PROGRESS REPORT
MILLENNIUM SCIENCE COMPLEX

Developed By:

KGB Maser

Management. Engineering. Consulting.

KGB Maser’s Team Goal

Reducing the cost of the structural system will provide the necessary funding for energy efficient upgrades which is anticipated to produce life cycle savings.

Façade analysis has included exploring different overhang depths, construction types, and shading

FAÇADE REDESIGN

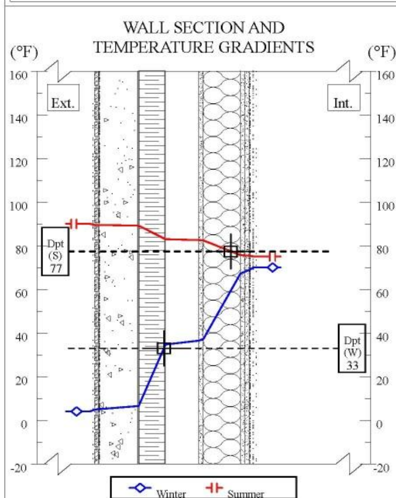
DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS

R VALUE ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (12)



PROJECT

Name	MSCexisting
Number	111
City	Pittsburgh AP, PA
Date	1/21/2011
Analysis by:	MPG
Wall Type	Option

CLIMATIC CONDITIONS

	Winter		Summer	
	Int.	Ext.	Int.	Ext.
Temp (°F)	70	4	75	90
RH (%)	25	80	50	66
DPT (°F)	33	-1	56	77

PENNSYLVANIA STATE UNIVERSITY

104 ENGINEERING, UNIT A
UNIVERSITY PARK, PA, USA, 16802

	Generic Material	Manufacturer	Model No.	Thick (in.)	RVal (R)	W.Temp. (°F)	S.Temp. (°F)
1	air film (ext), 3/4 in.	No Recor...	Generic...	0.75	0.17	4.8	89.5
2	brick, facing, 1/2 in.	No Recor...	Generic...	0.50	0.12	5.0	89.5
3	concrete wall, 6 in.	No Recor...	Generic...	6.02	0.87	6.5	89.1
4	rigid ins.,(expand.), 4 in.	No Recor...	Generic...	4.00	15.81	34.7	82.9
5	cavity, 5-1/2 in.	No Recor...	Generic...	5.00	0.98	36.5	82.5
6	gypsum bd., 5/8 in., (#1)	No Recor...	Generic...	0.63	0.46	37.3	82.3
7	batt ins., 5-1/2 in.	No Recor...	Generic...	5.50	16.76	67.2	75.6
8	gypsum bd., 5/8 in., (#2)	No Recor...	Generic...	0.63	0.46	68.0	75.4
9	gypsum bd., 5/8 in., (#2)	No Recor...	Generic...	0.63	0.46	68.9	75.3
10	air film (int), 3/4 in.	No Recor...	Generic...	0.75	0.64	70.0	75.0
	Total or (Layer 0)			22.90	36.73	(4.5)	(89.6)

Existing Thickness to Space: 22.90 inches

Existing R Value: 36.73

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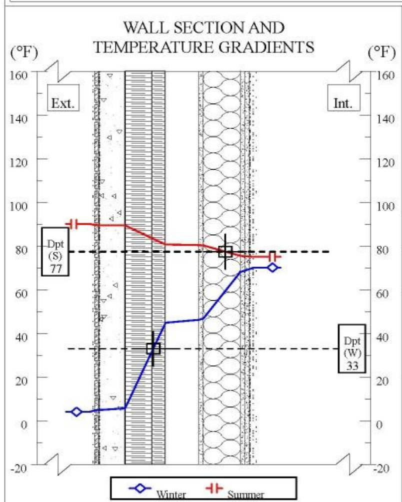

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1	air film (ext), 3/4 in.	No Recor...	Generic...	0.75	0.17	4.7	89.6
2	brick, facing, 1/2 in.	No Recor...	Generic...	0.50	0.12	4.8	89.5
3	concrete wall, 4 in.	No Recor...	Generic...	4.00	0.58	5.6	89.4
4	rigid ins.,(extru.), 4 in.	No Recor...	Generic...	4.00	20.55	31.7	83.5
5	rigid ins.,(extru.), 2 in.	No Recor...	Generic...	2.00	10.27	44.8	80.6
6	cavity, 5-1/2 in.	No Recor...	Generic...	5.00	0.98	46.1	80.3
7	gypsum bd., 5/8 in., (#1)	No Recor...	Generic...	0.63	0.46	46.7	80.2
8	batt ins., 5-1/2 in.	No Recor...	Generic...	5.50	16.76	68.0	75.4
9	gypsum bd., 5/8 in., (#2)	No Recor...	Generic...	0.63	0.46	68.6	75.3
10	gypsum bd., 5/8 in., (#2)	No Recor...	Generic...	0.63	0.46	69.2	75.2
11	air film (int), 3/4 in.	No Recor...	Generic...	0.75	0.64	70.0	75.0
				24.88	51.45	(4.5)	(89.6)

2” additional layer of insulation

Proposed Façade Thickness to Space: 24.88 inches

Proposed R Value: 51.45

NEGLIGIBLE ENERGY IMPACT

Façade analysis has included exploring different overhang depths, construction types, and shading

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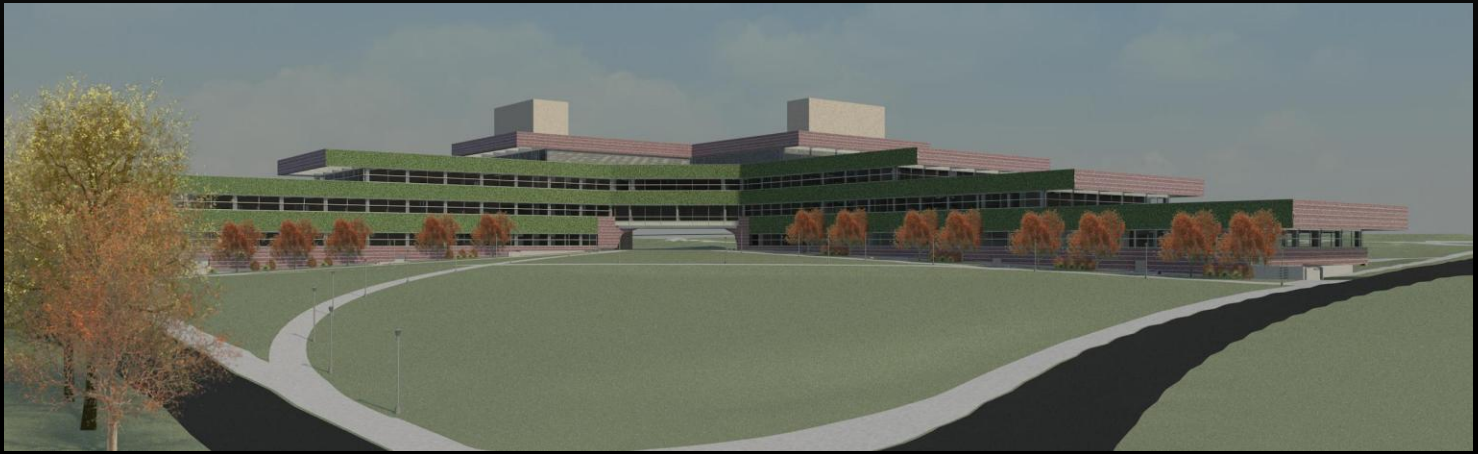
COST & SCHEDULE PROGRESS



GSky Green Wall System rendered on the East façade of the Life Science wing and South façade of the Material Science wing

Façade analysis has included exploring different overhang depths, construction types, and shading

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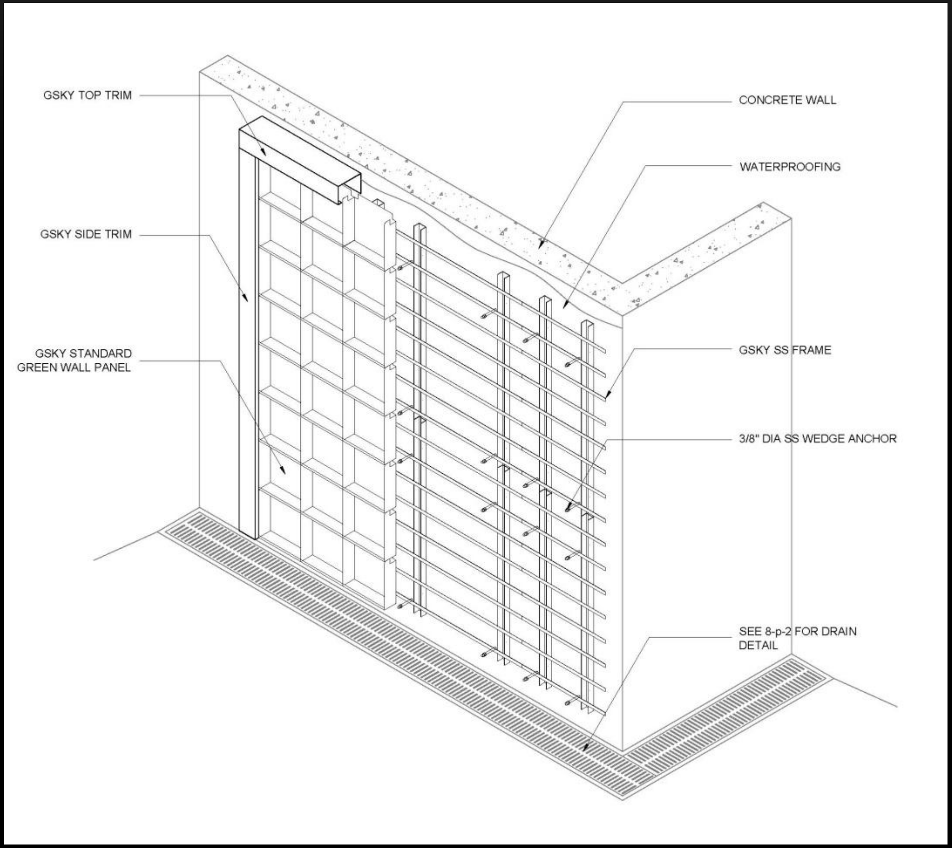

Isometric specification of Green Wall application to concrete wall

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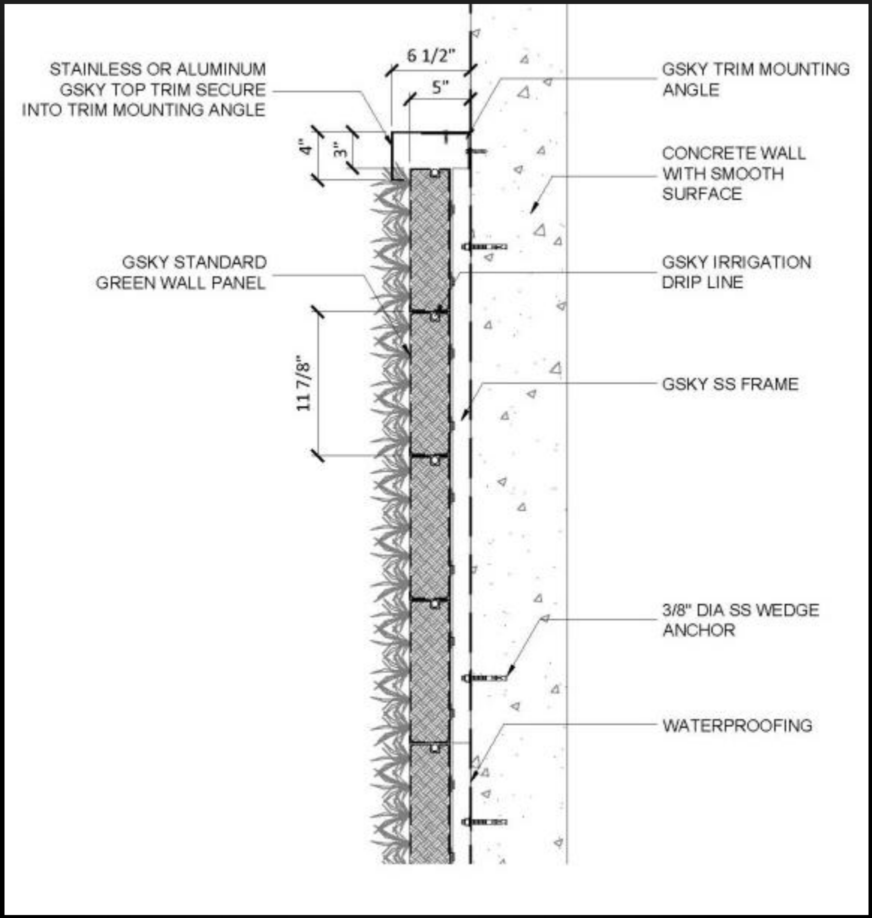

Green Wall Section

Façade analysis has included exploring different overhang depths, construction types, and shading

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COST & SCHEDULE PROGRESS

SCENARIO		ENVELOPE LOADS	PRIMARY HEATING ENERGY	PRIMARY COOLING ENERGY	AUXILARY ENERGY
		% Decrease	% Decrease	% Decrease	% Decrease
VARYING REVEAL DEPTHS	3'	0.02	0.00	0.01	Negligible
	3.5'	0.04	0.01	0.02	
	4'	0.05	0.03	0.02	
IMPROVED GLAZING + REVEAL DEPTHS	2.5'	0.11	0.01	0.04	
	3'	0.12	0.01	0.04	
	3.5'	0.14	0.03	0.05	
	4'	0.15	0.06	0.05	

Façade analysis has included exploring different overhang depths, construction types, and shading

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DISTRIBUTION SYSTEMS

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COST & SCHEDULE PROGRESS

SCENARIO		HTG OPERATING SAVINGS	CLG OPERATING SAVINGS	TOTAL ENERGY SAVINGS	PERCENT OF OPERATING COST
		$/yr	$/yr	$/yr	%
VARYING REVEAL DEPTHS	3'	0	$182.10	$182.10	0.25%
	3.5'	$552.84	$364.20	$917.04	1.25%
	4'	$1,658.52	$364.20	$2,022.72	2.75%
IMPROVED GLAZING + REVEAL DEPTHS	2.5'	$552.84	$728.40	$1,281.24	1.74%
	3'	$552.84	$728.40	$1,281.24	1.74%
	3.5'	$1,658.52	$910.50	$2,569.02	3.50%
	4'	$3,317.04	$910.50	$4,227.54	5.75%

Façade analysis has included exploring different overhang depths, construction types, and shading

FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

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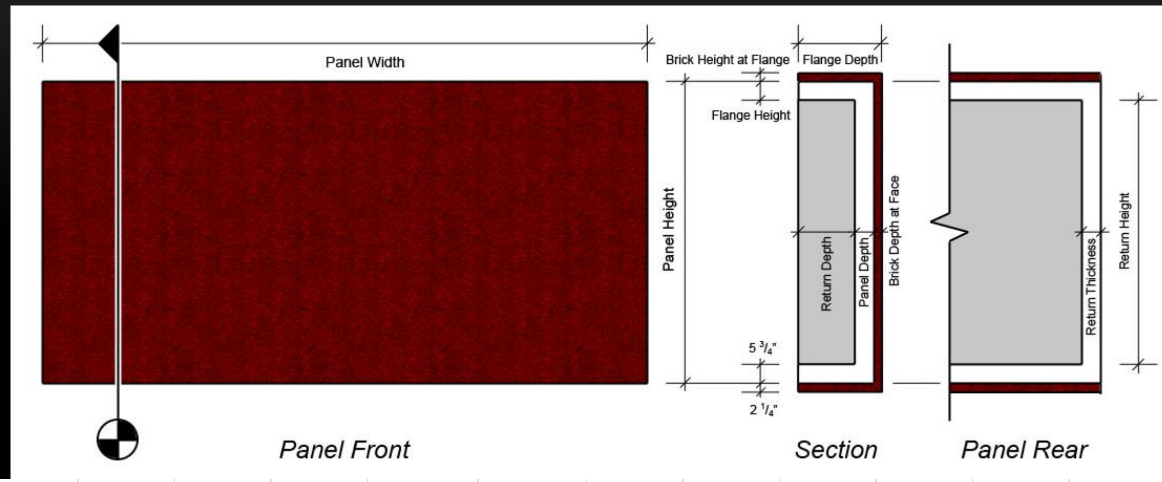
COST & SCHEDULE PROGRESS



	Precast Panel Dimensions		
	Panel Height	141.125	in.
	Panel Depth	5	in.
	Brick Depth at Face	2	in.
	Flange Height	5.75	in.
	Brick Height at Flange	2.25	in.
	Flange Depth	27.6875	in.
	Panel Width	263.25	in.
	Return Thickness	6	in.
	Return Depth	20.6875	in.
	Return Height	129.625	in.
	Volume Concrete	162.3634	ft.3
	Weight Concrete	24354.51	lb.
	Volume Brick	61.9801	ft.3
	Weight Brick	7437.612	lb.
(factored)	Total	44508.98	lb.
(factored)	Total with Planters	44932.07	lb.

	Wind Force	
(factored)	50.992	psf.

Self Weight Check Upright			
Weight/in.	169.0749	lb./in.	
Inertia of Panel	2261764	in.4	
Moment	1464624	lb.in.	
Stress	45.69331	psi.	OK

Planter Gravity Check Upright			
Weight/in.	170.6821	lb./in.	
Inertia of Panel	2261764	in.4	
Moment	1478546	lb.in.	
Stress	46.12767	psi.	OK

Wind Check On Face			
Weight/in.	4.249333	lb./in.	
Inertia of Strip	125	in.4	
Moment	10578.86	lb.in.	
Stress	211.58	psi.	OK

Wind Check On Flange			
Weight/in.	24.98697	lb./in.	
Inertia of Flange	8121.797	in.4	
Moment	216451.3	lb.in.	
Stress	342.2946	psi.	OK

Self Weight Check Prostrate			
Weight/in.	9.625	lb./in.	(factored)
Inertia of Strip	125	in.4	
Moment	18836.44	lb.in.	
Stress	376.7289	psi.	OK

Planter Gravity Check Prostate			
Weight/in.	10.79167	lb./in.	(factored)
Inertia of Strip	125	in.4	
Moment	21119.65	lb.in.	
Stress	422.393	psi.	OK

Cantilever Check on Flange Self Weight		
Weight/in.	11.01042	lb./in.
Inertia of Flange	190.1094	in.4
Moment	2356.079	lb.in.
Stress	35.63068	psi.

Cracking Stress		
477.2971	psi	(factored)

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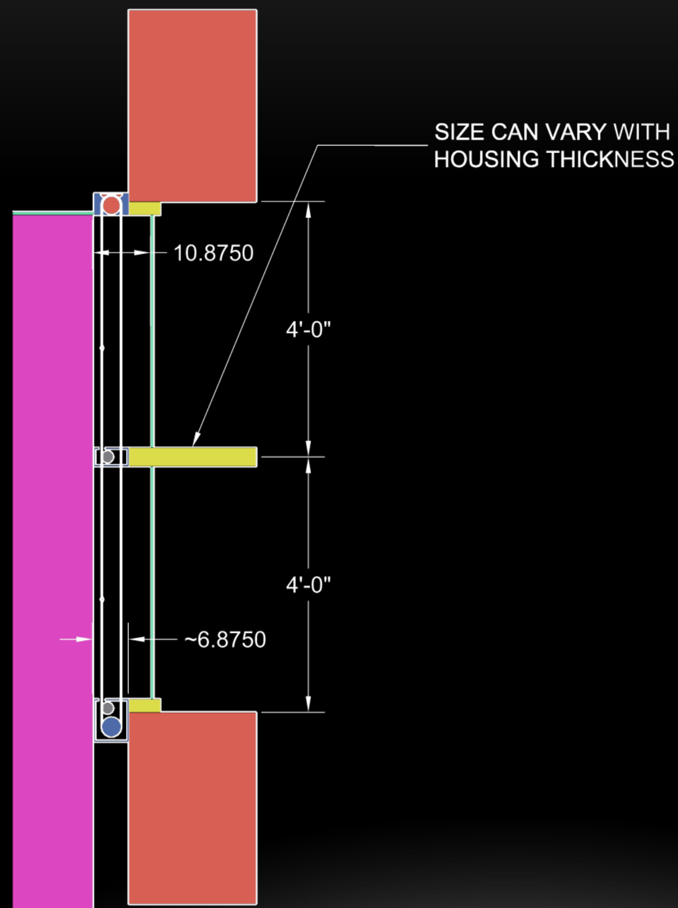
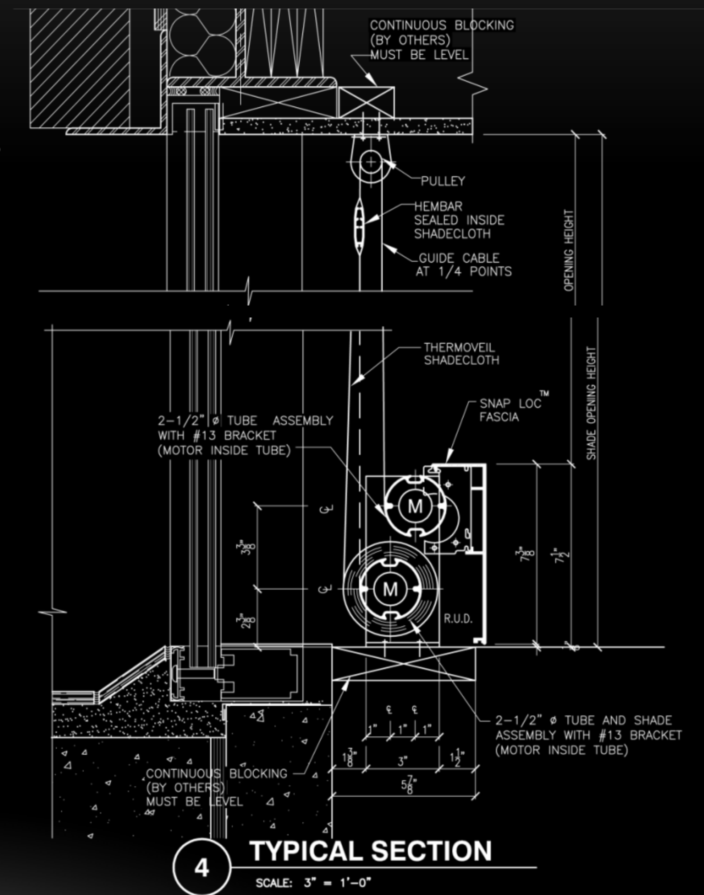
FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS





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DISTRIBUTION SYSTEMS

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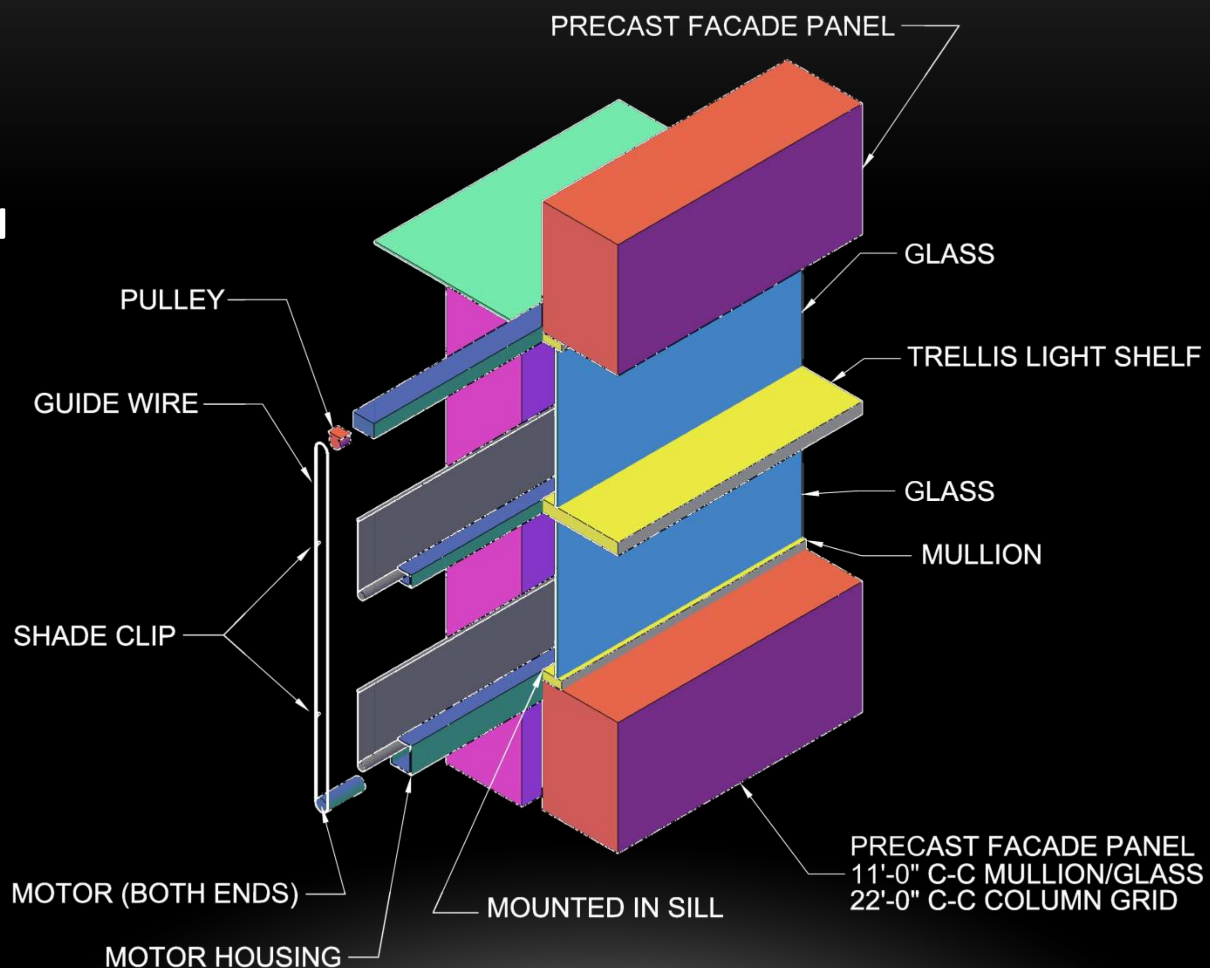
COST & SCHEDULE PROGRESS



Shading is integrated into electric lighting delivery

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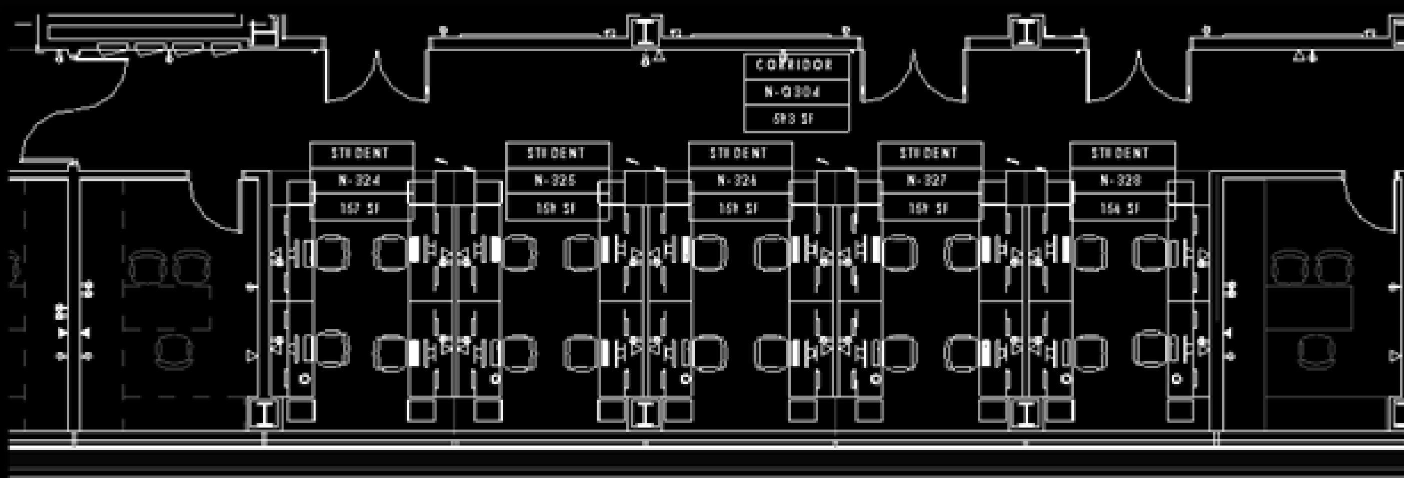
COST & SCHEDULE PROGRESS



Shading, electric lighting, controls, and geometry are combined in the central Revit file

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DISTRIBUTION SYSTEMS

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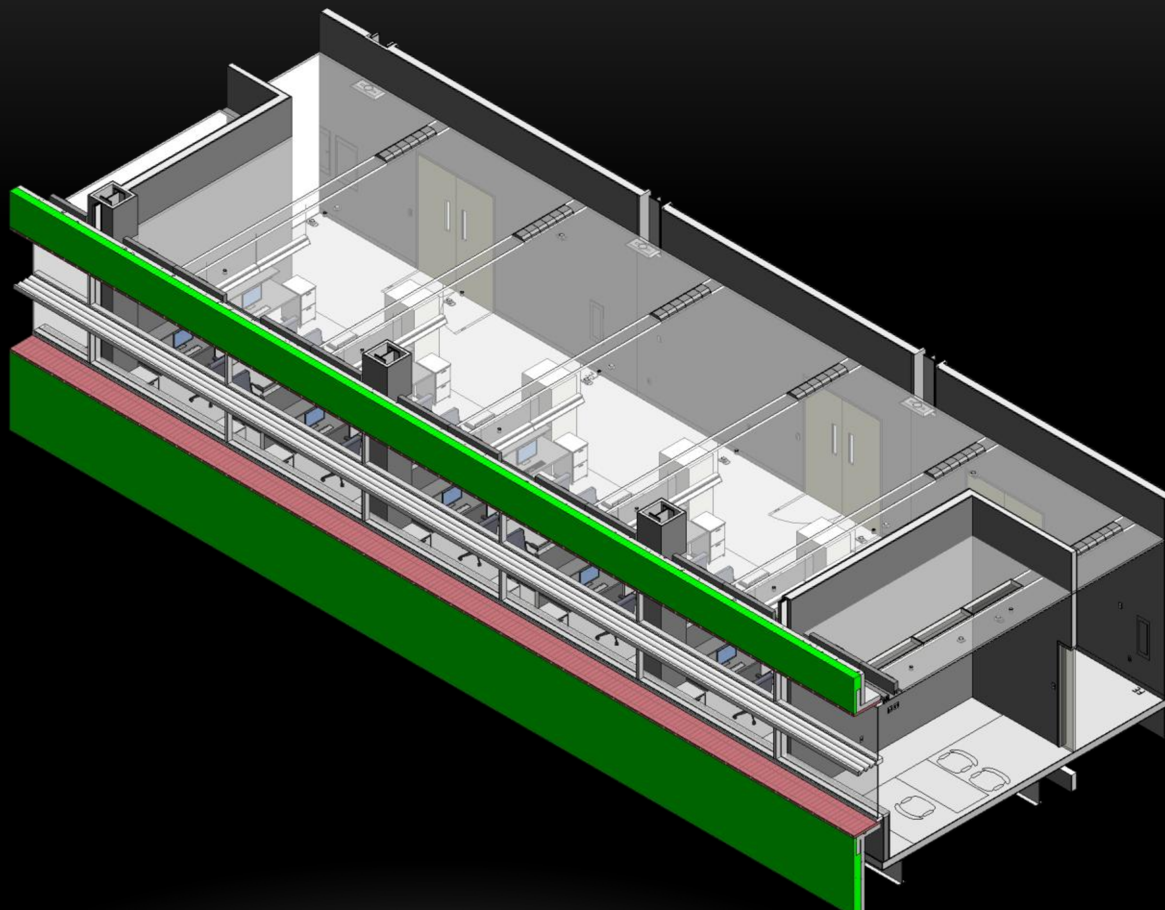
COST & SCHEDULE PROGRESS



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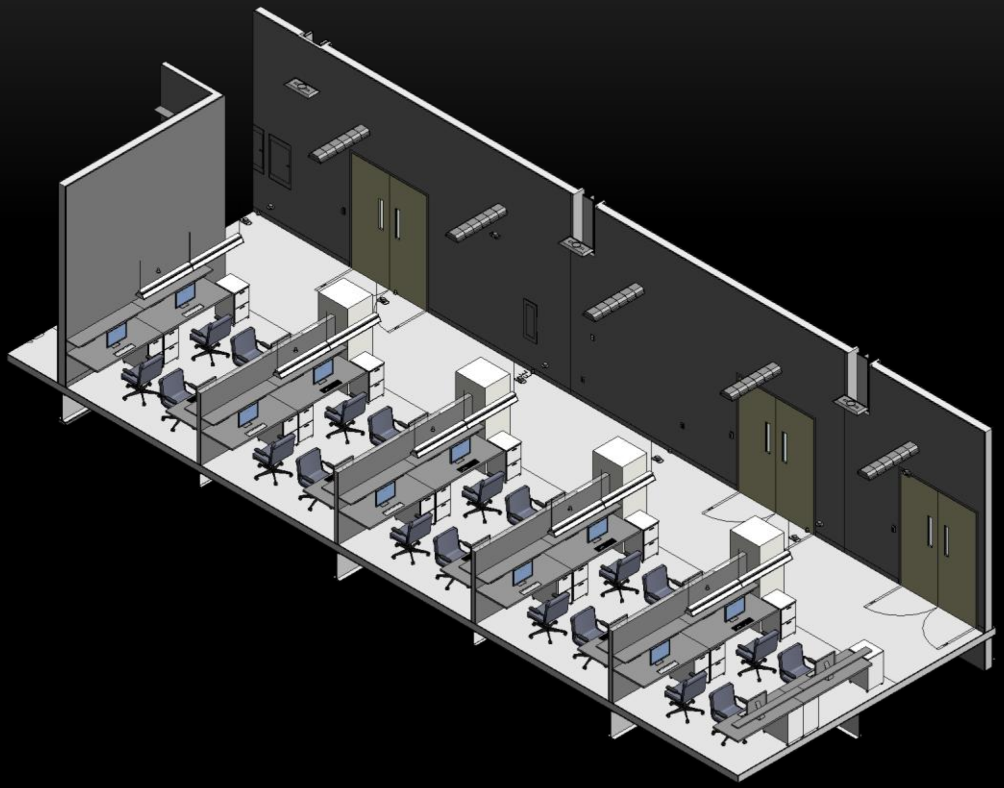

Family types are modeled and photometrics added for rendering ability in Revit Architecture

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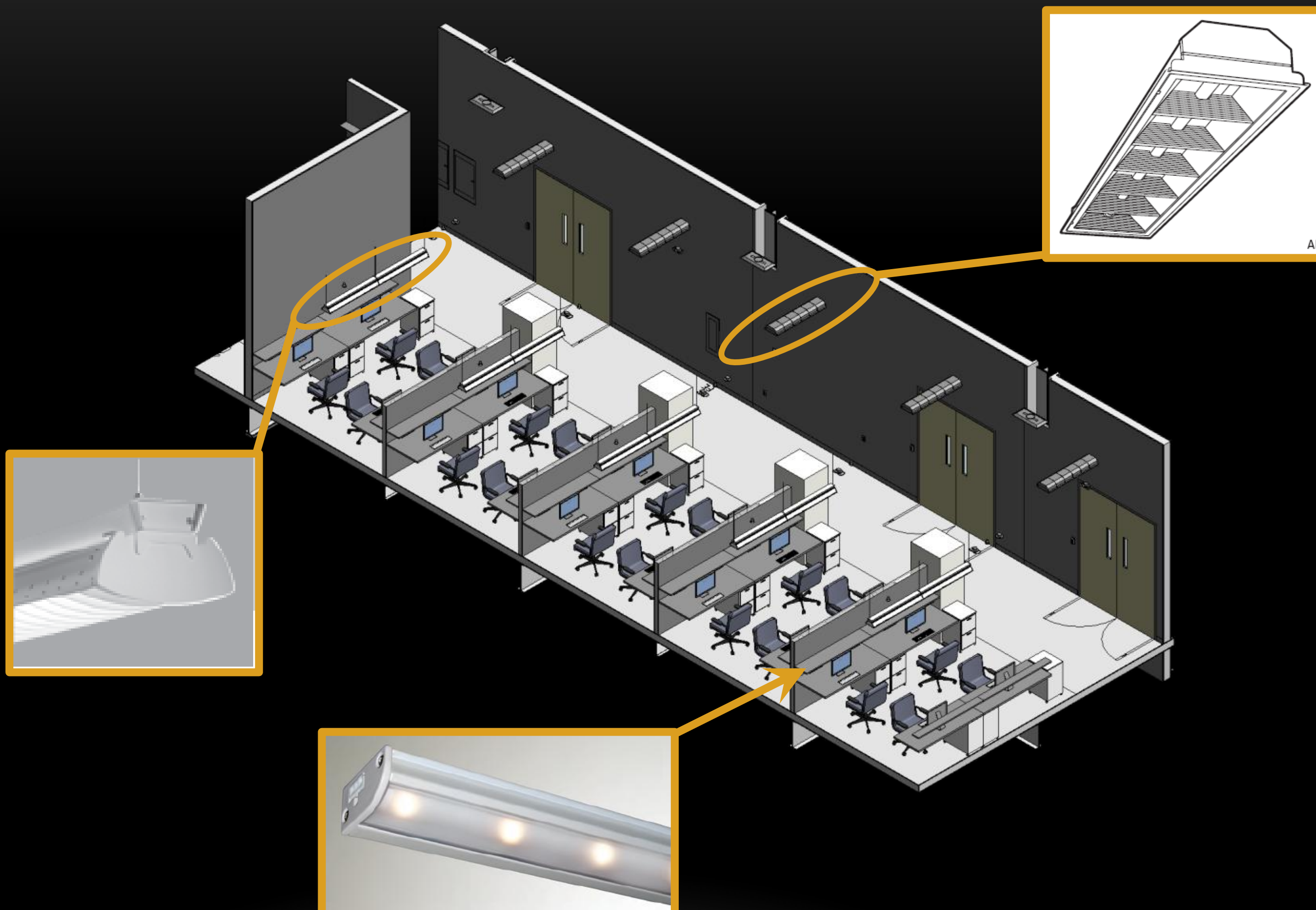
COST & SCHEDULE PROGRESS



Revit formats are exported to AutoCAD formats and imported into lighting analysis software

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COST & SCHEDULE PROGRESS

Chilled beams will be zoned to allow for application throughout the Millennium Science Complex

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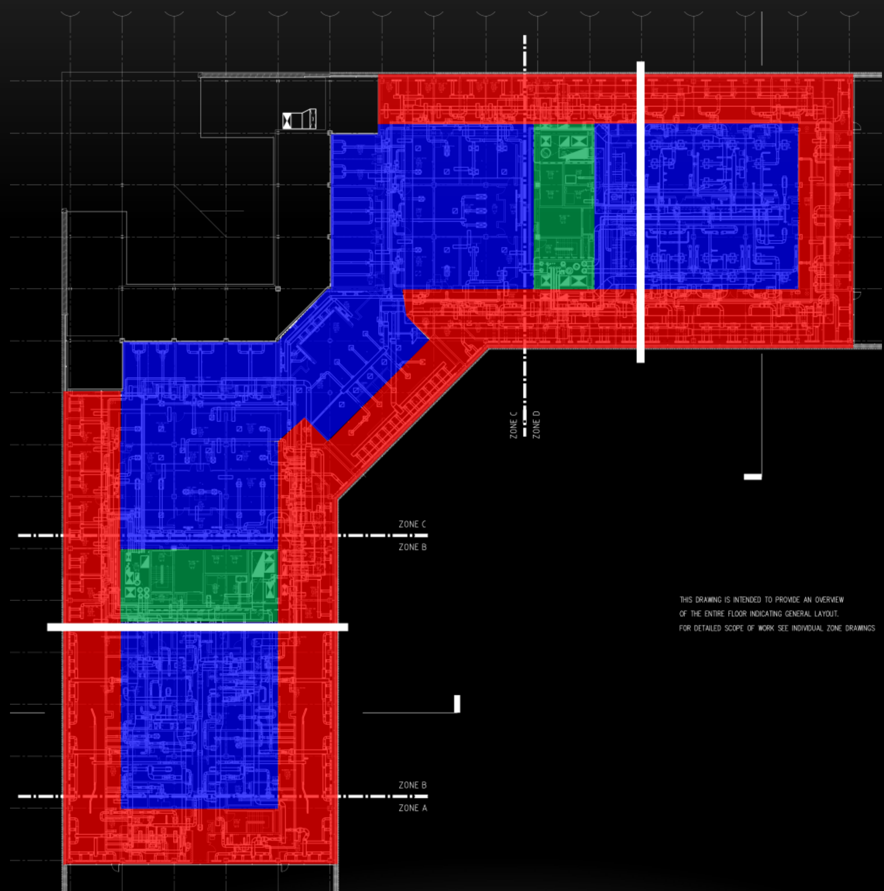
COST & SCHEDULE PROGRESS



EXTERIOR FOUR PIPE BEAMS

INTERIOR TWO PIPE BEAMS

SUPPLEMENTAL COOLING EQUIPMENT

Dual energy recovery at Lab AHUs will deliver neutral air to interior lab spaces and ACBs will provide cooling

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DISTRIBUTION SYSTEMS

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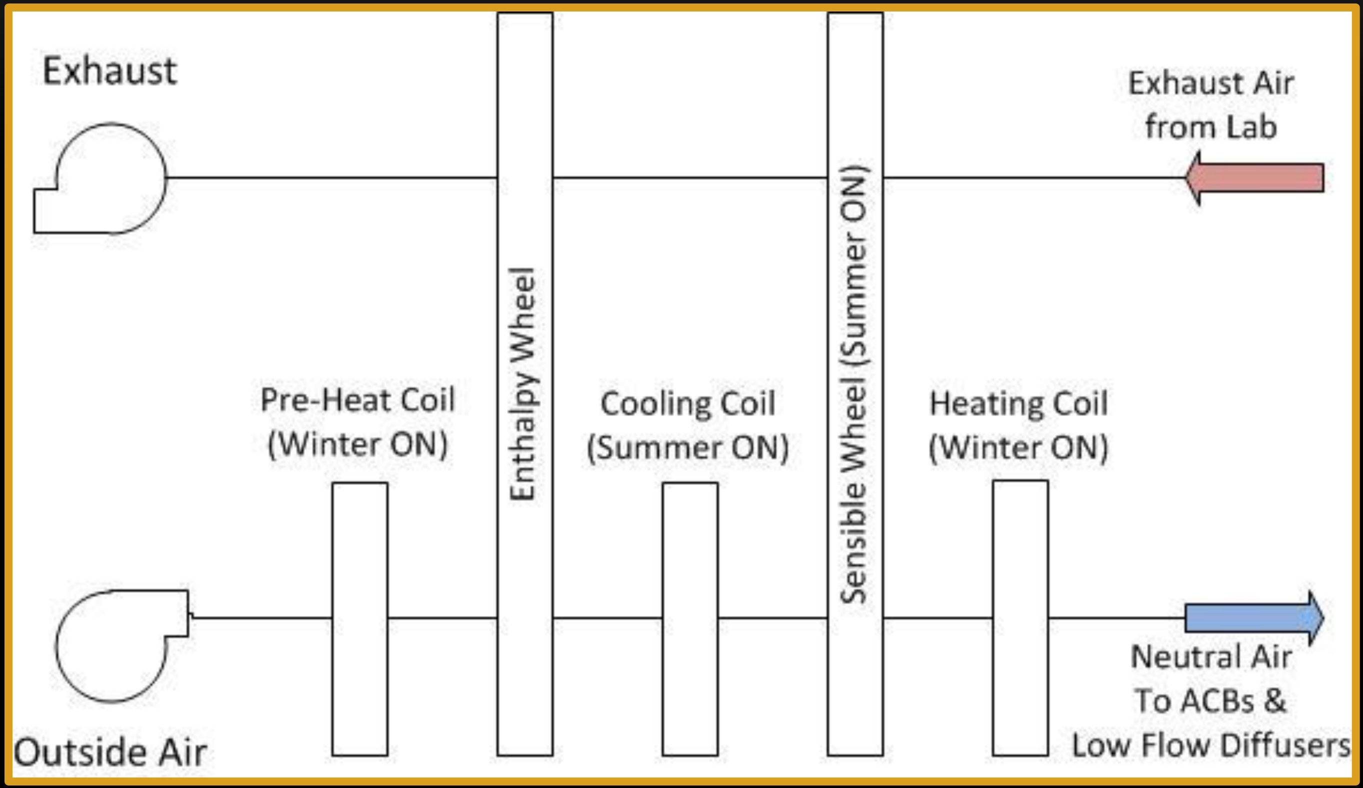
COST & SCHEDULE PROGRESS



Trane TRACE outputs have given preliminary estimates of quantity and performance of chilled beams

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DISTRIBUTION SYSTEMS

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COST & SCHEDULE PROGRESS

ROOM	NUMBER OF CHILLED BEAMS	CAPACITY OF BEAMS IN ROOM BTUH	DESIGN CHW INLET TEMP DEG F	DESIGN CHW OUTLET TEMP DEG F	PRIMARY AIRFLOW TO ROOM CFM
sp-N-237A	4	8331	61.2	65.2	206
sp-N-301	4	6925	61.2	65.2	171
sp-N-303	4	6925	61.2	65.2	171
sp-N-316	2	3055	61.2	65.2	75
sp-N-324A	4	8168	61.2	65.2	202
sp-N-328A	4	8493	61.2	65.2	210

3 Different cases for fume hood energy have been identified for energy and CFD analysis

Case 1: Existing VAV Fume Hoods - 100/125 fpm

Case 2: Low Flow VAV Fume Hoods - 80 fpm

Case 3: Constant Volume Hoods

Cellular members will provide pre-cut voids through which branch ducts will snake to the rooms

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COST & SCHEDULE PROGRESS

CELLULAR BEAM INFORMATION

Job Name	TEST	
Beam Mark #	LB1	
Span	22.000	ft
Spac. Left	11.000	ft
Spac. Right	11.000	ft
Mat. Strength-Fy	50	ksi
Cellular Beam	LB30X44	
Root Beams (T/B)	W21X44	W21X44
d	20.66	20.66
bf	6.5	6.5
tf	0.45	0.45
tw	0.35	0.35

CELLULAR PARAMETERS:

Min. Hole Diameter	15.69	in
Max. Hole Diameter	27.44	in
STD Hole Diameter Do	20.75	in
STD Hole Spacing S	29.250	in
Web Post Width "e"	8.500	in
S / Do	1.41	
Gross Depth "dg"	30.12	in
dg / Do	1.452	
Cutting Loss	0.910	
dt top	4.687	in
dt bot	4.687	in

CMC Steel Products

LOADING INFORMATION

Uniform Distributed Loads

Live Load	2640	plf	Pre-comp %	0%
Dead Load	1056	plf	Pre-comp %	85%

Concentrated Point Loads

Load # (#)	Magnitude (kips)	Dist from Lft. End (ft)	Percent DL (%)	Percent Pre-Comp.
P1	0.00	0.00	0%	0%
P2	0.00	0.00	0%	0%
P3	0.00	0.00	0%	0%
P4	0.00	0.00	0%	0%

COMPOSITE INFORMATION

Concrete & Deck:		Shear Studs:	
conc. strength - fc' (psi)	3000	stud dia. (in)	3/4"
conc. wt. - wc (pcf)	115	stud ht. (in)	5
conc. above deck - tc (in)	3 1/4	studs per rib	1
rib height - hr (in)	3	composite %	100%
rib width - wr (in)	6	STUD SPACING:	
		N=50,Uniformly Dist.	

RESULTS

Failure Mode	Interaction	Status
Bending	0.763	OK
Web Post	0.719	OK
Shear	0.537	OK
Concrete	0.322	OK
Pre-Comp.	0.537	OK
Overall	0.763	OK

WARNINGS

DEFLECTION

Pre-Composite Deflection	0.109	=L/2426
Live Load Deflection	0.146	=L/1812

EXPAND'D. SXN. PROP'S

Avg. wt.	44.00	plf
Anet	8.89	in^2
Agross	16.16	in^2
Ix net	1772	in^4
Ix gross	2032	in^4
Ix critical	1847	in^4
Min Sx net	118	in^3
Min Sx gross	135	in^3
Min Sx critical	123	in^3
rx min	11.22	in
Iy net	21	in^4
Sy net	6.35	in^3

COMPOSITE SXN. PROP'S

n	13.577	
beffec.	66.000	in
Actr	15.799	in^2
N.A. ht.	27.275	In Steel
Itr	4186	in^4
Ieffec.	4186	in^3
Sxconc	459.967	in^3
Sxsteel	153.462	in^3

CONSTRUCTION BRIDGING

End Connection type	Double clip
Min. No. Of Bridging Rows	0
Max. Bridging. Spacing (ft)	38

Stnd " Do " & " S "

To Help Sheet

Find Lightest Cellular Beam

Cellular members will provide pre-cut voids through which branch ducts will snake to the rooms

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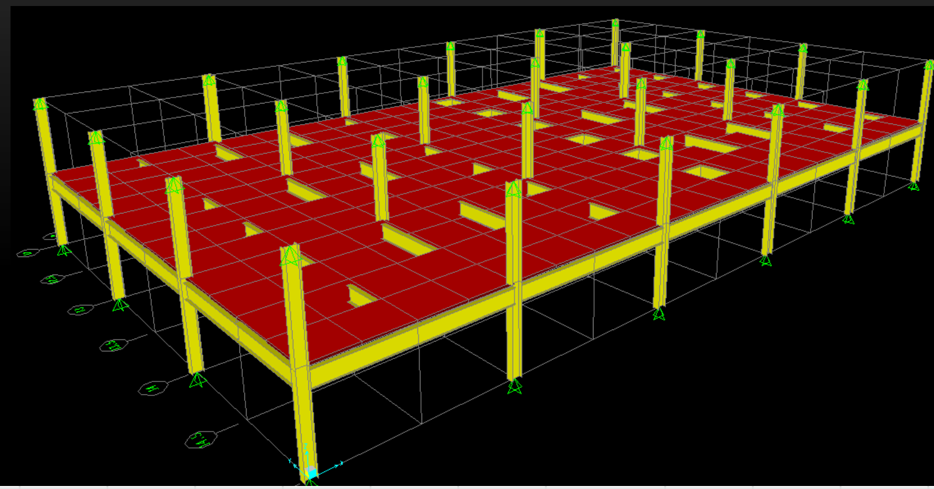

SPAN	Lx	Ly	t	w	Wslab	Wbeams	NODE	Wi	Δ	Wi.Δ^2	P.Δ	Tcalc	T(SAP)	Vel			fn
	ft	ft	in	ksf	kip	kip		kip	in		P=100 k	sec	sec	µ in/sec			Hz
SPAN-A	22.0	22.0	3.3	0.049	23.619	3.872	1	0.524	0.0013	0.0000	160.6674	0.0604		3075	Mod Walking		16.6
							2	0.893	-0.0175	0.0003							
- due to load at A13							3	0.893	-0.0295	0.0008							
							4	0.893	-0.0175	0.0003							
							5	0.524	0.0013	0.0000							
							A1	0.893	0.0470	0.0020							
							A2	1.631	0.0640	0.0067							
							A3	1.631	0.0981	0.0157							
							A4	1.631	0.0640	0.0067							
							A5	0.893	0.0470	0.0020							
							A6	0.893	0.0773	0.0053							
							A7	1.631	0.1908	0.0594							
							A8	1.631	0.2487	0.1009							
							A9	1.631	0.1908	0.0594							
							A10	0.893	0.0774	0.0054							
							A11	0.893	0.0525	0.0025							
							A12	1.631	0.6123	0.6116							
							A13	1.631	1.6067	4.2105							
							A14	1.631	0.6122	0.6113							
							A15	0.893	0.0526	0.0025							
							A16	0.524	0.0050	0.0000							
							A17	0.893	0.0907	0.0073							
							A18	0.893	0.1352	0.0163							
							A19	0.893	0.0905	0.0073							
							A20	0.524	0.0050	0.0000							
SPAN-B	22.0	22.0	3.3	0.049	23.619	3.179	A16	0.496	0.0012	0.0000	152.4988	0.0572		2714	Mod Walking		17.5
							A17	0.865	-0.0046	0.0000							
- due to load at B13							A18	0.865	-0.0075	0.0000							
							A19	0.865	-0.0046	0.0000							

A base electrical analysis model has been created for system performance analysis

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DISTRIBUTION SYSTEMS

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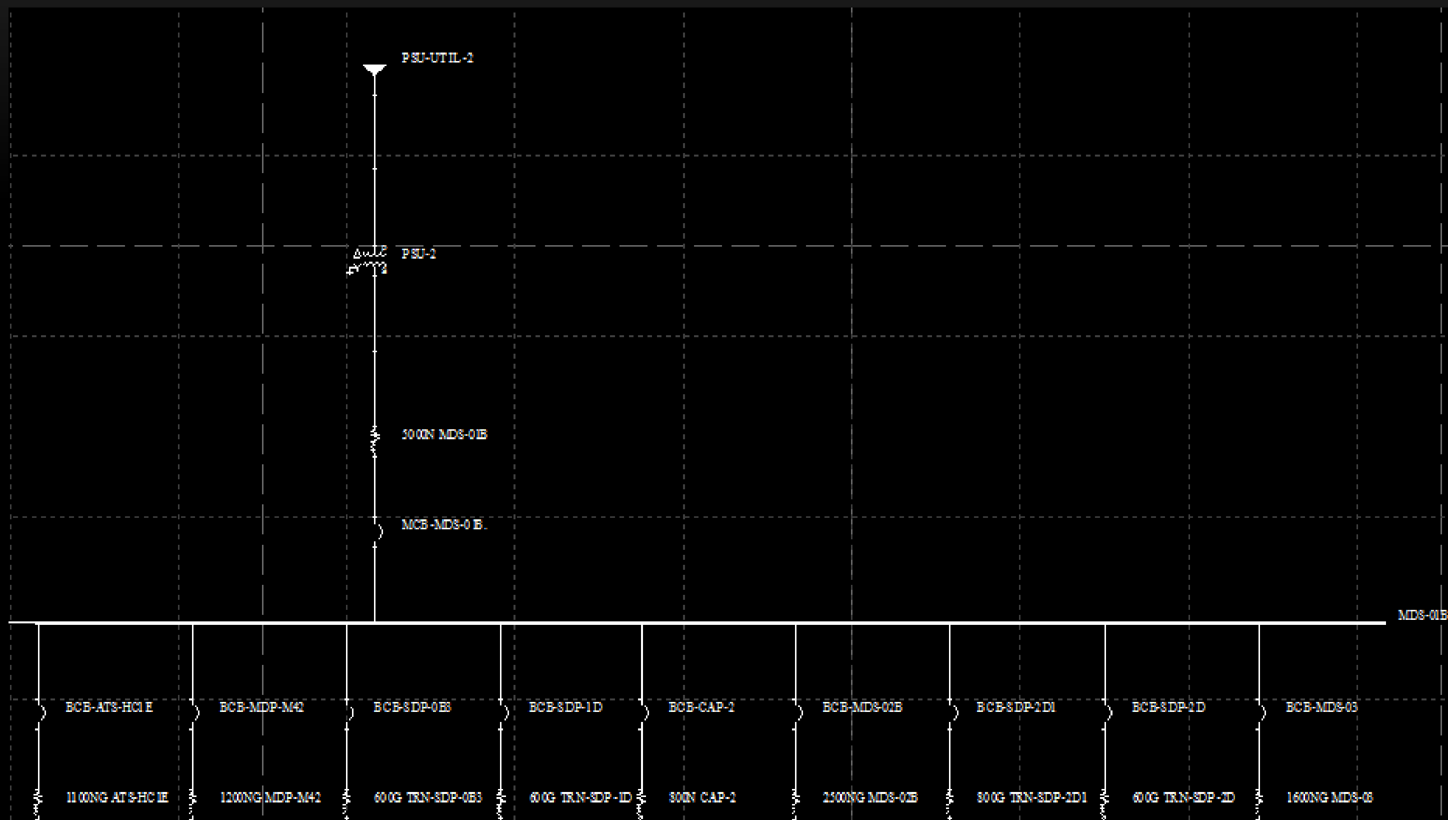
COST & SCHEDULE PROGRESS



Components include mechanical equipment supplying the third floor

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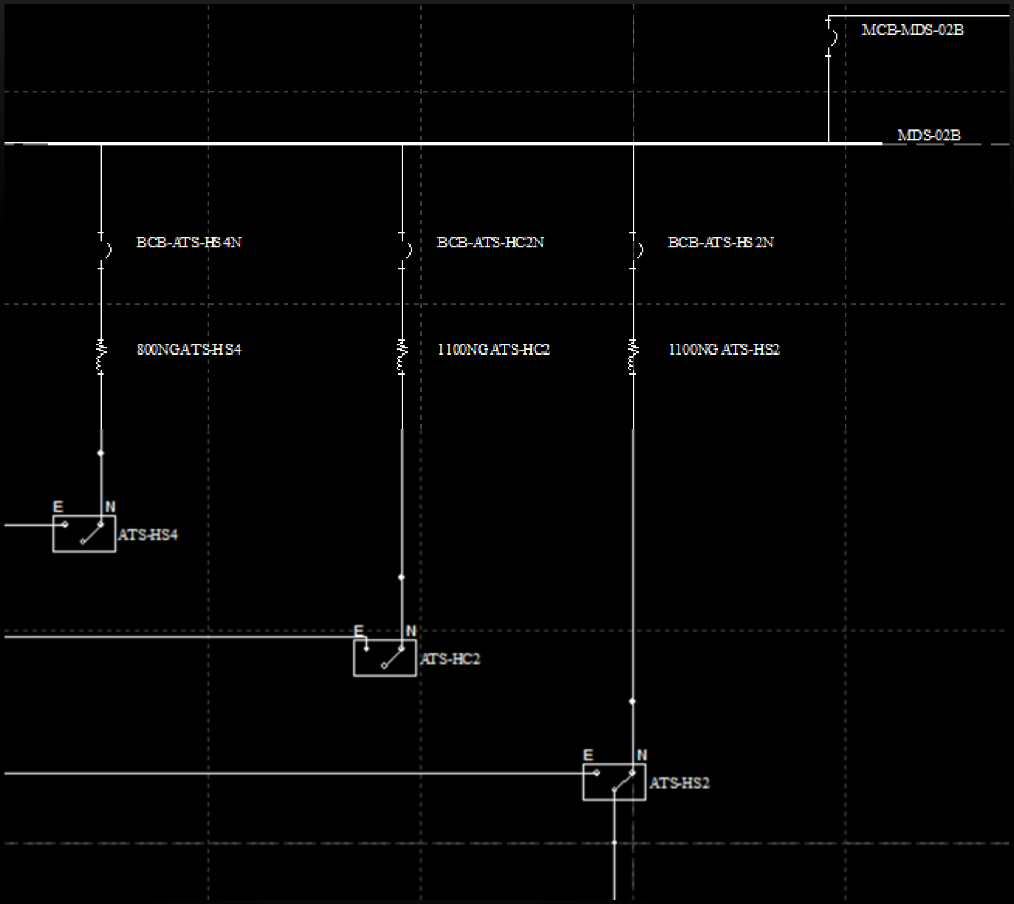

This model will be changed to reflect chilled beam additions later in the semester

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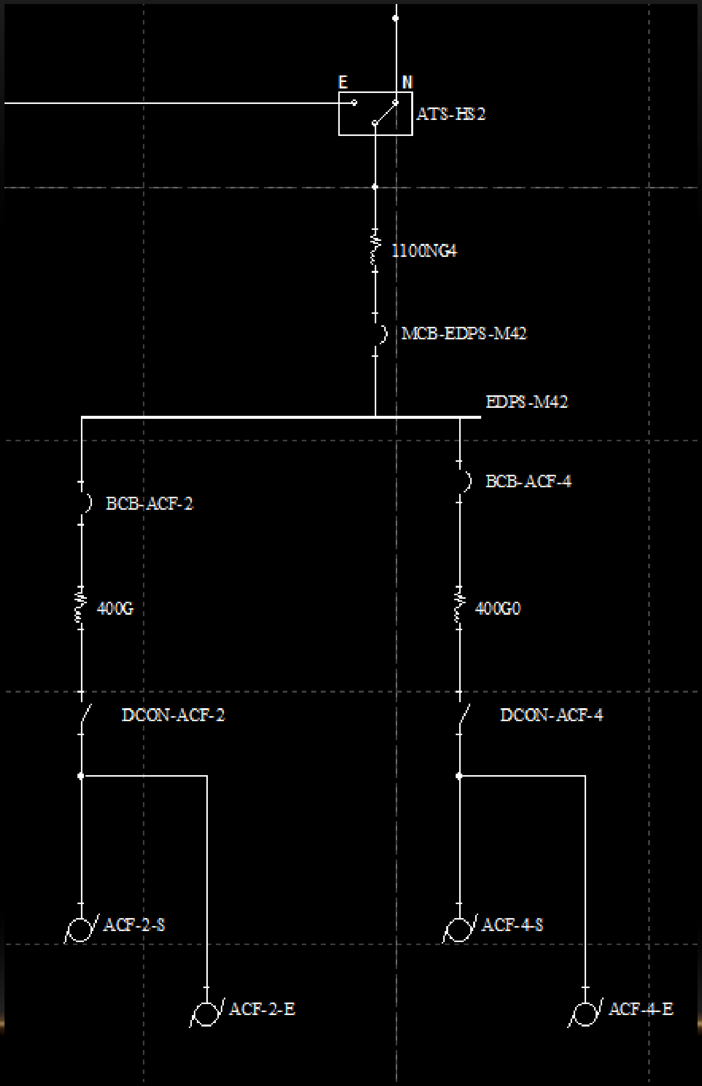
CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS



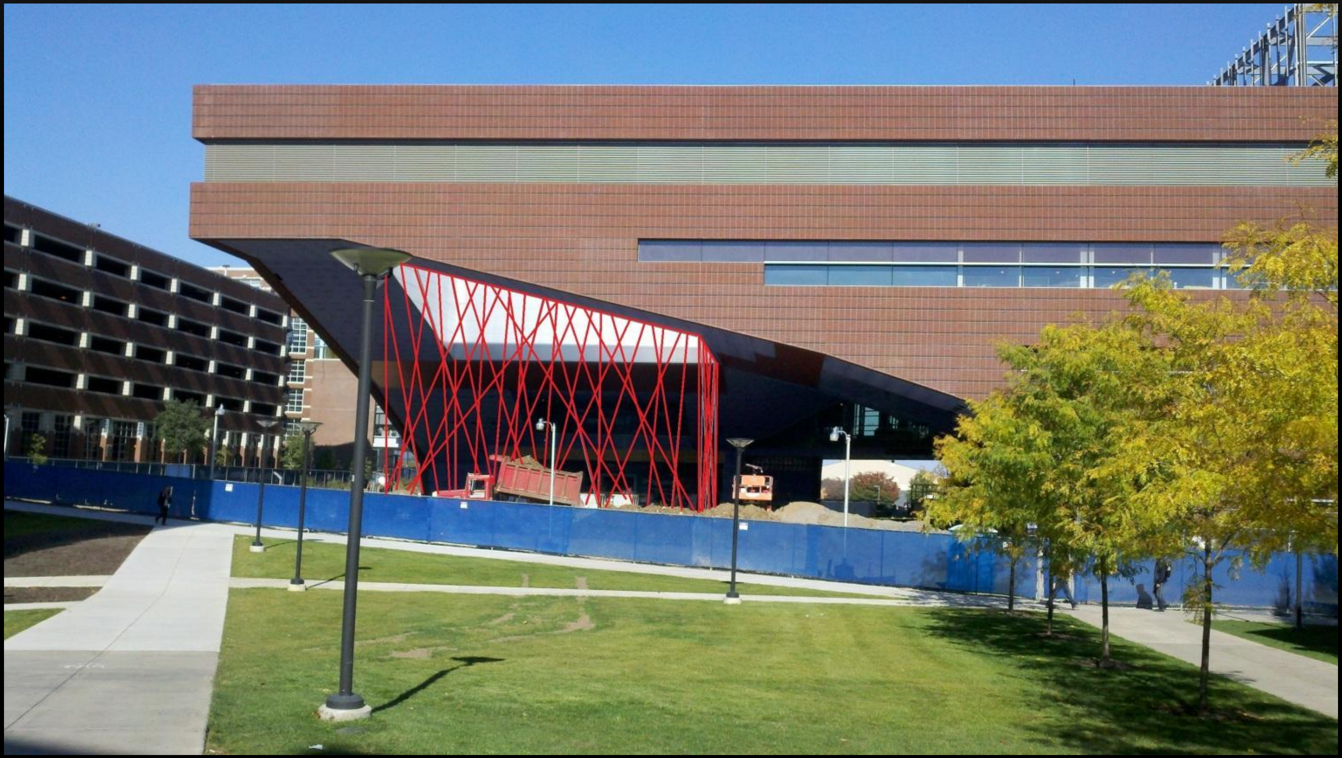
The cantilever support system redesign necessitates an architectural breadth

FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS



Cantilever Support Redesign Brainstorm

The cantilever support system redesign necessitates an architectural breadth

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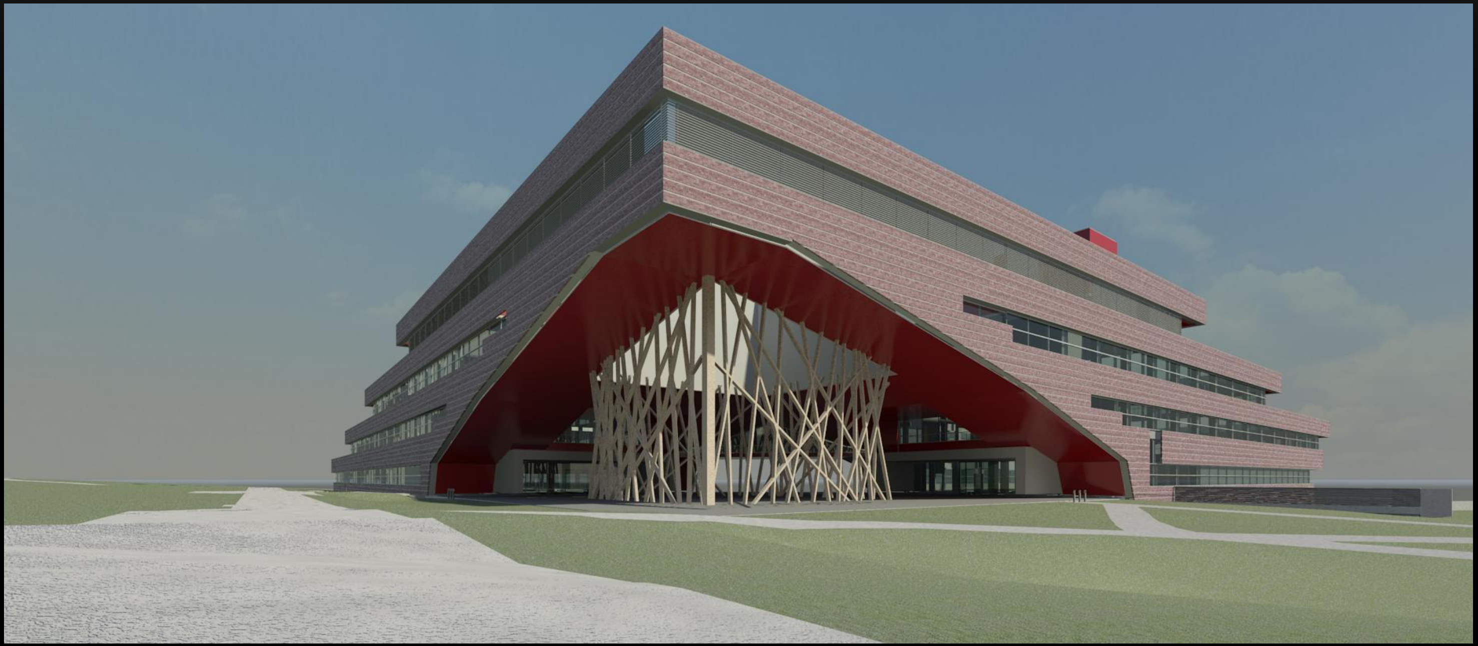

Developing Color Schemes And Nest Layout

The cantilever support system redesign necessitates an architectural breadth

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View From Project North East

The cantilever support system redesign necessitates an architectural breadth

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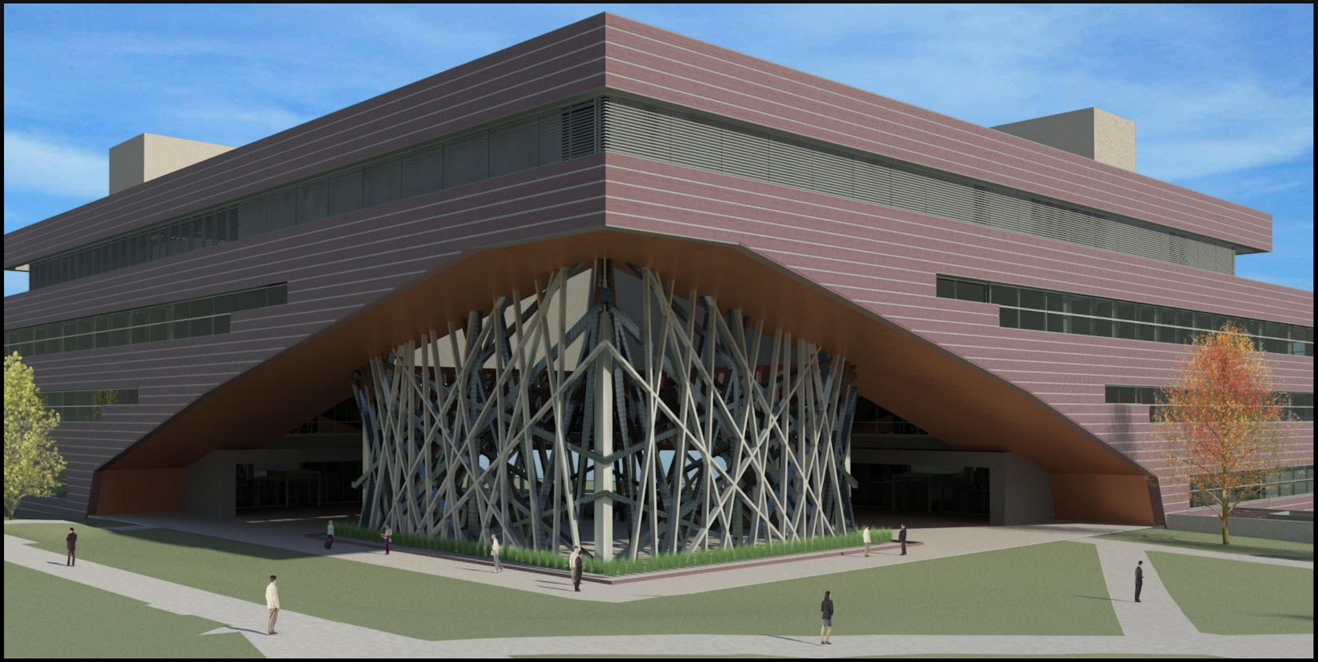

View From Project North West

The Cantilever Redesign will save money, space in the penthouse, and provide an interesting place to light

FAÇADE REDESIGN

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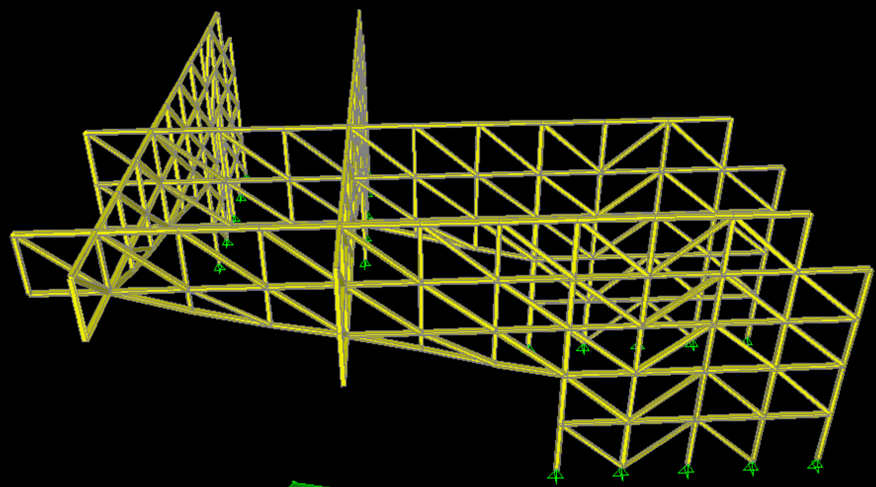

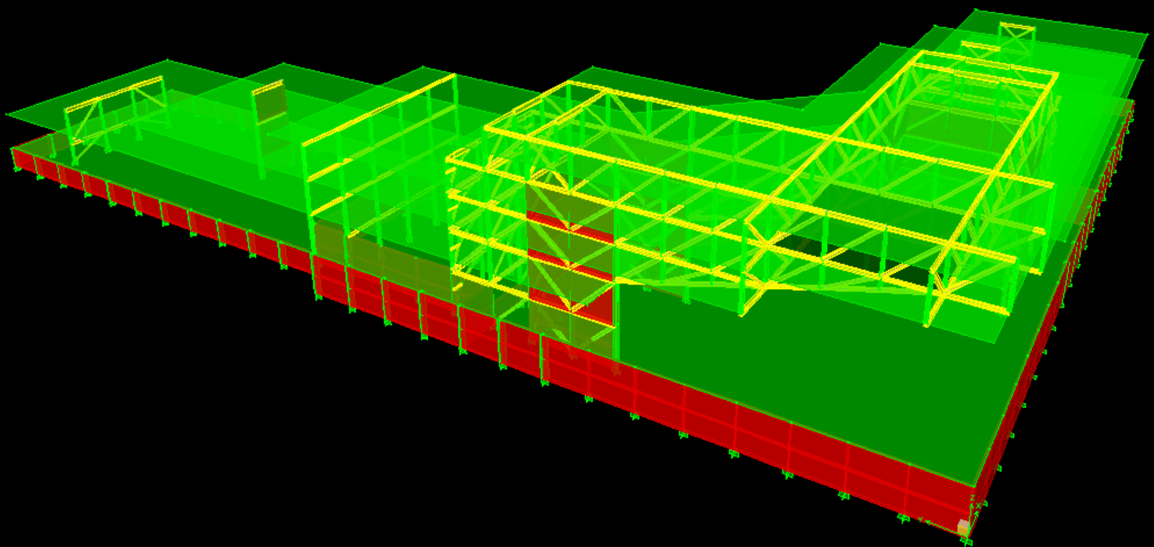

Breaking down the full schedule into different categories for the 4D model.

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DISTRIBUTION SYSTEMS

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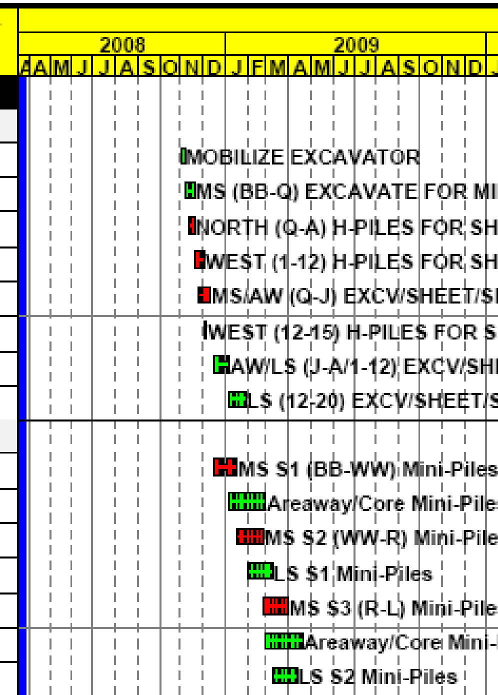
Activity Description	OD	ES	EF	TF
I-PILES/INITIAL STORM & SAN				
TION FOR MINI-PILES				
MOBILIZE EXCAVATOR	2	03NOV08	04NOV08	1
MS (BB-Q) EXCAVATE FOR MINI PILES	10	05NOV08	20NOV08	1
NORTH (Q-A) H-PILES FOR SHEETING & SHORING	6	10NOV08	18NOV08	0
WEST (1-12) H-PILES FOR SHEETING & SHORING	6	20NOV08	02DEC08	0
MS/AW (Q-J) EXCV/SHEET/SHORE FOR MINI PILES	12	24NOV08	12DEC08	0
WEST (12-15) H-PILES FOR SHEETING & SHORING	3	03DEC08	05DEC08	0
AW/LS (J-A/1-12) EXCV/SHEET/SHORE FOR MINI PILES	12	15DEC08	06JAN09	8
LS (12-20) EXCV/SHEET/SHORE FOR MINI PILES	15	07JAN09	30JAN09	19
PILES				
MS S1 (BB-WW) Mini-Piles	20	15DEC08	19JAN09	0
Areaway/Core Mini-Piles (1ST HALF)	30	07JAN09	26FEB09	9
MS S2 (WW-R) Mini-Piles	20	20JAN09	23FEB09	0
LS S1 Mini-Piles	20	02FEB09	06MAR09	19
MS S3 (R-L) Mini-Piles	20	24FEB09	30MAR09	0
Areaway/Core Mini-Piles (2ND HALF)	30	27FEB09	20APR09	9
LS S2 Mini-Piles	20	09MAR09	10APR09	19



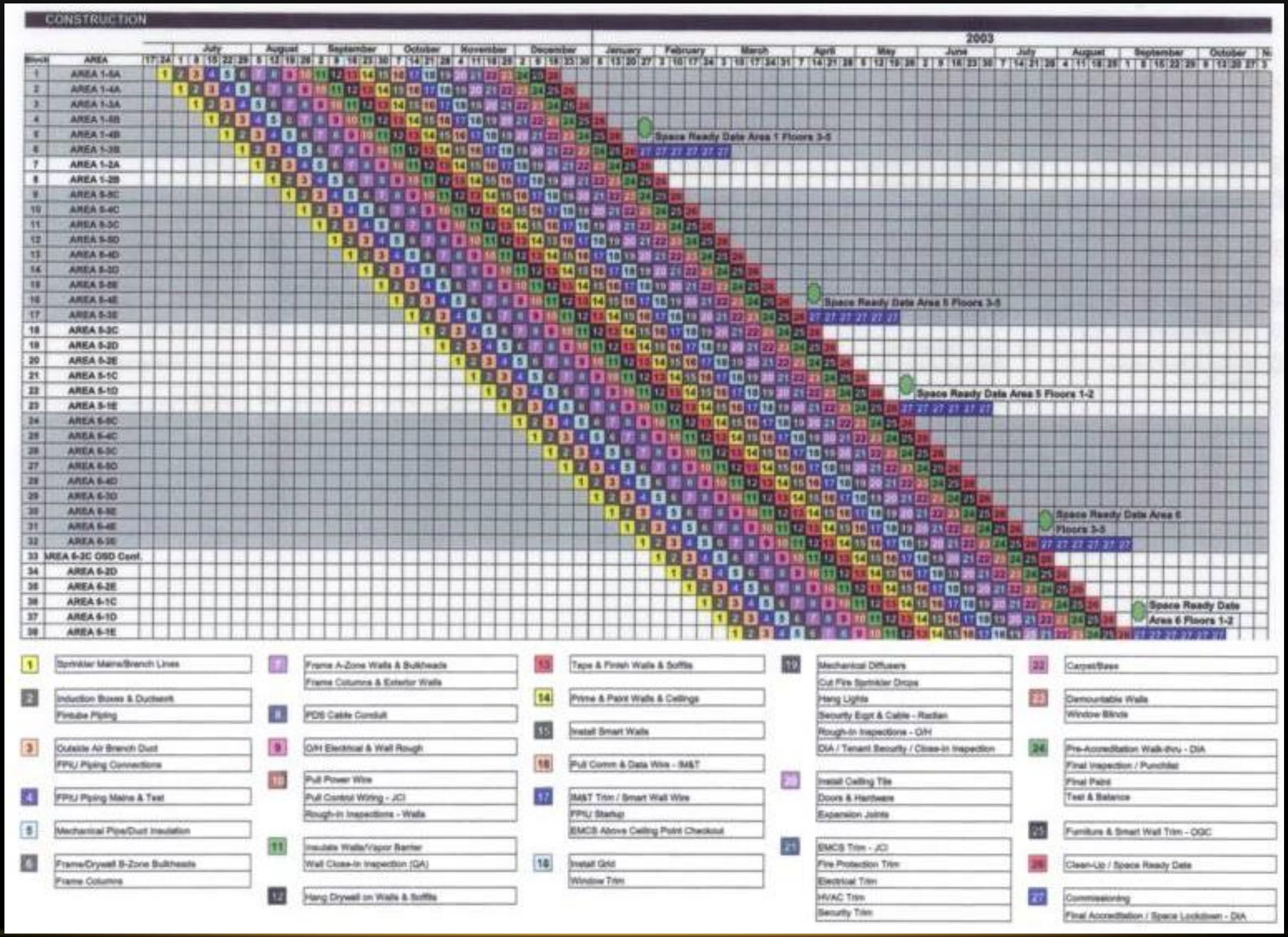
SIPS scheduling can reduce the longevity of highly repeatable spaces and construction types

FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS



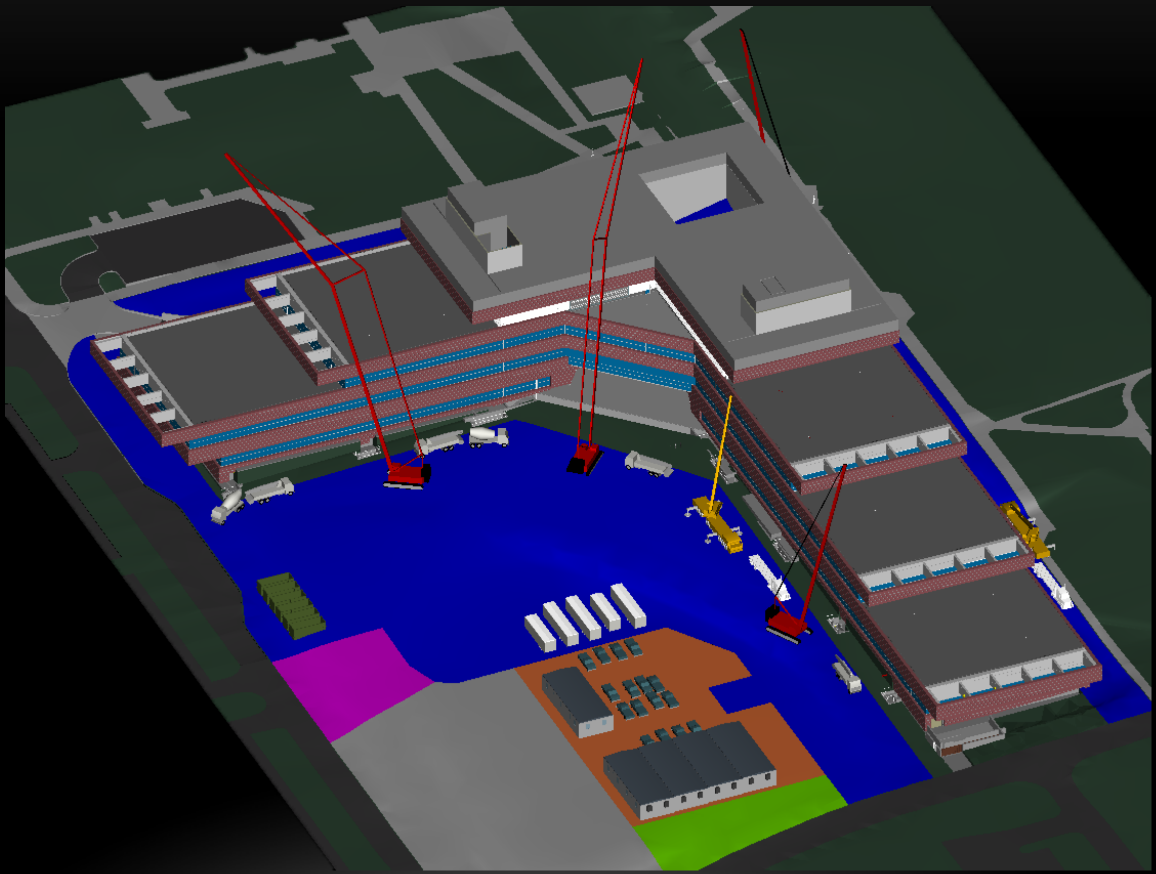
3D site logistics modeling and 4D modeling will help visualize the construction process

FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

COST & SCHEDULE PROGRESS



3D site logistics modeling and 4D modeling will help visualize the construction process

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DISTRIBUTION SYSTEMS

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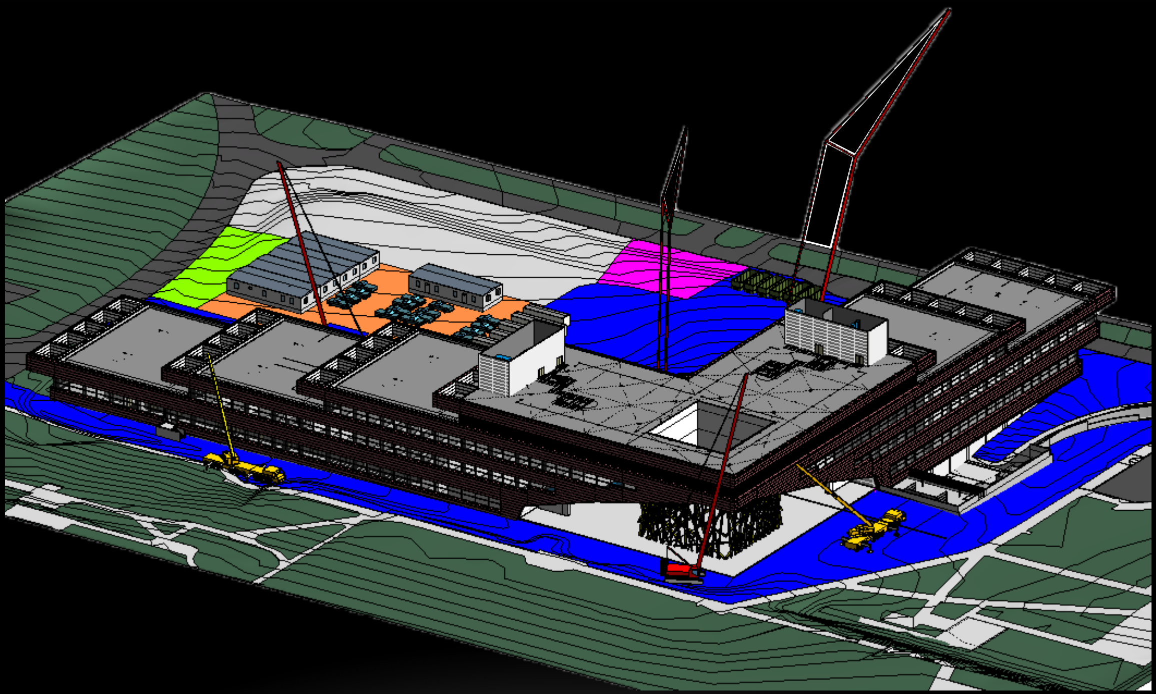
COST & SCHEDULE PROGRESS



Excel spreadsheets and takeoffs from Revit will help when is comes to last minute changes

FAÇADE REDESIGN

DISTRIBUTION SYSTEMS

CANTILEVER REDESIGN

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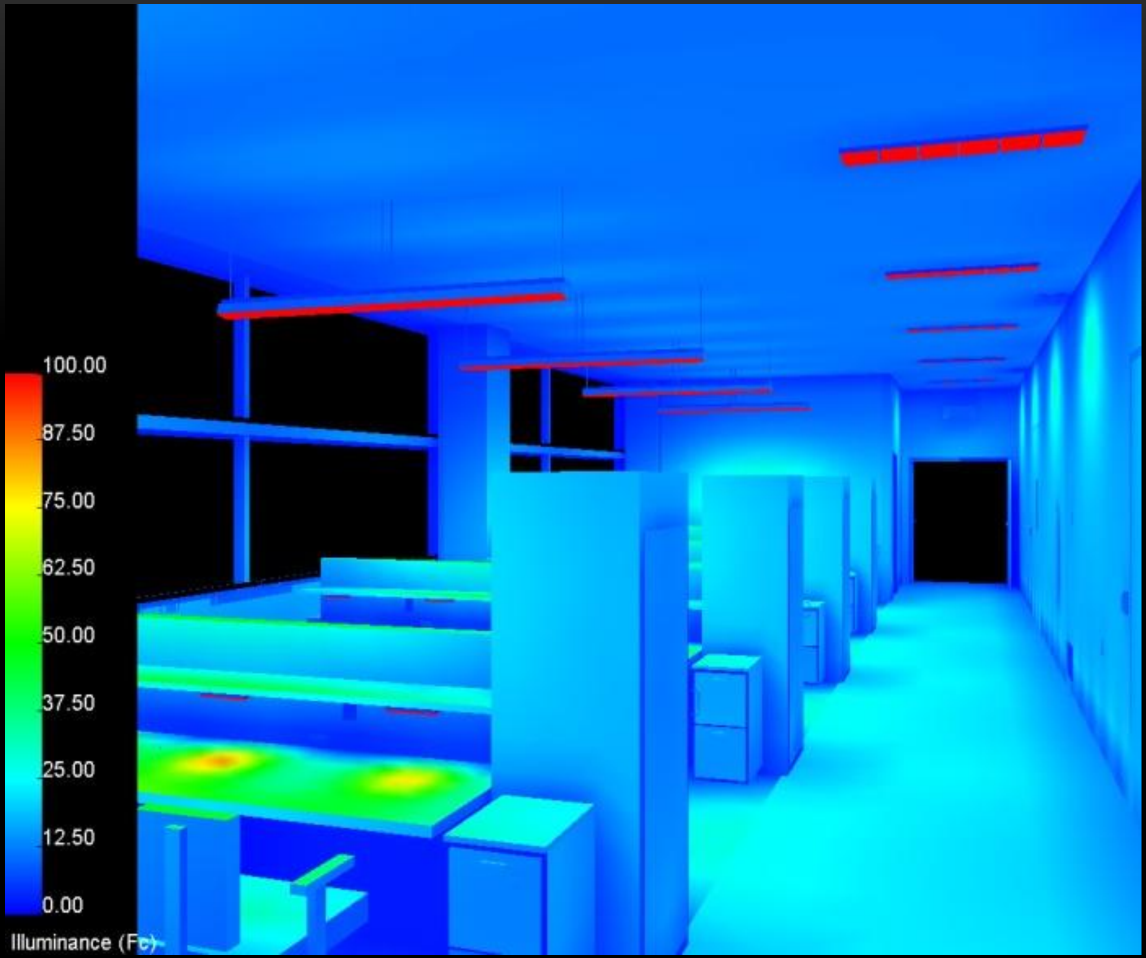
Structural Framing Schedule

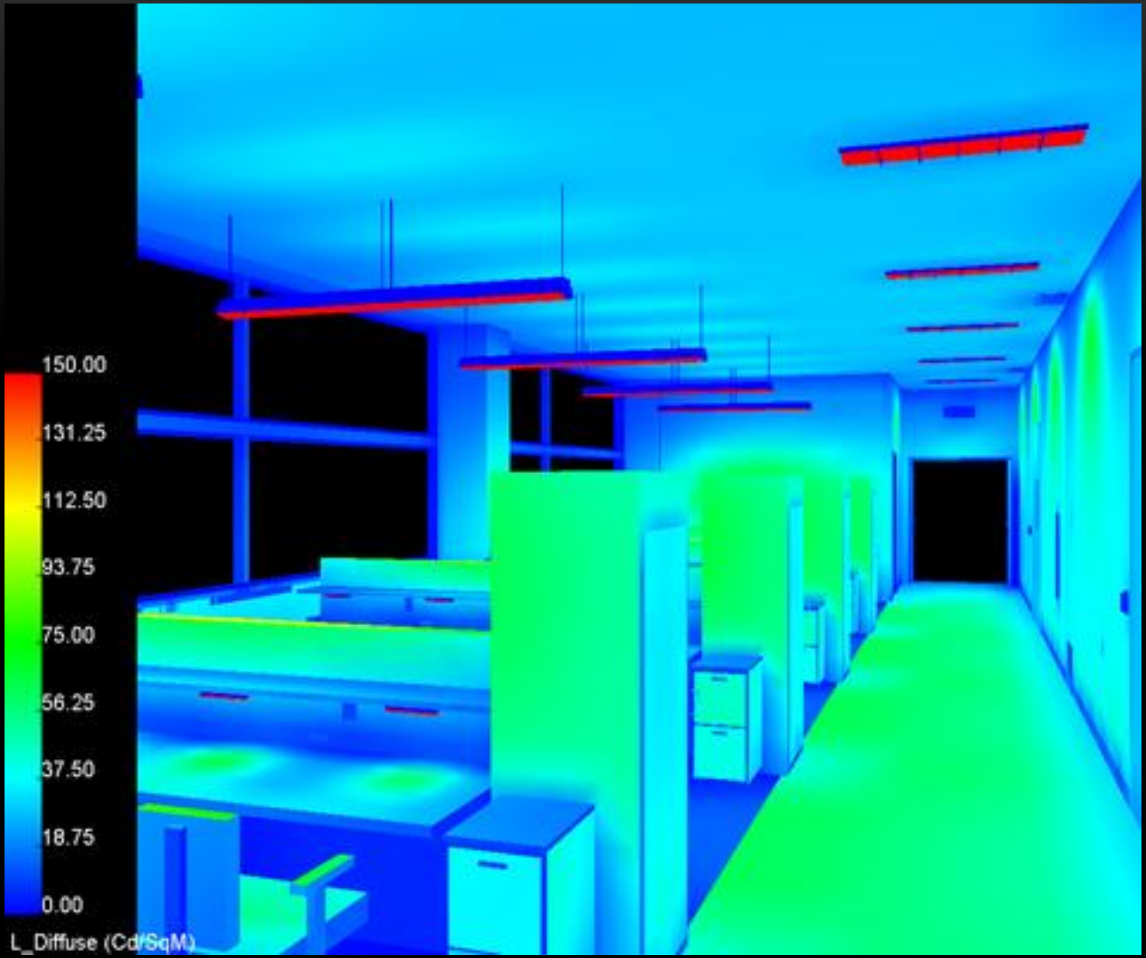
Type	Length_unitles	Unit	Volume	Unit	Weight_ton	Unit	Materia	Labo	Equipmen	Tota	Unit
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	13.500648	LF	1.43	CF	0.370814	TONS	37	2.43	1.36	40.79	LF
W24X55	8.499352	LF	0.81	CF	0.233446	TONS	37	2.43	1.36	40.79	LF
W24X55	8.499352	LF	0.88	CF	0.233446	TONS	37	2.43	1.36	40.79	LF
W24X55	13.500648	LF	1.43	CF	0.370814	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	11	LF	1.15	CF	0.30213	TONS	37	2.43	1.36	40.79	LF
W24X55	11	LF	1.14	CF	0.30213	TONS	37	2.43	1.36	40.79	LF
W24X55	11	LF	1.14	CF	0.30213	TONS	37	2.43	1.36	40.79	LF
W24X55	11	LF	1.15	CF	0.30213	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF
W24X55	22	LF	2.43	CF	0.60426	TONS	37	2.43	1.36	40.79	LF

KGB Maser’s Next Steps

- Finalize façade changes based on overall cost impacts
- Architecturally develop courtyard beneath cantilever
- Advance mechanical and electrical distribution systems
- Continue detailed estimate of structural, mechanical and lighting systems
- Frequently coordinate team designs
- Integrate prefabrication and SIPS scheduling of office and lab spaces

Questions?


100.00
87.50
75.00
62.50
50.00
37.50
25.00
12.50
0.00
Illuminance (Fc)



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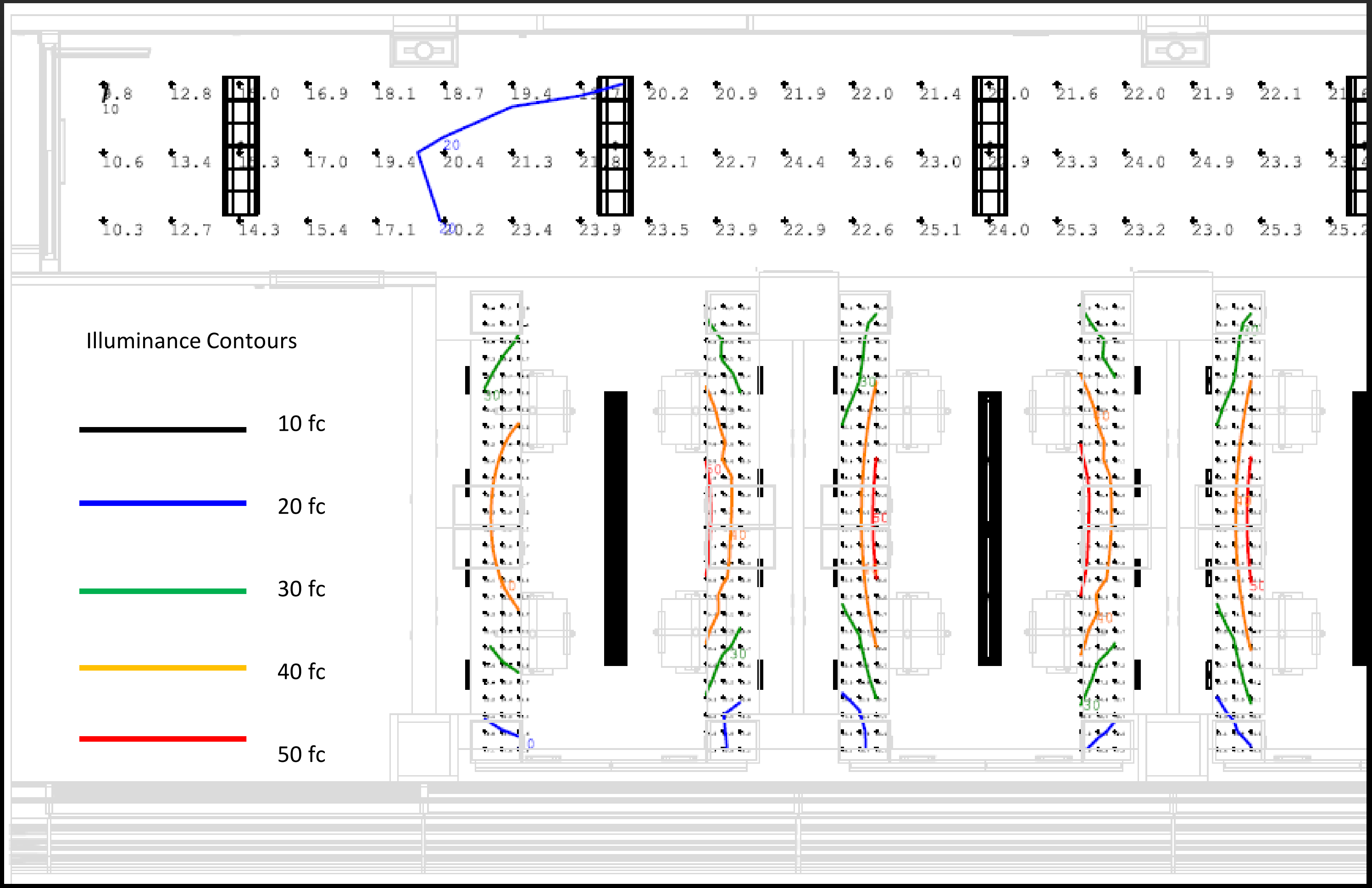
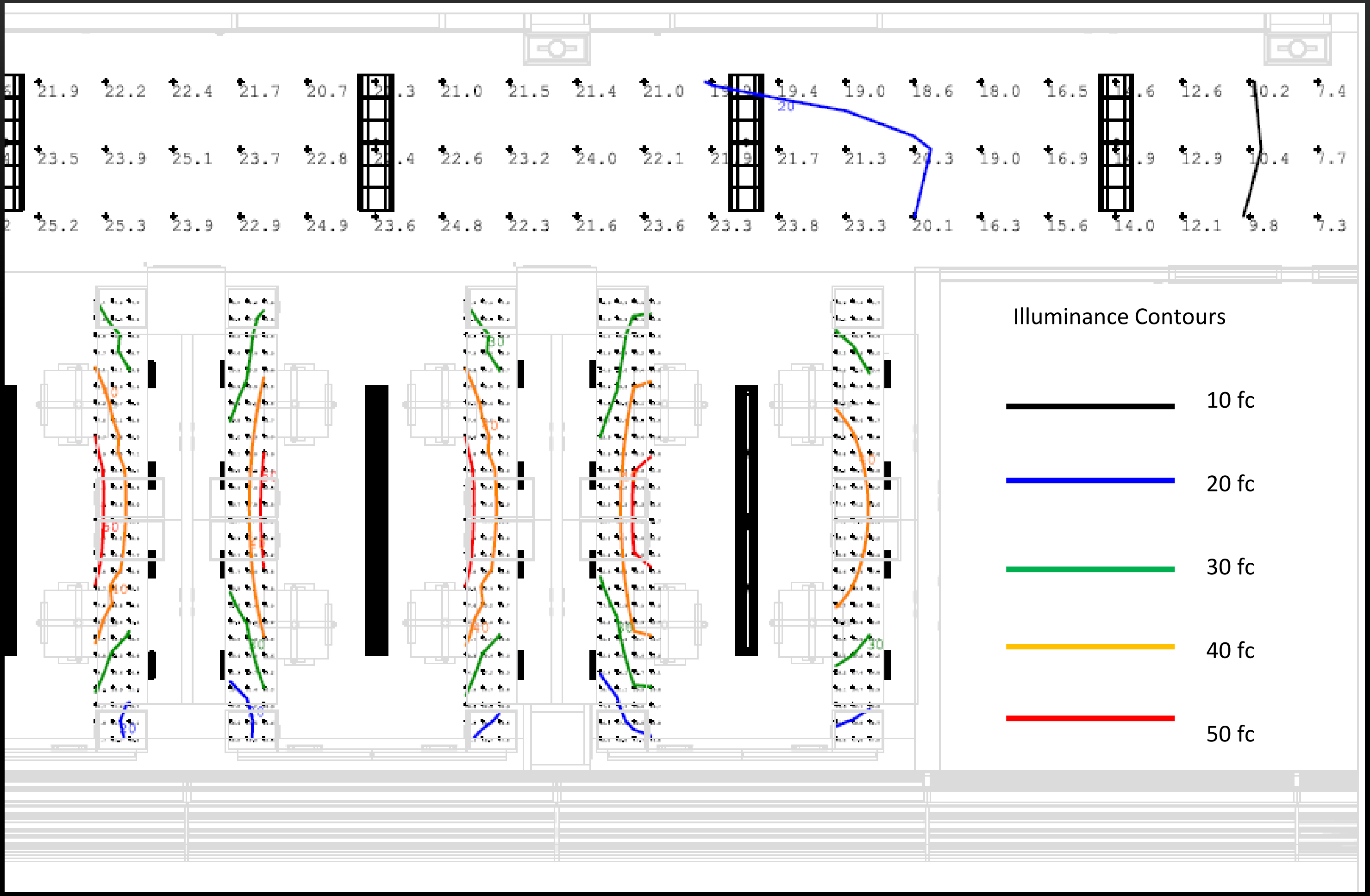

Illuminance Contours
10 fc
20 fc
30 fc
40 fc
50 fc


21.9 22.2 22.4 21.7 20.7 21.0 21.5 21.4 21.0 19.4 19.0 18.6 18.0 16.5 12.6 7.4
23.5 23.9 25.1 23.7 22.8 22.6 23.2 24.0 22.1 21.7 21.3 19.0 16.9 12.9 7.7
25.2 25.3 23.9 22.9 24.9 23.6 24.8 22.3 21.6 23.6 23.3 23.8 23.3 20.1 16.3 15.6 14.0 12.1 9.8 7.3
20
Illuminance Contours
10 fc
20 fc
30 fc
40 fc
50 fc

Space	Area (ft^2)	Allowable LPD (W/ft^2)	Allowable Power (W)	Total Power Used (W)	Actual LPD (W/ft^2)
Study Area	825.0	1.2	990.0	657.0	0.796
Corridor	657.9	0.5	329.0	224.0	0.681*

Illuminance Summary						
Space	Illuminance (fc)			Max./Min.	Coeff. Of Variation	Uniformity Gradient
	Min.	Avg.	Max.			
Study Area Only	9.0	36.5	106.0*	11.73	0.47	2.47
Corridor Only	4.5	9.36	10.8	2.40	0.15	1.31
Student Area Combined	15.0	34.3	55.0	3.67	0.27	1.42
Corridor Combined	7.3	20.0	25.3	3.47	0.23	1.38

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Active multiservice chilled beam
20/CBQ/1106/EN