Bush Elementary School Case Study
Mary Levengood
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Design Concept

The concept for the proposed design of Bush Elementary is to provide improvements that improve student and teacher health and performance while simultaneously improving the community and environment. The design will also aim to support the school district mission statement which reads the following: “In partnership with students, parents, staff and community, our Essexville-Hampton District Mission is to create a collaborative environment that encourages every learner to reach his or her unique potential. We strive for academic excellence and promote student development through the arts, athletics, and various co-curricular activities to foster a culture of discovery and achievement.” Design elements that are introduced are reinforced by research conducted on what building elements are beneficial for effective learning environments.
Bush Elementary School is located in Essexville, Michigan at the south eastern corner of Nebobish Avenue and Ledyard Road with the main entrance on Nebobish. Since the school is located in bay county it is considered in climate zone 5 according to ASHRAE which will be used to calculate the standards for the R-value of the walls and roof. As depicted in the photo the school is surrounded by residential homes and is used by the community for various events, after school programs, and daycare.
(1) Geothermal power sources were added to the design as a source of renewable energy to reduce pollution. The mechanical room will also have a transparent viewing for children to gain knowledge of alternative energy sources.

(2) An exterior sunshade device helps reduce the intensity of the sun, which utilizes daylight more effectively. The shading device also reduces the solar heat gain to reduce cooling requirements.

(3) Added insulation to increase R-value of exterior walls. This addition helps ensure better thermal comfort for building occupants and saves on heating and cooling loads.

(4) A greenhouse was added to previously unused space to provide a natural learning environment for students that fosters a greater connection with the natural environment. The area also features a place for large groups of students to collaborate together and created better views for the adjacent classrooms.

(5) A double pane insulated window increases the window's solar heat gain coefficient (SHGC), which transmits less solar heat through the glass creating a more consistent indoor air temperature.
Zone 2 Proposed Dimensioned Floor Plan
1/16" = 1'-0"
Lighting Power Density: Based on ASHRAE* 90.1-2010

668 sq. ft * 1.30 LPD = 868 max. watts

668 sq. ft * 0.093 = 62.124 sq. m
62.124 sq. m * 300 lx = 18,637.20 lumens

18,637.20 lumens / 5,000 lumens per fixture = 4 light fixtures

4 fixtures * 61 watts = 244 watts
244 watts/868 watts = 30% energy reduction

Ventilation Rates: Based on ASHRAE* 62.1-2010

668 sq. ft / 20 sq. ft per occupant = 33 people
33 people * 10 CFM per person = 330 min CFM circulation

668 sq. ft * 1.7 CFM = 1,135.6 CFM
1,135.6 CFM / 350 CFM per diffuser = 2 SA and 2 RA

**The proposed 30% increase in ventilation compared to baseline is in compliance with LEED V4

330 CFM * 1.3 = 420 CFM circulation
1,135.6 CFM * 1.3 = 1,476.28 CFM
1,476.28 CFM / 350 CFM per diffuser = 3 SA and 3 RA

*ASHRAE: American Society of Heating, Air-conditioning, and Refrigeration Engineers
A greenhouse was added to previously unused space to provide a natural learning environment for students that fosters a greater connection with the natural environment. The area also features a place for large groups of students to collaborate together and created better views for the adjacent classrooms.

Added insulation to increase R-value of exterior walls. This addition helps ensure better thermal comfort for building occupants and saves on heating and cooling loads (see A5.1 for details).

A double pane insulated window increases the window’s solar heat gain coefficient (SHGC), which transmits less solar heat through the glass creating a more consistent indoor air temperature.

An exterior sunshade device helps reduce the intensity of the sun, which utilizes daylight more effectively. The shading device also reduces the solar heat gain to reduce cooling requirements.
An extensive vegetated roof uses small native plants that require little to no maintenance and improve the building's roof insulation. A vegetated roof also reduces the heat island effect in urban areas due to hardscapes and nonreflective materials.

A greenhouse was added to previously unused space to provide a natural learning environment for students that fosters a greater connection with the natural environment. The area also features a place for large groups of students to collaborate together and created better views for the adjacent classrooms. Operable windows are added for increased ventilation.

A double-pane insulated window increases the window's solar heat gain coefficient (SHGC), which transmits less solar heat through the glass creating a more consistent indoor air temperature.

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Existing Exterior Wall R-Value

Exterior air layer = 0.17 R
Face brick = 0.44 R
Inside air Layer = 0.68 R
Sand and gravel aggregate = 1.1 R
⅝" Gypsum board = 0.56 R

Total existing R-value = 2.95 R

Proposed Exterior Wall R-Value

Existing wall R-value = 2.95 R
2" Rigid insulation = 8 R
⅝" Gypsum board = 0.56 R

Total proposed R-value = 11.51 R

Increased insulation performance by 26%

Sustainable Strategies

1. Added insulation to increase R-value of exterior walls. This addition helps ensure better thermal comfort for building occupants and saves on heating and cooling loads.

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4. An extensive vegetated roof uses small native plants that require little to no maintenance and improve the building’s roof insulation. A vegetated roof also reduces the heat island effect in urban areas due to hardscapes and nonreflective materials.