Transformative architecture for the shrinking city

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ABSTRACT

Many cities such as Detroit and Cleveland have been shrinking over the past decades. As cities shrink there is a weeding out of inefficiencies in businesses, social venues and in occupied spaces. When growth returns, the perforations in the urban fabric become the spaces for growth opportunities.

There are over 4.6 million commercial buildings in the United States housing nearly 70 billion square feet of floor space. Most do not meet ASHRAE Standards for thermal comfort, ventilation and energy efficiency, due to age. The embodied energy in each of these buildings is enormous. Replacement of outdated buildings is not only a loss of this embodied energy, but requires additional resources for the disposal of the demolished structure. A shrinking city has an abundance of outdated buildings at low prices creating opportunity to replace the concept of urban re-growth with that of transformation.

Transformation is different than restoration or renovation in that it does not necessarily strive to maintain the social, political or cultural embodiment of the place. Transformation allows a sustainable update with a new concept for user encounter. The idea of building replacement is the economical choice at present not due to the merits of replacement but rather due to the lack of research into the transformation of existing structures into sustainable environments.

While new methods and materials are important, the idea of building on a virgin site has passed its time. Exploration into the retrofitting of existing buildings with new program and updated sustainable systems is important and preferable to development of urban pockets or brownfields.

This paper will discuss the need for transformative architecture in research. Examples of transformative projects highlighting success and failures will be reviewed. The paper will provide a basis for discussion of the development of transformative ideas for practicing architecture firms.

CONFERENCE THEME: Ecology, Sustainability, and changing societal and political economies
KEYWORDS: sustainability, shrinking cities

THE SHRINKING CITY

Many cities such as Cleveland have been shrinking since the mid-twentieth century. Largely due to the decline of the American steel industry, most rust-belt cities have returned to population numbers not seen since the 1920s.[1] Cleveland began a rapid growth trend in the early twentieth century reaching a population of 900,000 by 1930. The city was able to maintain this population through World War II and the post-war building boom, but numbers have been falling since that time. From 914,808 in 1950, the population of Cleveland in 2009 had dropped 53% to 431,369.

While Cuyahoga County, home to Cleveland, has seen a population decrease of 8.5% over the past decade alone, the City of Cleveland population has decreased 9.8%. According to census data posted on the City of Cleveland planning site[2] (figure 2) the Metropolitan Cleveland area has seen slight growth during this period. What this data implies is that the city is de-centralizing but has an opportunity for re-growth, albeit slow growth as indicating by the increase in population of the surrounding counties.

The continual decline has left Cleveland with an urban landscape perforated with vacant lots and brownfields. On October 4, 2010, The Cleveland City Council passed amendments to the zoning code[3] to include urban agriculture as a principle use for vacant residential lots. The BioCellar[4] Project led by Terri Schwartz at the Cleveland Urban Design Collaborative plans to use foundations left by some of the eighteen hundred vacant dwellings scheduled for demolition in the upcoming year. These foundations will be converted to greenhouses, compost stations and fisheries in an effort to stave the decline of property values and social order in Cleveland neighborhoods.

Although the group is still negotiating funding for the first BioCellar, Figure 3 shows the possible impact and relatively uniform dispersion of Biocellars throughout Cleveland, indicating that the loss of residential units is not particular to one area.

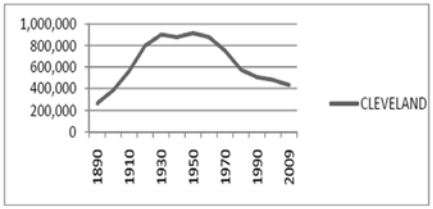

Figure 1: Population in Chicago, Detroit and Cleveland in the 20th century. Source: www.census.gov

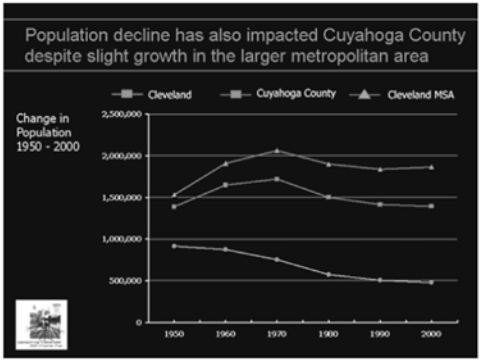

Figure 2: Population decline in Cuyahoga County. Source: Planning.city.cleveland.oh.us

Shrinking cities struggle with a vicious circle of tax base loss causing tax rate increase causing emigration causing tax base loss… And while the loss of 1800 homes in the next year is cause for concern, it is less than 10% of the total number of homes in Cleveland. The commercial sector in Cleveland has taken a harder hit. According to a study by Grubb & Ellis.[5], 23.5% of commercial real estate in Cleveland was vacant at the end of 2010. Further, five large tenants, occupying over 811,000 square feet in downtown Cleveland have leases expiring soon. Three out of the five reported to the Plain Dealer[6], Cleveland's newspaper, that they are considering the possibility of new construction, and not necessarily within city limits.

Predictions of a return to cities coincide with predictions of de-centralization. Herzog[7], in his book "The Return to the Center" states that:

> "One category of work in planning and urban design in the second half of the twentieth century involved the search for ways to rescue the "sense of place" in cities…but "sense of place" is, at best, a vague notion, difficult to measure, and highly subjective. Yet, seemingly everyone would agree that cities with meaningful spaces are more stimulating than those that are homogeneous."

Whether a prediction of return or a prediction of further de-centralization or even a prediction of the urbanization of suburbia is accurate, Herzog's simple observation that cities with more meaningful spaces are more stimulating indicates a course of action for rustbelt cities such as Cleveland.

As cities shrink there is a weeding out of inefficiencies in businesses, social venues and occupied tenant spaces. It begins slowly with the departure of a company with a large number of employees and significant lease space in the city. When the employees leave, support businesses such as restaurants and merchants suffer. Those businesses most highly impacted are those in close proximity to the new vacancy and that operate with a low profit margin.

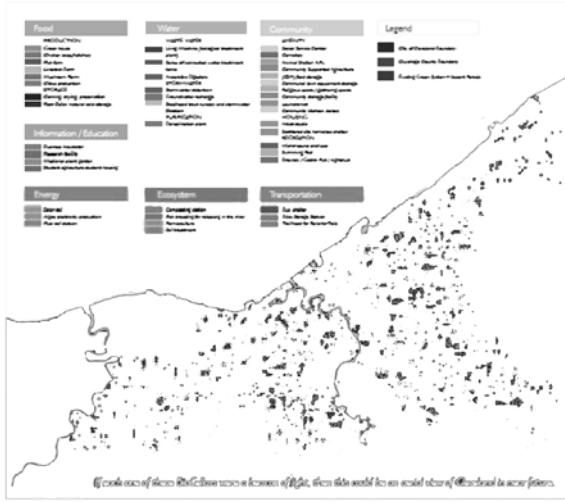

Figure 3: BioCellar proposed use map Source: Paul Vernon, Cleveland Urban Design Collaborative

If growth returns, however meager the rate may be, the perforations in the urban fabric become spaces for new opportunities. Unfortunately, not all growth occurs in vacant building space. Consider the implications of building replacement in a city with a declining population or very slow growth rate. On one hand, new buildings create constructions jobs, add to the tax base and create a sense of prosperity that helps the image of the city. The downside is that when the growth is not true growth, but merely a relocation of existing businesses into new buildings, the temporary surge in constructions jobs and boost to the tax base is offset by the creation of yet another vacant building. Vacant buildings not only pose a security threat, but they have an adverse affect on all the businesses in the area.

According to the University of Michigan Center for Sustainable Systems factsheet[8], there are over 4.9 million commercial buildings in the United States housing nearly 72 billion square feet of floor space. Most of these do not meet current ASHRAE Standards for thermal comfort, ventilation and energy efficiency, mainly due to date of construction. A building built after 2010 will be designed to use half the energy of a building built 35 years earlier.[9] Further, the embodied energy in each of these buildings is enormous. Replacement of outdated buildings is not only a loss of this embodied energy, but requires additional resources for the disposal of the demolished structure. A shrinking city has an abundance of outdated buildings at low prices making it a place of opportunity to replace the concept of building replacement with the idea of transforming existing vacant or underutilized buildings and leaving the urban perforations to develop natural or alternative uses.

1. TRANSFORMATIVE ARCHITECTURE

Transformation by definition requires change. Transformative architecture promotes a change in use, a change in appearance, and a change in efficiency and sustainability. By recognizing that every city is constantly in flux at some scale as it reacts to economic stimuli and by judicially employing sustainable strategies to affect positive change, transformative architecture becomes a means towards the attaining the next life of the city.

1.1 THE DYNAMIC VERNACULAR

Transformative architecture embraces the idea that the vernacular is dynamic. Just as language and customs defining a culture evolve over time, architecture also evolves. This constantly evolving vernacular can be seen in the timeline of any city. It can also be seen in the timeline of many

buildings not restricted by historical preservation. Kenneth Frampton, in writing about critical regionalism states

> "In order to take part in modern civilization, it is necessary at the same time to take part in scientific, technical and political rationality, something which very often requires the pure and simple abandon of a whole cultural past." [10]

In writing this, he was speaking of the problems facing newly developing nations, and yet, the same holds true for shrinking cities. As population dwindles and development is replaced by abandonment, the identity that a city once had is lost. In order to become a vital urban center again, the city will require a rethinking of its raison d'etre.

Cleveland, no longer a steel center, has such an identity crisis. One strategy currently employed is to redefine Cleveland as a medical service and supply center. The Cleveland Medical Mart & Convention Center broke ground in January 2011 and is expected to be completed by 2013. This center, located on the mall in the heart of downtown Cleveland is predicted to revitalize the downtown area. How successful this attempt at revitalization will be is dependent on the nature of future development.

In seeking a new identity, Cleveland, like other shrinking cities, must let go of its past and allow its vernacular to transform. Transformation is different than restoration or renovation in that it does not necessarily strive to maintain the social, political or cultural embodiment of the place. Transformation allows a sustainable update with a new concept for user encounter whenever that update is necessary to the survival of the city.

1.2 LOCATION, LOCATION, LOCATION

The idea of building on a virgin site has passed its time. And while developing urban pockets or brownfields, most of which are thriving parking lots, is better than developing greenspace; a plausible condition exists in shrinking cities to justify conversion of parking lots to greenspaces or greenspace-covered parking facilities and reserving redevelopment to existing and preferably vacant structures. By doing this, this urban fabric becomes a patchwork of occupied spaces connected by greenspace rather than one of new buildings dotting a landscape of vacant buildings.

The idea of building replacement is the economical choice at present not due to the merits of replacement but rather due to the lack of research into the transformation of existing structures into sustainable environments. For redevelopment to take place in vacant structures, it must become economically feasible. To achieve economic feasibility, more exploration into the retrofitting of existing buildings with new program and updated sustainable systems is required. Updated sustainable systems, passive and active, require more than adding a second skin to the façade.

1.3 THINKING OUTSIDE OF THE DOUBLE SKIN BOX

Double skin facades have become the method of choice in many retrofits today due in part to the following. The addition of a second skin leaves the original envelope intact, preserving the history of the structure, saving on demolition costs and allowing for possible occupancy during the retrofit. Second skins rely on a thermal stack effect from the solar radiation collected to draw air around the original façade; a passive system.

Yet, in order to be truly effective, a second skin must enhance user comfort for all conditions specific to a site. For example, in a Cleveland winter a double skin should augment heat transferred to the building through solar radiation and deter heat loss from the building through the skin in cloudy and night-time conditions. In the spring and autumn, natural ventilation should be encouraged. In summer, minimizing of heat gain is necessary. Simply enclosing an existing structure in a glass box is not going to achieve optimal user comfort. The second skin will need to provide natural ventilation at specific times of year, adjustable solar shading, ease of maintenance and recirculation of solar radiation to the north side in winter; in other words, an active system.

The Occidental Chemical Building in Niagara Falls, NY is exemplary in multi-seasonal adaptability. Studies at the University of Waterloo11 show a cavity temperature 14oC higher than outside temperature in the winter with dampers closed, but only 1oC higher in the summer with dampers open, exterior windows open and fan on. This indicates the a second skin could work well as a passive system. However, interviews with tenants found users were not thermally comfortable, due most likely to the fact that the louvers, intended to rotate for solar shading and nighttime insulation, had not been operable for the past 4 years. Because of reliance on a mechanical element, the double skin failed to create thermal comfort for the occupants. The double skin of the Occidental Chemical Building has a cavity depth 1.2m that allows room for maintenance workers to clean the space, and to allow for adequate air movement. It also has the luxury of a large open site. Although the building is referenced because it is located in a city with a climate very similar to Cleveland, Cleveland buildings have other challenges that hamper the design of a double-skin as a façade transformation. First, many buildings are constructed to the lot line and therefore do not have enough space to build a double skin without seeking to acquire sidewalk space from the city. Second, many buildings are not oriented properly to employ a double skin.

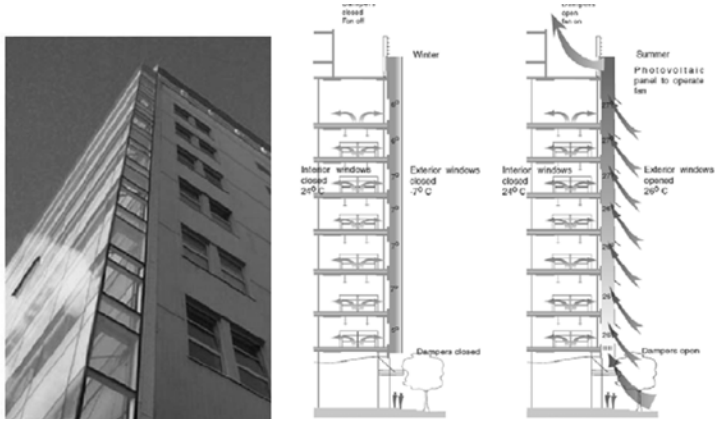

Figure 3: Double Skin Façade on the Occidental Chemical building. Source: The Tectonics of the Double Skin: Green Building or Just more Hi-Tech Hi-Jinx?

Why a second skin? Consider the idea of replacement skins for high rises constructed of stick or unit type curtain walls. Replacement of the curtain wall units can upgrade user comfort without adding to the weight of the façade or having to create a self-supporting second skin. The metal and glass from the existing skin can be recycled to reduce the carbon footprint of the upgrade. In such a case, new panels could offer natural ventilation, lower thermal conductivity, less air infiltration, solar energy production, rain water collection, and climate responsive shading strategies.

But is the cost of new envelope panels justified? If the largest heat transfer occurs through glazing, why not simply replace the windows? The Empire State Building[12] is undergoing a restoration in which a third pane of glass will be added during the re-manufacturing of its 6500 windows as part of a plan to reduce the energy consumption of the structure by 38% or 4.4million dollars annually. The windows alone are predicted to reduce the energy needs by 5%. The project reworks the R-2 double pane glass with "SeriousGlass"TM coatings which give the remanufactured unit an insulation value between R-5 and R-8. Simply rethinking the windows only provides a minimal reduction in energy costs.

Currently, at Kent State University, Adil Sharag Eldin, PhD and Hollee Hitchcock Becker are conducting research on climate responsive wall systems that employ a titanium foam structure immersed in a conductive fluid that relays input from both the interior and exterior environment to natural thermal regulators which present as veins and pores throughout the wall system. The Living Skin will be capable of adjusting temperature and oxygen levels without the use of an HVAC system. The development of responsive panels such as this have the benefit of achieving thermal

comfort without the creation of a double skin. And while daylighting conditions must be addressed, the panels could be employed as partitions to deliver thermal comfort and indoor air quality to all spaces within the structure, thus creating a significant reduction in time and cost associated with HVAC retrofitting.

1.4 THE LEAN, GREEN, BUILDING MACHINE

Strategies for Visual comfort, thermal comfort, auditory comfort, energy efficiency and water collection or usage reduction are abundant hot topics in architectural research today and for good reason. Clients demand more from their new building projects than ever before. In transformative architecture, the possible sustainable strategies are unhindered by formal restrictions. In order for these strategies to be effective and well –integrated, they must be investigated in the programming phase. In the UK, Michael Jaggs and John Palmer developed EPIQR: Energy Performance Indoor Quality Retrofit,[13] which is basically a methodology for building evaluation focused on energy efficiency, improved indoor environmental quality, addition of solar energy and cost effectiveness.

Consider a methodology based on transformative architecture, that augments the EPIQR goals as follows:

1. Potential uses: Understand the client's vision for the building space. Include flexibility in the occupancy types and proposed floor areas for future transformation.
2. Evaluate the structure. If the structure is not the sound, the project needs to be reconsidered because of economic considerations.
3. Consider passive strategies for user comfort. Consider adding a green roof. It not only adds thermal insulation to the roof, it provides occupants with a private park. Make note of solar and wind shadows. Plot overheated periods and consider shading options for the façade. Shading options may be as simple as retractable awnings. Consider rainwater collection and reuse as gray-water systems. Gray-water can be used to flush toilets or irrigate the green roof. Consider adding an insulated layer to the exterior of the building façade to reduce thermal conductivity through the structure. Consider adding a thermal layer to the interior of the façade when asbestos is present and must be isolated or removed. Consider adding an acoustical layer to walls and partitions. Consider improving day-lighting conditions through the size and height of windows, addition of light scoops and reflective shafts for indirect light and adjustable light shelves.
4. Consider active strategies. Chances are that the HVAC system will need to be replaced. The type of HVAC system chosen as replacement will depend on the type of structure and its natural tendency to integrate with the HVAC system. If the building is located on a waterfront, consider the possibility of geothermal using the water source. If the floor plates can hold an additional topper slab, consider radiant floor heating. Consider energy efficient lighting systems with LEDs, occupancy sensors or timers. Consider alternative energy sources such as photovoltaics or wind turbines.
5. Consider acoustical Comfort: Reorganization of space requires thought into the changes in reverberation time and decibel levels that will occur (for better or for worse). Consider if masking will be necessary for occupant privacy.
6. Find unique ways to integrate systems. For example, filter collected rainwater in a wall system that also includes micro-hydroelectric turbines for energy generation and creates white noise for auditory masking. Three needs fulfilled in one system.

1.5 LIVE, WORK AND PLAY

The dynamic vernacular is tightly linked to the life cycle of its neighborhood. Decentralization in cities occurs when neighborhoods no longer function as a place to live, work and play. Thus, it is important to reintroduce mixed use neighborhoods to the shrinking city. An office building does not always need to be an office building. It may become residential units over professional offices

over retail establishments. It may become a vertical university of classrooms, dormitories, cafeterias and studios. The December 2010 issue of Modern Steel Construction10 contains an article about the conversion of the Ottawa Street Power Station in Lansing, Michigan into prime office space. The project involves the construction of a ten story steel frame inside an existing masonry structure[13]. And while this article attests to the possibilities open in transformative architecture, the transformation of a power station to office space only provides a work environment which means that unless it is sitting within a neighborhood of residential, retail and entertainment spaces, it will not help counteract the decentralization of the city.

Successful cities understand the importance of mixed use neighborhoods and in many cases demand development reconcile to the idea. On Capitol Hill in DC, the area around Eighth Street is bustling with restaurants, shops, the Eastern Market, the Navy Yard and even a hardware store. Jenkins Row, a recent addition to the neighborhood located on Pennsylvania Avenue between 13th and 14th streets, contains 247 condo units atop a 45,000sf Harris -Teeter grocery store at street level.

Downtown Cleveland is not without residential units, although amenities such as grocery stores, pharmacies, dry cleaners, hardware stores and other essential shops are rare or non-existent. Most successful mixed use neighborhoods, such as University Circle and the Warehouse District are located in areas where building heights average around three levels. In a typical three story mixed use neighborhood, the pedestrian interface is linear, along the street line. The challenge that downtown Cleveland faces is the height and configuration of its existing structures; tightly built with narrow streets and dark urban canyons. To encourage regrowth, Cleveland should consider alterations to its urban streetscape to allow pedestrians to view more sunlight and vegetation. One method to accomplish this is to step back facades above every third level, creating a local green roof for occupants and reducing the solar shadow at the street level. Stepping back the facades would mean a reduction in rentable floor space, but when a building is vacant and has little chance of becoming fully occupied, the income earned from better quality work and living spaces will compensate for the reduction, if not directly, then by the positive influence it will have on the neighborhood as a whole.

2.0 PUTTING THE PIECES TOGETHER

Transformative Architecture could be a design methodology for shrinking cities. Embracing the idea of the dynamic vernacular allows cities to shed old identities and build new, performative environments. Celebrating open spaces, rather than trying to fill them motivates developers to rethink existing structures. Thinking beyond adding a second skin, to reinventing with new, performative form and use will allow the shrinking city to find itself again.

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