

---

**CONSTRUCTION PROJECTS COMMITTEE**  
**THURSDAY, NOVEMBER 20, 2008**  
**NASHUA HIGH SCHOOL NORTH LECTURE HALL**  
**6:00 PM**

---

A meeting of the Construction Projects Committee was held at Nashua High North on **Thursday, November 20, 2008**. Alderman McCarthy called the meeting to order at **6:10 p.m.**

Present: Alderman McCarthy, Alderman Tabacsko, Mr. Kelley, Mr. Hallowell (6:30)

Also Present: Mr. Mealey, Mr. Smith, Mr. Vaughan, Mr. Haas, Mr. Teeboom, Carl DuBois, Steve Caulfield, Kevin Drew

*Discussion – Gorham High School Geothermal HVAC System*

**Alderman McCarthy**

Steve, do you want to start with your impressions from that trip?

**Mr. Caulfield**

Overall it's a nice system and a nice school. If the numbers they told us are true, they got a great bargain there. There are some of the difference between what they have there and what we're proposing. The major difference is that's an all air system so the heating and cooling from air. The system we're proposing has similar dedicated air units, but the heat would come from thin tube radiation. I think the way they approached having the heat pumps in each room but having them separated by a closet was a novel way to get around the noise issues but still give you the individual controls. But it comes at a cost and here it would come at a cost from a renovation project. They were able to accomplish a lot in the framework of new construction. I think for us it would be a challenge. We'd have a lot of additional costs outside of the mechanical system if we were to build a system like that in these existing schools.

**Alderman McCarthy**

I assume the mechanical cost you got from that is just that and doesn't include the costs in masonry and sheetrock budgets for building those enclosures in each of the classrooms.

**Mr. Caulfield**

Oh, absolutely. Obviously, if we don't have an architectural budget to create those enclosures we can't duplicate that with the sloped ceilings we have in 60% of these schools... so that would be a budget outside of mechanical to create a system like that. But no, I don't think the umbers they shared with us included any of those costs of accommodating that equipment in the classrooms.

**Alderman McCarthy**

I was trying to get a feel for the size of their classrooms, which looked to be in the mid 900 sq. ft. range... substantially bigger than the ones we have.

**Mr. Caulfield**

I know Gary Connors asked that question specifically but I don't know what the answer was. I do know that they have more sq. footage in those classrooms than you have here. Particularly because the class sizes there are much smaller with 18-25 students and the rooms were bigger. That was the point that Gary was getting at... that the occupant density in the Nashua elementary schools is much higher than there. As that relates to mechanical, we'd have to provide more outside air per classroom than they have.

**Alderman McCarthy**

Do we know what their outside air rate was in their school?

**Mr. Caulfield**

It's in the report... I don't know off the top of my head. Oh, they have a total of 40,000 CFM available. But that includes the classroom CFM and also capacity for the gym, cafeteria, etc. when they're full. The overall price of that school was \$15.6 million. The number of \$11 million was just building costs... no site or alternates that they elected to go forward with. It brought the overall cost per sq. foot up over \$100 per sq. foot.

**Alderman McCarthy**

There's a trade publication that keeps track of construction cost ratios. What's the typical difference between Nashua and Gorham?

**Mr. Caulfield**

I'd have to look it up. There's a factor, but I don't have it off the top of my head. We've been comparing this project to a school project that we're doing in Westbrook, Maine. It's an elementary school with the square footage similar to Gorham. That's 135,000 square feet and the cost today was \$200 per square foot bid... and we were the low bidder.

**Alderman McCarthy**

Ouch... And for those who weren't on the tour, it was also related to us that Gorham receives about 85% reimbursement from the state of Maine for construction. That takes a lot of the sting out of \$200 per square foot. So do we have any general conclusion of what we ought to do based on what we've seen?

**Mr. Caulfield**

Which we are you referring to?

**Mr. Vaughan**

For those who did go, could someone describe what functionalities in the classroom and in the closet?

**Alderman McCarthy**

They have a fairly large space where the pumps are housed. They're looking at a well field that has a lot more wells than we're talking about but their shallower. They have 116 of them. And they have the heat exchange systems to get hot water loop. And they have a fairly conventional system for places like the gym and auditorium. In the classrooms, there's a 5-6' by 3' closet built in the classroom, which is acoustically isolated from the classroom. The heat pumps for the classroom are in there. The heat exchangers use ceiling diffusers and there's a return at the closet and another one at the far end of the classroom. So there's a fair amount of duct work above the ceiling in each classroom, and that's accommodated by the fact that they have about 4' of head space above the suspended ceiling, which we have in virtually no building.

**Alderman Teeboom**

I'd like to hear from Shawn, Mike, you...

**Mr. Smith**

Overall impression was that it was really a hybrid system. It wasn't a unitary system by any stretch of the imagination. I liked it and thought it was a good system. It's kind of right in the middle of a total unitary system and a total displacement air system.

**Alderman Tabacsko**

In the design that we're talking about here, do we need to replicate those big air handlers that we were seeing in the upstairs room? Is that what we're trying to accommodate?

**Mr. Caulfield**

Yes, we have a plan to do similar things. Some of it is space within the school and some is created penthouse space to do something similar to temper the outside air.

**Alderman Tabacsko**

I'm not quite sure why there's an individual heat pump in every classroom.

**Alderman McCarthy**

They don't have distribution to the classrooms... they'd need a lot more ductwork.

**Mr. Caulfield**

The individual units for each classroom provide the heating and cooling for that classroom. The units upstairs just temper the outside air so that it's not coming in at outside temperatures. So they're different functions.

**Alderman Tabacsko**

My feeling is, as long as we're looking at apples to apples... when you take everything into consideration I think this project is probably very close to what we're seeing as already existing out there. And that leads me to believe that this is something we should probably move forward with/ Because I think in the long run, the geothermal solution is a good one and I think that's where we ought to be trying to make this work.

**Mr. Smith**

This was a centralized controlled system. The teacher had a sensor and not a thermometer in their room so there's no way they can adjust the heat. They'd have to call the central station to dial a different temperature and put the compression on.

**Alderman Teeboom**

I came out with a different opinion entirely. They compared the energy costs of their systems with other schools, but didn't identify the other schools. The column that I outlined with my pencil mark is the annual cost comparing Gorham Middle School with the other schools. The first thing that hits you is the large energy costs. All of these hand handlers and pumps take a lot of energy and the cost is very high. Dr. Phetteplace explained all that. If you compare heating only compared to heat/air conditioning, the savings at the most is \$46,000 and you're dealing with a system that costs \$2 million just for mechanical.

The other point I want to make is that this is new construction. They went through extremes to explain to us how they spent an enormous cost and effort to isolate that building and the insulation of the roof is enormous. Because thermal insulation is extremely important. So the cost of this school I was told was \$21 million. He did say that the mechanical part was \$2 million. But all the other stuff is not part of the \$2 million. So you have to conclude that this system is a very expensive system. It's a very good system, but very expensive.

And my third point is to compare this to the data from Turner. This system is not unlike the system that Turner is proposing. The Turner data for an in-kind replacement for a school that's less than half the size... namely Fairgrounds is \$98,000. But when you look at the date predicted by Turner for geothermal, Turner is predicting a cost with solar of \$20,000 a year. And without solar \$28,000 a year.

What Gary Maedl and Dr. Phetteplace told us was that in order for geothermal pay off, it's got to be exceedingly efficient. Dr. Phetteplace said he doesn't recommend air handlers. He said you're moving all this air through these ducts and you're going to lose all the heat and all the cool. Unless someone can tell me that I'm misreading this data or that it's wrong, you can't argue the facts. Geothermal in a renovated building probably doesn't pay because you can't insulate it well enough. It could pay for a new construction. If you look to save money, you can't do it the way they did. If you want to be green, fine.

**Alderman McCarthy**

There is a glaring difference which may account for a lot of that. And that is the absolute lack of heat recovery in the Gorham system. In that system, they are bringing in outside fresh air at 20 degrees, heating it to 70 degrees and exhausting 70 degree air out from the classroom at about 10,000 cubic feet per minute when the building is occupied. Am I correct on that?

**Mr. Caulfield**

Yes, that's my understanding. They have no heat recovery on any of that.

**Alderman Teeboom**

The conclusion is still the same in my opinion. Minimize your ducts as much as possible, build as close to your heat pump as possible, move as little air as possible and get it right into the delivery area. And if you have a noisy pump, isolate the noise. So my conclusion is to get away from geothermal for Fairgrounds and the other 2 schools. It's a nice venture, but in the end to quote Alderman McCarthy, if you can't do it, forget it. I think we have to forget this one. If you build a new school, then you can build it around this system as Gorham did. And then there still may or may not be savings. So let's go back to in-kind. And whether or not we do air conditioning in the elementary schools or just to air conditioning for teachers and administration... let's go back to the beginning.

**Alderman Tabacsko**

Before we throw in the table based on that school, maybe it's time to go back and do that comparison cost. What does the design for our schools with the geothermal application compared to replacing the boiler and walking away? I'd like to get a sense of what that comparison would come down to.

**Alderman McCarthy**

I guess we have to ask, but I'm not sure that replacing the boiler is an option. We are required to meet fresh air standards and we can't with the equipment we have now. We certainly cannot meet the noise standard by leaving the existing equipment in the room, I assume. There are several things I'd like to do at this point. One is I'd like to go back and do a little more detail on the schematic estimates that we've got. They're almost a year old and I understand the industry is much more likely to deal with us at this time. I also want to know from the committee if we though it might be worth while to get in touch with the gentlemen that we've talked about from Toronto to come and talk to us.

**Mr. Caulfield**

I guess I would leave that to Mr. Smith and Mr. Mealey if they feel there's worth in that.

**Alderman McCarthy**

This is actually someone who has experienced with these system sin cold weather places.

**Mr. Mealey**

I also think it might be good because he's had experience with renovations and not just new construction. We can arrange to get in touch with him.

**Alderman McCarthy**

Secondly, we've had an offer from the Jordon Institute to have someone come to talk to us about work with schools and I'd like to take them up on that for our next meeting. I'll get you (Mr. Mealey) some contact information on that.

**Mr. Vaughan**

I'm still preoccupied with the fact that they didn't put in the heat recovery. Is there an obvious reason why they didn't or is it a design choice?

**Mr. Caulfield**

Sometimes that's done because that's done because it's difficult to recover the heat from one air stream to another. I couldn't answer why they didn't choose to do that.

**Alderman McCarthy**

There were some details that were a little fuzzy. They clearly have centralized air intakes that apparently distribute exhausts, and the exhausts are on a classroom basis. The other thing we could never quite figure out was where the fresh air coming into the classrooms came into the in room air handling units. Supposedly there's central distribution that gets out and mixed with the recirculated air, but it was tough finding the plumbing that did that.

**Mr. Caulfield**

I believe the fellow giving the tour was incorrect when he said the duct coming into the top of that was another return. I think that was actually the fresh air that was coming into a mixing box and mixing with the return air from the classroom. And the exhaust was totally separate on the outside wall.

**Mr. Hallowell**

I presume the gentleman from Toronto is the person who designed the system and would know how it all works and why they didn't do certain things. On Alderman Teeboom's analysis of the numbers... I only got the spreadsheet this afternoon. The calculations seem reasonable to me and the reduction is on the order of 10% if you only look at heating only and 20% if you look at heating and air conditioning when you consider those costs. Can we at least get agreement that this analysis is correct?

**Mr. Caulfield**

We've looked at these numbers before. It's hard, because none of these are apples... they're all individual schools. I don't know if you can compare or not. One of the things I look at is comparing the school we looked at to the school just above it. It looks like the electric costs are almost exactly the same on a sq. ft. basis. But essentially with one school you're just doing air conditioning, lighting, pumps, etc. And the other school you're doing heating, lighting, air conditioning, pumps, etc. for the same cost.

**Alderman McCarthy**

Are these total energy costs for the building?

**Mr. Caulfield**

Yes, so those include everything. What this gets you is a snapshot of what's happening now at that price. What it doesn't get to is the fluctuation... specifically the fuel number that could fluctuate significantly or not in the future. If it had stayed where it was four months ago, these numbers...

**Mr. Hallowell**

But even in your analysis of the life cycle cost, you're assuming some average increase of 7%. So that is one of the reasons we're looking at geothermal is because it reduces your variability. But in the end, the only way to do the analysis is to assume some nominal... you can't just put a spike in there, because you can justify any system by doing that.

**Mr. Caulfield**

Right. And we're assuming 5% actually, a year escalation from essentially where you're out right now. But if prices for oil were what they were 4 months ago and you did this same analysis on a snapshot basis, the savings would be \$100,000 or more for the year as a starting point. And the \$46,000 difference is the starting point for that school, essentially. You look 20 years from now and that number is likely to be much higher on a per year basis.

**Mr. Hallowell**

So, Alderman McCarthy makes a good point, which I was thinking which is that I don't know what else they put in this school that potentially could use a lot of electricity even though they were trying to make things green. So, we haven't taken that out in order to figure out what the costs of the system is.

So setting this aside for a minute, the thing that I struggle with in this whole analysis is the design that Turner has come up with... I'm trying to resolve the differences between what a known expert in the field (Dr. Phetteplace) says is his view of how geothermal ought to be used, and Turner's design. And in the response to Dr. Phetteplace's review, I didn't get any sense from Turner that there were any changes they were considering. For instance the concentric tube design. You've got someone who's done it and knows there were problems with it in the past. And yet I didn't hear from Turner something like, oh that's a good point. When I'm reviewing something for the government and tell the people I'm reviewing it for that here are the problems with the system... if they can't either tell me why it's going to work (other than we think it will) or maybe that's correct and we need to re-think about our design... I start to get worried about the people who are helping me design something or build the system that we're reviewing.

So that's my fundamental problem. I'm not confident in the expertise on the Turner side, in all due respect. I know there are a lot of smart people there who think they can put a system together well. But I wonder if we're looking back to see what's been done and not just inventing something without really thinking about how we're putting it all together.

Regardless of whether Alderman Teeboom's analysis is completely correct or not, I do have a concern about the fundamental thing that Dr. Phetteplace was saying, which is the core temperature of the water that you're dealing with is at a lower temperature of what it would normally be if you were doing oil fired boilers. And so the key to geothermal is you really want to keep it as water for as long as possible because you don't have the same core temperature of the air that you're heating up. I don't know all the things about HVAC, but that seems pretty fundamental to me. That the efficiency of moving it around in the air handling system, you're going to lose efficiency there. So I wonder in five years, when we go to really analyze the numbers to see whether they match what your models say are going to happen... whether they will. And I don't what we're going to do in 5 years if they don't, because at that point we're stuck with whatever we have.

I would love to do geothermal, but I don't know how I move forward. And so I'm almost forced to say that I'd rather do oil fired boilers, because I do think Turner knows exactly how to do that and have done that well in the past. So that's where I'm at.

**Alderman McCarthy**

I guess I would like to understand that as well. I'm more concerned with the characteristics of the end product than how we get hot water. I'd like to understand what our options are in the classrooms for heat and air distribution. If we think we have to take out existing unit ventilators and case work and do the kind of demo and refit that we've talked about no matter what... then I want to think about what our costs and options are. I think you guys have a handle for where we want to be heading for cost and maybe you can think about that for our next meeting and get us thoughts on that. If we abandon geothermal and get hot water from a boiler system, what can we do to get noise down and air quality and homogeneity in the classrooms up?

**Mr. Haas**

I mirror what Mr. Hallowell just said. My little understanding of geothermal is that it's better to take 51 degree air and try to warm it to 70 than to take 20 degree outside air and try to warm it to 70. And it seems to me that it's cheaper to run a 2" copper tube from a well to a room than to demo the whole roof and put in big, giant air handling systems. That's the struggle I have. So I'm confused as well.

**Mr. Hallowell**

We have very short ceilings in our schools and they're reasonably small...

**Mr. Caulfield**

No, actually the ceilings are very high in the majority of the school. The older section, which is about 60% of the school has about 13' ceilings at the peak, which is where we take the air out. So they're ideal for displacement. Fairgrounds Middle School has 9' ceilings and we've got displacement air in there and it works fine.

**Mr. Hallowell**

Presumably when we did Fairgrounds Middle School, there was an analysis of what we thought our energy usage would be for the system that got installed there. Have we ever done an analysis to compare the original analysis with what actually happened, or did we not have an original analysis?

**Mr. Smith**

I haven't come across anything yet, but that was before my time.

**Alderman McCarthy**

There wasn't really an analysis done of expected cost. But the system is sized appropriately for the building. So if it were going to not perform, you wouldn't be able to keep the rooms up to temperature. That would be the way to discover that.

**Mr. Hallowell**

Okay, have we done any kind of analysis to determine the temperature spread across all the rooms in Fairgrounds? Have we ever done an actual analysis of how it's working?

**Mr. Smith**

I don't believe we have.

**Alderman McCarthy**

That system has a centralized control that records all that. And if it were out of spec for long periods of time, we would know that fairly readily.

**Mr. Smith**

I maintain all the schools in the city and we have 2 that have the displacement air system and there are no complaints from those schools at all... as compared to those with the more traditional unit ventilators and that sort of thing.

**Mr. Hallowell**

That's a good measure if you get the least complaints there.

Alderman Tabacsko moved to adjourn. **So voted at 7:08 p.m.**

*Submitted by Jacki Waters*