

Green Architecture:  
Reuse, Recycle, Rebuild.

## Abstract.

The change in the environment continues to grow into a crisis, with the building of 'shelters' responsible for the consumption of almost 17 percent of the world's pure fresh water, twenty five percent of the world's wood harvest, and forty percent of the world's fossil fuel and prefabricated materials, as a result the building sector is the leading contributor to climate change and environmental crisis around the world. It would seem like many architects are oblivious to these statistics, as a majority of architects continue to design buildings and structures that have principles rooted in the style, force and industrial technology movements associated with architects like Le Corbusier, and other twentieth century designs. It's hard to understand how this happened, what steps occurred between early civilization Mesopotamia and Egypt architecture and the present modern contemporary architecture in metropolis cities like New York? What affects has architecture and the building industry had on the environment? What makes a 'green' building? In this essay I discuss the number of ideas, history and design concepts of 'ecological architecture', including a review of ancient to 20<sup>th</sup> century green architecture, and to what degree of success they have achieved in helping contemporary architects design a sustainable environment. Was it based on the materials used at the time or the ideas behind the designs? My essay also explores the various influences of great Modernist architects have had on new designs since early modernism. In 1923 Modernist pioneer Le Corbusier declared a new industry filled with new technologies, materials, and ideologies, and since, If you ask any architect now in 2012 to draw their dreams for a visionary building in the world of the future, their visions will "invariable look like a prophetic sketch that might have come from the hand of a Constructivist architect" from the 1920s. Finally this essay discusses new sustainable designs past and present involved in city rebuilding and re-planning towards a green future city, as well as the various features designers often ignore, recommendations of solutions which could help achieve a simultaneous interaction between architecture and the environment", as well as the role architecture plays in this "new age of ecology" caused by the aftermath of man's dominance over the earth, and its unintentional plans to 'clog the rivers, pollute the air, foul the beaches, poison the soil, and impose general havoc on nature'.

The modern practice of architecture is defined by repetition and referencing to its origins, and past. Since its origins architects have learned to balance the “art, science, material, form, style, and craft”<sup>1</sup> to produce their designs, often disregarding the balance of nature and the environment. The earliest forms of building were constructed as a response to the human need for shelter and security from the environment. From dwellings in caves as far back as 30,000 years ago, to tent structures which “evolved into...sun-dried mud brick round houses...in about 8000 BC”<sup>2</sup>, then eventually into a rectangular structure with straight walls and windows, in 6500BC. At that time more natural materials such as twigs, clay, sand, wood, and stone were used and developed to create advanced effective structures. Egyptians were the first with such techniques of using natural building material. They used materials like reeds, bounded them together to form pillars and beams, as well as bending them inwards and tying the tops of the reeds to shape an arch or dome, which were then “filled with smaller branches and mud to complete a weather-proof”<sup>3</sup>structure. The Egyptians were also responsible for the creation of pyramids around 3000-2500 BC. Although the pyramids differed in shapes and size, from a rectangular flat-roofed to angular roof, these pyramids often used the same materials of mud-brick, and then as their methods developed, they used massive blocks cut from stones. The pyramids created continue to be an “astounding creations”<sup>4</sup>, because of its scale, sustainability, natural materials and techniques used, however it still “bears little relation to anything in subsequent human history”<sup>5</sup>. By contrast Le Corbusier Cartesian skyscraper, which was designed to be made of steel and glass in 1938, could be seen “almost as impressive in scale”<sup>6</sup>, and unlike the pyramids it stands as a lasting inspiration and unintentional guideline to modern architecture. In-between this shift or natural building materials to a more modern building materials were years in development of civilization.



*The Saqqara pyramid used small pieces of stones, almost as if it were still mud bricks.*

After the Egyptians “pioneering monumental architecture”<sup>7</sup> other spectacular and influential remains were developed and later left behind. From the fortress palaces erected in Mycenae (on the Greek mainland) and their “renowned beehive tombs” around 1400, the Greeks were the next civilization to “leave impressive remains”<sup>8</sup>. They built palaces, and then enclosed them with a fortress made of stone blocks. These fortress walls were so large in scale that “only giants would seem capable of heaving them into place”<sup>9</sup>. With the scarcity of other materials like wood, stone architecture became very popular in ancient architecture, such as monumental stone architecture like the temples of Karnak and Luxor located near the east bank of the Nile at Thebes. Known as the “city of temples”, the temples of

Karnak are the largest in the world, containing groups of temples, like The Ipt Temple, and The Temple of Ptah, all of which are enclosed in a 20m high mud brick wall. These temples are more than just stone temples, unlike other temples the time it took to develop “enabling it to reach a size, complexity, and diversity” is like nothing else. The size and details on the columns have close resemblance to versions of wood from an early period.



**Karnak Temples.** *The 20m high wall surrounding the temples.*

Out of all the periods and places in the history of architecture and building, the most influential is Greece. Throughout the centuries emerged various elements of classical styles, like pillars, and “ornate columns”. They used raw materials like unbaked bricks, wood, and many of the impressive buildings created through the centuries, as far back as the 5<sup>th</sup> century, have survived with some remnants still standing today. Stone was the most common used material in architecture up until the 19<sup>th</sup> century. From the stone European castles and towers during the 12<sup>th</sup> century to the gothic style from the 12<sup>th</sup> to 15<sup>th</sup> century.

Architecture in the 18<sup>th</sup> century was characterized by development and movement. The industrial revolution resulted in “new mechanized technologies and industrial materials, especially iron, steel and glass”<sup>10</sup>. The change in society’s structure from the revolution meant the construction of new types of buildings, inconceivable in a previous age. Buildings like “government offices, banks, hospitals, theaters, libraries, educational institutions, museums, railroad stations, factories, warehouses, commercial buildings such as department stores and a whole range of new types of housing for every social class from factory workers to industrial barons required innovative engineering and design



solutions, mostly within rapidly evolving urban settings”<sup>11</sup>. The 19<sup>th</sup> century was the continuation of this development. The purpose and definition of a building change from the simple basic need for shelter and protection, with the “emergence of modern culture and social values”<sup>12</sup>. Technological development continued, and cast-iron architecture advanced and was used for the “superstructure of many buildings” in the 18<sup>th</sup> and 19<sup>th</sup> century. Impressive iron structures like the Eiffel tower were built in 1889, railroads, of steel, steam and smoke were built around Europe, and gradually the shift of materials like stone, twigs and rock (green architecture) to more modern material like steel, and glass was created.

Architecture in the beginning of the 20<sup>th</sup> century celebrated the modern age. The Modern Age and Movement were obsessed with the “industrial and technological dream.” (Wines, 2000.p.16). Architects focused on the emphasis of “shape, form, light, and transparency, especially at the expense of decorative embellishment and local style-as well as its ideological faith in utopian rationalism and functionalism,”<sup>13</sup>, completely separating from nature and anything ‘Green’. Technologies and new materials now enabled for construction at increasing speed. People “demanded so much from their buildings and expected them to be machines for performing specific functions.”(Glancey,2003.p.7). The result was nature and the green spaces being substituted with cities filled with “highly-serviced boxes”(Glancey,2003.p.7), which functioned as office blocks, factories, apartment blocks, shopping malls, or suburban houses. This construction, destruction, and then construction again ideology made it a century that saw the most rise and fall of many buildings, in comparison to previous centuries. Societies became very complex. Designs like Bauhaus founded by Walter Gropius, which operated from 1919 to 1933, became one of the most influential in modernist architecture and modern design because of its style. The style of the Bauhaus buildings was usually cubic; they took advantage of new modern materials like reinforced concrete, rolled steel and large sizes of glass. Bauhaus windows were usually the basic elements and façade of the buildings. They were a simple steel design, with a glass curtain wall suspended in front of the load-bearing framework. The Bauhaus influenced many other modernist architects.



*Bauhaus, glass façade, Walter Gropius*

However French- Swiss architect Le Corbusier was the leading architect of the 20<sup>th</sup> century. His buildings were also constructed of steel and reinforced concrete, and focused on clear geometric forms and structures. His designs emphasized mass production and town planning. He wrote a series of theoretical writings and projects on architecture that laid our guidelines for urban planning. In 1920 he devised a ‘dream city’ called Ville Radieuse’ or ‘Radiant city’. This ideal city composed not of low buildings made from natural materials, but instead mainly skyscrapers (the symbol of modern architecture) within a park. Le Corbusier wrote “Suppose we are entering the city by way of the Great

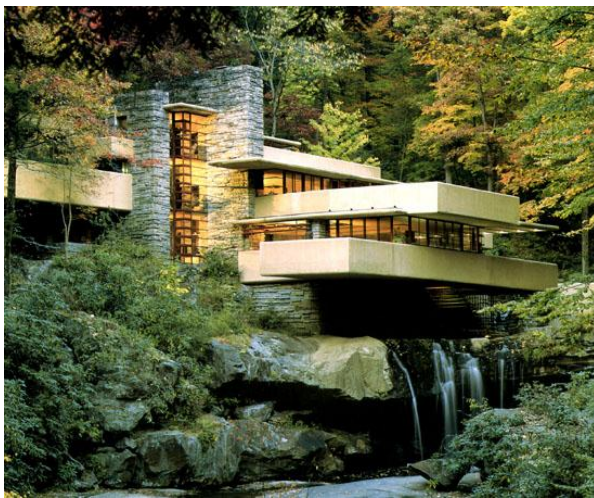
Park...Our fast car takes the special elevated motor track between the majestic skyscrapers: as we approach nearer, there is seen the repetition against the sky of the twenty-four skyscrapers; to our left and on the right on the outskirts of each particular area are the municipal and administrative buildings; and enclosing the space are the museums and university buildings. The whole city is a Park." (Jacobs, 1961.p.22). His high density, vertical city housed 1,200 inhabitants per acre. The skyscrapers occupy 5% of the ground and since they were so high, all the inhabitants would be placed inside the skyscrapers, leaving 95% of the ground open. The skyscrapers were then divided by class, with the high-income people living on "lower, luxury housing around courts" (Jacobs, 1961.p.22), and with the ground empty, recreational spaces like restaurants and theaters would occupy the space.

Although Radiant City was never realized its principles served as the blueprint for city planning and attempts at green city design for many architects. Radiant city was Le Corbusier's attempt at reuniting man to the environment through modern building blocks. He obviously was not the first architect to try and achieve the utopian dream through architecture of city and nature coexisting. Garden city by Ebenezer Howard is where it started. Le Corbusier's Radiant City comes directly from Garden City. Corbusier described his design as "the Garden City made attainable." (Jacobs, 1961.p.22). The Garden City was proposed in 1898, years before Radiant City. The aim of radiant city was to build a new town which would "halt the growth of London, and also repopulate the countryside, where villages were declining" (Jacobs, 1961.p.17), and finally a town where the poor could live close to the nature again. Howard wanted to create self-sufficient small towns; with industries set in the garden city, so the citizens could earn their living. It was to be "encircled with a belt of agriculture. Industry was to be in its planned preserves; schools, housing and greens in planned living preserves; and in the center were to be commercial, club and cultural places" (Jacobs, 1961.p.17-18), the town's population was to be capped at thirty thousand people to prevent any increase in its density. The Garden city was conceived as an "alternative to the city, and as a solution to city problems" (Jacobs, 1961.p.18). Tons of garden cities were built in England and Sweden, since world war two, and there has been various modifications of the idea that have been implemented in the United States, and the underlying principles behind the Garden City are still used by city planners and designers today. But are Howards Garden City and Corbusier's Radiant City enough to consider them 'Green architecture'? What is "Green architecture"? What make a 'green' building, house or material? Is it enough for Corbusier to place towers in a park?, or for contemporary architects to add solar panels on a building or placing undersized wind turbines on site, to minimize energy production? Or were designs like the Farnsworth House by Mies Van der Rohe and Falling Water by Frank Lloyd Wright more 'green' than the modern energy-efficient designs by contemporary architects? For me Farnsworth House and Falling water could be categorized as true green architecture because both demonstrated harmony between human habitation and the natural world through design techniques and ideas so complementary and 'well integrated' within their site. In Farnsworth house, the glass pavilion open facades, allow the landscape to become the walls of the design. It was designed to respond to its environment. Unlike other early modernist designs Mies Van der Rohe pays great attention to details like the sun and the wind when he was designing. Taking maximum advantages of solar lighting with the majority of the pavilion material being glass, he also considered environmental strategies like cross ventilation and seasonal changes in light and temperature. All of this allows the Farnsworth house to become part of its landscape, almost disappearing into its landscapes, and without compromising the architecture of the buildings aesthetics, function or purpose. Before Farnsworth House was Frank Lloyds Wright Falling Water. Wright designs shaped the "fundamental principles of integrating architecture with its context." (Jacobs, 1961.p.18). As far back as 1910 he was pioneering the environmental movement, when most architects were pushing the Modern Movement, long before the term 'green architecture' or ecology was in use when discussing architecture. Unlike other architects of his generation he understood the potential for buildings to "become extensions of their environment" (Wines, 2000.p.23) through techniques like creating forms which reflect the contours of surrounding topography and the "use of construction materials drawn from regional resources" (Wines, 2000.p.23), both the best examples which demonstrated Wrights ideas is the Falling Water. The falling water location of a water fall, gives it the illusion that the building is stretching out over a waterfall. Wright used stones from an old rock quarry for the walls of the house. Every aspects of the house from the interior to the exterior spaces emphasize a harmony between man and nature, a very important aspect of design with many architects ignore when designing. Although Wrights Falling Water gained huge recognition and attention from architects, and designers for may years, Wrights ideas fell out of favor and was replaced with the high rise of Modernism and its "fickleness and superficiality of stylistic vogue." (Wines, 2000.p.23).





*Fransworth House, Mies Van Der Rohe.*



*Falling Water during two different seasons, Frank Lloyd Wright.*

Wright's crusade for green, organic architecture declined after the Falling water and was substituted with "quick and easy cubes, cones, spheres, and nine-square grids of academic design" (Wines, 2000.p.25), and in some ways this ideology continues today. There are still tons of architects and architecture dominant which completely disregard the environment in their work. It is a time of ecological concern. We have all been warned by scientist and even politician over the past decade or so about the dangers of environmental neglect. The Building sector is responsible for nearly half (48%) of all fossil fuels and CO<sup>2</sup> emissions. Buildings are the largest contributors to climate change, caused from all the machineries during construction and all the electricity produced to operate the buildings. This contradiction has existed since the beginning of architecture. Even the most environmentally friendly shelter requires energy and produce CO<sup>2</sup> emissions. Therefore the health of the economy and ecology means a healthy, green building sector, where energy reductions is achieved through a reduction in fossils fuels, and lower greenhouse emissions, which "costs far less than building new energy sources such as coal, natural gas and nuclear plants"<sup>14</sup>. At the moment there is a strong drive and push towards green architecture. But often architects seem to believe that it is enough to simply

design a modern structure or building and then later incorporate a park or garden near or around it. Planting a tree or growing a garden in a building does not make it 'green architecture.' From the beginning of design projects, immediately after architects are hired by their client to design a "well-balanced building in terms of appearance, planning, construction, initial and maintenance cost" (Green. 1962.p.13), the architect should start to consider ways of implanting nature and the surrounding in their design, so that in the end when the built design is revealed, there is a clear dominance of cohesion between the architecture and the environment. There are tons of examples of buildings and cities that have already adapted and sometimes perfected this cohesion, for instance Reykjavik, Iceland. Iceland 'sits alone in the midst of the cold dark waters of the North Atlantic'. It is an island where with the current population of only about 320,000 and a total area of 103,000 km<sup>2</sup> (40,000 square mi), with around 200,000 of the populations residing in Reykjavik, the capital. Iceland is filled with an abundance of natural resources and phenomenon. It has 103,00km square of landscapes ranging from dramatic peaks to pastoral lowlands. Iceland is blessed with fishing stocks, pure water, a good grazing land, and cities like Reykjavik with the world's richest economies, and contented citizens enjoying a sky-high standard of living.

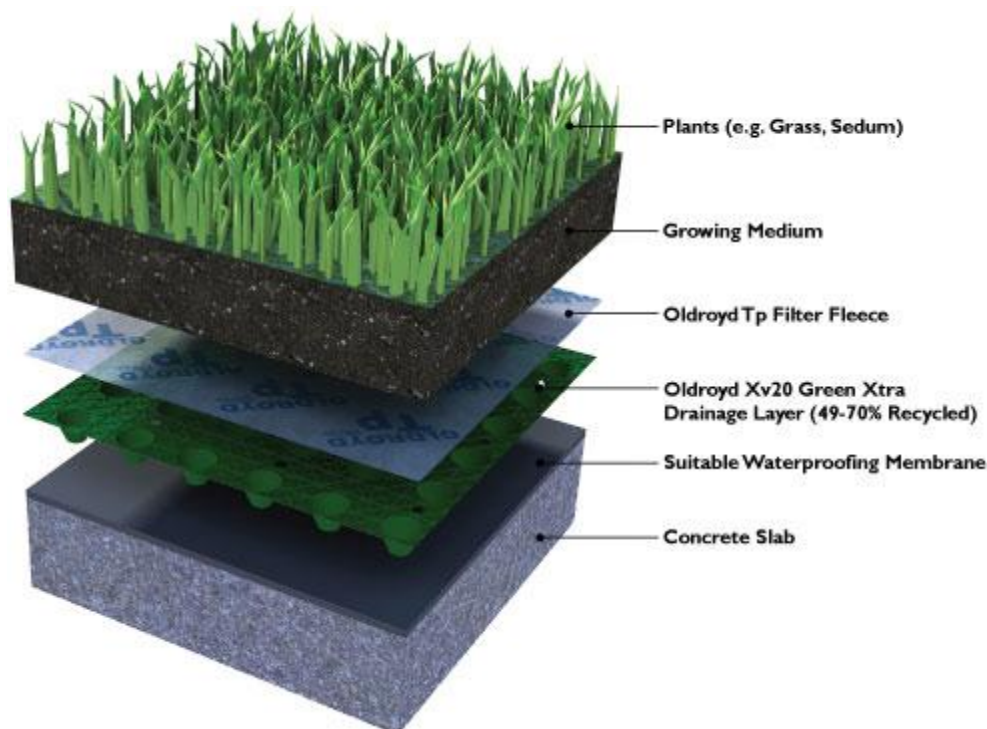


*Traditional Turf Houses now Museums at Skógar, Iceland.*

Because of Iceland location and proximity to volcanos, all of Iceland's electricity is provided by geothermal energy and hydropower. They have various geothermal plants around Iceland. The biothermal plants produce hot water and electricity to all homes in Iceland, and since Iceland uses hot water heating systems with many bath houses, swimming pools, and phenomenon like the blue lagoon which is run-off water from the biothermal plant, 95% of heating in Iceland is biothermal and hot water and expect to be energy independent by 2050. Icelanders emitted "6.29 tonnes of CO<sup>2</sup> in 2009 equivalent of greenhouse gases per capita."<sup>15</sup> Iceland is one of the few countries that have geothermal stations, so not only are they saving the planet with their low energy consumption, and CO<sup>2</sup> emissions, their energy bills cost incredibly less than in comparison to most power plants because there is no use to buy fuel or coal. Along with their large amount of renewable resources, Icelandic building materials is mostly regional material, implementing Frank Lloyd Wright ideas of using 'construction materials drawn from regional resources'. Their early architecture of grass and turf covered houses were a result of Scandinavian influences, extremely cold climate condition, as well as a lack of native trees on the island. The turf on the houses provided superior natural ventilation for the Icelandic people. Then later materials like stone and concrete became popular. Present cities like Reykjavik is



filled with houses made of traditional wooden frames, clad with corrugated metals painted in bright colors. Icelandic cities like Reykjavik are great examples of 'true sustainability', with buildings producing as much energy as it consumes. Unfortunately not every city is as lucky to be located on an island with so much renewable resources, like metropolitan city New York City. New York before late 20<sup>th</sup> century and the 21<sup>st</sup> century, city planning mostly involved the city's appearance, and building architecture that was the tallest, biggest, or most contemporary. As a result New York has benefited economically, it is one of the most populous, most recognizable, and the center of financial and cultural information. It was the leading city of modern architecture in the 20<sup>th</sup> century, with buildings like The Empire State Building built in 1931. Due to New York City's location, it is a major transportation and trade route, so almost any material has always been easily accessible to the city, therefore the 102-storey, 1252 feet, 381 meters high Art Deco skyscraper was made from materials like brick, stainless steel, limestone and other modern materials, and it has in all 6500 windows (glass). It stood as the world's tallest building for more than forty years, until it was replaced with the World Trade Center's in 1972, also located in New York City. Unfortunately cities like New York are the most common types of cities, where "as pavement spreads, nature is pushed farther away." (Wines, 2000, p.25), fortunately these cities have begun to take action, by planting additional trees, designing more parks within the city's landscapes, and designing new zero energy homes and buildings. New York City is also a leading city in 'Green Roof', so much so that "the city provides Green roof tax abatement from city property taxes."<sup>16</sup> With so many blocks or buildings with empty flat roofs, contemporary designers have decided to explore new ways of utilizing the roofs into useable green space. Roof designs can become a necessary part of a "network of sustainable systems for a green building [which help] to purify its connection with its surrounding environs"<sup>17</sup>, in cities similar to New York City. Green Roofs consist of growing plants and vegetables on rooftops, through an extensive system (which are often placed on top of roofs in trays or bags, usually having up to 6" of growing medium), or an intensive system which are a deeper installations "that include full continuous soil [anywhere from 8" deep and higher] over an integrated drainage mat"<sup>18</sup> and a waterproofing system. There are many environmental advantages to a green roof; they offer an insulating layer, which would help gather energy in the winter seasons and "reflect sunlight in the summer, reducing the heat island effect felt in urban centers"<sup>19</sup> like New York. They also generate biodiversity and can produce organic food production.



**Green Roof System.**

In 2010, as an addition to the "Green roof" initiative, New York City planned to include 'Blue Roofs', a project intended to achieve a cleaner city. Blue Roof involves the targeting of storm water managements, by installing weirs at the roof drain inlets and along any roof, which would "create temporary ponding and a gradual release of storm water"<sup>20</sup>. If both these sustainable Roof systems were implanted on every roof in New York, not only would it be a visually more attractive city, and an environmentally cleaner city, but as well statistics say it could save the city "2.4 billion dollars over 20 years"<sup>21</sup>. New York has managed to find a solution to urban cities using a combination of new high tech

materials, new design inventions, along with some old architectural knowledge. Unlike other sustainable designs Green Roof and Blue Roof is mainly dependent on residents, and their initiative to invest in roof systems, since it's meant to be used on already existing buildings, rather than building new blocks and adding a Green Roof.



*Floating Cities, Keon Olthuis.*

"But no matter how ecologically progressive our society becomes, demand for new housing is not going to dry up anytime soon." (Green. 1962.p.13). There has been many works by contemporary architects that can be considered legitimate examples of "true green" that could replace early modernist architecture. Designs like "floating buildings and aqua-ecture" by Dutch architect Keon Olthuis "pushes boundaries of possibility when it comes to the built environment"<sup>22</sup>, with designs for a future city on water filled with floating buildings. They have designed everything, floating apartments, a floating mosque, and even an entire floating community of islands for the Maldives. His floating architecture is a solution to recent flood devastation in Japan and New Orleans. His designs for floating apartments develop the "Floating city" idea, by gathering inspiration from Netherlands, a place that is half submerged below sea level. Olthuis flood resistant, floating buildings, is designed so that all the buildings "will be perfectly suited to float on top of rising and falling water."<sup>23</sup>. This idea of designing on water, in the future might help in designing for the "unforeseen effects of climate change [of rising sea levels] and urbanization"<sup>24</sup>. There have also been numerous designs for green architecture on land. A design located in the city of Ho Chi Minh (largest city in Vietnam), named 'Ha House' uses the idea of stacking Green House to create a home. The design is only 4meters high, but includes four full floors, the ground floor being a bedroom, pantry and exit to a patio, the second level is a living room and a kitchen, and the third floor has a second bedroom and bathroom, and finally with the last floor designated for an office. The design is inspired by typical architecture in the city. A walk around Ho Chi Minh will reveal the local cities customs of homes adorned with plants in pots. With the front and back façade constructed in layers of "concrete planters", with a height varying between 25cm to 40cm, depending on the height of the plant for each planter."<sup>25</sup>, this piece of architecture takes advantage of natural light, and "there's even a rooftop garden and two giant [sunroofs] to allow the light to flood in from above. The side walls consist of stacked 2cm slabs of granite, which display beautiful shadows from the sunlight entering through the various plant leaves."<sup>26</sup>. This design could be easily incorporated in many other metropolitan cities. "This stunning urban oasis offers peace and tranquility within its living walls."<sup>27</sup>



(left) **Ha House** exterior, Va Trong Nghia Architect. (right) **Ha House** interior.

In a period of an abundance of recent ecological designs, and research, there are still attacks on current city architecture and planning. This dissatisfaction makes it is hard to decide which one is the best, which design is truly green. However with all these new technology in contemporary building and construction, it can be proven that “virtually no form of shelter constructed today can be credited as authentically green”.(Wines, 2000.p.226)

The future of Architecture and the environment is restoration and rebuilding the present conditions in cities before building new architecture. Rebuilding left-over mass produced buildings from the 19<sup>th</sup> and 20<sup>th</sup> century as in the near future most of these building from the past will be derelict due to a combination of age and the continuing effects from the economic crash of 2008, which left many homes, office, recreational centers in various cities around the world empty, abandoned, or stuck in mid construction. There’s so much potential in all these forgotten spaces to design a new space which incorporate and respond to their present landscape and environment. It’s a great opportunity for architects to invent and change the way of designing. In every century the various architectural forms are developed and are incorporated into the next century, now in the 21<sup>st</sup> century we have an abundance of architectural form and environmental knowledge that architects should develop and incorporate into existing cities. We should halt the modern idea of always building and buying something new something better than the previous years and instead focus on achieving truly sustainable architecture which will depend on the re-creation of empty homes, offices, skyscrapers to “unite conservation technology with an earth-centric philosophy.” (Wines,2000.p.237).



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