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October 16, 2019
ESVT Project No. 18120

Ilisley Public Library
75 Main Street
Middlebury, VT 05753

Attn: Dana Hart, Director
Re: Ilisley Library HVAC System Evaluation and Study

Dana,

It was a pleasure to meet with you and Dan Werner to discuss the findings of our report and evaluation. The following report summarizes the results of this study, identifies the existing conditions, as well as evaluation of the existing systems and recommendations to address the existing HVAC system for the future.

I. PURPOSE

1. The purpose is to provide a report with evaluation for the conversion of the heating system to a more controllable, reliable and energy efficient system, as well improving and upgrading the building cooling systems.
2. This evaluation will as consider future plans for adding onto the building and how the proposed system could be designed to allow for the future planning including the proposed addition.

II. EXISTING CONDITIONS:

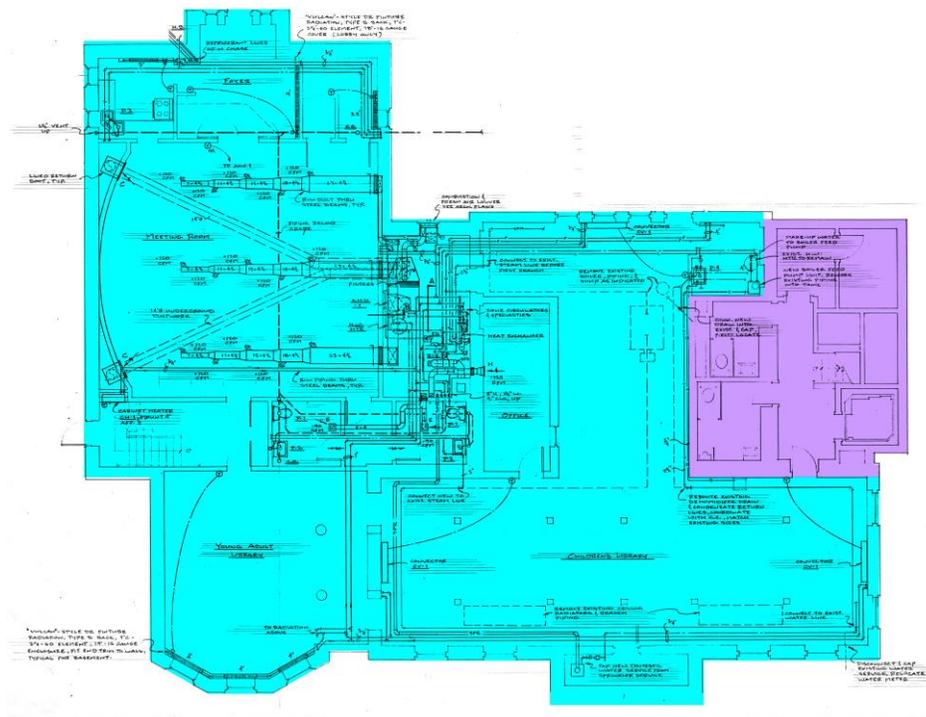
1. General:
 - a. The original library building was constructed in 1922, it consist of a granite and masonry building consisting of an approximate in 1987 an addition was constructed, the total building area is 16,350 square feet of gross area. In general, the last major renovation that took place was in 1987, at which time a new boiler was installed and addition was constructed for additional stacks, the renovated areas and new areas of the building were provided with hot water heat, in an effort to improve controllability and comfort. Although air conditioning was planned for the new additions, the only area which was provided with air conditioning was the basement Meeting Room. In the years since the 1987 addition, air conditioning unit shave been added to provide cooling to the remainder of the building, these systems have been done in a piecemeal approach, with smaller ductless air conditioning units installed around the building.
2. Heating System:
 - a. Boiler: The existing building is heated by a low pressure steam, oil fired hot water boiler.

- The boiler is a Weil McLain model 78, size 878 rated for 886,000 BTUH with a net I-B-R steam output of 665,000 BTUH. This boiler was installed in 1997 and is approximately 22 years old and is at or near the end of its useful life.
- b. The original building is heated using a one pipe steam system with radiators, this distribution system serves the basement south entrance area, first floor, second floor and third floor. The remainder of the building is provided with a hot water heating served form a steam to hot water heat exchanger located in the boiler room, heating system pumps and hot water distribution is distributed to the hot water heating zones through the basement using heating piping and pumps.
 - c. The steam distribution is original to the building and has exceeded its useful life. The steam system is controlled by one thermostat which controls the firing of the boiler. The individual radiators in the building are equipped with thermostatically adjustable air vents for control of the individual radiators.
 - d. The hot water heating system was installed in 1987, this system is at or near the end of its useful life, and should be replaced.
 - e. The following building plans show the areas heated by the steam and hot water systems.

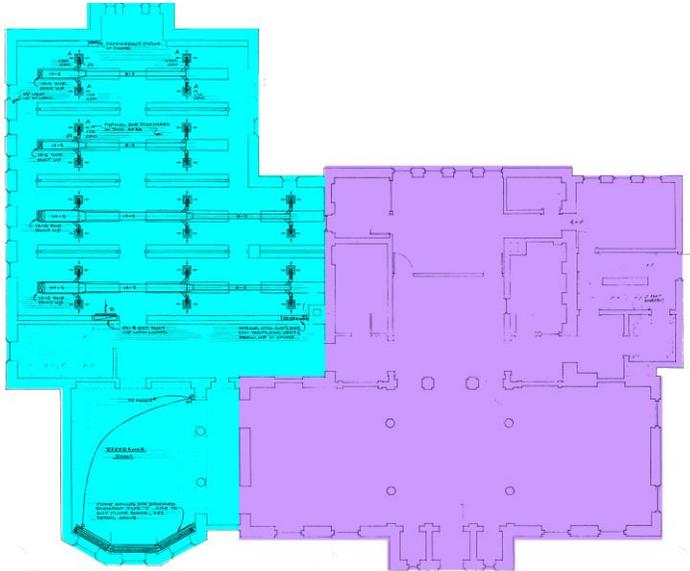
Legend



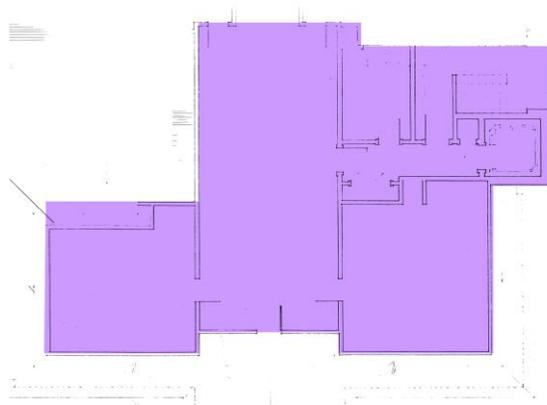
Basement



First and Second Floor



Third Floor



- f. The existing boiler is served by an underground oil tank, it appears that this tank was installed in 1987 and is located on the south east side of the building. There are no leak detection or spill containment systems installed for the tank and oil piping. We recommend that this tank be removed.
3. Cooling Systems:
- a. Under the 1987 project a 2.5 ton air handling unit with outdoor air cooled condensing unit was installed in the boiler room to serve the Meeting Room. No additional air conditioning systems were installed at this time.
 - b. Since the 1987 project, eight (8) additional ductless air conditioning systems with

approximately 20 tons of cooling capacity have been installed to provide cooling in the remainder of the building. These system consist of ductless wall mounted fan coils with individual exterior condensing units.

4. Ventilation Systems:

- a. With the exception of the Basement Meeting Room, the building does not have any mechanical ventilation systems, fresh air is supplied by windows. Toilet rooms are provided with mechanical exhaust fans.

III. SUMMARY OF DEFICIENCIES:

1. General:

- a. In general, the last major renovation that took place was in 1987, at which time an addition was constructed. The renovated areas and new areas of the building were provided with hot water heat served by a heat exchanger connected to the steam boiler, we believe this approach was taken in an effort to keep construction costs down and to improve controllability and comfort in the 1987 addition when compared to using steam heat. In 1997 a new steam boiler was installed. The original steam heating system piping and radiators in original building still remains in service and is connected the central steam boiler. The heating system have exceeded their expected useful life, and they offer very poor control temperatures in the building. In our opinion, these systems have exceeded their useful life and should be replaced.
- b. Although air conditioning was planned for the new additions under the 1987 project, the only area which was provided with air conditioning was the basement Meeting Room. In the years since the 1987 addition, nine (9) air conditioning units have been added to provide cooling to the remainder of the building, these systems have been done in a piecemeal approach, with smaller ductless air conditioning units installed around the building. The controls for these system are not integrated with the heating controls so the systems can run simultaneously with both heating and cooling operating at the same time.

2. Heating System Deficiencies:

- a. The existing steam boiler and heat exchanger has reached the end of its useful life and should be replaced.
- b. The original steam heating piping is still in operation and is nearly 100 years old and should be replaced.
- c. The existing oil tank is over thirty years old and should be replaced.
- d. The current control system for the building is in poor condition and does not allow for adequate automatic setback and control of the HVAC systems. It is also not integrated with the cooling systems so both heating and cooling can operate at the same time.

3. Ventilation System:

- a. The building does not have a mechanical ventilation system to provide adequate fresh air.

4. Air Conditioning Systems:

- a. The air conditioning systems in the building have been installed at various times. The

ductless cooling systems are over ten years old and are reaching the end of their useful life.

IV. RECOMMENDATIONS:

1. General Evaluation and Recommendations:
 - a. The building heating system is at the end of its useful life and should be replaced.
 - b. The air conditioning systems are nearing the end of their useful life and should be replaced.
 - c. In our opinion, the existing controls and systems are not adequate to comfortably and efficiently heat and cool the existing building and should be replaced.
2. HVAC System Replacement Options:
 - a. Option 1: Under this option we would recommend installing a Hyper Heat Heating and cooling system. With the latest technology, it is now possible to install a cold climate all-electric heat pump system which can provide heating and cooling using a refrigerant based system. These systems are capable of providing full heating capacity down to -25 deg. F and can serve the entire needs of the building without supplemental heat. These units include controls and compressors designed to provide guaranteed output at -25 deg. F.
 - b. Option 2: Under this option we would install standard heat pumps which would provide heat approximately 78% of their output at -13 deg. F and would therefore require a supplemental heating source to meet the peak heating demands. For a supplemental system we would recommend that the existing hot water heating system be retrofit with new heating pumps and controls, as well as replacement of the existing steam heating with a new zoned hot water system. The supplemental heating source could be fueled by a pellet or natural gas fired hot water boiler system. Based on the existing fuel usage we have estimated the peak heating load for the existing building to be approximately 300,000 BTUH or approximately 20 BTUH/SF.
 - c. Under either option we recommend installing a 2,000 CFM air to air heat recovery system to provide fresh air to the existing library.

V. ESTIMATED CONSTRUCTION COST ESTIMATE:

1. We have prepared the attached probable construction cost estimate for the project for each option. This estimate should be used as a planning tool, it is not intended to be a final construction cost estimate.
 - a. Option 1: **\$485,300**
 - b. Option 2: **\$918,610**
2. We have investigated the potential incentives from GMP and efficiency Vermont for this project. They have estimated the following incentives for this project:
 - a. GMP incentive for Option 1 only: \$6,000
 - b. Efficiency Vermont \$4,000

Total Estimated incentives: \$10,000

I would be happy to review the details of these findings with the building committee and to assist with future plans for the next steps at the Library.

In the meantime, please call if you have any questions, or need more information.

Respectfully,
Engineering Services of Vermont

A handwritten signature in black ink, appearing to read 'D. Dupras', with a long horizontal flourish extending to the right.

Daniel W. Dupras, P.E.
Mechanical Engineer, Principal

Item	Description	Units	Quantity	Material	Labor	Total
Option 1 HVAC System Estimate						
A	MECHANICAL					
1	Demolition					
	Remove Air Handling Unit	Ea	1	\$0.00	\$2,500.00	\$2,500.00
	Remove Existing Split AC Units	Ea	20	\$0.00	\$750.00	\$15,000.00
	Remove Condensing Units	Ea	21	\$0.00	\$750.00	\$15,750.00
	Remove Main Pumps	Ea	2	\$0.00	\$250.00	\$500.00
	Remove Oil Boiler	Ea	1	\$0.00	\$2,000.00	\$2,000.00
	Remove Oil Tank (Allowance)	Ea	1	\$0.00	\$15,000.00	\$15,000.00
	Subtotal Demolition					\$50,750.00
2	General Construction Work					
	Cutting and Patching	Ls	1	\$5,000.00	\$5,000.00	\$10,000.00
	Misc General Construction	Ls	1	\$10,000.00	\$5,000.00	\$15,000.00
	Subtotal General Construction Work					\$25,000.00
3	New Hyper Heat VRF Heat Pump					
	Refrigerant Piping	Ton	25	\$750.00	\$250.00	\$25,000.00
	Indoor Fan Coil Units	Ea	25	\$1,500.00	\$750.00	\$56,250.00
	Outdoor Heat Pumps	Tons	25	\$3,000.00	\$1,500.00	\$112,500.00
	VRF Controls	Sf	16,350	\$1.00	\$2.00	\$49,050.00
	New Hyper Heat VRF Heat Pump Sub Total					\$242,800.00
5	New Heat Recovery Unit					
	2000 CFM HRU	Ea	1	\$15,000.00	\$2,500.00	\$17,500.00
	Ductwork	Tons	5	\$3,000.00	\$1,500.00	\$22,500.00
	Heating Coil	Ls	1	\$1,000.00	\$500.00	\$1,500.00
	Controls	Ea	1	\$5,000.00	\$2,000.00	\$7,000.00
	New HRU Total					\$48,500.00
6	Electrical					
	Demo 21 Condensing Units	Ea	21	\$0.00	\$750.00	\$15,750.00
	Demo 21 AHU	Ea	21	\$0.00	\$500.00	\$10,500.00
	New Circuits to new fan coils	Ea	21	\$500.00	\$1,000.00	\$31,500.00
	New Circuits to Outdoor Heat Pumps	Ea	6	\$750.00	\$1,500.00	\$13,500.00
	Control Power	Ea	4	\$250.00	\$500.00	\$3,000.00
	Electrical Sub Total					\$74,250.00
	Sub Total Cost					\$441,300.00
	Recommended Contingency	10%				\$44,130.00
	Estimated Construction Cost					\$485,430.00
	Cost/SF					\$29.69

Option 2 HVAC System Estimate						
A	MECHANICAL					
1	Demolition					
	Remove Air Handling Unit	Ea	1	\$0.00	\$2,500.00	\$2,500.00
	Remove Existing Split AC Units	Ea	20	\$0.00	\$750.00	\$15,000.00
	Remove Condensing Units	Ea	21	\$0.00	\$750.00	\$15,750.00
	Remove Main Pumps	Ea	2	\$0.00	\$250.00	\$500.00
	Remove Oil Boiler	Ea	1	\$0.00	\$2,000.00	\$2,000.00
	Remove Oil Tank (Allownace)	Ea	1	\$0.00	\$15,000.00	\$15,000.00
	Subtotal Demolition					\$50,750.00
2	General Construction Work					
	Cutting and Patching	Ls	1	\$5,000.00	\$5,000.00	\$10,000.00
	Misc General Construction	Ls	1	\$10,000.00	\$5,000.00	\$15,000.00
	Construct new Boiler Room	Ls	1	\$25,000.00	\$10,000.00	\$35,000.00
	Subtotal General Construction Work					\$60,000.00
3	Boiler and Heating System Piping Work					
	New Pellet Boiler (250 MBH)	Ea	1	\$100,000.00	\$50,000.00	\$150,000.00
	Pellet Silo (20 Ton)	Ea	1	\$20,000.00	\$10,000.00	\$30,000.00
	New Gas Boiler (200 MBH)	Ea	1	\$8,000.00	\$2,000.00	\$10,000.00
	New Piping Distribution and Pumps	Sf	16,350	\$4.00	\$3.00	\$114,450.00
	New Radiation Heating Units	Sf	16,350	\$2.00	\$1.00	\$49,050.00
	New Heating Controls	Sf	16,350	\$2.00	\$1.00	\$49,050.00
	Subtotal Boiler and Heating System Piping Work					\$402,550.00
4	New VRF Standard Heat Pump					
	Refrigerant Piping	Ton	25	\$750.00	\$250.00	\$25,000.00
	Indoor Fan Coil Units	Ea	25	\$1,500.00	\$750.00	\$56,250.00
	Outdoor Heat Pumps	Tons	25	\$2,000.00	\$750.00	\$68,750.00
	VRF Controls	Sf	16,350	\$1.00	\$2.00	\$49,050.00
	New VRF Standard Heat Pump Sub Total					\$199,050.00
5	New Heat Recovery Unit					
	2000 CFM HRU	Ea	1	\$15,000.00	\$2,500.00	\$17,500.00
	Ductwork	Tons	5	\$3,000.00	\$1,500.00	\$22,500.00
	Heating Coil	Ls	1	\$1,000.00	\$500.00	\$1,500.00
	Controls	Ea	1	\$5,000.00	\$2,000.00	\$7,000.00
	New HRU Total					\$48,500.00
6	Electrical					
	Demo 21 Condensing Units	Ea	21	\$0.00	\$750.00	\$15,750.00
	Demo 21 AHU	Ea	21	\$0.00	\$500.00	\$10,500.00
	New Circuits to new fan coils	Ea	21	\$500.00	\$1,000.00	\$31,500.00
	New Ciruits to Outdoor Heat Pumps	Ea	6	\$750.00	\$1,500.00	\$13,500.00
	Control Power	Ea	4	\$250.00	\$500.00	\$3,000.00
	Electrical Sub Total					\$74,250.00
	Sub Total Cost					\$835,100.00
	Recommended Contingency	10%				\$83,510.00
	Estimated Construction Cost					\$918,610.00
	Cost/SF					\$56.18