Rebecca Bires | Scott Brown | Scott Eckert | Jordan Huey | Helen Leenhouts | Andrew Levy | Jeffrey Loeb | Patrick Vogel

Apollo

Energy Producing Measures

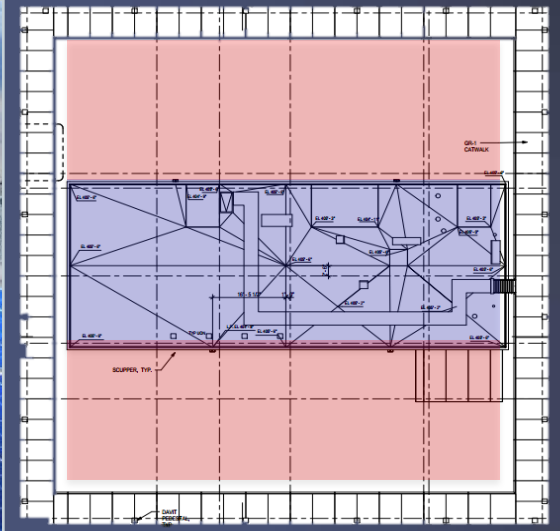
Solar Panels on the Roof

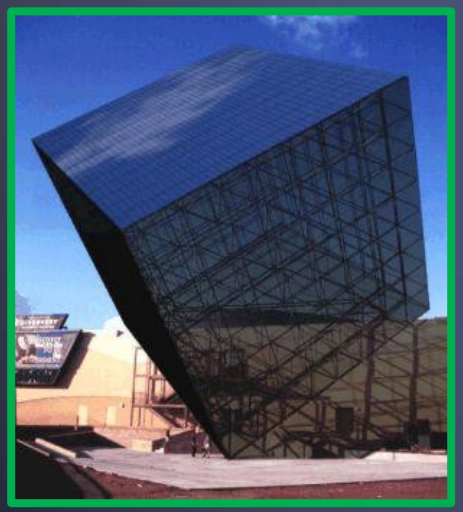
- REC 215 AE-US - 3′x5′
- About 650 Panels fit on this roof

- Summer: 325-520kW per day*
- Winter: 163-390kW per day*

*Depending on cloud cover

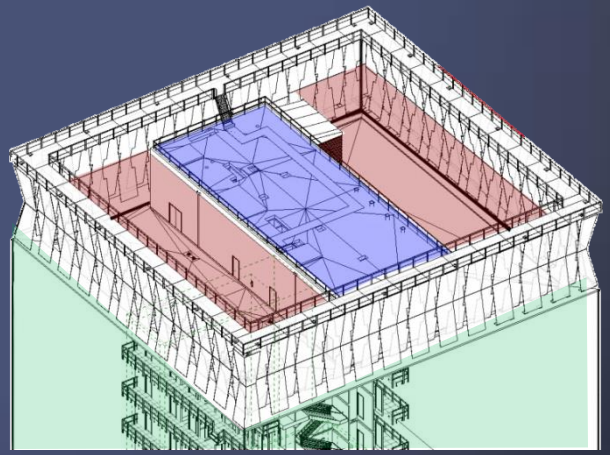
- 100% South Facing at a vertical angle of 10◦-20◦





Photovoltaic Glazing on Upper Floors

- Architecturally integrated for seamless design
- Amount of energy produced will depend on area of PV Glazing



Effects of Solar System

Structural

- Coordinate to ensure roof will be stable/strong enough

Construction

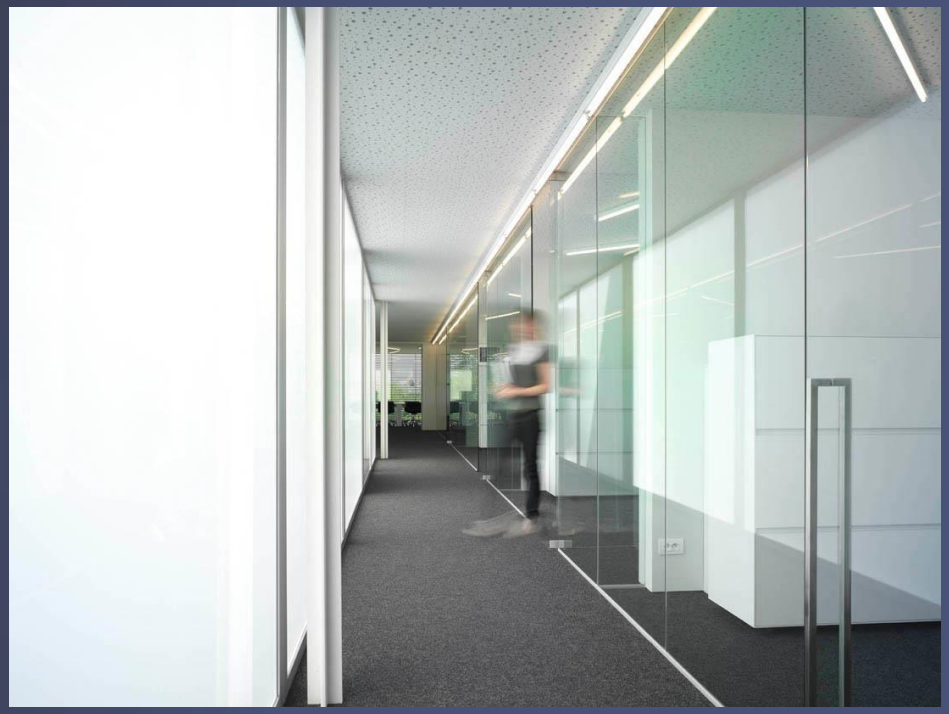
- Added schedule time for installation
- Limited roof access once installed

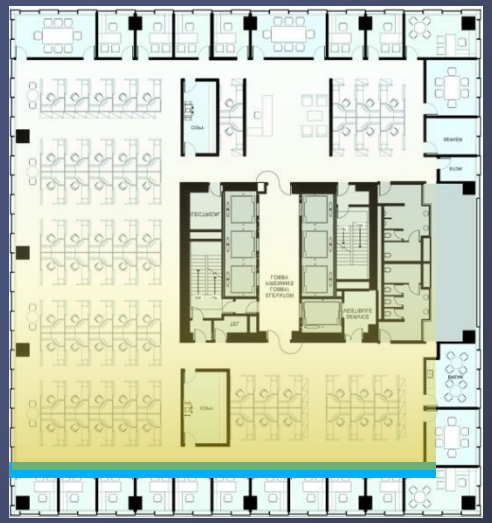
Mechanical

- Coordinate with cogeneration mechanical rooms on roof
- Glazing changes will effect solar heat gain

Apollo

Translucent Partitions





Effects of Glass Partitions

Structural

- Weight of glass partitions should be considered

Construction

- Schedule decrease, easy installation
- Quick drop off time

Mechanical

- Coordinate with building energy modeling to accurately measure heat gain/loss between rooms

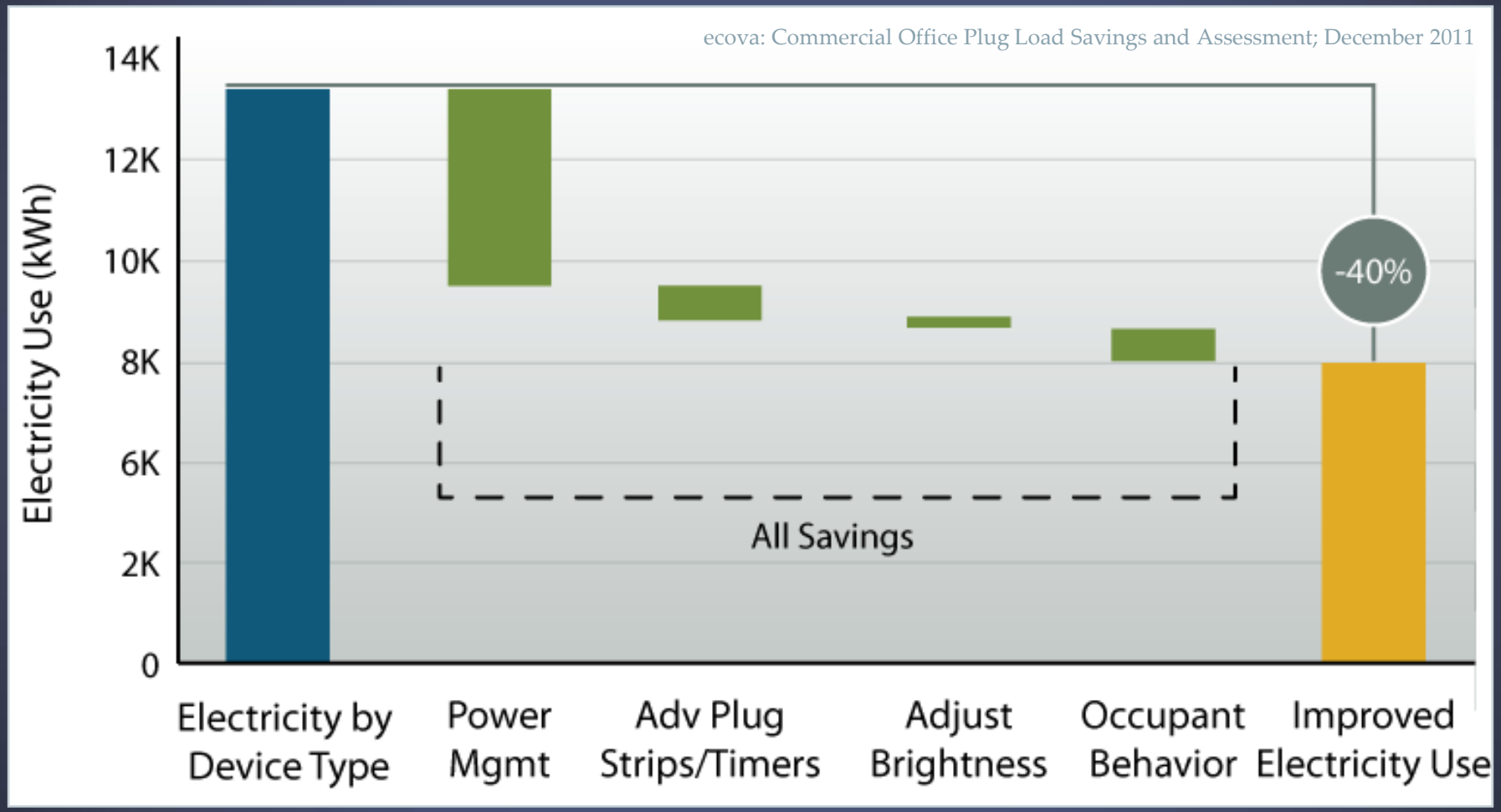
Energy Saving Measures

113 W
495 kW-hr/year

10 W
44 kW-hr/year

APOLLO

ENERGY SAVING MEASURES



Apollo

Energy Saving Measures

113 W
495 kW-hr/year

10 W
44 kW-hr/year
26 kW-hr/year

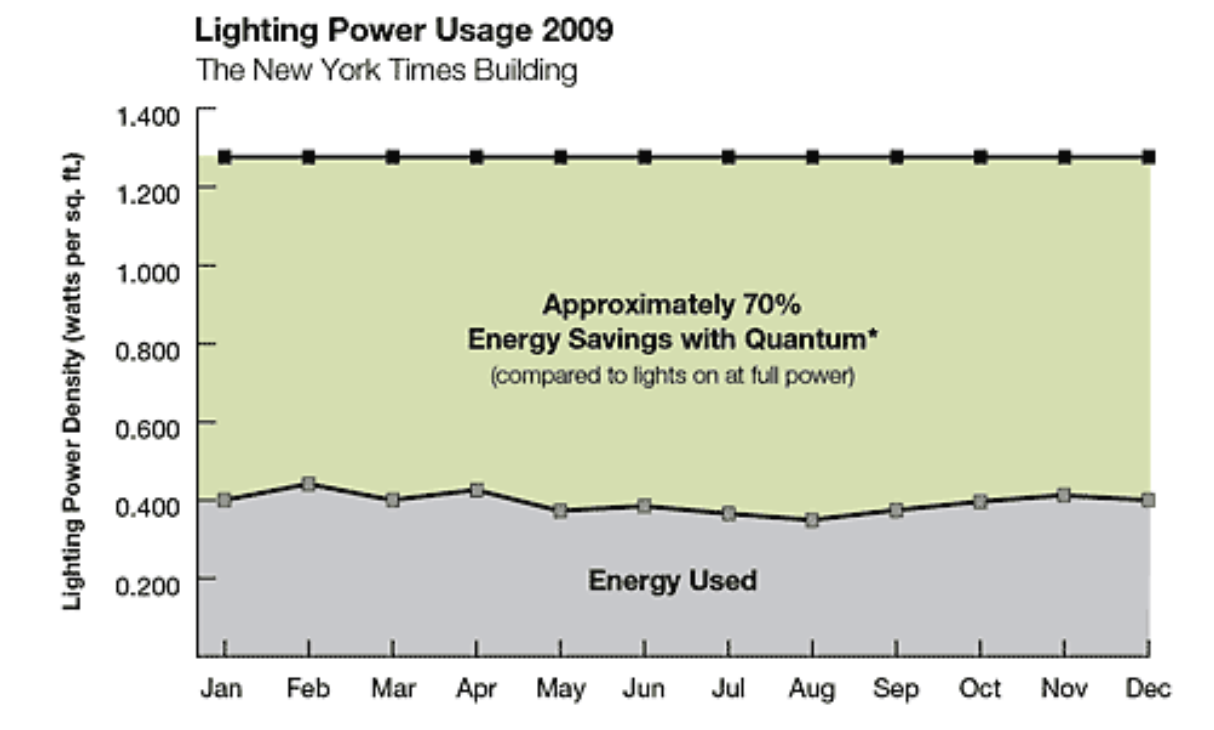
85 Computers per floor
39,865 Kw-hr saved
$ 9,089 saved per floor
$227,230 potential savings

Apollo

Energy Saving Measures

Design to 75% Code Mandated LPD

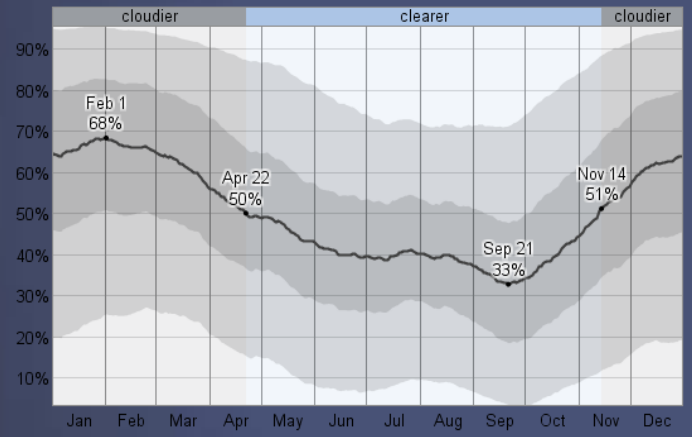
~ 0.65 watts/sf

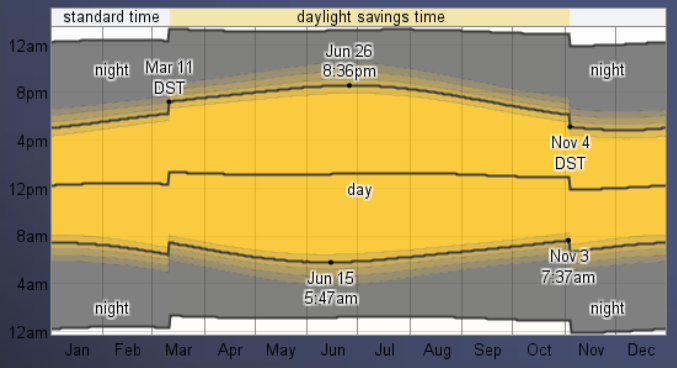


Progressive energy controls system

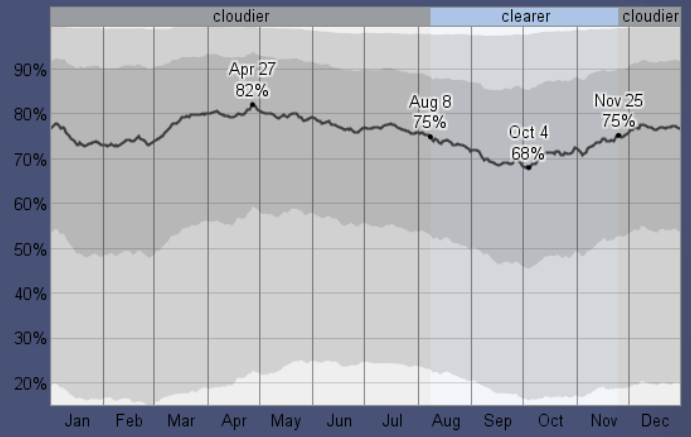
ENERGY SAVING MEASURES

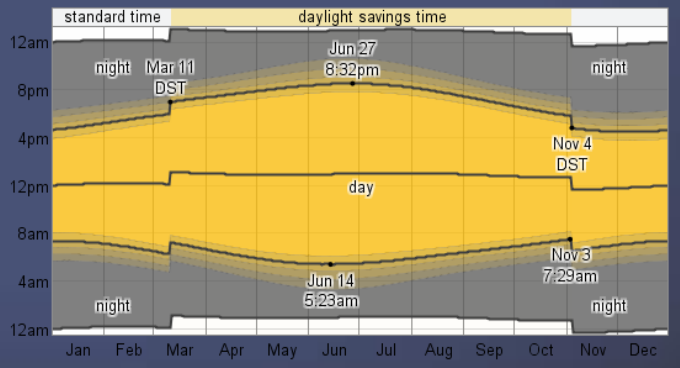
San Francisco





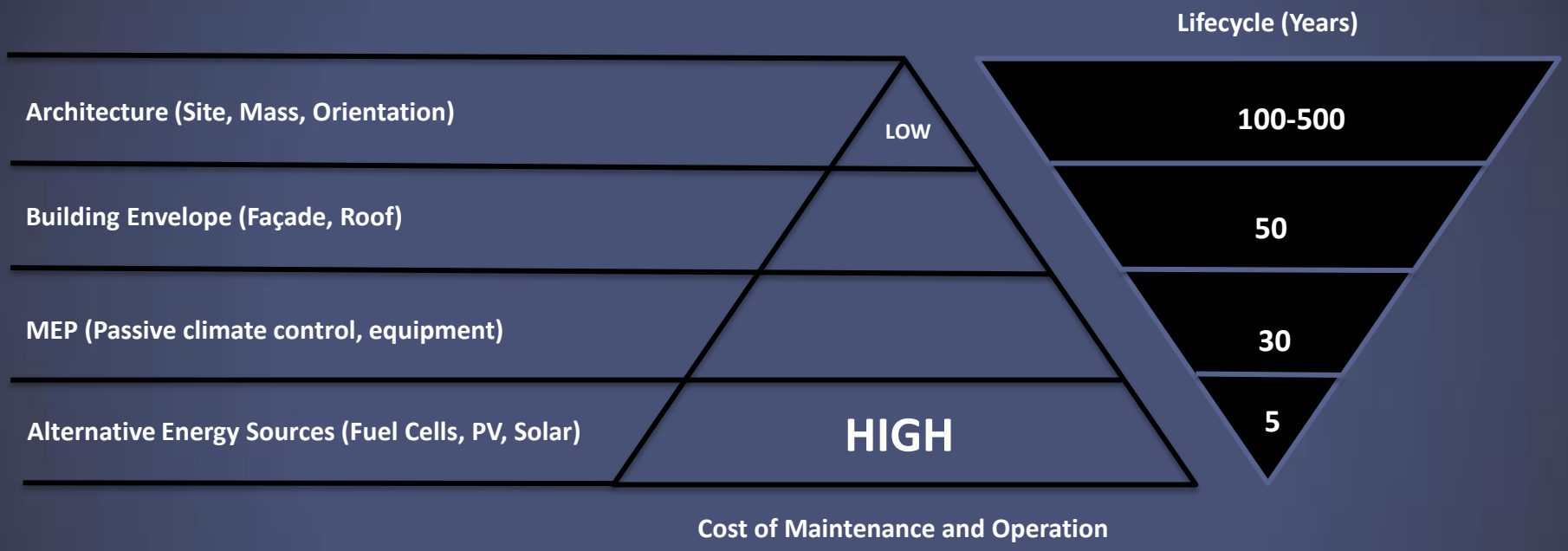
New York



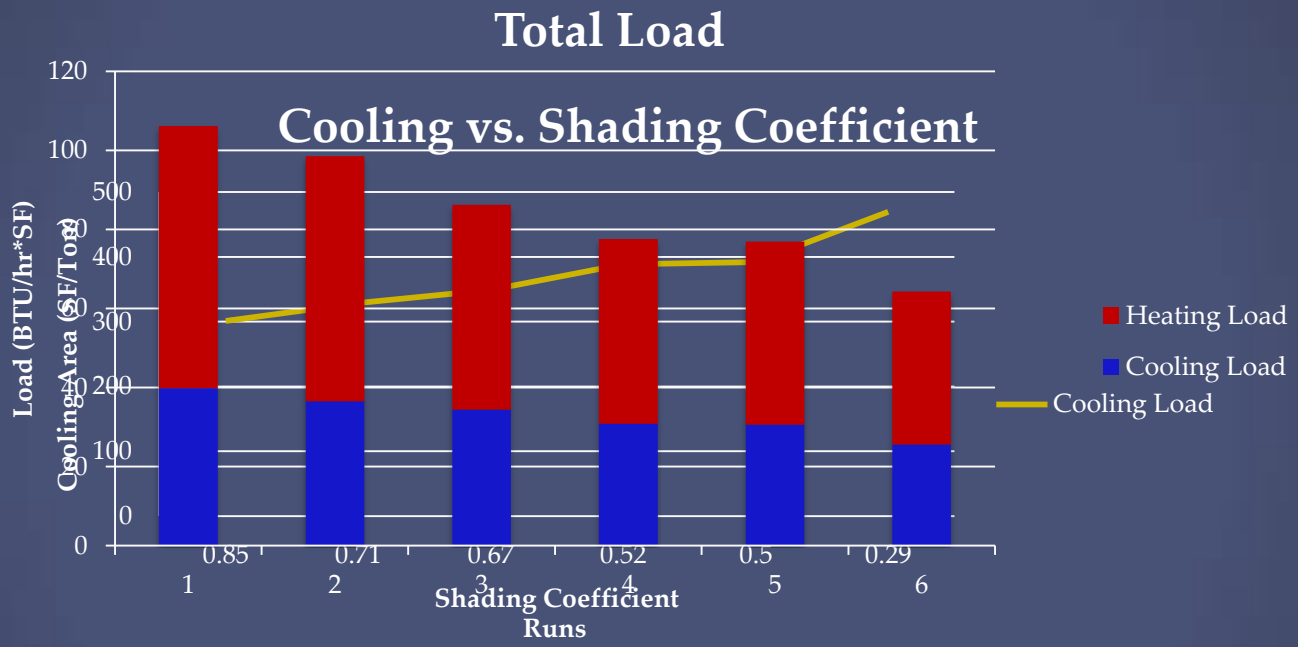


APOLLO

Design Strategy



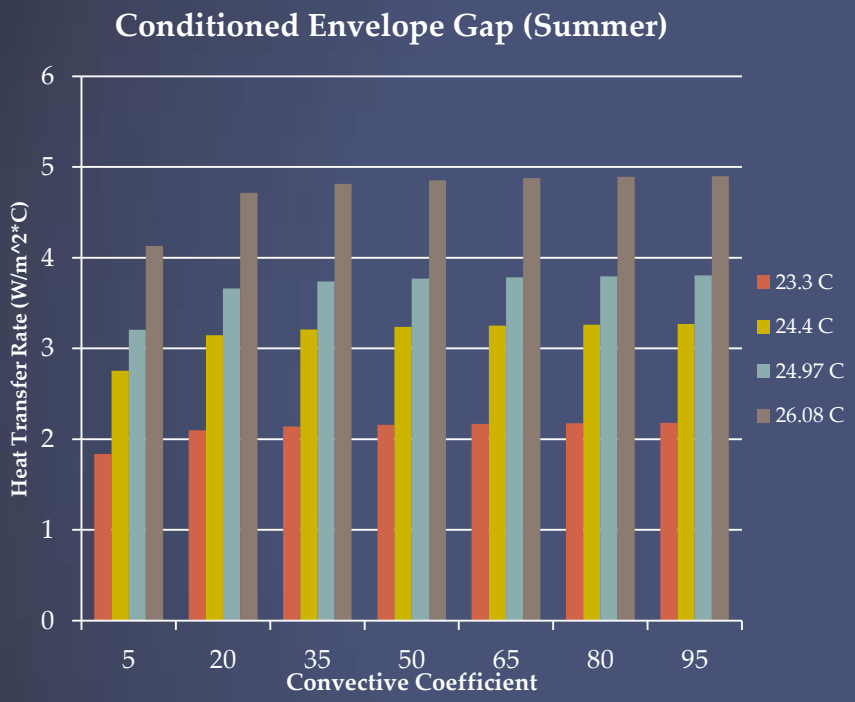
FAÇADE ANALYSIS

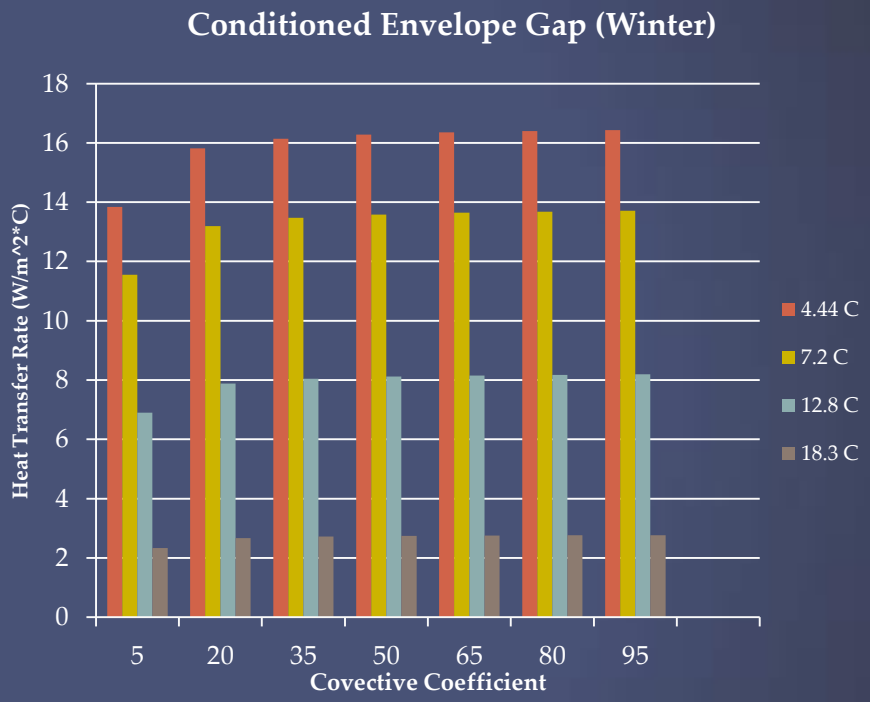


Graph Run	Run #	Description	Cooling (SF/Ton)	Cooling (BTU/hr*SF)	Heating (BTU/hr*SF)	Total (BTU/hr*SF)	U-Factor	Shading Coefficient
1	6	Single Coated 1/8"	301	39.87	66.31	106.18	1	0.85
2	4	6mm Sgl Bronze	328.6	36.52	62	98.52	1	0.71
3	1	3mm Tpl Low-E (e5=1) Clr 6mm air	348.9	34.39	51.85	86.24	0.319	0.67
4	3	3mm Quad Low-E Films Clr 8 mm Krypton	388.6	30.88	46.67	77.55	0.117	0.52
5	2	3 mm Dbl Low-E (e2=.04) Clr 13mm Air	392	30.65	46.29	76.94	0.295	0.5
6	5	6 mm Tpl Low-E Film (66) Tint 13mmAir	469.3	25.57	38.74	64.31	0.218	0.29

APOLLO

SIMULATED ENVIRONMENT

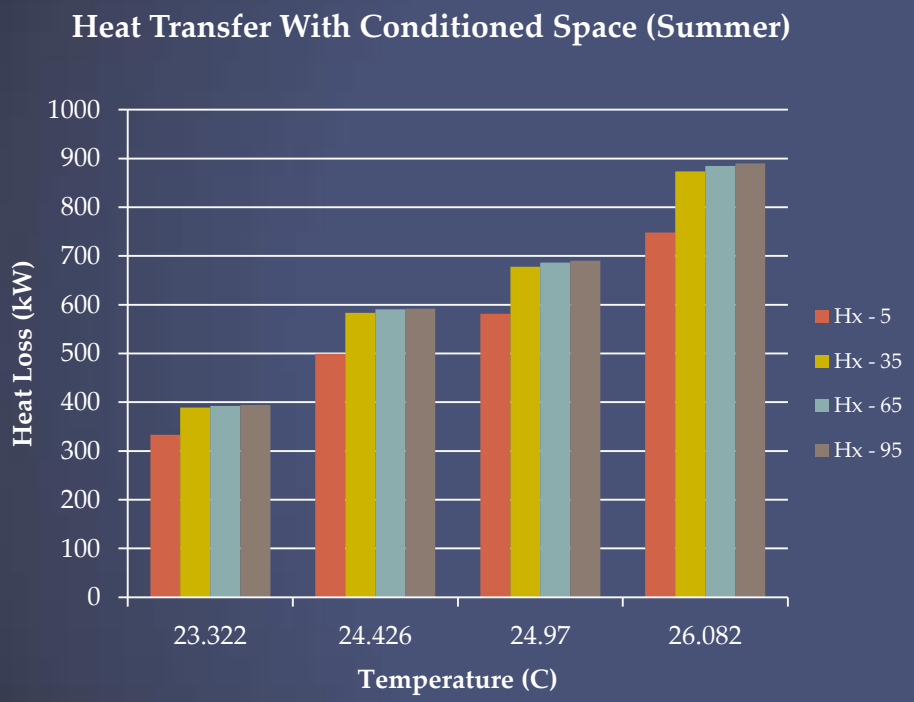


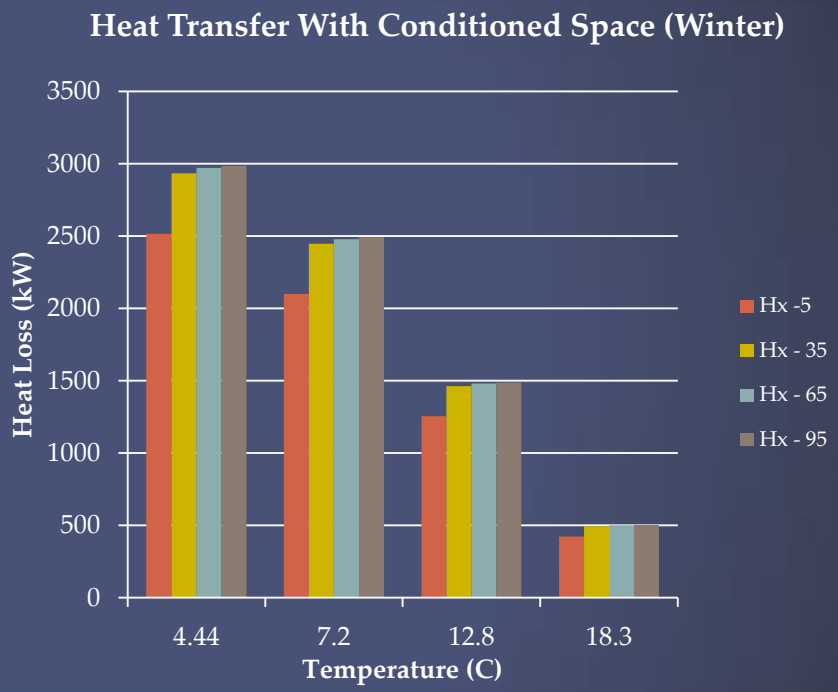


Summer: Exhaust cooler air to the air gap
Winter: Exhaust heated air to the air gap
Goal: Create an artificial/simulated environment to retard heat transfer while using conditioned air that would normally be exhausted
Challenges: Humidity and complicated control scheme

APOLLO

SIMULATED ENVIRONMENT





Summer: Exhaust cooler air to the air gap
Winter: Exhaust heated air to the air gap
Goal: Create an artificial/simulated environment to retard heat transfer while using conditioned air that would normally be exhausted
Challenges: Humidity and complicated control scheme

Effects of Double Facade

Structural

- Increase loads

Construction

- Schedule increase

Lighting/Electrical

- Shading coefficient

Apollo

Underfloor air distribution

<1% of office market in 1995 to 6% in 2004

PROS

- No “short cycling” of air
- Ease of renovation
- Better air quality
- If done right, same price
- Floor-to-floor height can be reduced by 6-12 inches

CONS

- Designers, owners, tenants unfamiliar
- Some designed recently are performing poorly
- Too quiet
- Need to find experienced installer

Effects of Underfloor System

Structural

- Localized movement during earthquake must be examined

Construction

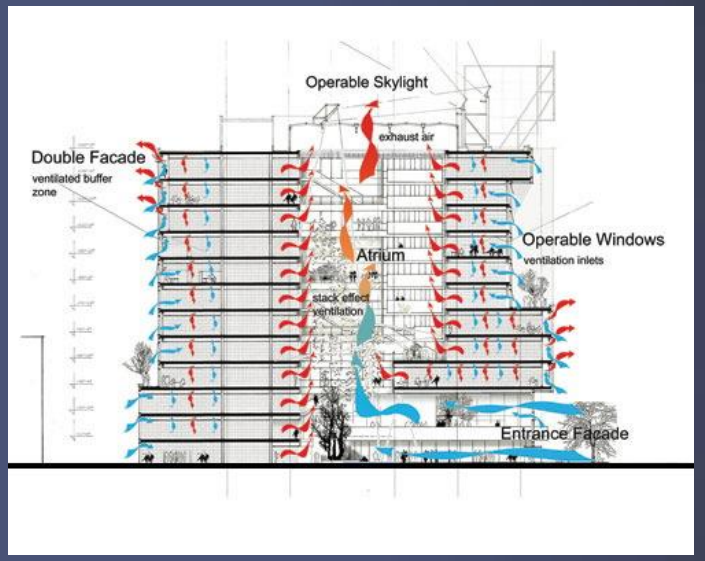
- Schedule increase
- Find Specialist
- More supervision will be needed

Lighting/Electrical

- Data/cable moved to under the floor

Natural Ventilation

- Use pressure differences to move air
- Pros
  - Reduce energy consumption
- Cons
  - Best in hot, dry climates
  - Does not remove humidity from the air
  - Does not remove outside contaminants



COGENERATION

Benefits

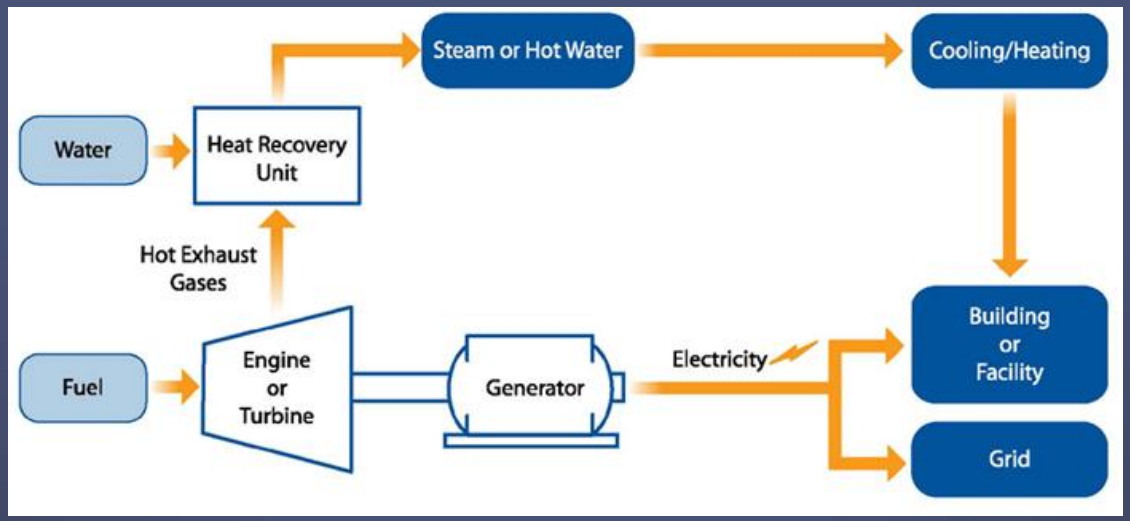
Cost savings for host facility/customer
Partially independent from utility grid
Environmental benefits
Incentive programs (Self Generation Incentive Program "SGIP")

Technology Type	Incentive ($/W)
Renewable and Waste Heat Capture	
Wind Turbine	$1.19
Waste Heat to Power	$1.19
Pressure Reduction Turbine	$1.19
Non-Renewable Conventional CHP	
Internal Combustion Engine – CHP	$0.48
Micro-turbine – CHP	$0.48
Gas Turbine – CHP	$0.48
Emerging technologies	
Advanced Energy Storage	$1.80
Biogas Adder	$1.80
Fuel Cell – CHP or Electric Only	$2.03

APOLLO

COGENERATION CASE STUDY

	201 Mission Street	350 Mission Street
Building Type:	Office	Office
Floor Area:	490,000 SF	480,000 SF
System Size:	x2 375 kW	-
Annual Electricity Supply	40%	-
Annual Steam Demand	90%	-



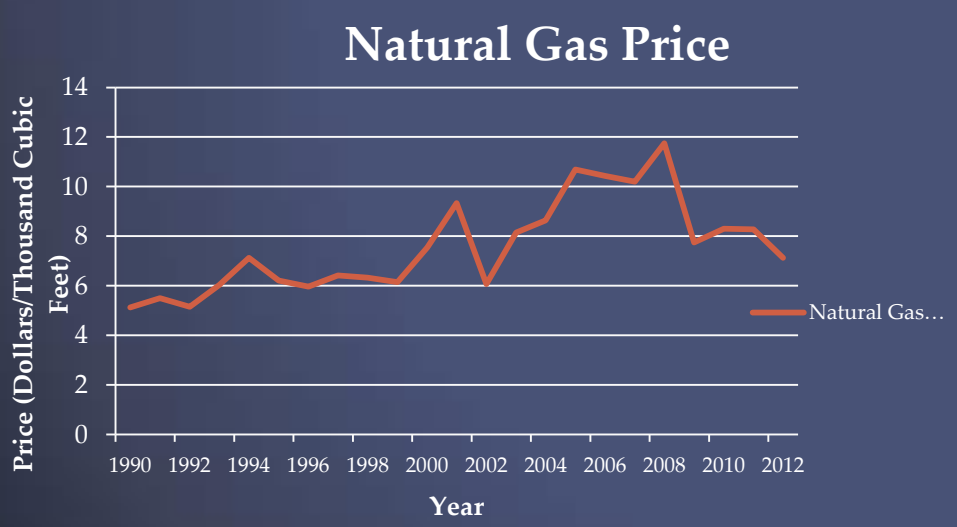
APOLLO

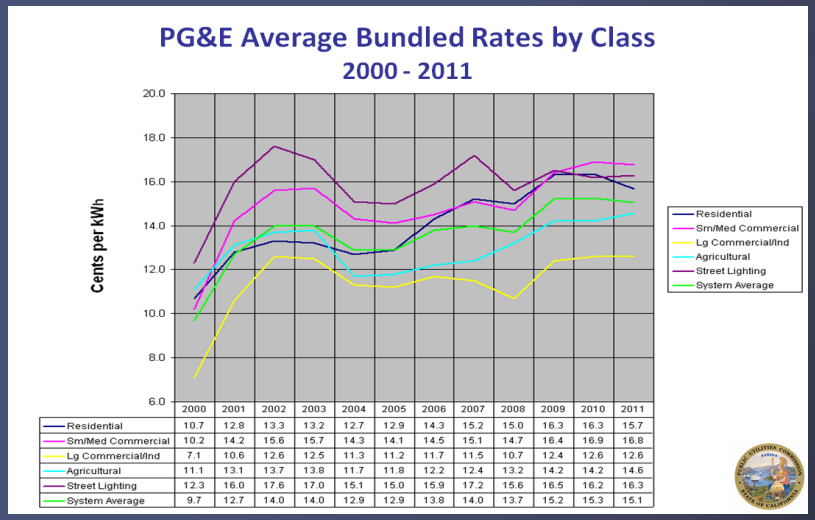
CHP Cost Benefit

Typical CHP output: 125kWh per Mcf

Source	Unit Price	Cost
Electricity:	$.126/kWh	$15.75
Natural Gas:	$7.13/Mcf	$7.13

(Note: Doesn't take into consideration additional benefits such as waste heat recycling)

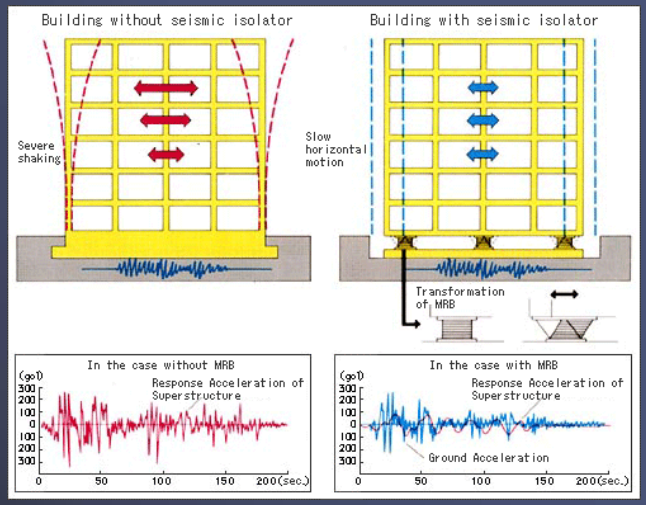




	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Residential	10.7	12.8	13.3	13.2	12.7	12.9	14.3	15.2	15.0	16.3	16.3	15.7
Sm/Med Commercial	10.2	14.2	15.6	15.7	14.3	14.1	14.5	15.1	14.7	16.4	16.9	16.8
Lg Commercial/Ind	7.1	10.6	12.6	12.5	11.3	11.2	11.7	11.5	10.7	12.4	12.6	12.6
Agricultural	11.1	13.1	13.7	13.8	11.7	11.8	12.2	12.4	13.2	14.2	14.2	14.6
Street Lighting	12.3	16.0	17.6	17.0	15.1	15.0	15.9	17.2	15.6	16.5	16.2	16.3
System Average	9.7	12.7	14.0	14.0	12.9	12.9	13.8	14.0	13.7	15.2	15.3	15.1

INITIAL IDEAS

- Keep Concrete structure and add stiffness where required to control drift
- Base Isolation
- Fluid Viscous Dampers
- Steel Plate Shear Walls



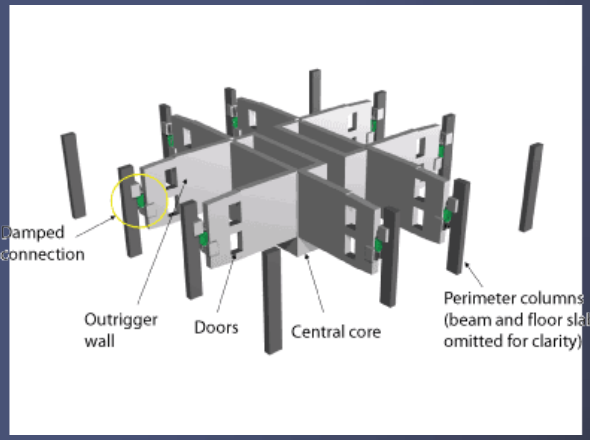
After Meeting

Eliminated Ideas:

- Keeping Concrete structure
- Base Isolation

Ideas Worth More Consideration:

- Steel Plate Shear Walls
- Fluid Viscous Dampers
- Dampers with Outriggers



Effects Of Ideas

Mechanical

- Heavy integration with systems

Construction

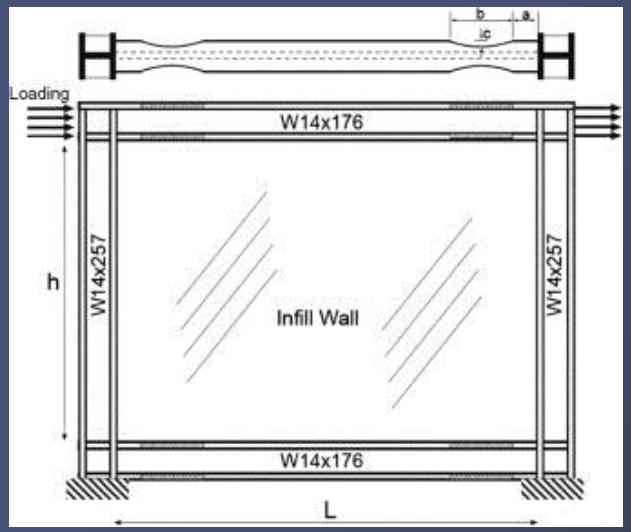
- Increased modularization
- Schedule decrease

All Options

- Building height will increase
- Possible floor plan change
- Possible façade changes

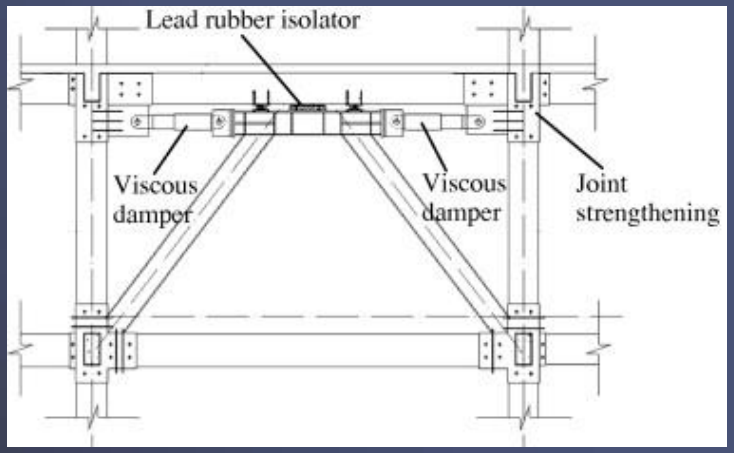
Steel Plate Shear Walls

- Large energy dissipation
- Very stiff
- Ability to assemble off site
- Opens up space
- Ability to replace
- Time and Cost



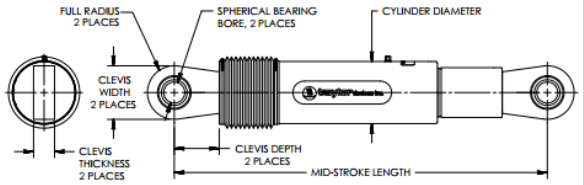
FLUID VISCOUS DAMPERS

- Adds 20-30 percent damping to structure
- Drift Limit
- Lifetime Cost
- Flexibility of configuration
- Range of Sizes
- Load Paths



taylor devices inc.

FLUID VISCOUS DAMPERS & LOCK-UP DEVICES



FORCE	SPHERICAL BEARING BORE DIA. (INCHES)	MID-STROKE LENGTH (INCHES)	STROKE (INCHES)	CLEVIS THICKNESS (INCHES)	CLEVIS WIDTH (INCHES)	CLEVIS DEPTH (INCHES)	CYLINDER DIA. (INCHES)	WEIGHT (lbs.)
55 KIP	1.50	34.13	±3	1.63	4 MAX.	3.25	4-1/2 MAX.	90
110 KIP	2.00	42.00	±4	2.13	4-3/4 MAX.	4.00	5-3/4 MAX.	185
165 KIP	2.25	47.00	±4	2.25	6 MAX.	5.10	7-1/4 MAX.	300
220 KIP	2.75	48.75	±4	2.75	7-1/2 MAX.	5.88	8-1/4 MAX.	425
330 KIP	3.00	51.75	±4	3.00	8 MAX.	6.38	9-1/2 MAX.	600
440 KIP	3.50	62.00	±5	3.50	9 MAX.	7.50	11-1/4 MAX.	900
675 KIP	4.00	62.00	±5	4.50	12-3/4 MAX.	8.00	13-3/4 MAX.	1300
900 KIP	5.00	74.00	±5	5.50	12-3/4 MAX.	10.75	16-3/4 MAX.	2650
1450 KIP	6.00	84.00	±5	6.00	13-3/4 MAX.	12.00	20-1/4 MAX.	4100
1800 KIP	7.00	88.25	±5	7.00	16-1/4 MAX.	12.50	22-1/4 MAX.	5500

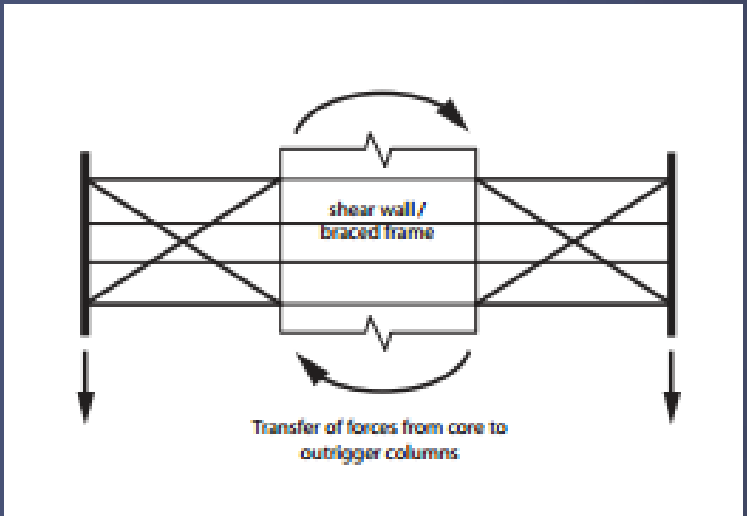
NOTE: VARIOUS STROKES ARE AVAILABLE, FROM ±2 TO ±36 INCHES. FORCE CAPACITY MAY BE REDUCED FOR STROKE LONGER THAN STROKE LISTED IN TABLE. ANY STROKE CHANGE FROM THE STANDARD STROKE VERSION DEPICTED CHANGES MID-STROKE LENGTH BY FIVE INCHES PER ±1 INCH OF STROKE.

EXAMPLE: 220 KIP ±4 INCHES STROKE, MID-STROKE LENGTH IS 48.75 INCHES
220 KIP ±6 INCHES STROKE, 6-4 = 2 TIMES FIVE = 10
48.75+10 = 58.75 INCHES MID-STROKE LENGTH

BELLOWS MAY BE REPLACED WITH A STEEL SLEEVE AS DESIRED STROKE LENGTHS INCREASE. CONSULT TAYLOR DEVICES FOR STROKE OVER ± 12 INCHES AND/OR FOR FORCE CAPACITIES FOR STROKE LONGER THAN LISTED IN TABLE.

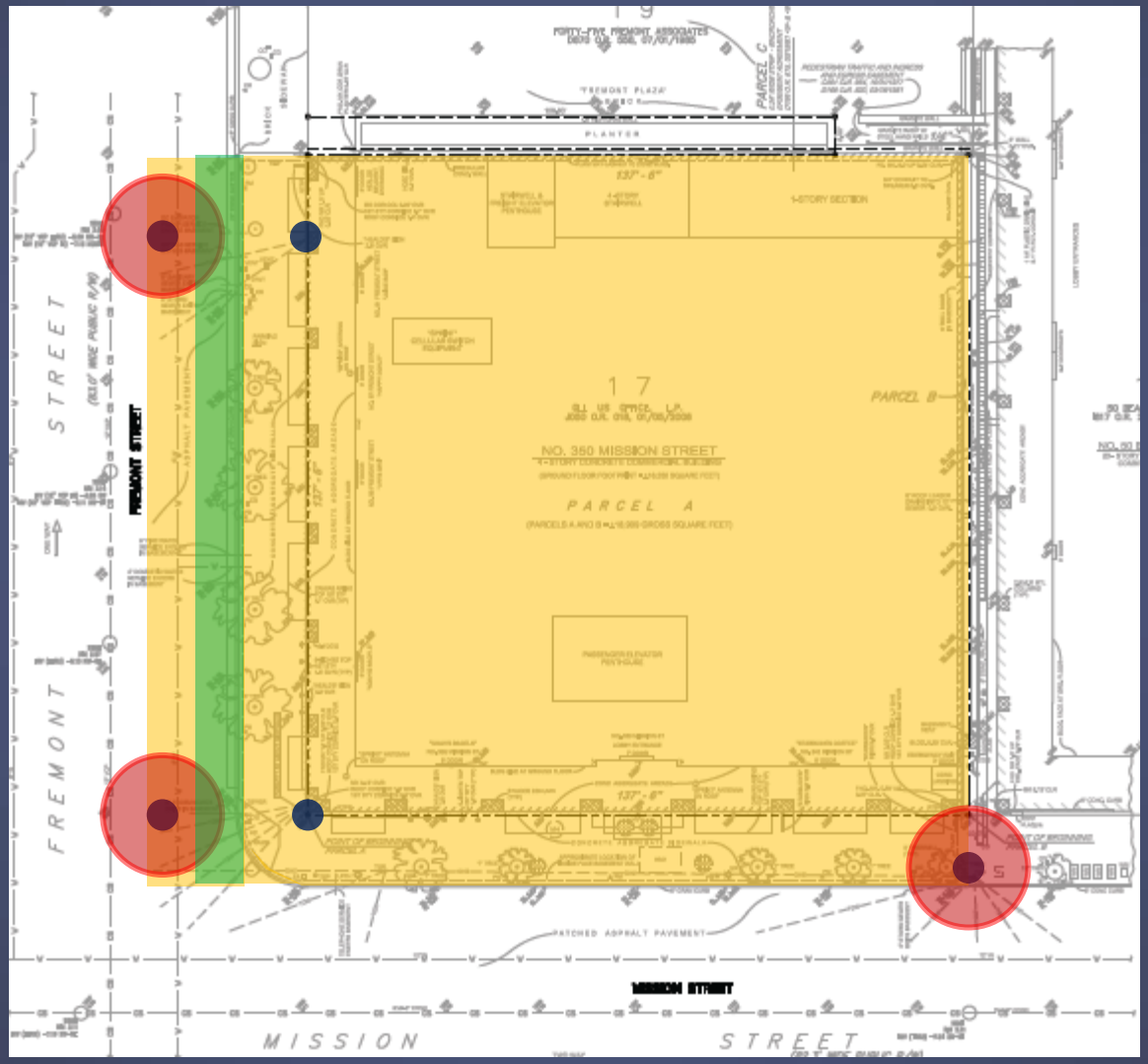
Damped Outriggers

- Decrease overturning moment
- Reduces column size
- Use of outrigger can be concealed
- Adds redundancy to our passive system
- Our size Building will only need one outrigger



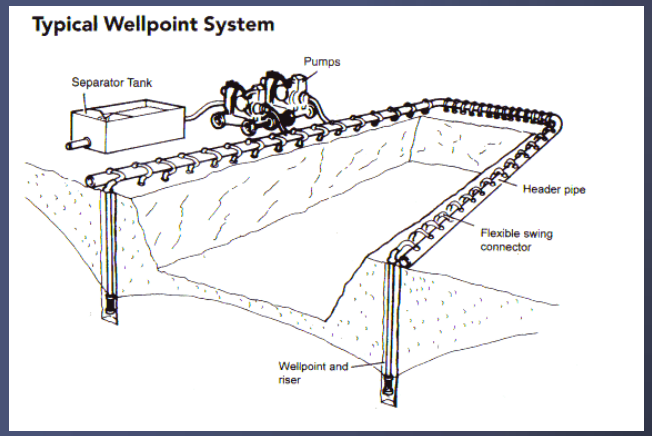
METRO SYSTEM

SITE CONSTRAINTS



Dewatering System

- Design groundwater level at Elevation -3ft
- Excavation to extend at Elevation -52ft
- Maintain at least 3ft below planned max. excavation
- Performance: Number, Depth, Position of wells, & Rate of pump
- Cost for disposing water into City's wastewater system



Opportunities to Prefab

- Mechanical system
- Structural System
- Kitchenette/Bathroom Pods

MEETING SCHEDULE

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9:00							
9:30							
10:00							
10:30							
11:00							
11:30							
12:00							
12:30							
1:00							
1:30							
2:00							
2:30							
3:00							
3:30							
4:00							
4:30							
5:00							
5:30							
6:00							
6:30							
7:00							

LIGHTING/ELECTRICAL

MECHANICAL

STRUCTURAL

CONSTRUCTION

Lighting/Electrical | Mechanical | Structural | Construction

Questions?