Award Details

A novel framework for multi-hazard performance-based design of sustainable and resilient tall timber and hybrid buildings

Research Details

Competition Year:	2019	**Fiscal Year:**	2019-2020
Project Lead Name:	Tesfamariam, Solomon	**Institution:**	University of British Columbia
Department:	Okanagan	**Province:**	British Columbia
Award Amount:	43,000	**Installment:**	1 - 5
Program:	Discovery Grants Program - Individual	**Selection Committee:**	Civil, Industrial and Systems Engineering
Research Subject:	Earthquake engineering	**Area of Application:**	Structural engineering
Co-Researchers:	No Co-Researcher	**Partners:**	No Partners

Award Summary

Rapid growth of urban populations and associated environmental concerns are challenging city planners and developers to consider sustainable building systems. Timber is a sustainable material, but the 2015 National Building Code Canada (NBCC) limits height of stick frame construction to 6 storeys. With recent introduction of large-scale engineered cross-laminated timber (CLT) panels and glulam timber, mid- and high-rise timber buildings became viable option. A decision on the selection of tall building by different stakeholders should consider economics, aesthetics, technology, regulations and political factors. The political factors are indeed satisfied as the Canadian timber industry and Natural Resources Canada are backing design and construction of tall-timber buildings. With this initiative, an 18-storey UBC's Brock common (the tallest hybrid wood building in the world in 2017, at 18 storeys) and 13-sotrey Origine (the tallest all-wood condominium building in North America in 2017, at 13 storeys) buildings are constructed in Vancouver and Quebec City, respectively.******Current seismic design guideline of the NBCC, however, is not suited for tall-timber buildings. In addition, tall-timber buildings are lighter and more flexible, making such buildings vulnerable to wind. The state-of-the-art global building codes and standards consider wind and earthquake design loads separately with the worst case governing the design. In a city like Vancouver, for example, both wind and seismic loads can compete and govern the design. Risk-based design and optimization, can be used as a unifying procedure for wind and earthquake hazard to meet different performance objectives (e.g. serviceability/comfort, life safety). The long-term program of the proposed research is to develop a performance-based design (PBD) frameworks for innovative tall-timber buildings under multi-hazard consideration (earthquake, wind, fire). The design framework will incorporate minimization of risk and cost, formulated as a multiobjective optimization problem. To achieve the long-term program, the short-term objectives are: ***A) develop a multi-hazard (earthquake and wind) PBD framework; ***B) develop innovative tall-timber buildings incorporating energy dissipators; ***C) extend the state-of-the-art on energy-based design and incorporated soil structure interaction (SSI); and ***D) apply advanced multi-objective structural design optimization algorithms.******This research will have a significant impact on Canadian society and the engineering community. The outcome of this program is develop a new framework for multi-hazard performance-based design tall timber buildings to improve the sustainability and resiliency of cities. The applicant has been working in the area of timber-based hybrid structures, seismic risk and performance-based wind engineering.