Building Performance "What Ifs"

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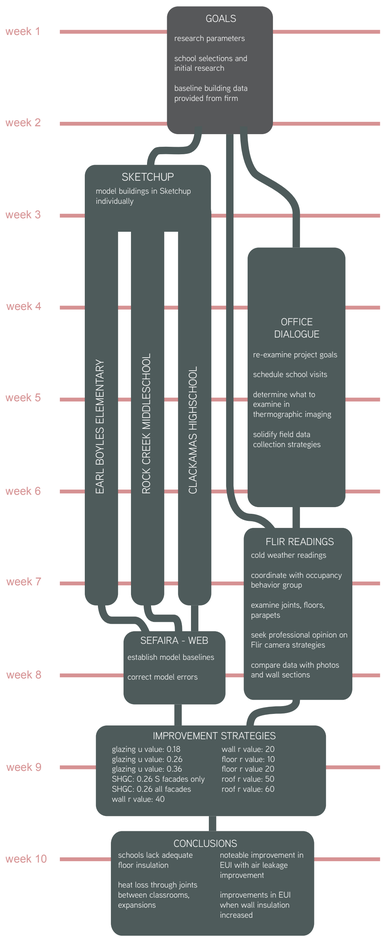
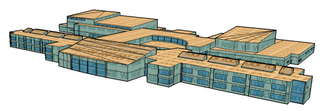
The "Building Performance What Ifs" project collaborated with Boora Architects to analyze the envelope design performance for three schools in the Portland area. The three selected schools, North Clackamas High School, Rock Creek Middle School, and the Early Learning Center addition to Earl Boyles Elementary School serve as examples of evolving knowledge and strategies in envelope performace design in recent years.

Methodology and Timeline

The research consisted of taking thermographic image readings of the building envelope. Data was collected over two separate field visits to each school during times of cold outdoor temperatures in late November and early December. In addition to this, the three schools were modeled and brought into Sefaira to analyse strategies for improved envelope performance. The thermographic images were used to help identify areas where the envelope is underperforming.

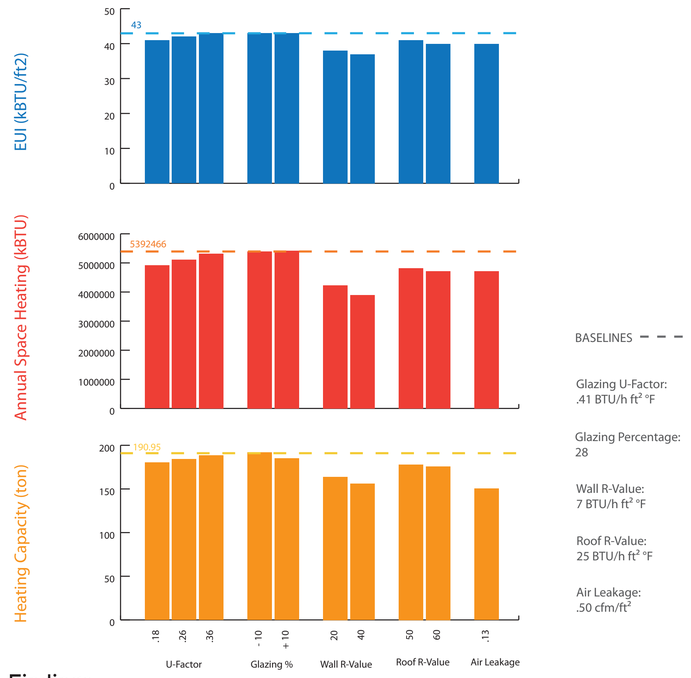




North Clackamas High School

Location: 14486 SE 122nd Ave, Clackamas OR
Year of Completion: 2002
Square Footage: 275,000 sqft
Occupancy: 2,213

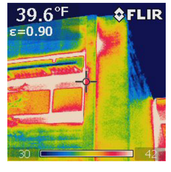
Sefaira Strategies



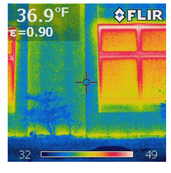
Findings

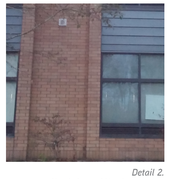
Thermographic imaging found obvious heat loss through Clackamas High School's exposed floor slab. Through Sefaira, improving the building's air leakage strategy had the biggest effect on the overall performance. Increasing the roof to 60 had a significant impact. Increasing the r-value of wall glazing by a percentage change of ten had a marginal impact on energy use due to overall square footage.

Thermographic readings

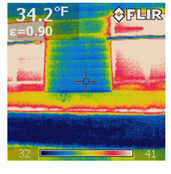


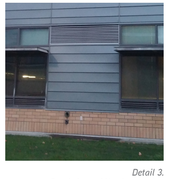
Detail 1. Southeast corner of Northeast wing



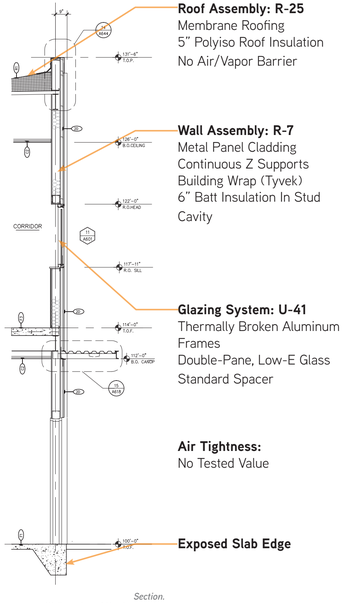


Detail 2. North face of Northeast wing





Detail 3. South face of Northeast wing



Section. Wall section of Northeast wing

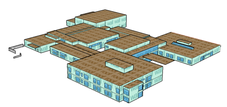
Roof Assembly: R-25
Membrane Roofing
5" Polyiso Roof Insulation
No Air/Vapor Barrier

Wall Assembly: R-7
Metal Panel Cladding
Continuous Z Supports
Building Wrap (Tyvek)
6" Batt Insulation In Stud Cavity

Glazing System: U-41
Thermally Broken Aluminum Frames
Double-Pane, Low-E Glass
Standard Spacer

Air Tightness:
No Tested Value

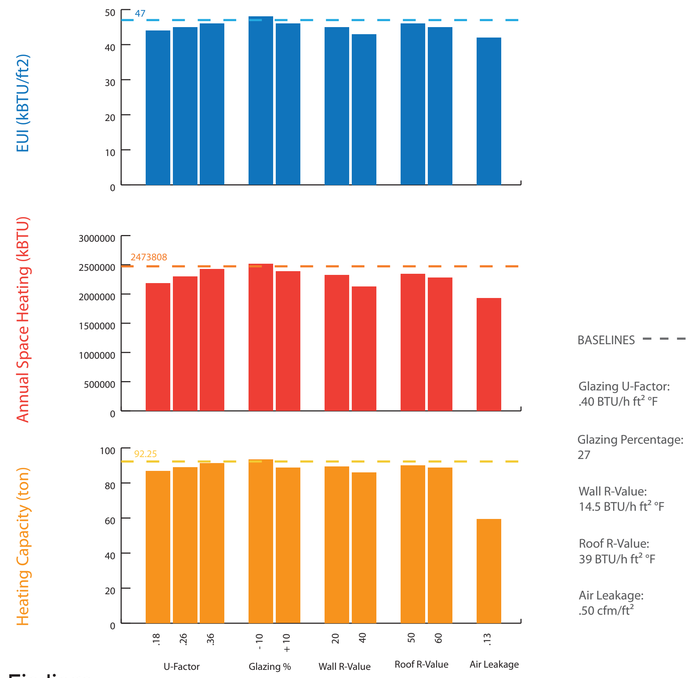
Exposed Slab Edge



Rock Creek Middle School

Location: 14897 SE Parklane Dr, Happy Valley, OR
Year of Completion: 2010
Square Footage: 129,000 sqft
Occupancy: 750

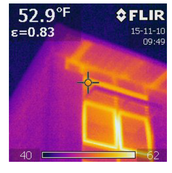
Sefaira Strategies

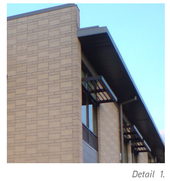


Findings

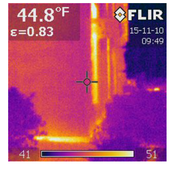
For Rock Creek Middle School, significant loss through the exposed slab edge could be seen in the thermographic imaging. The thermographic imaging findings were consistent with predictions made from baseline data. Strategies in air leakage as well as wall R value showed the most significant changes in Sefaira

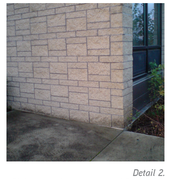
Thermographic readings



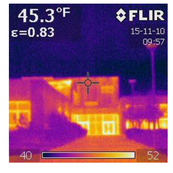


Detail 1. Roof overhang, Southwest corner of South wing

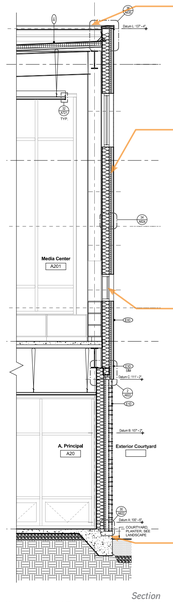




Detail 2. Slab on southwest corner of South slab



Detail 3. Thermal bridging in studs on North face of Media Center



Section Wall section of East facade of courtyard

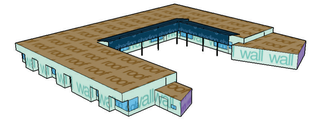
Roof Assembly: R-38
Membrane Roofing
3" Polyiso Roof Insulation
Polyethylene Vapor Barrier
Batt Insulation Below Deck

Wall Assembly: R-16
Metal Panel Cladding
Continuous Z Supports
1-1/2" Extruded Polystyrene Insulation
Building Wrap (Tyvek)
6" Batt Insulation In Stud Cavity

Glazing System: U-30
Thermally Broken Aluminum Frames
Double-Pane, Low-E Glass
Standard Spacer

Air Tightness:
No Tested Value

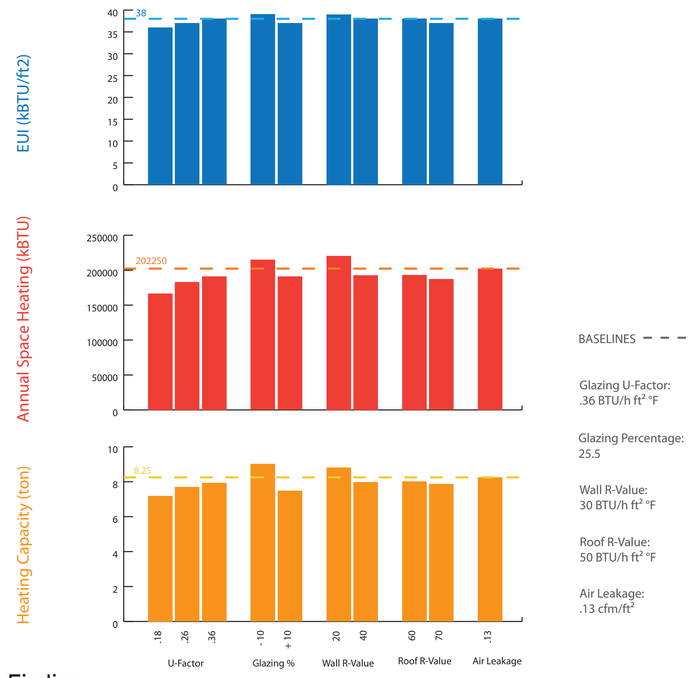
Exposed Slab Edge



Earl Boyles Elementary School

Location: 10822 SE Bush St, Portland, OR
Year of Completion: 2014
Square Footage: 15,000 addition
Occupancy: 188

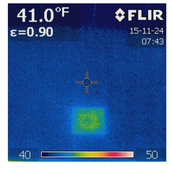
Sefaira Strategies

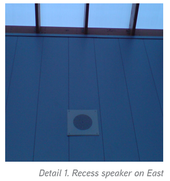


Findings

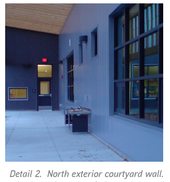
Because the envelope is well designed, Sefaira iterations were less telling in Earl Boyles; however, the thermographic imaging revealed a thermal bridge in the slab that was not forseen.
Using a higher performance glazing would actually have a significiant impact on the school's annual space heating. This is because the rest of the envelope is so tight.

Thermographic readings

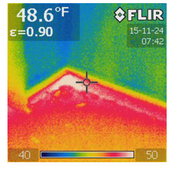




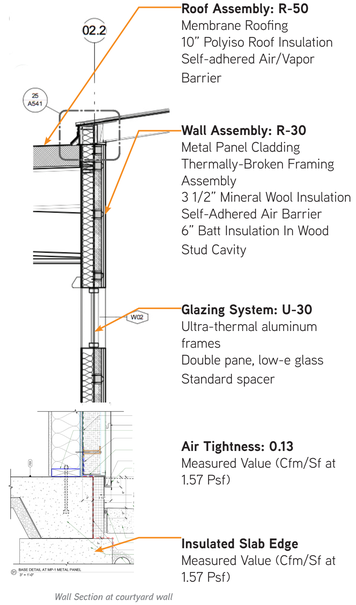
Detail 1. Recess speaker on East Cexterior courtyard wall



Detail 2. North exterior courtyard wall. Leakage through windows, door, and concrete slab



Detail 3. Slab of corner of North exterior courtyard wall



Wall Section at courtyard wall

Roof Assembly: R-50
Membrane Roofing
10" Polyiso Roof Insulation
Self-adhered Air/Vapor Barrier

Wall Assembly: R-30
Metal Panel Cladding
Thermally-Broken Framing Assembly
3 1/2" Mineral Wool Insulation
Self-Adhered Air Barrier
6" Batt Insulation In Wood Stud Cavity

Glazing System: U-30
Ultra-thermal aluminum frames
Double pane, low-e glass
Standard spacer

Air Tightness: 0.13
Measured Value (Cfm/Sf at 1.57 Psf)

Insulated Slab Edge
Measured Value (Cfm/Sf at 1.57 Psf)