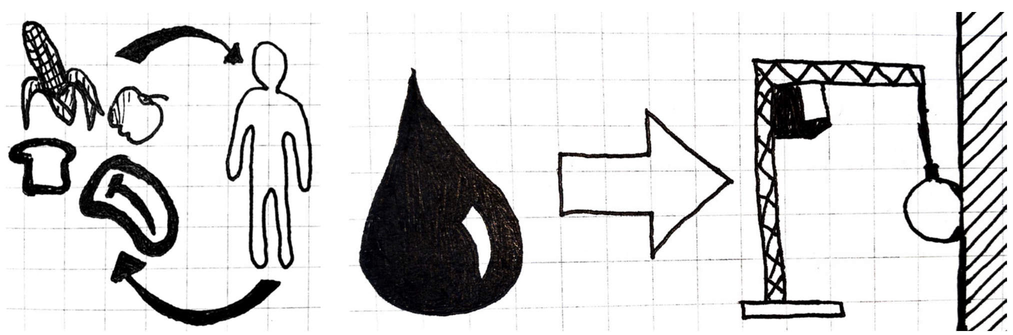


Figure 4.2

A couple of sketches showing where we get our energy source from vs. machines. However, it takes people to operate machines. That means machines today need two energy sources to operate, both the renewable and non-renewable.

we have no way to recapture that energy.[18] It is a dead-end cycle, essentially once that energy has been released in a different form (in this case, greenhouse gases), there is not a way for us to recapture that energy yet. Not all sources of energy are equal; some energy sources go much further in terms of the energy they produce than others. If the same amounts of coal and oil are burned, oil will produce more energy than coal will. Both of those forms will produce more energy than solar energy with the technology we have today.[18]

The way we transfer energy between sources is when it gets much more complicated. The transference of energy is when energy changes form so it can be used. Energy transference in terms of organic and natural processes is much more straightforward than non-renewable chemical-based energy sources. The most common example of this is photosynthesis. Photosynthesis is how the natural world grows around us. Plants use the heat and radioactivity of the sun as energy and a food source to grow. Plants then produce food, a vital source for animal and human life. Plants are the middle man between us, and the energy sun provides for us. Chemical-based energy sources need to be mined or drilled from their place in the ground or landscape, taken to a refinery, refined and then combusted in some way for the energy to be released.[1] The process of refining and converting non-renewable sources of energy into forms that can be used for engines and electricity is much more intensive; it creates toxic wastes that are usually buried somewhere. Renewable sources of energy feed back into a natural cycle, non-renewable sources do not, but they can harness much more energy from non-renewable sources than renewable ones.

Materials, humans, machines, everything requires energy and accumulates energy through different sources some, more similar than others. Architecture and our built environments require a lot of accumulated energy; most of that energy is not from renewable sources. Energy use is broken down into five sectors, industrial, transportation, residential, commercial, and electric power.[19] The top two sectors that use the most energy are industrial and transportation, two vital parts to architecture. The way a built environment is designed impacts the amount of energy that a building or house needs. Meaning, architecture impacts and is impacted by all five sectors of energy use. Understanding the movement of energy through buildings and architecture is vital to building for the future.

Figure 4.1

A sketch representing the use of energy and release of it into the world. It exists still but, where?

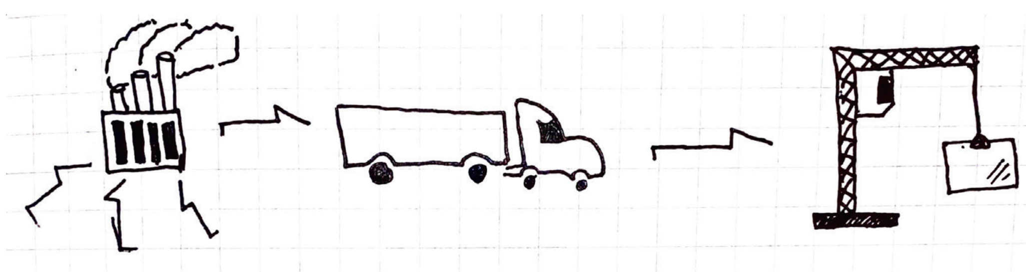


Figure 4.3

A sketch to show a few elements a material might go through and where some of that embodied energy needs to be accounted for.

EMBODIED ENERGY VS. OPERATIONAL ENERGY

Buildings contain and use energy; the accumulation of energy in buildings is known as embodied energy. The energy buildings use is known as operation energy. Both are important to keep track of, yet we really only account for the use of operational energy. The drive to have buildings reach operation energy usage of zero has driven up the energy embodied in buildings.[20] This effect is called "green-washing" also is known as "ecologism." Green-washing is are mandates and measures put into place by governments with the intent to help the environment or be eco-friendly.[2] Documenting and measuring embodied energy is just as important because it documents more than just the temporary usage of a building. It adds another dimensional quality to the use of energy through building. "Rather than only accounting for operational energy, embodied energy registers the longer life cycle of a material or construction."[20]

Operational energy (OE) is the energy a building uses. The reduction of operational energy use in buildings and quite honestly anything and everything that uses energy has been a huge focus. It is assumed that a building's operational energy can account for 80-90% of the building's energy during its use. [21] A building's operational energy at one point may have surpassed its embodied energy. However, today with the progression of energy-efficient appliances, light bulbs, HVAC systems, and other things, the operational energy of a building has gone down quite a bit (figure 4.4).

Embodied energy (EE) is the calculation of non-renewable energy used to acquire, mine, produce, manufacture, transport, construct, dismantle, and decompose or get rid of the material.[22] It is complicated to quantify embodied energy because it is intangible in a way operational energy is (such as turning on the lights, feeling the hot and cold air).[20] One of the biggest problems with accounting for embodied energy is the fact that the government does not acknowledge it as something important. "Energy is always consumed, and selective accounting cannot rewrite this most fundamental law of the universe." [20]

Embodied energy is an important thing to start measuring. It is part of a bigger globalist view, especially as the world becomes more interconnected. Merely dismissing it will not make it go away. Energy is quite literally all around us; once something is thought about in terms of each component used to create it, and how each of those components got there, the impact of embodied energy can be realized.

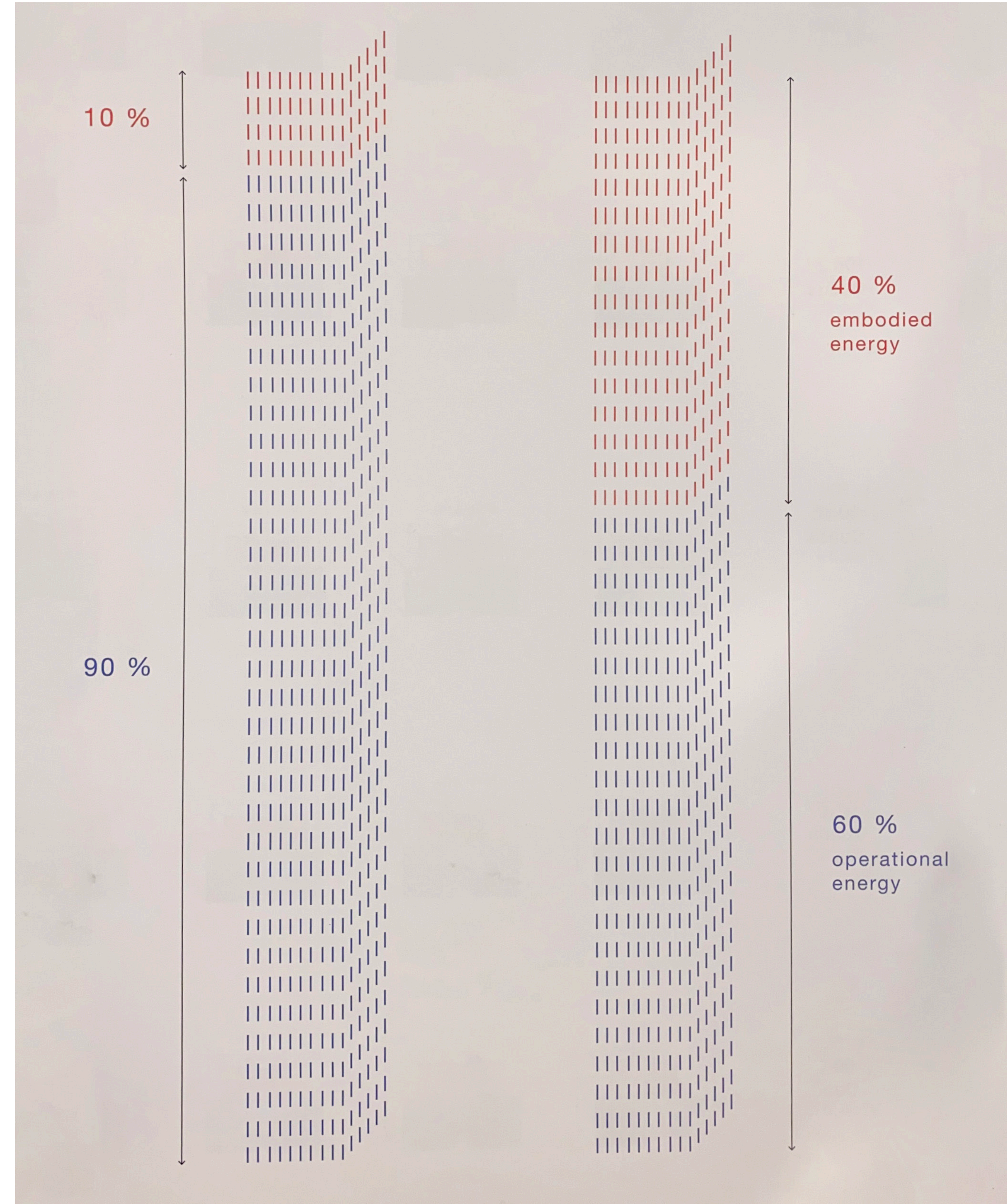
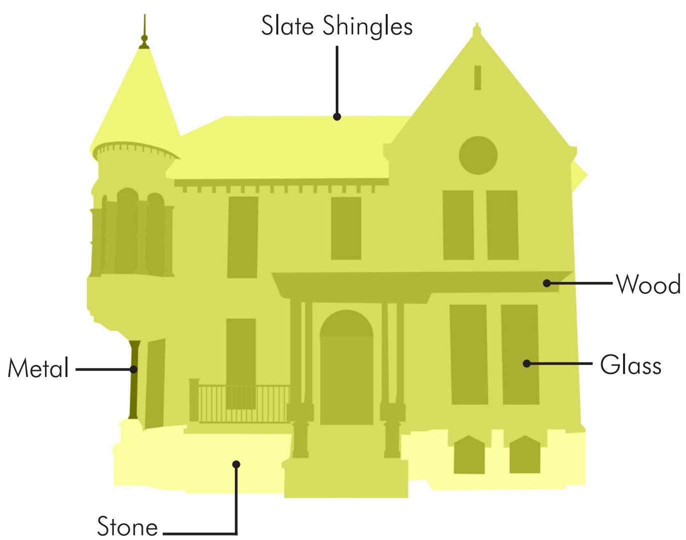


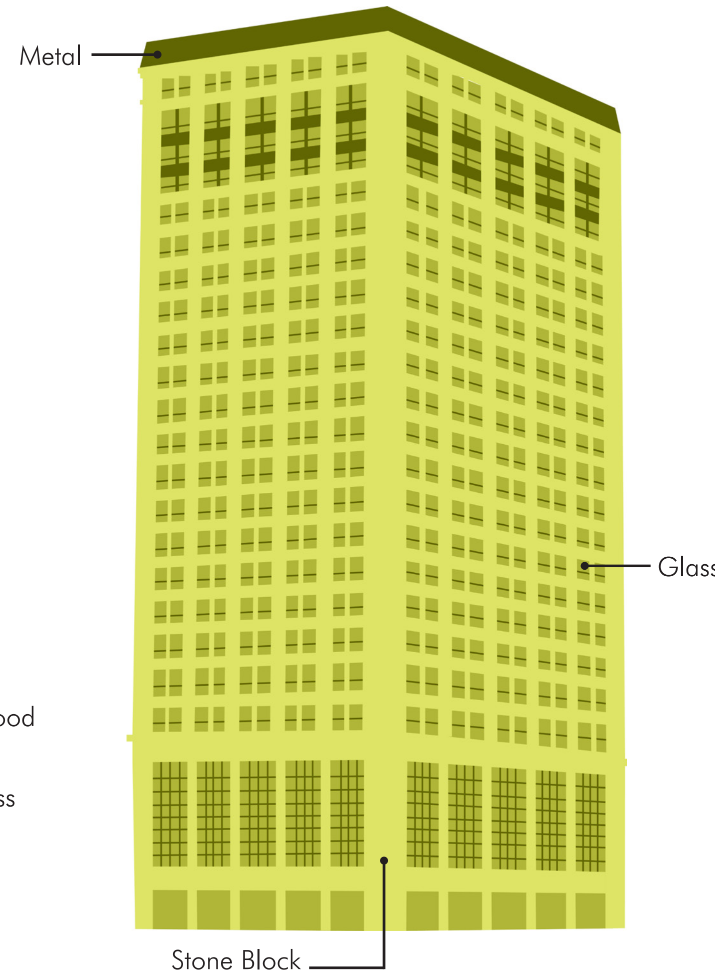
Figure 4.4

A graphic from *Embodied Energy and Design*, page 27. It is representing the trade off in operational energy and embodied energy.

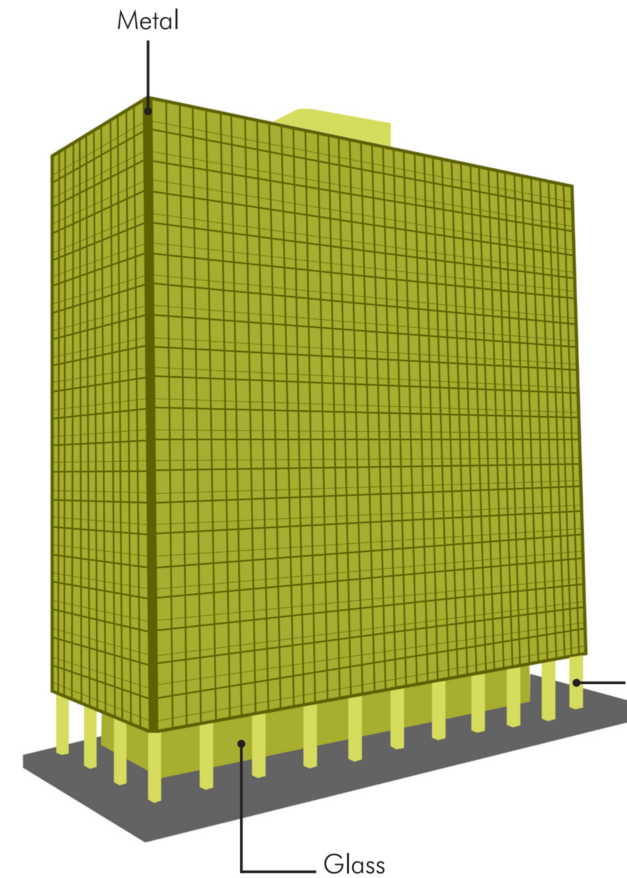
As mentioned earlier in the chapter about materiality, the goal of having net-zero operational energy buildings has inspired the innovation and design of higher-performing materials that help to build meet an operational energy value of zero. With the growth of the population, the growth of building size, and material quantity.[2] These two facts alone have exponentially increased embodied energy.



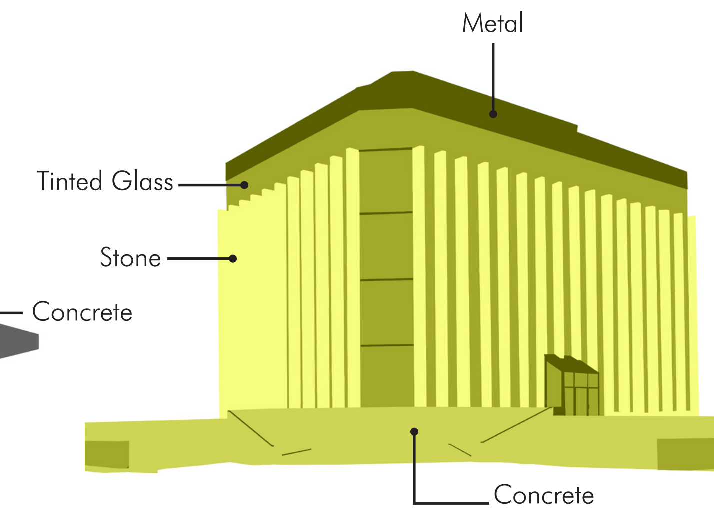
RANSOM GILLIS HOUSE
Architect: Henry Brush & George Manson
Year Built: 1876



FIRST NATIONAL BANK
Architect: Albert Kahn
Year Built: 1922



LAFAYETTE TOWERS
Architect: Mies van der Rohe
Year Built: 1963



FISHER ADMINISTRATION BUILDING
Architect: Gunnar, Birkets & Associates
Year Built: 1965

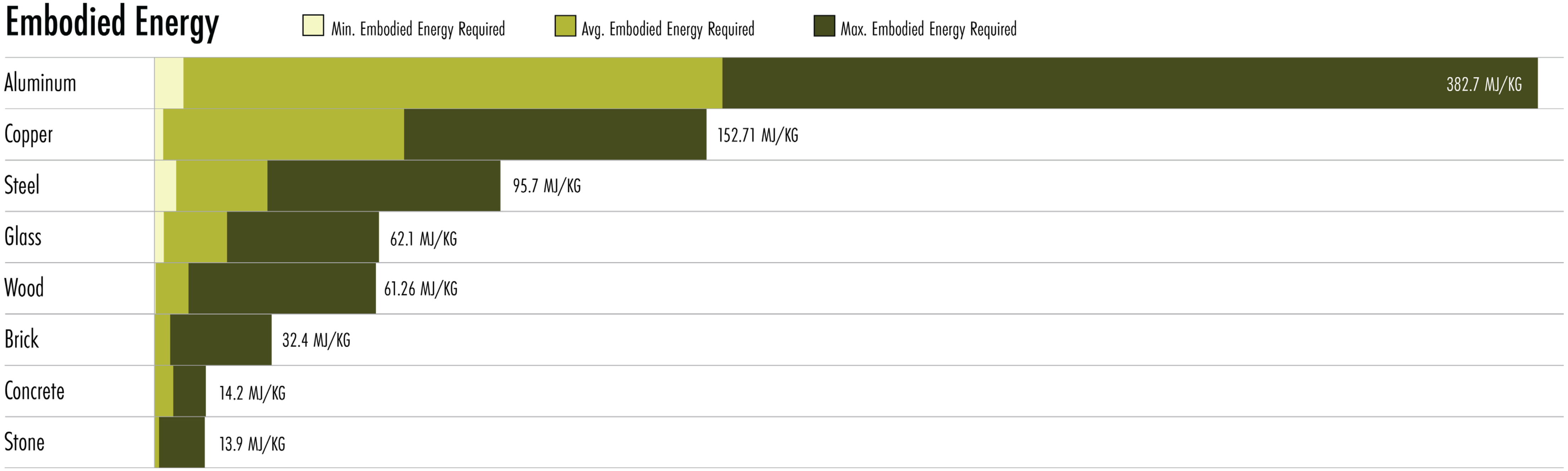
LOW EE — HIGH EE

Figure 4.5

The different elements of these buildings are different shades of green based on the materials that could be made out from the photo and the average EE number associated with that material. Although each of these buildings were built in different time periods, styles and designed by different people, they all have the same basic materials just in different quantities.

The embodied energy of a material is commonly confused with the embodied carbon of a material. The embodied energy is measured in megajoules per kilogram of material, megajoules is a unit of energy. Embodied carbon is the measure of released carbon in relation to the material. It is measured in kilograms, a unit of weight. Embodied carbon is just one element used to calculate the embodied energy of a material. Take aluminum as an example; the dark green represents the energy required to mine and extract the aluminum from its original source. However, recycled aluminum requires 95% less energy to manufacture into a usable material again; the light green represents that measurement.

Embodied Energy



Embodied CO2

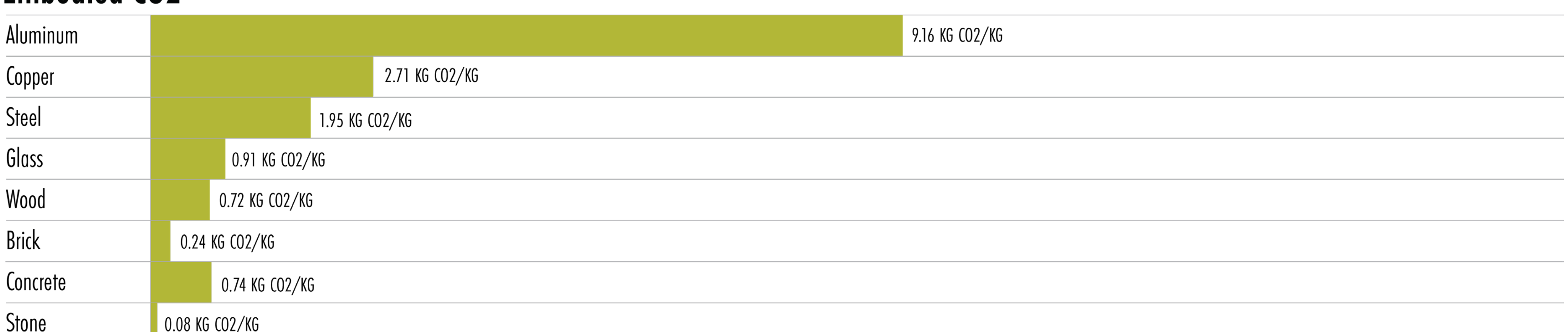


Figure 4.6

These two graphs are comparing the embodied energy and embodied carbon of the materials identified on the previous four buildings. The embodied energy graph is representing the most amount of embodied energy needed as well as the least amount. Data found in *Embodied Energy and Design*.

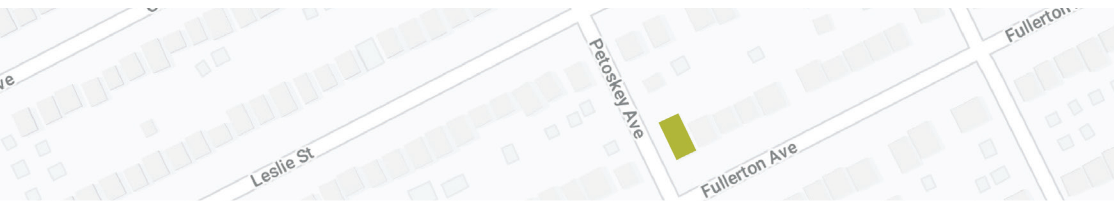


Figure 4.7

Photos of 4098 Fullerton Ave. in it's current condition getting ready for construction.

4098 FULLERTON AVE.

4098 Fullerton Ave. was constructed in 1962 and designed by Nathan Johnson, a well-known architect in Detroit. The house is situated in the northwest neighborhood of Russell Woods. It was slated to be demolished in 2015 by the land bank, luckily one of the vertical studios (led by Kris Nelson) this semester is working with a local architect to renovate and turn it into a sustainable house. The surrounding community could not be happier to see the house being fixed up.

Russell Woods is a neighborhood that the City of Detroit has committed to revitalizing. Within the neighborhood, there are about eight hundred homes, and it is considered one of the largest neighborhoods in Detroit. The city is planning to reactivate the commercial corridor as well as implement playgrounds within the parks. Russell Woods predominantly features houses built from the 1920s to the 1960s.[23] Driving through the neighborhood, one can see the neglect of some buildings and houses, but there is also some beautiful architecture.

As part of the research, a Tally analysis was run on the 3D Revit Model to calculate the amount of potential energy that would have been lost had the house been torn down. Tally is a Revit plug-in that was designed and produced by Kieran Timberlake Studio. It runs an analysis of all the materials in the building and measures the potential embodied energy. As part of that analysis, it breaks down the components of the building into categories of windows, walls, roof, doors, and floors. Tally then gives a percentage of global warming potential (GWP) to each of those categories, so it can be determined which category has the most global warming potential in the project. GWP is the measurement of greenhouse gases (carbon dioxide, methane, etc.) that increase the absorption of radiation emitted by the Earth. Tally also calculates a total megajoule number which tells the architect how much energy is embodied in the house.[24]

The house is 1,385 square feet. It has some structural damage and has not been inhabited for about thirty years. The tally software estimated that the house almost two million megajoules of energy. For some perspective, three-point-six megajoules equals one kilowatt-hour (kWh). An average house operates on about ten and a half thousand kWh per year. That means the embodied energy in 4098 Fullerton Ave. is enough energy to power a house for fifty-one years. The embodied energy of the house has surpassed its operational energy use by almost twenty years.

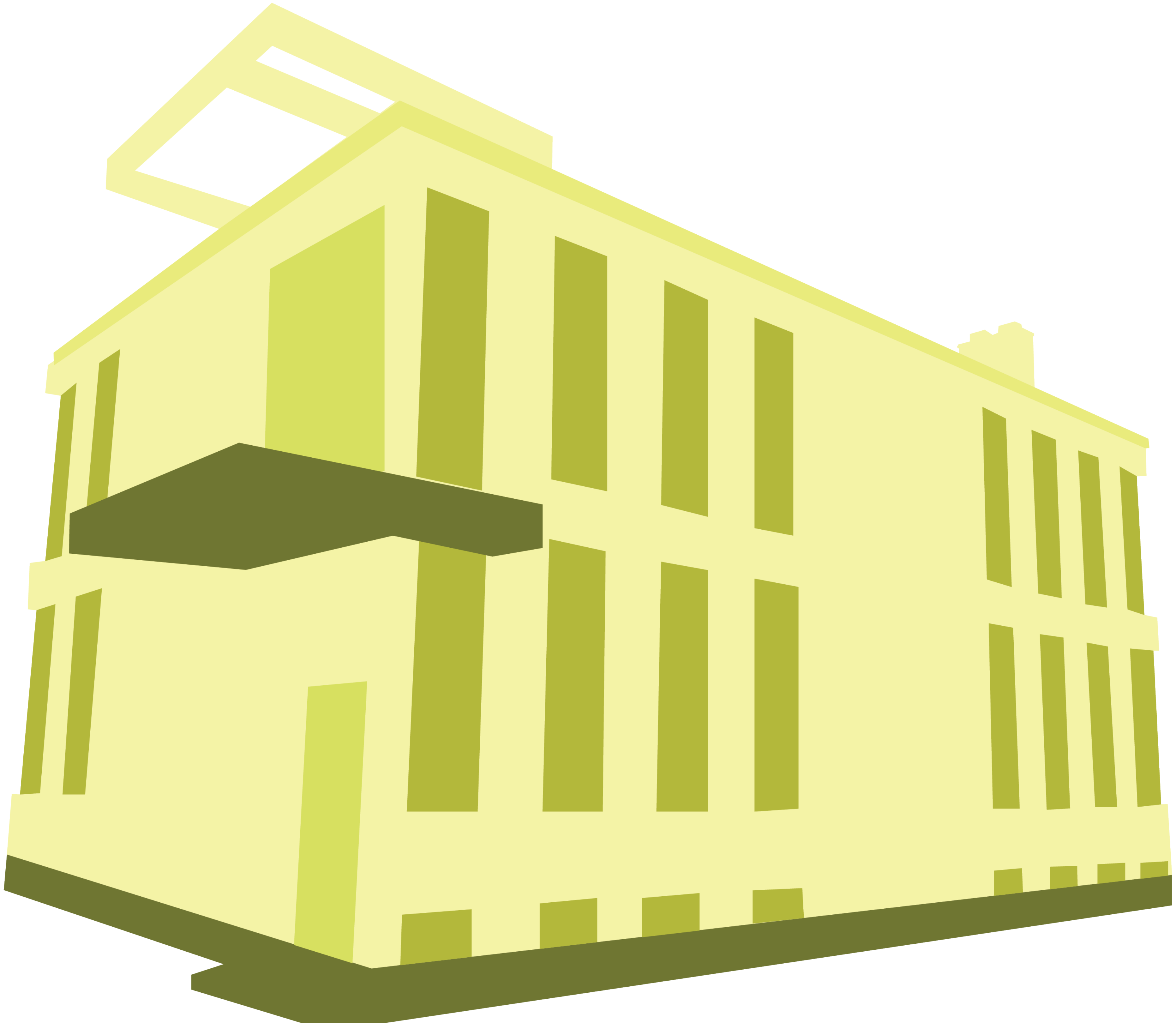


Figure 4.8

Numbers are based off of the Tally analysis. The total potential energy loss would have been equal to 1,919,568 megajoules. Thats is equal to the average kWh of a house for 51 years. The percentages of global warming potential (GWP) for each category is a percentage of the total global warming potential the house materials have.

MATERIALS

Wood
Masonry
Concrete
Steel
Aluminum
Glass/Glazing
Plywood
Gypsum
Polystyrene EXP

WALLS	5% GWP
ROOF	11% GWP
DOORS	15% GWP
WINDOWS	20% GWP
FLOORS	49% GWP

If the house had been torn down, there would have been a loss of material, energy, and a release of carbon. Not only would there have been a substantial loss of energy, but the community would also have been left with an empty lot in their neighborhood. The house now has an opportunity to serve its purpose again. Hopefully, a family will love this house and enjoy being part of the community.

Figure 4.9

Final renderings for the studio project produced by Anthony Vannoy.

> "EE requires a globalist perspective, a vision of the world, where materiality in nature, the build environment and technology are understood as interrelated parts."
> - *Sheila Kennedy*

CYCLES OF ENERGY

The movement of energy matters greatly when thinking about architecture. As mentioned before, there are ways we can capture and release energy in a way that it can be recaptured again. Where we are harnessing our energy from is just as important as how we are releasing it, but more importantly, we need to think about how we are recouping or replacing it. We need energy to move, and we need it to move forward into the future. Granted, we are cognizant of the operation energy buildings use, and we are striving to build better, greener, smaller impact buildings, but that only goes so far. Every component of a building is important to understand where the energy comes from, not just the operational but embodied as well.

Location is vitally important to both the operational and embodied energy when it comes to a building. The mass manufacturing of material and the global standardization of buildings does not work. "…one cannot treat a building as if it were an autonomous system of energy behaviors."[20] Buildings need to be designed for location; this is a fact that even operational energy cannot deny. For a building to operate at its best possible energy usage understanding the location, through the sun, the wind, the weathering of material is vital.[2] It affects the way a building functions and operates. However, creating closed-off environments has become the answer to low operating buildings.

"As humans have become more entangled in eco-systems, the scientific undertaking of designing an isolated, closed-circuit system is perhaps not very practical. Instead, energy-responsive design should acknowledge variables, new and declining sources, and methods of anticipation. Buildings, cities, and constructed landscapes alter existing eco-systems, but they also offer new synthetic (eco)systems." [20]

Simply choosing to close the building off to its environment does not prove or solve anything; in fact, it adds to the problem and stops the flow of energy within the environment. There is nothing like walking into a cold air-conditioned office building when it is a beautiful breezy seventy-five-degree day outside. Firstly, the shock that comes from going between two very different temperatures quickly is not comfortable. Secondly, that just further reinforces the idea that we are no longer designing for human comfort.[11] Humans are resilient, and almost any design that has become or is considered "timeless" is designed to function for more than just looks. It is designed for comfort, the human experience, and functionality. The same goes for interior spaces; it is not a newfound phenomenon that

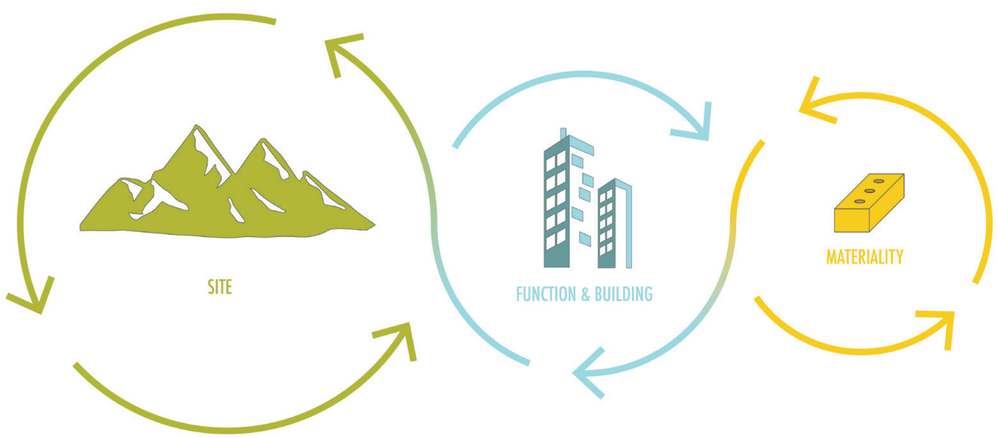


Figure 4.10

A visual representation of energy movement through site, building and materiality. The embodiment of materiality into a building and building into a site.

people like being connected to nature and, at the very least natural light. We try and achieve these correlations between nature and the indoors through materiality.

Materials are the little blocks that feed into the bigger cycle. It is from site that we get our materials, the landscapes around us provide raw material and matter that allow us to create the high preforming cladding system. Tracking the energy that goes into the production and manufacturing of material is much easier to calculate than trying to calculate the whole building. In fact, in order to calculate the whole building, it needs to be broken down at the materiality level. The amount of energy embodied in materials can be expansive. All the components that go into each system of a building, walls, floors, windows, become embodied in that system. Each part of the building system, the walls, floors, windows become embodied in the building itself. At this point the building is just a series of embodiments.

The functionality of the building is where the importance of operational energy exists. Operation energy is an important thing to keep track of, and the drive to lower it has pushed for better energy usage in the active systems and appliances that make up a building. However, the embodied energy that resides within the walls, floors, and roof are all components that make space and have now become embodied in that building. They are just as important because the building has become an embodied element in the surrounding landscape.[20] Bringing us back to the site part of the cycle. We are moving energy from one site to another through the embodiment of energy in materials and buildings, which then become embodied in larger systems—thus creating the cycle represented in figure 4.10, all components matter from the largest to the smallest. Simply neglecting one breaks the cycle, it all connects back to the basic fundamental understanding of energy.

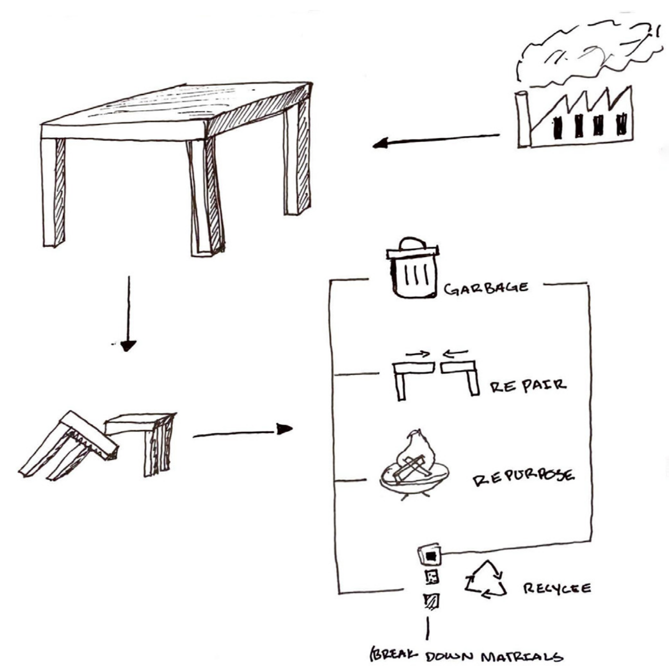


Figure 4.11

Sketching through the end-cycle opportunities for the IKEA table. It is not very recyclable because of all the materials involved. Its end-cycle will most likely thrown into the garbage.

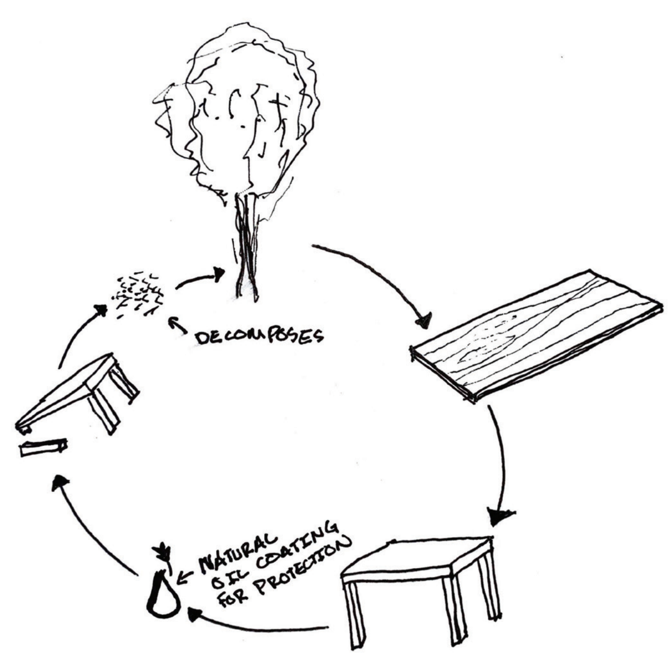


Figure 4.12

Sketching through the end-cycle of the Local table. It can simply be returned outside and decompose naturally because the coating used was a natural oil. It is an example of the embodied energy the table once held being put back in the ground and used to grow trees or other plants. It is part of a cycle.

THE TABLE

The Table is a controllable comparison to start understanding embodied energy at a basic level—a table designed by IKEA but made with local materials. The IKEA table is a mass-produced, flat-pack piece of furniture. The idea of it is wonderful, easy to pick up, assemble, and the cost very minimal (a benefit to mass production). The goal of the locally made table was to use what was accessible and materials that could decompose or be reused easily without having much to break down. The hypothesis was that the mass-produced table had more embodied energy than the locally made table. When comparing the amount of energy used to get the table or material from its source to Detroit, there was a stark difference. The amount of energy needed for the flat-pack pieces of the IKEA table to get from Poland where it was manufactured to Detroit required exponentially more energy than to get the piece of plywood from Canada to Detroit. Not to mention the IKEA table required many other materials, and it is hard to say where those were materials source and manufactured. However, based on globalization, it is fair to assume that not all the materials were manufactured and produced in Poland. The breakdown of the materials and potential second life cycle can be seen in figure 4.11. This comparison was insightful on the dimensionality embodied energy has. It reaches beyond the tangible, reaching into the past and for the future. It pushes one to question their design decisions and every little detail that makes up a final product.

Local Table Construction

Materials
Colombia Forest Plywood
48"x96"x1/2"
Titebond Wood Glue
Self Tapping Screws

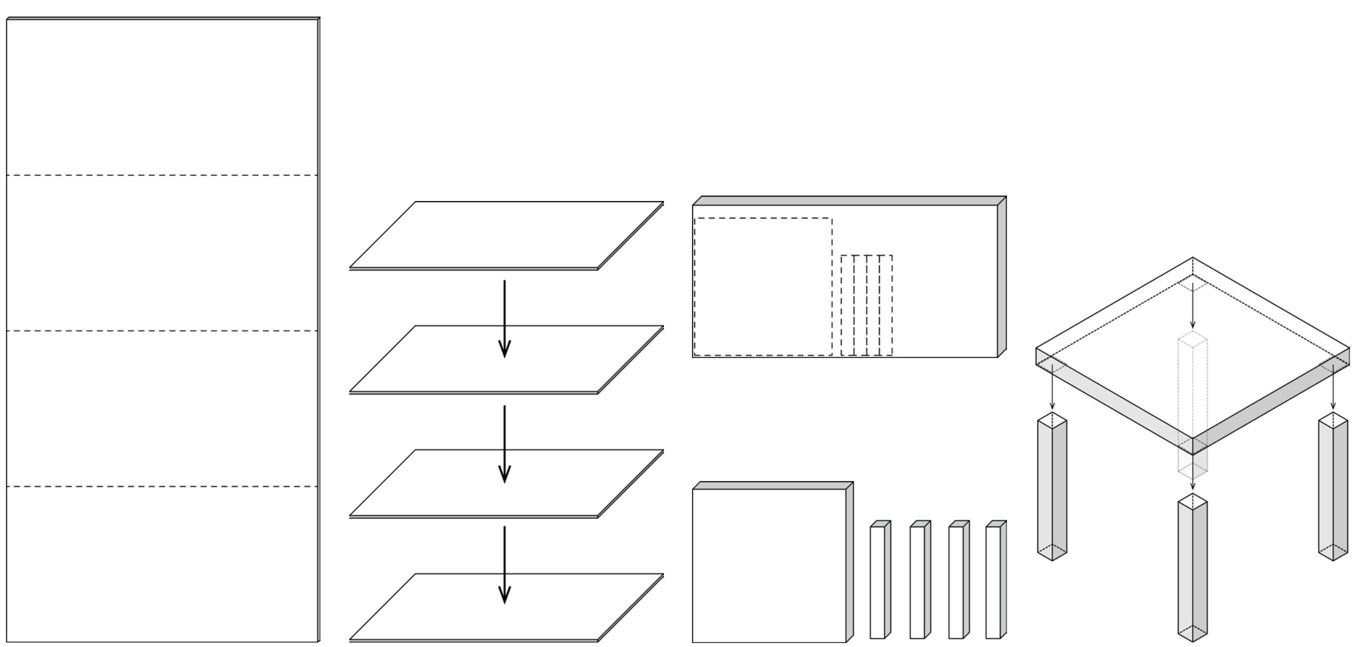
Time
24 hrs to Glue
1 hr to Cut Down & Assemble

Reflection
Constructing the table from a piece of plywood was actually an interesting process. Limited to materials that were accessible within a five-mile radius, allowed me to reach out to local businesses. Which highlighted another element of embodied energy, lower embodied energy can help support the local economy. This realization only reinforced the idea that the dimensional qualities embodied energy has reach beyond a percentage or numerical value associated with the quantity of energy. In addition, the finish of the plywood is a much more appealing finish than that of the IKEA table. The final result also weighs much more than the IKEA table because it is solid wood. The waste left over from this table can be reused to make other things or possibly another smaller table. Overall it was a good exercise, and I am pleased with the results of this table.

Cost
$60.00

Waste
3.5 ft² of unused plywood

Local Table Construction



1.
Acquire & Cut Down Plywood to Four 2'x4' Pieces

2.
Glue 2'x4' Boards Together to Make a 2" Thick Board

3.
Let 2" Thick Board Dry for 24 Hrs, Cut Down to Size

4.
Assemble w/ Self Tapping Screws & a Dab of Glue

IKEA Table Analysis

Materials
Particleboard
Fiberboard
ABS Plastic
Acrylic Paint
Acrylic Lacquer
Cardboard
Paper Foil

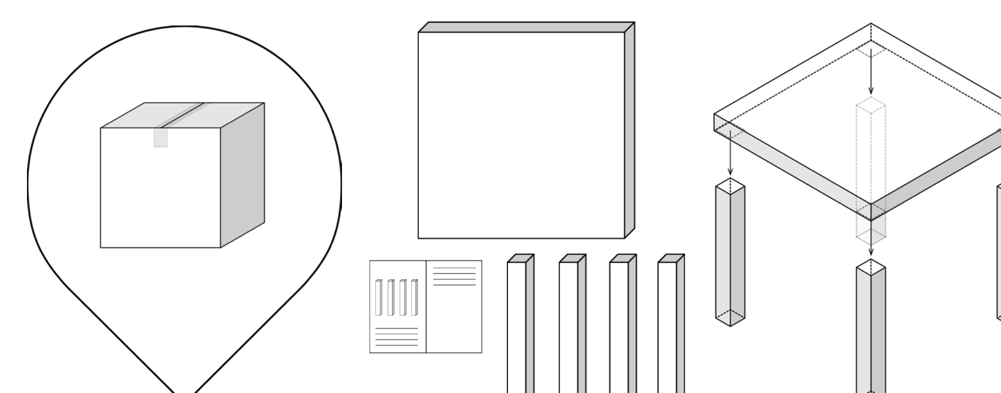
Time
1.5 hrs to Pick Up From Store
15 mins to Assemble

Reflection
Constructing the IKEA table was so incredibly easy, but as I was constructing it, I could already feel the particleboard that made up the legs falling apart. Picking up the table was effortless, easy to pick out online, and find in store. Which meant limited contact with the salesperson, and honestly, I do not think I talked to any personnel until I checked out. The price was very appealing, and the design is contemporary and minimal. The amount of time need was minimal compared to the table I built, but going to the store was almost more socially exhausting because of the amount of people and the forty-minute drive involved to get there. I was very surprised by how light the table was when I picked it up. Intrigued by the weight, I cut it open to find the central horizontal plane was cardboard. The waste that came along with the IKEA table was plastic shrink wrapping, which had to be thrown out and a cardboard box that had the potential to be reused, but I had no use for so it ended up in the recycling bin. Overall it was an interesting process, and my favorite part was cutting the table open to find that it was constructed with cardboard.

Cost
$15.00

Waste
Plastic Wrapping
Cardboard Box

IKEA Table Construction



1.
Pick-up Table Pieces from IKEA

2.
Read Instructions & Unpackage

3.
Assemble

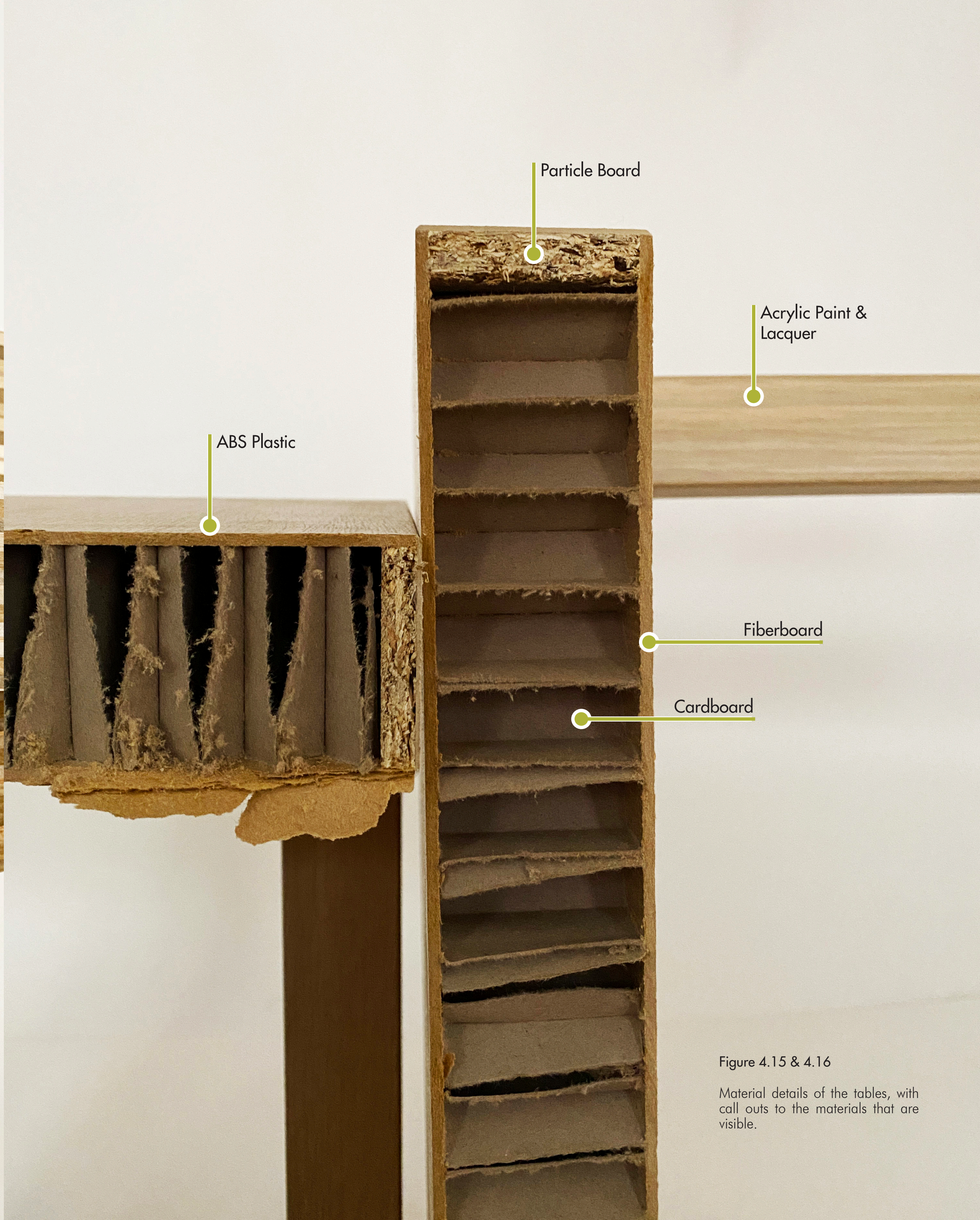


Figure 4.15 & 4.16

Material details of the tables, with call outs to the materials that are visible.

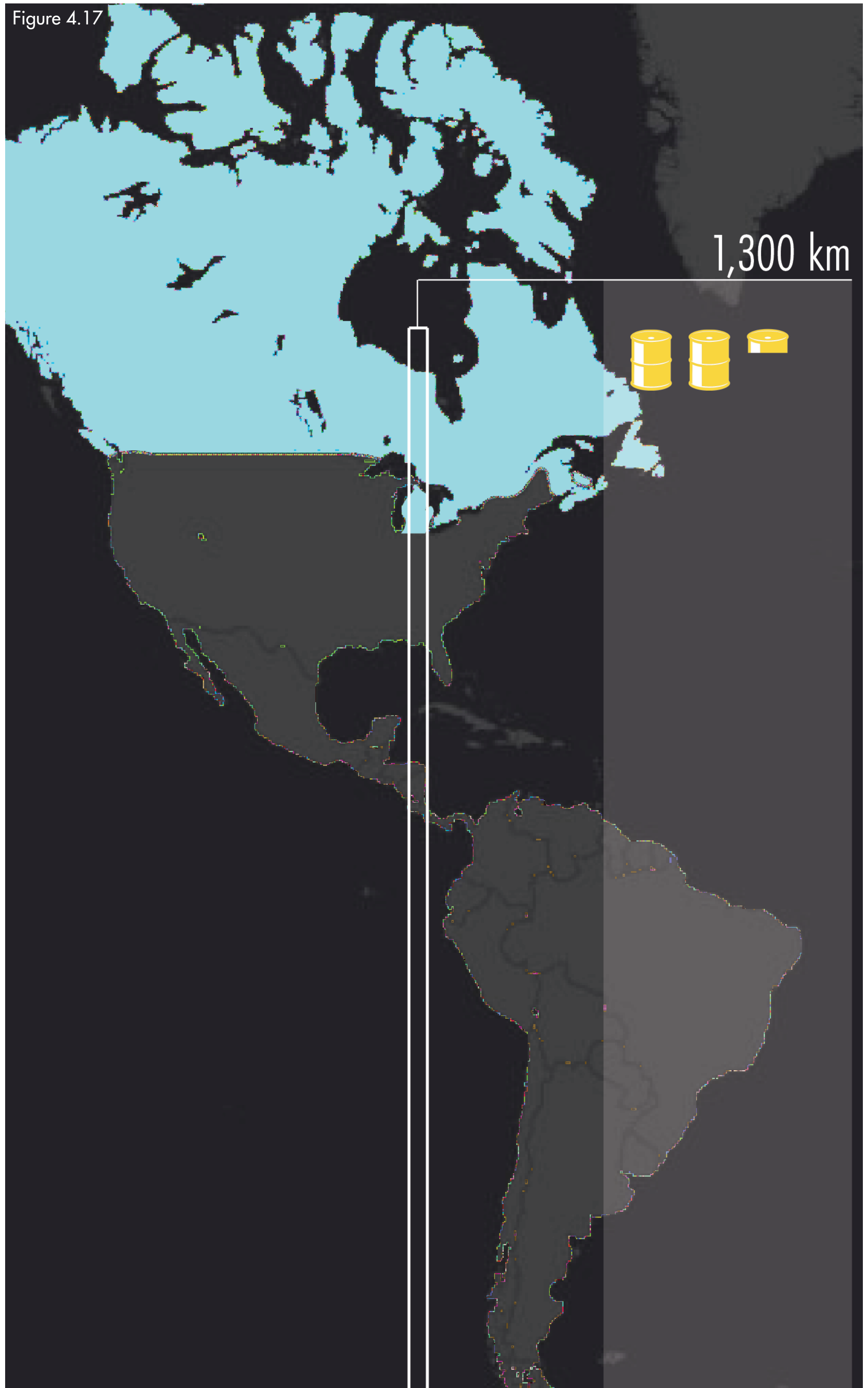


Figure 4.17 & 4.18

These maps show the distance between the point of origin and Detroit. Figure 4.18 is not accounting for all the materials and components that went into making the table, it is only accounting for the location of manufacturing for the final product.

= 100 Liters of Fuel

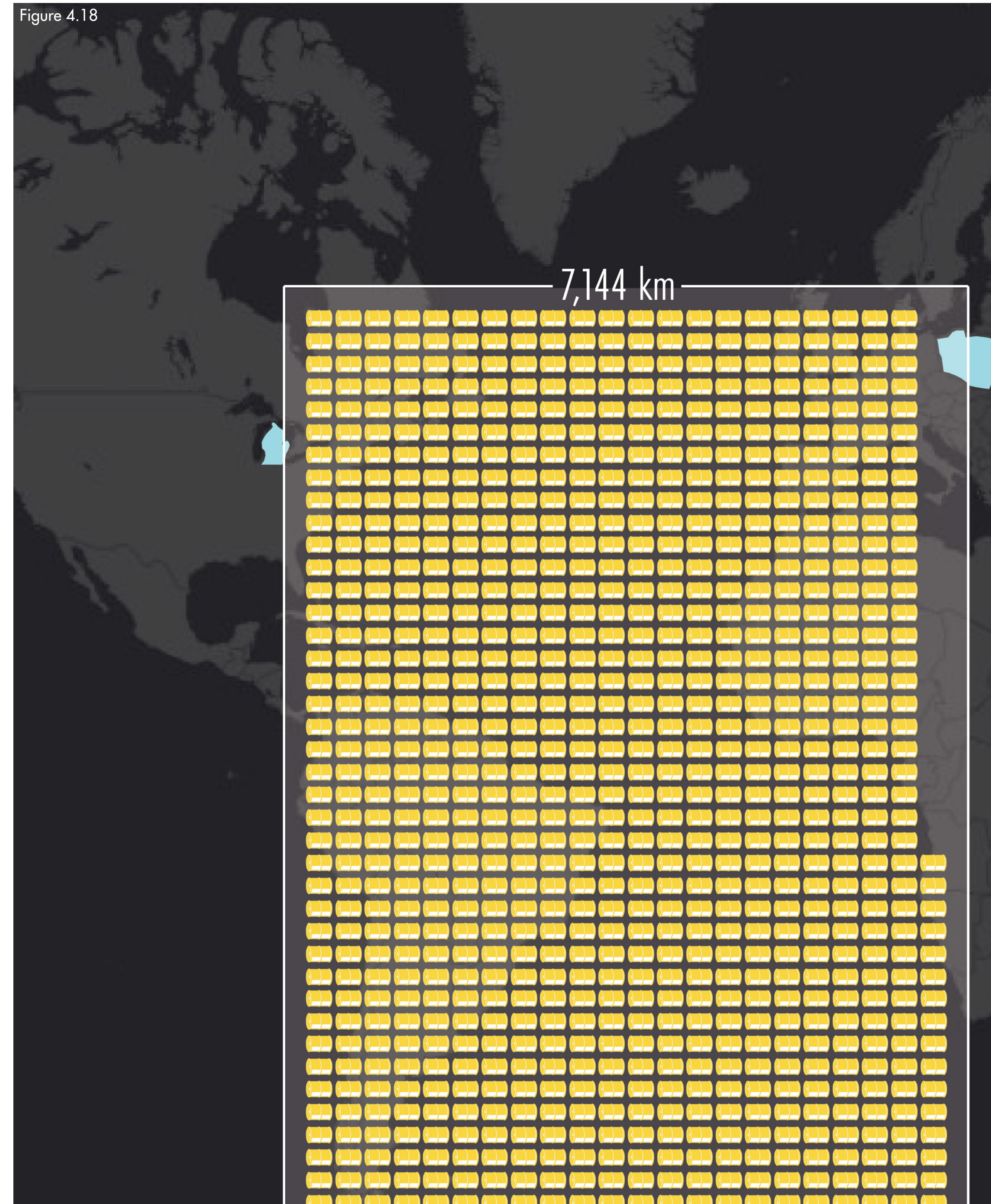


Figure 4.19

A photo of the table made with local materials.

Figure 4.20

A photo of the IKEA table.

REFLECT

05

"Considering energy as something to design, embodied energy is not so much a necessity tied to sustainability but more an opportunity to enhance spatial and experimental values"

- Mason White

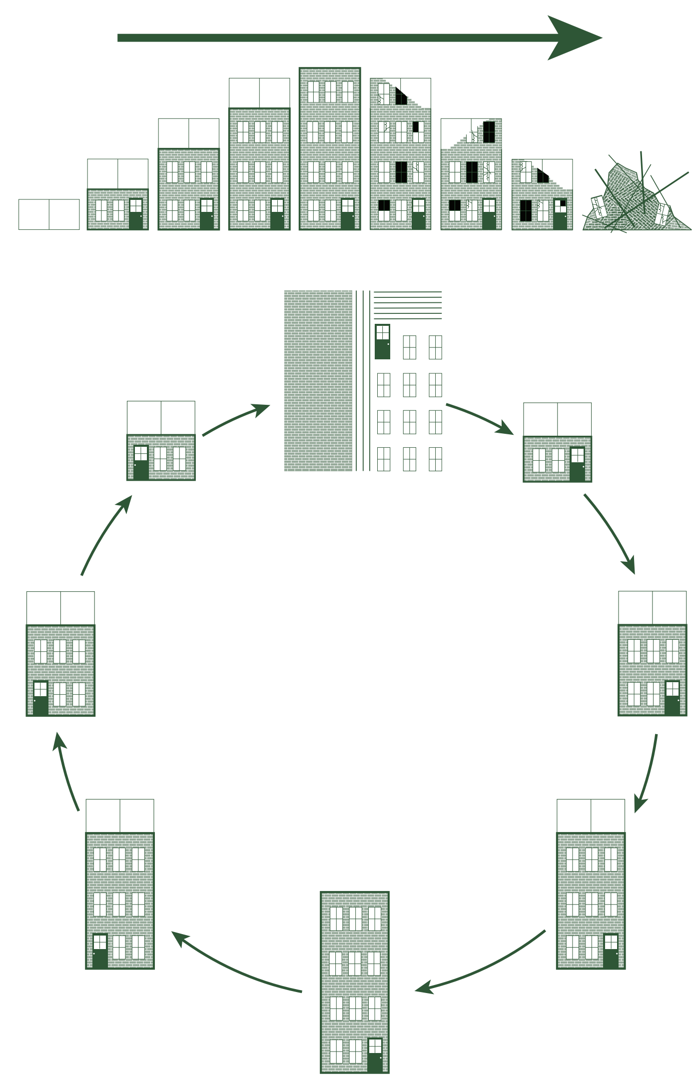


Figure 5.1

A graphic representing the way buildings work today and the potential they have to turn into cycle.

CONCLUSION

The connection between time, energy, and materiality can seem complicated, and at times, it is. However, through materiality and time, energy can become embodied and tangible. All three of these elements are vitally important. If there was no time, energy, or material (matter), we would not exist, life as we know it would not exist. The balance between the three allows us to build and create the landscapes we know today. How can we design something that does not fit into the existing cycle, that is bigger than us? Architecture has the potential to be designed in a way that adds to the cycle and the environment around it. The world does not work on a zero-sum operation, trees, plants, animals all add negative and positive things to their environments and atmospheres, merely reaching a goal of zero is not enough. Architecture is an active element in our landscapes and ecosystems; it cannot be a neutral element.

Embodied energy has a strong connection to sustainability and green thinking, but it is more than that. It is a way for us to connect time and energy to our environments and materials. Understanding the cost and consequences (or benefits) from the movement of energy through time is the next step in creating architecture that works as a cycle. That does not mean that we stop building skyscrapers because the material is not found locally. It does not mean that we stop mass-producing material and using the exponential amount of energy that we are using today. It does not mean we stop construction or planning for the future; what it means is that we start to question our actions and the potential consequences they carry at a deeper level. What does it mean to ship steel from China to build another skyscraper, one that may not even be fully occupied? Is using up that energy worth it? What are the alternatives? The dimensional qualities we can explore through the use of time, material, and energy in architecture can become tangible through design.

We are at a moment in time where knowledge and data are at our fingertips. Our world is changing, and with it, the social, economic, and political structures we know and use today need to change too. Architects can redesign, energy, and time through architecture. "Yet this is fitting because, if nothing else, an exploration of embodied energy and design suggests that we could reinvent time in architecture."[20] If we learn from the past, experiment with the present, and plan for the future through an understanding of time, materiality, and energy, it allows us to design time through architecture. On the Clock is a call to action, how are we going to move energy forward? What does the future look like?

Figure 5.2

A reminder that we are all on the clock, so let us begin.

REFLECTION

I have always thought of architecture as a degree in critical thinking and problem solving through design. It has balanced logic and creativity. I wanted a thesis that found a way to balance the theoretical and the applied. I believe a strong argument is made up of a balance of both. I wanted a thesis that was able to reflect that.

When I started, I had no idea what I wanted to study, I just knew I wanted it to impact the way I think and question the world around me. Starting with time and questioning architecture through time helped me to figure out ways we identify architecture through time. Time is a constant, unrelenting element that we find comfort in every day, its dimensional qualities are untouchable. Knowing and thinking about how we work with the fourth dimension lead me to the accumulation of time and its relation to energy through materiality.

Materiality has always been something I love, the textures the colors, the way we can interact with it, or how it can psychologically affect someone is incredibly interesting. The difference between time and energy in relation to materiality is the fact that it is so incredibly tangible. We literally interact and experience it every day. Through my research, I knew there was always going to be a section on materials, and I am pleased about the way it took shape within my thesis.

After mid review and a very in-depth analysis of the relationships between architecture, time, and us, I was ready for the information I was researching to be relevant today. What does all this information mean for the future? What defines the past, present, and future? Over the break, I worked on what the present means. How do we define it because it is always fleeting into the past. Ultimately I came to the conclusion that it is a psychological construct. Yet, it is also the thing that happened five years ago because we are feeling the consequences of our actions and choices we made five years ago.

Through this thesis, I have explored three elements that are vital to this world. I think that time, material, and energy is to architecture as food, shelter, and water are to us. All of those elements, time, energy, material, food, shelter, and water are elements that have substantial and, in some cases, priceless value. Our entire economy is based on trade, value, and power, those elements can give a country. That realization made me think about all the decisions we are making today, the constant tension in the political climate, globalization, the seemingly dystopian view we have about the future. Where does architecture fit into all of this, and what can architects do to make an impact on it? The future impacts the local level to the global level, and it needs to be thought of designed and prepared for that way. An answer in one place does not work for another.

The state we live in is an example of this, there are various complex layers but broken down simply there may be three levels. The state as a whole is how the United States sees us; there is no differentiation between the East side or the West side, it is merely the State of Michigan. Within Michigan, we break it down into three parts (maybe more, but for the simplicity of this, I'm going to stick with three), the West side, the East side, and the Upper Peninsula (UP). Each of these sections has different cultures, different micro-climates, and different socio-economic situations. At an even smaller scale, there are the counties that get grouped together, such as Wayne, Oakland, and Macomb or Ottawa, Allegan, and Kent counties. What does that group of counties mean from a globalist point of view? This is how we should start thinking about time, energy, and material with concern to architecture.

After my final benchmark, I was left thinking about what locality means and does it have to restrict the way we design. No, I really don't think it means we have to make policies and rules about the distances we have to go to get the materials we need to build. I think the more important thing is being able to question where our materials are coming from and what the associated trade-off is. Simply ignoring or being selective about what we choose to calculate as significant energy is no longer an option. Sure, non-renewable energy may not run out in my lifetime, but why rely on a source that will run out. We have the inherent capability to control and create new sources of energy, why not start with the environments we create.

NEXT STEPS

My next steps are to continue educating myself on this topic. It has successfully helped to understand and question architecture and all design.

What does it mean to scale the perspective and think about the same topic at different global scales?

How will I keep energy moving forward, what will my impact on the future be?

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4.11- 4.20 All documentation and building of the tables done by me. The local table was constructed with the advising of Thaddeus Lindsay.