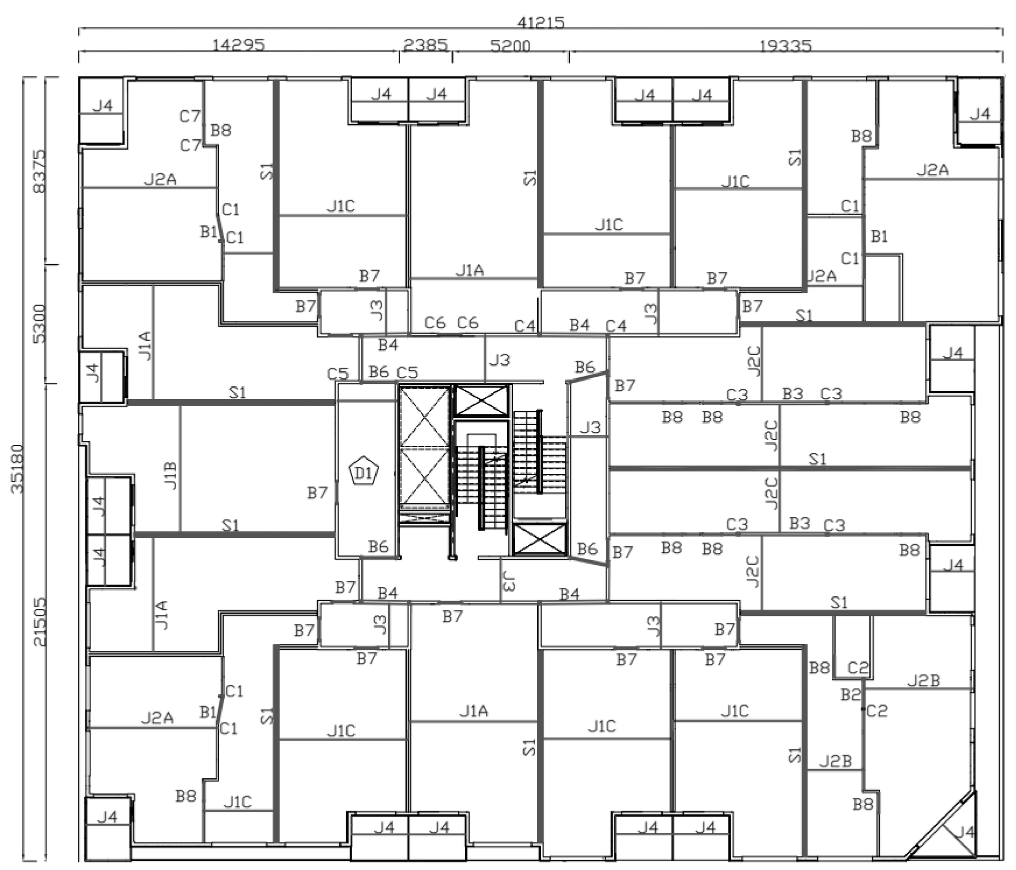
Montgomery Mixed Use Structural Design

Team Elev8HER
Schulich School of Engineering, University of Calgary

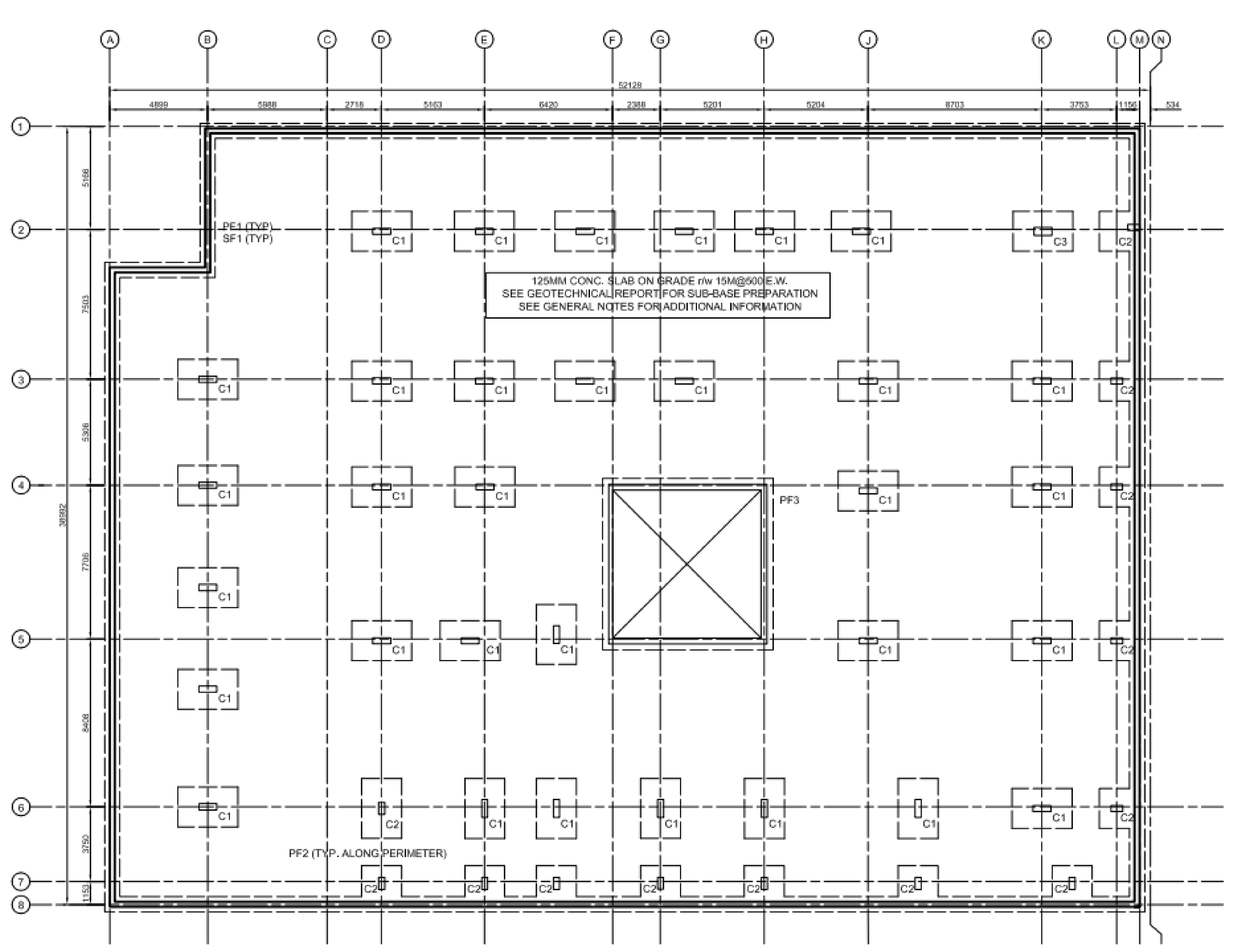
Introduction

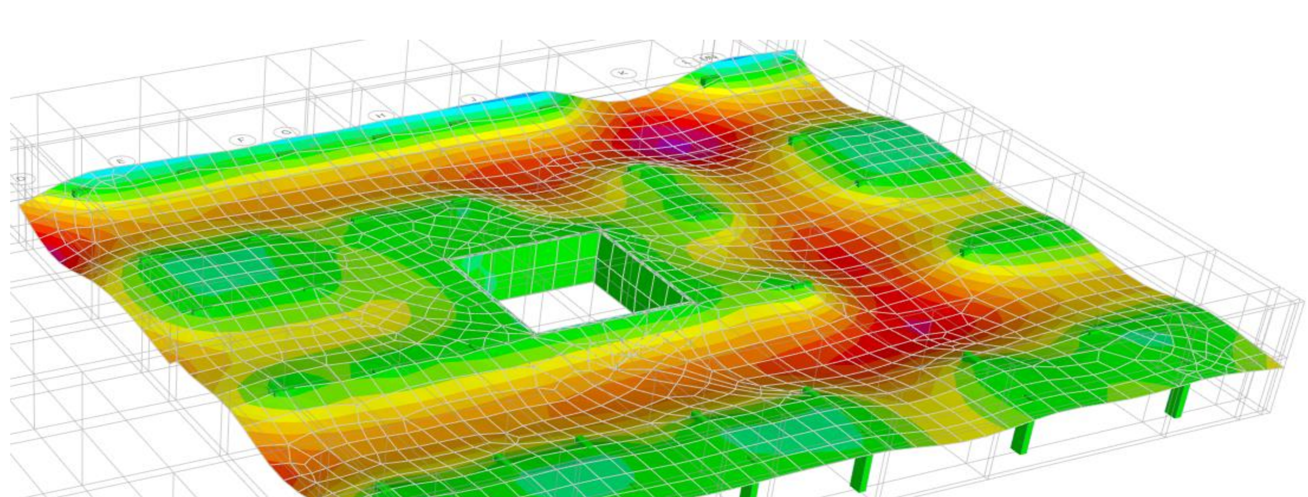
- Structural design of a 6-storey mixed-use building in Montgomery, Calgary, for client: RJC Engineering.
- The team designed the superstructure and substructure of the building following best practice and codes (NBCC 2020, CSA S16:19, CSA-A23.3, Wood Design Manual 2020).
- Six stories including one commercial level, five residential levels, one mechanical penthouse, and a below grade parking level.

Wood Floor Plan Drawing



Concrete Foundation Drawing





Transfer Slab Superimposed Dead Load Deflection 3D View

Key Problems Solved

- **Gravity Wood Superstructure:**

Designing structural members that would properly resist the gravitational loads in the superstructure. Ensuring that the load path from the joists to the beams then the columns, all the way to the transfer slab was continuous.

- **Lateral Wood Superstructure:**

The design of the lateral wood superstructure effectively addresses key engineering challenges such as providing lateral stability against wind loads, ensuring proper load distribution, controlling deflections, selecting appropriate materials, complying with codes and standards, and facilitating constructability. By carefully considering these factors, the design achieves structural integrity, safety, and performance while contributing to the project's overall success.

- **Concrete Foundation:**

Navigate and successfully applied Equivalent Frame Analysis for designing a two-way transfer slab, when the easier Direct Design Method criteria could not be met. Use Safe Software in conjunction with manual calculations to solve structural problems.

Design Materials & Methodology

Appropriate design materials and methodology are important for a structural design project, in terms of optimizing the use of resources and ensuring safety, stability, and performance.

Gravity Wood Superstructure:

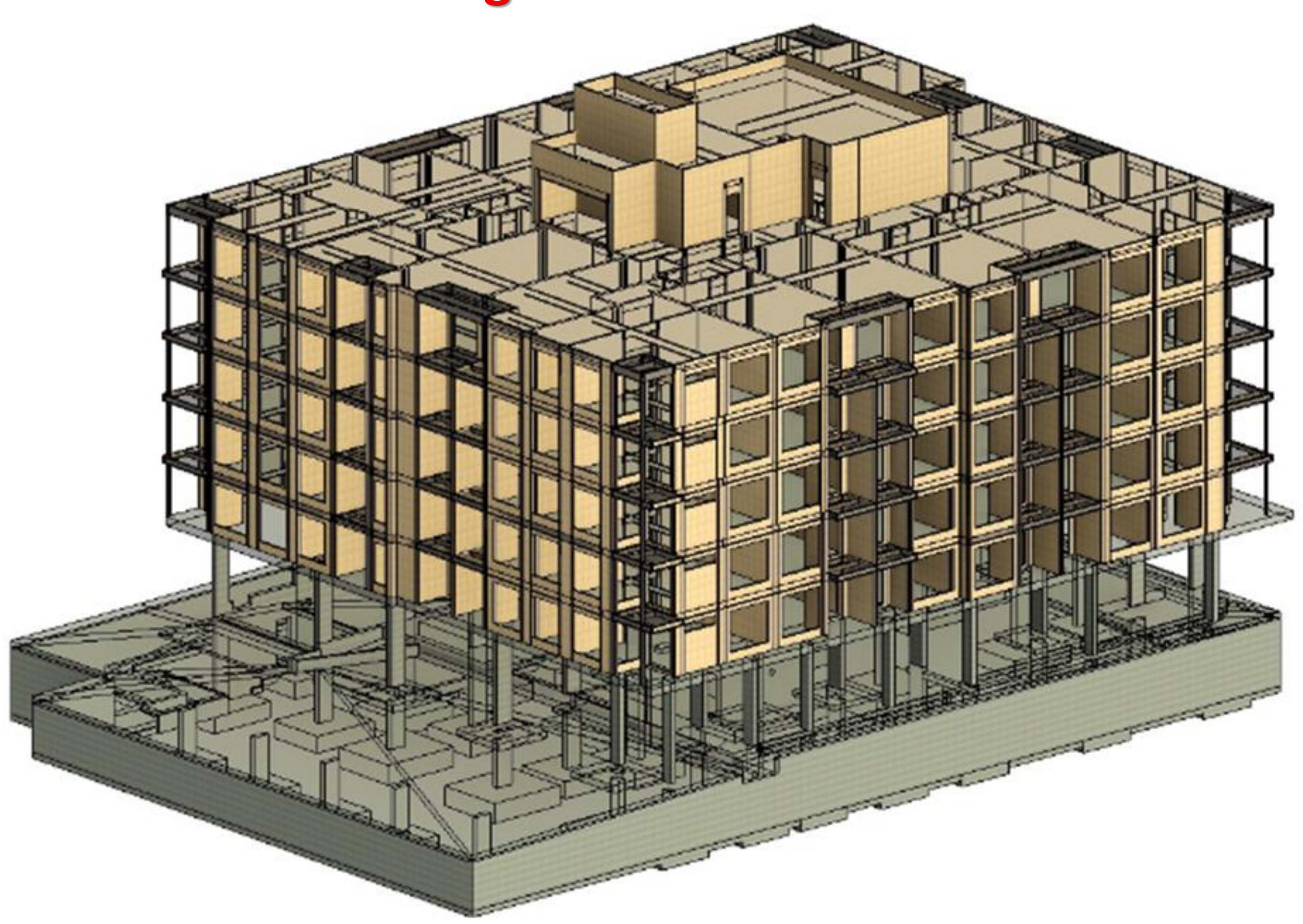
TJI joists and 38mm **Sawn Lumber of Spruce-Pine-Fir** with grades of No.1/No.2 were used for the joists in the floor assemblies. The design process required the assumption that the structural members were simply supported to determine the factored moment for each, which was then compared to the maximum resistive moments from Weyerhaeuser for TJI joists and the Wood Design Manual 2020 for wood joists.

For the beams, **Laminated Strand Lumber** with a grade of 1.55E and 38mm **Sawn Lumber of Spruce-Pine-Fir** with a grade of No.1/No.2 were used. The design process required the assumption that the structural members were simply supported, and the loads properly transferred from the joists to the beams. The calculated factored moments were then compared to the factored moment resistance values from Weyerhaeuser for engineered beams and the Wood Design Manual 2020 for built-up beams.

Lateral Wood Superstructure: **Canadian softwood plywood (CSP)** based panel has been selected for the roof and floor diaphragm, **Oriented Strand Board (OSB)** panel has been selected for the shear wall. The design methodology includes preliminary design steps such as load determination and layout, followed by detailed design phases focusing on diaphragms, shear walls, connections, and serviceability checks. Through this process, the lateral wood superstructure can be effectively designed to withstand lateral forces while meeting safety and performance requirements.

Concrete Foundation: The iterative design has been applied throughout the decision-making processes, with accumulated experience and intuition in the form of heuristic rules, the group committed efforts and tried to find the most acceptable solutions, for transfer slab, and foundation system design using **low carbon concrete**.

Structural Rendering



Sustainability

- **Social & Economical Sustainability:** Low grade, locally available LSL (Laminated Strand Lumber) and PSL (Parallel Strand Lumber) has been used to align with the goal of keeping the building affordable to live in, and visually appealing to look at; while not compromising the strength resistance capacity.
- **Environmental Sustainability:** Use low carbon concrete to reduce CO_2 Emission for foundation system.

CONTACT:

Alexandra Lau, Alice Luo, Layan Daoud Agha, Lorianne Buzar, Melanie Qin, Sarah Chen, Yashi Xu, Zyra Pascua