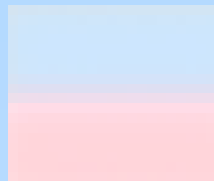


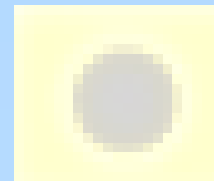
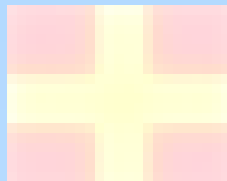
**The Erie Convention Center and
Sheraton Hotel
Erie, Pennsylvania**



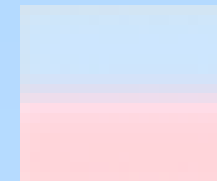
Caitlin Ferrell
Structural Option
Senior Thesis Presentation
Spring 2006



Architectural Engineering

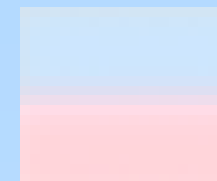
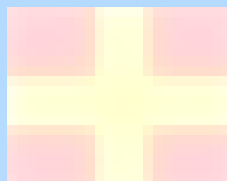
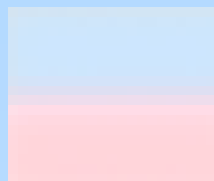


The Pennsylvania State University



Presentation Overview

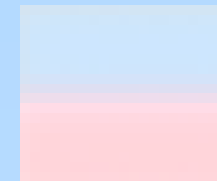
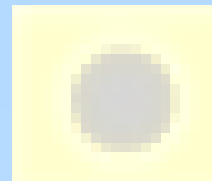
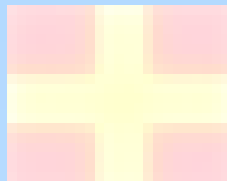
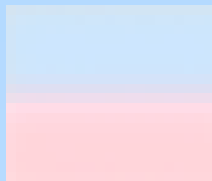
- Project Background
- Depth Study:
 - Two alternative floor systems
 - Staggered truss system design
- Breadth Study
 - Mechanical
 - Acoustics



Project Background

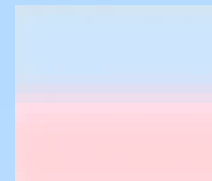
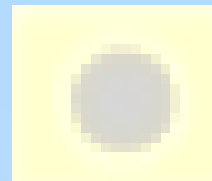
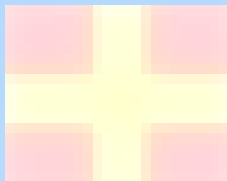
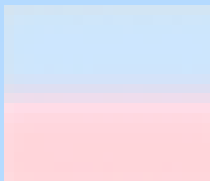
Building Statistics

- Size-
 - 11 stories
 - 132,000 sq.ft.
 - 200 guestrooms
- Part of the Bayfront Convention Center Complex
- \$62 million + local business contributions
- Expected completion date: Summer 2007



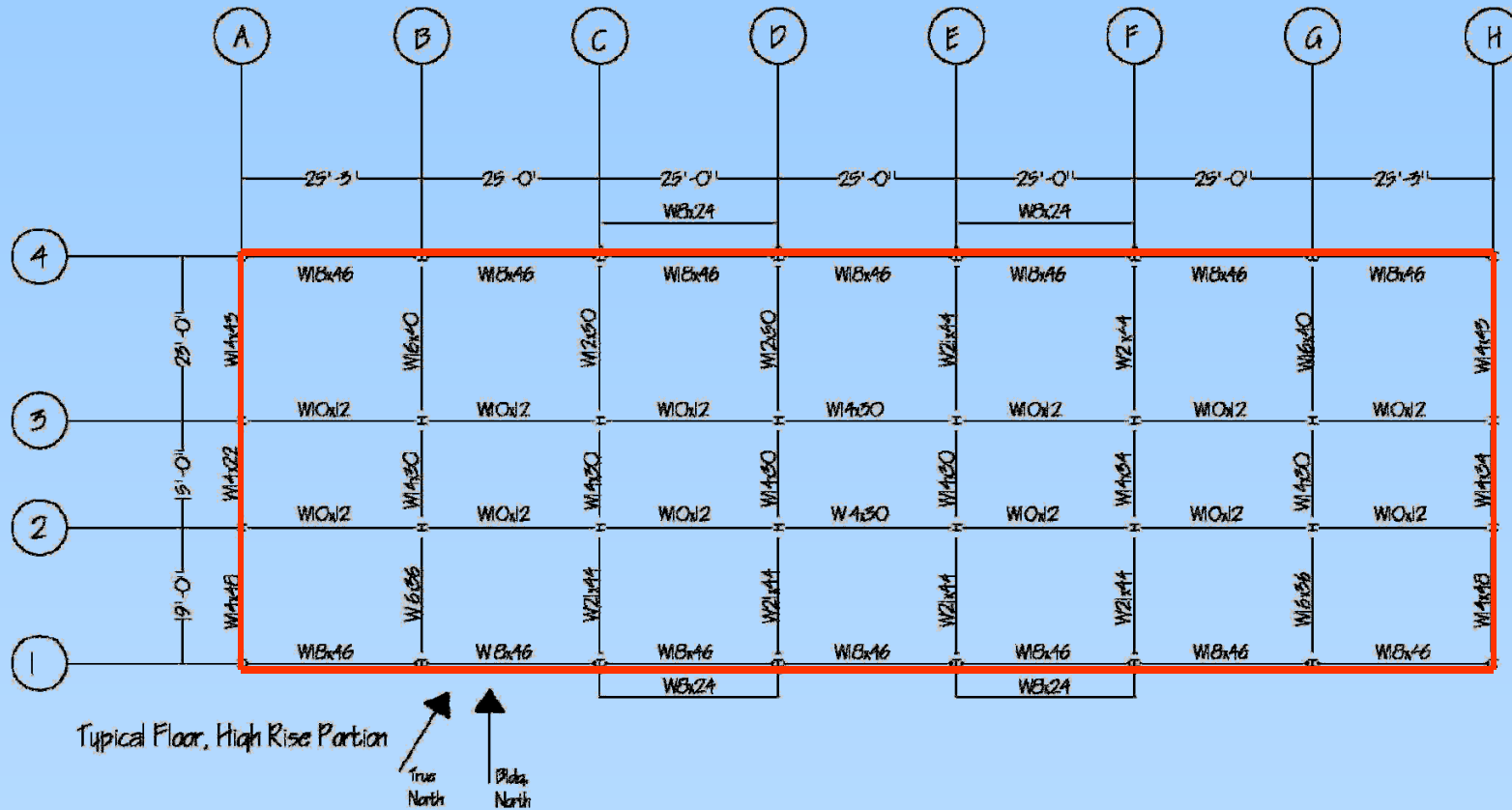
Project Background

The Site



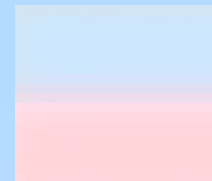
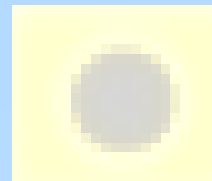
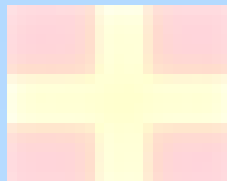
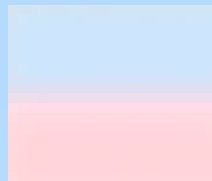
Project Background

Existing Structure



Typical Floor, High Rise Portion

True North
Bldg North

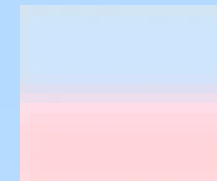
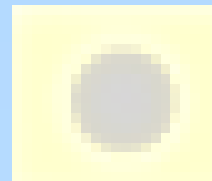
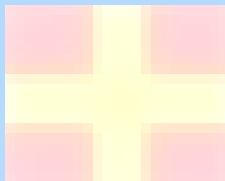
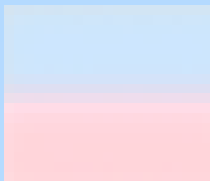


Project Background

Existing Structure

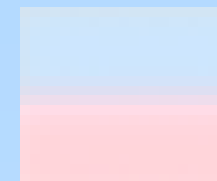
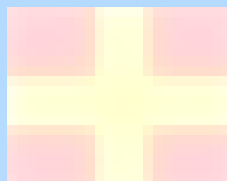
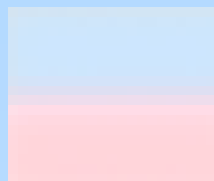


Bracing allows for ribbon windows



Presentation Overview

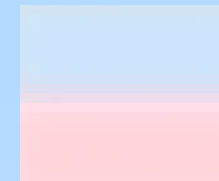
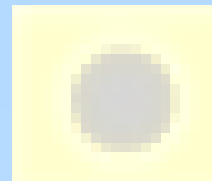
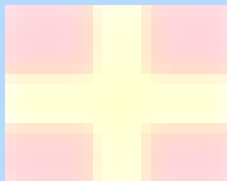
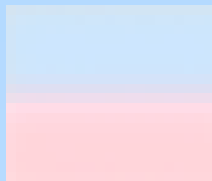
- Project Background
- Depth Study
 - Two alternative floor systems
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 - Mechanical
 - Acoustics



Depth Study Proposal

- Need for open floor plans on lower levels
- Quick and inexpensive construction
- Lateral resistance to wind in N/S direction
- Hotel provides a regular pattern with a single corridor on the upper floors

Staggered Truss System



Depth Study

Alternate Floor Systems

Precast Plank

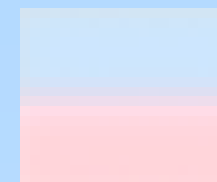
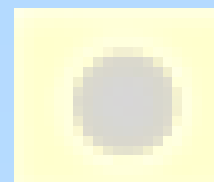
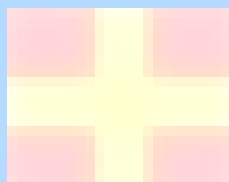
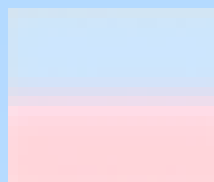
8" hollow-core precast plank with 2" topping

vs.

Steel Joist with Deck and Slab

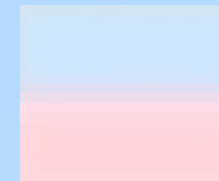
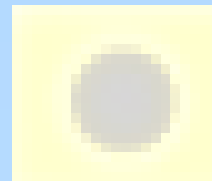
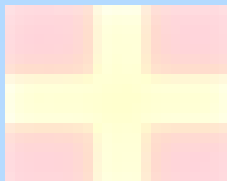
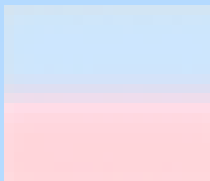
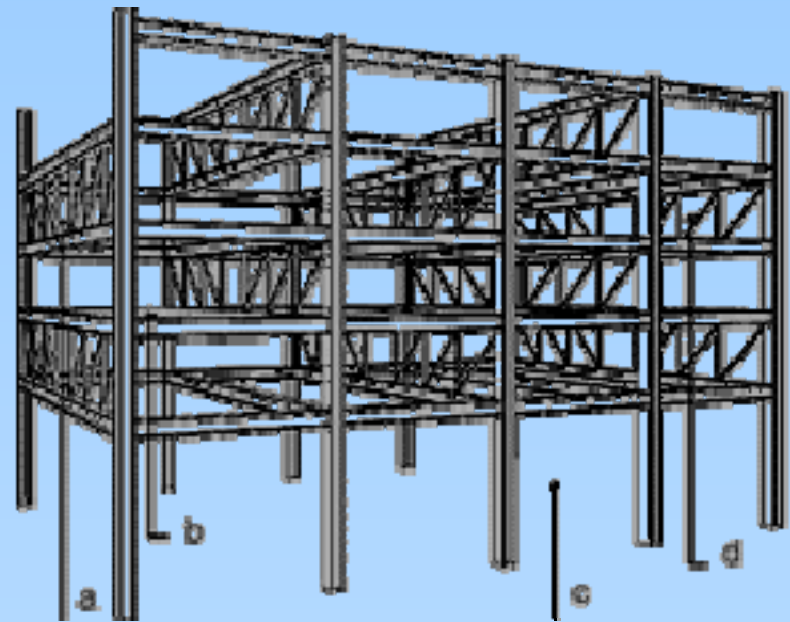
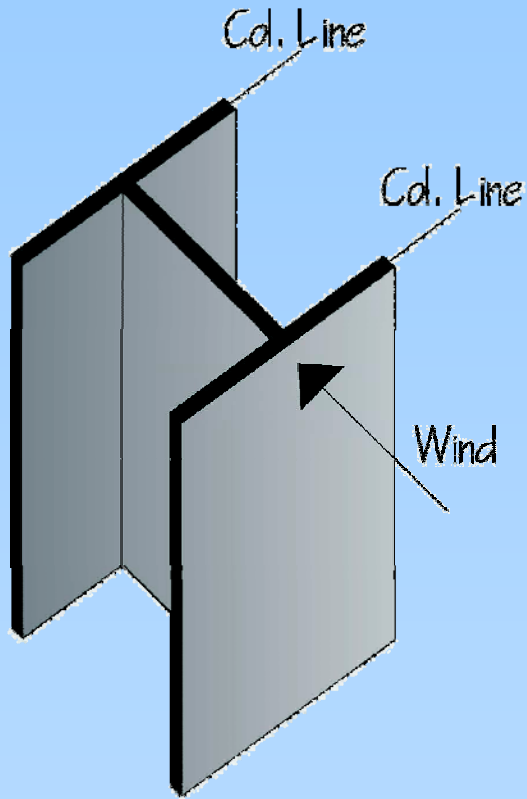
22K7 (lower floors), 18K4 (upper floors)

22 Ga. 1.5" Composite Deck w/ 4" NW slab



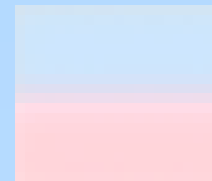
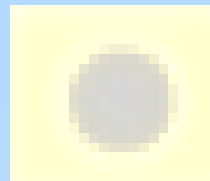
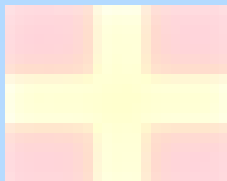
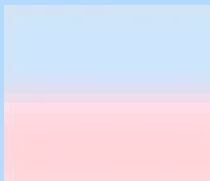
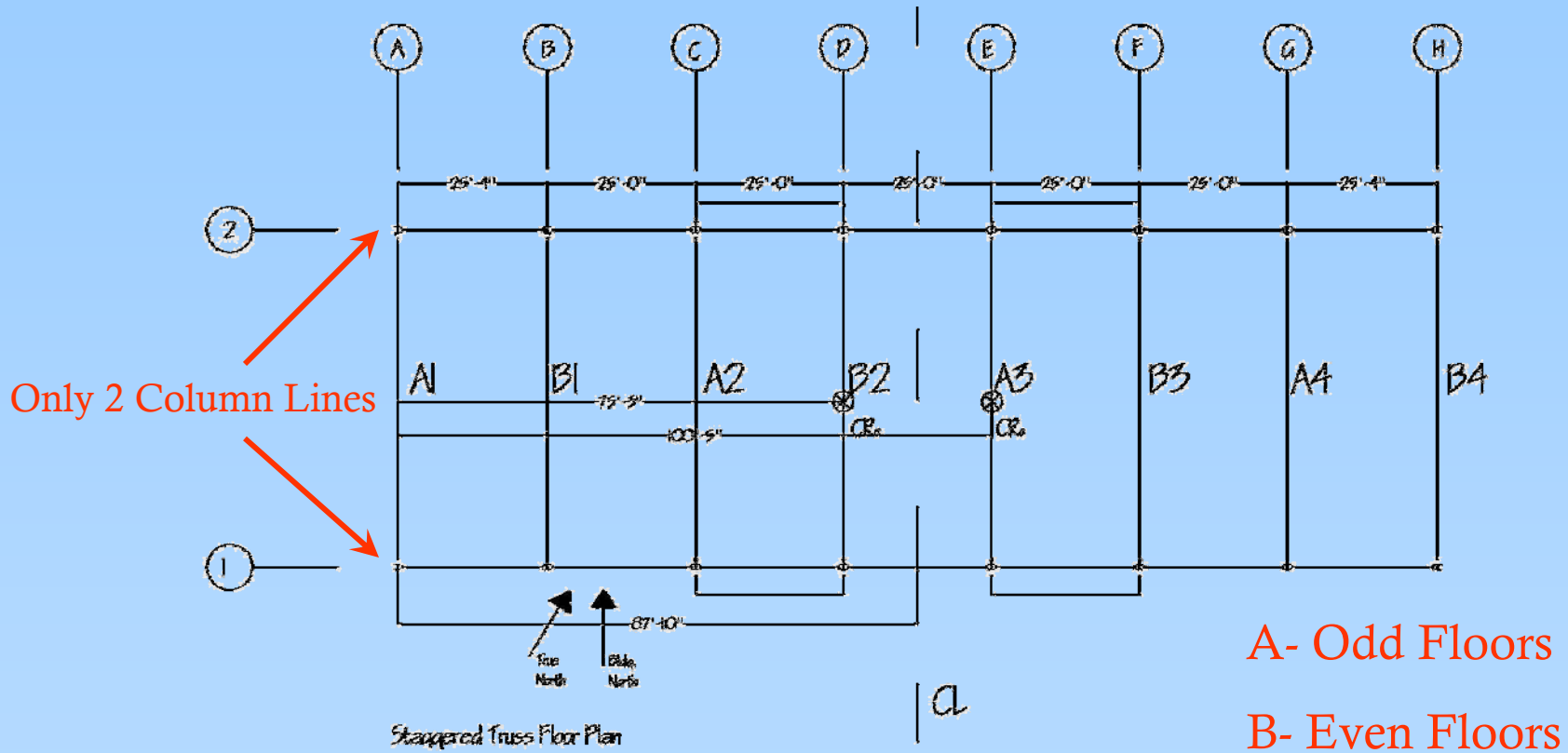
Depth Study

Staggered Truss System



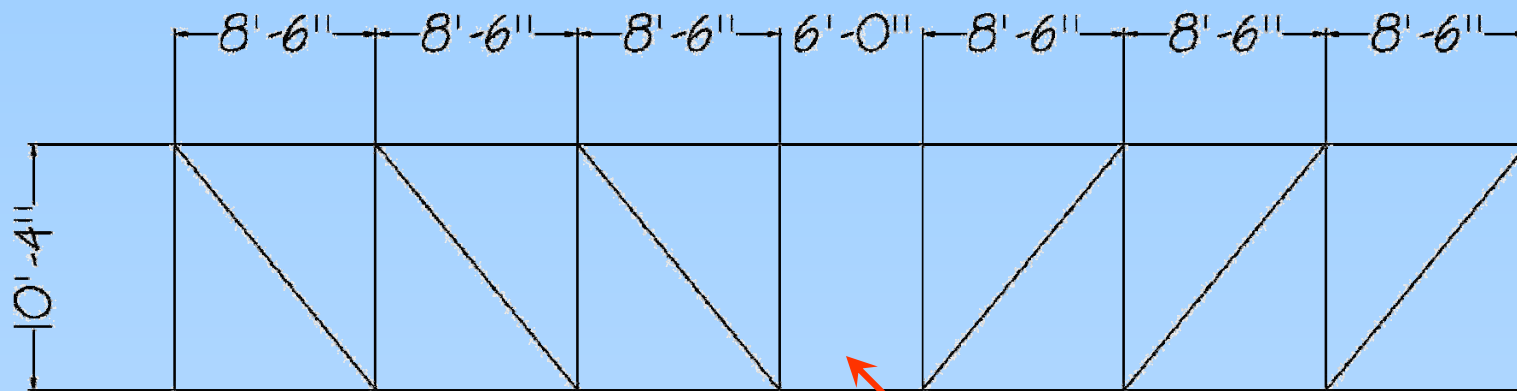
Depth Study

Staggered Truss System



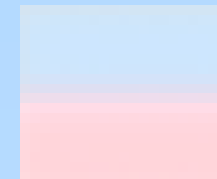
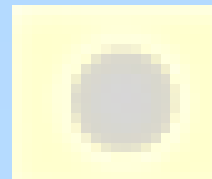
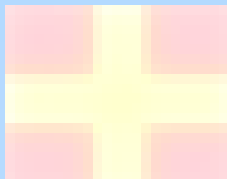
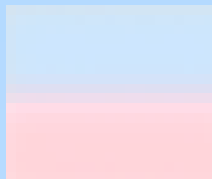
Depth Study

Staggered Truss System



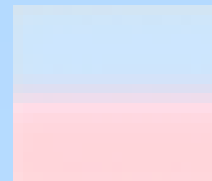
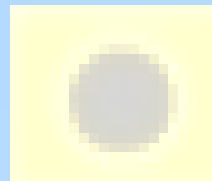
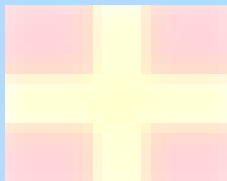
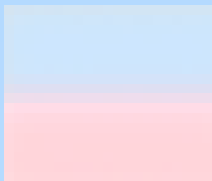
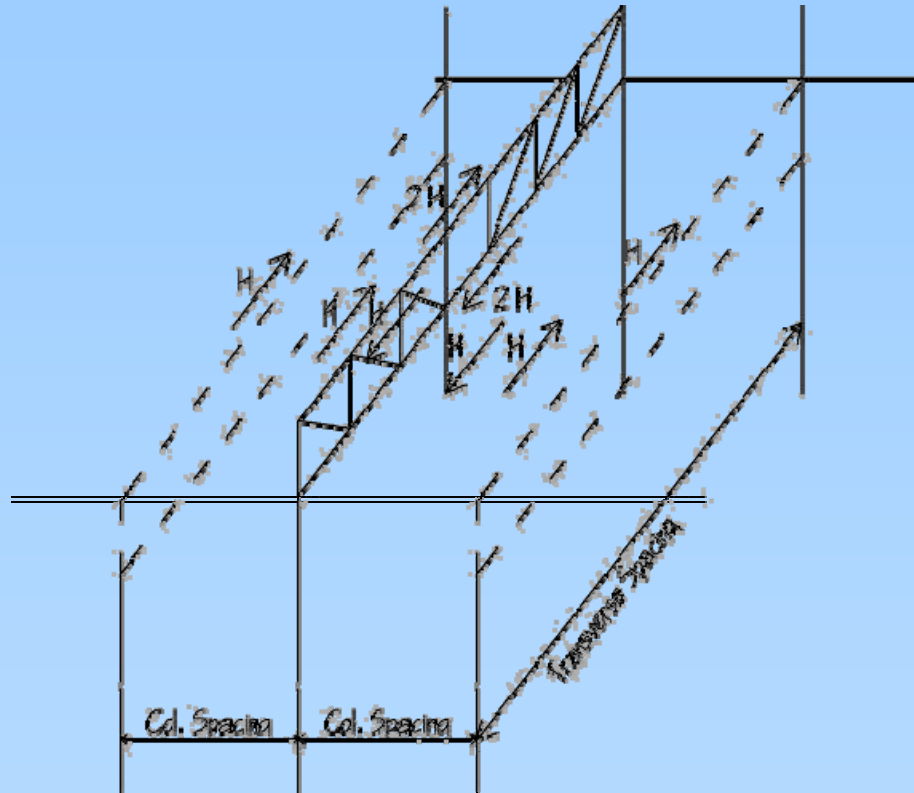
Typical Truss

Vierendeel panel
allows for corridor



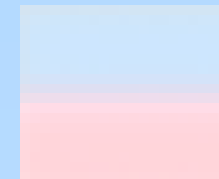
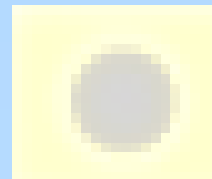
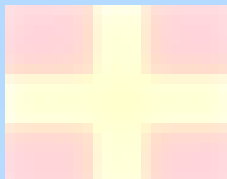
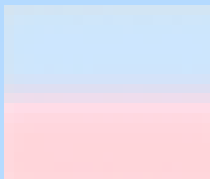
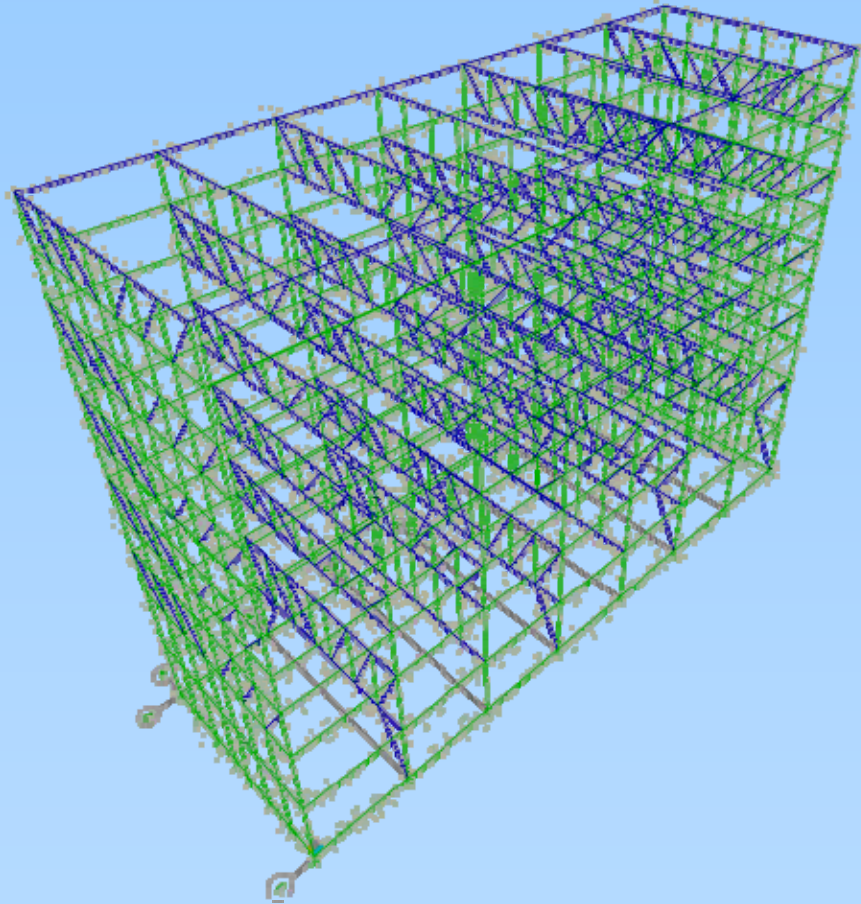
Depth Study

Staggered Truss System



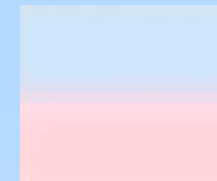
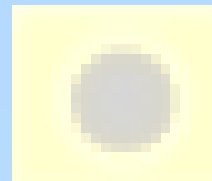
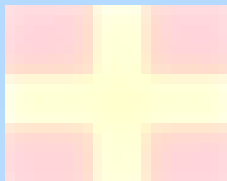
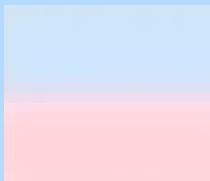
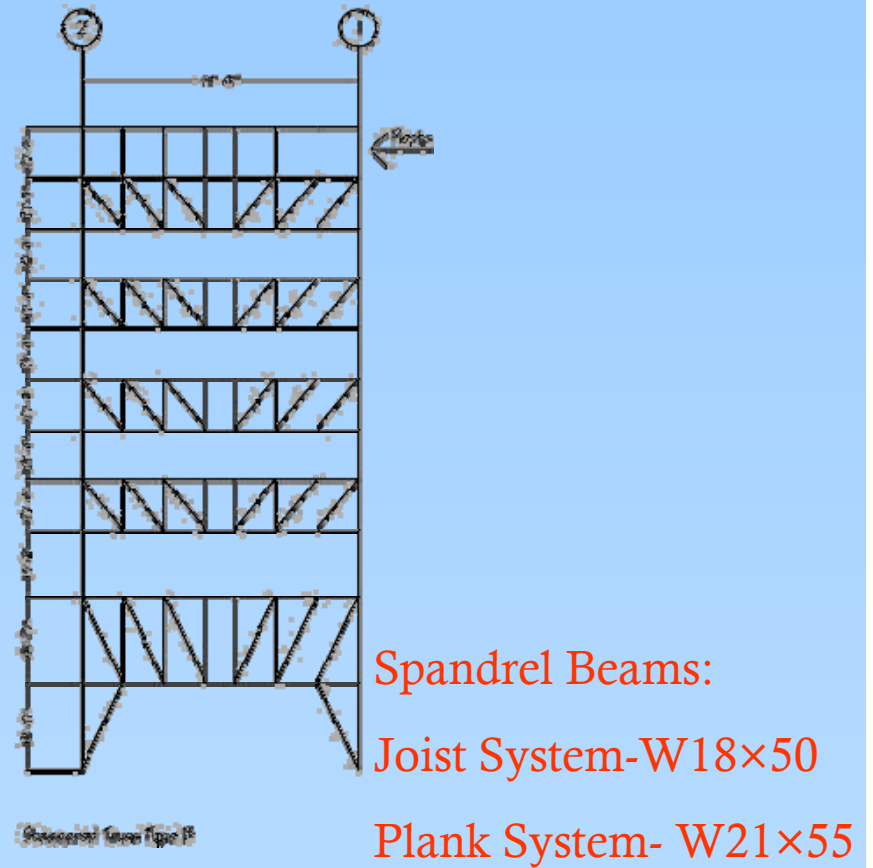
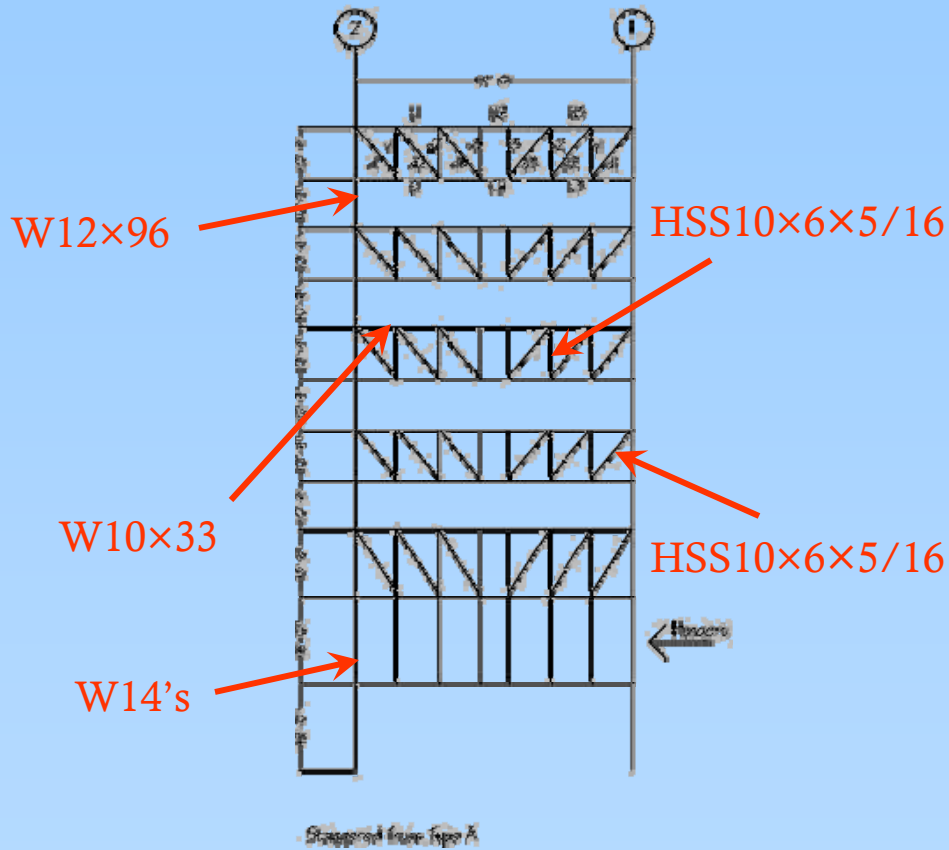
Depth Study

Staggered Truss System



Depth Study

Staggered Truss System



Depth Study

Staggered Truss System

Controlling Load Combinations

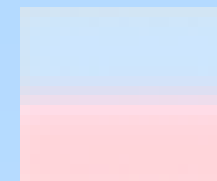
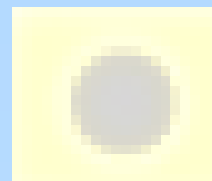
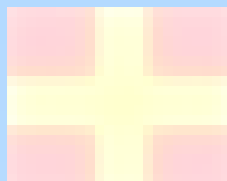
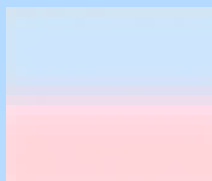
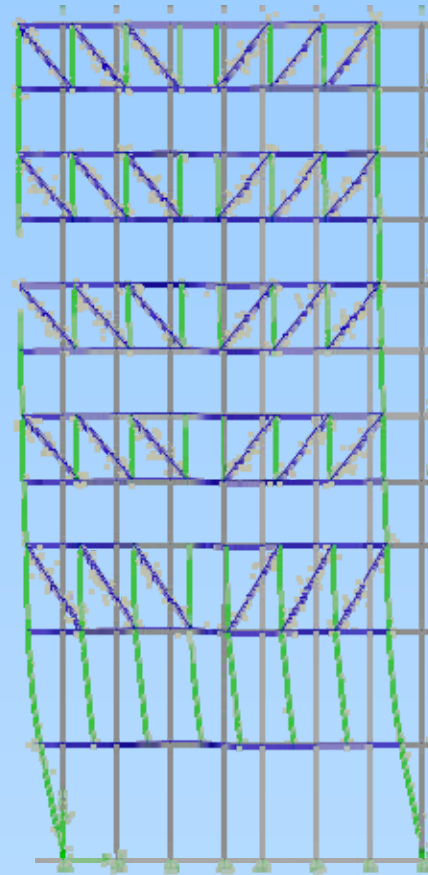
- N/S: $1.2D+1.6W+1.0L+0.5R$
- E/W: $1.2D+1.0E+1.0L+0.2S$

Building Drift (N/S Direction)

- Precast Plank System- 2.8"
- Joist System – 1.68"

Allowable Drift

- H/400
- 3.96"



Depth Study

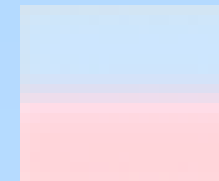
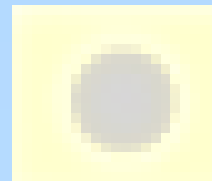
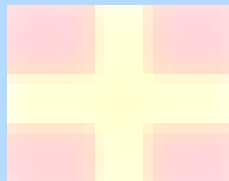
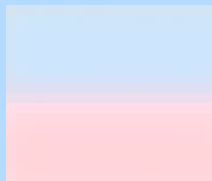
Alternate Floor Systems

Precast Plank
Slightly Larger Members

vs.

Steel Joist with Deck and Slab

Adds 1' to each floor → 11' total

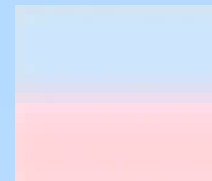
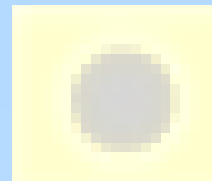
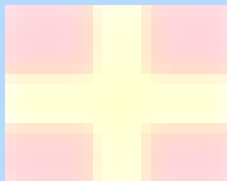
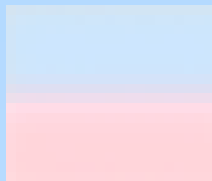


Depth Study

Staggered Truss System

Additional Factors:

- Erection and Coordination of Trades
- Foundations
- Fire Resistance
- Architecture

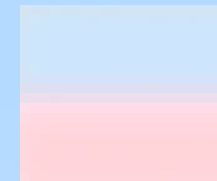
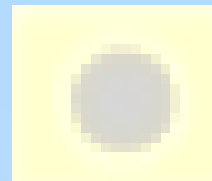
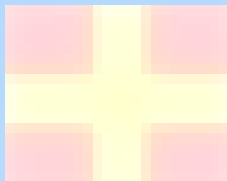
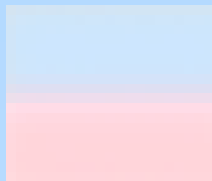


Depth Study

Structural Costs

Existing System Installed Cost per Ton of Steel

	weight (lbs)	tons	pricing	total cost
Columns	511765.29	255.8826	\$2,000.00	\$511,765.29
Beams	481446.34	240.7232	\$2,000.00	\$481,446.34
Cross-Bracing	101888.98	50.94449	\$2,200.00	\$112,077.88
				\$1,105,289.51

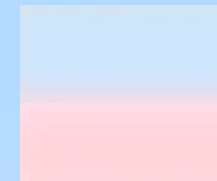
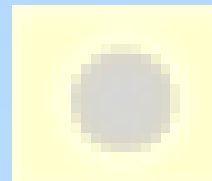
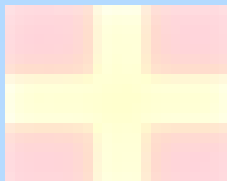
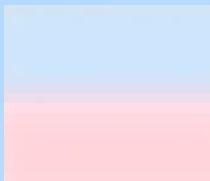


Depth Study

Structural Costs

Staggered Truss w/ Plank Installed Cost per Ton of Steel

	weight (lbs)	tons	pricing	total cost
Transverse Beams	242967.54	121.48	\$2,500.00	\$303,709.43
Col. Line 1	142171.76	71.09	\$2,000.00	\$142,171.76
Col. Line 2	142171.76	71.09	\$2,000.00	\$142,171.76
Truss Elevation A	47839.93	23.92	\$2,200.00	\$52,623.93
Truss Elevation B	50478.00	25.24	\$2,200.00	\$55,525.80
Truss Elevation C	48181.93	24.09	\$2,200.00	\$53,000.13
Truss Elevation D	49425.36	24.71	\$2,200.00	\$54,367.89
Truss Elevation E	47839.93	23.92	\$2,200.00	\$52,623.93
Truss Elevation F	49059.16	24.53	\$2,200.00	\$53,965.07
Truss Elevation G	48181.93	24.09	\$2,200.00	\$53,000.13
Truss Elevation H	47421.16	23.71	\$2,200.00	\$52,163.27
				\$1,015,323.08



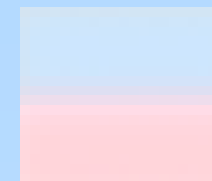
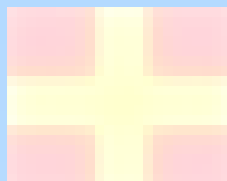
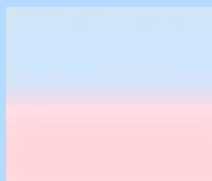
Depth Study

Structural Conclusions

	Existing	Staggered Truss
Cost	\$1,105,289.51	\$1,015,323.08
Schedule	More Members to Erect	Prefabricated Trusses

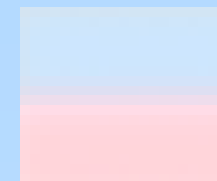
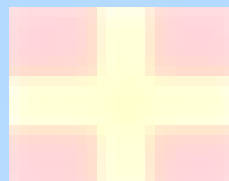
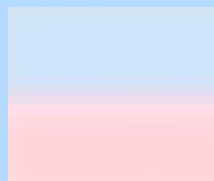
Savings of:
\$89,966.43

Shorter field
erection time



Presentation Overview

- Project Background
- Depth Study
 - Two alternative floor systems
 - Staggered truss system design
- Breadth Study
 - Mechanical
 - Acoustics



Breadth Study-Mechanical

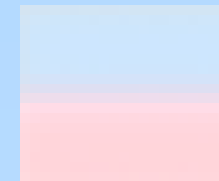
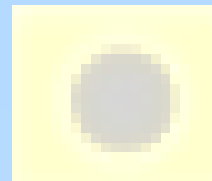
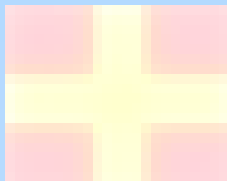
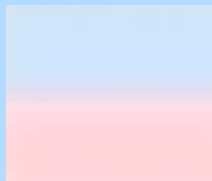
Open-Loop Geothermal Heat Pump

Existing System: air to air through the wall units

Proposed System: air to water system

- Higher COP (Coefficient of Performance)
- Saves 6.58×10^5 kWh in heating per year
- Saves 7.52×10^5 kWh in cooling per year
- Cost of electricity in PA at \$0.0873/kWh
- Additional energy needed to pump water from lake

\$119,752.85 saved per year



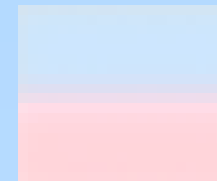
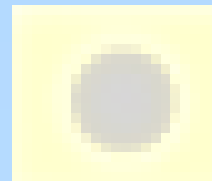
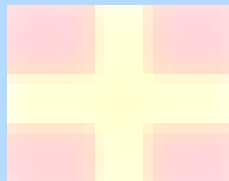
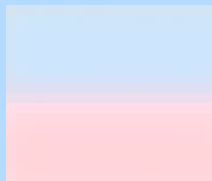
Breadth Study

Open-Loop Geothermal Heat Pump

Initial Costs:

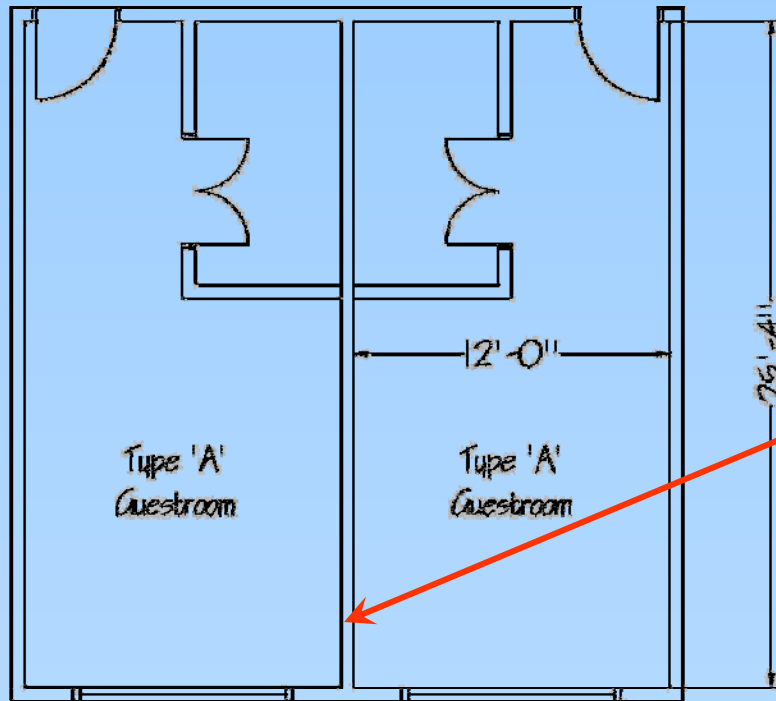
- Drilling, pipe, pumps, strainer, labor
- \$27,608.82

3 month payback period



Breadth Study-Acoustics

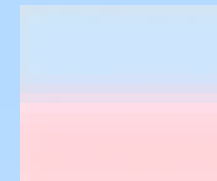
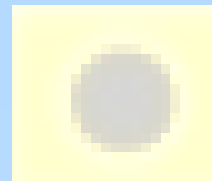
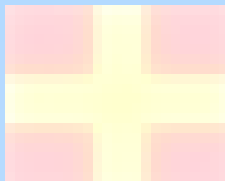
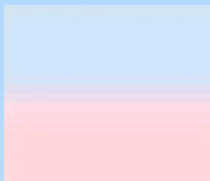
Sound Transmission Through Guestroom Walls



Wall Construction:

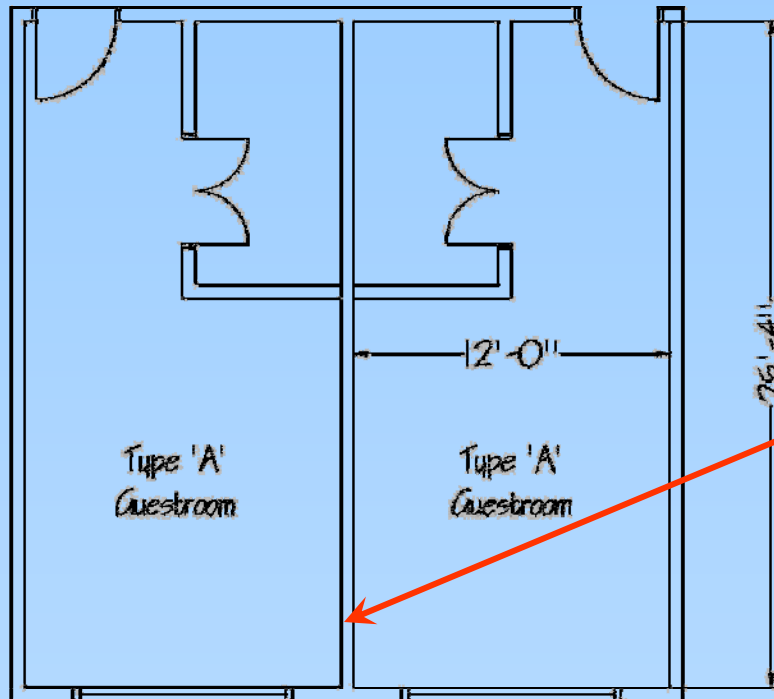
2 layers 5/8" gypsum board, 3-5/8" metal studs, 3" fiberglass insulation

Sound Transmission Loss (TL) through wall						
STC	125	250	500	1000	2000	4000
57	38	52	59	60	56	62



Breadth Study-Acoustics

Sound Transmission Through Guestroom Walls

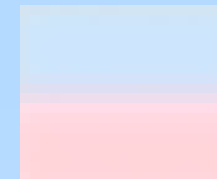
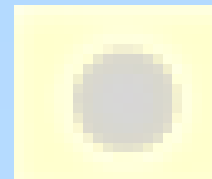
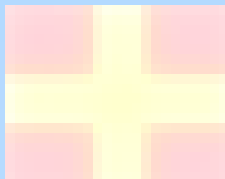
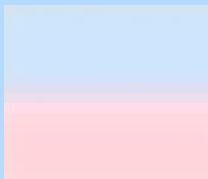


Wall Construction:

2 layers 5/8" gypsum board, 3-5/8" metal studs, 3" fiberglass insulation

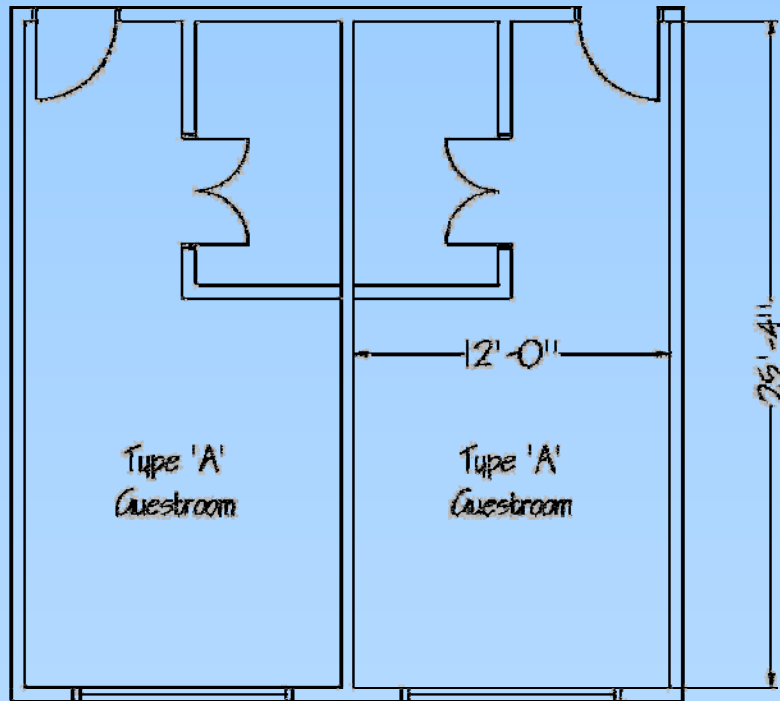
Noise Reduction (NR) Between Rooms (dB)

125	250	500	1000	2000	4000
36	50	59	61	57	63



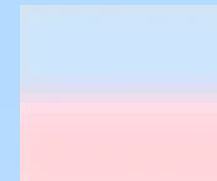
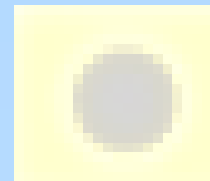
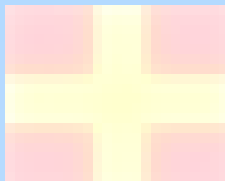
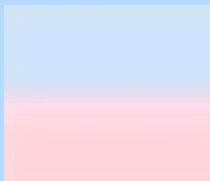
Breadth Study-Acoustics

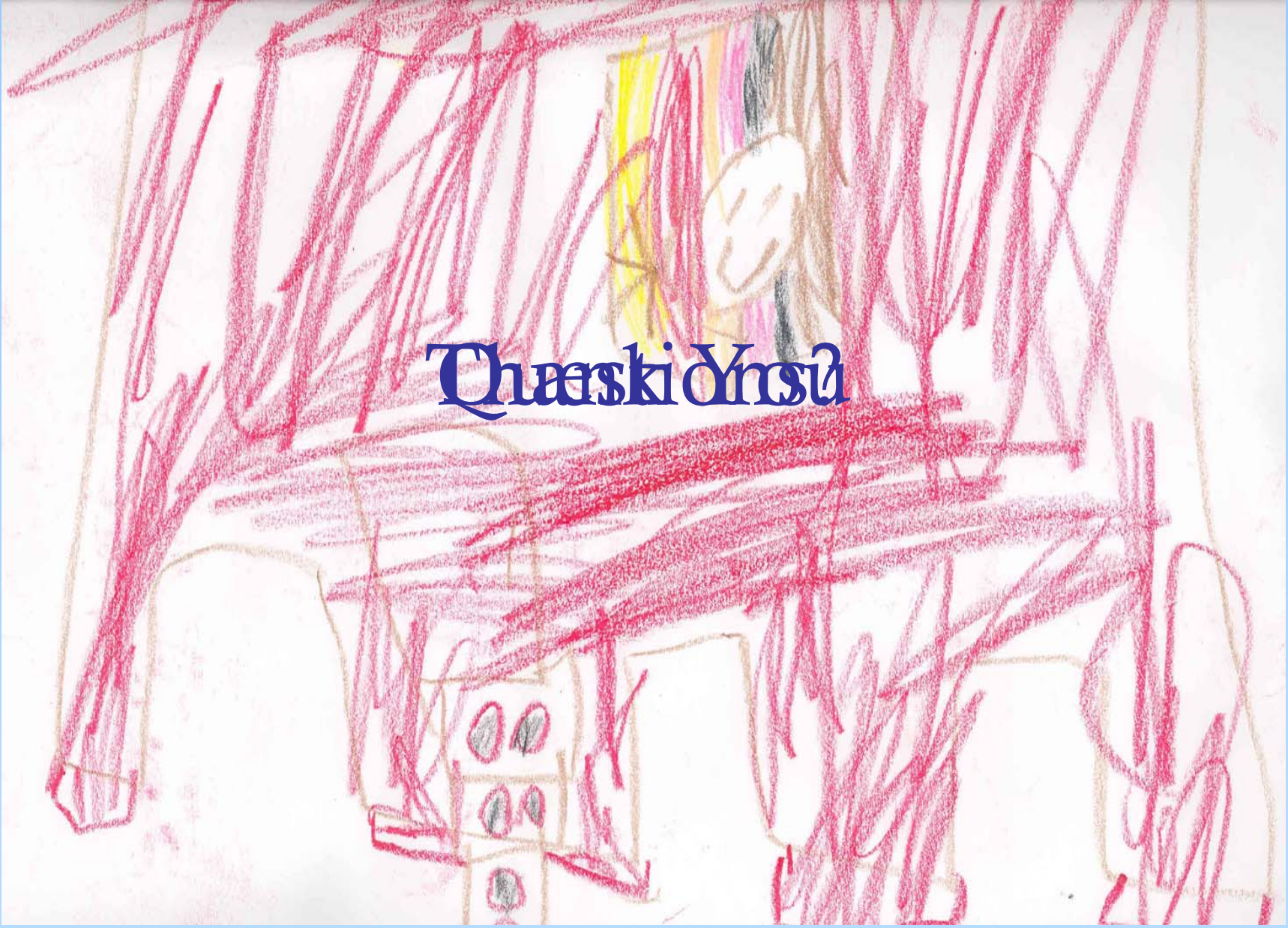
Sound Transmission Through Guestroom Walls



Lp (Receiving Room)						
	125	250	500	1000	2000	4000
Normal Voice	17	9	4	-3	-7	-16
Raised Voice	14	5	-1	-12	-11	-22

Window AC Unit Sound Pressure - 5dB					
125	250	500	1000	2000	4000
59	60	51	48	53	39





Thærski ðrsú