Preliminary Thesis Proposal

Project Background

The construction project of McKeesport Elementary/Intermediate School is a public school construction project on the site of demolished Cornell Elementary School at McKeesport, PA. The project has two stories above ground with a clearstory level.

The building structure is almost symmetric with the central core and two wings housing the elementary school and the intermediate school separately. The construction started in February 2013 and is planning to be completed by January 2014. Completion date is one of the owner's major concerns since the owner, McKeesport School District, would like to have the project completed and up for running starting the spring school semester in 2014.

Another key feature of this project is LEED implementation. The project is aiming for a USGBC LEED Gold Certificate by completion. There are a lot of LEED features incorporated in the design. Part of the exterior walls is curtain wall to improve day lighting. Grey water capture system will be installed to collect and recycle rainwater for use in toilets. Geothermal system will be utilized in addition to the hot water boilers to support the heating system. Two small-scale pole mounted wind turbines will be installed to the northeast corner of the building for educational usage.

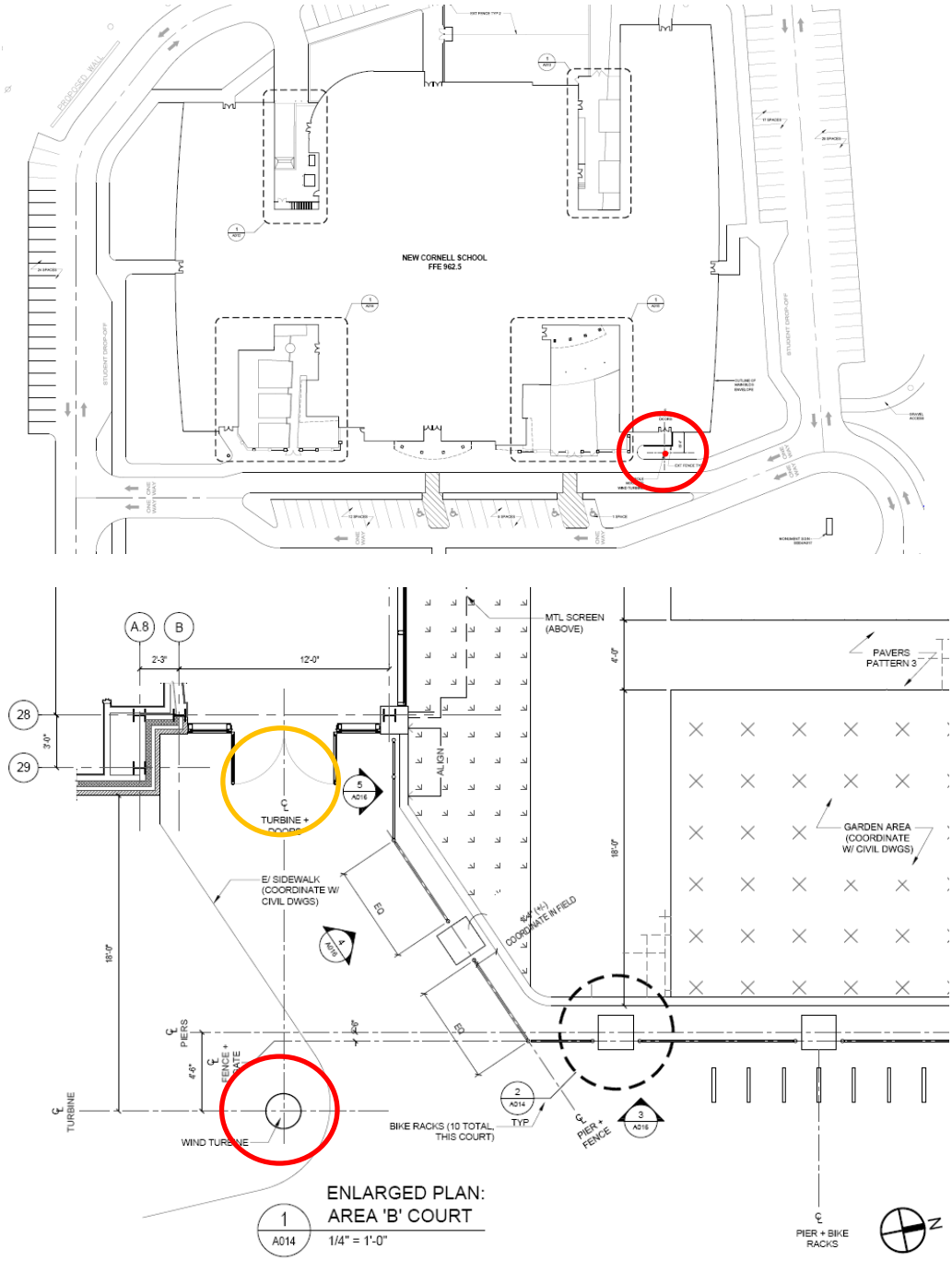
Other than project schedule, cost is also one of the owner's major concerns. There have been several implementation of value engineering.

Problem Identification and Technical Analysis

There have been several value engineering design change as studied in technical report 3: the update of steel support on the clearstory level, the modification of rain water capture system over music room and the metal decking over library room towards the west corner of the core. To further improve the design for value engineering, a re-design of the roof is proposed to be studied.

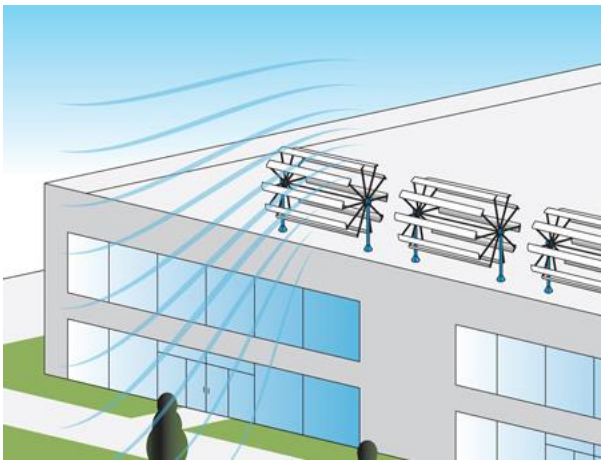
Current design of the roof system is that the core of the building is one story tall with grey water capture system on the roof; while two wings of the building have two stories above ground and a clearstory level above that. Majority of the roof is composed of insulation on structure decking with some sloped standing metal roofing system. The possibility of installing rooftop wind turbine on the north wing roof on top of the elementary school wing will be analyzed. One of the owner's goals for this project is to build a science education center for the school district in addition to build the school

facilities. The installation of rooftop wind turbines would help to fulfill owner's goals. Rooftop turbine units can be used for educational purpose and energy production purpose as well. As stated in building background section, there will be two small-scale pole mounted wind turbines installed to the northeast corner of the building as noted in red on the following graphs. Power produced by the turbines will be directed into a turbine room marked in orange. Energy generated from the rooftop wind turbine can also be directed into the turbine room.



Existing design of the electrical system have two power distributions of 208/120V. The possibility of having an additional electric distribution panel there should be analyzed. With the rooftop turbine units and the pole mounted wind turbine, power consumption of the building will decrease and thus reduce the building operation cost in long run. A life cycle cost analysis of the updated system compared to the original design will be done. The risk of possible higher equipment maintenance cost should also be analyzed. The possibility of changing of the distribution system into 480V will also be studied for cost effectiveness consideration.

Installation of the rooftop wind turbines will not influence the performance of grey water capture system. Instead, it will help the school to self-generate energy, thus reducing the building operation cost with relatively low initial cost. Possible models of rooftop wind turbines are shown below.



Based on the existing design, the gray water capture system is located on top of the core instead of the two wings. The update of roof design on top of the two wings will thus not affect the rainwater collection system.

With the installation of rooftop wind turbines, roof framing need to studied to see if an update is necessary. In current design, roof framing is comprised of structural steel columns and beams in-filled

with open-web steel joists. Due to the additional weight from rooftop wind turbine units, the structure of the roof systems might need to be updated.

As noted, LEED implementation is one of the key features of the construction project of McKeesport Elementary/Intermediate School. The project is aiming for a LEED Gold Certificate beyond completion. Incorporating self-generated wind energy would help to improve the "Energy and Atmosphere" category in the LEED System, reflected as usage of renewable energy. The opportunity of using two pole mounted wind turbines as one of the sources of energy should be studied in addition to the rooftop wind turbines since the pole-mounted turbines are already in the current design. A different model of wind turbine might be studied and chosen.

Since completion date is one of owner's major concerns, the impact on construction schedule due to the proposing updates should be studied. The current construction schedule may also be analyzed and re-planed since there are a good amount of activities on there right now are "finish-start". Possible schedule acceleration techniques might be studied. Based on the material and the manufacturer, changing over from metal deck roofing to installation of rooftop wind turbine units may accelerate or delay the schedule.

Conclusion

Based on the analysis above, the possible improvements include:

1. Rooftop wind turbines
2. Roof framing system (Structural Breadth)
3. Electrical distribution for renewable energy (Electrical Breadth)
4. Pole-mounted wind turbines
5. Construction schedule

Among those analyses, the leading options for spring proposal are analysis of rooftop wind turbines, roof framing system, electrical distribution for renewable energy, and wind turbines. The two possible breadth options would be the structural analysis of the roof framing system and the electrical analysis of the electrical distribution system.