Sustainable Redesign of a Mid-Rise Office Building

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OVERVIEW
- The construction industry accounts for roughly 13% of Canada’s greenhouse gas (GHG) emissions. The industry generated over 96 million metric tons of GHGs in 2022 alone.
- Our project is a redesign of an existing mid-rise office building located in Burnaby, BC. A holistic approach to sustainability was the basis of our design methodology.
- A complete structural design in mass timber was completed, considering the various implications of this emerging building material.
- A thorough sustainability analysis and full LEED assessment was completed to gauge the environmental and socio-economic impacts of the redesign.

STRUCTURAL SYSTEM
- **Framing** utilizes CLT panels for the floor system and shear walls, along with GLT columns and beams for the structural skeleton.
- **Column layout** aligns with the original building layout to prevent excessive loads on the middle of the ground floor concrete slab. This layout contrasts with the closely spaced columns typical of mass timber structures.
- **Gravity Load Transfer**: CLT Floor Panels → Beams (Spanning East-West) → Girders (Spanning North-South) → Columns
- **Lateral loads** are governed by earthquake loading, as the building is located in a high seismic zone.

SHEAR WALLS
- CLT panels are designed with a slender height-to-width ratio. This results in a rocking motion of individual panels for energy dissipation, preventing shear failure of the panels themselves during a seismic event.
- **Ductile connections** between CLT panels and discrete hold-down connections allow for greater energy dissipation. The discrete hold-downs are designed to be 20% stronger than the ductile panel-panel connections, ensuring effective seismic energy dissipation by the CLT panels.
- **Rigid connections** link CLT panels to the floor system, transferring seismic loads to shear walls.

CROSS LAM & GLUE LAM
- **Alternating layers** allow for strength and stiffness in-plane, ideal for high seismic zones.
- **Implemented a one-way system** to stress major strength directions while accounting for both major and minor strengths.

Each element was designed to meet the required 2-hour fire rating, maintaining structural integrity through two hours of sustained fire exposure.

LEED RATING
- A full LEED v4.1 BD+C: Core and Shell assessment was performed, achieving the highest LEED Platinum certification.
- The design excelled in categories including Materials and Resources, Energy and Atmosphere, and Indoor Environmental Quality.

ENVIRONMENTAL SUSTAINABILITY
- **Reduction of 2,759 tonnes of CO2 emissions** compared to the existing conventional office building, equivalent to taking 657 cars off the road for a year.
- The mass timber structure significantly reduced the embodied carbon compared to concrete.
- **26% energy savings** by using an efficient envelope design.
- **2,768 sqm of extensive green roofing** to minimize the heat island effect, promote biodiversity, improve stormwater management, and enhance thermal performance.

HIGHLIGHTS
- Five Story Office Building
- Exposed Mass Timber Structural System
- Open Atrium over the North Lobby
- Green Patio Space
- Extensive Green Roof

REFERENCES
- WoodWorks. [2024]
- Envision: Sustainable Infrastructure Framework
- Build or Rebuild Manual [2019]
- Canadian CLT Handbook [2019]
- Encapsulated Mass Timber Construction to 12 Storeys [2021]
- OneClickLEA [2024]

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