

For Mid Span 1 use: #4 @ 7 ½" = 0.31 in² or #5 @ 12" = 0.31 in²

For Int. Support use same as Ext Support

For Mid Span 2 use: #3 @ 5" = 0.26 in² or #4 @ 9" = 0.26 in²

Factor Shear @ d

$$V_U = (1.15)(210)(20)/2 - (210)(4.75/2) = 2,332 \text{ lb}$$

$$V_n = V_c = 2(f'c)^{0.5}(b)(d) = 2(3,500)^{0.5}(12)(4.75) = 6,744.33 \text{ lb}$$

$$\phi V_c = 0.75(6,744.33) = 4,721 \text{ lb} > V_U = 2,332 \text{ lb} \text{ GOOD}$$

For hand calculations of the roof slab see Appendix D

Conclusion:

Using the new upgraded area of steel will let the roof slab hold the load. The cost will increase but only slightly. This extra cost is found in the next section with the conclusion to all three analyses.

Conclusions

Each analysis has had its own individual conclusions stated in each section, but when combining the conclusions you can see that the project can save money with the new façade in order to add a green roof. The energy and cost savings can be minor, but every little bit helps. With these new materials the building is much more environmentally safe and the savings shown in **Table 5**, proves a green roof is feasible and the project still saves money.

I've also decided to add a **very rough estimate** of how much more it would cost to add the rebar. I used the existing building value of #4 @ 15", 0.668 lb/ft and compared it to the biggest difference in steel area from the hand calculations #5 @ 10", 1.043 lb/ft. Using these numbers over the area of the entire roof, with a length of 214.5' and width of 121.5' is not

completely accurate and will end up giving me a larger number difference than needed considering not every area needs #5 @ 10 in. Money is still saved by using the equations below to find the difference in steel weight to equal:

#4 @ 15", 0.668 lb/ft

$$(121.5')(12"/15") = 97.2 \text{ bars}, (97 \text{ bars})(214 \text{ ft})(0.668 \text{ lb/ft}) = 13,866.344 \text{ lb}$$

#5 @ 10", 1.043 lb/ft

$$(121.5')(12"/10") = 145.8 \text{ bars}, (146 \text{ bars})(214)(1.043 \text{ lb/ft}) = 32,587.492 \text{ lb}$$

Change in lb → 32, 587.492 lb - 1 3,866.344 lb = 18,721.148 lb

Using RS Means 2006 and a 1.03% year inflation to find price/lb of an elevated slab, #4 to #7 reinforcement = \$0.93/lb

$$(18,721.148 \text{ lb})(\$0.93/\text{lb}) = \$17,410.67 \text{ more than the original reinforcement}$$

Façade Costs					
	Quantity	Unit	Total Unit Cost	Total Cost	Money Saved
Precast (Existing)	23,663	sf	109.88	\$2,600,000.00	0
Versawall	23,663	sf	30	\$709,890.00	\$1,890,110.00
Dimension Series	23,663	sf	60	\$1,419,780.00	\$1,180,220.00

Table 5

By using either Dimension Series or Versawall, buying a green roof, and using extra reinforcement you can save:

Dimension Series:

$$\$2,600,000 - \$1,419,780 - \$441,220 - \$17,410.67 = \underline{\underline{\$721,589.33}}$$

Versawall:

$$\$2,600,000 - \$709,890 - \$441,220 - \$17,410.67 = \underline{\underline{\$1,431,479.33}}$$

This fact accompanied by the list of metal panel and green roof advantages below proves to be a good decision to be applied to this project.

- Tested Insulation Value – series panels have insulation U-Values, based on independent testing, which exceed baseline values prescribed in ASHRAE 90
- High Recycled Content – an average postconsumer recycled content of 16% to 19% and an average postindustrial recycled content of 6% to 7% for a total of 22% to 26%
- Low-Emitting Materials – sealant used in side joints have less than the limit of grams/liter established by the LEED Green Building Rating System
- Reduced Jobsite Scrap – panels are fabricated-to-length in the factor, meaning little or no jobsite scrap is generated
- Miscellaneous – the panels are available with a natural metallic surface and reflective coatings for high solar reflectance to potentially result in lower building cooling costs.
- Life Span – Panels require little maintenance and are extremely durable with a realistic service life of 20 years or more
- Faster Installation for metal panels
- Storm water runoff reduction
- Improvement of air quality
- Sound absorbing and insulating properties
- Increase life expectancy of rooftop waterproofing
- Reduce urban heat island effect
- Increase habitat for birds and butterflies
- Provide attractive views for other people
- Insulating a building reducing heating and cooling costs.

With the new designs of this building the façade looks may change, but saving up to about a quarter million to a million and a half dollars per change could be worth it. Using these new materials is not only cost effective, but they do reach the goals I set out to do, which is save money, time, and energy costs no matter how minor they are. So my recommendations are to use the CENTRIA Formawall Dimension Series and the green roof because of the money,

time, and energy saved. Also this type of building envelope material was recommended by other building envelop contractors such as Mr. Myers, from Harmon Inc., and Ben Marnyk, from CENTRIA, to closely resemble the precast look. Also returning some green to the surface area taken up by the building and the vast parking lot seems to be more environmentally sustainable. Using this new envelope material the building will not have to be scrubbed down repeatedly to match the color of each other, which took 4 days for Plaza East to do for the precast panels. The architectural precast used also had a fairly expensive aggregate to enhance its darker shade, this in turn made the value of these panels so costly. The perimeter girders will most likely be smaller saving on concrete and rebar. The crane picks can be lighter and less dangerous.

In the end the building will look different from the original design, but the project can still keep the architectural wall that looks to split the building in half. This wall was covered with flat precast panels which can easily be switched to the Dimension Series panels, leaving Plaza East's looks changed, but not completely.