

Readymade

In Toronto, an unusually large number of high-rise apartments poke above the flat landscape many miles from downtown... this is a type of high density suburban development far more progressive and able to deal with the future than the endless sprawl of the US.¹

—Richard Buckminster Fuller, 1968

INTRODUCTION

This paper and speculative design project reconsiders the concept of waste in architecture; not simply the byproducts of construction, but of design itself—the purportedly failed architectural ideas and built form of a previous era.

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PROLOGUE

If scarcity, necessity, and crisis are indeed agents of constructive innovation, then after four years of prolonged global environmental and economic meltdown we should be on the verge of some significant reconsideration of previous paradigms. One of these is the concept of “progress” and “growth” as a way to reach carbon neutrality.

Less than six years ago Architecture 2030 reasoned that, based on the trajectory of growth in the construction industry, by 2035, 75% of the existing built environment of the US would be replaced by either new or renovated “green” buildings, transporting the U.S. industry to carbon-neutral status by 2035.² That target is elusive in this post-2008, world economic crisis situation of extremely limited growth. Old paradigms of growth—even the growth of a “sustainable” construction industry cannot be depended on to remedy the current condition of profligate fossil fuel energy use by the existing vast inventory of inefficiently built infrastructure. Architecture 2030’s assumptions about this target appear to be predicated on the growth patterns of the past 50 years. In the current situation of economic crisis and potentially prolonged flattened or negative growth, we need to tip architecture’s contribution to carbon emissions reduction toward renewable energy production, and the retrofit of existing infrastructure, rather than so heavily toward the presumed salvation of new construction.³ Author of the *Third Industrial*

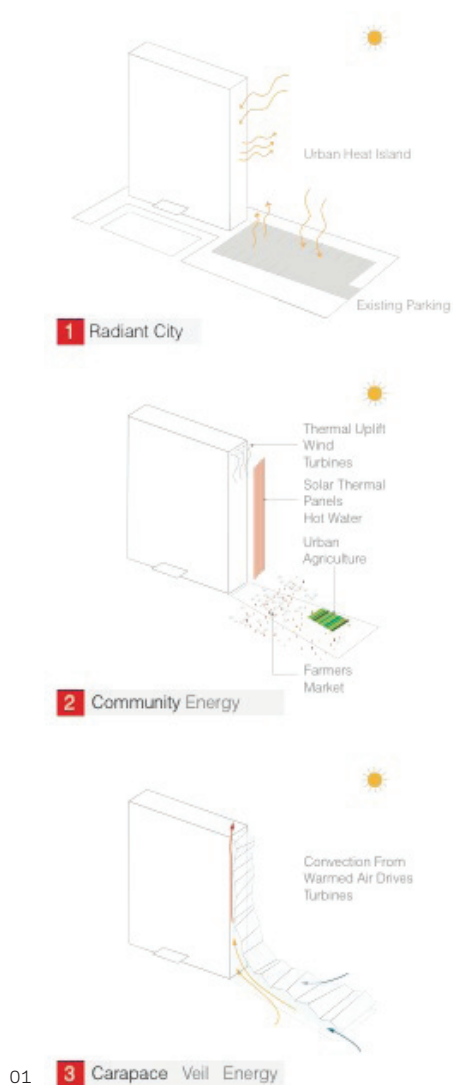


Figure 1: Design Diagrams

Revolution, Jeremy Rifkin’s renewable energy economy of “lateral power sharing”⁴ similarly argues that buildings need to be net producers of energy rather than consumers, where the aggregated impact of multiple individual energy producers is shared on a great energy grid as easily as the Internet.

This paper and speculative project attempts to transform the suburban post-war “tower block” into a renewable energy generator. The site is Toronto, Canada.

International modernism’s most prolific, maligned, and energy profligate elements⁵ of urban infrastructure are particularly prevalent in the Greater Toronto Area and Hamilton, where between the core and inner suburbs of the metropolitan area there are more than 1,000⁶ of these buildings. Between 1947 and 1975, Toronto (unlike anywhere else in North America) enthusiastically embraced the CIAM prototype to accommodate its post-war population boom and the urban rhetoric that accompanied it. Clusters of these towers, some 250,000⁷ units, between 12 and 25 stories tall,⁸ were built on the periphery of the urban core surrounded by parkland and connected by parkways. These “apartment neighborhoods” were mostly privately developed, desirable, even glamorous places to live. Now a generation later, Toronto’s structures, lost in the inner suburbs are unfashionable, aging poorly, and seen as not adequately proximate to quality urban commercial, community activities, employment, or public transit.

As a result, they are affordable and the location of choice for the newly arrived. Despite their many inadequacies, they are currently providing almost 48% of the rental housing of the city,⁹ and generally without the ghetto-like conditions that characterized many renowned American, English, and European examples of purpose-built social housing. In the context of the ongoing 10%¹⁰ annual immigration to Toronto, this infrastructure is an invaluable resource.

Nevertheless, there are a number of these tower neighborhoods identified as “Priority Neighbourhoods.”¹¹ Blaming architecture and urban design alone, for a largely demographic, economic, and social condition, Toronto is currently in the process of demolishing an entire urban neighborhood¹² (Regent Park) of these buildings, replacing them with new mid-rise and point tower buildings. If we see this situation from the perspective of resource “scarcity and necessity” it seems questionable to justify the destruction of any single one of these structures.

RADIANT

This late-modern period infrastructure, the “slab block” concrete tower, is generally seen as irredeemable, not only for its legacy as a symbol of the failed ideological enterprise of the modern movement, but now also for its inherent energy inefficiencies. These reinforced concrete structures operate in a cold climate like Toronto as great thermal bridges, the multiple balconies like enormous radiating fins transferring interior heat to the perimeter, and transferring cold to the interior.¹³ They are typically un-insulated, single-glazed and without the full cross ventilation condition integral

to the skip/stop corridor system of Corbusier's l'Unité d'Habitation that they are distantly related to. Surrounded by large asphalt surface parking, the buildings and their sites create huge heat radiant islands.

TOWER

The "Mayor's Tower Renewal Project"¹⁴ in Toronto is a research project spearheaded by the University of Toronto, E.R.A Architects, and the City, that has been studying the problems and opportunities offered by these buildings. Their contention is that these towers should be refurbished rather than demolished and rebuilt in another form. Their value as affordable housing, embodied energy, and architectural heritage, is considered indispensable.

Building on the success of European precedents like the refurbishment of Bijlmermeer in Amsterdam and Marzahn¹⁵ in Berlin, this study proposed the development of a process to enclose balconies, thermally overclad structure, install renewable solar thermal and district geothermal energy, and to reinvigorate them with additional built form at grade for community, commercial, and amenity space. This process would make a significant impact on the carbon footprint of the overall city (3-5%)¹⁶ as they make up such a large proportion of its housing stock.

While this project was enthusiastically adopted and promoted by the City in 2008, no significant aspect of this project has been initiated to date. The capital costs for owners for its implementation are too high in the current economic climate.

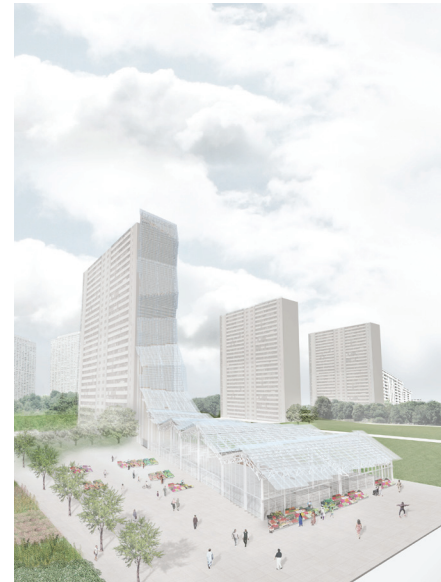
THE GREAT WASTE¹⁷

This project takes the concept of waste—the buildings themselves and the vast asphalt parking areas surrounding them; and treats these as raw matter for producing renewable energy and community. It then looks at the industry that precipitated this suburban housing form—the automobile industry, as a protagonist in the creation of this energy.

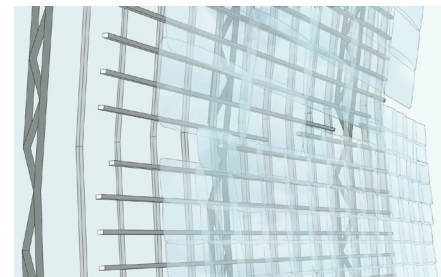
Like the slab block building typology, the car is bulky, laden with embodied energy (1 ton of steel per car)¹⁸ and dependent on fossil fuel. Designed for obsolescence, its active life span is often less than ten years because of body corrosion from road salt in northern climates.¹⁹

This design proposal uses salvaged automotive glass to create a great glass canopy and vertical solar-thermal convection chimney against the solid end walls²⁰ of these towers. Like the towers themselves, automotive-safety glass and steel, retrieved from end-of-life vehicles are also "ready-mades,"²¹ second-generation materials in the transformation of architecture from a consumptive to a productive state.

The underutilized land surrounding these buildings is tapped as both a heat source for the convection air that drives this wind tower, and a greenhouse, community, commercial, and amenity space at grade identified as critical to the holistic success of the Tower Renewal Project.



02



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Figure 2: Carapace: Recycled Automotive Glass

Figure 3: Greenhouse and Community Space

Figure 4: Aerial View of Glass Solar Thermal Veil in Situ



05

Figure 5: El Anatsui, "Man's cloth"
the British Museum

NOTES

1. Metropolitan Form, Density, Transportation: (Toronto Neptis Foundation, 2007)
2. "By the year 2035, approximately three-quarters (75%) of the built environment will be either new or renovated [1] This transformation over the next 25 years represents a historic opportunity for the architecture and building community to avoid dangerous climate change." [1] Data Source US Energy Information Administration, Architecture 2030. http://architecture2030.org/the_solution/buildings_solution_how.html. Accessed August 2012
3. See Architecture 2030 (renewable energy to be 20% of the mix with 40% renovation and 40% new construction)
4. "The creation of a renewable energy regime, loaded by building, partially stored in the form of hydrogen, distributed via a green electricity Internet, and connected to plug-in, zero-emission transport, opens the door to a Third Industrial Revolution." from "The Third Industrial Revolution: How the Internet, Green Electricity, and 3-D Printing Are Ushering in a Sustainable Era of Distributed Capitalism," Huffington Post Tech. Accessed July 2012.

SOLAR CHIMNEY

Large-scale solar updraft towers have been installed in Jinshawan, Mongolia China²², and are being planned for the United States, Spain and the Middle East.²³ They typically are large-scale, freestanding power plants, located remotely from the site of power usage, designed to maximize output with extremely large purpose-built towers and glazed solar collection fields. In this project, this idea is translated into a smaller, on-site version. What it lacks in intensity it makes up for in its multiplicity. Productive by aggregation, it is an evolution of the vernacular Middle Eastern wind towers brought to popular attention by Rudofsky's, Architecture Without Architects.

The applied layer of glass over a multi-story vertical and horizontal thermal mass, with a horizontal greenhouse at grade induces warm air convection (stack effect) to a series of wind turbines located at the roof level of the buildings to generate electrical energy for direct use by the host building. A solar thermal vertical water-storage chamber against the existing wall would store the collected heat for use to supplement the boiler for the units' radiant heating system.²⁴ This latent heat could also warm the fresh air intake to the buildings in winter.

LOCAL ENERGY

The existing "average prototypical tower" uses 104% KW of energy annually.²⁵ The energy collected annually from the combined effects of the solar thermal storage, and the convection air updraft would be expected to be enough to supply the needs of the building and still have excess capacity to sell energy back to the grid or share with its neighbors in the cluster.²⁶

VEIL/CARAPACE

While dismantled architectural glass is not typically re-used architecturally because of its brittleness, it is readily recycled through melting and reprocessing. Glass used in the automotive industry, however is typically sent to landfill or crushed for use as aggregate, as it is not conducive to recycling because of the presence of butyl membranes between layers and the adhesive remains and sometimes heat sensors incorporated in the glass.²⁷ The tempering and lamination inherent in the auto glass make it very strong for reuse without remanufacture and reprocessing—an energy intensive proposition with glass. Easily removed prior to the shredding of the cars for steel recycling, automotive glass is plentiful (16 million end-of-use cars a year in the United States).²⁸

Recycled car, bus, and truck glazing are appropriated for use as a new suspended veil. Like armadillo skin, the various size and shape platelets are gathered to accommodate changes of direction in the surface, and overlap and array with one another. Friction-fit standard glass fittings for dry glazed railing and guard systems would clamp panels at their top and bottom edges and be assembled in steel-framed panels made in factories off site. The two-way curvature of each component gives the glass added strength and allows the whole surface to shimmer in the sunlight.

SKELETON

A steel space frame trusses would support the weight of the glass and these clamping elements. It could also be made of recycled structural components.

The structure allows for both repetition and variation and is adaptable to suit the aggregation of the found components and the particularities of each building and site. The framing and support systems could be pre-manufactured in reasonably scaled panel components, offsite in a factory, minimizing installation costs.

COMMUNITY

By covering the car parks adjacent to the solar wall with the same glazing system, common amenity spaces are created for a variety of communal activities. Urban agriculture for commercial or tenant use, play space for children, leisure space for the elderly, and social and commercial space opportunities would be made available at grade.

AGGREGATE

The potential for repetition of the project in Toronto is significant because of the sheer number of these buildings. Replication of this idea, not only increases the renewable power generated, but also creates the density to support an industry in designing, engineering, and manufacturing the support structure for the glazing, and for collecting the obsolete automotive glass.

SCARCITY/CREATIVITY/INNOVATION

There is a history of creativity, craft, and beauty in the repurposing of material in cultures and economies where materials are scarce. The Shaker quilt and rag-rug up-cycle spent material into new uses. Scarcity does instigate innovation, as evident in the twenty years of work produced by the Rural Studio in rural Alabama, where the \$20,000 house is an ongoing research challenge to students. The Mason's Bend Community Centre Project designed by a group of students in 1999 under Mockbee, is an inspiration for the work of this project.²⁹

The work of artists like Ghanian, El Anatsui, comment on the material discrepancy between the developed and developing worlds, where diminishing natural materials are supplanted as raw resources for new products, by the leftovers of globalized waste. El Anatsui (see Figure 5) works with this concept of aggregation, where commonplace and ubiquitous items like the foil caps of liquor bottles are collected, flattened, and knitted together to create gigantic glittering chainmail-like scale tapestries that recall traditional colorful textile traditions of Ghana. Canadian aboriginal artist Brian Jungen similarly juggles consumerism, scale change, global detritus, and cross-cultural comparison in his body of work that includes a life-sized whale skeleton (titled "Shapeshifter", 2000)³¹ fabricated out of hundreds of nested and deconstructed dollar-store plastic chairs.

5. "...Although density is generally thought to aid sustainability, this stock of concrete slab apartments demands more energy per square meter than any other housing type, current data suggesting up to 20 per cent more than a contemporary single detached house. Although certain efficiencies are gained from reduced land coverage and transit use, the buildings themselves perform poorly." Ted Kesik and Ivan Salef, *Tower Renewal Guidelines: For the Comprehensive Retrofit of Multi-Unit Residential Buildings in Cold Climates* (Toronto: University of Toronto, John H. Daniel Faculty of Architecture Landscape and Design, 2009) p. 8
6. Kesik and Salef, p. 4
7. Kesik and Salef, p. 7
8. Kesik and Salef, p. 7
9. Kesik and Salef, p. 27
10. "Population and Dwelling Counts, for Canada, Census Metropolitan Areas, Census Agglomerations and Census Subdivisions (Municipalities), 2001 and 1996 Censuses - 100% Data". Statistics Canada, 2001 Census of Population. 2011-02-08. <http://www.toronto.ca/demographics/pdf3/cpa55.pdf> Accessed 2012-02-08.
11. There are 13 identified "Priority Neighborhoods" in the city recognized for gang activity and gun play. These neighborhoods that have been identified as having insufficient support facilities (community centres, recreation programs etc.) <http://www.towerrenewal..> Accessed August 2012.
12. For a Summary of the Regent Park Revitalization project see <http://www.torontohousing.ca/regentpark>. Accessed July 2012.
13. Kesik and Salef, pp. 59-70
14. City of Toronto Memo http://www.toronto.ca/planning/pdf/markham_elles_mayor_towerrenewal_oct08.pdf. Accessed August 2012.
15. Kesik and Salef, "Global Precedents," p. 18-21.
16. City of Toronto Memo http://www.toronto.ca/planning/pdf/markham_elles_mayor_towerrenewal_oct08.pdf. Accessed August 2012.
17. To Corbusier "the Great Waste" was the live/work commute to "the garden city from the city" and the inefficiencies of this development type. Le Corbusier, "The Great Waste", in *When the Cathedrals Were White*, (New York: McGraw Hill, 1964) pp. 176-177.
18. <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/elvs>. Accessed July 2012.
19. "In 2007 the overall median age for automobiles was 9.4 years, a significant increase over 1990 when the median age of vehicles in operation in the US was 6.5 years and 1969 when the mean age for automobiles was 5.1 years." http://www.bts.gov/publications/national_transportation_statistics/html/table_01_26.html. Accessed July 2012.
20. There are several different modernist tower typologies identified in Toronto's inventory (Kesik and Salef pp. 48-50), but they are typically consistently, double-loaded corridor

buildings with concrete shear walls separating units. The shear walls between units are functionally expressed on the narrow north and south walls as blank facades. Fire stairs are typically found there.

21. Marcel Duchamp, "Apropos of 'Readymades,'" Lecture at the Museum of Modern Art, New York, October 19, 1961. Published in: *Art and Artists*, 1, 4 (July 1966).
22. J. Sol. Energy Eng. / Volume 127 / Issue 1 / TECHNICAL PAPERS "Design of Commercial Solar Updraft Tower Systems—Utilization of Solar Induced Convective Flows for Power Generation" <http://dx.doi.org/10.1115/1.1823493> p.117 Retrieved August 2012. 2012. See also article on commercial application in Jinshawan China. http://news.xinhuanet.com/english2010/china/2010-12/27/c_13666710.htm. Accessed July 2012.
23. Bernard Rudofsky, *Architecture Without Architects A Short Introduction to Non-pedigreed Architecture* (New York: Museum of Modern Art. 1964)
24. Kesik and Salef, p. 28.
25. Kesik and Salef, pp. 154-157.
26. Estimations in consultation with Paul Walsh Ph.D.P.Eng. (Dept. of Aerospace Engineering) and Co-Investigator, Ibrahim Bradley Miles, with reference to the report by them titled *Energetic Building Façade Systems* (unpublished) January 31 2012
27. ARC of Canada <http://www.autorecyclers.ca>. Accessed July 2012.
28. Each year, the steel industry recycles more than 18 million tons of steel from cars. This is equivalent to nearly 18 million new cars. <https://sites.google.com/site/steelingssuccess/4-1-literature-review>.
29. Victoria Ballard Bell, Patrick Rand, "Masons Bend Community Centre" in *Materials for Architectural Design* (London: Laurence King Publishing, 2006) pp. 26-27. Designed by Forrest Fulton, Adam Gerndt, Dale Rush, Jon Schumann and supervised by Advising Professors Sam Mockbee and Bryan Bell.
30. For images of this work see, <http://www.gallery.ca/en/see/collections/artist.php?iartistid=25208>
31. "Heat, Beat and Treat" is a quote from Janine Benyus from "A Conversation with Janine Benyus" <http://www.biomimicryguild.com/janineinterview.html>. Accessed August 2012.

IMAGE REFERENCES

Figures 1-4

Design: Cheryl Atkinson Architect

Illustration: Ibrahim Bradley Miles

Figure 5

Artist: El Anatsui, "Man's Cloth," On public display at the British Museum, Department of Africa, Oceania and the Americas.
Photographer: hahnchen

http://en.wikipedia.org/wiki/File:El_Anatsui_-_Man%27s_Cloth.jpg#globalusage Accessed August 2012

The conception of an item designed to do one thing that can have a second life as another when accreted is satisfying ecologically, intellectually, and aesthetically (from the element of surprise in the transformation of something familiar, remade new.) The re-conception of waste as a resource to be used as is—rather than being recycled through another iteration of the manufacturing process of "heating, beating and treating"³¹ it, is one that has to be universally adopted in the definition of "sustainable" design and "resources." We need to take a look at existing structures and materials, both natural and manmade as creatively as possible, with as little manipulation and energy expenditure as possible.

CONCLUSION

As we look for opportunities to redress the repercussions of the modern architectural project—fossil fuel consumptive buildings, and sprawl and its associated problems, the predominant architectural response is still predicated on the notion of "progress"—to invent new paradigms, new forms, new technologies, and new construction.

The modern project was conceived with the best of intentions and did succeed in many ways, housing great numbers of people economically and equitably around the world at a time of great need and upheaval. This ideology, an altruistic response to the dire urban conditions of the first industrial revolution—housing shortages, pollution, disease, and social inequities—precipitated the second industrial revolution and its fallout—the dire urban and environmental conditions we are facing today.

This is something to keep in mind as we reinvent ourselves once again as the icebergs melt. Most of the fabric of North American cities has been constructed in the last 50-odd years since World War II. The post-carbon city needs to look at the large quantity of high-density housing that already exists, as ready-made resources rather than liabilities.

The automobile singlehandedly transformed the form, culture, and ecology of the city and the economies of the West, and the developing world is now welcoming it enthusiastically into their lifestyles and cities. The developed world needs to inventively reprise these resilient components as second-generation resources with potential beauty and integrity. ♦