BUILDER INSIGHT

BC HOUSING
RESEARCH CENTRE

Bulletin No 7 | 330 Goldstream Avenue

Project Debrief – High-Performance Social Housing Project

Located in the City of Colwood in the Capital region of Vancouver Island, 330 Goldstream Avenue comprises 102-units of nonmarket housing for individuals, couples, and families with low-to-moderate income.

Developed by the Greater Victoria Housing Society (GVHS) and funded by BC Housing, the six-storey wood frame building comprises 6,121m^2 (65,862ft^2) of gross floor area over two storeys of underground parking. The building accommodates a range of unit sizes – 50 studios, 39 one bedroom, one two bedrooms and 12 three bedrooms.

Tight Budget and Timeline

GVHS had a tight budget and timeline. The contractor, Kinetic Construction, offered to use Lean Project Delivery to help manage the project, streamlining the construction phase to address these constraints.

330 Goldstream Ave

Photo courtesy James Jones in media publications & @jamesjonesphotos on Instagram

FACTS AND FIGURES

Construction timeline:
January 2019 – May 2021

Construction budget:
$18.99m

Residential units:
102

Site area:
3,820m^2 (41,103 ft^2)

Total Gross Floor Area:
8,323m^2 (89,555 ft^2) inc. Parking

Gross Floor Area, Residential:
6,121m^2 (65,862ft^2)

Building Height:
23.9m (78.4ft)

Occupancy Classification:
BCBC 2012, Group C- Residential (6 levels), Group F3 – Garage (2 levels)

PROJECT TEAM

Owner:
Greater Victoria Housing Society

Architect:
Cascadia Architects

Envelope and Energy modelling:
RDH Building Science

Structural Engineering:
RJC Engineers

Building Code and fire science:
GHL Consultants Ltd.

General Contractor:
Kinetic Construction

Timber and prefab. installer:
Ron Anderson & Sons

Timber panel fabricator:
ZyTech

Siding contractor:
Brytar Contracting

Research management:
Scius Advisory

Lean coach:
Shift2Lean

Video, webcam and photography:
Multivista

This bulletin series covers different aspects of this innovative social housing project. Find them all in the BC Housing Research Centre Library.

330 Goldstream Project Review

330 Goldstream started in 2017 as an ambitious affordable housing project on a difficult "land-locked" site, with a tight budget and schedule. The project met unexpected challenges such as unexpected geotechnical conditions, an acute labour shortage and the COVID19 pandemic. Despite these challenges, the project team delivered an extremely energy efficient, climate resilient building, using a novel prefabricated light wood envelope system and state of the art mechanical system.

The project team adopted Lean Project Delivery ("Lean") principles during the construction phase. Lean has the potential to significantly improve project efficiency, productivity and performance. Lean was new for the owner, consultants, many trades and suppliers. Lean relies on the Last Planner® system to manage the tight schedule and budget, and address challenges. Lean coaching and two workshops were provided for the entire project team to familiarize them with the principals prior to construction starting in early 2019. **An important tenet of Lean is for the project team to debrief on what worked, what didn't and key lessons learnt.**

As the project progressed, and even though the full deployment of Lean was curtailed due to COVID 19 restrictions, the Last Planner process helped the team to build goodwill, create strong relationships and develop a collaborative approach that would be instrumental in overcoming many of the known and unexpected challenges.

In 2021, the project was successfully completed, delivering much needed sustainable, affordable and comfortable housing to individuals, couples, and families with low-to-moderate income.

330 Goldstream Timeline	
May 2018	Development Permit submitted to the City of Colwood
May 2018	Kinetic Construction retained as the "Construction Manager at risk"
August 2018	Procurement opens
November 2018	Construction contract awarded to Kinetic Construction
December 2018	Development & Building Permits issued
	Mobilization and temporary road construction
January 2019	Construction commences
March 2019	Prefabrication of light wood frame panels begins
October 2019	Prefabricated panels installation begins on site
	Envelope enclosure begins
December 2019	Concrete foundations and parkade complete
January 2020	Six-storey prefabricated structure complete
March 2020	COVID-19: Work safe precautions begin on-site
June 2020	Envelope substantially complete
March 2021	Final full building airtightness test successful
May 2021	Project substantial completion, Occupancy Permit issued
June 2021	Occupants start to move in

Target Energy Performance
Thermal Energy Demand Intensity (TEDI) (kWh/m2/yr)
15
Thermal Energy Use Intensity (TEUI) (kWh/m2/yr)
100
Air tightness (ACH @ 50pa)
0.6

Major Event: COVID-19 Pandemic

The COVID-19 pandemic created significant uncertainty for construction projects around the world. 330 Goldstream was under construction when COVID health measures came into effect in BC. Even though construction was deemed an "essential service" and work on site was allowed to continue, the effects of the pandemic itself, the restrictions imposed as a result along with significant disruptions to the supply chain, seriously affected the project's schedule. In particular:

Lean Planning moved to virtual meetings

Weekly Big Room planning, which underpins the Lean process and which the trades valued very highly, had to be moved on-line or over the phone. The construction team felt that with the shift to virtual meetings they lost the value of in-person huddles around drawings, the planning board, and the inter-personal dynamic that gives rise to ideation and creative problem solving. Despite trying to hold Big Room meetings outdoors to respect social distancing requirements, the usefulness of these sessions diminished to the point that they, along with the entire Lean and Last Planner processes, were halted in April 2020.

The impact on Kinetic of managing the project during COVID and of reverting back to traditional project delivery methods mid-stream was far reaching. Vancouver Island was already in the grips of an acute construction labour shortage which already impacted the availability of workers with the appropriate level of experience. The site supervisor found that he needed a lot more time to brief and coordinate trades, as group sizes had to be limited. On the other hand, the culture of collaboration and the good will that Last Planner instilled in the construction team did help with project management long after Lean was abandoned.

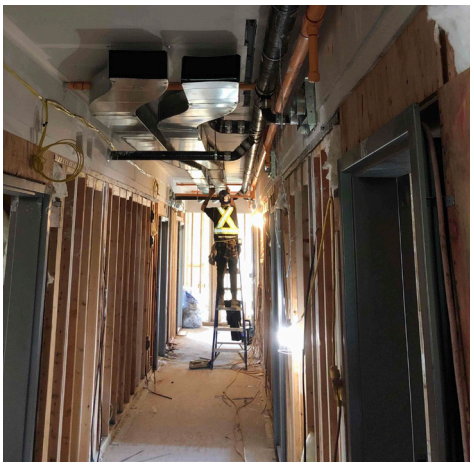
Area and space limitations

Given social distancing requirements, the rough-in and finishing work was slower than scheduled. 330 Goldstream's HVAC runs and services spaces were tightly packed to maximize livable area. This meant trades needed to extend their schedules in order to stagger the timing of their respective tasks which increased the chances of coordination errors.

Supplier disruption

The supplier disruptions that were a consequence of the pandemic mainly affected the interior fit out work – in particular, HVAC and other equipment, finishes and appliances.

Last Planner during COVID 19
(Source: Kinetic Construction)



Tightly packed service runs while maintaining social distancing (Source: Multivista)

Lean Project Delivery

Success: Stand-out team cooperation and resilience

Kinetic Construction, as the Lean champion, noted that the most significant benefit of using Lean and the Last Planner system was dramatically improved trade coordination. The trade team also appreciated the weekly planning sessions, which helped them to coordinate and plan their tasks in advance. The process helped everyone to deliver their scopes of work with less "back and forth", miscommunication and errors that often results in last-minute changes to their own company's schedules to accommodate priority projects. However, some trades did note the upfront time commitment was more than expected.

In particular, Last Planner was a supportive framework for the collaboration between Kinetic, the framer and panel installer (Ron Anderson and Sons) and the envelope contractor (Brytar Contracting). This was important for optimizing the design of 330 Goldstream for prefabrication, coordinating the offsite assembly of the exterior and interior wall panels (which includes a pre-applied sheathing membrane) to the envelope panels, then installing the prefabricated elements on site.

The redesign of the project for prefabrication from the initial suggestion to approval of the off-site scope of work by the consultant team only took one month.

Despite the late adoption of Lean (which started when Kinetic came on board and the design was largely done), the Lean practices helped to successfully bridge the design and construction gap. The architect (Cascadia Architects), building science consultant (RDH Building Science), Kinetic and Brytar (along with key suppliers) began collaborating on building envelope details during the second Lean training workshop, carrying in on during construction with multiple mock-ups to substantial completion.

Lesson learned:

Lean was adopted late in the project (late design). 330 Goldstream's design was considered complete, leaving little opportunity to realize Lean's advantages in design optimization for constructability, sequencing and delivery.

Lean is most effective as a project "commitment" up front – whereby the Lean planning principles can be established to guide the project and can be leveraged to plan exactly what is needed from the design for the construction team to deliver the building that will satisfy the owner's needs. Without this commitment baked in at the start, not all of the consultants bought into the methodology and the Lean process was unable to eliminate the "waste" that arose from, for example, unnecessary over-design, lack of adequate coordination between consultants' drawings, limited constructability review, and unclear drawings and specifications.

Kinetic noted that Lean can work within the "Construction Manager (CM) at risk" delivery method utilized on 330 Goldstream. With Kinetic as CM in a design-assist role during design, Lean practices such as Last Planner could have bridged the design and construction gap early on, ensuring only what can be built is designed. Late adoption of Lean also meant consultant fees did not anticipate the additional effort required to participate in the Lean process during the construction phase. Nevertheless, the consultants went out of their way to support Kinetic's Last Planning process when possible.

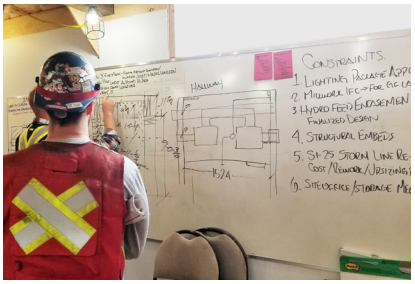


Image series: The most significant benefit of the Last Planner system was its ability to foster deeper collaboration. However, some trades noted that the time commitment was more than expected. (Source: Scius)

Lean requires all stakeholders who have an impact on outcomes to be integral, equal and engaged members of the team. A general rule of thumb is anyone who has decision-making power affecting the critical path's schedule, budget or resource allocation, must participate at all times as demanded by the project.

High-performance Envelope Construction

Success: prefabricated envelope performance

Kinetic Construction and Brytar Contracting, supported by Cascadia Architects and RDH, were pleased with the envelope air tightness test at the completion of the project. The first test result (conducted when the envelope was completed) was 0.44 ACH which is better than required to meet the Passive House Standard. While the envelope design required more field reviews and mockups than the project team anticipated, they agreed that taking the extra time to fully develop details and build it right the first time was key to success. Brytar noted that "this is the equivalent of measure twice, cut once" for building science.

Lessons learned:

There was a lot more time spent on collaboration and coordination during construction of the 330 Goldstream project than anticipated. The decision to prefabricate the panels late in the process was a major factor, but a significant amount of extra time was needed to refine details for practical and safe construction.

Kinetic recommended, and Brytar and Cascadia Architects generally agreed, that integrating envelope design-assist into the design phase can eliminate the "last-minute" rush to finalize details for construction. While the team agreed that the building envelope details were well designed, meeting Step Code 4 or Passive House performance standards must include constructability and trade coordination. This ensures that the details will be cost effective, buildable to an acceptable quality, and meet the requirements for the trades who will build it and the consultants' responsible for quality assurance. The more that can be resolved and agreed upon during design, the less that can go wrong once construction starts, when time and fees are at a premium.

The construction team noted that in most projects many contractual "grey areas" exist where the responsibility for a particular task is not clearly allocated to a trade's scope of work. Collaboration, whether supported by Lean practices or not, can help to identify and address such issues before they become problems. For example, on 330 Goldstream, the window supplier gave the window installation scope of work to the envelope contractor to ensure one trade was responsible for all critical membrane connections, contributing to the excellent air testing.

South elevation, complete.

South Elevation, during construction.

Photos courtesy James Jones in media publications & @jamesjonesphotos on Instagram

Light Wood Frame Panel Prefabrication

Success: Rapid site assembly in 69 days

Using the Last Planner process in the Big Room, Kinetic, the framer and prefabricated panel installer (Ron Anderson and Sons (RAS)), the panel fabricator (ZyTech) and the envelope contractor (Brytar), successfully coordinated the prefabrication and site assembly of 330 Goldstream's light wood wall panels. Once site assembly started, RAS was able to erect the building in 69 working days – only 9 days longer than planned (delays being caused by weather, the structural steel installation and the late delivery of the roof trusses).

Lessons learned:

For prefabrication to be successful, the fabricator's shop drawings must be based on a fully coordinated design that is ready for production. Mechanical, electrical, plumbing and sprinklers must be "set" (i.e., no further changes) so the panels can be fabricated with pre-cut openings to allow rapid on-site assembly. This was overlooked on 330 Goldstream. The numerous penetrations through corridor shear walls (required for ventilation ducts to serve each suite) were not sized correctly, requiring extensive field modifications. This eliminated the benefit of quick assembly as the modifications slowed down interior fit-out.

To mitigate this challenge, Kinetic recommended that, on future projects, the fabricator should be hired as a structural consultant to develop the prefabricated structural package as part of the consultant team. This method lends itself to Lean. Combining prefabrication into the design process can eliminate the need to design the building twice: once by the structural engineer, and again by the fabricator – waste that can lead to an increase in cost and time, and result to coordination errors.

Bringing the fabricator on board early can also ensure that the building envelope details will be optimized for prefabrication. For example, the pre-installation of the sheathing membrane (or the complete assembly of the building envelope) could have been incorporated and planned for, versus Goldstream's stressful and last-minute incorporation of the membrane application into the prefabrication process.

Other project challenges also limited the advantages of prefabrication. Construction of the foundations and parkade was hampered by site conditions and design changes, which pushed the framing start date back several months. This not only caused production scheduling issues at ZyTech's plant, but also the prefabricated panels had to be stored for some time on site (where there was limited space). Most critically, site assembly of the timber structure and envelope was pushed into the rainy season. The need to dry out the structure before interior fit out could start further affected the project's overall schedule.

Team Debrief: Other Important Lessons

Project schedule and timing

The seasonal sensitivity of construction is often under appreciated. In the case of 330 Goldstream, the construction start date differed significantly from the

Image sequence, left to right: rendering to construction progression, Southeast elevation.
(Rendering source: Cascadia Architects, progression photo source: Multivista)

date in the bid schedule. Construction risks (arising from weather, logistics, labor availability etc.) can vary widely depending on the season.

Goldstream started site construction December 2018, as opposed to the bid schedule's August 2018 start. This meant excavations and site work happened in winter. Being a heavily sloped, landlocked site, rain run-off pooled onto the site. Kinetic needed as many as 27 pumps to manage the rainwater. The knock-on effect of this late start was that framing began at the start of the rainy season instead of at the height of summer.

Administration workflows

Construction administration can be burdensome at the best of times. However, the slow pace of decision-making and the arduous administrative procedures of the various decision-makers involved with 330 Goldstream during the construction phase was frustrating.

The time required to reach decisions, to process paperwork and to follow procedures unintentionally affected the project's critical path. The project team agreed that current project procedures (such as those in standard contracts) can often be onerous and contrary to the principles of Lean (i.e., they could be very wasteful of time).

Lean's overarching principle of "respect for people" is about minimizing non-value add tasks, so they can focus their expertise on value-add tasks – building the building and doing a great job at it. Therefore, if a decision-maker has "go/no go" power over when value-add tasks start, they must be scheduled in as a "critical path requirement" with the decision-maker made responsible for the go ahead or for any delays or costs that result from it.

Supplier proprietary "products"

In a bid to improve efficiency, Kinetic is considering approaching prefabrication (structure and building envelope) as "proprietary" design-build products. Taking full responsibility for the entire structural and envelope packages, the trade or supplier will be brought on early, designing the components and coordinating with the consultant team, as well as pricing and execution when the project moves into the construction phase. This approach seeks to bridge the design-construction gap and improve coordination and planning. For example, on 330 Goldstream, this approach would have facilitated Lean project delivery and could have eliminated material waste, mitigated coordination issues and addressed construction challenges earlier during the design phase.

Continuous Improvement: Practices & Procedures

In addition to 330 Goldstream's lessons learned, the project team also highlighted a few common practices that industry will need to improve on for future projects.

Contract documents

During construction, information was spread across a large number of different drawings, specifications, etc. which, due to a lack of sufficient coordination, often led to missing, confusing or conflicting information that slowed down progress or led to errors.




Contract administration

The administrative procedures required for changes, mock-ups and communication between consultants were varied, and become increasingly onerous as the project progressed, leading to confusion and mistakes.

Design-construction silo-ing

Kinetic observed that deeper involvement with consultants earlier in the pre-construction phase could have helped set more clear expectations, practices and procedures.

Prefabrication quality control and responsibility

GVHS and Kinetic noted that prefabrication and delivery to Colwood via ferry from Langley yielded some unique challenges. Who takes responsibility for the panels and when, needs to be considered, especially with pre-installation scopes of work. It is also important to confirm who takes responsibility for damages during transit or storage of panels, as well as quality control and assurance.

GVHS stressed the importance of assessing and defining all of the site-specific factors with the general contractor and suppliers as early as possible to set up quality control procedures and address potential issues.

Regional labour and material supply

Persistent skilled labour and material supply issues in the Capital region of Vancouver Island as a result of a hot construction market in BC and the COVID pandemic, contributed to the cost and scheduling challenges for 330 Goldstream.

External suppliers coordination

Coordination with the many external stakeholders on a typical project can be one of the most difficult challenges. Utilities, the Authorities Having Jurisdiction and Project Funders are examples of parties that are “key influencers” in a project’s success, but who have no contractual relationship with the building project. For example, public utility teams do not have direct obligations to the project but can often have significant impact on those that do, and the project’s schedule or budget. This often means that someone has to pick up the tab for delays, deficiencies or solutions that are technically outside the scope of the project. For 330 Goldstream, difficulties arose when coordinating with external suppliers that affected power (temporary and permanent) which, in turn. impacted the substantial completion date.

Acknowledgement

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About BC Housing Research Centre

BC Housing’s Research Centre works in collaboration with housing sector partners to foster excellence in residential construction and find innovative solutions for affordable housing in British Columbia. Sharing leading-edge research, advances in building science, and new technologies encourages best practice. The Research Centre identifies and bridges research gaps to address homelessness, housing affordability, social housing challenges and the needs of distinct populations. Mobilizing knowledge and research expertise helps improve the quality of housing and leads to innovation and adoption of new construction techniques, Building Code changes, and enhanced education and training programs. Sign up to receive the latest news and updates from BC Housing’s Research Centre at **www.bchousing.org/subscribe**.

BC HOUSING RESEARCH CENTRE
1701-4555 Kingsway, Burnaby, BC V5H 4V8
Phone: 778-452-6454
Toll-free: 1-866-465-6873
Email: research@bchousing.org
www.bchousing.org

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