

PROJECT PROFILE

AXE BUILDINGS



AXE Buildings is a prefabricator of timber home components based out of St. Catharines, Ontario. They specialize in the design and construction of panelized structures for single and multi-family residential use. Their unique panel designs allow for flexible floor plan layouts and their manufacturing process facilitates the construction of homes by installing 90 percent of services in the factory.

PROJECT BACKGROUND

The timber housing industry in Canada has been highly favoured due to the convenience that comes with obtaining its materials and the simplicity of light wood frame construction. In recent years, a number of higher-rise structures have gained in popularity in hopes to address housing shortages in major cities. With the increase of higher-rise structures, the need for new technology in the timber construction industry has become apparent. Partnered with AXE Buildings, a panelized wood home builder in Ontario, a desktop review has been done to address some of the limitations surrounding the allowance for them to build to storeys greater than their current two-storey height limit. An assessment of the company's current structural design and an in-depth review of literature on mid to high-rise timber buildings were reported. A comparative analysis was done to identify areas of improvement for the company's current design and construction processes, and recommendations for next steps were provided.

RESULTS

AXE Buildings' current design features include light wood frame construction with cross laminated timber (CLT) panels for floors and ceilings. Prefabricated wall panels are assembled on-site using platform construction techniques. The design was evaluated against identified considerations for higher-rise buildings, focusing on vertical instability, shrinkage, differential movement, lateral instability, and accumulation of errors.

Key Findings:

Vertical Instability:

- Current design uses 2x6 framing for exterior walls and lightweight cladding to reduce loads.
- Recommendations: Specify stronger wood products like Douglas Fir for lower levels and consider nail laminating studs.

Shrinkage:

- Use of CLT and LVL headers minimizes shrinkage.
- Recommendations: Use kiln-dried lumber or engineered wood for sill and top plates.

Differential Movement:

- Current design's uniform wood materials minimize risk.
- Recommendations: Use wood products for stair and elevator shafts or incorporate slip joints if using concrete/masonry.

Lateral Instability:

- Design includes CLT diaphragms and OSB-sheathed shear walls.
- Recommendations: Add interior shear walls, stagger CLT panels, and install continuous tie-down anchors.

Accumulation of Errors:

- Prefabrication helps control quality and speed of construction.
- Recommendations: Survey and adjust each floor during construction to prevent error propagation.

RECOMMENDATIONS

Next steps in the implementation of this design for increasing the number of storeys for AXE Buildings' apartment would be conducting an analysis, determining the critical load paths. The results from the analysis would identify areas in the structure that would require higher load carrying capacity members. In addition, an analysis can be done to determine the optimal placement of additional shear walls and tie-down rods within the structure. This would be done taking into account the layout of the structure with special considerations made to the MEP walls. Finally, a structural analysis can be done for seismicity, which can be critical because of the lack of ductility of CLT panels