The Importance of Better Buildings

Natural Solutions in a Modern World

Graham Cavalier

Supervisor: Chris Cavanagh

A Major Paper submitted to the Faculty of Environmental Studies in Partial Fulfillment of the Requirements for the Degree of Master Of Environmental Studies, York University, Toronto, Ontario

July 2015

Foreword

This major paper is the culmination of my Plan of Study for my Masters of Environmental Studies. The five sections of this paper directly relate to the four components and objectives in my Plan of Study. Section 1 of this major paper directly relates to Objective 1: *Critically examine Industrialized Building Practices*. Sections 2 and 4 of this major paper relate to Objective 4: *Show how Buildings Connect With Myriad Aspects of Society*. Section 3 relates to Objective 2: *To Show How Rammed Earth and Other Alternative Building Methods Can and Should be More Broadly Developed in Industrialized Societies*. Section 5 and the appendices relate to Component 3: *The Importance of Education Within Alternative Building*. The courses and independent directed studies done during my time at FES have all in varying degrees contributed to the research for this major paper.

Abstract

Shelter is a human necessity, a concept that has evolved throughout history. The current industrialized world's concept of housing is just another stage, albeit a pervasive one, in the evolution of shelter. This current stage is unsustainable, however, as it uses an unnecessarily large number of resources and pollutes the atmosphere with carbon and other harmful greenhouse gas emissions. Fortunately, there are alternative forms of building to respond to the issues created by the current built environment and limit the impact caused by buildings. Embracing these sustainable techniques is the next step in the evolution of shelter.

The challenge therefore lays in creating and raising in the broader public an awareness of the harmful effects of current building practices. As part of this process, significant questions must be posed. For example, how and why are buildings, particularly suburban tract housing and skyscrapers, constructed the way they are currently? What are the effects of these structures on society, both from a climate change perspective as well as from a human happiness perspective? What role does the profit motive play in driving the construction of suburban houses and skyscrapers? What are the ramifications of current society remaining heavily dependent on the extractivist industry as it moves forward?

Answering such questions and subsequently setting out specific criteria to be followed in the construction of any building and demonstrating how using natural materials meet these criteria are key in creating a much healthier built environment. If alternative buildings were constructed more widely in the industrialized world, it would

create a more sustainable society in many ways, not the least of which by altering the guiding philosophical principles that have contributed to what has become a heavily consumptive way of life.

Bringing better building techniques to the forefront of the construction industry is the challenge, and education is the key tool in meeting this challenge. Everyone involved in the alternative building industry is to some degree a teacher and as such must be prepared to effectively promote learning about a more sustainable life, not just to potential clients but to society at large.

Table of Contents

Section 1: The Problem

Buildings are responsible for 30 percent (Klein) of global carbon emissions. The standard construction, operation and maintenance of buildings, especially in the industrialized world, are harmful to the physical environment. The design and construction methods used to build skyscrapers and conventional stick-frame homes incorporate highly processed materials and require large amounts of energy to heat and cool, all of which contribute to climate change and negatively affect people's physical and mental health. Although these buildings are compliant with local building codes, the standards specified in the codes represent the minimum requirements for energy efficiency and offer no encouragement for designers to exceed those standards. In effect, present building codes do little more than reinforce mediocre building methods. To help curb climate change, we must construct our buildings in such ways that they use less energy during the building process as well as throughout the building's lifespan.

Design

Heating and Cooling

The heating and cooling of buildings creates a massive carbon footprint in Canada and the rest of the industrialized world. The dependence on fossil fuels for heating and cooling of the overwhelming majority of Canadian buildings is considered a given in Canadian building codes. As a result, unsurprisingly, buildings are reliant on heavy energy use to remain temperate: “The heating and cooling of buildings – both residential and commercial – accounts for 14.6 % of

Canada's total greenhouse gas emissions" (Natural Resources Canada, 2010). Moreover, when each individual building is considered, the need for change is even clearer:

> Heating & cooling energy represents 75–85% of the total life-cycle environmental impact of a building in Canada, so our singular priority for achieving sustainable buildings must be a dramatic reduction in their energy use (Passive House Canada).

Although the construction process itself can create a sizeable carbon footprint, the overwhelming majority of the environmental impact is caused by the energy intensive methods used for the heating and cooling of a building, due largely to poor construction, design and building methods.

Whether oil and gas are burned directly in a building's furnace or fossil fuels are burned to create the electricity to power heaters and air conditioners, most contemporary Canadian buildings are dependent on fossil fuels to remain at comfortable temperatures. This is mainly because the building envelopes, in other words, the walls, floors and roofs of most buildings, are neither air tight nor well insulated:

> If the power goes out, envelope measures will still protect the home's occupants, whereas mechanical systems will be of no value. A modern, well-insulated and sealed Canadian home can provide shelter during the most brutal weather conditions - even if the entire mechanical system is disabled by a power outage or some other catastrophic event. The better insulated and more airtight the envelope, the better the protection which the house can provide during such events (Proskiw, 2014).

Ontario's building code, like all building codes, does prescribe a minimum R value that must be achieved. R value refers to resistance value: the more insulation, the more ability a building has to resist the temperature outside. However, the specified R values are not high enough to combat the harsh Canadian winter without the aid of a furnace. For

example, the Ontario Building Code specifies R50 for the ceiling, R22 for walls and R12 for the basement (OBC, 2012). Although air tightness is not enforced, "prescriptive paths" are proposed so that buildings allow only three air changes per hour (or ACH). Compared to any well-insulated, alternative building, these R values are very low and the ACH are very high. For example, a house built to Passive House standards would have R values at least three times higher and have less than one ACH. Clearly, the Ontario Building Code, like most North American codes, presumes the use of a furnace and air conditioners for any newly-constructed building.

For the majority of Canadian buildings, the materials used should have a higher insulative value and builders in turn must consider issues like above code R values and air tightness in the planning stages of a building as described by Passive House Canada:

> Depending on the climate zone, houses built in Canada will likely need between three and seven times better insulation performance than that provided by current national and provincial Building Codes, in order to achieve Passive House performance. The designer must ensure complete insulation coverage for all parts of the building shell i.e. thermal bridge-free design (Passive House).

Such is the poor situation presently regarding the built environment in Canada. For most houses the R value would have to be at least three times higher if the building were not to rely on fossil fuels for heating and cooling.

The design and materials used other than the insulation also greatly affect the R value of a given building. This is very clear when considering the materials in modern high rise construction:

> The glass isn't in the wall, it is the wall, and that's a real problem... Glass has a very low insulating value, it's equivalent to a couple of sheets of cardboard. It also is totally transparent to the sun so the apartments can really heat up in the summer time,

> requiring the air conditioning to be running a lot and in the winter they are very uncomfortably cold anywhere near the windows because there's no insulating value (Alter, 2014).

In any building, glass will have comparably the lowest R value of any material used. This makes its use as the primary wall system of a building highly impractical and there would be no way for one of these buildings to remain at an inhabitable temperature without added heat in the winter and air conditioning in the summer. Thus, from the outset, skyscrapers are extremely expensive to heat and cool and highly energy inefficient.

Although the heating and cooling within houses and low rise buildings is inefficient, there are particular reasons why skyscrapers use exponentially higher levels of energy than other buildings:

> The higher the building, the higher the windspeeds around the building, the more difficult to keep the wind out, and the more the wind pressure on the envelope sucks heat from the structure, particularly as with many twentieth century tower blocks the envelope leaks. The higher the building, if standing alone, the more exposed to the sun it is and the more it can overheat. And hence the higher the building the more it costs to keep the internal environment comfortable (Roaf, 244).

Skyscrapers are an excellent example of how a building's design can heavily influence the efficiency of a building. Every aspect of a skyscraper makes it inefficient. Its height and use of low quality windows as outer walls only add to heating and cooling costs.

The overall reliance on air conditioners in all modern buildings is also extremely troubling. Not only do AC units require a massive amount of energy to continuously run, they also lower the quality of the air inside the buildings they are cooling:

> Indoor air quality can be worse in an air-conditioned building than in a comparable naturally ventilated one. Worryingly, researches are finding that the filters, ducts and

> plant of air conditioning systems are often filthy, introducing air that is dirtier than if one simply opened the window, even in the city (Roaf, 218).

With the proper design and use of appropriate materials, most buildings would not require furnaces or air conditioners to maintain a controlled temperature. Not only would eliminating this equipment keep the running costs of a building lower, but it would also create a smaller carbon footprint, all while improving the air quality within these buildings.

Suburban Houses

In the period after World War II, factories began to mass-produce building materials, leading to the quick construction of a massive number of houses. However, this phenomenon came at a price. Maximizing the number of houses built meant that the amount of planning going into each individual house was minimized. This in turn not only affected the quality of these buildings, but led to troubling psychological effects on the people living in them:

> More buildings will be built during the next ten years than have accumulated since the beginning of civilization. Unfortunately, it is just such a situation as this that all considerations of quality, all efforts at meaningful planning may be swallowed up in the demand for quantity (Moller, 1968, 11).

As the mass-production of houses continued to grow, especially during the 1970s, the diminishing quality created a troubled relationship between houses and occupants. In fact, lack of planning, mass-production and the low quality of houses continue to this day as the central problems associated with stick-frame suburban construction.

The uniform method used to build stick-frame suburban houses has also created a built environment that feels lifeless. Christopher Alexander suggests that for a building or a town to be alive it must emulate nature. The mass production of suburban houses, however, creates a built environment that is uniform and unnatural:

> (Within nature) each part is slightly different, according to its position in the whole. Each branch of a tree has a slightly different shape according to its position in the larger tree. Each leaf on the branch is given its detailed form by its position on the branch (Alexander, 1979, 367).

Nothing in nature is completely uniform. Diversity is what keeps nature alive, and likewise the standardized method of constructing suburban houses makes for a dead built environment.

Because suburban houses have a perceived "perfection" about them, they can never truly be built in a way that they become alive. Instead, the idea of perfection in the built environment must be replaced with one that emulates the natural world:

> A building in which angles are all perfectly right angles, in which all windows are exactly the same size, and in which all columns are perfectly vertical, and all floors perfectly horizontal, can only reach its false perfection by ignoring its surroundings utterly. The apparent imperfections of a place which is alive are not imperfections at all. They follow from the process which allows each part to be fitted carefully to its position (Alexander, 152).

Uniqueness should not be seen as imperfect, but rather as one of the important elements making a building feel alive. Unfortunately, the current philosophy guiding the construction of stick-frame houses is one that promotes mass-production and "perfect" duplicates and leaves people feeling uninspired by the resulting lifeless built environment.

Another major reason why suburban developments seem lifeless is the uniform nature of the materials used in these houses. Driven by the profit motive, designers and developers want to minimize the labour needed for any given project but still ensure that there is a uniform "quality" to all of the buildings. This means that standardized parts created for subsequent assembly are made in factories:

> We try to turn out really technical parts that we'll just have some technicians put together. They're prefab. Talk to any architecture student... they want to be able to have precision control over their materials, they want to be able to deliver it, have it assembled on site with as little labour as possible and they believe that that gives them the surest chance of realizing the building that they have designed (Krahn, 2015).

When a standard design is followed using standardized materials, and little to no decision making authority is given to the builders, there is very little room for creating uniqueness and this limits the ways that natural qualities might be brought to the construction of suburban houses.

Skyscrapers

When multi-storey buildings are constructed, they create many negative effects, not just from a climate change perspective, but also for the buildings surrounding them and the people living in them. Because they are so tall, they infringe on access to sun for neighbouring buildings. This is a current problem for occupants of buildings near skyscrapers, and it will become increasingly more problematic as solar energy becomes more heavily integrated into the urban context. Sue Roaf explains the scope of this problem:

> The shadow cast by a two-storey building is larger than the shadow of a one-storey building of identical floor plan by 2%. A building of 16 storeys casts a shadow 43%

> larger than a one-storey building, at noon on the winter solstice. A high-rise building will cast a shadow over a huge area of a city, affecting the light and warmth and ability of the shadowed building to generate solar energy (Roaf, 246).

As high-rise buildings take up more of urban skylines, the shadows cast by these massive structures rob sunlight from much of the low-rise buildings in the downtown core. A large number of skyscrapers on any given street also becomes an issue for the pedestrians and cyclists on the street below as the tall buildings create wind tunnels that push colder and faster winds down to the ground level.

However, it is not just the space surrounding skyscrapers that is negatively affected. The mental health of the people living in skyscrapers suffers compared to those living in low-rise housing:

> Studies were done evaluating and reporting on the often chronic problems amongst tower dwellers, including many psychological and social problems, such as slower motor development in children who are prevented from spending time outside without adult supervision; distress and alienation, especially amongst groups of certain ages or genders who spend many hours indoors (Roaf, 242).

The height of these buildings can lead to feelings of alienation for those living in them. Because inhabitants live so far above ground level, it becomes more difficult to spend time outside. This negative effect on the psychology of high-rise dwellers demonstrates that humans need a connection with nature within the built environment, and the unnatural scale of skyscrapers removes inhabitants from a more natural human scale.

Materials

The heating and cooling of conventional buildings are not the only ways that they contribute to climate change. The materials used in conventional buildings also cause environmental degradation in a variety of ways. For example, most conventional materials such as dimensional lumber, concrete, vinyl siding and bricks are heavily processed and their production causes carbon emissions. The quality of these materials has also degraded over time thus shortening the lifespan of most contemporary buildings. As an example, dimensional lumber has degraded over time. A 2x4 was originally 2" x 4". Today, however, a standard 2x4 is 1 1/2" x 3 1/2". As well, the quality of the wood has diminished over time. To meet growing demands for lumber over recent decades, lumber companies have been harvesting more new growth wood, wood with fewer rings that is more susceptible to warping and has less strength. Moreover, lumber and most other conventional materials are produced in a polluting fashion:

> The extraction, manufacture and transportation of building materials are major contributors to global environmental problems. Manufactured products are often toxic...they also create enormous waste-disposal problems (Smith, 2002, 1).

The environmental issues caused by conventional building materials run more deeply than simply contributing to climate change. Clear cutting of forests, water contamination and pollution from industrial processes are also side effects of the production of standard building materials.

Many of the conventional building products used in stick-frame houses and skyscrapers carry high embodied energy. Embodied energy refers to the amount of energy used to create a product before it has even been incorporated in the construction process.

This means that every step in the building of a conventional home adds more carbon to the atmosphere as well as causing environmental degradation in other ways:

> The trail from clear cut to sawmill to building site is easy to follow. Other major building components depend on destructive mining: gypsum for plasterboard; iron for hardware, rebar and roofing; lime and other minerals for cement. Every material used in a typical modern building is the product of energy-intensive processing. The mills that saw our lumber, the factories that make plywood and chipboard, the foundries that make steel, the plants that turn natural materials into cement by subjecting them to enormous heat- all consume vast quantities of power, supplied either by the combustion of coal and oil, the damming of rivers, or the splitting of atoms (Smith, 7).

This simple overview only begins to show the ways that conventional builders do not consider the environment when using materials such as concrete, dimensional lumber and glass and how each of these materials in its own way contributes to climate change.

Concrete

Concrete is a material used in almost all buildings either solely as the foundation, or as an entire wall system itself. Although it has unparalleled strength as a foundation system, the extensive use of concrete is unsustainable, impractical and creates an unattractive grey built environment:

> Concrete is a perfect example of the kind of energy-intensive building material that has led us to our current environmental state. The production of the Portland cement that is the “glue” in concrete requires using large quantities of fuel to heat limestone to very high temperatures to change its chemical composition. In the process the carbon dioxide trapped in the stone is released into the atmosphere. Cement manufacture is one of the world's leading sources of greenhouse gas emissions (Magwood, 2014, 1).

With an environmental record like this, it seems clear that the building industry should at least attempt to minimize its use; however, the use of concrete continues for wall systems

and not just for foundations. If an extremely heavy wall system such as rammed earth is being built, concrete may be the only option to provide the necessary strength for the foundation. However, there are very few wall systems that have a weight necessitating the use of concrete. And using concrete as a wall system is ridiculously wasteful with so many better, more environmentally-friendly alternatives available.

However, despite its strikingly high carbon footprint, dull appearance and limited R value, concrete is still a widely used wall system. This is especially true in the construction of skyscrapers, most of which use concrete for the parking garage, supporting pillars, floors, walls and the structure for the roof. The Simcoe Place skyscraper in downtown Toronto used "135,000 tonnes of concrete. More than 1800 tonnes (was) placed in the core at the base in a single day" (Gooderham, 53). When this amount of concrete is used in the construction of just one building, it is very troubling to consider the amount of concrete being used every day globally and the subsequent detrimental effects on the climate. Because of its unparalleled strength, forgoing the use of concrete entirely may not be an attainable goal throughout the entire building industry. However, using it only when it is the most appropriate choice would certainly help to limit the carbon footprint created.

Wood

Wood is the dominant building material in the suburban stick-frame house. Wood is used for the wall frame, floor joists, floor sheeting, roof joists and the roof sheeting of most houses. As the National building code of Canada explains it:

> Wood frame construction is the most common construction type used in Canada for single-family homes, row housing and low-rise apartment buildings. The National Building Code of Canada (NBC) permits builders to use wood to construct buildings up to four storeys high (CMHC, 1999).

If sustainably harvested and used in moderation, wood need not be a particularly carbon intensive material. Unfortunately, using the amount of wood that a stick-frame house calls for in every new home creates unnecessary deforestation, and because so much wood is needed to meet these demands, as explained earlier, the quality of the lumber continues to diminish as more new growth wood must be used to meet this demand.

If a variety of materials other than wood were incorporated in the building of the single family dwelling, the source and quality of wood used during the construction process could be monitored more effectively and deforestation would no longer have to be an issue. But unfortunately, within the current building industry "resources are not always harvested responsibly (and elements of the building) may not be an efficient use of wood material" (Magwood, 135). Wood is an effective and potentially sustainable building material, but the more it is used, the harder it becomes to track its source. This means that there is a huge potential of an increased carbon footprint from shipping large distances, as well as a larger chance that deregulated clear cutting could have been the source of lumber for any given construction job. If wood were only used for elements of a construction process that maximized its potential such as rafters, roofs and floors, but not as walls, sheeting and ground floors, then its use would be limited, thus more heavily regulated and its source more easily traced.

Glass

Windows are a very necessary element in any building. Windows not only allow natural light into a building but also often open to allow fresh air into a building. They are also a necessary component for properly maximizing thermal mass. Unfortunately, the majority of windows used in Canada have very poor R values and raise the level of energy needed to heat and cool a building. The reality of the situation surrounding windows is explained by the Canadian Passive House group:

> As the thermally weakest part of a building envelope, windows are a critical component, often representing 50% of all heat loss in a building. The quality of the windows is also critical to interior comfort, and in a Passive House the interior glazing and frame surfaces need to remain warm enough on cold nights to minimize interior cold spots and downdrafts. In all parts of Canada triple glazing is essential to achieve this, using two low-e coatings and argon (or krypton) gas fill, as well as insulated spacers. It's also critical that window frames are insulated (Passive House).

Windows in Canada tend to consist of two panes of glass, rather than three, and the building code does not require window frames to be insulated. This leads to much of the energy used to heat and cool buildings exiting through the windows, wasting precious resources, polluting the atmosphere and keeping energy bills high. The problem with double-paned glass becomes more obvious when its use as the entire wall structure in high-rise buildings is considered.

As discussed earlier, skyscrapers using floor to ceiling glass are very difficult to heat in the winter and almost impossible to keep cool in the summer. The quality of the glass used in these buildings also makes their lifespan extremely problematic:

> What happens after about ten or fifteen years is that the argon gas that they put between the two panes of therma-pane glass leaks out and the glass becomes ineffective even as the insulative value it is. So the glass has to look at being

> replaced... The metal expands at a different rate, then the gaskets start leaking (Alter, 2014).

The use of poorly insulated floor-to-ceiling windows mean that these buildings, which already have an extremely low R value, lose whatever insulation they have and require replacement glass. This adds to the carbon cost of a building because instead of adding a third pane of glass in the initial building process, which would add marginally more embodied energy to each window, the interim costs of keeping the building temperate would be negated and the lifespan of each window would be greatly increased.

Like concrete and wood, glass is an important element in a building. However, its use should be limited and only the highest quality of window should be used to ensure that its embodied energy is counterbalanced by the thermal benefits bestowed on a building and the extended lifespan of each window. When used in moderation, even the most carbon intensive production processes begin to have more limited environmental impacts. The materials that are used in any building are extremely important. The consideration that goes into the larger environmental implications of those materials should be deemed equally important. If builders and designers considered moderation and incorporating an appropriate variety of materials, buildings would look very different and create a significantly smaller carbon footprint.

Conclusion

The two dominant styles of residences in our current industrialized society have a variety of negative effects on the environment. The heating and cooling of these inefficient

buildings requires a massive amount of energy, mostly provided by fossil fuels. This means that the construction, heating and cooling of buildings globally accounts for a staggering 30% of carbon emissions. Because building codes do not demand air tightness and only specify a very low R value as a minimum, builders are allowed to continue to construct poor quality buildings. The fact that this type of construction continues is particularly troubling when the negative effects on mental and physical health of the inhabitants of these buildings are examined. Moreover, the overuse of concrete, wood and poor quality glass leads to environmental degradation. Each of these materials has its use in any building but its overuse leads to higher carbon emissions and poorly constructed buildings. Clearly, industrialized societies must build more efficient buildings to keep carbon footprints low, and thereby minimize their contribution to climate change.

Section 2: Causes & Effects

As is widely seen in the present conventional building industry, the notion of a constant growth economy is antithetic to environmentalism. It should be obvious that time, effort and money must all be spent if a specific product is to be made properly. “Cheap” products may save individual consumers money in the short term, but in the long run quality takes time, and by extension, money. The profit motive cannot continue as the sole driving force of the building industry. Environmental concerns must be central to the equation if carbon emissions are to be curbed and climate change negated. However, for the present, capitalism shapes the types of buildings constructed in the industrialized world, and invariably, the quality of the buildings drops as profits go up. As well, the extractivist industry continues to work diligently to keep its profits up and the industrialized world dependent on fossil fuels. For example, the phenomenon of the urban/suburban divide feeds industrialized society's dependence on oil and gas corporations. Capitalism is not an ideal system for human fulfillment. The disconnect that individuals feel from their own labour in industrialized societies and the “developed”/ “underdeveloped” dichotomy both perpetuate global capitalism and are side effects of the constant growth economy.

Causes

Stick Frame Houses

As discussed earlier, stick-frame suburban homes have become the most common type of house built in the industrialized world. This is not because they reflect the highest quality of buildings available, but because they are the most inexpensive for a developer to build and the easiest to replicate. The typical suburban model is to construct a large number of stick-frame houses following a similar design. By using a similar design for each of the houses, developers can have architects and engineers do the work for multiple homes just the once. This is significantly less expensive than hiring these professionals for every house separately. The downside to this design approach, however, is explained by Christopher Alexander:

> On the housing market, personal and individual houses are always worth more than mass-produced houses. When you buy such a house, it fits you better, *not* because you are a person who created it, but simply because a *particular person* created it. This simple fact in itself is enough to guarantee that the places in the house are more real, better adapted to use, and more closely in tune with the actuality of living, than any house created impersonally for the mass market, by the designer (Alexander, 1975, 49).

This suggests two things: individuals living in a one-design-fits-all stick-frame house will never feel fully satisfied with the home they live in and developers will always be able to keep their prices lower than that of a custom house designed specifically by an architect or a prospective owner. Although design is not the most expensive element in building a house, removing it from the equation of the suburban house allows large-scale developers to minimize costs and maximize profits.

The method by which suburban stick-frame houses are built also allows developers to keep costs low and profits high. By constructing houses that just meet the minimum code requirements, mass production becomes easier, and houses can be built very quickly, minimizing labour costs and again, allowing for higher profit margins. The Canadian Society for Civil Engineers explains how suburban development occurs in the Greater Toronto Area:

> The majority of houses (in the Greater Toronto Area) have been constructed by large "tract" homebuilders in accordance with the current Ontario Building Code (OBC). Under such production conditions, emphasis is placed on achieving the lowest initial capital cost. However, an economic and energy consumption analysis will show that the lowest capital cost is not necessarily the cheapest option for the prospective homeowner (Canadian Society for Civil Engineering, 2005).

Despite the fact that this approach to development may not be the most cost effective for the homeowner, prospective buyers may not be thinking about how a more energy efficient house would save them money through energy bills over time. Also unfortunately, many prospective homeowners only see houses as finished products; they may never be given the opportunity during the initial construction phase to purchase a more energy-efficient house.

When builders use standard designs, little time has to be wasted stopping production and considering next steps. This approach turns the potentially beautiful art of building into little more than repetitive, factory-style work. This in turn has much to do with how labour is viewed within the construction industry. The undervaluing of workers' skill becomes clear when there is a technical problem on a work site. Structural engineer Tim Krahn explains:

> There's always still an issue and if you've got skilled people on site, you can potentially end up with a better building because you don't always see everything when you're sitting at your computer. Even with good 3D software nowadays you still don't technically have a three dimensional realization and that on site skilled labour, not just labour but skilled labour, skilled trades, guild members are going to be able to realize better things with materials than prefab (Krahn, 2015).

It is difficult for an individual to feel pride in his or her work if there is little stimulation during the workday. Contractors and their workers do their work quickly so as to maximize profit on their contract, and the developers benefit from creating a race to the bottom with contractors' quotes. In this style of building, a very small amount of the money being spent on building these houses ends up with the workers who are the ones who ultimately should be ensuring the quality of the houses. If speed is more important than doing a job well, problems are “solved” quickly and the quality of the houses is likely to suffer. The initial cost of buying such a house, however, remains comparatively low for the homeowner, with the majority of the profits going to large tract developers.

When earning a substantial profit is the sole motivation behind building houses, the lifespan of the houses shortens greatly and the cost of upkeep becomes incrementally more expensive for the homeowners as time passes. The average lifespan of a contemporary stick-frame house is estimated to be between 30 and 50 years (Easton, 2007, 70). This fact is a troubling one for myriad reasons. First, if one of these houses is actually going to last that long, it will require homeowners to spend money both on general upkeep as well as on structural renovations. Secondly, when compared with many other building approaches, even techniques accepted in the building code, 50 years is not a long time at all for a building to stand. Lastly, there are currently stick-frame houses

that were built well over a hundred years ago that are still in better condition than many contemporary suburban homes, suggesting that the quality of work and materials going into building houses has greatly diminished over time.

As houses are currently mass produced solely to maximize profits, developers are likely only to fulfill the minimum building code requirements. This means that the longevity of houses is likely to become shorter and shorter as the disposable nature of for profit building has become a given within the building industry:

> While it drives GDP it's just a race to the bottom. You have the same thing that creates the low bid culture also creating a twenty year life cycle for low grade light industrial, light commercial. We just set out these rectangles that we know we are going to replace. You just put that into the budget and pass those savings on to the consumer and it has nothing really to do with craft or health or appearance. It just has to do with the profit margin (Krahn,2015).

As the quality of buildings diminishes, occupants become more inclined to just tear them down and build new. This approach creates more waste, but it also creates more profit for builders. It is a further demonstration of modern buildings being built for profit, not for environmental or aesthetic reasons.

Skyscrapers

In the urban landscape, skyscrapers are also built to maximize the profits for developers. Although the initial cost and upkeep of these massive buildings is very high, profit is still realized because there are hundreds if not thousands of occupants who either buy, lease or rent their buildings. When the square footage at street level is considered, there is no other residential building that can bring in as much revenue as a skyscraper. However,

when skyscrapers are considered from any other perspective, they make very little sense. In fact, high-rise apartments bring a multitude of problems:

> High buildings have no genuine advantages, except in speculative gains for banks and landowners. They are not cheaper, they do not help create open space, they destroy the townscape, they destroy social life, they promote crime, they make life difficult for children, they are expensive to maintain, they wreck the open spaces near them, and they damage light and air and view (Alexander, 115).

Despite all the negative impacts skyscrapers have on their surroundings, the speculative gains for banks and landowners are given priority and as a result, massive numbers of highrise buildings are constructed in the urban landscape, leaving many of their residents with the high costs of utilities and upkeep.

The desire to maximize each square foot of property for capital gain is obvious with the description of a new style of concrete:

> The improved concrete has reduced the size of the building's supporting columns, which would otherwise have been uncomfortably large. The result is a real-estate agent's dream: there will be more leasable space in the tower offices, in the shops on the building's concourse and ground floor and in the underground garage (Gooderham, 53).

As discussed earlier, cement is the element in concrete that has the most embodied energy and thus causes the most environmental degradation. Despite this fact, however, concrete with a higher cement content is being used because it allows for making thinner walls, thus maximizing usable space per square foot. Clearly the idea of creating 'green towers' is an impossibility.

Green building requires longevity in a building's life cycle. Because the upkeep for a skyscraper is so difficult and so much heavily processed material is used in the first place, there is no way that a skyscraper can be truly sustainable:

> You simply can't have 'green towers' because they use too much of the Earth's rapidly dwindling raw materials, they cost too much, their impacts are too great for small areas and in most cases they don't retain their value as well as, or for as long as, lower less polluting buildings. (Roaf, 243).

Because skyscrapers will never be part of a sustainable built environment, the only viewpoint that makes sense of their construction is a shortsighted profit motive. It is obvious that longevity is not at the heart of decisions regarding skyscrapers when the life cycle of these buildings is investigated. In her book examining the building of a skyscraper in downtown Toronto, Mary Gooderham discusses how quickly the city's skyline can be transformed: “Sometimes a building lasts only a matter of decades before it is torn down, prompting few protests because a relatively recent structure seems to have little historical significance” (Gooderham, 17). It is an appalling waste of the earth’s precious resources when the massive amount of material going into a skyscraper stands for only a few decades.

Considering the huge number of downsides for skyscrapers, it is clear that even when high density living is the goal, skyscrapers are not the appropriate solution: “In any urban area, no matter how dense, keep the majority of buildings four storeys or less. It is possible that certain buildings should exceed this limit, but they should never be buildings for human habitation” (Alexander, 119). Buildings erected to the height of four storeys or less keep the urban environment feeling within a human scale. As discussed

earlier, skyscrapers can leave people feeling psychologically unstable and can give cities a sense that they are not made to a human scale. This is particularly ironic given the fact that cities and the tall buildings within them are made by people, supposedly for people. Buildings should be made to leave people feeling secure within their living environment, not alienate them from those surroundings.

Extractivist Industries: Creating Reliance for a Profit

As discussed earlier, the industrialized world relies heavily on oil and gas for heating and cooling. In turn oil companies are diligent in ensuring the continued exploitation of this dependency for their own profit. Despite the environmental issues caused by the burning of fossil fuels, "[f]ossil fuel corporations can be counted on to resist any new rules that cut into their profits" (Klein, 113). This resistance is usually geared against increased environmental regulation or corporations having to pay a larger portion of tax. In fact, "not only do fossil fuel companies receive $775 billion to $1 trillion in annual subsidies, but they pay nothing for the privilege of treating our shared atmosphere as a free waste dump" (Klein, 70). Fossil fuels are seen as so necessary for the functioning of industrialized societies that wealthy corporations can in fact take money from governments, rather than pay governments a fair tax rate. In effect, these companies use the dependence on their product to continue resisting regulation and keeping tax rates low while maintaining high profits.

The Alberta tar sands are an excellent example of the great depths that oil companies are willing to sink to continue profiting off society's need for energy. When the devastation to landscapes, drinkable water, and air quality are considered, it becomes clear that the planet can no longer sustain the forms of extraction that the oil industry currently employs:

> Oil and gas drilling throughout the province (Alberta) has laid waste to countless wetlands. The biggest destruction so far is in the region of the oil sands. Here, oil companies have destroyed thousands of acres of boreal forest wetlands, including rare fens. The boreal forest represents three to four thousand years' accumulation of peat, with pine trees surrounded by wetlands, natural canals and shallow lakes. Many of the wetlands have been plowed up and drained in order to get to the oil sands beneath (Marsden, 111).

With this much destruction wreaked on the environment simply to keep our society running on oil, it is clear that new solutions must be explored in all facets of society to minimize its use. Hence it is of the most pressing importance to create sustainable buildings that do not require the use of oil or electricity to remain temperate year round.

Effects

The Suburban/Urban Divide

Heating and cooling buildings with oil in industrialized societies, is just one part of a larger system that is entirely dependent on oil in order to continue. The divide that is created between urban centres and suburbs also cements society's dependence on oil. And this issue is becoming paramount as more people move to urban/suburban areas: “The United Nations Population Fund (UNFPA, 2007) asserts that 50% of the world's population of over 6 billion live in urban areas and by 2025 two thirds of the world's population will be living in cities” (Hammond, 2012, 33). As the world's population becomes more urban, it is increasingly more important that housing and transportation become less reliant on oil. One solution would be to break down the divide between urban and suburban settings and develop what is described as green urbanism.

The concept of green urbanism focuses mostly on the idea of cutting down on vehicle use. For this to occur the notion of integration must be embraced. The idea is to change the traditional urban setting as that where people work and the suburbs where people sleep to the paradigm of people living close to where they work. This means that neighbourhoods would have to be more heavily integrated and the entire urban/suburban landscape would have to take on a mixed use approach:

> The solution to the climate change and energy challenge does not necessarily pit suburb versus city; rather, it requires their reintegration into sustainable regional forms... Both must co-evolve into more integrated forms, establishing a seamless interface (Calthorpe, 5).

Integrating regional forms would have a huge influence on the number of vehicles used daily. If everyone were able to walk, bike or take public transit to work every day, then the carbon footprint caused by transportation would be greatly reduced. This would also allow households to go without owning a vehicle, and with the savings on car insurance and upkeep there would be more money available to renovate houses to become more energy efficient, thus further limiting the use of oil in industrialized societies.

The concept of compact neighbourhoods is also very important to investigate. Obviously, there is a finite amount of space available on Earth, so constant expansion is inherently unsustainable. Calthorpe uses the analogy of food to explain the difference between urban and suburban layouts:

> Urban neighbourhoods are like healthy diets: they build on unique places and local history, they use natural ingredients and mix them well, they tend toward local sources, and they are lean. America's postwar suburbs are like fast food: their history and sense of place trumped by mass production; their ingredients dominated by a few generic staples; their resources distant and large; and their infrastructure highly subsidized. Our urban footprint—its physical size and resource demands—has expanded in unsustainable ways for too long (Calthorpe, 5).

This description is an apt one. Cities and suburbs must be structured differently. If suburban areas organized themselves around the more densely populated urban centres, less land would be used and personal vehicles would not be necessary for individuals to get around their neighbourhoods. When it is more widely recognized and accepted that the land is finite, the sprawl presently occurring around urban centres will have to be more compact and organized in such a way that workplaces and housing are integrated in every neighbourhood.

It is of the utmost importance that the industrialized parts of the world embrace this change, especially as other parts of the world are following the industrialized example. If the industrialized world were able to make changes to its urban/suburban system, then other parts of the world would see that better ways of organizing cities are out there and should be embraced:

> So here (The United States), more than for the rest of the globe, buildings and transportation— and therefore land use and urbanism—represent two thirds of our GHG impacts. And as the rest of the world develops, they may converge to the same place (Calthorpe, 46).

The earth already cannot sustain the unprecedented growth of currently industrialized countries. This means that not only must currently industrialized countries change the layout of urban and suburban spaces, but this poor model of development must not be followed in other parts of the world.

The Dehumanization of Labour

In current industrialized nations many workers have precarious contract employment so more and more people feel alienated from their work. This occurs for a variety of reasons but the main one is that workers presently require fewer skills as more and more jobs are being taken over by mechanization. Wendell Berry explains: “The growth of the exploiters' revolution on this continent has been accompanied by the growth of the idea that work is beneath human dignity, particularly any form of hand work” (Berry, 1978, 12). By devaluing hand work, more people see the use of mechanization not only as preferable but as necessary for any given task to be completed. A worker on the Simcoe Place skyscraper in Toronto commented, “Eventually they won't need construction

workers like me any more, machines will do our work" (Gooderham, 207). Construction work is one of the few forms of work that still requires labourers who use their hands, but even within this sector, more technology is constantly being developed to limit the number of workers and mechanize the entire process. This creates a negative feedback loop where workers are replaced by technology, but because workers do not value their work in the first place, this technological takeover occurs with little protest.

During the construction process, when manual labour is needed, generic labourers are often preferred to skilled tradespeople. This allows the construction industry not to become reliant on a small number of skilled tradespeople but instead have a workforce that realizes that they can be easily replaced:

> The business culture highly values the mobility of labour. You want to be able to slot generic worker A in slot A anywhere in the world and that ends up with a lowest common denominator set of skills for that labourer. They have to be able to lift that much weight, they have to be able to hold this screw gun or whatever but it doesn't really allow them to become true craftspeople. (Krahn, 2015).

This situation limits the role of the builder in the construction process, from that of a creative, skilled member of a project to just another of the interchangeable workers on any given job site. This view of interchangeable labour is another way that workers undervalue their own work and thus think of themselves as expendable within the construction process.

The reality that is created by this devaluation of human contribution to labour is that workers are left feeling powerless and disconnected from their work. When an individual works only to obtain a wage rather than for the love of a craft, he or she will be left feeling unfulfilled:

> He has not the power to provide himself with anything but money and, his money is inflating like a balloon and drifting away... From morning to night he does not touch anything that he has produced himself, in which he can take pride. For all his leisure and recreation, he feels bad, he looks bad, he is overweight, his health is poor. His air, water, and food are all known to contain poisons (Berry, 1978, 21).

In this system, people are always one step removed from what is being produced. For example, if an individual is just driving the tractor that harvests a field, he or she will not feel the same connection to the food that has been harvested as he or she might have had he or she hand picked the food. The addition of mechanization to any form of production leaves workers one step further removed from the process. This gap leads to workers feeling less pride in their work than had they used their hands directly.

When maximizing profit is the goal that motivates all decisions in all industries, the quality of the output is very likely to suffer. Although Berry is writing in reference to industrialized American agriculture, the parallels are clear throughout the entirety of industrialized culture, especially with the building industry: “Our system of agriculture, by modelling itself on economics rather than biology, thus removes food from the cycle of its production and puts it into a finite linear process that in effect destroys it by transforming it into waste” (Berry, 137). When the money made from a product is more important than the product itself, the quality of the product is destined to suffer. Corners will have to be cut to maximize those profits, and with every cut corner it is more likely that the quality will have suffered. This is the reality in the building industry, as it is in agriculture and any other production sector.

Dominion and Development

In Western industrialized society the term “development” is seen as a positive concept and those who live in “developed” parts of the world often refer to development as interchangeable with “progress”. This creates the false and self-perpetuating idea that the quality of life in the “developed” world is better than that in the “undeveloped” world, that if all countries had the chance to live life as it is lived in industrialized society, they would: “Industrial ideology transforms simplicity into poverty... it claims that the technological modesty of traditional people is not voluntary but a reflection of backwardness, of inferiority” (Bourgeois, 2004, 35). The ideology promoted and followed by industrialized societies presumes its own superiority over those who do not buy into the ideology. This attitude is not only highly paternalistic, but it also presumes that the highly industrialized way of living is better for the world and its inhabitants than the ways that more traditional societies function.

One need only consider the language used in industrialized societies in describing other parts of the world to see the air of the superiority at work. The language suggests that if left to their own devices, non-industrial societies would undoubtedly emulate industrialized society:

> In order to avoid the indignity of the word “poor”, traditional societies are euphemistically called 'pre-industrial', 'underdeveloped', 'less developed' or 'developing'...The terms enshrine in our very language our optimism, even conviction, that the non-consuming world is upwardly mobile and shall one day join our club... The industrialized world... (which) can more accurately be seen as 'overdeveloped' societies that need to be 'de-developed' (Bourgeois, 36).

Obviously, the philosophy of industrialized society brings with it a large variety of problems: environmental destruction, high levels of greenhouse gas emissions, poor quality of buildings, poorly grown food and a workforce feeling alienated from its labour. These are not the symptoms of a healthy society. Clearly, industrialized societies must put more energy into making better lifestyle decisions, ones that lead to less dependence on oil, electricity and machinery before they attempt to convince others that their way is superior.

Not all those living in the industrialized world, however, see themselves as superior to other cultures. Increasingly, there are those who see that all people have a responsibility to restore the planet and oppose the constant growth philosophy promoted by industrialized parts of the world. Klein shows how despite the fact that it may only be a minority, members of industrialized societies are looking to traditional societies, both past and present for guidance as to how our relationship with the Earth should be shaped:

> Many people are remembering their own cultures' stewardship traditions, however deeply buried, and recognizing humanity's role as one of life promotion. The notion that we could separate ourselves from nature, that we did not need to be in perpetual partnership with the world around us, is, after all, a relatively new concept, even in the West. Indeed it was only once humans came up with the lethal concept of the earth as an inert machine and man its engineer, that some began to forget the duty to protect and promote the natural cycles of regeneration on which we all depend (Klein, 445).

The concept that human beings are a part of Earth, not the owners of it is a crucial one. The actions of industrialized society clearly show a philosophy based on dominion. But as Klein argues, within the great length of human history, this is a relatively recent, albeit very pervasive idea that guides the actions of extractive industries and industrialized

society as a whole. The destructive nature of this philosophy must be recognized and industrialized societies must begin to de-develop if irreversible environmental devastation is to be stopped and climate change is to be curbed. The building industry can be a part of this change: builders must look more deeply into the history of human buildings to find answers to the problems caused by poorly built, for-profit building.

Conclusion

A society that has profits as its main goal is unlikely to address environmental concerns properly. The profit motive promoted in the industrialized world has led to environmental degradation and has played a large part in causing climate change. For the building industry, suburban houses and skyscrapers are the two most popular forms of residence in industrialized society. These types of buildings are both low quality but because the profit motive has more influence on how they are built than good building sense, they are the most heavily produced. The extractivist industry has also played its part in the degradation by making everything come secondary to profits for oil companies, especially environmental concerns. The way that buildings are organized within cities and around them also shows how the entire system is dependent on and continues to perpetuate the control of the extractivist industry, from heating and cooling buildings to transporting people to work. The philosophy of maximizing profits creates a society where people feel isolated, and because they are always at least one step removed from the goods being produced, they cannot feel pride in their work. Lastly, there comes with profit-driven industrialized society the philosophy of dominion, a philosophy has spread

throughout the world and has in some cases replaced philosophies of harmony promoted by traditional societies. When a society designed around maximizing profit has such detrimental effects on the well being of people and the environment, it is time for that society to adopt a different philosophy, one that promotes harmony with the earth, not humanity's dominion over it.

Section 3: The Solution

Contemporary approaches to building predominantly used in industrialized societies cause environmental degradation both from a life cycle energy use perspective as well as the production process perspective. What is essential for a substantial societal shift is a change in the guiding philosophy of building and a subsequent list of criteria to be followed by anyone involved in the construction of a house. Although there will always be compromises throughout any building's construction process, designers and builders should never lose sight of a guiding philosophy for building that minimizes environmental impact. All buildings should be healthy and comfortable, keeping occupants feeling physically and psychologically well. Buildings should also use a minimal amount of energy, both in the construction process and the ongoing energy costs. For these requirements to be met, buildings must be designed well, considering the aforementioned goals from the beginning of the design phase. Finally, buildings should use locally available materials such as rammed earth or straw bale to further minimize the energy used in any given building.

Design

Comfort

Insulation & Air Tightness

For a house to be truly sustainable, it cannot be reliant on a furnace blowing stale air and running on fossil fuels. To avoid dependence on technological fixes to keep a house

temperate, a house must have a high R value and be entirely air tight. R values are increased by using more insulation and having it installed continuously from the bottom of the footing to the top of the roof: “Good insulation in walls and ceilings protects indoor environments from daily and seasonal temperature swings and provides the greatest comfort for the least energy input” (Wanek, 64). The more insulation that is used, the higher the R value and the less the temperature of the outside air influences the temperature inside the house. Air tight construction is also very important because it eliminates unwanted gaps where the outside air can make its way inside the house.

As mentioned earlier, for a typical stick-frame house to function without a secondary source of heat, the walls would require an R value of approximately R60 (Passive House) while Ontario's building code requires that the walls of any given house have only an R value of R22. This sets the reality significantly below the ideal:

A typical Canadian house consumes 50 to 70 per cent of its total energy during the fall, winter and spring heating seasons...Retaining heat is a primary function of the building envelope. Heat flow through a wall assembly from an area of a higher temperature to one of a lower temperature is a basic principle of physics. While the flow cannot be prevented, it can be controlled or slowed to decrease the total energy consumption of the building (CMHC).

If the correct amount of insulation is used, the outdoor temperature does not matter. Regardless of extreme hot or cold, the indoor temperature will remain close to constant. Also, because furnaces and air conditioners would not be required, the indoor air quality

within a well insulated, airtight building would be much better than in a conventional house.

Good indoor Air Quality

Unless the materials used in a house are carefully chosen, over time there will likely be mould issues and other toxins that affect the indoor air quality of a house. There are various steps that can be taken to reduce or remove toxins from the indoor air. The following is a three-step approach to improving the indoor air quality. The three steps are eliminate, separate, and ventilate:

> 'Eliminate' means to just say no to highly toxic carpets, paints, adhesives, sealers and other materials... 'Separate' means that you minimize the impact of interior pollutant sources that it is impractical to eliminate. For example, apply a sealer to cabinets that are made of materials that off-gas formaldehyde... 'Ventilate' is a good idea in any case. Fresh air is not only important to our health in itself, but it can also dilute any pollutants that happen to be in the indoor air, rendering them less harmful (Venolia, 40).

Obviously, it is of the utmost importance to create good indoor air quality in any building, as the occupants of the home will be breathing the air day after day. Therefore, the better the indoor air quality, the healthier the occupants.

One way to create a house with excellent indoor air quality is to begin by using non-toxic building materials: “Natural materials like stone, wood, straw and earth, are not only non-toxic, they are life enhancing” (Smith, 8). It is, for the most part, the heavily processed building materials that introduce toxins because of the way they are produced and they are more likely to off gas, releasing toxins into the air, thus causing poor indoor air quality. Because young wood is currently used to make most dimensional lumber

(2x4s, etc.), it is more likely to create mould and degrade the indoor air quality. The more the indoor air of a house mimics the air in the natural world, the healthier people will feel breathing within these spaces. The positive effect on indoor air quality is one of the major reasons that building with natural materials is such an important concept. Also, if the natural material is inorganic, like earth or stone, there is no way that mould can develop. Wood and straw, if used properly can also be healthy choices, but as they are both organic materials, there is more of a chance that rot can occur, releasing mould toxins into the indoor environment.

Psychological Health

It is obvious that a building can positively influence people's physical health, through limiting toxins in the built environment, but well built, natural buildings can also positively influence the psychological health of their occupants. The natural elements in these buildings have an almost indescribable effect on people's mental health as Michael G Smith explains:

> We get a good feeling from natural buildings that is difficult to describe. Even though conditioned to prefer the new, the shiny and the precise, we respond at a deep level to unprocessed materials, to idiosyncrasy, and to the personal thought and care expressed in craftsmanship (Smith, 8).

Smith goes on to speculate that the way that people feel in natural buildings is similar to the way that people feel within nature itself, at harmony with their surroundings. It has to do with a deeper connection with nature that makes people feel more at peace in a natural building.

During the 1970s Christopher Alexander wrote a trilogy of books in an attempt to define the quality in buildings that makes them live. In his view buildings that live, like natural buildings, make people feel mentally grounded. In his definitive work *The Timeless Way of Building* he explains the quality that make buildings truly live:

> The difference between a good building and a bad building... is an objective matter. It is the difference between health and sickness, wholeness and dividedness, self-maintenance and self-destruction (Alexander, 25).

Throughout his work Alexander explains that design is a series of patterns; there are some patterns that live and others that do not. It is the responsibility of architects, builders and the occupants of buildings to promote the use of living patterns, that promote physical and psychological health.

Creating beautiful, well-designed buildings is important not just to create a sense of harmony within the built environment but also to promote inner harmony. A person's physical and mental health are entirely intertwined: “The fact is, a person is so far formed by his surroundings, that his state of harmony depends entirely on his harmony with his surroundings” (Alexander, 106). If one's surroundings are causing emotional distress then it is unlikely that a feeling of balance can be achieved. Only when people feel comfortable within their external environment can they begin to look inwards and achieve personal harmony.

The concept of buildings influencing the inner self has also been explored by Alain de Botton in his book *The Architecture of Happiness.* According to de Botton, the use of outer physical things is merely a way for individuals to get in touch with their inner selves:

> We look to our buildings to hold us, like a kind of psychological mould, to a helpful vision of ourselves. We arrange around us material forms which communicate to us what we need- but are at constant risk of forgetting we need- within" (de Botton, 107).

This synthesis of inner peace and architectural harmony is something that has been explored in religious architecture. De Botton described the sensations he has experienced in a beautiful cathedral, despite not being religious himself:

> Everything serious in human nature seemed to be called to the surface: thoughts about limits and infinity, about powerlessness and sublimity. The stonework threw into relief all that was compromised and dull, and kindled a yearning for one to live up to its perfections (de Botton, 109).

When this connection between the self and one's surroundings is examined, it becomes clear why countless hours have been put into the construction of massive churches and cathedrals. The unparalleled craftsmanship and beauty of these buildings is evidence of how religious institutions have used this inner connection with architecture to their advantage by connecting God with beautiful and awe-inspiring buildings.

The connection between good architecture and inner harmony is best articulated by showing how, despite being inanimate, there are certain buildings that live. When a building lives, it is felt within the self as well as within the living building:

> When a building lives we can always recognize its life- not only in the obvious happiness which happens there, not only in its freedom and relaxedness- but in its purely physical appearance too (Alexander, 143).

When the effect that buildings can have on a person's mental state are considered, it becomes clear that there is more to creating a home than just four walls and a roof. Care and forethought must go into the creation of buildings if they are to possess the almost

indefinable attributes that make them live. The more buildings live, the more the occupants become healthier and happier.

Sustainability

Low Embodied Energy

For a building to be truly sustainable, it must have a low carbon footprint. In other words, energy must be saved throughout the building's entire life-cycle. One major concern for a sustainable building is limiting the amount of embodied energy in the materials used:

> The energy used to gain raw materials, process, manufacture, transport and build is known as the embodied energy of a building. Many standard building materials use large amounts of energy for their production (Beddoes and Booth, 133).

The fewer stages of production a material goes through, the less energy intensive the production process, and the lower the embodied energy of a material. The other major factor influencing embodied energy is transportation energy costs. If a particular material has low production energy usage but has been produced on the other side of the world and then shipped to a particular job site, then it becomes increasingly difficult to keep the new building's embodied energy costs low.

The tracking of embodied energy becomes even more problematic as many building materials pass through a large number of distributors and each of these distributors may not give the whole truth regarding the origins of these products or if the transportation costs are exceptionally high. This can make it increasingly difficult for builders to trace their materials:

> The assessment of embodied energy from basic data supplied by manufacturers can be difficult. Manufacturers, of course, have a vested interest in presenting favourable data and therefore some may base their data on primary energy, which is the total energy used; whereas others base their data on delivered energy, which is the energy used at the point of use. It can be very misleading and in some cases the embodied energy calculated from primary energy values can be double that given by the delivered energy data. Therefore there is increasing ownership on designers to understand and to use materials efficiently and specify those with minimum environmental impact that can also be readily reused or recycled (Beddoes and Booth, 133).

When the tricky subtleties of embodied energy become murky, it is obvious that using locally sourced, unprocessed materials as often as possible is an excellent way to keep a building's embodied energy low. When local is not an option, the highest quality material is always the better option because it is likely to last longer than a lower quality alternative.

Long lifespan

The longer the lifespan of a well built building, the lower its carbon footprint will be. This has to do with the fact that regardless of what kind of materials are used, there is always a certain amount of carbon to be spent during the building process, about 25% of the total carbon footprint of a building by most estimates (Passive House Canada). Therefore, the longer a building lasts, the more future construction carbon costs are negated:

> Building an environmentally responsible house means building for longevity. A house built with the health of the planet in mind will last longer than a house thrown together without a thought as to where the materials came from or how they were manufactured (Easton, 71).

From an environmental perspective, building homes with long lifespans is the only method that makes sense. Even if materials with a high level of embodied energy are used in a building that will last for hundreds of years, the relative carbon cost goes down over time. The longer the lifespan of a given building, the fewer replacement buildings will be needed to take its place and over all the less the carbon created by the original buildings.

Low Ongoing Energy Use

The more airtight and higher the R value, the lower the ongoing energy costs of a building will be. If a house is not dependent on a furnace or air conditioner to stay temperate year round, the energy costs compared to those of a conventional home will be very low. This can be advantageous, especially when energy prices tend to fluctuate erratically:

> Life cycle considerations are particularly important for institutions that cannot count on increased income to offset foreseeable large increases in costs for energy, water, or other resources. Comfort and health, energy and water use, waste and recyclability are key issues (Bainbridge, 31).

By keeping the ongoing energy costs of a house low, fluctuations in the cost of utilities will have very little effect on how much it costs month to month to keep a house running. In fact, a well designed, well-built house can actually reduce the cost of living for occupants:

> I'm a great believer in the necessity for Passive House simply from a climate change perspective, although the extreme comfort, energy savings, durability and indoor environmental quality are all pretty good incentives on their own. The additional fact that a well-designed Passive House can be cash-flow-positive compared to the same conventionally-built house (in other words, the energy savings more than offset the

> additional monthly mortgage cost) is the tipping point we're about to see in the building industry.... We can change the world by changing how we build (Homesol).

Well-insulated, well-built, airtight homes have myriad advantages for the environment and homeowners alike. In fact, it seems that the more a homeowner makes decisions based on environmental criteria, the better the home becomes in the short term and the long term as energy is expensive as well as harmful to the environment.

Design Principles

Passive House

One organization that has created criteria for how well a house must perform in relation to temperature regulation is Passive House. Originating in Germany (Passiv Haus) the concept is that every building should be designed in such a way that the use of energy for heating and cooling is minimized as much as possible. Currently the highest standard of Passive House is PH-15:

> The term Passive House 15 refers to it taking only 15 kWh per square meter, per year to heat the building. This study shows that compared to all other new construction methods, the PH-15 is the only scenario that takes five years or less to counterbalance the initial carbon spike and as such remains very close to energy neutral for the rest of its lifespan (Saynajoki, Heinonen and Junnila, 2012, 6).

There are no methods of house building that do not have an initial carbon spike during the construction phase. However, the closer to energy neutral (passive) that a house is built to, the less time it takes to counterbalance this initial spike. The above study shows that if a new house is to be constructed, it should be built to PH-15 standard as it is the only standard that remains close to energy neutral throughout its lifespan.

The potential downside of Passive House as a guiding principle, however, is that it does not specify what materials are to be used to achieve PH numbers. This could perpetuate reliance on "conventional" building materials, so lifespan and material reuse could be seen as an issue. On the other hand, the lack of specification in terms of materials to be used might also be seen as a positive because many natural materials such as straw bale and rammed earth can have insulative values that would make them prime candidates for use in Passive Houses. Over all, Passive House is a good third party certification organization because it sets aggressive goals for builders and does not micromanage how those goals are to be met. This allows builders the creative freedom to achieve these goals and address such issues as embodied energy and longevity in a variety of ways.

Detailing

For any of the aforementioned criteria to be achieved, however, the design process must be detailed and the goals based on these criteria should be made clear well before the construction phase begins. It is very difficult to achieve an energy efficient design without any thermal bridges. In fact it is almost impossible if the design has not called for these specifications from the very beginning:

> It's important to get qualified advice on achieving this standard at the beginning of the design process. Unless this is a clearly defined goal from the start of a project, the building will likely never meet Passive House performance standards (Passive House Canada).

To build a Passive House requires thick walls with a large amount of insulation, an airtight design and care and effort at every step of the construction process. It is nearly

impossible for current building design and techniques to be converted into being passive. This is where having professionals with an understanding of sustainable design on board from the beginning of the project becomes extremely important.

Good insulation and an airtight design are not the only factors to help heat a house passively, however. With proper southern exposure and a wall to act as a heat sink, the sun can help heat up a house, and with proper design, that heat can be harnessed to keep a house warm even on a cloudy day:

> Consider the contribution of solar energy and natural processes (including breezes and shade) to the heating and cooling of the home... A home that is oriented true south, is tightly constructed and well insulated, and has operable windows for air circulation should not require large fossil-fuel burning equipment to maintain thermal comfort (Kachadorian, 109).

The natural world has its own heating and cooling mechanisms, and if designed correctly, a house can use these mechanisms to keep itself temperate. In most climates, if a proper heat sink is built and passive solar principles applied, the sun need be the only heat source for the entire building.

A Note on Technology

The many technological solutions available in the field of sustainable building can be useful for improving the quality of a house but solely relying on them can also be problematic as it implies that the issue of green building is just an offshoot of green energy creation. Although green energy is a necessary part of a more sustainable society, converting the heating of a house to solar power is still an inefficient use of energy:

> Green design must be simple and inexpensive, with practical features that the consumer can understand and operate. Society should not aim to increase dependence

> on technologies, unless they are cost effective, practical, simple and reliable in use. Such a philosophy will ensure that benefits are lasting and sustainable (Beddoes and Booth, 135).

By minimizing the high-tech aspects in a sustainable home, a well-designed passive house will moderate its own temperature, making it accessible for anyone living in it. Minimizing energy use will always be a more effective strategy than creating just as much energy from renewable sources.

Locally Adaptive

Despite the fact that the mass production of houses continues to be dominant in industrialized societies, there is not only one way to build and design a house. The local landscape, locally available materials and local historical building methods should all affect how a natural house in any given location is to be built. The organization Building Without Borders brings natural building techniques to many non-industrialized countries. Their analysis shows how important local input is in the construction of any natural house:

> It's impossible to create a good housing solution (technologically or esthetically) outside of the local context, or without local input. Though it may seem difficult or inefficient, developing a solution in partnership with local expertise is the most efficient and effective, if not the only, path to successful technology transfer (Lerner, 86)

Without taking into account local weather conditions, cultures and native resources, there is no way that a builder can construct a building that fully fits into the local landscape and enhances a community. Of course, considering all of these factors may lead to the use of some “unconventional” building techniques.

If a regional group is not consulted about the kind of housing in which they would like to live, the alternative is very likely to be inadequate. An example of this situation is the use of igloos and tents by Canada's Inuit population: “Dwelling types that evolved over millennia are disappearing fast. In many cases alternative housing has been provided but it is a poor match to requirements” (Oliver 213). For many generations, the Inuit have lived in igloos and tents. As their lifestyle has changed, so too has their housing. Unfortunately, the stick-frame replacements have been entirely inadequate dealing with the intense cold of the tundra. This is a clear situation where local input and local materials could have been used to create year round buildings that would have a high enough R value to deal with local conditions without having to continuously pump fossil fuels into them. In fact, the end result might very well have been superior to both the traditional solutions and the stick-frame solution.

Natural Materials

The concept of using a certain set of pre-produced, standardized building materials is a recent one. Up until the latter half of the twentieth century, the process of building a house was much different from the way it is done today. The use of factories became normalized after World War II, creating a disconnect between people and their own houses:

> For most of human history, manual labour has been used to convert local raw materials into buildings. The harvesting, processing and crafting of materials into buildings was done regionally, and it was the work of a great number of people in every city, town and village to provide these services... Materials are now harvested more intensively, transported to centralized factories to be processed, and then

> transported as building products to distributors, sub-distributors and retailers. Local trades purchase these products and assemble them into buildings using as little manual labour as possible. The occupants of buildings have become far removed from the process of designing and constructing, and therefore know little about what goes into making a building (Magwood, 1).

This process demonstrates how the use of local materials would result in occupants experiencing more of a connection to local buildings and also how there is more manual labour involved in building a house using local materials. Society has changed greatly in the post-war era. People do not always live in the same area for their entire lives and generationally speaking, very few people in industrialized societies will die in the same area in which they were born. This might change the community approach to house building, but it in no way means that local materials should be ignored in the construction of a house.

The materials used to build a home are of the utmost importance, but so are the guiding philosophical values as to how decisions are made during the building process. There is no one material that is ideal for all situations, but there is one philosophy that creates better buildings. The Fourth Pig collective explains:

> Sustainable building amasses and chooses from a range of techniques from traditional plaster methods and materials to the use of new recycled materials, state-of-the-art renewable technologies... Sustainable building is about making a choice to fit the shelter design to the space and to your needs, while creating a home that lives in harmony with the planet (Fourth Pig).

Two materials that fit this philosophy and are local to most parts of the world are rammed earth and straw bale. These materials have proven to be extremely effective for building and as such they have become the most popular natural building techniques within the

industrialized world. Moreover, the buildings constructed with these materials surpass the quality of conventional stick frame houses.

Rammed Earth

Rammed earth is a material for walls that has been used in the Middle East and China for thousands of years. Although relatively new in the North American building environment, it has proven to be highly suitable for Canada's changeable climate. Traditionally, rammed earth walls has been made of subsoil compacted into forms. Recently when used in the industrialized world, reinforcement bar (rebar) and a stabilizer (usually cement) has been added to the composition of rammed earth walls. After the earth has been compacted, the forms are removed and beautiful finished walls that will remain standing for hundreds of years are revealed. As subsoil is the primary element of rammed earth construction and subsoil can be found almost everywhere, rammed earth becomes highly available for almost anyone:

> Earth is common to nearly every building site- in fact to build a sturdy foundation, it's generally necessary to excavate. After the topsoil is set aside for gardening or landscaping, the subsoil must be dealt with. Very often it can be combined with other natural materials often found on-site -both of which can be utilized in construction (Wanek, 62).

Historically, rammed earth construction used the soil found on a given building site. As building standards in industrialized nations require a certain level of consistency with the soils that are used, modern rammed earth uses A gravel and sand from local quarries. Compared to the large distances that lumber is shipped, for example, soil from a quarry only a few kilometres from a build site greatly limits the carbon footprint of the materials

used for any given rammed earth building, especially when compared to conventional stick frame construction.

Another way that rammed earth greatly reduces its carbon footprint is through a limited use of processed materials. For example, the formwork used to build rammed earth walls is reusable, meaning that the same lumber can be used to build a number of buildings. The advantages of this approach is explained by Ontario rammed earth company AERECURA:

> Rammed earth uses local unprocessed subsoil with only a small percentage of processed cement. Stick frame housing has an expected lifespan of less than five decades, with most of the materials ending up in a landfill site. A stabilized rammed earth house will last for centuries, at which time the materials could be reused for more rammed earth (AERECURA).

With the extended lifespan of a rammed earth building, even the use of processed materials has less of an impact. A contemporary rammed earth home uses approximately 8% cement, compared to the 20-30% cement used in concrete. Not only does this minimize the amount of cement being created and used but also, as the cement in a rammed earth wall continues standing for centuries, the embodied energy cost of the cement will eventually be cancelled out by eliminating the carbon cost of rebuilding subsequent conventional homes.

Rammed earth's longevity is great from a carbon perspective. The longer a single building stands, the fewer the replacement buildings to go up in its place:

> Durability in construction means less waste in the landfills. When a building reaches the end of its useful life, it has to be torn down, buried in a landfill somewhere, then reconstructed using new materials that must all be harvested, processed and transported. By surviving for just one generation longer, a well-built house saves 5000 to 10000 board feet of lumber, 500 gallons of diesel fuel, countless pounds of

> solid, liquid and gaseous manufacturing by-products, and roughly 200 cubic yards of landfill space (Easton, 71)

With its extremely long lifespan, rammed earth offers a wall system that will be carbon neutral in regards to heating and cooling for far more than just one generation, making Easton's numbers modest at the very least. Also, after a rammed earth structure becomes structurally unsound, it can be broken down into smaller pieces that can be re-used as material for future rammed earth structures, making it a truly regenerative building material that can continue to negate the waste created by the building and tearing down of buildings.

When solar design is used with a rammed earth structure, the thermal mass of the rammed earth will heat the home quite effectively. In a cold climate like Ontario, rammed earth is insulated so that an inner wythe is completely separate from the outer wythe. When this wall system is developed with solar design in mind, the sun heats the inside of the house, and distributes it through the rammed earth: “A mass wall stores heat energy for return to the living spaces as needed. This concept is often referred to as “thermal flywheel” (Easton, 43). Because rammed earth naturally stores the sun's heat it will still remain warm, even on a cloudy day. With the combination of Passive House R values and passive solar heating, rammed earth is ideal for creating a natural passive built environment.

Straw Bale

Anywhere grain plants are grown, straw is created as a natural bi-product. This makes straw bales abundant, especially in agricultural areas. The benefits of using straw bales for construction are myriad:

> Straw is commonly underutilized, composted, or burned as an agricultural waste product. The 'staff' or the 'staff of life', straw is available at a cheap price wherever grain is grown. And stacked like giant bricks to form a thick wall, bales offer super insulation from the heat or cold or noise outside, providing a quiet, comfortable living space with modest lifetime energy requirements. Replacing stick frame walls with bales can cut by half the amount of timber needed in a modern home, reducing demands on forest resources (Wanek, 189).

The major benefit of using straw bale walls is the insulation factor. Most other insulation that achieves the same R value as straw bale bears a significantly higher level of embodied energy, as it has to be heavily processed. As straw is created every year, it is a readily available and renewable resource, and any of its embodied energy is mostly created through growing the grain, not creating the straw.

Although straw bales are excellent for insulation, a stacked straw bale wall must have interior timber framing for structure, as well as plasters to cover the bales for waterproofing and appearance:

> The bales can be plastered with mud, lime or cement plaster. In many cases stucco netting is not needed and plaster can be applied directly to the bales... Although they are quick to build with, details are time consuming to finish (Kennedy, 181).

The details are what make straw bale houses attractive, but they can also create some unfortunate results. Because straw is an organic material, it is extremely important that no moisture is allowed into the walls, as rot can easily occur. Straw bales also do not make for beautiful walls without being properly plastered. This means that not only is a

secondary building material necessary to fully complete the wall system, but also a great level of skill is necessary for the finishing touches of a straw bale wall.

Conclusion

There are countless decisions that go into the design and construction of an energy efficient building and a philosophical checklist is an essential part of the process. Most people will have to make sacrifices during the construction phase, based on cost, size, availability of material and geographical location, but these guiding principles should still help to inform each step of the building process. There is no one way to build a truly sustainable home; there are many. The ideology that guides construction decisions can help yield a variety of results that will meet these criteria.

Section 4: Benefits

Just as the negative effects of creating sprawling suburban communities and massive skyscrapers resonate throughout society at large, so do the positive effects of making better buildings. A better building is not just better for the individuals who live and work in it, but it promotes a better, more environmentally-conscious society. Better designed buildings in turn lead to better designed towns and cities. A well-built natural building also promotes a philosophy that counters the culture of domination presently permeating the industrialized world. Well-built buildings also require skilled workers and demand the use of physical labour, thereby empowering the workforce. And finally, the more passive a building, the more it reduces the power of extractivist industries by helping to shift the global reliance on oil and gas. Clearly, changes must be made within the building industry and in government policy for natural and passive buildings to move to the forefront of the built environment in industrialized societies.

"Living" Buildings

Well-designed buildings are merely one element of a truly well-designed society, but an important one nonetheless. In *The Pattern Language*, Alexander begins by explaining how there are patterns that dictate, how the built environment should be organized, both in terms of buildings as well as towns and cities. There are many commonalities between these various patterns which predominantly focus on how the human experience can be enhanced by good design. While cities are important to human development, they should only be one of many types of communities to be developed:

> If the population of a region is weighted too far toward small villages, modern civilization can never emerge; but if the population is weighted too far toward big cities, the earth will go to ruin because the population isn't where it needs to be, to take care of it…. On the one hand, people are drawn to cities: they are drawn by the growth of civilization, jobs, education, economic growth, information. On the other hand, the region as a social and economic whole will not be properly maintained unless the people of the region are fairly well spread out across it, living in many different kinds of settlements – farms, villages, towns and cities- with each settlement taking care of the land around it (Alexander, 17).

There must be a balance within society and not just a urban/rural balance. There must also be a balance in terms of the types of communities. Small towns, villages, farmland and cities all contribute to human progress. Developing each of these in a well thought out fashion would make for a dynamic and better balanced society.

The size of current cities does have certain cultural merits but when cities are constantly expanding at an exponential rate, there is no way that sprawl can occur in a well-designed, well-planned fashion. The greater the sprawl, the more the culture of a downtown core becomes inaccessible to suburban communities: “Continuous sprawling urbanization destroys life, and makes cities unbearable. But the sheer size of cities is also valuable and potent” (Alexander, 22). For large cities to work properly, there must be forethought as part of the growth process. The urban/suburban divide must be eliminated and replaced with a series of neighbouring cities that have mixed use communities so that people can live closer to where they work. Not only does this lower the transportation carbon footprint caused by the over-reliance on personal vehicles, but it also makes formerly suburban areas more dynamic.

Alexander also shows that just as the urban/suburban divide can be reformed into mixed use space, so too can the urban/rural divide. It is not uncommon for people living

in cities to take trips to get out of the city in an attempt to "get back to nature". The city design proposed by Alexander has agriculture as a major part of the urban landscape. This way, city dwellers are never too far from "nature" and city life can be more enjoyable:

> Keep interlocking fingers of farmland and urban land, even at the centre of the metropolis. The urban fingers should never be more than 1 mile wide, while the farmland fingers should never be less than 1 mile wide (Alexander, 25).

Not only would this proposed design have positive psychological effects for residents of a city, but it would also reduce food transportation costs, allow farmers more access to the culture provided by a city and city dwellers more access to the calming effect of fields and trees. This type of integration would not only provide balance for the people who live in these areas, but also would create healthier air within cities and allow more city dwellers to gain a greater awareness of the origin of their food.

Often when planning for both buildings and cities, designers feel that they must continually come up with completely original ideas. However, the most suitable idea may have already been used for hundreds of years:

> The upshot of this paradigm shift has been an awakening- a realization that there really is nothing new under the sun as far as ecological architecture is concerned... Every recent low-tech discovery in the ecological area has subsequently been found to have a more vernacular predecessor (Steele, 62).

This is encouraging because it means that rather than having to reinvent the wheel, architects, city planners, and builders can look to the past of pre-existing designs and study the design rationale. This approach also focuses on low-energy natural technologies, which when considered from a reducing climate change perspective, have many benefits.

With regards to city design, if one city can follow a master plan, presumably, so can others. The ancient city of Al Fatamid is just such an example. It was built in such a way as to keep the entire desert city climate controlled and in shade:

> The street pattern laid out by the Fatamids, Ayyubids and Mamluks was far from haphazard. It was planned so that its only wide street, Al-Muizz, would run in a north-south direction at a right angle to the path of the sun to keep it in the shade most of the day. The secondary streets to the east and west are narrow so that the overhanging upper stories of the houses on each side can stay in continuous shade. The only areas exposed to direct sunlight are the intersections of the side streets with the main road (Steele, 68).

This is an especially impressive design because unlike contemporary city designs that have as their primary focus accommodating vehicles and controlling the climate in buildings solely through the use of heating and cooling technologies, the entirety of the city has a controlled climate, inside and out, without the aid of fossil fuel dependent technologies.

In the contemporary industrialized world where technology is used in almost every aspect of human life, it would be almost impossible to bypass its use. However, it is extremely important to limit technological solutions, especially if those technologies are dependent on energy created by the combustion of fossil fuels. A balance of good technology and good design must be found in every aspect of human life:

> The urban solution involves both technology and design. For example, we will need to dramatically reduce the number of miles we drive as well as develop less carbon intensive vehicles. It will mean living and working in buildings that demand significantly less energy as well as powering them with renewable sources. It will involve the kinds of food we eat, the kinds of homes we build, the ways we travel, and the kinds of communities we inhabit. It will certainly involve giving up the idea of any single “silver bullet” solution (whether solar or nuclear, conservation or carbon capture, adaptation or mitigation) and understanding that such a transformation will

> involve all of the above—and, perhaps most important, that they are all interdependent (Calthorpe, 10).

Transportation, energy creation and housing all factor into the carbon footprint of any given city. Using a variety of good, low carbon solutions to combat each of these problems is necessary if any contemporary urban design is to become sustainable.

Balance

The guiding philosophy of industrialized societies claims humans are the most important beings on the planet with dominion over the natural world and all the other creatures in it. The Judeo- Christian creation story has “man's” dominion over the world as a paramount element in its telling:

> And God said, Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea and over the fowl of the air, and over the cattle and over all the earth, and over every creeping thing that creepeth upon the earth (King James Version, Gen. 1 vs. 26).

When a culture is based on the belief that one particular species can exploit the entire planet along with all of its creatures, it is not surprising that that planet is heavily exploited and humans do not feel any obligation to restore nature for nature's sake, merely for their own ability to continue to survive. For any attempt to curb climate change to be successful, humans must think of themselves as a part of nature, not above it. Despite whatever mythologies have told us, we cannot control nature, as we are just as much a part of nature as the fish, fowl and beasts.

Another ancient philosophy, Taoism, promotes a very different approach to humans' relationship with nature. The primary text of Taoism is the *Tao teh Ching* which promotes

balance and harmony, states that cannot be attained while following a philosophy of dominion:

> Does anyone want to take the world and do what he wants with it?
> I do not see how he can succeed.
> The world is a sacred vessel, which must not be tampered with or grabbed after.
> To tamper with it is to spoil it, and to grasp it is to lose it.
> In fact, for all things there is a time for going ahead, and a time for following behind;
> A time for slow-breathing and a time for fast-breathing;
> A time to grow in strength and a time to decay;
> A time to be up and a time to be down.
> Therefore the sage avoids all extremes, excesses and extravagances (Lao Tzu, 65).

The human race is discovering that we cannot succeed in taking the world and doing what we want with it without serious repercussions to our living environment. As a species we must avoid the "extravagances" that destroy the world, and instead find a way to live in harmony with nature.

In relation to the built environment, the more order that humans attempt to impose on the natural world, the more the natural world exerts its power over human creations:

> Nature is in truth opposed to the order we rely on to survive. Left to its own devices, nature will not hesitate to crumble our roads, claw down our buildings, push wild vines through our walls and return every other feature of our carefully plotted geometric world to primal chaos. Nature's way is to corrode, melt, soften, stain and chew on the works of man. And eventually it will win (de Botton, 180).

The more that buildings are built for longevity, not built to defy and oppose nature, the more they will become a part of the landscape, and by extension, more a part of nature. The more time and effort that is put into the construction of a building, the more it will be able to stand up to natural processes and remain standing.

However, every time a building is erected in a field or forest, or any other natural, wild location, there is a sense of loss. The beauty of the natural world that has been standing, undisturbed will be gone, replaced by human construction. As a part of nature, humans have a responsibility to build something well-designed that promotes beauty and harmony:

> We owe it to the fields that our houses will not be the inferiors of the virgin land they have replaced. We owe it to the worms and the trees that the buildings we cover them with will stand as promises of the highest and most intelligent kinds of happiness (de Botton, 267).

If in place of the beautiful open field a standard design stick-frame house is built, the natural world has been misused. Not only has the landscape been changed for the worse, but the houses will also continue to pollute the environment for their short lifespan until they end up becoming waste in a landfill. If beautiful design and natural materials are used, the idea is that the house will not combat nature, but complement it.

The natural building movement in North America strives for harmony with nature and uses that as a philosophy to guide how houses are built. The connection that is felt with natural materials is something that is lacking in a mass-produced house. Mass-produced houses are expensive, poorly built and can leave residents feeling disconnected from where they live:

> We go to jobs doing possibly meaningless work for thirty, forty or fifty years to pay for a house with which we no longer have and direct connection. How many of us have been in a steel mill or a drywall factory? If we have do we enjoy what we smell and hear and feel there?... The natural building movement has helped humans reconnect with our tradition of self-reliant shelter, surely one of our natural rights (Evans, 5).

When one is in a natural home, there is a discernible feeling of harmony within the self, within the building itself and with the natural world. Building with natural materials aids the sense of balance and harmony, creating shelter that does not exploit but rather is unobtrusive within the natural world.

Meaningful Labour

Physical labour in modern industrial society is undervalued and becoming less and less skilled. In the construction industry, as materials are made offsite and technology is used to assemble most of these materials, workers require fewer skills and as such are seen as expendable. When asked about what career path he hoped his son would take, a construction worker on Simcoe Place had this to say: “I want him to be something. I don't want him to be in construction like me, I'm nothing” (Gooderham, 205). This construction worker's self view is not uncommon. Physical labour is presently perceived as a last resort for employment. This perspective not only leads to workers undervaluing themselves, but also does not lend itself to much critical thinking about the construction process by the workers themselves. If a worker thinks of himself or herself as “nothing”, then that same worker is unlikely to begin thinking critically about how a job is done and the larger effect that his or her work has on society.

With construction workers viewing themselves as an unnecessary part of the construction process, the entire industry is able to use labourers interchangeably, which in turn creates precarious employment. The more that materials are prefabricated in a distant factory, the more workers' jobs become unskilled and the quality of workmanship drops:

> The whole culture just steers everything away from any type of mastery and says instead you only have to have these types of characteristics. In the grand army of builders, we only want privates and that's it (Krahn, 2015).

For craftspeople to emerge in the construction industry, the entire industry must reframe how its workers are viewed. If workers are constantly viewed by others and by themselves as unskilled and easily replaceable, then of course this approach will perpetuate itself. As new methods of construction come to the forefront within North American building, they must be accompanied by a new approach with regards to labour.

Regardless of what the job is, work can be highly rewarding and meaningful, but for this to occur, labour must be truly valued both by those performing a task as well as the broader culture at large:

> Work has the potential to be a source of great pleasure and meaning- it can be where intellectual and practical challenges are posed and met, where we can create new things, use our ingenuity, interact with others and accomplish things...all kinds of work can be fulfilling (Gibson-Graham, 17).

Within the building industry also work can be highly fulfilling and meaningful when framed correctly. However, the focus must be put on the empowerment of skilled workers, not the creation of more interchangeable labourers and low skill assembly jobs.

There are many groups actively attempting to change the perception of construction workers to that of highly skilled individuals who think critically about the construction industry and developing low carbon methods to create low carbon buildings. The Environmental Career Organization of Canada has stressed the importance for green employers to lay out the skills necessary for green collar careers:

> It is advantageous to know the skills in demand in a green economy so we can ensure our workforce is capable. It helps both those new entrants to the green economy and

> employers to clearly define skill sets and competencies required to enter emerging sectors. It also helps post-secondary institutions to develop the proper skill sets for the labour market (EcoCanada, 4, 2013).

Green collar jobs are jobs that would formerly have been referred to as blue collar jobs but have an environmental focus. Green collar jobs have a focus on skilled manual labour rather than an over-reliance on machinery. Creating a workforce comprised of green collared workers is an important step towards having a stronger and more environmentally friendly, worker-oriented economy.

In Ontario, AERECURA Rammed Earth Builders sees the benefits of using manual labour whenever possible, often in place of machinery. Founder and president Sylvia Cook explains how the use of physical labour can have a positive effect on society as a whole and inspire an otherwise uninspired generation:

> We have a generation of disenfranchised youth who would like to have jobs that have meaning that don't wreck the planet for their children or grandchildren. I think that we owe it to them to provide them those types of jobs, and rammed earth is fun. It's challenging, it's hard work, and it's fun. I'd love to give jobs to everyone who would like to participate in that, and I certainly get a lot of people wanting to participate, which is very encouraging as well. So I have great optimism that the future of rammed earth will involve more and more people without increasing the energy-intensivity of the industry (Cook, 2015).

This type of perspective is especially important in an industry that has such a high carbon footprint, much of which is caused by an over-reliance on machinery. Rammed earth construction, like many other green collar jobs, provides a career that workers can feel good about. The work requires the use of a worker's body and mind and the end result are houses that are environmentally appropriate.

Oakland, California has myriad examples of how green collar jobs promote environmentalism and combat poverty. The organization Green for All, created by Van Jones, is an organization that focuses on providing green collar jobs, mostly in environmental renovation, to young people living in poverty:

> Placing job ready workers with barriers to employment in green collar jobs can be an effective way to provide low income people with access to good jobs that can lift these individuals and their families out of poverty (Pinderhughes, 6)

Organizations like Green for All not only give jobs to disenfranchised young people, but also allow these youth to see the broader environmental impacts of their work. Within the construction industry there are many specialized jobs requiring specific skills if they are going to be carried out with environmentalism as the guiding principle. Companies must consider the benefits of using manual labour both for the well being of the workers as well as the well being of the planet.

In the alternative building community it is especially important, as it is a new industry, that workers are paid fairly and have power in the decision making process for these companies. These ideals lend themselves well to a worker co-op. One such co-op is the straw bale building co-op Fourth Pig. Co-founder Melinda Zytaruk explains part of the motivation for creating a workers' co-op:

> One thing that inspired a lot of us to start the worker co-op was that a lot of us came from the not-for-profit sector or even from the building sector, the natural building world, and were frustrated with this idea that somehow if you're doing something that is of benefit to society that you should be completely altruistic and not even want to be paid or be willing to work for really crappy wages. And I don't think that's fair or right. This whole idea that because it’s built out of straw bale, professionals are just going to show up and build it for free because they love it so much and it’s such a great thing. That doesn't work. These are often accountants and others who get paid all sorts of money for doing things in the private sector and don't translate it into

> thinking that people who do things that they actually enjoy doing should be paid enough to feed their families too. That's something we're trying to do: people can have good jobs in this sector (Zytaruk, 2015).

For alternative building to become a strong industry that can promote workers' rights and see the true value of labour, workers must be fairly paid for the work that is done. There is a cost for quality and in the case of natural building that cost is paying skilled workers a fair wage. For the industry to thrive, workers must be able to sustain themselves.

A Sustainable Economy

The main reason that extractivist industries have so much power in industrialized societies is that so many industries are entirely dependent on fossil fuels. The electricity that is used, the food that is eaten, the vehicles that are driven, the buildings that are erected and the majority of products that are created require fossil fuels for each level of their development. Industrialized society has become complacent about the supremacy of the fossil fuel industry. That is why “there is no more potent weapon in the battle against fossil fuels than the creation of real alternatives” (Klein, 398). Alternatives in energy, agriculture, transportation, construction and manufacturing are being developed that will lower carbon emissions and help remove society’s reliance on fossil fuel companies. The less dependent on fossil fuels our society is, the more environmental decisions can be informed by climate scientists, not lobbyists for oil companies. The more industries to minimize or eliminate their reliance on fossil fuels, the more money that can be invested into low carbon initiatives, and the stronger the alternatives will become.

Workers would also greatly benefit from having real alternatives to working for the extractivist industry. Extractive workers may be paid well, but there are few other

benefits to their job. It is dirty, environmentally destructive and workers feel as though they can be easily replaced. Often workers take these jobs because there are no financially feasible alternatives. Klein shows the difference between spending $5 billion on a pipeline and spending $5 billion on green industry promotion:

> If $5 billion is spent on a pipeline, it produces mostly short-term construction jobs, big private sector profits and heavy public costs for future environmental damage. But if $5 billion is spent on public transit, building retrofits, and renewable energy, economies can gain, at the very least, three times as many jobs in the short term, while simultaneously helping to reduce the chances of catastrophic warming in the long term. In fact the number of jobs could be as many times more than that, according to the institute's modeling. At the highest end green investment could create *thirty-four times* more jobs than just building another pipeline (Klein, 400).

Not only could at least three times more jobs be created, but those green collar jobs could be more meaningful as workers help to reduce carbon emissions and develop alternatives to the extractivist industry's monopoly.

In a recent document about the environment, the Ontario government demonstrated its commitment to using alternatives to fossil fuels with the larger goal of lowering greenhouse gas emissions. This document promotes “Economic Growth that is based on multi-factor productivity- the productive use of our human, natural, social, manufactured and financial capital. It is growth without carbon subsidies that is decoupled from greenhouse gas emissions” (Ontario Government, 2015).

Although this is just a preliminary planning document, it is encouraging to see a government in Canada attempting to develop a new strong economy, one that would limit the use of fossil fuels. If carbon emissions are to be curbed in a meaningful way, more

governments in the industrialized world will have to develop low carbon solutions that strengthen economies, not crash them.

Conclusion

Better buildings can help create a better society. Not only do more energy efficient buildings reduce the carbon footprint of a society, but they can also help to change the philosophies guiding that society. Having efficient and beautiful buildings has the potential to inspire the use of efficient and "living" urban and rural designs. Natural buildings also have the potential to change the philosophy of industrialized societies from one of domination to one of harmony and balance. The way that natural buildings are constructed also promotes a different approach within the building industry by creating meaningful jobs that value manual labour rather than an over-reliance on machinery. The more efficient our society becomes, the more money and power are removed from extractivist industries that have an apparent disregard for the environment and their effect on it. For changes in the built environment to be felt throughout all of society, the initiative will have to be supported by all three levels of the building industry: small business, the industry as a whole and the government. With these positive outcomes in mind, the need to create alternative buildings and create public awareness of how buildings contribute to climate change becomes even more pressing.

Section 5: Moving Forward

Current building practices are a large part of industrialized society's unsustainable path. However, changes in the building industry can help lead to changes to society at large. The obvious avenue for this change is education. Learning about alternative building methods will in turn encourage individuals to consider how they can live a more sustainable life. Solutions posed by the problem of poorly made buildings already exist. Now it is important to move those with solutions from the fringe to the mainstream. The more people aware of better alternatives, the more likely it is that better buildings will become commonplace. For this change to occur, however, it cannot just be left to a small group of experts. Society as a whole must become better informed about how buildings contribute to climate change, and changing the built environment can be the first step to creating a more sustainable and equitable society. For education in this area to truly work, people must reframe their understanding of buildings in industrialized nations. Moreover, the teaching strategies for creating this shift cannot follow the conventional 'teacher passing information to students' relationship. In its place, all participants within the building industry whether builders, designers or occupants must view themselves as teachers of sorts to help others make better informed decisions about how buildings can become more efficient.

Three Levels of Change

Within the building industry there are many groups effecting change. Each of these levels has its own contributions in terms of how to change the industry as a whole. There are

three levels of society outlined by Jo Williams in her book *Zero Carbon Homes* that effect change within the building industry:

- Micro-level:
    - Niches (individuals/groups) with local practices
- Meso level regime:
    - Culture
    - Structure
    - Practices
- Macro-level landscape:
    - World views and paradigms.
    - Macro-economy.
    - Material infrastructure.
    - Natural environment.
    - Demographic trends.
    - Institutions/regulation/policy instruments (Williams, 184).

Within the building industry these three levels break down as such: the Micro level is small businesses developing a way to use alternative materials, or improve on building code standards. The Meso level is the industry as a whole. This would mean, for example, large tract developers recognizing the importance of better buildings and altering their business plans to accommodate better buildings. The Macro level is the government. By creating incentives and subsidies for alternative builders and those people who choose to live in alternative buildings, governments can help to create a shift in the built environment.

In Ontario a handful of small businesses have begun constructing alternative buildings but the market for these buildings is mostly clients who have the money to pay for a

premium product. Because these businesses are new, initial capital must be earned if they are to continue expanding and creating more buildings:

> There are (other) rammed earth companies in Canada. It might have been possible to get one of them to come out and build for us but that would have been beyond my financial means and that also brings up that I want to make rammed earth affordable for ordinary people, like me. My husband and I are retired teachers, not investment bankers (Cook, 2015).

This view is widely shared throughout the alternative building industry. Natural builders do not want to build only expensive custom homes for the small minority of people who can afford to spend a premium; most alternative builders want their buildings to become a part of the mainstream and as such become accessible to anyone who can afford to buy a home. For this to become a reality, alternative buildings can not just remain on the fringes of the building industry. These techniques must move through the meso and macro levels and become a part of everyone's understanding of what a good building is.

Alternative building is still well within the micro-level of the building industry, but there are signs that alternative methods are being recognized within the mainstream and these alternative concepts are beginning to push their way into the meso-level, the building industry at large. Architect Terrell Wong, who specializes in using alternative materials and designing homes that meet Passive House standards, explains how views of her work have changed over her twenty year career:

> I can see that there is a change in the industry, even at the level of the consumer, so that somebody who runs their own, very niche firm can actually make a living... I remember being told when I started this twenty some odd years ago that I was crazy, that I would never make a living and that I should just give up and get a car, get with the program... Public perception changed by virtue of the fact that I was doing the same buildings but I had won a competition. Now I have people come to me and ask me for my knowledge (Wong, 2015).

As Wong points out, the industry is changing. Current architecture students can focus on green architecture, something that Wong herself could not have done when she was in architecture school. This move from fringe to mainstream building may occur slowly, but the shift is very necessary if alternative building is to be more widely accepted into the built environment.

The macro-level of changing the building industry comes from government policies and whether or not they are willing to subsidize the use of alternative building methods. Although the Ontario government has not as of yet put forward a detailed plan regarding its relationship with sustainable building, its 2015 plan addressing climate change has shown that it intends to go even further than the minimal changes regarding energy efficiency recently put into the Ontario Building Code:

> Building code changes that came into effect this year mandate improved energy efficiency. However, while these efforts will reduce emissions they are not sufficient to achieve our targets. We know we need to go further, and look at how to make policies like these more effective at reducing emissions and will consider what new policies and programs we need to put in place and will examine other planning initiatives of government, such as long term capital and infrastructure plan, Building Together, to ensure that carbon emission impacts of public investments are considered (Ontario Government, 2015).

Although Ontario's government has not at this point put any definite plans forward, their approach towards the built environment and its relation to climate change is an excellent example of how the macro-level can effect change within all levels of the building industry by helping to promote and subsidize alternative, environmentally appropriate buildings.

Education

Using All Levels

The three levels described earlier all require people to gain a better understanding of the necessity of sustainable and alternative building. For people to reach this level of understanding, educators must use techniques that guide people to discover the benefits of this way of building for themselves. Each of the first four appendices of this paper targets at least one of the micro, meso and macro levels. Teaching professionals such as architects, engineers and city planners (Appendix 1) have the potential to effect change within all three levels, but especially the meso, and macro levels. If more designers were to begin incorporating alternative materials into their work, more builders would be required to meet the demand created by these designs. Architect Terrell Wong explains how she is able to exclusively design alternative buildings, thus progressing the industry:

> Nobody calls who wants a regular old 2x4 house anymore... I did one job with straw bale and the client had never even heard of straw bale but was willing to put her faith in me to do that because it seemed like the best option for what we wanted to do for that house. Even though we had terrible times with the municipal officials... it was fun because we got to push through the government bureaucracy to get passed ill-conceived conceptions about natural materials. Hopefully, that will make it easier for other people in the future to do the same (Wong, 2015).

As Wong's work has shown, the more alternative buildings that are brought into the built environment, the more building officials have to develop a standard approach of dealing with them. If these workshops were able to influence city officials, then it would cause some internal push to incorporate alternative materials into the building code, which in turn would greatly affect the future of alternative building on the macro-level.

Potential homeowners, the target group in Appendix 2, have the ability to influence all three levels if they choose to purchase a home constructed with alternative materials. If more homeowners were to choose to buy better buildings, it would increase business for small micro-level companies, which in turn would draw the attention of larger meso-level companies. If there were enough alternative materials being used, governments would eventually grow tired of dealing with each build on a case by case basis and would begin to develop legislation allowing more alternative builds at the macro-level, thus impacting the whole of society. Passive House builder, Ed Marion explains the education process involved with clients when building an alternative building:

> When I do a project I spend a lot of time focussing on the building envelope itself and I have deep conversations with homeowners about it and that is something that they're not indifferent to. When you actually approach them about that they totally see the benefits. They recognize, yeah, that makes sense, what you're saying. But it'll never happen if that conversation doesn't happen and I think that conversation needs to happen a lot more (Marion, 2015).

Dialogues like this must occur before every house is constructed for the built environment to improve. Potential homeowners are likely to want the best product for themselves, but they have to know what that product is. Workshops with prospective homeowners can help create a greater understanding of how much homes can be the first step in creating a more sustainable future. If alternative buildings are adopted as the norm, people can feel that their actions are helping to curb climate change, not perpetuate it. The more homeowners who live in alternative buildings, the more likely they are to promote these buildings and, in turn, a more sustainable lifestyle. Living in an alternative

building will also change the sensibilities of the occupant, creating a more sustainable world one building at a time.

Students in building programs at the college level (Appendix 3) can help to strengthen the micro-level as well as bring change to the meso-level. Learning about alternative building methods may inspire young people to pursue careers within alternative building. Sylvia Cook explains how talks that she has given at trades' colleges have inspired students and leaves her feeling optimistic for the future of the alternative building industry:

> It was exciting... talking with a group of young people who are getting into the building industry, who were themselves excited at the idea of being able to build in a new, environmentally responsible and sustainable way. They asked excellent questions that showed they had been thinking about this and responded very well to concepts as diverse as how to lower energy intensity in the building itself or how to create a more socially sustainable building culture (Cook, 2015).

In the short term, workshops at trades colleges would give small alternative building companies more employees, allowing them to grow and build more. In the longer term if the majority of trades college graduates had an understanding of alternative building methods, they would bring this knowledge into the workforce, causing change at the meso-level, both by starting their own alternative building companies and by proposing changes within larger companies. If enough students were truly to see the benefit of alternative building, they might choose to only work for alternative companies with equitable approaches to labour, further strengthening the alternative building industry.

Grade 5 students (Appendix 4) may have very little influence on the building industry at present, but these students will grow up to effect change at every level of the building

industry when they become the next generation of architects, builders, city planners, engineers, politicians and homeowners. If they have learned to think critically about buildings at a young age and also know of alternatives, then by the time they become adults, alternative building methods will already be a part of their vernacular, for a major issue amongst current builders is that there is a lack of understanding about building science:

> There's not enough understanding of building science amongst trades and building officials. Outside of the alternative building industry there is still a lack of knowledge about building science and the things that people need to understand if people are going to create more alternatives of flashy, resilient style housing because it is a joint effort. If people don't ask for it, then typically the architect and builder don't get to do them…. More people need to start asking for homes that are going to be more resilient, that are better built homes from an environmental standpoint (Marion, 2015).

If at the age of ten, every future builder, designer and homeowner has a basic understanding of alternative buildings, then the building industry is likely to improve exponentially when they become the building professionals and prospective homeowners. This investment in the future of sustainable building would help to create a thriving industry for years to come.

Bringing Change to the Built Environment

It is inspiring to consider what the proper combination of knowledge and dedication can accomplish. When a retired teacher living in small town Ontario realized that her actions could help change the suburban sprawl that characterizes Ontario's house building industry, she felt that she had the responsibility to try something different for her second career:

> I was living in a small town that is an hour's commute (from Toronto)... I looked around at those houses sprouting up like mushrooms on previous agricultural land and realized that they were by in large poorly built and they were going to need extensive maintenance and renovations throughout their lifetime. They were going to use lots of fossil fuels to keep them both warm in the winter and cool in the summer and it just seemed a colossal waste. And I hate waste. The efficiency of building with rammed earth has probably excited me the most... There were just too many reasons to go with rammed earth and too many reasons not to keep doing what we're doing in our mainstream building environment (Cook, 2015).

Half a decade after Cook decided to build her own home with rammed earth. She is now the president of AERECURA Rammed Earth Builders, Ontario's first rammed earth construction company. Her story helps to demonstrate the power of knowledge. This is not to say that everyone who is educated about alternative building and thinks critically about it will go out and start their own sustainable building company, but rather shows that if someone is educated, he or she is far more likely to make a well-informed decision about the kind of house to live in. The more that people realize that better alternatives exist, the more those alternatives will be pushed to the forefront of the built environment.

As alternative buildings exist currently on the fringe of the building industry, it is very important that the approach taken is given proper consideration with regards to educating both specific groups and the general public about building. As alternative builders are a relatively small group, it falls to them to be the ones to educate others, but this process should take on a group brainstorming approach rather than an expert teacher and ignorant student approach:

> We need to ask ourselves which matters more: that the participants conclude that the instructor is brilliant, or conclude that they themselves are brilliant? Our work is meant to lead people to discover inner strengths and capabilities that sometimes they have not recognized in themselves (Burke, 143).

An approach to learning that looks like this leaves those people who have been involved feeling empowered and pondering how they can become more engaged within alternative building whether as a worker, designer, prospective sustainable homeowner or simply someone who spreads the word about how current buildings should be critically examined. If an 'expert' simply tells everyone about the great things that he or she does, the same level of engagement is unlikely to be achieved.

There will always be those members of the alternative building industry forging ahead and creating new ideas, but the more these people teach others well, the more likely it is that buildings will improve:

> There will always be pioneers because there's always a fringe somewhere, like that Passive House movement where we're the fringe pushing things way beyond the code and in some cases it's the same insanity. Pushing and pushing helps move the market forward. The people who push at the very tip, the very bleeding edge as they call it with construction, end up having a greater effect. They're the pinpoint at the top, but it fans out…. It pushes people to provide better materials because people are asking for them.... It's a ripple effect. (Wong, 2015).

The need for leaders and forerunners will not change for any social movement, and the alternative building movement is no exception. Just because there are leaders, however, does not mean that everyone's voice should not be involved in the education process. Everyone, from a grade 5 student to a city planner, may have a revolutionary way of thinking about building, and if their teacher spends the entire lesson or workshop extolling his or her own virtues, those ideas may never become part of the broader building landscape. The forerunners must not only continue to revolutionize building themselves; they must also learn to teach well so that ideas can be continually developed and passed on from new sources.

Reframing ‘Common Sense’

There are many 'common sense' notions about buildings that alternative building methods dispel. Some examples of a 'common sense' understanding of buildings is that they must have furnaces and air conditioners. Another 'common sense' notion is that typical red brick, stick frame houses are the best way to build because they are the most common way that single family dwellings are presently built. Antonio Gramsci's concept of common sense shows that despite what is believed, common sense approaches are not always the best:

> Common sense is not a single unique conception, identical in time and space. It is the “folklore” of philosophy, and, like all folklore, it takes countless different forms. Its most fundamental characteristic is that it is a conception which, even in the brain of one individual, is fragmentary, incoherent and inconsequential, in conformity with the social and cultural position of the masses whose philosophy it is (Gramsci, 1971, 419).

The 'common sense' house described is not the best way to build a house. It is the building style that maximizes profits within the capitalist system and as such is the house that most people in industrialized societies understand. There are numerous ways to build a house that will function effectively and comfortably without a furnace, but these methods go against the common sense notion that people have about how a house stays warm in the winter.

Clearly, the concept of reframing common sense is important. So much of education in regards to sustainable building is convincing people that there are better ways of creating a built environment, and those methods must be incorporated and improved upon. This

requires reframing conventional understandings of buildings. Dian Marino explains her concept of reframing:

> Re:framing occurs when problems or experiences are represented in ways that both retain the realities of existing political relationships and transcend them by opening up new (for those involved) and real opportunities for acting on the inequities of those relationships. This is not just a substitution of one headline for another, but rather requires both teachers and students to co-construct new and useful frames on their experiences-ones that mobilize and empower them (Marino, 109).

Not only is it important to have numerous perspectives within the educational process, but also it is the educator's job to show that just because something is common does not mean that it is the most efficient, or best way. Reframing within an alternative building setting would involve discussions about why modern houses look the way they do and critically examining the culture that has these buildings dominating the built environment. This approach would not only allow participants to think differently about buildings, but also about society at large as other “common sense” notions could be reframed.

The next step in reframing the common approaches to building is to differentiate between 'common sense' and 'good sense'. It is often assumed that the reason that ideas become dominant is because they are the best ideas. Any exploration of buildings within the industrialized world shows that this is not the case. This distinction must weigh heavily on any exploration of alternative building education:

> Gramsci's other distinction between “common sense” and “good sense” is important.... What is called “common sense” is often oppression so deeply embedded in a culture that it is assumed to be natural and inevitable. “Common sense” tells us that social problems are utterly complex, that change is extremely difficult, that experts are the only ones who know, that ordinary people have no ability to understand or no power to influence. This is just the way it is in a modern industrial

> world, and it helps keep things the way they are. Those who control the production of knowledge use a simple but sophisticated language that persuades us to “see the world from their point of view”. So “good sense”, often comes about when we look at these assumed interpretive habits and ask questions about power or disempowerment (Marino, 127).

In an alternative building education framework the 'common sense' mass produced stick-frame house construction must be replaced by 'good sense' alternative building. For this to happen, however, all participants must understand that typical buildings are not ideal, just the most available. With even a basic level of information, any participant should be able to see beyond the 'common sense' notion of building and recognize that there are 'good sense' solutions.

Non- Traditional Teaching

As shown earlier, the idea of an alternative building workshop is not to impress students with how knowledgeable the teacher is but rather to actively engage the members of the workshop so that they walk away inspired to promote an alternative building culture and hopefully create some buildings of their own. An effective way to cultivate this love of alternative building techniques is through asking engaging questions:

> Ask real questions and expect real answers. Open-ended questions invite reflection, diverse opinions and discussion. If the discussion turns up views that are factually wrong or potentially damaging, correct those points gently at the end. If the discussion turns up opinions that differ from your own, think twice before making that known (Burke, 148)

Asking questions with the intention of stimulating discussion forces participants to come up with creative ideas and think about concepts for themselves. For example, an excellent conversation starting question could be, “What experience do you have with building?” Most people will feel that they do not have any experience which means it is important

for the facilitator to prompt with suggestions such as baking a cake, playing with Lego, building forts, drawing buildings, etc. The answers to these questions may have members of the workshop discussing the concept of building in a very unique and creative way. This process is an excellent way for all members to think of themselves as individuals who can be involved in a conversation about building. If 'experts' are the only ones contributing new ideas, the field of sustainable building will not progress nearly as quickly as it would if everyone were thinking about new ways to improve it.

A facilitator should not only ask good questions, but also have a measured response to misinformation. This reaction can set the tone of a workshop. As the goal is to teach people about alternative building techniques, ignorance in regards to building should not be met with scorn, leaving some feeling alienated. Instead, ignorance should be addressed, and factual information should be given, but not at the risk of making a participant feel stupid:

> How we choose to challenge misinformation can either help build the movement or alienate the people we want to reach. As educators, one of our first tasks is to protect the targets of the remark.... We also need to help people learn. If our response to an uninformed opinion makes a person feel stupid or marginalized, their original views will most likely become more, not less, entrenched. And we have to deal with stereotypes in a way that challenges them, not confirms them (Burke, 149).

If during a workshop a participant is making claims such as “It is too expensive to build with rammed earth”, the teacher's response is very important. One strategy that could be used is to acknowledge that there is some validity in the participant's statement but then reframe how the concept of cost in building is determined. A good question might be “How much is your energy bill typically?” The answer to this question may help to show

that although there is an initial price that is higher, the saving over time will make a rammed earth house significantly less expensive. The use of questions to reframe ideas is important because the answers come from participants, not just from the one 'expert' in the room.

Involving the Stakeholders

When modern buildings are responsible for 30% of carbon emissions (Klein) and almost everyone lives and works in them, everyone must come to view himself or herself a stakeholder in the movement towards more environmentally friendly buildings. With the construction, heating and cooling and maintenance of buildings causing almost a third of global carbon emissions, it is clear that people must become more active and buildings more passive. Not everyone who learns about sustainable building will become a builder or designer, but if the knowledge is part of the common vernacular, then everyone's actions can be oriented towards creating a more healthy built environment. The more that members of society know about environmentally friendly construction, the more often the right questions will be asked in the design process for a building. If airtight, passive buildings become common knowledge, people will begin demanding more from builders, and standard builders will have to improve their practices to create better homes, better offices and an all-round better built environment. As shown earlier, alternative buildings are a first step towards a more sustainable way of life. When the stakes of creating better buildings are the creation of a sustainable future, everyone clearly becomes a stakeholder in the conversation about alternative buildings.

Learning is important because it allows everyone to think about how they can have an effect on making better buildings. Regardless of how large an effect each individual has, it is important that everyone be informed and understand how they can help in the movement towards a better built environment. Whether it is an individual telling his or her landlord about the advantages of creating an airtight, passive building, petitioning local government to consider low-rise energy efficient buildings rather than more high-rise condominiums or starting a career in sustainable building, everyone can do their part to create a better built environment. The key for any of these actions is helping the population recognize the problems inherent in the for profit building paradigm. "Non-experts" can still help to influence the future of building in the industrialized world. Much of Christopher Alexander's work can be drawn on as inspiration for everyone's inclusion in the design of buildings.

There is a common view that only experts are able to effect change within any industry. The alternative building workshops presented in Appendices 1-4 have as their goal to explain that everyone is affected by buildings and everyone can affect buildings. Architects may be the only people who make drawings to get permits, but everyone can have ideas that influence how those drawings end up looking:

> Only the people can guide the process of organic growth in a community. They know the most about their own needs, and they know most about how well or how badly the rooms and buildings, paths and open spaces are working (Alexander, 38).

Not everyone may be able to carry out each step of a design, or be the builders of their own projects, but everyone has an understanding of what they need from a particular building that a designer or a builder may not know unless every voice is heard.

During his time working with the University of Oregon, Christopher Alexander revolutionized the design of the campus by incorporating the needs of each department into the overall design that was used. His justification for this was that the science department, for example, would know how much light was needed in particular laboratories and the size that each room had to be to maximize its use:

> The people involved entered fully into the design process; they could make the design what it is only because of their working knowledge of the day-to-day activities and problems of the school (Alexander, 56).

This approach is contrary to the typical "hire a team of experts and grumble about the poor results" approach that is followed with most large-scale design projects. Although more voices involved in the design stage can overcomplicate the process, the end result is a more functional and better building. The key to this approach is having everyone recognize that they have knowledge about buildings and that that knowledge can help create better buildings.

Conclusion

Education will open the door to bringing alternative building methods into the common vernacular. This knowledge will also allow for members of industrialized societies to think critically about how their actions can create a more sustainable society. For the education process to be effective, workshops should draw on popular education techniques such as reframing "common sense" and changing the common student-teacher dichotomy. The more people educated about better buildings, the greater the momentum that is created for change within the built environment. When the problem of poorly built buildings affects the future of our planet so greatly, do the members of the alternative

building community not have a responsibility to educate everyone about what active role they can take in the development of a more sustainable future in regards to buildings?

Summary

Within most people's lives, a house will be the largest investment that they will make, regardless of how well it is constructed. When housing uses so much of our money and we spend so much of our time there, should we not be sure that care and effort goes into its construction to ensure that it is making the smallest environmental impact possible? Most people want what is healthiest for themselves, their families and the world as a whole which is why education regarding alternative construction is so vitally important.

Contemporary building practices such as the construction of suburban tract homes and skyscrapers cause environmental degradation both by the materials used and the constant need of heating or cooling. The only benefit is the profit made by developers who construct these poorly built structures and sell them en masse. Unfortunately, this profit driven capitalist approach is not unique to the construction industry. It has created a wasteful society that through its reliance on fossil fuels continues to cause climate change.

A more sustainable built environment is possible. The methods have already been developed. Now the philosophy and "good sense" of alternative construction must be brought into the common vernacular of building. For this to occur, members of the alternative building industry must act as educators, not only extolling the virtues of passive, environmentally friendly buildings but also showing how building in these ways can lead to a more sustainable way of life for industrialized societies. Poorly built, for profit construction techniques have run their course. It is time for buildings to evolve, using natural materials and passive temperature control.

References

Aerecura Rammed Earth Builders. “How is Construction With Rammed Earth More Sustainable?” www.aerecura.ca Accessed Dec. 9 2013.

Alexander, Christopher. *The Oregon Experiment.* Oxford University press, 1975.

Alexander, Christopher, Sara Ishkawa, Murray Silverstein. *A Pattern Language*. Oxford University Press. 1977.

Alexander, Christopher. *The Timeless Way of Building.* Oxford University Press, 1979.

Alter, Lloyd. "Globe and Mail Interview." Interview. *How Will Our Glass Condo Obsession Affect Us 20 Years from Now?* Globe and Mail. Toronto, Ontario, 13 Nov. 2014. Television.

Bainbridge, David A. “Life Cycle Cost and Value of Four Homes” *The Art of Natural Building.* Ed. Joseph F. Kennedy, Michael G. Smith, Catherine Wanek. Canada: New Society Publishers, 2002. print

Beddoes, David W. And Colin A. Booth. “Insights and Perceptions of Sustainable Design and Construction” *Solutions to Climate Change Challenges in the Built Environment.* Ed. Colin Booth, Felix Hammond, Jessica Lamond, David Proverbs. Oxford: Wiley-Blackwell, 2012. print

Berry, Wendell. *The Unsettling of America: Culture and Agriculture* Sierra Club Books San Francisco, 1978.

Bourgeois, Jean-Louis "Speaking the Vernacular: Mud vs. Money in Africa, Asia and the US Southwest" *Building Without Borders* Ed. Joseph F. Kennedy. Canada: New Society Publishers, 2004. print

Burke, Bev. *Education for Changing Unions.* Toronto: Between the Lines, 2002.

Calthorpe, Peter. *Urbanism in the Age of Climate Change.* Island Press. 2011. print

Canadian Society of Civil Engineering. *33rd General Conference of the Canadian Society of Civil Engineering*. Toronto June 2005. accessed January 10 2015 http://www.canadiansforproperlybuilthomes.com/html/currentprojescts/nationalissues/uoftpaper.html

CMHC. *Best Practice Guide Building Technology: Wood Frame Envelopes.* Canada: CMHC 1999. accessed January 9 2015 http://www.civil.uwaterloo.ca/beg/archtech/cmhc_wood_frame_bpg.pdf

Cook, Sylvia "Alternative Building Interview." Telephone Interview. 20 February 2015.

De Botton, Alain. *The Architecture of Happiness.* McClelland and Stewart Press. 2006. print

Easton, David. *The Rammed Earth House: Rediscovering the Most Ancient Building Method.* USA: Chelsea Green Publishing Company, 1996. print

ECO Canada "The Green Jobs Map" eco.ca Accessed Dec. 8 2013

Evans, Ianto. “Philosophy, Background and Design” *The Hand-Sculpted House.* Ed. Ianto Evans, Michael G. Smith, Linda Smiley. The United States: Chelsea Green Publishing, 2002. print

Fourth Pig. “Why Sustainable Building?” fourthpig.org Accessed Dec 9 2013

Gibson-Graham, J.K. *Take Back the Economy: An Ethical Guide for the Transforming of Our Communities.* University of Minnesota Press, 2013.

Gooderham, Mary. *A Building Goes Up: The Making of a Skyscraper*. HarperCollins, 1998. print

Gramsci, Antonio *Selections from the Prison Notebooks*, 1971. print

Hammond Felix N., Kwasi Baffour Awuah Gyau and Stanislaus Y. Adiaba. “Urbanization and Climate Change” *Solutions to Climate Change Challenges in the Built Environment.* Ed. Colin Booth, Felix Hammond, Jessica Lamond, David Proverbs. Oxford: Wiley-Blackwell, 2012. print

Homesol Building Solutions. “We Can Change the World By Changing the Way We Build” draftexample.squarespace.com Accessed Dec 2 2013

Kachadorian, James. *The Passive Solar House: Using Solar Design to Heat and Cool Your Home.* Chelsea Green Publishing, 1997. print

Kennedy, Joseph F, Michael G. Smith, Catherine Wanek (eds). *The Art of Natural Building*. New Society Publishers. 2002. print

Kennedy, Joesph F. “A Critical Overview of Sustainable Building Techniques” *Building Without Borders* Ed. Joseph F. Kennedy. Canada: New Society Publishers, 2004. print

Klein, Naomi. *This Changes Everything.* Alfred A Knopf Canada. 2014. print

Krahn, Tim “Alternative Building Interview.” Telephone Interview. 05 March 2015.

Lao Tzu. *Tao Teh Ching*. Boston: Shambhala Publishers. 1961. print

Lerner, Kelly “Down-to-Earth Technology Transfer” *Building Without Borders* Ed. Joseph F. Kennedy. Canada: New Society Publishers, 2004. print

Magwood, Chris. *Making Better Buildings: A Comparative Guide to Sustainable Construction*. New Society Publishers. 2014. print

Marino, Dian. *Wild Garden: Art, Resistance and the Culture of Resistance*. Toronto: Between the Lines, 1997.

Marion, Ed “Alternative Building Interview.” Telephone Interview. 15 March 2015.

Marsden, William. *Stupid to the Last Drop. How Alberta is Bringing Environmental Armageddon to Canada (and Doesn't Seem to Care)* Vintage Canada. 2007. print

Moller, Clifford B. *Architectural Environment and Our Mental Health.* Horizon Press. 1968. print

Natural Resources Canada. “Canada's GHG Emissions By Sector” oee.nrcan.gc.ca Accessed Dec 8 2013.

OBC. *Ontario Building Code 2012*. Ontario: Ontario Building Code Office 2012.

Oliver, Paul. *Dwellings: The House Across the World*. University of Texas Press. 1987. print

Ontario Government *Ontario's Climate Change Discussion Paper 2015*. Government of Ontario. accessed February 20 2015. http://www.downloads.ene.gov.on.ca/envision/env_reg/er/documents/2015/012-3452.pdf

Passive House Canada. "Design Fundamentals" passivehouse.ca Accessed Dec 2 2013.

Pinderhughes, Raquel. "Green Collar Jobs: An Analysis of Green Businesses to Provide High Quality Jobs for Men and Women with Barriers to Employment" environmenthamilton.org Accessed Dec 7 2013.

Proskiw, Gary. *Sustainable Energy Efficiency of Homes Starts with an Uncompromised House Envelope.* Naima Canada. August 6 2014. accessed January 10 2015. http://www.naimacanada.ca/News.asp?a=view&id=51

Roaf, Sue. David Crichton and Fergus Nicol. *Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide.* Architectural Press. 2009.

Sayanajoki, Antti, Jukka Heinonen and Seppo Junnila "A Scenario Analysis of the Life Cycle Greenhouse Gas Emissions of a New Residential Area" iopscience.iop.org. Accessed Dec. 1 2013.

Smith, Michael G. "The Case for Natural Building" *The Art of Natural Building.* Ed. Joseph F. Kennedy, Michael G. Smith, Catherine Wanek. Canada: New Society Publishers, 2002. print

Steele, James “Tradition and Innovation in Green Architecture and Urbanism” *Green Living: Architecture and Planning* Ed. The Prince's Foundation for the Built Environment. New York: Rizzoli, 2010. print

The Holy Bible Containing the Old and New Testaments (King James Version) Westport Conn. Trinity Publishing Company Inc. Print.

Venolia, Carol. “Designing for Vitality” *The Art of Natural Building.* Ed. Joseph F. Kennedy, Michael G. Smith, Catherine Wanek. Canada: New Society Publishers, 2002. print

Wanek, Catherine. “Combining Natural Materials for Energy Efficiency” *The Art of Natural Building.* Ed. Joseph F. Kennedy, Michael G. Smith, Catherine Wanek. Canada: New Society Publishers, 2002. print

Williams, Jo. *Zero Carbon Homes*. Earthscan publishers. 2012. print

Wong, Terrell “Alternative Building Interview.” Telephone Interview. 01 March 2015.

Zytaruk, Melinda “Alternative Building Interview.” Telephone Interview. 21 March 2015.

Appendices: Lesson Plans

Appendix A: Architects, Engineers and City Planners

Goals

- Designers learn about alternative materials
- Designers are inspired to design with new, sustainable materials and using alternative methods of design
- Designers promote the use of sustainable materials to clients
- Designers recognize the thermal benefits of alternative buildings, as well as the aesthetic value of natural materials

Activities

- Have architects, engineers and city planners visit sustainable buildings. Allow them to understand how it works in regards to temperature control and air tightness
- Allow professionals to come to buildings and perform blower door tests or show results of these tests to these professionals
- Invite these professionals to see buildings during the construction process, so they can understand the process and gain an understanding of how they are built.
- Hold a “Lunch and Learn” during this workshop get very technical, appeal to designers' desire to see efficiency in buildings and show how alternative buildings offer that efficiency in a creative way.
- Show pictures and brief videos that showcase the beauty of alternative buildings
- Explain how sustainable building can help to positively influence the world

Appendix B: Potential Homeowners

*This would be a one day workshop

Goals

- Homeowners become knowledgeable about the broader environmental implications of buying a stick-frame tract house.
- Homeowners become aware of alternatives.
- Homeowners become aware of the benefits of using alternative materials (financial and otherwise).
- Homeowners make informed decisions

Activities

- House in a jar- an explanation of each part of a stick frame house and the harmful byproducts of each.
- Documentaries about alternative building styles
- Give a life-cycle explanation of a conventional house vs. a sustainable house
- Ask participants to make a list of what would be in their dream house. Show how many of the dream elements of their house can be achieved just as easily if not better in an alternative building.
- Dispel “common sense” notions about what a house is
- A cost/savings analysis of building a house that is 15% more expensive but does not have a heating or cooling bill

- Explain how buildings affect climate change and show how an energy efficient house can help to reduce personal contributions to climate change. Show how a house can help to make a positive change.
- Show how well-built buildings are multi-generational, and explain how these homeowners can leave their alternative house to their children and grandchildren.
- Make sure that potential homeowners are aware that they have power to effect positive change and create a better world for future generations.

Appendix C: Trades College

*This lesson plan will take place over an entire semester. Assuming the class meets once a week over 12 weeks, there will be 12 classes to cover sustainable building.

Goals

- Students have an understanding of sustainable building and the desire to pursue this field professionally.
- Students become more critical of conventional building
- Students have a basic understanding of how to build with various alternative materials.

Lesson 1: Critique of Conventional Building

* These lessons, as they are for a college course, will be accompanied by various readings that provide critiques of conventional building and its effect on climate change and environmental destruction. These readings are referenced in Chapters 1 and 2.

This lesson will begin with the "House in a jar" an exercise that visualizes what is in a conventional wall and helps to explain the various harmful effects of many of these products. This exercise will also help confront "common sense" notions about these materials. Good questions that could address these issues:

- Why are these materials used?
- Are these materials the best for their particular specifications?
- Have we seen other materials that are used instead of these materials?

Next, an explanation of the conventional philosophy of heating and cooling within homes and how this approach contributes to climate change.

Look at how mass production has affected the built environment in terms of quality and aesthetic.

Examine the concept of embodied energy.

Lesson 2: The Profit Motive

An exploration of the "common sense" notions that cause suburban houses and skyscrapers to be the dominant forms of housing in society.

A cost/savings analysis of building a house that is 15% more expensive but does not have a heating or cooling bill.

An extensive look at how labour is undervalued within conventional construction and how there is not enough focus on skilled labour.

Lesson 3: Passive Buildings

Give an overview of how to achieve Passive House standards.

Compare and contrast this building technique with conventional stick frame building.

Give the history of Passive House and the guiding philosophy behind it.

Show a slideshow of passive buildings, at various steps of the process.

Explain how triple paned windows make a difference to the thermal envelope

Give an overview of various types of insulation and make a pros and cons list.

Lesson 4: Rammed Earth

Give a brief history of rammed earth

Explain all the steps of how it is constructed:

- forming
- grain size analysis and mixing
- ramming
- -tripping the forms

Show a slideshow of the process and the end result

Lesson 5: Straw Bale

Give a description of how straw bale is built

Explain each step of the construction process

Show a slide show of the process and the end result

Lesson 6: Hands on: Footings

* All lessons past this point presuppose that a college has space to build test buildings and the funding to buy materials.

The students will learn how to make insulated footings including rebar, tie wire and concrete.

A relatively small footing will be created 20' by 20' wide enough to accommodate both rammed earth and straw bale walls (2').

Lesson 7: Hands on: Straw bale wall I (placing bales)

Have students construct an approximately 20' section of a stray bail wall including putting in the rebar, stacking the bales and tarping the wall.

Lesson 8: Hands on: Straw bale wall II (earth plastering)

Have the finer points of earth plastering explained to the class as they try their hands at getting a smooth finish

Lesson 9: Hands on: Rammed earth wall I (forming)

Explain to the class how to create a form for rammed earth. Explain the following elements:

- LVL strong backs
- 2'x10' walers
- formply
- end panels
- rebar
- insulation

Lesson 10: Hands on: Rammed earth wall II (ramming)

Explain the elements that are part of the earth mix and explain the consistency that the mix should have.

Have students try their hands at mixing and driving the skid steerer.

Once the dirt is mixed, put it into the wall in 9" lifts. Pneumatically tamp the earth. Then hand tamp.

Repeat this process until the form is filled and tamped.

Lesson 11: Hands on: Rammed earth wall III (stripping)

Explain the delicate way that forms must be removed from the finished wall and enjoy the finished product.

Lesson 12: Hands on work: Double stud passive framing

Build a third wall on the square footings. This third wall will be double stud, passive house stick frame. Students will learn about

- framing
- insulation
- vapour barrier
- air barrier
- passive building with stick frame materials

Appendix D: Grade 5 Class

This lesson plan will take place over a number of classes within class, it is essentially what the lesson plan for a natural building unit will look like. The lesson plan begins with the ideal list of goals of what students will learn about in this unit. A possible list of activities follows, and the actual lessons with their proposed amount of time will follow.

Goals

- Students have a knowledge of the importance of sustainable buildings
- Students have a way to critique contemporary building practices
- Students understand the jobs related to sustainable buildings
- Students ask questions of parents, teachers and community members about houses and buildings.
- Students get a sense of how design is done
- Students have an understanding of what stops alternative buildings (building codes etc.)

Activities

- Role playing (Defending the use of these materials vs. Alternative builders) -debate from groups
- House in a jar (Conventional vs. Alternative)
- Group Research project about conventional building materials
- Drawing the 'ideal' home in small groups.
- Building a scale model (possibly lego, or blocks, or supervised woodworking).
- Field trip to an alternative building

Lesson 1: Introduction to Sustainable Building

*The purpose of these activities is to get students thinking about different types of buildings, and hopefully peek their interest in buildings in general.

This introduction would be done best through the use of a field trip to an alternative building, whether that is a private residence or public building. As time passes and alternative buildings become more common within the built environment, local field trips should be easier to arrange. For this trip to be most effective it should be to a rammed earth or straw bale building, something that looks very different from a conventional building.

If a field trip is not feasible, then a slideshow/brief documentary could be used as an introduction to the concept of sustainable building.

Lesson 2: Role Playing Debate

*The purpose of this exercise is to show students the merits of alternative building materials, as well as the difficulty with getting these ideas passed in the current building industry.

Break the students up into two groups, one group will research conventional materials and the other will research alternative materials.

Possible conventional materials list:

- drywall
- bricks

- concrete
- single or double paned glass
- lumber
- “pink” insulation
- shingles
- paint

Possible alternative materials list:

- rammed earth
- straw bale
- cordwood
- cob
- thatch
- SIPs panels
- metal roofing
- cotton batt insulation
- passive house windows
- green roofs

After the students have been given a week to research these materials, they will bring their information forward and present it in the format of a debate. The teacher should be sure to make sure that facts are correct.

This debate will allow students to learn about building materials in a way that engages them and forces them to think critically. This method will also make students understand why members of the building industry defend their products, it is not always that what they are using is best, it is often a fear of change that causes potentially poor products to be defended.

Lesson 3: Drawing Plans

* The purpose of this exercise is to give students a basic understanding of how buildings are drawn up.

In small groups of 2-3, students will draw their dream house. These drawings will happen from a number of perspectives:

- plan view
- side views

These drawings will also be drawn to a scale.

Accompanying these drawings will be a short description of the materials used for the house and why the rooms were included within the house.

Lesson 4: Making Models

*The purpose of this will be to allow students to see how clearly they create plans, as well as to test their creativity in three dimensions.

Each small group will give their plans to another group. Each group will end up building out of lego the house that has been designed by the other group. Students will be assessed on how well their plans were able to be followed as well as how well they were able to creatively build using lego. Materials other than lego may be used, but as lego is readily available and does not require special skill, it would be the easiest way to build in a standard, easy to follow way.

Lesson 5: Presenting the Models

*The purpose of this would be to let students present their work and elaborate on what they've done.

These presentations would have both the “designer” group and the “builder” group present so that any questions about either the design or the final product can be answered by the group responsible.

This presentation will also help to show how important it is to have good communication between designers and builders.

Appendix E: Interviews

Sylvia Cook: President of AERECURA Rammed Earth Builders

What inspires you about your job?

I get excited at the thought that rammed earth has the potential to become a mainstream building material and that I am there at the very onset of the journey.

It was exciting yesterday when we were talking with a group of young people who are getting into the building industry, who were themselves excited at the idea of being able to build in a new, environmentally responsible and sustainable way. They asked excellent questions that showed they had been thinking about this and responded very well to concepts as diverse as how to lower energy intensity in the building itself or how to create a more socially sustainable building culture.

What has been most difficult for you on your current career path?

I think what has been the most disheartening is being dismissed: “Oh, you're just a fringe element, a wannabe mainstream builder, and you aren't and can never be one.” But I think what's interesting is as time goes on, I'm encountering that less and less. Even the same mainstream architect who may have been dismissive a few years ago is now recognizing

that rammed earth is the next sexy building material and maybe she should be looking at incorporating it too. And boots on the ground contractors who would not have even heard of it a few years ago are now recognizing, hey rammed earth is out there; it sounds really cool. It floors me when people actually know what I'm talking about without me having to explain it. I'd say even those sorts of hurdles that we've encountered along the way such as trying to get a building permit in the City of Ottawa have led to expanded opportunities of letting people know the realities of building with rammed earth. It is not anything that is scary or freaky or way out there -- it's an acceptable way to build.

The local concrete builder, it's what he knows. He knows how to make the same batch of concrete day in and day out and he knows how much less expensive under our current system concrete is than rammed earth. He says, "It will never catch on. It's too expensive. What's the point of having a labour intensive alternative to my product?" Society is starting to recognize that labour intensive is not necessarily bad but what is necessarily bad is energy-intensive building processes. It's killing the planet to keep using cement at the rate that we do. That concrete manufacturer is going to have to, as we rethink our energy mix, come up with a better system for his product, something that is going to make our product more and more viable.

We have a generation of disenfranchised youth who would like to have jobs that have meaning that don't wreck the planet for their children or grandchildren. I think that we owe it to them to provide them those types of jobs, and rammed earth is fun. It's

challenging, it’s hard work, and it’s fun. I'd love to give jobs to everyone who would like to participate in that, and I certainly get a lot of people wanting to participate, which is very encouraging as well. So I have great optimism that the future of rammed earth will involve more and more people without increasing the energy-intensivity of the industry.

We've been exploring ways of reducing even the very small carbon footprint of our building system to make it even less carbon intensive and more labour intensive, which seems counter-intuitive to the ways that profit-based companies are creating their products, but I feel that it is going to be both profitable and necessary.

What inspired you to do something different within the construction industry?

I was living in a small town that is an hour's commute (from Toronto) on the 400, not counting traffic delays, and falls in that into that magical zone where it seems to make sense to provide lots and lots of housing. I looked around at those houses sprouting up like mushrooms on what was previously agricultural land and realized that they were by in large poorly built and they were going to need extensive maintenance and renovations throughout their lifetime. They were going to use lots of fossil fuels to keep them both warm in the winter and cool in the summer and it just seemed a colossal waste. And I hate waste. It is the efficiency of building with rammed earth that has probably excited me the most. And that was before I built it. Now that I'm in it, I have to say it’s the comfort that's the best. The efficiency and the comfort are probably just two sides of the

same coin. The reason that it’s so comfortable is that it’s so efficient. But it’s also zero maintenance, not contributing to building materials ending up in landfill sites, and it uses so much less energy that we're not even talking the same language. There were just too many reasons to go with rammed earth and too many reasons not to keep doing what we're doing in our mainstream building environment.

Zero was the number of rammed earth builders in the neighbourhood and that seemed an incredible shame. I either had to become the neighbourhood rammed earth builder or give up on the dream, and it was a good dream and I'm glad that I made the choice. It involved sacrifices along the way; pioneers always have to put more in to get things going, but there's a lot of satisfaction that comes with that as well.

There are rammed earth companies in Canada. It might have been possible to get one of them to come and build for us but that would have been beyond my financial means and that also brings up the point that I want to make rammed earth affordable for ordinary people, like me. My husband and I are retired teachers, not investment bankers. We'd like to be able to provide houses for other people who are not investment bankers. Though if investment bankers would like rammed earth houses, they should definitely build them.

Terrell Wong: Architect with Stones Throw Design

What inspires you about your job?

It's always changing for sure. When I'm designing with different materials, I really like getting into the interesting qualities of those materials and finding out how we can push them, trying to find alternatives to standard construction and then going into the science behind it. I like trying to figure out how it can satisfy the criteria of the code while at the same time being able to push these materials so that we get the best out of them on the site so they become more than what they were before.

I get to do interesting projects with interesting people. I'm constantly doing something different. No project is ever the same. Even if all the criteria are the same, by the virtue of the fact that all the people are different, no job can ever be the same as another. It's like a fingerprint each time, and that's kind of fun, always challenging.

I like the fact that after twenty some odd years, I'm doing this and people are looking for me rather than me trying to force it upon other people. I can see that there is a change in the industry, even at the level of the consumer, so that somebody who runs their own, very niche firm can actually make a living. I like that it's expanding and that other people are able to get into it. I remember being told when I started this twenty some odd years ago that I was crazy, that I would never make a living and that I should just give up and get a car, get with the program. It's funny. At the start I just wouldn't tell people what I was doing. I would just design them houses and add extra insulation and try to make it all a little more airtight, not doing a very good job because I was young and didn't know

everything, still don't know everything, but enough that I could do a little better job each time I did a house. And then public perception changed by virtue of the fact that I was doing the same buildings but I had won a competition. Now I have people come to me and ask me for my knowledge and how I can push, so that's kind of a nice change too.

The first (accolade) was the archetype house. It kind of put me in front of people for the first time and it's still out there so people can go and tour through the house. What I know now and what I knew then, it's amazing the difference. But I'm glad that I went in that competition. I wouldn't be where I am today if I hadn't won that competition. It's amazing how much perception changes when you end up on TV. Suddenly, I have more credentials than I did before, but it put me in front of the people who needed to see me and I got to meet some amazing people like Sylvia. Then doing the straw bale building has helped as well. It means I get interesting jobs anyway. Nobody calls who wants a regular old 2x4 house anymore.

I have more authority now. I did one job with straw bale and the client had never even heard of straw bale but was willing to put her faith in me to do that because it seemed like the best option for what we wanted to do for that house. Even though we had terrible times with the municipal officials trying to get it passed, and I pulled my hair out and didn't make a dime, it was fun because we got to push through the government bureaucracy to get past ill-conceived conceptions about natural materials. Hopefully, that will make it easier for other people in the future to do the same.

What has been most difficult for you on your current career path?

Bureaucracy (laughs). Fighting the government is the hardest part of my job. There's no timeline for it, you don't get paid for it, there's no indication, there are no rules that are followed. You have to keep pushing and pushing and saying, "Well the city has established these rules, why can't I use them?" and then you get back to "Oh you're different. I don't know how that works." So you keep going back and then you have to go around and try and find political allies. With political allies it depends on the hour of the day. They smile if they think they are going to get your vote, but as soon as they don't think they are going to get your vote, they drop you like a hot potato. They are not very helpful. Occasionally, you can use them to your advantage for a few minutes to get things moving. They might get you a phone call. That's all I've found out about political people. At the end of the day it comes down to the person who's pushing it, how adamant they are, how much information they have, how much backing they have and how annoying they are. The squeaky wheel, that's me. If I just keep annoying them and barraging them with information, eventually they will back down. It's just how much time and how much money it's going to cost the client in terms of the slowdown and things like that, which is unfortunate because if I wanted to I could be a homeowner and do my drawings to the minimum of the code and get my permit within 10 days. But with a full crew of engineers and architects on the same drawings, trying to push the envelope and make things better, I

get held up for as long as two years in some cases. So it seems unfair, but that's the hardest part of my job.

What inspired you to do something different within the construction industry?

I think it fell in my lap. I blame Ranger Rick. This is what I tell everyone when they ask how I got into environmentalism. My aunt gave it to me as a gift when I was a kid and I used to read it late at night and I think it rattled my brain. I've just always been that kid who gave composters to my Mother for Mother's Day. I just thought there was a simpler and easier way of doing things and couldn't understand why things were done the way they were done. So, every time I've been given an opportunity I've always said yes. But most of it is self-taught. They didn't have environmental studies when I went to architecture school, but I think that's the best way because the people who are learning it can learn it and be passionate about it. It's all about growth and now you can go to school and take all of these courses and get degrees in it.

There will always be pioneers because there's always a fringe somewhere, like that Passive House movement where we're the fringe pushing things way beyond the code and in some cases it's the same insanity. Pushing and pushing helps move the market forward. The people who push at the very tip, the very bleeding edge as they call it with construction, end up having a greater effect. They're the pinpoint at the top, but it fans out and then at the bottom it pushes the window industry to create better windows. It pushes

people to provide better materials because consumers are asking for them. I would say the fact that so many North Americans started buying and looking for better windows has changed dramatically in the last few years what is available on the North American market and it has even caused the North American market to say, “Uh Oh, you can't have a window that isn't tested in North America in your building.” It’s actually in the building code now and that was because they were afraid of too many European windows coming into the market. So the European windows, the smaller companies are only going to be used in a retrofit where they're not going to be checked, but if you want a German quality window, it has to be tested to North American standards now. In fact this is a positive thing and a negative thing. It forces North America to do better but it also kind of cuts off some of our links to some of the better products that we were bringing in. It’s a ripple effect. I see it as all good in some way.

Tim Krahn: Engineer Focusing on Alternative and Sustainable Materials

What inspires you about your job?

Probably the biggest thing is working together with clients and builders and other designers on creating well built spaces for people. The beginning part of every project is generally the most exciting where people come together, someone expresses a vision and other people either get on board or not. But usually people are pretty excited at the beginning and it’s because we want to do something either that we've done before and we

want to do it better or we want to do something totally new. Either way it’s an exciting prospect.

New is a strong word. I'm often inspired by things that have been done in the past that we are not doing today like vaults and that sort of thing. Conversion structure stones, vaults, domes used to be pretty common in public buildings in North America even in the middle of the last century, and they've kind of fallen away. It’s not that we can't do those things; it’s that we haven't for a while. So it’s exciting and new to me but we're not suddenly doing something that has never been done. It’s actually very common around the world and there are examples in our cities of these kinds of structures. Pretty much all the train stations, passenger terminals in Canada have tile vaults, domes that at the time were the most economical way to get a fireproof span of that size and have the kind of open air that people wanted. But if you asked a builder today to reconstruct Union station, they probably wouldn't know what to do.

What has been most difficult for you on your current career path?

It’s the two-headed beast of the high cost of labour but the undervaluing of skill. We put a really high price on labour so that has caused the North American construction industry to become pretty padded. We try to turn out really technical parts that we'll just have some technicians put together. They're prefab. Talk to any architecture student and they are very excited about prefab because they want to be able to have total control, they want to

be able to have precision control over their materials, they want to be able to deliver it, have it assembled on site with as little labour as possible and they believe that that gives them the surest chance of realizing the building that they have designed. But what I find is that there's always still an issue and if you've got skilled people on site, you can potentially end up with a better building because you don't always see everything when you're sitting at your computer. Even with our good 3D software nowadays you still don't technically have a three-dimensional realization and that on-site skilled labour, not just labour, skilled labour. Skilled trades, guild members are going to be able to realize better things with materials than prefab, in my opinion.

So a technique like a vault where you start with simple tiles and a plaster terrace that counts on skilled labour to make large span domes with minimal formwork is just foreign now. I don't know if we have anyone in North America who could do a dome or vault that was bigger than twenty feet. I might be wrong. I've seen some experimental things but they're more like installation pieces. They've become a piece of art because they're so unique, and they don't really turn into a building. Maybe that's fine but I don't think these techniques should be relegated to sculptural installations. They can still be buildings.

We price labour so high, but we don't value it. We don't trust the builder’s hands. We trust a contractor or a construction manager to assemble the pieces of something that has been largely created off site with the exception of things like concrete where we have

extensive formwork created on site. But that's one where the material is relatively inexpensive.

You could add something about the business culture that highly values the mobility of labour. You want to be able to slot generic worker A in slot A anywhere in the world and that ends up with a lowest common denominator set of skills for that labourer. They have to be able to lift that much weight, they have to be able to hold this screw gun or whatever but it doesn't really allow them to become true craftspeople. And really, I don't know if specialize is the right word. But to an extent it is that it would be impossible to become a master of all of these materials and techniques, but I think the whole culture just steers everything away from any type of mastery and just says you have to have these types of characteristics. In the grand army of builders, we only want privates and that's it.

The regulatory environment is one that seeks to minimize risk and the construction industry is one that seeks to minimize risk. Probably the biggest manifestation of that is low-bid culture. You've got to be able to bid really accurately in order to get work and because major clients are going to take low bids. So you can only take two or three jobs where you bid too low because to stay in business you still have to maintain some type of profit. But you're forced to keep things really, really lean. So that steers builders away from anything they've never done before, steers them away from materials they've never used. And if there's any regulatory hitch around anything they might be familiar with in terms of working, like maybe their uncle built a stack wall log cabin and maybe they

helped and they have an understanding of how to build that way, they still look at that and say, “We'll never get a permit for that.” So that would be a delay that would add risk and add time to their bid, and as a result, they will shy away from it.

It doesn't take long in that kind of low-bid culture to just end up with these off the shelf materials and techniques that I was complaining about before. It all has to be preordained, if you will. So from a designer's standpoint, and I dealt with this quite a bit in Australia where there were a couple of other engineers at this conference. One in particular was an engineer in Western Australia with a great reputation. The bulk of his work has been done in the mining industry and on the side, he doesn't just do this on the weekends, he does do some rammed earth engineering. He is such a respected person that he is able to do pretty much whatever he wants and he's of the opinion that having a specific code for rammed earth will hogtie designers. He may have a point but I think there are so few people willing to take the risk of working with this material in terms of engineers that we need something to open the door. To me the door is firmly shut. There are very few people who can open that door and we need something there. So it’s a delicate balance. I agree with him that if we put something too firm together than we'll always be using cement stabilization. We'll basically be making a different kind of concrete and that's it. Where I would love to move is to either using different stabilizers or no stabilizers aside from clay and water. That's the goal for rammed earth but you can apply it to other things as well. I'd like to think that the mycelium insulation products that are coming out are going to be embraced with open arms, but I don't know if they are. It'll be quite a challenge for all

these companies to jump through the hoops that have been created by our regulators. It's not that those hoops were created maliciously.

The OBC has become a huge document and I don't think it's going to get smaller anytime soon. We're going to just keep adding to that thing. I don't know how you back away once you've said this is what you need. It's like a Chinese finger trap: it only goes one way, the noose just gets tighter. It's a philosophical difficulty. Do we regulate or do we trust the skill and experience of the designer? It's kind of parallel to the valuing the high cost of labour and not valuing skill. I would say that the average engineer is just a highly trained technician who simply uses cookbook type solutions. They're just slightly more complicated than what a tech or lumber yard designer might do, but very few engineers are willing to take risks and really understand their materials, use the laws of physics and go from there. That's because it's risky. If you're working for a company that has a mandate of minimizing risk, then you are likely to stay away from that stuff. I don't think it's malicious. It's just the culture.

What inspired you to do something different within the construction industry?

I used to frame houses way back, but by the time I became an engineer, I was determined to do something different. I started getting into engineering with the goal of doing water and waste and then got steered back into buildings. I just wanted to use different materials than what are being used and I wanted to use them more elegantly. I don't know

what inspired me, maybe reverse inspiration? I just looked around and thought, wow that's pretty ugly and disposable and while it drives GDP, it's just a race to the bottom. You have the same thing that creates that low bid culture, also creating a twenty-year life cycle for low grade light industrial, light commercial. We just set out these rectangles that we know we are going to replace. You just put that right into the budget and pass those savings on to the consumer and it has nothing really to do with craft or health or appearance. It just has to do with the profit margin. I've never been interested in profit margins really. I don't think money is a good tool to measure things. That's part of the problem. It's a bad metric. I don't really have a replacement for it. I dream about the day that we measure our currency in calories or kilojoules because those things obey the laws of physics, but I have no idea how to implement that. I have no idea.

Ed Marion: Passive House Builder/Consultant

What inspires you about your job?

What excites me about the whole process is educating people about what is possible, about what their indifference to building better homes is actually doing.

What excites me about my job? I would say one of the main things is just getting to wear a lot of hats for what I do. I run a small design/build firm and I'm a PH consultant. You get to be the designer one day and you get to be the general contractor the next day and

then you get to be the guy who is on site with construction boots on the day after that nailing walls together. I think the fact that I get to spend everything from office time to boots on the ground time is very exciting. When I'm doing design work, I sit for hours and days at my computer and I think to myself that it’s really neat that I can do this but I'd really hate to have a career where I do nothing but computer work all the time. Then there are days where it’s -20 and I'm helping the framing crew on the roof of a house and I realize that I can't wait to get back to the computer. It’s nice to be able to have the skill set that has evolved over time to allow me to do all of those different things. That's one of the best things that I like about this particular job.

The next thing I like is just to create. It’s a very creative type of job and at the end of the day you end up creating some really high quality homes for people and that is extremely rewarding. The homes that I aim to build and have been fortunate enough to build are homes built to last and built to be resilient. None of them are decked out with the latest renewable technology. They're well built to avoid the built-in level of redundancy, failed windows, roofs that tends to be part of the normal building culture in this country. The homes are very well insulated so in the event of some sort of catastrophic and prolonged power outage, I have complete confidence that they wouldn't sustain freeze damage or anything that other houses would be susceptible to. So that's one of the things that I like. When I finish a project, I know that I'm leaving the client with a really good product and so far, so good.

Another thing that inspires me is working with other trailblazers, having this evolving, building envelope performance-focused field, working with all the people who work in this field: architects, designers engineers who are really discovering the benefits of good building science. These are really good people to get involved with. That event we went to last week, “Boots on the Ground”, is really a fun event. We get to meet all types of like-minded people and trade ideas and there's still at this point in time a lot of honest information sharing. If you and I are discussing projects, we're going to be able to tell each other what has worked, what hasn't worked. We're not trying to sell each other our point of view completely coated with some kind of bias because my approach is better than yours or whatever. So there's still a lot of honest information sharing. I don't know if that's typical of any grassroots evolution. Maybe at the beginning of any grassroots movement there's a lot of sharing and love at the beginning and then as soon as it gets profitable everyone turns on each other. Maybe that's when the poison of capitalism clicks into the whole thing. But at this point in time, I really like that aspect of my job as well, just being able to share knowledge with participants in this field.

What has been most difficult for you on your current career path?

Probably the biggest challenge that I'm faced with, and I would think this is common with most colleagues, is the television culture that focuses on accessories. Most people get their knowledge about building from lightweight sources and I know that sounds terribly condescending, but if you only watch television shows for your inspiration,

you're not going to be picking up the phone and calling an alternative home builder. It's not really promoted as something that people should be discussing. It's all about interior accessories, you know, the stuff that people typically enjoy, the tactile benefits at the end of the day, the countertops, the carpets. You can't derive any pleasure from touching your insulation or the air tightness in your home, even though those things are providing daily benefit to you. So the marketplace really doesn't have any idea about this. It's a lack of understanding that buildings are systems, not just places that you drop a whole bunch of countertops and carpets into. On the flipside, I think the way to battle that is some of the smarter ones amongst us need to come up with the perfect pitch for a television show: We've got a really good show that focuses on alternative building and these are the real issues we would like to present and the consumer should be talking about.

When I do a project I spend a lot of time focusing on the building envelope itself and I have deep conversations with homeowners about it and that is something that they're not indifferent to. When you actually approach them about that they totally see the benefits. They recognize, yeah that makes sense what you're saying. But it'll never happen if that conversation doesn't happen and I think that conversation needs to happen a lot more.

There's not enough understanding of building science amongst trades and building officials. Outside of the alternative building industry, there is still a lack of knowledge about building science and the things that people need to understand if they are going to create more alternatives to flashy, resilient style housing because it is a joint effort. If

people don't ask for it, then typically the architect and builder don't get to do them. They give people what they want, so if people want a building with no windows, ignoring the building code for one second, you're not going to be able to convince them they want windows. If they want the opposite, they'll do that. More people need to start asking for homes that are going to be more resilient, that are better built homes from an environmental standpoint.

It's risky going into words like "environmental" and "green" because every clever marketing campaign has capitalized on that and it's just set the bar so low. I always used to joke that if they took away spent nuclear fuel in burlap sacks that it would go over really well because they would think they were being so environmental because oh, yeah, the burlap is biodegradable.

The other thing that makes it difficult, I think, is the speculative nature of the real estate market here and the culture of home ownership as an investment tool. These things combined lead to a lot of homes being built with a completely different set of criteria and those criteria are usually based on "Let's bring it to the market as cheaply as we can so that we can capitalize on flip and move on to the next one." That has happened a lot, certainly in the last decade and probably longer than that, so this makes it difficult to convince people to take a more long term approach. A lot of people don't buy homes to live in them. They buy homes to make money and move on, and a lot of people have

made money doing that so it's really hard to convince them otherwise. But that is a big problem as well that affects the entire alternative building industry.

I do a lot of tours in my home, and by a lot I mean dozens of people through my home in the last three years including architects, builders, homeowners, lots of student groups from Ryerson and Sheridan and no one has ever walked away saying:"God, this is bullshit, man" or been indifferent. They all come away being like "Yeah, this is pretty cool what you've done here. I think you're onto something." If people are exposed to the alternative, a lot of them will see the benefit of going that way. When people buy their large flippable houses, I don't know whether there is the cool factor that lingers. My wife and I are always talking about what a great house this is, I guess because we're in our tee-shirts looking out and it's -15 and the house has just been good to us in so many ways.

What inspired you to do something different within the construction industry?

The first thing that got me going was I had an epiphany. I was reading "Fine Home Building" and I came across this article on Passive House design and I was working in the custom home business and every home had two furnaces, two air conditioning systems, and I was making a good living. But I was thinking that at some point this may not be a smart way to be building. It's certainly not a sustainable way in that we can't be building all houses like this. This would be in the mid 2000s. At the same time I started to read more stuff about sustainability and climate change and global warming and peak oil

and all these things kind of converged on me at the same time and I started to read a lot and research a lot and the more I did that, I already kind of had several layers of increasing knowledge about sustainable issues when I came across the Passive House concept and it was just the perfect fit. So discovering Passive House design and going to my first Passive House conference was one of the biggest inspirations to never do "regular" construction. Then I went a step further and did the Passive House training course and decided that I would do my house as a training ground for Passive House construction. It was a good thing to do because it would have been difficult to do for a client for a paying project because I wouldn't have known what to begin with what to charge or to estimate for time, etc., etc., etc. Of course having completed the project and lived in the house, there's no way I'm going back. I will always do something different before I go back to conventional construction.

We're not reinventing the wheel. It's a pretty simple set of principles that you're following. A lot of it is just simplifying things. We live in a world that is so busy with fluff and all sorts of peripheral distractions that we don't need in everything, not just our houses. All these things are distracting and they take money away from simpler solutions. If you look at the history of housing construction over time, it has always been, especially with the shape of buildings, pretty simple unless you are exceptionally wealthy and even Georgian mansions were square or rectangular buildings. These people didn't lack imagination. They just knew from trial and error and lessons of time that these are just more comfortable shapes than rambling shapes. Maybe a house with windows all facing

north is a bad idea. Yeah, it was darn cold all winter and they never did it again. I think there is a definite hubris among modern man that these things don't matter anymore, that we're masters of energy now and we can build whatever we want to. Houses with 20 dormers in them, and the view is west-north so let's put all the windows north and everything else be damned.

What inspired me to leave? It was just a growing awareness of sustainability issues and discovering by accident that there was a better way. A real better way, not just changing the light bulbs. Because that will garner a front page in the home's section. The low hanging fruit is always what people want to go to. I always say if people could download a phone app to save the planet they would do that rather than turning the temperature down a half degree. Do you know what I'm saying? Everybody wants to use technology to solve problems but we can't abandon common sense.

What inspired me most was just meeting like-minded people. When I discovered how many great awesome people were working on this level, on this mission, it was very exciting to me. One of my U.S. Passive House colleagues describes the same type of euphoria. He says, “I've finally found my tribe. I've been looking all my life for my tribe and I finally found them.” At Passive House conferences, it’s a whole bunch of people from all walks of life all involved in the same crusade and it’s all really cool.

My journey started in 2008 thinking that I had singlehandedly discovered this new concept and then discovering the tribe. I was one of the first ones to do it in Canada without a lifeline in that there was no other project I could even drive to an hour away to check out what they had done. When I look at that compared to what's happening now, a lot has happened and a lot is happening and that's very encouraging, but I think the infection is sort of happening at the trailblazer phase. It needs to get out and start infecting the general population. I think people need to start getting the message about what's possible and what they should really be talking to their builders about.

Melinda Zytaruk: Worker/Owner of Fourth Pig Straw Bale Builders

What inspires you about your job?

Because of the way we decided to structure our business as a not-for-profit worker co-op in the mission, we created very deliberately the enormous opportunities for flexibility and creativity in terms of how we go about our jobs. So while we build and renovate buildings, we also try to seek out clients who have similar goals to our organization. For example, we've been fortunate to do work with our second food co-op. We did renovations and did some educational workshops with the West End Food Co-op in Toronto, which embodies why we came together as the Fourth Pig Worker Co-op in the first place, to be able to work on projects that have a greater change. They're not just using materials that are less toxic, but are also doing it in a way and for a purpose that have a greater community impact and look at the broader future of teaching our communities and benefiting our communities. Now I'm working with the Muskoka North Good Food Co-op and that's really exciting as well. It’s not always easy trying to figure out how to achieve those goals and pay the bills at the same time. But because of our structure and flexibility, it is certainly never boring. We never do the same thing twice.

We get to do education and get other people excited about the possibilities. People recognize the opportunities that natural building and more energy efficient buildings bring and see how that can also help that community in general.

What has been most difficult for you on your current career path?

What's difficult for me is finding the time to do everything I want to do and keeping up with it. There's so much changing and so much going on in our sphere and choices we have interest in trying to bring together, so it's just so hard to keep up. I've got a stack of books to the ceiling which I'm trying to read and I have the last straw printed out beside me and the building code up on the screen and I'm trying to absorb some of it. Because we do have such a broad number of things we do, the hardest thing is coming up with the time to learn all the things I want to know to do my job well, which is exciting because there's so much going on that I want to know compared to say 8 or 9 years ago. We started in 2007. I had read every book then, more than I could now. Now there has been an explosion in thought around sustainable building, natural building in North America. Anyway we're catching up to some places around the world so that's exciting but also challenging because it's hard to know everything and read everything.

Back in 2007 I'd have to spend so much time seeking out materials and trying to find alternatives to PL500 or whatever it was. A large chunk of my time was spent finding ways of getting products from California and Europe that were more environmentally friendly because there certainly wasn't anyone retailing them, but now we have the building resource and other retailers specializing in these things. Now I call up and say,

“Hey, I need something that doesn't give people cancer but sticks to a wall.” “Ok, I'll go get that for you.”

The least exciting things to me are WSIB reconciliation. I do enjoy an excel spreadsheet from time to time but there's other stuff I'd rather do. We're trying to download as much of that onto better software and better systems so we can spend our time trying to do things we like to do.

What inspired you to do something different within the construction industry?

Beer and quitting my job. It just so happened that we had a really interesting group of us with varied skills and backgrounds that came together and wanted to do something together. So we had a group with a lot of co-op experience and we all had shared values and had been working in various other sectors and were passionate about the built environment and found an opportunity to combine our efforts to try and change the way we think about shelter and how shelter gets approached and try to demystify things about our built environment for people to make it more accessible and more sustainable and try and do something positive to address climate change and the other unique challenges in our world that we face. We happened to have a nice mix of skills and backgrounds and people who found themselves in that area looking for a job, so we decided to create a workers' co-op to create our own jobs. There were four of us. One of our four founders is

not currently an employee but still on the board as an adviser and now we have two other members that have come on as well.

Another thing that inspired a lot of us to start the worker co-op was that a lot of us came from the not-for-profit sector or even from the building sector, the natural building world,and were frustrated with this idea that somehow if you're doing something that is of benefit to society that you should be completely altruistic and not even want to be paid really or be willing to work for really crappy wages. And I don't think that's fair or right. This whole idea that because it’s built out of straw bale, professionals are just going to show up and build it for free because they love it so much and it’s such a great thing. That doesn't work. These are often accountants and others who get paid all sorts of money for doing things in the private sector and don't translate it into thinking that people who do things that they actually enjoy doing should be paid enough to feed their families too. That's something we're trying to do: people can have good jobs in this sector.