

CLT & Mass Timber Opportunities



Glulam & CLT



Cross Laminated Timber



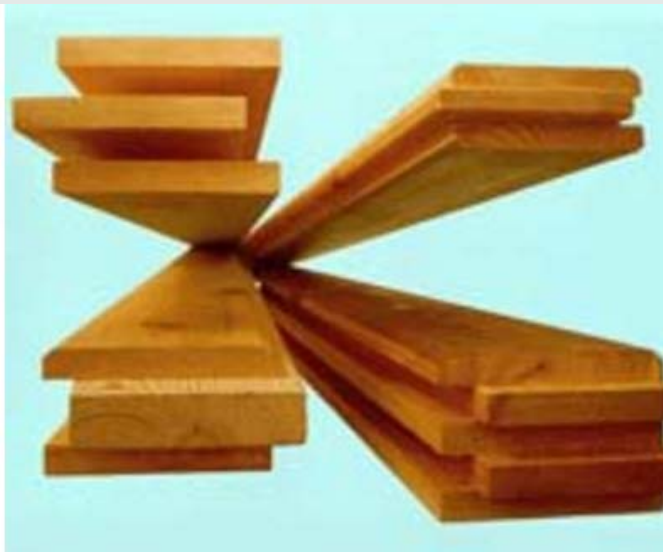
Nail Laminated Timber

Who am I



- UMaine Civil Grad., Umass, B.U.
- Practiced Structural Engineering '95-'02
- Construction from '02 – today
 - Consigli Construction Co., Inc. – Northern N.E.
 - Academic, Healthcare, Laboratory, Institutional, Government

Other Wood Based Components



Lockdeck



Structural Insulated Panels
(SIPS)



Laminated Strand
Lumber (LSL)

Construction Managers always looking for:

1. Environmentally responsible
2. Safe to work with
3. Fast / Efficient to erect
 - a) (low on-site labor cost)
4. Positive thermal, acoustic performance, durable
5. Aesthetically pleasing (or easy to cover up)
6. Uniform and or known capacity / strength
7. Available subcontractor market able to construct
8. Readily available from multiple vendors/fabricators
9. Cost competitive material to build structures
10. Unlimited restrictions or a predictable code path

Wood – What it has going for it

Opinion – Equal/better than Steel & Concrete

1. Environmentally responsible
2. Safe to work with
3. Fast / Efficient to erect
 - a) (low on-site labor cost)
4. Positive thermal, acoustic performance, durable
5. Aesthetically pleasing (or easy to cover up)
6. Uniform and or known capacity / strength

Mass Timber – Limitations

1. Available Field Installers / Erectors
2. Available from local fabricators
3. Perceived Fire Durability
4. Limited Design knowledge
5. Flexibility / Not Economical long spans
6. Not cost competitive in light commercial / low rise
7. Lobbying from Steel and Concrete Industry?
8. Building Code Constraints specifically on height

Mass Timber – Easy Hurdles

1. Available Field Installers / Erectors
2. Available from local fabricators
3. Perceived Fire Durability
4. Limited Design knowledge
5. Flexibility / Not economical long spans

Mass Timber – Harder Hurdles

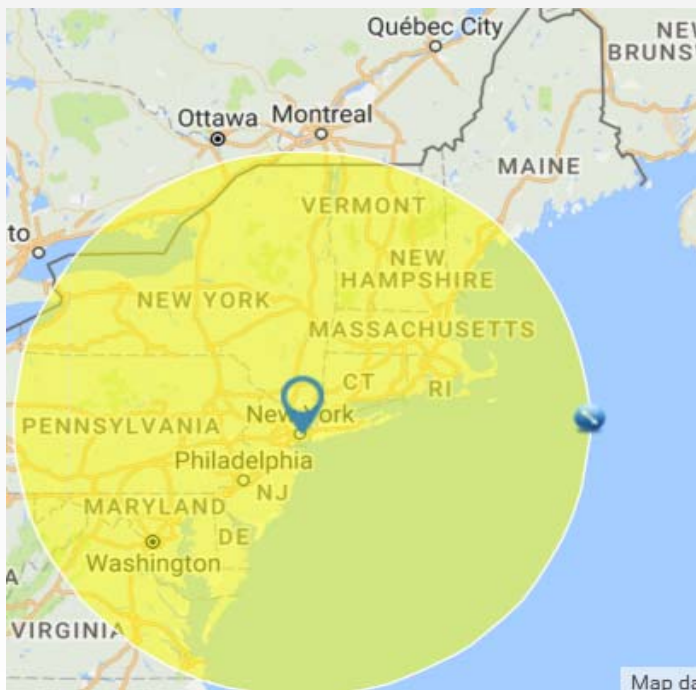


1. Not cost Competitive in light commercial / low rise
Easy – don't compete against stick frame
2. Lobbying from Steel and Concrete Industry?
Not my Expertise
3. Building Code Constraints specifically on height?
Need your Energy

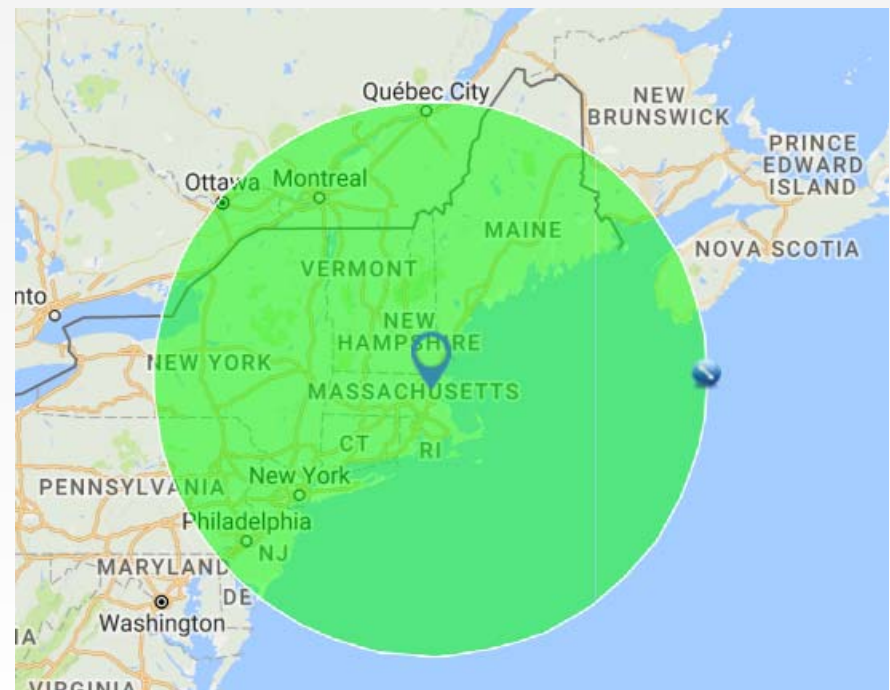
Mass Timber Opportunities in Maine



1. European Market has figured it out
2. Plentiful SPF #2 or better stock
3. Existing Value Chain – Logging, Processing, Lumber
4. Location - LEED



500 miles New York



500 miles Boston

Cost Case Study



- Higher Education Classroom and light laboratory building in Southern Maine
- Compared Structural Systems
- Compared Solid Exterior Wall Backup Framing Systems

Compared Costs and Environmental Impact across three Superstructure Schemes

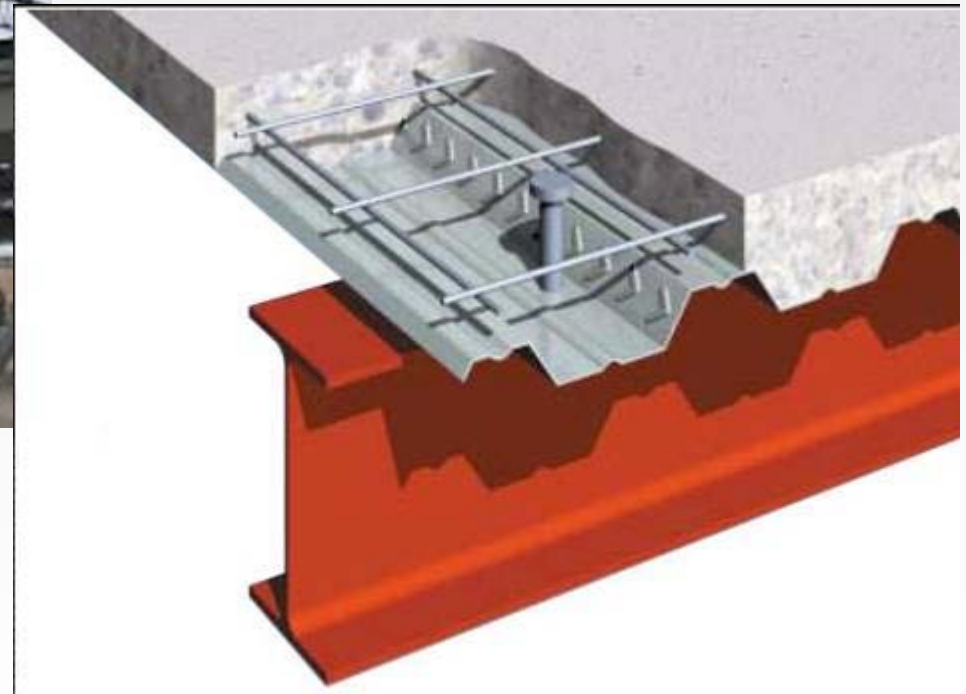
- **Base Case:** Steel Beams, Steel Columns, Concrete floors on metal deck, metal roofdeck
- Glu-laminated Timber Beams, Columns with solid plank wood floor and plank roof plates
- Glu-laminated Timber Beams, Columns with Cross Laminated Timber floor and roof plates

Exterior wall comparison

- **Base Case:** Light Gauge metal framed exterior walls with glass fiber gypsum sheathing
- **Cross Laminated Timber (CLT)**
- **Structural Insulated Panels (SIPs)**
- **Laminated Strand Lumber (LSL)**

Terminology – Base Case

- Structural Steel / Metal Deck and Concrete slab



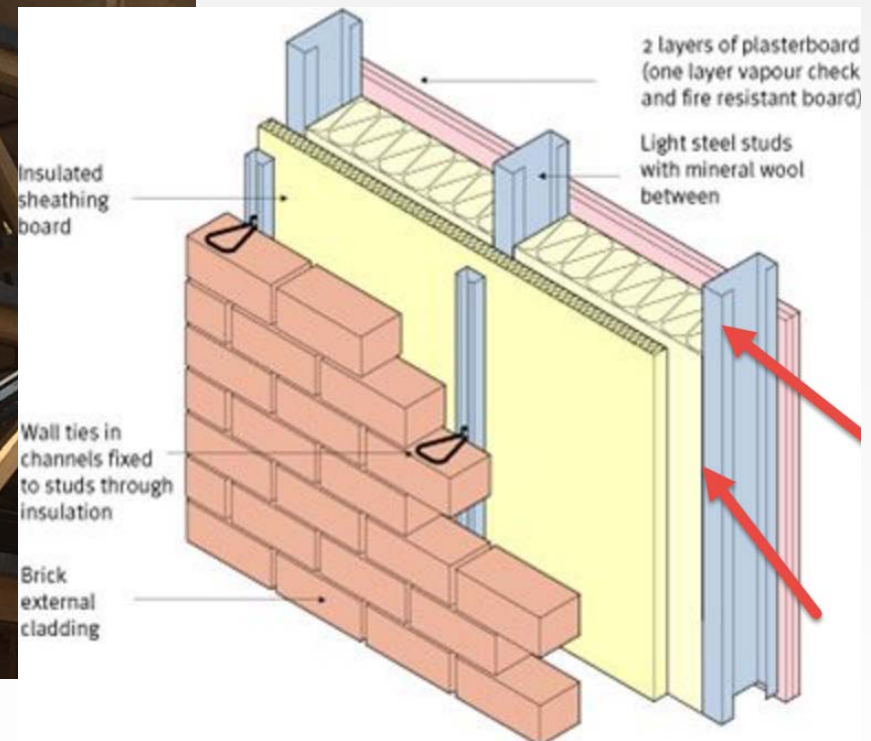
Terminology – Alternate Schemes

- Glu-Laminated Timber
- Cross Laminated Timber (CLT)
- Laminated Strand Lumber (LSL)



Terminology – Base Case

- Light Gauge Metal Framed Exterior Walls
 - With glass fiber reinforced gypsum sheathing



Evaluation of Costs

- Structural Engineer provided (3) Designs
- Developed Control Baseline for Steel & Concrete option
 - Quantified and costed on historical costs
 - Subcontractor pricing - (2) Steel Fab/Erectors
- Developed Matrix of Costs for Timber
 - Varied Supply only options from various vendors with installer pricing
 - Developed Self Perform Estimates for scopes proposed as Supply only
 - Evaluated Best Option / Combination (cost)

Responses Mass Timber



Vendor	Location	Status	Scope
South County Post & Beam	Rhode Island	Submitted	Fab & Install – Glulam Install only – CLT
Libby Timber Frame	Freeport, ME	Declined	N/A
Nordic	Quebec	Submitted	Fab & Install Glulam and CLT
Smartlam	Montana	Submitted	Fab & Deliver CLT
Structurlam	Ontario	Submitted	Fab & Deliver Glulam & CLT
DR Johnson	Oregon	Submitted	Fab & Deliver Glulam & CLT
Louisiana Pacific	Houlton, ME	Submitted	Fabricate LSL Billets
Guardian Structures	Ontario	Pending	waiting
Mayr Melnhof Holz	Germany	Submitted	Fab & Deliver Glulam & CLT
KLH	Austria	Submitted	Fab & Deliver Glulam & CLT
Binderholz	Germany	Submitted	Fab & Deliver Glulam & CLT
Stora Enso	Germany	Declined	N/A

Cost Summary / Combination



Trade Level Cost analysis of Framing Options offered by various vendors/sources

Refer to detailed levelling sheet and RFP for method of pricing and source of information

Option A (structural Steel) is based on costs carried in the Schematic Design estimate dated 9/9/2016 and refers to Qualls and Assumptions associated with that estimate



	STEEL AND CONCRETE	MASS TIMBER	MASS TIMBER	MASS TIMBER	COPY OF PREV. COL
	Baseline Structural Steel Option A Steel Marketplace	Glulam Beam and Column with Lockdeck Floor System South County Post & Beam Undisclosed Wester Glulam Vendor Western US States Undisclosed Wester Glulam Vendor Southern US	Glulam Beam and Column with Lockdeck Floor System South County Post & Beam South County Post & Beam South County Post & Beam Louisiana Pacific Houlton Maine	Glulam Beam and Column with Cross Laminated Timber South County Post & Beam South County Post & Beam South County Post & Beam Smartlam Montana	Glulam Beam and Column with Cross Laminated Timber South County Post & Beam South County Post & Beam South County Post & Beam Smartlam Montana
Vendor Combination					
Glulam Material Vendor					
Glulam Source Location					
Deck Material Vendor					
Deck Material Source					
Grade Level Steel and Slab (constant across all options)	\$ 78,643	\$ 78,643	\$ 78,643	\$ 78,643	\$ 78,643
2nd Floor Framing and Deck	\$ 311,291				
3rd Floor / Low Roof Framing and Deck	\$ 236,593				
High Roof Framing and Deck	\$ 128,290				
Glulamated Timber Supply		\$ 580,000	\$ 580,000	\$ 448,000	\$ 448,000
Glulamated Timber Install		incl. above			
Floor Deck / Roof Deck Product Supply (industrial /non-featured finish)		\$ 255,000	\$ 127,902	\$ 306,937	\$ 306,937
Floor Deck / Roof Deck Product Install		incl. above	\$ 101,183	incl above	incl above
Shear Wall Supply and Instal at Stair Towers (industrial finish / non-featured)		\$ 103,278	\$ 103,278	\$ 103,278	\$ 103,278
Safety Rails at perimeter of floors		\$ 8,000	\$ 8,000	\$ 8,000	\$ 8,000
Floor Topping slab and sound isolation mat		\$ 45,000	\$ 45,000	\$ 45,000	\$ 45,000
Temporary protection for concrete and construction on exposed wood		\$ 7,500	\$ 7,500	\$ 7,500	\$ 7,500
Subtotal	\$ 754,816	\$ 1,077,421	\$ 1,051,505	\$ 997,358	\$ 997,358
Escalation	3% \$ 22,644	\$ -	\$ -	\$ -	\$ -
Total Anticipated Cost of Superstructure System	\$ 777,460	\$ 1,077,421	\$ 1,051,505	\$ 997,358	\$ 997,358
Add for Finish of underside of floor deck / shear walls		\$ 37,500	\$ 37,500	\$ 37,500	\$ 37,500
Add for protection for exposed finish on floor deck and shear wall		\$ 22,500	\$ 22,500	\$ 22,500	\$ 22,500
FSC Certified Wood	n/a	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000
other					

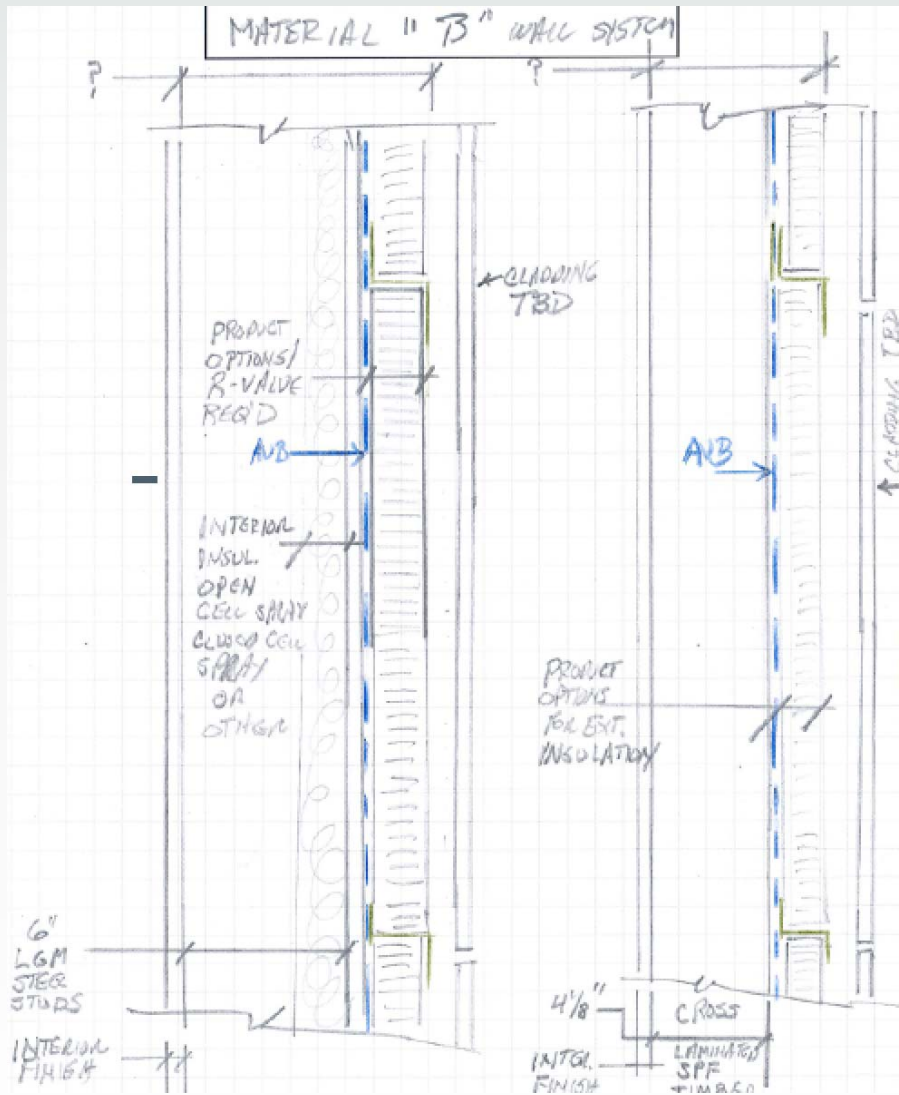
Carbon Comparison	IN Progress	IN Progress	IN Progress	IN Progress	IN Progress
EXTERIOR WALL PANEL ANALYSIS - SOLID WALLS EAST AND WEST ELEVATION (INBOARD OF LGM AND NOT INCLUDING INTERIOR FINISHES)					
Wall Panel Material Vendor	LGM Sub/ Dietrich / USG	SIP manufacturer in VT	LP in Houlton	Smartlam - Montana	LP in Houlton
Wall Panel Material Source	Unknown	Vermont	Maine	Montana	Maine
Exterior wall LGM Wall system and Soffit framing	\$ 188,315	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
Wall Panel Install (exterior)	incl above	incl above			
Exterior Mass Timber Wall system	incl above	\$ 213,500	\$ 117,604	\$ 135,103	\$ 117,604
Wall Panel Install	incl above	incl above	incl above	incl above	incl above
Exterior envelope components (for Rainscreen)	\$ 240,000	\$ 215,000	\$ 240,000	\$ 240,000	\$ 240,000
Exterior Wall System (solid walls)	\$ 428,324	\$ 443,509	\$ 372,613	\$ 390,112	\$ 372,613
Total of Structural System and Exterior Solid Walls (No finishes)	\$ 1,205,784	\$ 1,520,930	\$ 1,424,118	\$ 1,387,470	\$ 1,369,970
Variance from Baseline Structure and Envelope option	n/a	\$ 315,145	\$ 218,333	\$ 181,685	\$ 164,186

- Woodworks Environmental Calculator
- Athena Software

- Results: Carbon Sequestration – show of hands.....
- GHG significantly lower ~ (45%) less

Cost Comparison Process

- Exterior Solid Walls – LGM
 - Quantified and costed on historical costs
 - Labor and Material priced based on performing
- Exterior Solid Walls – Wood (or composite)
 - Quantified and costed on self perform install
 - Analyzed LSL, SIPS, CLT



Best Current Combination



Superstructure – Glulam Timbers

Douglas Fir from Oregon
or Spruce from Austria

Floor Plates – Cross Laminated Timbers

Spruce from Montana
or Spruce from Austria

Exterior Solid Walls – Options Pending Technical Quest.

SIPs from New Hampshire
Laminated Strand Lumber from Maine

- Sourcing of wood combinations – HARDER
- Cost of wood combination – More
 - By 24% on structure alone compared to steel, concrete structure
 - By 6% on structure if Lateral system is combined with exterior solid wall design
 - By 0.7% on total cost on \$11MM project
- Environmental Impact of wood - Better

Superstructure Alone Cost Result



Baseline Combination

Steel, Concrete, metal deck: \$777,500

Best Mass Timber Combination

Glulam and CLT: \$997,400

(Oregon Glulam, Montana or Austria CLT)

2nd Best Mass Timber Combination

Glulam & LSL Floors: \$1,050,000

(Oregon Glulam, Maine LSL)

Baseline Combination

Steel, Concrete, metal deck: XXX Tons C

Best Mass Timber Combination

Glulam and CLT: XXX Tons C

(Oregon Glulam, Montana CLT) xxxx cuft miles

2nd Best Mass Timber Combination

Glulam & LSL Floors: XXX Tons C+

(Oregon Glulam, Maine LSL) xxxx cuft miles

Sacrifices using Mass Timber

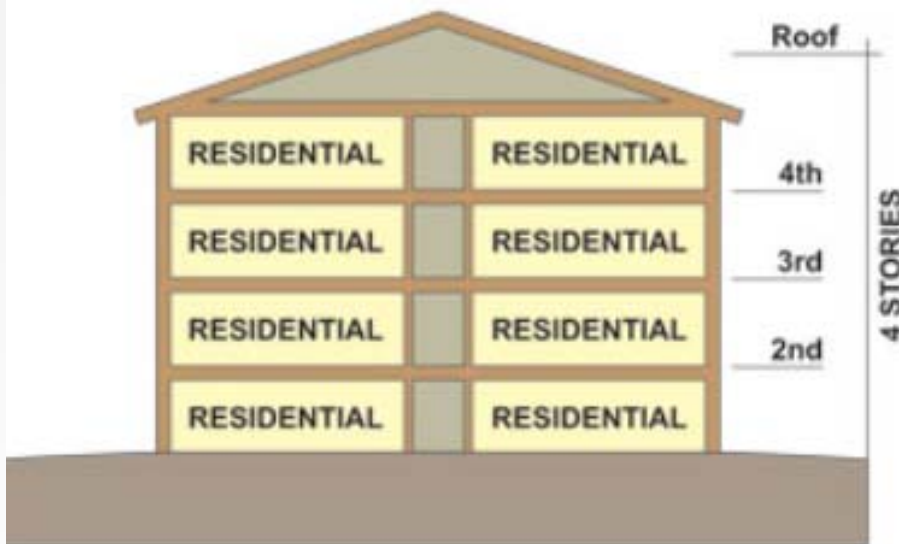
- Could have cost premium to steel & conc. (on this cost study)
- Space planning flexibility column density
- Does not maintain cost neutral position if
 - Space planning controls layout
 - High mechanical / ductwork complexity (laboratory facilities)
 - Stick frame becomes an option
- Smaller market from which to buy
- Lack of knowledge of detailing in design community
- Lack of confidence across Construction Management and GC market – (its easier to buy steel)

Conclusions

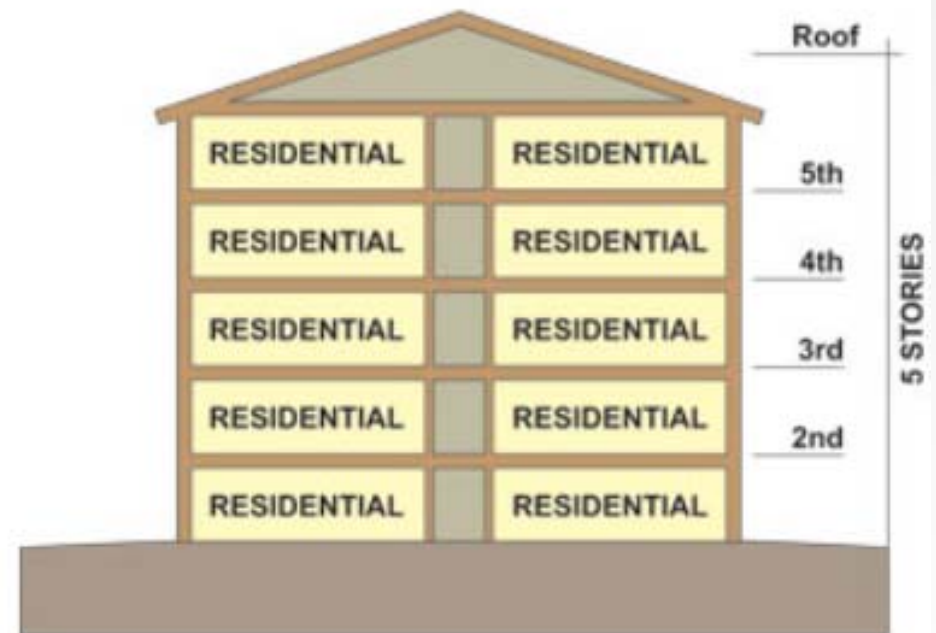
- Wood can be competitive – with the right design, construction building type and client.
- Limited slice of construction market where it can work against stick framing and steel
- Shipping cost premium is smaller driver than anticipated
- Without a local vendor or larger market from which to buy – more risk than established products
- Play environmental card after finding cost neutrality
- Code Limitations are one of largest hurdles

IBC 2012 – Height Limitations

IBC Table 503: Base Height

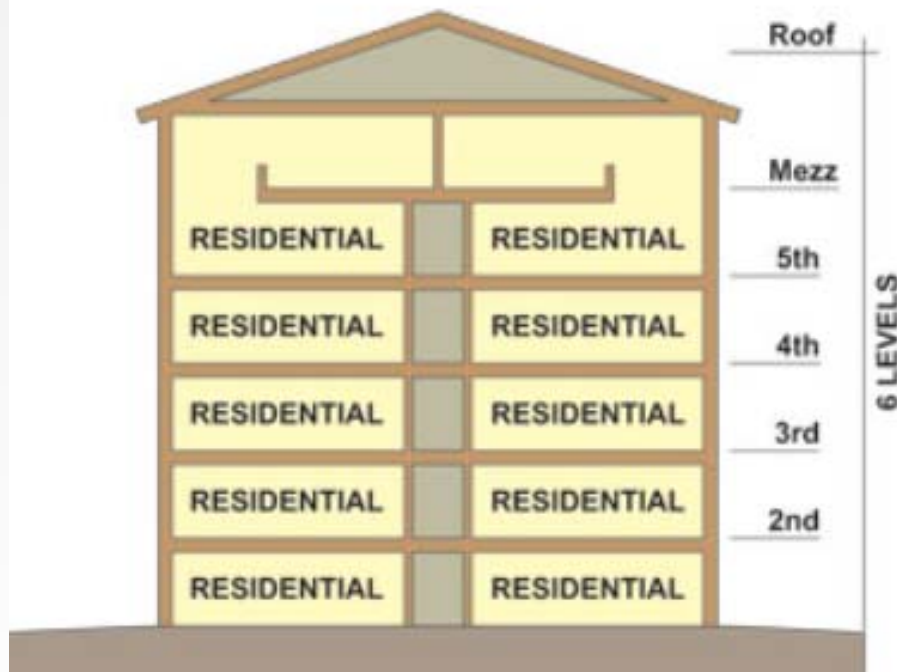


IBC Section 504: NFPA 13-Compliant Sprinkler System

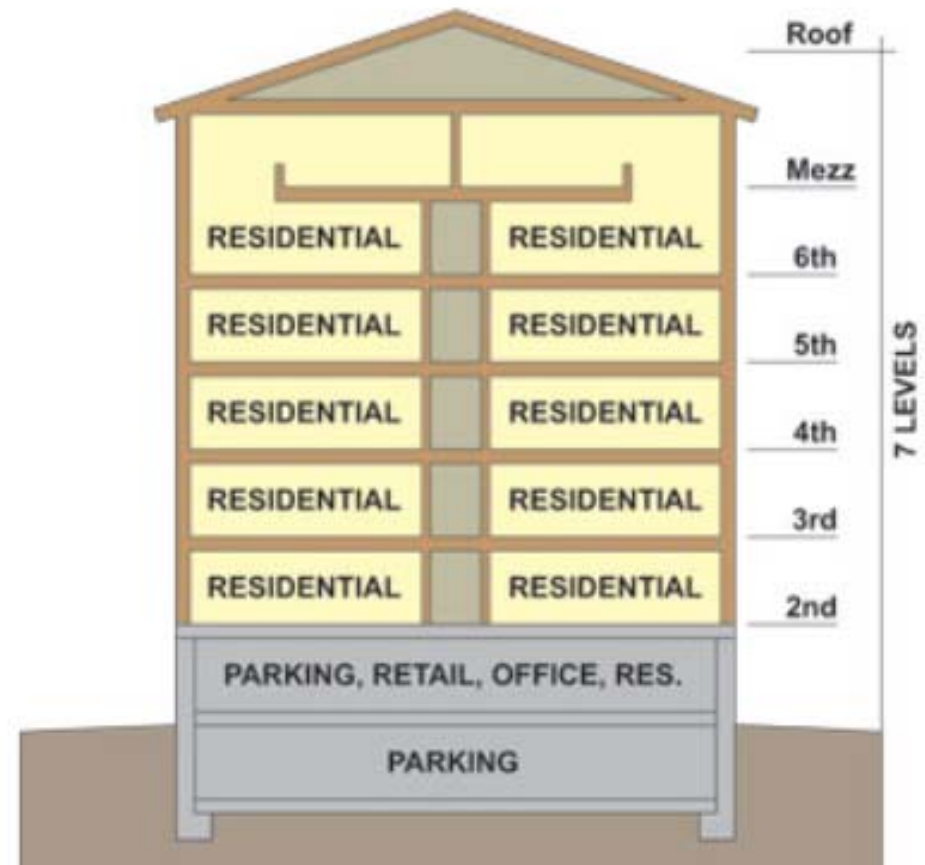


IBC 2012 – Mezz & Podium

IBC Section 505: Mezzanine



IBC Section 510.2: Podium



Can go higher with IBC's Alternative Materials, Designs, and Methods of Construction (IBC Section 104.11).

Next Steps

- Work on Building Code Lobby
- Focus on competing against Structural Steel and Concrete buildings
- Educate the design community – Woodworks!
- Drive costs down for fabrication and shipping
- Generate confidence in Construction Managers
- Fabricator of CLT (and Glulam?) in Maine