

# Press Box and Concessions Building

May 12, 2006  
ENGR 340



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## **I. Executive Summary**

The Athletics have been given the opportunity to work with the Health Physical Education Recreation Dance and Sport (HPERDS) department. The HPERDS department is located at Calvin College and is the head of all athletic programs at Calvin. It was their request for the design of two buildings to accommodate athletic personnel at the track and soccer field. The buildings designed by the Athletics were: a press box and a concessions building which includes restrooms. A full plan set was created along with two scale models. Another concern of the HPERDS department was snow accumulation on the track. Solutions were formulated and selected by the Athletics to manage this accumulation.



## II. Introduction

Calvin College is a Christian liberal arts college located in Grand Rapids, Michigan. Calvin has an athletic program that continues to grow and improve. For years, the college has used moderate facilities at field level to accommodate its personnel. The HPERDS department requested better facilities which included a press box and a concessions building to be added to the track/soccer complex. They also requested ideas for snow management for the early spring concerning the track. The Athletics goal was to provide the HPERDS department with a thorough plan set and scaled models of both buildings as well as efficient ideas for snow management.

### A. Acronyms

- A.C.I. – American Concrete Institute
- A.D.A. – American Disabilities Act
- A.I.S.C. – American Institute of Steel Construction
- A.S.C.E. – American Society of Civil Engineers
- C.M.U. – Concrete Masonry Unit
- E.F.I.S. – External Finishing Insulation System
- K.S.I. – 1000 Pounds per Square Foot
- L.R.F.D. – Load and Resistance Factor Design
- M.A.S. – Mid–American Services
- M.S.J.C. – Masonry Standards Joint Committee
- M.T.C. – Materials Testing Consultants
- S.I.P. – Structural Insulated Panel
- T.P.O. – Thermal Polyolefin
- P.S.F. – Pounds per Square Foot



### **III. Problem Specification**

#### **A. Challenge**

One challenge presented was to properly facilitate athletic personnel for the track and soccer field. The other challenge was to provide ideas to the client for snow management solutions. For these tasks the location of the project had to be considered. In Grand Rapids, Michigan there is a lot of snow accumulation. This was considered for both the buildings and the track. A big challenge was learning new design aspects. Masonry wall design had to be learned along with deciphering the best way to design member connections.

#### **B. Requirements**

The HPERDS department had many requirements for the two buildings. For the press box they wanted it to facilitate twelve occupants at each bank of windows. They also wanted an area for storage at ground level. This area only needed to take into account medium and smaller size non-flammable equipment. The client also requested that the press box building face both East and West in order to accommodate for future relocation of the track to the west of the press box. The press box will need to facilitate the existing track and soccer field as well as the proposed soccer field. The final requirement for the press box was to stay under a \$50,000 budget. As the project was in its initial stages, the client made another request to add a viewing deck to provide a better view for video recording.

The requirements for the concessions building were different. For this building the client wanted bathroom facilities as well as an area to sell concessions. The bathrooms were to be barrier free, meeting all ADA requirements. The use of Calvin Brick, or the brick color used exclusively throughout campus, was also required in the design of both buildings.

Snow management requirements consisted of removing the snow and causing as little damage to the track as possible. The solution must not void the warranty of the surface or the paint on the track in the process of removing the snow. In order for the solution to be feasible the cost of the solution must be low.



## **IV. Proposed Solution**

### **A. Project Management**

#### **i. Team Organization**

In order to effectively complete this design, work organization was critical. Design work was done in pairs in order to be thorough in the calculations. Two team members would work on the same design piece and then verify by checking each others work. Some of the design work was done only by one person thus to be more efficient with the work time available. All design calculations were checked by another team member.

When drawing sheets were being constructed a list was made of all the drawings that would be needed. Then the drawings were evenly distributed among team members to effectively create the project plan set. All drawings where then checked for errors by one or two other team members.

Work on the track part of the project was initially spilt between the team members, but when no design solution was needed it was finished by one team member. This was done to help with the addition of the concessions building during the 2<sup>nd</sup> semester.

#### **ii. Schedule**

At the beginning of the year, a schedule was produced to the best guess of how long specific aspects of the design would take. From meeting to meeting with HPERDS and the Calvin College Architect, Frank Gorman, the overall look and design of the press box changed frequently. The schedule often did not meet the work that needed to be done at certain times. The time it took to learn and design masonry walls and concrete foundations was underestimated. In Appendix A4, there is the final copy of the schedule.

### **B. Project Budget**

#### **i. Materials**

In this project, the majority of the cost for each building was in raw materials needed to build the press box and concessions building. Each building uses similar materials giving them similar costs. The material cost for the press box is \$55,846 and the concessions building will cost \$21,976. The most expensive material cost was represented in the Calvin Brick used for facing the masonry wall. Concrete was also an expensive material



to used in the footings, foundation walls, and floor slabs. This was due to the rising cost of concrete. The other major components of the materials budget were the CMU block and the steel used in the structural framing of the roofs for both buildings. A more detailed list of the material cost for both the press box and the concessions building can be found in Appendix A1-3.

ii. Labor

Labor will be a large factor in the construction project, of the press box and concessions buildings. The labor cost was included in the budget for a rough total cost of the project. Calvin College uses its own Physical Plant employees to build many projects that are constructed at Calvin. The press box at the Gainey Fields was built by the Physical Plant and it was presumed that all construction with the exception of the steel erection can be done by the college. Labor cost where calculated as \$18,000.00 and \$21,000.00 for the press box and concessions buildings, respectively.

iii. Models

To help the client and general public to get a better understanding of the buildings, scale models were constructed. The press box and concessions building models were made in half scale, 1 inch equals 1 foot. These replicas were constructed of foam core board, Plexiglas, and pins. The total cost for the models was \$45.00. This cost came out of the Senior Design Fund, from which each team gets \$300.00.

iv. Engineering

Although the engineers of this project will not be charging any amount for their effort, a cost estimate was created for educational purposes. A rate of \$25.00 an hour was charged for the engineering work done on this project. The total engineering cost came to \$105,000.00. Raw labor costs were figured to be about \$33,330.00 while engineering fees and indirect labor overhead contributed to the rest of the engineering costs.

v. Total Project Cost

The total cost of this project can be seen below in Table 1. This cost includes all of the factors outlined above. There are sub-total amounts spaced through the table to clearly show the appropriate cost.



**Table 1. Total Cost of Project.**

<b><u>Total Project Cost</u></b>			
<b>Press Box</b>			
Material	\$		55,845.82
Labor	\$		17,869.27
Sub-Total	\$		73,715.09
<b>Concession Building</b>			
Material	\$		21,976.20
Labor	\$		20,999.47
Sub-Total	\$		42,975.67
Building Total	\$		116,690.76
Contingency Cost (30%)	\$		35,007.23
Sub-Total	\$		151,697.98
Engineering Cost	\$		104,552.25
<b>Project Total</b>	<b>\$</b>		<b>256,250.23</b>

### C. Preliminary Research

From the start to the completion, research has been a crucial part of understanding the work for this project. Preliminary research has always been important whether in design calculations, architecture, site layout, or choice of material. When the task of designing a press box and concessions building was decided, research was done on what current press boxes looked like and how they were constructed. Trips were taken to visit local press boxes in order to formulate ideas. The Gainey Field press box, the South Christian High School press box, and numerous other press boxes seen online were used for ideas of how to architecturally and structurally design a press box. Frank Gorman, the campus architect, was also consulted for ideas. This helped inspire and produce adequate brainstorming. Many books were used to help research methods of design. Websites such as the e-tek website accessible through the Consumers Concrete website were useful for understanding design practices. Research was also done to understand snow removal methods for tracks. This helped select a possible solution for the snow management part of the project. Also researched, were the material costs. To stay in budget, materials were selected based on



price and effectiveness. Low cost materials were used in place of more expensive ones in order to benefit the client. Research was also done on the project's location to obtain a site layout for the designed press box and concessions buildings. Shade studies were conducted to determine areas of the track where natural melting of snow does not occur. Studies showing line of sight were also necessary for determining the location of the press box and the windows needed for optimal viewing. Measurements were taken to provide a better feel for the area and size limitations of the buildings. For example, the height of the press box depended on the height of the bleachers and its length was dependant on the aisle width and spacing.

## **D. Track Design**

### **i. Track Snow Removal**

#### *a. Design Options*

##### *i. Snow Blower*

A snow blower is an option that raises many concerns. The snow blower is very effective in removing the snow and has a relatively low cost compared to the other options discussed in this section. The concerns with this option are that the blades of the snow blower must be designed to break before the track surface does or they must not come into contact with the surface. For this reason, a two stage auger style snow blower has been considered. This style of snow blower does not contact the surface and the height of the auger off the surface can be adjusted. Costs for a snow blower range from \$500 to \$2,000. Maintenance and operational costs for a blower would be very small, approximately \$100/yr.

##### *ii. Surface Chemicals*

Surface chemicals such as salt are not recommended due to negative effects on the track. The MAS Care and Maintenance guide specifically states to not use salts on the track surface. Alternatives to traditional road salt are calcium chloride, magnesium chloride, magnesium acetate, and potassium acetate; these are seen in Table 2. All of these chemicals are proven ice repellants and are currently used on highways.



**Table 2. Deicing Chemicals.**

Chemical	Lowest Temp. (°F)	Advantages	Disadvantages
Calcium Chloride	-25	Attracts moisture and melts snow Releases Heat	Low Corrosiveness Creates Slush
Magnesium Chloride	5	Can be applied before snow fall	Low Corrosiveness Creates Slush
Magnesium Acetate	20	Bio-degradable Not corrosive	Creates Slush
Potassium Acetate	-20	Fewer applications than others Bio-degradable Not corrosive	Creates Slush

The problems with these alternatives are the potential high cost of implementing the application system. Salt and its alternatives are used primarily for ice deterrence. Chemical salt alternatives are not effective with standing snow and often fail to melt snow completely resulting in slush. In order for this option to work effectively, it would have to be used in combination with some sort of manual slush removal system such as a brush.

Environmental concerns with a chemical application require consideration. The grass of the current soccer field must not be killed or disturbed. The chemicals must not be toxic due to the large amounts of human activity in the area. As stewards of God's creation we should not introduce harmful chemicals into the environment. The chemical system has far more concerns than benefits and is not a recommended solution.

*iii. Sub-Track Heat Sources*

Sub-Track Heat Sources consist of installing a heat source underneath the track surface. The two systems used for this application are electronic heat mats or a



hydronic system. Both of these methods would work in all conditions such as ice and hardened snow.

Heat mats are used in many commercial and residential applications such as sidewalks. This system utilizes heat given off by the resistance of an electrical current. Heat mats are relatively easy to install and require no maintenance. The system needs to be placed under the track surface thus requiring a new surface to be installed.

Hydronic systems have been used effectively for many years on many large scale projects such as airport runways and driveways. This system consists of cross-linked polyethylene pipe installed underneath the surface intended to be cleared. The pipe is filled with a circulating water/glycol mixture being pumped in a loop through the system. The water/glycol mixture is passed through a heat exchanger thus warming the water/glycol solution. This fluid then heats the surface and melts the snow and ice. The system would be buried under the asphalt base and is virtually maintenance free. Periodic maintenance may be needed for the pump and heat exchanger. This method has a high up front cost as well as a relatively high seasonal cost compared to the other options.

The hydronic system would be most easily installed by removing the existing track surface and asphalt base and installing a new track on top of the PEX piping. The cost of replacing the track would be approximately \$200,000. Another option would be to bore underneath the track and run the pipe underneath the existing surface.

Costs for these systems range from \$200,000 to \$320,000 and would cover the hydronics and \$250,000 to \$430,000 for the resistance system.

Thinking into the future poses a problem for both of these snow melt systems. In the future when the track may need resurfacing, the snow melt systems would have to be removed and replaced. Doing so would be extremely wasteful of financial resources.





c. *Basis for Track Design*

In order to decide on the best option for the snow removal a design matrix was created. The design matrix can be seen in Table 3.

**Table 3. Design Matrix for Track Snow Removal.**

	Weight	Snow Blower	Tarp	Hydronics	Resistance	Chemicals
Initial Cost	8	5	4	2	1	3
Appearance	1	3	1	6	6	4
Maintenance	4	2	1	5	6	2
Environmental Effects	3	2	5	4	4	1
Ease of Installation	2	6	4	1	1	3
Cost to run	7	5	6	2	1	3
Ease of use	6	3	2	6	6	4
Durability	5	4	2	5	6	4
Effectiveness	9	4	3	5	5	2
Score		<b>178</b>	<b>151</b>	<b>176</b>	<b>170</b>	<b>128</b>

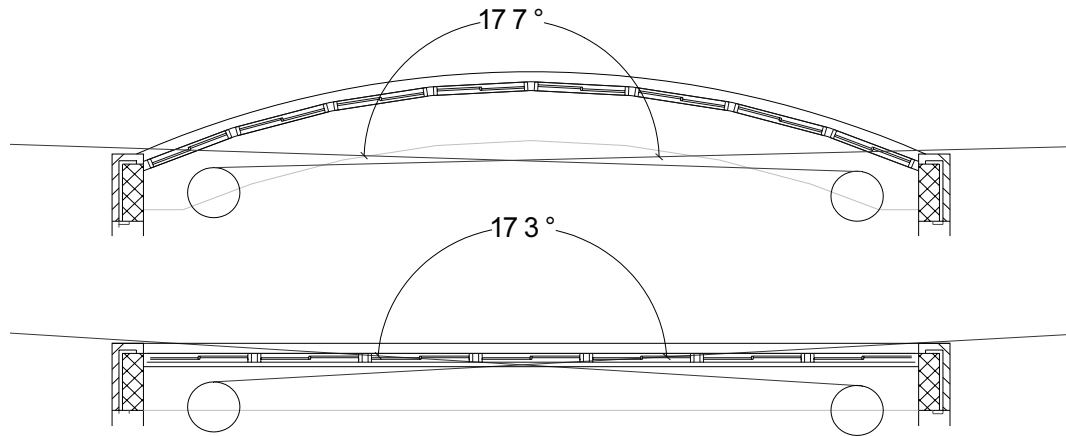
The decision was based on nine different design aspects with varying weights according to importance. The heaviest weighted aspects are effectiveness, initial cost, and cost to run. From the matrix, the snow blower and tarp option are the best options when considering the high cost of the snowmelt systems. Using one of these two methods in conjunction with tree maintenance should be an effective way of managing the snow.

**E. Press Box / Concessions Building Design**

i. Design for Line of Site

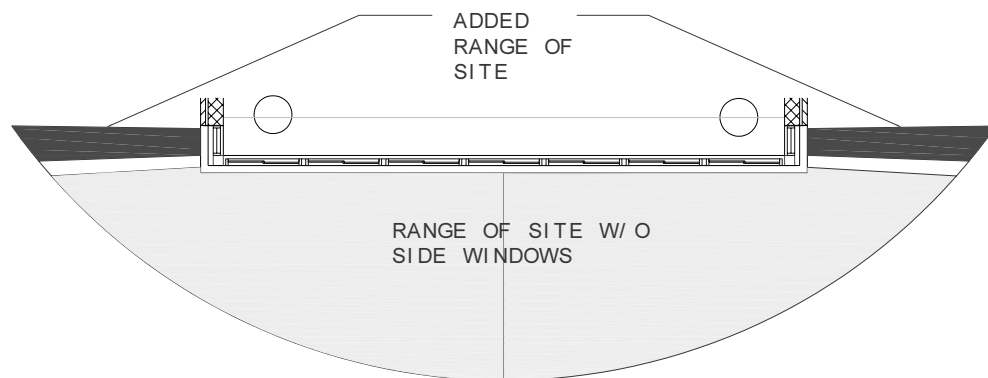
One major design consideration for the press box was line of site. The desired result of the press box was to provide improved site lines for event officials and statisticians. This criterion was very influential in the final look of the building and its location. Evidence of the influence can be seen in the curved west face of the structure as well as the two small windows located at the east edge of the north and south walls. Shown below in Figure 2, the curved face provides a 4° greater site range than if the building were to be designed with a flat face such as the east elevation.





**Figure 2. West Elevation Site Lines**

This value results in much greater visibility of the playing fields. Figure 3 shows the site range when the two windows were added to the design. Both of these features have become distinguishing architectural features as well.



**Figure 3. East Elevation Site Lines**

ii. Viewing Deck

Mid-way through the design process the HPERDS department requested a viewing deck to be added to the press box design. This design feature allows for an unobstructed view for video cameras. The viewing deck is located at the middle of the building and inset into the roof structure. Reasoning behind this was to hide the viewing deck as much as possible and to use the walls of the building as a guardrail. A consequence of its location is that the viewing deck will act as a bowl for rain and snow to accumulate. This problem is solved by placing a 3" diameter roof drain in the center of the deck allowing for rain



water to exit. In order to assure that the rain reaches the drain, the deck was designed to slope towards the center. A TPO roofing membrane is to be laid over the deck and walls in one piece to seal the deck and add protection. Snow accumulation was addressed by designing the structure to support the snow loads. In order to reduce the amount of rain and snow entering the viewing deck a roof was designed above the deck. The viewing deck could be enclosed at a later time or covered during the off seasons if the client chooses.

### iii. Truss

For the support of the press box roof two steel member trusses were designed. Several structural members of the building are steel and this will give the building more continuity. The trusses can be pre-fabricated off site to avoid Michigan's harsh weather. This will also save time on the final construction and provides a durable rigid frame to the roof of the press box. The truss has a curved shape and is comprised of two types of steel beams. The beams making up the perimeter of the truss are WT 3x6 while the members attaching and bracing these members are L25203. For the design of the trusses, STAAD.Pro was used. This is a computer model that allowed simulation of the loading and design of the press box truss. The loading applied to the truss was a combined nodal load of 0.65kip. STAAD.Pro gave us the results of the beams specified above. Then hand calculations, which can be seen in Appendix B13, were done to verify the programs output.

### iv. Framing

The east and west walls of the upper half of the press box were designed as a wood 2x4 framed structure. Wood stud walls were chosen instead of CMU block walls due to the ease of construction and the minimal loads that will exist in these walls. By using wood construction for these walls, window installation will be much simpler and easier. The framing for the 2<sup>nd</sup> level floor consists of 2x10 wood joists spaced at 16" off center which is a very common floor design in structures of this size. This is sufficient to withstand the floor loading of 196 psf. Wood was chosen instead of steel due to its relatively low cost and ease of installation.



Viewing deck walls were designed as 2x4 stud walls for their relative low cost and ease of installation. Floor framing was designed as 2x6 wood joists spaced 16" off center which is a typical in many similar structures. Loading for this floor was calculated at 161 psf.

v. Beams

There are several steel beams used throughout the project. In the press box the main support structure of the viewing deck is made primarily of steel. This is comprised of two W8x15 purlins attached between the two steel trusses. These two steel beams also serve as the support for the viewing deck roof which has two HSS 3x3x3/16 columns bolted at the mid-points of the beams. The floor structure of the viewing deck is framed off of these beams as well. The beams supporting the roof of the viewing deck are W6x9's. These were designed to support the load on the roof of the viewing deck, which can be found in Appendix B19.

In the concessions building the roof is spanned with steel beams. The beams in-between the north and south walls are five feet off center. The beams parallel to these at the ends of the roof are six feet from the walls of the building. To support the overhangs, columns were designed. For the west end of the overhangs no columns were provided, rather, a steel beam was designed to support the load. W6x9 beams were designed for all beams in the roofing connection. The Manual of Steel Construction was used to design all the beams in the design project. The calculations were done in MathCAD, a mathematical program. All calculations were checked by a team member.

vi. Columns

Supports for the viewing deck roof, the North/South top bond beam for the press box, and the roof overhangs on the concessions building were designed to be provided by steel columns. These columns are all HSS sections and were designed for compression per Chapter E of the Manual of Steel Construction Specifications and Codes. The columns located in the concessions building and those supporting lintels in the press box were both chosen for the dimensions of the column and not for their structural capabilities. The reasoning for this is that a certain look was desired for the concession's columns and an 8in x 8in member was needed in the press box to fit with the windows and walls.



Once a size was chosen, the strength of the members was checked and in both cases the members were found to be more than sufficient. The columns for the viewing deck were modeled in STAAD.Pro and were calculated by hand (see Appendix B19). The column was first modeled as a column in compression and then as a cantilevered beams. This was done in order to account for the lateral forces on the column due to the wind and the moment exerted by the lateral movement of the roof structure. This resulted in a HSS 3x1.5x1/8. In order to give more stability, uniformity, and strength a HSS 3x3x3/16 was chosen for the design.

There are two concrete columns for the concessions building. Each is exactly the same and both support a very small load. Because of the lack of time and the small load on the large column, minimum reinforcement bars will be placed inside. The minimum standards came from the ACI code. In the footing for the column there is a mat of eight #5 bar, four each way. There are four #5 bar vertical bar in the column with eight two by two foot #3 bar stirrups holding them in place. The concrete column will be surrounded by Calvin Brick.

#### vii. Masonry Walls

All of the walls of the press box and concessions building were made up of essentially two masonry walls. The inside wall is a CMU. This wall is designed to withstand all of the forces that will be applied to the building. The outside wall is for aesthetics. It is a brick wall using the ever prevalent Calvin Brick. This brick is tied to the CMU wall using typical ties that are inserted in the grout layers of both the inner and outer walls.

In order to explain what was done for the CMU design the example of the north and south walls of the press box will be stated. Starting at the top, a masonry bond beam was designed to hold the trusses as well as bridge the door and window gap just below it, seen in Appendix B28. A bond beam is a beam made up of CMU filled with mortar and reinforcing bar to provide tensile strength. Once the loads were found, the working stress method was used to size the appropriate bar to withstand the tension force acting on the bottom of the beam. The ACI code was then used to find the development length. This hand calculation can be found in Appendix B28.



The lower portion of the wall was next. Initially, the wall was going to be split up between the two floors. Problems arose when trying to account for the loads that would be applied by the stairs leading to the 2<sup>nd</sup> floor. To solve this problem, the wall was taken as one section from bottom to top. Again, the working stress design as well as the MSJC was used to design the wall for both the load bearing CMU and the brick. The general process is to find all the loads that will be applied to the wall, the wind loads, and all the moments that will result from the loading. First, the CMU wall was checked with the wind load for axial compression and maximum bending moments in the plane of the wall. The compression force was checked at half the wall height. The bending moment was checked at the worst point, and in this wall that point was at the height of 9.3 ft in the middle of the stair supports. In order to find the moments in the wall, every load was applied to the wall separately and the resulting moment was found modeling the wall as a simply supported beam. The CMU is good for handling the axial compression force, but tension force is absorbed by the mortar in between the blocks. Secondly, the outer brick wall was checked with the wind load. After that the MSJC states that the wall needs to be checked with no wind load. This was done with both the inner and outer walls. The wind load actually does make a significant difference in the distribution of forces in the wall. A 12 inch CMU works with the compression load but the wall does not handle the tension forces that the extra moments the stairs apply to this wall. This means that some reinforcement bar is needed. For the design of a reinforced masonry wall, the Army Corps of Engineers method of working stress was used. This method resulted with a bar size and spacing of #5 bar every 40 inches fully grouted within the 12 inch CMU wall. A check was then used by trying the new wall properties, the test that failed before. This resulted in a successful design; this calculation can be seen in Appendix B53.

There is a lintel above the overhead door on the South side of the press box. A lintel is like a bond beam but placed above an opening. They can be either masonry or reinforced block. The masonry lintel was chosen to increase the overall learning of masonry wall design. All the lintels in both the press box and the concessions building were designed using the working stress method, shown in Appendix B33. With the opening in the wall for the overhead door, the walls on either side of the door were checked with the working stress method and the Army Corps of Engineering reinforcement working stress design.



This check resulted in two vertical bars in these small walls. One #5 and one #6 bar is needed up until the overhead door lintel.

The concessions building has the same walls as the press box. They were easier to design in the respect that there were little to no moments applied to the wall compared to those of the press box. These walls were also designed using the working stress design for masonry wall, the hand calculation is found in Appendix B48. The resulting wall is an 8 inch CMU with no reinforcement required throughout the entire building. The lintels for the doorways were also designed similar to those of the press box.

#### viii. Foundation

Foundation walls for both buildings consist of reinforced concrete designed per ACI code 14.8 – Alternative Design (LRFD). See Appendix B pages 77, 82, 127, and 132 for calculations. Concrete was chosen for its durability and strength. Concrete is commonly used in this faculty and has proven itself in many other facilities. Loads for the foundations were calculated as the entire load of the building per linear foot. This amounted to the load of the bearing walls including the dead load of the wall materials. These loads are attached in Appendix B12, 92. The foundation walls were designed to have a brick ledge for grading purposes and all aspects of the foundations were specified in the construction drawings attached.

Footings for both buildings were designed as reinforced concrete spread footings. Soil borings for the site were obtained from Materials Testing Consultants (MTC) Inc. Results from the boring are attached in Appendix D. From the boring results the bearing capacity of the soil was calculated which allowed for the footings to be designed accurately. Again, ACI code was used in this design and the calculations are shown in Appendix 12, 92.

#### ix. Bolts

Bolt connections were used to connect most of the steel in the design of the two buildings. The bolt connections used in the design were all calculated by hand. In order to calculate the size of the bolts needed for the design an LRFD manual was used. The LRFD manual gave the design requirements and aided in the process of designing the



bolts. Through the design calculations, which can be seen in Appendix B18, ½ in bolts were used. This was determined by the load applied to the bolts along with the number of bolts chosen to be used in the connection. In all the designed bolted connections in the buildings, four varieties of bolts were used. This was determined by uniformity and assured strength.

x. Welds

In some of the steel connections in this design, welds were used. Certain connections required a steel plate or angle to be mounted to a beam. In order to make this connection a weld was designed. These weld connections were also determined through the LRFD manual. In this calculation the length and size of the weld are factored. Other considerations are the load and the strength of the steel, which are 4.69ksi and 42ksi respectively. The calculations, shown in Appendix B17, show that a 3/16 inch fillet weld will be used for these connections. All welding connections may be made prior to construction. However, the builder may decide whether or not to do on-site welding.

xi. Exterior

For the exterior of the building, Calvin Brick was chosen to be placed on the insulation and concrete block. Calvin Brick is a standard exterior face on campus and was used for continuity and uniformity. Calvin Brick will mainly cover the outside of the first floor of the press box on the east and west faces. It will cover both the north and south sides of the building. To accent the brick, EFIS will be used for the east and west faces of the 2<sup>nd</sup> floor, surrounding the windows. EFIS is another common material used as a finish on Calvin's buildings. This was also chosen because it is an effective insulator and HPERDS has stated they might use space heaters to heat the building. EFIS is also a durable material that will help with minor abuse. Laterally separating the EFIS and brick veneer will be a brick rowlock sill.

xii. Roofing

The roofing consists of two layers of materials. The first layer of roofing material is made of SIP's. A SIP consists of a Styrofoam center placed between two pieces of plywood. This was chosen for insulation along with EFIS to help maintain comfortable temperatures. The SIP material will be connected to the trusses and beams of the two



buildings. SIP was also chosen because it is labor friendly, making it easier to construct. The SIP material can also span long distances with out bracing. On top of the SIP layer will be a ribbed metal material. This roofing is similar to that of Calvin's Crossing. Metal was chosen for its durability as well as energy efficiency. Metal roofing lasts a long time and requires very little maintenance. They are also proven energy savers.

#### xiii. Stairs

Entering and exiting the press box is made possible by the use of staircases located at each end of the 2<sup>nd</sup> floor. These were designed to lead onto the existing bleachers and were upon request of the client. The location of the building in reference to the bleachers is such that the building fits in between two existing aisles. This makes for easy routing of the stairway. The stairway's framing was designed out of steel HSS sections. This was in order to provide strength, durability, as well as to provide for easy upkeep. Decking for the stair landing and steps were specified as aluminum decking similar to the existing bleacher construction. This will save weight and cost while keeping the same appearance of the current facility. The stairs were designed to connect to the building with steel HSS sections and are to be anchored to the CMU wall. All connections and framing is detailed in the construction documents.

Loading for the stairs was calculated per ASCE 7 and are attached in Appendix B11. Design calculations for the steel framing were performed using the LRFD design method per AISC and are attached in Appendix B36.

#### xiv. Doors & Windows

All doors for the two buildings were designed as hollow steel flush doors. These were chosen mainly for there security benefits. HPERDS requested that the buildings be relatively secure due to its location away from the rest of campus. These doors do not have windows and are fairly solid. Surface treatment of these doors consists of paint and occasional washing with soapy water. These doors are also relatively less expensive compared to alternative doors with windows.

The press box has five of the hollow steel flush doors, two located at each end of west wall on the ground level. These serve as service doors into the storage and meeting area.



Two doors were used in order to ease congestion and to allow for safe exit in case of a fire. The ground level is also equipped with a 7ft x 8ft sectional overhead door. This is to be located at the south end of the building and will allow for larger objects to be transported to and from the storage floor. The 2<sup>nd</sup> floor is equipped with two steel doors located at the north and south walls. These doors serve as the only entrance and exit of the 2<sup>nd</sup> floor and are accessible via the two stairways coming from the bleachers.

Viewing deck access is provided by a 2 ½ ft. tall steel door located at the north end of the viewing deck. This would be accessed by a ladder provided by the client. This entrance could be changed to a standard roof hatch which would cost approximately \$700 more than the door entrance.

Entrance into the concessions building rooms consists of one door into each room. The entrances into the restrooms are located in an alcove in order to limit line of site issues into the bathroom. This proved effective for the bathroom layout.

Windows for the press box were specified as vinyl sliding windows. These windows are very common and are readily available from any window supply company. Installation is simple and upkeep consists of washing the panes of glass in order to keep up the visibility quality. If desired, shatter proof glass could be specified. However, current pricing was performed using a standard unit.

Locations of the windows were determined with the goal of minimizing site impedances. Windows were located as close to each other as possible without sacrificing the structural integrity of the walls. In order to increase the line of site of the track, two small windows were located at the eastern edge of both the north and south elevations. Another feature of the window locations is the curved west face of the press box. This curve allows for increased line of site at the edges of the proposed soccer field while adding a dramatic aesthetic feature to the structure.



## V. Conclusion

### A. Final Design

#### i. Press Box

The final design of the press box meets the needs of the HPERDS department. The press box is tall enough to provide good sightlines of the track and proposed soccer field. It also is large enough to have up to twelve people at the windows. In order to facilitate good sight lines of the proposed soccer field the West wall was curved to allow greater sight lines. The building will also include the use of Calvin Brick and the typical eaves found on Calvin's campus. See Appendix A18, 19 for renderings that were done by a pre-architecture student, Todd Palmer.

The press box is slightly over budget at \$ 74,000. This price includes labor cost of constructing the building. Calvin College in the past has done a large part in constructing small structures around campus i.e., Gainey softball press box, baseball press box, HVAC addition to the library including a tunnel to Calvin's Crossing. If Calvin College decides to take this route the material cost will be \$ 56,000. A detailed break down of the material cost is found in Appendix A1. The construction plans for the press box are also found in Appendix C.

#### ii. Concessions Building

The design of the concessions building was concluded to meet the needs of the client. As stated earlier, many details make up the construction of this building. Very important decisions were made in order to effectively satisfy the HPERDS department. The design meets all the requests stated by the client. Cultural appropriateness was intended in the design through various Calvin features that were implemented. Some of these features include long overhangs, brick columns, and Calvin Brick. Other design features, such as the curved roof and face, were incorporated to fit the look of the press box. This design is effective for the purposes it will be used. Detailed renderings of this building can be found in Appendix A20, 21. Along with the renderings, a thorough plan set that includes the concessions building can be seen in Appendix C. This plan set includes elevations, floor plans, framing plans, and details of intricate parts of construction. The final cost of this building is approximately \$43,000. Although there was no set budget by our client for this building, the cost is fair for the building type.



### iii. Track Snow Removal

As was stated earlier, our recommendation for snow management is to either invest in large high strength poly tarps or to purchase a quality two stage snow blower with adjustable auger height. Both of these solutions are effective and produce no foreseen danger to the track surface. Trimming of the trees located on the Southeast corner of the track is recommended in order to increase the amount of sun reaching the track. This will increase the rate of the natural snow melting process while having minimal cost. Low cost solutions are the best option when considering the soon to be built indoor track facility. With this facility many of the problems with snow accumulation would be bypassed.

## **B. Lessons Learned**

Being a two semester team project there were many learning experiences. The biggest of these would be the client-architect-engineer relationship. Many times the client would have an opinion on what they wanted to see while the architect would have a different opinion. It was necessary, as the designers, to find a solution that would satisfy both parties, resulting in many redesigns and changing of the project goals. Some examples of this would include the addition of the viewing deck and concessions building. In the end, this proved to be invaluable in the project design.

Organization was pivotal in the projects success. Dividing up tasks throughout the year and meeting consistently aided in the design being completed on time. Throughout January team meetings were held twice a week in order to keep up with the design process during interim. Once interim was finished meetings were held three times a week at 1:30-2:30PM. These meetings helped to stay organized and on top of tasks.

## **C. Future Work**

To compliment the lessons that were learned, there are several things that can be done for future work. To start, wood trusses are continually improving. These could have been implemented in the design to possibly reduce the project budget. Some other things to consider are the viewing deck and roofing materials. The SIP was chosen in this design. However, this was not necessarily needed. The client said that they might heat the buildings with space heaters, but it was never a requirement. Therefore, another roofing system could



have been chosen. Although the best way to access the 2<sup>nd</sup> floor of the press box was the stairways that were designed, they may not have been the most cost effective. A stairway incorporated inside the building or with another material may have been implemented. Another reason changing the stairway would change the budget is the affect it has on the walls of the press box. The size of the concrete block would be reduced along with the size and amount of reinforcing bar needed. The viewing deck that was required by the HPERDS department could have been taken out of the design. It adds a nice feature to the design, but it is also a significant cost.



## VI. Acknowledgements

The Athletics were aided by several people on this project. Through many ways, the Athletics would like to show their appreciation and recognize those who aided in this design;

Dean Gunnink – Calvin College’s Physical Plant provided the Athletics with site plans.

Mr. Gunnink also helped acquire information on the track surface and provided contact information for the snow management studies.

Frank Gorman – Campus Architect, gave much insight on the design of the buildings. He provided help in roof orientation and style. Mr. Gorman also provided us with soil borings for our projects site.

GMB Architects and Engineers – Helped with code interpretation. They were able to provide information on barrier free code.

HPERDS Department – Introduced the project and chance for experience. They were valuable clients and provided clear ideas and important insight to this project.

Professor Leonard DeRooy, P.E. – For provided many design books. These design books consisted of mainly code and masonry design. These books were incorporated throughout the design of the buildings.

Professor David Wunder, P.E. – He gave valuable project insight from industrial experience. He also acted as the team advisor and supplied them with adequate resources.

Roger Lamer, P.E. – He was the industrial consultant for the project. He advised the Athletics and aided in building codes and layouts.

Todd Palmer – A Pre- Architecture student at Calvin College. He produced high quality renderings of the press box for the Athletics.

Van Laan Concrete – They provided current concrete prices in order to produce the cost estimates of the final products.



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