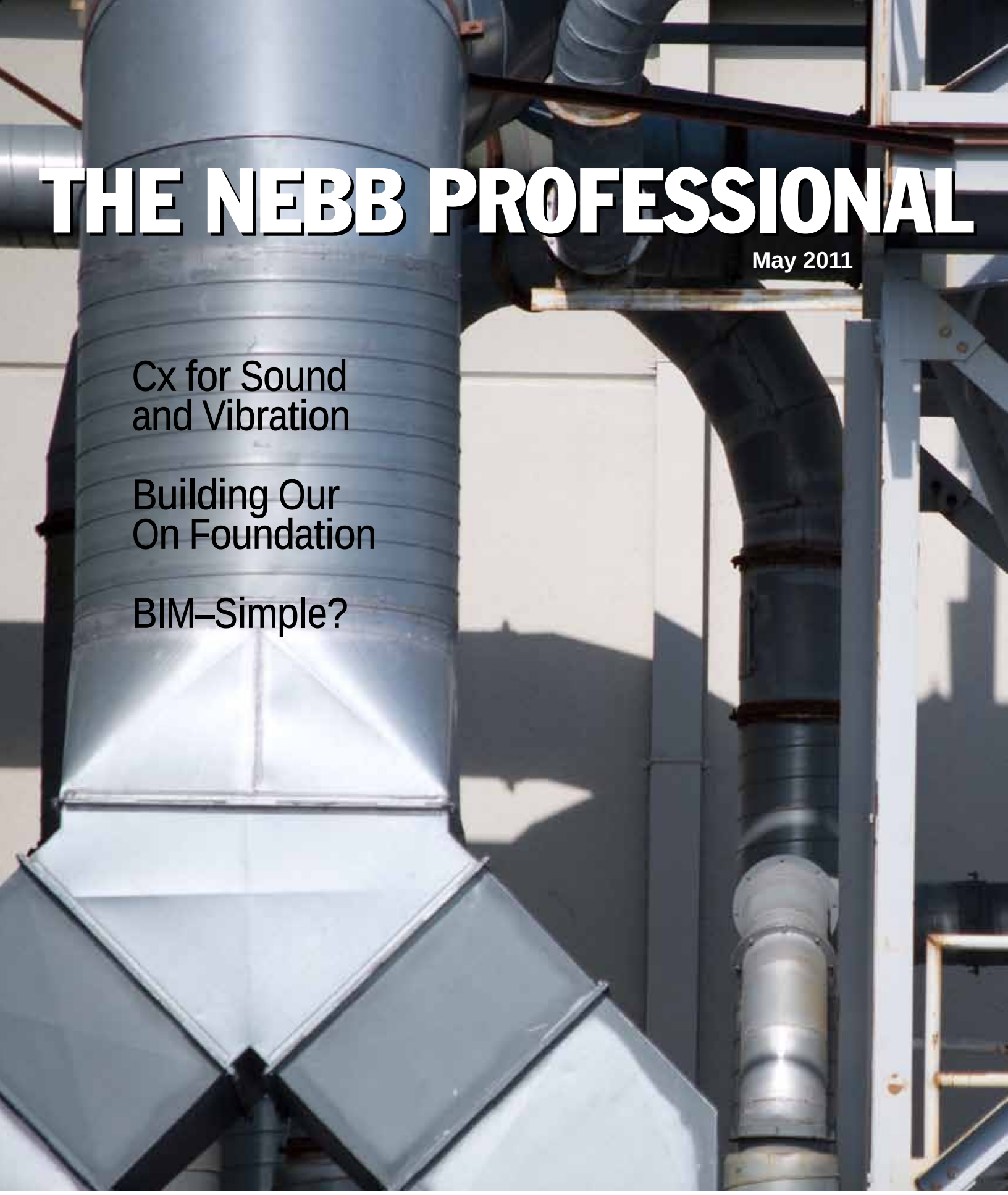

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May 2011

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Building Our On Foundation

BIM–Simple?

The Official Magazine of the National Environmental Balancing Bureau

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NEBB conducts several seminars to enhance the educational experience of each NEBB discipline: Testing, Adjusting, and Balancing (TAB) of HVAC systems; Building Systems Commissioning (BSC); Sound and Vibration Measurement (S&V); Retro-commissioning (RCX); Fumehood Testing (FHT); and Cleanroom Performance Testing (CPT). Please note, locations for NEBB seminars have moved to a regional format.

For more information about NEBB seminars, please contact Elana Noel at elana@nebb.org.

Retro-Commissioning	**June 8-11**
Fume Hood Seminar	**September 19-23**
Certified Professional Sound Seminar *Capital MarVA Chapter*	**July 12-13**
Certified Professional Vibration Seminar *Capital MarVA Chapter*	**July 14 -15**
Basic BSC Seminar *Philadelphia, PA*	**November 7-11**

Simple BIM

Automating Project Setup

By: Andy Stadheim, PE

What is BIM?
BIM, Building Information Modeling, is the re-use of digital data and passing information between trades in the construction industry.

So, what is SIMPLE BIM?
The ability to take either an industry standard file format (gbxml, COBIE) OR a custom file (likely Excel) and mapping the data according to your own data system for consumption and use.

How can it help TAB?
In this article we will discuss automating project setup by pulling in design data for AHU's, VAV's and even design CFM for air outlets.

Where can I get BIM? Where can a TAB contractor get a digital file? The two most likely data sources for a TAB contractor are the Engineer and the Mechanical Contractor. Now, we frequently hear, "We can't get BIM or an Excel file from the engineer" and often times, that may be the case. However, you will start to find more and more projects you WILL have access to a digital file. Army Corp of Engineers is starting to mandate digital data be available for and by all trades. It is also likely you will find that the largest projects you get are also the projects most likely to have BIM or digital data available. So, the opportunity for cost savings on the setup side will be the highest on these larger projects that DO have digital data available. In a recent conversation with a TAB contractor, he stated they had $25k in the project price just for setup on an $800k hospital job they had just been awarded. What if that setup time approached ZERO? That would be $25k straight to the bottom line.Or, maybe you discount the project price a little bit to ensure you win the bid; either way a potential big win for your company.

Source File

It's fairly basic and simple; the main elements the digital file needs to carry are:

1. A header row that defines what data elements are in each column. This is typically ROW 1 of the Excel file.
2. An equipment name or TAG value that defines each unique piece of equipment. This is where engineers using VAV-A (57 thus) does not work. Each and every piece of equipment needs a unique name.
3. Data elements worth pulling into your project setup file such as Inlet size, Max CFM design, Min CFM design, etc.
4. An optional data element is Equipment served by. Building a system out as it appears on the print has many benefits. You would first import and setup the AHU's, then you import the VAV's so the VAV Excel file needs to carry a column defining the AHU it is connected to so you can build your system accurately. Also, if you are lucky enough to get an air outlet Excel file that defines which VAV box or AHU the air outlets are connected to it would need to follow the same steps as the VAV box.
5. Another optional data element is Unique ID's. Unique ID's allow you to connect an export back to the CAD package that was the original source of your information. This is where you can complete the loop and have the "Actual CFM" read connected back to the original floorplan where the engineer can display the Design and Actual CFM's side by side on the print.

How does BIM work? What does a useable Excel file look like and contain, and how does it help TAB?

Mapping the Excel Files

Due to the fact native BIM files will not be available on all jobs for some time to come, the opportunity to bridge the interim BIM gap is captured by using something every engineer has, Excel files. Importing data from an Excel file and mapping it straight into setting up your projects can save you a lot of time. You can start leveraging Excel files today and if you are able to "map" the data to whatever element you want, then the added intelligence and time savings is at your finger tips.

Let's take a look at a sample project and the corresponding set of Excel files.

CASE STUDY

Hospital Project

20+ AHU's
2000+ VAV's
5000+ Outlets

Two sample Excel files:

Where importing this file picks up the "TAG" or name of each VAV box, Size, Max CFM, Min CFM, Reheat CFM and the AHU the VAV is served by.

Where importing this file picks up Design CFM, Neck size, Area the outlet serves and VAV box that serves the outlet. A weak point of most digital file sets is illustrated here, and that is the fact that many times the diffusers/ outlets are not uniquely tagged or numbered. Ideally, engineering groups would start numbering outlets under each VAV box or AHU and start at "1" each time. As BIM becomes more common, we will see a shift to all "items" having discrete unique names, or at least unique within their "system" or "sub-system".

Diffuser Schedule

Diffuser Tag	Design CFM	Neck Size	Room	VAV Box
CD-2	320	10"	1123	VAV-A-01121
CD-2	380	12"	1121	VAV-A-01121
CD-1	350	12"	1135	VAV-A-01135
CD-1	170	8"	1131	VAV-A-01E03
CD-1	280	10"	1130	VAV-A-01E03
CD-1	120	6"	1139	VAV-B-01133
CD-1	360	12"	1133	VAV-B-01133
SG-1	3080	36X20	1290	VAV-B-01280U
CD-1	200	8"	1227	VAV-B-01C16
CD-1	200	8"	1227	VAV-B-01C16
CD-1	80	6"	1217	VAV-B-01C20
CD-1	120	6"	1113	VAV-B-01C20
CD-2	360	12"	1117	VAV-B-01C20
CD-2	290	10"	1111	VAV-B-01C20
CD-1	80	6"	1125	VAV-B-01E02
CD-1	90	6"	1116	VAV-B-01E02
CD-1	180	8"	1324	VAV-B-01E02
LD-3	210	8"	1320	VAV-B-01E02
SG-1	1710	20X20	1280	VAV-B-01290U
CD-1	80	6"	1325	VAV-B-01351
CD-1	110	6"	1351	VAV-B-01351
CD-1	130	8"	1330	VAV-B-01351
CD-3	150	8"	1393	VAV-B-01351
CD-1	80	6"	1385	VAV-B-01351
CD-1	180	8"	1385	VAV-B-01E04
LD-3	190	8"	1410	VAV-B-01E04

Setup Time Savings:

For the hospital project listed above, the first phase was (178) VAV's and (585) air outlets. The TAB contractor performing the work figured it would've easily have been 16-24 hours of setup time for phase I alone, completed in just 15 minutes. Aggregating that over the entire job, the time savings could be 160-240 man hours saved. It's pretty easy to see those savings add up.

VAV Schedule

Model	Size	Tag	Max CFM	Min CFM	ReheVAV CFM	AHU	Drawing
Price SDV5000 LH	10 LH	VAV-A-01121	700	380	700	AHU-05	1N
Price SDV5000 LH	6 LH	VAV-A-01135	350	150	350	AHU-05	1N
Price SDV5000	8	VAV-A-01E03	450	340	450	AHU-05	1N
Price SDV5000	6	VAV-A-03170	300	300	300	AHU-05	3N
Price SDV5000 LH	12 LH	VAV-A-03174	1110	340	560	AHU-05	3N
Price SDV5000	8	VAV-A-03176	600	470	470	AHU-05	3N
Price SDV5000	8	VAV-A-03180	580	180	270	AHU-05	3N
Price SDV5000	8	VAV-A-03183	680	490	490	AHU-05	3N
Price SDV5000 LH	8 LH	VAV-A-03184	460	320	320	AHU-05	3N
Price SDV5000	8	VAV-A-03188	480	480	480	AHU-05	3N
Price SDV5000 LH	6 LH	VAV-A-03189	340	220	220	AHU-05	3N
Price SDV5000	24x16	VAV-A-03206U	3090	0	0	AHU-05	3S
Price SDV5000 LH	6 LH	VAV-A-03210A	220	220	220	AHU-05	3N
Price SDV5000 LH	10 LH	VAV-A-03210B	720	340	420	AHU-05	3N
Price SDV5000	8	VAV-A-03216	440	440	440	AHU-05	3N
Price SDV5000	14	VAV-A-03270U	1710	0	0	AHU-05	3N
Price SDV5000	24x16	VAV-A-03280U	3070	0	0	AHU-05	3N
Price SDV5000 LH	14 LH	VAV-A-03290U	1700	0	0	AHU-05	3S
Price SDV5000 LH	10 LH	VAV-A-03520	830	680	680	AHU-05	3S
Price SDV5000	6	VAV-A-03E02	370	300	300	AHU-05	3N
Price SDV5000	8	VAV-A-04162	490	230	360	AHU-05	4N
Price SDV5000 LH	6 LH	VAV-A-04166A	330	200	200	AHU-05	4N
Price SDV5000	8	VAV-A-04168	490	360	400	AHU-05	4N
Price SDV5000 LH	8 LH	VAV-A-04174	470	300	470	AHU-05	4N
Price SDV5000	8	VAV-A-04178	670	420	420	AHU-05	4N
Price SDV5000	10	VAV-A-04181	800	420	420	AHU-05	4N

Summary:
Even though BIM is still evolving it is being used today to help companies become more efficient. BIM files will not be available on every project, but the projects they are available on are likely the larger projects, especially hospitals. Larger projects have the most significant opportunity for time savings during the project setup process. The time savings gained by using BIM and reducing the setup time may be the difference between winning and losing a bid, or improving your bottom line. TAB firms who are integrating BIM now will have an advantage over their competitors, especially as BIM becomes more mainstream.

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But Savannah is much more than a favorite leisure destination. It is the destination of the **2011 NEBB Annual Conference from October 19th-22nd.**

Held in the heart of Savannah at the Hyatt Regency Savannah, enjoy a brief walk to fine dining, historic tours and of course, state of the art technical sessions! Of course, we will have your favorites—the Get Acquainted Party, the 2nd Annual Fishing Tournament and the 14th Annual Golf Tournament Presented by TSI!

Registration for the conference will be open on June 1, 2011 at www.nebb.org. As we did in 2010, all registration will be processed electronically.

Take a peek at the 2011 Annual Conference Schedule.

NEBB 2011 Annual Conference

Wednesday, October 19th

8:00 am – 4:00 pm	Closed Committee Meetings
8:00 am – 4:00 pm	Chapter Coordinator Meeting
8:00 am – 4:00 pm	EFC Meeting
4:00 pm – 5:00 pm	Past Presidents Meeting

Thursday, October 19th

7:00 am	2nd Annual Fishing Tournament
8:00 am	Consultative Selling Seminar
1:30 pm – 5:00 pm	Technical Sessions Start!
5:00 pm	General Session
7:00 pm	Get Aquainted Party

Friday, October 21st

9:00 am – 12:00 pm	Technical Sessions
1:00 pm – 6:00 pm	14th Annual Golf Tournament *Presented by TSI*

Saturday, October 22nd

8:00 am – 12:00 pm	Technical Sessions
9:00 am – 2:00 pm	Spouses Breakfast/Tour
12:00 pm – 1:00 pm	Industry Luncheon *(MCAA & ASHRAE speakers)*
1:15 pm – 4:00 pm	Technical Sessions
4:00 pm	Closing Session Golf Awards Fishing Awards

Commissioning for Sound and Vibration

Adding sound and vibration as an additional service brings added value to customers, the end user, and the building or facility.

By Kevin Gaghan, Gaghan Mechanical Inc., Alexandria, Va.
Stuart McGregor, Engineering Dynamics Inc., Englewood, Colorado
and Jim Huber, CEM, LEED AP, NCP, Complete Commissioning Inc., Clinton, Maryland

One of the most overlooked areas in building systems commissioning is the proper control of sound and vibration. This is a shame, because most of the sound or vibration issues that need to be corrected at the end of the project usually could have been avoided through proper commissioning at the beginning of the project. Commissioning for sound and vibration control is not as complicated as most providers might think. A basic understanding and a little common sense can go a long way. If you do not have a basic understanding of sound and vibration fundamentals, consider taking classes through a certifying organization. You can also hire a consultant to assist you when necessary.

Commissioning for sound and vibration is the same as commissioning for any other discipline—it must start at the beginning of the project to provide maximum benefit. This means the expected or acceptable levels must be clearly defined in the owner's project requirements (OPR) and properly addressed in the basis of design (BOD). If you do not see these requirements in the OPR, you need to stop and ask both the owner and the design team why. Remember, there is no way for you prove that the systems are installed and operating as designed if you don't have a target.

Sound and vibration levels are not unlike lighting levels, in that owners frequently do not know how to describe or quantify their expectations. Never assume that because you don't see any expectations listed, the owner doesn't have any. The owner does have expectations, and you do not want to be the one explaining to him at the end of the project why his new ceiling-mounted water source heat pumps are so much louder than the single-duct variable air volume (VAV) system he had in his previous facility.

A word of warning: Don't be surprised if you initially get a lot of resistance when you raise these topics. Many design professionals do not believe in putting this type of information in writing. As one architect recently stated, "You're asking me to give the owner the rope he's going to hang me with." That is a poor business attitude, and nothing could be further from the truth. In reality, you are doing the design team a big favor by putting the expectations in writing. Many projects are designed and built under tight budget constraints. This often leads to higher sound levels in the finished spaces due to less expensive HVAC equipment, and less expensive construction materials and methods. Documented sound and vibration expectations are your insurance that the owner receives what he is paying for, especially when the owner isn't paying for a lot.

Commissioning Review of Design Documents

Once the target sound and vibration levels have been established (along with the owner's other requirements), it is time for the design and construction documents to be created. As the sound and vibration commissioning provider, it is critical that your contract includes at least one review of the design documents before they go out for bid. It is better to have at least two reviews because sound and vibration issues are more expensive to correct

the later in the design process they are discovered. This is a great opportunity to sit with the owner to explain the pros and cons of the systems that have been selected. It is hard for an owner to relate to noise criterion (NC) or room criterion (RC) ratings. In some cases, it may be necessary to take the owner to a facility that has systems similar to what have been proposed (or build a mock-up) for the owner to get a feel for the differences in sound and vibration levels between the types of systems.

During your reviews, you need to ensure that the sound and vibration testing requirements are included in the project specifications. Make sure that the testing specifications require that the testing firm is certified in sound and vibration measurement. A sample sound and vibration spec can be downloaded from the National Environmental Balancing Bureau website. During your review of the plans, make sure that the system as designed can achieve the sound and vibration levels established in the OPR. For example, if the owner desires all private offices to have sound levels of NC35 or less, you want to make sure there is no equipment above the office ceilings that has fans or compressors. Classrooms designed for NC30 should not have open ceilings when there is ceiling hung equipment (it happens more than you think).

Typical items to consider during your commissioning review include:

- Does the building have a lightweight structure, specifically a lightweight roof structure? If so, have isolation requirements been addressed for all rooftop mechanical equipment?
- Has inertia mass, i.e., housekeeping pads, of normal weight concrete been shown beneath the pumps/air handling units?
- How are the supply and return chases constructed? For plenum returns, mechanical equipment rooms should be provided with return air baffle walls.
- Are duct airflow velocities excessive? For rules of thumb, see Table 1.
- Do the plans have installation details incorporating the proper vibration isolation methods?
- Is the supply ductwork lined where required? Some building owners prohibit internal fibrous liner. There are nonfibrous liners on the market that are gaining acceptance by owners.
- Are inlet ducts to VAV terminals hard-ducted instead of being connected with flexible duct?
- Pay close attention to plenum ceilings. The return paths used can cause the ceiling assemblies to essentially be acoustically transparent. If light fixtures are being used to return air to the plenum, do not install equipment above the lights. Pay particular attention to return grill placement.

Items continued on page 14 >>

Typical items to consider during your commissioning review include:

- Pay attention to damper locations. Dampers must be located as far from the diffusers as possible. Avoid face dampers in the diffusers if at all possible. If face dampers must be used, verify that there are air straightening vanes prior to the damper.
- Pay attention to diffuser locations. There is an additive effect from multiple diffusers; for each doubling of the number of diffusers, the sound pressure levels increase 3 db.
- Have sound attenuators been used properly? Ask to see the equipment selections with and without the manufacturer's attenuators. Do not assume that the attenuator will always make the equipment quieter, because in many cases the attenuators will increase the sound levels in some octave bands while reducing levels in others.
- Are duct silencers properly applied where required? Remember that duct silencers require laminar flow to be effective. When straight ducts with laminar flow cannot be provided, the fan speed changes required to overcome the increased pressure drop can actually create higher sound levels than if the silencer wasn't used at all. Duct silencers with pressure drops in excess of 0.25 in. wg should be avoided if at all possible.
- Are sound sensitive areas located away from areas with the highest sound levels? Conference or training rooms are often placed in interior areas since these areas offer easy access to restrooms and elevators. Often these rooms end up right next to the mechanical equipment room.
- Are mechanical equipment room partitions of proper construction (i.e., alternating stud partition, double-wall, double-layered drywall)? Many designs show only stud-to-stud partitions for the mechanical equipment rooms.
- Is mechanical equipment oriented to reduce sound pressure levels in the normally occupied spaces? If the mechanical room is situated adjacent to a stairwell, it is usually possible to orient the unit such that the noisiest end of the unit is directed toward the stairwell in lieu of the occupied areas.

Construction Phase

Your contract should include periodic site inspections during construction of the project, and it is wise to perform one of those inspections early in the project, especially when the equipment is being installed. Missing or improper isolators are easy to correct before duct or other systems are installed. Isolators that do not match the approved submittals are often found on projects, so be diligent in your inspections.

Also remember that new equipment can mask future vibration problems. Over time, belts will wear, sheaves get out of round, etc. A system that does not exhibit a vibration issue during startup or the warranty period may still develop issues later in life, especially if the original installation was not performed per industry standards and correct practices. The equipment manufacturer's specific sound and vibration requirements and recommendations should be incorporated into the prefunctional checklists for the project.

During your field inspections, be on the lookout for the items that were identified during your design phase review. Information is not always conveyed to the personnel who are installing the equipment. Also ensure the following:

- All ductwork is properly isolated from walls and lights (no physical contact).
- There are no poor (highly turbulent) duct fittings.
- All duct connections are properly sealed. (Air leaks can generate noise.)
- All penetrations of partitions are properly sealed.
- There are no improperly adjusted isolators.
- There are no improperly adjusted duct connectors.
- All shipping blocks have been removed.
- There are no flanking paths of transmission.
- There is no excessive dirt on blower wheels.
- There is no misalignment of couplings, sheaves, and other drive components.
- Flexible conduit has been used between rigid electrical conduit and reciprocating or rotating equipment.
- Fan discharge and inlet fittings are correctly installed and fan orientations are correct. (This not only reduces system effect but also reduces sound levels.)
- LEED 2009 for Healthcare includes IEQ Credit 2 for acoustic environment. Once point is available for measuring or calculating sound levels in each representative room type to confirm compliance with criteria in the ASHRAE 2003 Handbook, Chapter 47, Sound & Vibration Control, Table 34.
- Properly commissioned buildings also include sound & vibration testing specifications, and those specifications are being enforced.

Owners have already taken note of the impact of acoustics to their bottom lines. How is the industry addressing these issues? For starters, sound & vibration is being referenced to a much greater extent in building codes and design standards, as well as LEED. *For example*

Acceptance Phase

Once all equipment and systems have been properly cleaned, started, and balanced, it is time for the acceptance phase to begin. All specified systems must be properly tested in accordance with the project specifications and other design documents. It is extremely important to perform actual testing or witness verification in proper order. First and foremost, all test, adjust, and balance (TAB) work must be complete before sound or vibration testing for acceptance takes place. If pumps are cavitating or fans are in any kind of surge, the readings of sound and/or vibration are falsely elevated. If applicable, vibration testing and verification should be performed and completed before moving to the sound portion of acceptance. All sound and vibration measurements should be reported on the specified test forms, and included in either the final TAB report or the commissioning report, whichever is specified in the contract documents. Sound measurements should be given in terms of NC or RC, or, in some cases, both criterion are specified.

For vibration reporting, final verification of “isolation in place” should be performed by the commissioning provider, but some specifications allow this to be done as paperwork verification by the installing contractor. This should also be done for proper “housekeeping” of the equipment (pump pads cleared of debris, isolators properly set, bolt down of fans removed, etc.).

The next procedure should include verification of vibration testing being actually performed. It is not always realistic to be able to witness every piece of equipment being tested, and if not actually seen, proper forms with the equipment readings, as set out in the commissioning specifications, must be properly and fully filled out. These forms should also note any piece of equipment that does not meet proper vibration specification. These deficiencies should then be routed to the proper people for remediation with follow-up testing. If the commissioning provider is not performing the sound or vibration testing, it is imperative that sound and vibration verification be performed with the sound and vibration testing contractor. The verification process is the same as for the TAB process, with random measurement locations selected for retesting. The systems must be postured as indicated in the original report.

Incorporating sound and vibration requirements into your commissioning tasks is not incredibly time-consuming. You are already reviewing most of the plans, specifications, contract documents, and systems as part of your other commissioning disciplines. Adding sound and vibration as an additional service brings added value to your customers, the end users, and the facilities. If the buildings could talk, they would thank you.

About the Authors:
Gaghan is owner of his own mechanical contracting business, Gaghan Mechanical. He obtained most of his knowledge in the sound and vibration area while with Trane, where he participated in the company's national vibration standardization. McGregor is a full partner and senior acoustical engineer at Engineering Dynamics. He has experience analyzing, designing, and measuring noise and vibration from building mechanical systems. Huber is the president of Complete Commissioning, where he performs building system commissioning for new and existing facilities and systems. All three are on the sound and vibration committee of the National Environmental Balancing Bureau (NEBB).

Table 1: **This shows the maximum recommended duct airflow velocities necessary to achieve specified acoustic design criteria.**

Main Duct Location	Design RC (N)	Maximum Airflow Velocity (fpm)	
		Rectangular	Circular
In Shaft or Above Drywall Ceiling	45	3,500	5,000
	35	2,500	3,500
	25	1,700	2,500
	15	900	1,200
Above Suspended Acoustic Ceiling	45	2,500	4,500
	35	1,750	3,000
	25	1,200	2,000
	15	600	1,000
Duct Located Within Occupied Space	45	2,000	3,900
	35	1,450	2,600
	25	950	1,700
	15	500	900

Notes:
1. Branch ducts should have airflow velocities of about 80% of the above stated values.
2. Velocities in final runouts to outlets should be 50% of the above stated values or less.
3. The presence of elbows and other fittings can increase airflow noise substantially, depending on the type of elbow or fitting. In those cases, duct velocities should be reduced accordingly.

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