BROOKLIN LIBRARY & COMMUNITY CENTRE

Submitted for the Canadian Consulting Engineering Awards 2012
Category: A. Buildings

PROJECT HIGHLIGHTS

If best practice in structural engineering is represented by projects that are ideally suited to the needs of the client while increasing efficiency and improving the sustainability and environmental impact, the Brooklin Library and Community Centre is a great example of such a project.

Nestled on a remnant forest in the historic village of Brooklin, Ontario, this 41,000 square foot, two-storey district Library and Community Centre includes a library, a gymnasium and a community wing with youth and senior centres, each housed under one of the three linked structures whose rooflines and simple forms evoke a barn-like aesthetic. With a budget of approximately $15 million, it was designed by Perkins + Will.

The Town of Brooklin wished to consolidate its library, athletic and community spaces into one new building. Their vision of the new facility was that it should seamlessly address its multiple functions, be environmentally responsible with an iconic presence. Our efficient design for the main structure and our innovative cable scissor truss solution for the three feature roofs met all of these requirements within the projects tight budget, resulting in an inviting community focal point.

Christian Bellini, a principal at Blackwell, and Michael Feindel, an associate at Blackwell, were the lead engineers on this project. We believe that this project showcases our firm's ability to provide an efficient structure using innovative technology that meets all program requirements, within a tight timeline. It also demonstrates our capacity to deliver on a large project with extensive, complex program requirements. For many reasons, we believe this project is an excellent candidate for an award from the Canadian Consulting Engineers.

Photo credit: Lisa Logan

PROJECT DESCRIPTION

INNOVATION AND COMPLEXITY

The biggest innovative engineering element of the project, as well as the most complex, was the three-dimensional cable scissor truss, which was used in each of the three main spaces of the building and which represents over 80% of the overall roof area. The architect's vision for the roof of the building had to meet a number of specific criteria:

- It had to be an innovative and unique structural truss design
- It had to be efficiently designed to meet a very tight budget
- It had to suit the agreed building form – a shed roof
- It had to be adaptable to the three main spaces, library, gymnasium and community use
- It had to allow sufficient headroom to suit the gymnasium
- It had to allow the different use spaces to be acoustically separated within the truss depth without impacting the truss form

We approached this challenge by starting with the idea of using a scissor-truss to address the shed roof form as well as maximizing headroom. Structural steel was chosen for the top chord of the truss as it achieved the long spans required with compact sizes and connections relative to glulam. To address conditions where walls had to be brought up to the tip of the roof to create acoustic separations between spaces, we came up with the idea of splaying the bottom tension chords in the horizontal plane to allow glazing to pass right up the centre axis of the truss (a detail of this is included in this submission). And finally, we decided on cable as the bottom "tension" chords of the truss to complete the unique character of the trusses. The trusses were

scaleable to each of the three spaces by varying the sizes of the top chords and cables. Wood deck was chosen over steel decking for its performance, aesthetic and environmental qualities.

While the standard solution for a project of this nature might have been a load-bearing masonry structure with flat roofs framed with open web steel joists, the design team's vision was a building making extensive use of glazing for natural light and a connection with the unique natural qualities of the site. Addressing these goals had a large impact on the complexity of the structure, and the challenge was to achieve this while maintaining the projects tight budget.

As mentioned, the most complex element was the three-dimensional cable scissor truss roof, which was used extensively. Design of this involved complex structural modeling to determine how it might behave under a variety of loading scenarios. In particular, the overall lightweight nature of the roof structure meant that under uplift wind loading, the cables of the truss would slacken. To address this, we pre-tensioned the cable structure and provided nominal moment capacity at the ridge node of the trusses.

Lateral support for the entire complex was also a challenge, give that its configuration, which was largely dictated by the site, meant that the whole complex comprised three main forms which each needed to be supported. Steel braced frames were primarily used. In the library, one of these frames had to be offset from the main structure to suit the architectural intent. Additional modeling was required to confirm that we could achieve this, and bring the lateral load back to the column grid using horizontal bracing, while concealing all of this from view.

EXCEEDING CLIENT NEEDS

Our prime objective is to solve the tough problems of architects and adding value to projects for owners. Our client's project goals were to construct a new building by consolidating three diverse uses to serve the community residents. For these goals to be reached, we had to meet a set of requirements which included:

1. Meet a tight budget
2. Become a destination for the local community
3. Be an iconic structure
4. Be sensitive to the existing site
5. Be sensitive to the environment

The owner was very pleased with the outcome of the project. Our direct client, the architect, was very happy to see their architectural vision for the structure come to life, particularly the unique visual impact of the three-dimensional cable scissor truss roof. The locating of the new structure on the existing site, preserving and engaging the hardwood forest met and took full advantage of the site requirements. The use of sustainable materials and natural lighting and shading met the environmental goals of the project.

ENVIRONMENTAL IMPACT

For this project, as we do on all our projects, we aimed to consider the environmental impact of every design decision we made. Elements of the program of this building speak directly to its sensitivity to environmental sustainability.

The building materials chosen for this project, both structural and finishes, contributed to lessening its environmental impact. Structural steel for the main building components is an excellent way to make use of recycled materials (structural steel has a very high recycled content) while achieving long spans with less material. The extensive use of wood, as structure in the wood decking, as well as in building finishes, also meets the sustainability goals. Sustainably sourced wood products are excellent design solutions because as opposed to other non-renewable materials that require large amounts fossil fuels to produce, wood helps reduce carbon dioxide emissions. In fact, Perkins + Will was presented with a Wood WORKS award from the Canadian Council for this project for its innovative use of wood.

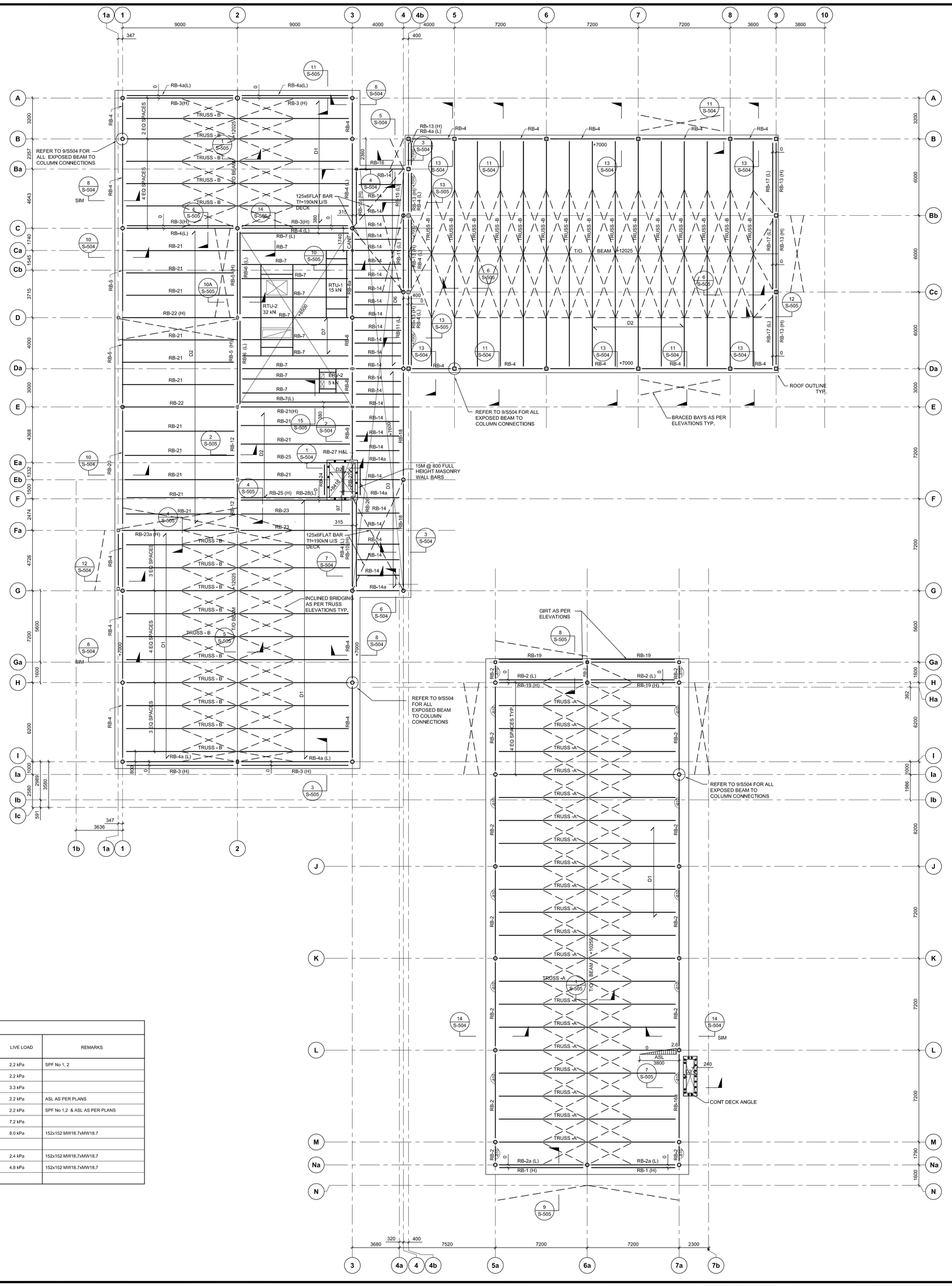
Additional features that contributed to lessening its environmental impact include:

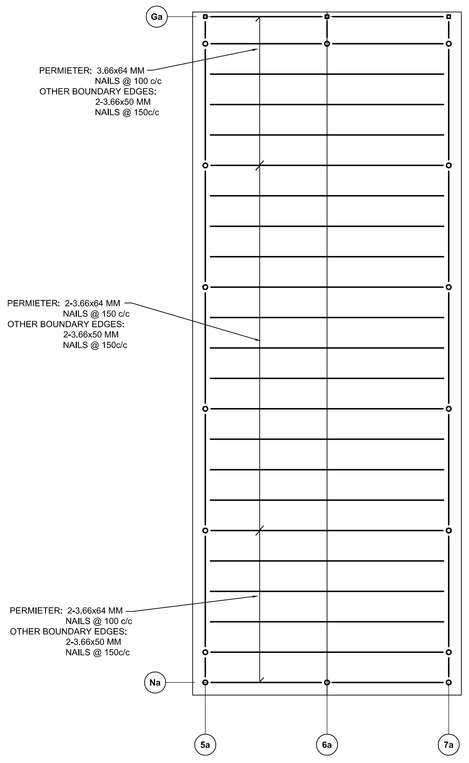
- preserving the existing hardwood forest on the site, as well as the natural topography and existing site irrigation patterns;
- the extensive use of natural light, as well as daylight sensors to ensure an even level of illumination;
- the South and West facing windows were outfitted with an internal wood grille that provides permanent attractive and maintenance free shading;
- stormwater management included filtering through bi-swales.

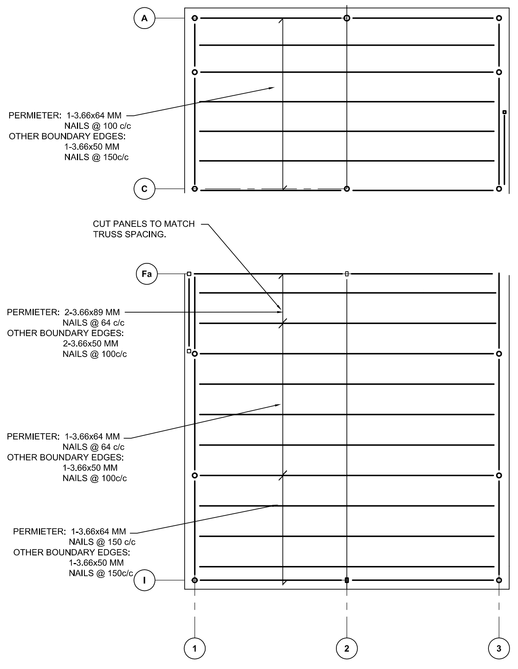
SOCIAL AND ECONOMIC BENEFITS

Our decisions in this project have obvious design and environmental merits, but in addition, they also served the growing community of Brooklin. At the time this project was conceived, its existing community infrastructure was ageing and inadequate. The Town identified the need for updated and enlarged facilities that would address these requirements, and conceived the idea of combining them in a new community hub on an existing site in the town centre. The site itself included a significant area of hardwood forest, and the development of the new facilities had to incorporate and preserve that feature.

The new building addresses all of these needs. Working closely with the owner, the design team came up with a landmark structure carefully located to preserve and take full advantage of the existing natural site features. It has provided the community with ample library, athletic and community resources to meet current and future needs. The building's iconic roof structure, which is also visible from the exterior approach, makes the library a popular destination. It has been well received by the community and has enhanced the lived experience of the residents it was developed to serve.







NAILING PLAN NOTES

1. ALL PLYWOOD TO BE 19 MM DOUGLAS FIR
2. EACH PANELS ARE TO BE INSALLED WITH PERIMETER NAILING AS SHOWN ON PLAN.
3. PERIMETER EDGE REFERS TO ABOVE TRUSS IN EAST-WEST DIRECTION
4. OTHER EDGES REFER TO NORTH-SOUTH DIRECTION
5. NAIL SPACING TO BE 300 MM C/C IN BOTH DIRECTIONS TYPICAL AT INTERIOR OF PANEL
6. PANELS ARE TO BE PLYWOOD, OSB, OR WAFERBOARD. CONFORM TO CSA-O121 FOR DOUGLAS FIR PYWOOD. PANELS ARE TO BE 1220x2400 OR LARGER EXCEPT WHERE SMALLER SHEETS ARE NEEDED NEAR BOUNDARIES.
7. STAGGER NAILING AT PANEL EDGES

ROOF FRAMING PLAN
1:125

1. ROOF DATUM IS 7000 ABOVE THE GROUND FLOOR DATUM EXCEPT AS CROSSED AND NOTED.
2. RIDGE LINE ELEATIONS ARE SHOWN ON PLAN REFER TO TOP OF STEEL
3. THE ROOF DATUM REPRESENTS THE UNDERSIDE OF METAL DECK AT ITS HIGHEST POINTS. THE ROOF SLOPES. SEE ARCHITECTURAL DRAWINGS FOR THE SLOPES.
4. TOP OF STEEL BEAMS ARE 0 mm BELOW THE ROOF DATUM UNLESS NOTED THUS -200. WHERE NOTED, THE DIMENSION IS RELATIVE TO THE ROOF DATUM.
5. JOISTS, TRUSSES AND BEAMS ARE ALL EQUALLY SPACED BETWEEN GRIDLINES UNLESS OTHERWISE NOTED
6. SUPERIMPOSED LOADS USED IN THE DESIGN:
   SNOW + RAIN = 2.21 kPa PLUS SNOW ACCUMULATION SHOWN ON PLAN
   DEADROOFING - 0.36 kPa
   SUSPENDED - 0.48 kPa (ON JOISTS AND BEAMS ONLY)
7. ASSUMED SELF WEIGHT OF STRUCTURE USED IN THE DESIGN:
   METAL DECK, 0.10 kPa
   STEEL JOISTS AND BEAMS, 0.38 kPa
8. L76x76x6.4 CONTINOUS DECK ANGLE AT ALL ROOF AREAS IS REQUIRED UNLESS NOTED OTHERWISE.
9. L102x102x9.5 CONTINOUS DECK ANGLE AT ALL ROOF AREAS WITH CONCRETE TOPPING IS REQUIRED UNLESS NOTED OTHERWISE.
10. REFER TO SECOND FLOOR PLAN FOR ROOF LOADING AND DECK SCHEDULE

DECK SCHEDULE

DECK MARK	DESCRIPTION	DEAD LOAD	LIVE LOAD	REMARKS
D1	38 WOOD DECK	0.7 kPa	2.2 kPa	SPF No 1, 2
D2	38 METAL DECK	1.0 kPa	2.2 kPa	
D3	38 METAL DECK	1.0 kPa	3.3 kPa	
D4	38 METAL DECK	1.0 kPa	2.2 kPa	ASL AS PER PLANS
D5	38 WOOD DECK	0.5 kPA	2.2 kPa	SPF No 1,2 & ASL AS PER PLANS
D6	38 METAL DECK	1.0 kPA	7.2 kPa	
D7	114 CONCRETE ON 38 METAL DECK	4.5 kPa	8.0 kPa	152x152 MW18.7xMW18.7
2D1	64 CONCRETE ON 38 METAL DECK	3.8 kPa	2.4 kPa	152x152 MW18.7xMW18.7
2D2	64 CONCRETE ON 38 METAL DECK	3.8 kPa	4.8 kPa	152x152 MW18.7xMW18.7

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SEAL:

LICENCE OF PROFESSIONAL ENGINEER
C. G. V. BELLINI
PROVINCE OF ONTARIO

ISSUE:		
3.	02.FEB.09	ISSUED FOR BUILDING PERMIT
2.	24.OCT.08	ISSUED FOR 50 % COSTING
1.	08.JULY.08	ISSUED FOR COSTING

PROJECT NAME:
BROOKLIN COMMUNITY CENTRE & LIBRARY

ADDRESS:
BROOKLIN, ONTARIO

FILE NAME:	CADD/BIM PROGRAM: AUTOCAD
DRAWN BY: G.C.	CHECKED BY: C.B.
SCALE: 1:125	PROJECT NUMBER: 080150

SHEET TITLE:
ROOF FRAMING PLAN

S-103

PLOT DATE: January 29, 2009
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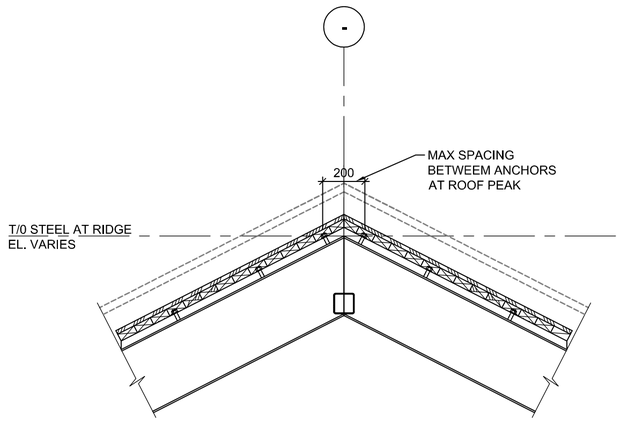

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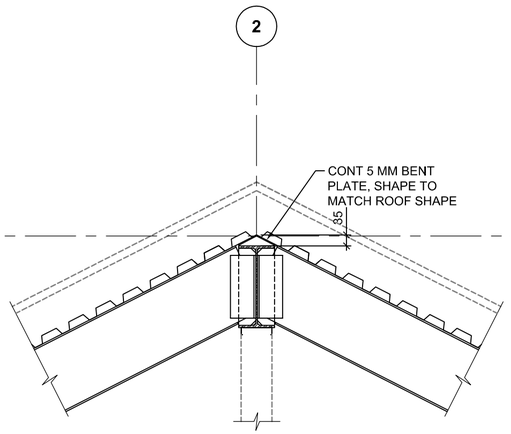

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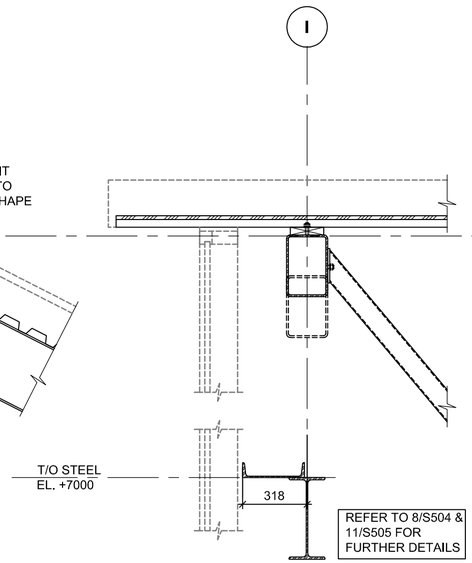

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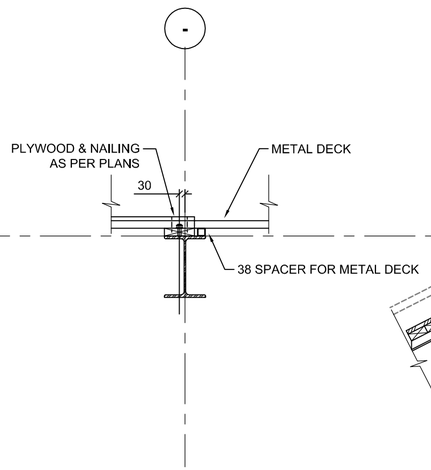

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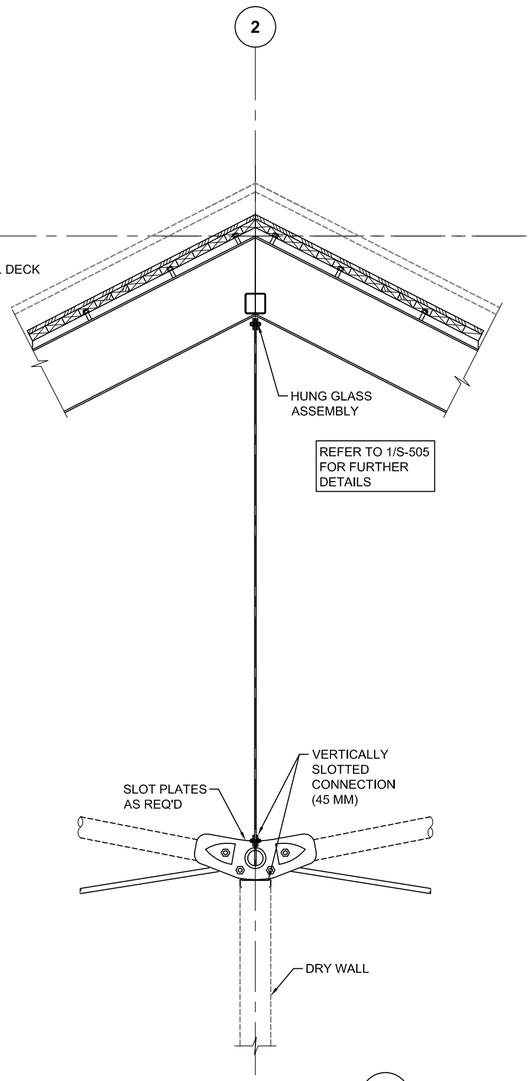

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Brooklin Community Centre
and Library
S505 - Selected Details