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WHEN FAST TRACK CONSTRUCTION LEADS TO AFFORDABLE HIGH END HOUSING

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Abstract: The most common types of structural framing systems used in residential construction remains to these days wood framing, cast in place concrete, light gauge steel or steel framed buildings. Although each type offers its advantage and inconvenient, when it comes to reach high speed of construction in tight urban job sites, a balanced use of prefabricated components remains the key to access high end quality buildings at lower cost. Belgravia Square is presented in this paper as an example of hybrid construction using steel frame combined with precast foundation walls, floors, stair cases, elevator shafts and an innovative precast tree root ball protection system. The fast track construction from detailing to erection, and the economics of this 68 condominium units erected in less than 6 weeks is described and compared to other conventional construction methods. This case study serves to demonstrate that short construction time in complicated urban site is no excuse to affordable and luxury multi-unit housing.

1 PROJECT OVERVIEW

Belgravia Square located on 76 St, Edmonton, south of the University of Alberta, is the second building built by Niche Development and engineered by Consultants SteelSSALG using 80% of prefabricated concrete structural components combined with a conventional steel frame. Each level of hollow core floor panel is to receive a 76 mm of structural concrete and are used as rigid diaphragm transmitting all inter story shear to all three prefabricated shafts. This latest project also integrates geothermal heating/cooling along with an innovative caisson system to protect century old trees on the front property line. Figure 1 shows a rendering of the future building to be complete by April 2019. Figure 2 shows the property line.



Figure 1 – Belgravia Square rendering

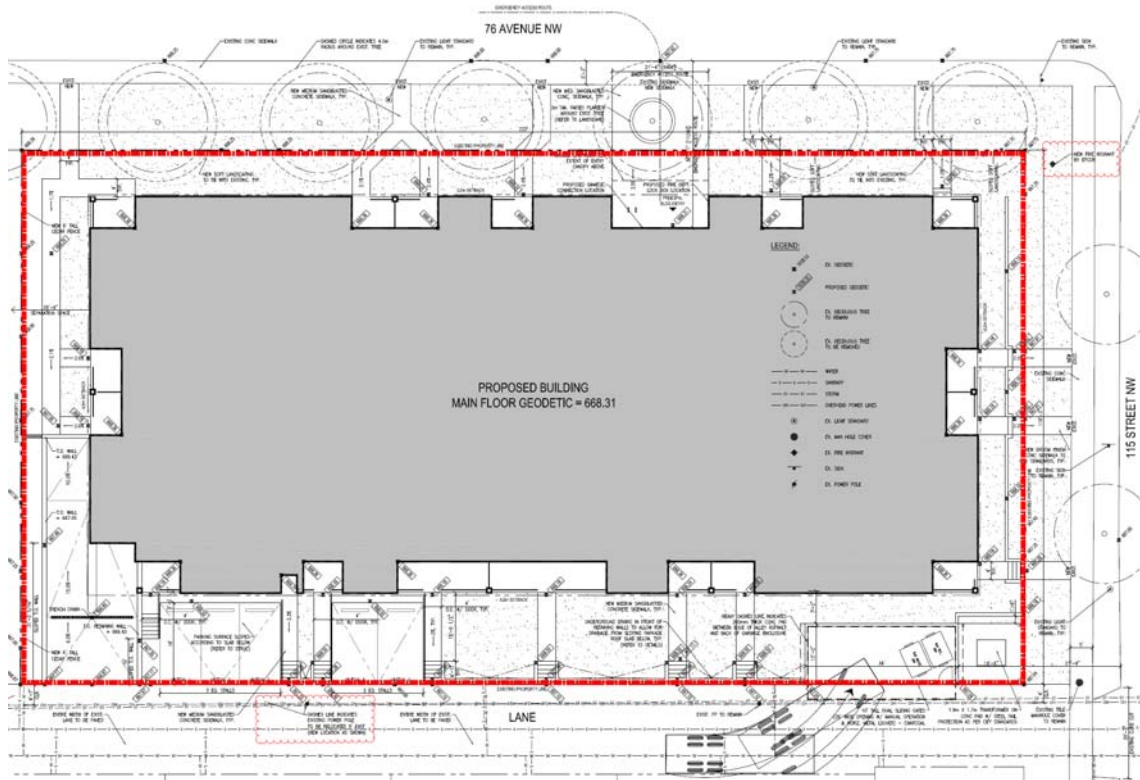


Figure 2 – Belgravia Square – Property Line

John Clark who started his career with Western Pacific, and company CEO Peter Purwall created Niche Developments in 2013. Both men describe their company's goal as bringing high-quality, affordable homes to the average person. For the past 6 years, S. Parent was the EOR for all of their projects using this type of steel and concrete precast components in Alberta, including steel detailing, and site assistance from pre-construction to the completion of the entire structure. Over the past 6 years, both companies developed

various connection details and erection procedures to speed up the construction regardless of the construction season. One of the main advantage of this type of framing is the low insurance premium when compared to wood-framing multi-unit buildings (75% less on the average). The sound rating offered by pre-stressed hollow core floor panels covered with a structural topping is above 62 STC. Finally, Belgravia Square brings the same combination of geothermal heating, precast concrete and structural steel that they employed on their first multi-family housing project in Calgary in 2016. Numbers from Niche One show the average monthly cost for heating a 900-square-foot unit can be as low as \$22 per month.

The main constraints for this projects were a one level underground parkade extending on 3 properly lines, a delivery schedule of 7 months, from site prep to occupancy permit, and the conservation of 6 oak trees 1 meter away from the south underground parkade wall. Above all these technical requirements, an average cost of \$300,000 per 900 square feet unit was required.

To counteract all project constraints, it was decided to combine the demolition of two existing wood structures onsite with the excavation and pile driving sequence. It was then justified to use as much prefabricated concrete components as possible, and to accurately alternate each shipment of structural steel and precast wall/floors due to a single truck unloading area. Un-shored vertical trench excavation technic was required to drop all precast foundation walls 300 mm from property line from pile to pile. Careful excavation around tree bowl root was secured by the use of a prefabricate C-shape tree box as shown on Figure 3. This precast box-concept was designed to extend the underground parkade space underneath a line of existing trees. Steel fabrication and prefabricated concrete components were fast-tracked by the direct import of the Revit model into Safi (steel design program), and Tekla (detailing program). This eliminated multiple cycles of drawing prints/coordination issues, and ultimately led to one printed permit set and one final construction set of stamped drawings. Steel detailing was part of the engineering packaged, and all steel shop drawings were directly supplied to the steel fabricator by the EOR in order to eliminate detailing RFI's between the fabricator and structural consultant. The concrete topping pours were sequenced from bottom to top to avoid concrete dropping from above while temporary erection bracings were dismantled as each rigid diaphragm was set. Figure 4 shows the first third of the building being erected after 2 weeks, and the limited unloading area at the site.

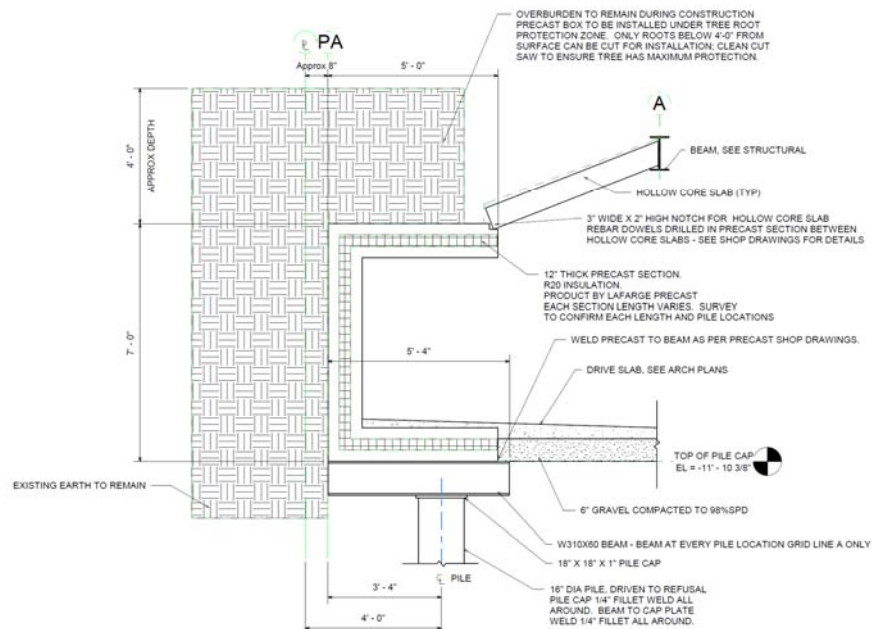


Figure 3 – C-shape tree-box



Figure 4 – Construction Site with Limited Unloading Area

Lessons Learned:

- During this current project, and for other similar structures, it was proven that this type of low rise building can be built for \$135/ft² which is less than a complete cast in place concrete structure (\$200/ft² – local pricing offered by local contractors) or wood frame structure (\$165/ft² – previous projects managed by Clark and Purwall).
- It was also established that the use of well-coordinated prefabricated concrete components can resolve issues such as construction on property line, high speed erection by same crew putting up the steel frame, and winter conditions.
- In-house detailing by the structural time has been found a great time saver. This avoids dealing with generic connection specifications, and provides access to exact connection loads needed to properly detail all connections.
- As for all previous projects, the entire construction team gathered weekly to assess any site conditions that could speed up or hamper the construction process. One of the lesson learned from this particular project was to avoid dealing with two different surveyor to separately implement structural components and pile foundations. In this case, a basic differential of 76 mm between two benchmark resulted in a tricky repair of piles being now loaded eccentrically.
- The construction sequence/elements used for this project shortened the schedule by 45% when compared to a similar conventional cast in place project - 4 storeys high, same square footage, built in Edmonton during that same period.