

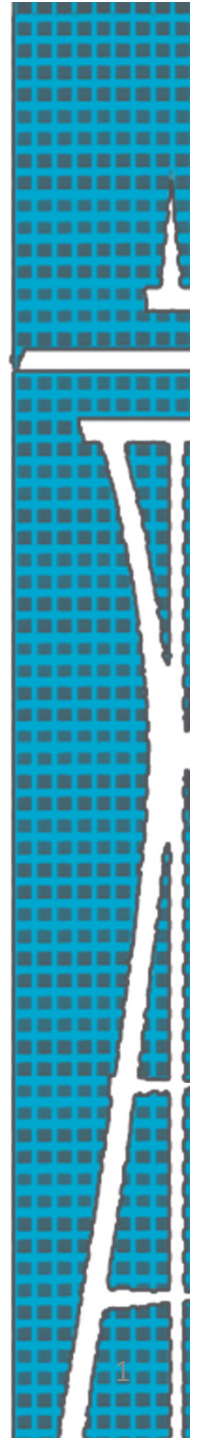


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Seminar 31 - Air Dispersion Systems

Design and Construction of Metal Air Dispersion Systems

2014 ASHRAE Annual Conference Seattle



Learning Objectives

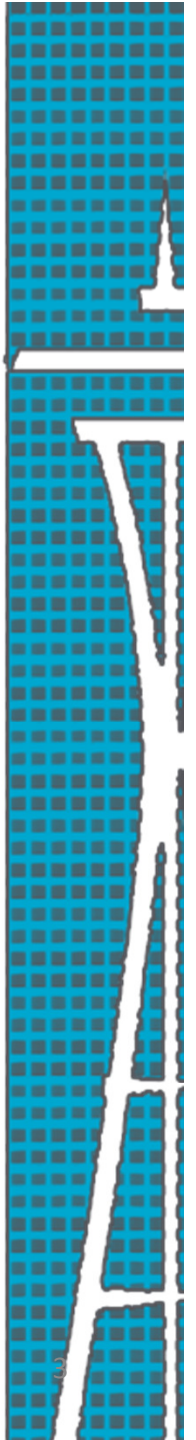
- 1. Become familiar with air dispersion systems.
- 2. Understand the advantages of air dispersion systems relative to traditional metal duct systems.
- 3. Learn basic design principles of air dispersion systems.
- 4. Learn applications where textile or metal air dispersion systems are commonly employed.
- 5. Compare the performance of textile and metal air dispersion systems.
- 6. Learn of new textile and metal air dispersion system products that are becoming available commercially.

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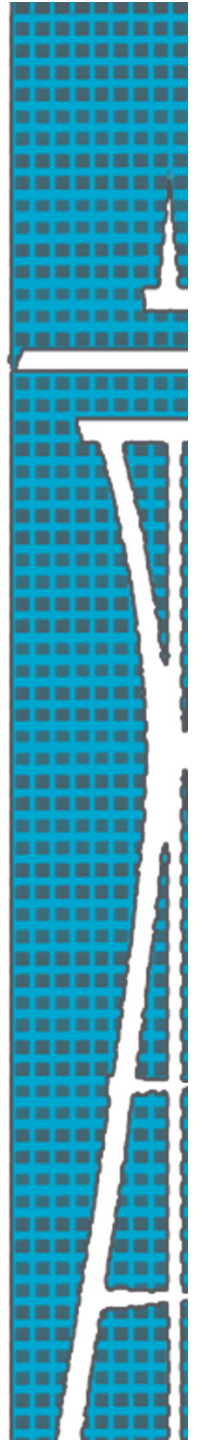
Acknowledgements

- Larry Smith, P.E. --- Lindab
- Josh Crichton --- SEMCO



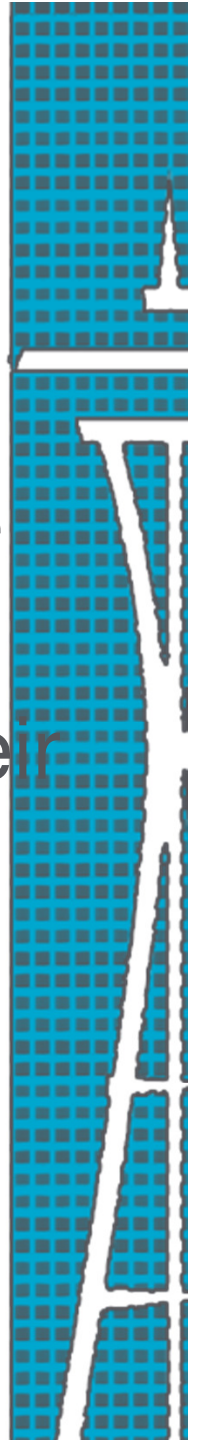
Basic Principals

- Air is dispersed through a series of holes in the duct
- Conventional “grilles” are not used
- Volume and throw are a function of duct static pressure, hole size and, in some cases, nozzle shape



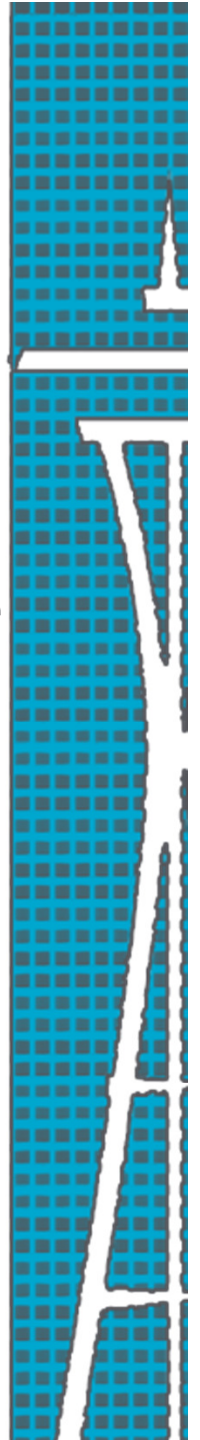
Metal versus Fabric Air Dispersion Systems

- Both use a common design methodology
- Metal air dispersion systems can operate at higher velocities
- Aesthetics --- metal systems maintain their shape, even when air is not flowing through them
- Metal systems can have consistent performance, even at reduced flow rates



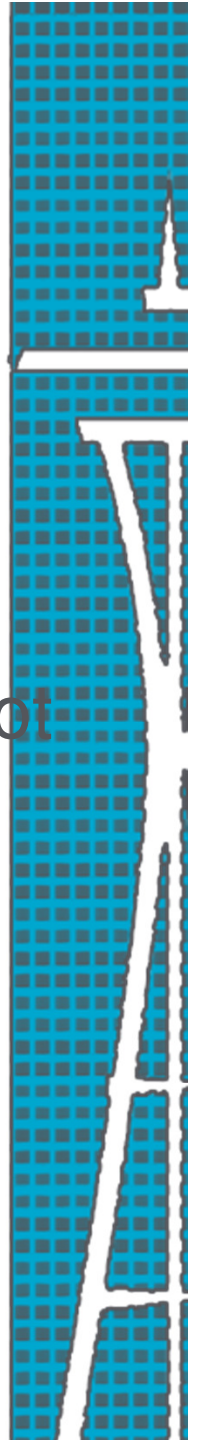
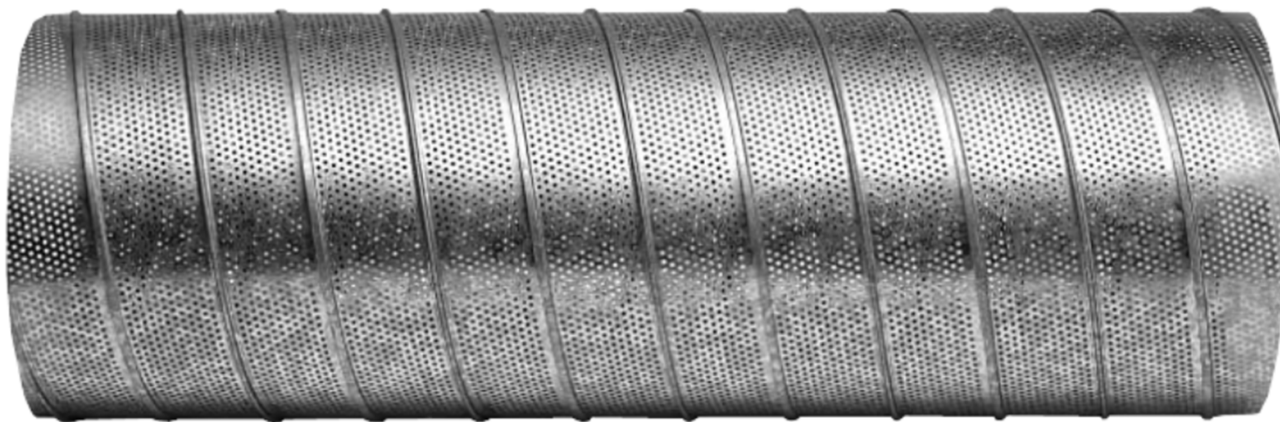
Metal versus Fabric Air Dispersion Systems

- For metal systems, the cost usually increases above installed fabric duct systems as air placement becomes more precise
- Few manufacturers offer an “engineered” product with performance data



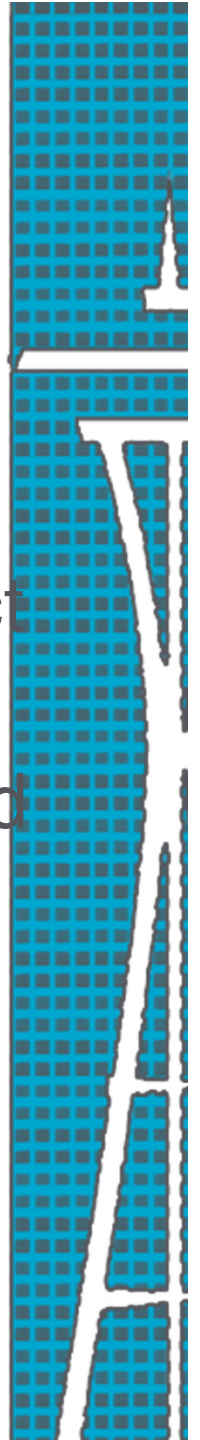
Least Cost

- 360-degree perforated duct products
 - Several manufacturers produce a product made from perforated base material
 - Many potential uses, but low throw --- and not all of it in the direction you want.



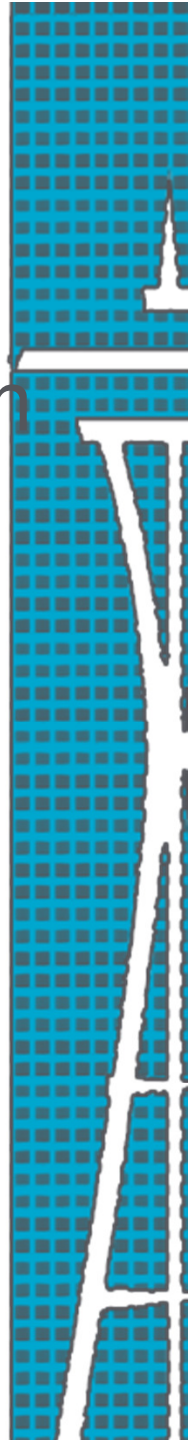
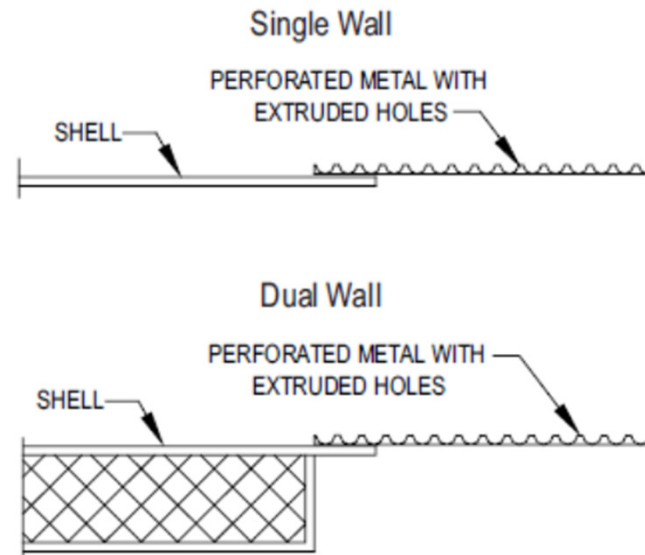
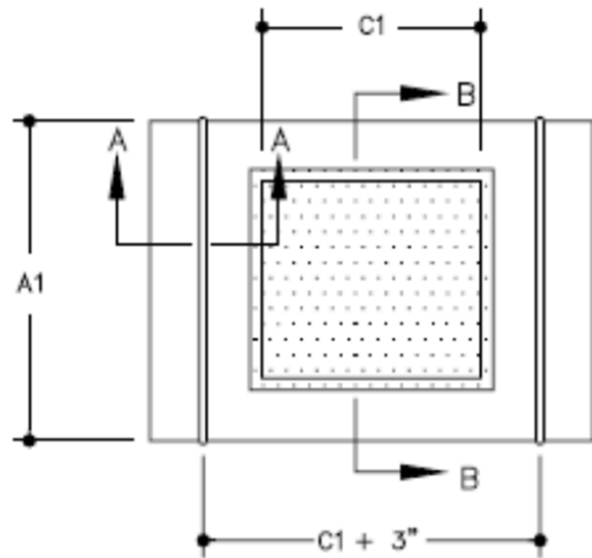
Mid Cost

- Drilled, punched or burned holes
 - A metal replica of common fabric products, but few suppliers with an engineered product
 - Technology is now available to make manufacturing easier, but not yet widespread



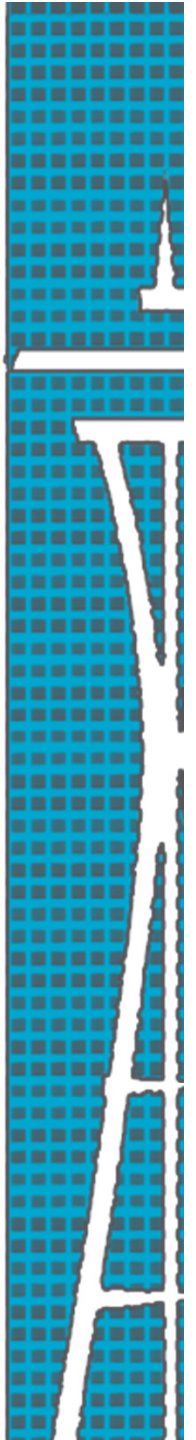
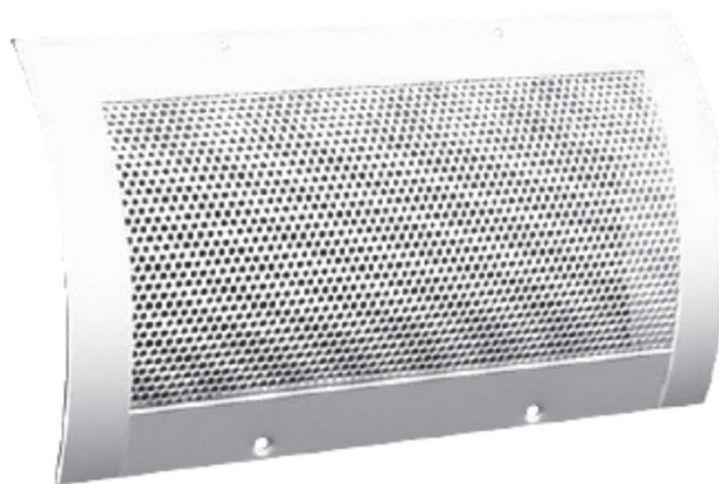
Higher Cost

- Perforated sections installed as panels on duct
 - Hole sizes and patterns limited



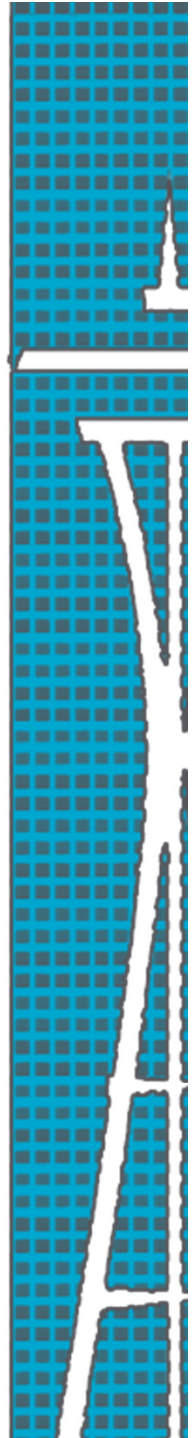
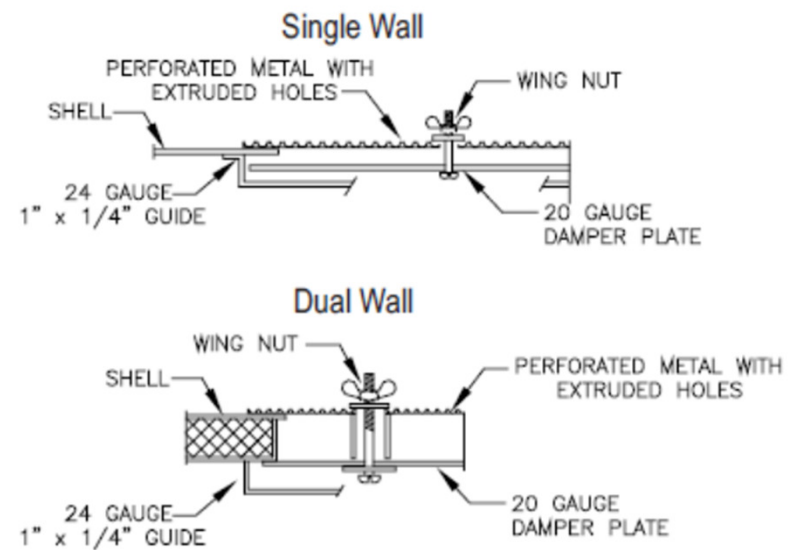
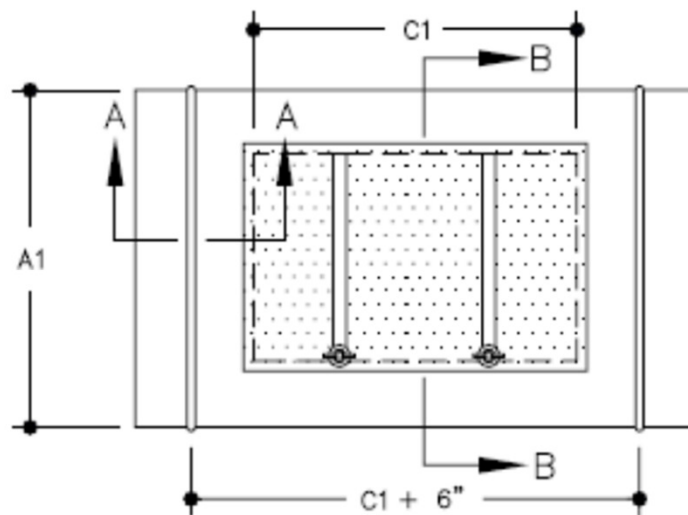
Higher Cost

- Perforated diffusers from conventional grille manufacturers



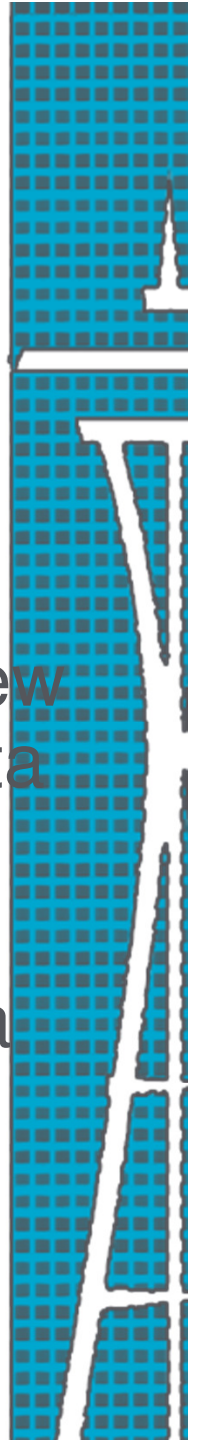
Highest Cost

- Adjustable perforated diffusers



Industry Concerns

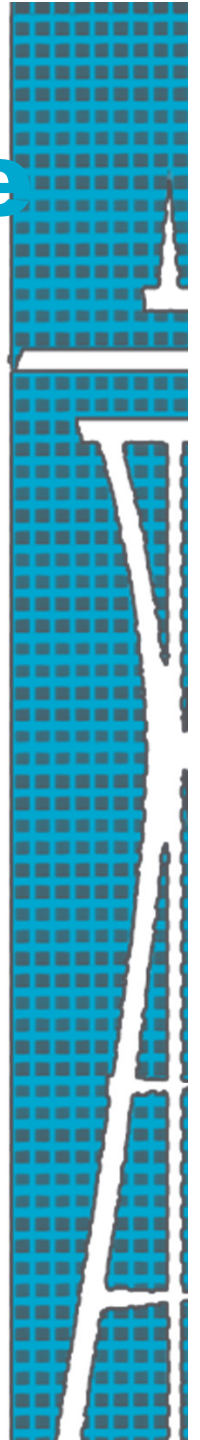
- “Holey Duct” --- metal air dispersion systems provided with little or no engineering
 - While engineering is fairly straightforward, few duct manufacturers publish performance data or have on-staff expertise
 - Someone will need to do the engineering --- either a manufacturer with performance data or expertise, or the design engineer must specify hole size and location



Aesthetics vs. Performance

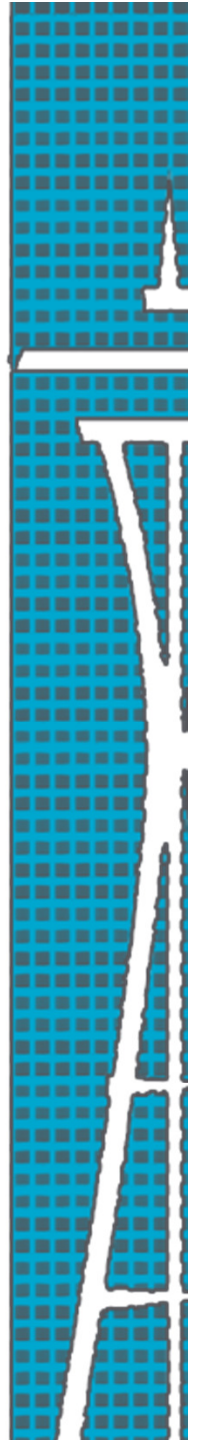
18" dia. X 80'-0". 36 sets of 3" dia. Holes spaced 15" apart. No internal orifices.

Concerns: Air primarily dumped at both ends. Very little throw.



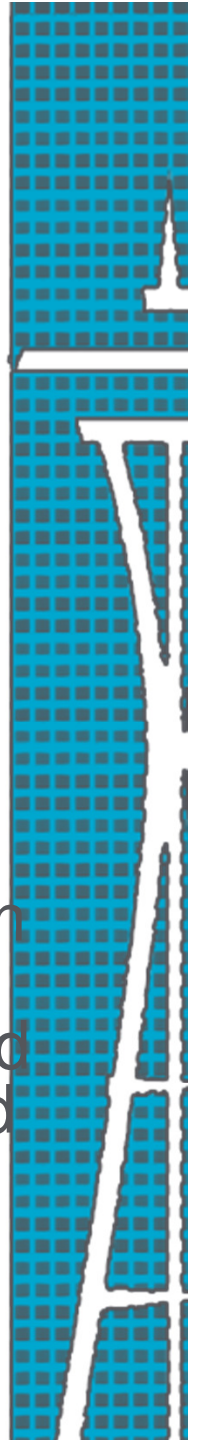
Calculating Flow (basic flow through an orifice)

- $Q = AV$
- $V = CKP^{0.5}$
 - Q = volume (SCFM)
 - A = area of opening (ft²)
 - $C = 0.65$
 - $K = 4005$
 - $P = \Delta P$ (average)



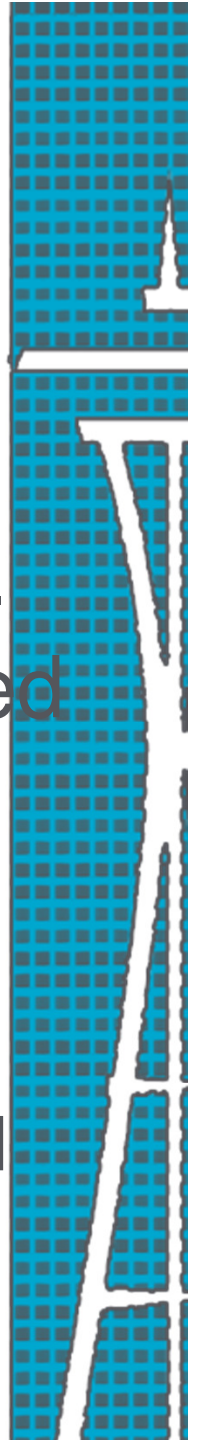
Our Aesthetic Example

- $Q = (0.049 \text{ ft.}^2)(0.65)(4005)(0.05^{0.5})$
- $Q = 28 \text{ SCFM per } 3'' \text{ hole at } 0.05'' \Delta P$
 - Approx. 2,000 CFM in 18"Φ duct = 1,132 FPM
 - Approximate throws:
 - 150 FPM at 7'
 - 100 FPM at 11'
 - 50 FPM at 20'
- Duct provides conditioning for bar, 80' x 20' x 10' high
--- at 2,000 CFM that is 1.25 CFM/ft². Throws are nominal for intended use. Internal duct orifices would be recommended for maintaining duct pressures and to prevent "dumping".



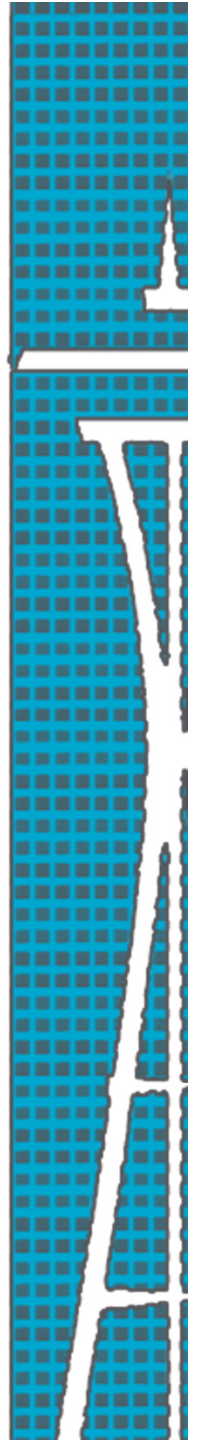
Conclusions

- Metal air dispersion systems are already available from several manufacturers as branded products with performance data.
- Effective custom systems can be designed using theoretical performance
 - For fine tuning the art, flow calculations should be derived that take into account orifice shape and the effects of hole spacing
 - Guidelines for internal orifice spacing should be established



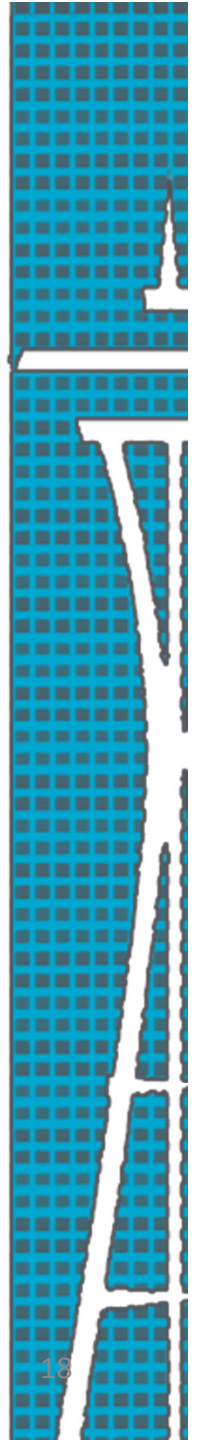
Conclusions

- “Holey Duct” metal copies of fabric duct products have not been common
 - Few manufacturers with design experience
 - Most hole cutting has been done by hand with templates --- very time consuming and difficult
- Automated pipe cutting equipment could greatly reduce the cost. Design fundamentals must be established before easy technology leads to bad jobs.



Outline/Agenda

- Overview of existing types of commercial metal air dispersion systems
- Show potential for engineered “orifice type” metal air dispersion systems



Questions?

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