

SWEDISH AMERICAN HOSPITAL HEART AND VASCULAR CENTER



SWEDISH AMERICAN
HOSPITAL

PHILIP FREDERICK
STRUCTURAL OPTION
AE SENIOR THESIS
15 APRIL 2008

PRESENTATION OUTLINE

- PROJECT BACKGROUND
- SITE PLAN
- PROPOSAL
- GRAVITY FRAMING
- LATERAL FRAMING
- FAÇADE ANALYSIS
- CONCLUSIONS/RECOMMENDATIONS



THE HEART HOSPITAL

PROJECT INFORMATION

LOCATION: ROCKFORD, IL

FLOORS: 4 STORIES (DESIGNED FOR 7)

FLOOR PLATE: 25,000SF PER FLOOR (175,000SF TOTAL)

PROJECT TEAM

OWNER: SWEDISH AMERICAN HOSPITAL

ARCHITECT: PERKINS + WILL ARCHITECTS

STRUCTURAL ENGINEER: SIMPSON GUMPERTZ AND HEGER

CONSTRUCTION MANAGEMENT: TURNER CONSTRUCTION

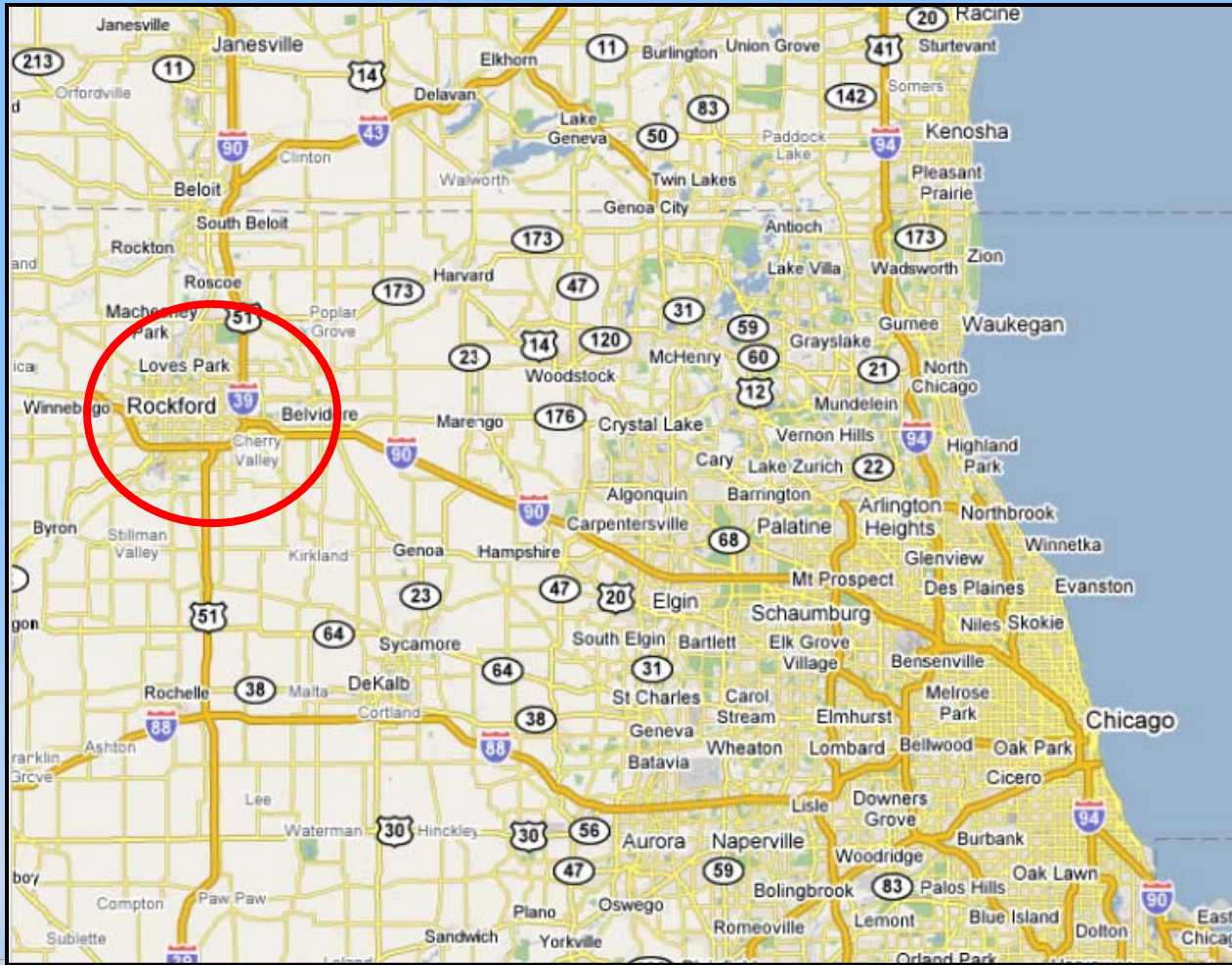


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SITE PLAN



SITE PLAN



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GOALS

DEPTH STUDY

- REDUCE MEMBER SIZES & STEEL COST

- REDUCE DRIFT

BREADTH STUDY

- ANALYZE WINDOW CONDENSATION

PROPOSALS

DEPTH STUDY

- ALTERNATIVE GRAVITY FRAMING LAYOUTS

- ORDINARY STEEL BRACED FRAMES

BREADTH STUDY

- DEVELOP REPAIRS



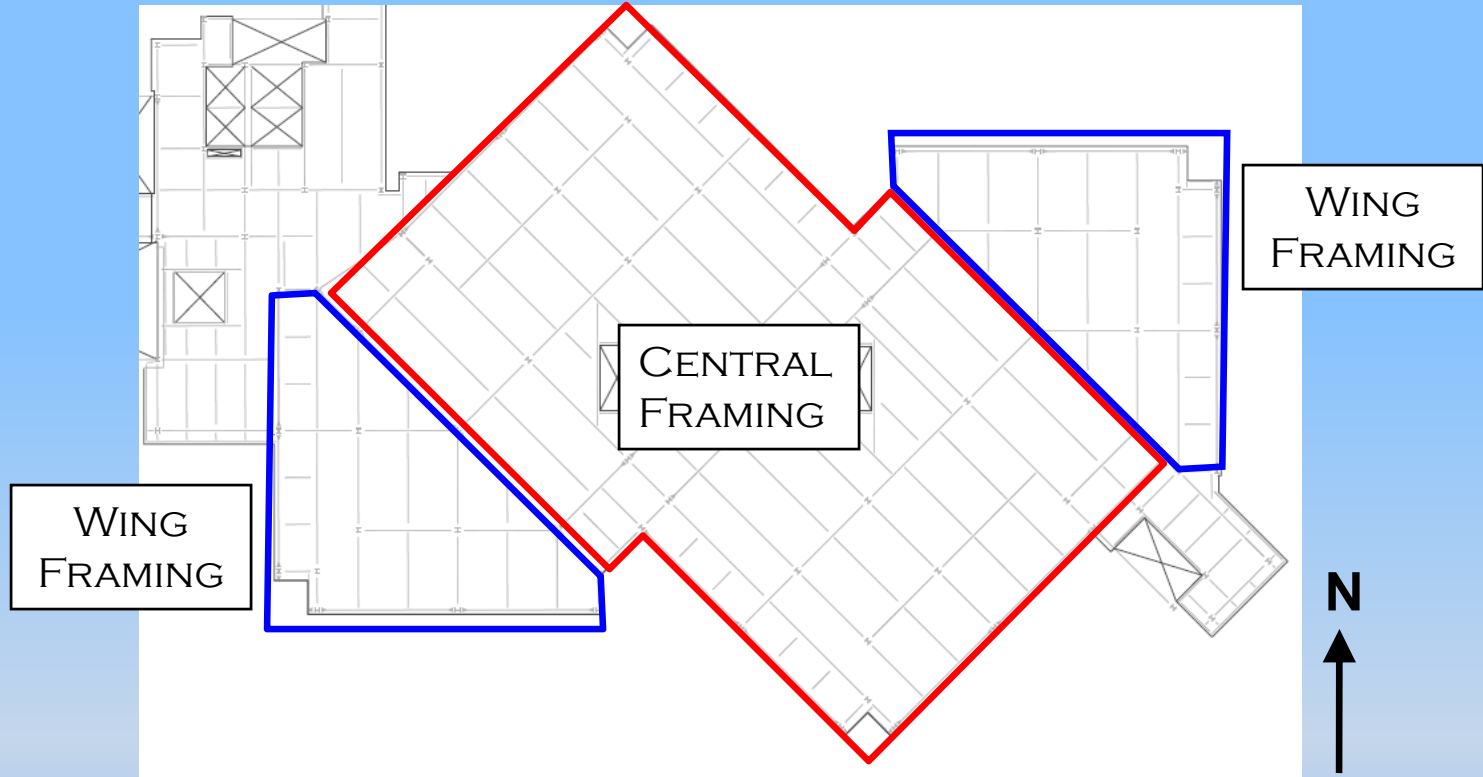
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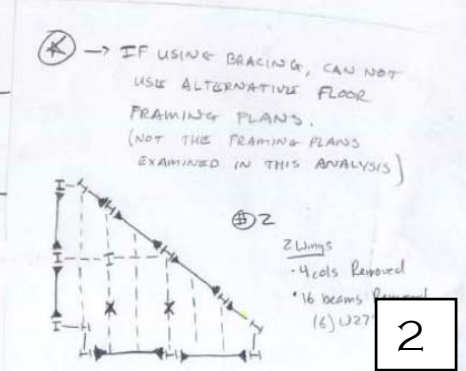
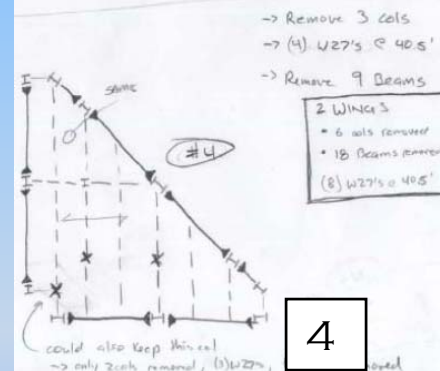
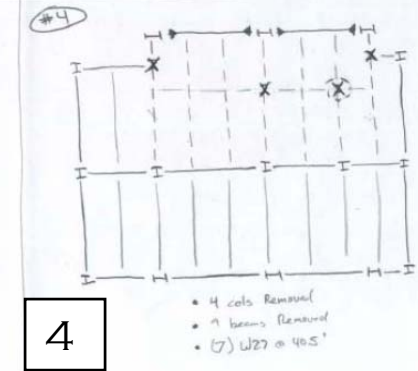
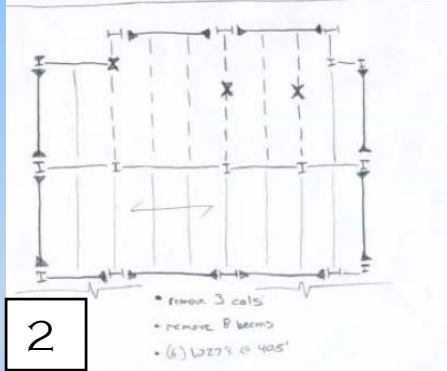
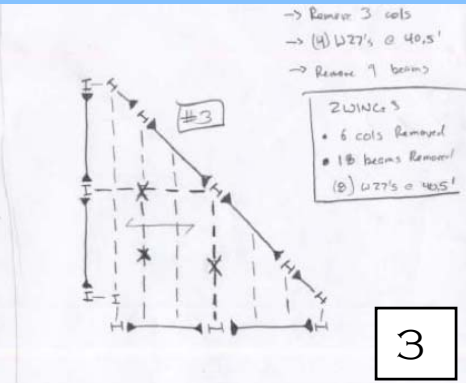
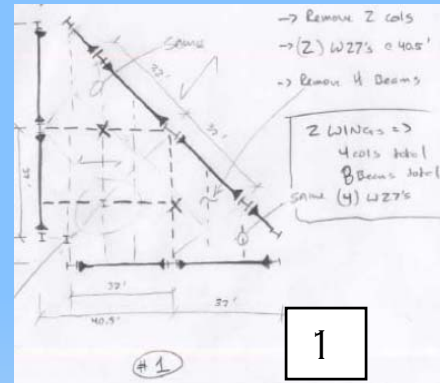
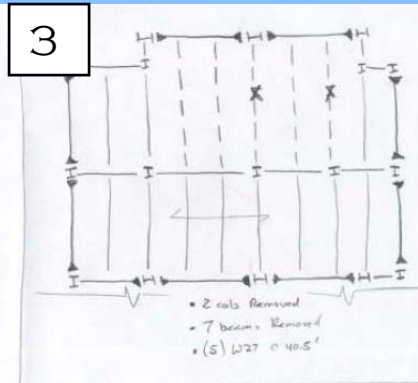
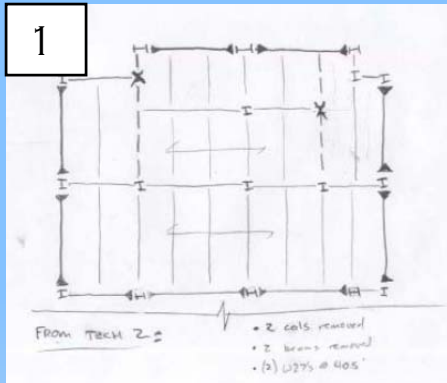
DEPTH STUDY : GRAVITY ANALYSIS

EXISTING FRAMING



DEPTH STUDY : GRAVITY ANALYSIS

ALTERNATIVE FRAMING



DEPTH STUDY : GRAVITY ANALYSIS

ALTERNATIVE FRAMING

Gravity Framing							
Floor Plan	Floor Framing			Column Framing		Total Weight (lbs) (assume 10lb/stud)	# of Pieces
	# of Members	Studs	Weight (lbs)	# of Members	Weight (lbs)		
Existing Floor	701	7,813	399,802	42	87,242	565,174	743
Floor Alt 1	687	8,013	445,443	30	69,788	595,361	717
Floor Alt 2	589	7,575	476,404	24	59,157	611,311	613
Floor Alt 3	603	7,546	463,162	30	67,614	606,236	633
Floor Alt 4	575	7,655	488,753	18	50,655	615,958	593
Wing Existing	322	3,088	120,742	24	41,852	193,474	346
Wing Alt 1	266	3,288	183,358	12	19,618	235,856	278
Wing Alt 2	210	3,004	177,886	12	22,388	230,314	222
Wing Alt 3	196	3,094	211,792	6	8,502	251,234	202
Wing Alt 4	196	3,074	190,376	6	13,886	235,002	202



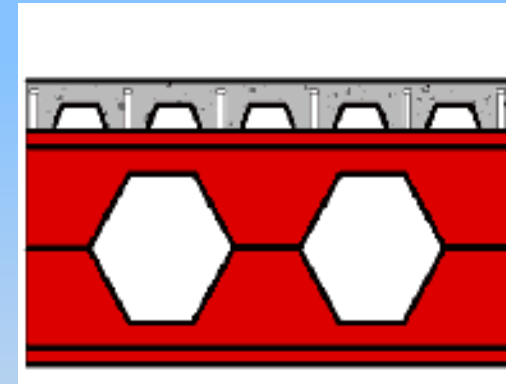
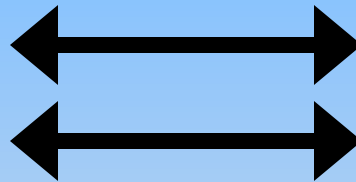
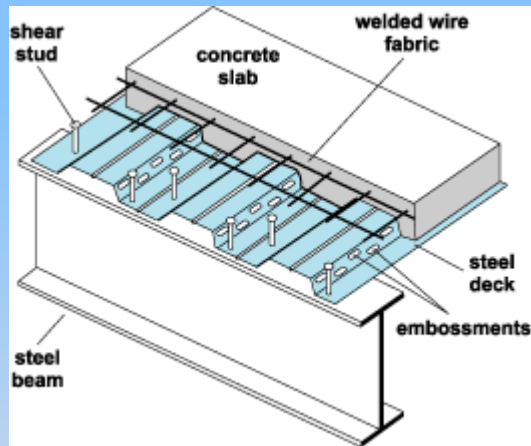
DEPTH STUDY : GRAVITY ANALYSIS

WHAT DOES IT TAKE TO REDUCE THE WEIGHT OF THE GRAVITY FRAMING?

TYP. COMPOSITE BEAMS

VS

CASTELLATED BEAMS



DEPTH STUDY : GRAVITY ANALYSIS

TYP. COMPOSITE BEAMS

VS

CASTELLATED BEAMS

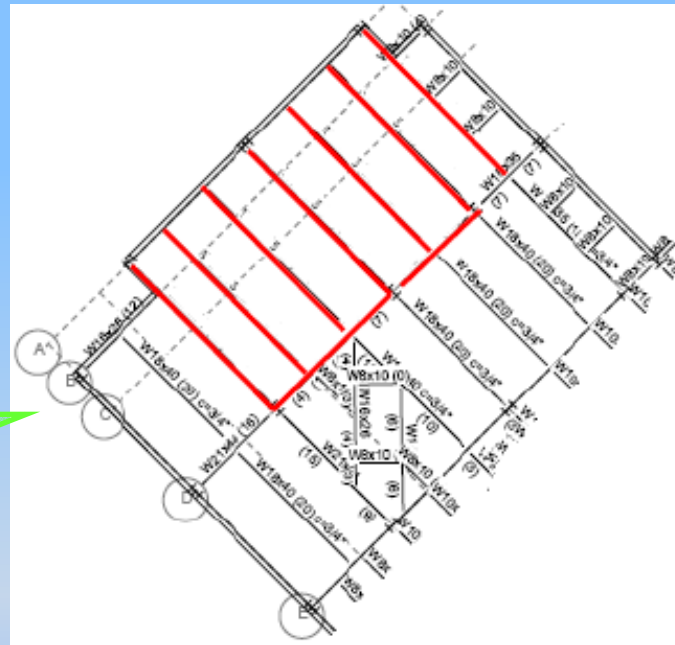
EXISTING
FRAMING
LAYOUT

W = 565,174LBS
743 MEMBERS

\$427,715

(*CHARLIE CARTER)

CENTRAL FRAMING ONLY



ALT #4
LAYOUT WITH
CAST. BEAMS

W = 559,337LBS
593 MEMBERS

\$595,296

(*R.S. MEANS)



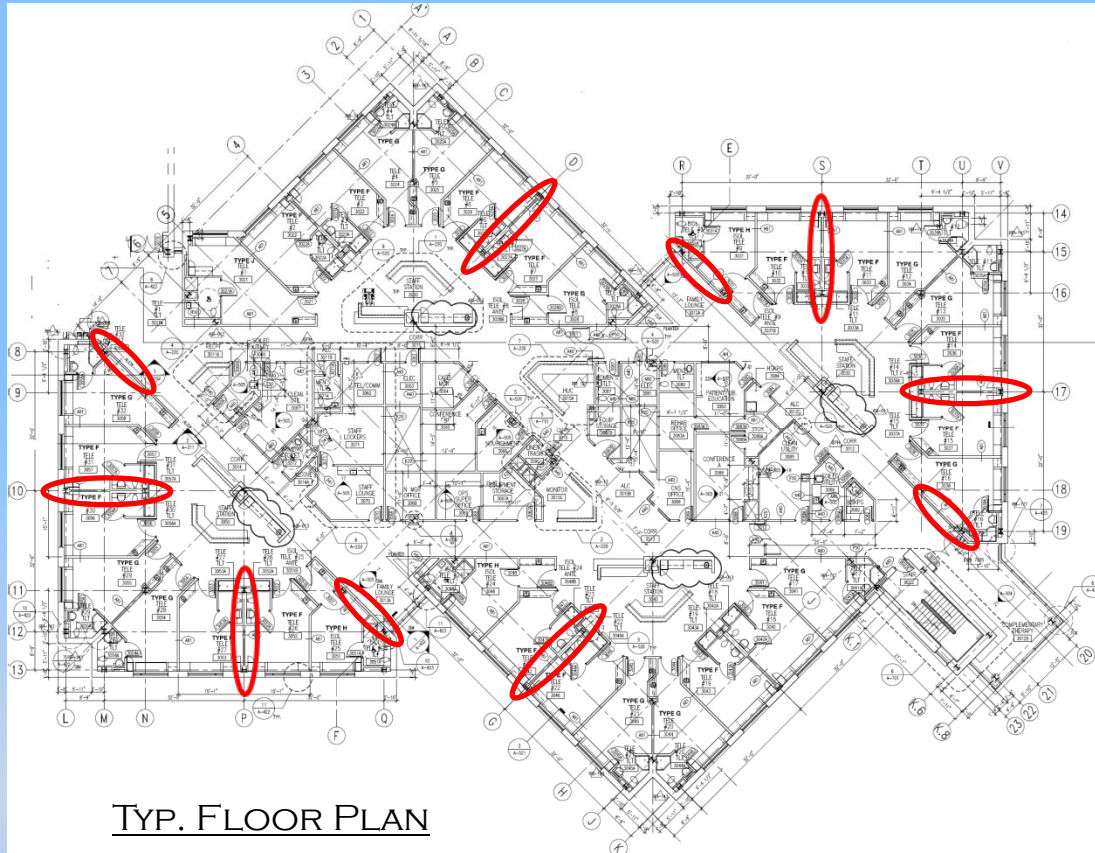
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DEPTH STUDY : LATERAL ANALYSIS

PROPOSED BRACED FRAMES



DEPTH STUDY : LATERAL ANALYSIS

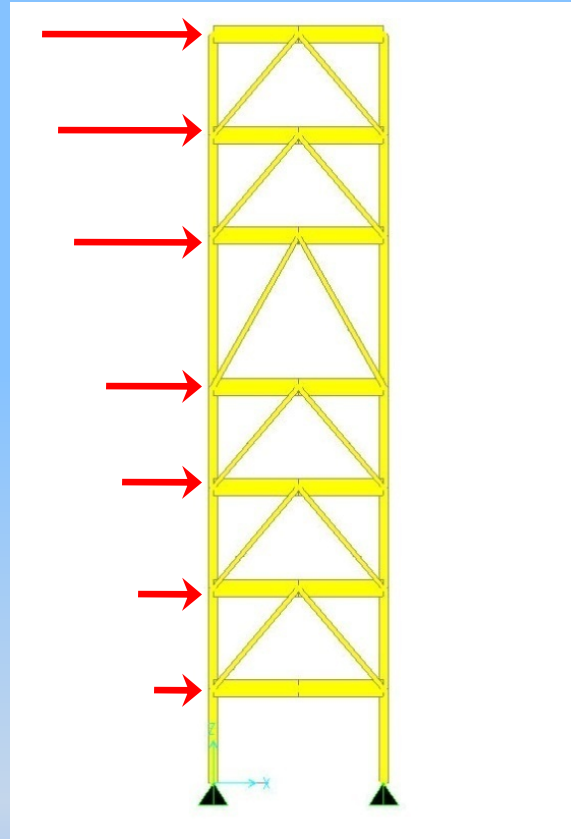
ASSUMPTIONS:

- 4 FRAMES IN EACH DIRECTION (X AND Y)
- RIGID DIAPHRAGM
- 25% OF LATERAL LOAD DIST. TO EACH FRAME

LOADS:

- $V_{WIND} = 1045k$
- $V_{EQ} = 978k$

TRIAL BRACE SIZES



COLUMNS:

W14x120

BEAMS:

W16x50

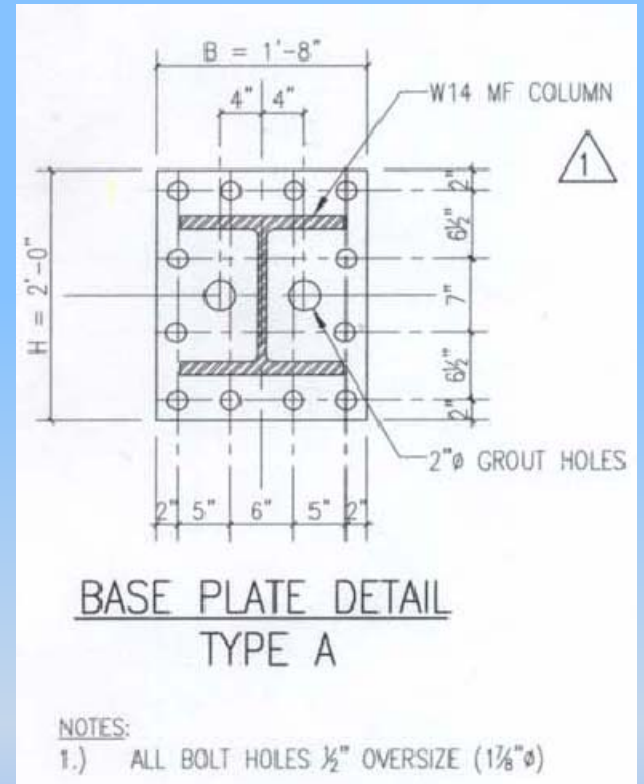
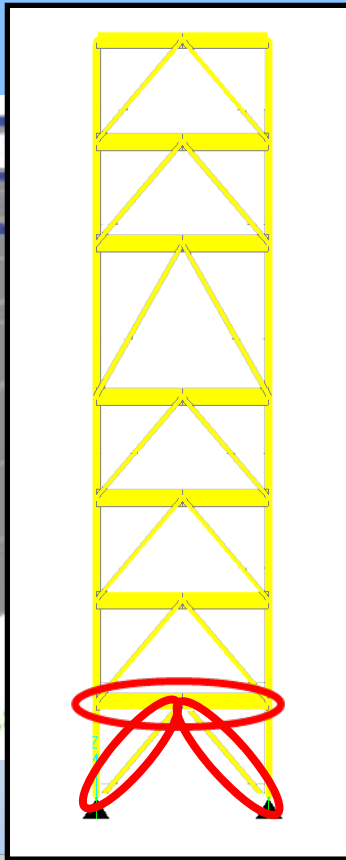
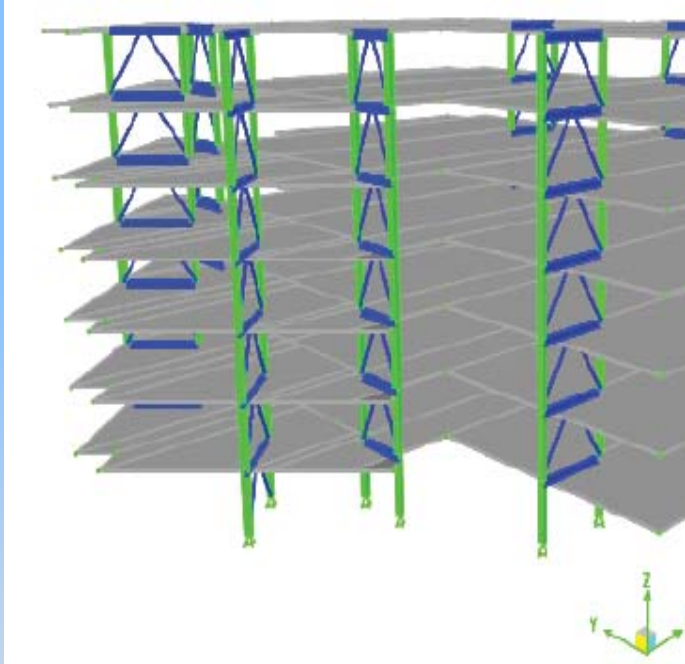
BRACES:

HSS6x6x1/2



DEPTH STUDY : LATERAL ANALYSIS

PROPOSED BRACED FRAMES

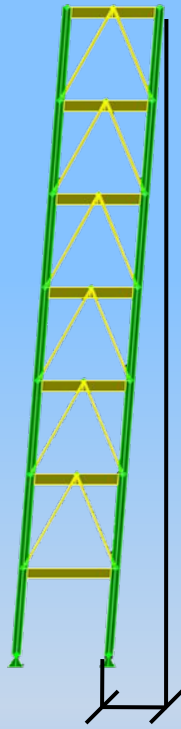


DEPTH STUDY : LATERAL ANALYSIS

PROP. BRACED FRAMES

VS

EX. MOMENT FRAMES



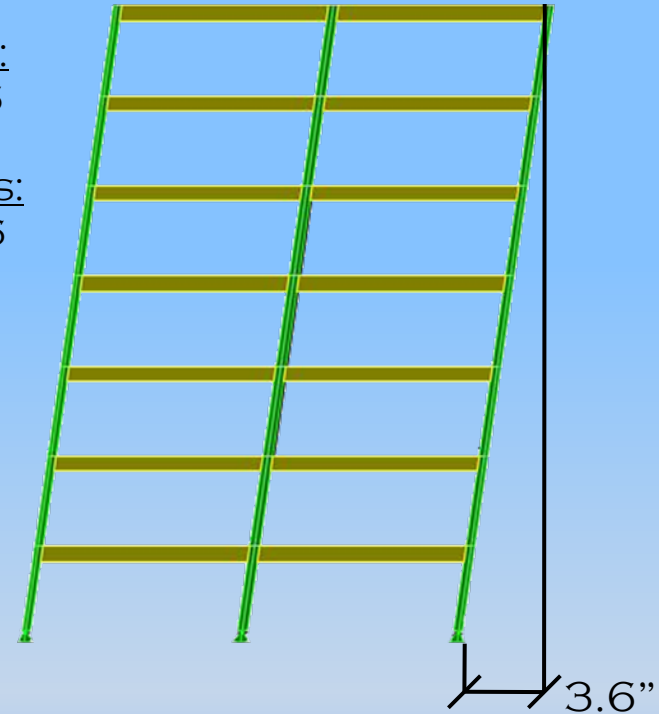
COLUMNS:
W14x120

LAT. BEAM:
W21x68

BRACES:
HSS6x6x3/8
TO
HSS8x6x5/8

2.1"

$$< \frac{H}{400} = 3.0''$$



COLUMNS:
W14x176

LAT. BEAMS:
W27x146

3.6"



DEPTH STUDY : LATERAL ANALYSIS

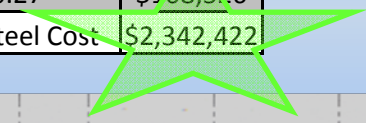
EX. MOMENT FRAMES

VS

PROP. BRACED FRAMES

Project Cost Comparison						
Moment Frames						
Item	Pieces	Weight (Tons)	Cost/lb	Mat'l Cost	Divisor Factor	Steel Cost
Gravity Beams	925	309.6	0.44	\$272,448	0.27	\$1,009,067
Lateral Beams	210	444.5	0.44	\$391,160	0.27	\$1,448,741
Gravity Columns	42	47.7	0.44	\$41,976	0.27	\$155,467
Lateral Columns	120	349.5	0.44	\$307,560	0.27	\$1,139,111
Total Mat'l Cost				\$1,013,144	Total Steel Cost	\$3,752,385

Braced Frames						
Item	Pieces	Weight (Tons)	Cost/lb	Mat'l Cost	Divisor Factor	Steel Cost
Gravity Beams	1065	418.1	0.44	\$367,928	0.27	\$1,362,696
Lateral Beams	70	22.8	0.44	\$20,064	0.27	\$74,311
Gravity Columns	102	102.1	0.44	\$89,848	0.27	\$332,770
Lateral Columns	60	142.4	0.44	\$125,312	0.27	\$464,119
Lateral Braces	108	29.9	0.49	\$29,302	0.27	\$108,526
Total Mat'l Cost				\$632,454	Total Steel Cost	\$2,342,422



ESTIMATED COST SAVINGS\$

EX. MOMENT FRAMES

- \$3,752,385
- 1297 MEMBERS
- 38 DAYS OF CONSTRUCTION
(35 PIECES/DAY)

PROP. BRACED FRAMES

- \$2,342,422
- 1405 MEMBERS
- 21 DAYS OF CONSTRUCTION
(70 PIECES/DAY)

DIFFERENCE

- -\$1,409,963
- + 108 MEMBERS
- -17 DAYS OF CONSTRUCTION
(70 PIECES/DAY)

OTHER CONSIDERATIONS FOR SAVINGS:

- SMALLER CRANE SIZE
- SCHEDULE SAVINGS
- CONNECTIONS



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BREADTH STUDY : FACADE

ISSUES:

- MOISTURE CONDENSATION

DRAWINGS/DETAILS:

- MANUFACTURER'S DETAIL
- CONSTRUCTION DRAWINGS
- EXISTING CONDITIONS



SOLUTIONS/REPAIRS:

- ACTIVE
- PASSIVE

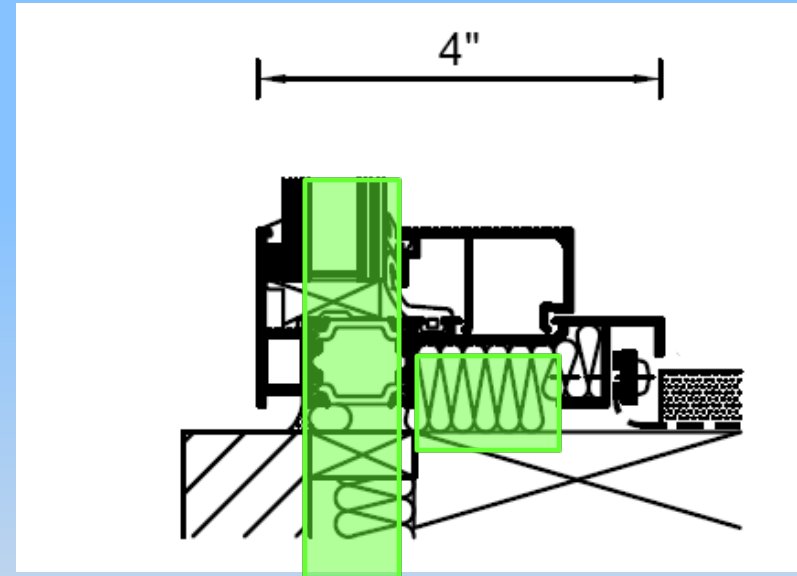


BREADTH STUDY : FACADE

MANUFACTURER'S DETAIL

KAWNEER WINDOWS

- KAWNEER 5500 ISOWEB WINDOW
- CONTINUOUS THERMAL BARRIER
- INSULATION UNDER SILL

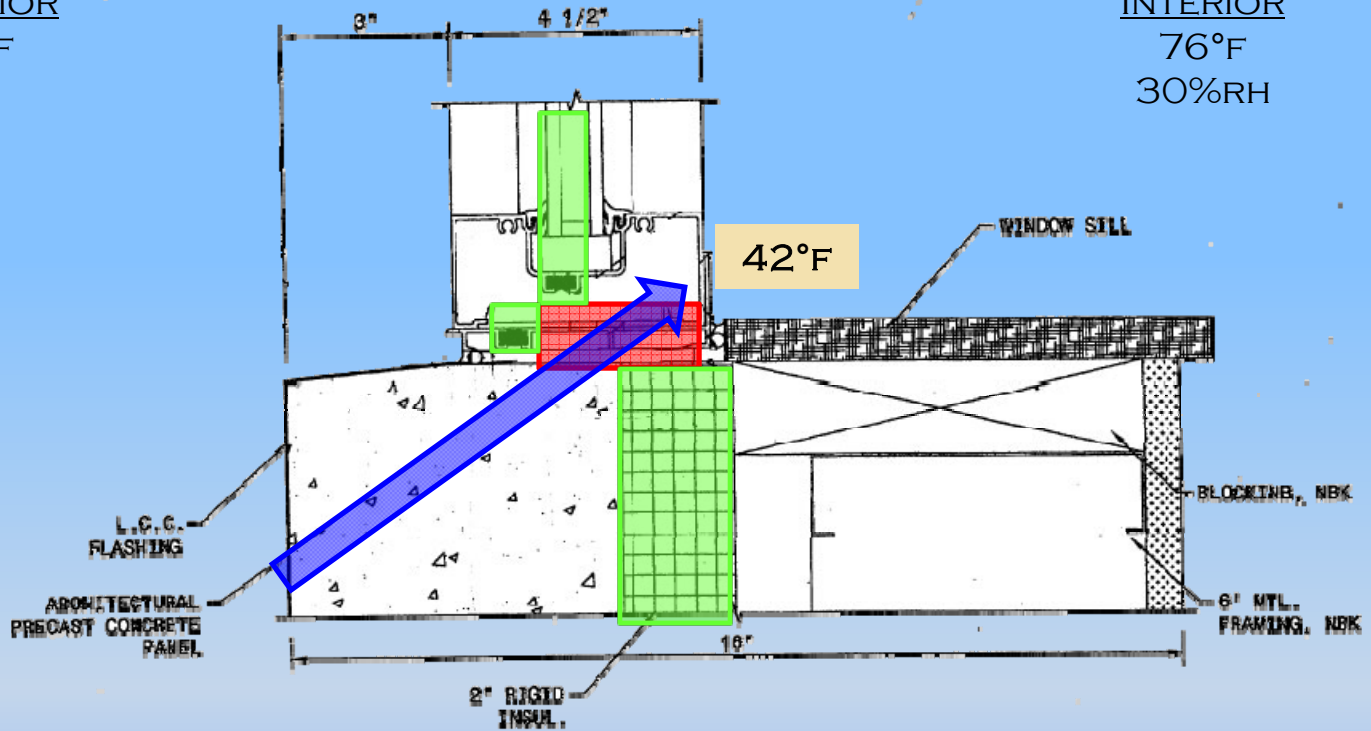


BREADTH STUDY : FACADE

EXISTING CONDITIONS

EXTERIOR
15°F

INTERIOR
76°F
30%RH



BREADTH STUDY : FACADE

PROPOSED SOLUTIONS - ACTIVE

NEW CONSTRUCTION:

- SPEC NEW WINDOW SYSTEM
- MOVE EXISTING WINDOW INBOARD
- INSTALL INSULATION WHERE NEEDED

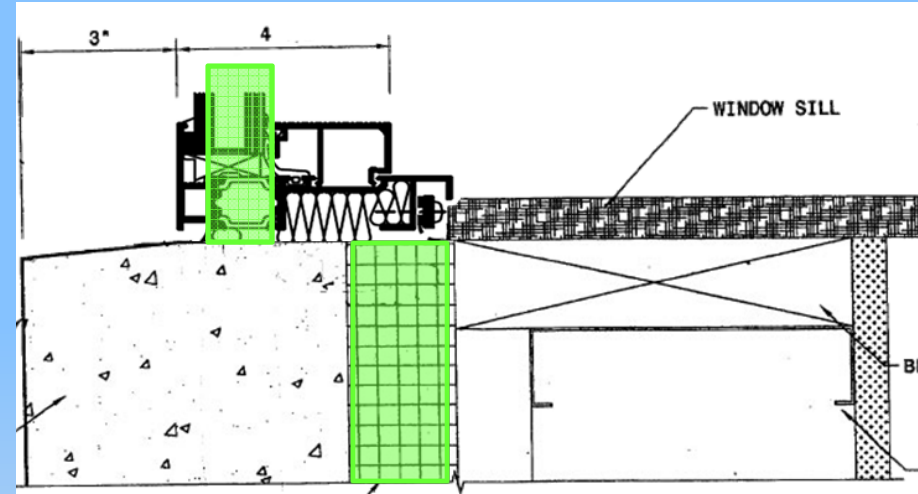
AS - BUILT:

- SPEC NEW WINDOW SYSTEM
- MOVING EXISTING WINDOW INBOARD
- REMOVE SILL/INSTALL INSULATION
- HEAT TRACE

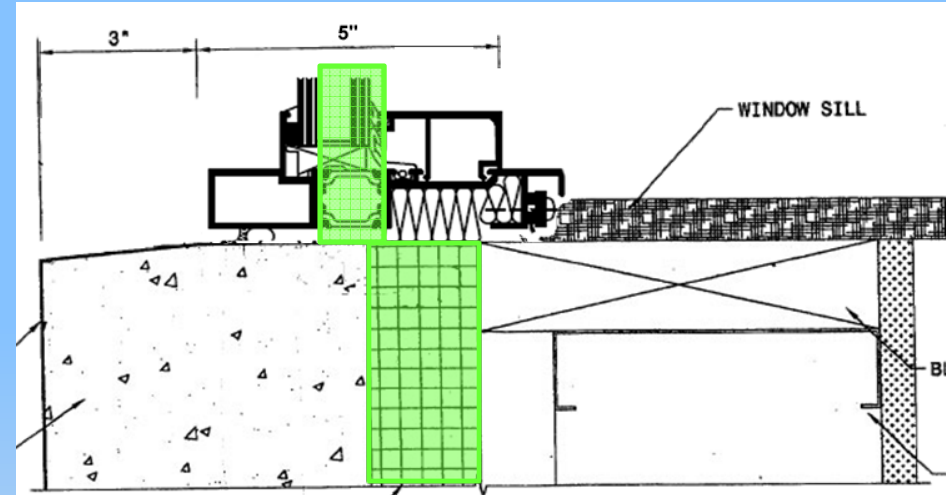


BREADTH STUDY : FACADE

NEW WINDOW SYSTEM



ISOWEB 5500 MODEL



ISOWEB 5525 MODEL

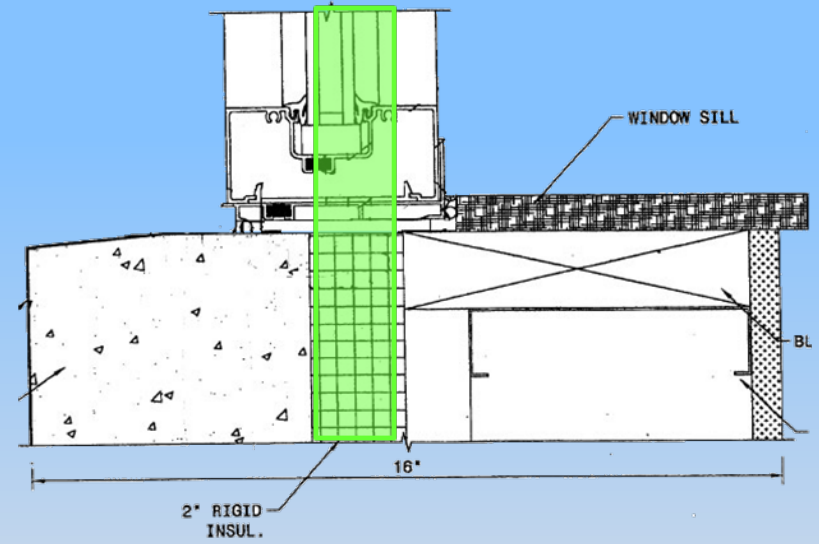
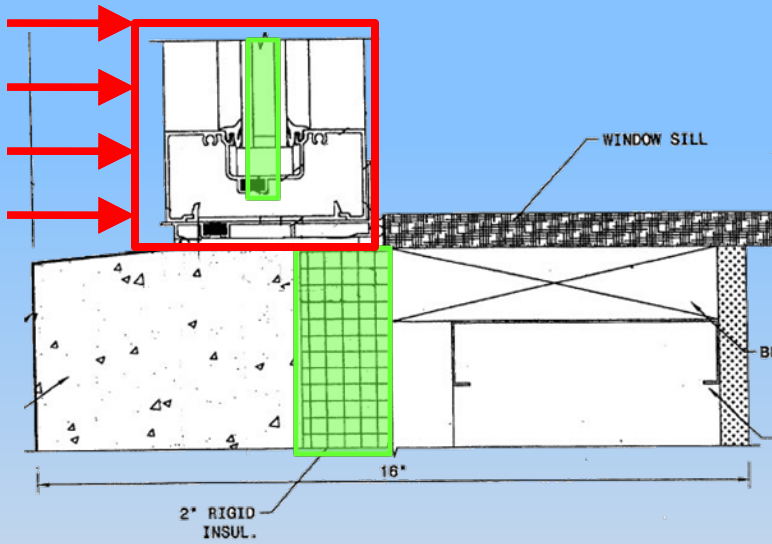
KAWNEER 5525 ISOWEB WINDOW

- MINIMIZES DISCONTINUITY IN THE THERMAL BARRIER



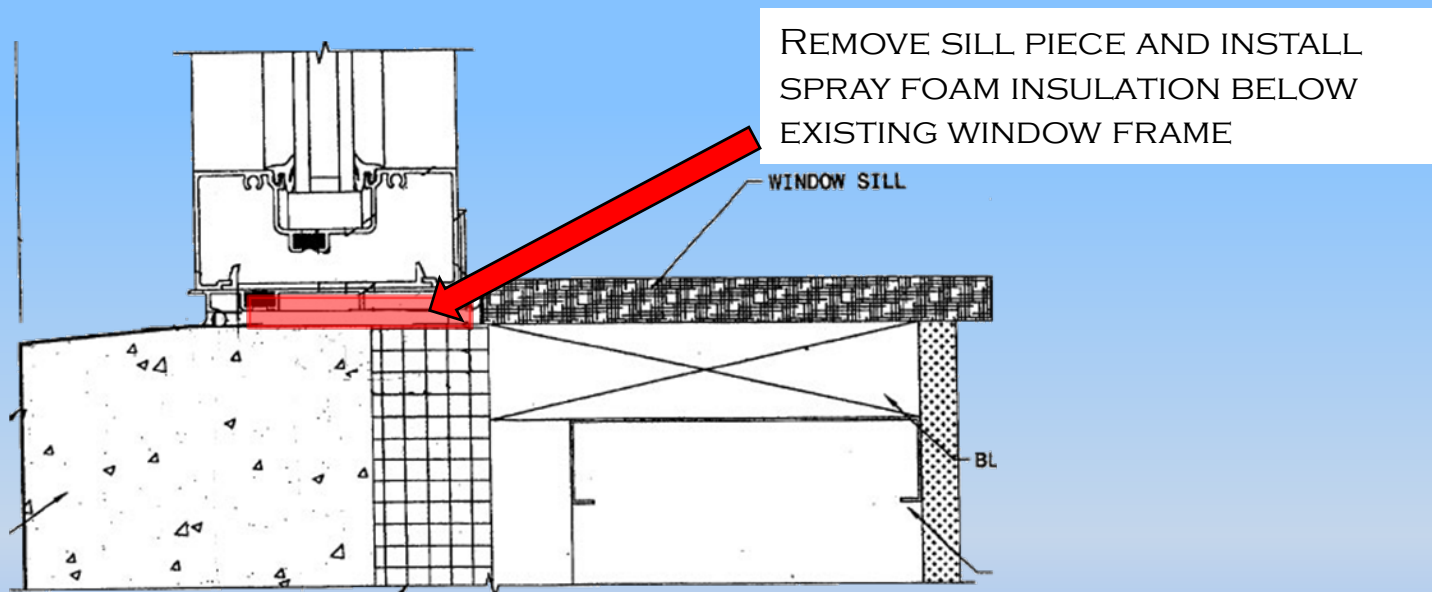
BREADTH STUDY : FACADE

MOVE EXISTING WINDOW INBOARD



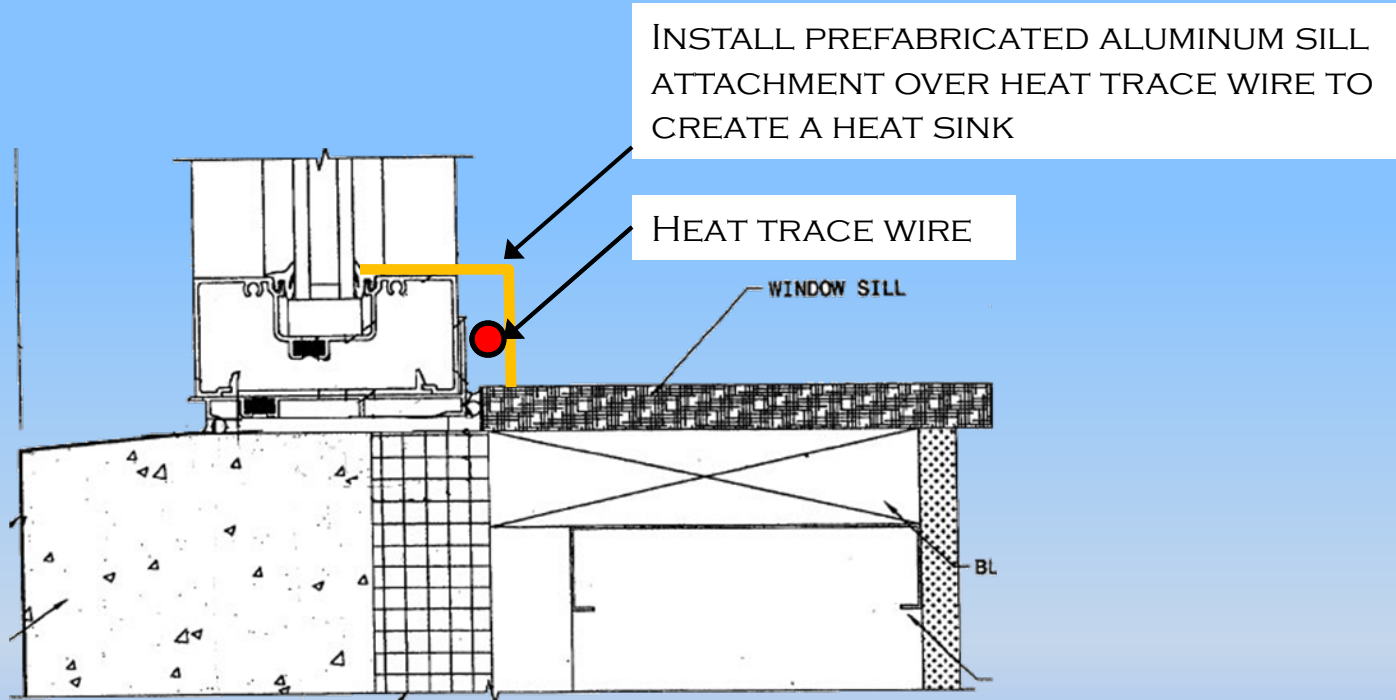
BREADTH STUDY : FACADE

INSTALL SPRAY FOAM INSULATION BELOW WINDOW FRAME



BREADTH STUDY : FACADE

INSTALL HEAT TRACE ALONG INTERIOR WINDOW FRAME

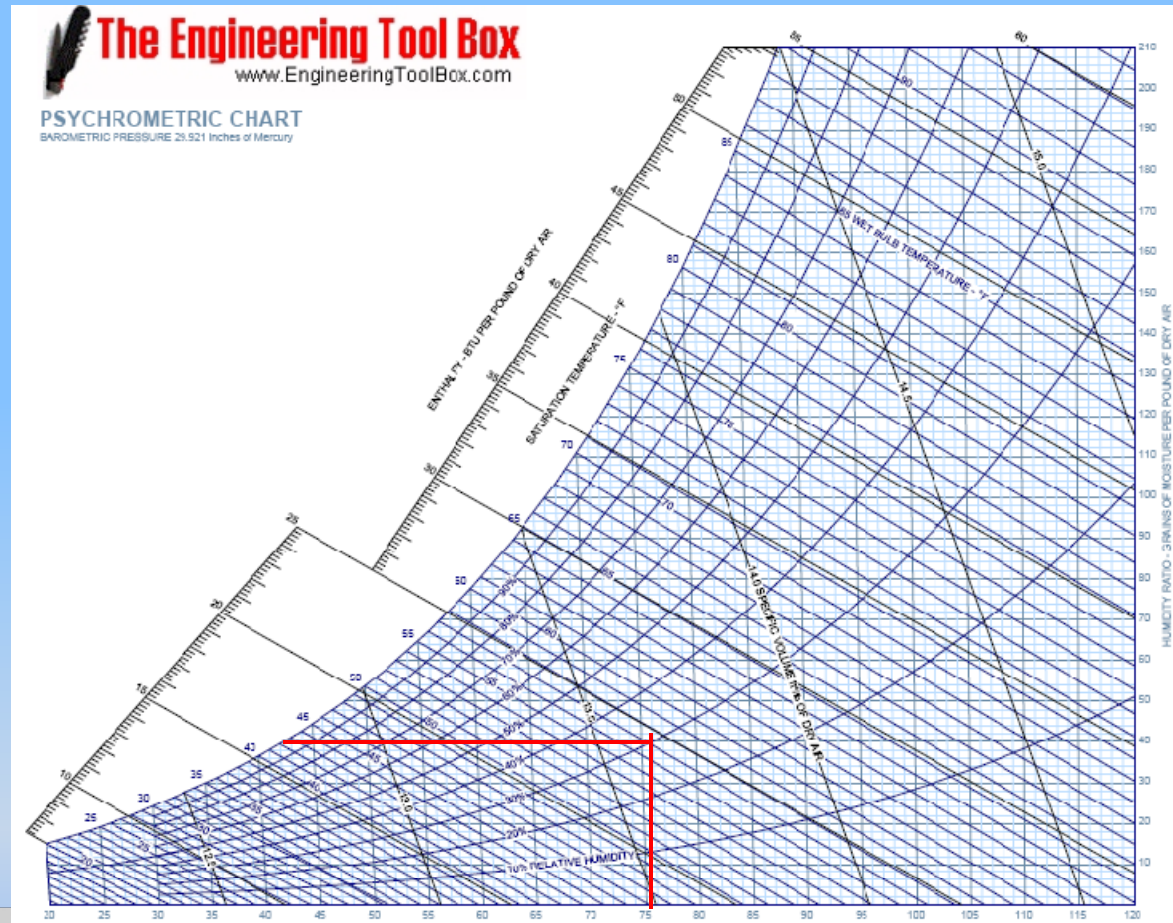


BREADTH STUDY : FACADE

PROPOSED SOLUTIONS - PASSIVE

AS - BUILT:

- SUPPLY/DIRECT MORE WARM AIR FROM HVAC DUCTS TO WINDOW SURFACE
- LOWER THE RELATIVE HUMIDITY LEVEL (CHECK BUILDING CODES AND ASHRAE STANDARDS)
- LOWER THE TEMPERATURE OF THE ROOM



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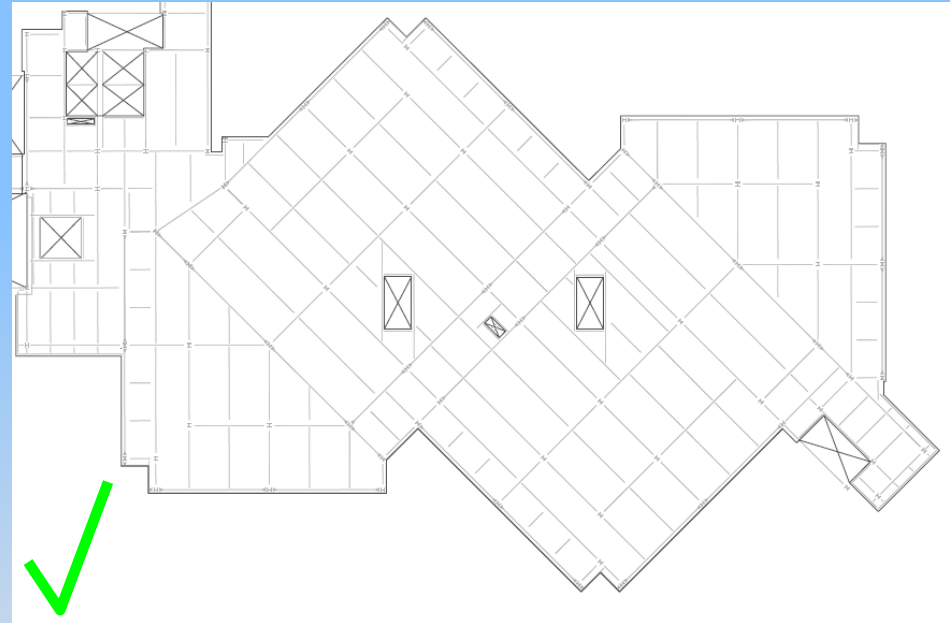


CONCLUSIONS : DEPTH STUDY

GRAVITY ANALYSIS

- EXISTING FRAMING IS LIGHTER THAN ALTERNATIVE FRAMING PLANS
- CASTELLATED BEAMS CAN REDUCE WEIGHT (5837LBS) – 39% INCREASE IN COST

✓ STRUCTURAL ENGINEER CHOSE THE BEST GRAVITY SYSTEM LAYOUT ✓

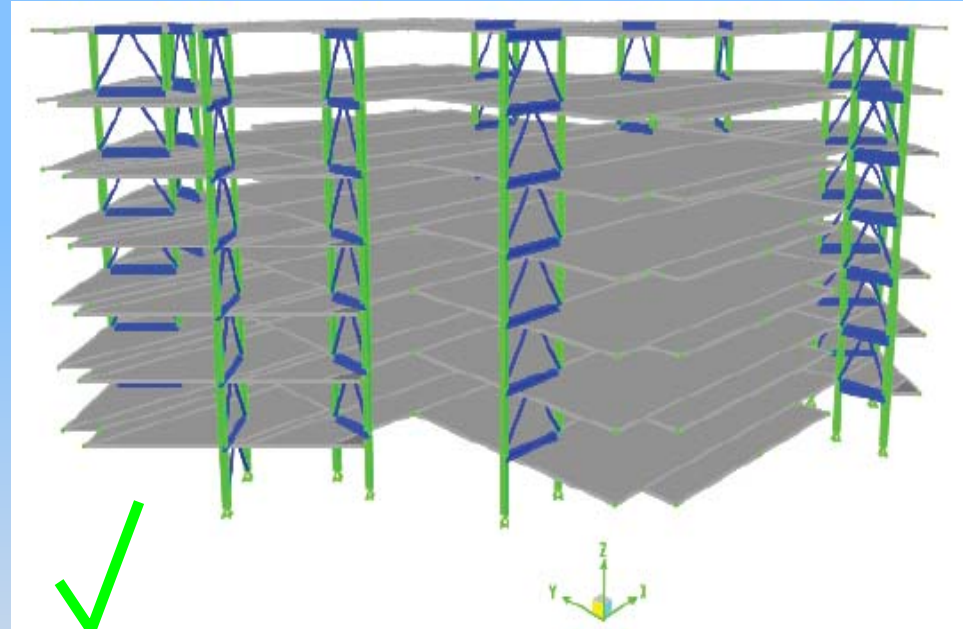


CONCLUSIONS : DEPTH STUDY

LATERAL ANALYSIS – BRACED FRAMES

- REDUCES MEMBER SIZES
- DECREASES WEIGHT OF STRUCTURAL STEEL
- INCREASES LATERAL STIFFNESS
- REDUCES DRIFT BY 1.5”
- QUICKER CONSTRUCTION

✓ BRACED FRAMES ARE A SUITABLE ALTERNATIVE TO MOMENT FRAMES ✓



CONCLUSIONS : BREADTH STUDY

FAÇADE ANALYSIS

OPTION 1:

REDUCE THE RELATIVE HUMIDITY IN PATIENT ROOMS



- LEAST DESTRUCTIVE
- INEXPENSIVE
- CODE DEPENDANT

OPTION 2:

INSTALL HEAT TRACE ALONG EXPOSED EDGES OF WINDOW SILLS



- MINIMAL CONSTRUCTION
- MOST COST EFFECTIVE OF ACTIVE SOLUTIONS
- THIRD PARTY CONSULTANT



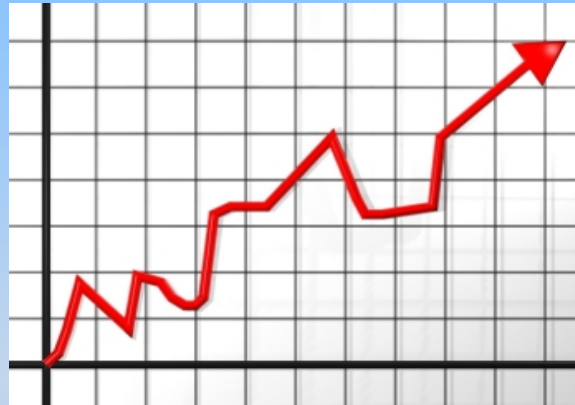


**THANK YOU
QUESTIONS?**



STATISTICS OF
HEART FAILURE

% OF THESIS
COMPLETE



TIME

