New Skin, New Hope for Old Buildings

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INTRODUCTION

→ Cast your eye across the horizon of any major city and you will see collections of ageing tower blocks punctuating the skyline. Built largely after the Second World War to fill an urgent need for housing and office space, their construction paid little heed to aesthetics or energy efficiency. Now they are not only an eyesore and prone to disrepair, but their wastefulness with energy has become a major part of our global climate change problem.

Buildings are responsible for nearly 50 percent of North America's greenhouse gases (GHGs). Operating them consumes over 70 percent of all electricity generated in the region. The GHG emissions rate is most intense in cities, with buildings responsible for 79 percent of New York's carbon footprint. It is a similar picture elsewhere – the figure for London, for example, is 60 percent. To put this in perspective, SUVs count for just 3 percent of emissions in North America.

If we are to successfully tackle global warming, we clearly have to do something about the carbon footprint of our buildings, and particularly our old and an inefficient residential and office stock. The good news is that if we do, we will reap far more than just climate change benefits.

Making buildings more efficient will cut energy bills and save expenditure on new power generation infrastructure. Less fossil fuel-generated power will mean cleaner air and better health, leading to lower health costs. Upgrading apartments and offices could transform the lives of residents and workers. And if we approach the task in the right way, we could give a facelift to many of the constructions that blight our landscapes and revitalize the aesthetics of our cities.

So how do we go about solving this problem?

DEMOLISH, RETROFIT OR RESKIN

→ One way would be to knock down all the offending buildings and start again. Technology, materials and design have improved dramatically since the 1960s, and we have learned a lot about how to construct buildings that are energy efficient, pleasing on the eye, and provide comfortable living and working spaces. We can use regulation to ensure that all the replacement buildings meet these standards.

But tearing everything down and rebuilding would create enormous environmental damage. London alone would have to dispose of 40 million tonnes of building rubble if it demolished just its high rise towers.

Rebuilding would also consume monumental amounts of resources, including massive amounts of cement whose manufacture is one of the most carbon intensive of all industries. And it would take decades, if not centuries, and far longer than we have to turn things around.

Or we could retrofit. There are now well established techniques, such as changing heating sources from electricity to gas, double-glazing windows, fitting low energy lights and so on. Many retrofitting programs are under way in cities like Johannesburg, Mexico City and Mumbai. A project in Washington is investing $175 million in retrofitting 400 government and private buildings with the aim of saving $36.5 million in energy costs per year. President Obama has committed his administration to programs of retrofitting all federal government buildings in the US.

But there can be problems with this approach too. In some old blocks, ventilation is restricted to hallways, with an assumption that doors are so leaky that apartments will be ventilated by default. Suddenly making buildings airtight can create new difficulties. Also, traditional retrofitting can be expensive when measured against the energy efficiency it achieves. President Obama's program is on the ambitious side in seeking efficiency gains of 25 percent within five years. Valuable as this may be, it is simply not enough for us to meet the emissions reductions necessary to avoid runaway global warming.

There is another option that promises far greater energy efficiency gains, and comes with a number of other benefits besides as well. This is to give our old, ugly, energy-leaky buildings a brand new skin.

Reskinning' is more than just adding a layer of cladding to the outside of a tower block to freshen up its looks or protect its deteriorating exterior. If we approach it in an holistic manner, reskinning can seal energy leaks and provide a new layer of insulation as well. If done in conjunction with traditional retrofitting, such as installing geothermal heating and cooling systems, it can maximize these efficiency gains. (New materials offer the possibility of making the skin part of the heating and cooling system itself.) Furthermore, a new skin can hide added piping, cabling and other services, making retrofitting quicker and cheaper. Finally, it can alter the face of a building, as well as its interior conditions, making it easier on the eye, and a more comfortable and flexible place to live or work.

SOUND FOUNDATIONS

→ Many of the old tower blocks in our cities were soundly built, and have often been well maintained. Their problems arise from the fact that they were designed in an age when energy prices were cheap and stable, and when the science of building envelopes was more rudimentary. The exterior walls of many old towers are concrete. Also, one of the major architectural changes of the past 40 years is the design of buildings around a solid core or shell, where they no longer rely on the exterior walls to hold them up. This gives a great deal more flexibility when it comes to changing a building's skin. The cores and shells of our old city towers are good for many more years – it is their exteriors that have grown tired, worn, degraded and dirty.

The design of old towers is such that they act to capture heat in the summer and lose it in the winter. Without a thermal barrier between a building's inner core and the outside weather, it will simply radiate heat out into the world in winter. The concrete layers between floors and the concrete walls and balconies that adorn many old apartment blocks become conduits for precious heating to escape. In summer, they play the opposite role, capturing and storing heat and increasing the workload of air-conditioning systems.

Reskinning can provide a thermal break between a building's carefully managed internal environment and the vicissitudes of the elements outside. It works like double glazing, where air is trapped between two panes of glass to provide a layer of insulation. The over-cladding of a reskinned building is set away from the wall, creating an effective thermal barrier. Insulated from the outside world, the concrete core now acts as a giant thermal storage device, capturing and storing the building's heating or cooling rather than wasting it. With reskinning, the structural core becomes an asset rather than a problem.

RETROFIT CAMOUFLAGE

→ By creating a gap between the old walls and their new skin, we also make a very useful space for carrying all the piping, ducting and cabling to retrofit more efficient services to a building. It can be a nightmare trying to fit new pipes and ducts inside apartments. The drilling, banging, re-plastering and covering up are hugely disruptive. By contrast, fitting the services on the outside is simple, quick and clean, and causes minimal inconvenience to the tenants or office workers. Meanwhile, the new skin quietly hides everything. There is no need for re-plastering or boxing in of pipes. This makes retrofitting far cheaper

and its energy savings more cost effective. Although this is an obvious insight, it is no less significant for that.

While the engineers are fitting the pipes for the new heating and cooling system, they could also fix fiber-optic cable to walls and run it into all the apartments or offices. What's that got to do with energy efficiency and greenhouse gases, you might ask? Having high-speed Internet access makes it easier for workers to telecommute, either full or part time. It makes it easier for office workers to video-conference, thereby avoiding flying. These are essential measures if we are to reach our global greenhouse gas targets.

Amsterdam is one of the first cities to attempt to connect every household with fiber-optic cable. Begun in 2006, the project aims to link all of the city's 450,000 households with fiber-optic cables by 2013. Officials see the project as a way of improving the business and cultural life of the city as well as reducing road congestion and cutting carbon emissions. But the problem with recabling is what is known as 'the last mile'. It is easy to lay fiber-optic cables along the main arteries of a city, but much more difficult to fan it out to individual households and offices. Many proposed projects in other cities are on hold because no one wants to pay for this last lap. Fitting it under the new skin simplifies the process for tower blocks and lowers the cost, bringing the carbon benefits of high-speed Internet access a step closer.

We can make further gains if we connect not just the occupants of buildings to the Internet, but the all the operational devices within them too – heating and ventilation (HVAC) systems, lighting, water heaters, electric window blinds, etc. If we fit our buildings with sensors and monitors, and give them intelligent control software, we can make them smart and efficient in the way our cars are today. We can install control programs that will direct heating or cooling or lighting or air where rooms are occupied, and turn it off where they are not. If we go a step further, and connect up all the domestic or office appliances to the network as well, and introduce variable electricity pricing, we can program our washing machines or clothing driers to operate when power is cheapest. This will reduce peak loads on the grid, with the potential to make significant savings in carbon emissions from reduced power generation.

SKIN RENEWAL

→ We can also look to the nature of the skin itself. Materials science and technology have advanced to the point where we can make the exterior part of a building's electricity generation or water heating systems, or use them as media or for some other function. There are already examples of skins being used in this way. The UK's Co-operative Insurance Services has clad the deteriorating facade of its 25-storey headquarters in Manchester in shimmering blue photovoltaic cell panels that can generate up to 181 megawatt-hours of renewable electricity a year, and save 78 tonnes of carbon emissions. Research suggests that if we use photovoltaic materials in the skin and integrate geothermal heating and cooling, we can improve the energy efficiency of buildings by an extra 20 percent.

Science and technology will continue to advance and no doubt bring us new materials with even more useful properties. Meanwhile, the core structures of our buildings will remain good for 50 or 100 years or more. Animals shed their skins on a regular basis. We humans do it relatively unobtrusively in an ongoing process of skin cell loss and renewal. Others, like snakes and tarantulas, do it all in one go, climbing out of their old skins when their new one is ready. We could design our buildings with the idea of replacing their skins at regular intervals to take advantage of new inventions, as well as to keep up with the wear and tear of the elements upon them.

Finally, reskinning presents us with the opportunity to give yesterday's buildings a facelift. With their worn, deteriorated and dirty façades, old tower blocks blight the landscape of some of the world's most beautiful cities. You can see these tall, ugly, utilitarian structures in the suburbs of Paris, in South London, on the outskirts of Belgrade, Moscow and Tokyo. Toronto has 2,500 towers, New York 5,000 and Chongquing, China, has over that number. Imagine if we could recreate their exteriors, giving them a design and decorative makeover using the very latest materials. Reskinning could transform the appearance of old buildings and enhance the aesthetics of our urban environments.

LARGE-SCALE BENEFITS

→ If we approach the problem of modernizing our towers and other buildings in this way, the benefits can be substantial. Research by Ted Kesick and Ivan Saleff at the University of Toronto suggests that proper implementation of skinning techniques could cut energy demand by half – and up to 70 percent if we integrate photovoltaic and geothermal

technologies into reskinning projects. This would lower the demand for power generation, and avoid the need for new generation infrastructure. Less power generation means less burning of fossil fuels, lower carbon emissions, cleaner air and better health. Kesick calculates that if all deteriorating buildings in the Ontario region were reskinned by 2030 it would prevent 142 million tonnes of carbon emissions, and save $60 billion in energy costs, $3.6 billion in avoided generation infrastructure, and $10.2 billion in health care costs. It would also provide over 800,000 jobs and create a green energy industry worth $95 billion annually.

When you look at reskinning in this holistic way, it seems like a panacea for many of our modern-day illnesses, not least the looming threat of climate change. Reskinning's benefits are clear, tangible and substantial. So what's stopping us from forging ahead with massive renewal programs?

The truth is that while there have been a number of successful re-cladding and reskinning projects, most have focused on one objective or another, such as just improving appearance or only energy efficiency. Even where there have been multiple objectives and successful outcomes, the solutions have tended to be customized and one-offs. It's clear that if we apply enough brainpower and resources, we can solve almost any individual building refurbishment problem. But what we need today is a methodology, plus technologies and materials, which we can apply in a wide range of circumstances, and scale up into major renovation programs in a cost-effective manner.

THE ZEROprize

→ The idea of reskinning buildings is not new. Architects and academics such as George Baird, Michael McClelland and Graeme Stewart, among others, have been advocating skinning for a long time. And there are projects that attempt to take a more holistic view of building refurbishment. The Mayor of Toronto's Tower Renewal Project aims to tackle the city's deteriorating residential towers and stimulate the development of local communities and green industry, as well as achieve significant reductions in greenhouse gases.

The need to do something about our ageing buildings is so urgent that we are in danger of rushing into programs without enough thought. If we plough ahead with poorly conceived solutions, cutting corners and

taking a one-dimensional view, we will miss the opportunity to make profound, long term, sustainable change and to reap the full range of benefits that reskinning can offer.

This is the rationale behind the ZEROprize. It aims to draw the best minds and talents to the problem of reskinning buildings, and engages our very best architects, designers, engineers and builders in rethinking the built space to the benefit of people and the planet. In recognition of the scale of the challenge and the importance of the solution, we are offering the biggest prize ever for an architectural competition - $1 million.

The focus of the competition is on urban tower blocks, but there are many other categories that we could apply reskinning to – offices, universities, schools, hospitals, Victorian houses, and so on. We will need to examine each of these in turn, and they could be the subjects of other competitions in the future.

CONCLUSION

→ Reskinning offers a solution to the many problems of our older building stock, and particularly for our residential urban tower blocks. If approached in an holistic way – integrating the protection of deteriorating exteriors, creating thermal barriers, enabling low-cost retrofitting, linking occupants and appliances to the internet, and changing the aesthetics of our cityscapes – reskinning promises substantial and timely benefits for people and the planet.

In his presidential campaign, Barrack Obama set out a goal of making all US buildings carbon neutral or zero emissions by 2030. This is hugely ambitious, but in the light of the looming threat of climate change, absolutely essential. The question is how will Obama achieve this? Holistic reskinning programs could provide a big part of the answer.

ACKNOWLEDGEMENTS- PREVIOUS WORK AND LEADERS IN THE FIELD

→ The ZEROprize is informed by the groundbreaking work of those individuals and organizations currently working in the field of building retrofits and skin renewal. The bold leadership of the Mayor's Tower Renewal Project and the examples of successful skin renewal projects by architecture firms like Gensler, Hassell, and ERA have all been essential in shaping the ZEROprize. The Mayor's Tower Renewal Project was an especially important influencer of the Competition. The initiative is a program designed to drive broad environmental, social, economic, and

cultural change by improving Toronto's concrete apartment towers and the neighborhoods that surround them. The Toronto region contains North America's second highest concentration of these buildings, but only in Toronto will you find them integrated with both urban and suburban neighborhoods. They are some of the city's most inefficient buildings, and they present an incredible opportunity for re-skinning and retrofits, which will further enhance Toronto's status as a world leader in building retrofits and re-skinning technology.

ABOUT ZEROFOOTPRINT

→ Zerofootprint is a socially responsible enterprise whose mission is to apply technology, design and risk management to the massive reduction of our environmental footprint. We operate both in the for-profit and charitable domains through two entities, Zerofootprint Software and Zerofootprint Foundation using shared technology.