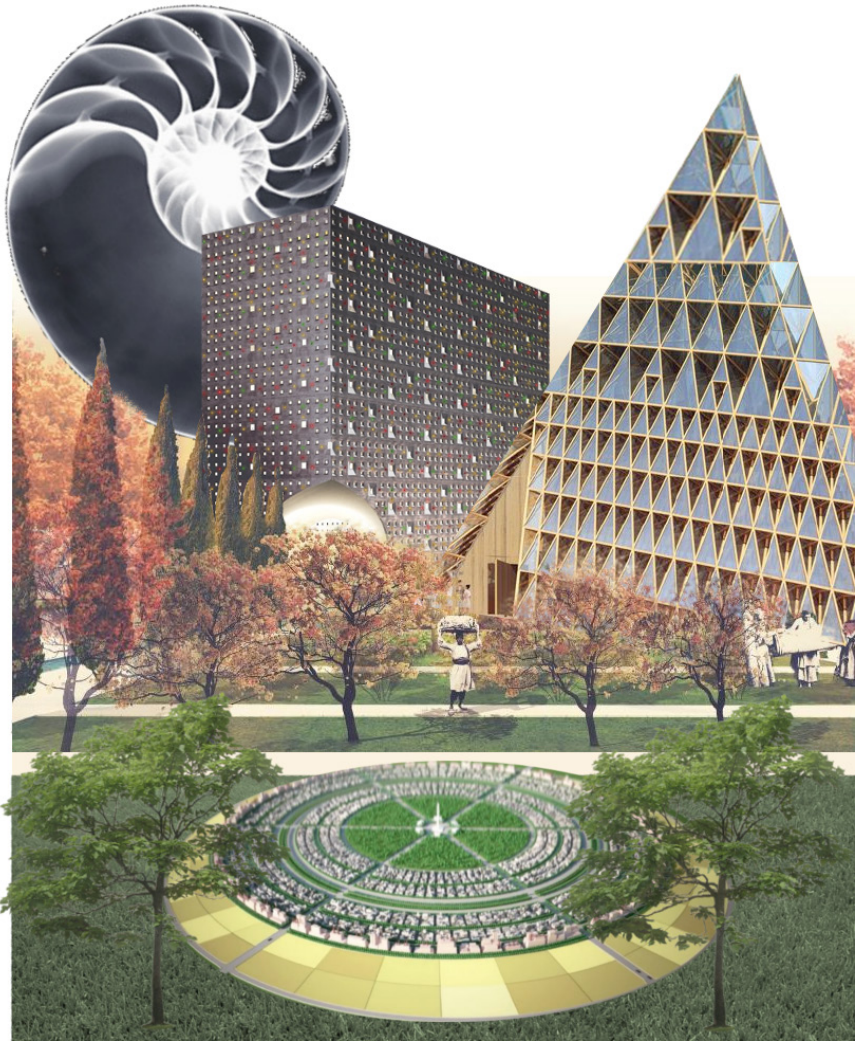# History of Architecture II
ARCH 329

Material & Immaterial Architecture, 1890s–present

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Fig. 2. Letchworth Garden City http://bit.ly/2gGXAmd

Fig. 3. Toyo Ito Fractal Serpantine Pavilion http://bit.ly/2gPEb7w

A Question Regarding Nature

For centuries past, the built environment used the natural resources the land provided. The Egyptians used limestone from the deserts, the indigenous tribes of tropical islands used trees and fronds, the Greeks used stone. All of these structures felt native and natural to their respective environments. People were very much connected to the land and nature they were surrounded with. The rise of great cities however, and rise in the Earth's population taking up more space, there became a lack of nature in the daily lives of people everywhere. Leading up to the Industrial revolution of the 1820's, there had never been a greater want or need for fresh air and space. Industry brought about many harmful things in the workplace and lifestyles of the people working the factories. By this point in history, people had long since moved on from using materials off the land they were building on, and instead shipped building materials through trade routes and railroads from places afar.

On July 21, 1853, the New York State Legislature enacted into law the setting aside of more than 750 acres of land central to Manhattan Island to create America's first major landscaped public park; they would soon refer to it as "the Central Park." Frederick Law Olmsted and Calvert Vaux, the winners of the 1858 design competition for Central Park, along with other socially conscious reformers understood that the creation of a great public park would improve public health and contribute greatly to the formation of a civil society. (Conservancy).

Taking cues from the socially conscience Olmstead and Vaux, Ebenezer Howard had an ideal to reform society and reconnect people with nature through the creation of Garden Cities at the turn of the 20th Century. He too saw the importance and potential benefits of open planned garden and natural space. Not only on people's attitudes and well-being, but on the health of the city and environment too as shown in Figure 2. Looking ahead at the turn of the 21st century and the rise of the computer age, fractal architecture saw a resurgence as complex forms could easily be realized through digital mediums. This resurgence also made an attempt to reconnect people with nature on a higher subconscious level using patterns and complex forms found in and mimicking nature, as can be seen in Figure 3 on the left with Toyo Ito's Serpentine Pavilion.

How then, are the accomplishments and ideals of Garden Cities comparable to those of Fractal Architecture in relation to their ideas and success in reconnecting people to nature?

Introduction

We will begin to take a look at the successes and downfalls of both the Garden City and Fractal Architecture through historical analysis and research. Through research on the two subjects, one can find many similarities, one such being their connection to nature and tying people back to it. Most of the ideals that both garden cities and fractal architecture have,

Fig. 4. 'Redefining Space through Utopian Garden City Ideals' Scottie Manners

Fig. 5. Ebenezer Howard's Garden City Plan 1898

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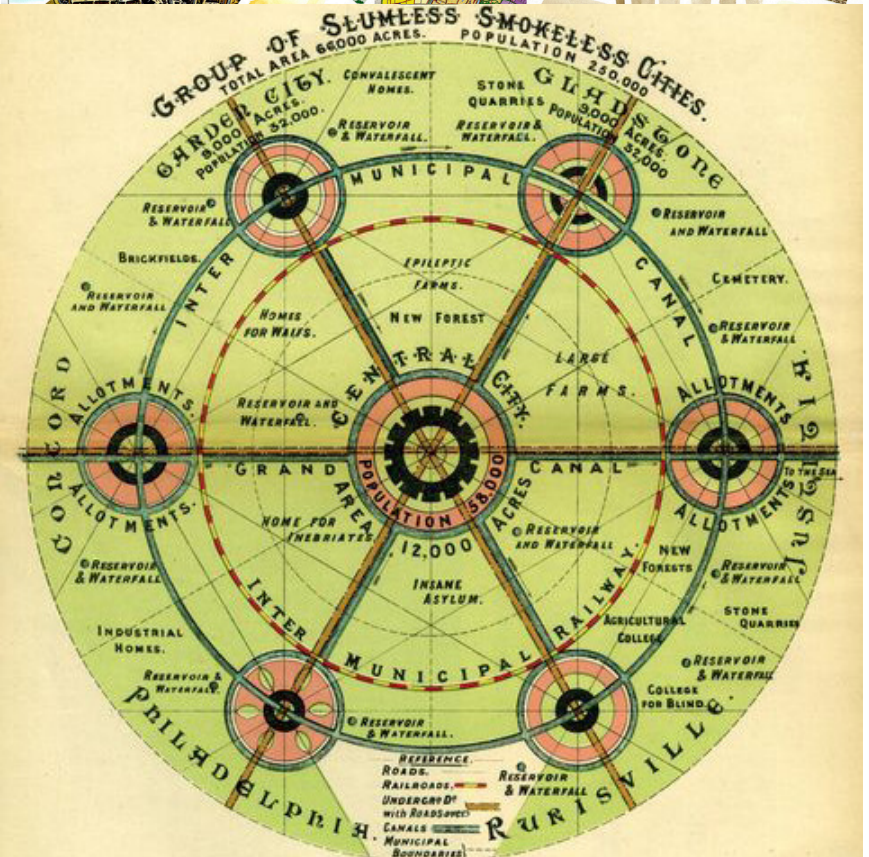
never make it out of the conceptual stage. Garden cities were sparsely funded, and computer generated fractal architecture, stays in the conceptual explorational phase within the computer. We will look at both real examples that have been built, as well as concepts and ideas. We will also visit architects and planners behind these movements such as Ebenezer Howard, and Daniel Libeskind. From concept, to iteration, to being built, garden cities and fractal architecture have powerful ways of affecting people and fulfilling their need and affinity for nature.

Garden Cities

Ebenezer Howard brought forth the ideals of a Garden City as a solution to solve the paradox between thriving yet filthy overcrowded cities, and the open fields and well-being of the countryside. The city had economic and social opportunity, but overcrowded housing and an appalling physical environment; whereas the countryside offered open fields and fresh air, but held too few jobs and very little social life (Hall 17). Housing for workers in both city and country was equally as bad. It is the marriage of both the city and country that a Garden City is born.

It was Howard's intent, as well as others such as Edward Bellamy and Peter Kropotkin during the late 1890's, to create social reform and worker equity through these planned garden cities. In Howard's view of these communal cities, individual land ownership would be prohibited, however other forms of capital could be privately, collectively, or municipally owned (Parsons 23). Having this common shared space created opportunity for the working class to live a more enhanced, "middle-class" life with such luxuries as fresh air and open space they might not have afforded on their own, just as the countryside estates owned by the rich. Not only would it provide more equitable living, but would spring new hope, new life, and a new civilization (Howard 48). Living in the filth of the city in poor worker housing, could hinder one's mindset and create a slow detached worker; however, if they were exposed to light and air and nature, their mindset would be altered, creating a much happier enthusiastic and productive member of society (Air). These social desires were sought by many, yet people were forced to remain in their social construct set before them, stuck in a low wage job and economic status, trapped.

Howard's architectural plan for these cities (Figure 5) were to house 32,000 people in a 1000 acre circular city within a 6000 acre agricultural plot (Howard 53). These cities would contain open space, gardens, community farms, as well as jobs for everyone. These cities would restore people to the land, back to nature from which we were born (Parsons 27). The garden city resonated so well with the social reformists of the time that Howards ideals were not far off from what others wanted to achieve. Thus, a board of directors was created for the First Garden City of Letchworth, and the city was built. The board was made up of lawyers and business men, helping influence the garden city with their expertise and knowledge (Parsons 31). The city achieved some of its goals
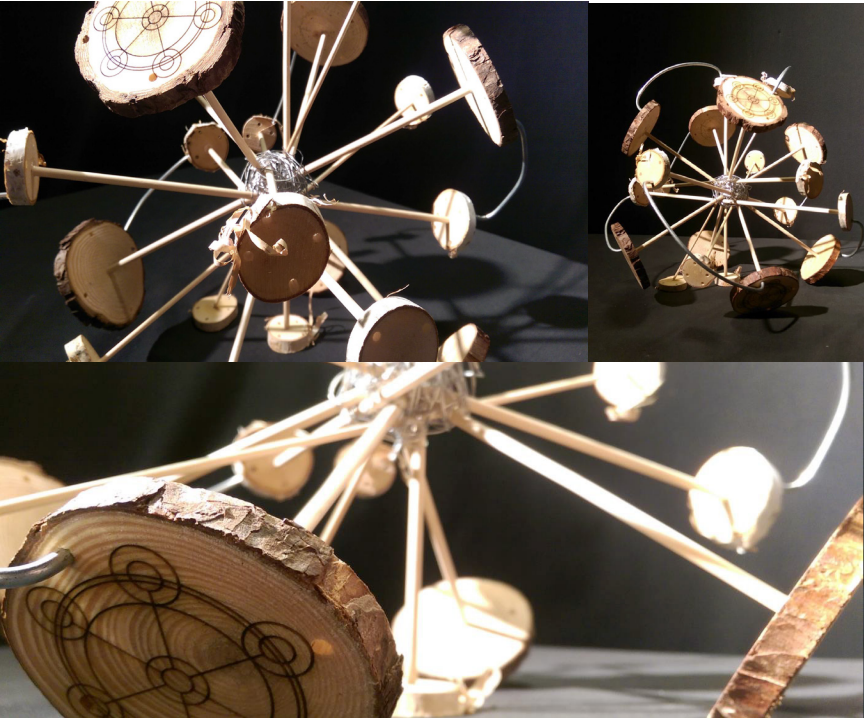
but never gained as much momentum as planned (Hall 29).

Thus far we have seen how the industrial era has created poor conditions in cities, prioritizing the need for nature and healthy conditions. Let's take a look at how these new city plans were put into action, through leadership of visionaries and idealists at the turn of the 20th century.

Ebenezer Howard: Experiencing Garden Cities

The Garden City, according to Ebenezer Howard,

"was a place where better opportunities of social intercourse may be enjoyed, where the beauties of nature may encompass and enfold each dweller therein, …where the best results of concert and cooperation are gathered in by a happy people" (Hall 19)

Just as Darwin's theory of Evolution supported competition and struggle, it also supported cooperation among species. The City, in Howard's as well as other reformists opinion, needed to evolve and the city plan and layout could make people respond in a way that inspired cooperation (Parsons 40). There was a general reaction against the form of the industrial city, and instead a need to wholly transform the urban environment…These ideal cities are perhaps the most ambitious and complex statements of the belief that reforming the physical environment can revolutionize the total life of a society (Parsons 41).

Howards ideals of a garden city consisted of grand boulevards lined with trees, open park spaces, amenities within walking distance, and plenty of air and nature for the residents to enjoy. His plan for a garden city was a 1000 acre city within 5000 acres of agriculture. The town would be centrally located and divided up by 6 main boulevards. His plan was merely suggestive and would be much departed from, in later garden city models that were made a reality (Howard 51). One would start in the city center where the public buildings would be located such as town hall, theatre, library, museum and hospital. The rest of the space would be encompassed by a 145 acre park, ample grounds for recreation. Surrounding the park in a ring is a covered glass arcade, where open air markets and shopping could be done. The park and arcade are intersected by the 6 boulevards, and of course like every avenue and street were lined with trees. Moving further out are concentric rings of excellently crafted homes on ample grounds. The varying designs and architecture the homes display, are fully up to individual taste and preference (Howard 54). On the outer rings of town were more parks and then finally industry. The industry was encircled by a railroad that moved into city center as well as other towns, thus decreasing traffic on the roads and mostly limiting it to pedestrian movement where walking was encouraged (Howard 55).

The Garden City movement was attracting a growing number of architects, especially those influenced in the Arts and Crafts movement. The
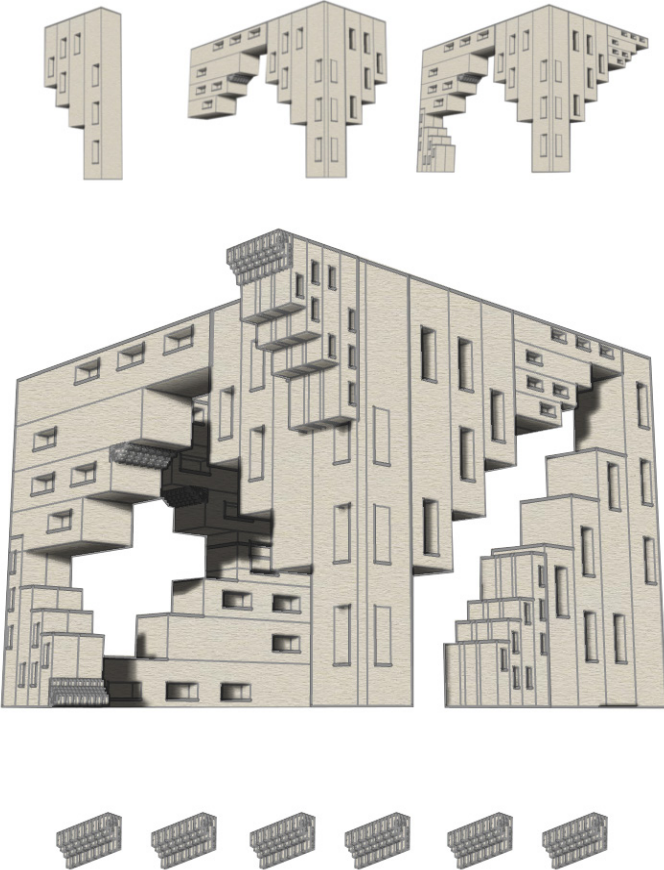
vernacular of arts and crafts homes of pre-industrial times meshed with Howard's concepts of garden cities and many homes in Garden Cities such as Letchworth (Figure 7), New Eastwick, Hampstean, and Welwyn (Figure 8) were designed by these arts and crafts architects (Hall 32).

Not straying too far from the ideals and designs of what a garden city stood for, once put into practice, a garden city did not actually consist of the concentric ring plan of Howards, and many were only garden suburbs and not a whole city. However, Howard, Parker, and Unwin heavily influenced urban planning and changed the thought process of many on what a city should consist of in order to create a healthy, enjoyable environment (Hall 35).

Fractal Architecture

Fractals are found in both the built environment and nature everywhere. By replicating the processes of morphogenesis, fractal geometry can create forms inherent to characteristics found in natural structure through repetitious patterns (Figure 9), self-similar forms, and complex hierarchy of structure (Harris 25). Forms that emulate nature help to fill the need-for-nature humans crave. They can be found in the built environment as far back as 9th Century Persia, in the ceilings of Islamic Mosques (Harris 237). However, a resurgence of fractal architecture came about in the early 1990's and 2000's due to the rise of the personal computer. Coding, mathematics, and software allowed for complex algorithmic shapes and fractal patterns to be formed virtually, previously too complex to realize without the aid of the computer. The amazing technological advancement of the past 20 years has made possible the scientific exploration of areas previously impossible because of technological constraints (Harris 237).

Fractal architecture uses elements repeated at different scales in patterns just as in nature. Patterns of cells, biophilic design, morphology, bio-mimicry, and computer generated geometries of infinite iterational capabilities with today's processing power, all play a role in designing with fractals. They can include buildings which have curves, geometric patterns, look like natural objects or are environmentally friendly (Ostwald 25). Since the personal computer age, the fabrication of fractals in architecture have been designed and made a reality. Fractal design shares both biophilic and deconstructive principles a lot of the time. The affinity for nature and biophilia is hardwired into the human capacity. These values fashion diverse emotional responses and instill feeling and provocation in each person that experiences a space (Otswald 45). That could be one reason fractals found a resurgence in architecture – to reconnect people in the computer age back to nature.

Deconstructivist buildings such as the 2002 Toyo Ito Serpentine Pavilion, the 2002 Federation Square in Melbourne, the 2003 Kunsthaus Graz, and the 1998 Jewish Museum in Berlin all exhibit fractal design (Jencks 246). The aid of software helped to organize the complex iterations of the
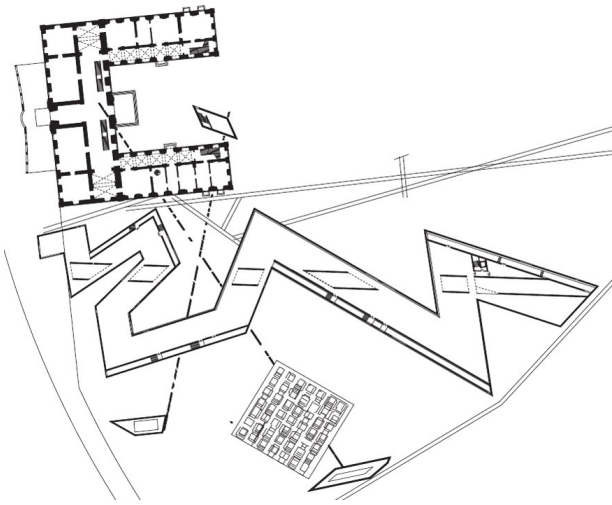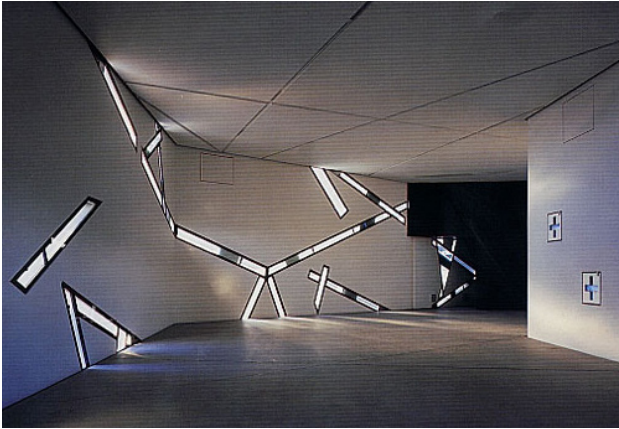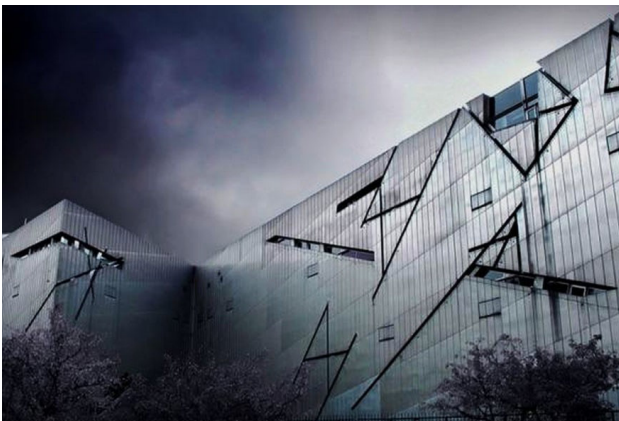
facades and interiors of these fractal buildings. For example, the façades on the Federation square buildings are scalene triangles with dimensions of 1,2, $\sqrt{5}$ derived by mathematics. They can be repeated in a pinwheel pattern, getting ever-smaller. On Daniel Libeskind's 1998 Jewish Museum, self-similar forms, angles, slashes and lines, were a fractal grammar put to symbolic use (Jencks 247). These fractal forms helped to portray certain feelings within the building as one experienced the space. He simply used fractals as the complex language to represent the range of emotional responses he wished to evoke (Jencks 243).

Because of the diverse motives for adopting fractal geometry, there is neither an agreed upon definition nor a common title for works that use fractals for inspiration, design rationale, or form generation (Ostwald 23).

"Fractal architecture is a contemporary form of organic design, suggesting that fractal geometry in architecture are essentially organic in character, amounting to a continuous linking through iterative cues and cognitive association (Otswald 185).

## Daniel Libeskind: Experiencing Fractal Architecture

With the creation of the computer came about new and exciting ways to explore and create architecture that wasn't thought of before. The help of coding and software, 3D manipulation and the use of math to make complex geometric shapes and forms, sparked a new era of fractal architecture, especially in the 1990's and early 2000's. One could create repetitious patterns at varying scales, fractal geometries that were unthinkable without rapid prototyping and computer generation. Many algorithms mimic what occurs in nature, making fractal design so appealing, subconsciously creating a favorable reaction in people based on biophilic design and our need as humans to be close with nature and patterns found in nature.

One such fractal building that evokes a multitude of reactions ranging the full emotional spectra is the 2001 Jewish Museum Berlin, designed by Daniel Libeskind. Using self-similar forms, angles, slashes and lines, a fractal grammar is put to symbolic use (Jencks 247). Three basic ideas inform the Jewish Museum's design: First the impossibility of understanding the history of Berlin; second the necessity to integrate the Holocaust physically and spiritually; third, that only through acknowledging and incorporating Berlin's erasure of Jewish life can the history of Berlin and Europe have a human life (Blumenthal 9).

The interlocking interpenetration of the building's convolutions with straight lines of the voids (Figure 11) is based on an idea concerning the relationship of Jewish history to that of Berlin and Germany in general (Schneider 58). Both the zigzag and fragmented straight line form the building's plan and present a disruption of the x-axis (Eisenman 237). The relationship between them are only recognizable on the ground floor plans. These geometric relationships remain hidden from the

Fig. 14. 'Jewish Museum Berlin Abstracted Geometries' Scottie Manners
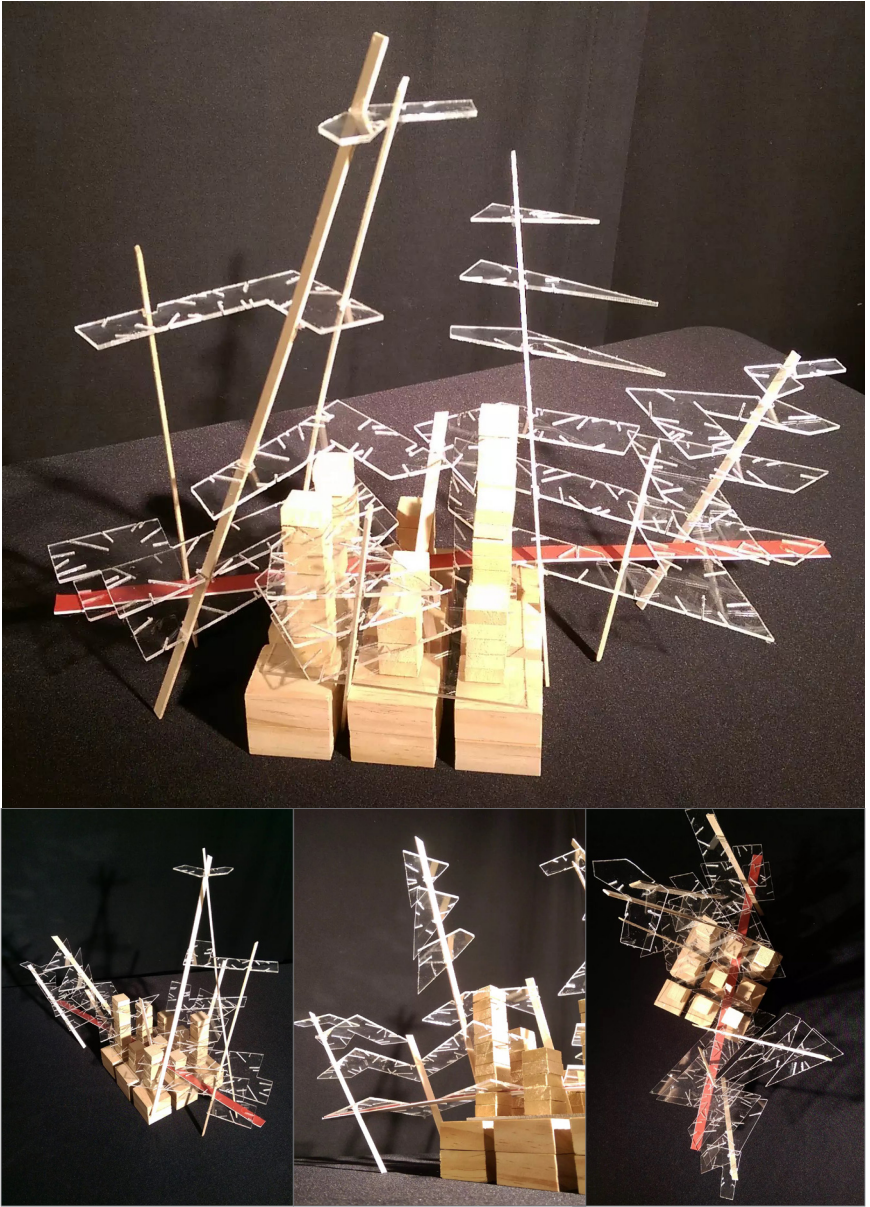
viewer, yet are continually hinted at in different spatial contexts and various intervals through the black sections of walls, floors, and ceilings, which indicate the presence of line of voids (Schneider 58). Inside, circulation plays a key role in the critique of the need to understand space through movement. The staircases function to interrupt continuous movement and deny any continuity on a horizontal plane. Users experience an interruption along a Cartesianal axis and fail to remain on a single datum, forced to move up and down into new spaces (Eisenman 237). These spaces and voids inside are what create the magic for the user.

Libeskind highlighted the spaces between walls as the primary element of the design, it was the void "between the lines." "A void so real, so elemental to Jewish history in Berlin as to be its focal point after the Holocaust, a negative center of gravity around which Jewish memory would assemble" (Libeskind 50).

The window bands and apertures that extend beyond the ceilings have a powerful effect on the interior. Floor and ceiling seem to abut the walls in a free arbitrary way (Figure 12). The interplay of the diagonal lines of the ceilings and window bands create visually charged points, never repeating what the other has, developing their own unique configurations and patterns (Schneider 55). These fractal patterns create the underlying thread that ties the building together, lines and voids. Libeskind wanted to capture the quality of the space of Berlin through something that can never be exhibited…Humanity reduced to ashes. So there is nothing except the walls and a line which runs across Berlin. The line is both decisive and mysterious (Blumenthal 29).

Libeskind said "The voids of the museum provide a setting for nothing really to be displayed, because there is nothing really to be seen. It is just emptiness which will never be eliminated from Berlin."

Comparison

It can be seen thus far that both the garden cities of the early 20th Century as well as the Fractal Architecture at the turn of the 21st, have successful methods in reconnecting people back to nature; There are however some setbacks that make both ideas unsuccessful and ultimately not as wide spread as their designers would have hoped them to be.

Let us compare the two archetypes with one another. Garden cities are on a much larger scale than that of a single building using fractals. However, the patterns and repetitious algorithms of fractal geometry can actually be seen in the city planning of Garden Cities. The plans are replicable on larger scales as they move away from their central concentric rings. They get larger and repeat their shape, thus creating a repeating pattern as in nature. The city itself is

then repeated elsewhere in a different city in Howard's overall plan. When you zoom further out, you can see a network of these cities of repeated patterns on a larger scale connect to one another. Fractal buildings use these same repeated patterns of geometries on different scales. It is all dependent on the scale one is observing from. Fractal architecture is on a more personal human level and the patterns might be a little more obvious.

Another major similarity between fractal architecture and garden cities is their occurrence after a major revolution. The two revolutions were enablers that allowed each to take place. The poor working conditions and large influx in city populations after the Industrial Revolution enabled the ideals of Garden City planners to come up with such a scheme because there was a need for a problem. The Technological revolution of the 20th Century and the coming of the computer age, enabled architects and designers to realize complex forms with the aid of software. Without the time period in history, neither would have been created, thus connecting the architecture to its respective time.

The two are very different in their method of connecting people back to nature however. Garden cities were all about the city plan. The perfect utopian idea of a city with ample space for everyone. Boulevards of trees, grassy plots of land, farmland surrounding the city, and nature everywhere, the connection to nature can be easily seen and the health benefits reaped. The connection to nature is taken quite literally, where fractals create a connection by using biophilic patterns that are associated with nature. This is where Garden cities differ from Fractal Architecture. Fractals are hard to see. If you are trying to find them they will appear, but the average on-looker will not notice them. Their subconscious will however be aware that the designed geometries are nature-like and this pushes people towards a higher level of thought and thought provocation. Fractals are pleasing to look at because of people's affinity for nature, since fractals show similarity to patterns found in nature. Take a tree for example, it's branches infinitely get smaller from the largest branch (the trunk) to the smallest bud just coming in. They are a repeated pattern getting smaller and smaller. Cells, leaves, layers of the earth, snowflakes, sand, all have patterns on different scales. These learned experiences make up the human experience, and create an engaging interaction when a fractal building is visited.

Conclusion

How are the accomplishments and ideals of Garden Cities comparable to those of fractal architecture in relation to their ideas and success in reconnecting people to nature?

I believe through my research that I have found both garden cities and fractal architecture to be successful in reconnecting people back to nature, however it is my opinion that garden cities connect people in a more successful manner than that of fractals. Garden cities might have been a utopian ideal, and only few cities were ever built throughout history, but I believe their concept was carried through time in an

everlasting manner. Idealists Howard, Parker, and Unwin heavily influenced planning and changed the thought process on what a city should consist of (Hall 35). That is why today we see more fully developed streets, parks spaces, transit, and consideration into how a city is planned out. Today's cities enjoy a much healthier environment than 150 years ago. In other words, Garden cities have had a direct impact and can be seen through the usage of parks and open space within cities, successfully carrying ideas into today and reconnecting people within a city to nature.

Fractal Architecture after the computer age, has been present in the built environment, but not monumental as far as impact in people's lives. The connection to nature is a lot subtler and not as directly seen as garden cities. Only through patterns and algorithms that mimic nature, do fractal designs show their success in the human subconscious when evoking certain emotional ranges. The Jewish Museum in Berlin was successful at creating a range of emotions using this fractal grammar due to humankind's affinity for nature (Jencks 247). While not directly obvious on how nature is tied into fractals with something so obvious as a plant or shrub, the driving force behind fractals is inspired from nature, leaving traces and hints of nature in the work and in the patterns.

Where they both fail is in their complexity. Garden cities are too complex in their pure form of a utopian society. There are too many rules and too big of a societal change people would have to endure. The lack of owning anything was such a foreign idea that people were hesitant to buy into it. Having everything planned out and everyone have a job seemed too good to be true. There was also a whole system of how the land would get paid back to the loan company that it wasn't viable. The idea was there, but never realized in it's purest form, the one thought up by Howard himself. Fractal architecture shows signs of complexity all over. The driving design is complex to begin with. The fractal pattern and repetition is one that an average consumer is not likely to analyze or understand. The floor plans, or the design of the skin hold complexities that people hardly understand as being natural. In fact, because of the use of modern materials, people associate the designs with being contemporary and futuristic, not with nature.

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