A Strategic Initiative for the Canadian Wood Council - Wood WORKS!
wood + innovation = sustainable future

EXPANDING MARKET DEMAND FOR CANADIAN WOOD PRODUCTS
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EXPANDING MARKET DEMAND FOR CANADIAN WOOD PRODUCTS
PROJECT GOALS
The project goal is to expand market demand for Canadian wood products, specifically in the mid-rise (6-8 storey) development market. This will be achieved by undertaking research, constructing a prototype and ultimately revise the National Building Code to permit combustible assemblies in mid-rise construction.

Positioning wood as the most sustainable and the only renewable building material is essential to achieving the project goal.

PROJECT PHASES
The project consists of the following four phases, with Phases 1 and 2 completed:
1. WOOD USE IN MID-RISE CONSTRUCTION POSITION PAPER
2. EXPERT FORUMS
3. CONSTRUCT PROTOTYPE (Proposed)
4. IMPLEMENT CHANGE IN NATIONAL BUILDING CODE (Proposed)

PHASE 1: WOOD USE IN MID-RISE CONSTRUCTION POSITION PAPER
The first phase of this project consisted of research, workshops and the preparation of a preliminary report: “Sustaining Wood Use in Future Development.” (Urban Arts Architecture, 2007). This paper identified the issues and established the overall project phases.

PHASE 2: EXPERT FORUMS
Two national Expert Forums of approximately 50 industry participants each were held to identify challenges facing the industry and propose solutions for enabling the construction of mid-rise buildings in wood.

The goal of this phase was to further explore the issues with national and international participants, building upon the initial report; and through brainstorming and technology transfer, learn from international and local research into multi-storey wood construction.

NEXT STEPS
The next steps are to construct a prototype project and to ultimately implement change in the National Building Code. These two phases will address the five streams of exploration determined in the Expert Forums: sustainability, code issues, prefabrication, structural and marketing.

PHASE 3: CONSTRUCT PROTOTYPE:
The third phase of the project will further build upon work to date, aiming to apply the research in the two built prototype projects.

The scope of work included the design and construction of two prototype projects, located respectively in eastern and western Canada. Achieving a built prototype primarily addresses code issues, but will also be a demonstration project that:
• positively addresses market image and perception,
• is a sustainable LEED™ gold equivalent and / or Green Globe project (minimum),
• address structural issues, and
• demonstrates further research and development into new products and prefab approaches.

PHASE 4: IMPLEMENT CHANGE IN NATIONAL BUILDING CODE
This phase will consist of the application to revise the National Building Code. It will build upon the equivalencies and construction strategies established in the development of the prototype.
Sponsors:
The Canadian Wood Council - Wood WORKS! would like to take this opportunity to thank all of our sponsors and contributors to this important strategic initiative:

Project Team:

PROJECT MANAGER:
CWC / BC Wood WORKS!
• Mary Tracey
• Oscar Faoro

ARCHITECTURAL FIRM:
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CONSULTANT TEAM:
• Eric Karsh, Principal, Equilibrium Consulting Inc.
• Terry Ward, President, Newhaven Projects
• Dominic Allouche, Project Manager, Newhaven Projects
• Geoff Triggs, Principal, LMDG Building Code Consultants

EXPERT FORUM PRESENTATIONS:
• Dr. Vahik Enjily, International Research Director, Building Research Establishment, Watford, England
• Dr. Kevin Cheung, Technical Director, Western Wood Products Association, Portland, Oregon, USA
• Geoff Triggs, Principal, LMDG Building Code Consultants, Vancouver, BC
• Shelley Craig, Partner, Urban Arts Architecture, Vancouver, BC
• Eric Karsh / Guido Wimmers, Equilibrium Consultants Inc., Vancouver BC

ACKNOWLEDGEMENTS

The Canadian Wood Council - Wood WORKS! would like to take this opportunity to thank all of our sponsors and contributors to this important strategic initiative:
The Canadian Wood Council - Wood WORKS! commissioned this initiative to develop strategies to expand market demand for Canadian Wood products, particularly in the mid-rise sector.

In this era of global warming, sustainable development strategies are not only essential, but are increasingly mandated by government. Wood, as the most sustainable, natural, and renewable building material, needs to be more widely used in the building industry.

To achieve this, the Canadian Wood Council - Wood WORKS! is seeking ways to increase the amount of wood commodity in the growing mid-rise (5-8 storey) construction sector. Currently wood is limited to 4 storeys in height.

This ongoing research project will lead to real sustainable change.

Wood supports a triple bottom line sustainable approach: Economic, Social, and Environmental.
Project Goal:
Expand the market demand for Canadian Wood products, by seeking ways to use wood in the mid-rise construction sector.

By concentrating on the single family and low rise residential markets, the Wood Industry is losing out as the market shift towards mid-rise construction, currently dominated by the steel & concrete industries.

The project’s detailed goals are to:
• Identify barriers prohibiting wood use in mid-rise construction,
• Develop solutions to address the identified barriers,
• Seek ways in which to increase the amount of wood commodity used in the mid-rise residential construction sector,
• Explore conceptual design options of mid-rise alternate building forms,
• Develop a sustainable approach to support the use of wood in this market sector,
• Design and construct a prototype 6-8 mid-rise development constructed primarily of wood, and,
• Ultimately revise the National Building Code to permit combustible assemblies in mid-rise construction.
The project was initiated with a position paper “Sustaining Wood Use in Future Development”, March 2007. The paper was presented at a National Conference and has resulted in the Canadian Wood Council launching 3 additional phases to this major strategic initiative. The first two phases have been completed as of March 31, 2008.

The four phases are outlined as follows:

1. **WOOD USE IN MID-RISE CONSTRUCTION POSITION PAPER**
   A workshop was conducted as an integral part of the project process. Scenarios were developed, exploring increased height in wood construction, limitations, benefits and constraints. Scope of Work included:
   - Research, globally, of existing 5-8 storey wood projects
   - Exploration and design of conceptual options of Alternate Building Forms,
   - Preparation of Research Paper.

2. **EXPERT FORUMS**
   A panel of experts were assembled to address the Canadian Code and Wood Product limitations for buildings greater than 4 storeys. Forums were held in Vancouver, February 2008 and Toronto, March 2008.

3. **CONSTRUCT PROTOTYPE (Proposed)**
   Create a partnership between the Development Industry and the Wood Industry to design and construct a prototype 6 – 8 storey mid-rise project comprised of combustible (wood) construction.

4. **IMPLEMENT CHANGE IN NATIONAL BUILDING CODE (Proposed)**
   Revise National Building Code (NBC) to permit combustible construction in mid-rise buildings. Develop a strategic process for submission of proposed changes to the NBC; including:
   - identification of specific Code sections/requirements to be changed,
   - further discussions with stakeholders, and
   - other Research & Development support work (i.e., fire modelling) to make the best possible case for revisions to the model NBC documents.
   This in turn should result in associated changes to the various Building Codes adopted at the Provincial and Municipal level.
6.0 PHASE 1: POSITION PAPER

6.1 Summary
The first phase of this project consisted of research, workshops and the preparation of a preliminary report: “Sustaining Wood Use in Future Development” by Urban Arts Architecture, March 2007.

Areas of explored in the paper included:
- Market Context and Sustainable Densification
- Benefits of Wood in Mid-Rise Development
- Identifying Technical and Perceptual Barriers
- Review of Current Status of National Building Code
- Proposed Alternate Concepts
- Hybrid Construction, Product and Prefab Development

The areas of review are expanded in the following section.
6.0 PHASE 1: POSITION PAPER

6.2 Market Context: Sustainable Densification

Canadian wood products are predominantly used in low rise and single family residential construction in Canada and the United States. Currently there is a shift towards sustainable densification of urban and suburban centres with mid-rise residential construction replacing single family houses.

As the National Building Code does not permit combustible Wood construction (wood) over 4 storeys in height, mid-rise projects currently cannot use this renewable material as a major component.

EXAMPLE: SOUTHEAST FALSE CREEK:
Located on the south side of False Creek, Vancouver BC, this high density sustainable mixed use community is being developed with a focus on residential use. Southeast False Creek is expected to house 12,000-16,000 people by 2018.

Most of the development will be 6 – 8 storey mid-rise construction, with mixed use occupancies, including retail, at grade and housing above.

Wood frame construction is not being used in this 1 million sq. ft. sustainable showcase development.
6.3 Benefits of wood in mid-rise construction:
The following benefits of using wood were identified:
- Lower labour and material cost
- Reduced construction time
- Improved quality through off-site prefabrication
- Improved productivity levels
- Lighter construction (eliminates pre loading requirements in some cases)
- Ease of running services
- Wider range of labour available
- Wood is the only 100% renewable building material.
- Locally available resources

Wood is the only 100% renewable building material.
6.4 Perceptual Barriers
Wood is perceived as being not durable, low-tech, combustible, and not appropriate for multi-family housing. The wood industry needs to implement a marketing strategy to overcome these perceptual barriers.

6.5 Technical Barriers
The performance expectations of wood are increasing at the same time as new challenges are presented to the North American forest industry. The following have been identified as barriers the Wood Industry must overcome to increase wood use:

1. **NEED FOR PREDICTABLE AND DURABLE PRODUCTS**
   In order to compete with the quality expectations of steel and concrete construction, wood has to become more durable and predictable.

2. **NEED FOR ENHANCED FIRE PERFORMANCE**
   Enhanced fire performance and assemblies are required. The industry must build upon global research work to support the increased use of wood in fire rated assemblies.

3. **BUILDING CODE RESTRICTIONS (HEIGHT AND AREA)**
   Projects were identified in Europe, Great Britain, USA and New Zealand that are in the 5-8 storey range. The industry must use global precedents to support national initiatives for combustible construction in mid-rise development.
6.6 National Building Code: Status of Combustible Construction

Under the current National Building Code, combustible construction is only allowed in buildings up to 4 storeys in height.

However, within the existing code, it is possible to add a Mezzanine level within a floor area. It will not be counted as an additional storey if it conforms to the requirements of a Mezzanine, as follows:

“Mezzanine means an intermediate floor assembly between the floor and ceiling of any room or storey and includes an interior balcony.”

To expand the height and number of storeys permitted without relying on the definition of a mezzanine, the building code needs to be revised. This is of paramount importance, as additional mezzanine levels are limited to 40% of the area below, resulting in limited, though spatially interesting, units with double height spaces.

In many countries around the world, (New Zealand, England, USA, etc.) the allowable building height for wood construction is being revised in the building codes. For instance, the height of wood construction is unlimited in New Zealand. The English Code has recently been amended to allow wood construction up to 8 storeys in height.

Currently, projects that move beyond the prescriptive code can only be done through the development of alternate solutions in Canada.
6.7 Proposed Alternate Concepts

Conceptual strategies for maximizing building height were developed, and the resultant issues and limitations identified. Key examples include:

**MAXIMUM MEZZANINE**
This concept uses the Building Code definition of the mezzanine to increase the number of levels in the building:
- 4 storey building containing a mezzanine level of maximum 40% of the room or floor space below within each storey.
- Total height of approximately 80’.

**HYBRID TOWER: ANY HEIGHT ANY AREA**
This concept aims to increase the use of wood construction to category of Any Height / Any Area within the National Building Code.

A non-combustible super-structure is erected with non-combustible floor assemblies every four levels. Wood infill may be added between the super-structure platform levels, creating four storey wood buildings within a non-combustible super structure.

This is a hybrid approach to construction, and aims to use different materials to suit their implicit strengths. Hybrid solutions are often used in the commercial / institutional market, and are applicable to mid-rise residential projects. For instance, the Nicola Valley Institute of Technology, Merritt, BC, is a three storey structure with concrete floor slabs supported by wood columns.
6.8 Hybrid Construction

Hybrid construction is the use of multiple materials in a building taking advantage of the specific properties of each material. There are 3 ways hybridization can be used in construction:

- **Material**: a mix of materials within a structural element.
- **Systems**: the assembly of different materials to create a structural system.
- **Structure**: a building constructed of both wood and non-wood systems.

The wood industry needs to expand the potential and develop markets for hybrid wood products and systems. Hybrid construction technologies have been embraced in many non-residential construction projects in BC. There may be many cross over opportunities for the mid-rise residential market.

6.9 Prefabrication

Currently, the prefabrication industry in North America is lagging behind Europe, particularly in residential construction. However, prefabrication of composite wood products is being used successfully in the commercial and institutional markets in North America. Current examples in British Columbia include:

- Richmond Speed Skating Oval (insulated roof panels),
- Whistler Cultural Building (insulated roof panels), and
- Skytrain Stations, Vancouver + Burnaby, BC.

Research and development and technology transfer from other jurisdictions and markets are the key to success for the wood industry. The residential market needs the development of basic repetitive wood components, and may include the following:

- Fully Integrated Wall Systems
- Fully Integrated Floor Systems
- Fully Integrated Modular Systems
- Hybrid Plate and Stud
6.10 Phase 1 Conclusion

As identified in “Sustaining Wood Use in Future Development” (Urban Arts Architecture, 2007), the Wood Industry needs to undertake a series of initiatives to maintain and to grow market share for wood commodities. These initiatives need to address the following areas:

1. Prototype:
   - Design and construct a mid-rise prototype.

2. Prefabrication:
   - Increase the amount of wood commodity being used in construction processes.

3. New Products:
   - Develop new products that are more durable and predictable to meet a higher standard of fire & structural performance.

4. Hybrid Construction Technologies:
   - Increase the amount of wood commodity and products being used in system solutions.

5. Building Code Revision:
   - Revise National Building Code to permit combustible construction in Mid-rise (5 to 8 storey) buildings.

   - Proactively market wood as the most renewable and sustainable material.
7.0 PHASE 2: EXPERT FORUMS

7.1 Introduction and Goal:

INTRODUCTION:
Two national Expert Forums of approximately 50 industry participants each were conducted to identify challenges facing the industry and propose solutions for enabling the construction of mid-rise buildings in wood. These all day forums were held in Vancouver on February 7, 2008 and in Toronto on March 6, 2008.

GOAL:
The project goal was to further explore the issues with national and international participants, building upon the initial position paper; and through brainstorming and technology transfer, learn from international research into multi-storey wood construction.

Speakers included:

- Dr. Vahik Enjily, International Research Director, Building Research Establishment, Watford, England
- Dr. Kevin Cheung, Technical Director, Western Wood Products Association, Portland, Oregon, USA
- Geoff Triggs, Principal, LMDG Building Code Consultants, Vancouver, BC
- Shelley Craig, Partner, Urban Arts Architecture, Vancouver, BC

TIMELINE:
November 2007 - March 2008
7.2 Forum Outline:

INTRODUCTIONS:
Moderator welcomed participants and introduced forum’s purpose, schedule, and participants.

PRESENTATIONS:
1. Setting the Scene: Sustaining Wood Use in Future Development:
   Shelley Craig, Partner, Urban Arts Architecture, Vancouver, BC

2. European Experience: BRE Timber Frame 2000 Project:
   Dr Vahik Enjily, International Director, BRE, Watford, U.K.

3. American Experience: Multi-storey Wood Frame Construction:
   Kevin Cheung, American Wood Products Association, Portland, Oregon, USA

4. Canadian Code Issues:
   Geoff Triggs, LMDG Building Code Consultants, Vancouver, BC

5. European Technologies:
   Eric Karsh, Equilibrium Consulting Inc, Vancouver, BC

BRAINSTORMING SESSIONS:
Moderator gathered themes, issues, and questions from the forum participants. Participants broke out into topic groups to brainstorm constraints and opportunities related to these topics. Participants each had the opportunity to engage in two topic areas each, for 15 minute brainstorming sessions.

IN DEPTH DISCUSSION GROUPS:
After the conclusions of the presentations, all forum participants engaged in two in-depth discussions groups of 30 minutes each. The goal of these discussion groups was to explore issues in mid-rise wood construction related to the following topics:
- Sustainability
- Code Issues + Fire Safety
- Prefabrication + Product Development
- Structural
- Marketing

The discussion groups were moderated by pre-selected expert presenters. All findings were presented at the end of session.

CONCLUDING REMARKS:
Moderator summarized the findings of the forum, thanked participants, and reviewed next steps in overall program.
7.0 PHASE 2: EXPERT FORUMS

7.3 Forum Participants:

Focus group participants were invited from a broad range of disciplines including:

- Architects
- Envelope Consultants
- Code Consultant
- Government Wood Agencies
- Product Development
- NBC representative
- Builders
- Engineers
- Sustainable Experts
- Research + Technology
- Wood Suppliers
- ULC representative
- Municipal Representative
- Developers

The Western Forum participants were:

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### 7.3 Forum Participants: (continued)

The Eastern Forum participants were:

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7.4 Summary of Presentations:

SETTING THE SCENE: SUSTAINING WOOD USE IN FUTURE DEVELOPMENT:
Shelley Craig, Principal Urban Arts Architecture, Vancouver, BC

Ms. Craig reviewed the project goals and reviewed the scope of work in the first phase of the project – a Position Paper: “Sustaining Wood Use in Future Development”. The presentation briefly summarized the issues identified in position paper, as identified and summarized in the Section 6.0 of this report, including:

- Benefits of using wood in Mid-rise construction
- Technical and Perceptual Barriers
- Existing Code Limitations
- Alternate Concepts: Maximum Mezzanine and Hybrid Tower
- Proposed Prototype
7.4 Summary of Presentations: (continued)

EUROPEAN EXPERIENCE: BRE TIMBER FRAME 2000 PROJECT:
Dr Vahik Enjily, International Director, BRE, Watford, UK

BRE – Building a Better World: Dr Enjily outlined the mandate and work of BRE and then reviewed the BRE Timber Frame 2000 Project.

Timber 2000 Project:
- Consists of the construction and performance testing of a 6 storey wood frame building,
- Is an applied research result based on performance testing for stability, disproportionate collapse, differential movements, compartmental fire test, stair fire test and acoustic floors.
- Enabled harmonization of the England and Wales Building Regulations with Scottish Standards for fire requirements of mid-rise timber frame buildings which resulted in 6 storeys timber frame buildings requiring one hour fire resistance.
- Codes and standards were updated to provide guidance for design and construction of multi-storey timber frame buildings up to 7 storeys.
- Note: Timber frame buildings of 8 storeys and above are also possible but the fire requirements increase as the height of the building increases, thus reducing economic viability.

As identified in the project, the issues that 6 storey or greater wood frame buildings need to address are:
- Differential movement due to moisture and shrinkage,
- Vertical and lateral construction tolerances,
- Lateral and vertical stability/resistance,
- Disproportionate Collapse,
- Acoustics – a major concern in a timber frame building,
- Workmanship.

The building was tested during a fire in both the unit and egress stairway. The results were during a 66 minute fire exposure, included:
- no disproportionate collapse,
- compartment was fire damaged, but fire did not spread to adjacent, units or above or below compartments,
- common escape routes were maintained.

This applied research project significantly contributed to the recent amendment of the British Standard 5268: Part 6 permitting wood construction up to 7 storeys in height.

The level of support from industry and government for the project was unprecedented with many leading industrial organizations represented. This project provided a unique opportunity to demonstrate the safety, benefits and performance of timber frame construction and provided additional market comfort in lightweight construction technologies.

This project brought all aspects of construction together, including Regulations, Research, Design, Construction, and Whole Building Evaluation. Many Building Regulations, codes and standards have been and still being updated as a result of this project. This project was the most challenging and exciting opportunity to obtain technical back-up data for promotion of timber frame in the last 30 years in the UK.

All the results of this project have been used to produce a design guide entitled: “Multi-storey timber frame buildings – a design guide.” BR454, BRE, 2003, UK, ISBN 1 86081 606 3.
7.4 Summary of Presentations: (continued)

AMERICAN EXPERIENCE: MULTI-STOREY WOOD FRAME CONSTRUCTION:
Kevin Cheung, Director of Technical Services, American Wood Products Association, Portland, Oregon

Portland Ordinance:
As part of a sustainable initiative, the City of Portland has outright expanded their Building Bylaw to allow 5 storeys to a maximum height of 65 feet.

The Jeffrey Building:
80 units affordable housing, designed to LEED Silver.

Pine Square / Pacific Court
California
• 4 storey wood frame residential: 142 units
• 2 storey steel construction: 37,400 sq ft retail and theatre
• 2 storey concrete: parking

Mr. Cheung illustrated a number of built cases of maximization in California, Oregon, and Washington. Currently the American Building Codes allow 3 storeys only. Anything built higher has been through footnotes and exceptions. The Code allows an extra storey if the building is sprinklered, and another storey as a mezzanine. Other loopholes included using grade changes as a way to define the ground floor plane and building height in favour of adding storeys.

As part of a sustainable initiative to constrain their urban growth, the City of Portland has outright expanded their Building Bylaw to allow 5 storeys of combustible construction to a maximum height of 65 feet. This densification initiative was based on Fire Department approval, as follows:

• Single Construction: Maximum 5 storeys Type V-1 (combustible)
• Mixed Construction: 1 storey Type 1 (non combustible) and top 5 storeys Type V-1 (combustible)

The issues encountered in these mid-rise projects are:

• Shrinkage
• Structural: Overturning moment: compression, shear, and hold-down
• Fire Regulations addressing Fuel Load and Egress

Forms of development that hold some promise in increasing wood use are:

• Mixed Material Construction, such as using steel for structural work with all other components in wood.
• Wrap Construction, integrating wood frame residential building around concrete parking structure, that serves as structural stabilizer and allows non-combustible egress.

These projects have been approved on a case by case basis only and are not recognized by the Building Regulations.
7.4 Summary of Presentations: (continued)

CANADIAN CODE ISSUES:
Geoff Triggs, LMDG Building Code Consultants, Vancouver, BC.

Mr. Triggs began by reinforcing the fact that "Wood is the only natural structural or finishing material".

Presentation included:
• Overview of Building Code Obstacles & Opportunities
• Where We Came From – Code History
• Where We Are Now – Current Use
• Where We Can Go From Here – New Initiatives & Technology

Code History:
The current building regulations are somewhat biased against wood – which is a main factor in the limitations for the use of wood products in the mid-rise commercial construction industry. The Current codes limit the height and area of buildings built in wood. For the past 20 years, the industry has been chipping away at regulations, but there have been few major technical changes to the code relative to the use of wood. The most significant Code change that occurred in the past 20 years, has been the permitted building height increase from 3 to 4 storeys for most occupancy types (except Group A & B) and this direction needs to be pursued further for the increased use of wood products.

Current Use:
The current building code requirements will permit wood-frame construction for most occupancy types up to a max. height of 4 storeys, and there are further opportunities in the current code which would permit the overall vertical height of a building to exceed a 4-storey massing (e.g., loft/mezzanine design concept).

At the same time, there are already many examples of Projects (primarily residential) exceeding the typical 4-storey height envelope and reaching 5 or 6-levels in overall height (examples provided in slides). These enhanced building designs were facilitated through the site topography as well as the development of equivalent or “alternative solution” approaches in order to gain the required approvals from the Authorities having Jurisdiction (AHJ).

Objective-Based Codes (OBC) & Building Code Intents:
• The main objectives for creation of OBC were for greater flexibility, technological innovation and transparency in application of building code regulations

• The intent statements and associated functional/objective statements of the new OBC provide “qualitative” information and insight relative to the actual goals or objectives of Code requirements.

• The main objective of most Part 3 requirements is based on protection of buildings or “fire safety” – either occupant safety from the effects of fire and/or damage caused by fire (such as fire spread or structural collapse).

Note that the functional/objective statements for combustible vs. noncombustible building types are effectively the same in terms of overall fire/life safety objectives.

Objective Based Codes introduced: NBC 2005, Vancouver Building Bylaw and BCBC 2007. They are structured as follows:
• Division A states objectives and options for developing “alternative solutions”.
• Division B quantifies performance criteria and outlines basic acceptable solutions (i.e., similar to previous Codes).

In order to get wood construction on a level playing field with other N/C construction types, a new definition of fire safety “to reduce the probability that a person in or adjacent to a building will be exposed to an unacceptable fire hazard as a result of the design and construction of a building” needs to be adopted for general building types.

The overall Building Performance Level (BPL) of a given building design, taking into account all interrelated design factors, will ultimately demonstrate that a sufficient level of structural/compartment integrity, fire protection and life safety can be provided for a particular wood building design.
7.4 Summary of Presentations: (continued)

Canadian Code Issues (continued):
Geoff Triggs, LMDG Building Code Consultants, Vancouver, BC

Where can we go from here?
The new building codes allow an opportunity for increasing wood use on a case by case basis, through application of objective-based analysis and performance-based design approaches. These approaches are equivalency or alternative solution designs based on quantitative information and objective statements focusing on Fire Safety of both building construction/geometry and its occupants. These types of approaches are intended to and will allow for innovation and greater flexibility in wood building design. The use of fire modeling and simulation analysis greatly enhances the possibility of innovation and can assist in both design solutions and authority review/approval as required. The overall design approach for the Richmond Speed Skating Oval was reviewed as an example.

FIRECAM: Fire Risk Evaluation and Cost Assessment Model
This fire evaluation and cost assessment model was developed by NRC in part for use with objective or performance-based building design and analysis, but has seen little recognition or use since its introduction. Essentially, the model combines the deterministic behaviour of fire effects with the behavioural response of the occupants, and determines the expected loss based on the probabilities of the events which are collated from fire statistics. This is one of many potentially valuable tools that can be utilized to support the case for expanded use of wood at the National Code change level.

The presentation concluded with short and long term strategies as developed in the Position Paper: “Sustaining Wood Use in Future Development.” One of the key points made was that the Code change cycle for the next National Code edition (2010) is now closed and in order to make changes for the following Code edition (2015), the necessary research and development work must commence now. In addition, it was noted that in order to affect real and meaningful change for wood/wood products, significant revisions should ultimately be implemented in the Code.
7.4 Summary of Presentations: (continued)

**EUROPEAN TECHNOLOGIES – SOLID WOOD CONSTRUCTION:**
Eric Karsh, Equilibrium Consulting Inc, Vancouver, BC

Mr. Karsh introduced solid wood construction as the “concrete of the 21st century”, with the ability to utilize lower grade and beetle killed lumber. Solid wood panels are economic when compared to concrete construction, reduce site time due to prefabrication, ensure accuracy of construction, and may be erected quickly.

Architectural Qualities:
- Thermal mass double that of concrete by weight
- Good R-value lowers effects of cold bridges
- Helps control interior humidity
- Good acoustics performance
- Good vibration control
- High level of quality through prefabrication
- Beauty – found to help heal, learn, and reduce stress
- Sustainable and renewable

Structural Qualities:
- Shallow system
- No cross grain bearing issues
- Laterally strong & stiff
- Accurate fabrication
- 3 to 4 times stiffer and stronger if composite
- Long spans: non-composite spans 5-7 m or composite construction spans 9 to 12 m
- Composite with concrete, wood acts as the tension member in place of rebar.

Construction Qualities:
- Economically, compares well to concrete construction
- Pre-fab reduces on-site demands
- Fast erection
- Accurate

Referrat Tower, Germany:
Proposed 36 storey hybrid tower, concrete structure every three storeys, with solid wood panels infill.

European Solid Wood Panels Product Information and Built example.
7.4 Summary of Presentations: (continued)

EUROPEAN TECHNOLOGIES – SOLID WOOD CONSTRUCTION:
Eric Karsh, Equilibrium Consulting Inc, Vancouver, BC

Mr Karsh concluded with three examples of apartment buildings in Switzerland and Germany ranging from 5 – 7 storeys comprised of hybrid construction featuring a variety of wood solutions, including:

**Lucerne Apartment Building:**
7 storeys 2005
Wood Frame construction utilizing a hollow core wood panels and steel brace wall system, and direct connections with wall and floor eliminating sill plates and thus reducing shrinkage.

**Vevey Apartment Building Switzerland:**
5 storeys 1996 Julius Natterer
Primary structure consists of concrete and wood composite floors and walls. Lateral forces are addressed with concrete circulation core. The concrete slab is keyed directly into the solid wood floor. Walls are comprised of two layers of solid wood panels with concrete infill.

**Apartment Building Berlin:**
2008 Julius Natterer
7 storey post and beam (glulam) with prefab solid wood panels. Lateral cross bracing is done in steel.

An overview of types of European solid wood panels available include:
- SOLM: edge laminated dowel panel
- THOMA: cross laminated dowel panel
- HUNDEGGER: cross laminated nailed panel
- KLH: cross laminated glued panel

Principle of HBV system – connect concrete topping to wood structure to achieve deeper section (designed by Prof. Leander Bathon)
Bresta Dowelled Composite – no mechanical connection, relies on friction between concrete and wood.
7.5 Summary of Brainstorming:

Topics for discussion in the Brainstorming Sessions were generated by the participants. The topics identified for discussion differed in the eastern and western forums. In the Vancouver Forum there was more of an emphasis on sustainability, perception, planning issues and marketability; whereas the Toronto Forum participants were more concerned about technical and building code issues.

Similar Topics reviewed at both sessions are as follows:
- Liability and lack of confidence in the Building Industry
- Workmanship and Quality control / Contractors Ability to Deliver
- Prefabrication and Product Development
- Fire Protection
- Structural Capacity of Wood/ Differential movement and Structural Issues
- Structural Connections / Adhesives and Connections

Topics discussed solely in Toronto or Vancouver are as follows:

Vancouver:
- Marketability and Perception
- Affordability and Increased Density
- Wood as a Sustainable Material
- Envelope Issues
- Willingness to Adapt

Toronto:
- Product Availability
- Building Code Issues
- Code Limitations
- Integrated Building Design
- Fire Protection

It is notable that in all the brainstorming sessions there was a significant amount of overlapping and intertwining of themes and issues.

The following sections include the distilled notes amalgamated from the Vancouver and Toronto sessions.
7.0 PHASE 2: EXPERT FORUMS

7.5 Summary of Brainstorming (continued):

2 WORKMANSHIP, QUALITY CONTROL, & CONTRACTOR’S ABILITY TO DELIVER

- Prefab - extremely valuable. Controls cost, waste, quality, construction time, dependence on weather, helps mitigate fire insurance costs, less skill. Could stick frame on site by hand, but will not be cost effective
- Engineered wood products required
- Training required for all parties. Architects mostly schooled in steel and concrete use
- Certification of erectors
- Differentiation across country with product supply
- Marketing perception
- Quantity Surveyor – a supply issue to keep materials dry!!!
- Identify areas where work has not been done
- Skilled trades disappearing. Shortage of skilled labour
- Government initiatives needed
- Hybrid construction could compound problem by mixing trades
  Hybrid requires 2 sub-trades vs. 1, potentially affecting economies of scale

3 AFFORDABILITY & INCREASED DENSITY

- Higher buildings = higher costs
- Long term view versus sale-ability
- Higher buildings must be combined with prefabrication
- Mid-re concrete is not profitable as mid rise efficiencies are worse than high rise.

4 MARKETABILITY & PERCEPTION

- Why focus on increasing residential wood construction – given the choice of wood versus concrete for a 6 storey building, which one would you choose? Buying is investing. Perception of investing in concrete is for long range. With age of building, cost of maintenance of wood apartments will grow faster than with concrete. Buyers buy wood for affordability reasons not by choice as quality product.
- Most wood construction is in suburbs – affordable compared to downtown.
- Industry/Cost Implications – will additional measures required by code allow wood to be cost competitive? There are pro-forma issues with built form of mid-rise – efficiency of floor plate is less than high rise.
- Perceptual barriers of public – poor acoustics, rot factor, affordable housing all lay a role in negatively affecting marketability
- Look at increasing energy performance as one way to bolster marketability

Architects and Engineers willingness to adopt:

- Lack of education at college level means lack of awareness
- Architects and Engineers need to feel/know what merits there are to higher wood use
- Consider incentives to clients/design team
- Consider incentives for builder
- Social housing is a good opportunity (affordable)
- Alternative solution approach vs. standardized/prescriptive approach
- Professional level of involvement from top to bottom (Architect to Contractor/Trades)
- Bottom line is education at all levels and resulting change
7.0 PHASE 2: EXPERT FORUMS

7.5 Summary of Brainstorming (continued):

5 PREFABRICATION & PRODUCT DEVELOPMENT

- Potential for Prefab is HUGE. Prefab can enhance the performance of buildings in the following areas:
  - Acoustics
  - Fire rating
  - Structural (do more with less)
  - Price Point
  - Quality Control
- Learn from international examples (Europe, USA: Bensonwood Open Build System)
- Existing situation:
  - Quality gap between product supply and requirements for wood performance as height increases is widening.
  - Roof trusses are only prefab product widely used at this time
  - Companies such as Britco are getting into the prefab cottage business.
  - We don’t have a good way of analyzing a mid-rise wood building
  - Codes don’t reflect or recognize innovative solutions
- Engineering limitations can be overcome
- Prefab – 4 to 5 story is suitable, planning is critical, trade experience can be an issue, allows for excellent product, and repetitiveness in design is an advantage with prefab construction
- Building in a controlled environment resolves quality & workmanship issues
- Increases speed, efficiency and accuracy of construction
- Panel system to be more accepted
- Requires lead time for design and could be supported by software
- Not easy to adapt to changes made on site
- Insurance industry should be involved
- Ultimately prefab will improve quality control
- Consider interconnectivity between components and plumbing and electrical systems - tolerances, moisture/thermal considerations, differential movement
- Explore what can be done to expand/adapt existing technologies/methodologies
- Modular design must fit transportation restrictions (width)
- Connections for modular units for hold down etc. is an issue, especially time to tighten them up

6 PRODUCT DEVELOPMENT

New product development:
- New products such as solid panels & thick OSB/OSC plates (timber strand) hold promise – cost effectiveness in comparison steel and concrete is essential.
- Hybrid prefab products are an avenue to explore – Kevlar timber strand etc.
- Can accomplish much taller buildings now with existing panelized products
- What are the challenges that will arise? Vertical load issues, lateral resistance, connections. Then what products are needed?
- Need (probably) to mix products as needed – timber studs above but glulam or structural composite lumber (SCL) needed for lower floor due to loads? Optimize product use.

Product availability:
- More availability to architects, designers to use material
- Natural growth material – renewable, sustainable
- Cheaper and easier to use
- Being exported as our natural resource for other countries
- Have the bounty here
- LEED considerations relating to CSA, FSC and SFI
- Use our wood as part of panelization, solid panels in Europe
- Comparison of wood types/properties - limited use in our code by types/categories for structural use.
7.5 Summary of Brainstorming (continued):

7 WOOD AS A SUSTAINABLE MATERIAL
- LEED rating system does poor job of representing wood sustainability. There are contradictions in the LEED system.
- Amount of GHG substitute:
  - wood for concrete save 100-1,000 kgCO2/l3
  - wood for steel save 40-500 kgCO2/l3
- Sustainability of wood in the marketplace.
- Social & political issues addressed w/ FSC?
- Cutting down forests must be properly managed. Government owned logging leases paradox?
- Lack of marketing/Branding of wood as sustainable
- Importing products make a difference
- BC Products – grown & harvested locally – currently most is exported
- Integrated design process for whole building design life cycle costing, building science
- Cradle to site issues on environmental impacts vs. full cycle issues eg. waste demolition, maintenance/ durability
- Recycle reuse Biomass energy source
- Tools need developing e.g. Athena et al.
- Role of public policy e.g. zero-energy, 200 year, carbon neutrality
- Social aspects/ cultural influences
- Push for codified solutions

8 ENVELOPE ISSUES & INTEGRITY OF BUILDING
- Composite Structures:
  - concrete frame
  - curtain wall in wood
- Building Envelope:
  - Biggest problem of quality is envelope
  - Higher building loose efficiencies
  - Thermal bridges a major problem for concrete buildings
- Europe:
  - Some wood frame considered “higher quality”
- Integrated Design Process:
  - Craftsmen part of the team.
  - Contractor on board early
- Design Features:
  - Balconies as architectural feature illustrative of many issues
- Product development:
  - Innovation through certification of products or components
7.5 Summary of Brainstorming (continued):

9 BUILDING CODE LIMITATIONS/SOLUTIONS

- Review limitations of all occupancy uses (ie: mixed uses, assembly, retail, residential, etc.)
- Support of non-combustible construction with combustible materials – review barriers or reasons for this
- Definition of non-combustible vs. combustible – look at clarification and further exemptions

FIRE:
- Increased fire load with use of combustible components vs. non-combustible construction
- Conflicting sentiments with combustible versus non-combustible construction and objective based code – if it meets performance, why can’t it be used?
- Is 4-storey limit simply historical precedent?
- What are all factors involved?
- Fire rating for safety and egress
- Residual issues – how much is required to repair after a fire event?
- Code Section 5 doesn’t allow reductions for live load in combination with fire – overly conservative
- Limitations of wood for fire ratings, for 2-hour wall and floor ratings

STRUCTURAL:
- Approval of proprietary systems for higher buildings
- Connections
- Are all structural systems applicable to all heights? Light framed, heavy timber, hybrid?
- Limitations of wood for structural integrity – how high can you go? Why limit height at all? Limits are in place by economics, ability of structure.

SOUND:
- What improvements in assemblies and/or testing is required to improve final product

10 COMBUSTIBILITY/ FIRE PROTECTION OF WOOD

Combustibility:
- Fire performance issues related to adhesive use
- Incorporate 2-hour rated designs for floor/wall assemblies in wood (ie: ULC design, Wernock Hershey, etc.)
- Penalizing of new technologies
- Limited experience in Canada
- Objective based codes should facilitate more wood use.
- Lack of performance levels expected by code
- Performance based behavior
- Objective Based Code provides avenue for education
- Perception of public
- Fire service
- Construction safety

Fire protection of wood in increased height:
- Reluctance to accept sprinklers. How to promote acceptance?
- Problem with detail on firewalls
- Perception of fuel load issues
- Construction fire issues – lack of security, arson
- Wood structures fail in details – need more education, training, tools – prefab a potential solution
- FRT why not used more? Chemophobia? Long-term effects?
- Poor quality of treatment
- I-joist protection mandated for multi-level
- How do different wood materials behave in fire?
- Need for models
7.0 PHASE 2: EXPERT FORUMS

7.5 Summary of Brainstorming (continued):

11 STRUCTURAL CONNECTIONS/ADHESIVES

Connections:
- Failures are with connections in many cases
- Ductile failure into the connectors, transfer failure into weakest link, disperse energy into connectors
- In integration of design, focus on connection details
- Work towards controlled failure

- Limited experience in evolving technologies
- Wood is more trouble to detail
- Limitations of wood:
  - Shrinkage @ interface of wood & steel
  - Seismic design requires constant maintenance/ tightening
- Overturning seismic resistance design
- Limits on connections (Moment resistance)
- Lots of innovative systems & specialty products (one-off)
- Non-commodity – issue of engineering knowledge (training & education)
- Product versus systems (bracing & lateral loads)
- Lack of software for dynamic analysis & total modeling (Seismic analysis)
- Code is not prescriptive beyond residential scale. (small scale)
- Use adhesives (structural) with mechanical fasteners (ie: glued in rods)

12 STRUCTURAL CAPACITY OF WOOD/DIFFERENTIAL MOVEMENT/ STRUCTURAL ISSUES

- Goal of 6-8 storeys: higher floor area ratio.
- Simple design is required
- Limited size of windows
- Hybrid seismic design – using materials other than wood in shear walls
- Shrinkage solutions – alternate material for plates
- Combine balloon & platform framing techniques
- Older 5 storey wood buildings in Gastown, Vancouver, built in early 1900’s with no codes and less litigation
- Stacking floor plans limits architectural design
- Dynamic analysis – structural
- Engineered wood products
- Be aware of implications of mixing different materials
- Prefab ensures quality control at manufacturing plant
- Ensure proper detailing to mitigate problems
- Need checklist or Design Aid related to movement
- Need to better define issues re:
  - moisture
  - mixed materials
  - climate condition
  - interior vs exterior walls
  - changes in EMC,
  - air conditioning,
  - compression forces
- Explore material solutions with coatings or cross lamination
- Review cladding systems, particularly compatibility of materials
  - be aware of mixing different structural products (such as a steel column in a wood wall)
- Review limits for material use as pertinent to height. Construction solutions – implications of balloon framing vs. platform framing, expansion joints, controlling movement
- Review thermal movement issues for different materials and products
7.6 In Depth Discussion Groups

All forum participants engaged in two in-depth discussions groups of 30 minutes each, as moderated by the Forum Expert Presenters. The results from the discussion groups in Vancouver and Toronto have been combined and summarized below. The goal of these discussion groups was to explore issues in mid-rise wood construction related to the following topics, moderated as shown:

- Sustainability: Craig
- Code Issues + Fire Safety: Triggs/Enjily
- Prefabrication + Product Development: Cheung/Karsh
- Structural: Karsh/Moses
- Marketing: Lalonde

All findings were presented and discussed at the end of the afternoon session.

1 SUSTAINABILITY

RENEWABLE

The forum participants, particularly in Vancouver, strongly articulated that understanding wood as the only RENEWABLE sustainable building material is seminal to expanding the market demand for Canadian Wood Products. The wood industry needs to be very proactive to promote sustainable wood solutions technically, commercially and with the Authorities having Jurisdiction.

Equally, the importance of wood in our urban environment needs to be evaluated from a building material and urban design perspective.

URBAN DESIGN AND DEVELOPMENT

From an urban design perspective, creating carbon sinks of mid-rise buildings is extremely beneficial in both city making and as an environmental approach. As the mind set of the North American culture moves from predominantly single family suburban form of development to more dense urban sustainable development, wood must be made available as a material.

7.0 PHASE 2: EXPERT FORUMS

Tax incentives for sustainable building materials need to be created, similar to the Energy Star program for appliances. Tax credits or GST reductions should be considered for green design. We need to understand and celebrate our vernacular history of using wood, from log buildings and barns, to industrial developments such as Gooderham and Worts Distillery District in Toronto.

The Portland Ordinance of adding one additional storey is an excellent example of innovative local solutions. It is of key importance as a proactive illustration of Building, Fire and Planning Authorities working together to create a sustainable mandate that encourages the use of wood.

As a starting point, CWC and Wood Industry representatives could meet with the City of Vancouver building officials and instigate a trip to Portland to promote a similar approach in Vancouver.

MATERIAL BUILDING SCIENCE:

A science based approach to building is fundamental. The prototype should be designed to Athena standards, and take advantage of research as completed globally and locally through Forintek. Life cycle analysis and the implementation of green codes should be undertaken for all projects. The building code must be viewed as minimum design criteria. Use of wood products in a well considered manner can exceed the code expectations and aggressively promote sustainability.

The Wood Industry is well positioned, through positive marketing, to lead by example.
7.6 In Depth Discussion Groups

1 SUSTAINABILITY (CONTINUED)

SUSTAINABLE BUILDING MATERIAL:
From a sustainable building material perspective, wood has to be examined and reviewed on a complete life cycle perspective: cradle to cradle.
Issues to consider are:
- Long term durability - wood has to be designed for 150 years.
- Long term energy consumption
- End of life options
- Adaptability to change of use
- Deconstruction: Simple connections that are easy to assemble and to deconstruct
- Biomass
- Zero waste
- Locally available

PERCEPTION:
The wood industry need to address the North American perspective of quality and short-term solutions. Fundamentally, societal attitudes and the level of mobility of the North American population has resulted in a short-term profit approach to development. The construction industry, to think sustainably, has to consider increased longevity for projects.

Buildings can no longer be treated as “throw away”, components need to be easily disassembled and recyclable at the end of a building’s life cycle. Buildings also need to be durable to maximize the life span. Wood should be designed to last 150 years!

Prefabrication is the future for sustainable solutions as it equals predictability, less waste, higher quality, a controlled construction environment and reuse in the deconstruction phase. The industry will need to move beyond platform construction in order to pro-actively and sustainably offer durable products with inherent longevity.

LEED™
LEED™ is not the only measure of success in terms of sustainable development. However, it is the most commonly referenced and therefore, the wood industry has to work within the LEED™ system to better promote the sustainability of wood, particularly:
- Harvesting does not diminish sequestered carbon
- Forestry practices
- Certification for bamboo
- Year renewability cycle
- FSC vs CSA Certification - only a small percentage of Canadian wood products are FSC Certified. This is a temporary road block. As the building and design community moves beyond LEED and embraces other sustainable systems this won’t be a problem anymore.

In conclusion, wood needs to be promoted for its humane, warm, tactile, healing characteristics. Combined with its inherent sustainability, the use of wood will lend a human scale to mid-rise development.

The public needs to know that wood is the only RENEWABLE building material – this is the key message we need to convey.
Discussion Groups (continued):

2. CODE ISSUES + FIRE SAFETY

This discussion group identified and focussed on three major issues:

1. What are the barriers to change the code?
2. How to change the code?
3. What is a reasonable height for wood construction?

In addition, the Toronto Discussion Group discussed a series of different approaches to Code Revisions:

1. “Chipping” away at the code by adding, once again as per historical precedent, one or two more storeys.
2. Harmonize combustible and non-combustible sections by building and system performance criteria only, thus eliminating the two categorizations.
3. Write a whole new code section exclusively for Wood.

This initiative may launch a complete code overhaul, transforming it from a philosophical standpoint.

1. WHAT ARE THE BARRIERS TO CHANGE THE CODE?
The barriers were identified as follows:
- Time it takes to change
- Funding to implement research
- Influence of competing industries (concrete & steel)
- Commitment & support of wood industry
- Tradition – standard practice
- Local authority inspectors
- Fire fighting community
- Involvement of other associated sectors
- Technical back-ups
- Lack of Planning/management

2. HOW TO CHANGE THE CODE?
- Testing and compare
- Infiltrate the code committees and change paradigm
- Performance based on a case by case basis (Use alternate solutions)
- Build a test case prototype
- Objective based code (work with intent statements)
- Industry supported research
- Look at international examples

3. WHAT IS A REASONABLE HEIGHT FOR WOOD CONSTRUCTION?
There was a significant range of opinion as to the appropriate height for wood construction, including:
- No limit – based on performance rather than height
- 8 storeys
- 6-8 storeys
- Non-highrise (less than 18m)

It was generally accepted that height is not the issue, building performance is the issue.

In addition to fire safety, code discussions must consider: acoustics, durability, and envelope design considerations.
7.6 Discussion Groups (continued):

3 PREFABRICATION & PRODUCT DEVELOPMENT

Prefab was acknowledged as addressing the following issues:
- Quality – allows control of conditions and precision of product
- Skilled labour – low skill level requirement.
- Reduced waste and site time

Currently little prefabrication work is being done in Western Canada (limited to roof trusses), however, there are 4-5 companies in Toronto area that are producing prefab buildings/products. To successfully establish a prefab market it is necessary to:
- Consider a design/build team approach
- Address negative perception of prefab through the association with the modular home – identified with low quality

Certain European knowledge is starting to be imported to North America, and some preliminary cost comparisons show that there is not a significant up-charge for prefab.

CONTRACTORS NEED TO:
- Understand the value of prefab,
- Work to retrain and re-educate their work forces: There is a fundamental difference between framers and manufacturers / installers.
- Be involved in determining the extent of prefabrication, and
- Scheduling is critical to ensure proper site preparation and address storage issues.

DESIGN TIME:
- Prefab should be agreed upon at the beginning of the design process and resolved in an integrated team approach: selecting the right design team is critical
- Prefab requires more design time but less site time, requiring adjustment to design fees to encourage innovative thinking
- Comprehensive shop drawings are essential to a successful approach to prefabrication.

ADVANTAGES:
- Reduction in waste
- Reduction in site time
- Products prepped and manufactured in a controlled environment
- Better quality
- Reduced labour costs
- Less overhead, and insurance costs

All these advantages should make prefab cost competitive. However, this may only be realized on larger scaled projects with an inherent amount of repetition.

PRODUCT DEVELOPMENT IN VANCOUVER:
- Generally felt by participants that new products were not needed to achieve the mid-rise objectives. Quality & price point are past issues.
- There is a perceived “Quality Gap” between increased requirements and reduced product (lumber) quality
- Need to address performance regulations for acoustics, fire, and structural. Hybrid products are an option here.

Most participants believed that a six storey building should include prefabricated components.
7.6 Discussion Groups (continued):

4 STRUCTURAL ISSUES

A variety of structural issues for mid-rise structural wood construction, that will need to be addressed are as follows:

MATERIALS & DESIGN ISSUES:
- Shrinkage - Impact on lateral behavior
- Water damage – address by tarping & pre-heat space to dry
- Dynamic behavior – need design tools – California – flexible diaphragm & rigid
- Wall jogs
- Material stability
- Impact of non-structural elements greater than for steel & concrete
- Stiffness degradation
- Avoid cross grain stresses – balloon frame back?
- Seismic and ductility of solid wood construction need to be reviewed.

CONSTRUCTION & MATERIAL QUALITY:
- Construction knowledge & quality
- Material quality
  - 10 years ago 1 in 20 pieces were rejected on site – this figure is much higher now.
  - Exports eat up the quality materials
  - Stiffen up quality w/ engineered wood products & much tighter standard
- Accuracy of construction – wood framers not known for precision
- Quality will be achieved in “non-market” construction. Market pressure leads to poor workmanship.

HYBRID CONSTRUCTION:
- Hybrid construction
  - consider lateral & gravity loads
  - need manual or design guides
  - involves using each material in an optimum way – and must be related structurally, architecturally and from a fire perspective.
- Explore design process alternatives – with collaborative design build with suppliers.
- Need to determine what the limits are for stick frame construction, to mandate responsible use and to necessitate the use of other products that are more adequate.

DESIGN + ENGINEERING:
- Design software need to produce and use sophisticated wood solutions.
- Education - not enough knowledge of the material itself, design examples, and design aids are required
- Guidelines on progressive collapse need to be compiled.
- Quality of design – no longer small buildings (Fees)
- A review of the role of the engineer of record, re prefab solutions, is required.

High performance wood, like high performance concrete, can transform the industry.
7.6 Discussion Groups (continued):

5 MARKETING

The Wood Industry / Canadian Wood Council need to establish a clear Business Case and Marketing Strategy, including the following steps:

1. Detailed market analysis, outlining:
   - need to identify the market opportunities and customers
   - develop the value proposition
   - know and understand the marketplace
   - identify and promote the benefits of mid-rise wood buildings: focus on positives, particularly sustainable characteristics.

2. Key Features to promote:
   - Sustainable forest management practices
   - Code changes and alternative solutions
   - Technical details
   - Green systems, solutions, characteristics,
   - Sustainable and renewable message
   - Construction speed and ease
   - Material locally available and accessible
   - Affordability

3. Prepare a Cost/benefit Analysis of Wood Products in Mid-Rise Construction in comparison with Steel or Concrete identifying:
   - cost – price point competitiveness
   - long term maintenance & durability
   - green benefits, sustainable environment
   - energy consumption/efficiency
   - ease of construction, and
   - locally grown

4. Change perception of wood by highlighting advantages of wood over other competing products, and promoting the innovative, sophisticated engineering possible with innovative wood construction.

5. Communicate and market technical solutions, to:
   - De-mystify wood construction in mid-rise
   - Talk about the solutions
   - Create a comparative study on wood versus competing products

6. Educate Key Audiences:
   Develop a broad campaign and also “work in the trenches” to define an strategies to address:
   - Design community (Architects and Engineers)
   - Building Code Officials & Fire Marshals
   - Builders
   - General public
   - One-on-one marketing & networking strategy with developers

7. Case Studies:
   Provide examples of successful wood mid-rise buildings in Canada (Case Studies)

8. Encourage through simple messaging and by using testimonials.

9. Engage supply chain:
   Develop business case for supplier, manufacturer to ensure “high-tech” products are available to builders

10. Build confidence in Wood Construction, by
    - Need high profile spokesperson
    - Develop simple message
    - Promote/educate on code – fire, seismic
    - Develop a wood champion builder/developer
    - Develop marketing strategy for building code groups
    - Promote complete system solutions
    - Invest in specific projects that can be repeated
    - Focus on some key segment such as social housing to capitalize on visibility
    - Feedback from customers living in innovative wood buildings
7.6 Discussion Groups (continued):

5. MARKETING (continued)

11. Code Issues:
   - Develop marketing strategy for building code officials
   - Market building code “wins”
   - Promote to building code officials

12. Lobby and Advocacy with Government, Developers, and community, promoting wood as a system of renewable and sustainable materials, NOT individual products.

13. Timing:
   - NOW: Develop the prototype to plant the seed
   - FUTURE: Provide new straightforward solutions
7.7 Moderator Summary (Vancouver):

VANCOUVER MODERATOR SUMMARY:
Lance Berelowitz, the moderator, wrapped up the forum session with observations based on the discussions and as his perspective as a planner.

1. AUTHORITIES HAVING JURISDICTION:
LEARN FROM REGIONAL EXAMPLES
As a planner Mr. Berelowitz saw some work to be done in the Planning/Zoning arena. It would seem to be straightforward to go to 5 storeys as in the Portland example, where City enabled a local increase in height based on Fire Department approval.

Not only are Building Code revisions required, but zoning amendments will also be necessary at a municipal level. For example, parking can be accommodated underground on 1 level for 4 floors of residential use. However, with an additional floor added; another floor of underground parking will be required. It would appear that the answer to this is to move away from Parking Standards and reward Developers with less parking. This will require a paradigm shift in Zoning. To be more sustainable, reduce Parking Standard to 1 stall per unit maximum, not the current 1+ stall per unit minimum.

2. MARKETPLACE
Some of the developers present expressed that the affordability and marketability up to four storeys or over 12 storeys were workable known development models. Mid-rise development (5 storeys - 11 storeys) is not cost effective, as non-combustible construction concrete, to warrant this form of development if given the choice. If concrete is not cost effective @ 5-8 storeys (above 4 floors, below 12), this is an advantage for wood: If NBC will permit wood construction, industry should follow.

3. CODE REVISIONS
Don’t Wait! We have passed the window for amending the 2010 code. If this project initiative to amend the code to allow 6 – 8 storey construction in wood is to make the 2015 code, the work must begin immediately. If it is taken to committee and approved in principle, it could make it into other codes (provincial & municipal) sooner.

Work from the local level up.

4. PROTOTYPE
The prototype project is an important vehicle to improve market perception, and to act as a built example to address code issues. To get a prototype built, will involve:
- Research, development, application & approval
- Engage authority as a stakeholder in process
- Identify a potential development partner.

5. OTHER SUGGESTIONS FROM PARTICIPANTS, INCLUDED:
- Whole building design
- Create a National Evaluation Service
- Learn from innovative wood examples in Assembly Occupancies such as the Thunder Bay Hospital
- Create a data bank for projects: a manual of precedents and a “Repository of Alternate Solutions”
TORONTO MODERATOR SUMMARY:
Shelley Craig, the moderator, wrapped up the forum session with observations based on the discussions and presentations as follows:

1. SUSTAINABILITY:
The sustainability agenda was more muted than in the Vancouver forum. This may be a result of a significantly different mix of participants with more building officials and engineers than architects.

2. CODE ISSUES:
A detailed comparison of the British Building Code (BS) and the National Building Code is a necessary step to further evaluate the recent inclusion of the 7 storey buildings in the BS. This will need to be examined from a philosophical approach as well as objective and performance criteria. It will be interesting to compare with particular reference to not only height but sprinkler requirements. (The requirements for sprinklers are much less stringent in the UK)

A revision to the code may result in a more performance based approach – an approach that harmonizes (effectively eliminating the differences between) combustible and non combustible construction. A more wide spread use, or mandated for larger projects, of fire-modelling strategies and software, such as FiRECAM, would contribute significantly to a performance based code.

The delineation of combustible and non-combustible inserts an implicit prejudice in the code. The wood industry may choose to focus a long term goal on eliminating this distinction – effectively opening up the possibilities for wood construction in any height, any area and any building type.

3. MUNICIPAL ORDINANCES:
An educational trip to Portland for Vancouver Building officials should be instigated. This could lead to “Vancouver Ordinance” permitting one more floor of combustible construction. Rather than a “trickle down” approach, code changes could be generated at the municipal level and later adapted provincially and nationally.

4. PROTOTYPE:
The prototype needs to explore a variety of structural, fire performance, acoustical and envelope considerations. They need to be designed to LEED™ gold standards, as it is the most widely acceptable sustainable system at the present. However, they should aim to go beyond LEED™, and acutely demonstrate the fallibility of the LEED™ system in reference to wood. The prototype should:
   - Use sustainable wood, including innovative use of pine-beetle timber.
   - Demonstrate a cradle to cradle, system approach including a guideline for maintenance and deconstruction.
   - Review hybrid possibilities and a system based approach to structural design, optimizing all materials.
   - Embrace positive planning characteristics, creating an “urban small forest” and carbon sink landscape as part of the project.
   - Reduce needless construction – particularly use of underground parking stalls.
   - Create assemblies where the wood may be exposed and featured – reduce the reliance on drywall to create Fire Resistance Rated Assemblies.

5. PREFABRICATION
The emerging prefab industry in the Toronto area needs to be promoted, expanded and marketed across the country. The prototype presents a unique opportunity to illustrate prefab methods. In the short term, much needs to be learned from particularly European technology. Panels and products may have to be shipped from Europe for this demonstration project. An integrated design team needs to commit to prefab solutions at the outset of the project, and work to identify sources and possible local manufacturing partners.
7.8 Forum Summary:

GENERAL:
It is notable that the summary comments from Vancouver and Toronto had different areas of focus. The sustainability message was much stronger in Vancouver. The Toronto Forum was more focussed on innovative and sweeping code changes and technical issues.

At both forums, there was great interest in the design and construction of a prototype project, and there was consensus that this is a logical next step.

TASK GROUP:
A project team or task force should be set up to establish the parameters for the development of the prototype project. The task force should include a project team of architectural, code, and structural consultants and partners to date, as well as fire officials, insurance industry representatives. Sub -groups comprised of industry reps will also be required. Dr. Enjily will be a good contact to assist in the development of group types. There are numerous areas to explore.

To expand market share, an approach must be established to address the following five streams:

SUSTAINABILITY:
As we reach the second solar age, and our dependence on petroleum based products must diminish, wood is uniquely positioned as a renewable and sustainable material. It is the only material that grows in sunlight. Market this concept widely!

As the building industry moves beyond the prescriptive LEED™ approach to a more all encompassing zero net energy approach, construct a sustainable prototype that clearly illustrates a net zero energy, cradle to cradle approach: from sustainable harvesting to a deconstruction plan utilizing prefab products.

Hold a preliminary integrated team meeting to establish sustainable criteria and mandate for the prototype.

PREFABRICATION AND PRODUCT DEVELOPMENT:
Continued coordinated research to include prefabricated items in the prototype is critical. The prototype must be a vehicle to encourage the development of a home grown prefabrication industry. Discuss specifically with development industry to examine from a cost benefit perspective.

CODE ISSUES:
Commission a detailed review of the National Building Code in comparison to other objective based codes, including the British Building Code, and potentially the New Zealand building codes, as pertinent to wood construction.

Prepare a preliminary Alternate Solution Report detailing what needs to be addressed to design and building a six storey mid-rise building.

Coordinate and schedule an educational trip to Portland, Oregon, for City of Vancouver Building Officials and the project team.

STRUCTURAL ISSUES:
The prototype is an applied research project: consider two prototypes or a mixture of approach using conventional framing, hybrid construction, and innovative solutions such as solid panel construction, to demonstrate different approaches.

Prepare a compendium of alternate wood based structural solutions, as applicable to mid-rise construction. Promote wood construction to engineering students. Encourage collaboration with design/build fabricators. Work with Forintek to learn from the current research project for an eight storey wood building in Quebec.
7.8 Forum Summary (continued):

**MARKET STRATEGY:**
Establish a communications plan, employing numerous marketing strategies, with a focus on a sustainability agenda.

It is critical to establish key industry liaisons at this stage, and to include key wood community members in the marketing of the prototype project. The success of the project is contingent on successful contributions and support from the wood industry. Identify new potential partners and spend “face time” with them. Engage the Government Ministers responsible to the Wood Industry in this process.

The first step is to widely promote the work completed to date, and to establish support for the development of the prototype and the subsequent code revisions. The first marketing should be done within the industry to establish support. Thereafter, many of the key strategies identified in the marketing section may be implemented.

At a later date, it is critical to transfer all accumulated building science and code knowledge to design and building practitioners.

**FORUM SUMMARY CONCLUSION:**
These five streams should be developed simultaneously, and will all be critical to the success of the prototype project. As part of the prototype project, it may be of interest of establish a video documentary of the process – from design through to construction.

Develop partnerships and agreements and engage the experts required to build on the current momentum and to move the project forward.
8.0 NEXT STEPS

8.1 Introduction:

Two phases remain in the ongoing development of the project:
Phase 3: Development of Prototype Project
Phase 4: National Building Code Revisions

PHASE 3: PROPOSED PROTOTYPE:
The third phase of the project will further build upon the research work and technology transfer achieved from the National Forums.

The scope of work, for this applied research project, includes the design and construction of two prototype projects, located respectively in eastern and western Canada. Achieving a built prototype primarily addresses code issues, but will also be a demonstration project that:
- positively addresses market image and perception,
- is a sustainable LEED™ gold project, and
- demonstrates further research and development into new products and prefab approaches.

This work will require a coordinated initiative from the Canadian Wood Industry with a selected Development Partner and will benefit from the active and ongoing involvement of the CWC.

TIMELINE:
April 2008 – December 2010

A detailed Work Plan for Phase 3 follows.

PHASE 4: NATIONAL BUILDING CODE REVISIONS

This phase will consist of the application to revise the National Building Code. It will build upon the equivalencies and construction strategies established in the development of the prototype. It will involve in depth research and committee work with Authorities Having Jurisdiction, Code Consultants, the Wood Industry, and testing agencies.

TIMELINE:
September 2008 – January 2013

A detailed Work Plan for Phase 4 will be developed in Phase 3. The work plan will likely include:
- Comparisons with the English Building Code and other International Codes
- Preparation of proposed amendments
- Consideration of performance criteria
- Gather test data from prototype

The ultimate goal of this project initiative is to revise the National Building Code to allow greater use of combustible construction in mid-rise buildings.
8.0 NEXT STEPS

8.2 Phase 3: Proposed Prototype Workplan

GOAL:
Create a partnership between the Development Industry and the Wood Industry to design and construct two prototype projects, located respectively in Eastern and Western Canada. The prototype will be a 6 – 8 storey mid-rise residential or mixed use with commercial at grade project comprised of combustible (wood) construction.

STRATEGY:
The two prototype projects will be developed using “equivalencies” to the existing building code. The “equivalencies or alternative solutions” will be used as test cases to further develop long-term strategies for the revision the National Building Code.

The development of equivalencies are not long-term solutions, as they are only considered, by Authorities having Jurisdiction, on a project by project basis. The development of the prototype(s) is necessary to design, build and test alternate construction strategies. The evaluation of the equivalencies will form the nucleus of the Phase 4 application to amend the National Building Code. Legislating the strategies, as part of the National Building Code, is essential to make the use of wood in mid-rise construction accessible for the majority of builders.

This project will use wood in a variety of ways as:
- the primary structural system,
- an integral part of Hybrid construction solution(s), and
- the primary cladding and finishing material
- Integrated Wall Panel Systems
- Composite Floor Systems
8.2 Phase 3: Proposed Prototype Workplan (continued)

SUSTAINABILITY:
This project will be a sustainable development with a minimum 50 year life span, and will aim for LEED™ gold certification and/or Green Globe certification. As part of this process, research into pre-fab and innovative product solutions, such as panelized building systems, will be undertaken.

The City of Vancouver may be a good jurisdiction to construct the prototype as the Building Department is flexible and has an open mind towards technological developments. The eastern and western locations will be determined at the conclusion of Phase 2. Location is dependent on identifying development partners and progressive local AHJ.

FUNDING:
It is anticipated that the development partner will pay for the base consultant fees. The additional fees required to research and develop the equivalencies and construction methodologies for a 6 – 8 storey mid-rise project will be sought through funding submissions.
8.3 Phase 3: Proposed Workplan Stages

The following Workplan will be implemented simultaneously in Eastern and Western Canada. The project teams, as established in both jurisdictions, will meet three times throughout the process to participate in collegial review workshops. The project stages for Phase 3 are proposed as follows:

**ORIENTATION AND FEASIBILITY**
- Clearly establish the timeline and specific tasks for Phase 3.
- Develop business case for the prototype project, examining macro and specific issues - including a demand estimation and market potential, and an indepth project proforma,
- Develop project budget and identify and confirm funding strategies,
- Identify and confirm development partner,
- Select project consultant team,
- Establish marketing plan.

**RESEARCH**
- Review and research construction methodologies including cost/benefit and construction limitations of the following wood systems: standard wood frame, engineered wood, and hybrid system solutions,
- Building upon research work to date, prepare conceptual code review and approach.
- Coordinate with Wood Industry re product development initiatives, supply and sponsorship.
- East / West Workshop 1: Key project team members to attend an east / west forum to brainstorm, share knowledge and compare project process to date.

**SCHEMATIC DESIGN**
- Working from the Research Report, develop up to three schematic design options that respond to:
  1. wood construction strategy,
  2. building program,
  3. code equivalency approach
  4. sustainable design strategy, and
  5. budget
- Coordinate with Wood Industry re product development initiatives, supply and sponsorship as identified in Schematic Design.

**DESIGN DEVELOPMENT + CONSTRUCTION DOCUMENTATION**
- Complete all design development of the project confirming code, construction and equivalency approach.
- Complete construction documents and prepare report itemizing all innovative wood strategies.
- Coordinate with Wood Industry re product development initiatives and supply and confirm product donations and sponsorship.
- Sustainability / LEED™: Further coordinate and document sustainable wood strategies and LEED™ points.
- Obtain Building Permit.
8.3 Phase 3: Proposed Workplan Stages (continued)

CONSTRUCTION PROCUREMENT
- Complete all Construction Procurement tasks, as either a Stipulated Price Bid or Construction Management as deemed appropriate with Development Partner.

CONSTRUCTION ADMINISTRATION AND ANALYSIS
- Complete all Construction Administration tasks.
- Coordinate a forum to review East and West Projects with Consultant Team, Authorities, Development Partners and CWC.
- Prepare a final report documenting entire project process for use in developing long term Code Revisions.