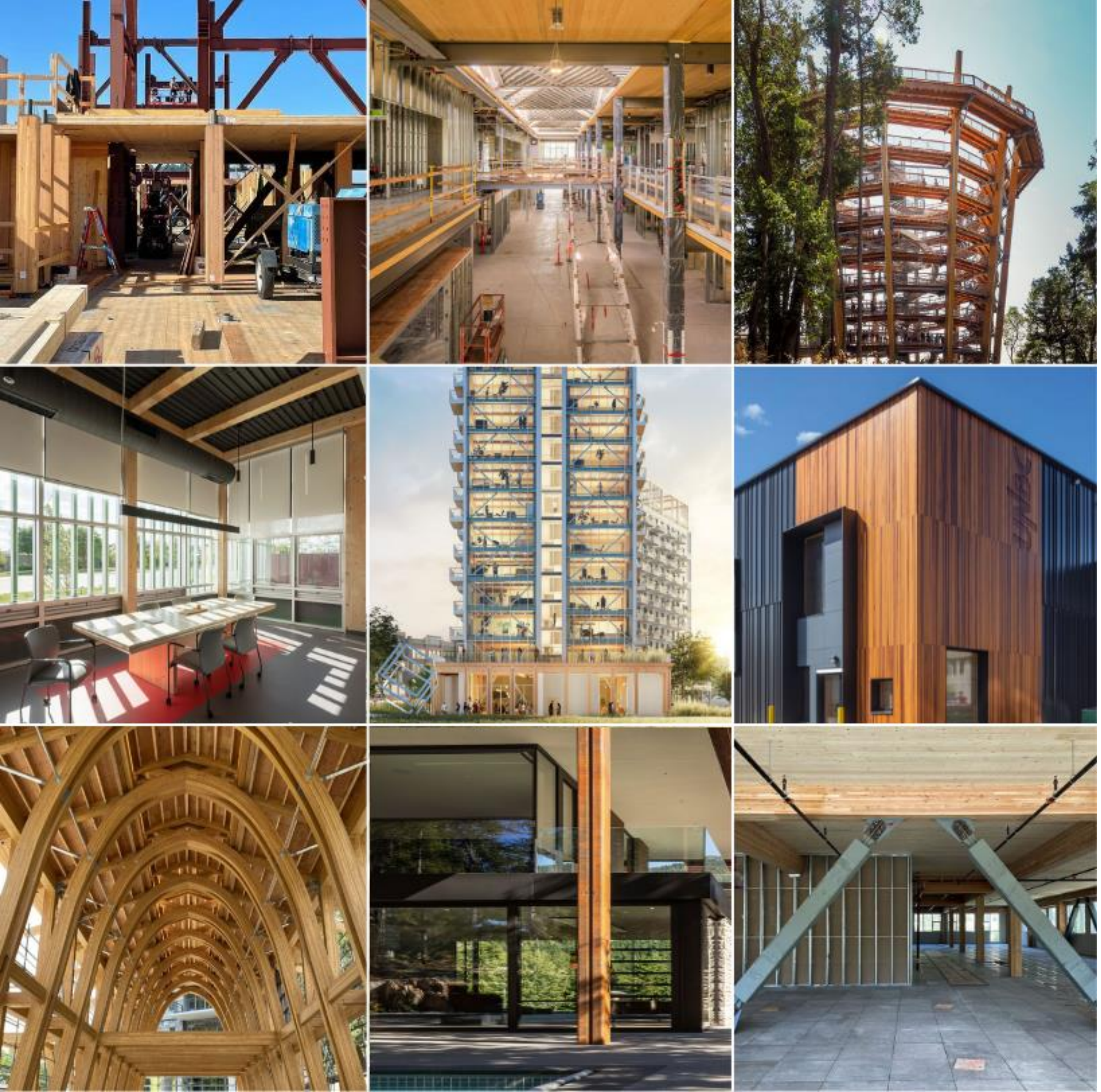


ASPECT
STRUCTURAL ENGINEERS

Terminus – Timber Office Building with an innovative Seismic Force Resisting System

Bernhard Gafner
Struct.Eng., P.Eng., MIStructE, Dipl. Ing. FH/STV.
Bernhard@aspectengineers.com

ASPECT INTRO

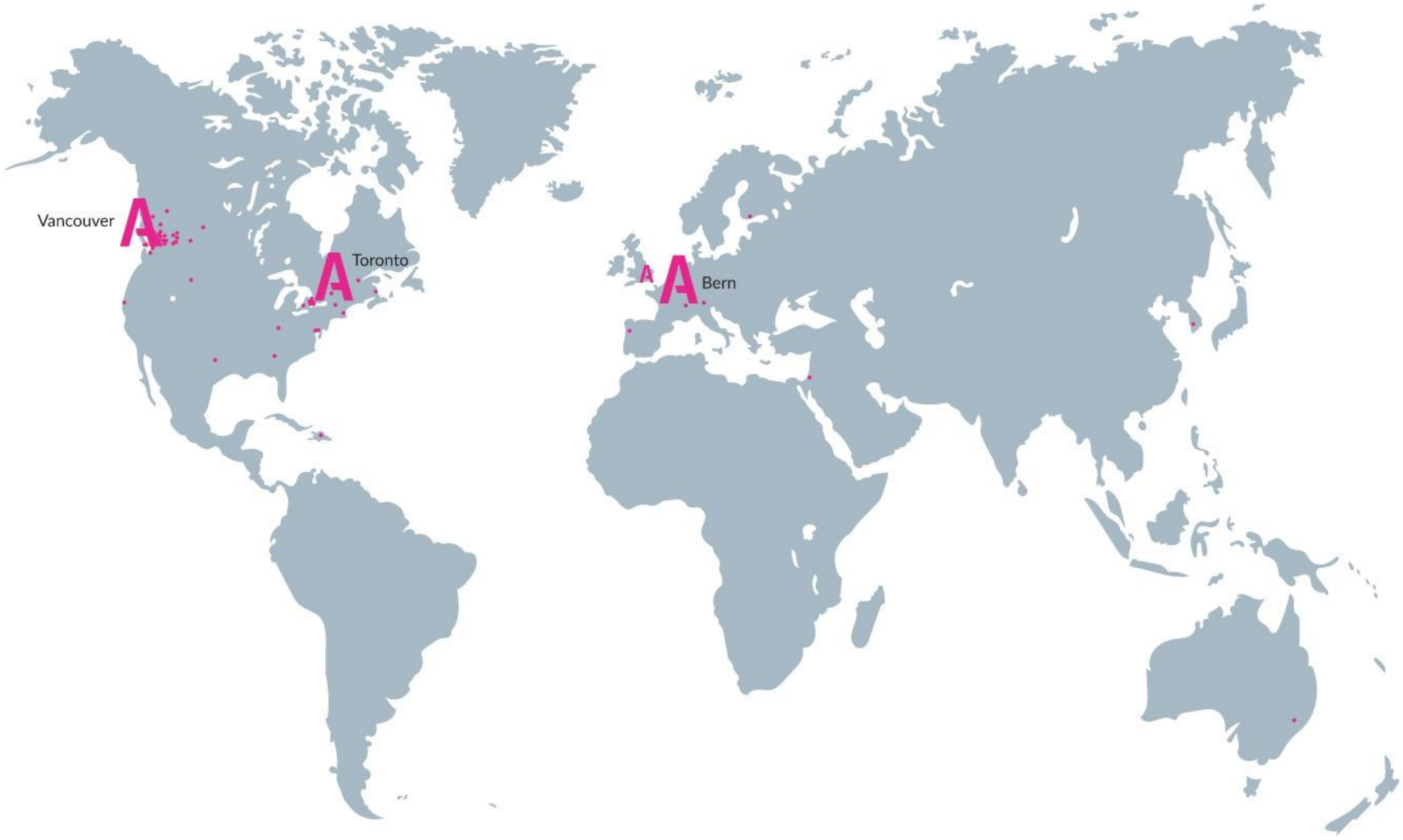
Pleasure to meet you!

OUR TEAM & LOCATIONS

Team of 05+ and growing

3 Offices

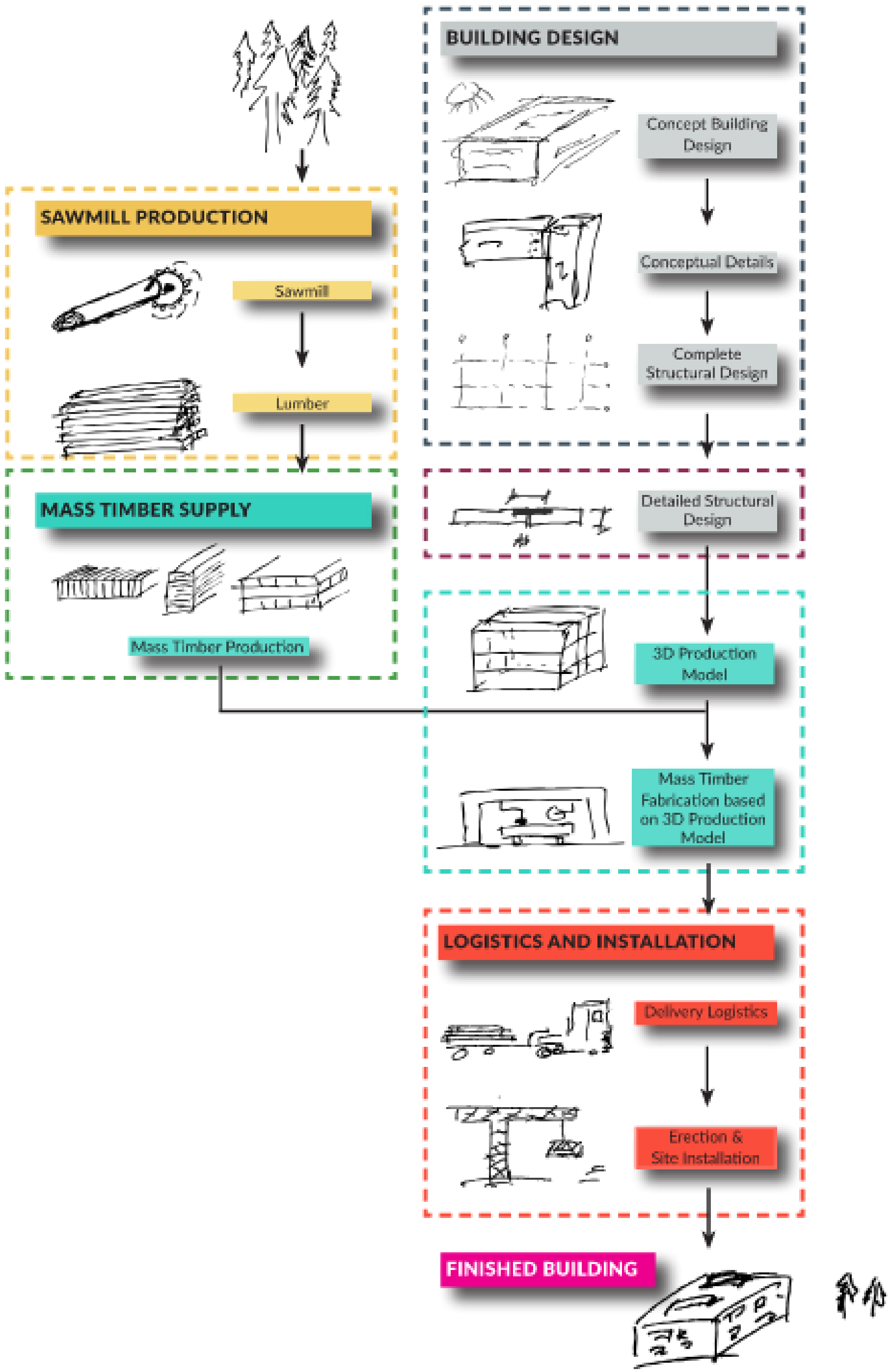
Global Reach



OUR SERVICES

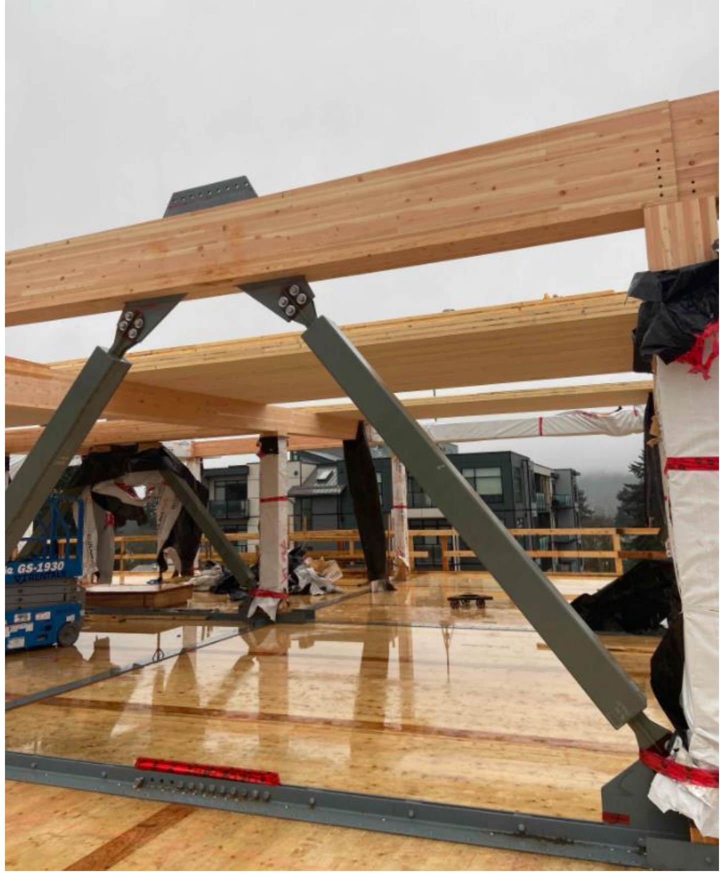
"Forest to Frame"

Mass Timber Vertical Integration

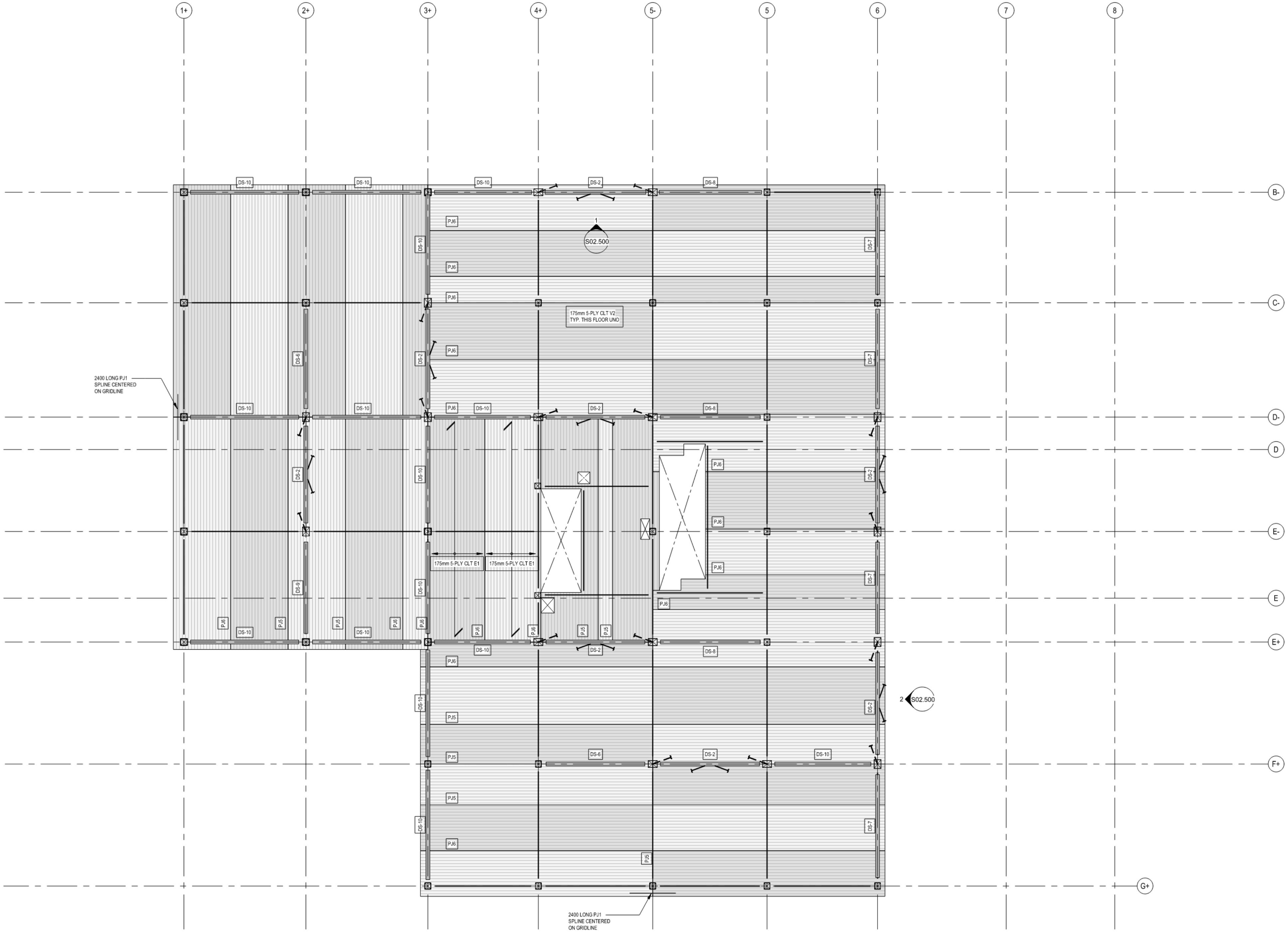


LANGFORD, BC,
CANADA

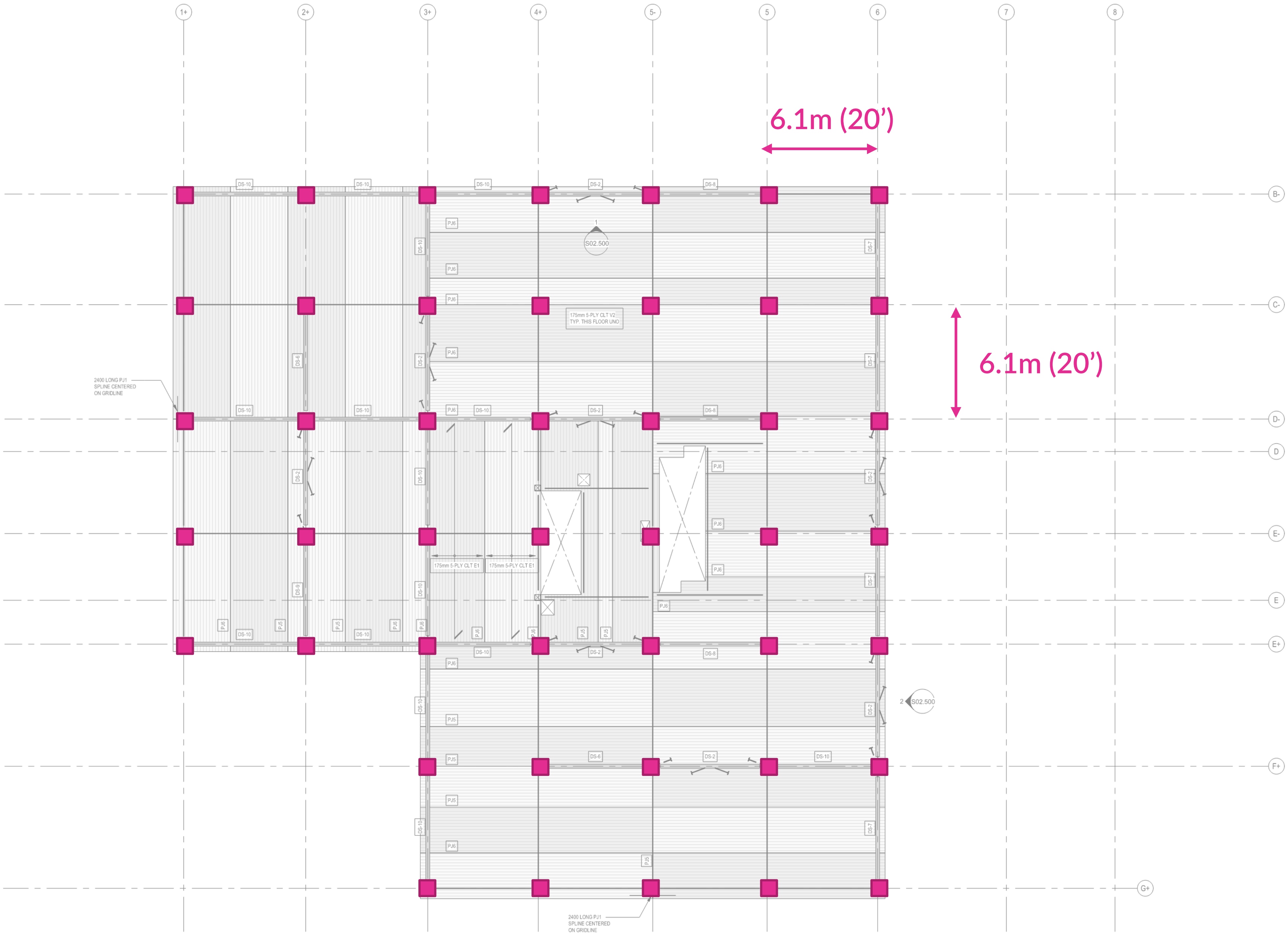
TERMINUS



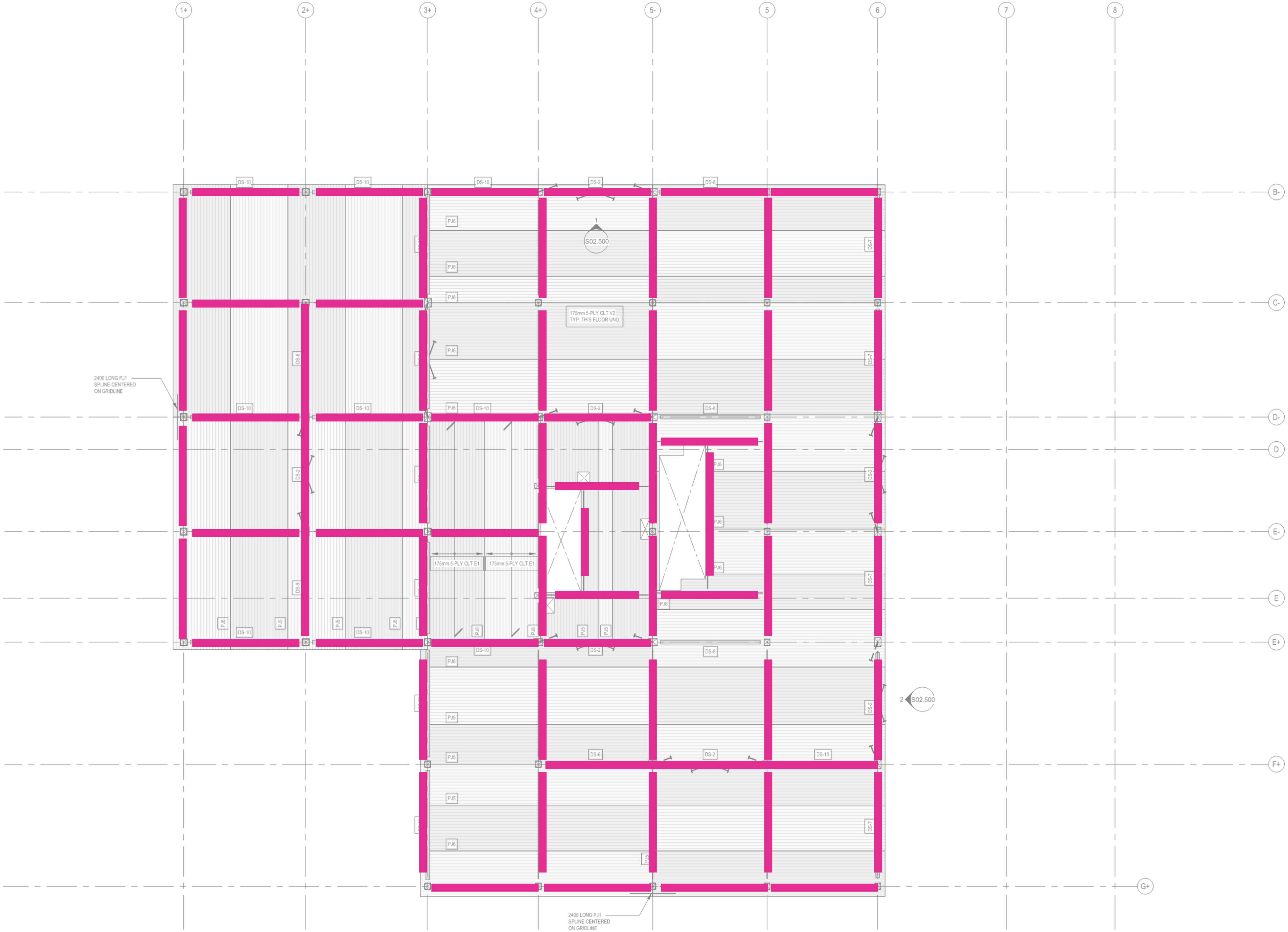
Terminus – Buckling Restrained Braces (BRB’s) w/ CLT Diaphragm



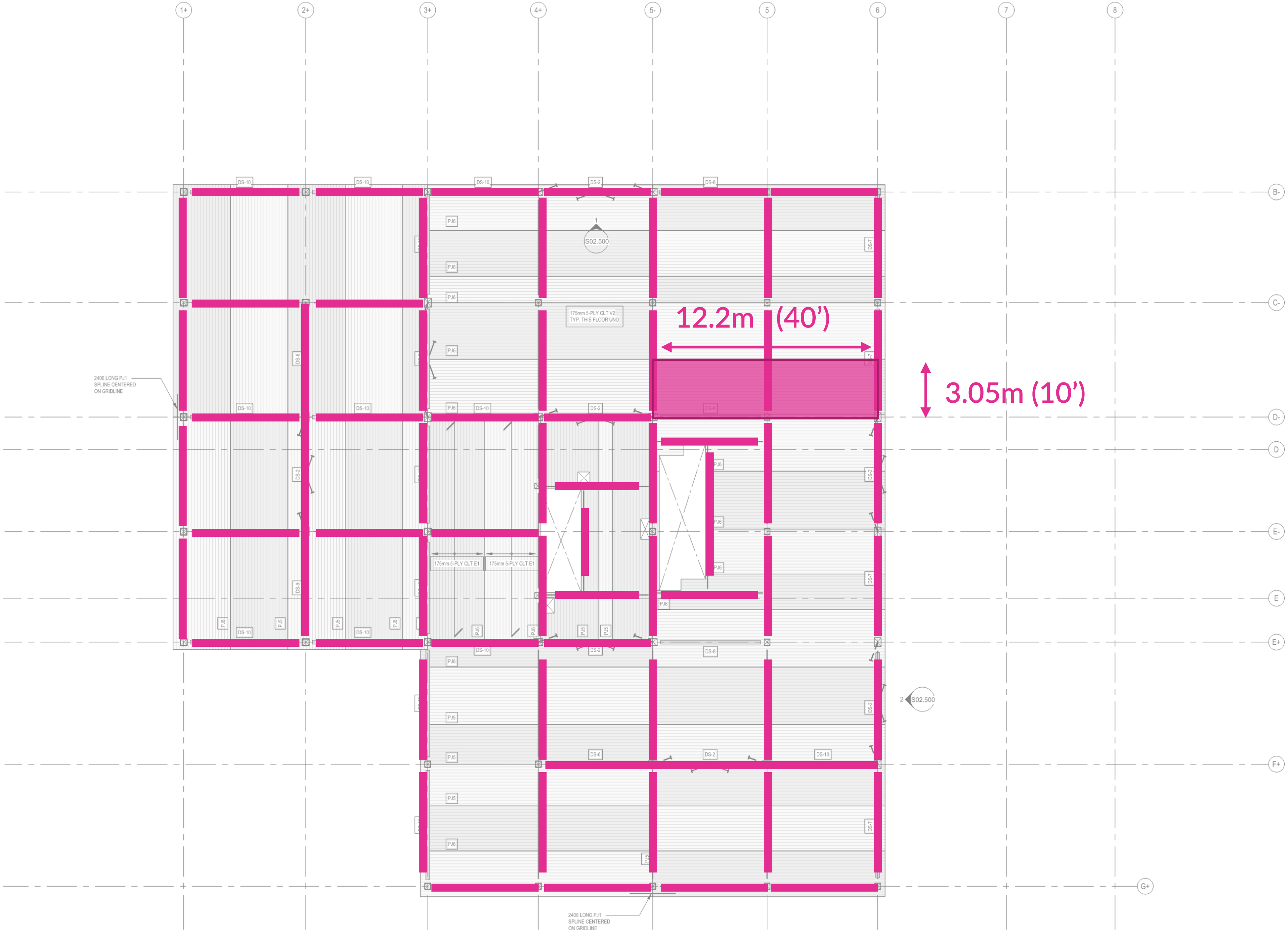
175mm 5-PLY CLT V2
TYP. THIS FLOOR UNO
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE
175mm 5-PLY CLT E1
175mm 5-PLY CLT E1
S02.500
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE



6.1m (20')
6.1m (20')
175mm 5-PLY CLT V2
TYP. THIS FLOOR UNO
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE
175mm 5-PLY CLT E1
175mm 5-PLY CLT E1
S02.500
S02.500
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE



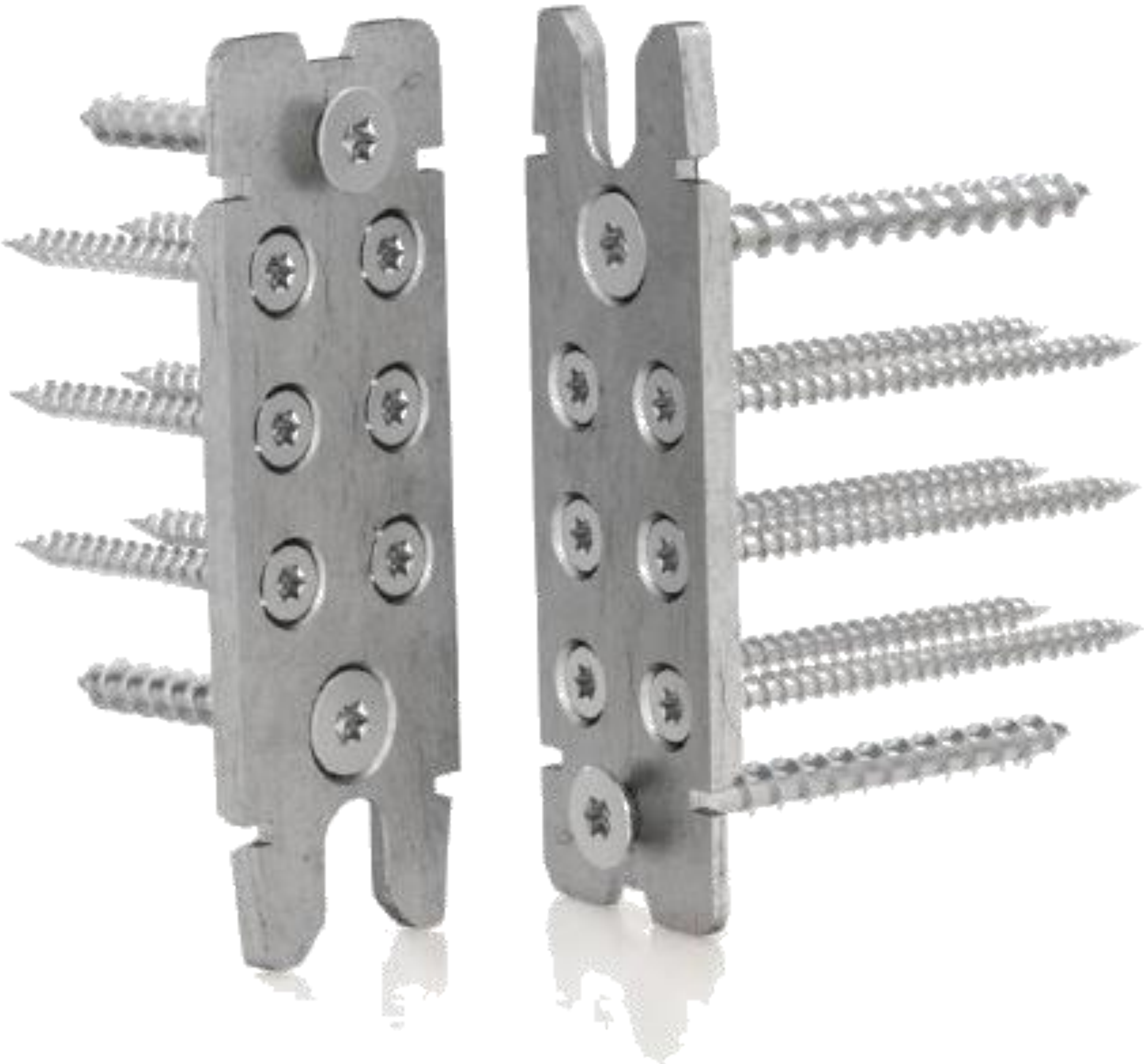
1+
2+
3+
4+
5-
5
6
7
8
B-
C-
D-
D
E-
E
E+
F+
G+
175mm 5-PLY CLT V2
TYP. THIS FLOOR UNO
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE
175mm 5-PLY CLT E1
175mm 5-PLY CLT E1
S02.500
S02.500
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE


12.2m (40')
3.05m (10')
175mm 5-PLY CLT V2
TYP. THIS FLOOR UNO
175mm 5-PLY CLT E1
2400 LONG PJ1
SPLINE CENTERED
ON GRIDLINE
S02.500


GLULAM PLUS
BY STRUCTURLAM
Genie GS-1930

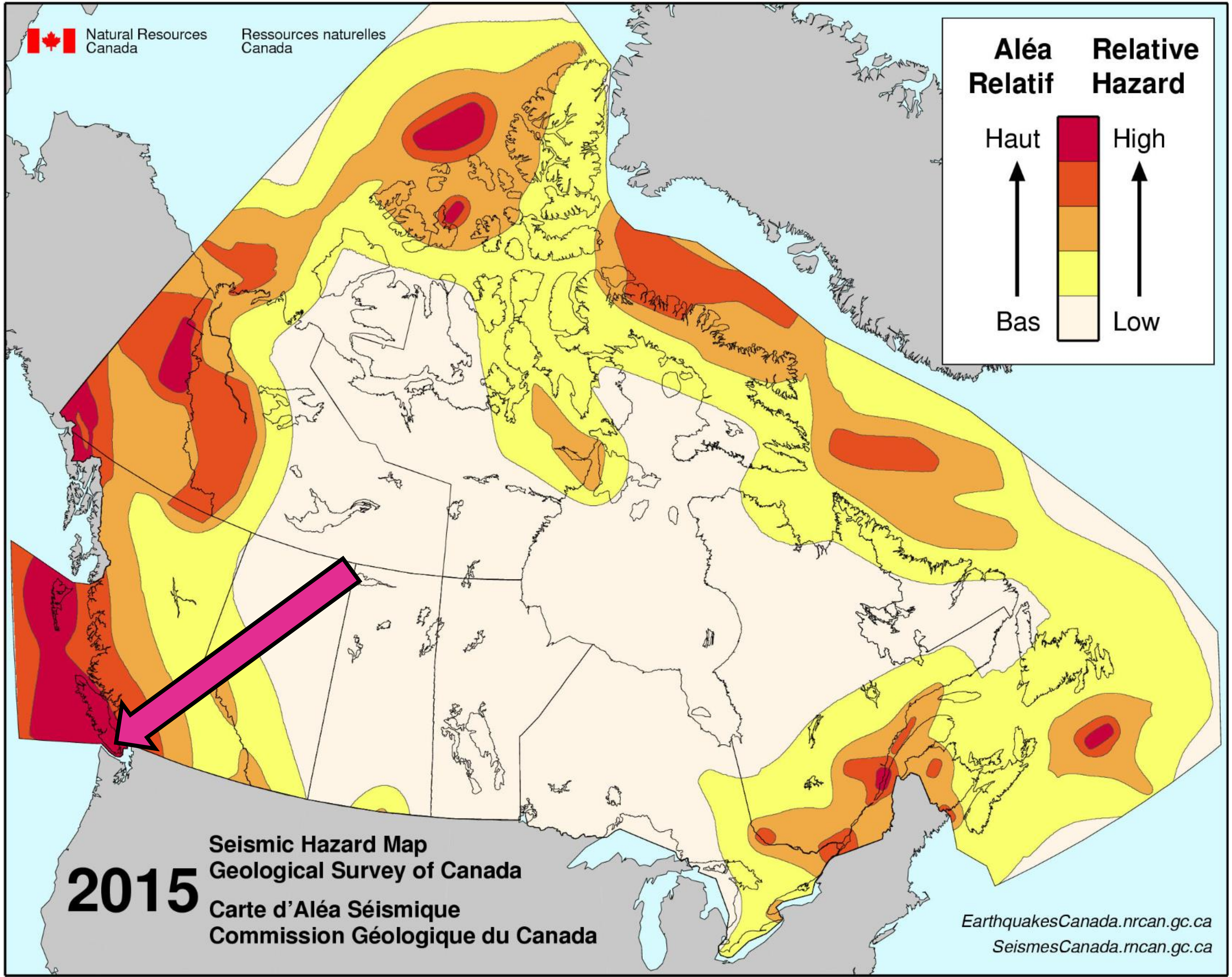

12.2m (40’)
3.05m (10’)
GLULAM PLUS
BY STRUCTURLAM
STRUCTURLAM.COM

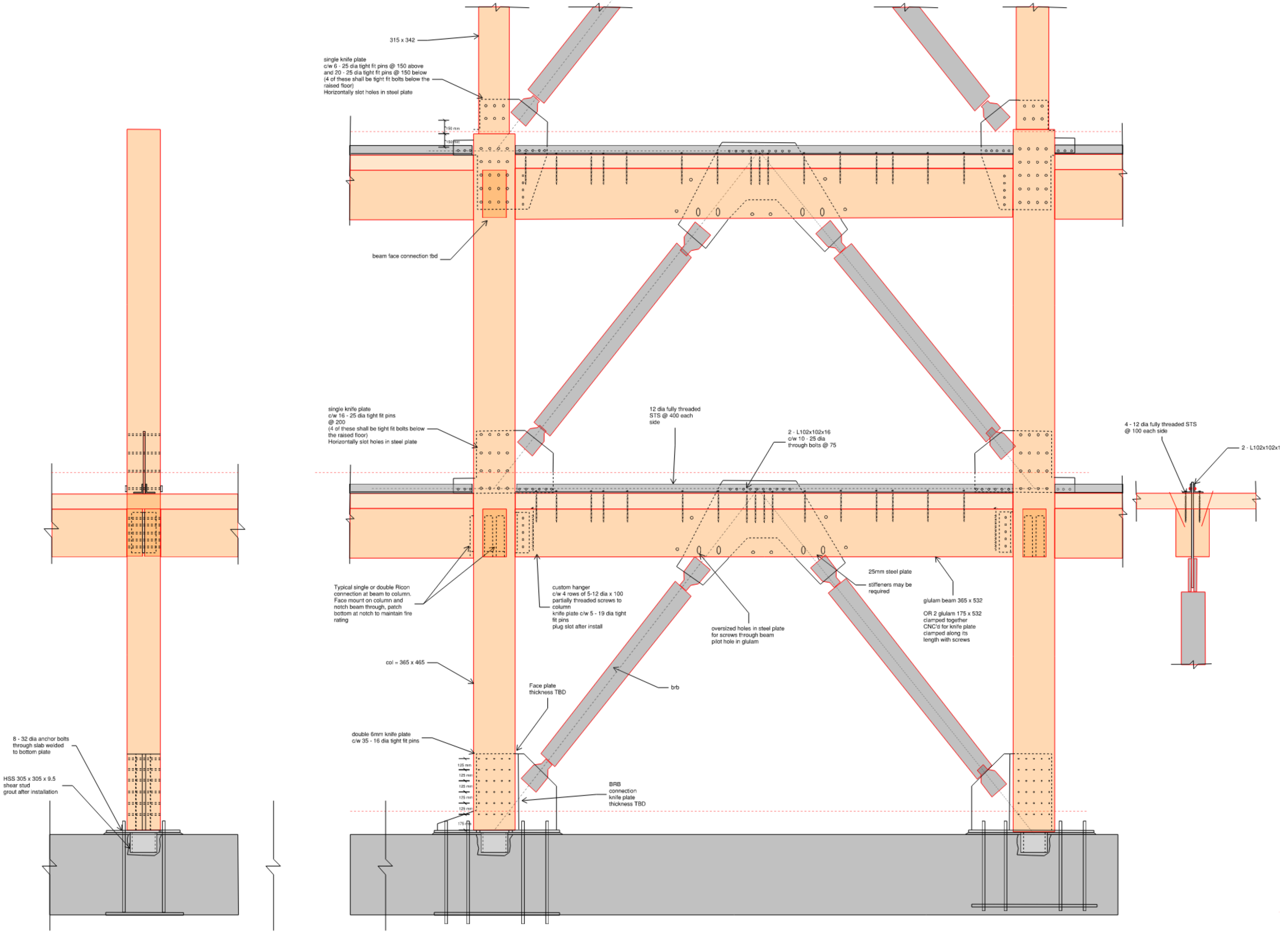

GLULAM PLUS
GLULAM PLUS
GLULAM PLUS
R

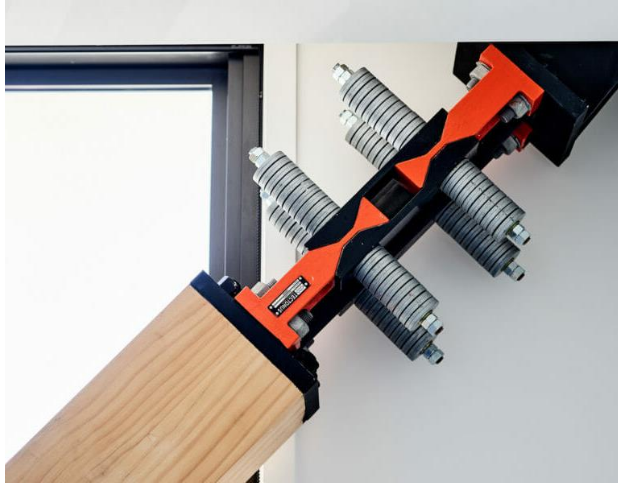


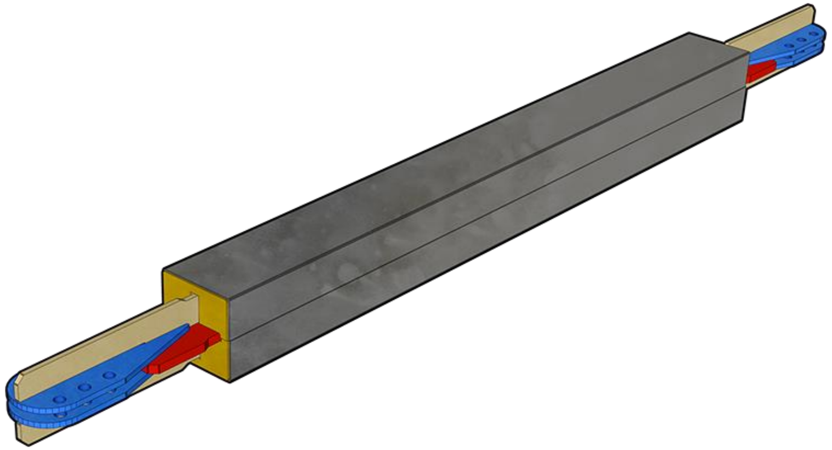

GLULAM PLUS
B-315

LATERAL SYSTEM


Natural Resources Canada
Ressources naturelles Canada
Aléa Relatif
Relative Hazard
Haut
High
Bas
Low
2015
Seismic Hazard Map
Geological Survey of Canada
Carte d'Aléa Séismique
Commission Géologique du Canada
EarthquakesCanada.nrcan.gc.ca
SeismesCanada.rncan.gc.ca


315 x 342
single knife plate
c/w 6 - 25 dia tight fit pins @ 150 above
and 20 - 25 dia tight fit pins @ 150 below
(4 of these shall be tight fit bolts below the
raised floor)
Horizontally slot holes in steel plate
150 mm
150 mm
beam face connection tbd
single knife plate
c/w 16 - 25 dia tight fit pins
@ 200
(4 of these shall be tight fit bolts below
the raised floor)
Horizontally slot holes in steel plate
12 dia fully threaded
STS @ 400 each
side
2 - L102x102x16
c/w 10 - 25 dia
through bolts @ 75
4 - 12 dia fully threaded STS
@ 100 each side
2 - L102x102x1
Typical single or double Ricon
connection at beam to column.
Face mount on column and
notch beam through, patch
bottom at notch to maintain fire
rating
custom hanger
c/w 4 rows of 5-12 dia x 100
partially threaded screws to
column
knife plate c/w 5 - 19 dia tight
fit pins
plug slot after install
25mm steel plate
stiffeners may be
required
glulam beam 365 x 532
OR 2 glulam 175 x 532
clamped together
CNC'd for knife plate
clamped along its
length with screws
oversized holes in steel plate
for screws through beam
pilot hole in glulam
col = 365 x 465
brb
Face plate
thickness TBD
double 6mm knife plate
c/w 35 - 16 dia tight fit pins
8 - 32 dia anchor bolts
through slab welded
to bottom plate
HSS 305 x 305 x 9.5
shear stud
grout after installation
BRB
connection
knife plate
thickness TBD

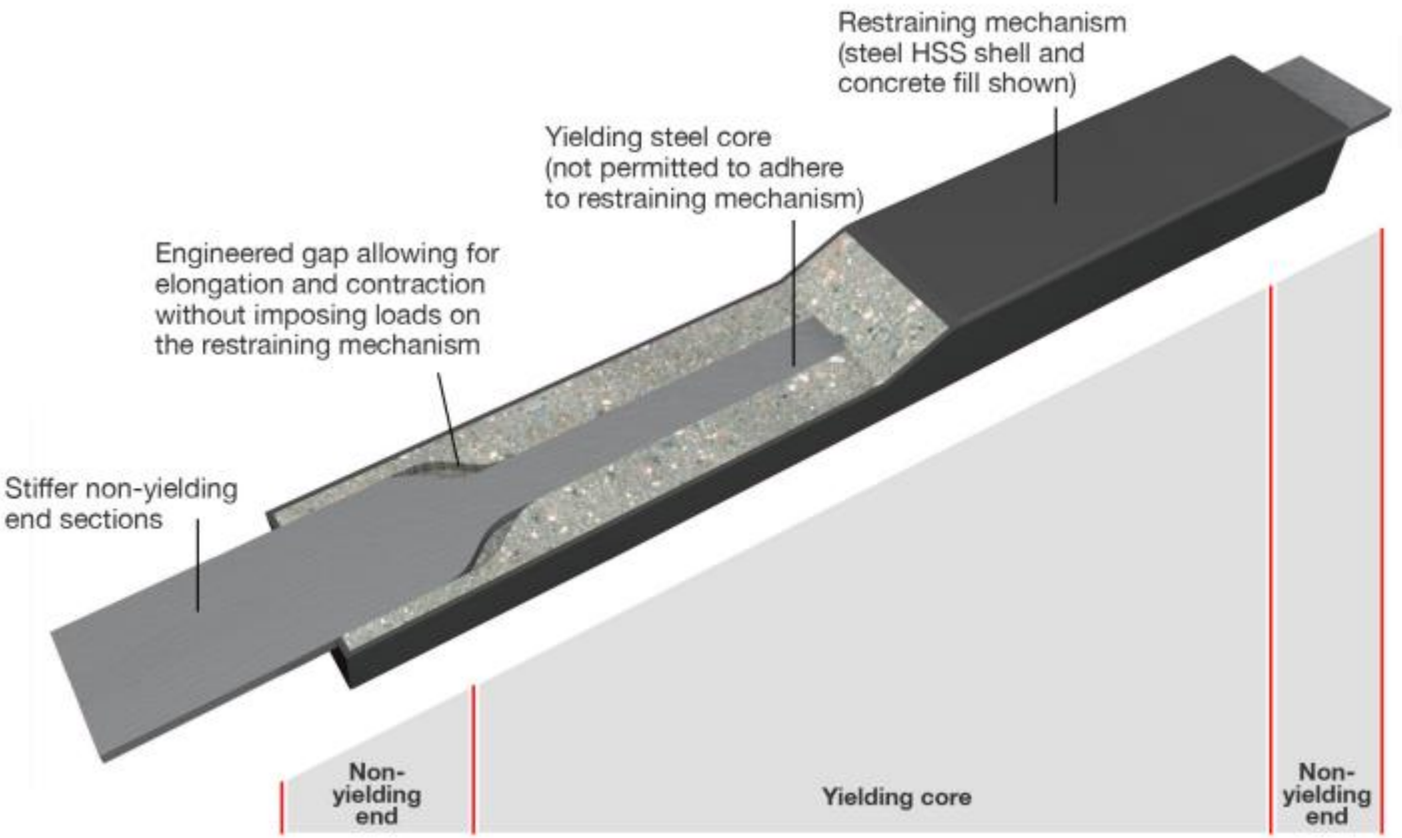




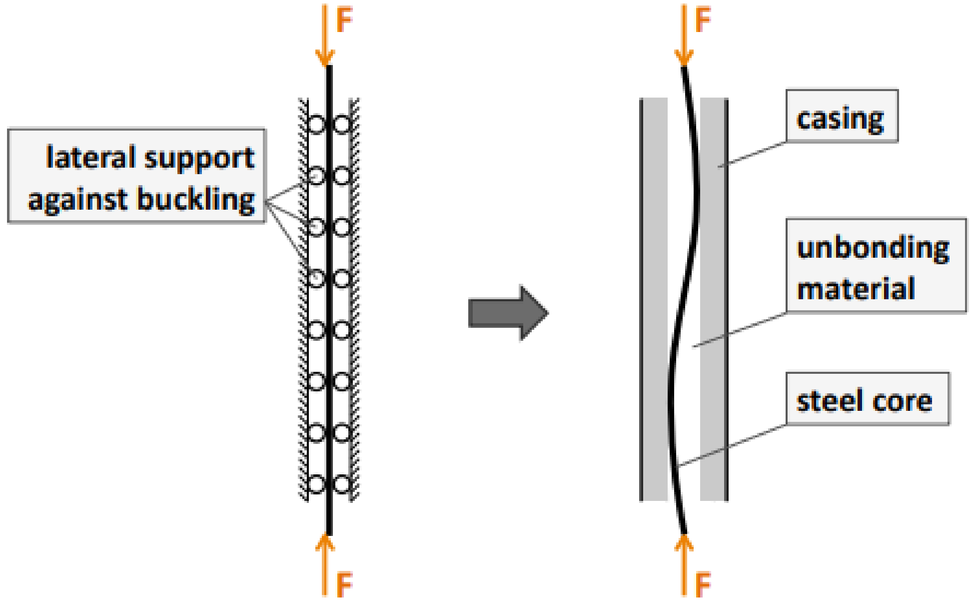
TECTONUS

QUAKETEK

BRB'S



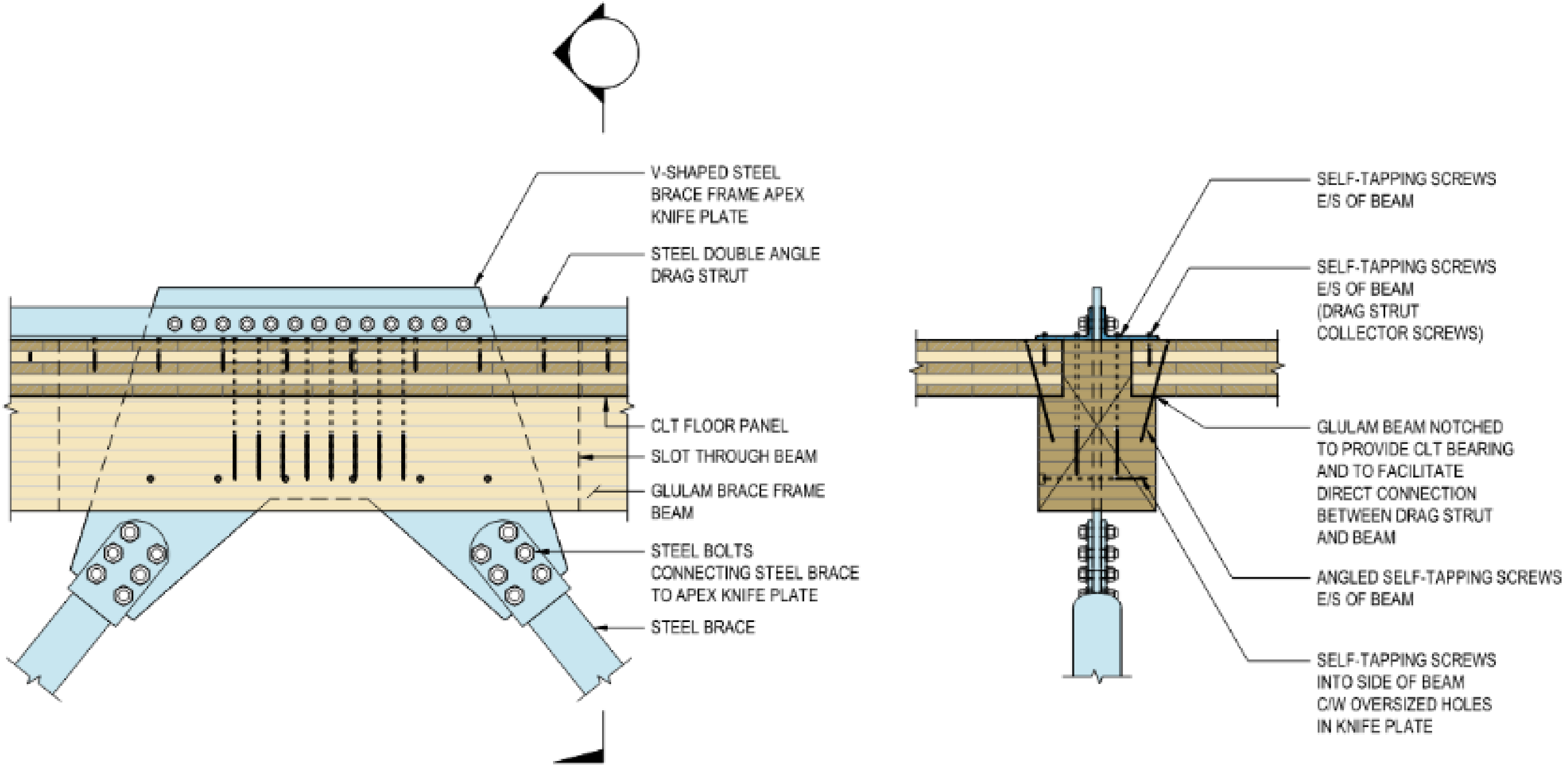
Restraining mechanism
(steel HSS shell and
concrete fill shown)
Yielding steel core
(not permitted to adhere
to restraining mechanism)
Engineered gap allowing for
elongation and contraction
without imposing loads on
the restraining mechanism
Stiffer non-yielding
end sections
Non-
yielding
end
Yielding core
Non-
yielding
end



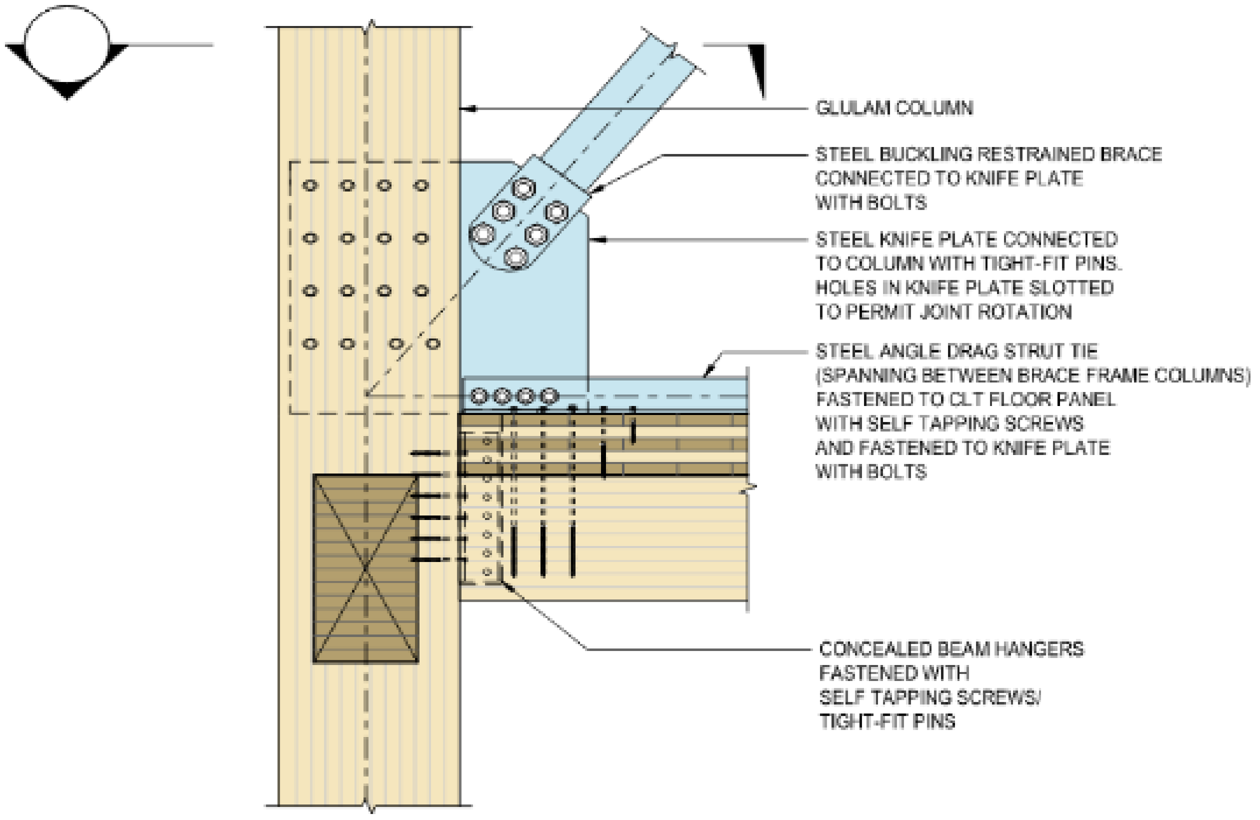
F
lateral support
against buckling
F
F
casing
unbonding
material
steel core
F

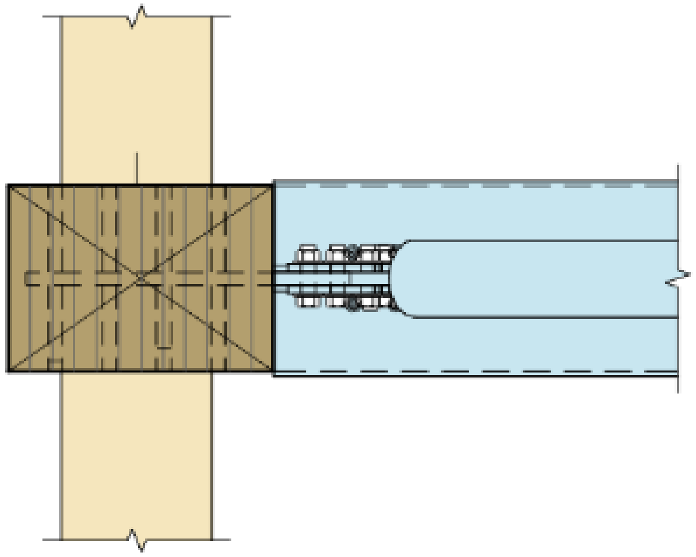

GLULAM PLUS
-1930


GLULAM PLUS
BY STRUCTURLAM



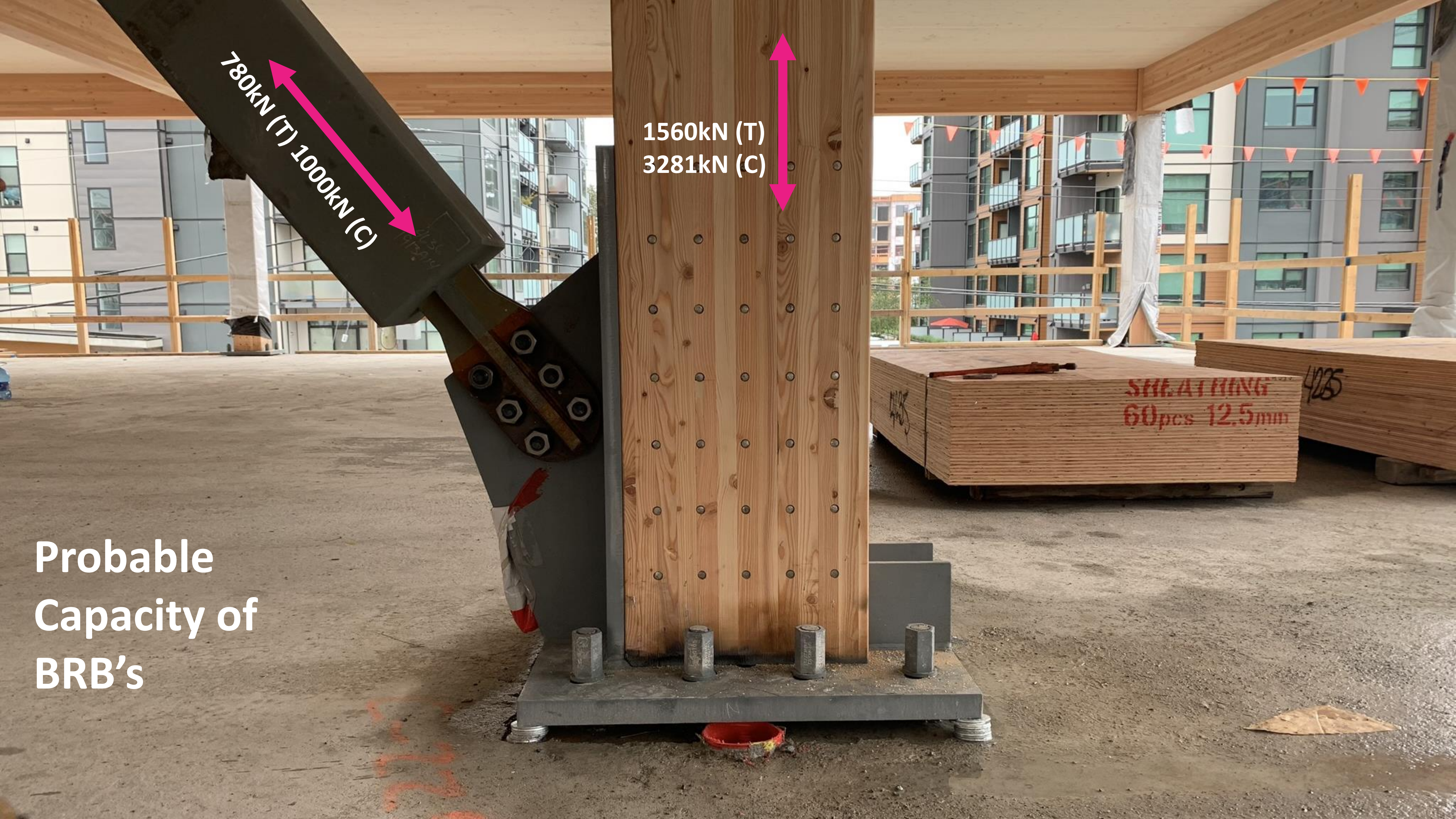
TYPICAL BRACE FRAME APEX DETAIL





TYPICAL BRACE FRAME COLUMN CONNECTION


Probable Capacity of BRB's



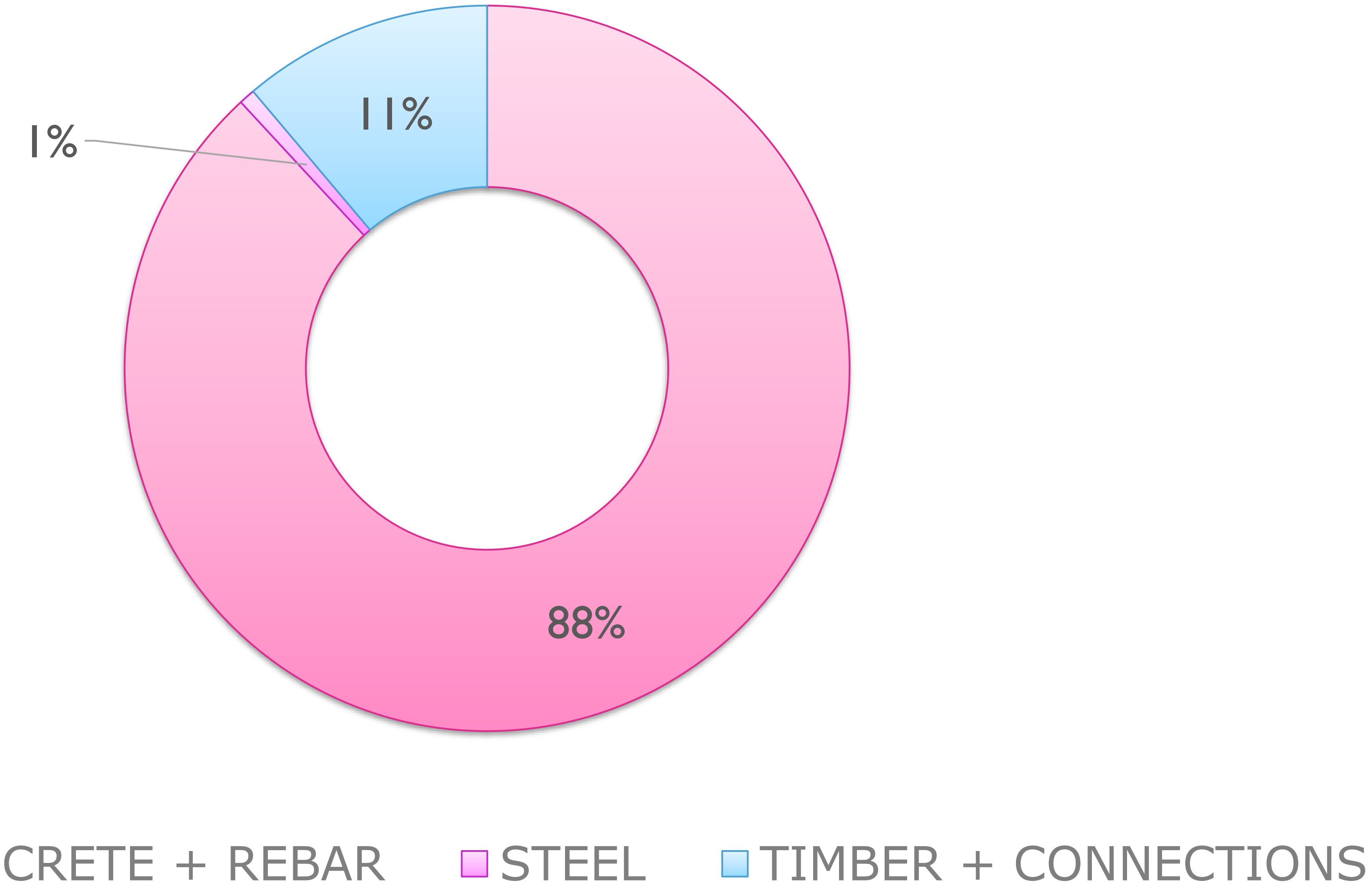
Embodied Carbon Calculation Breakdown

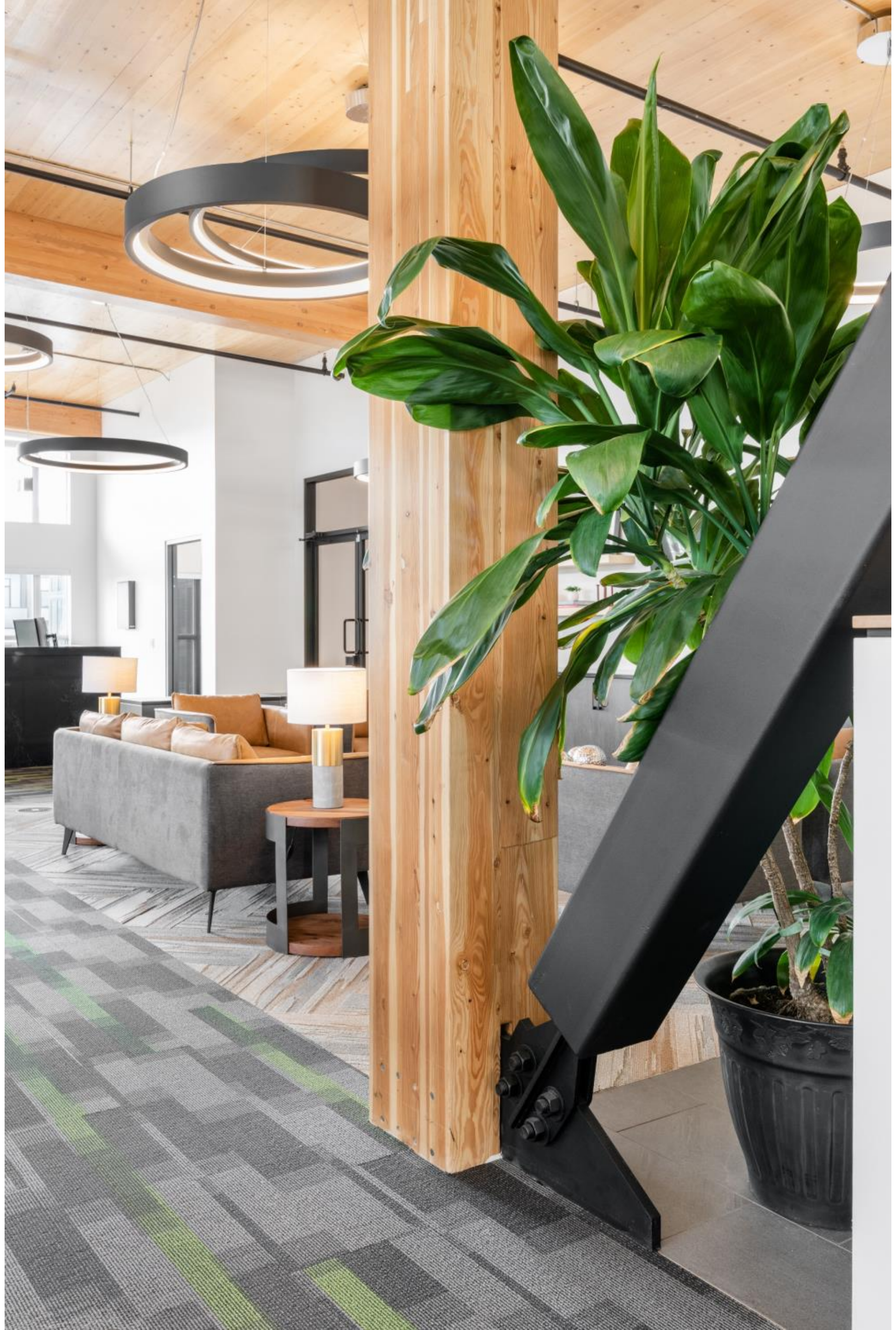
Element	A1-A3	A4	A5	A1-A5		
				$kgCO_2e$	$[kgCO_2e/m^2]$*	$[kgCO_2e/m^2]$**
Foundations	272,233	3,654	9,505	285,392	31	29
Basement	699,242	7,629	22,637	729,508	79	75
Ground floor slab	281,651	3,052	9,055	293,758	32	30
Glulam frame	54,891	8,786	1,807	65,483	7	7
CLT slabs	147,045	22,244	4,710	173,998	19	18
Floor build-up (Screed)	55,727	935	2,433	59,096	6	6
First floor transfer system	503,858	5,460	16,200	525,517	57	54
Stability system	14,565	272	604	15,441	2	2
Other structure	437	35	12	485	0.05	0
TOTAL				**2,148,678**	**232**	**220**

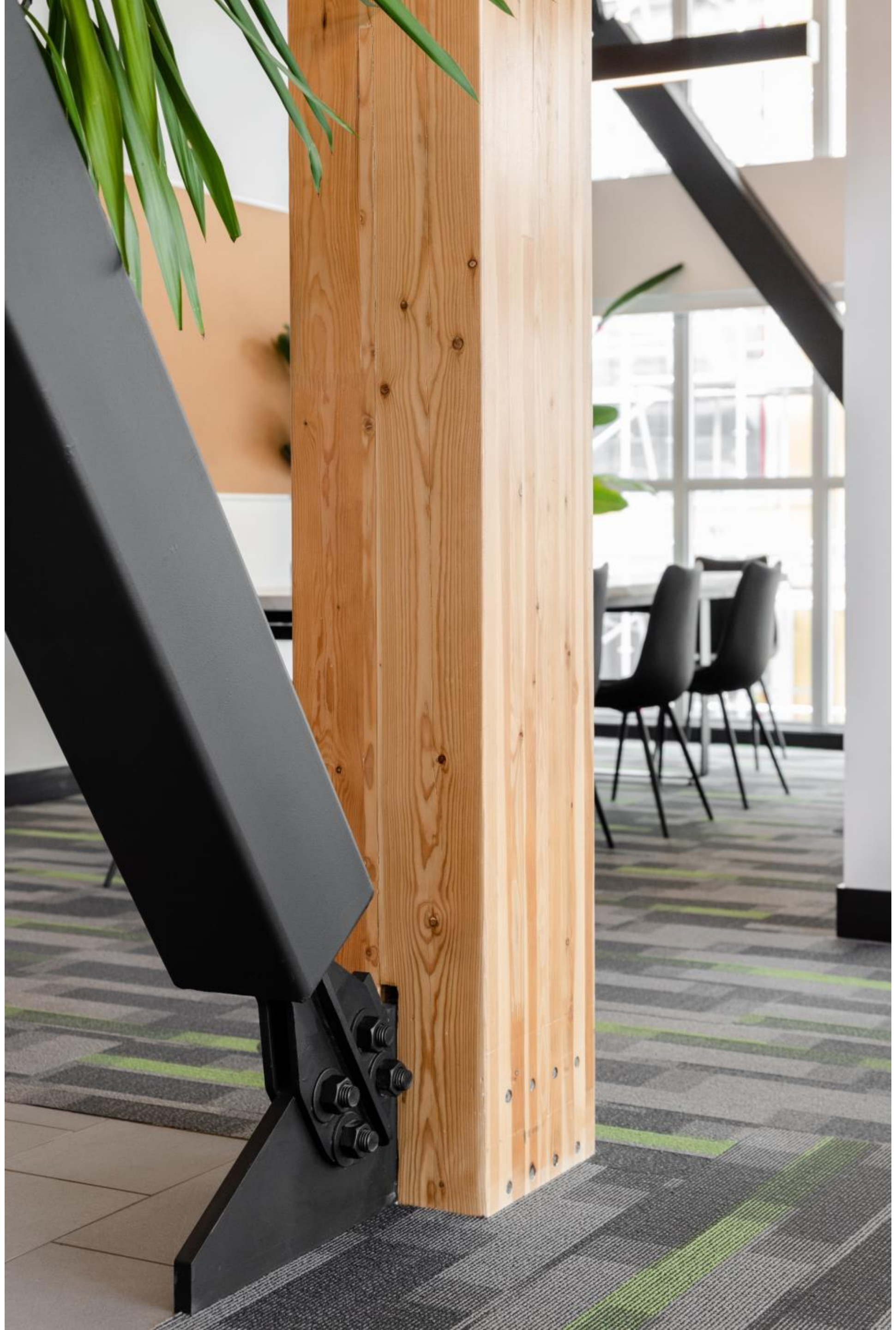
* Rate based on GIFA only

** Rate based on GFIA + Covered Parking

Embodied Carbon Calculation Breakdown







CHICAGO
THANKS YOU!


CHICAGO
THANKS YOU!

PROJECT CREDITS

Structural engineer: Aspect Structural Engineers

Architect: Jack James Architect

Developer, building designer and general contractor: Design Build Services (DBS)

Mass timber supplier/fabricator and 3D modelling: Structurlam Mass Timber Corporation

Steel brace designer and supplier: CoreBrace