TECTONUS

resilient seismic solutions

Timber Wall Cost Study

Timber Walls

- The number of mass timber buildings is forecasted to double very year through to 2034.
- Most timber buildings are built using steel or concrete lateral systems.
- All-timber lateral systems are easily achievable using Tectonus seismic devices on timber walls or timber braces.
- Clients and designers need to understand the cost implications.

Cost Study

Objective:

- Explore impact of Tectonus devices as hold-downs for shear walls on cost and seismic performance.

- Two configurations of the same mass timber building are compared:
  1. Conventional Building with CLT shear walls and semi-rigid hold downs.
  2. Tectonus Building with CLT shear walls and Tectonus hold downs.

Note: all costs are given in New Zealand Dollars (times 0.6 for USD)

Introduction

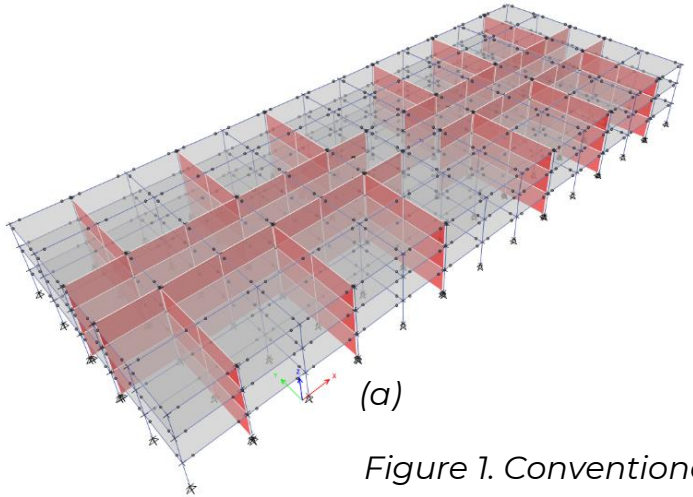
The Building

- Rectangular plan with dimensions: 78m (longitudinal) x 30m (transverse).
- Thirteen bays in longitudinal (X) direction and five bays in transverse (Y) direction.
- Comprises 3 levels with a total height of 9.3m.
- Located in Wellington on Site soil Class D.
- Typical building classified as Importance Level 2 (IL2) per NZS1170.5.

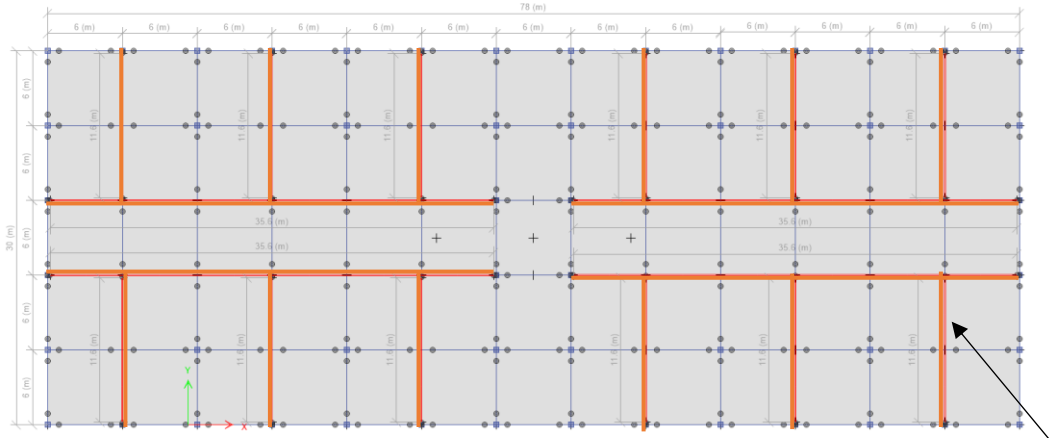
Seismic Assessment Method

- Seismic performance using NZSEE guidelines (similar to FEMA 356).
- Utilizes Nonlinear Static Pushover Analysis and capacity spectrum method.

Building Models



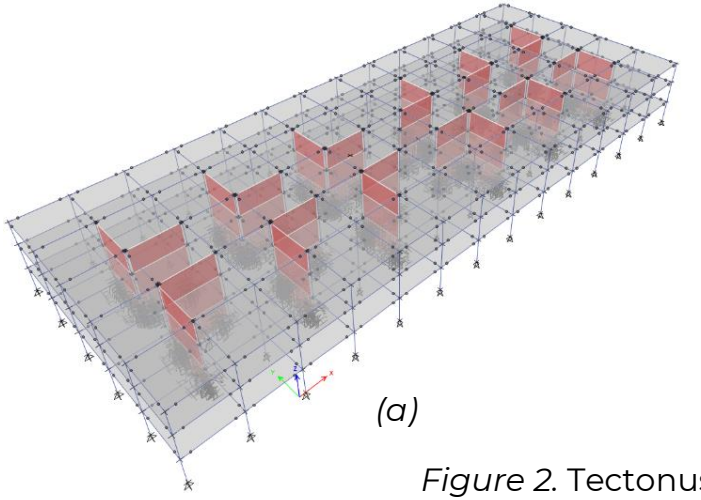
(a)



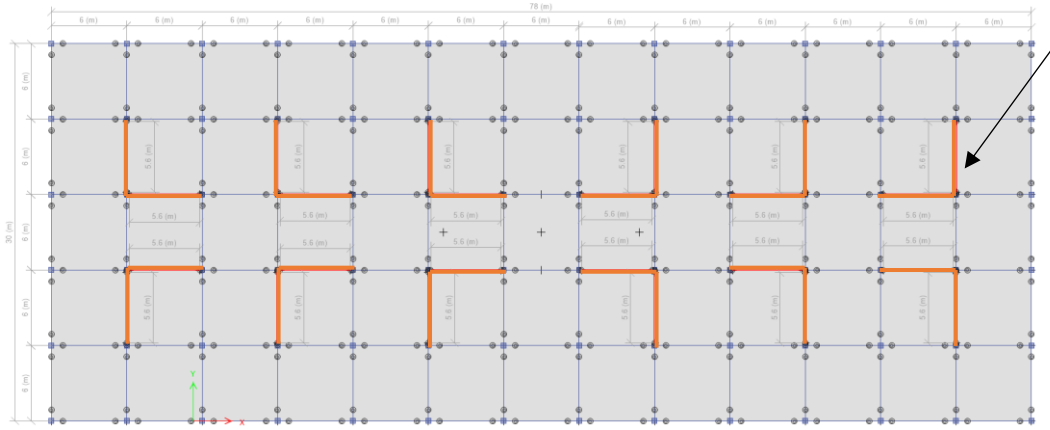
(b)

CLT shear walls

Figure 1. Conventional Building : (a) 3D ETABS Model, (b) In-Plan View



(a)



(b)

Figure 2. Tectonus Building: *(a) 3D ETABS Model, (b) In-Plan View*

Tectonus Devices

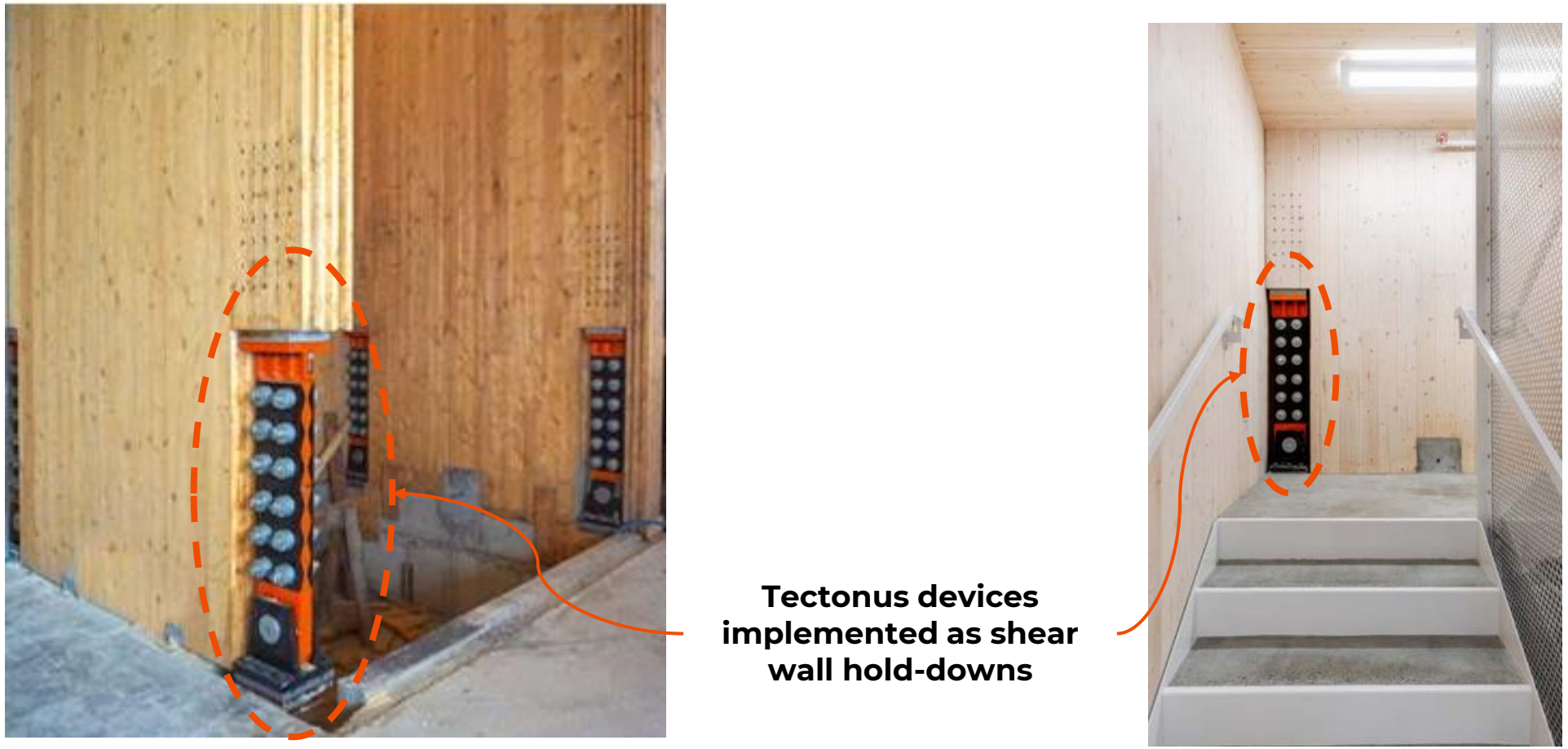


Figure 3. Tectonus Building with Tectonus shear wall hold-downs

Technology Benefits

As well as reducing post-quake damage and downtime, Tectonus saves on construction costs by reducing demand on superstructure and foundations.

Technology features:

- Increased damping and ductility up to 3X
- Best in class capacity design factor (1.35) applied to adjacent members

Construction benefits:

- Removal of entire walls and brace bays
- Reduced member sizes e.g. braces, columns, beams
- Reduced pile depth and/or pad thickness

Seismic Analysis

- Ductility of 3.8+ is achieved in Tectonus Building cf. 2.0 in Conventional.

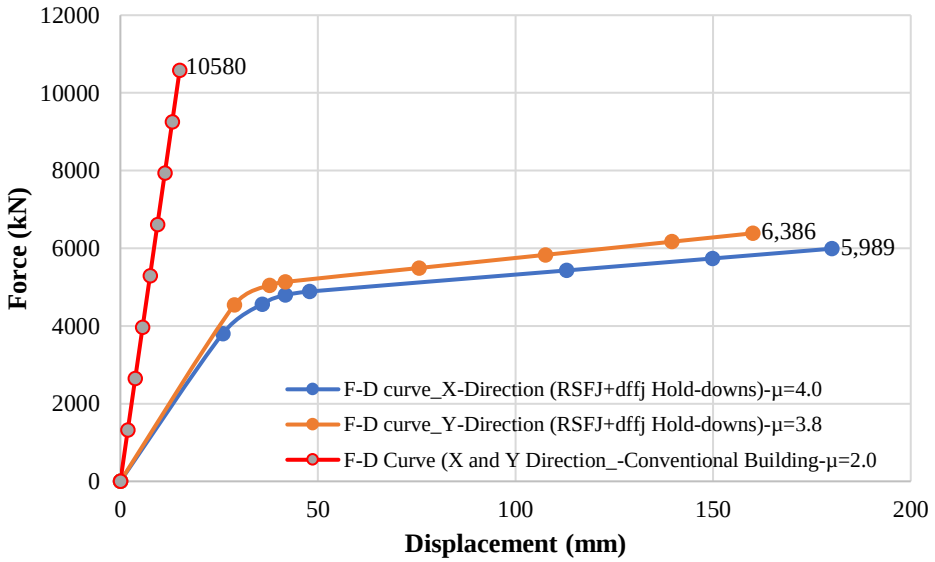


Figure 4: Force displacement curve for the two buildings in consideration

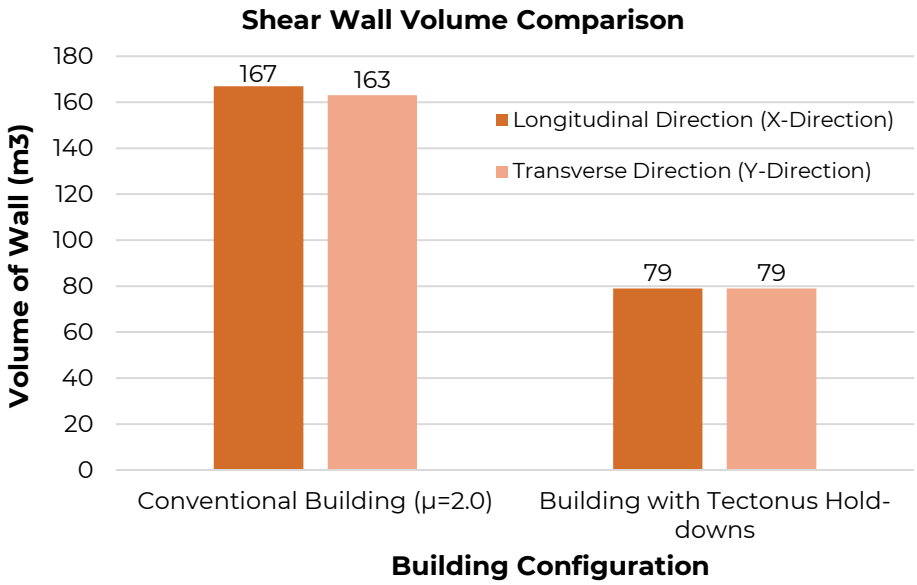
RESULTS			
Load Pattern	**Direction**	**Ductility in Force Terms (μ)**	**Base Shear (kN)**
Conventional Building	**X**	2.0	10580
	Y		
Tectonus Building	**X**	4.0	5989
	Y	3.8	6386

Shear Wall Volume

- >47% reduction in shear wall volume in Tectonus Building cf. Conventional.

Case Study Schematics	Longitudinal Direction (X-Direction)				
	No. of Wall	Length (m)	Height (m)	Thickness (m)	Volume (m^3)
Conventional Building (μ=2.0)	4	35.6	9.3	0.126	167
Building with Tectonus Hold-downs	12	5.6	9.3	0.126	79
		Reduction in Wall Volume:			**47%**

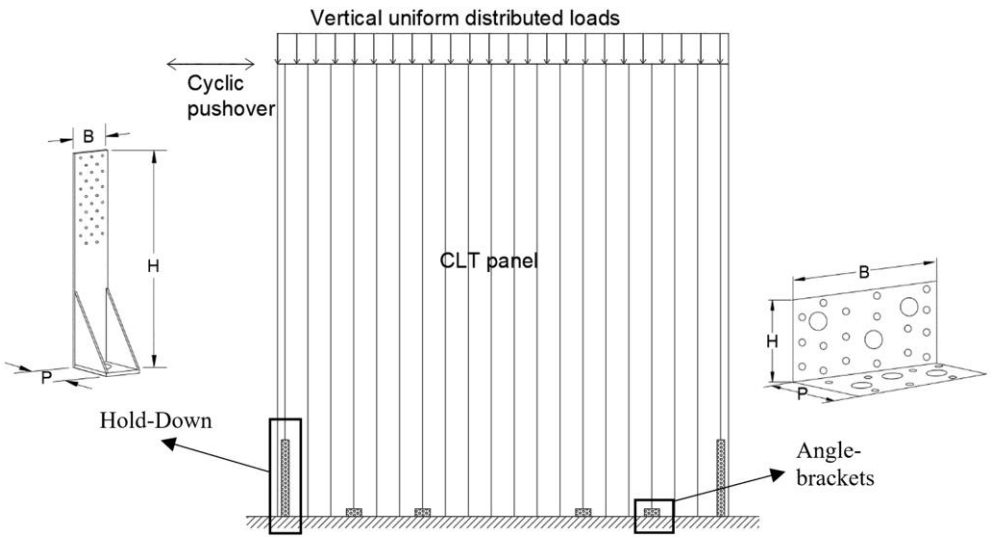
Case Study Schematics	Transverse Direction (Y-Direction)				
	No. of Wall	Length (m)	Height (m)	Thickness (m)	Volume (m^3)
Conventional Building (μ=2.0)	12	11.6	9.3	0.126	163
Building with Tectonus Hold-downs	12	5.6	9.3	0.126	79
		Reduction in Wall Volume:			**48%**

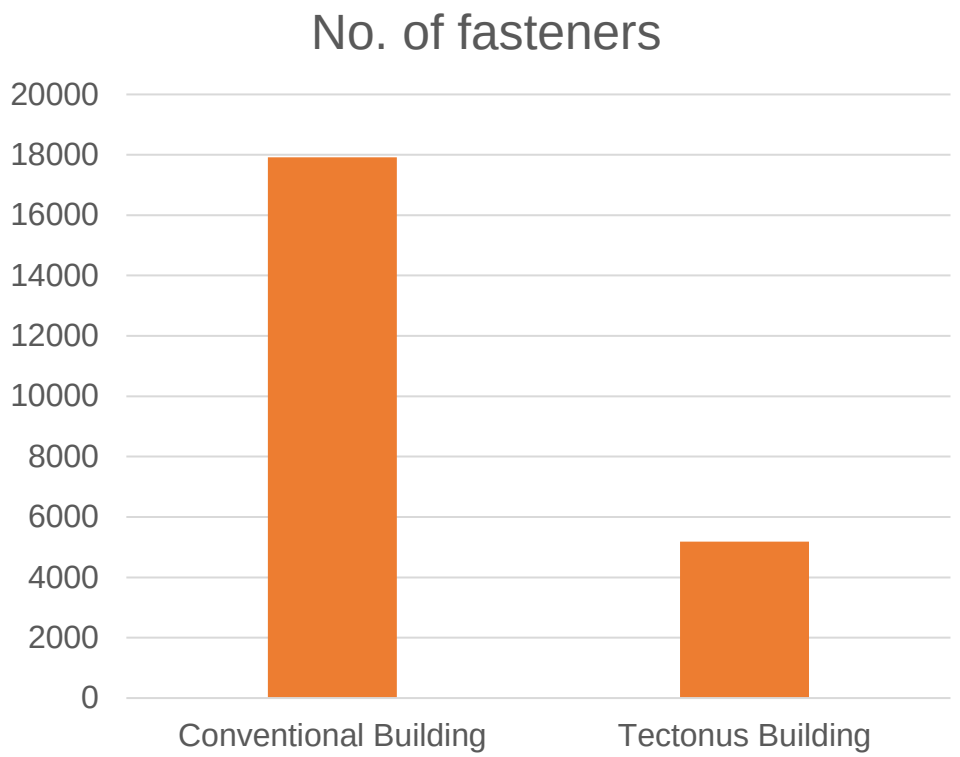


Fasteners

- 71% reduction in number of fasteners cf. Conventional
- Note connection cost assumed to be equivalent

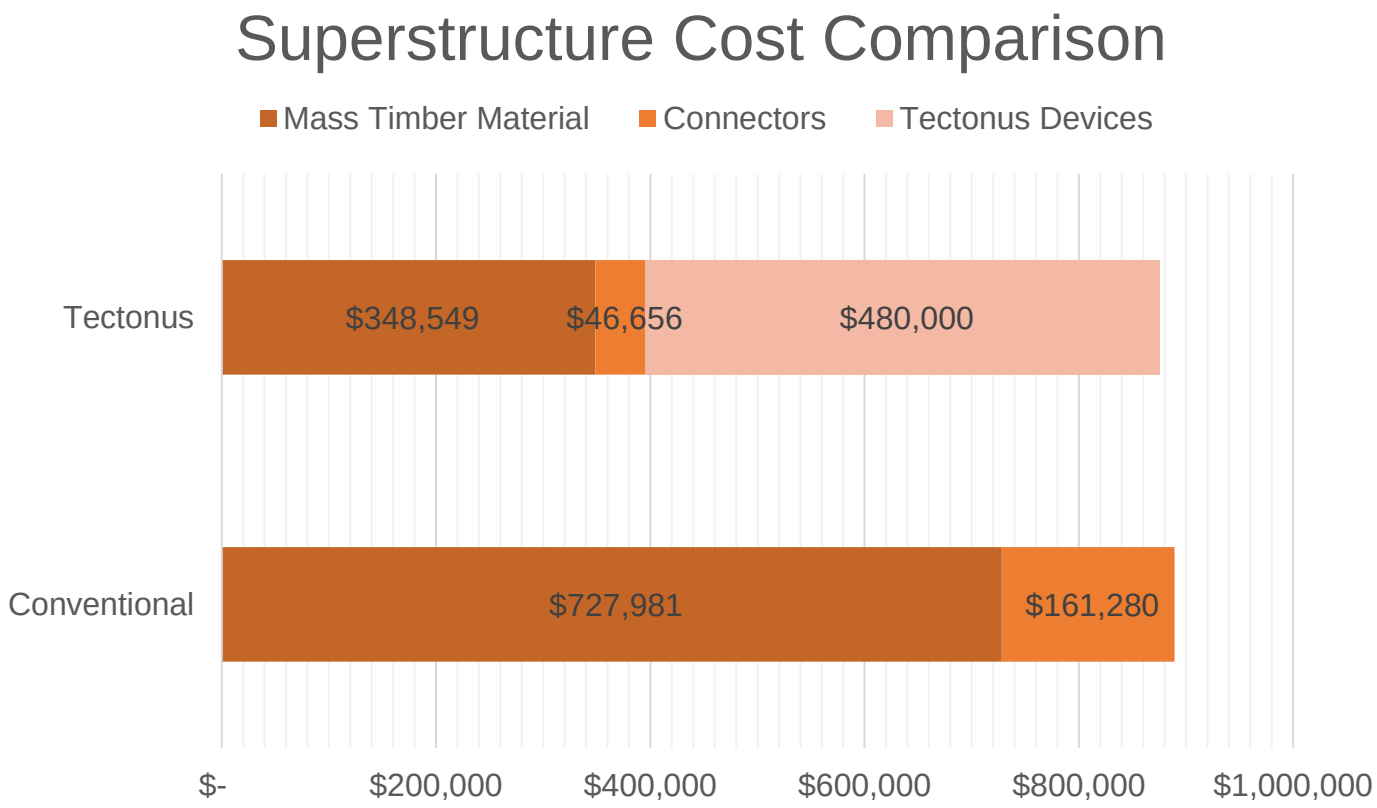
Conventional Shear Wall





Cost Comparison

- Tectonus cost is paid back by savings in timber and connectors alone.



Other Costs

Foundations
- Base shear is reduced more than 40% in Tectonus Building cf. Conventional
- Additional savings $50,000 to $200,000 depending on multiple factors.

Transportation
- Fewer shear walls transported to site
- Additional savings depending on distance travelled

Installation
- Fewer shear walls results in additional savings
- Tectonus devices are bolted in place – simple and fast

Engineering
- Detailing costs are assumed to be equivalent
- Cost of alternative design and peer review with Tectonus ~$50,000

Conclusion

- Case study demonstrates the cost saving potential of Tectonus devices
- Tectonus cost is paid back by the savings in timber and connectors
- Additional savings expected in transport, installation and foundations
- Seismic performance is greatly improved – ductility increased 2X
- In the event of an earthquake, the building will experience little damage and be available for re-occupancy almost immediately.

For more information:

→ Visit www.tectonus.com

→ Contact us for a no obligation consultation info@tectonus.com