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Sojka Pavilion and Kinney Natatorium – Bucknell University
Lewisburg Pa
Lepage
Technical Assignment #1
October 5, 2006

Executive Summary:

This Report is a Structural Analysis of Sojka Pavilion and Kinney Natatorium, located on the Campus of Bucknell University in Lewisburg Pa. The report includes a description of the structural system and design codes as well as an analysis of the lateral forces and typical floor elements.

Sojka Pavilion and the Kinney Natatorium were constructed on the Bucknell campus in and finished in May 2003 as part of an addition to the existing Robert Langone Recreation and Athletic Center. At over 122,000 Square feet the new portion of the building houses a NCAA regulation size pool and a basketball arena that seats 4000. Because of this large spans are used which could affect the way the Lateral loads are distributed through the building.

The exterior structural system of the building consists of cold formed steel members. These members are supported laterally by both steel cross members and cmu shear walls. The roof is supported in both structures by a combination of open web steel joist comprised of W shape steel members on the top and bottom cords and steel angles as the web members and simply supported W shape steel members.

A typical floor spot check was preformed on the composite floor system in the second floor of the Sojka Pavilion as well as a typical beam supporting the roof. The results of these spot checks showed that the existing elements are slightly overdesigned. This could possibly be attributed to higher superimposed dead loads in the initial design. A more in depth discussion of the discrepancies is provided in this report.

In addition to the floor spot check simplified lateral analyses were performed to determine the forces induced by wind and seismic forces. These lateral analyses were done using ASCE 7-05. The wind forces seem to be higher then expected. The seismic forces determined in this report also are higher than the forces determined in the original design. This report show that seismic is the controlling lateral design force.

Also included in this report are other structural issues that will need to be addressed with further investigation, including footing capacities and exterior wall deflection.

Introduction:

Sojka Pavilion and the Kinney Natatorium are 122,000+ Sqft addition to the Robert Langone Recreation and Athletic center build to house a 4000 seat basketball arena and NCAA regulation size swimming pool on the campus of Bucknell University in Lewisburg Pennsylvania. Because of there functions both buildings require clear spans of over 100' which could affect the distribution of lateral forces. For the purpose of this report the lateral loads will be applied along the length of the building.

Overall Structural System:

The ground floor of both the Sojka Pavilion and Kinney Natatorium is a 5" deep concrete slab on grade, reinforced by 6x6 W2.9x W2.9 welded wire fabric. The second floor of each building is a composite construction, using 2" deep 18 gauge metal decking with ¾" x 5" shear studs and 6 ½" deep concrete slab. This floor is supported by W shape steel beams varying in size as needed.

Bearing walls are W shaped steel columns of varying size support on concrete continuous footings. The columns are supported laterally by steel cross bracing and cmu shear walls.

The foundation is comprised of Strip footings. The strip footings range from 1'6" to 8' wide and 1'6" to 4' deep. They are reinforced with continuous #8 or 9 bars with additional reinforcement as required. These strip footings carry concentrated loads from columns and distributed loads from walls. The Footings were designed with a soil bearing capacity of 2500 PSF.

The lateral force resisting system of the Sojka Pavilion and Kinney Natatorium is comprised of X-braced shear walls. The shear walls are located along all 4 walls of both adjoining builidings. The X-bracing uses both steel angles and tubular steel.

Design Codes and Code Requirements:

- BOCA 1999 – Building Officials Code Administrators
- ASCE 7-95 – Minimum Design Loads For Buildings
- ACI 301 – Specifications for Structural Concrete
- ACI 318 – Building Code Requirements for Structural Concrete
- AISC Manual of Steel Construction, LRFD
- AISI – American Iron and Steel Institute

Material Strengths:

Concrete:

- Normal Weight, 4000 psi
- Normal Weight, 3500 psi on Metal Deck
- Reinforcing bars – ASTM A615 Grade 60
- Welded Wire Mesh – ASTM A 185

Concrete Masonry Units:

- Normal Weight, 2500 psi
- Joint Reinforcement – ASTM A-153, Grade B

Structural Steel:

- Steel Shapes for Beams/Columns – ASTM A992, Grade 50
- Angles, Plates and Channels – ASTM A36
- High-Strength Bolts – ASTM A325

Gravity Design Loads:

Dead Loads:

- See Appendix

Live Loads:

- Roof – 20 PSF
- Snow – 30 PSF
- Public Area – 100 PSF
- Fixed Seating – 60 PSF
- Movable Seating – 100 PSF
- Office Areas (including partitions) – 70 PSF
- Concession Areas – 100 PSF
- Storage Areas – 125PSF
- Mechanical Areas – 150 PSF
- Stairs – 100 PSF

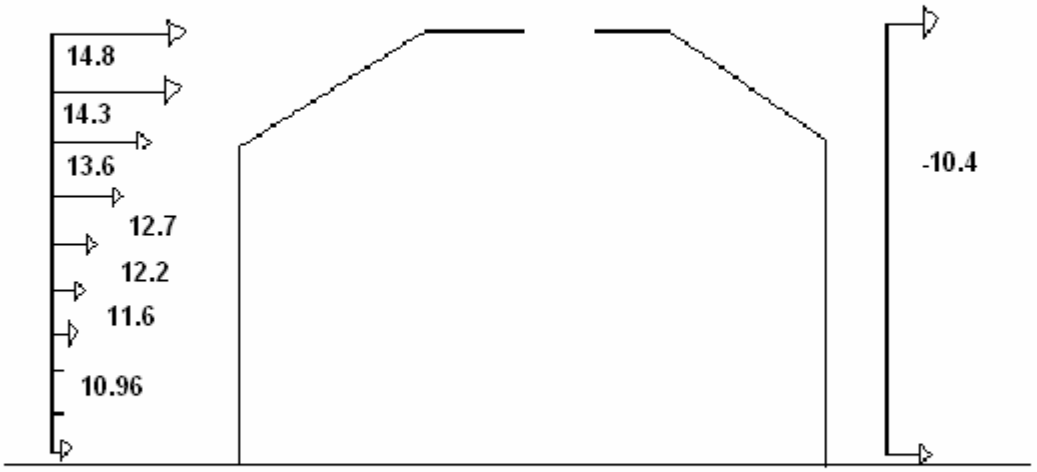
Wind Design Loads:

Wind Loads were calculated using IBC 2003 and ASCE 7-05 and the following design factors:

V= 90 MPH
I = 1.15
K_{zt}= 1
K_d= .85

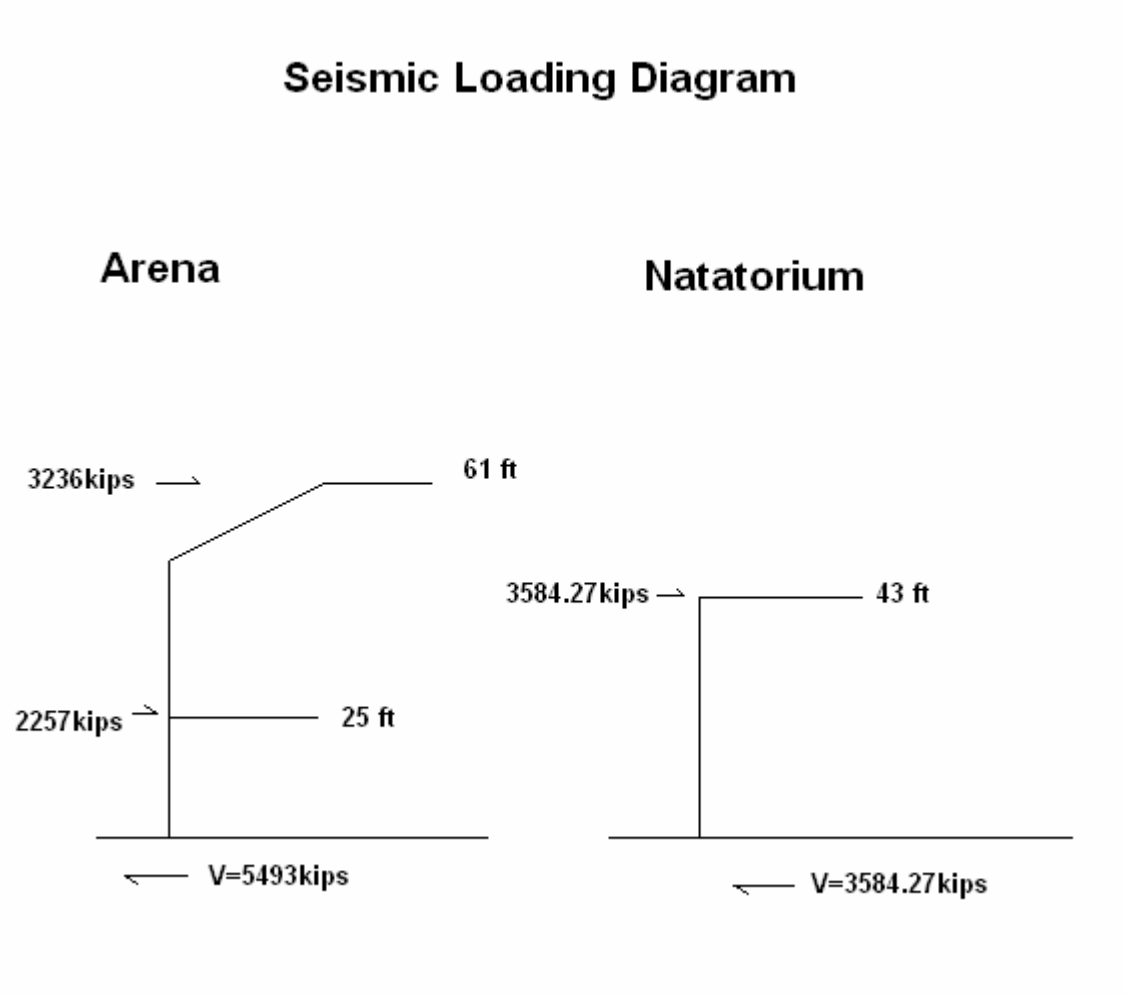
The building is category II with an exposure category B. The wind loading diagram is shown below. Detailed calculations can be found in Appendix.

Wind Loading Diagram



Seismic Design Loads:

Seismic Loads were calculated using IBC 2003 and ASCE 7-05 See Appendix for Calculations.



Appendix