SINE NOMINE ASSOCIATES
25 Years
Customer Success

Fur in the Data Center?

Data Center Cooling Improvements

SNA-COOL Project

2025

Description

SINE NOMINE ASSOCIATES

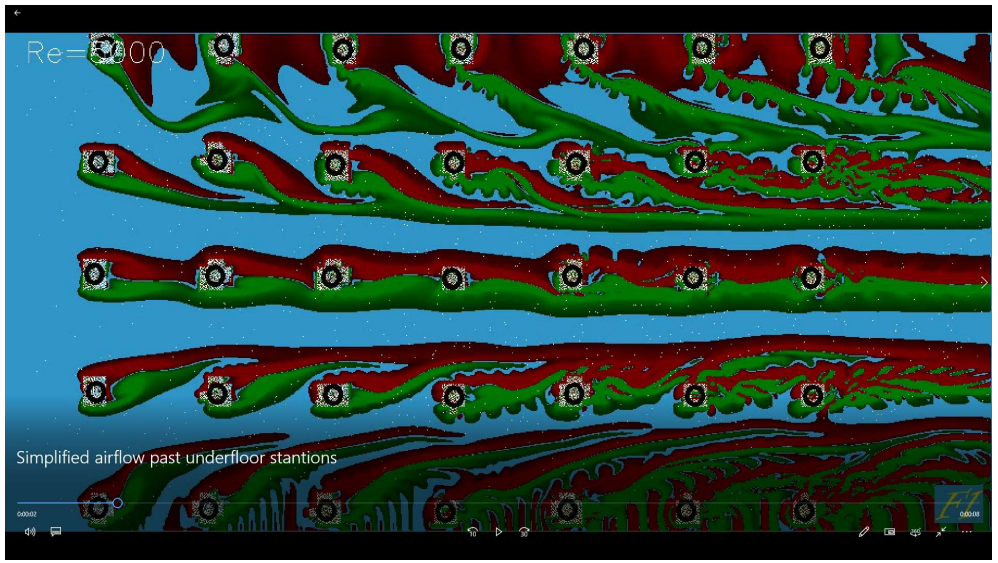
- Our team started work in November 2023 on an idea to enhance data center cooling using passive technology. (Saving the planet was a secondary goal).
- We evolved the test using 3D flow visualization, 3D scale models, physical 3D scale model testing with smoke, fluorescent dye, phase change chemicals, phase change solids, 3D computational fluid dynamics simulations, aerodynamic and thermodynamic science plus in-situ measurements and testing.
- With positive results and a very easy to implement and modular solution we are now bringing this to market. Our goal is to provide a consulting service which uses AI/ML to optimize installation based on a customer's floorplan.

2D Computational Fluid Dynamics (CFD)

Aerodynamic Turbulence

SINE NOMINE ASSOCIATES

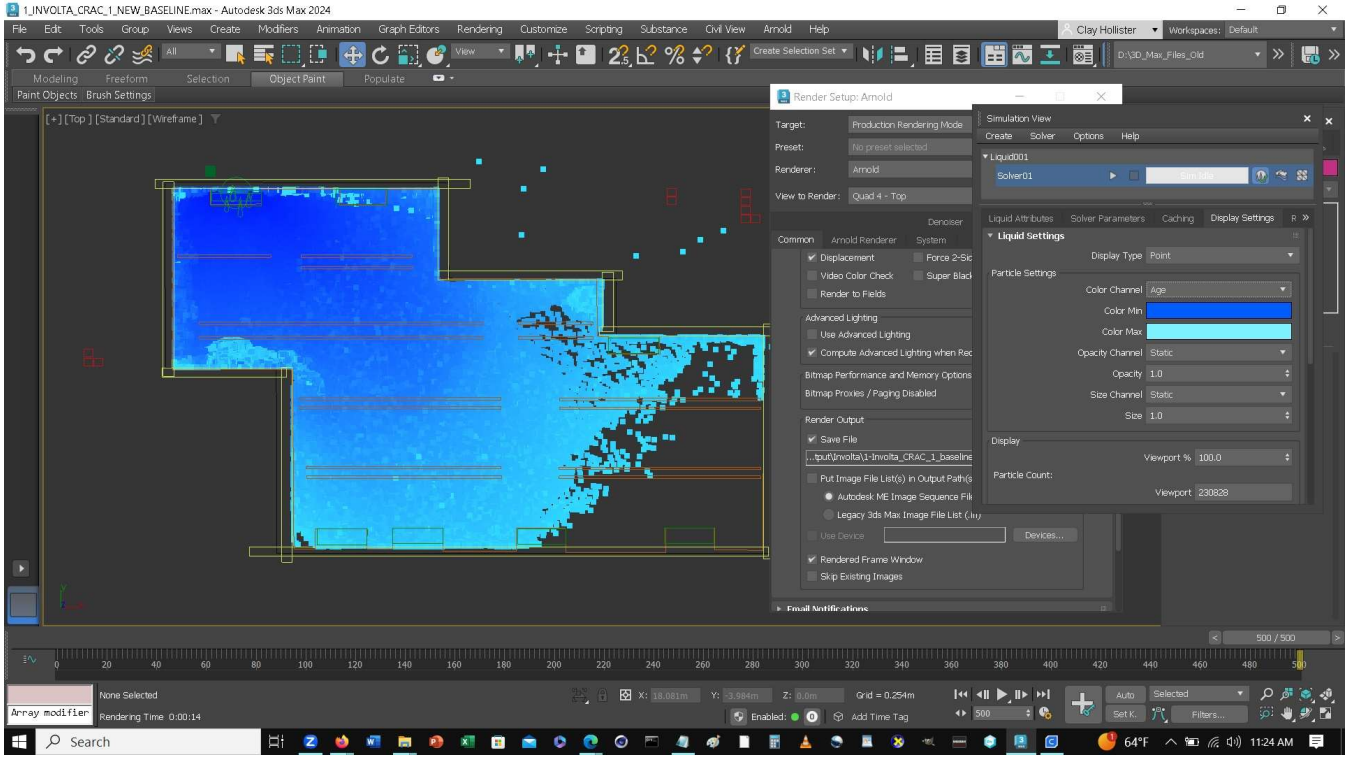
Chilled air under raised floor flow



Which is better aerodynamically round or square?

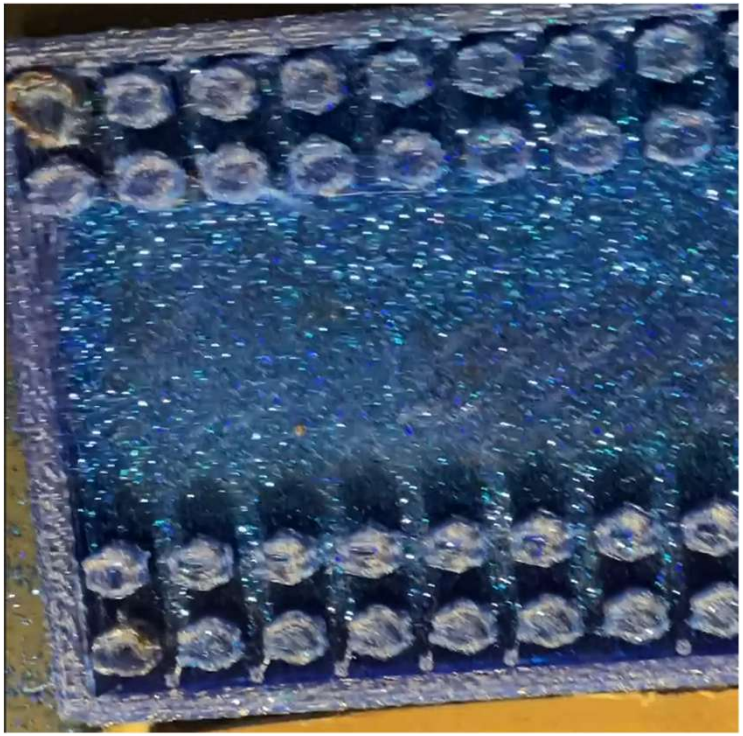
3D Visualization

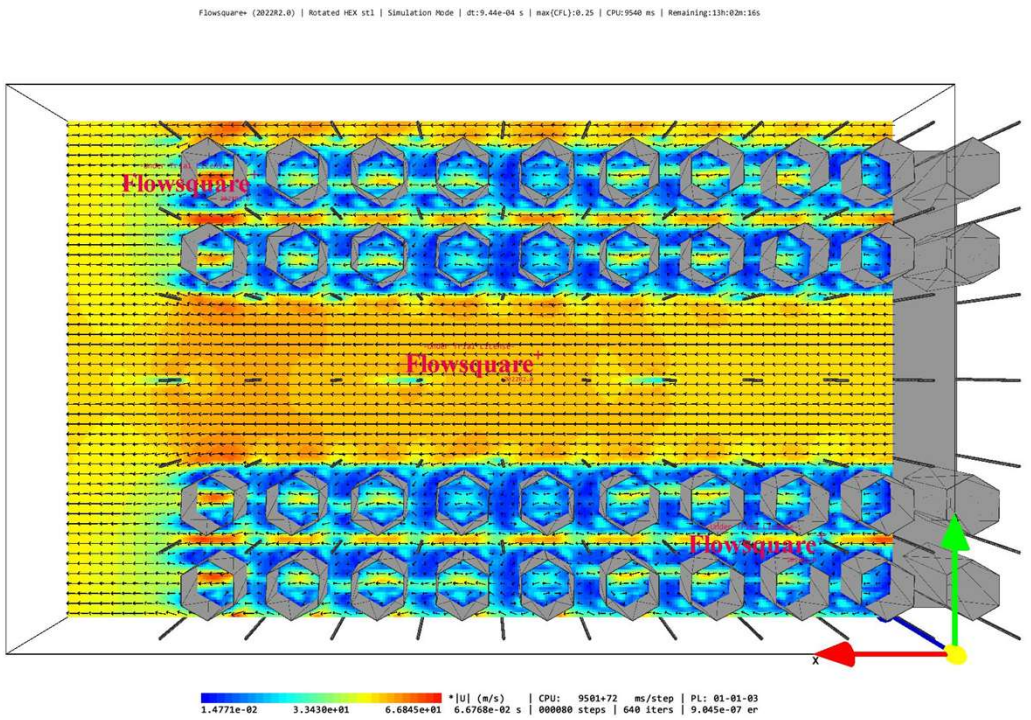
SINE NOMINE ASSOCIATES



3D Physical Model (Blue Glitter Test)

SINE NOMINE ASSOCIATES



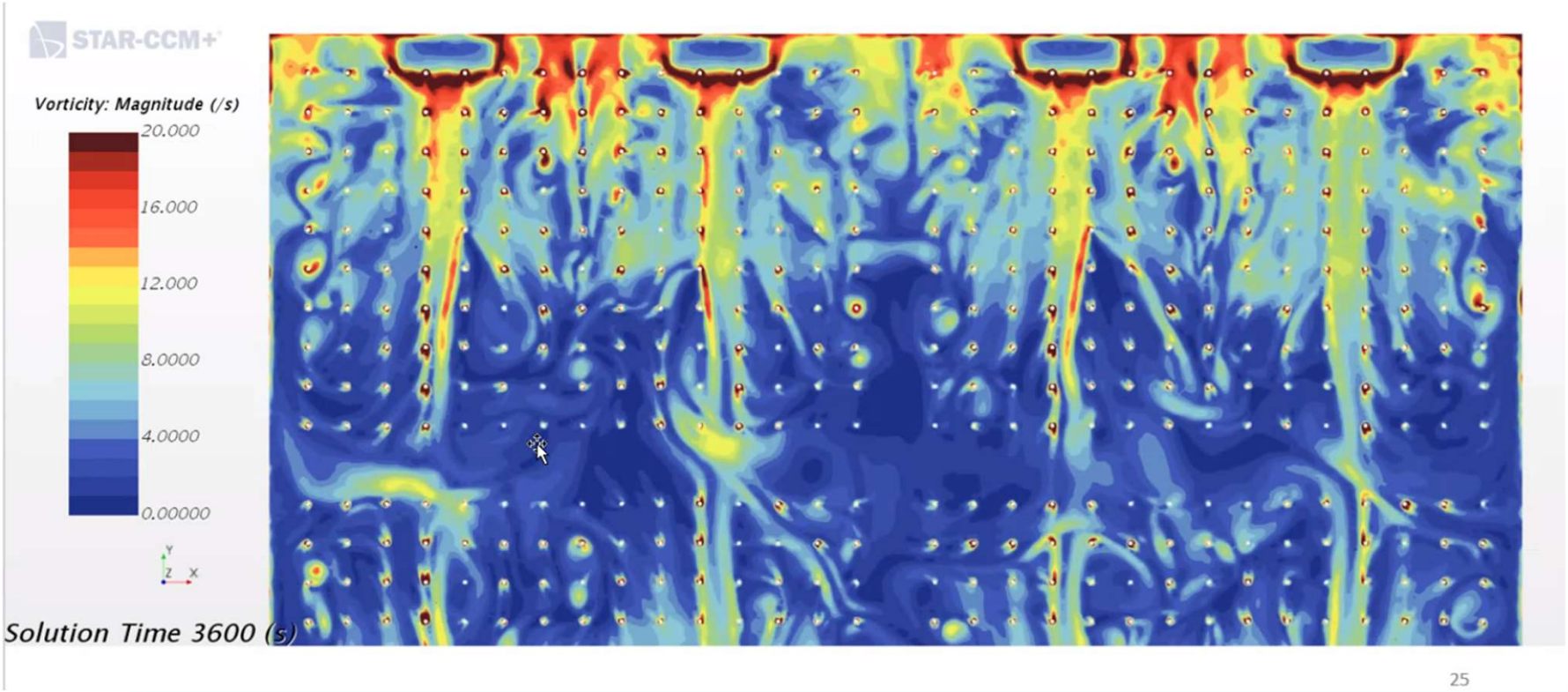


Visualization to Simulation

- We needed to understand the numbers behind the science. We asked ourselves how much change would be needed in order for this to be beneficial to a customer.
- Our experts developed a solid business case
- Our service offering uses a digital twin model of a data center to perform aerothermodynamic simulations which train an AI/ML engine to determine the optimum configuration to implement for improved efficiency.

3D Simulations

SINE NOMINE ASSOCIATES



Business Case Small Data Center

SINE NOMINE ASSOCIATES

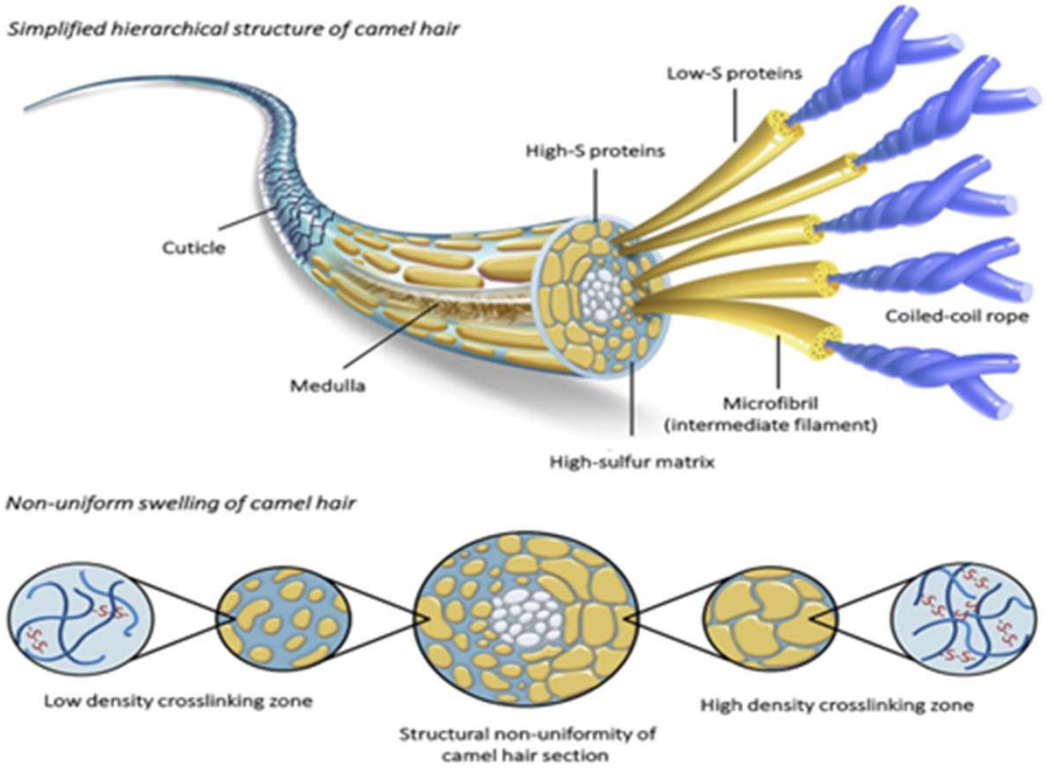
- 1-degree Celsius (1.8 F) increase in set point = significant savings

Table 2: Projected savings per ΔT, if CRAC set-up temperature could be raised

ΔT raise	# "on" CRACs	KWatt save /year	Annual money save
+0.1°C	4 / 5	22,240 /27,800	$1750 / $2190
+0.5°C	4 / 5	111,200 /139,000	$8,750 / $10,938
+1°C	4 / 5	222,400 /278,000	$17,500 / $21,875
+2°C	4 / 5	444,800 /556,000	$35,000 / $43,750

MIT Research: Hydrogel + Aerogel

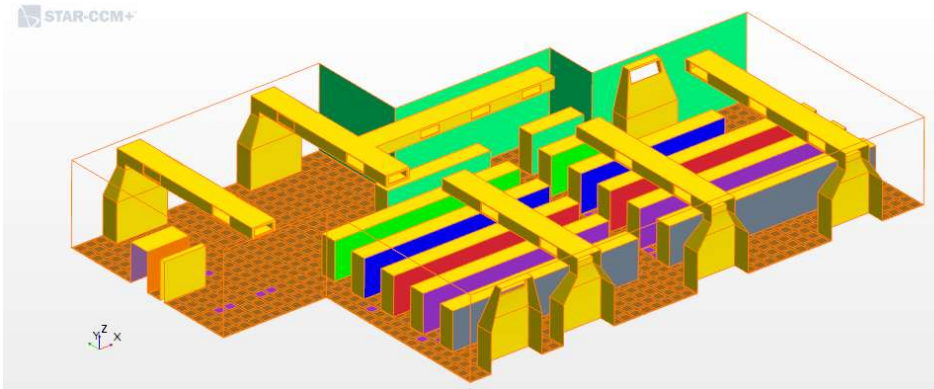
SINE NOMINE ASSOCIATES

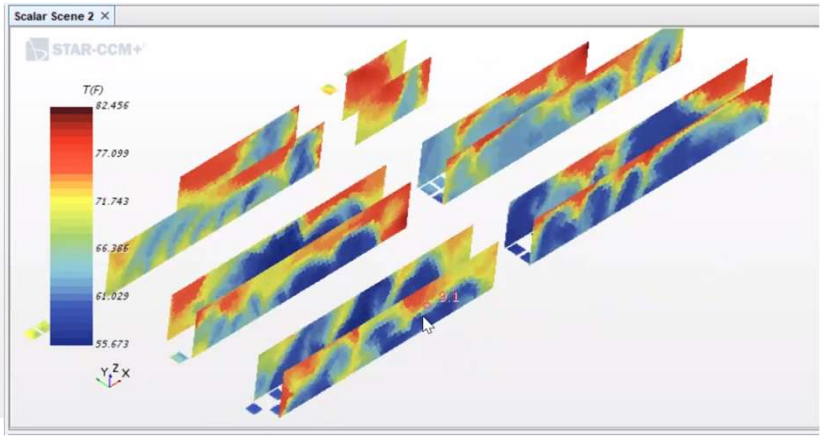


Digital Twins 3D Visualization Model

SINE NOMINE ASSOCIATES

Above the raised floor visualization

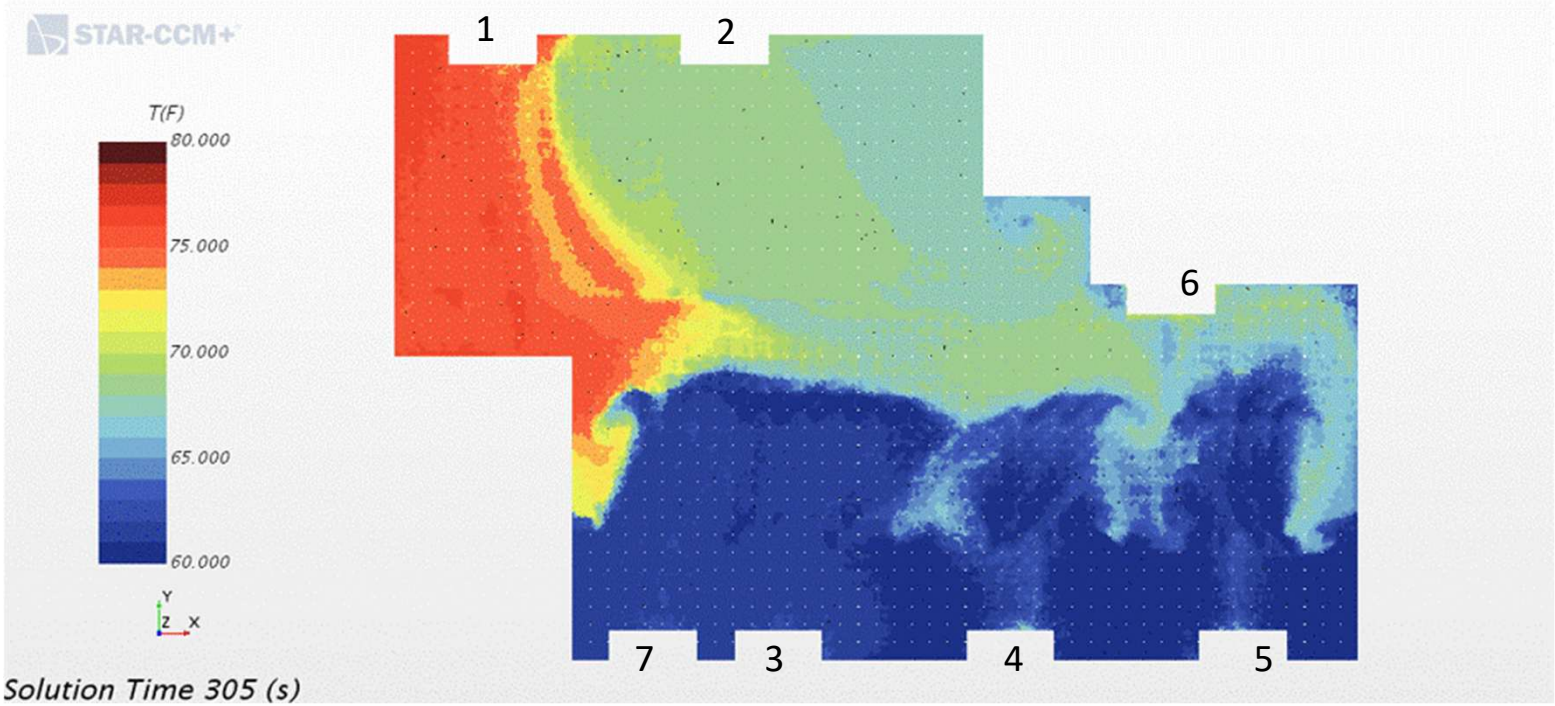




Underfloor Simulation

SINE NOMINE ASSOCIATES

CRAC 1 and 6 are normally off with fans running at 20% to prevent backflow of return air. Each CRAC is independently controlled by set point of return air temperature.

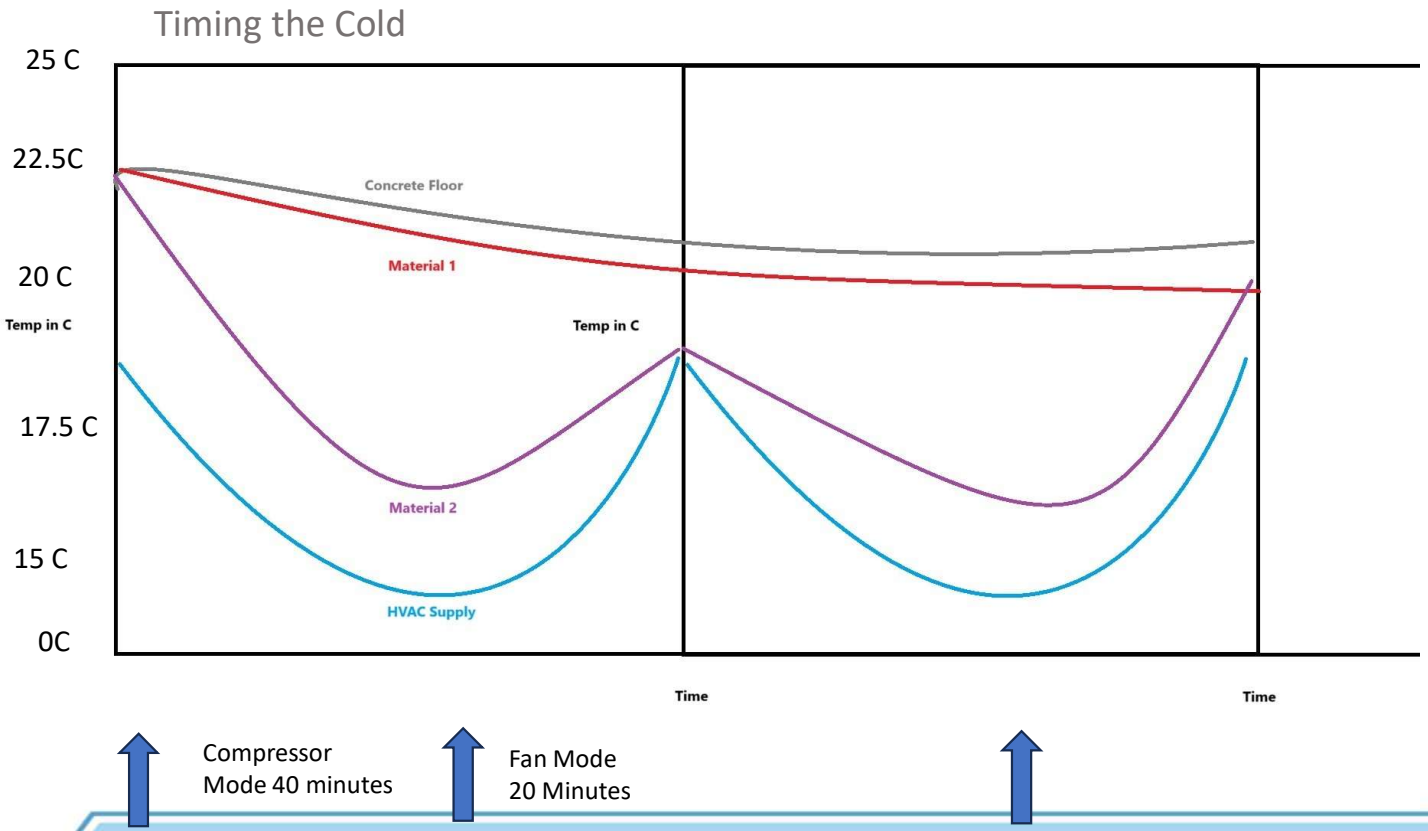


Timing

SINE NOMINE ASSOCIATES

- This idea used materials with a different thermal conductivity and absorption rate to allow the charge and discharge of the cooling of the material to happen at a different rate than the concrete floor.
- This idea allows us to steer some of the chilled air and to smooth the temperature fluctuations. By changing the timing of the passive chilled air delivery when the CRAC cycles down we increase the time between cycles.
- If a CRAC can run in level 1 for an additional 2 minutes per cycle a significant monthly and annual savings in electricity and maintenance can be realized.

Materials Physical Thermocouple Test



Mean behavior (F) (CRAC's 2-3-4-5-7) Inefficient Data Center Design

SINE NOMINE ASSOCIATES

location	CFD, baseline ambient: 70F	+SNA Material 1	+adj. OFF CRAC flow, 2.5F dead band, +SNA M2 blocks
CRAC output	59.7	59.9	61.4
vents	62.4	62.1	63.5
cold aisles	69.1	68.8	70.0
CRAC returns	77.0	76.6	77.8
cold aisles max	86.3/91.5	85.8/90.2	86.0/90.1
power (kW)	203.3	198.9 (-2.2%)	193.9 (-4.6%)

Goals Met

SINE NOMINE ASSOCIATES

- Passive technology no additional power required
- Use inert plenum safe readily available inexpensive materials
- Make our solution low cost easy to install and modular
- Easy to reconfigure in case of changes in the data center
- Reduce amount of expensive chilled air under hot aisles
- Reduce kilowatts required 2-5%
- Reduce carbon footprint
- Reduce maintenance cost

Findings

SINE NOMINE ASSOCIATES

- Initial testing performed in an inefficient data center design configuration showed significant savings (non-linear alignment to CRAC, no rack blanking panels, 50% average rack fill).
- Further testing/simulation in a conventional data center design confirmed testing results with improvement.
- Expansion of the simulation models indicate savings scale up with size. More materials act like a larger cold pack.

What Works Under Floor?

SINE NOMINE ASSOCIATES

- 3D Printed blocks, to minimize the space under floor: Boyles Law flow, pressure, temperature
- Manifold effect pressure equalization
- Reduce turbulence
- Change the flow direction: blocks, ramps
- Chilled air away from corners: eliminate pooling of chilled air Bernoulli effect
- Block dead space, insulate floor, vermiculite, perlite, zeolite, others
- Block hot aisles underfloor plenum area
- Phase change chemicals, rock salt means ice cream
- Material changes SNA MM 1 and SNA MM 2

How Many Months Into It?

SINE NOMINE ASSOCIATES

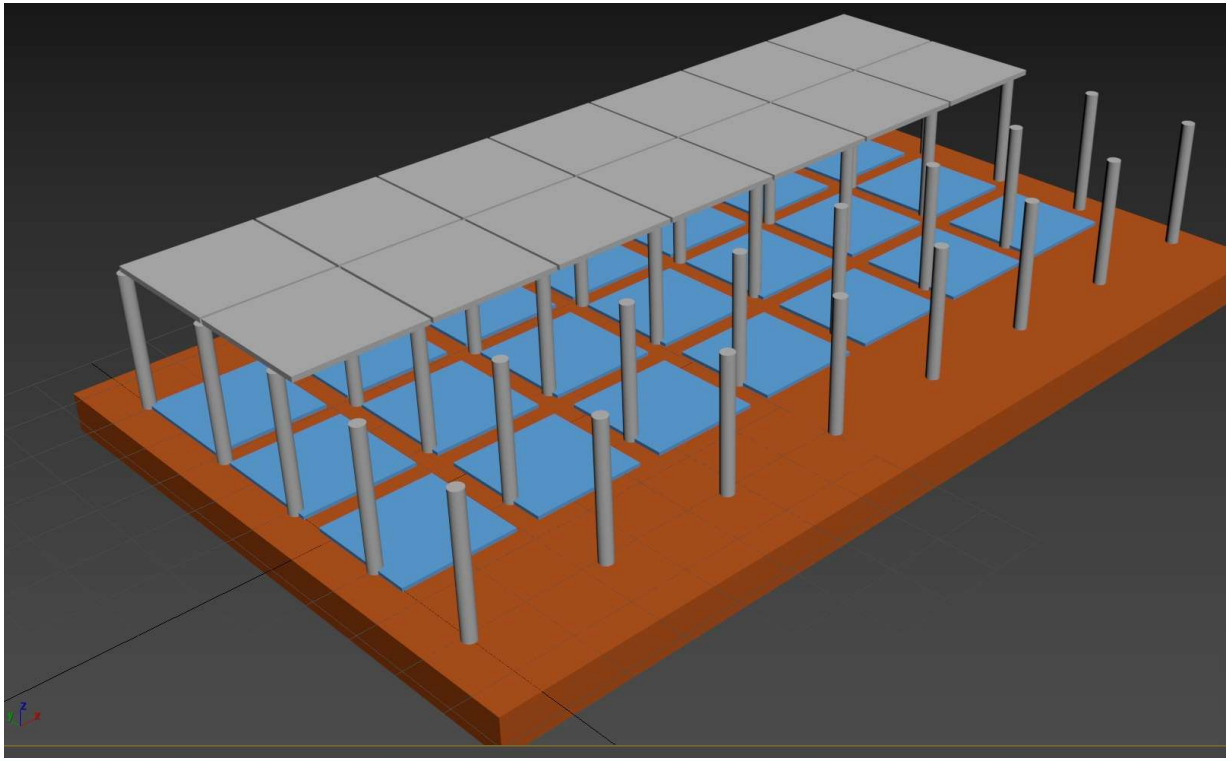
What Works Above Floor?

SINE NOMINE ASSOCIATES

- Block return ducts in areas without heat sources
- Align return ducts with hot aisles
- Change fan speed CFM
- Change the set point
- Containment: hot aisles
- Full containment: hot and cold aisles
- Containment height extensions (various)
- Insulate walls with SNA MM 2

Installation

SINE NOMINE ASSOCIATES



We Need Volunteers

SINE NOMINE ASSOCIATES

- We are seeking some friends a few brave souls to help pioneer a success story.
- Install our low-cost, modular solution; easy to install, just remove a floor tile, install this technology and replace the floor tile and repeat Our testing confirms a 2-5% ongoing power savings which also reduces carbon footprint and maintenance cost.

Q&A

- We look forward to hearing your voices
- Thank you we appreciate your time
- Chollister@sinenomine.net
- +1 402-210-3723

Acknowledgments

- The Sine Nomine Associates management, IT and engineering teams,
- Leonid Naimark, Digital Twins, Control System Modeling , Business analysis
- Konstantinos Vogiatzis, Aerodynamics and Thermodynamics
- Robert Boyle FRS (25 January 1627 – 31 December 1691) natural philosopher, chemist, physicist, alchemist and inventor.
- Edme Mariotte (1620 – 12 May 1684) was a French physicist and priest (abbé). He is particularly well known for formulating Boyle's law independently of Robert Boyle. Mariotte is also credited with designing the first Newton's cradle.