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August 16, 2005

Reading Public Schools Administration
Attn: Mr. Patrick Schettini, Superintendent
Administration Offices
82 Oakland Road
Post Office Box 180
Reading, MA 01867

Re: Review and Commissioning of HVAC Systems
Wood End Elementary School

Dear Superintendent Schettini:

Enclosed please find a copy of the report prepared by Garcia-Galuska-Desousa following their review of the HVAC design and construction at the Wood End Elementary School. In our review meeting with Garcia-Galuska-Desousa, they indicated that none of the identified items compromise the use and occupancy of the Wood End Elementary School. However, we recommend that the following steps be taken:

1. The full report should be issued to the A/E of record for review and comment. I will copy project counsel on this correspondence. Garcia-Galuska-Desousa indicated that some of the issues may simply involve varying design approaches and that the engineer of record should be given an opportunity to respond.
2. After receipt of comments from the A/E we should schedule a meeting with the A/E and Garcia Galuska-Desousa for purposes of reviewing all items.
3. Subsequent to this meeting we should review remaining items we believe the A/E is responsible for correcting. Project counsel should attend this meeting for discussion of next steps.

If you have any questions please contact me.

Sincerely,

L. Scott Dunlap, AIA
Project Manager

cc: Joan Langsam, Esquire

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370 Faunce Corner Road, Dartmouth, MA 02747-1217
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To:	Architecture Involution (AI-3)		
Attn:	Steve Shaugnessy	**From:**	Edward Galuska
Fax:	781-942-1648	**Fax**	508-998-0883
Phone:	781-942-1647	**Phone:**	508-998-5700
Date:	8/16/2005	**Pages:**	8 (Including cover sheet)

Subject: Wood End Elementary School

Job Number: 868 001

Notes: Commissioning

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001 00
L#18668

August 16, 2005

Town of Reading
Administration Office
82 Oakland Road
Reading Massachusetts 01867

Attn: Mr. Patrick A. Schettini
Superintendent of Schools

Re: Wood End Elementary School

Dear Mr. Scahettini

Per our agreement of February 28, 2005 we have completed the thermodynamic analysis, a review of the contract documents, and an overall assessment of the design which was prepared for you by LFG consulting engineers in Connecticut for the above noted project. We believe we have undertaken an extensive investigation in response to your request and we have noted several design issues some of which could have a significant impact on the overall operation of the installed HVAC systems. Many of the noted items are non code compliant issues as well as a number of which represent poor engineering and design judgments.

On Thursday May 12, 2005 I met with Mr. Johnson and Mr. Thiffault of your facility staff to interview them and experience the overall operation of the HVAC system as they are installed and as a further investigation of the issues noted. The results of the field investigation are also addressed herein.

The following comments are the result of our review of the contract documents, overall assessment of the design, and field investigations:

Drawing M 1. a

Room #	Deficiency
114 C	No supply or ventilation air provided.
132 B	Corridor not provided with supply or ventilation air.
102 A	No heat or ventilation air provided.

Drawing M 1. b

144	No heat provided in stairway. (In our field investigations we had determined that the heat originally installed in the adjacent corridor was relocated to the noted stairway. We do believe that the amount of heat installed is inadequate during frequent door use.)
145	No heat provided in stairway. (In our field investigations we had determined that the heat originally installed in the adjacent corridor was relocated to the noted stairway. We do believe that the amount of heat installed is inadequate during frequent door use.)
105 C	No supply air or ventilation air provided.

101	Inadequate heat provided at main vestibule. No secondary cabinet heaters provided at corridor side of vestibule.
127	Exhaust air quantity does not provide for adequate air changes. No make up air provided for room.
128	Exhaust air quantity does not provide for adequate air changes. No make up air provided for room.
124	Elevator machine room not provided with code required exhaust system based on temperature rise. (Although this was not confirmed in the field, we were advised that the code required amount of exhaust ventilation along with the appropriate control was installed by change order during construction.)
128 A	No corridor supply or ventilation air provided.
121	No exhaust system provided in copy machine area.
103 D	Media Center Work Room is not provided with air-conditioning and is served from AHU-2 which could be off when media center is being used.
143	No heat provided for stairway 2 or vestibule 129 B.

Drawing M 2. b

217	Exhaust air quantity does not provide for adequate air changes. No make up air provided for room.
218	Exhaust air quantity does not provide for adequate air changes. No make up air provided for room.
220	No fire damper provided in duct penetration of wall. Refrigerant lines run through electric room which is not code compliant.
213 E	No supply or ventilation air provided.
213 C	No supply or ventilation air provided.

Drawing M 3. b

102 B	Cabinet unit heater provided in atrium is undersized for application. No pipe guides or anchors provided before or after expansion loop.
107	No heat provided resulting in 3.6 MBH deficiency. Air is high by 61 CFM based on cooling load.
112 B	Heat is provided however deficient by 11.5 MBH. Air is deficient based on cooling load by 122 CFM.
105 C	No heat provided resulting in .6 MBH deficiency. No supply or ventilation air provided.
111	No heat provided resulting in 5.3 MBH deficiency. Air is high by 142 CFM based on cooling load.

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106 A	No heat provided resulting in 4.7 MBH deficiency. Air is high by 40 CFM based on cooling load.
104 A	Heat is provided however deficient by 11.2 MBH. Air is high by 281 CFM based on cooling load.
108	No heat provided resulting in 1.4 MBH deficiency.
109	Heat is provided however deficient by 3.5MBH. Air is high by 56 CFM based on cooling load.
112 A	Heat is provided however deficient by 5.7MBH. Air is high by 77 CFM based on cooling load.

Drawing M 3. b

220	No heat provided resulting in .6 MBH deficiency.
219	No heat provided resulting in .6 MBH deficiency.
218	No heat provided resulting in .9 MBH deficiency.
216 A	No heat provided resulting in .9 MBH deficiency.
214	No heat provided resulting in .7 MBH deficiency.
213 D	No heat provided resulting in 1.3 MBH deficiency.
213 E	No heat provided resulting in .5 MBH deficiency.
213 B	No heat provided resulting in .5 MBH deficiency.
213 C	No heat provided resulting in .6 MBH deficiency.
201 A	No heat provided in center of corridor however ends of corridors are provided with cabinet unit heaters. The amount of heat is adequate however the poor distribution could result in cold area in center of corridor.

Drawing M 3. a

131 A	No heat provided resulting in --- MBH deficiency.
130	No heat provided resulting in .3 MBH deficiency.
132 E	No heat provided resulting in .1 MBH deficiency.

Drawing M 4. a

223 B	No heat provided resulting in .3 MBH deficiency.
223 C	No heat provided resulting in .3 MBH deficiency.
223 D	No heat provided resulting in .3 MBH deficiency.
223 E	No heat provided resulting in .3 MBH deficiency.

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224 No heat provided in center of corridor however ends of corridors are provided with cabinet unit heaters. The amount of heat is adequate however the poor distribution could result in cold area in center of corridor.

222 No heat provided resulting in 1.7 MBH deficiency.

221 B No heat provided resulting in 1.3 MBH deficiency.

Equipment # Deficiency

AC-1 Not provided with code required economizer control. Outside air is sized only for minimum and not capable of higher amounts when outside air temperatures permit.

Design shows a supply ducts originating at both ends of the unit.

Design shows outside air ductwork tying into supply air duct at left end of unit.

Design calls for both interior and exterior spaces served from same supply duct with no area control.

No supply or ventilation air provided to kitchen or adjacent corridor.

Overall fan and air handling system is oversized based on cooling load performed on each individual space. Total of all spaces requires 1895 CFM of total air however schedule indicates 2400 CFM is being provided. The excess amount of the air provided utilizing a single zone unit along with the imbalance of the air at the individual zones will create extremely uneven temperatures throughout.

Cooling coil and condensing unit is oversized based on the cooling load performed on each individual space and utilizing a resulting block load. It appears that the system is oversized by approximately 26%.

Based on population of space and utilizing the code required amount of 15 CFM per person the air handling unit is deficient by approximately 100 CFM of outside air.

The building code requires that all systems over 5 tons in capacity must be provided with economizer control and has not been provided.

Connection of outside air duct to louver is limiting amount of outside air drawn into louver due to the very poor connection and lack of intake plenum.

AHU-1 Building code requires either CO2 control or energy recovery be installed it all air handling systems over 3000 CFM of outside air neither of which is provided.

No relief or exhaust air accounted for in system to match minimum outside air requirement and to maintain space pressurization. Design presently allows for 100% recirculating air.

Outside air provided is deficient based on overall population of spaces served by unit. Total population of the area is 325 people. Based on building code requirement of 15 CFM per person minimum outside air should be 4875 CFM.

Heating coil provided in unit is oversized based on the amount of outside air considered in design. Approximately 264.6 MBH is required however, schedule indicates 950 MBH provided.

AHU-2

No relief or exhaust air accounted for in system to match minimum outside air requirement and to maintain space pressurization. Design presently allows for 100% recirculating air.

Outside air provided is deficient based on overall population of spaces served by unit. Total population of the area is 147 people. Based on building code requirement of 15 CFM per person minimum outside air should be 2205 CFM.

Heating coil provided in unit is oversized based on the amount of outside air considered in design. Approximately 124.7 MBH is required however, schedule indicates 564 MBH provided.

RTU-1

No design provided to allow for 100% outside air or economizer relief when outside air temperatures allow.

Building code requires either CO2 control or energy recovery be installed if all air handling systems over 3000 CFM of outside air neither of which is provided.

Outside air provided is deficient based on overall population of spaces served by unit. Total population of the area is 171 people. Based on building code requirement of 20 CFM per person minimum outside air should be 3420 CFM. The design indicates a deficiency of approximately 2420 CFM of outside air.

The supply diffuser total in plan indicates 4700 CFM of supply air. The ductwork is designed for the distribution of 4700 CFM of supply air. The schedule indicates 9000 CFM of supply air with a resulting 9000 CFM of return air. It does appear that the duct distribution system was incorrectly designed and installed and does not match the output of the rooftop unit. This opinion is supported by completing an air change calculation for the area. At the 4700 CFM indicated in the design the space would receive approximately (2) air changes well below acceptable design parameters. At the 9000 CFM of total supply air approximately (4) air changes are being maintained which is considered acceptable for this type of application.

The gas fired furnace provided in unit is oversized based on the amount of outside air considered in design. Approximately 74.2 MBH is required however, schedule indicates 900 MBH provided. At the required 3420 CFM of outside air approximately 258.5 MBH is required. The schedule calls for modulating gas control valves however our experience with this manufacturer suggests this type of control is not available in more than likely not installed. If this is the case wide variations in space temperature will be maintained due to the excess of capacity of the furnace installed and a minimal amount of heat required in the space. This is additionally complicated by the installation of (2) vertical unit heaters within the space which are contributing additional heat which would generally overheat the space to a greater extent.

The internal insulation within the rooftop unit is separating from the sheet metal panels.

RTU-2

The supply air volume indicated by totaling the diffusers equals 8370 CFM however the schedule indicates 9000 CFM delivered by the supply fan.

The space served by this unit is a dual purpose area used as an auditorium as well as the cafeteria. The building code requires that the design must reflect the condition representing the most demanding design in that case the area must be designed as an auditorium which reflects a higher population. Considering this design philosophy, the outside air should be approximately 4410 CFM based on a population of 294 people. The design schedule indicates a total outside air capacity of 3000 CFM.

RTU-3 All supply and return air registers are located in the same ceiling plane which are short-circuiting a percentage of the total ventilation and supply air to the space. This condition is reducing the overall "ventilation effectiveness" recommended by ASHRAE as a minimum standard of design.

RTU-4 Outside air provided is deficient based on overall population of spaces served by unit. Total population of the area is 58 people. Based on building code requirement of 15 CFM per person minimum outside air should be 870 CFM. The design indicates a deficiency of approximately 120 CFM of outside air.

At the 4400 CFM indicated in the design the space would receive approximately (3.7) air changes which is below acceptable design parameters. A minimum of approximately (4) air changes is considered acceptable for this type of application.

Heat is provided however deficient by 12.3MBH.

Vestibule cabinet unit heater entering main lobby is undersized and there is no backup cabinet unit heater located in main lobby at the inside entrance of the main vestibule.

Boiler When totalizing the entire connected load of all heating equipment the net output of the boiler should be 2488 MBH. The output of all boiler modules combined is 2274 MBH representing a 214 MBH deficiency. Considering the above comparison and representing deficiency there was also no redundancy in equipment and in the event a boiler module should fail the deficiency issue would become greater.

There does not appear to be a boiler water reset control or the ability to reduce supply water temperature based on outside air temperature. This possibly could be built into the module boiler control system however it is not evident on the contract documents.

During field visit it was noted that all boilers were off however, the combustion louver located high on wall was open.

The pressure gauges located on the supply water pumps do not seem to be operating correctly. When shutting down either of the two pumps the pressure gauge does not change.

EF-1 Tip speed of 4313 and sone rating of 8.4, which represents the design condition of the noted fan, would suggest fan should be operating in a very noisy condition.

EF-8 Tip speed of 4350 and sone rating of 8.1, which represents the design condition of the noted fan, would suggest fan should be operating in a very noisy condition.

EF-9 Tip speed of 5991 and sone rating of 14.5, which represents the design condition of the noted fan, would suggest fan should be operating in a very noisy condition. It was also noted that the fan was not securely fastened to the roof curb.

General notes:

1. There are no fire dampers indicated at any duct penetrations of the first-floor.

2. All supply and return air outlets are located in the same ceiling plane which is short-circuiting a percentage of the total supply air to each space which is reducing overall effective ventilation control.

3. There is no seismic control devices indicated or installed for any equipment, piping, or ductwork.

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Page 7

4. During an investigation of the rooftop equipment it was noted that the roofing membrane did not appear to be adhered to the roofing structural system. This may or may not be the result of an over pressurized HVAC system however, this overall condition should be investigated

Very truly yours,

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Consulting Engineers Inc.

Edward J. Galuska, P.E.

EJG

READING PUBLIC SCHOOLS

ADMINISTRATION OFFICES

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John F. Doherty
Assistant Superintendent

Mary C. DeLai
Director of Human Resources and Finance

September 23, 2005

Ms. Linda Phillips
42 Willow Street
Reading, MA 01867

Dear Mr. Phillips,

In response to your request for information dated September 19, 2005, please find attached a copy of the report from Garcia, Galuska, & Desousa analyzing the heating, ventilating and air conditioning system at the Wood End School.

If you have any questions, please feel free to contact me.

Sincerely,

Patrick A. Schettini, Jr.
Superintendent of Schools

c: Reading School Committee