



Pat Allen | Rachel Barrow | Alex Byard | Melanie Fonner | Brad Frederick | Brian LaChance | Mike Palmer

# mission

nexus

function

experience

community

education

conclusion

appendix



# nexus

Our mission is to develop a design that merges education with the community in a facility that is safe and cost effective while functioning as a learning tool.

# goals

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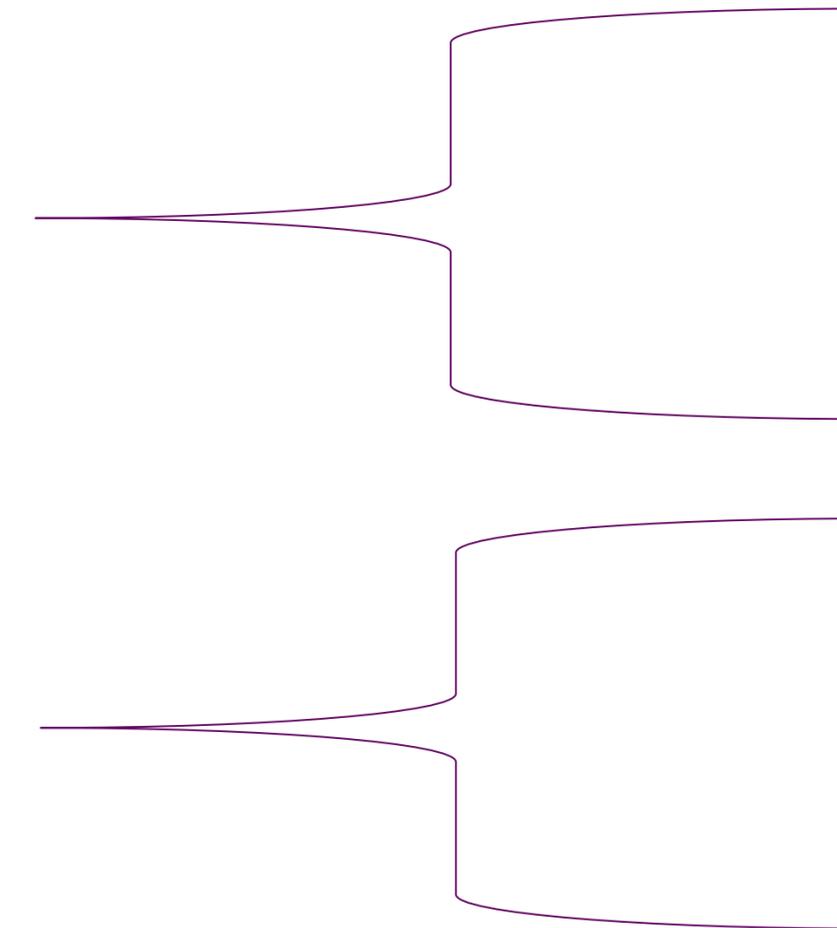
conclusion

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owner

nexus



safety & security



lifecycle & maintenance



cost effective



integration



reduce, recover, reuse



learning tool



# reading elementary school

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**function**

experience

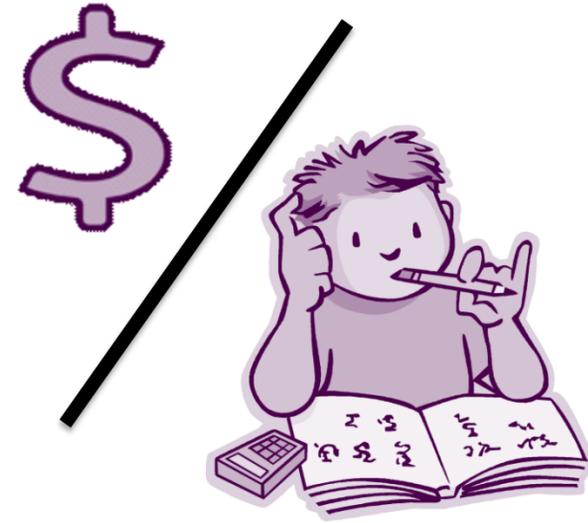
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**PA Average- \$14,535**

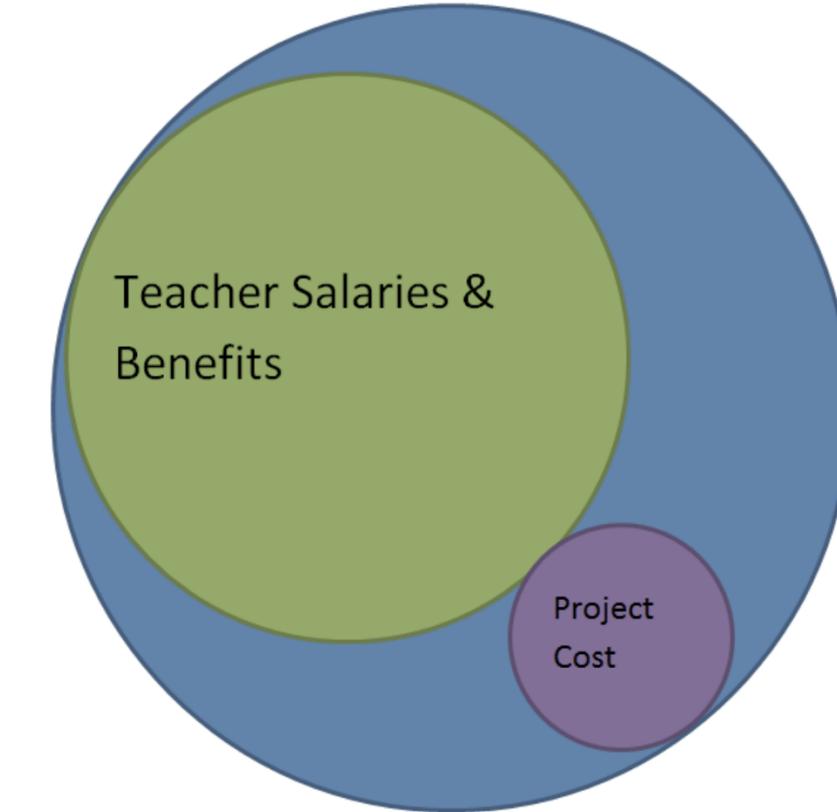
**Reading- \$12,989**

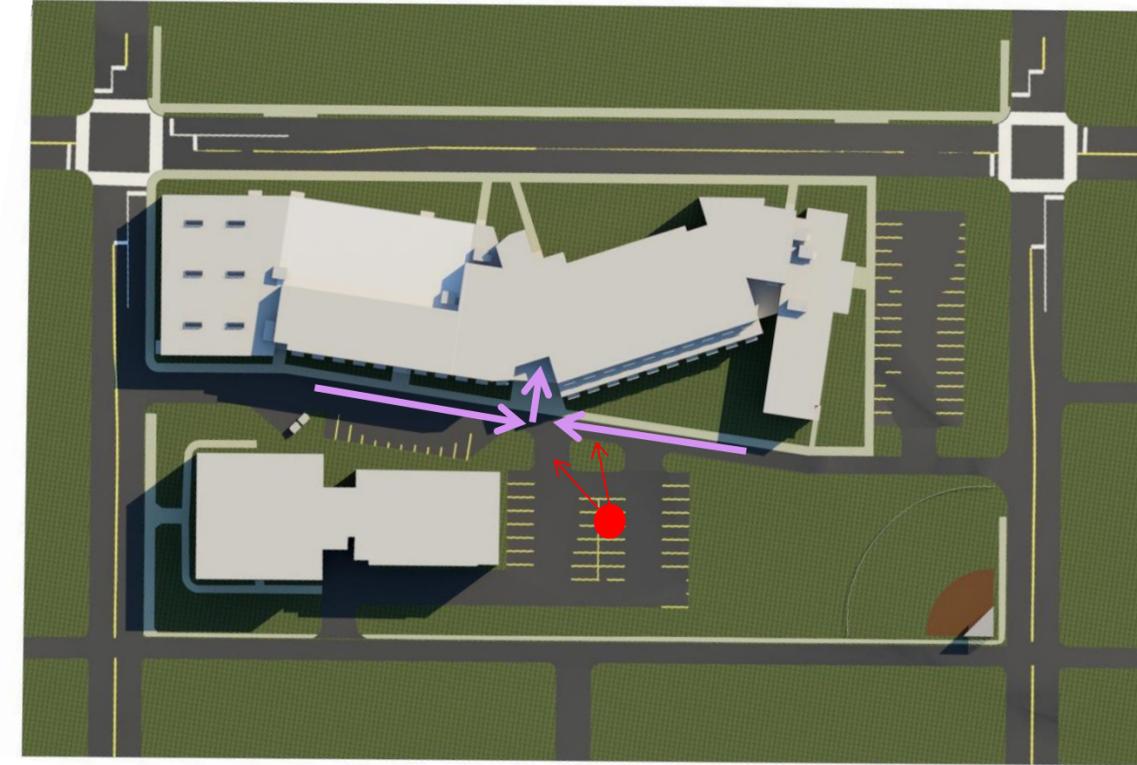
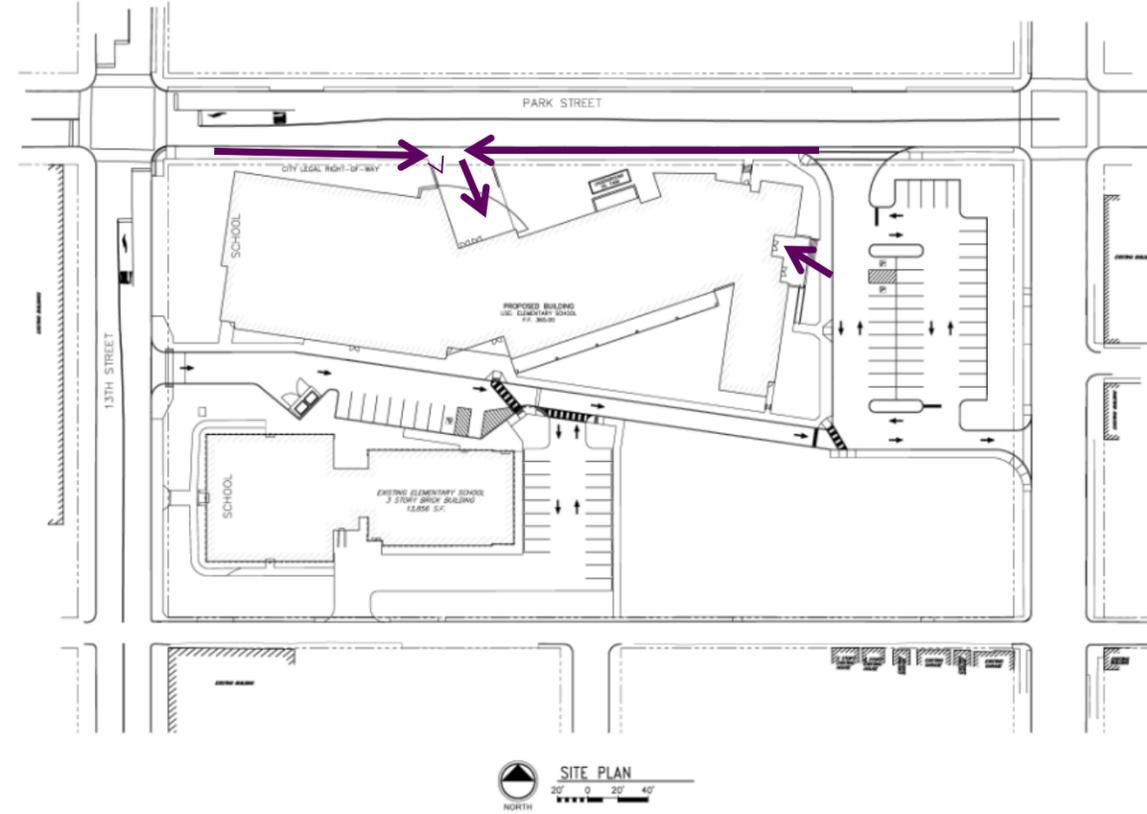
$$\$12,989 / \text{student} \times 1055 \text{ students} = \$13.7\text{MM}$$

$$\$13.7\text{MM} / 89,500 \text{ SF} = \$153 / \text{SF}$$

$$\$17.5\text{MM} / 89,500 \text{ SF} = \$195 / \text{SF}$$

Reading School District Budget





nexus

**function**

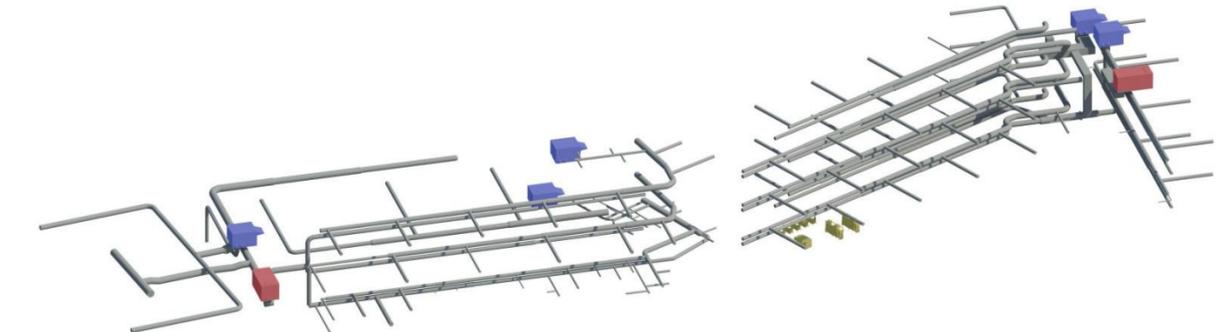
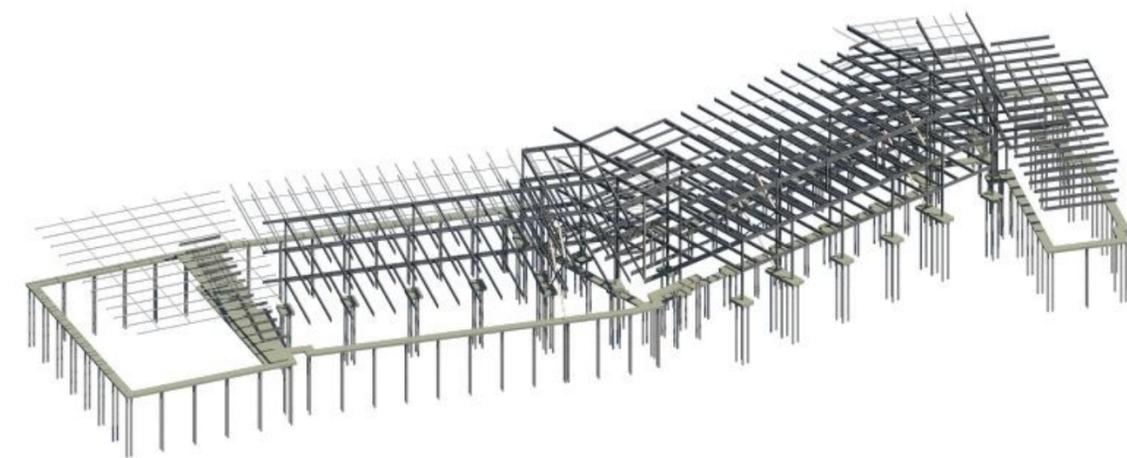
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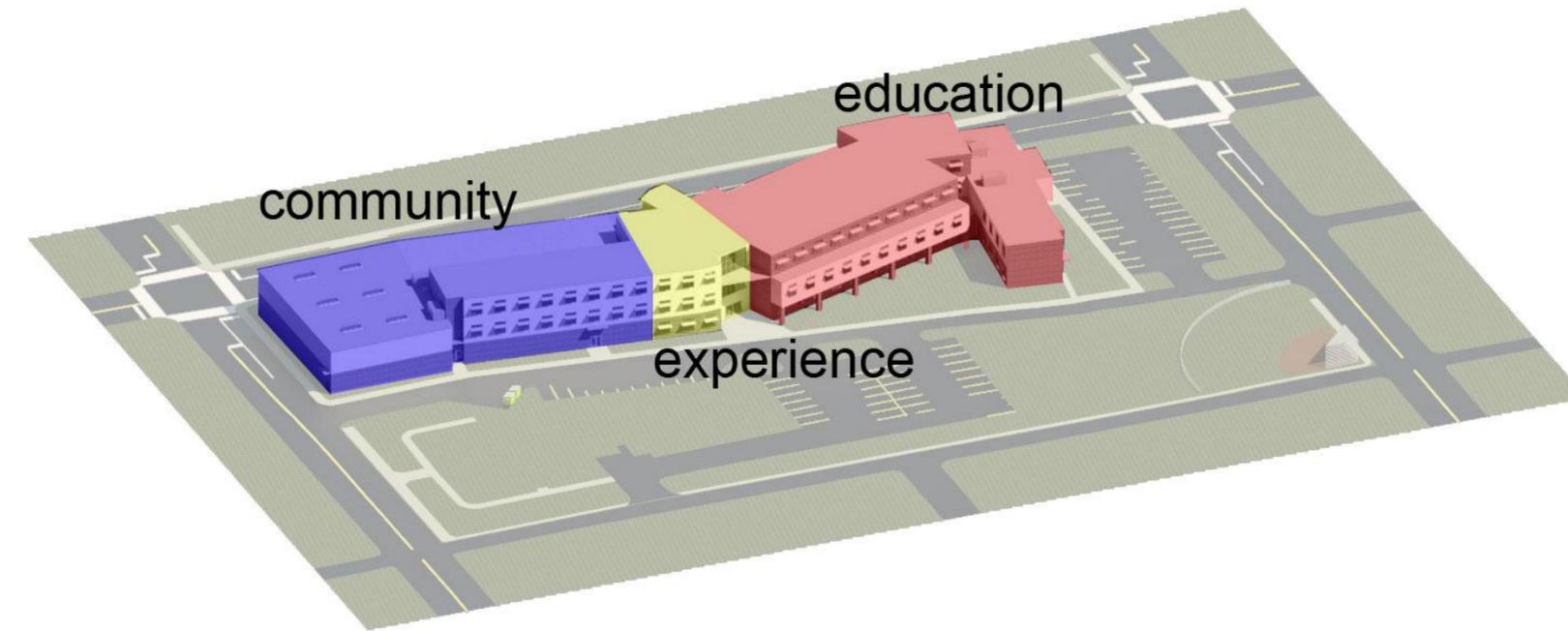
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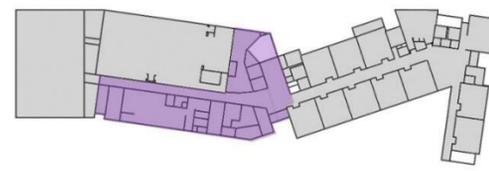
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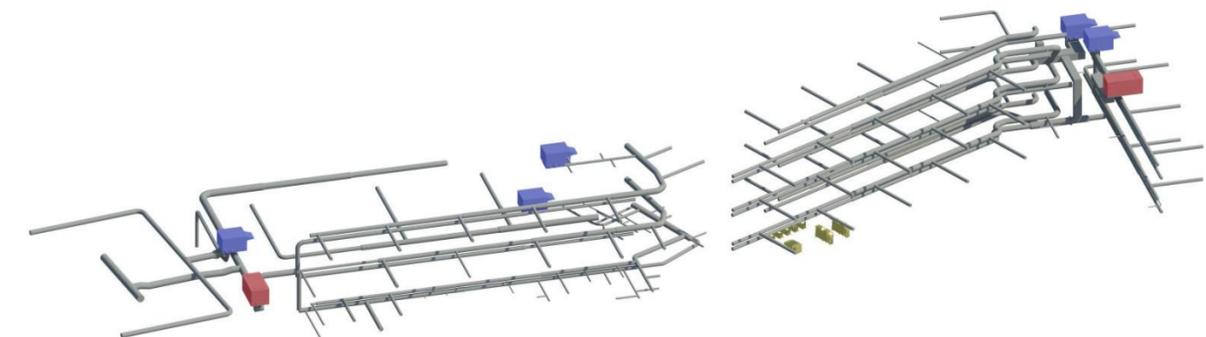
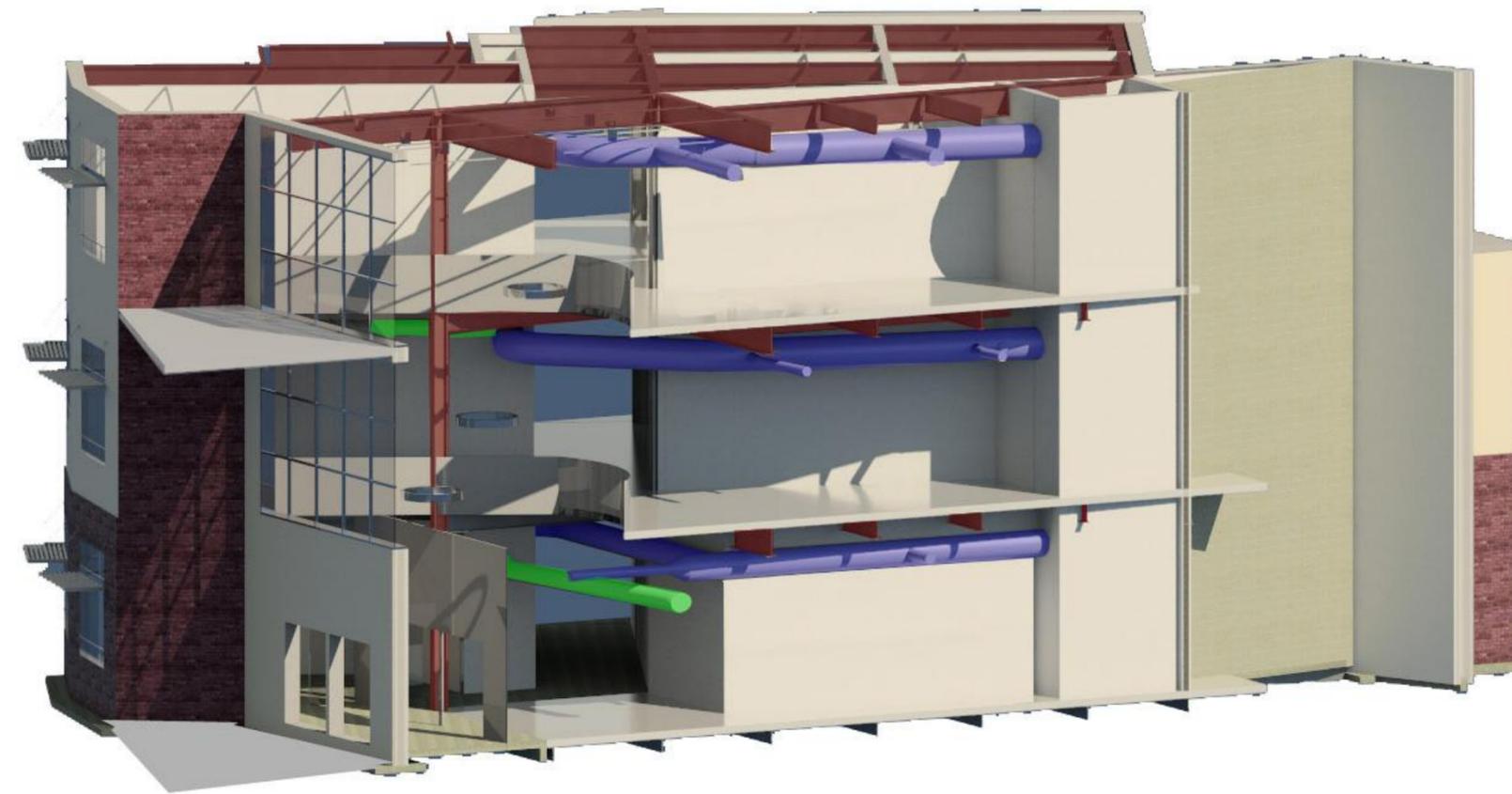
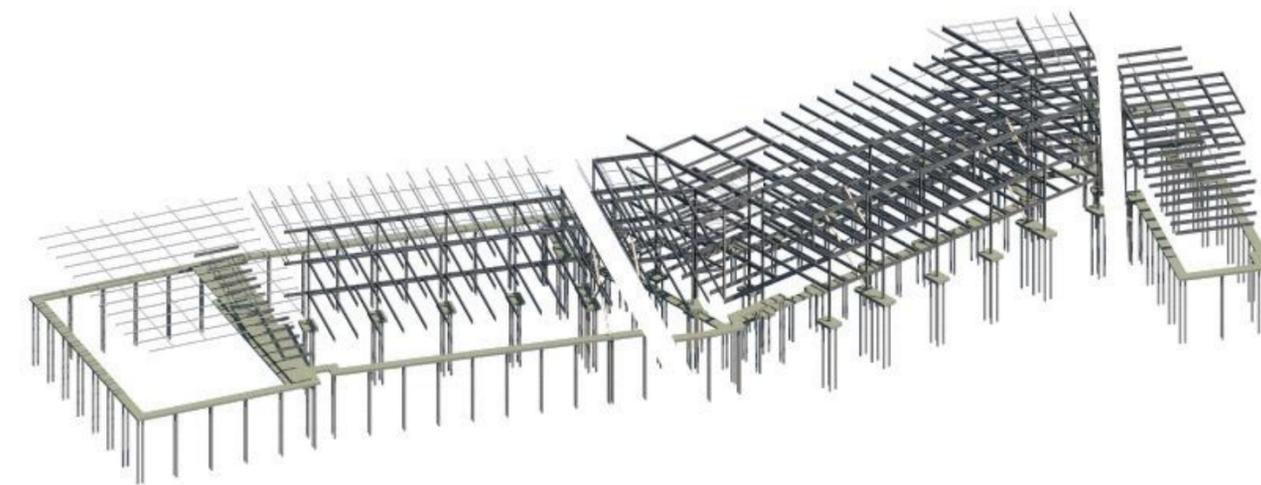
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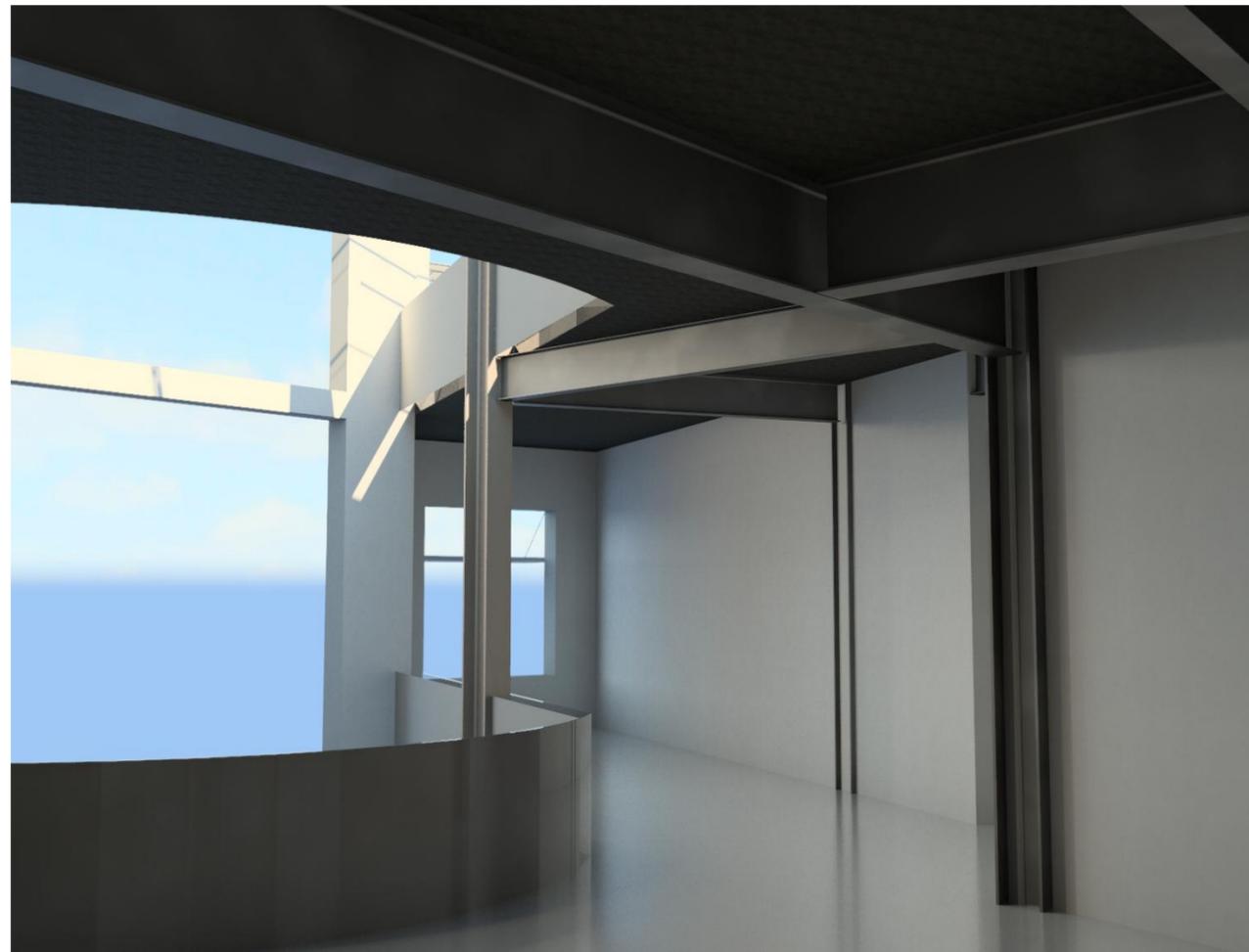
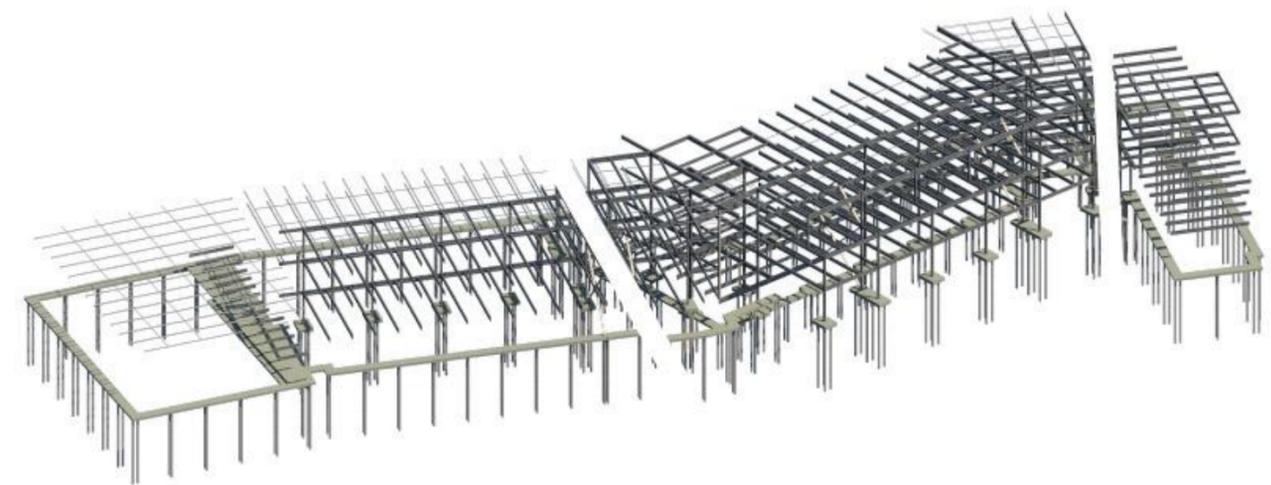
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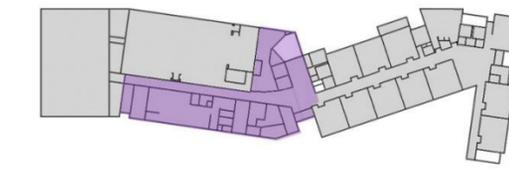
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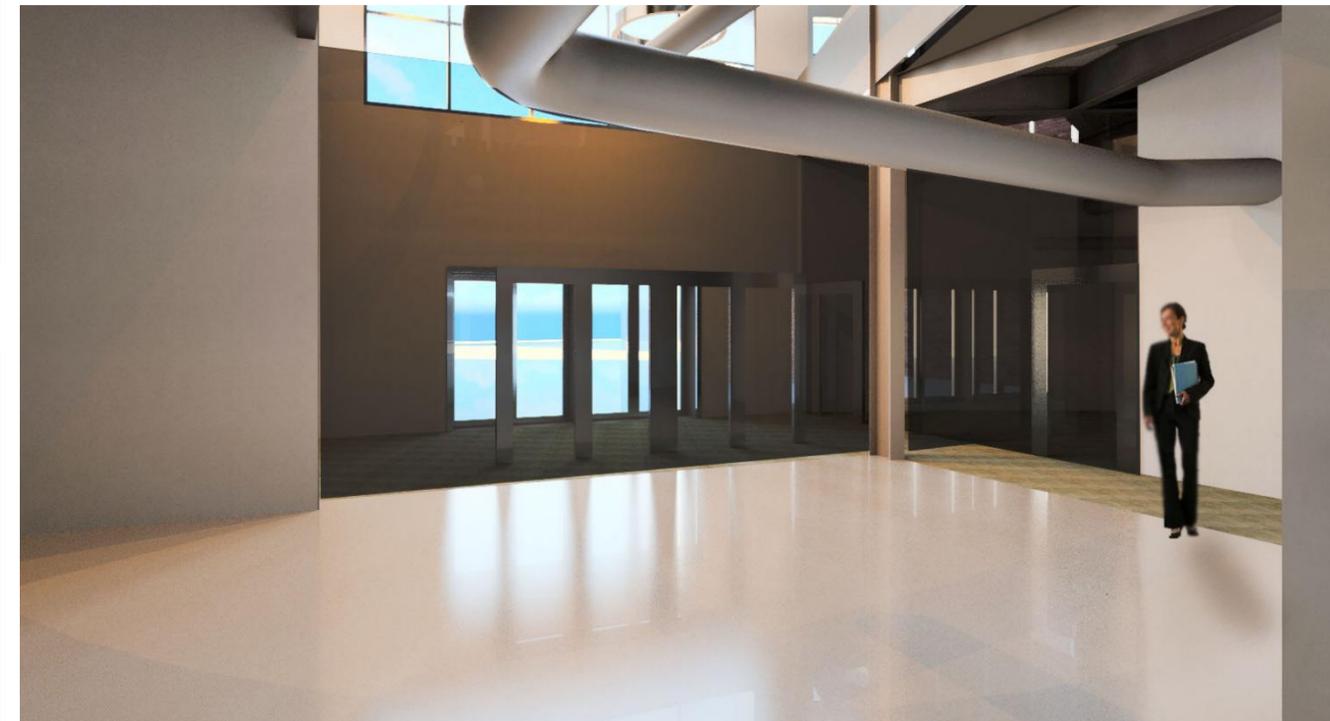
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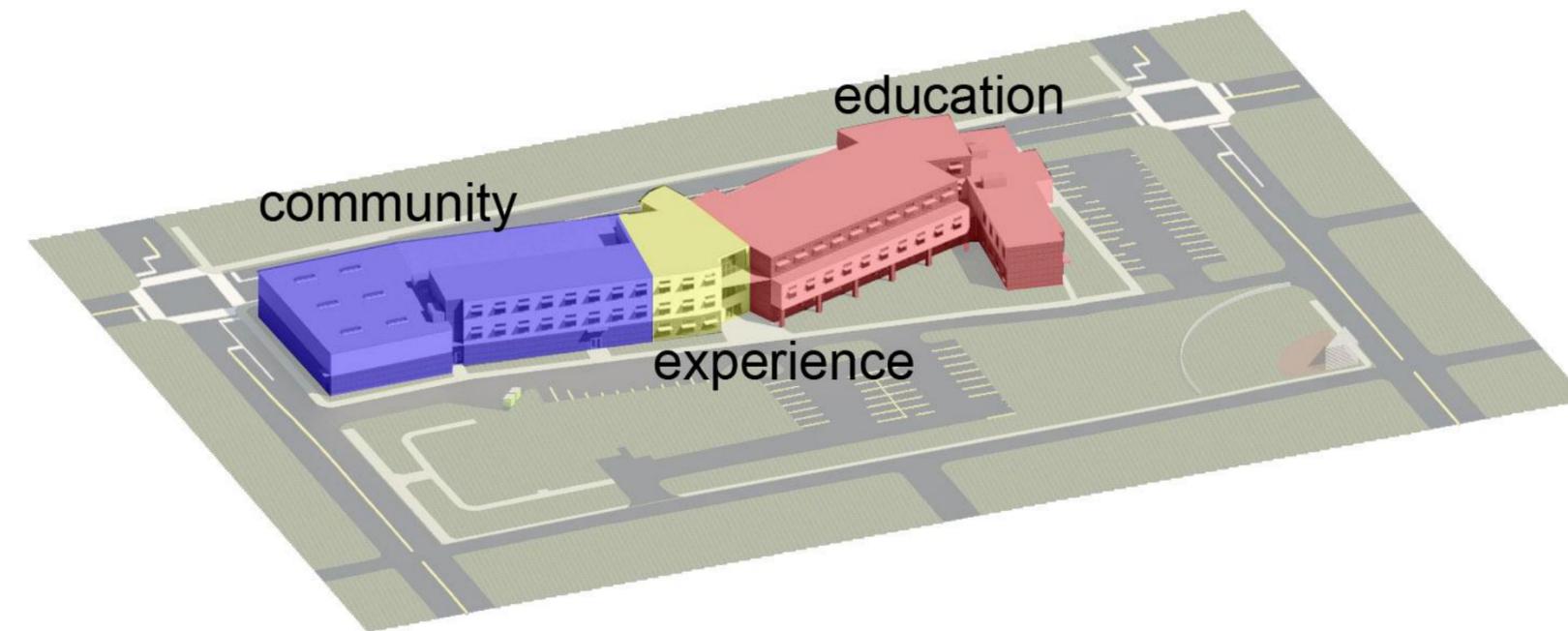
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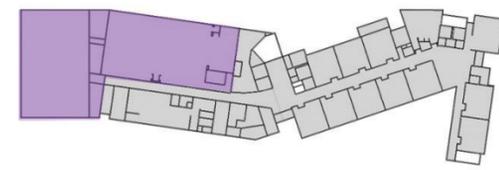
**community**

education

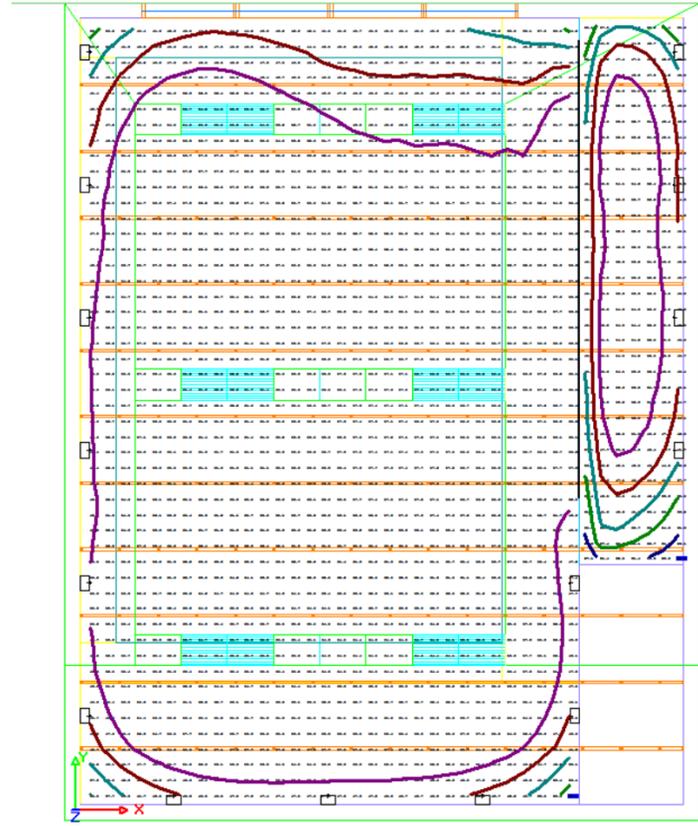
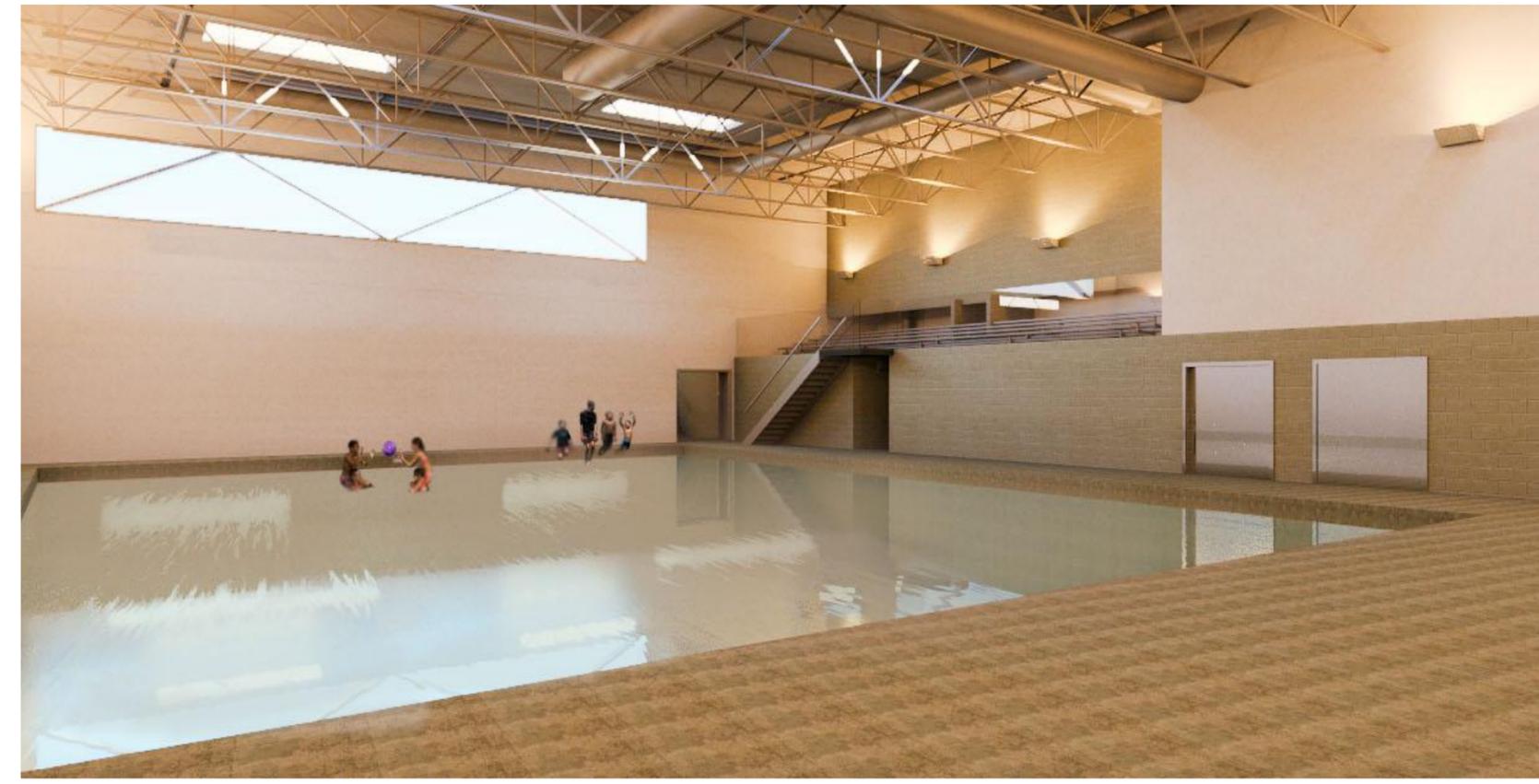
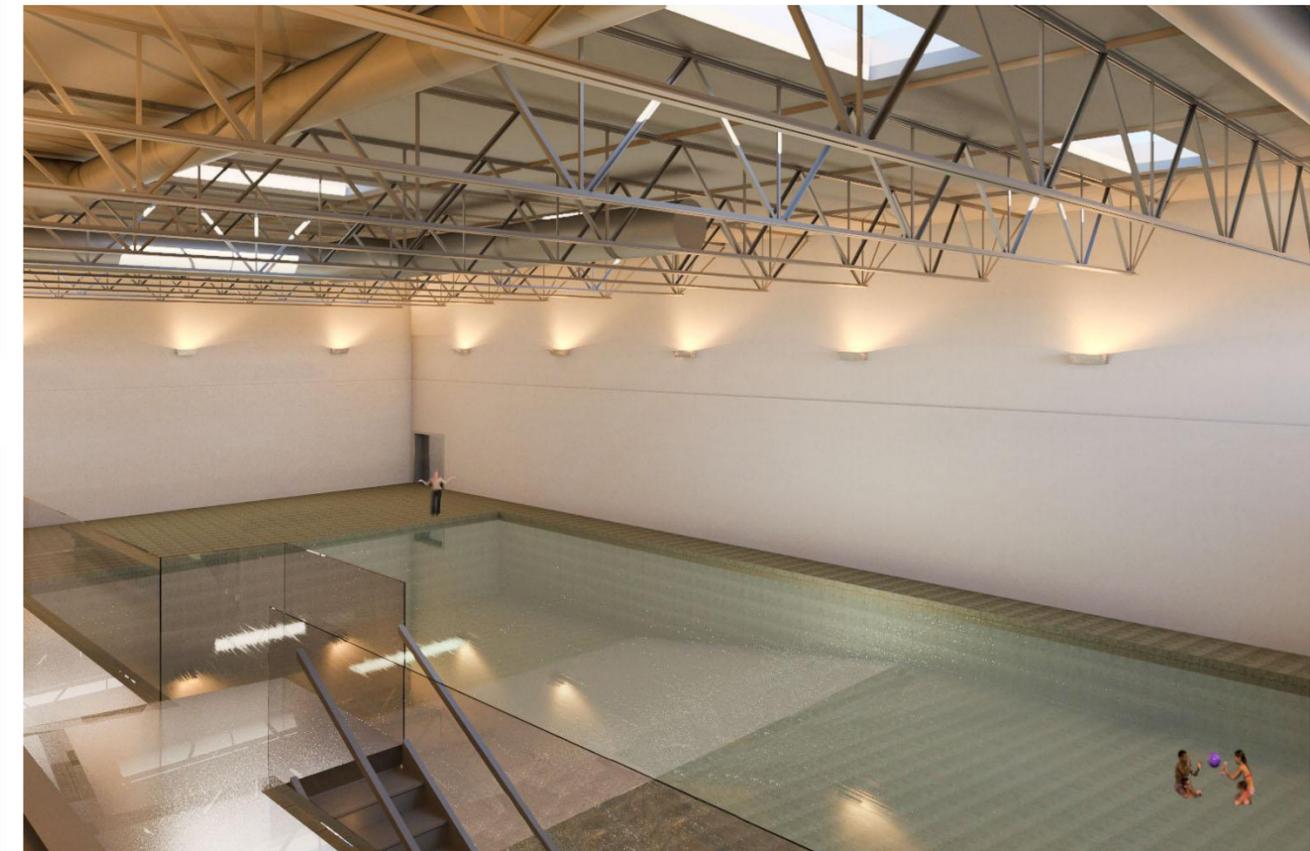
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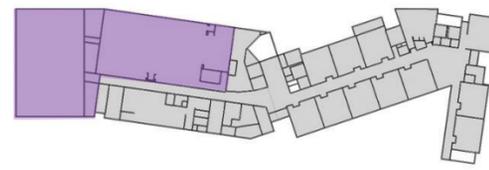




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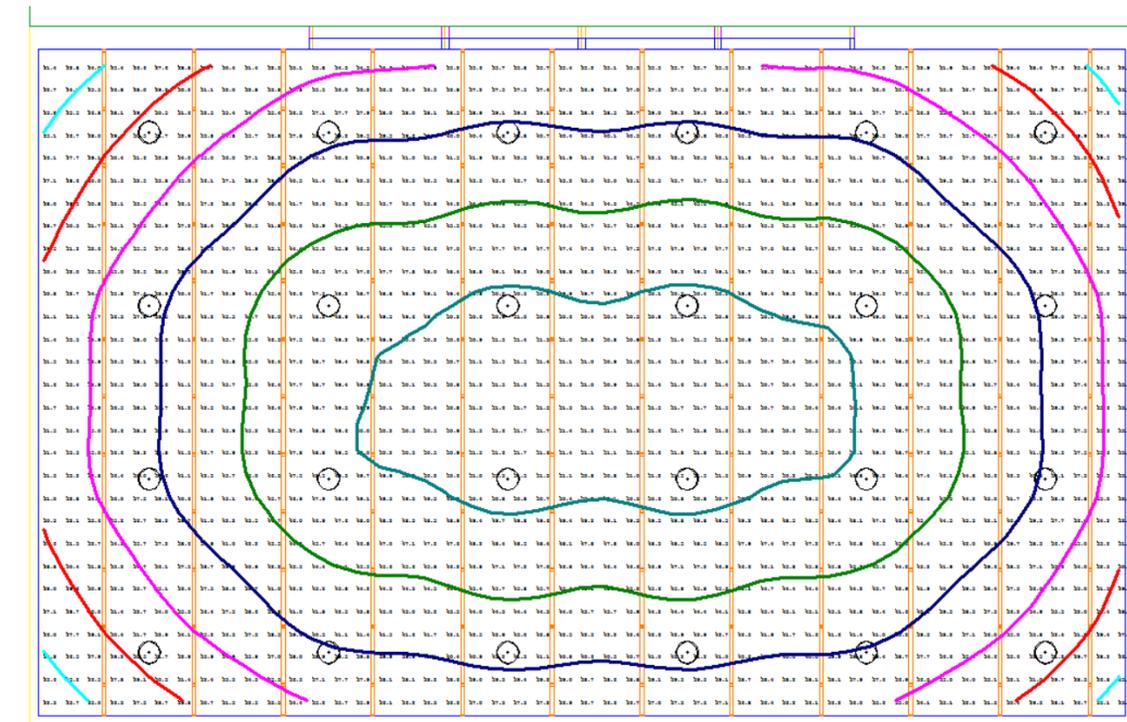
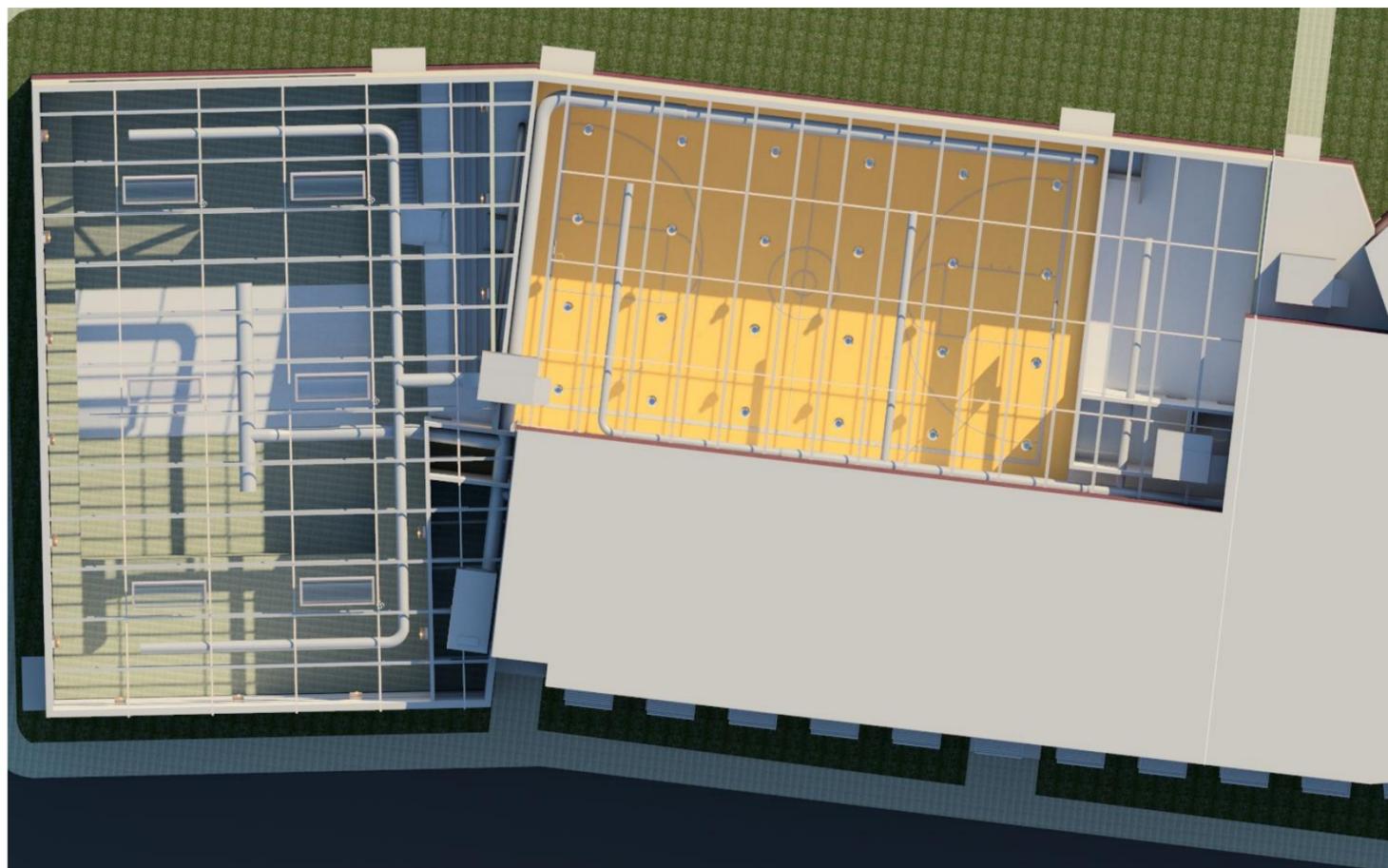
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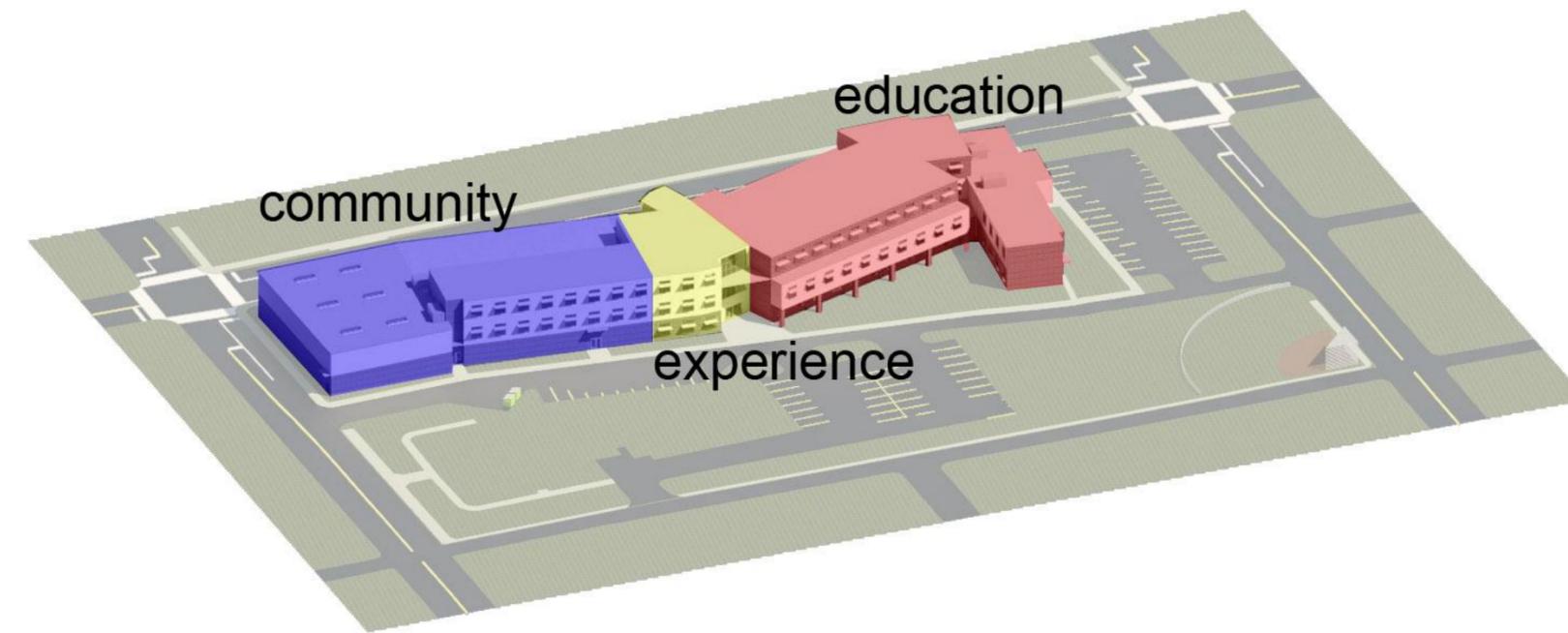
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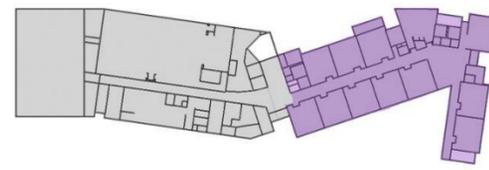
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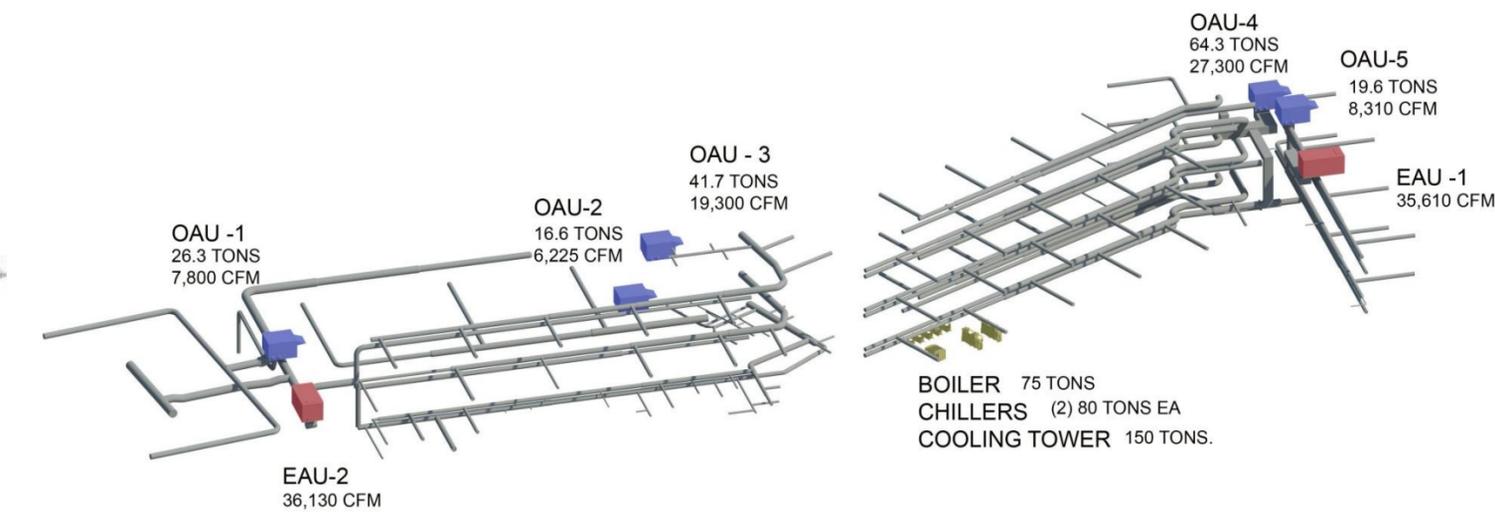
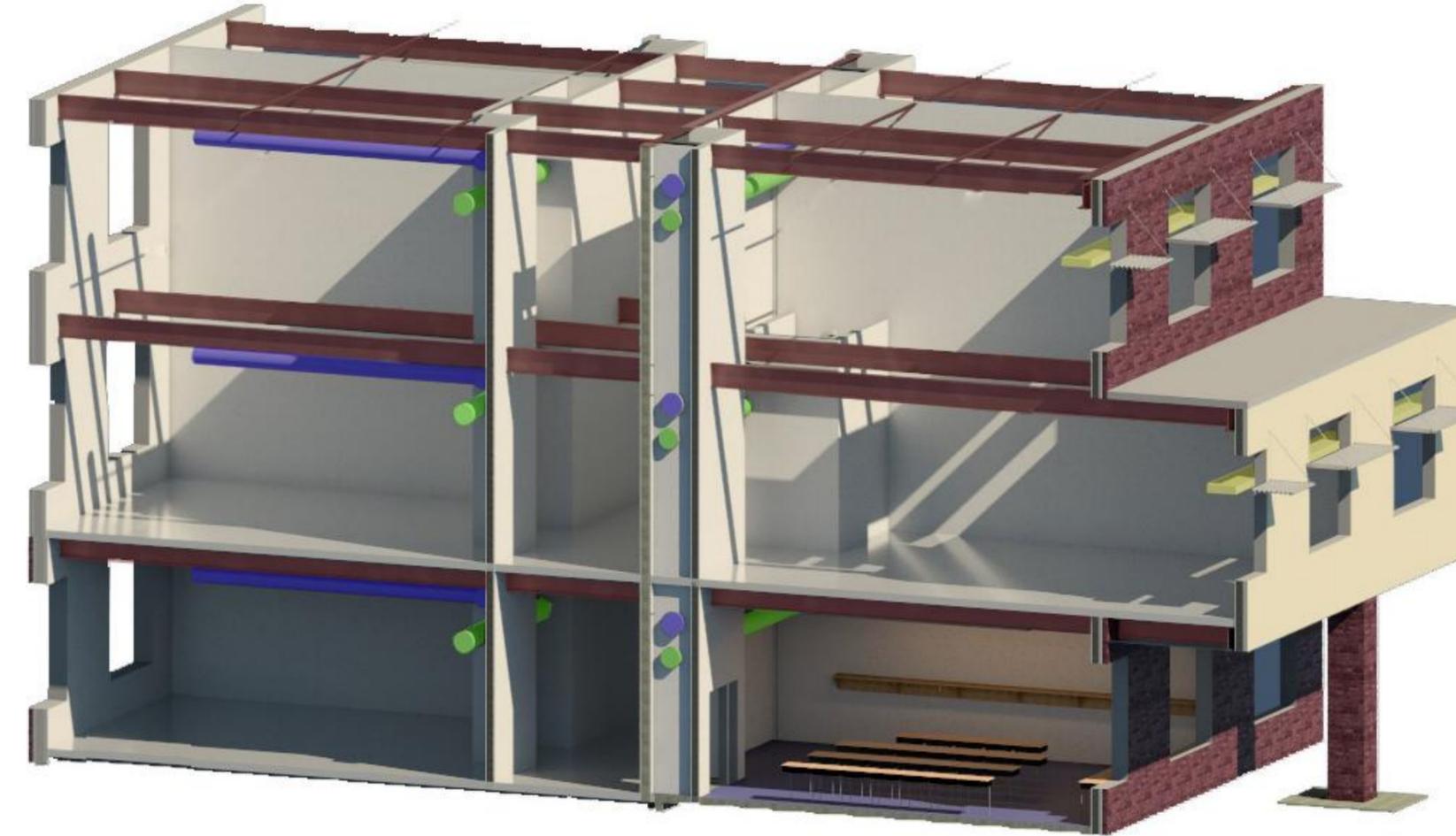
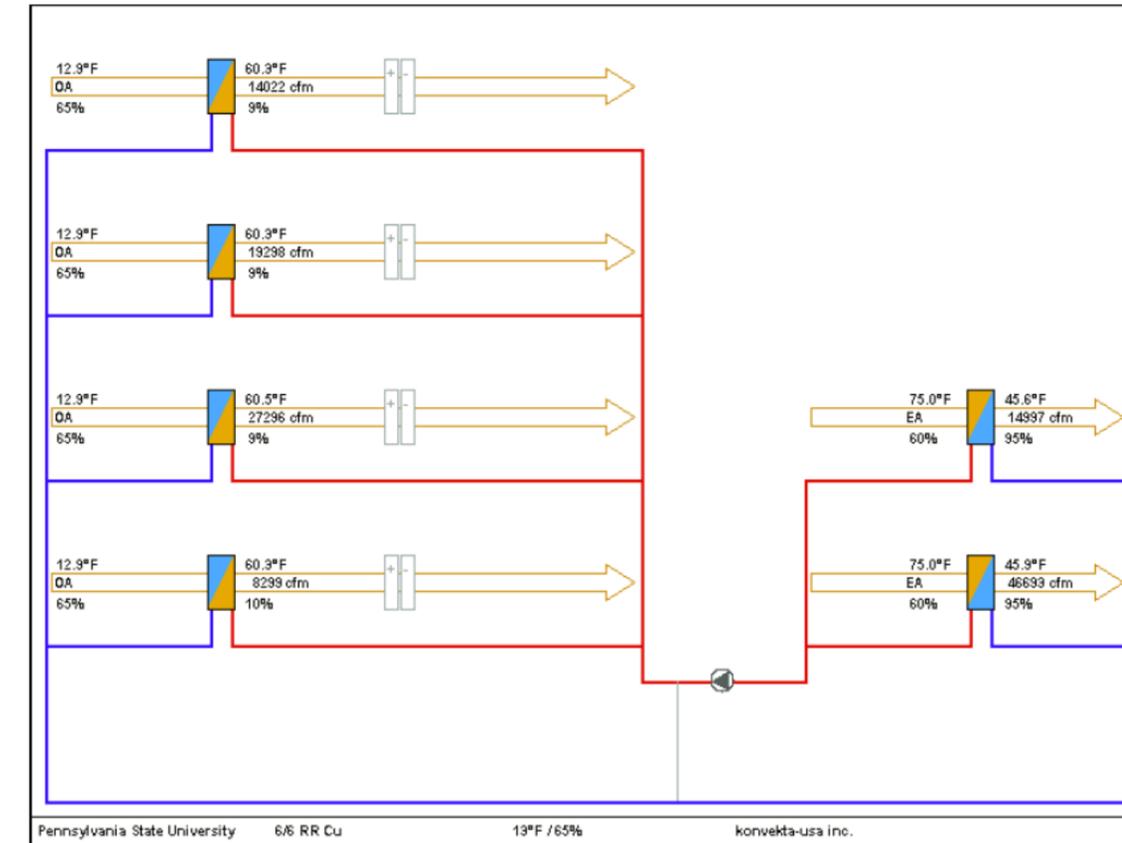
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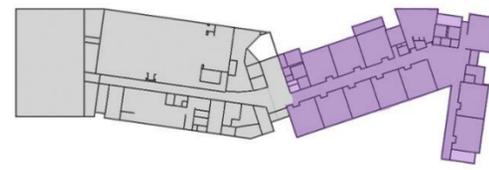
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## 100% Air Volumes





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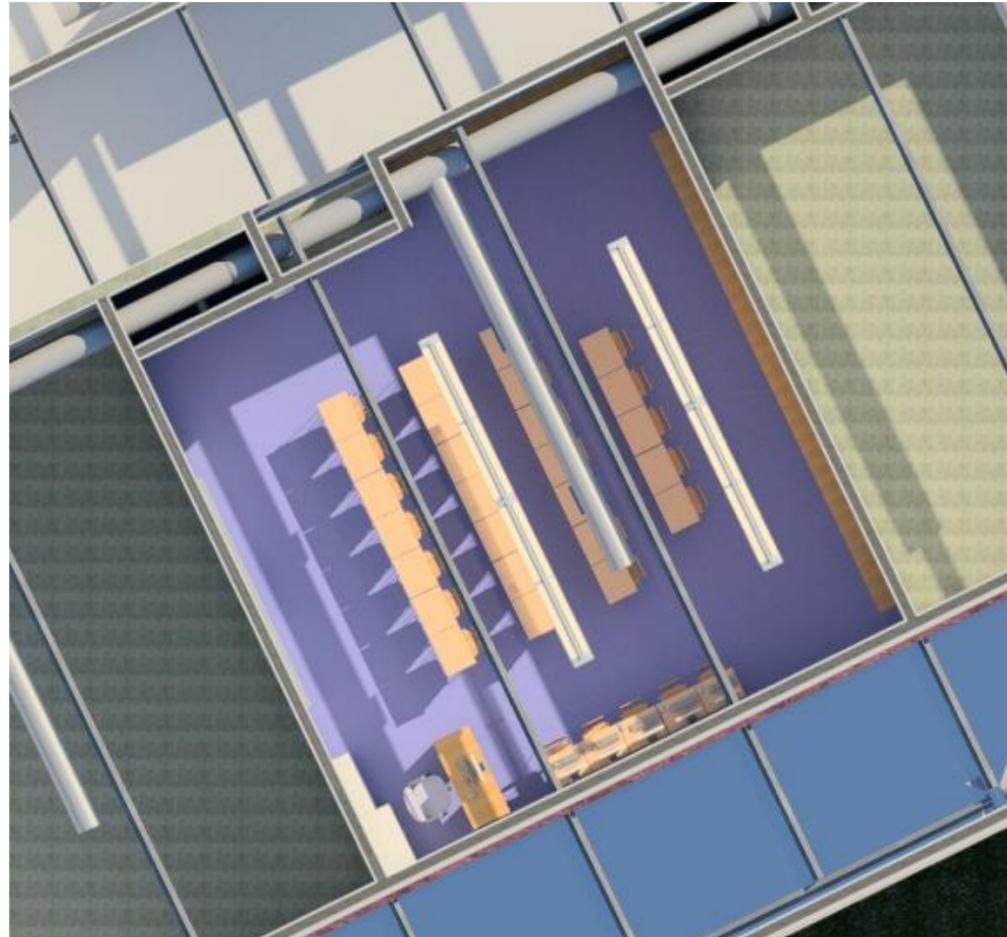
experience

community

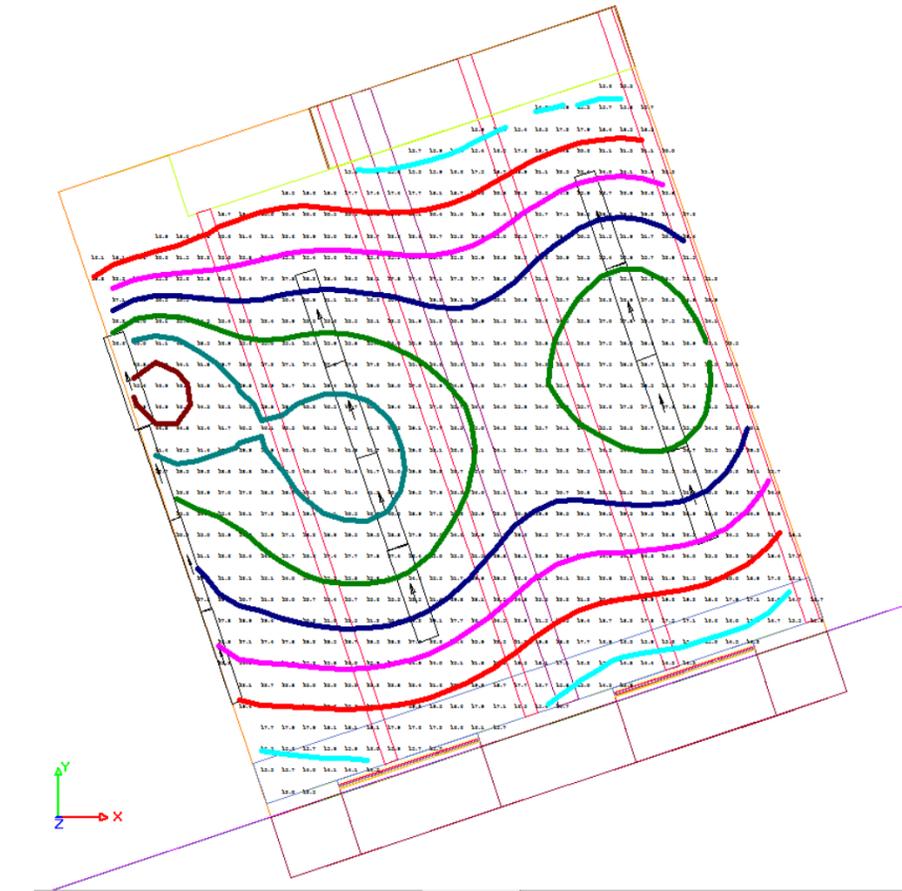
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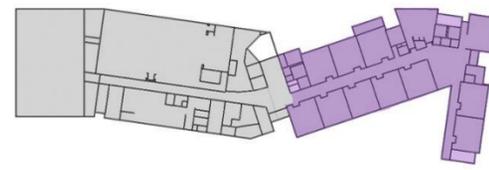


teacher perspective



electric light





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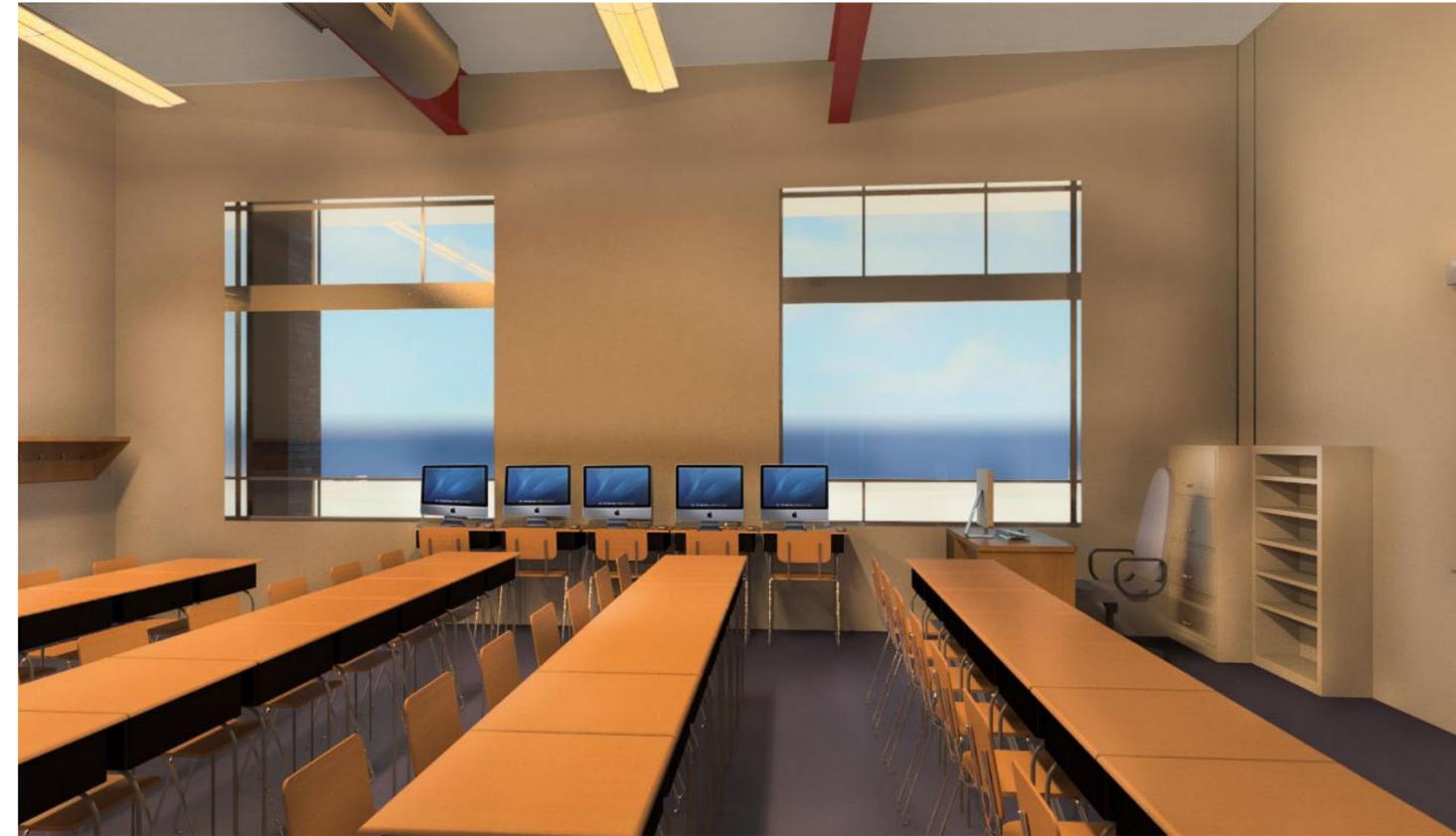
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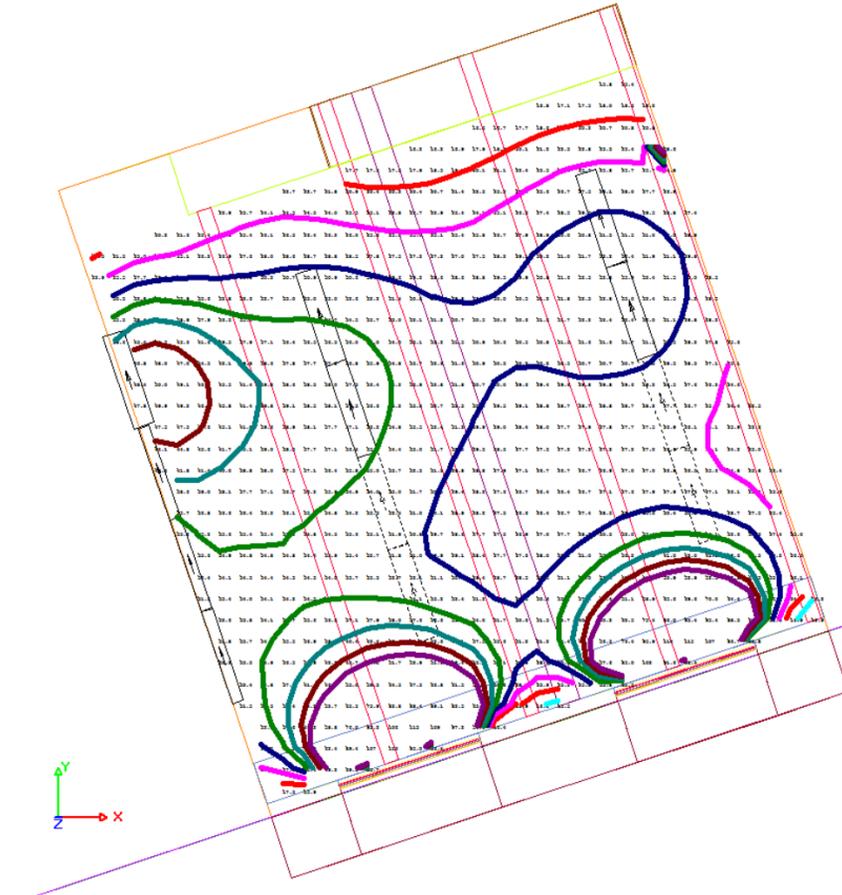
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student perspective



entrance perspective



daylight and electric – december



# function

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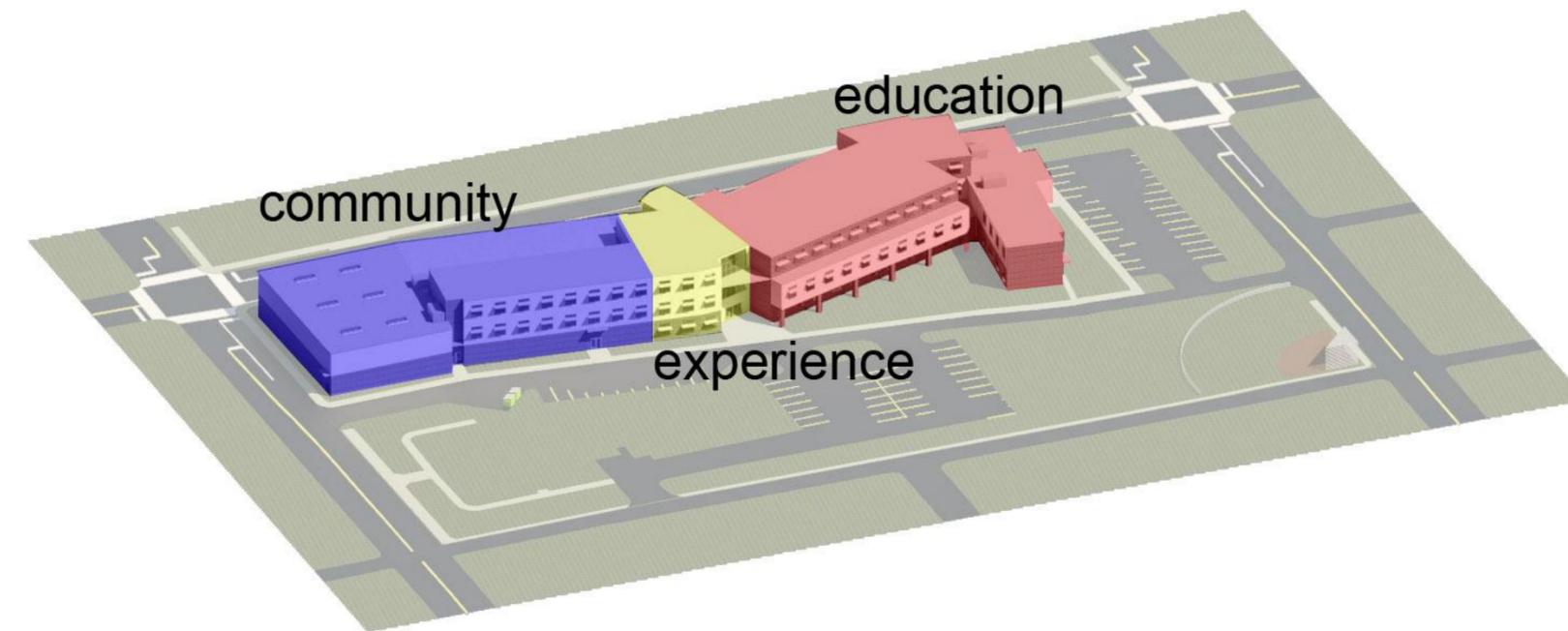
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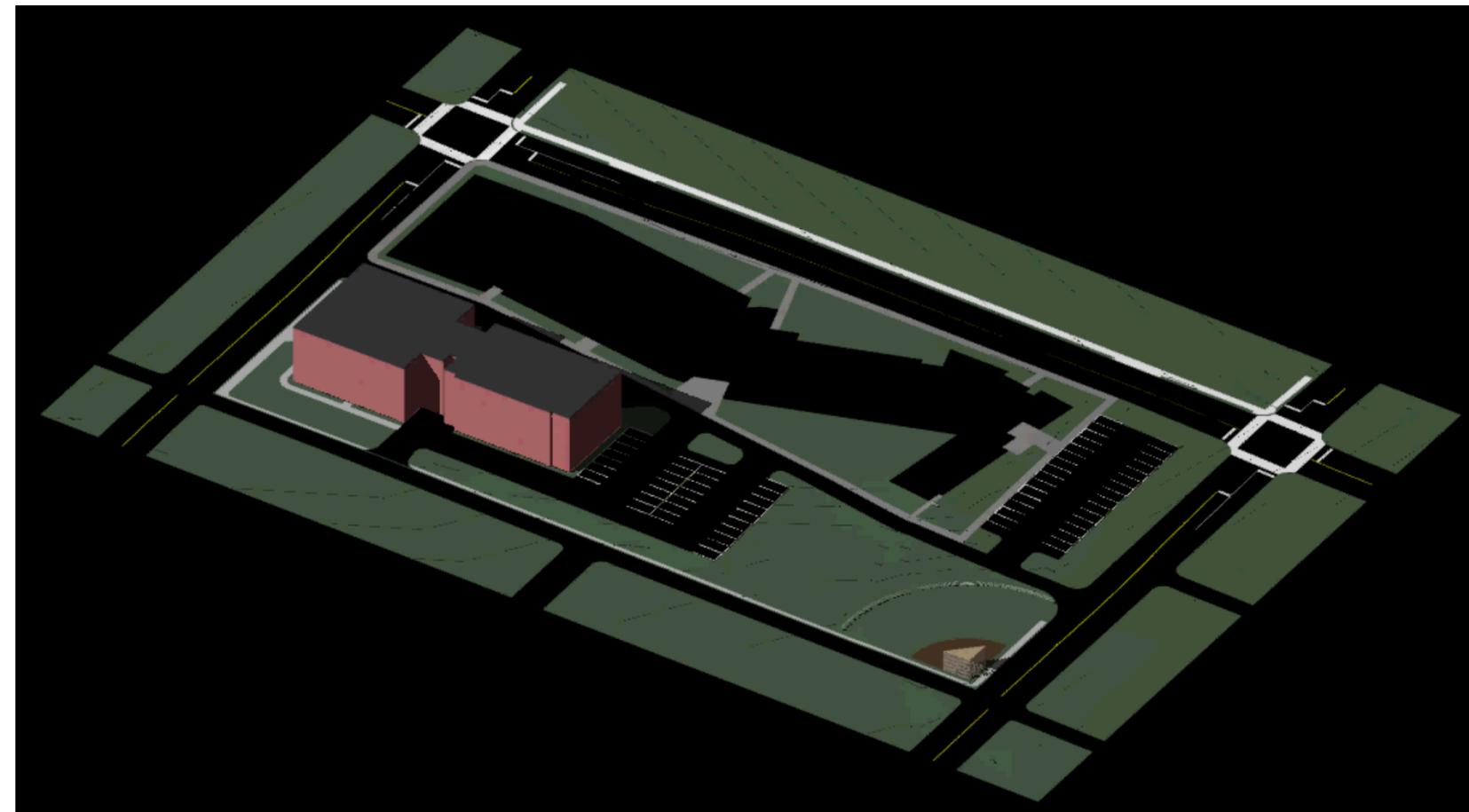
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# reading elementary school

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# recap of goals

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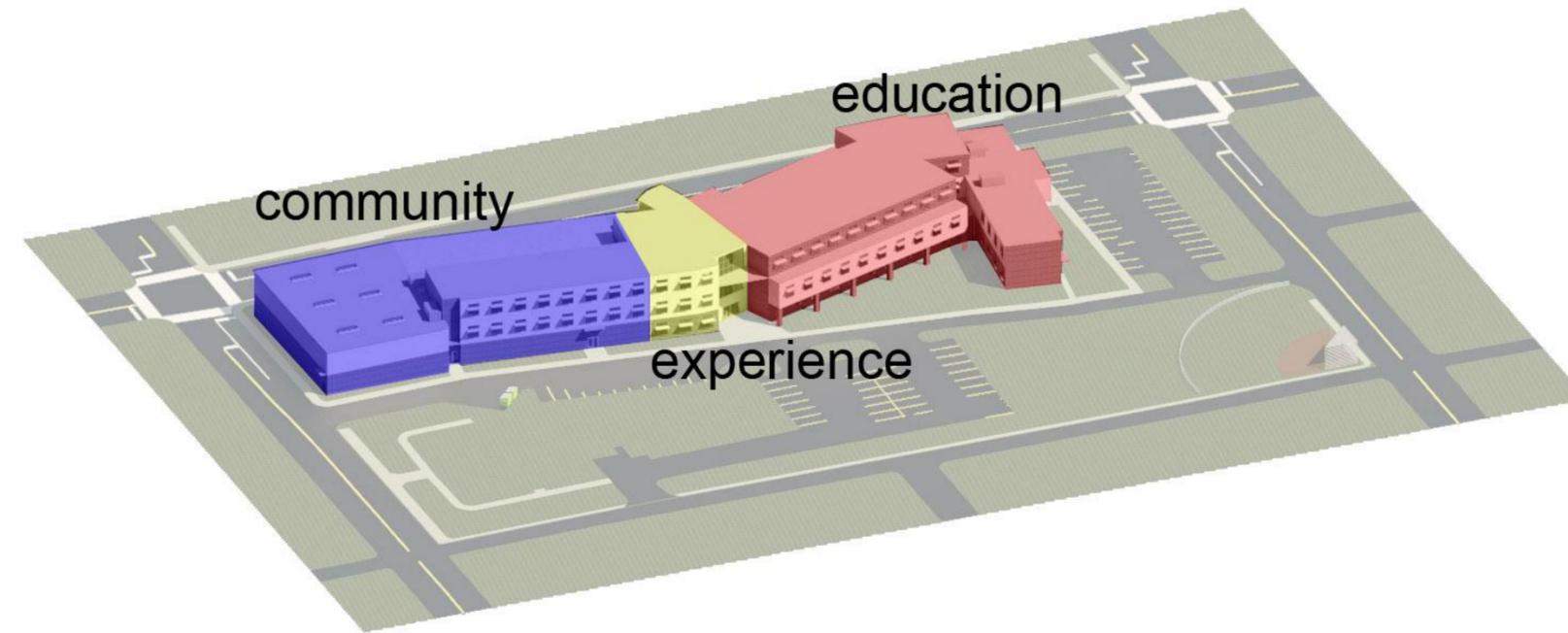
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safety & security



lifecycle & maintenance



cost effective



integration



reduce, recover, reuse



learning tool



# look-ahead

< 15 weeks until Friday, February 22, 2013



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## structure

- ETABS model
- RAM model
- detailing structure
- detailing connections of the steel beams to the concrete bearing wall
- detailing the reinforcing in the concrete walls for compression and for lateral shear

## mechanical

- working with HVAC manufacturers
- system investigations - energy storage
- investigate ways of altering the configuration of the air handlers and exhaust components
- investigate opportunities for more advanced energy savings; update energy models

-modeling – building completeness, material selections, rendering capabilities  
 -supporting documentation and drawings – codes, zoning, and other legal requirements; specification standards

Nov. 12 – week 1 (presentation 11/12)

Dec. 10 – week 5 (report draft 12/14)

Jan. 7 – week 9 (presentation 1/9)

Jan. 21 – week 11 (presentation 1/23)

Feb. 4 – week 13 (presentation 2/6)

Feb. 18 – week 15 (final submission 2/22)

## lighting / electrical

- light the offices, hallways, clinic, and exterior
- investigate and determine the appropriate electrical system
- update energy models to determine energy savings

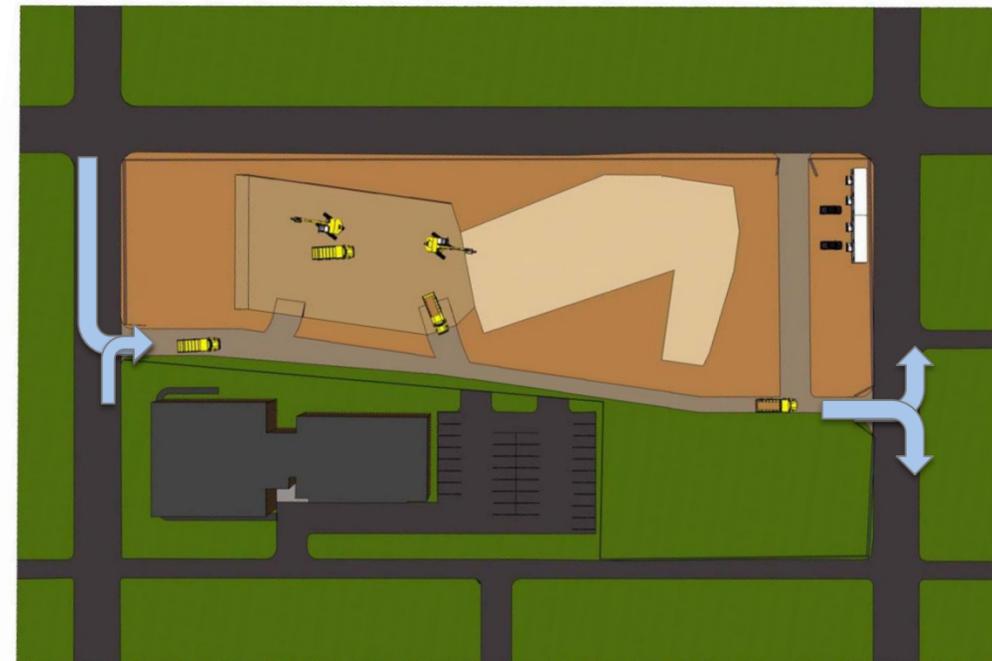
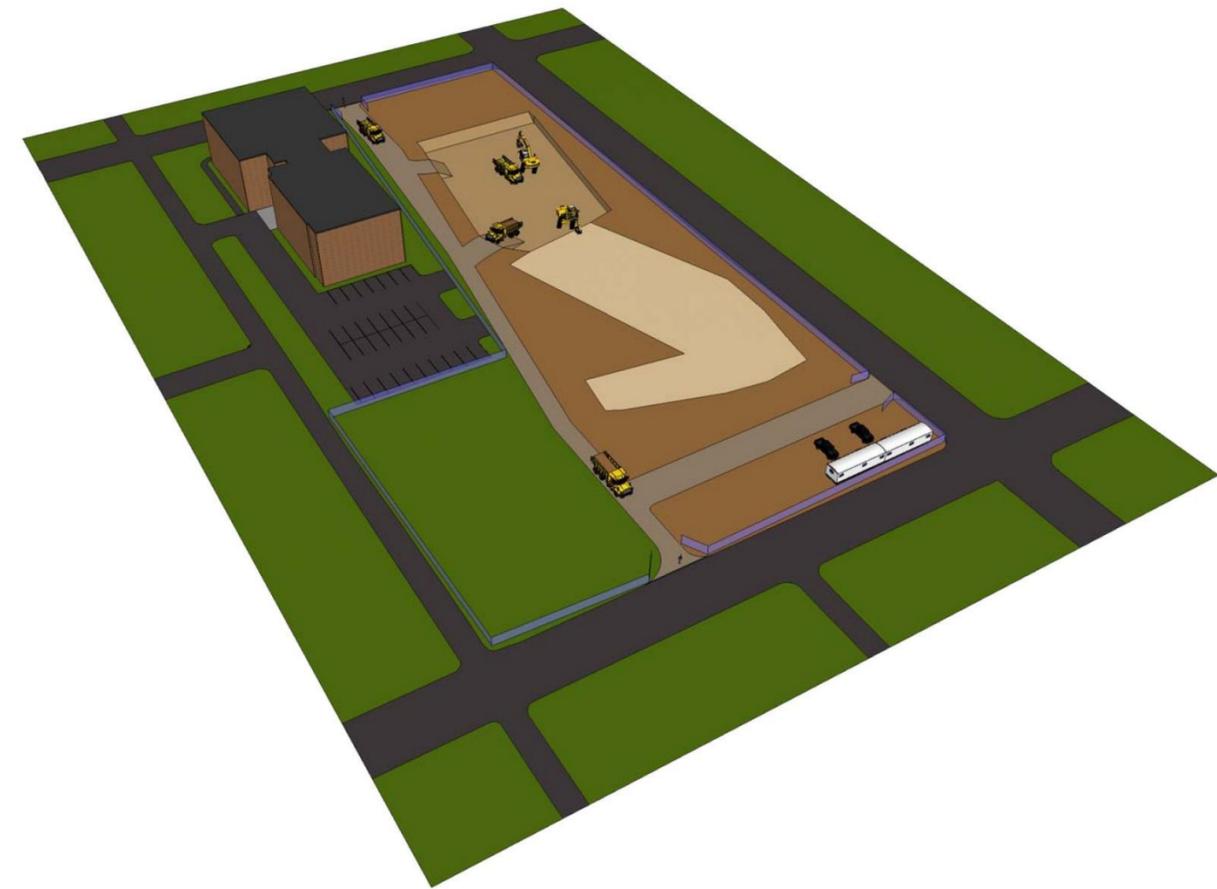
## construction management

- detailed estimate – structure, façade, MEP, finishes
- first cost versus life cycle analyses
- detailed schedule – update structural components; more in-depth MEP and finishing sequences; risk analysis
- site logistics / 4D – more detailed including equipment simulations; clash detection
- constructability – systems integration; crane and concrete pump sizing; hoist functionality
- LEED analysis – LEED checklist; sustainability challenges; cost benefit analysis

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# site logistics

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# site logistics

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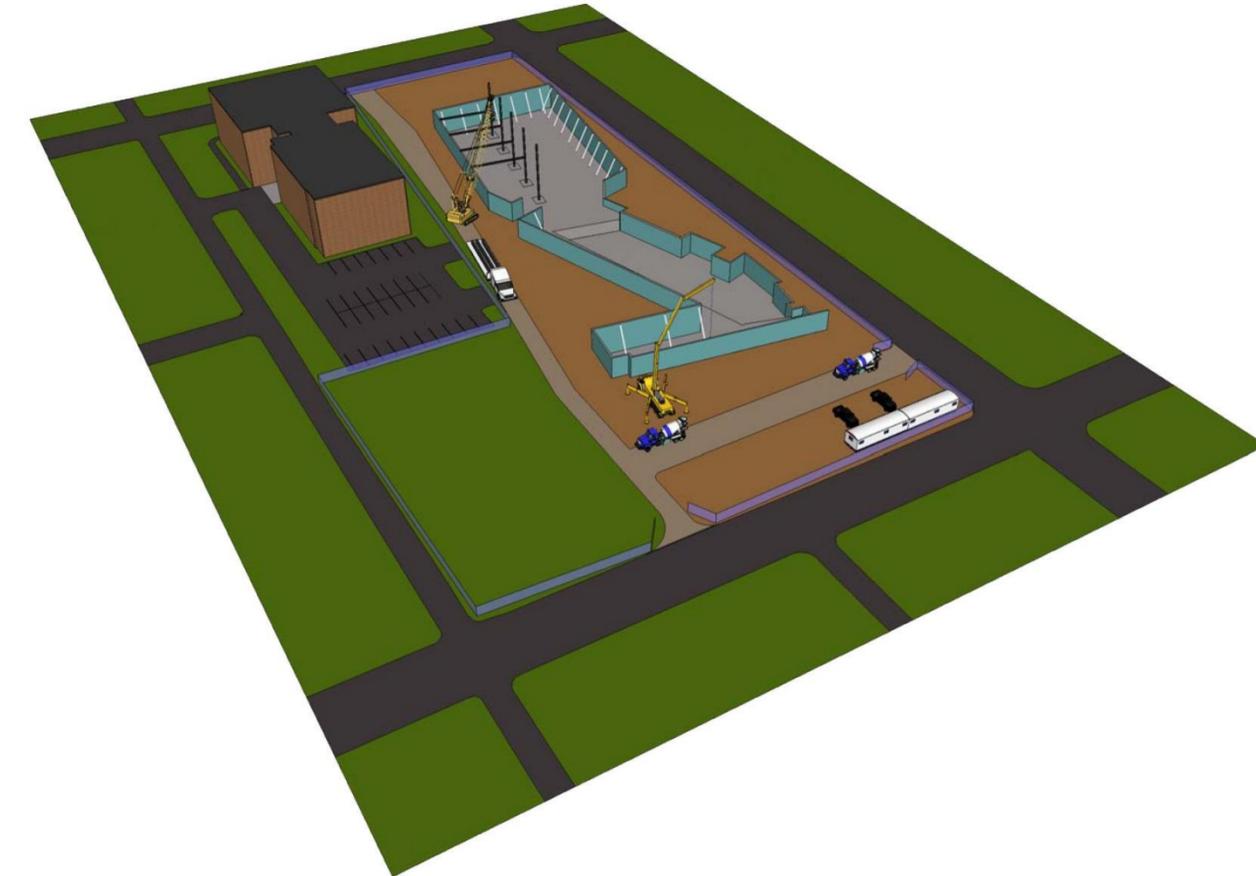
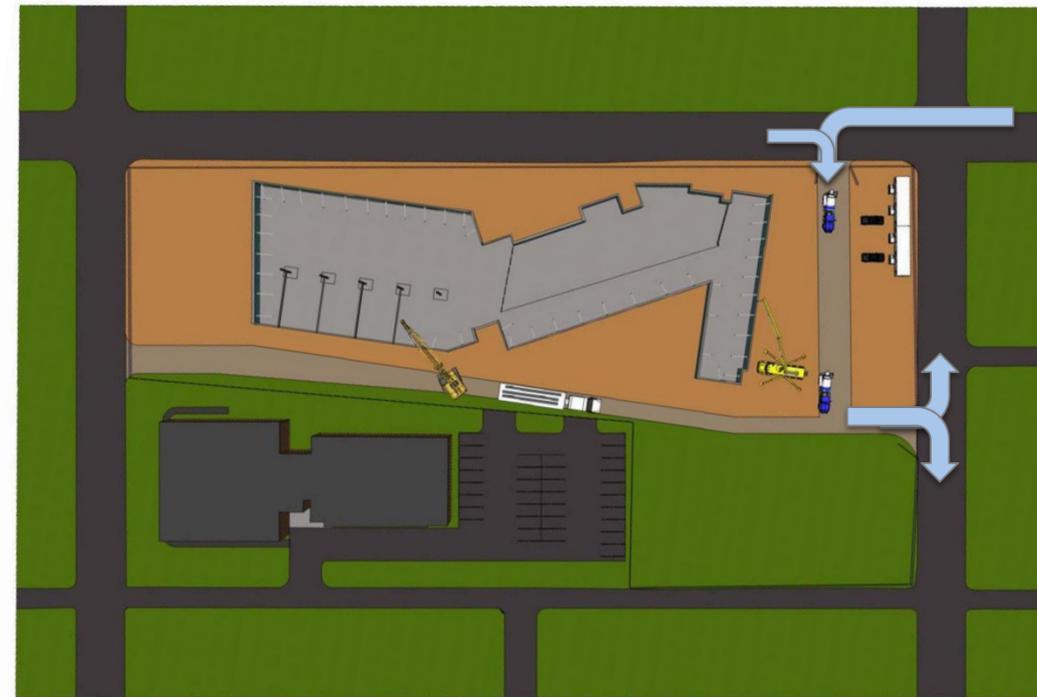
experience

community

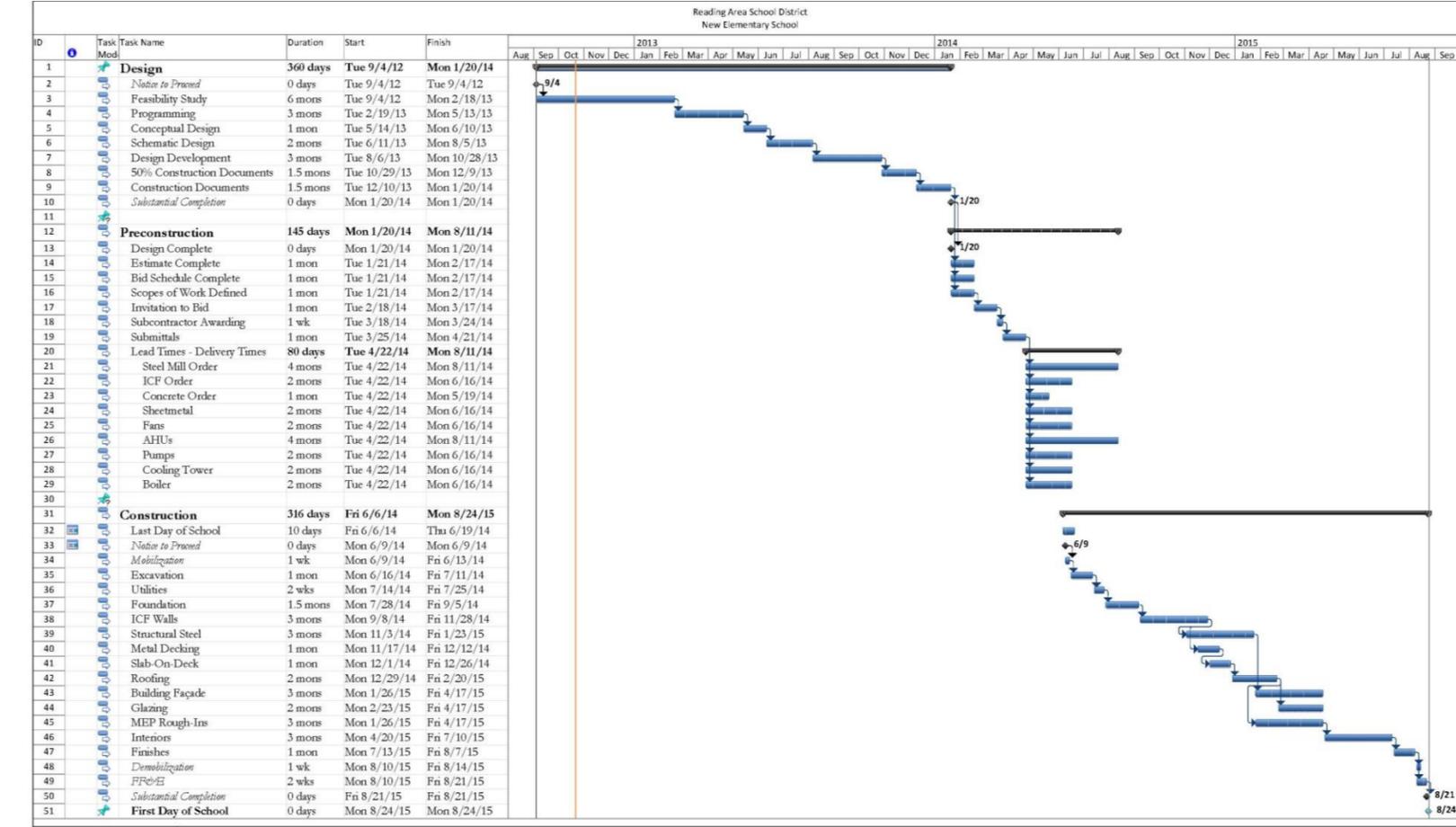
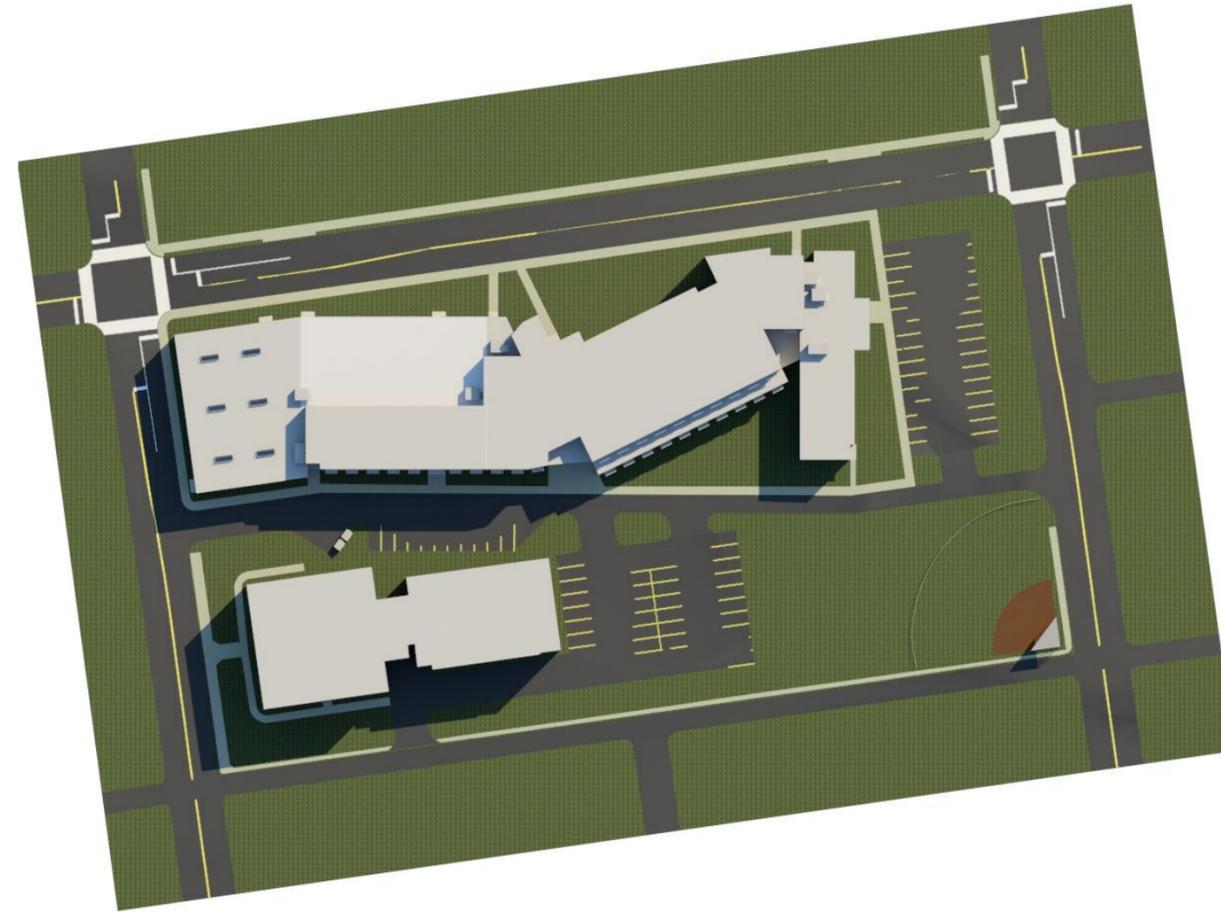
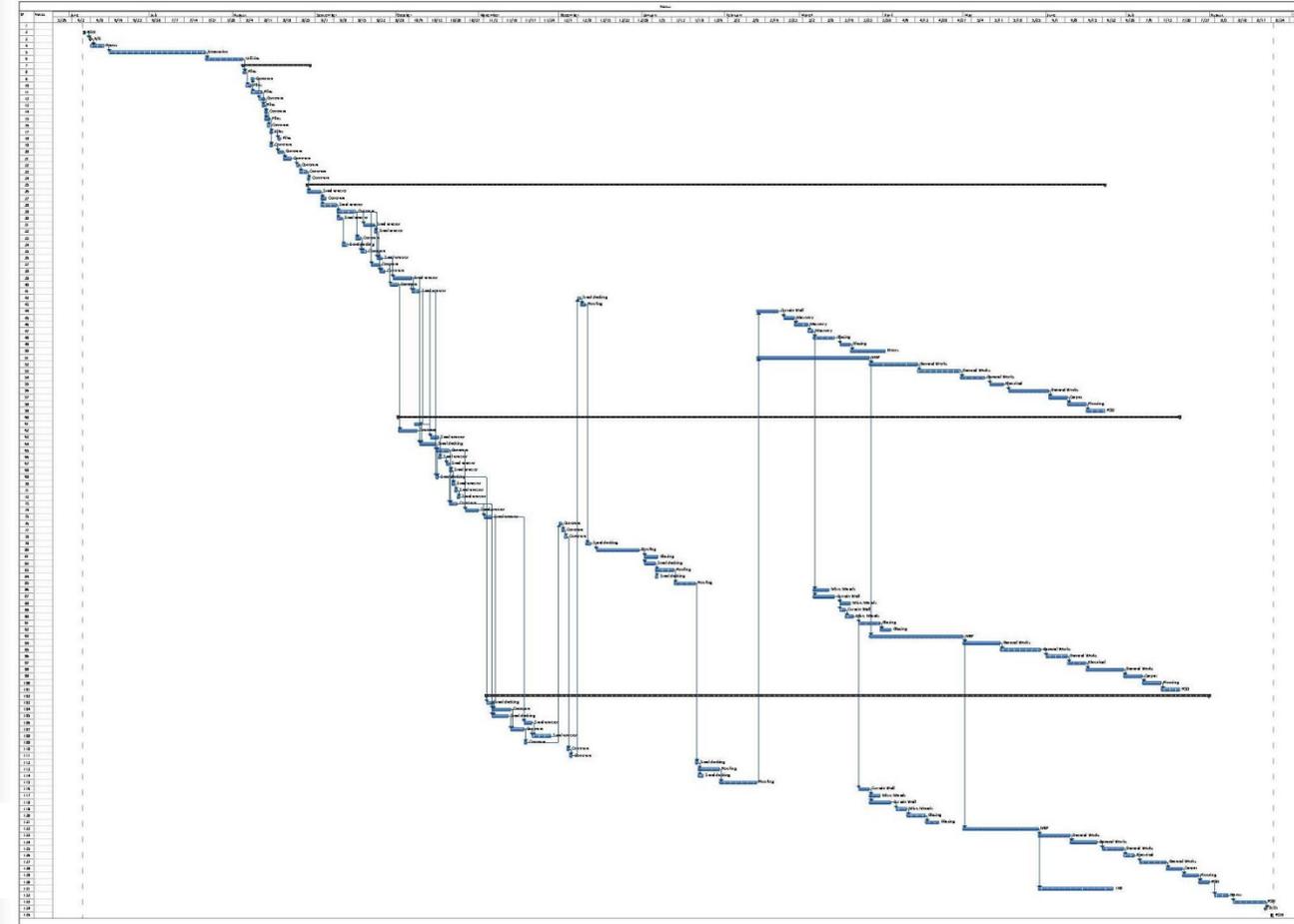
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# schedule





# cost

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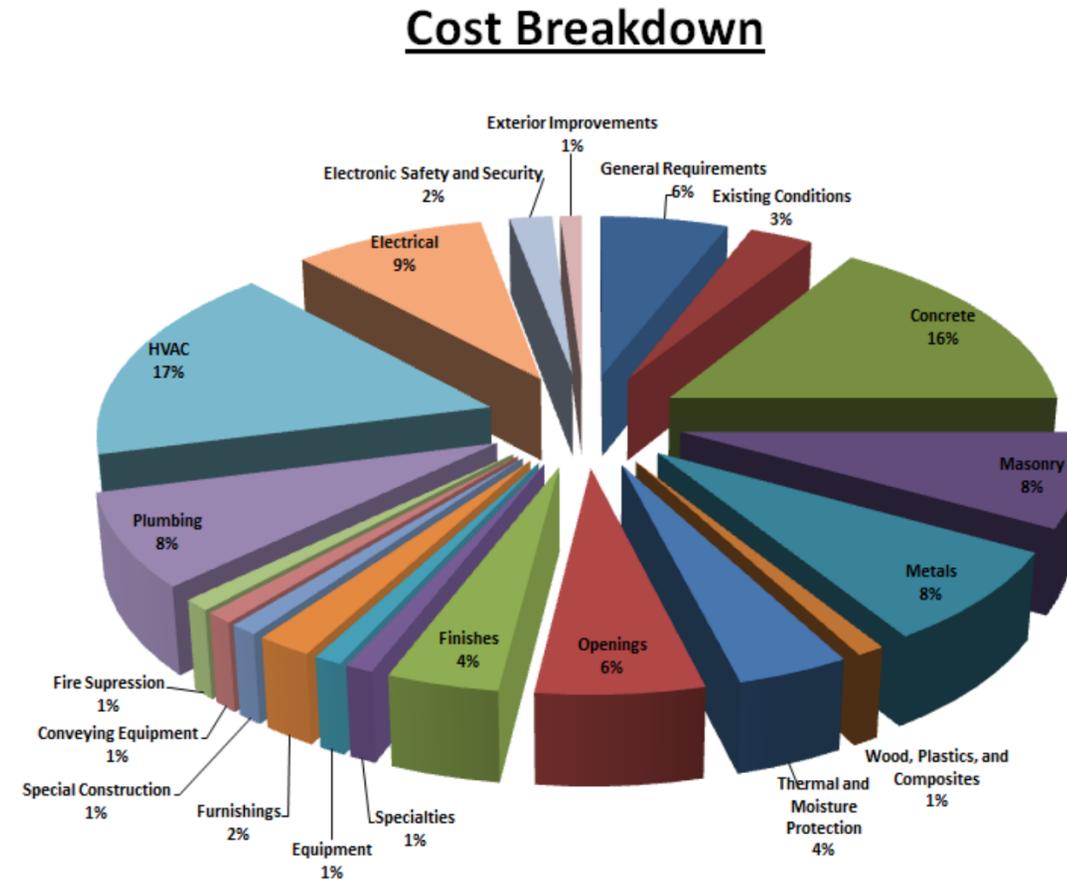
community

education

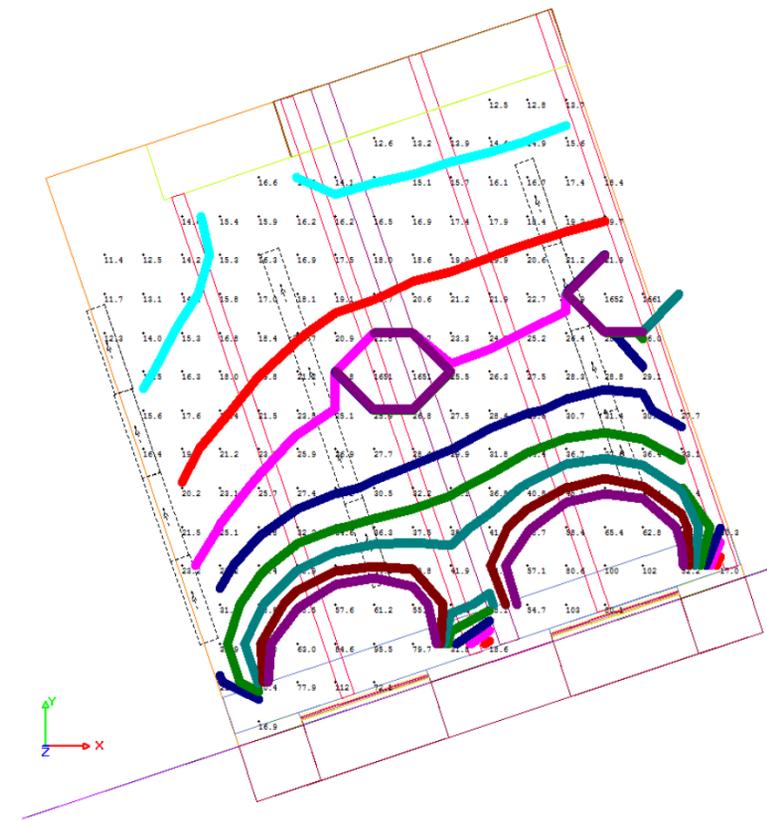
conclusion

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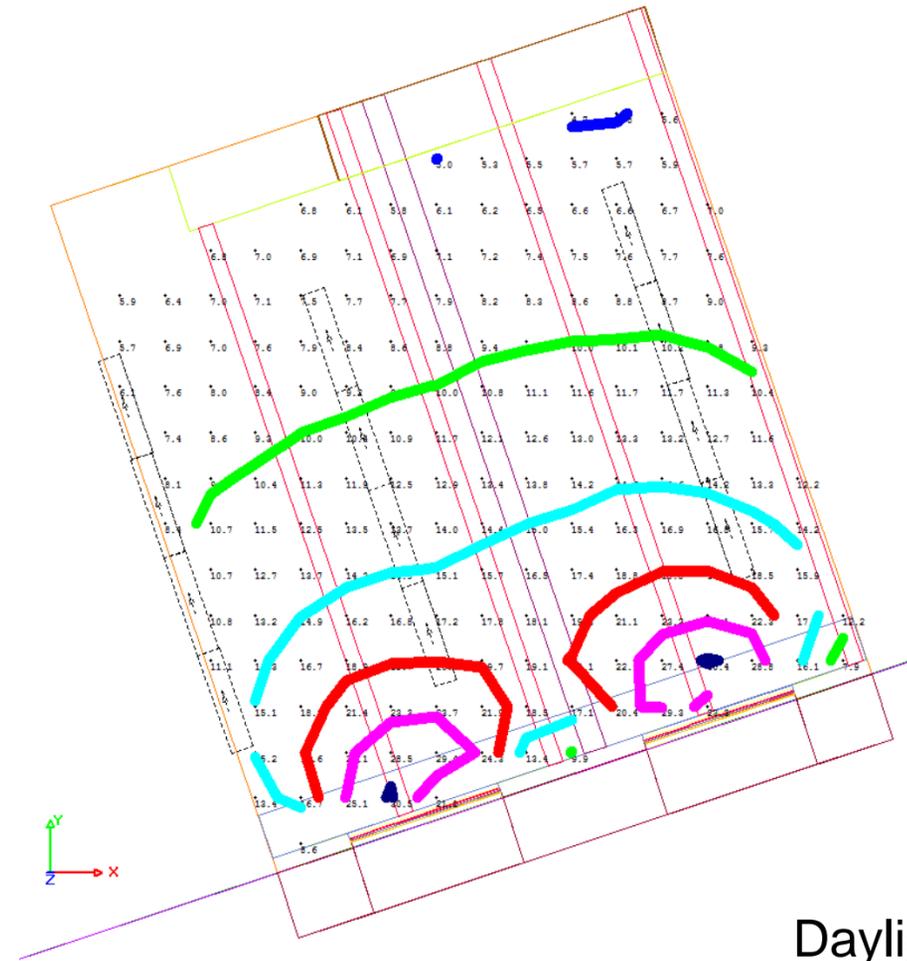
Cost Breakdown				
		Cost/SF	% of Cost	Cost
Division 1	General Requirements	\$ 11.73	6%	\$ 1,050,000
Division 2	Existing Conditions	\$ 5.86	3%	\$ 525,000
Division 3	Concrete	\$ 31.28	16%	\$ 2,800,000
Division 4	Masonry	\$ 15.64	8%	\$ 1,400,000
Division 5	Metals	\$ 15.64	8%	\$ 1,400,000
Division 6	Wood, Plastics, and Composites	\$ 1.95	1%	\$ 175,000
Division 7	Thermal and Moisture Protection	\$ 7.82	4%	\$ 700,000
Division 8	Openings	\$ 11.73	6%	\$ 1,050,000
Division 9	Finishes	\$ 7.82	4%	\$ 700,000
Division 10	Specialties	\$ 1.95	1%	\$ 175,000
Division 11	Equipment	\$ 1.95	1%	\$ 175,000
Division 12	Furnishings	\$ 3.91	2%	\$ 350,000
Division 13	Special Construction	\$ 1.95	1%	\$ 175,000
Division 14	Conveying Equipment	\$ 1.95	1%	\$ 175,000
Division 21	Fire Supression	\$ 1.95	1%	\$ 175,000
Division 22	Plumbing	\$ 15.64	8%	\$ 1,400,000
Division 23	HVAC	\$ 33.23	17%	\$ 2,975,000
Division 26	Electrical	\$ 17.59	9%	\$ 1,575,000
Division 28	Electronic Safety and Security	\$ 3.91	2%	\$ 350,000
Division 32	Exterior Improvements	\$ 1.95	1%	\$ 175,000
<b>Cost / SF</b>		<b>\$ 195.48</b>	<b>Total</b>	<b>\$ 17,500,000</b>



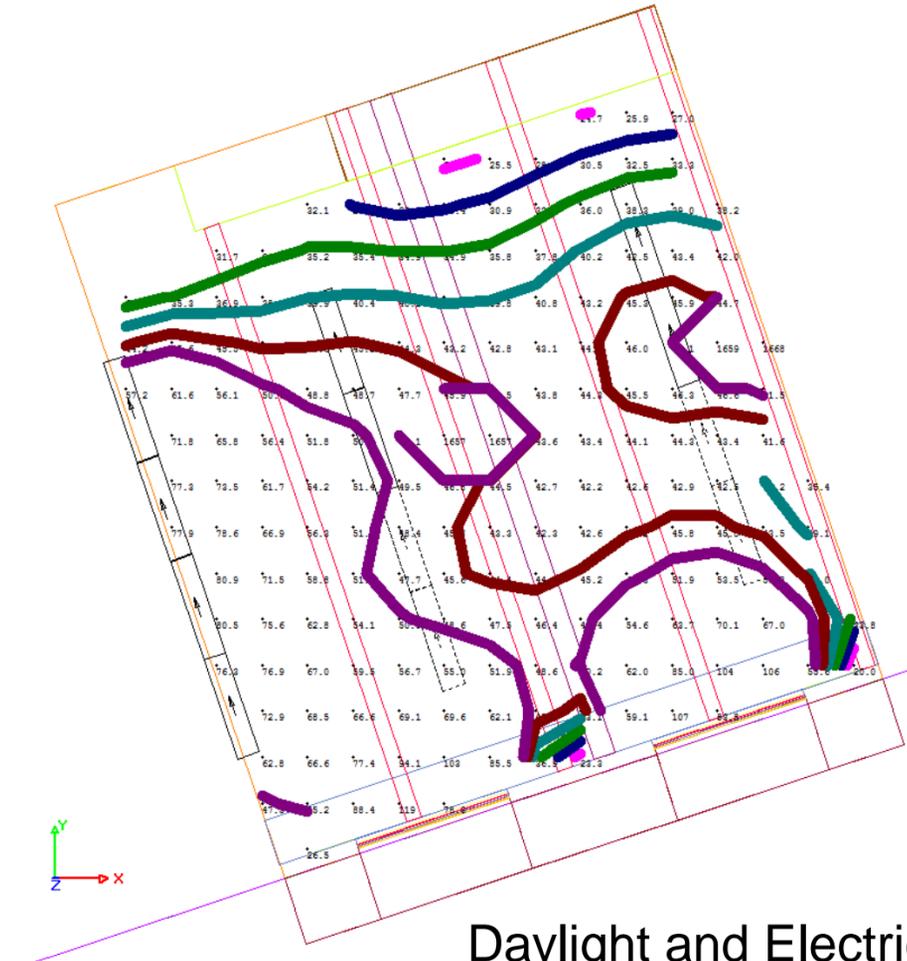
Cost Breakdown w/ Pool				
		Cost/SF	% of Cost	Cost
Division 1	General Requirements	\$ 11.73	6%	\$ 1,050,000
Division 2	Existing Conditions	\$ 5.86	3%	\$ 525,000
Division 3	Concrete	\$ 31.28	16%	\$ 2,800,000
Division 4	Masonry	\$ 15.64	8%	\$ 1,400,000
Division 5	Metals	\$ 15.64	8%	\$ 1,400,000
Division 6	Wood, Plastics, and Composites	\$ 1.95	1%	\$ 175,000
Division 7	Thermal and Moisture Protection	\$ 7.82	4%	\$ 700,000
Division 8	Openings	\$ 11.73	6%	\$ 1,050,000
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Division 10	Specialties	\$ 1.95	1%	\$ 175,000
Division 11	Equipment	\$ 1.95	1%	\$ 175,000
Division 12	Furnishings	\$ 3.91	2%	\$ 350,000
Division 13	Special Construction	\$ 1.95	1%	\$ 175,000
	Pool	\$ 27.93	-	\$ 2,500,000
Division 14	Conveying Equipment	\$ 1.95	1%	\$ 175,000
Division 21	Fire Supression	\$ 1.95	1%	\$ 175,000
Division 22	Plumbing	\$ 15.64	8%	\$ 1,400,000
Division 23	HVAC	\$ 33.23	17%	\$ 2,975,000
Division 26	Electrical	\$ 17.59	9%	\$ 1,575,000
Division 28	Electronic Safety and Security	\$ 3.91	2%	\$ 350,000
Division 32	Exterior Improvements	\$ 1.95	1%	\$ 175,000
<b>Cost / SF</b>		<b>\$ 223.41</b>	<b>Total</b>	<b>\$ 20,000,000</b>



Daylight - December

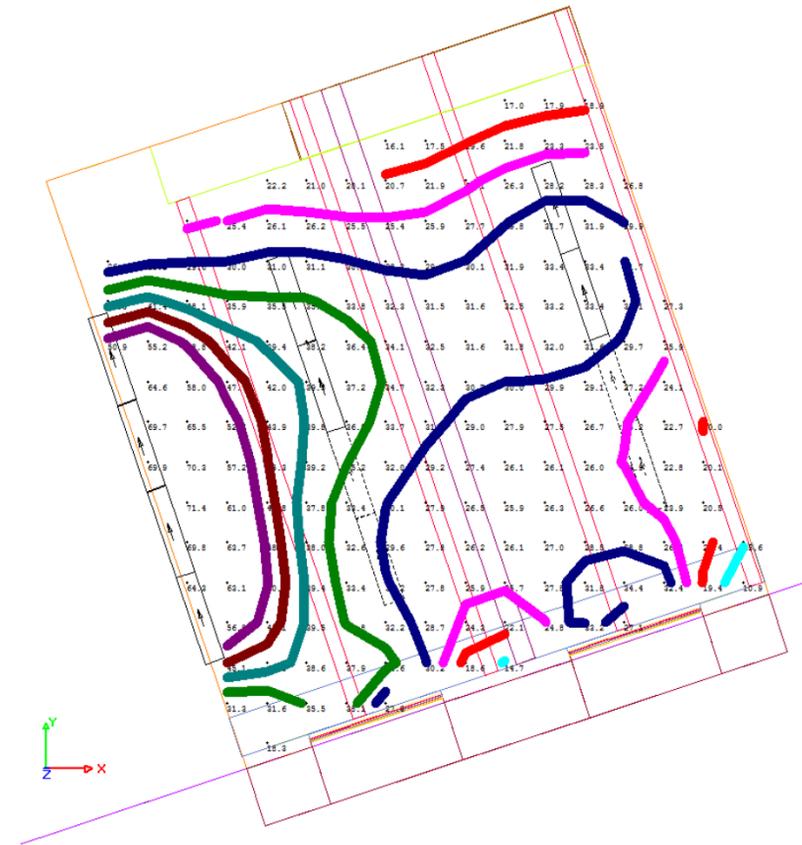


Daylight - June

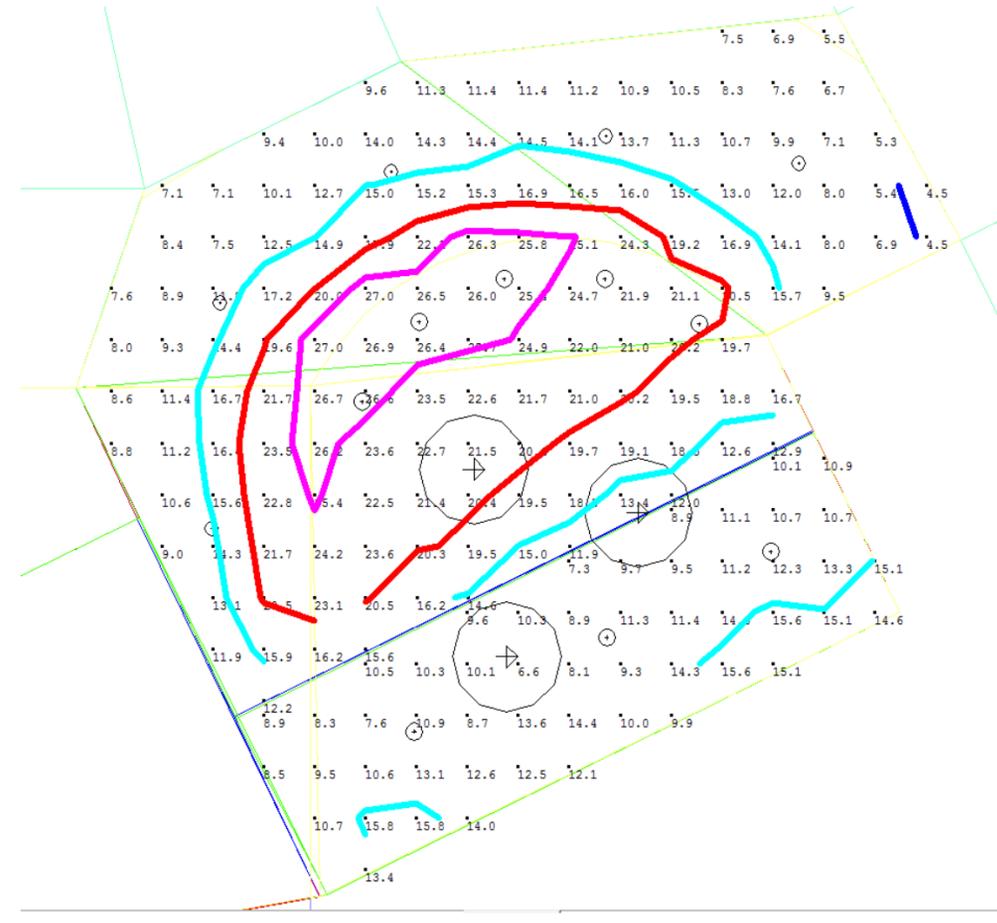


Daylight and Electric - December

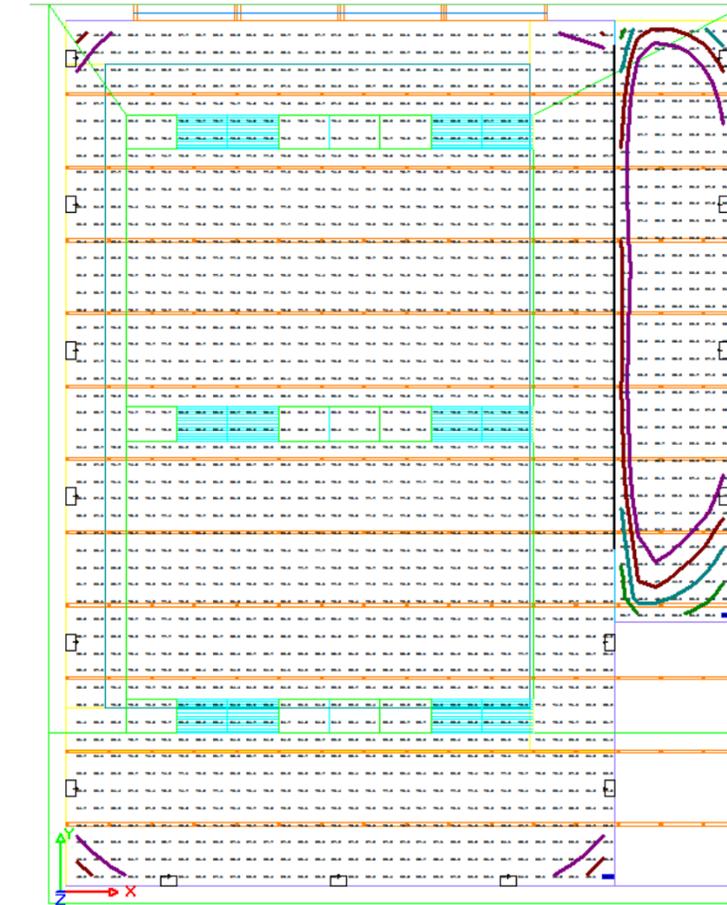
# daylighting / artificial



Shades - December



Lobby



Pool - June

nexus

function

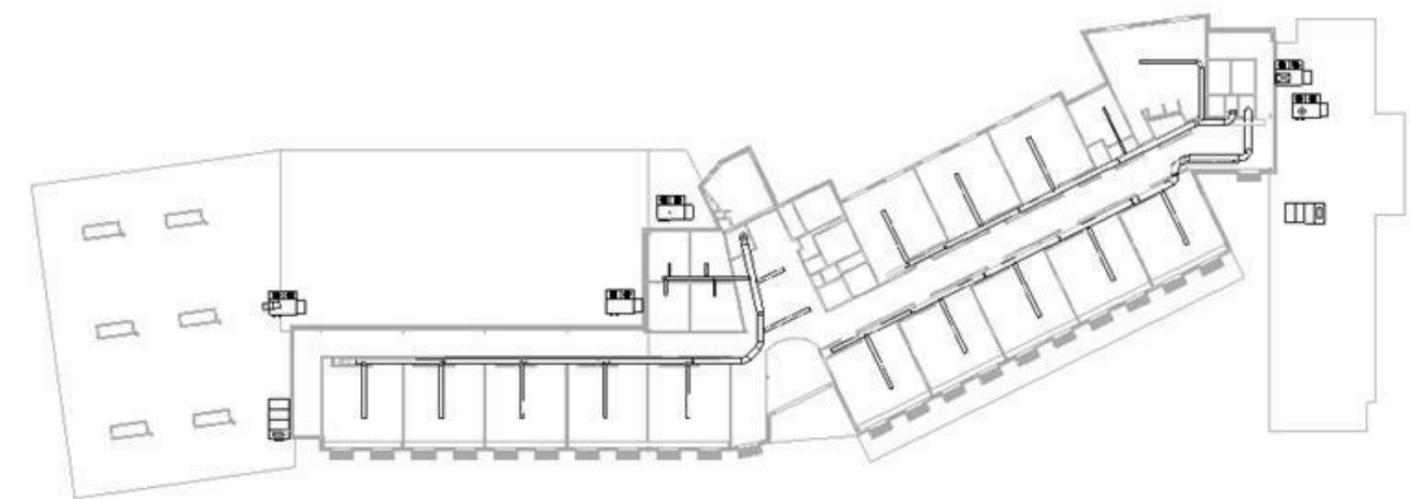
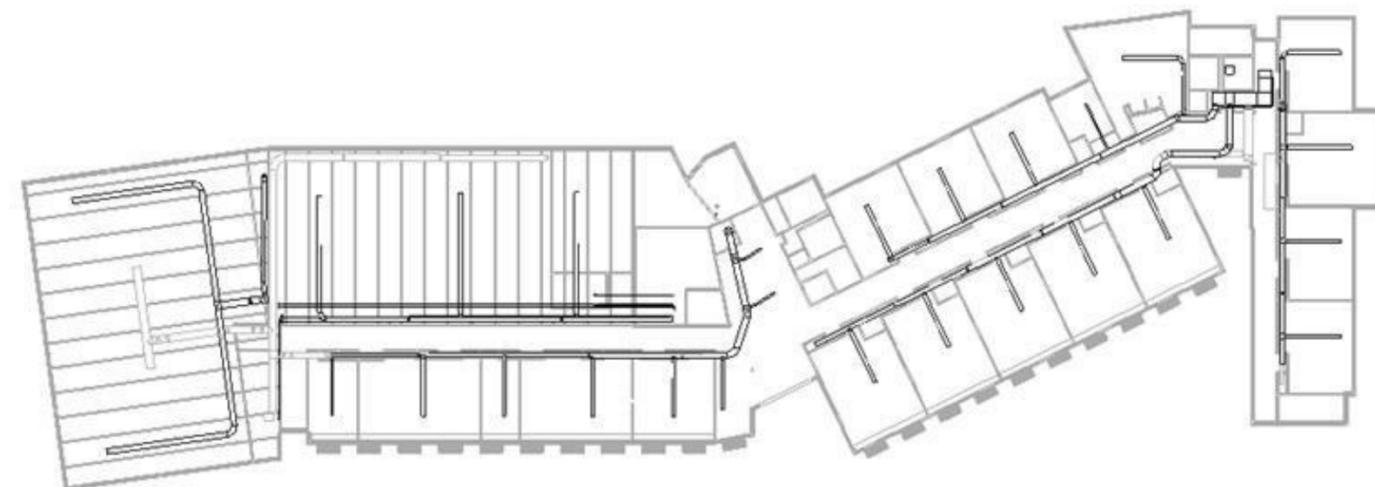
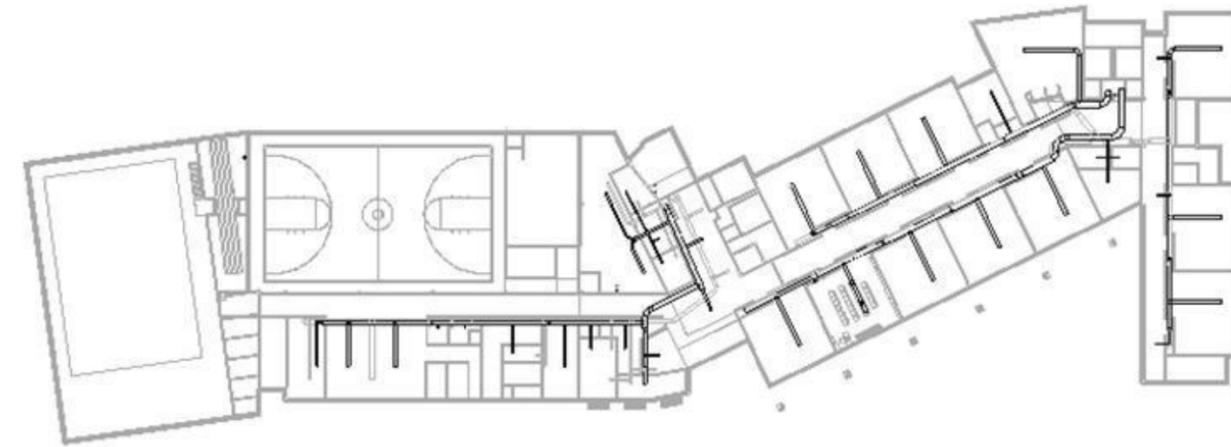
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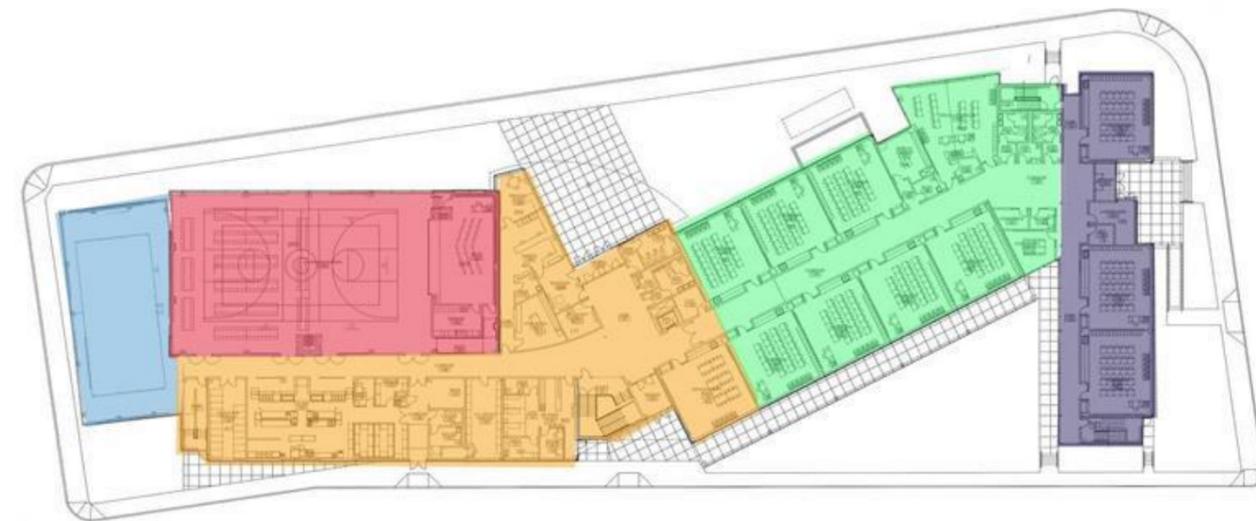
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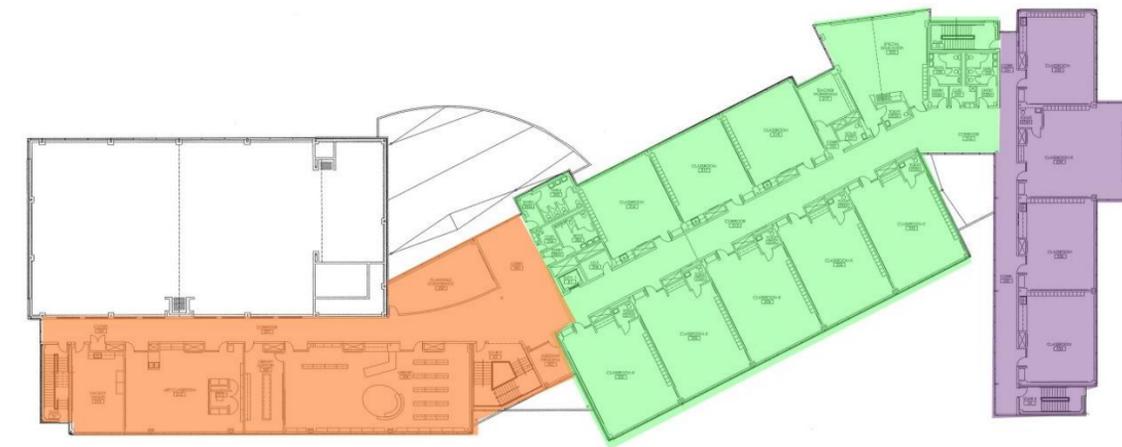
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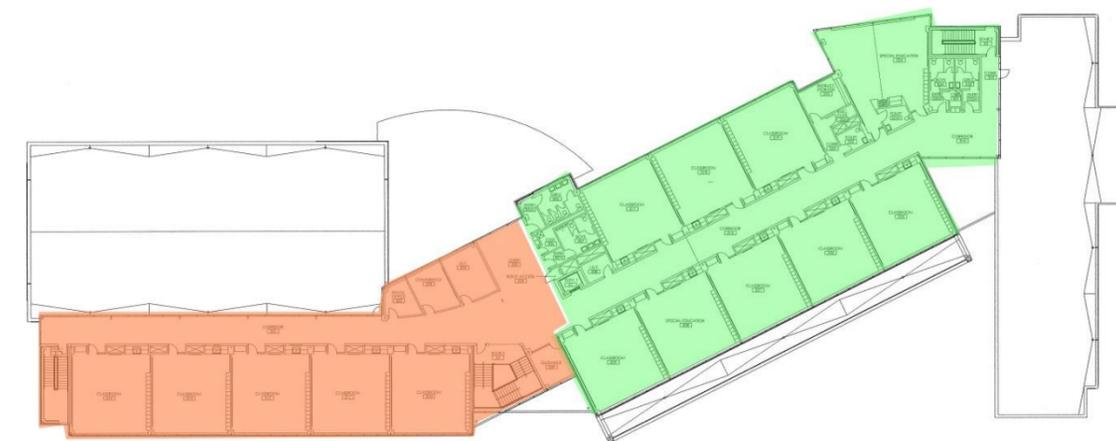
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1/16"=1'-0" FIRST FLOOR PLAN



1/16"=1'-0" SECOND FLOOR PLAN



# mechanical

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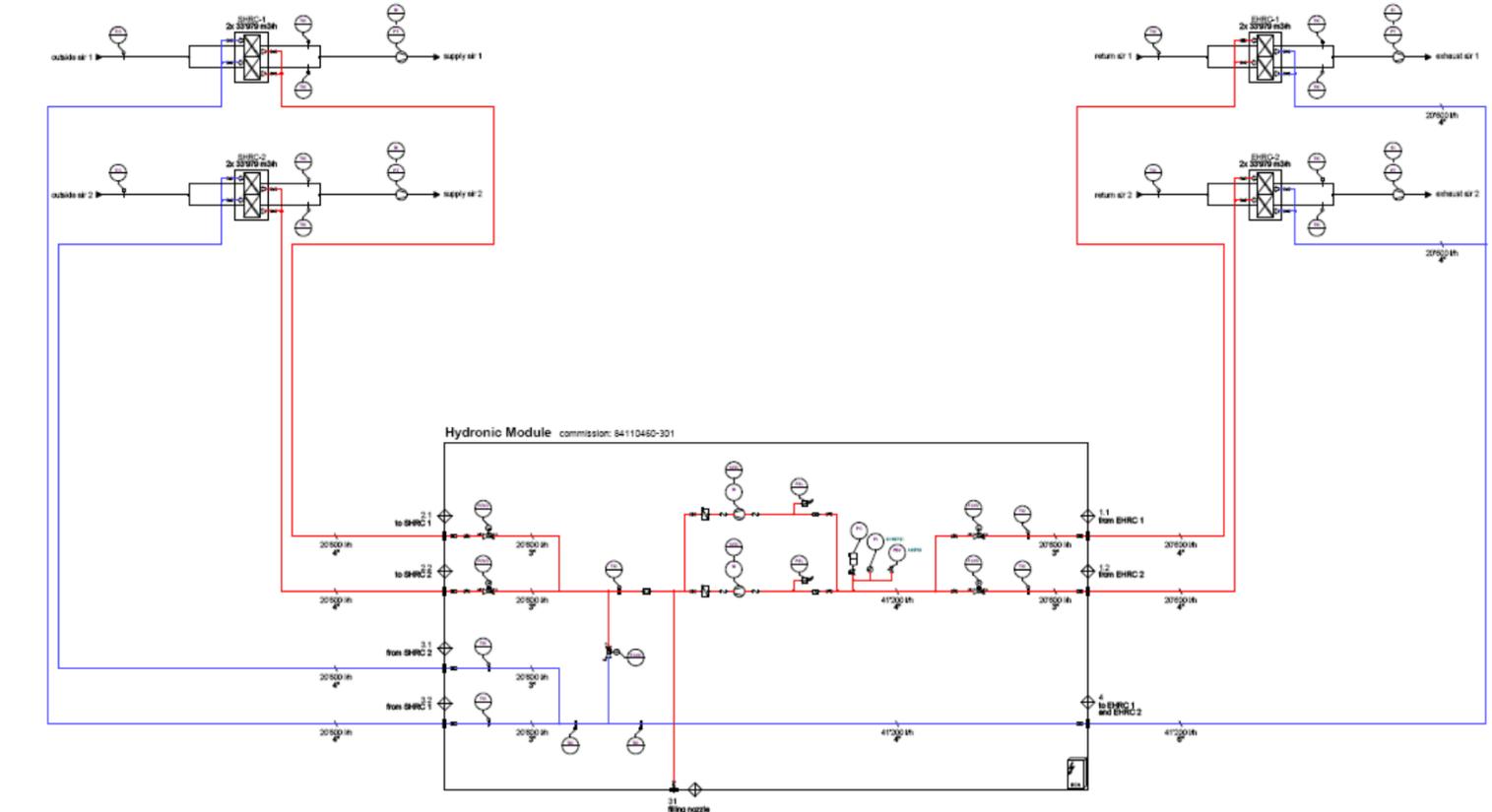
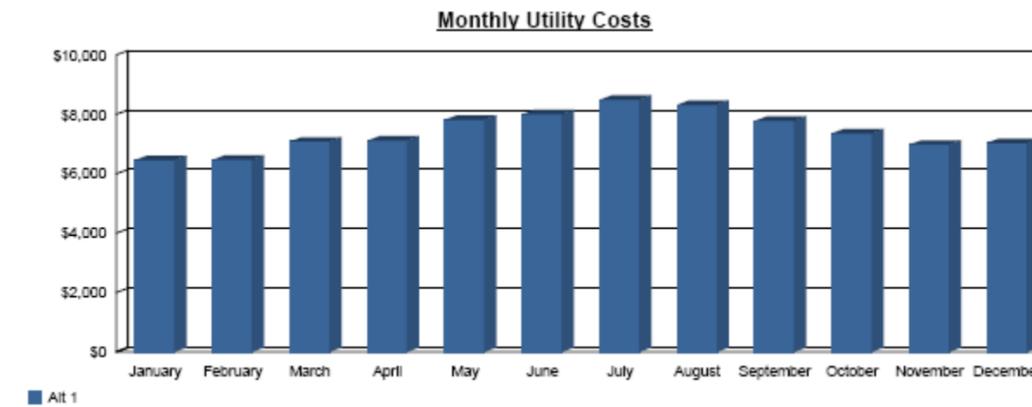
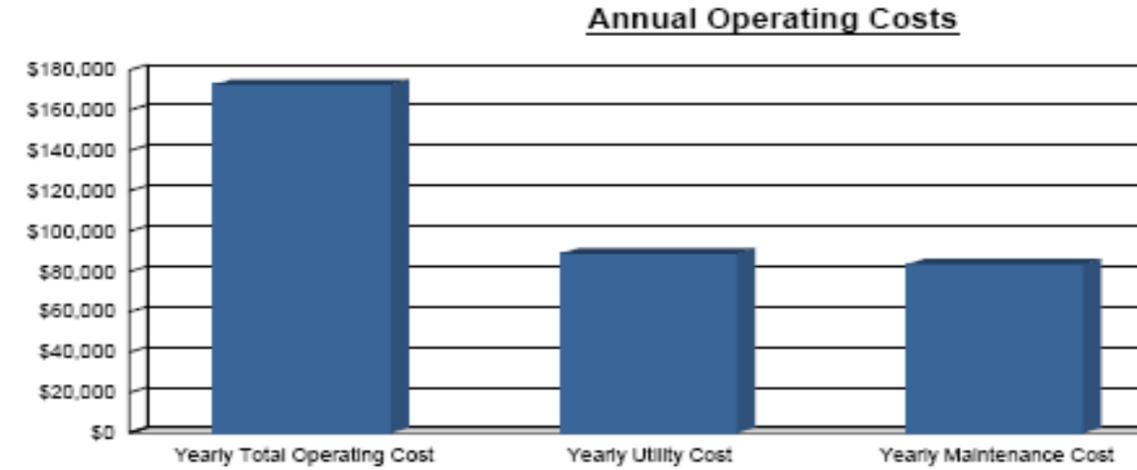
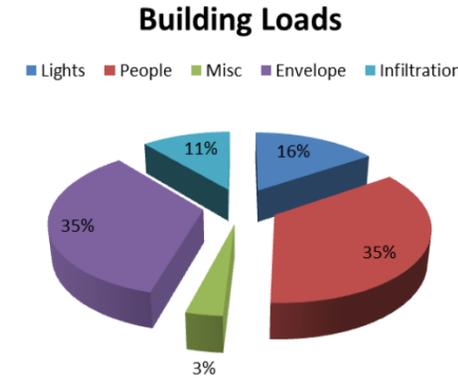
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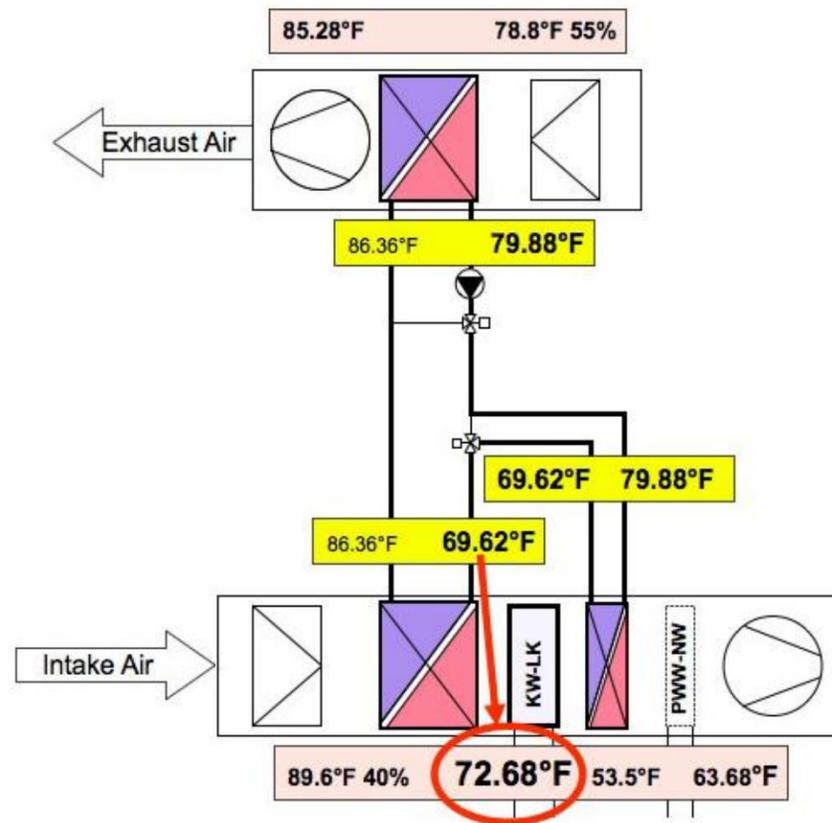
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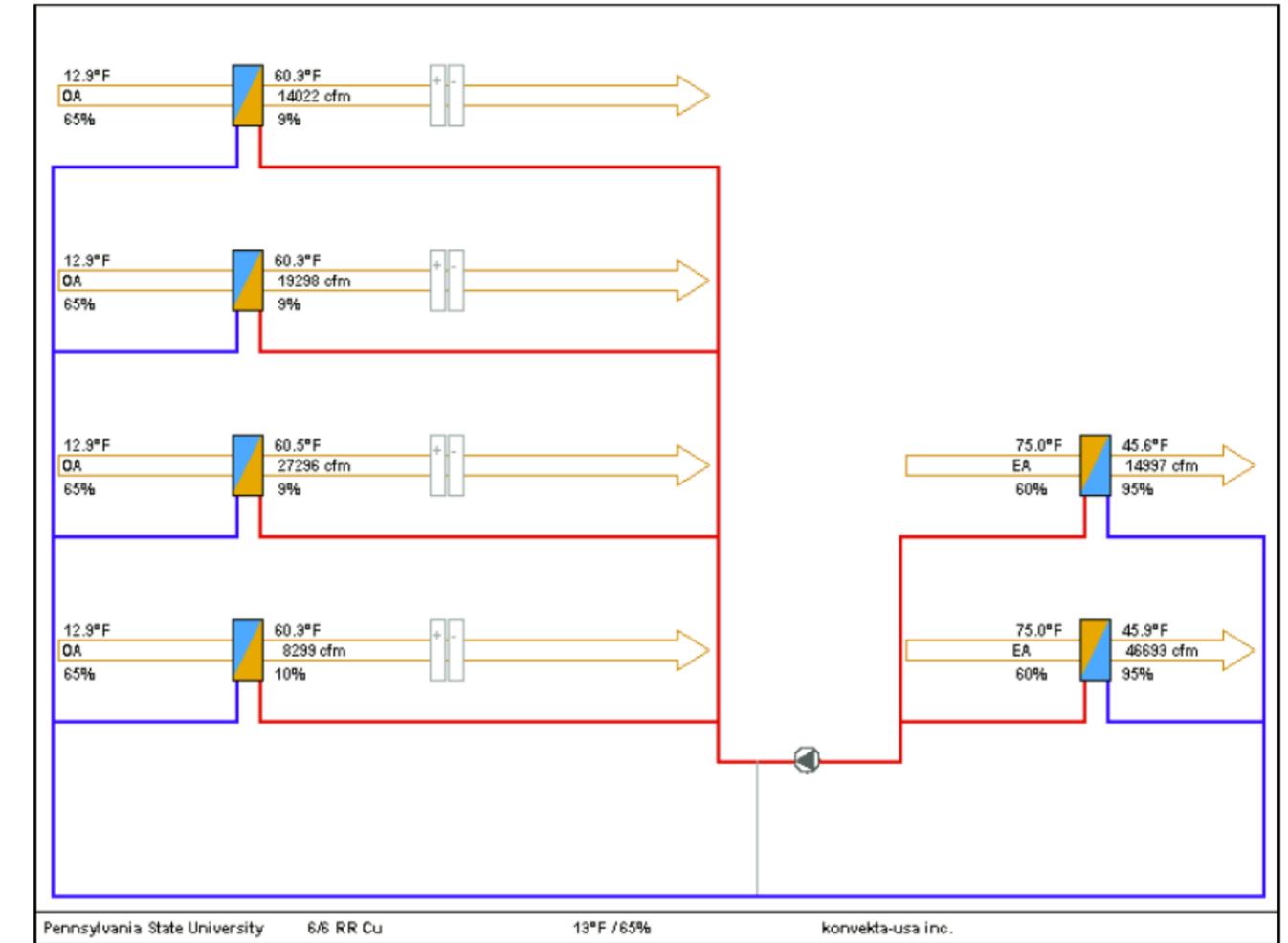
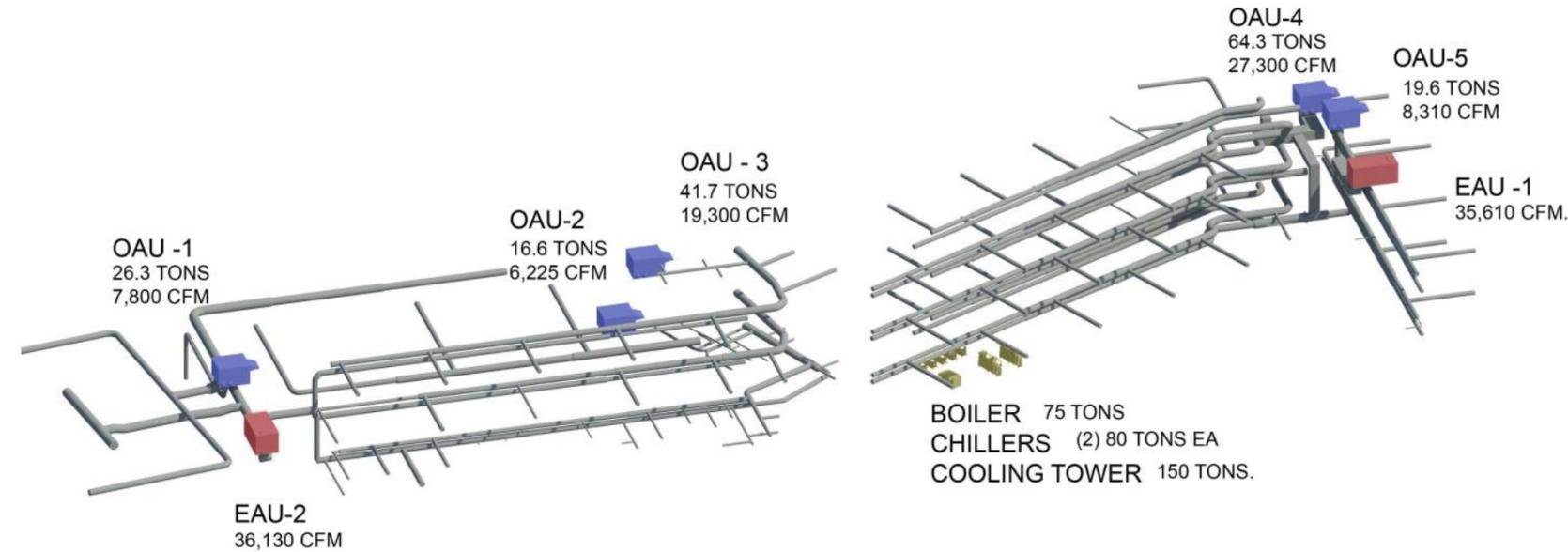
appendix

	Zone	Cooling Capacity [TONS]	Heating Capacity [TONS]	Airflow [CFM]
1	Pool	15.6	26.3	7800
2	Multi-Purpose Room	16.6	7.6	6225
3	Lobby/Admin Wing	41.7	33.0	19300
4	Central Wing	64.3	71.1	27300
5	Right Wing	19.6	10.8	8310
	TOTAL	157.8	148.7	68935





De-humidification Circuit



### COMPOSITE BEAM DESIGN SPREADSHEET

LL 27 psf	Reduced LL 22 psf	$K_{LL}$ 2	
Superimposed DL 15 psf	Deck depth 3 in.	Slab depth 3 in.	Total depth 6 in.
Span 40 ft	Spacing 9.33 ft	Deck and Slab DL 56 psf	Beam Self Weight Assumption 5.2 psf
$W_{DL}$ 0.71 klf	$W_{LL}$ 0.3 klf	$W_{SL}$ 1.35 klf	Concrete strength 4 ksi
$V_U$ 27.0 kips	$M_U$ 269.7 kip-ft		
$b'$ 56 in.	$b_{eff}$ 112 in. interior exterior	$Q_u$ 17.2 kips	$\Delta_{LL, Allowable}$ 1.33 in.
$I_{max}$ (From $\Delta_{LL, Allowable}$ ) 375.39 in <sup>4</sup>	a (assumed) 2 in.	$Y_2$ 5 in.	
Pick Section From Steel Manual W 14 x 48		$I$ (Non-Composite) 510 in <sup>4</sup>	$\phi M_p$ 249 kip-ft
$I$ 484 in <sup>4</sup>	$\Sigma O_u$ 260 kips		
# of studs 32	Economy 2240		
$\Delta$ 2 in.	$I_{min}$ (From $\Delta_{TL, Allowable}$ ) 957	$LL_{Construction}$ 20 psf	
$W_{unshored}$ 0.83 klf	$M_{unshored}$ 165 kip-ft		
$\Delta_{wet\ concrete}$ 2.34186	$W_{wet\ concrete}$ 0.6 klf		
Check Self-Weight 5.2 psf	a 0.68 in.		
Camber 1.25 in			

### COMPOSITE GIRDER DESIGN SPREADSHEET

\*Add 1 kip to each point load for beam self weight

$P_D$ 28.448	$P_L$ 10.08	$P_U$ 51.266	Concrete strength 4 ksi	Deck and Slab DL 56 psf
Span 28 ft	Spacing 40.00 ft	$b'$ 42 in.		
$b_{eff}$ 84 in. interior exterior	$V_U$ 51.3 kips	$M_U$ 478.5 kip-ft		
$I_{min}$ (From $\Delta_{LL, Allowable}$ ) 504.53 in <sup>4</sup>	$\Delta_{LL, Allowable}$ 0.93 in.			
$Q_u$ 21 kips	a (assumed) 2 in.	$Y_2$ 5 in.		
Pick Section From Steel Manual W 24 x 68		$I$ (Non-Composite) 1830 in <sup>4</sup>	$\phi M_p$ 664 kip-ft	
$I$ 2970 in <sup>4</sup>	$\Sigma O_u$ 251 kips	$\phi M_n$ 916 kip-ft		
# of studs 24	Economy 2144			
$\Delta$ Checks	$\Delta_{TL, Allowable}$ 1.4 in.	$I_{min}$ (From $\Delta_{TL, Allowable}$ ) 1286	$LL_{Construction}$ 20 psf	
$P_{unshored}$ 43.53 kips	$M_{unshored}$ 406 kip-ft			
$\Delta_{wet\ concrete}$ 1.2951074	$I_{min, WC}$ (From $\Delta_{TL, Allowable}$ ) 1693			
Check Self-Weight OK	a 0.88 in.			
Camber 1.25 in				

### EARTHQUAKE LOAD CALCULATION SPREADSHEET

C<sub>s</sub> Coefficient Calculation

Spectral Response Acc. (from ASCE 7-05)

$S_{D1}$ 0.25	$S_{D2}$ 0.16	$S_{D3}$ 0.1	$S_{D4}$ 0.06
$F_p$ 1.5	$F_v$ 1.5	$T_p$ 0.417	$T_v$ 0.140
$R$ (N-S) 1.5	$R$ (E-W) 1.5		

Building Data

Total Height 38 ft	Roof 42 ft	3rd Floor 28 ft	2nd Floor 24 ft
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Story Heights

Roof 42 ft	3rd Floor 28 ft	2nd Floor 24 ft
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Triangular Areas

Roof 1836 m <sup>2</sup>	Floor 2136 m <sup>2</sup>	ICF Wall 2136 m <sup>2</sup>	Curtain Wall 1558 m <sup>2</sup>
Roof 712 m <sup>2</sup>	Floor 7712 m <sup>2</sup>	ICF Wall 4796 m <sup>2</sup>	Curtain Wall 2136 m <sup>2</sup>
Roof 568 m <sup>2</sup>	Floor 6072 m <sup>2</sup>	ICF Wall 4916 m <sup>2</sup>	Curtain Wall 2136 m <sup>2</sup>

Roof Level Load  
 $W_u = 1031.5$  kips

3rd Floor Load  
 $W_u = 2151.2$  kips

2nd Floor Load  
 $W_u = 2140.1$  kips

Total  $W_u = 5322.73$  kips

Load Distributions:

N-S: Base Shear 1023.6 kips	E-W: Base Shear 831.7 kips
$C_{u1}$ 0.3245	$C_{u2}$ 0.4511
$C_{u3}$ 0.2244	

Roof  
332.1 kips

3rd Floor  
461.8 kips

2nd Floor  
229.7 kips

Roof  
269.8 kips

3rd Floor  
375.2 kips

2nd Floor  
186.6 kips

### WIND LOAD CALCULATION SPREADSHEET

Building Classification: III

Basic Wind Speed: 90 mph

Exposure: B (urban)

Building Height: 42 ft

Gust Factor: 0.85

Velocity Pressure  
 $q_z = 0.00256KzKztKdV^2$

$Kz$	Case 1 (C&C)	Case 2 (MLFRS)	$q_h$ (psf)	Case 1 (C&C)	Case 2 (MLFRS)
0-15	0.7	0.57	0-15	14.188608	11.5535808
20	0.7	0.62	20	14.188608	12.5670528
25	0.7	0.66	25	14.188608	13.3778304
30	0.7	0.7	30	14.188608	14.188608
40	0.76	0.76	40	15.4047744	15.4047744
50	0.81	0.81	50	16.4182464	16.4182464

Internal Pressure Coefficient  
Probability +/-  
Maybe +/-

Internal Pressure Coeff. Part. Enc.	Open
Windward	-0.5
Side	-0.7

Roof Ex. Press. Coeff.

Roof	-0.9
h-2h	-0.5
>2h	-0.3

Wind Load Study: Safe Room

Building Classification: III

Basic Wind Speed: 160 mph

Exposure: B (urban)

Building Height: 42 ft

Gust Factor: 0.85

Velocity Pressure  
 $q_z = 0.00256KzKztKdV^2$

$Kz$	Case 1 (C&C)	Case 2 (MLFRS)	$q_h$ (psf)	Case 1 (C&C)	Case 2 (MLFRS)
0-15	0.7	0.57	0-15	44.843008	36.5150208
20	0.7	0.62	20	44.843008	39.7180928
25	0.7	0.66	25	44.843008	42.7895904
30	0.7	0.7	30	44.843008	44.843008
40	0.76	0.76	40	48.866944	48.866944
50	0.81	0.81	50	51.8897664	51.8897664

Internal Pressure Coefficient +/-

Internal Pressure Coeff. +/-	0.55
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External Pressure Coeff. Part. Enc.

Roof	-0.5
Windward	0.8
Side	-0.7

Roof Ex. Press. Coeff.

Roof	-0.9
h-2h	-0.5
>2h	-0.3

Roof Ex. Press. Coeff.

Roof (h-h)	Roof (h-2h)	Roof (>2h)
-8.96855552	-43.7219328	-36.09862144

Roof Ex. Press. Coeff.

Roof (h-h)	Roof (h-2h)	Roof (>2h)
-8.64124672	5.605376	13.27868736

### ROOF/SNOW LOAD CALCULATION SPREADSHEET

Snow Load

$p_g$	35 psf	$p_f$	27 psf
$C_e$	1	$p_s$	54 psf
$C_d$	1	$p_g$	49
$l$	1.1	$w$	10.5
$h_u$	2.625		
$\gamma$	18.55		

Roof Live Load

LL	20 psf	$A_1$	200
$R_1$	1		
$R_2$	1		
LL Reduced	20		

Total Load  
146 psf

Roof Deck  
3C22 56 psf

Joist  
TL= 1.28 klf

Joist-Girder  
TL= 18.0

60' span G10N60 41 plf

Capacity 87 psf

3-Span-Max Span 6'11"

10.1 plf

Superimposed DL 15 psf

38

49 psf

27 psf

10.5ft

Snow Drift

### EXTERIOR BEARING WALL DESIGN SPREADSHEET

1st Floor  
2nd Floor  
3rd Floor  
Roof

$P_u$	47.2		
	41.2		
	41.2		
	17.6		
Total	147.2		
x2	294.4		

Empirical Design Method  
 $\phi P_n = 0.55\phi f'_c A_g [1 - (k_l/32h)^2]$

Wall Dimensions

0.50	x	7	504
			$(A_g)$

$\rho_{min\ vert}$  0.0015

$\rho_{min\ horiz}$  0.0025

$s$  12

$k$  1

$h$  12

$l_c$  504

$f'_c$  4

Compression Members  
 $\phi P_{n, max} = 0.80\phi [0.85f'_c (A_g - A_{st}) + f_y A_{st}]$

$A_{st}$  14

$A_g$  504

$f_y$  60

$f'_c$  4

$\phi$  0.85

$\phi P_{n, Max}$  1704.08

Shear in Walls  
 $V_c = 2\lambda f'_c A_c^{1/2} h d$

$V_s = A_v f_y d/s$

$\lambda$	$f'_c$	$h$	$d$	$\phi$
1	4000	6.00	67.2	0.75
$V_c$	$V_s$	$s$	$A_v$	bar#
51.00121	49.28	18	0.22	3
$\phi V_n$				
75.21091				

nexus

function

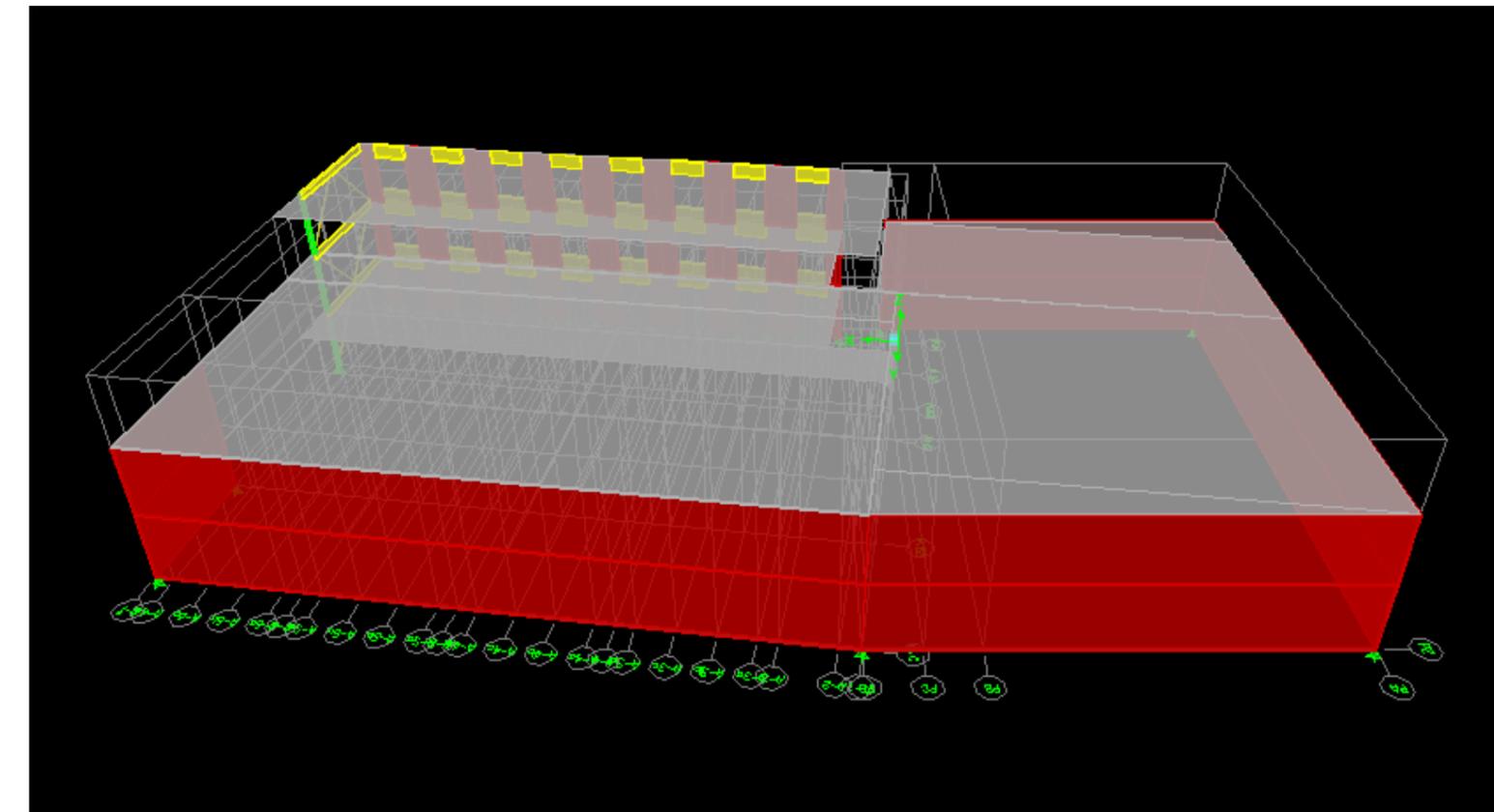
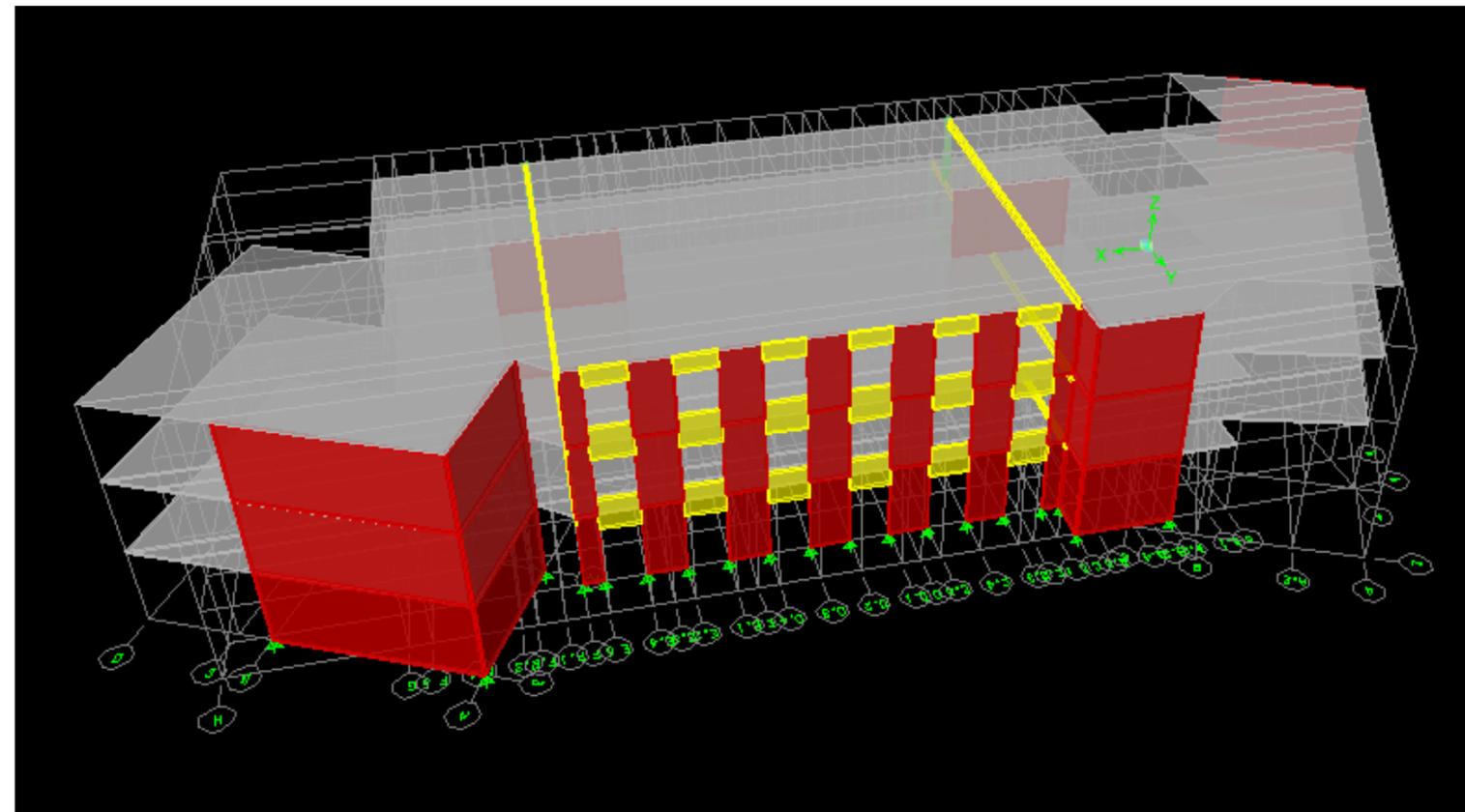
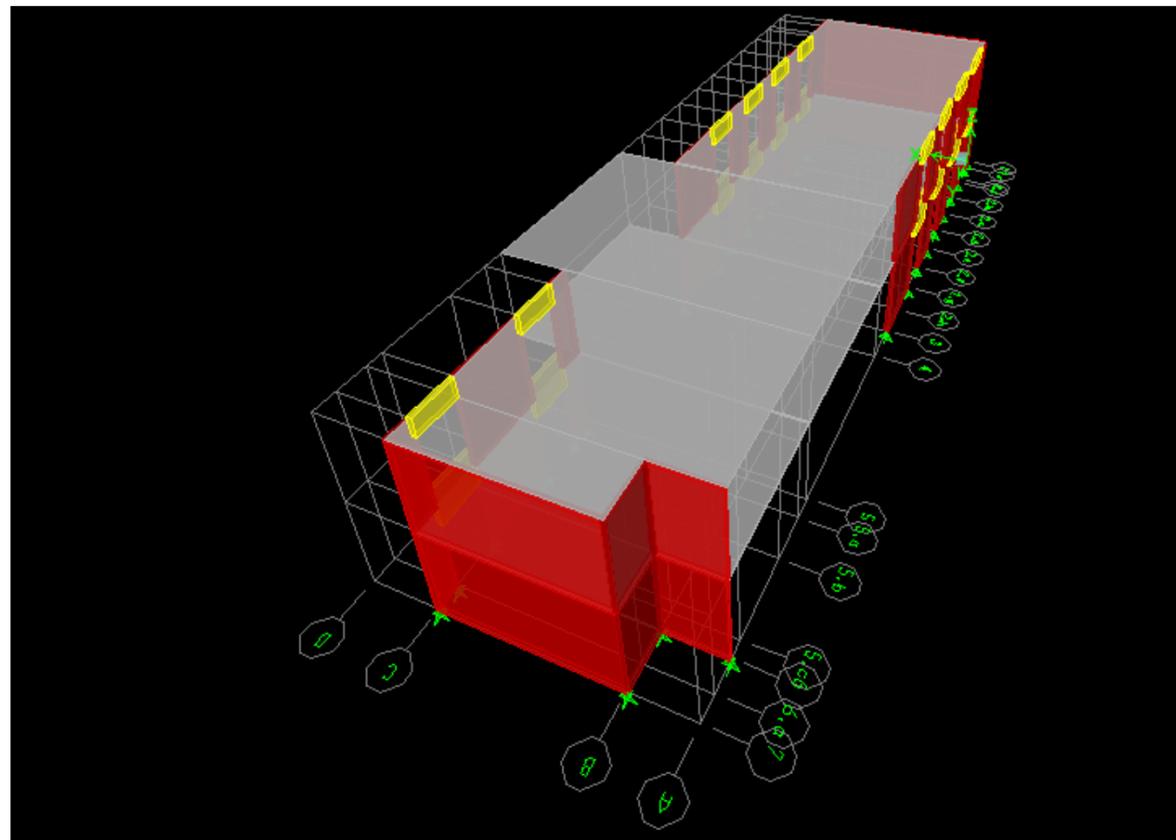
experience

community

education

conclusion

**appendix**



# conclusion

nexus

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experience

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**conclusion**

appendix



experience



community



education

