

CONCEPTUAL
COST MODEL

for

Office Building
Underfloor Air Comparison Study
Culver City, CA

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INCLUSIONS

The study includes the Culver Office project which is a four story office building (approximately 300,000 sf). The Conceptual Cost Model is for the Core and Shell of the building based on a structural steel scheme. The purpose of the study is to compare the construction costs of an underfloor air distribution system to a conventional ceiling-based air distribution system.

Base Design:

The base design includes a conventional overhead air distribution system. The steel structure allows for a floor to floor height of 14'-0". An allowance of conventional wall and column footings has been included for the foundations. A total allowance of 11.5 pounds per square foot includes the vertical structure of structural steel columns and the horizontal structure of structural steel beams and girders. Also included is a reinforced concrete slab on grade, suspended floors of 3" metal decking with 3-1/4" light weight concrete fill and fireproofing to the steel. The exterior cladding includes an exterior wall system (Kalwall), 1" insulated glass and 1/2" monolithic glass. Interior partitions and finishes are included for the restroom, lobby and corridor areas. Allowances are included for restroom equipment and fire extinguishers. Vertical transportation includes 4 passenger and 1 service elevator as well as 4 sets of stairs.

Underfloor Air System Option:

The alternate scheme is the underfloor air system. For the purposes of this study it has been assumed that the raised floor will be installed at the building's net assignable areas. For this building type a two-thirds ratio of the total building area is used (200,000 sf). The underfloor air system impacts the building design and estimate as follows:

- The dead load of the building is increased by approximately 10-20 lbs/sf (the raised floor system weighs approximately 11.5 lbs/sf). However the height of the building is reduced by 10%. A cost increase allowance of 10% has been included to the foundation and the steel structure.
- An allowance has been added for the raised slab that will be necessary at the areas without the access flooring
- The floor to floor height has been reduced to 12'-8". This is accomplished by reducing the overall height of service plenums. There is a total height savings of 5'-4" for the building. This results in a reduction in the building exterior cladding as well as a small savings to the interior partition quantities.
- There is an added cost of \$7/sf for the raised access flooring to the interior finishes.
- A reduction in the HVAC costs of \$5.00/sf (for the area of the raised access flooring) is included for the savings on air capacity, zoning, ductwork, controls and the downsizing of some mechanical equipment. The key differences with underfloor systems include their use of an underfloor air supply plenum, localized air distribution and the resulting floor-to-ceiling air flow pattern, and the solutions used for perimeter systems. The stratified floor-to-ceiling air flow pattern in underfloor air systems allows most convective heat gains from sources outside the occupied zone to be exhausted directly at ceiling level, and therefore to not be included in the air-side load.

INCLUSIONS

The estimate includes the cost comparison of the Core and Shell of the office building. However, there are potential savings to the Tenant Improvement budget through the use of the raised access flooring. The Overall Summary Sheet of this study includes the savings due to the simplified nature of the tenant build-out using the access flooring. An allowance of \$3/sf (at the areas of the raised access flooring) has been included for the ease of electrical, telephone data, and HVAC distribution to workstations. This is assuming mostly open office space (25% closed offices).

Note that the base design is a steel framed structure with a floor to floor height of 14'-0". It has been assumed that there could be a reduction in the floor to floor height of 16" with the underfloor air system included with the steel design. Concrete flat slab construction is more expensive than steel beam construction, but is preferred for underfloor systems due to thermal storage benefits as well as significantly reduced vertical height requirements. If the structure is changed to concrete then the floor to floor height reduction could reach 22". However, the cost savings from the further reduction in building height does not make up for the increased cost of the structure.

Even greater savings can be realized if the ceiling plenum and dropped ceilings are completely eliminated, exposing the concrete structure. Appropriate acoustic treatment would need to be incorporated into the new design.

Life Cycle Cost Analysis:

Life cycle costing has been completed for the Underfloor Air System. The analysis is based on Present Value of first cost, annual costs and periodic costs.

The first cost includes the items described in the Underfloor Air Study Option above. The annual costs include the energy savings and the savings from decreased churn. The decreased energy use is calculated based on a savings of 1.75 kWh/sf/year. This is from a study that was completed by Keen Engineering. The decreased cost of churn is assumed to be \$5/sf for 10% of the area of raised access floors. This cost/sf is based on the decrease in wiring necessary for power and data redistribution, the reduced costs in reconfiguration of air supply, and the savings in floor finishes due to the decreased quantity of replacement carpet tiles. The periodic costs include replacement of the raised floor panel. An allowance is included for replacing 50% of flooring panels at Year 25 and at Year 50.

The result of the life cycle analysis shows that the payback is significantly good for the underfloor air system. The Sensitivity Analysis shows the payback at Years 10, 25, and 50. At Year 5 the payback is already over \$100,000. The cost of reduced churn is a real cost but is subjective. If this is completely eliminated from life cycle analysis, and the saving is calculated only from energy savings, there is still a positive result.

EXCLUSIONS

Compression of schedule, premium or shift work, and restrictions on the contractor's working hours

Design, testing, inspection or construction management fees

Architectural and design fees

Scope change and post contract contingencies

Assessments, taxes, finance, legal and development charges

Environmental impact mitigation

Builder's risk, project wrap-up and other owner provided insurance program

Land and easement acquisition

Building equipment at café, health club, screening rooms

Telephone/data equipment and cabling

3rd Party Independent Commissioning

Piped overflow roof drainage

CCTV surveillance to Building Security Systems

OVERALL SUMMARY

	Gross Floor Area	\$ / SF	Total Core & Shell Cost
Culver Office - Base Scheme (Core and Shell)	300,000 SF	106.44 \$	31,932,695
Culver Office - Underfloor Air Scheme (Core and Shell)	300,000 SF	110.61 \$	33,181,695
Cost Difference (Core & Shell)		4.16 \$	1,249,000
Additional Potential Savings for Tenant Improvement			
Simplified tenant build-out		(2.56) \$	(768,894)
Potential Cost Difference (Tenant Improvement)		1.60 \$	480,106

Please refer to the Inclusions and Exclusions sections of this report

CULVER OFFICE - BASE SCHEME (CORE AND SHELL) COMPONENT SUMMARY

	Gross Area: 300,000 SF		
		\$/SF	\$x1,000
1. Foundations		3.67	1,100
2. Vertical Structure		5.60	1,680
3. Floor & Roof Structures		20.46	6,138
4. Exterior Cladding		22.37	6,710
5. Roofing, Waterproofing & Skylights		4.04	1,211
Shell (1-5)		56.13	16,839
6. Interior Partitions, Doors & Glazing		1.50	450
7. Floor, Wall & Ceiling Finishes		0.86	257
Interiors (6-7)		2.36	707
8. Function Equipment & Specialties		0.12	35
9. Stairs & Vertical Transportation		3.35	1,005
Equipment & Vertical Transportation (8-9)		3.47	1,040
10. Plumbing Systems		4.45	1,336
11. Heating, Ventilating & Air Conditioning		8.76	2,627
12. Electric Lighting, Power & Communications		6.50	1,950
13. Fire Protection Systems		1.40	420
Mechanical & Electrical (10-13)		21.11	6,333
Total Building Construction (1-13)		83.06	24,919
14. Site Preparation & Demolition		0.00	0
15. Site Paving, Structures & Landscaping		0.00	0
16. Utilities on Site		0.00	0
Total Site Construction (14-16)		0.00	0
TOTAL BUILDING & SITE (1-16)		83.06	24,919
General Conditions	7.00%	5.81	1,744
Contractor's Overhead & Profit or Fee	4.00%	3.56	1,067
PLANNED CONSTRUCTION COST	April 2004	92.43	27,730
Contingency for Development of Design	10.00%	9.24	2,773
Escalation to Start Date (December 2005)	4.69%	4.77	1,430
RECOMMENDED CORE AND SHELL BUDGET	February 2005	106.44	31,933

CULVER OFFICE - UNDERFLOOR AIR SCHEME (CORE AND SHELL) COMPONENT SUMMARY

	Gross Area: 300,000 SF		
		\$/SF	\$x1,000
1. Foundations		4.02	1,205
2. Vertical Structure		6.16	1,848
3. Floor & Roof Structures		22.97	6,890
4. Exterior Cladding		21.02	6,305
5. Roofing, Waterproofing & Skylights		4.04	1,211
Shell (1-5)		58.20	17,459
6. Interior Partitions, Doors & Glazing		1.35	405
7. Floor, Wall & Ceiling Finishes		5.52	1,657
Interiors (6-7)		6.87	2,062
8. Function Equipment & Specialties		0.12	35
9. Stairs & Vertical Transportation		3.35	1,005
Equipment & Vertical Transportation (8-9)		3.47	1,040
10. Plumbing Systems		4.45	1,336
11. Heating, Ventilating & Air Conditioning		5.42	1,627
12. Electric Lighting, Power & Communications		6.50	1,950
13. Fire Protection Systems		1.40	420
Mechanical & Electrical (10-13)		17.78	5,333
Total Building Construction (1-13)		86.31	25,894
14. Site Preparation & Demolition		0.00	0
15. Site Paving, Structures & Landscaping		0.00	0
16. Utilities on Site		0.00	0
Total Site Construction (14-16)		0.00	0
TOTAL BUILDING & SITE (1-16)		86.31	25,894
General Conditions	7.00%	6.04	1,813
Contractor's Overhead & Profit or Fee	4.00%	3.69	1,108
PLANNED CONSTRUCTION COST	April 2004	96.05	28,815
Contingency for Development of Design	10.00%	9.60	2,881
Escalation to Start Date (December 2005)	4.69%	4.95	1,486
RECOMMENDED CORE AND SHELL BUDGET	February 2005	110.61	33,182

COMPARISON SUMMARY

	Underfloor Air System Design		Base Building Design		Difference +/-	
	300,000 SF		300,000 SF		0 SF	
	\$/SF	\$x1,000	\$/SF	\$x1,000	\$/SF	\$x1,000
1. Foundations	4.02	1,205	3.67	1,100	0.35	105
2. Vertical Structure	6.16	1,848	5.60	1,680	0.56	168
3. Floor & Roof Structures	22.97	6,890	20.46	6,138	2.51	752
4. Exterior Cladding	21.02	6,305	22.37	6,710	(1.35)	(405)
5. Roofing & Waterproofing	4.04	1,211	4.04	1,211	0.00	0
Shell (1-5)	58.20	17,459	56.13	16,839	2.07	620
6. Interior Partitions, Doors & Glazing	1.35	405	1.50	450	(0.15)	(45)
7. Floor, Wall & Ceiling Finishes	5.52	1,657	0.86	257	4.66	1,400
Interiors (6-7)	6.87	2,062	2.36	707	4.51	1,355
8. Function Equipment & Specialties	0.12	35	0.12	35	0.00	0
9. Stairs & Vertical Transportation	3.35	1,005	3.35	1,005	0.00	0
Equipment & Vertical Transportation (8-9)	3.47	1,040	3.47	1,040	0.00	0
10. Plumbing Systems	4.45	1,336	4.45	1,336	0.00	0
11. Heating, Ventilating & Air Conditioning	5.42	1,627	8.76	2,627	(3.34)	(1,000)
12. Electric Lighting, Power & Communications	6.50	1,950	6.50	1,950	0.00	0
13. Fire Protection Systems	1.40	420	1.40	420	0.00	0
Mechanical & Electrical (10-13)	17.78	5,333	21.11	6,333	(3.33)	(1,000)
Total Building Construction (1-13)	86.31	25,894	83.06	24,919	3.25	975
14. Site Preparation & Demolition	0.00	0	0.00	0	0.00	0
15. Site Paving, Structures & Landscaping	0.00	0	0.00	0	0.00	0
16. Utilities on Site	0.00	0	0.00	0	0.00	0
Total Site Construction (14-16)	0.00	0	0.00	0	0.00	0
TOTAL BUILDING & SITE (1-16)	86.31	25,894	83.06	24,919	3.25	975
General Conditions	6.04	1,813	5.81	1,744	0.23	69
Contractor's Overhead & Profit or Fee	3.69	1,108	3.56	1,067	0.13	41
PLANNED CONSTRUCTION COST	96.05	28,815	92.43	27,730	3.62	1,085
Contingency for Design Development	9.60	2,881	9.24	2,773	0.36	108
Allowance for Rising Costs	4.95	1,486	4.77	1,430	0.18	56
RECOMMENDED CORE & SHELL BUDGET	110.61	33,182	106.44	31,933	4.17	1,249

Life Cycle Analysis

Life cycle analysis is based on Present Value of first cost, annual costs and periodic costs, using the following factors:

Discount factors

Inflation

Water & energy inflation 3% per annum

Maintenance & construction cost 3% per annum

Discount rate 5% per annum

Life cycle period 50 years

Utility Rates

*Electricity ** \$120.00 per MWH

Sensitivity Summary

	1 Year	5 Year	10 Year	25 Year	50 Year
	NPV \$x 1,000	NPV \$x 1,000	NPV \$x 1,000	NPV \$x 1,000	NPV \$x 1,000
Design Option					
1. Underfloor Air System	341	(189)	(795)	(1,865)	(3,295)

Note: Positive value indicates an increase in life cycle cost to go to the best case design option, a negative value indicates a reduction in cost to select the option

Underfloor Air System Option

	<i>Quantity</i>	<i>Unit</i>	<i>Rate</i>	<i>Total</i>
Design Option, Underfloor displacement air distribution system				
First Cost				
Use underfloor displacement system				
Core and Shell				
Increase structure	300,000	SF	3.42	1,025,000
Reduce floor to floor height	300,000	SF	(1.50)	(450,000)
Add raised access floor	200,000	SF	7.00	1,400,000
Reduce HVAC costs	200,000	SF	(5.00)	(1,000,000)
Tenant Improvements				
Simplified build-out	200,000	SF	(3.00)	(600,000)
GC Overhead & profit, contingencies, design & supervision	375,000		28%	105,559
	<hr/>			480,559
Subtotal first cost				
Annual Cost				
Decreased electrical energy for chilling & air distribution				
Decreased energy use (1.75 kWh / sf / year **)	(350)	MWh/yr	120.00	(42,000)
<i>Present Value at 2% net discount rate for 50 years</i>				(1,319,791)
Decreased churn cost				
Decreased churn (10% of area @ \$5 / sf / year)	20,000	SF	(5.00)	(100,000)
<i>Present Value at 2% net discount rate for 50 years</i>				(3,142,361)
	<hr/>			(4,462,152)
	Subtotal - Present Value of Annual Cost			

Periodic Cost					
Replacement at years 25 and 50					
Replace raised access flooring (50% of area @ \$7 / sf)	100,000	SF	7.00	700,000	
<i>Present Value at net 2% discount rate</i>					686,742
	<hr/>				
	Subtotal - Present Value of Periodic Cost				686,742
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Net Present Value of Option, Use underfloor displacement air distribution			SAVE		(3,294,851)

* based on current Southern California Edison utility rates
 ** based on study by Keen Engineering, dated June 2, 2003