Connection Solutions in Modern Timber Structures

LEARNING OBJECTIVES:
AT THE END OF THIS PROGRAM, PARTICIPANTS WILL BE ABLE TO

1. Learn about state-of-the-art timber fabrication and connection technology and how they can be used in actual structures.
2. Learn about sustainability and other advantages of timber as a construction material.
3. Learn how these advantages and the recent changes in the timber industry have impacted the decision to use wood in many public projects large and small.
4. See numerous innovative timber project examples.
RENEWED USE OF WOOD IN COMMERCIAL CONSTRUCTION

- Renewed interest in timber as an architectural medium
- Technical advances in materials, fabrication, connections & fire protection
- Trends towards sustainable construction
- Economics (material cost and construction time)
- Successful out of country examples
- Political will: Woodworks! and Wood first policies

TRANSFORMATIVE ADVANCES

- 3D Modeling and CNC Fabrication
- New Age Connections
3D MODELLING + DETAILING

• CadWork
• Dietrich

CNC FABRICATION

• Hundegger K2
• Créneau

• Number of structural wood frame CNC’s in 1998
  North America:  2
  Switzerland:    300

  Today, about 75 CNC’s in North America.
HUNDEGGER K2

- German design
- 3 axis or 5 axis
- Fixed tool head
- Up to 10” x 14” pieces, 24’ long
- Fast, reliable and economical
- The Volkswagen of CNC’s

CRÉNEAU

- French design
- 5 axis – 14 tool rack
- Gantry type
- Up to 16” x 60” pieces, 100’ long or more
- Extremely versatile
- Slower and more expensive
CONNECTIONS

- North American connectors
- Others

NORTH AMERICAN CONNECTORS

- Nails + screws
- Bolts
- Drift Pins
- Lag screws
- Timber rivets
- Shear Plates + split rings
- Truss plates
- Pre-engineered light gauge metal connectors (Simpson)

OTHERS

- Notches (wood-to-wood; Steel-to-wood)
- Castings
- Block Gluing
- Tight-fit pins + bolts
- Ring nails
- Glued-in rods / rebar
- BVD system by Bertsche
- WS system by SFS Intec
- New-age self-tapping screws
- Sherpa system
- HBV system by TiComTec

086 – 01 – CLAUSE 3.3.2

3.3.2 New or special systems of design and construction

New or special systems of design or construction of wood structures or structural elements not already covered by this Standard may be used where such systems are based on analytical and engineering principles, reliable test data, or both, that demonstrate the safety and serviceability of the resulting structure for the purpose intended.
• First principles: Notches, castings
• Foreign codes: Block gluing, ring nails, tight-fit bolts + pins
• Proprietary: Bertche, SFS – WS, Self-tapping screws, Sherpa, HBV, etc.

Supported by empirical data and local approvals.

NOTCHES

• Used all over the world for centuries
• Making a comeback due to CNC fabrication
• Design from first principles

CASTINGS

• Design from first principle
• Extremely versatile, elegant, reliable
• Relatively economical in large numbers
• Susceptible to fire

BLOCK GLUING

• Gluing of glue laminated elements to form built-up shapes
• Uses low-pressure glues
• Used to increase the cross section (at connections or for long unrestrained compression elements)
• Careful: Low-pressure glues are often soft and susceptible to creep

Avoid in bending members
TIGHT-FIT PINS + BOLTS

- Design using European codes, reconciling values for load factors, wood species, etc.
- Hole in the wood must be 0.0 to 0.5mm smaller than the pin
- Hole in the steel is 0.0 to 1.0 mm larger than the pin.
- Multiple fastener connections only practical with the use of CNC fabrication
- Reliable, concealed and elegant
- Can use multiple knife plates
- Can achieve ductile connections with small diameter pins

WHY TIGHT FIT?

Unequally loaded bolts in a bolt group.

RING NAILS

- Covered in European codes (Swiss)
- Similar to timber rivets
- Some proprietary (Gunnebo – Sweden)
- Can be used for ductile connections

GLUED-IN RODS / REBAR

- Rebar glued into the wood with epoxy
- Popular in Australia and Europe, some examples in USA & Canada
- Proprietary systems – Ferwood (Ducret - Orges in Switzerland)
- Versatile, concealed (fire resistant)
- Reliable perpendicular to grain (30° or more from grain axis)
- Less reliable parallel to grain (less than 30° from grain axis)
- Must use the right resin
**BVD SYSTEM BY BERTSCHE**

- Proprietary system from Germany
- Probably the strongest available in tension
- Reliable, concealed
- Tight-fit
- Not as versatile as some

**WS SYTEM BY SFS INTEC**

- Proprietary system from Switzerland
- Consists of self-tapping, small diameter tight-fit dowel system
- Compact, reliable, concealed, elegant
- Ductile (due to small diameter dowels)

**SELF-TAPPING SCREWS**

- Proprietary (SFS, GRK, Wurth, Heco, etc)
- Up to 1/2” diameter, up to 24” long
- Self-tapping – no pre-drilling
- Fast and more reliable than North-American lag bolts
- Elegant, low profile heads

**SHERPA**

- Proprietary system from Germany
- Consists of an aluminum dovetail connection fastened to the timber with self-tapping screws
- Fast erection
- Completely invisible
HBV SYSTEMS BY TiComTec

- Proprietary system from Germany
- Concrete – wood composite and wood to wood
- Steel mesh bonded to the wood with patented resin

INNOVATION

PROJECT EXAMPLES

EQUILIBRIUM

EVOLUTION
Nicola Valley Institute of Technology
Merrill, BC
Busby and Associates (Perkins+Will)
Prince George Airport Expansion
Phase I&II
Prince George, BC
McFarlane Green Architects

Phase I

Phase II
Squamish Lil’Wat Cultural Centre
Whistler, BC
Alfred Waugh Architect
Original Glued-in Rod Tail Connection

Original King-Post Connection

BVD SYSTEM BY BERTSCHE

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Revised Tail Connection

Revised King-Post Connection
First People’s House

University of Victoria, BC

Alfred Waugh Architect
Marie Victorin Soccer Stadium
Montreal, QC
Nordic Wood Structures

BRACE DETAILS
QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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