

# RESEARCH

## Existing Building Systems

### Building Envelope

-Envelope consists primarily of solid brick masonry and glazing

-Insulation is minimal, as there is only one inch of rigid insulation on the roof and no insulation in the walls

-Upstairs windows were replaced in the 90s and are double-glazed; all other windows in the shelter are single-pane

	Area (ft <sup>2</sup> )	Current type	R-value (ft <sup>2</sup> ·°F·hr / Btu)
Roof	5,670	1" rigid r 5 per inch	5.60
Window 1	1,674	Double-pane	1.82
Window 2	842	Single-pane	0.91
Door 1	60	Main entrance (single-pane glass)	2.00
Door 2	23	Metal Insulating (2in w/ urethane)	15.00
Exterior walls, net	5,866	12" brick	4.85
<b>Total</b>	<b>14,134</b>		<b>3.45</b>

### Plumbing

-Water closets operate at 3.5 gallons per flush--over double current plumbing standards

-Urinals meet code at 1.0 gallons per flush, but more efficient systems are available on the market and are reasonably easy to implement

-Showers have unreliable water pressure and no personal temperature controls



### Electrical System

-Electrical system was sized to meet the needs of college students in the 1960s and lacks the ability to handle modern load requirements

-Past retrofits have increased the number of available outlets, but tripping circuits has become more frequent

-Members of the fraternity may be ignorant of their personal contributions to energy consumption

Item	Duration (hrs)	KWH	Avg Power (Watts)	Annual Cost (\$)
Personal Space Heater	125	47.77	382.16	363.84
K Fridge	888	253	284.91	271.25
Ice Machine	41.15	11.65	283.11	269.54
DR Fridge	2	0.32	160.00	152.33
PC	165	20.98	127.15	121.06
LR TV	164	16.29	99.33	94.57
Beverage Dispenser	287	25.64	89.34	85.05
Printer	43.53333333	2.54	58.35	55.55
K Freezer	112	6.43	57.41	54.66
Microwave	174	6.69	38.45	36.60
Dryer	166	4.29	25.84	24.60
LCD TV	130	3.18	24.46	23.29
Cow	112	2.64	23.57	22.44
Washer	72.58333333	1.54	21.22	20.20
LCD Monitor	213	2.63	12.35	11.76
Toaster	174	1.45	8.33	7.93
External HD	7.466666667	0.02	2.68	2.55

### Mechanical Systems

-Radiant fin tubing lines the perimeter of the first and second floors; many of the fins are no longer effective, and the system has no working control system aside from being turned on or off

-There is no insulation on the boiler or the pipes supplying the radiant heating system

-Boiler currently operates at only 80% efficiency

-The exhaust fan in the center of the building is no longer fully effective and often has problems functioning

-There is no active cooling system, and the building's layout is not conducive to effective cross ventilation or other passive strategies

## Proposed Solutions

### Building Envelope

-Permanently seal all dysfunctional operable windows on the first floor until replacement

-Replace all windows with more thermally resistant choices when enough funds are available

-Replace the existing roof in order to improve thermal resistance and to repair ponding and minor leaks that the shelter currently experiences

### Plumbing

-Installation of dual-flush toilets would reduce water consumption by more than 50%

-Replace urinals with water-less varieties, which use zero water and require easy, routine maintenance

-Replace shower supply with adjustable temperature in order to comply with current expectations among students in dorm-living situations

### Electrical System

-A presentation outlining power use may help raise awareness and educate members as to their impact



### Mechanical Systems

-Radiant floor retrofit has the potential to decrease wasted energy currently due to objects blocking the radiant fin tubes

-Solar thermal panels could occupy the unused space on the roof in order to supplement the boiler; payback is estimated at 25 years

-An energy monitoring system could record specific energy use data of all systems in order to help track how energy use is being distributed day-by-day

Description	Initial cost (\$)	Savings (therms/yr)	Unit price (\$/therm) (\$/kWh)	Savings (\$/yr)	Simple payback (yr)	Lifetime (yr)	SIR
Insulate heating water and DHW pipes	800	1875.0	1.1	2062.5	0.4	25	64.5
Air-seal, insulate roof to R-38	8,030	2259.0	1.1	2484.9	3.2	30	9.3
Air-seal, insulate all exterior walls R-12	125,000	4041.0	1.1	4445.1	28.1	50	1.8
replacing 1st floor windows	60,000	1718.4	1.1	1890.2	31.7	30	0.9

	25%	50%
Estimated Cost	\$229,556.76	\$459,113.52
Post Incentive Cost	\$129,268.80	\$534.77
Avg. Monthly Savings	\$267.39	\$534.77
25 Year Savings	\$133,626.81	\$267,253.62
25 Year ROI	103.37%	100.65%
Break Even	24.47 years	24.90 years

## Implemented Solutions

Part of the IPRO team's budget was spent to implement easily accomplished solutions to some of the shelter's most pressing issues. Brothers spent the day insulating the boiler tank and pipes which supply the shelter's radiant heating system--and which, previously, were entirely uninsulated. Secondly, new weather stripping was applied to the first floor's operable windows to help reduce air infiltration. Lastly, the industrial refrigerators in the kitchen were cleaned in order to optimize performance and reduce energy use.

In addition to these improvements, a presentation was prepared and conducted by a member of the team to inform the fraternity members of ways to reduce their personal energy consumption. The presentation emphasized the direct monetary benefits of taking such actions and encouraged members to be conscious of their impact on the earth.



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