

Yearly savings comes to **36,130kWh**. The original fan energy value is based on the Energy Model built in Technical Assignment 2 (Wyczalkowski). Assuming \$0.08/kWh utility rate (Appendix H), annual cost savings amount to **\$2,890**.

14 COST ANALYSIS AND CONSTRUCTION BREADTH

14.1 FIRST COST ANALYSIS

All costs include area of future expansion.

DUCTWORK

With DOAS, the ductwork will be smaller because of reduced supply air. Appendix B shows detailed calculations and RS Means^k costs for all of the ductwork in the main section of the first floor. By extrapolating SF costs over the entire building, one can find total savings.

Table 14.1.1. Original vs Redesign Ductwork Costs¹

	Cost/SF	Total Cost	Savings
Original	\$0.56	\$26,042	
Redesign	\$0.23	\$10,426	\$15,615

¹Detailed Cost Breakdown in Appendix B

PIPING

Piping first costs will go up, because of the addition of chilled water pipes. Hot water pipes can be kept the same size as original, according to pressure drop tables^d. In addition, the redesign includes steel^k and PEX piping^L, where appropriate. With high copper prices, these alternatives provide additional cost savings to the owner.

Table 14.1.2. Original vs Redesign Piping Costs¹

	Hot Water Piping	Chilled Water Piping	Total Cost	Savings
Original	\$40,050	\$0	\$40,050	
Redesign	\$30,990	\$50,070	\$81,060	(\$41,010)

¹Detailed cost breakdown in Appendix C

RADIANT PANELS

Radiant panels are the most significant first cost for the mechanical system at \$13/SF^c and covering a large portion of the ceiling space. Cooling panels are concentrated along the perimeter of the building, as well as in the interior of the building, but in a smaller percentage of total ceiling space. As discussed in Section 11.2, heating panels overlap the cooling panels. These panels become 4-pipe and only add \$2/SF to cooling panel cost^h. The following table shows total prices for heating and cooling panels.

Table 14.1.4. Radiant panel cost

	Total Area (SF) ¹	Cost/SF	Price	Total Cost
Cooling Panels	17,615	\$13	\$228,990	
Heating Panels	6,316	\$2	\$12,630	(\$241,620)

¹See Section 11 for calculation

CHILLER SIZE

As discussed in Section 12, chiller size can be reduced because of the enthalpy wheel. Total chiller reduction is 5.9 tons. Every ton in chiller size reduction reduces first cost by \$1,000^c.

Savings = Size reduction * \$1000 = 5.9*1000 = **\$5,900**

MISCELLANEOUS

Table 14.1.3. Mechanical Equipment Cost Comparison

	AHU	Enthalpy Wheel	Diffusers ¹	Fan Terminal Units ¹	Total	Savings
Original	\$105,000 ^e	\$0	\$5,873	\$52,450	\$163,323	
Redesign	\$20,000 ^f	\$10,600 ^k	\$7,342	\$7,570	\$45,512	\$117,811

¹See Calculation Appendix for calculations

FINAL FIRST COST

Total cost for the entire original mechanical system totals \$1,394,511 (Appendix I). As seen in the figure below, first cost will increase with the DOAS system because of the large cost of radiant panels. The table below shows difference in total price and per SF.

Table 14.1.5. Total First Cost Comparison

	Total Mechanical Cost	Cost/SF	Redesign Savings	Savings/SF
Original	\$1,394,511	\$27.56		
Redesign	\$1,537,814	\$30.40	(\$143,303)	(\$2.83)

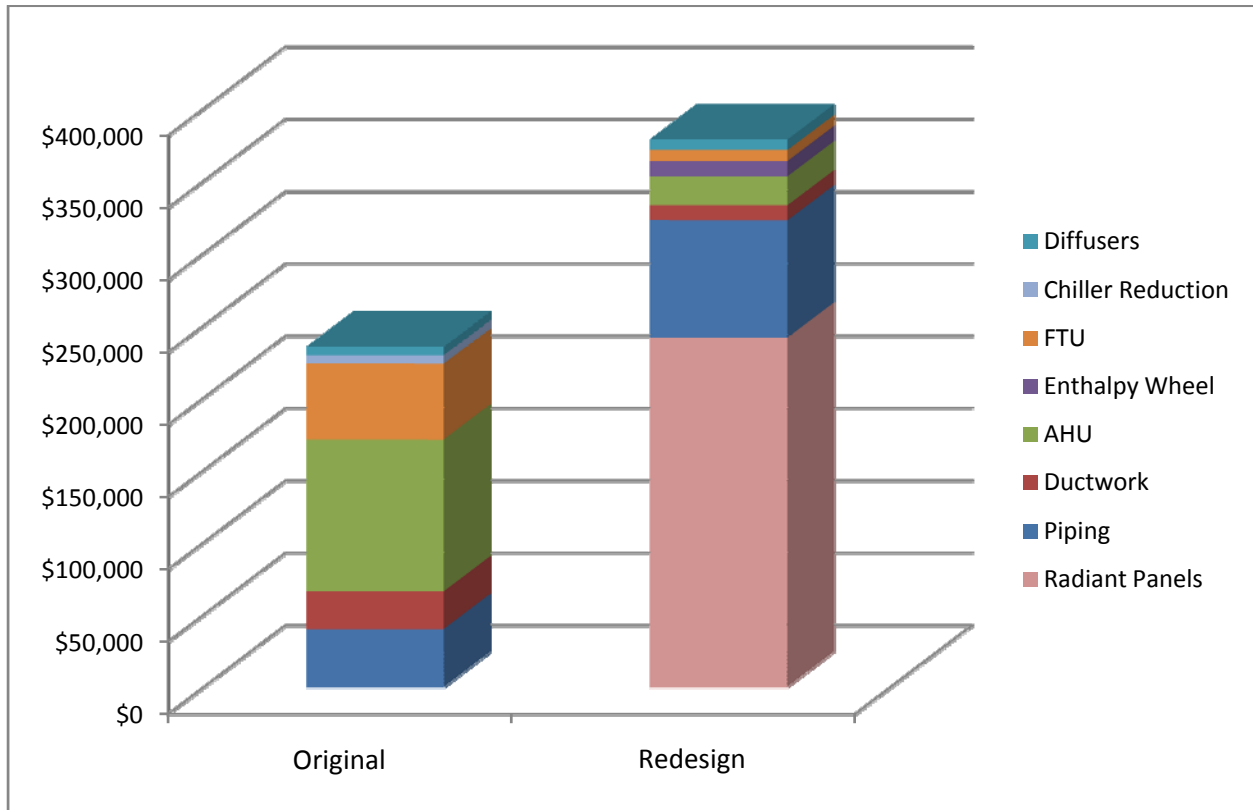


Figure 14.1.1. Mechanical First Costs

14.2 YEARLY SAVINGS AND PAYBACK PERIOD

Although the first cost of the mechanical system will increase with the redesign, yearly energy consumption has been reduced. This comes from two different sources. Ventilation load is reduced from the enthalpy wheel (Table 13.1.1) and fan power is also reduced due to less supply air (Section 13.2). The following table shows yearly energy savings and payback period assuming a \$0.08/kWh utility rate (Appendix H).

Ventilation	Fan Energy	Total Savings	Cost Savings	First Cost	Payback
15,100 kWh	36,130 kWh	51,230 kWh	\$4,100	\$143,303	35.0 years

CONSTRUCTION PHASING

A 35 year payback period is fairly high. However, current construction is scheduled to only finish 67% of the office spaces. The rest of the space will remain unfinished until McKinstry expands, or the space is leased to tenants. When considering this, much of the first cost savings will still be fully present, such as the AHU and Chiller reduction. However, some of the cost deficits such as piping and especially radiant ceiling panels will decrease by 33%. The following table shows first costs for all equipment with 67% office space completion.

Table 14.2.2. 67% Completion Costs

	Original	Redesign
Ductwork	\$17,448	\$6,985
Piping	\$26,833	\$54,310
AHU ¹	\$105,000	\$20,000
Enthalpy Wheel ¹	\$0	\$10,600
Diffusers	\$3,935	\$4,919
FTU	\$35,142	\$5,072
Radiant Panels	\$0	\$161,885
Chiller Reduction ¹	\$0	(\$5900)
TOTAL	\$188,358	\$257,872
Savings		(\$69,514)

¹Cost does not scale down

Even though first cost is still higher, initial added first cost has reduced by over 50% to \$69,514. Payback period will also reduce, however not proportionally with first cost because not all of the building is in use. ***It will reduce 33% because 1/3 of the building is not in use. Payback then reduces to 25 years.**

Payback = First Cost / yearly savings

Payback = \$69,514 / (\$4,100*0.67) = 25 years*