CFD Analysis Report

CFD Analysis of Building Screen

FEAmax LLC. Engineering Design, Analysis & Manufacturing Services.
Email: info@FEAmax.com; *Web*: www.FEAmax.com

7/17/2019

FEAmax LLC.

PROJECT INFO.

Change History:

Version Number	Date	Prepared by	Reviewed by	Contact
V 1.0	7/17/2019	Bill Bin	Frank Wang	Frank.Wang@feamax.com

FEA Requestor Info.:

Contact name:	
Email:	
Company name:	AMICO
Address:	245 Fayette Ave, Birmingham, AL 35208

CONTENTS

PROJECT DESCRIPTION

Project Description:

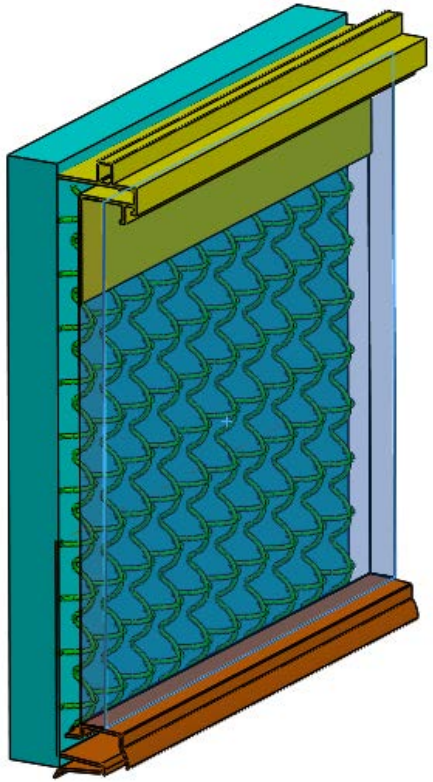
1. Perform CFD analysis to simulate the water and vapor flow moving through the greendrain design, and determine the flow rate.
2. Total 4 CFD steady flow analysis:
   - Case#1: water moving downward, 10mm thick greendrain, room temp
   - Case#2: water moving downward, 6mm thick greendrain, room temp
   - Case#3: vapor moving upward, 10mm thick greendrain, 40F
   - Case#4: vapor moving upward, 6mm thick greendrain, 100F
3. All related documents were received by 6/10/2019

CAD MODEL

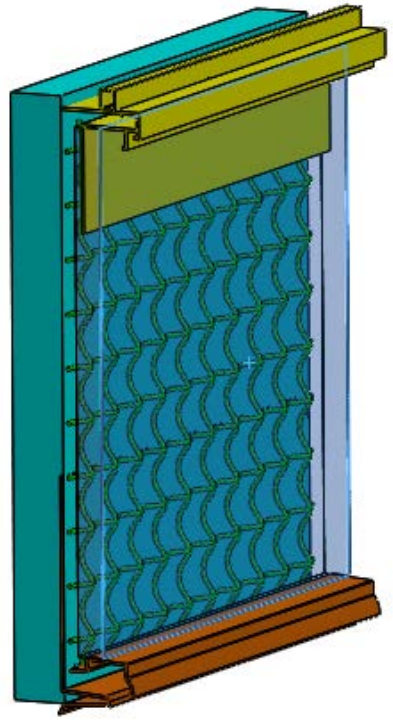
CAD Models

We choose the CAD model with typical size 10” X 11” for the FEA analysis.

Two models would be analyzed: the designs with 10mm and 6mm thick green drain.



10mm thick greendrain



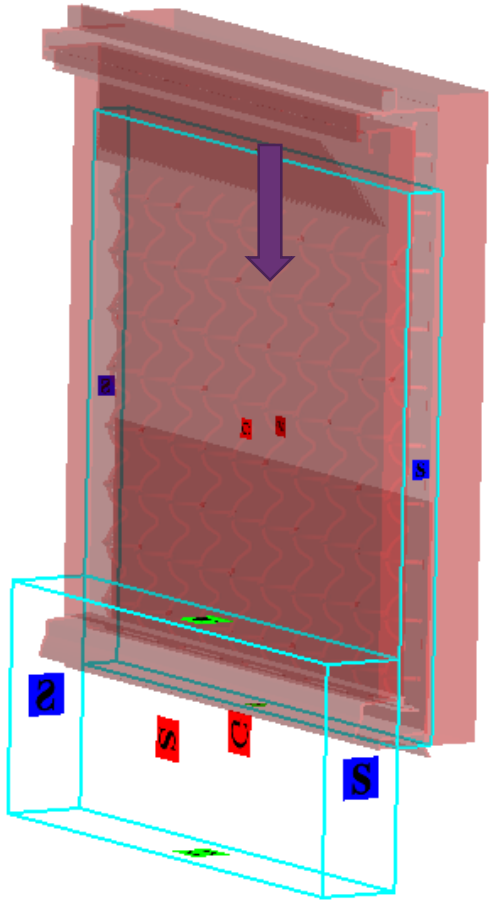
6mm thick greendrain

LOAD CONDITION

Load Conditions:

- **Case#1:** water moving downward, 10mm thick greendrain, room temp:

1. Gravity is in the vertical downward direction.
2. Room temperature.
3. Ignore the surface tension force of the water.
4. Apply inlet water velocity = 0.1 m/s = 0.9144 m^3/h
5. Fill the inlet water about 4s, and then turnoff the inlet water.

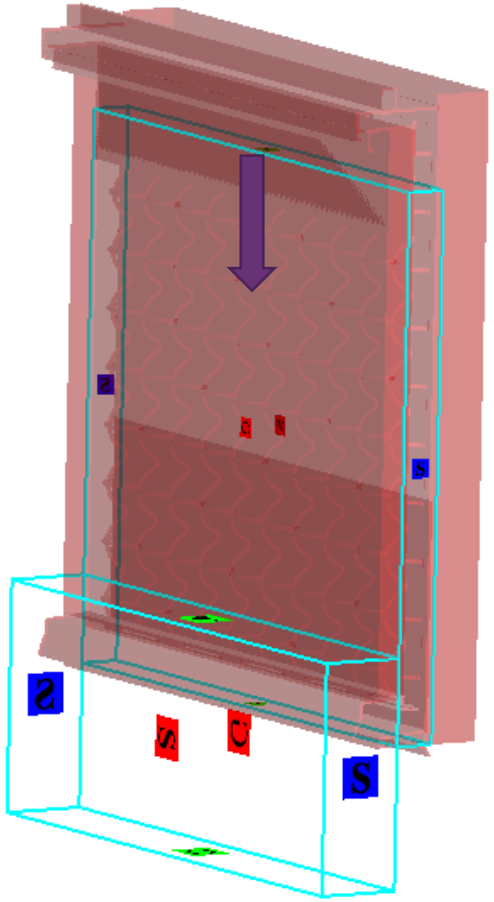


LOAD CONDITION

Load Conditions:

- **Case#2:** water moving downward, 6mm thick greendrain, room temp:

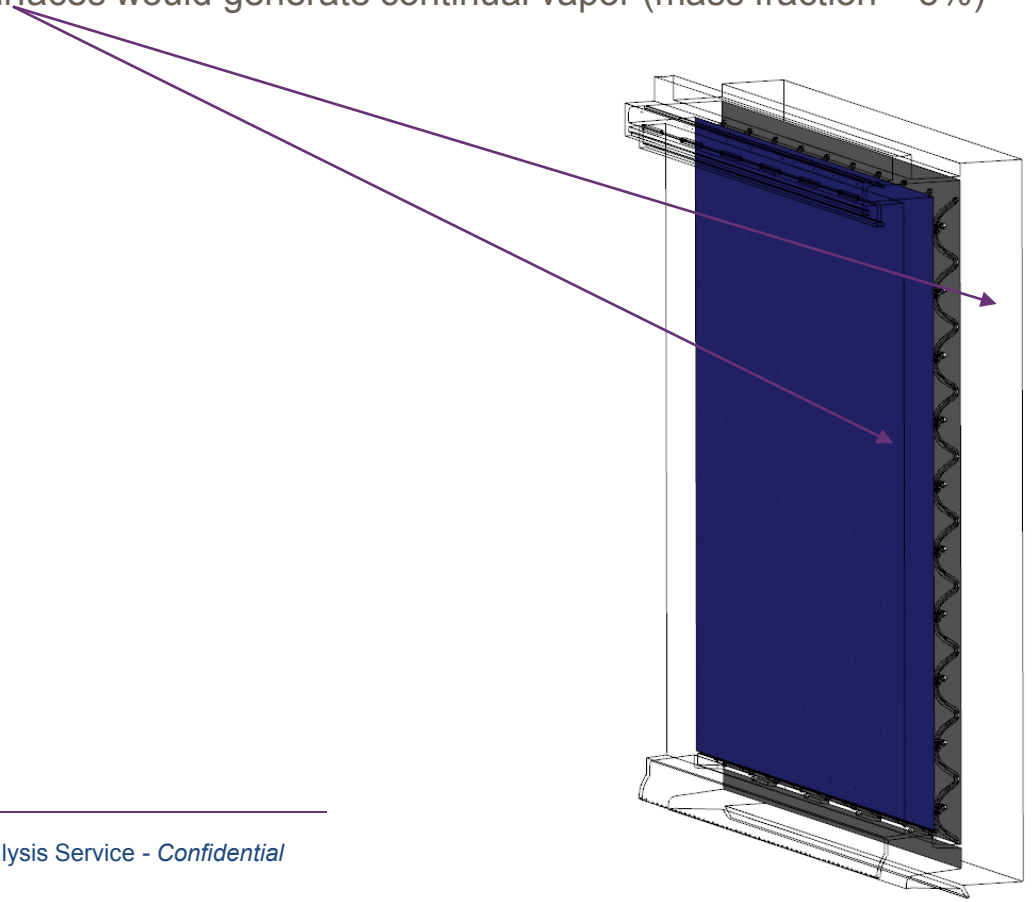
1. Gravity is in the vertical downward direction.
2. Room temperature.
3. Ignore the surface tension force of the water.
4. Apply inlet water velocity = 0.1 m/s = 0.9144 m^3/h
5. Fill the inlet water about 4s, and then turnoff the inlet water.



Load Conditions:

- **Case#3:** vapor moving upward, 10mm thick greendrain, 40F:

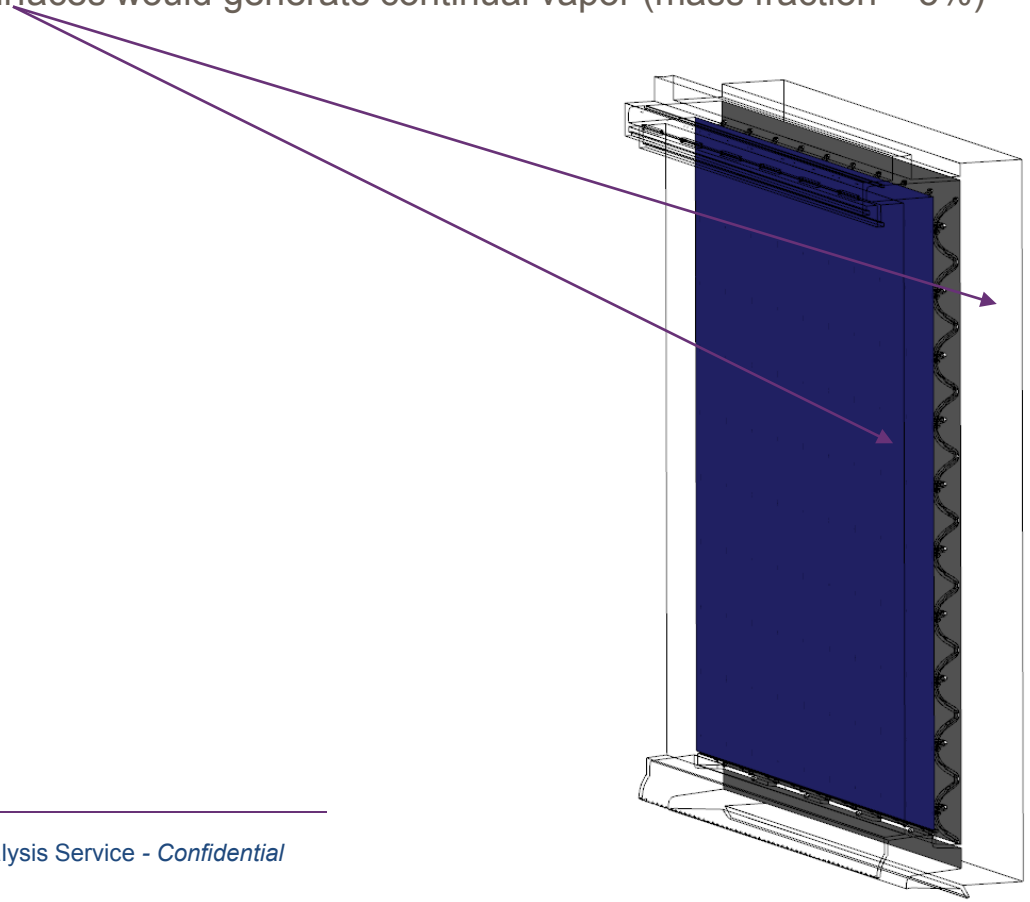
1. Gravity is in the vertical downward direction.
2. Assume the temperature change would generate about 1Pa Convective pressure difference.
3. Assume these two surfaces would generate continual vapor (mass fraction = 5%)



Load Conditions:

- **Case#4:** vapor moving upward, 6mm thick greendrain, 100F:

1. Gravity is in the vertical downward direction.
2. Assume the temperature change would generate about 1Pa Convective pressure difference.
3. Assume these two surfaces would generate continual vapor (mass fraction = 5%)



ANALYSIS TYPE AND MESH

Analysis Type:

Steady CFD flow analysis

Analysis Tool:

Choose Flow3D for water flow analysis

Choose Fluent16 for vapor flow analysis

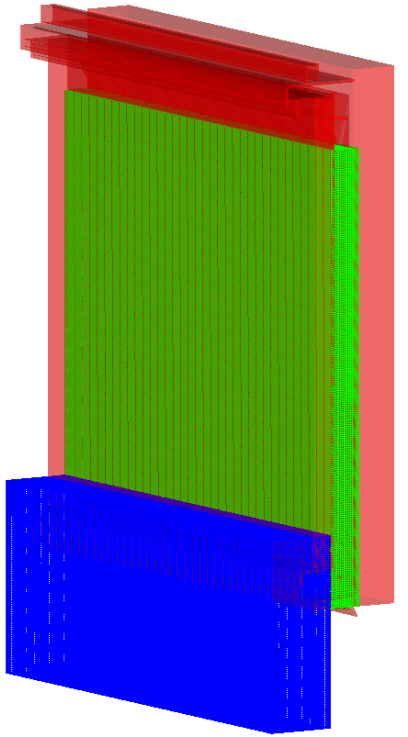
Mesh:

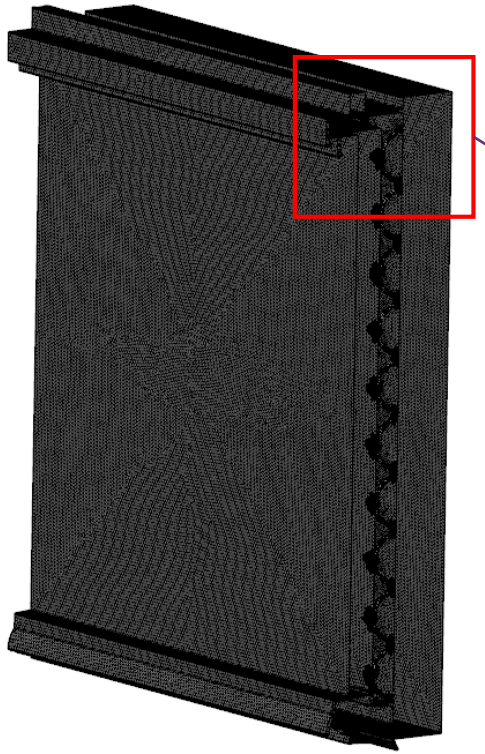
Mesh Type: 3D Solid element

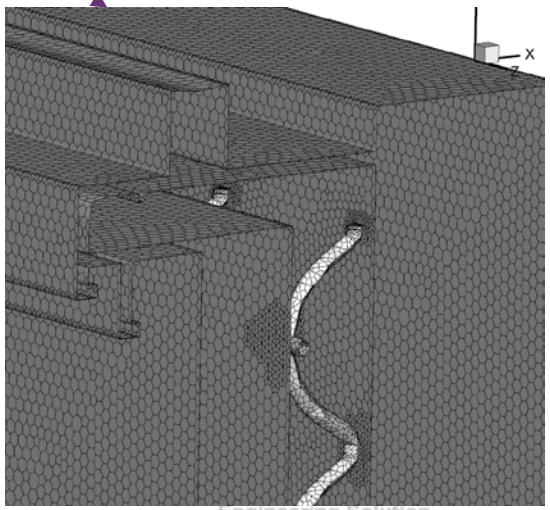
Element Shape: Hex & Tet

Total Element Number:

1. About 1,120,000 for water flow analysis
2. About 764,000 for vapor flow analysis



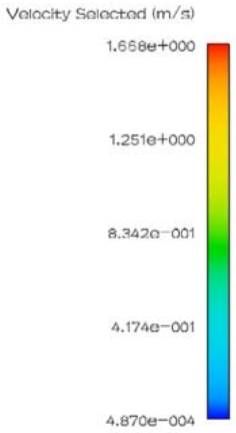


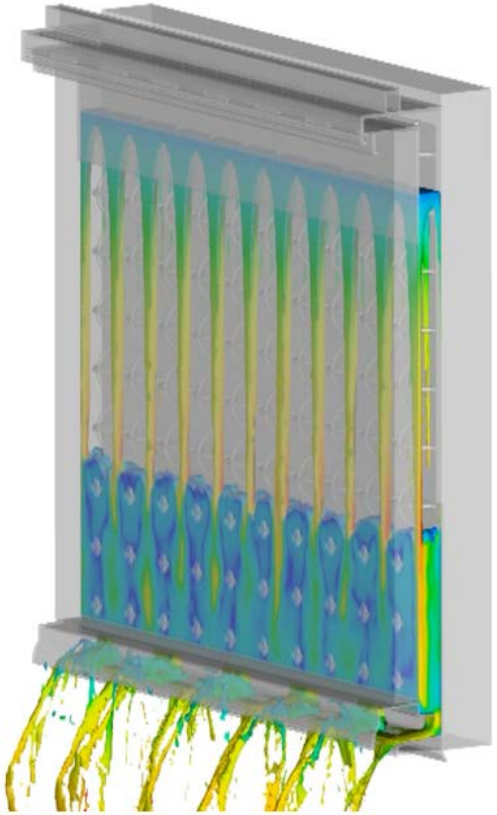


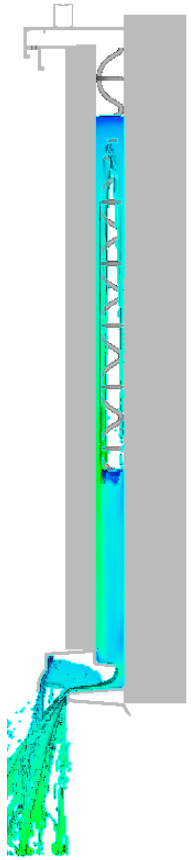
CFD RESULT

CFD Result #1 (Water flow, 10mm design)

- Some water would stay inside, the water height would be about 69mm
- The flow rate at outlet is about 0.92 m^3/h (for the design width of 10”).



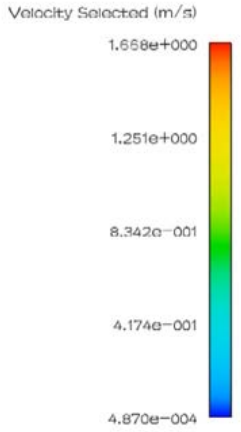


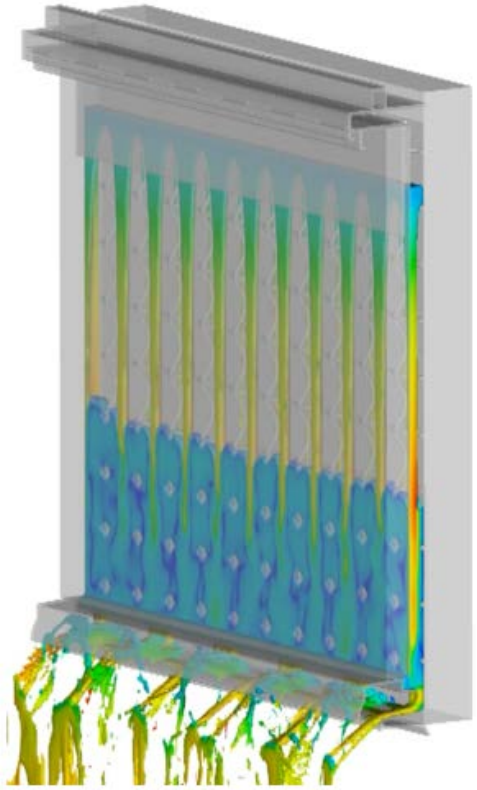


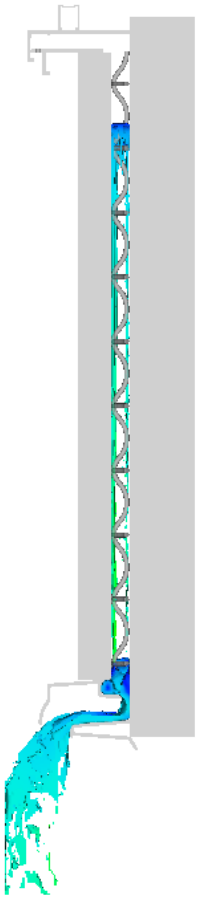
CFD RESULT

CFD Result #2 (Water flow, 6mm design)

- Water would come out through the drain holes, no water would stay inside.
- The flow rate at outlet is about 0.92 m^3/h (for the design width of 10”).



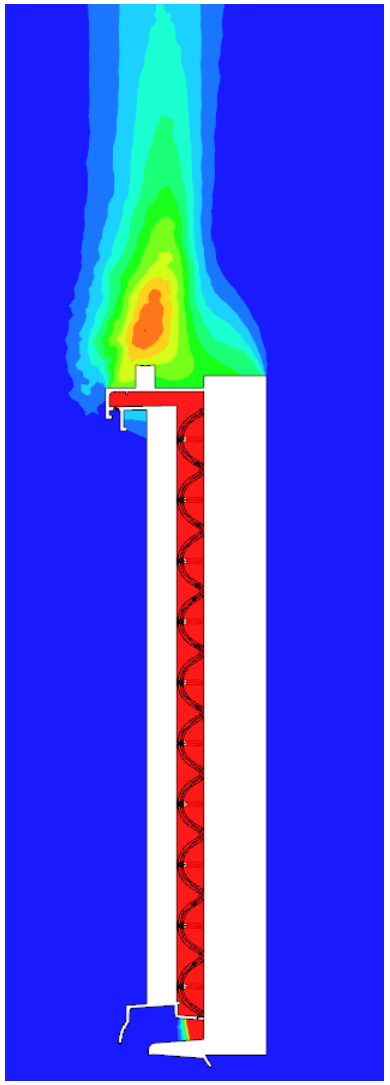




CFD RESULT

CFD Result #3 (Water flow, 10mm design)

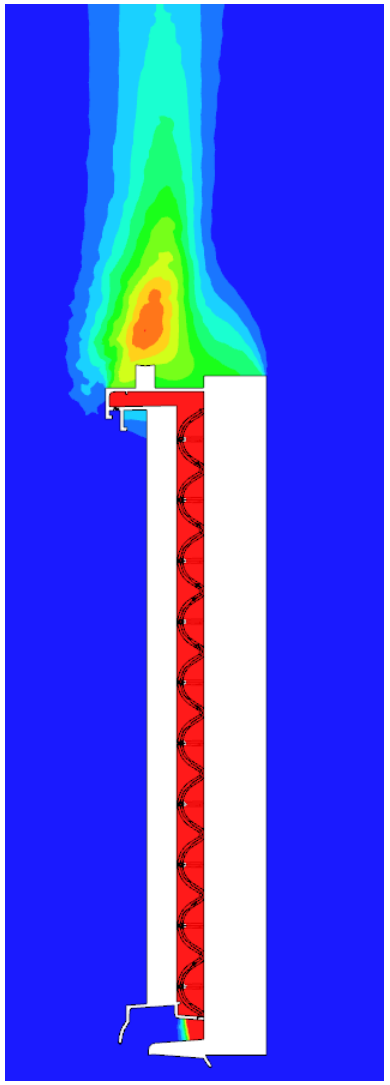
- The vapor distribution. The flow rate at outlet is about 0.0375 kg/h (for the design width of 10”).



CFD RESULT

CFD Result #4 (Water flow, 6mm design)

- The vapor distribution. The flow rate at outlet is about 0.0311 kg/h (for the design width of 10”).



SUMMARY

Summary

Load case	Green drain thick	Flow	temperature	Flow rate
Case #1	10 mm	Water	Room	0.92 m^3/h
Case #2	6 mm	water	Room	0.92 m^3/h
Case #3	10 mm	Vapor	40F	0.0375kg/h
Case #4	6 mm	Vapor	100F	0.0311kg/h

CONCLUSION

Conclusions:

1. When we choose the same inlet water flow rate as 0.92m^3/h for the 6mm and 10mm designs:
   - The stacked water height is about 69mm for the 10mm design, and about 85mm for the 6mm design. the 6mm design would stack more water height than the 10mm design.
   - Since the water height of 6mm is higher than the 10mm design, the outlet pressure of 6mm design would be higher. And then when we turnoff the inlet water, the water evacuation time for the 6mm would be shorter than the 10mm design.
   - The CFD result showed that the water evacuation time for the 10mm is about 1.82 second, and the evacuation for the 6mm design is about 1.6 seconds.
2. If we choose the same stacked water height for the 6mm and 10mm design, the max flow rate for the 10mm design is 0.92 m^3/h, and the max flow rate for the 6mm design would be about 0.80 m^3/h.
3. The temperature would not affect the flow rate result of water.
4. The effect of temperature to the flow rate of vapor is very small.
5. The 10mm thick greendrain design is better than the 6mm thick greendrain design.

COMMENTS

Comments:

1. For the vapor CFD analysis, we did not count the phase change (evaporation or condensation) in the analysis program, and then the predicted flow rate result is not much related with the temperature. If count the effect of phase change, the result would be more related with the temperature, but the CFD analysis would be much more complicated for this project.