LANSDOWNE PARK
OTTAWA CIVIC CENTRE & NORTH STANDS

FEASIBILITY STUDY
OF
POSSIBLE REDEVELOPMENT

Prepared By

LEIBE ENGINEERING ASSOCIATES
MAY 2018

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1.0 Executive Summary

The purpose of the Feasibility Study of the proposed Lansdowne Park Redevelopment is to address the following question:

> -Are the existing structure and foundations of Ottawa Civic Centre and North Stands structurally adequate to allow for a redevelopment into a mixed-use Residential, Retail and Sports Complex, with a life expectancy of 50 years?

The findings of this Feasibility Study are as follows:

- The existing condition and under-capacity of the structure of Ottawa Civic Centre and North Stands has resulted in restrictions on use and occupancy.

- The recent refurbishment of the Ottawa Civic Centre and North Stands did not address the structural overload issues highlighted in previous reports by Adjeleian Allen Rubeli.

- The current Ontario Building Code requirements for Wind Loadings and Snow Loading & accumulations cannot be applied to this structure. A Wind Tunnel study and computer analysis has been recommended for any future redevelopment.

- The existing stadium roof structure is designed for wind swept conditions resulting in a reduced design snow load. Any new adjacent building, which is higher than the stadium roof, must be located such that the distance between the two buildings is 10 times the difference between the elevation of the high roof of the new building and the top of the full snow depth on the stadium roof.

- The two options for the redevelopment of the Civic Centre / North Side Stands represent a major change, addition or redevelopment as defined by the Ontario Building Code. A seismic upgrade of the structure would be required.

- A computer model of one of the box-girder frames was developed and analyzed for gravity and seismic loads. The results indicate that seismic upgrading of the existing building would impact the box-girder frames, secondary elements and foundations of Ottawa Civic Centre and North Stands.

- The seismic upgrade required to the box-girder frames, secondary elements and foundations would result in the demolition, replacement and reinforcement of substantially all of Ottawa Civic Centre and North Stands, along with additional structural elements such as bracing and foundations.

From the above findings, it was concluded that the existing structure and foundations of Ottawa Civic Centre and North Stands are not structurally adequate to allow for a redevelopment into a mixed-use Residential, Retail and Sports Complex, with a life expectancy of 50 years. The seismic upgrading, structural reinforcements and other Building Code upgrades, required for a redevelopment, would require the demolition of the existing Ottawa Civic Centre and North Stands.

2.0 Scope of Feasibility Study

The purpose of the Feasibility Study of the proposed Lansdowne Park Redevelopment is to address the following question:

> -Are the existing structure and foundations of Ottawa Civic Centre and North Stands structurally adequate to allow for a redevelopment into a mixed-use Residential, Retail and Sports Complex, with a life expectancy of 50 years?

Any limitations, other than structural, inherent to the existing Ottawa Civic Centre and North Stands and any possible redevelopment are not within the scope of this study.

We have been provided with the following reports from Adjeleian Allen Rubeli (AAR):

AAR letter, July 8, 2009	- Structural Summary Existing Conditions
AAR Report, September 2007	- Structural Adequacy Report 2007
AAR Report, August 2008	- 2008 Structural Adequacy Report including the Steel Box Girder Structural Investigation
AAR Report, November 2008	- 2008 Structural Design Analysis of Main Box Girder Frames

Along with:

As-Built Structural Shop Drawings	- Details of recent structural repairs undertaken
Trinity Development Group Ltd.	- Lansdowne Redevelopment Option #1
Trinity Development Group Ltd.	- Lansdowne Redevelopment Option #2

In order to address the above question, we have undertaken the following:

- Review available reports relevant to the existing building structure;
- Review available original structural drawings;
- Review drawings detailing recent structural repairs;
- Summarize findings of reports, structural repairs and information affecting redevelopment;
- Analyse the effects of seismic loading on the existing building structure;
- Prepare and present a report summarizing our findings.

3.0 Building Description

The Ottawa Civic Centre and North Stands were constructed in 1967. The Civic Centre Complex is a multi-functional facility incorporating an indoor arena, exterior stadium and associated seating, as well as an exhibition hall, assembly hall, service spaces, shipping and receiving, exterior access ramps, steps, and concourse area. The roof of the indoor arena, halls and spaces is provided by a long span steel roof structure and the precast seating of the exterior stadium. The long span roof structure, and the precast seating elements span between the eight main steel box girder frames. The main box girder frames are a series of three-pinned structures composed of several steel box girder elements that underly the exterior stadium seating, the interior arena seating, and the overhanging cantilevered roof structure. The stadium seating is partially protected by a roof which cantilevers beyond the top pin connections of the main box girder frames.

4.0 Previous Engineering Reports

Three previous Structural Engineering reports produced by Adjeleian Allen Rubeli (AAR) were provided and have been reviewed as part of this feasibility study. The deficiencies noted, analysis findings and recommended repairs (including associated costs) are listed in their "Executive Summaries", which have been reproduced for each of the reports, as follows:

4 .1 AAR Lansdowne Park - Structural Adequacy Report 2007
Executive Summary

"There has been, for a considerable time, a load restriction requirement for this structure which is to not permit simultaneous use of the arena and stadium during the winter months due to the design parameters of the original design. As a precautionary measure, it is our recommendation that the load restriction be expanded, as outlined in this report, until all suspected load distressed areas in the box girder arch frames have been located and repaired for all of the arch frames. The primary structure is comprised of eight, three pin, structural steel box girder arch frames. A visual inspection was carried out for those portions of the structure where access was visible. Detailed weld inspections and structural steel review was carried out by Inspec-Sol. Broken welds that were discovered were repaired and inspected by Inspec-Sol. The Civic Centre Arena and North Stadium structure were found to be generally in good condition with only local areas of distress and deterioration. Due to isolated conditions noted in the inspection of the steel box girder arch frames, it is recommended that non-destructive testing be carried out on the remaining box girders not tested, at the lower 20 ft. of the main girder on the north side. Furthermore, a full inspection of the remaining box girder arch frames, not inspected at this time, should be carried out within the next 2 years with repairs to noted areas also undertaken. The report identifies a full program of inspection, maintenance repairs and painting to be carried out in the next 5 years. An order of magnitude cost estimate for the investigations, repairs and re-conditioning of the structure is $1,685,000."

4.2 AAR Lansdowne Park - Structural Adequacy Report 2008, including Box-Girder Structural Investigation Executive Summary

"There has been, for a considerable time, a load restriction requirement for this structure, which is to not permit simultaneous use of the arena and stadium during the winter months due to the

design parameters of the original design. Further to the discovery of stress fractures in box girders B and C, a precautionary measure was introduced in our 2007 structural adequacy report, where by the existing load restriction was modified until all suspected load distressed areas in the box girder arch frames have been located and repaired for all of the arch frames. A full visual review of box girders A, D, E, and H was undertaken to complete the visual review undertaken in 2007. In addition, ultra sound testing was carried out by Inspec-Sol in box girders A, D, E, F, G and H in locations coinciding with the areas of steel distress found in box girders B and C in 2007. Based on our structural review and on-site observations, it is our recommendation that the expanded load restrictions be lifted. It should be noted; however, that the issue of load restrictions may have to be revisited pending the results of the structural design analysis of the frames for which the results will be issued in 2008 under separate cover. Remedial work pertaining to the areas of distress in box girders B and C have been prepared. The structural cost of this work is estimated at $6,000 plus GST. A reinspection interval of the box girders per the 2007 report remains in place, where all eight are to be inspected in 2013. The scope of work was further expanded to include a review of the upper and lower stadium concourses with regards to potential water infiltration through the membrane system. Based on our observations and understanding of the building, a full removal and reinstatement of the concrete topping and membrane system are recommended to provide long term sustainability of the upper and lower stadium concourses. The structural cost of this work is estimated at $3,355,000 plus GST. A structural review of the stadium corporate boxes was also included, where distress was noted in the secondary structural elements in March 2008 due to the roof snow loads. Based on our on-site observations, remedial details have been provided to reinstate the existing stadium corporate box structural steel to its original design intent. The structural cost of this work is estimated at $36,000 plus GST. Re-inspection is recommended in April 2009 and November 2009. Finally, it is our recommendation that the stadium roof structural steel be cleaned and painted to re-iterate our recommendations presented in the 2007 Structural Adequacy Inspection. The structural cost of this work is estimated at $1,445,000 plus GST."

4.3 AAR Lansdowne Park – 2008 Structural Design Analysis of Main Box Girder Frames Executive Summary

"Since the completion of construction of the Civic Centre at Lansdowne Park in 1967, there have been numerous changes, additions and repairs to this facility. In addition, codes and standards have changed in the 41 years of the existence of the Civic Centre. Further, there has recently been considerable interest in the redevelopment of all of Lansdowne Park, including the Civic Centre, together with the real possibility of professional football returning to this facility as a result of a conditional granting of a CFL franchise to a Proponent in Ottawa.

As a result of the above, the following questions were being asked:

• Does the building structure, with all the changes, additions, and repairs, still comply with current codes and standards, specifically the 2006 Ontario Building Code?

• Are there any restrictions or cost impacts in the redevelopment of the Civic Centre and in the Lansdowne Park land adjacent to the Civic Centre?

To respond to these questions, Adjeleian Allen Rubeli Ltd. was commissioned by the City of Ottawa to undertake a limited investigation of the structural capacity of the primary structural framing of the Civic Centre and, in addition, to advise on the limitations, if any, to its on going uses as originally intended, and restrictions on development in the near vicinity of the Civic Centre. The report provides details on all of the loading conditions including additional loading due to the many changes and additions over the years that have an impact on the primary structure, consisting of the main box girder arch frames. The structural analysis was undertaken for gravity loads only and did not include lateral loads. The findings from the structural design analysis and investigation are as follows:

• The dead load of the precast concrete seating reported on the original structural steel design detail drawings is significantly lower than the weight identified in the original precast concrete shop drawings. The weight of seating used in the steel design was 80 psf (3.84 kPa), whereas the precast shop drawings indicate a weight varying between 101 to 106 psf (4.85 kPa to 5.09 kPa), which was confirmed by site measurements.

• There are currently three operational modes for the facility, noted as:

- Fall stadium occupancy with partial snow load. No arena occupancy.
- Winter arena occupancy with snow load. No stadium occupancy.
- Occupancy of the arena and stadium simultaneously (no snow on roof).

Equivalent stress checks using the Limit States Design approach of the 2006 Ontario Building Code (OBC) indicated that with the exception of one element, all elements of the main box girder arch frames meet the requirements of the 2006 OBC for gravity loads. However, for all operational modes involving the full occupancy of the stadium seating, the ratio of load to resistance of the stadium raker beam exceeded acceptable code values at mid-span, in accordance with the provisions of the 2006 OBC, by a factor of 1.14 or 14% in the tension zone at the bottom flange. The ratio of load to resistance of the top flange exceeded acceptable code values in compression by 7% under the governing load combination. Further, a review of the impact of future development on the structural design gave rise to the following comments:

• For full use as a stadium, strengthening of the stadium raker beam is required to meet the 2006 OBC. Temporary loading restrictions are recommended in the interim until remedial work is undertaken.
• If minor local alterations or changes are made to the facility, then a seismic upgrade of the structure would not be required according to the OBC.
• If a major change or addition is made that has an impact on the structure, a seismic upgrade to meet the intent of the seismic provisions of the 2006 OBC would be required.
• The roof is designed for wind swept conditions resulting in a reduced design snow load. This is permitted under today's OBC as well as previous codes. Any new adjacent building, which is higher than the stadium roof, must be located such that the distance between the two buildings is 10 times the difference between the elevation of the high roof of the new building and the top of the full snow depth on the stadium roof."

4.4 Summary of Previous Report Findings

Findings, deficiencies and repairs listed in the previous reports can be summarized as follows:

1- There has been a load restriction requirement in place for the Ottawa Civic Centre and North Stands structure, which is to not permit simultaneous use of the arena and stadium during the winter months due to the design parameters of the original design. These restrictions are:

   - Fall stadium occupancy with partial snow load. No arena occupancy.
   - Winter arena occupancy with snow load. No stadium occupancy.
   - Occupancy of the arena and stadium simultaneously (no snow on roof).

2- Site inspections of the Ottawa Civic Centre and North Stands structure have found numerous defects including:

   - Cracked welds in the box girder arch frames;
   - Series of cracks in the plate walls of the box girder arch frames attributed to a lifetime of continuous vibration / load reversal due to wind and snow loading;
   - The upper and lower stadium concourses have deteriorated due to water infiltration through the membrane system. A full removal and reinstatement of the concrete topping and membrane system was recommended to provide long term sustainability of the upper and lower stadium concourses;
   - The secondary structural elements of the stadium corporate boxes are distressed due to the roof snow loads.

3- The upper and lower stadium concourses have deteriorated due to water infiltration through the membrane system. A full removal and reinstatement of the concrete topping and membrane system was recommended to provide long term sustainability of the upper and lower stadium concourses;

4- The original design dead load of the precast concrete seating reported on the original structural steel design detail drawings is significantly lower than the weight identified in the original precast concrete shop drawings. This results in the stadium raker beams being overloaded in the structural analysis undertaken for only gravity loads.

5- The structural analysis was used to determine equivalent stress checks using the Limit States Design approach of the 2006 Ontario Building Code (OBC). This indicated that, with the exception of one element, all elements of the main box girder arch frames meet the requirements of the 2006 OBC for gravity loads. However, for all operational modes involving the full occupancy of the stadium seating, the ratio of load to resistance of the stadium raker beam exceeded acceptable code values at mid-span, in accordance with the provisions of the 2006 OBC, by a factor of 1.14 or 14% in the tension zone at the bottom flange. It should be noted that the stadium raker beam is the primary structural member that supports the precast seating for the north stands. For full use as a stadium, strengthening of the stadium raker beam is required to meet the current OBC requirements. Temporary loading restrictions were recommended in the interim until remedial work is undertaken.

6- If a major change, addition or redevelopment is made that has an impact on the structure, a seismic upgrade to meet the intent of the seismic provisions of the 2012 OBC would be required.

7- The roof is designed for wind swept conditions resulting in a reduced design snow load. This is permitted under today's OBC as well as previous codes. Any new adjacent building, which is higher than the stadium roof, must be located such that the distance between the two buildings is 10 times the difference between the elevation of the high roof of the new building and the top of the full snow depth on the stadium roof.

8- The current Ontario Building Code requirements for Wind Loadings and Snow Loading & Accumulations cannot be applied to this structure. A Wind Tunnel study and computer analysis has been recommended to determine the appropriate Design Wind Loading and Snow Load Accumulations to be used in any structural analysis required to future development.

9- Recommended investigative and repair cost estimates from the reports are as follows:

-AAR Lansdowne Park - Structural Adequacy Report 2007

Investigations, repairs and re-conditioning of the structure $1,685,000

-AAR Lansdowne Park - Structural Adequacy Report 2008

Upper and lower stadium concourse replacement	$3,355,000
Corporate box structural steel	$36,000
Roof structural steel - cleaned and paint	$1,445,000
	$4,836,000

5.0 2012-2015 Lansdowne Park Refurbishment

The recent refurbishment of Ottawa Civic Centre and North Stands included a significant amount of structural work. From a review of the provided shop drawings, the scope of this structural work consisted primarily of structural reinforcement, repairs, and remediations to cracked members, welds and connections.

A listing of the structural work undertaken included:

- Arena Roof Hangers
- Cantilever Raker Reinforcement & Welding
- Arena Joist Shoe Repair Details
- Secondary Beam Reinforcement Details
- Truss 1200 Reinforcement Details
- Upper Concourse Bracing Reinforcements
- Primary Beam Reinforcements
- Arena Roof Opening Reinforcement
- Cantilever Raker Reinforcing. & Raker A Connection Plate
- Beam BUV668 Reinforcement
- Splice Plate Replacement for Rakers
- Box Girder Reinforcements
- Add. Box Girder Reinforcements & Bolt Replacement
- Arena Upper Hanger Reinforcement Detail
- Box Girder Weld Remediation Detail
- Raker Weld Remediation Detail
- Raker C - Top Flange Additional Weld Detail
- Raker A Welding Repair
- Cracked Arena Raker Reinforcement
- Raker Top Repairs & Precast Knee Brace Reinforcing
- Alternate Splice Plate Replacement Detail – Reinforcing
- Ext. Main Concourse Diaphragm Bracing Reinforcing
- Hanger A & B Reinforcements

It is our opinion that this structural reinforcement, repairs, and remediations to cracked members, welds and connections is maintenance work that accumulated over the life time of Lansdowne Park and addresses some of the findings, deficiencies and repairs presented in Items 2 and 3 of Section 4.4 of this report. None of this work addresses the significant deficiencies items noted in Items 1, 4, 5, 6, and 7 above.

6.0 Possible Future Development

Two options, #1 and #2, for the possible redevelopment of the Civic Centre / North Side Stands have been provided. These have been attached to this report in Appendices A & B. The options included single or multiple residential towers located within or adjacent to Lansdowne Park. They also included the removal of the ice rink & arena stands and replacement with a new commercial retail level and below ground parking. Each of these redevelopment options are considered to be a major change, as defined by the Ontario Building Code 2012, and a seismic upgrade of the structure to meet the current requirements of Ontario Building Code would be required. Specifically, this means the structure of the redeveloped Lansdowne Park must meet the Seismic Load requirements of Section 4.1.8.11. New braced frames and foundations would be required throughout the entire structure to resist the seismic forces in two orthogonal directions. Existing structural elements, i.e. floor and roof deck, diaphragms, collector beam, chords, struts and connections, must meet the specific requirements of Section 4.1.8.15. Similarly, the foundations of the redeveloped Lansdowne Park must meet the requirements of Section 4.1.8.16. Failure of the existing structure, elements and foundations to meet these seismic requirements would require their removal and replacement by seismically adequate structures, elements and foundations. It was therefore considered necessary to evaluate the impact of these requirements on the existing structure, elements and foundations of the Civic Centre / North Side Stands. A simplistic computer model, dealing with the box-girder frame and foundations only, and its analysis was chosen as the method of evaluation and is presented in the next section.

7.0 SAP2000 Modelling & Analysis Summary

For purposes of this report, a computer model of one of the box-girder frames was developed and analyzed for gravity and seismic loads. The box-girder frame is the primary structural element of Lansdowne Park. We developed the finite element (FEM) model in SAP2000, a three-dimensional structural analysis/design software. We derived the properties of the box girder elements from Adjeleian Allen Rubeli's reports and the original Dominion-Bridge shop drawing.

The gravity loads applied to the model, Dead Loads and Live Loads, we taken from AAR's analysis report. Where-as the AAR's analysis included only gravity loads and wind load uplift on the cantilever, we have also included seismic loads in the analysis in order to estimate the changes to the forces in the structural members and on the foundations if the requirements of the Ontario Building Code 2012 are applied. The finite element model, the loads used in the analysis of the finite element model, and the results of the analysis are tabled in Appendix C.

The analysis results provide member stresses for each of the finite elements (Box girder sections) and the foundation reactions for several distinct load combinations.

These load combinations are:

D	Dead Load
D + L	Dead + Live Loads
D + S	Dead + Snow Loads
D + SEISMIC S-N + 0.25S	Dead + Seismic S-N + 25% Snow Loads
D + SEISMIC N-S + 0.25S	Dead + Seismic N-S + 25% Snow Loads

The first three load combinations represent the gravity loads applied to the structure, similar to AAR's analysis and report. The last two load combinations represent the seismic loads applied to the structure in each direction, along with the self weight of the building (Dead Load) and 25% of the Snow load.

A review of the results shows that the foundation forces or reactions of the structure on the underlying soil are significantly higher when the seismic loads are applied, in comparison to when only gravity loads are applied. This would indicate that the existing foundations and underground foundation ties are likely inadequate for any proposed redevelopment. Similarly, several of the box girder sections have significantly higher stresses when the seismic loads are applied. From the previous analyses by AAR, see Items 4 & 5 of Section 4.4 above, we know that some of the box girder sections are already overloaded due to gravity loading which has resulted in restrictions on use and occupancy, see Item1 of Section 4.4. The box girder sections would therefore have to be replaced or significantly reinforced.

8.0 Conclusions

The findings of this Feasibility Study are as follows:

- The existing condition and under-capacity of the structure of Ottawa Civic Centre and North Stands has resulted in restrictions on use and occupancy.

- The recent refurbishment of the Ottawa Civic Centre and North Stands did not address the structural overload issues highlighted in previous reports by Adjeleian Allen Rubeli.

- The current Ontario Building Code requirements for Wind Loadings and Snow Loading & accumulations cannot be applied to this structure. A Wind Tunnel study and computer analysis has been recommended for any future redevelopment.

- The existing stadium roof structure is designed for wind swept conditions resulting in a reduced design snow load. Any new adjacent building, which is higher than the stadium roof, must be located such that the distance between the two buildings is 10 times the difference between the elevation of the high roof of the new building and the top of the full snow depth on the stadium roof.

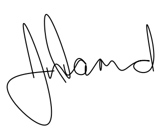
- The two options for the redevelopment of the Civic Centre / North Side Stands represent a major change, addition or redevelopment as defined by the Ontario Building Code. A seismic upgrade of the structure would be required.

- A computer model of one of the box-girder frames was developed and analyzed for gravity and seismic loads. The results indicate that seismic upgrading of the existing building would impact the box-girder frames, secondary elements and foundations of Ottawa Civic Centre and North Stands.

- The seismic upgrade required to the box-girder frames, secondary elements and foundations would result in the demolition, replacement and reinforcement of substantially all of Ottawa Civic Centre and North Stands, along with additional structural elements such as bracing and foundations.

From the above findings, it was concluded that the existing structure and foundations of Ottawa Civic Centre and North Stands are not structurally adequate to allow for a redevelopment into a mixed-use Residential, Retail and Sports Complex, with a life expectancy of 50 years. The seismic upgrading, structural reinforcements and other Building Code upgrades, required for a redevelopment, would require the demolition of the existing Ottawa Civic Centre and North Stands.

Report prepared and submitted by



James Diamond, P. Eng.
Partner

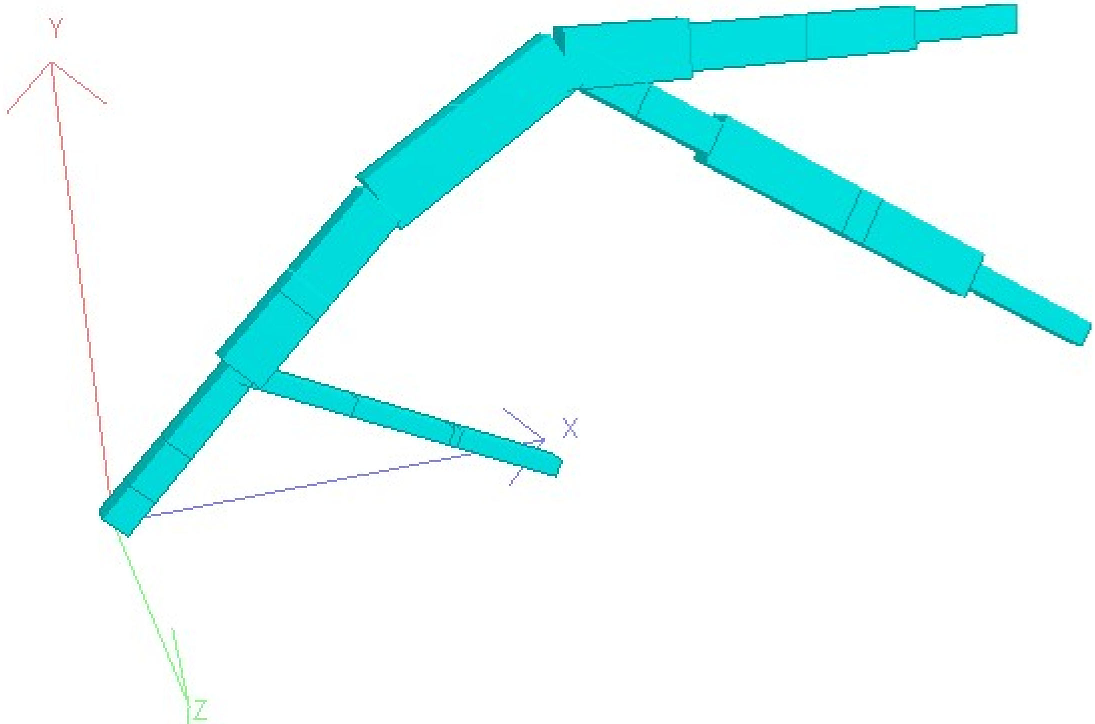
Appendix A – Redevelopment Option #1

Appendix B – Redevelopment Option #2

Appendix C – SAP2000 Computer Model & Results

STRUCTURAL DESIGN ANALYSIS
MAIN BOX GIRDER FRAMES

LANSDOWNE PARK
OTTAWA CIVIC CENTRE & NORTH SIDE STANDS



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MAY 2018

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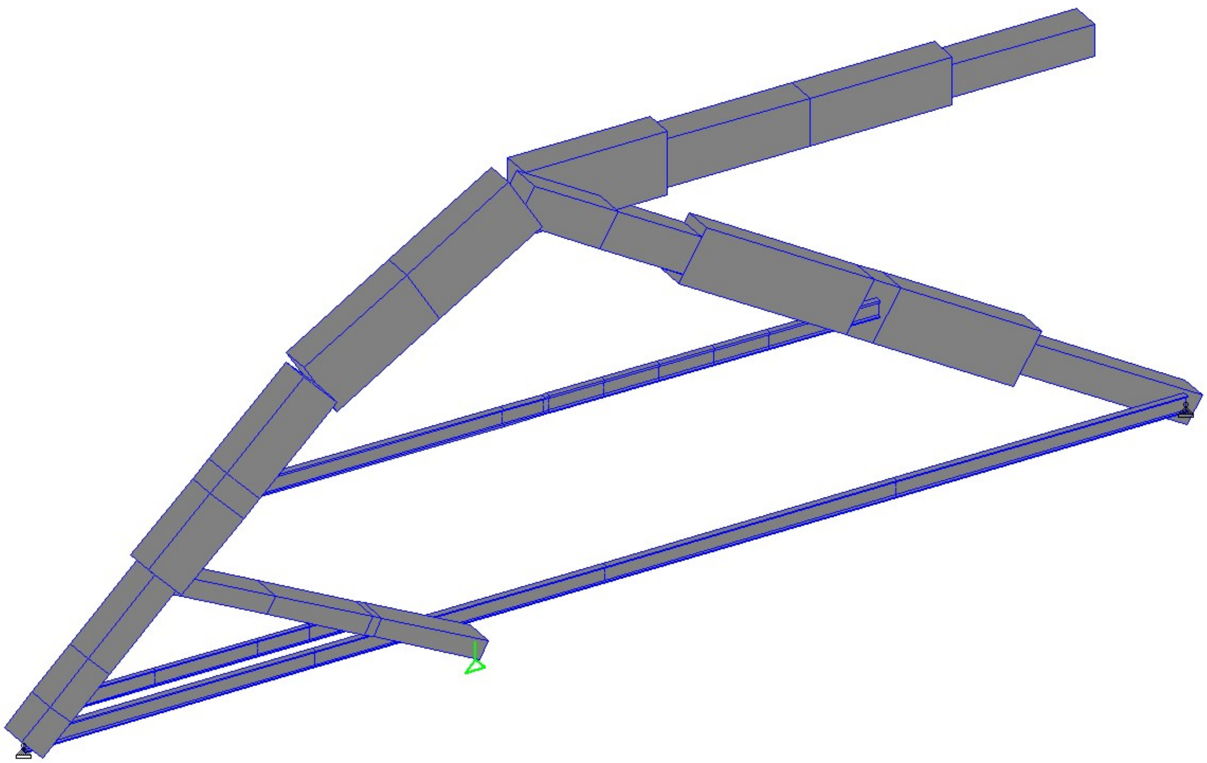
COMPUTER MODEL

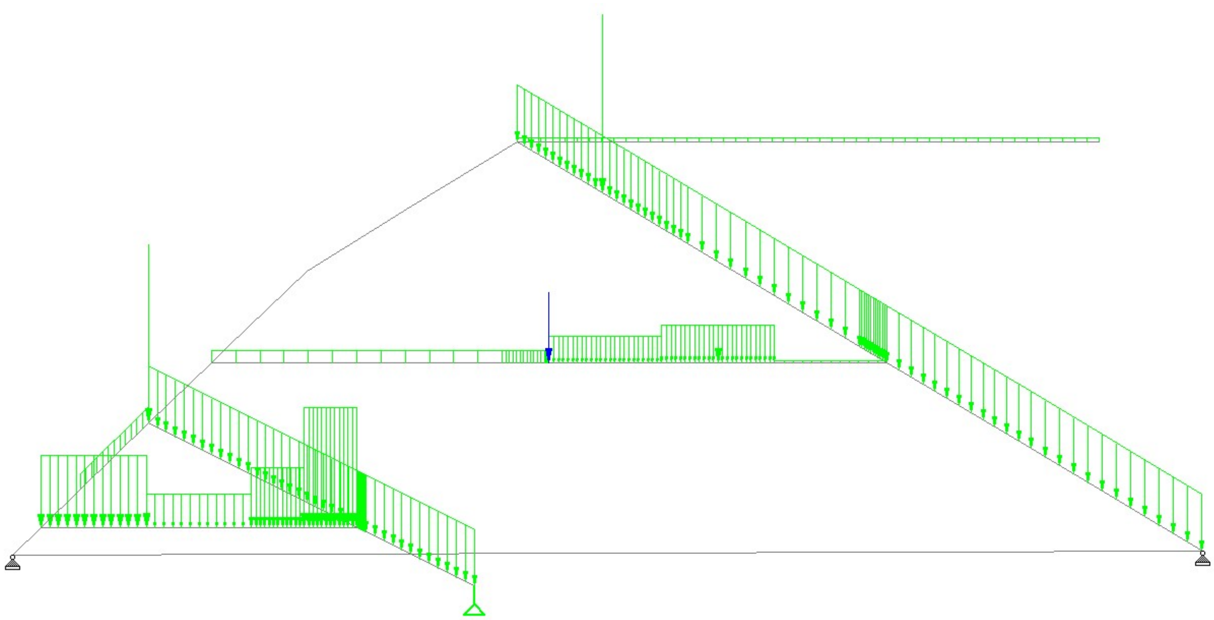
STAAD PRO 3D MODEL:



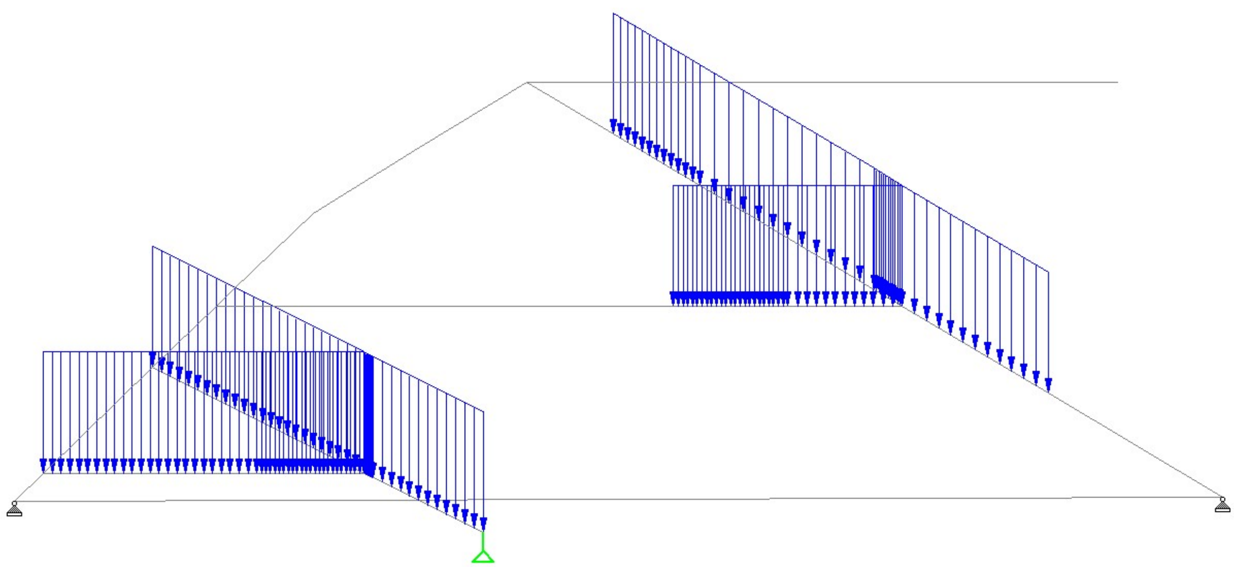
LOADING DIAGRAMS

Dead Loads:

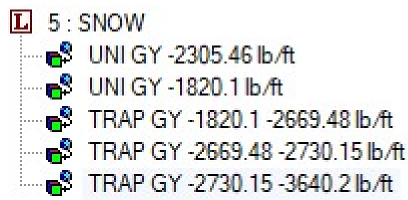
3 : DEAD
- UNI GY -1371.14 lb/ft
- UNI GY -3160.91 lb/ft
- UNI GY -448.96 lb/ft
- UNI GY -6734.37 lb/ft
- UNI GY -273.02 lb/ft
- UNI GY -4386.44 lb/ft
- UNI GY -1898.97 lb/ft
- UNI GY -8493.8 lb/ft
- UNI GY -3967.82 lb/ft
- UNI GY -7037.72 lb/ft
- UNI GY -14136.1 lb/ft
- FY -8129.78 lb,ft
- FY -32519.1 lb,ft
- FY -1122 lb,ft
- FY -4000 lb,ft
- FY -1312.5 lb,ft
- FY -3255 lb,ft
- FY -12837.8 lb,ft

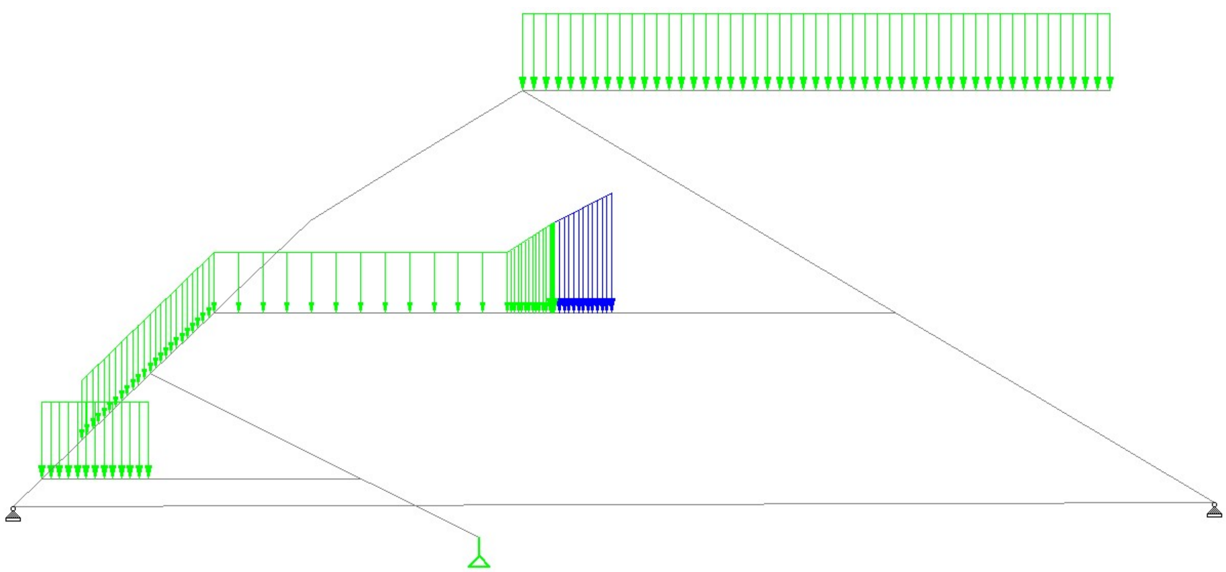


Live Loads:



Snow Loads:


5 : SNOW
UNI GY -2305.46 lb/ft
UNI GY -1820.1 lb/ft
TRAP GY -1820.1 -2669.48 lb/ft
TRAP GY -2669.48 -2730.15 lb/ft
TRAP GY -2730.15 -3640.2 lb/ft



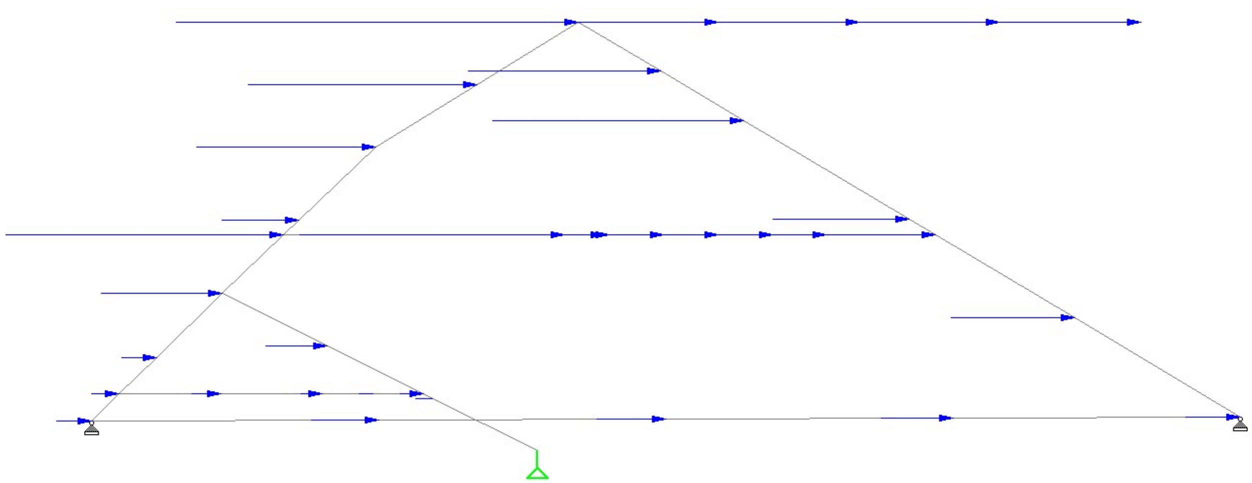
Seismic S-N:

Seismic Parameters

Type : CANADIAN: NRC - 2005

Parameter	Value
Sa(0.2) (SA1)	0.64
Sa(0.5) (SA2)	0.31
Sa(1.0) (SA3)	0.14
Sa(2.0) (SA4)	0.046
Importance factor (I)	1.3
Site class (SCL)	4
Higher Mode Factor, Mvx	1
Higher Mode Factor, Mvz	1
Base Overturning Reduction Factor, Jx	1
Base Overturning Reduction Factor, Jz	1
Force Modification Factor, (Rdx)	1.5
Force Modification Factor, (Rdz)	1.5
Force Modification Factor, (Rox)	1.3
Force Modification Factor, (Roz)	1.3

1 : SEISMIC S-N
NRC LOAD X



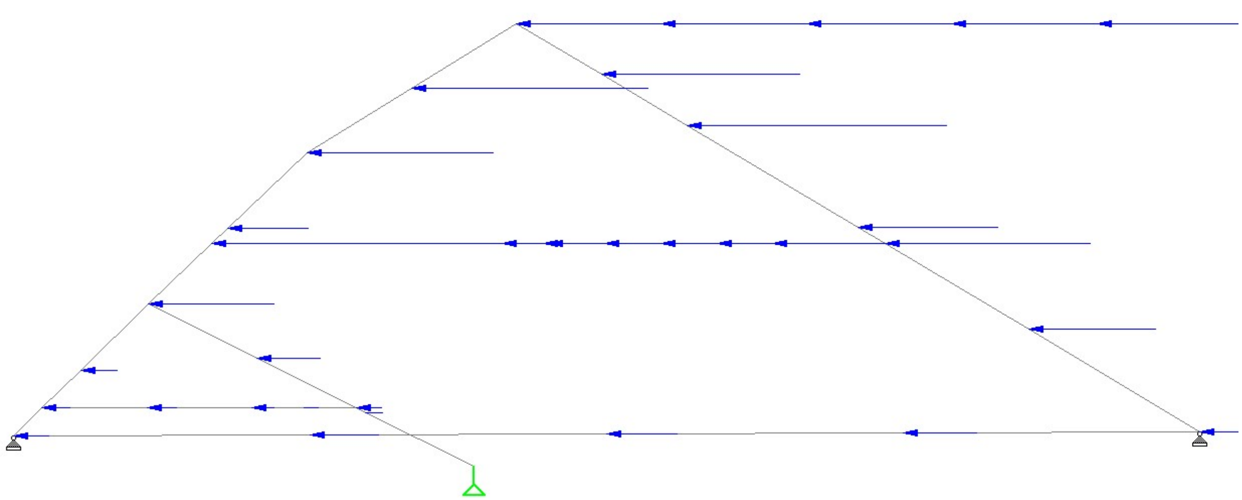
Seismic N-S:

Seismic Parameters

Type : CANADIAN: NRC - 2005

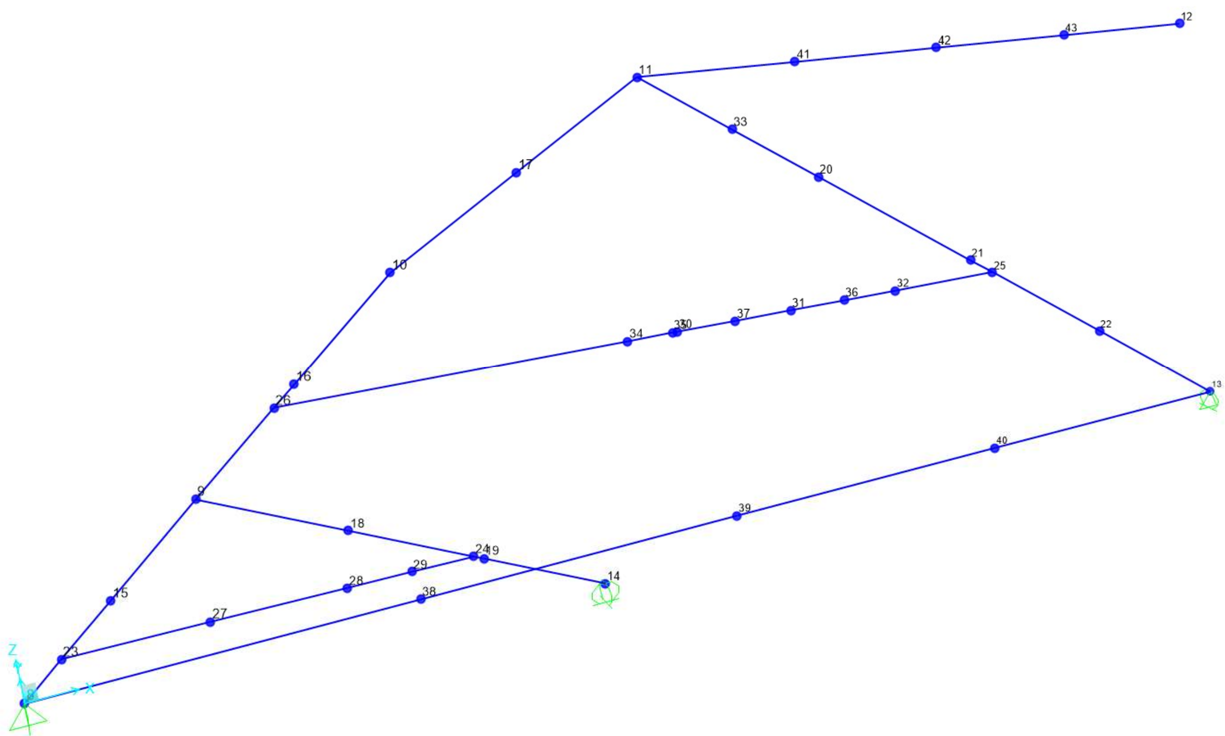
Parameter	Value
Sa(0.2) (SA1)	0.64
Sa(0.5) (SA2)	0.31
Sa(1.0) (SA3)	0.14
Sa(2.0) (SA4)	0.046
Importance factor (I)	1.3
Site class (SCL)	4
Higher Mode Factor, Mvx	1
Higher Mode Factor, Mvz	1
Base Overturning Reduction Factor, Jx	1
Base Overturning Reduction Factor, Jz	1
Force Modification Factor, (Rdx)	1.5
Force Modification Factor, (Rdz)	1.5
Force Modification Factor, (Rox)	1.3
Force Modification Factor, (Roz)	1.3

2 : SEISMIC N-S
NRC LOAD X



RESULTS

Node Labels: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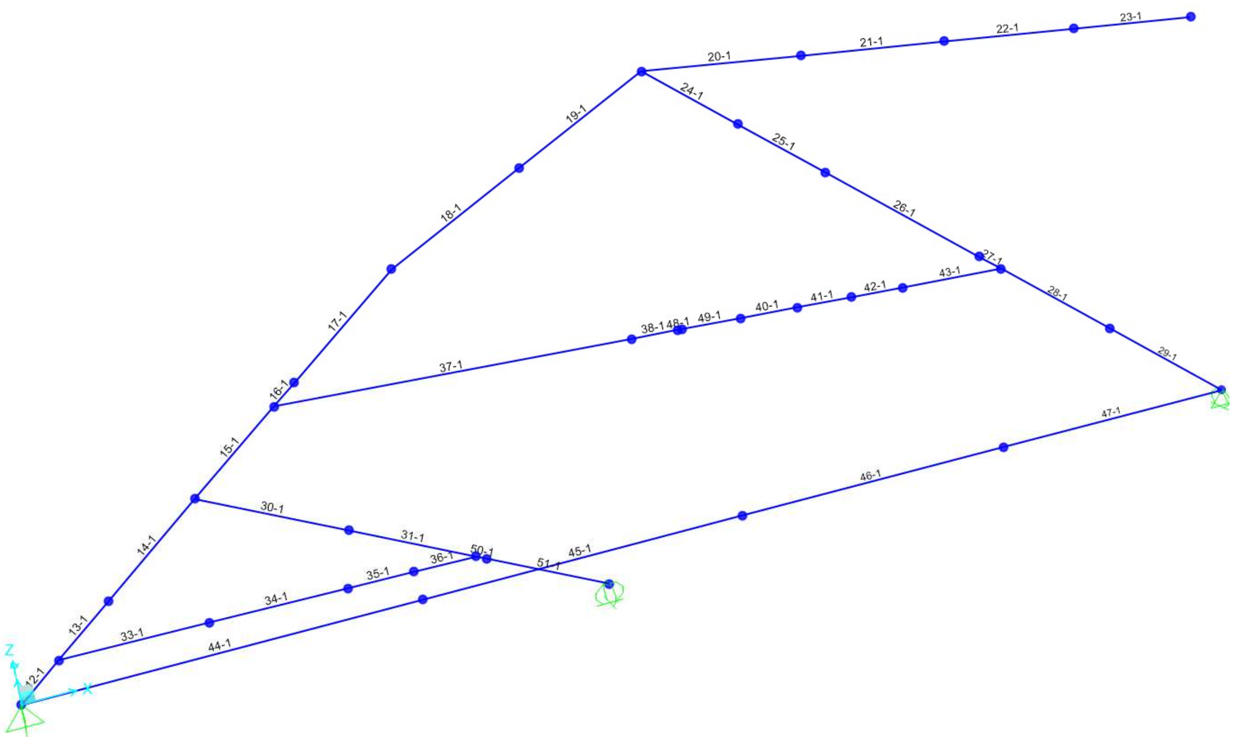
Beam Labels: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22-1
23-1
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36-1
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51-1
35-1
34-1
13-1
33-1
44-1
12-1
Z
X

Support Reactions:

TABLE: Joint Reactions						
Joint	**OutputCase**	**Fx**	**Fy**	**Fz**	**Fx**	**Fy**
Text	Text	Kip	Kip	Kip	%	%
8	D	2048	1794	0		
8	D + L	3200	2722	0		
8	D + S	2457	2141	0		
8	D + SEISMIC S-N + 0.25S	279	828	0		
8	D + SEISMIC N-S + 0.25S	4022	2934	0	126%	108%
13	D	-2048	1608	0		
13	D + L	-3200	2354	0		
13	D + S	-2457	1887	0		
13	D + SEISMIC S-N + 0.25S	-3785	2495	0	118%	106%
13	D + SEISMIC N-S + 0.25S	-516	861	0		
14	D	0	161	0		
14	D + L	0	302	0		
14	D + S	0	117	0		
14	D + SEISMIC S-N + 0.25S	0	386	0		128%
14	D + SEISMIC N-S + 0.25S	0	-86	0		

Arena Raker Beam SVM Stresses:

TABLE: Beam Stress			
Beam	**OutputCase**	**SVM Stress**	**Stress Ratio**
Text	Text	Ksi	
30	Dead	12.25	
	Dead + Live	22.05	
	Dead + Snow	11.32	
	Dead + Seismic S-N + 0.25S	14.23	
	Dead + Seismic N-S + 0.25S	9.84	
31	Dead	12.25	
	Dead + Live	22.05	
	Dead + Snow	11.32	
	Dead + Seismic S-N + 0.25S	15.02	
	Dead + Seismic N-S + 0.25S	10.42	
50	Dead	4.07	
	Dead + Live	8.09	
	Dead + Snow	1.71	
	Dead + Seismic S-N + 0.25S	10.32	1.28
	Dead + Seismic N-S + 0.25S	5.03	
51	Dead	4.07	
	Dead + Live	8.09	
	Dead + Snow	2.21	
	Dead + Seismic S-N + 0.25S	10.1	1.25
	Dead + Seismic N-S + 0.25S	4.17	

Stadium Raker Beam SVM Stresses:

TABLE: Beam Stress			
Beam	**OutputCase**	**SVM Stress**	**Stress Ratio**
Text	Text	Ksi	
24	Dead	8.06	
	Dead + Live	11.68	
	Dead + Snow	10.07	
	Dead + Seismic S-N + 0.25S	7.85	
	Dead + Seismic N-S + 0.25S	9.30	
25	Dead	10.57	
	Dead + Live	16.59	
	Dead + Snow	13.21	
	Dead + Seismic S-N + 0.25S	9.39	
	Dead + Seismic N-S + 0.25S	13.07	
26	Dead	10.57	
	Dead + Live	16.59	
	Dead + Snow	13.21	
	Dead + Seismic S-N + 0.25S	9.63	
	Dead + Seismic N-S + 0.25S	12.82	
27	Dead	3.49	
	Dead + Live	5.35	
	Dead + Snow	5.94	
	Dead + Seismic S-N + 0.25S	5.48	
	Dead + Seismic N-S + 0.25S	4.64	
28	Dead	8.93	
	Dead + Live	13.45	
	Dead + Snow	10.90	
	Dead + Seismic S-N + 0.25S	9.62	
	Dead + Seismic N-S + 0.25S	9.23	
29	Dead	15.70	
	Dead + Live	23.34	
	Dead + Snow	19.22	
	Dead + Seismic S-N + 0.25S	15.75	
	Dead + Seismic N-S + 0.25S	17.41	

Roof Box Girder SVM Stresses:

TABLE: Beam Stress			
Beam	**OutputCase**	**SVM Stress**	**Stress Ratio**
Text	Text	Ksi	
20	Dead	7.35	
	Dead + Live	7.35	
	Dead + Snow	17.14	
	Dead + Seismic S-N + 0.25S	10.79	
	Dead + Seismic N-S + 0.25S	10.79	
21	Dead	5.85	
	Dead + Live	5.85	
	Dead + Snow	13.89	
	Dead + Seismic S-N + 0.25S	8.67	
	Dead + Seismic N-S + 0.25S	8.67	
22	Dead	2.53	
	Dead + Live	2.53	
	Dead + Snow	6.12	
	Dead + Seismic S-N + 0.25S	3.88	
	Dead + Seismic N-S + 0.25S	3.88	
23	Dead	1.08	
	Dead + Live	1.08	
	Dead + Snow	2.68	
	Dead + Seismic S-N + 0.25S	1.65	
	Dead + Seismic N-S + 0.25S	1.65	