DESIGN AND PROTOTYPE COMPETITION

Prefabricated Wood-Based Facade Systems for Tall Wood Buildings
Client: Delta Land Developments
Participants: Manufacturer-led teams that may include contractors, engineers, architects, material suppliers, trades etc.

Key Objectives:
• To spur innovation in commercially available wood-based façade systems for mass timber and other projects
• To generate specific, implementation-ready solutions appropriate for use on Canada’s Earth Tower, an industry-leading tall wood project anticipated to be up to 40 storeys

DESIGN AND PROTOTYPE COMPETITION

Artists impressions are not intended to be demonstrative. Renderings are artists interpretation.
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INTRODUCTION

The purpose of this competition is to support creative collaboration to produce new solutions for tall wood design in Canada. Manufacturer-led teams will design, engineer, and prototype a working prefabricated wood-based panelized façade system suitable for installation on high-rise buildings¹. To encourage designs that are both imaginative and realistic, the façade system and design features will be designed for a specific project: the 30-40 storey Canada’s Earth Tower project in Vancouver (Perkins and Will for Delta Land Developments). However, while the project here is for the design of systems suitable for up to 40 storeys, the system is expected to be suitable for the larger 7-18 storey mass timber market soon to be allowed by Canadian and US building codes.

The top three teams as judged by an evaluation committee following criteria contained within this brief will be contracted at a fixed fee of $50,000 to complete preliminary mock-ups for demonstration purposes. Based on these mock-ups, one team will receive an additional PO and, upon completion of additional mock-up testing as described below, additional payment of $75,000. After successful completion of the façade testing program, the façade system may be selected for use on the Canada’s Earth Tower project.

All complete competition entries will be featured as part of a publicly funded research project documenting the development of wood-based façade systems and made accessible to the industry.

¹ For reference for architectural team members, this competition is considered a non-endorsed competition according to RAIC guidelines. As stated in those guidelines, competitions “for non-building projects and related selection processes do not require endorsement.”
https://raic.org/raic/architectural-competitions-%E2%80%93-introduction
The 2020 National Building Code of Canada (NBC) and Provincial adoptions of the NBC include provisions for the design and construction of mass timber buildings up to 12 storeys. The 2021 International Building Code (IBC), which will be referenced by some US States, allow for the construction of up to 18 storeys of mass timber for some building types. Many completed projects around the world have demonstrated the potential for high-rise wood structures. However, the façade systems for many of these early mass timber buildings, in particular the taller projects, have not been wood-based despite the desire from design teams to use wood as part of the building enclosure. This is partially due to a lack of commercially available wood-based façade systems.

Industry experience with the design and construction of taller wood buildings has shown that the structures of these buildings can be quickly erected, even up to a floor or more per day. With this pace of structure erection, there is a need to closely match the pace of the façade system installation in order to close-in and protect the wood structure from weather and gain construction scheduling efficiencies. While there are many complete façade systems available that could satisfy this need (aluminum curtainwall, precast concrete, steel framed wall panels, etc.) there currently are no wood-based or low-embodied carbon building enclosure/façade systems that are suitable for this purpose, nor many systems available that meet the high thermal performance targets of net zero carbon, net zero energy, and/or passive house buildings which are common goals (i.e. mass timber buildings are often pursuing low carbon and low energy goals).
Canada’s Earth Tower in Vancouver, BC is a multi-building mixed-used development, including a residential tower between 30 and 40 storeys depending on final rezoning. This tower is currently in early stage design, where the team is seeking to develop a façade system solution to be paired with the planned mass-wood structure. Schematic drawings are provided in the Appendix which indicate floor to floor heights and typical floor plans for the purposes of determining panel sizing and completing engineering calculations.

Specific cladding materials have not been selected, though the façade system is expected to be clad with a mix of light- to medium-weight panel claddings. The façade system is expected to allow for panels with punched windows, sliding glazed doors, and the integration of unitized curtainwall for the highly glazed winter gardens. Prefabricated balconies will be steel framed and bolted into or through the façade system.
COMPETITION OBJECTIVES

The intent of this Design and Prototype Competition is to innovate and design a prefabricated wood-based façade system that could be used for the 30-40 storey Canada’s Earth Tower project, in addition to other future projects.

DESIGN PARAMETERS

The overarching objectives are outlined in the list on the next page, along with more specific design criteria, loads, and performance targets outlined in the corresponding table. Evaluation criteria and scoring points are provided in the following section. Solutions should:

• Use wood as the primary structural element for the façade, excluding accessories and other connectors where wood may be deemed unsuitable for technical reasons.

• Be entirely factory prefabricated including the wood structure, membranes, insulation, claddings, and windows installed etc. Moisture sensitive components such as interior finishes may be excluded from the prefabricated panels.

• Be flexible in design concept to allow for glazing systems that include but are not limited to punched windows and doors, with details allowing ease of integration to adjoining fully glazed systems, including window wall or curtainwall etc.

• Provide thermally efficient design options for accessories, including prefabricated steel framed balconies and solar shading devices.

• Be able to accommodate large, near full height, triple glazed lift and slide balcony doors.

• Provide design solutions for horizontal elements such as roof decks and floor soffits if either its part of, or excluded from the façade system.

• Be engineered for use on high-rise buildings, including the high seismic region of the Lower Mainland of BC.

• Meet fire code requirements for tall wood buildings in Canada (i.e. Part 3 of the 2020 NBC) through code analysis and/or physical testing.

• Be thermally efficient and suitable for use on Passive House projects.

• Be cost effective and competitive against other façade systems.

• Be durable and resilient to moisture damage during construction and in-service.

• Be low embodied carbon.

• Use sustainably harvested wood.

• Be socially equitable.
A summary of the current design requirements and structural loads for Canada’s Earth Tower are provided to assist with the engineering of the façade system (Table 1). These are minimum requirements and if criteria cannot be met, then submissions will not be considered viable without a specific engineered rationale. If criteria can be exceeded, providing additional benefit, there is an opportunity for additional points as outlined in the following evaluation section.
### Design Load / Condition

<table>
<thead>
<tr>
<th>Construction and Structural Requirements</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor to Floor Height (Residential) for Panel Span</td>
<td>10 ft (3.05 m)</td>
</tr>
<tr>
<td>Floor Slab Construction</td>
<td>7 ply CLT, 9 5/8&quot; (245 mm) thick, exposed ceiling, char rate for fire protection</td>
</tr>
<tr>
<td>Floor Finishes &amp; Topping</td>
<td>Option A: wood decking with plywood and acoustic insulation underlayment Option B: concrete topping with insulation underlayment</td>
</tr>
<tr>
<td>Floor System Vertical Deflection</td>
<td>3/4&quot; (19 mm)</td>
</tr>
<tr>
<td>Interstorey Lateral Drift due to Wind</td>
<td>1/2&quot; (13 mm)</td>
</tr>
<tr>
<td>Interstorey Lateral Drift due to Seismic (Elastic)</td>
<td>1.5&quot; (38 mm)</td>
</tr>
<tr>
<td>Interstorey Lateral Drift due to Seismic (Inelastic)</td>
<td>3&quot; (76 mm)</td>
</tr>
<tr>
<td>Seismic Design Criteria</td>
<td>Site Class B assumed to preliminary design until site specific geotechnical study confirms</td>
</tr>
<tr>
<td>Wind Load (unfactored)</td>
<td>Q50 = 10 psf (0.48 kPa)</td>
</tr>
<tr>
<td>Balcony Depth and Width</td>
<td>6.5’ x 18’ approx (2 m x 5.4 m)</td>
</tr>
<tr>
<td>Balcony Deadload and Live Load Assumptions</td>
<td>50 psf (2.4 kPa) dead load, 100 psf (4.8 kPa) live load</td>
</tr>
<tr>
<td>Cladding Weight, Mix of Claddings</td>
<td>Maximum 15 psf (73 kg/m²) unfactored weight excluding cladding attachment and girts</td>
</tr>
</tbody>
</table>

### Building Enclosure Performance Requirements

| Opaque Panel Effective Thermal Performance (Including all panel connection thermal bridges, repetitive thermal bridges and cladding attachments, excluding balcony connection attachments), R-value | R-40, IP units – demonstrated by three-dimensional thermal modelling |
| Window Effective Thermal Performance | Better than R-6 (U-0.17) IP units, NFRC calculation methods – demonstrated by window supplier |
| Window Perimeter Installation Thermal Performance | No more than a 10% reduction when psi-perimeter added and accounted for in the overall window U-value, demonstrated by thermal modeling |
| Balcony Attachment Thermal Degradation | No more than a 10% reduction to the overall thermal performance of an individual façade panel they are installed into, demonstrated by thermal modeling |
| Condensation Resistance (Temperature Index, Ti) of Façade System including Installed windows and all connections. | Minimum Ti=70 as demonstrated by three-dimensional thermal modeling |
| Overall Whole Building Airtightness Target | More airtight than 0.50 L/s/m² @ 75 Pa which is better than 0.6 ACH 50 given the surface to volume ratio of this tower (as tested to ASTM E779 or similar whole building test) |
| Façade system airtightness including installed windows and panel joints and connections following conditioning | <0.25 L/s/m² at 75 Pa (tested to ASTM E283 lab or E783 field) |
| Façade system water tightness including installed windows and panel joints and connections (ASTM E1105) following conditioning | No visible or concealed panel connection or fenestration system or installation leakage allowed at 15 psf (720 Pa) (tested to ASTM E547 lab or ASTM E1105 field) |
Proof of concept design and engineering for a wood-based façade system to meet the criteria outlined here has been performed by the design team for Canada’s Earth Tower. This work has identified the need for a “kit-of-parts” hung curtainwall style façade system which includes an integrated wall system, window systems (punched windows and floor to ceiling windows) and balcony doors such that an entire façade of a building can be built by one supplier. Partnerships between existing panel and glazing companies are therefore encouraged.
It is expected that the balconies will also be prefabricated and likely consist of a steel frame, aluminum frame, light weight concrete or wood, where provided long term weathering and durability can be addressed. The balcony will be supported off of thermally broken connections into or through the panel and supported by tension rods/cables and/or compression struts. The design teams are encouraged to include a prefabricated balcony system within the design.

Panelized façade solutions may include a system of small panels 4-6’ in width x floor height (like window wall or unitized curtainwall) or larger panels like steel framed walls or large precast (ie 20-30’+ in width by floor height). Consideration for method and speed of erection should be taken into account for this small vs. large panel concept.

Challenges encountered in early designs have found that the joints for a hung curtainwall style panel system will be expected to accommodate up to 3” of inter-storey lateral drift. Corners may be problematic and will need to accommodate these drifts without damage to the system. Various structural façade anchoring and joint systems are possible and the exploration of different systems is encouraged.

In lieu of hung lightweight curtainwall style façade panels, bottom bearing or even load bearing systems for opaque portions coupled with an integrated window/door system can be developed.
SUBMISSION REQUIREMENTS

Format Requirements

Requirements vary at each stage of the competition and procurement process. Please see Program Timeline and Requirements (Page 16).

Facade System Evaluation Criteria and Scoring

The intent of this Design and Prototype Competition is to innovate and design a prefabricated wood-based façade system that could be used for the 30-40 storey Canada’s Earth Tower project, as well as other future building projects.
Design and Prototype Competition: Prefabricated Wood-Based Façade Systems for Tall Wood Buildings

A BETTER WAY TO BUILD
**TABLE 2: EVALUATION CRITERIA AND SCORING DETAILS**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points (/150)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Wood</td>
<td>20</td>
<td>The intent is for the primary structural system to be constructed out of wood. Accessories such as connectors, anchors, sealants, membranes, insulation, claddings, etc. are not expected to be wood based. Points awarded based on the total amount of wood used in appropriate applications.</td>
</tr>
<tr>
<td>Acceptance by Building Code</td>
<td>5</td>
<td>Ability to be readily accepted under current Canadian and US building codes. Points will be awarded based on demonstrating compliance with necessary building code requirements (excluding fire, below)</td>
</tr>
<tr>
<td>Acceptance by Fire Code &amp; Protection of Combustible Wood</td>
<td>10</td>
<td>Ability to be readily accepted under current Canadian and US fire codes. Points will be awarded based on the relative ease of code acceptance of the design (i.e. use of engineering judgement vs physical testing and the use of selected materials). Fire testing is not required for the submission; however, the system should have input from a fire specialist.</td>
</tr>
<tr>
<td>Design Flexibility</td>
<td>10</td>
<td>Ability to accommodate a wide range of cladding types, panel sizes, window sizes and window placement. Ability to be integrated with other building enclosure elements including roofs, roof decks, balconies, soffits etc. Points awarded depending on the degree of flexibility related to other submissions.</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>10</td>
<td>Overall aesthetic of system including exterior and interior finishes including joint size, placement and treatment. Points awarded by visual representation of system through renderings and mock-ups.</td>
</tr>
<tr>
<td>Durability</td>
<td>10</td>
<td>Demonstrate how the system addresses long term building enclosure and structural durability considerations in-service. Materials, design concepts and overall suitability within tall buildings. Points awarded by technical evaluation of the submission and for adequately addressing potential durability issues.</td>
</tr>
<tr>
<td>Acoustics</td>
<td>5</td>
<td>Demonstrate acoustic properties suitable for multi-unit residential and commercial buildings in noisy urban environments. Points awarded by technical evaluation of the submission against typical industry recommendations for OITC ratings.</td>
</tr>
<tr>
<td>Thermal Performance</td>
<td>10</td>
<td>Demonstrate through modeling and/or testing a very high degree of thermal efficiency with minimized thermal bridging, and exceptional airtightness per criteria above. Baseline points awarded for meeting minimum criteria with additional points awarded to the most thermally efficient systems in terms of relative material use and cost.</td>
</tr>
</tbody>
</table>
### Design and Prototype Competition: Prefabricated Wood-Based Façade Systems for Tall Wood Buildings

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points (/150)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructability</td>
<td>10</td>
<td>Demonstrate the constructability of the overall system, how the panels connect, ease and speed of installation. Systems should also address how construction challenges will be addressed, in particular how moisture is managed during erection and prior to protection by the completed building enclosure. Points will be awarded for visually demonstrating the ease of constructability and how the system works physically using still either images with text annotation, animations, videos or mock-ups.</td>
</tr>
<tr>
<td>Sustainable Wood</td>
<td>5</td>
<td>Demonstrate use of sustainably harvested wood. Points awarded for understanding of sourcing and a relative comparison between submissions.</td>
</tr>
<tr>
<td>Embodied Carbon</td>
<td>5</td>
<td>Demonstrate embodied carbon calculations including transportation to factory and site for whole façade system excluding the cladding. Points awarded for a clearly thought out and referenced calculation for the materials used with the typical façade system with additional points awarded to the best performing system(s).</td>
</tr>
<tr>
<td>Social Equity</td>
<td>5</td>
<td>Demonstrate social equity in manufacturing of the façade system. Points awarded for demonstration of social equity concepts.</td>
</tr>
<tr>
<td>Cost</td>
<td>10</td>
<td>Provide a detailed cost breakdown for the supply and installation of the façade system on the Canada Earth Tower project. Normalized to a cost per square foot of façade are including supply and installation using the method appropriate for the façade system. Relative points awarded between submissions and for being cost competitive in this market.</td>
</tr>
<tr>
<td>Manufacturing Experience</td>
<td>5</td>
<td>Team’s experience with manufacturing of similar systems. Relative points awarded with the understanding that there is limited manufacturing experience with this type of wood-based façade system.</td>
</tr>
<tr>
<td>Engineering Experience</td>
<td>10</td>
<td>Team’s engineering experience with wood and façade systems. Relative points awarded for demonstrated experience with similar types of façade system development.</td>
</tr>
<tr>
<td>Façade Systems Experience</td>
<td>10</td>
<td>Team’s experience with design and/or installation of façade systems for large buildings. Relative points awarded for demonstrated experience with façades.</td>
</tr>
<tr>
<td>Overall Submittal Quality</td>
<td>10</td>
<td>Provide a complete professional submittal, demonstrating the team’s ability to meet criteria</td>
</tr>
</tbody>
</table>

**TOTAL** 150
The intent of this competition is to have a prototype façade system suitable for use on Canada’s Earth Tower. Construction of the project is not anticipated until at least 2021, though the design of the façade and procurement of a system is necessary by the end of 2020.

**MILESTONE:**
The call for submissions will be officially released

**PARTICIPANT REQUIREMENTS:**
Participants can start work on the façade system design

**MILESTONE:**
Letter of intent deadline for all interested teams

**PARTICIPANT REQUIREMENTS:**
Submit a letter of intent to the Competition Administrator notifying such of the intent to participate in the competition, with a list of the proponents’ team members

**MILESTONE:**
Concept submission deadline

**PARTICIPANT REQUIREMENTS:**
Submit concept with engineered design submission electronically (and with small scale mock-ups if desired)

**MILESTONE:**
The top 3 eligible teams will be selected and POs will be issued for construction of small-scale mockups.

**PARTICIPANT REQUIREMENTS:**
Electronic submissions with drawings, details, renderings to show the design and engineering analysis to demonstrate performance with the project specific criteria. Proponents are encouraged to include small scale 3d printed or built physical models. To proceed to Stage 2, submissions must be deemed valid and be complete. Judging will screen and select the top three applications.
STAGE 2: PARTICIPATION – CONTRACTED RESEARCH DEMONSTRATION

**MILESTONE:**
Small-scale mockup deadline

**PARTICIPANT REQUIREMENTS:**
Submit small-scale mockups (top 3 teams). Physical mockups of a suitable size are required to demonstrate the proposed façade system and facilitate evaluation of suitability for full-scale testing.

**MILESTONE:**
Final-stage team will be announced and a final PO issued for completion of mockup and testing.

**PARTICIPANT REQUIREMENTS:**
A full scale 2-storey corner unit mock-up will be built and tested to evaluate erection speed and be further fully performance tested at a laboratory against the project air, water, structural, thermal requirements.

**MILESTONE:**
Project completion deadline
COMPETITION ADMINISTRATION

All submissions and communications are to be transmitted via email to the Competition Administrator, as follows:

Deanna Yue, Delta Land Development Ltd.
e. deanna@deltalanddev.com
p. 604.678.9220

Any physical submission materials, including any mock-ups, samples, etc, are to be delivered to the Competition Administrator at the following address during regular business hours (M-F, 9-5):

Delta Land Development Ltd.
560-669 Howe Street, Vancouver, BC, Canada, V6C 0B4
FEES AND COMPENSATION

There is no fee to enter the competition or proceed from Stage 1 to Stage 2. Teams will not be compensated for the preparation and delivery of their submissions during Stage 1. Teams will gain public exposure and potential marketing benefits through the competition and submissions will be documented and featured within various publications related to the Canada’s Earth Tower project.

Reimbursement of $50,000 is to be paid to each of the top 3 teams to further develop their designs and construct small scale mock-ups as a preliminary step in demonstrating feasibility and suitability. An additional $75,000 (hence $125,000 total) will be committed and, upon completion, paid to one of these three teams to execute a full-scale 2-storey performance mock-up for testing at a laboratory testing facility local to the project. This is a flat fee and any remaining costs will be borne by the team. The testing will include: air leakage, water penetration resistance, structural wind and seismic loading, and thermal performance condensation resistance testing to confirm acceptable performance against the project criteria. This full-scale installation will also prove out the installation speed and erection techniques.

This design competition is an integral part of the Canada’s Earth Tower design, procurement, and construction process. The intent of these efforts is that the team selected for full-scale mockup construction and testing would, at minimum, be invited to bid for the supply or supply and install of the panelized façade system for the project, with the benefit of a pre-vetted solution.
INTELLECTUAL PROPERTY RIGHTS AND USE

Given the source of funding for this Project, and further to the Owner’s intent to promote industry-wide adoption of transformative high performance buildings and their component parts and technologies, it is the Owner’s intention to make solutions and information obtained pursuant to this Competition accessible and shared with the public, so as to help drive the industry forward positively. By entering into this Competition, each Team understands and agrees that all information submitted and generated as a result of and in relation to this Competition, will be without any restriction on the intellectual property contained therein including, without limitation by way of patent, trademark, copyright, license or otherwise. Once a Team is selected to progress into Stage 2 of the Competition and prior to receiving any funding therefor, each Team will execute a contract with Owner. That contract will provide, among other things, that all intellectual property contained within such Team’s submission and/or generated as a result of or in relation to this Competition will be transferred to, and shall vest in the Owner, or be licensed to the Owner in the event that a team retains title to such intellectual property. As this is part of a publicly funded research project the Owner will grant the funder a non-exclusive, irrevocable, world-wide, free and royalty-free license in perpetuity to use, sublicense, modify and make publicly available, including by way of an unrestricted use creative commons license, any such information and intellectual property for any purpose whatsoever, including commercial purposes.

Note: The above clause requires that the information be free from IP restrictions on its initial submission and contemplates that prior to receiving $50K under Stage 2, each Team will enter into a contract with Owner that vests all IP in Owner or provides Owner with a royalty free license.
APPENDIX

Plan and Section for Canada’s Earth Tower.

The following drawings are not intended to be definitive, nor should they be transcribed or form the basis of any submission. The drawings are intended to show a general building scale and set of conditions as a reference. No additional hand drawings will be issued.
Canada's Earth Tower

PLAN
SECTIO
DESIGN AND PROTOTYPE COMPETITION

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p. 604.678.9220