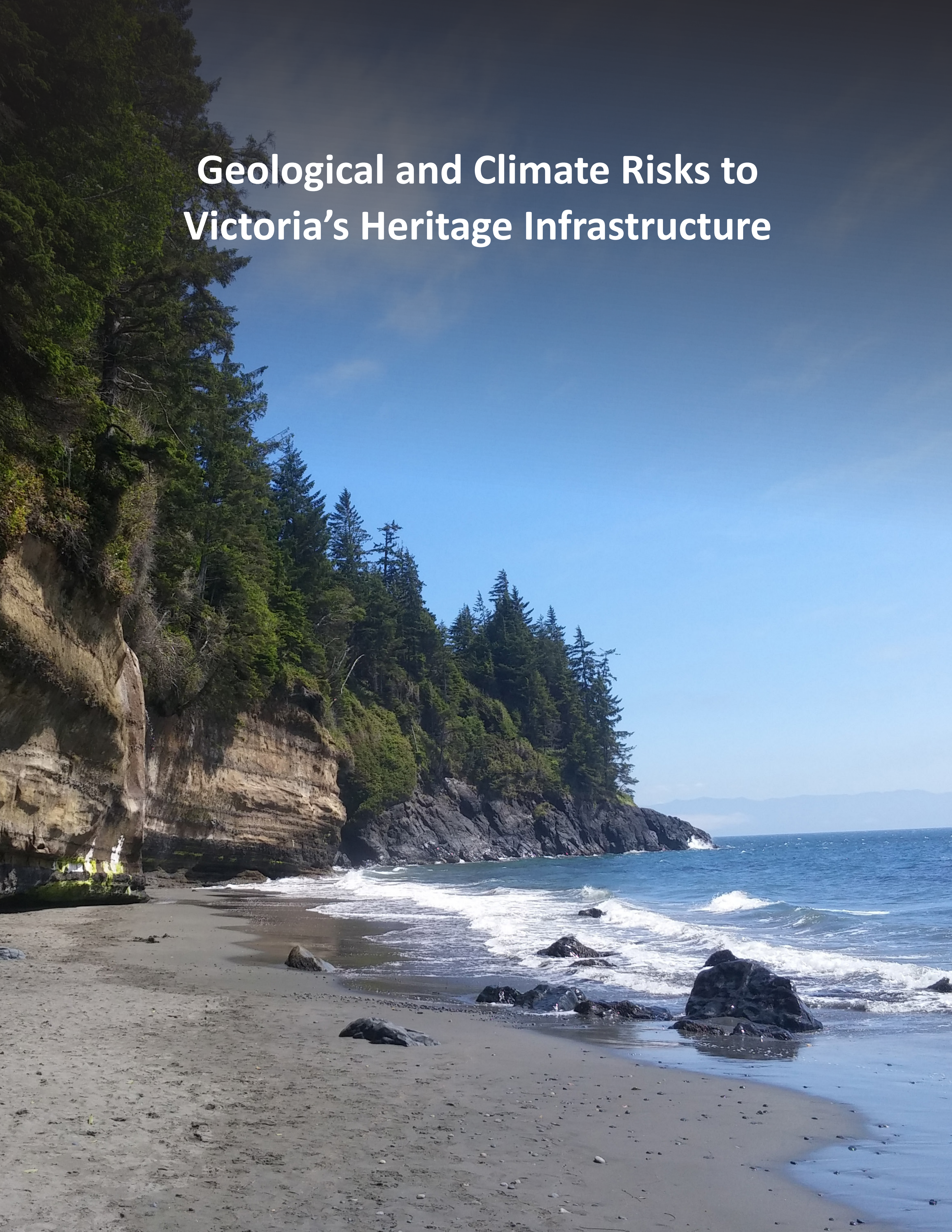
Geological and Climate Risks to Victoria’s Heritage Infrastructure



Geological and Climate Risks to Victoria's Heritage Infrastructure

SITUATION BRIEF # 21

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'Natural risks' to built and natural heritage have been the subject of increasing debate and international study over the last twenty years. Increasing awareness of these risks has paralleled rapid developments in seismic related sciences, but also the global debate focusing on climate warming mitigation.

Seismic Risk

At 9PM on January 26, 1700 one of the world's largest earthquakes occurred along the west coast of North America. On the west coast of Vancouver Island, a tsunami completely destroyed the winter village of the Pachena Bay people with no survivors.

The earthquake shaking collapsed houses of the Cowichan people on Vancouver Island and caused numerous landslides. The shaking was so violent that people could not stand and so prolonged that it made them sick. Known from written records of an "orphan tsunami" hitting the Japanese coast, it is probably the same event referenced in Saanich First Nations' oral history and legends, and particularly those associated with the struggles of Thunderbird and Whale shared among a number of Island Nations.

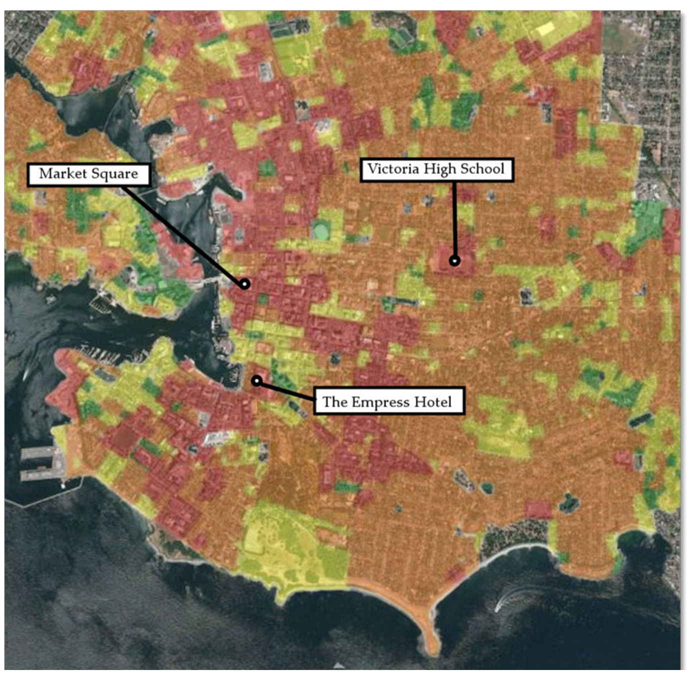
The 1700 "Cascadia Earthquake" occurred along the Cascadia subduction zone on January 26, 1700, with an estimated moment of magnitude 8.7–9.2. The megathrust earthquake resulted from the movement of Juan de Fuca Plate along a line from mid-Vancouver Island south along the PNW coast as far as northern California. The quake caused the entire Pacific Northwest coastline to suddenly drop 3 to 6 feet and sent a 33-foot high tsunami across the ocean to Japan. Concurring with Indigenous legends, other evidence includes drowned groves of red cedars and Sitka spruces in the Pacific Northwest.

The Cascadia zone remains one of the most active in North America. Mega-quakes seem to occur in approximately 300-900 year cycles. Another 9.0 magnitude quake is now anticipated. Seismic events, including the expected “big one” constitute one the greatest risks to Victoria’s built and natural heritage.

The British Columbia Building Code, which is updated every five years, has been refining its requirements for the performance of buildings in seismic events. In part this has been by refining the categorizations of risk according to place. According to the latest 2018 data update Victoria joins regions of the Province such as Queen Charlotte City to score a very high risk of extensive damage on the

Uniform Hazard Spectra (UPS) chart. Thus, code compliance for building structure performance has been ratchetted up. And this applies to heritage buildings as well as other extant building retrofits although there is a special provision allowing “alternative compliance methods” to help respect the “historical integrity” of a heritage site. At the moment, to meet minimal life safety standards a compliance level of between 60% and 70% of the full standard, dependent on location, is the goal.

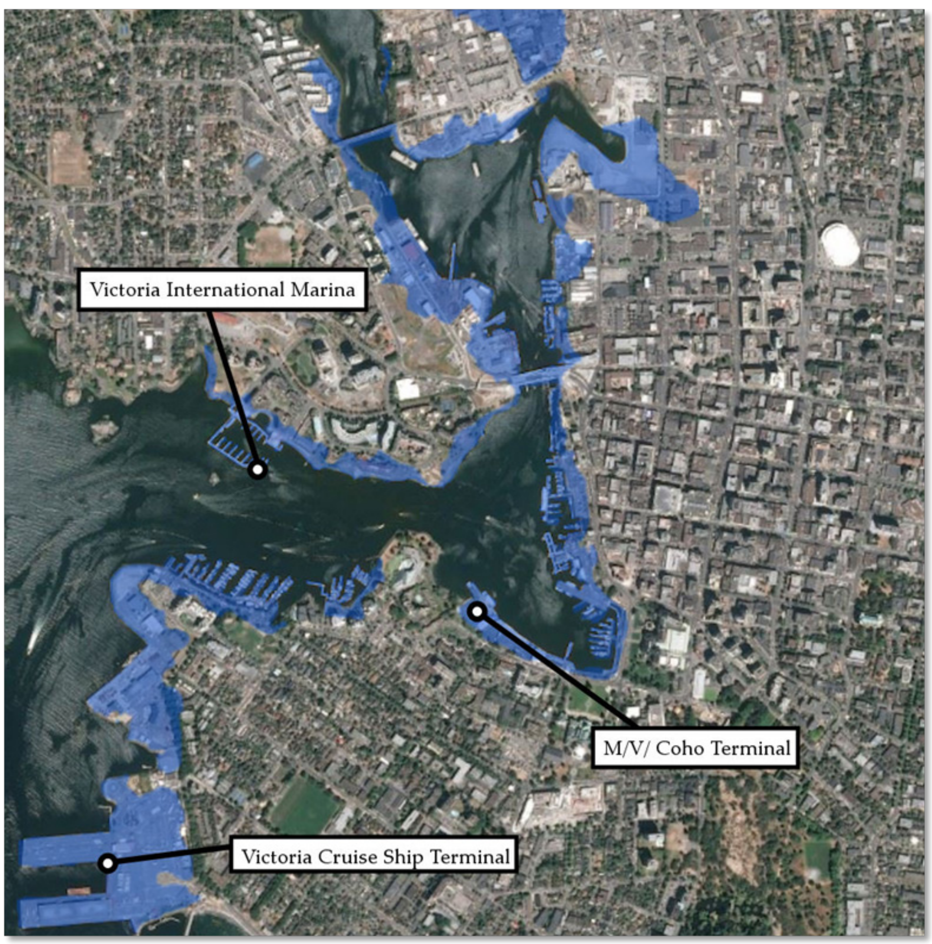
A recent analysis of a major heritage-designated masonry building in Old Town demonstrated that it now means a structural upgrade from an as-is 15% compliance rating is required to meet the current compliance measure, which is 45% more stringent that the previous version of the Code. However, the next iteration of the code, scheduled for 2024, is expected to increase compliance by another 35%. Obviously, future retrofitting of heritage masonry structures in Victoria, will incur substantial cost increases.



Earthquake damage map of Victoria in a worst -case scenario. Anything coloured red is expected to suffer “complete” damage, meaning buildings will either collapse or require demolition after the fact. (Credit: Photo illustration by The Capital layering V.C. Structural Dynamics Ltd. map over satellite image of Victoria).

Upgraded fire codes are also an issue. The collapse of buildings and damage to infrastructure is compounded by the risk of fire in the aftermath of a major seismic event.

More recently it has been recognized that seismic risk associated with tsunamis is compounded by threats from climate change, particularly rising sea levels when associated with increased wind-storm activity and coastal inundation from "king tides" (occurring when the Moon is closest to Earth in its elliptical orbit). Today the average the sea level has risen along the Victoria coast line at an average of 6.6 cm per century, more recently speeding up to about 3.4 mm per year.



Map of Victoria central core showing areas at high risk for tsunami damage (Photo illustration by The Capital layering City of Victoria map over satellite imagery).

Climate Risk

A recent study by the Capital Regional District Coastal Sea Level Rise Risk Assessment projects median local coastal sea level rises as follows:

- 0.5 meter increase by 2050.
- 1.0 meter increase by 2100.
- 2.0 meter increase by 2200.

Anticipating the City of Victoria own seismic-risk study, areas that were formally (many now filled and developed) tidal mud flats have long been categorized as high risk. These included the Upper Harbour, James Bay (Parliament Buildings and Empress Hotel, most of Old Town and neighbourhoods in James Bay and Fairfield. The high-risk coastal zones include Lekwungen village archeological sites, particularly those fringing the coastline of Oak Bay from Harling Point to Cadboro Bay.

Energy Efficiency

Another response to Climate Change which will profoundly affect built heritage is the need for improving the energy performance of buildings. Both new construction and renovations (including restorations) will need to demonstrate improved carbon efficiency. At the recent COP 27 Glasgow conference Canada announced its intentions to reach net-zero carbon emissions by 2050 and reduce green-house-gas emissions by 40-45% below 2005 levels by 2030. With Canada's building stock responsible for 17% of our total emissions the goal is already having a profound effect on building practices and construction materials.

In Canada, the regulation of buildings is a provincial responsibility. There are various laws, acts, codes and regulations, concerning the buildings and often administered at the municipal level.

In the province of British Colombia, the technical building requirements are regulated under the 2015 Building Act. Additional requirements could be set by local governments if a matter is ‘unrestricted.’

B.C. has developed its Energy Code as part of the Building Code in order to move towards high levels of energy efficiency in the building industry, and to make buildings net-zero energy-ready by 2032 in line with the goals of B.C.'s climate plan (CleanBC). To reach this goal BC introduced a multi-step scheme in April 2017 called the BC Energy Step Code. In this scheme, “the regulation sets performance targets for new construction and groups them into ‘steps” that apply across various building types and regions of the province. The Lower Steps are relatively straightforward to meet; the Upper Steps are more ambitious.” The defined performance targets are as follows:

- 20 per cent more energy efficient by 2022
- 40 per cent more energy efficient by 2027
- 80 per cent more energy efficient by 2032 which is the net-zero energy-ready standard.

Currently, the BC Energy Step Code is considered a voluntary provincial standard. However, “all authorities having jurisdiction over the BC Building Code, including local governments, can choose to require or incentivize builders to meet one or more steps of the BC Energy Step Code as an alternative to the code’s prescriptive requirements.”

There is no doubt that the Energy Codes are essential for creating a sustainable built environment. These codes, however, needs to be modified to accommodate historical buildings. Otherwise, they could potentially pose a threat to the integrity of these buildings. A positive aspect of the BC Energy Step Code is adopting a “performance” approach rather a “prescriptive” approach for complying with the code’s efficiency requirements. This allows for innovative and alternative solutions in reaching the desired energy performance in the historical buildings.

A good example of the complexity of complying with building codes in the case of the heritage buildings are the codes related to the windows. Windows are often a vital part of heritage character of a building. The prescriptive energy codes commonly require double- or triple-glazed windows and sashes with thermal breaks. In most cases, complying with this requirement would severely distort the heritage character of an historical building. This issue was recognized in B.C. by heritage advocacy groups who worked with bureaucrats and urged the provincial government to exempt recognized historic buildings from the strict window-replacement requirements for residential conversions under the Homeowner Protection Act.

According to the 2020 Climate Change Accountability Report, one of the main objectives of CleanBC in mitigating the risk of climate change is to "introduce an alternations code for existing buildings by 2021." A subset of the existing buildings are the heritage buildings. The introduction of the alternation code, therefore, provides an opportunity for addressing the requirements of the heritage buildings in the future codes.

Mitigation actions

Both the federal and provincial governments provide grants to home owners for energy efficiency refits although there are no grant programs for seismic reinforcing. Energy refit grants could be used to update the fabric of heritage residences although some of the approved applications run the risk of compromising protected features such as window casings.

The city of Victoria has an underground asset renewal program for the replacement and rehabilitation of water distribution, sanitary sewer and storm-water systems. The program is partially funded by Infrastructure Canada's Disaster Mitigation and Adaptation Fund (DMAF). The program helps in improving underground assets of the city and reduces the risk of damage to underground infrastructure in the events of earthquake, sea level rise, and extreme storms.

British Columbia instituted a Seismic Mitigation Program in 2017 with an allocation of $1.9 billion to address high-risk public buildings throughout the Province. A high priority category is public schools. Under this program a number a local heritage schools have been retrofitted and one of the largest projects underway in Victoria at the moment is the historic Victoria High School. However, probably an even larger and more significant project in the portfolio awaits: the iconic harbour-front, British Columbia Parliament Buildings.

The Victoria Civic Heritage Trust, under its Building Incentive Program (BIP), provides financial assistance to owners of commercial or institutional heritage designated buildings to assist with facade restoration, structural improvements, upgrading required by building codes, seismic, and other rehabilitation costs. Grants may cover up to 50% of the cost of eligible heritage work, up to a maximum of $50,000 per project.

BC Hydro Building, Victoria ca. 1954. Energy and seismic retrofit 2004.

As a final note, it is worth mentioning that any architectural intervention in order to improve the energy efficiency in the heritage buildings should be mindful of the heritage values of the buildings regardless of the building date or style. A good example of this is the case of BC Hydro Building, originally designed by Thompson, Berwick and Pratt Architects (1954) and was expanded by Richard Blanshard Building addition (Siddall, Dennis, Warner Architects 1974).

In 2001, the Wade Williams Corporation Architects (principle architect Terence Williams, project architect Chris Gower) undertook the design for a complete restoration and retrofit, including seismic and energy efficiency upgrades of the original Blanshard Street facing tower.

"The new wall elements replicated the original while improving thermal isolation values. Energy efficiency would be gained with a new deluxe triple glazed high-performance curtain wall… The seismic upgrade utilized Canada's first pneumatic-strut dampers."

"An extensive computer simulation study … demonstrated that one array of (solar) screens at each level could be eliminated. This also allowed for the use of more transparent glazing - and thus better natural lighting, and higher visibility through the glass. The curvature of the sunscreens also allowed for reflection of sunlight against the office ceilings - and thus brought higher levels of natural light into the central floor areas. A colour-tone of glass was selected that closely matched the original 'BC Electric Blue' of the original curtain wall in deference to Binning's original choice." (Chris Gower, project architect.)

In this project, the net result of the restoration and structural improvements preserved the overall International Style aesthetic of the building, changes to detail growing out of the original design concept. The structural update assures another office-use life cycle for this monument to early Victoria Modernism.

Observations

- A brief assessment of structural seismic and climate "risk" should form part of Statements of Significance for designated historic buildings within the CRD.
- While the Parliament Buildings might be considered a poster-child both for its historical significance, iconic monument status, and multiplicity of threats, other major heritage monuments at extreme risk would include the Empress Hotel and historic churches that define the historic core of Downtown Victoria.

- To the need for risk assessments for vulnerable historic buildings we need to add risk-prone natural habitats, especially as they often encompass sites of significance to local First Nations.
- A close review of the B.C. Step Code performance requirements needs to be undertaken, first in order to protect the historical integrity of heritage buildings, and secondly to document successful case studies of restoration work which satisfies the new codes.
- Stardards "equivalencies" written into the current building code are undoubtedly valuable but also signal a need for the development of the further methods and technologies that consider can be applied to address the specific conditions of historic structures.
- The continual upgrades to building performance requirements in the Codes, particularly with respect to seismic standards indicates higher economic public subsidy levels, either in cash or density/height allowances, might be required for the ongoing conservation of Victoria's heritage buildings.

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