Commercial Project Management:

Vapor Intrusion Mitigation in Large Buildings

-Tony McDonald

IPEC – San Antonio, TX - 10.30.17

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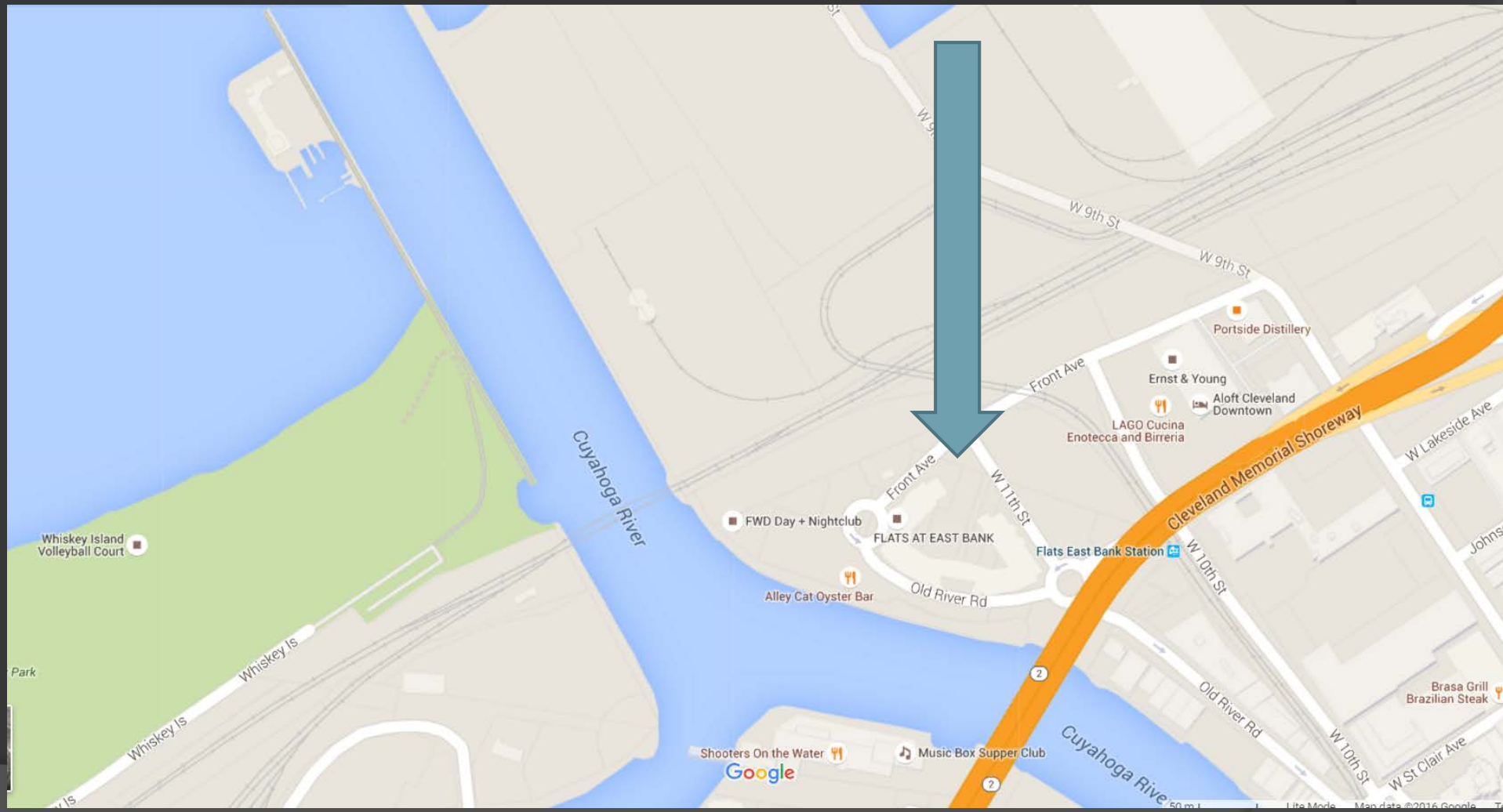
Project Location



Chemicals of Concern

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Project Dimensions

- A-Z was contracted to design/build Sub Slab Depressurization (SSD) Systems in two buildings being constructed during the redevelopment of the East Bank of the Flats in Cleveland, OH:
  - "Alley Cat Oyster Bar" – Two story 8,000 ft^2 steel building.
  - "Building 4" – 500,000 ft^2 8 story retail/ residential mid-rise building. Cast in place concrete building with post tension cables in every floor slab.

Design Requirements

- Constantly prevent VOCs from entering building
- Solution had to be repairable by general contractors
- Low/ no maintenance
- Energy efficient design
- Must coordinate installation with other trades
- ZERO ability to make adjustments after installation

No Room for Error

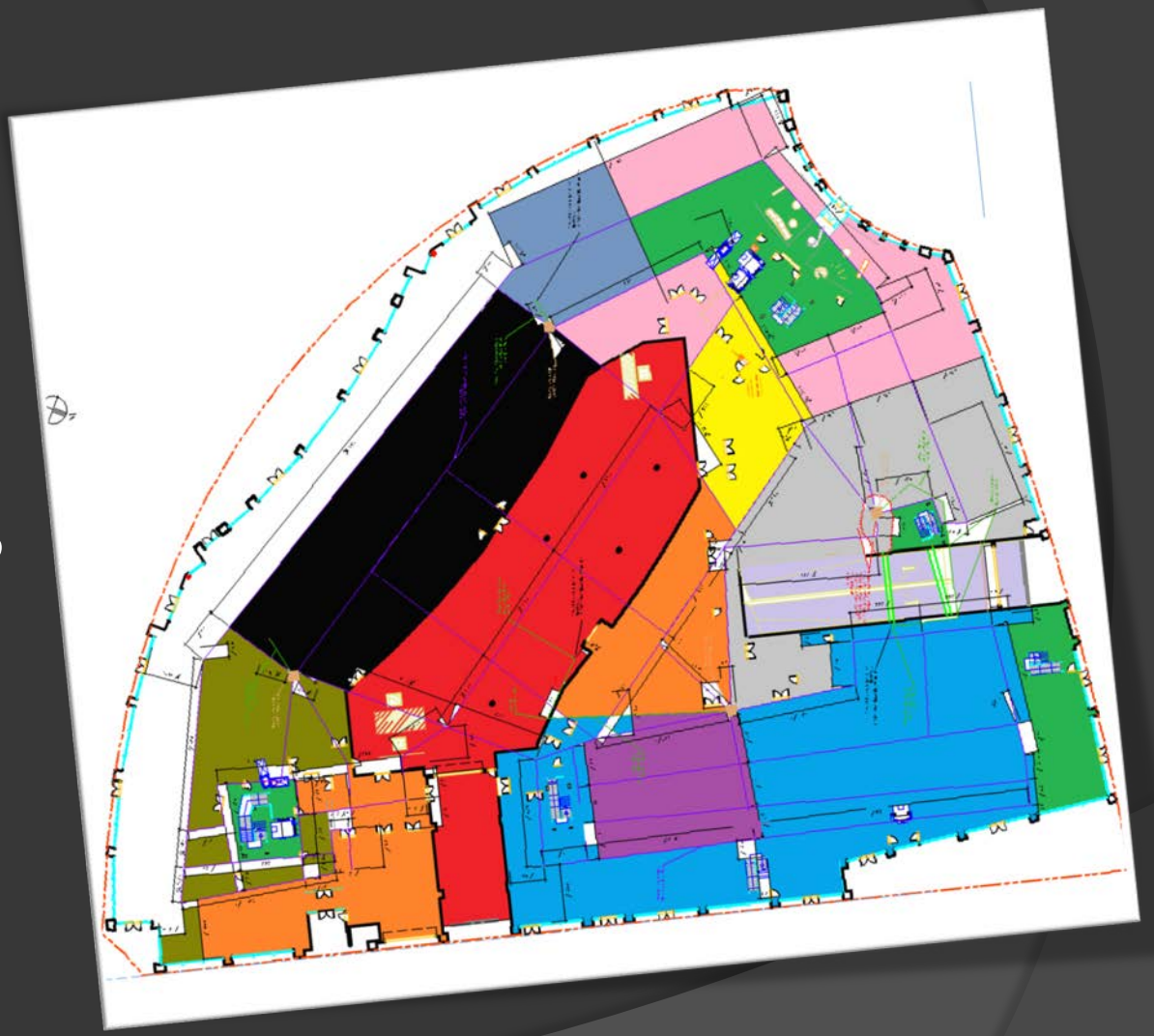
This picture shows ALL of the accessible piping on the first floor when the fans were energized.

Other Project Requirements

- Design assist, not design/ build
- Weekly coordination meetings
- Union labor
- Each building was built by a different construction company
- Building 4 had 9 different restaurant build outs on the first floor.
  - Completed by 5 different concrete contractors.

12 Different Concrete Pours

- by 5 Different Contractors



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Active vs. Passive Design

- Passive systems work via the stack effect. Warm air rises from the soil to the roof via a system of pipes.
  - They work best with large temperature differences between outside and inside.
- Active systems utilize a fan assembly to create a negative pressure field where the ground level concrete meets the soil.
  - The fans run continuously for the life of the building or remediation project.

Passive System Highlights

- Passive Systems typically consist of:
  - Vapor collection matting installed in a 20’ grid system.
  - Spray applied 60 mil vapor barrier installed by specialty contractor.
  - 4” PVC vent stacks typically spaced every 8,000 ft^2.
  - Designed with no exhaust blowers.
  - System effectiveness tested via Indoor Air Quality (IAQ) sampling.

Active System Highlights

- Active Systems typically consist of:
  - Vapor collection matting installed in a 60’ grid system.
  - 20 mil vapor sheet barrier installed by concrete contractor.
  - 8” PVC vent stacks typically spaced every 25,000 ft^2.
  - Exhaust blowers incorporated into design.
  - Measure effectiveness by either Pressure Field Extension (PFE) or IAQ sampling.

Active vs Passive Compared

- Building 4 -

	Passive	Active	Advantage
Matting	20,000 LF	3,000 LF	Active
Vapor Barrier	100,000 ft^2 Spray - Applied	100,000 ft^2 Sheet - Applied	Active
Conveyance Piping	20 - 4” PVC Pipe Stacks	4 - 8” PVC Pipe Stacks	Active
Fan Assemblies	0	4	Passive
Consistently Effective	No	Yes	Active
Verifiable Pressure Differential	No	Yes	Active

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Common Design Elements

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Under Slab Vent Matting

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Suction Pits

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Gas Permeable Layer

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Vapor Barrier

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Conveyance Piping

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High Flow Exhaust Fans

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System Monitoring

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Building 4

- 500,000 ft^2 8 story building
- 1st floor: Retail
- 2nd floor: Parking
- 3rd thru 8th floor: Luxury Apartments

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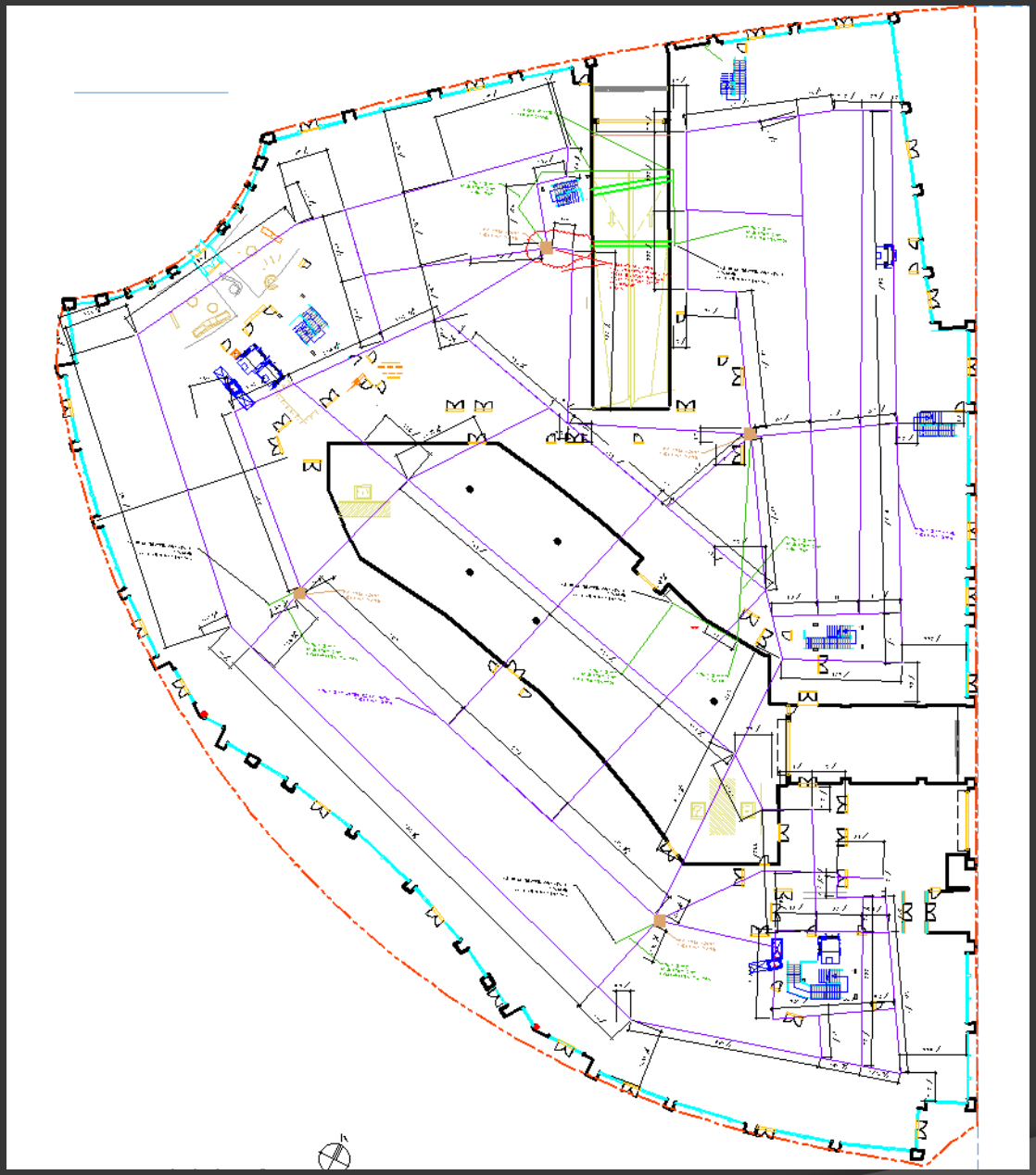

Design Components

4 Total Systems

- 3,500LF vent matting
- 4 suction pits
- 600LF of 8” SCH40 conveyance piping
- 4 Fantech FDK 12XL blowers
- 4 system monitors wired to a central monitoring point.
- 10 permanent sub slab pressure monitoring points.

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Design Coordination with other Trades

- The MEP trades have to coordinate their installations so there are no installation conflicts.
- These coordination drawings are part of the construction documents and are critical to the success of the project.
- Every floor penetration in Building 4 needed to run though a sleeve that was installed before the concrete floor was poured.
  - All penetrations needed to be on the drawings so engineering could make sure they would not conflict with the post tension cables.
  - The plumbing company installed the SSDS sleeves.
  - The foreman called to get permission to move a sleeve ¼” north.

Installation Timeline
- Building 4 -

- March 2014: Building foundation piers started.
- May 2014: A-Z design work begins.
- June 2014: SSD initial design completed.
- November 2014:
  - SSD system design change for new tenants.
    - New design has bowling lanes and sunken areas on first floor.

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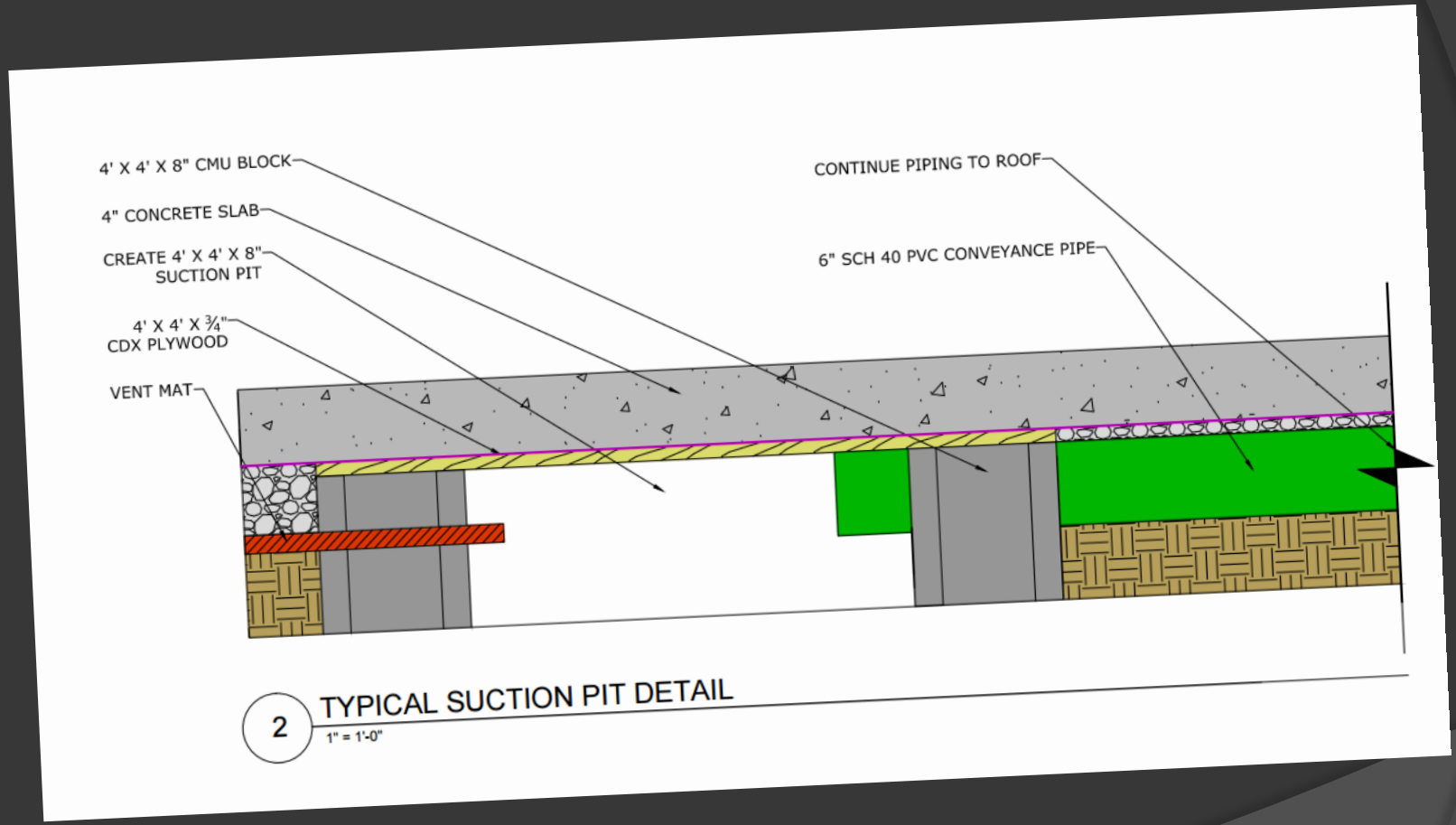
Suction Pit Issues



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Suction Pits - Building 4 -

This debris was found inside a suction pit. The pit was also 6” too low and the block were mortared together.

Repaired suction pit by A-Z at correct height.

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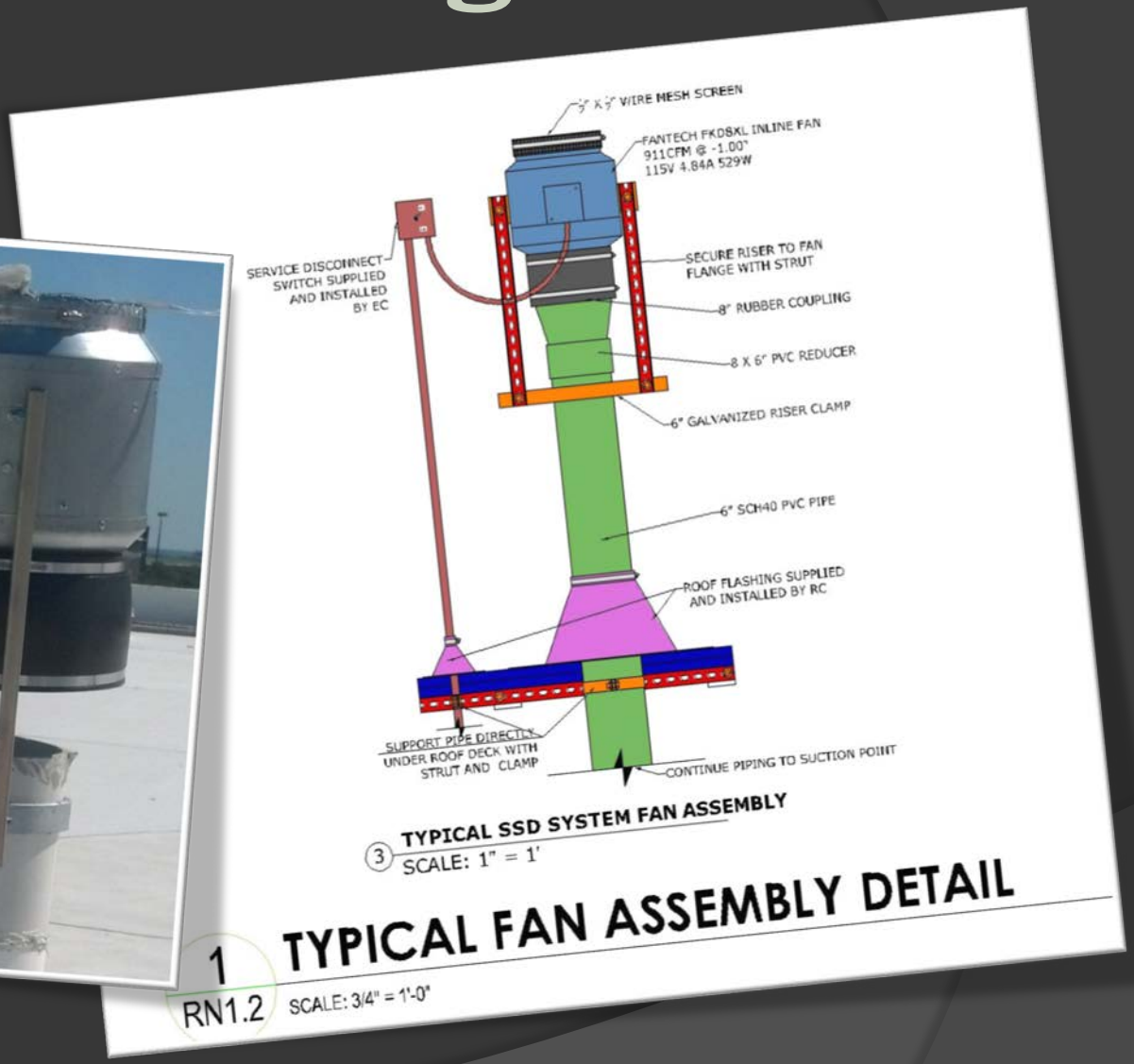
Timeline Continued

- Building 4 -

- March 2015: First floor restaurant buildouts begin.
- June 2015:
  - 2 tenant spaces are not leased.
  - 1 of the 4 main suction pits was now in an unrented space.
  - “Will this system work with only 3 systems running?”
    - We decide to install gravel and VB only in these two spaces.
- July 2015:
  - First floor concrete is finally finished in most spaces.
  - Most buildouts are completed.
  - Attempt 1 at installing the fans.

New Patented Design

- Building 4 -



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Timeline Continued

- August 2015 -
  - Fans actually installed and energized.
  - Monitoring system installed.
  - PFE Testing – FINALLY.
  - Several restaurants open.
- 15 Months in total!

Final Results -Building 4-

PFE Results		
Point	**Pressure**	**Distance**
1	-1.536”	30’
2	-0.006”	50’
3	-0.029”	60’
4	-0.010”	65’
5	-0.007”	109’
6	-0.044”	40’
7	-0.011”	74’
8	-0.036”	85’
9	-0.021”	56’

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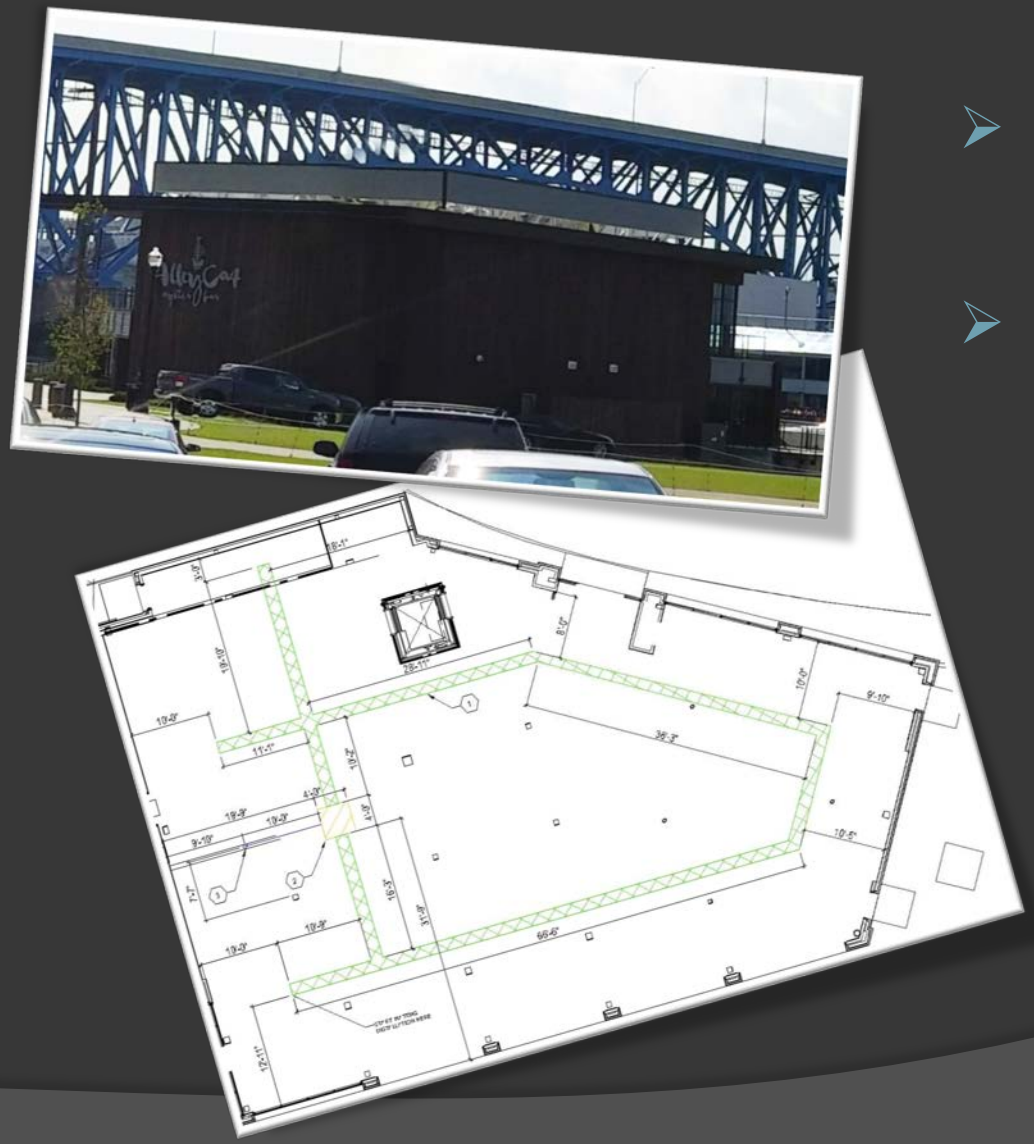
Alley Cat Oyster Bar



- 8,000 ft^2 2 story restaurant.
- A-Z scope of work:
  - Design
  - Oversight
  - Install underground piping

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Underground Work

A-Z installed the undergrounds at this property. The concrete company was uncomfortable installing the system.

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Suction Pit - Alley Cat -

Installed initially by A-Z.

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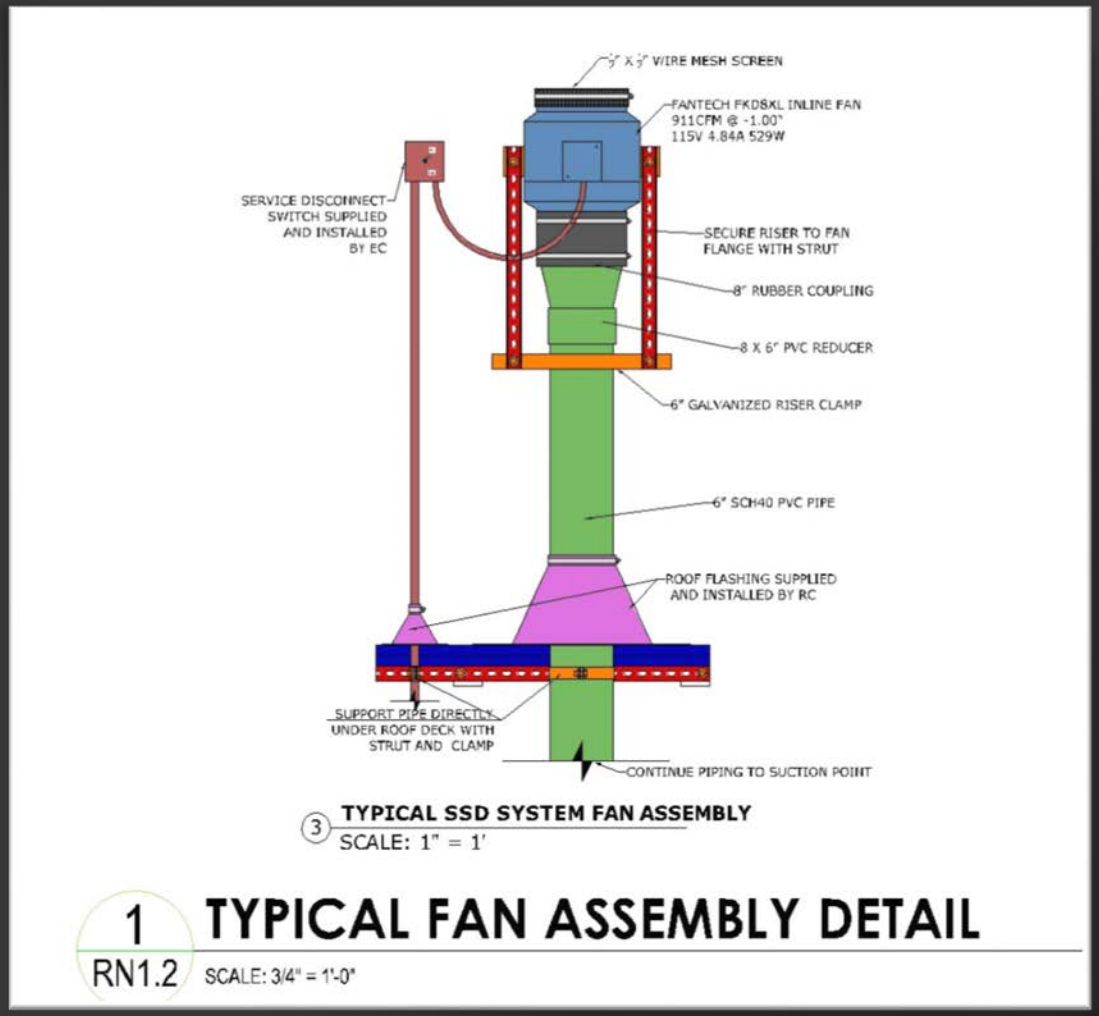
Final Inspection - Alley Cat -



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Deficiencies

- No rubber coupling
- Wrong support assembly
- Motor seized
- Wrong size motor
- Fan upside down
- Sticker flipped over to show proper flow

Corrective Action

- Issued paperwork outlining necessary corrective action.
- Included this picture from previous project.

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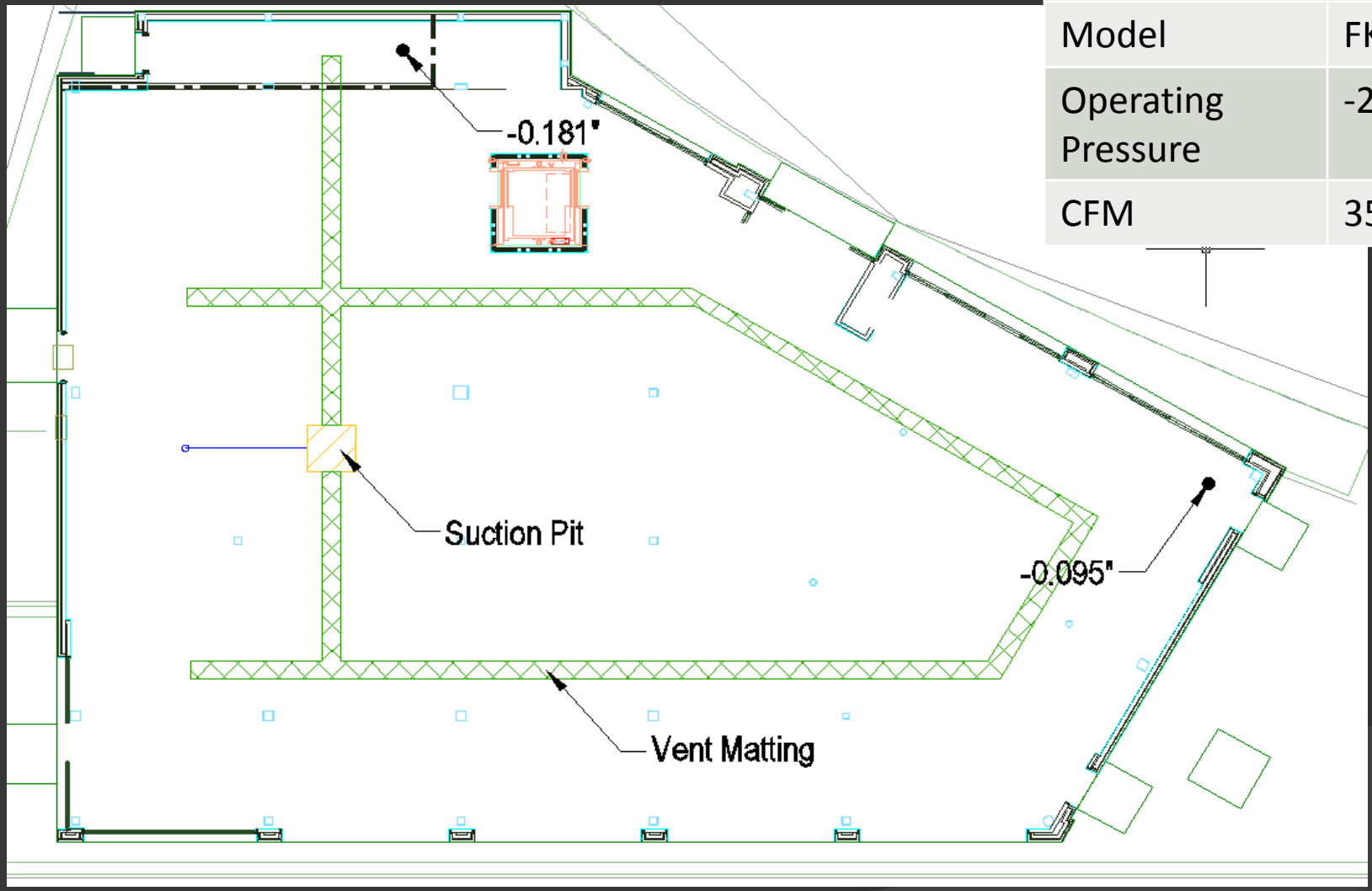
Follow up Inspection

- Not much better
- New fan
  - Still wrong model
- Orientated correctly
- Still no rubber coupling
- Wrong support assembly
- Lots of caulking

Final PFE Readings

Fan Info	
Manufacturer	Fantech
Model	FKD 10XL
Operating Pressure	-2.5”
CFM	350



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Final Metrics

	Building 4	Alley Cat	Total
Building Footprint	100,000 ft^2	8,000 ft^2	124,000
Fan Assemblies	4	1	7
Total Wattage	2124	327	3,105
Monthly Electrical	152.93	23.55	223.57
Cost Per ft^2	$0.001	$0.003	$0.002
Efficiency ft^2 Depressurized / Watt	47:1	25:1	40:1

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30 Year Operating Cost

	Fans	**AVG Life Span**	**Replacement Cost**	**30 Year Total**
Building 4	4	7 years	$850.00	$13,600.00*
Toby Keith	2	7 years	$650.00	$5,200.00*
			Fan Replacement Total	$18,800.00*
	Monthly Electric		**Yearly Electric**	**30 Year Total**
Building 4	$152.93		$1,835.16	$55,054.80*
Alley Cat	$23.55		$282.60	$8,478.00*
			Electric Total	$63,532.80*
			Grand Total	$82,332.80*
		Cost per leasable ft^2 of buildings		~ $0.20

* Cost does not include inflation in calculation.

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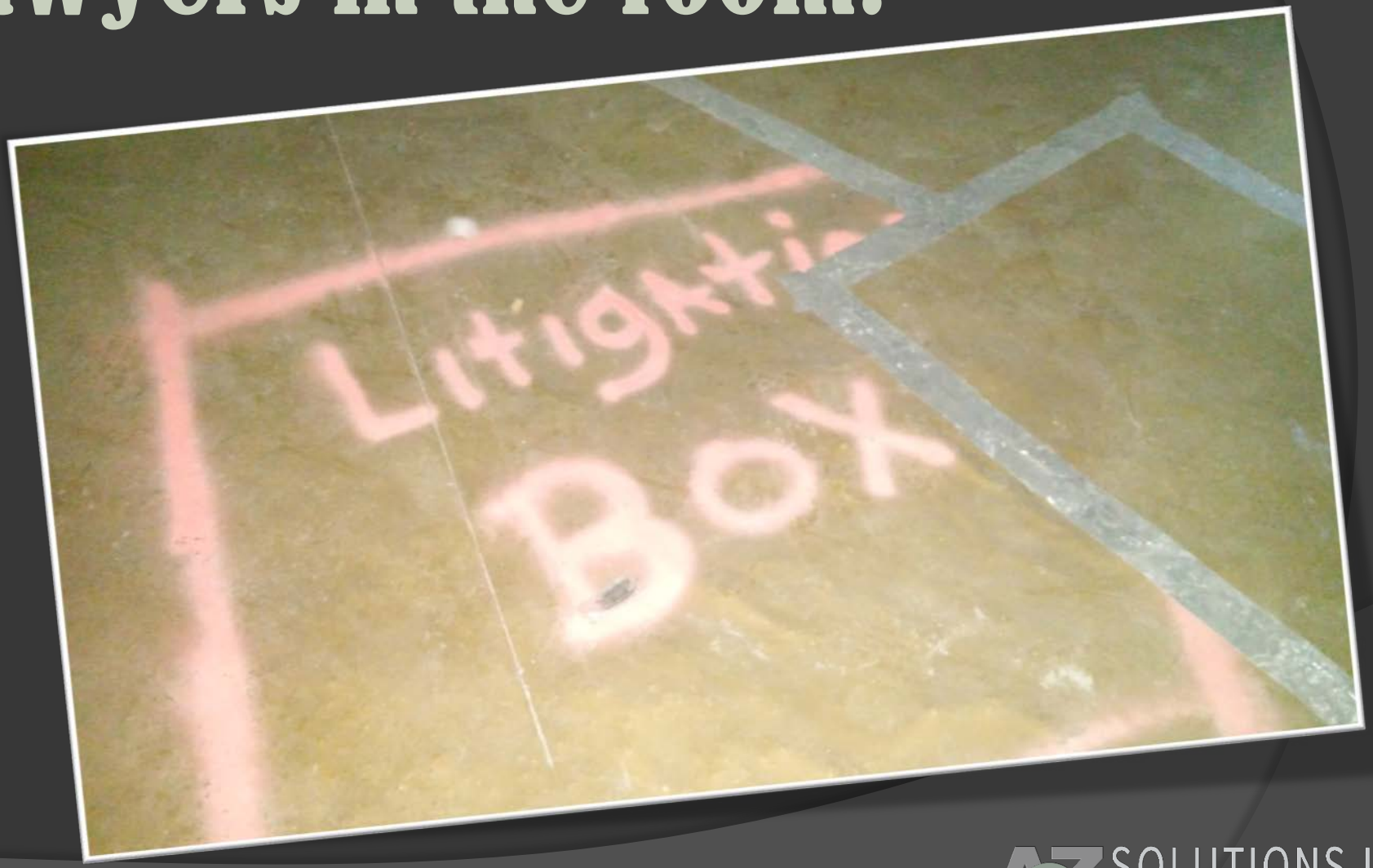
Let this be a lesson to all the lawyers in the room.



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Questions?

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