INSERT YOUR LOGO HERE

CFD Sample Report

Prepared For:

POWERED BY PREDICT

DISCLAIMER

CFD Modeling is an inexact science using fluid dynamic equations and numerical analysis to simulate the effects of different air flow conditions and parameters on room air patterns, comfort conditions, etc. The results are not to be taken literally, in absolute terms, but may be used as a comparative tool when evaluating different HVAC air distribution options one against the other. Even though CFD tools have been rigorously developed and validated and are completed by experienced and trained analysts, the presented results may or may not be reproduced in the built environment.

Prepared By:

Steven Thomasson, EIT,
Senior CFD Analyst

Jovanni Tubog, EIT
CFD Analyst

Reviewed By:

Mikhail Koupriyanov, M.A.Sc., P.Eng.
Manager, Advanced Research & Simulation

1. Executive Summary

- The proposed air distribution layout includes Price Linear Displacement Floor Grille (DFGL), Price Linear Floor Grille (LFG), and Price Double Deflection Supply Register (Model 520).

2. Recommendations

- Project specific recommendations are provided that cover:
    - Diffuser/return types
    - Diffuser/return layout
    - Airflow sizing
    - Supply air temperature
    - Contaminant removal/mitigation strategies (if applicable)
    - Cooling/heating load mitigation strategies

Table of Contents

List of Figures

List of Tables

3. Geometry

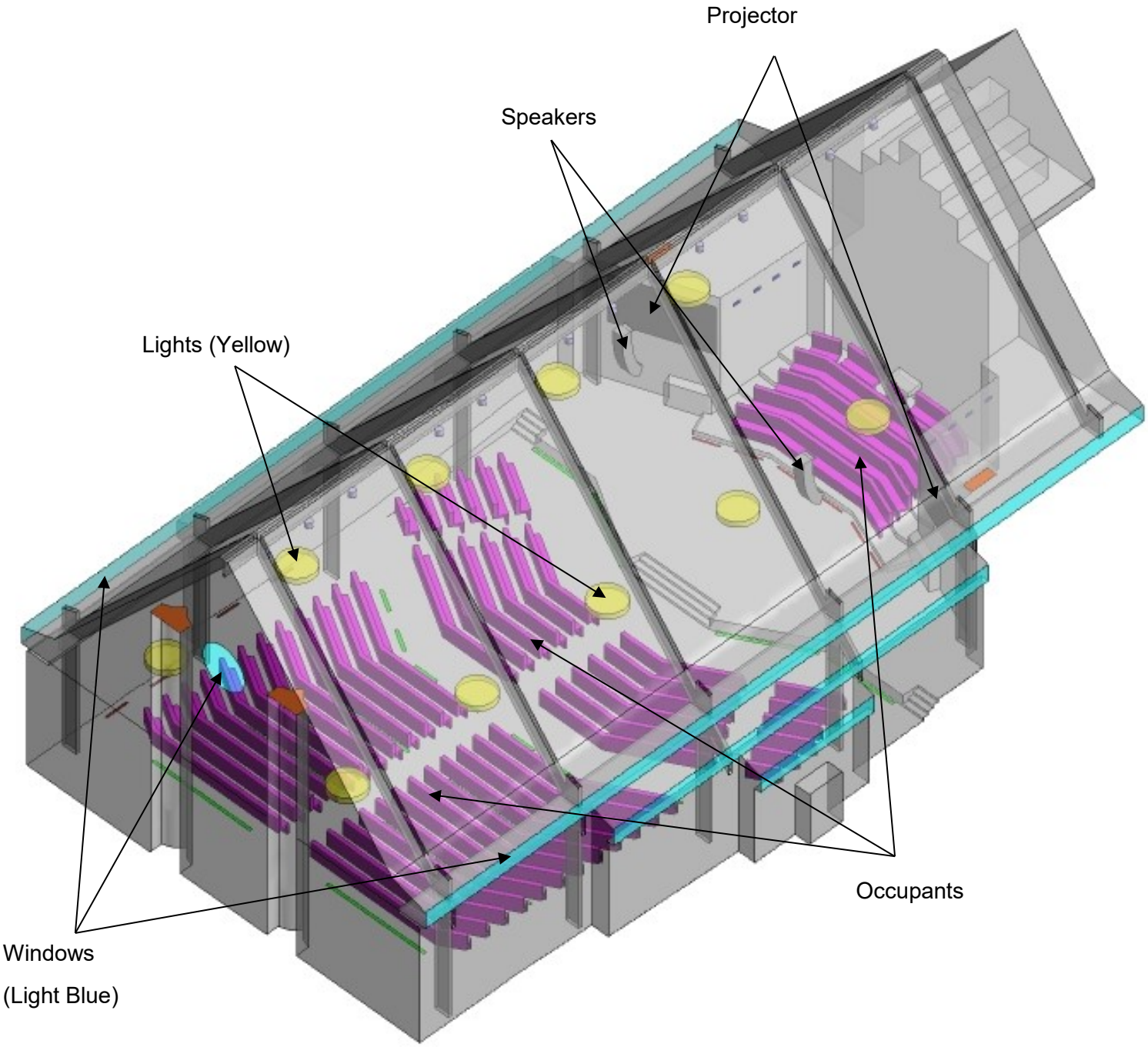

Figure 1: Geometry of the Space View

4. Definitions

The **predicted mean vote** (PMV) is an index that defines the average thermal sensation of a large group of people based on the ASHRAE seven point thermal sensation scale (ASHRAE standard 55-2010). It combines various environmental conditions such as temperature, humidity, air velocity and mean radiant temperature with human factors such clothing level and metabolic output to create a single comfort parameter. This index can be considered more complete than the draft risk (DR) since it takes a person's heat output and skin temperature into account. The acceptability limits defined by ASHRAE for this index are -0.5 < PMV < 0.5 and ASHRAE`s seven point sensation scale is shown below.

Hot	Warm	Slightly Warm	Neutral	Slightly Cool	Cool	Cold
3	2	1	0	-1	-2	-3

The **ventilation effectiveness** E_z used in this study is calculated based on the local **Age of Air**.

$$E_z = \frac{AoA_{Return}}{AoA_l}$$

Calculation of the ventilation effectiveness in this manner is accurate provided that contaminant transport is dominated by the diffusion and convection of momentum (rather than the contaminant species) which implies that the oldest air can be assumed to have the highest contaminant concentrations. Typically, a good mixing ventilation system has a E_z of 1.0 (ceiling supply of cool air) while a good displacement ventilation system has a E_z of 1.2 (floor supply of cool air & ceiling return).

5. Simulation Results

Table 1: Area Averages for Variables

Average at:	T [°F]	PMV	Relative Humidity [%]	E_z
4” AFF	71.2	-0.46	48	2.28
24” AFF	74.9	-0.04	50	1.35
42” AFF	76.1	0.23	50	1.19
66” AFF	77.2	0.32	51	1.11

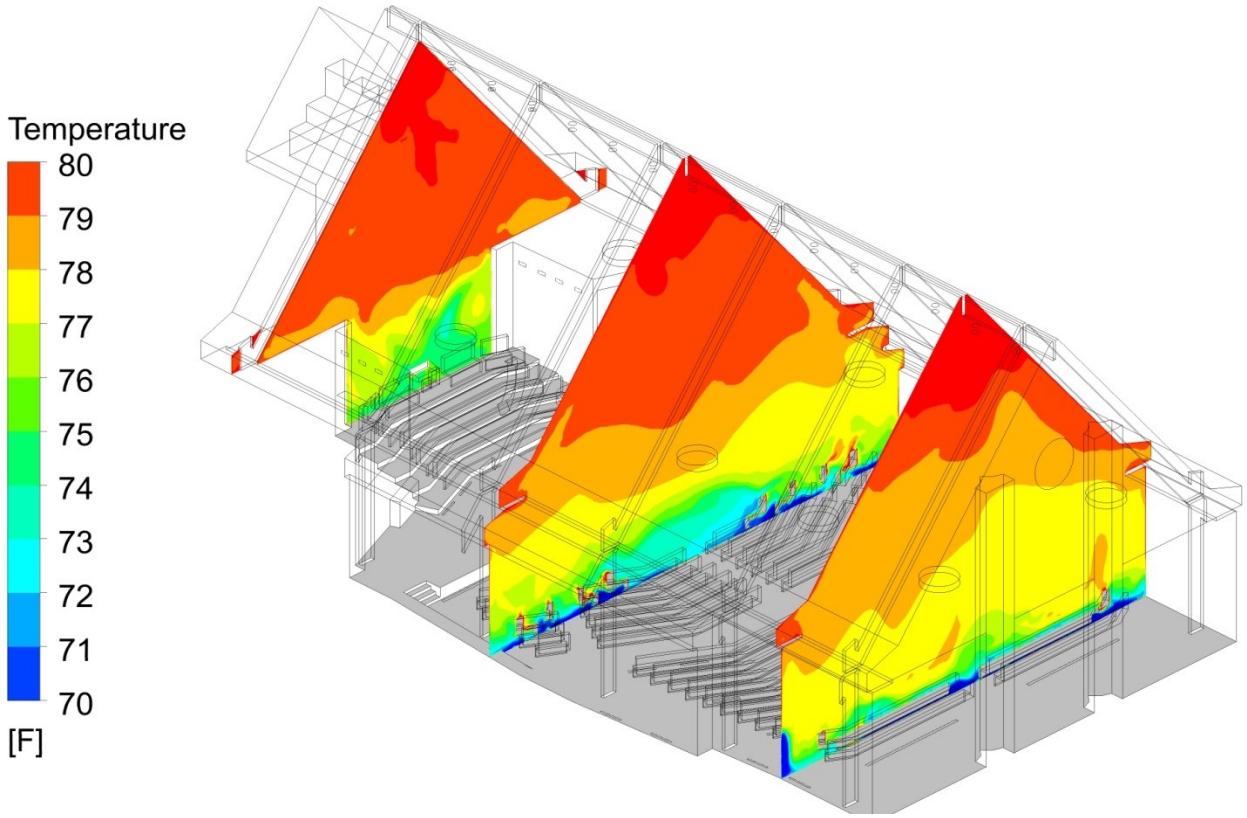

Figure 2: Temperature Contour

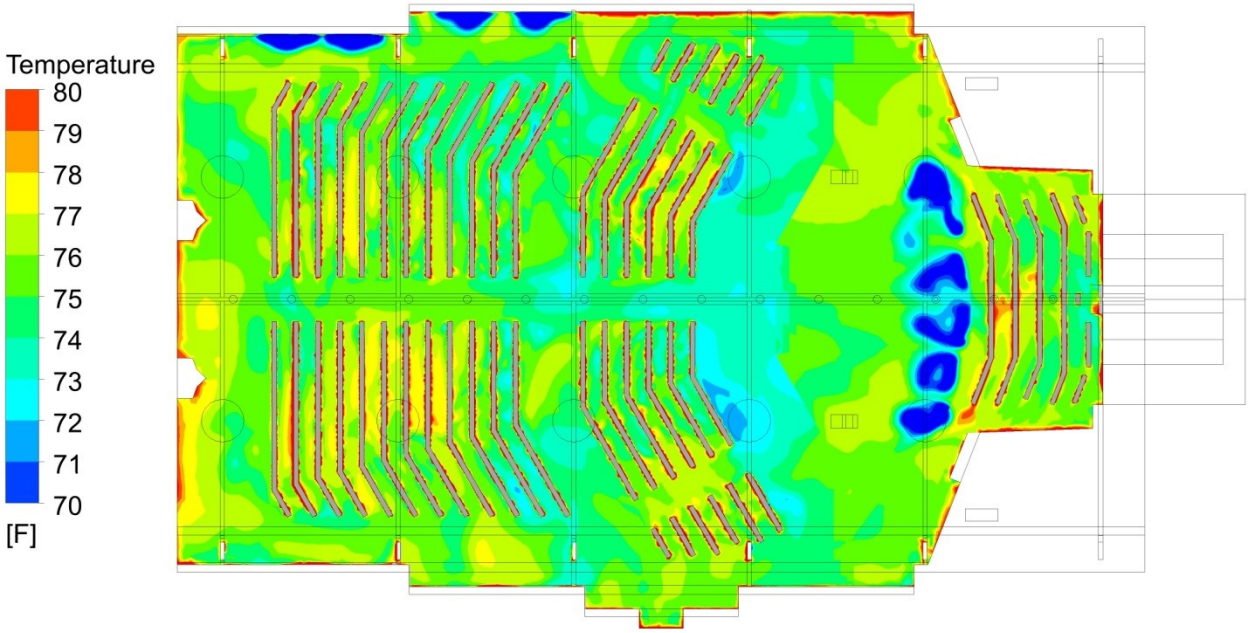

Figure 3: Temperature 42" above Floor

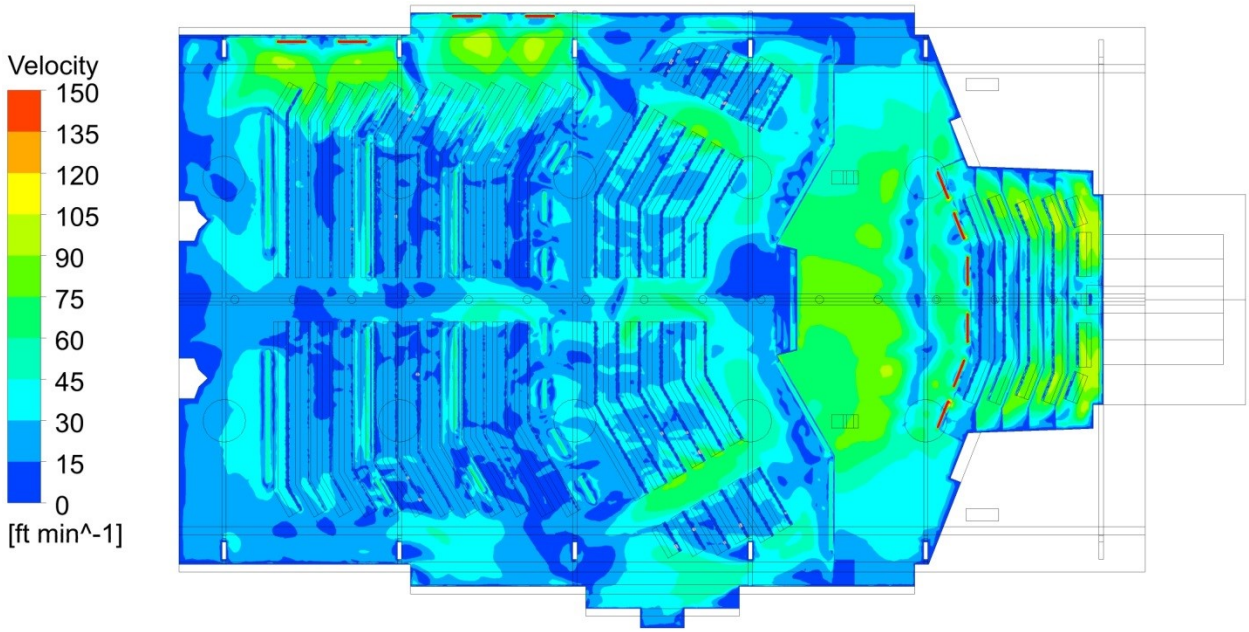

Figure 4: Velocity 4" above Floor

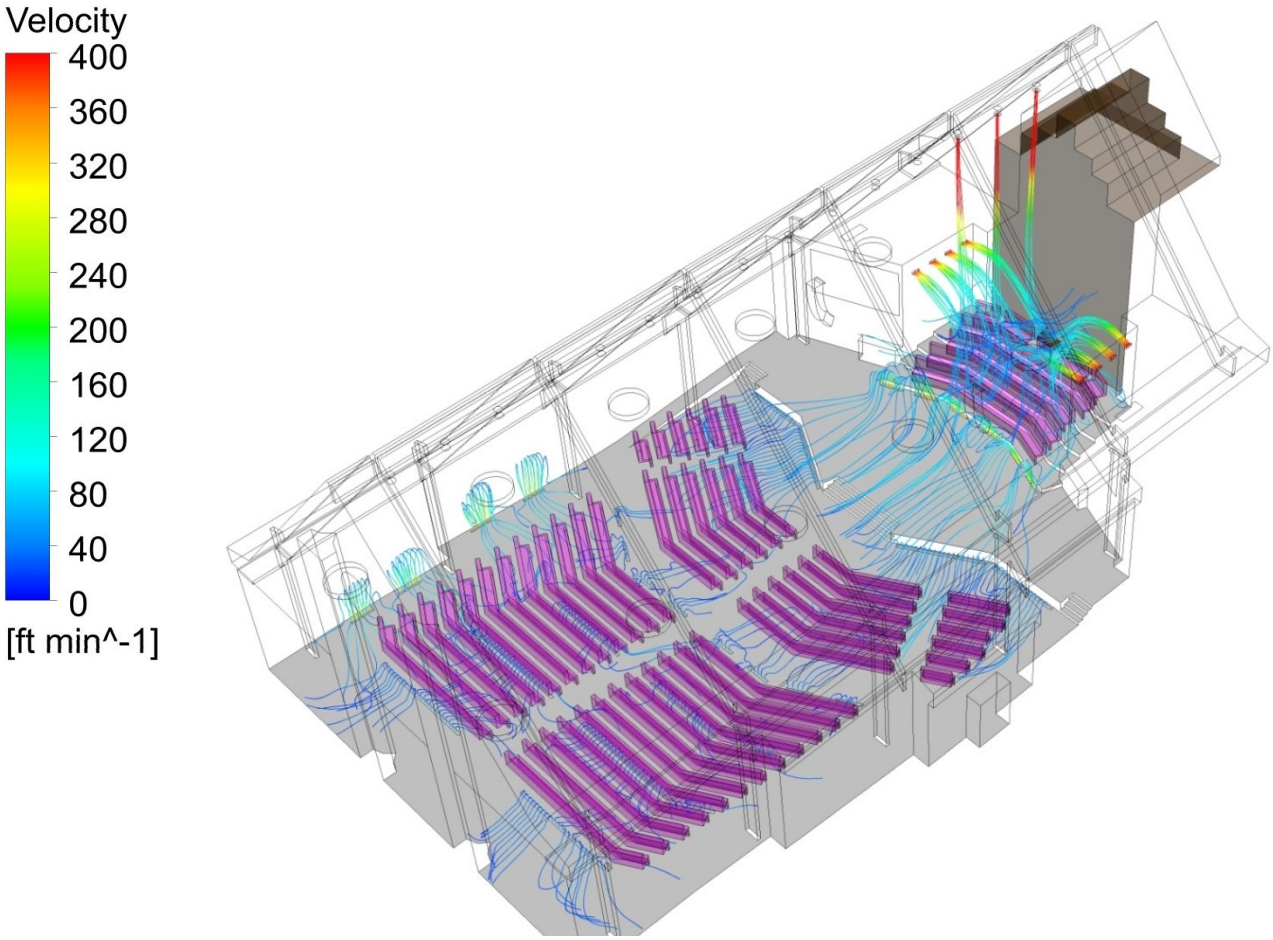

Figure 5: Velocity Streamline

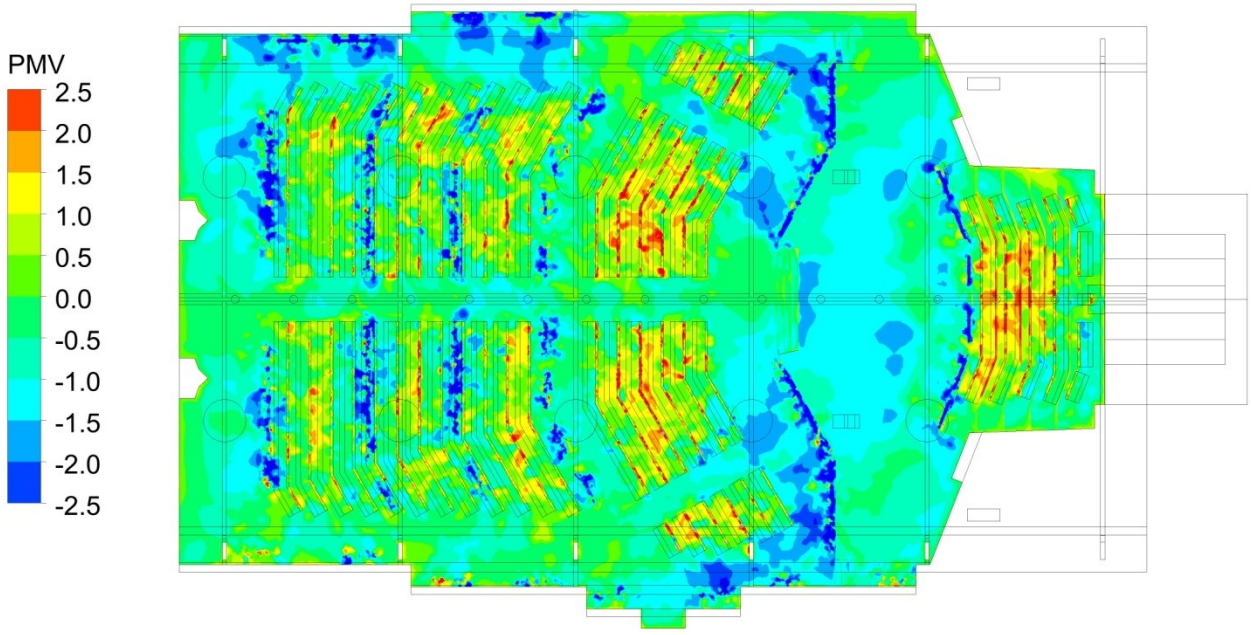

Figure 6: PMV 4" above Floor

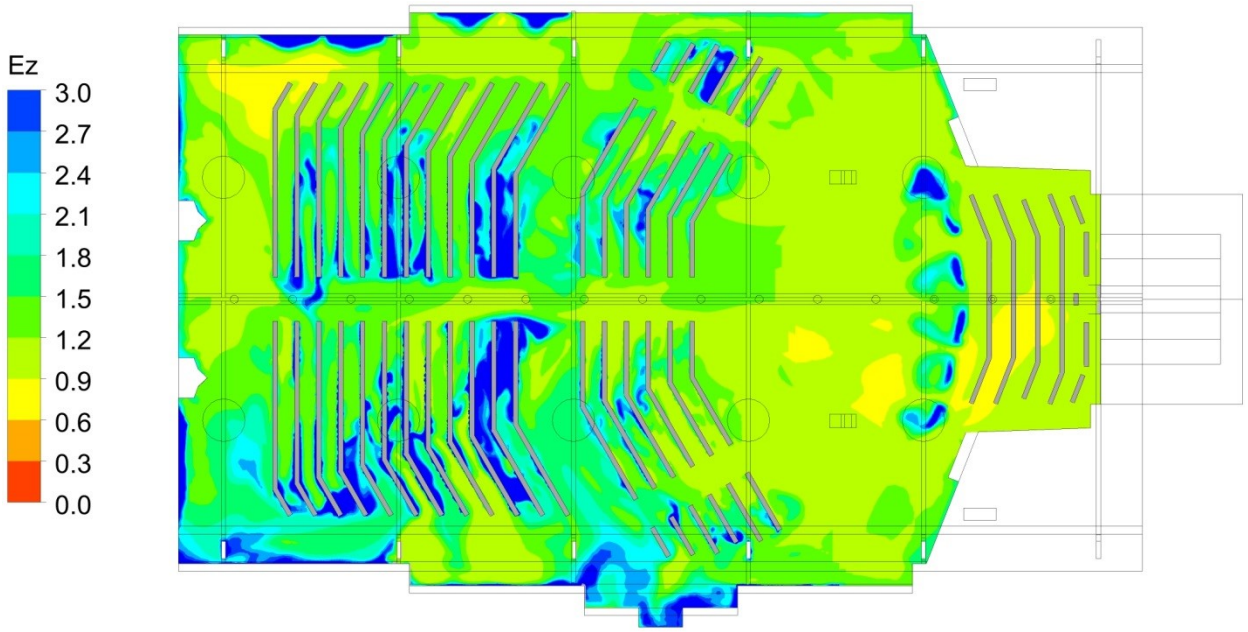

Figure 7: Ventilation Effectiveness (E_z) 42" above Floor

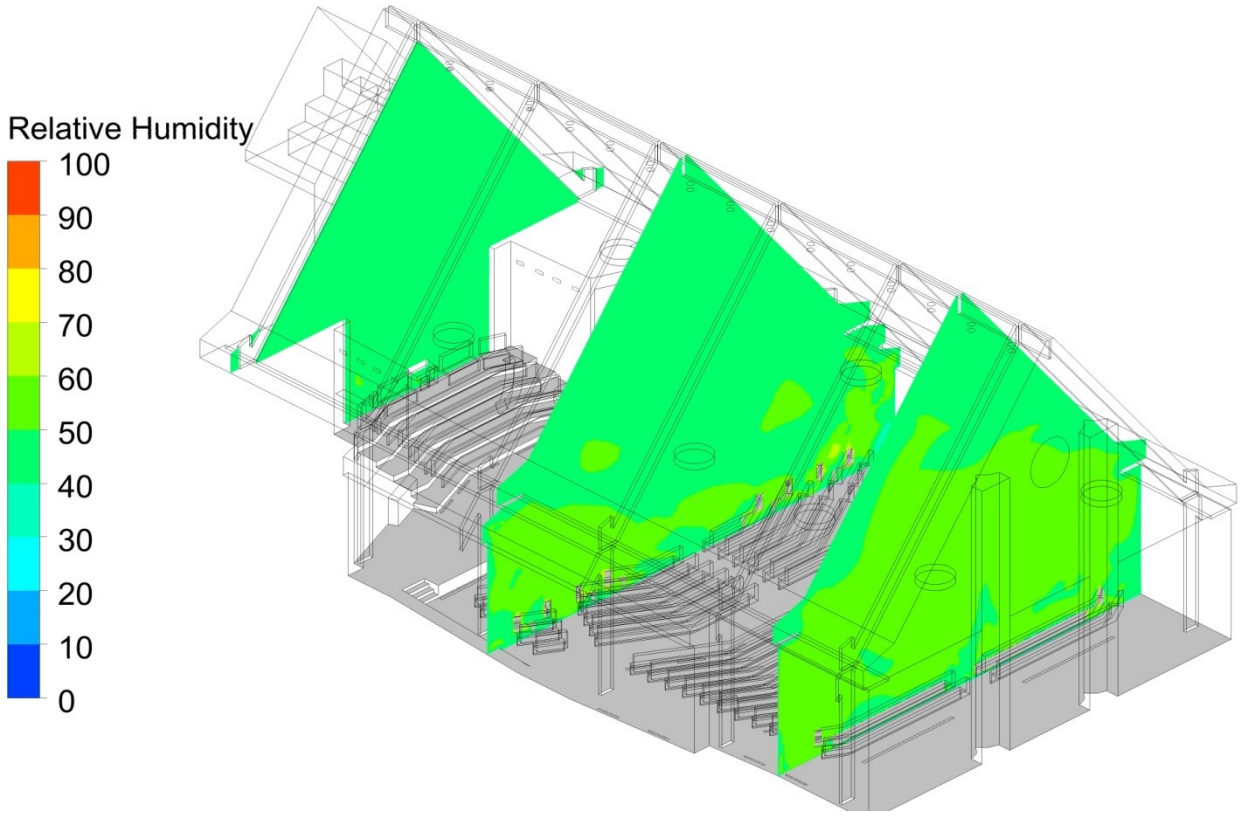

Figure 8: Relative Humidity Contour

6. Simulation Inputs

Table 2: Inlet Boundary Inputs[1]

DFGL Diffusers		LFG Diffusers		Supply Registers		Fans
Total Air Vol. [cfm]	**Air Temp. (Dry)[˚F]**	**Total Air Vol. [cfm]**	**Air Temp. (Dry)[˚F]**	**Total Air Vol. [cfm]**	**Air Temp. (Dry)[˚F]**	**Air Vol. [cfm]**
6,000	62	3,600	62	2,112	56	1,218

Table 3: Outlet Boundary Inputs

Storage 1 Return	Storage 2 Return	High Level Returns
Total Air Vol. [cfm]	**Static Pressure [Pa]**	
1,056	0	0

Table 4: Wall Boundary Inputs

Total Heat Load [BTU/hr]				
Occupants	**Fans**	**Equipment**[2]	**Lights**	**Solar**
195,500	113	1,024	29,276	1,521

Table 5: Thermal Properties

Wall Boundary	U-value [BTU/hr-ft^2-˚F]
Exterior Walls	0.1
Roof	0.05
Glass Windows	0.4

[1] See Figure 1 for diffuser and return locations.
[2] Equipment includes speakers and projector screens

Assumptions:

(1) Steady-state conditions

(2) Exterior air temperature is 90 ˚F (Dry Bulb).

(3) Moisture content in supply air is 4.43×10^{-4} lb/ft^3 (Case 2 & 3).

References

(1) ASHRAE. *"ASHRAE Handbook - Fundamentals."* ASHRAE, Atlanta, 2005.

(2) ANSYS. *"CFX-5 Solver Theory and Solver Modeling."* ANSYS.

(3) ASHRAE, ANSI. *"ASHRAE Standard - Thermal Environmental Conditions for Human Occupancy, 55-2010."* ASHRAE, Atlanta, 2010.

(4) ASHRAE, ANSI. "*ASHRAE Standard - Ventilation for Acceptable Indoor Air Quality 62.1- 2004."* ASHRAE, Atlanta, 2004.

(5) ASHRAE, ANSI. "*ASHRAE Standard - Measuring Air Change Effectiveness, 129-1997 (RA 2002)."* ASHRAE, Atlanta, 2002.

(6) ASHRAE, *"Simplified Diffuser Boundary Conditions for Numerical Room Airflow Models."* RP1009, ASHRAE, Atlanta, 2001.

(7) Incropera F.P., DeWitt D. P. *"Fundamentals of Heat and Mass Transfer, 5th Ed."* John Wiley & Sons, 2002