

Shock Proofing the Built Environment: An Evidence Review for Sustainable Buildings Canada

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Introduction

This evidence review was written for Sustainable Buildings Canada (SBC), as a student assignment in a Dalhousie University course. I would like to acknowledge Instructor San Patten for her guidance and support, through SUST3104 Sustainability and the Non-Profit Sector. SBC is a Toronto-based Non-profit that works in partnership with energy providers, the construction and development industry, as well as architects and designers to support sustainable, ecologically efficient developments. To guide their work in advancing Canada's building sector, they would like to understand current discussion about how buildings can become more resilient to pandemics, and what opportunities exist for improving building design because of Covid-19. An article by Megahed and Ghoneim (2020) in the *Journal of Sustainable Cities and Society* compares our history with the built environment to antivirus software, continually upgraded as it faces new and evolving viruses. We have always designed our built environment around threats to our health and safety, and SBC recognizes that designing for Covid-19 and future pandemics is the next step.

The recent journey of the development industry saw projects cancelled and unemployment, then a rise in demand for innovation as the world began to understand the long-term impacts of the pandemic (Kennicott, 2020). The sector must now adapt to people spending more time indoors working from home and locked down, but in need of social and mental wellbeing. Residential building design could incorporate multi-purpose living, and new developments need to consider the health of occupants in their design. In urban centres like Toronto, developments are tasked to do more with less as the city tries to limit urban sprawl and build increasingly smaller condominium units for more people (Vachon, 2018). Juan Cruz Serafini, an architect with the Lafarge Holcim Foundation offers hope as the pandemic lingers, "Architects and designers have unique skills in critical thinking and the ability to imagine new futures" (*Lafarge Holcim Foundation*, 2020).

Section 1: Building Design for Physical Health and Covid-19

In non-residential developments such as office buildings, a primary consideration for protecting occupants from Covid-19 is management of air circulation. A report on preliminary research of building operations and Covid-19 transmission by Schoen (2020) suggests simple adjustments in HVAC systems, after basic precautions such as social distancing have been met. These adjustments involve opening dampeners in vents to eliminate air re-circulation, replacing general central air filters with the more advanced MERV-13 model, and considering portable HEPA air filters for each room or ultraviolet germicidal irradiation for high-risk areas like waiting rooms (Schoen, 2020). Further specific recommendations have been released by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) on how to upgrade HVAC systems in existing buildings, and is summarized in a series by the interdisciplinary design firm ARUP providing guidance on healthy buildings (Cousins et al., 2020). An article for BBC Future considers the 21st century an era for pandemics, and references Jo da Silva with ARUP engineering firm to recommend designing buildings with more than one staircase and multiple elevators (Constable, 2020). With more time indoors, designing with good ventilation and natural air, light, and plants will improve health of residents (Megahed & Ghoneim, 2020).

Incorporating sanitization in building design is another consideration, and a more pressing issue for families of our essential workers throughout the pandemic. In an article for Boston Magazine,

architect Stephen Chung highlights the need for “mudrooms”, small separate entrances for returning home where you can put dirty clothes and wash hands before going inside (Kashdan, 2020). The incorporation of a decontamination room or station was included in an Architectural Digest article as well, as one of the top requests clients will have because of Covid-19. Other expected popular demands for healthier homes include touchless appliances, antibacterial surfaces such as porcelain tiles, and guest rooms designed as optional quarantine rooms with their own fridges (Alati, 2020). Consumer trends have clearly changed because of the pandemic, and a new public awareness of health indoors is a considerable new pressure on developers.

Section 2: Building Design for Overall Health and Wellness in a Pandemic-Focused World

Designing for More Time at Home

With lockdowns and social distancing requirements, the increase in those working from home has major implications for building design. 6.8 million, or 4 out of 10 Canadians worked from home in the week of March 22 this year (*Statistics Canada, 2020*). Conversations about multi-purpose residential building are on the rise, as we seek better working environments in our homes. In an article with *Livabl_* magazine, the director of Interior Design with the IBI Group says good home working environments include separate defined work areas, daylight, and acoustic control (McNally, n.d.). Flexibility of space is a common theme in the *Livabl_* article, and it discusses moveable walls to divide areas, and a possible rise in popularity for the “Murphy bed” that allows a bedroom to convert to an office (McNally, n.d.). Working with shrinking condo buildings is also a big consideration for Quadrangle, a multi-disciplinary design firm in Toronto. Their innovative work calls for changes in building construction, from shear walls to structural column grids that allow for moveable walls and would reduce the environmentally harmful use of concrete in building (Hanes, 2020).

Multi-purpose residential building in condos now includes designing for more time indoors and maximizing use of space. Moving plumbing, wiring, and storage to apartment floors would make ceilings taller and save space taken by closets (Hanes, 2020). Replacing balconies with optional enclosed sunrooms would allow for more sunlight in the winter, and could operate as hobby spaces like sheds would for a suburban home (Hanes, 2020). Flexibility in design is an important consideration with more time at home, and the new Mary Lyon Elementary School in Washington is a case of flexible design that has improved indoor education during the pandemic. The school was built with moveable glass walls for co-teaching and collaboration, that now allow for creating wide-open spaces (IBI Group, 2020). In a case for flexible building design, the Washington Post describes the social isolation of the pandemic caused by limitation in physical buildings as “...a mark of architectural failure and a real-time example of how people will spontaneously repurpose buildings if those buildings aren’t serving them well.” (Kennicott, 2020).

Facing Covid-19, we are now discussing how design supports survival. Mental health and a need for community is a concern with isolated apartment units, and having community to check in on you or bring you food when sick is key to survival (Reeves, 2020). To create community in condominiums, the Quadrangle team suggests incorporating glass windows next to doors with adjustable transparency, as well as package delivery and sanitation spaces in entranceways (Hanes, 2020). Designing buildings to create communities would create resilience in the tenants. Neighbourhood nests is an innovative design solution by Quadrangle’s Human Spaces team, that uses sidewalk and lobby spaces for community events. Now with social distancing they could also be used as a place for community food sales to

support local businesses (Reeves, 2020). To support both working from home and community development, multi-unit residential developments are increasingly including and promoting co-working spaces, which must now be adjusted to create Covid-19 safe working environments (McNally, n.d.).

An article by building design firm Stantec (2020) provides a global view of innovation for the built environment during the pandemic using the perspectives of an international staff team. In Italy, buildings are recognized for their purpose to meet human needs innovatively and empathetically, and it is suggested they include digitized delivery systems for access to goods in emergencies. For businesses that require in-person service like restaurants, building layouts should support flexibility in design that allows for gradual opening as we've seen in our phased recovery from lockdown (Stantec, 2020). In the United Arab Emirates, Abu Dhabi designers recognize the need for improvements in livability and predict a rise in the use of WELL building standards. In Dubai designing central food drop off zones is suggested (Stantec, 2020). A Stantec employee from Texas suggests designing large buildings such as hotels or conventions centres with the flexibility to switch their use in an emergency to something like a medical centre. This could also support resilience to natural disasters and climate change, as we saw convention centres in New Orleans support victims for days after hurricane Katrina (Scott, 2015). Finally, in Auckland there is also a newfound recognition for building standards that improve overall living, as well as a call for flexible multi-purpose buildings. This suggestion is expansive, giving examples of flexible space, including offices becoming lab spaces, car parks that could also be used for food production, and warehouses that could be field hospitals (Stantec, 2020). Stantec's urban planning representative in New Zealand recognizes the opportunity the pandemic provides for creating walkable cities that will support resilient economies that require less travel to succeed (Stantec, 2020). By collecting opinions from around the world we can now better understand the universal need for changes in building design brought about by Covid-19, and the demand for resilient spaces that meet our needs for flexibility in an emergency.

Designing for More Time Outside

Although a little outside of this paper's scope, a common discussion found through the evidence review is how cities can build better without increasing urban sprawl. So far we have seen an increase in the amount of space cities take up, from wider sidewalks with outdoor patios, to more bike lanes, and green space (McGrath, 2020). Many articles that already discuss building design and multi-purpose buildings are incorporating concepts of the 20-minute, walkable city. The urban planning sector also has a history of innovation after health crises, such as Howard's Garden City after the Spanish Flu and New York City's Central Park (Allam & Jones, 2020). To create connected cities, and develop buildings that improve a city's quality, the case has been made for focus on groups of buildings instead of the individual (Reeves, 2020), with new condos advertising local, walkable amenities. As discussed earlier, incorporating natural light and airflow where possible is key for physical and mental wellbeing, and designing condominiums with outdoor spaces on the ground floor would provide space for community resilience, so it is therefore imperative to integrate building design with urban planning where possible.

Section 3: Lessons in Resilience

Recovery from Other Health Crises

Modern design as we know it is a result of historic responses to health crises, with past plagues resulting in less cramped buildings, and a rise in tuberculosis leading the design trends of clean white

walls, natural light, and flat surfaces for easier cleaning (Megahed & Ghoneim, 2020). We must reflect on previous design responses around the world as we deal with Covid-19. Michael Murphy, the executive director of the international MASS Design Group wrote an article for the Boston Globe on lessons from past epidemics in reforming architecture. In 2006, a drug resistant strain of tuberculosis “XDR-TB” outbreak spread because of badly ventilated hospital rooms, and demonstrates the importance of air filtration and increased ventilation in all buildings (Murphy, 2020). Ebola in 2014 provided new challenges by lasting on surfaces for up to two weeks, and architects designed isolation units with unique ventilation systems, and pathogen-resistant surfaces (Murphy, 2020).

However, to build for social resilience is also a matter of health, as we rely on each other for survival, and designing buildings for social connection while socially distanced is an important new obstacle for the building sector. Though cities are densely populated making them high-risk areas for disease transmission, they offer hope for improving disease control through sustainable building design and technology (Pinheiro & Luís, 2020). As part of the Ebola response in West Africa, Chris Withington experienced the importance of creating trust in health care workers for effective public health communication, and this meant developing ways for families to visit patients while staying safe (Withington, 2020). With Covid-19 patients quarantining at home, building design should consider mental health in isolation and how buildings can support resilient patients and people.

What Climate Change Can Teach Us About Building for Resilience

It is telling that the strategy on building community in condominiums by Quadrangle was originally developed as a climate change response, and was easily applied to the pandemic (Reeves, 2020). The two issues are interconnected because the uncertainty of climate change and extreme weather events is now similar to the uncertainty of future pandemics or the length of Covid-19. We must study resilience in the built environment in regards to climate change so that we can apply the findings to Covid-19. With increasing severity of climate uncertainty, extreme weather events, and phenomena such as Desertification and the Urban Heat Island, an article by Meir & Pearlmutter (2010) highlights the need for self-sufficient buildings with insulation. The economic uncertainty brought by Covid-19 also gives reason to design self-sufficient buildings as access to natural resources becomes riskier. In 2007, an article in Multi-Housing News lists natural disasters and flu pandemics as top planning considerations for apartment companies, who are responsible for large numbers of residents that could be put at risk (Foong, 2007). Pinheiro and Luís (2020) published an article in Switzerland’s Journal *Sustainability* that provides an excellent analysis of if the pandemic will create lasting change in sustainable design, that includes a historical review, and how solutions in designing for a healthy built environment would also support overall sustainability. The article finds that lessons from climate change and Covid-19 for the built environment could go both ways, because developing long term resilience in the built environment to future pandemics would result in economic and socially sustainable buildings (Pinheiro & Luís, 2020).

Conclusion and Recommendations

KEY FINDINGS

A brief summary



The uncertainty of Covid-19 often creates new information and challenges, leaving areas of future research. Further research is necessary on the opportunities for designing quarantine spaces that allow social connection and interaction with family members and friends while sick. The importance of community spaces for resilience that was discussed in this review also prompts questions on designing such spaces while allowing for physical distancing. As we adapt to both Covid-19 and Climate Change, the interconnected issues provide hope for both environmental and healthy sustainable buildings, with the connection an important area for future research. Finally, the benefits of 20-minute walkable cities for supporting economies and health in a pandemic is an opportunity for multi-purpose buildings and community resilience that should continue to be investigated. As this review was completed for SBC by a student studying Sustainability and the Non-Profit Sector, lessons from the course do influence the analysis and recommendations. The connection between urban planning, building design, and Covid-19 is an important consideration and grouping buildings together is intrinsic in building community resilience.

The evidence has uncovered potential areas for political or market pressure that could be undertaken by the buildings/design community. According to the report on creating connected communities, developers need to be persuaded to allow architects to include community and resilience in a building's design (Reeves, 2020). Covid-19 is another factor, along with Climate Change, that demonstrates the importance of designing buildings for change and flexibility. Consumer trends in access to healthy, natural spaces discussed by Architectural Digest demonstrate the customer pressures developers will also face (Alati, 2020). As an advocacy activity, it is important to recognize the need for encouraging developers to include sustainable designs at accessible prices, as part of their standard design practice.

As this evidence review has presented, current discussion on Covid-19 and the built environment is full of calls for innovation, and answers across sectors of engineering, construction,

design, architecture, and urban planning. Common themes in pandemic-oriented design discussions include disease prevention, flexibility of space, and resilience through community. Notably, this review has discovered the close relationship between innovation from the pandemic and improving green buildings. Pandemic response has quickly become a key factor in building design, underscoring the need for safe, adaptable, self-sufficient, and resilient buildings as a way of addressing both Covid-19 and Climate Change.

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