Report on Vent System Cost Differences for:

Air Admittance Valves

vs

Conventional Venting Systems

at

Detroit Lions Stadium (Ford Field), Detroit, MI

June 8, 2011

Report Prepared By:

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Fold Field, Home of the Detroit Lions and Site of the 2006 Super Bowl

Report on the Comparison of the System Cost for:
Air Admittance Valves vs Conventional Venting Systems at Ford Field

Executive Summary

We were hired to provide a report on the cost comparison between two different venting methods for sanitary waste & vent systems in the Detroit Lions Stadium (Ford Field). Ron George was the lead plumbing system designer for the project and he made the decision to utilize air admittance valves (AAVs) for the venting system on the project. The reason for using air admittance valves was not originally for cost savings, it was to prevent sewer gas from entering the building from rooftop Air handling unit air intakes on the roof above the concourses. This cost comparison was done in June of 2011 to look at the overall cost of installing a cast iron venting systems up through the roof verses installing air admittance valves (AAVs) at the top of the each plumbing chase wall. The comparison shows a significant cost savings was realized when utilizing air admittance valves in lieu of conventions vents through the roof. The Stadium was built utilizing AAVs for venting the plumbing chases for most of the concessions and restrooms around the main seating bowl in lieu of installing conventional vent systems up to and through the upper concourse level roof. The air admittance valve option included several vents through the roof in appropriate areas to address positive pressures in the drainage system.

At the time of the system design, Air Admittance valves were available as an alternative engineered system and we never really considered the potential cost savings. The main reason that contributed to the decision to use air admittance valves for this project was to the conflict with the vent locations and the Air Handling units on the roof level above the concourses. To prevent drawing sewer gas into the air handling units on the roof, we decided to utilize AAVs. No cost estimate was done at the time to show the construction cost savings. In many areas of the stadium where we had planned to route conventional vents up through the concourse roof, there were rows of rooftop air handling units (AHUs) located on those rooftops for providing cooling and make-up air to the stadium. (See Figure 14 and Figure 16) If the vents through the roof were installed in these concourse roof areas, sewer gasses would have been drawn into the make-up AHU intake hoods and then it would have been distributed by the AHUs into the stadium. Installing conventional vents through the roof would have been extremely difficult because of the height above the concourse floor without significant additional piping away from the air intake hoods or routing the vents to the upper stadium roof which was in a location significantly higher and more difficult to reach for installation. Use of air admittance valves on the vents in these areas avoided the sewer gas from being drawn into the stadium through the air handling unit make-up air hoods. We knew it would be less expensive, but we never did an estimate to determine the actual savings. Other environmental advantages of using Air Admittance Valves were they are a product that saves material, labor which can be a Environmentally friendly, LEED or Green advantage. And they allow less methane gasses to be released or vented to the atmosphere and they cause less impact on the environment which is another LEED or Green advantage over conventional venting methods.

Cost Savings

Installing Air admittance Valve in this stadium saved over Two hundred sixty three thousand, four hundred and sixteen dollars ($263,416.00) in construction costs and the use of air admittance valve helped save the indoor air quality and using air admittance valves helps save the environment by reducing sewer gas emissions.

Stadium Statistics
Ford Field is the home to the Detroit Lions NFL football team. The stadium was designed over a two year period from 1999 to 2000 and it was constructed from 2000 to 2002. The stadium construction was completed in August 2002 in time for the Pre-season games for the 2002-2003 NFL season.
The stadium complex included renovation of an existing 9-story Hudson's warehouse building on the site and incorporating it into the plan. The complex consists of one million, eight hundred thirty thousand (1,830,000) square feet of space. The decision was made to utilize the existing warehouse as one wall of the stadium and provide the opportunity to renovate and re-use the old structure to save on structural costs. We used spaces in the warehouse for offices, a hotel lease space, restaurants, retail and other lease spaces. The concourse level went through two levels of the warehouse and there was a private club level with club level seating in the warehouse. Several levels of suites were included in the warehouse building on upper floors with views and seating areas looking into the stadium. The stadium site occupies 25 acres in downtown Detroit. The stadium bowl superstructure is a concrete and steel frame with a rigid steel roof. The rigid steel roof cost was mostly paid for with advertising dollars from naming rights to the stadium. The stadium has a seating capacity for 65,000 seats with the capability of expanding to 70,000 seats which was the minimum seating requirement for hosting the Super Bowl XL event in 2006. There are approximately 132 Suites located in the warehouse building each suite has a private bath. There were approximately 30 public restrooms on the lower concourse level and 23 public restrooms on the upper concourse level. The stadium had over 906 public water closets, 363 urinals, 625 lavatories, 47 mop sinks, 60 showers, approximately 152 stack-type air admittance valves and 140 individual air admittance valves. There was 750,000 square feet of roof to drain with a snow melt system and an ice fence. There were 25 food concessions on the lower concourse level and 21concessions on the upper concourse level. There was a 34 month construction schedule and the cost of the stadium was about five hundred million dollars ($500,000.00) in the year 2000. The Stadium was funded by the Detroit Lions Incorporated, City of Detroit, the Downtown Development Authority, Wayne County, Ford Motor Company, and Corporate Founding Investors. John Richards was the HVAC team leader and Ron George was the plumbing design team leader.

Piping Materials
The drainage, waste & vent (DWV) piping systems for Ford Field were designed with the following material requirements after meetings with code officials, the construction manager and the owner. Underground piping was allowed to be Polyvinyl Chloride (PVC) schedule 40 DWV piping. The piping above ground and inside concrete masonry unit plumbing chase walls was allowed to be PVC piping. The DWV piping beyond the plumbing chase walls and exposed to the stadium environment was to be cast iron.

Conventional Venting Option
The conventional venting system option in the stadium was designed with cast iron piping in all exposed areas. Vents were to be extended up through the roof where practical and located at least 25 feet away from any outside air inlet connections. The vent routing is illustrated in red on Figure 16.

Air Admittance Valve Option
The Air Admittance Valve (AAV) option was estimated by utilizing stack type air admittance valves on the vent pipe a few inches above each pipe chase. This allowed the elimination of the vent piping leaving each pipe chase and routing to the roof level above the upper mezzanine.
In the comparison we evaluated the cost of the specified pipe material and labor for the following items: Pipe Material, Fittings, Fire stopping for floor penetrations, Expansion joints where required, Pipe hangers, Vent flashings through the membrane roof and the cost of the air admittance valves
The cost estimate shows an overall cost savings when installing the air admittance valves in lieu of installing a conventional vent through the roof system.

Hybrid Conventional Vents through the roof and AAV Systems
This stadium design was a combination of air admittance valves and conventional venting methods. We found that in some strategic locations, conventional venting was necessary to provide for relief of positive pressures which were possible due to the high peak loads possible during halftime of sold out events. Sanitary drains are intended and normally designed to flow only half full to prevent slugs of waste or water

that can cause severe pressure fluctuations in a drainage system. Normally sanitary drain sizing charts include a probability of use that allows more connected load as drain sizes increase or as fixture units are added. In an assembly building the potential for simultaneous use of many fixture is much greater. The conventional vents were located at strategic restrooms and lower concourse manholes to minimize positive pressures and keep the drains within the pressure limitations in the code.
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Fire Stopping

Cast-iron pipe is fire resistant and will not burn away or otherwise deform when exposed to fire. To seal the penetration of a cast-iron pipe through a fire rated floor, all that is needed is some mineral wool batting and fire-resistant caulking or mortar. Firestopping assemblies from various manufacturers can be found in the Underwriters Laboratories standard UL 1479 (ASTM E814). All firestopping assemblies must be listed and approved by The American Society of Testing and Materials ASTM E814 (UL 1479) and ASTM E119 standards.

Cost comparison

This report is a cost comparison of using Air Admittance Valves (AAVs) vs conventional venting on the Detroit Lions Stadium project. for purposes of this report we compared the costs of installing a conventional venting system with the cost of installing air admittance valves for each public restroom and the vent up through the stadium to the roof level.

Material and Labor Costs

Figure 16 illustrates the approximate pipe routing for the vents from the lower concourse to the concourse roof. Each pipe chase from each restroom or concession area had a vent pipe routed from each pipe chase in the toilet rooms and concession areas up to the upper concourse roof level. The red piping indicated the vent piping for one set of stacked toilet rooms. The piping is itemized below showing quantities and lengths for materials:

Unit Prices

For venting the plumbing chases from the toilet rooms and concession areas the vents were 4inches in diameter. The following unit prices would apply to the materials and labor for the cast iron pipe, fittings, couplings, hangers and firestopping.

Unit Prices

Item Description:	Material Price	Labor Price	Total Price
4 in. C.I. Pipe:	$ 4:00 /ft	$ 8.50 /ft	$ 12.50
4 in. 90 C.I. Elbow	$ 13.00 ea.	$ 13.00 ea.	$ 26.00
4 in. 45 C.I. Elbow	$ 12.50 ea.	$ 13.00 ea.	$ 25.50
4 in. C.I. San Tee	$ 26.00 ea.	$ 21.00 ea.	$ 47.00
4 in. C.I. Pipe coupling	$ 8.00 ea.	$ 6.00 ea.	$ 14.00
4 in. C.I. Pipe hanger material	$ 17.00 ea.	$ 15.00 ea.	$ 32.00
6 in. Floor Penetration core	$ 25.00 ea.	$ 60.00 ea.	$ 85.00
4 in. Firestop floor penetration	$ 10.00 ea.	$ 25.00 ea.	$ 35.00
6 in. Wall sleeve	$ 10.00 ea.	$ 6.00 ea.	$ 16.00
6 in. Firestop wall penetration	$ 10.00 ea.	$ 25.00 ea.	$ 35.00
4 in. Vent thru Membrane roof/flashing	$200.00 ea.	$ 223.00 ea.	$ 423.00
Lift rental (8 hour day) for wk abv 10'	$125.00 per day	$ 520.00 per day	$ 745.00
Additional labor – lift oper. wk. abv.15 ft	$250.00 ea. lift rent	$1,040.00 per vent	$1,290.00
4 in. Stack type AAV	$ 49.10 ea.	$ 6.00 ea.	$ 55.00

Figure 16 - Material Take-off List for One Vent Stack

(As shown in Figure 16)

Description	Quantity	Unit Cost	Cost
4 inch cast iron pipe	210 LF	$ 12.50	$2,625.00
90 Elbow	9	$ 26.00.	$ 234.00
45 Elbow	2	$ 25.50	$ 51.00
San Tee	1	$ 47.00	$ 47.00
Pipe Couplings	32	$ 14.00	$ 448.00
Pipe Hangers	42	$ 32.00	$ 588.00
Floor Penetration core	2	$ 85.00	$ 170.00
Firestopping floor pen.	2	$ 35.00	$ 70.00
Wall sleeve	1	$ 16.00	$ 16.00
Firestopping wall pen.	1	$ 35.00	$ 35.00
Lift Rental – for work above 10'	2 days	$ 125.00/day	$ 250.00
Additional Labor for high work	2 days	$ 65.00/hr	$1,040.00
Vent through Roof	1	$ 423.00.	$ 423.00
Sub-Total cost per roof penetration			$6,247.00 per roof vent location
15% Overhead and Profit=			$ 938.00
Total cost per roof Penetration			$7,185.00
Less the cost of 4 Stack type AAV installations w/ OH&P			$ 253.00 per roof vent location
Total cost per roof penetration using conventional vents			**$6,932.00**

There were approximately 38 roof penetrations that were eliminated in this project. 38 x $6,932 per penetration = $263,416.00.

Summary

This report compares the cost of installing a conventional cast iron vent piping system verses installing air admittance valves at each pipe chase.
The comparison showed an overall cost savings when installing air admittance valves verses a conventional vent system. The material and labor savings for using Air Admittance valves in lieu of conventional venting was approximately Two hundred sixty three thousand, four hundred and sixteen dollars ($263,416.00) less than conventional venting methods.

The resulting design utilizing air admittance valves still required several conventional vents that were routed through the roof in appropriate locations to deal with positive pressures in the drainage system.

Certification:

This cost comparison report was prepared by Ronald L. George CPD, a Certified Plumbing Designer and President of Plumb-Tech Design & Consulting Services LLC in Monroe, Michigan and Robert C, Hulsey Jr., P.E., President, Hulsey Engineering Inc., registered as a Professional Engineer in the State of Texas.

Respectfully submitted,

Ronald L. George

Ronald L. George, CPD

and

6-7-11

Robert C. Hulsey Jr. PE

FIRM # 1255

References:
1. Nayyar, Mohinder L., Piping Handbook, McGraw-Hill, 6th ed., 1992, pp. D.9-D.11
2. Means Plumbing Cost Data.
3. Cast Iron Soil Pipe & Fittings Handbook, Cast Iron Soil Pipe Institute (CISPI).

Photos and illustrations

Figure 1 - Southwest Entry

Figure 2 - Suites along South Wall

Figure 3 - View from Southeast

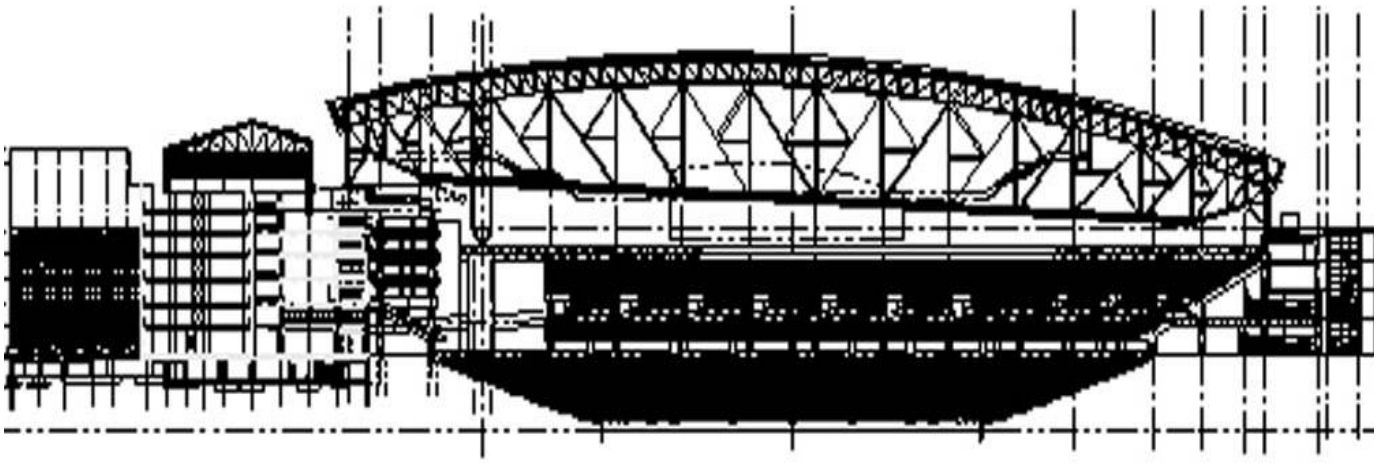

Figure 4 –Section through Stadium and adjacent 9-story warehouse building looking West

Drawings

The following are illustrations of the floor plans and sections through the building showing the number of public restrooms and concession spaces that needed to be vented.

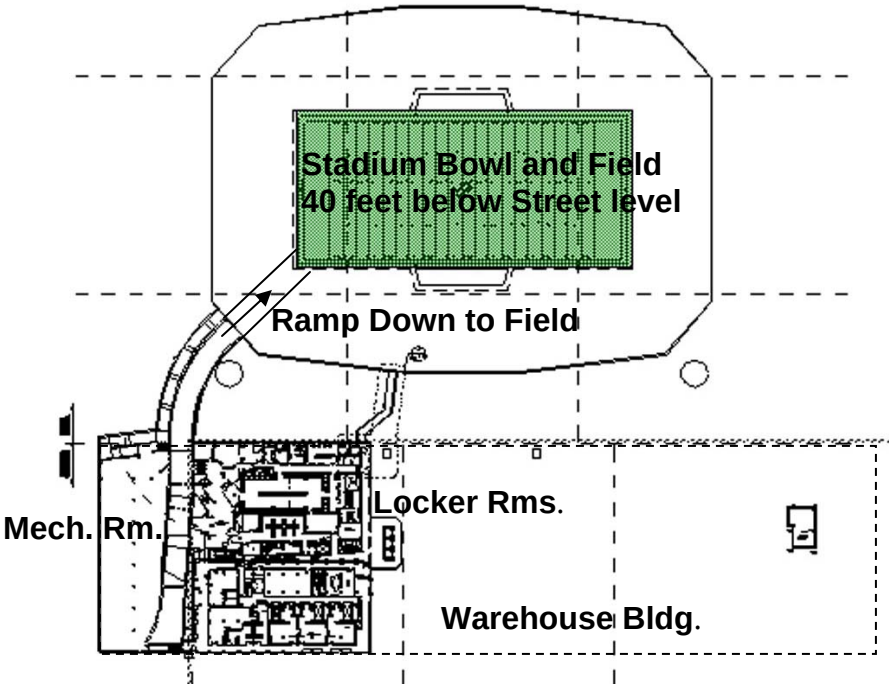

Figure 5 - Basement – Field Level – Mech. room, Players, Coaches, Officials, and Cheerleaders Locker Rooms

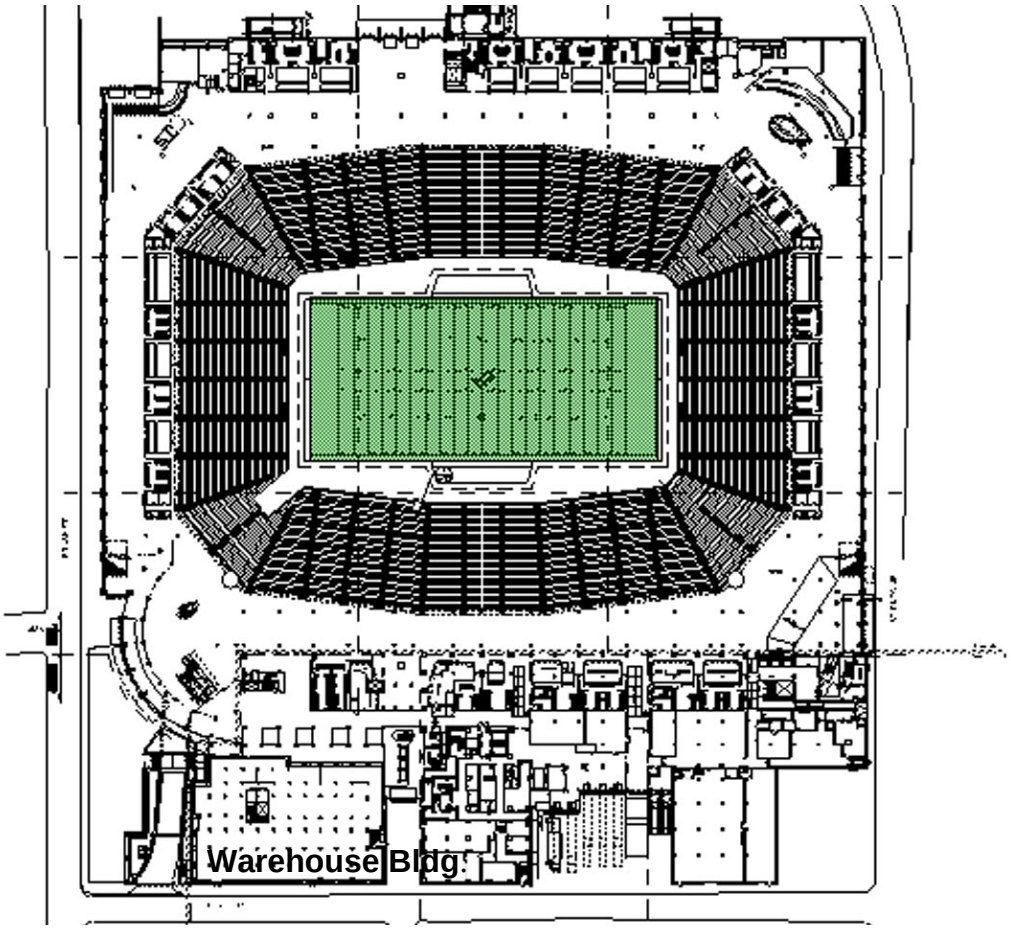

Figure 6 - First floor - Lower Level Concourse (30 Restrooms, 25 concessions)

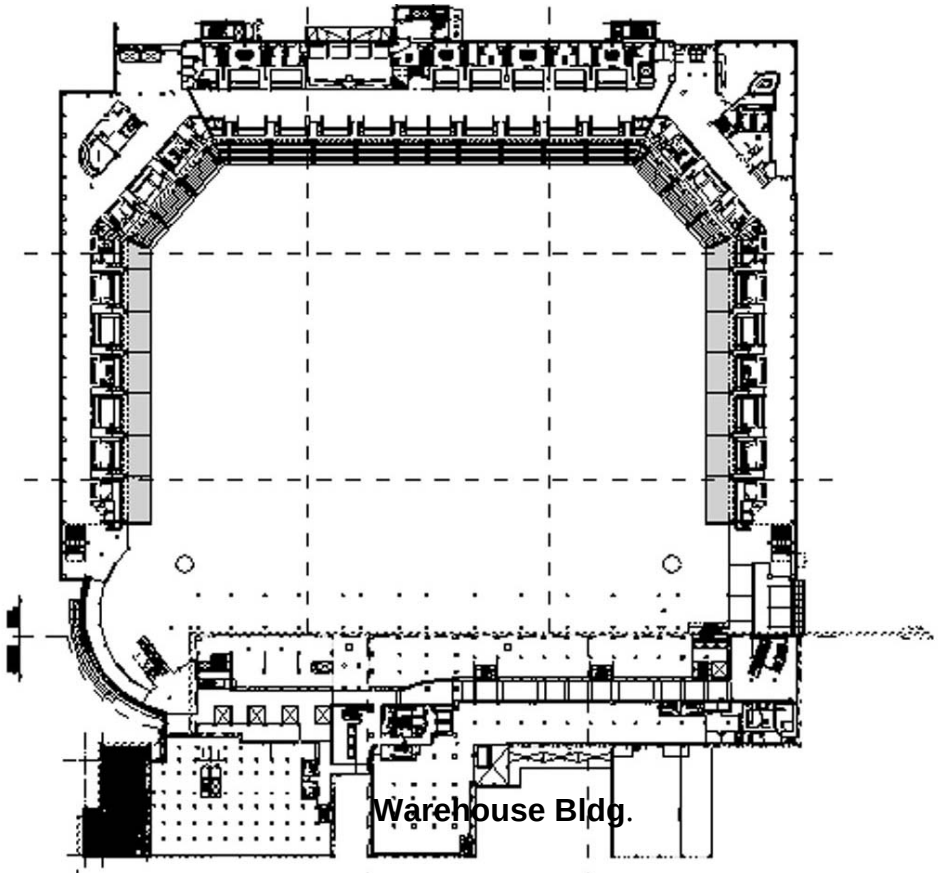

Figure 7 - Upper Level Concourse (23 Restrooms, 21 concessions)

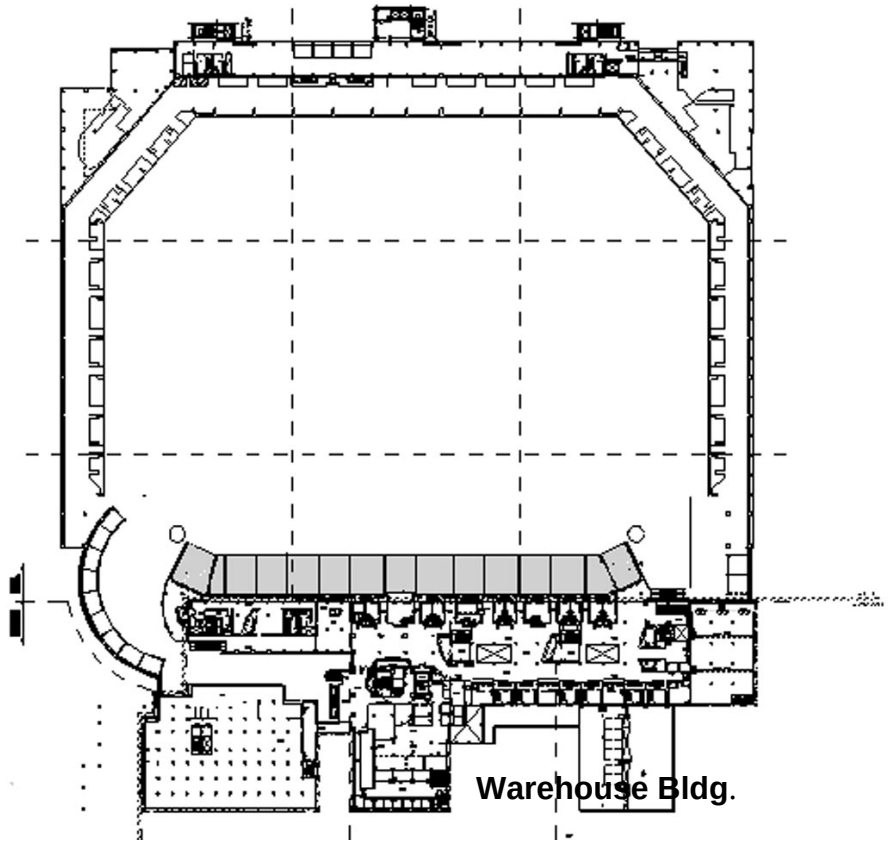

Figure 8 - Third Level – Club Level

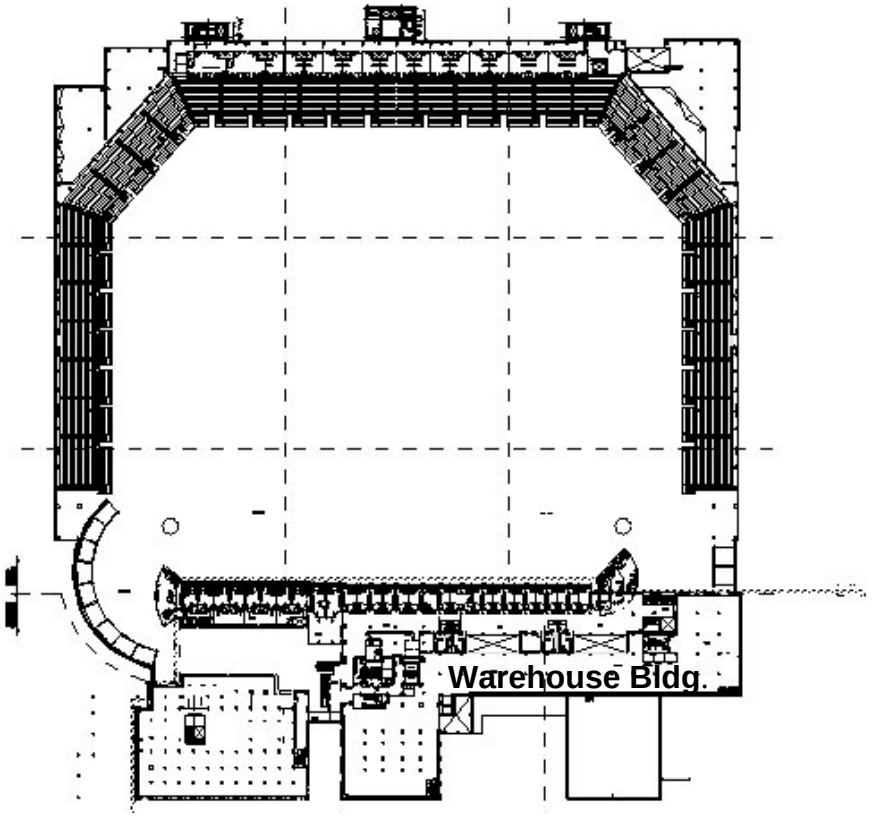

Figure 9 - Suite Levels 4 – 6 and Upper Deck Seating

Figure 10A – Concourse toilet Pre-Fab Plbg.

Fig 10B – Chiller Room

Figure 10 C – Mech Rm. Water Service

Figure 10 D – Mech Rm. Booster Pumps

24” CW Bldg Service off of a 48” street main, 16” Feed to the building, 12” feed to Fire Pumps., 12 in S/S CW loop around lower concourse, Duplex strainer, Electronic water meter, Duplex Reduced Pressure Zone Backflow Preventers, (2) quadraplex booster pumps, One a high volume medium pressure zone for the stadium bowl & the other is a medium flow high pressure zone for the 9-story Warehouse

Figure 11 - Playing Field Photo

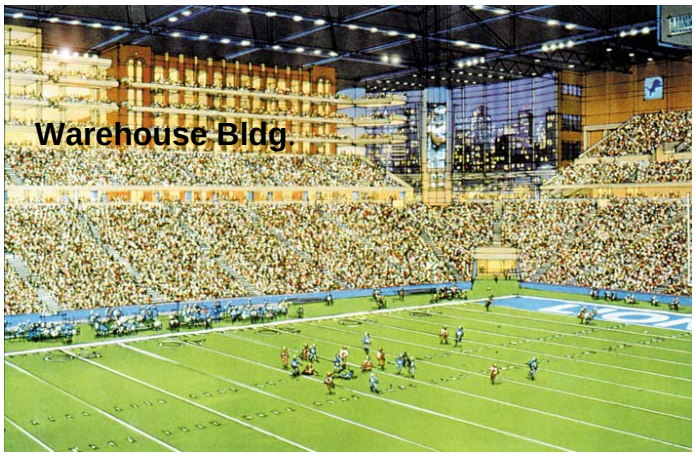

Figure 12 – Playing Field Rendering

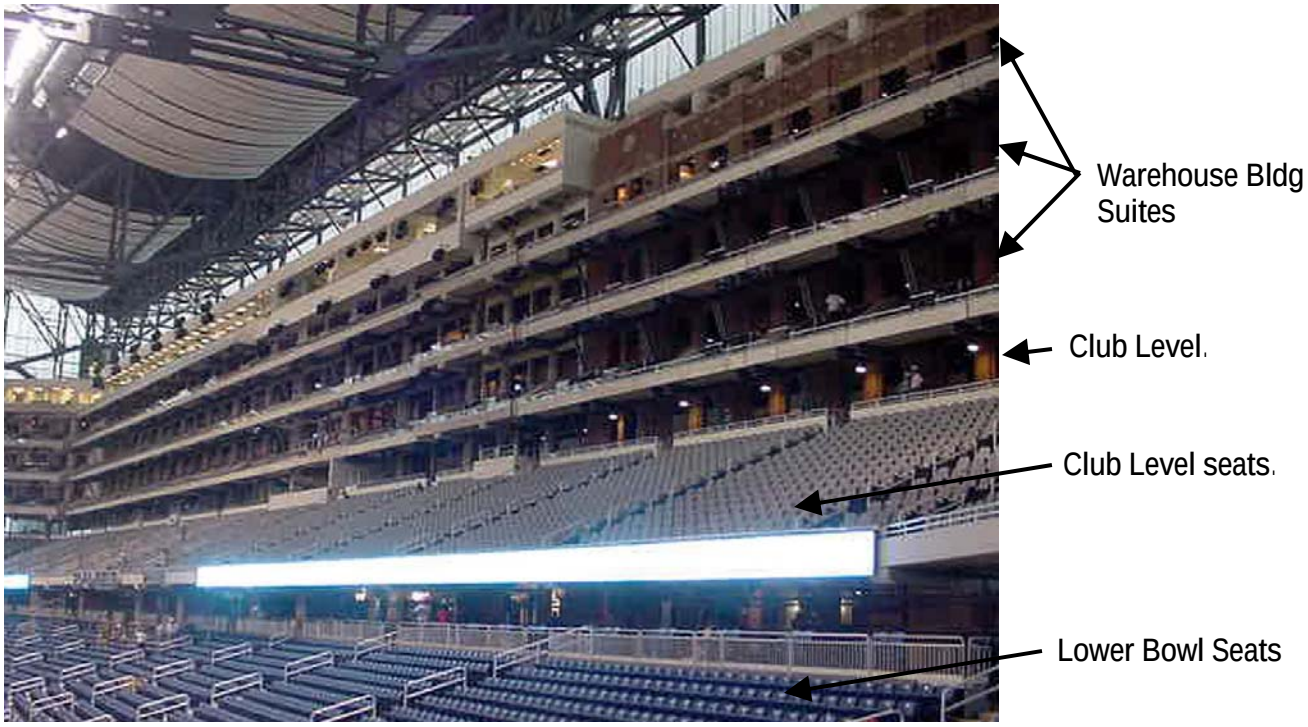

Figure 13 - Suite Levels 4 – 6 and Club Level Seating from the Old Hudson's Warehouse Building

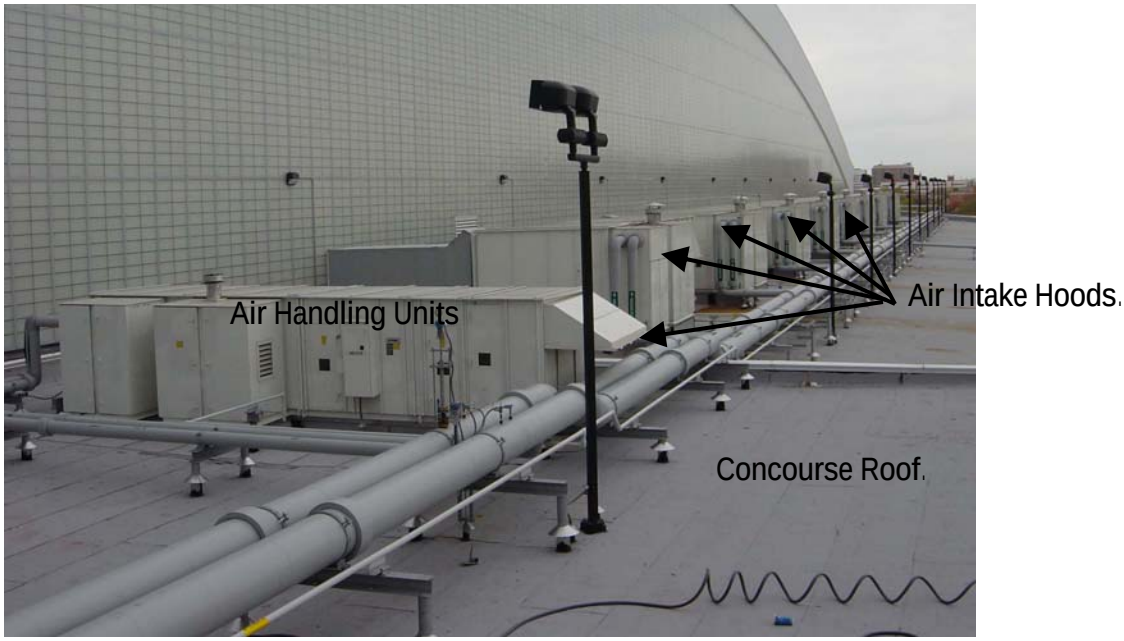

Figure 14 - View of Rooftop AHUs with make-up air hoods on roof above upper level concourses

The upper level concourses and concession areas are below this roof area. This is typical for three sides of the stadium. Plumbing vents through these roof areas would have created problems with the outside air intakes on the rooftop air handling equipment.

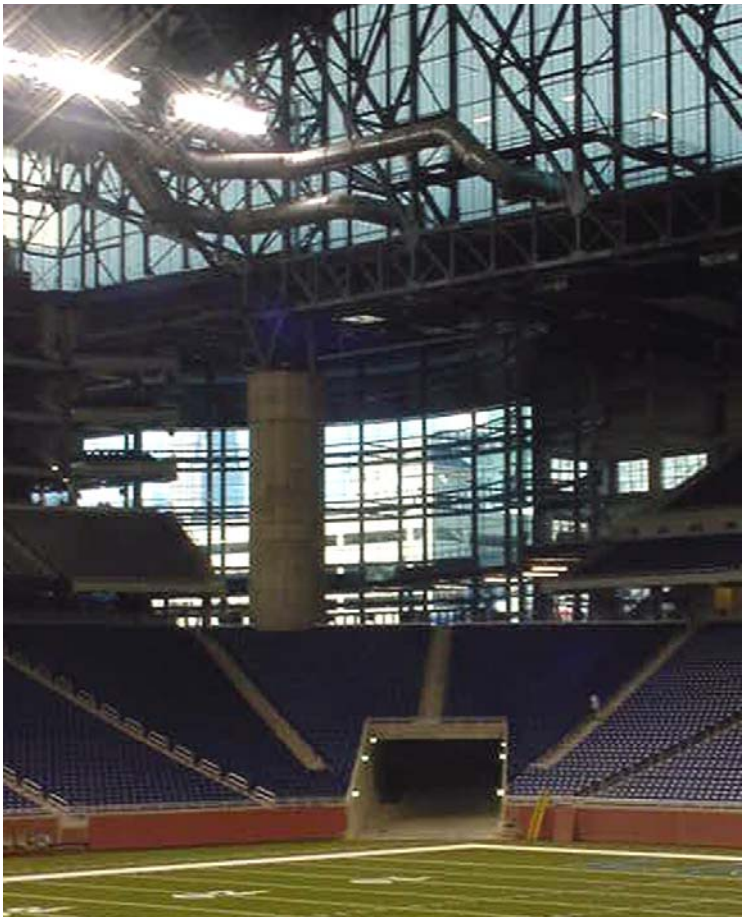

Figure 15 – View of the S. E. Corner of the Stadium

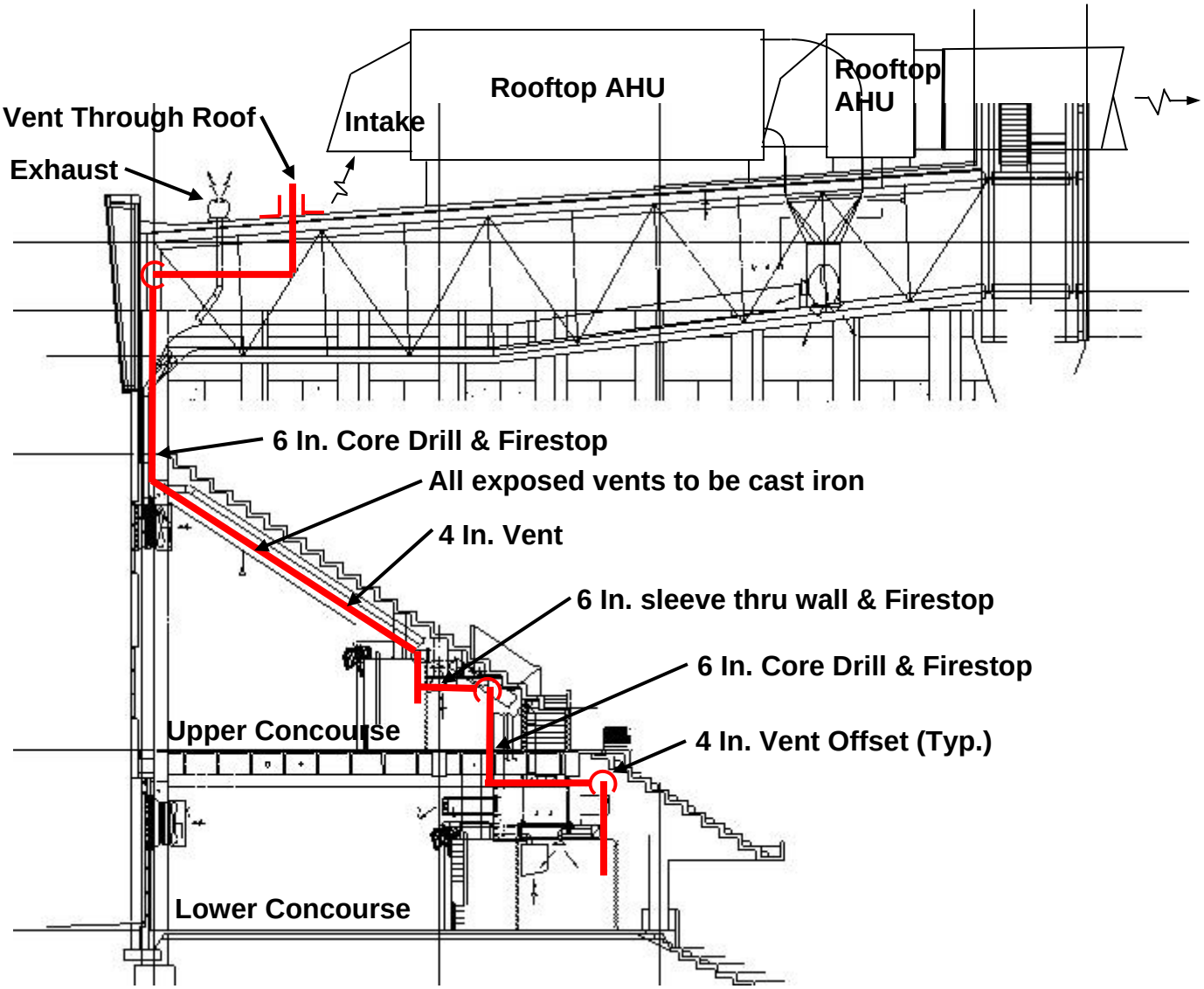

Figure 16 - Section through Stadium concourse levels at end zone Showing Conventional Venting
The red piping is the vent piping that was eliminated by using Air Admittance Valves.

Figure 16 - Material Take-off List for One Vent Stack
(As shown in Figure 16)

Description	Quantity	Unit Cost	Cost	
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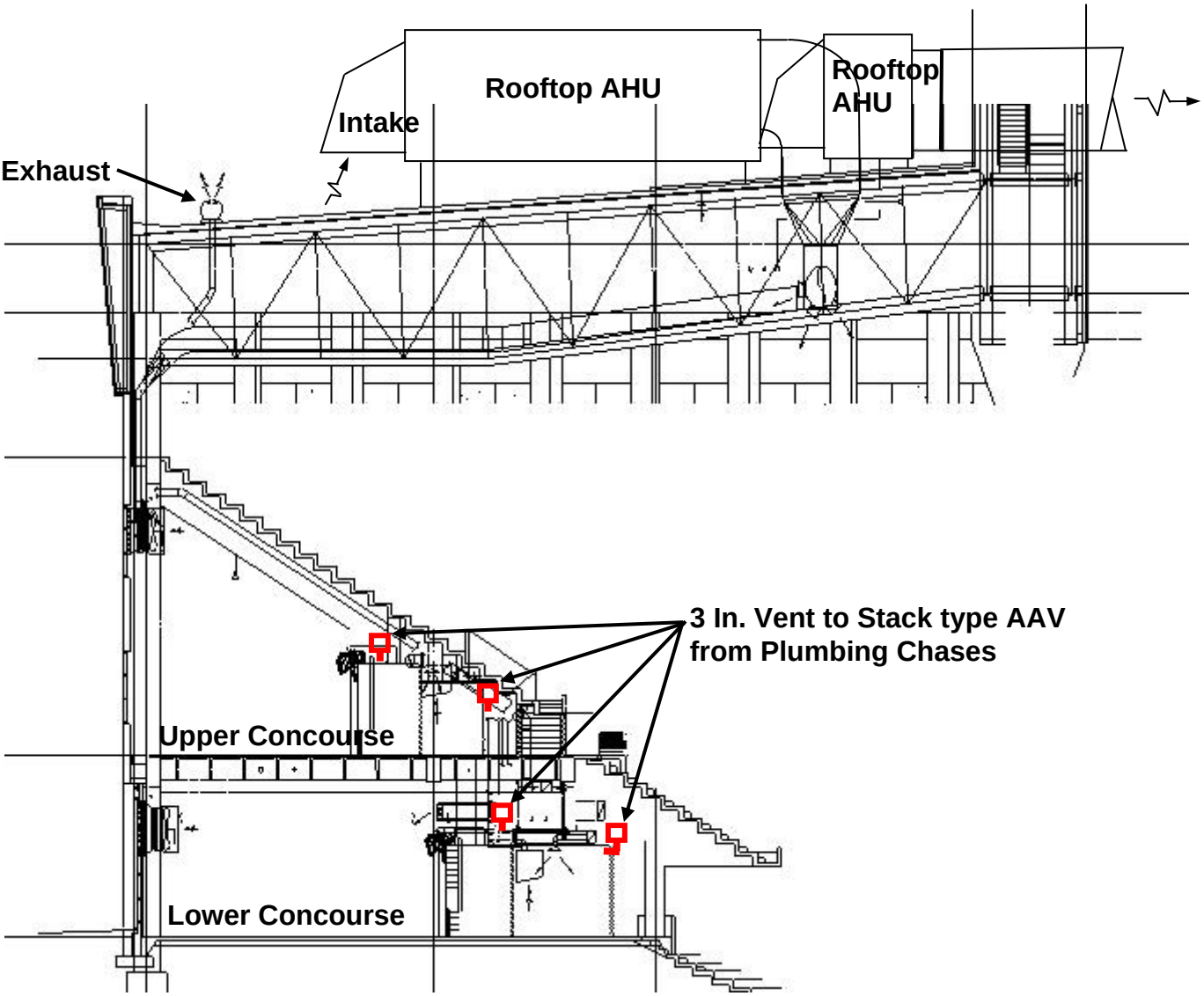

Figure 17 - Section through Stadium concourse levels at end zone showing AAV Design