City of Aurora
Building Codes Division
15151 E Alameda Pkwy
Aurora, CO 80012
(303) 739-7420

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R.S.N. 251428

BK

HealthOne The Medical Center of Aurora
Safety, Security and Disaster Preparedness
1501 S. Potomac St.
Aurora, Colorado 80012
Fax Number: 303-873-5756
Phone Number: 303-873-5744

Facsimile Transmittal

DATE: 1-17-07

TO: ANDREA ROSDIL Fax No. 303-753-8964

From: STEPHANIE SPARKS Phone No. _____

Re: MSDS + INFO

Pages (including cover page): 9

Cc: _____

__Urgent __For review __Please comment or respond X Per your request

Comments:

I sent you information out of our SPCC Plan.
Let me know if it includes too much info.
Call if you need anything else.
720-641-3480

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- CONFINDENTIAL -

Table 1
Containers and Equipment Storing Petroleum, Oils, and Lubricants, Spill Control and Countermeasure Plan, The Medical Center of Aurora – South Campus, 1501 South Potomac Street, Aurora, Colorado

Map No. / Location	Storage Unit	Material Stored	Storage Volume (gallons)	Materials of Construction	Containment	Containment Volume (gallons)	Potential Discharge Scenario
#1 / Outdoors (North of Emergency Room Entrance at Plant Operations	Above Ground Storage Tank; Attached to covered generator	#2 Diesel	2,440	Steel	Double-walled	> 2,440	Large
#2 / Outdoors (North of Emergency Room Entrance)	Underground Storage Tank	#2 Diesel	10,000	Steel	Double-walled	>10,000	Large
#3 / Outdoors (On East Wall outside of Kitchen)	Above Ground Storage Tank	Kitchen Grease	200	Steel	None	None	Medium
#4 / Indoors in room adjacent to Boiler Room	Drum	Used Oil	55	Steel	Mobile Drum Containment	> 55	Small
#5 / Indoors in Generator Room	(2) Above Ground Day Tanks Attached to (2) Generators	#2 Diesel	35	Steel	(1) with containment; (1) without containment	>35 gallons None	Small Small
#6 / Indoors in Elevator Room Serving Elevators 1,2 and 4	(3) Above Ground Storage Tanks; Attached to Elevator motors	Hydraulic Oil	85	Steel	None	None	Small

CAD DATE: 30 April 2008	PROJECT NO.: CC001133.0001	DRAWING: Figure 2	CHECKED: CHECKED	APPROVED: APPROVED	DRAFTER: JKC



Legend

- Storm Drain
- Flow Direction
- 1 AST Attached to Generator
- 2 UST
- 3 Kitchen Grease AST
- 4 Used Oil Drum
- 5 Generator Dry Tanks
- 6 Elevator AST's
- 7 Elevator AST's
- 8 Elevator AST's
- 9 Elevator AST's
- 10 Electrical Transformer
- Spill Response Equipment

troleum, Oil and Lubricant Location Map

The Medical Center of Aurora - South Campus
1501 South Potomac Street
Aurora, Colorado

FIGURE

2

PLEASE ADD TO FIG.

- THIS PLAN DOESN'T MATCH ADDITION
- ILLEGIBLE (105.4.2)

TOTAL PETROLEUM, INC.

MATERIAL SAFETY DATA SHEET

Total #2 Diesel

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (°F): Initial 325; Final 700
Specific Gravity (H_2O = 1): <1
Vapor Pressure (mm Hg @ 100°F): <50
Melting Point: NA
Vapor Density (Air = 1): 5-11
Evaporation Rate (Ether = 1): <1
Solubility in water: Insoluble
Appearance and odor: Pale yellow liquid with characteristic odor of kerosene

SECTION IV - FIRE AND EXPLOSION DATA

Flash Point (method used): 130°F - 180°F (pm)
Flammable Limits LEL: 0.7%
UEL: 5.0%

Extinguishing media: Dry chemical, foam or carbon dioxide, water spray or fog to cool surrounding containers.

Special Fire Fighting Procedures: Self contained breathing apparatus may be required.

Unusual Fire and Explosion Hazards: NA

SECTION V - REACTIVITY DATA

Stability Unstable:
Stable: X

Conditions to Avoid: Heat and flames

Incompatibility (materials to avoid): Oxidizers

Hazardous Decomposition or Byproducts: Carbon monoxide and other petroleum decomposition products.

Hazardous Polymerization May Occur:
Will not Occur: X

Conditions to avoid: NA

NA = No applicable information was found

TOTAL PETROLEUM, INC. February 9, 1989

MATERIAL SAFETY DATA SHEET

Total #2 Diesel

SECTION VIII - CONTROL MEASURES

Respiratory Protection (specify type): Organic vapor respirator approved by NIOSH.

Ventilation	Local Exhaust:	To control vapors
	Special:	Use explosion proof equipment
	Mechanical:	For confined spaces
	Other:	NA

Protective Gloves: PVC or equivalent resistant gloves.

Eye Protection: Chemical goggles or face shield.

Other protective clothing or equipment: PVC or equivalent clothing if splashing is likely.

Work/Hygienic Practices: Keep body contact and splash to a minimum.

SECTION IX - ADDITIONAL INFORMATION

Shipping Name - Diesel Fuel
Hazard Class - Combustible liquid
ID Number - UN 1993

SARA	Hazard class:	
	Flammable:	No
	Acute:	Yes
	Chronic:	Yes
	Stored Pressure:	No
	Reactive:	No

Section 313 listed components - None

The information accumulated herein is believed to be accurate, but is not warranted to be, whether originated with Total Petroleum or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances.

NA = no applicable information was found

KLEINFELDER
An employee owned company

April 7, 2006
File 66295-1

RSN 232867

Mr. Rodney Allen
HCA Management Services, L.P.
P.O. Box 550 (37202-0550)
Nashville, TN 37203

06-126126

Subject: **Geotechnical Investigation**
South Entry Addition
Medical Center of Aurora
Aurora, Colorado

Dear Mr. Allen:

Kleinfelder has completed a geotechnical investigation for the planned South Entry addition to the hospital. The purpose of the investigation was to explore and evaluate subsurface soil conditions at the addition site and, based on the conditions encountered, provide geotechnical recommendations for the design and construction of foundations and floor slabs. This letter presents our conclusions and recommendations regarding the project. The investigation was performed in conjunction with other geotechnical investigations at the hospital including the bed tower addition and a future parking structure reported under separate cover.

The conclusions and recommendations in this report are based on analysis of the data obtained from our field exploration and laboratory testing and on our experience with similar subsurface conditions in the area. The scope of our investigation included drilling and logging two exploratory boreholes, limited laboratory testing of soil samples, analyzing the field and laboratory data in terms of project requirements, and preparing this letter. Our services were performed in accordance with your authorization.

SITE AND PROJECT DESCRIPTION

At the time of our field investigation the area of the South Entry addition was occupied by an existing loading dock, concrete walkway entry, and landscaping. The west portion of the site was fairly level and concrete covered, while the east portion of the site was landscaped and sloped moderately up to the emergency room entry drive and helipad. The elevation difference between the emergency room access drive and the lower dock area was estimated at about 10 feet.

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The South Entry addition will be a two-story structure with an elevator at the location shown on Figure 2. The east side of the structure will be adjacent to the emergency room access drive and will act as a retaining wall. Construction will have limited access and the emergency room access drive must stay open, likely requiring shoring. The elevator pit will extend below the first floor slab elevation to accommodate the hydraulic equipment and may extend below existing foundations. We have assumed that the finished floor levels will match the existing building floor elevations. Loads are expected to be in the 2 to 4 kips per foot range.

If the loading, locations or conditions are significantly different from those described above, we should be notified to re-evaluate the recommendations contained in this report.

FIELD EXPLORATION

A field exploration made on February 27 and March 17, 2006 consisted of a site reconnaissance and the drilling of two exploratory borings (TB-7 and TB-8) near the building addition footprint at the approximate locations shown on Figure 2. Due to site constraints a smaller drill rig was required to drill boring TB-7. The borings were drilled to depths of about 20 feet using truck-mounted CME 55 and Boart Longyear 51 drill rigs equipped with continuous-flight auger. Samples were obtained during drilling at various intervals using a modified California sampler (2.5-inch I.D.).

Graphical logs describing the subsurface conditions encountered are attached in the Appendix. A legend describing the different information and graphical symbols used on the boring logs is shown at the front of the Appendix. The boring elevations are approximate and reference the lower floor as Elevation 100 feet. The lines on the logs indicating changes between soil types are estimated from drilling behavior or interpolation between samples, and are therefore approximate. Transitions between soil types may be either abrupt or gradual.

LABORATORY TESTING

Samples of the soil and bedrock obtained during the field exploration were observed and visually classified using the Unified Soil Classification System. Laboratory tests, including moisture content, dry density, swell-settlement, direct shear, and particle size gradation were performed on selected samples of the soil encountered in the borings. Test results as well as the standard penetration test values recorded during drilling are summarized on the borehole logs in the Appendix and on Figures 3 through 5.

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SUBSURFACE CONDITIONS

The subsurface conditions encountered in the exploratory borings were somewhat erratic, consisting of 3 feet of fill and 4 to 13 feet of silty sand overlying 3½ to 10 feet of sandy clay. Claystone bedrock was identified at depths of 18 and 19½ feet extending to the maximum explored depth, 20 feet. No groundwater was encountered during drilling. The borings were backfilled upon completion due to safety concerns.

The existing fill consisted of silty sand with occasional small gravel. The history and conditions during placement of the fill are unknown, but it was likely placed during grading for the hospital. The fill appeared to have been placed with some compactive effort, although, we do not recommend the fill be used for support of building foundations.

Native silty sand underlies the fill. The sand had a loose relative density based on penetration resistance tests variable from 11 to 19 blows for 12 inches of sampler penetration. A swell-settlement test, Figure 3, indicated no moisture sensitivity and slight consolidation under loading. A one-point unconsolidated, undrained direct shear test, Figure 5, was performed on a sample of the sand. Assuming no cohesion for the sand, an angle of internal friction of about 29 degrees was measured at peak strength.

A clay layer was found beneath the sand in both borings. The clay was slightly sandy to sandy and had a stiff consistency based on penetration resistance tests variable from 14 to 18 blows for 12 inches of sampler penetration. A swell-settlement test, Figure 4, indicated slight compression under wetting and light loading.

Claystone bedrock underlies the site at depths of 18 to 19½ feet. The bedrock was medium hard.

CONCLUSIONS AND RECOMMENDATIONS

Building Foundations: The existing fill appeared to have been placed with some compactive effort, but we do not recommend shallow foundations be supported on the fill because of the unknown conditions during placement. We recommend the structural loads for the addition be supported with spread footings bearing on the native silty sand below any fill. The design and construction criteria presented below should be observed for a spread footing foundation system. The construction details should be considered when preparing project documents.

- Continuous footings or individual pads supported on the undisturbed native sand, below any existing fill, should be designed for a maximum allowable bearing pressure of 2,000 psf provided total settlements of up to 1-inch and differential settlements of ¾-inch are acceptable. The majority of settlement should occur during construction, however, the settlement will be differential with respect to the existing building and a structural joint is recommended between the addition and main building to accommodate the differential movement.

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- If it is desirable to place the footings at an elevation within the existing fill, the fill should be completely removed, replaced, and compacted to at least 95 percent of the maximum standard Proctor density at moisture content within two percent of optimum moisture. Structural fill should extend beyond the edges of the footing one foot for each foot in fill depth.

- Spread footings should have a minimum width of 16 inches for continuous footings and 24 inches for isolated pads.

- Footings may be designed using a coefficient of friction of 0.40 for sliding and 350 psf for passive resistance.

- Exterior footings and footings beneath unheated areas should be placed at least 36 inches below grade for frost protection.

- Continuous foundation walls should be reinforced top and bottom to span an unsupported length of at least 10 feet.

- Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Disturbing the natural soils will increase settlements. Areas of loose or soft material encountered within the foundation excavation should be removed and replaced compacted or the footings extended to adequate bearing material.

- A representative of the geotechnical engineer should observe all footing excavations prior to concrete placement.

The current location of the elevator is immediately adjacent to the existing building. Since the elevator pit will extend below the first floor elevation, it is possible the excavation could encounter and undermine the existing building foundation. We understand the existing building is founded on spread footings. If excavation encroaches within a 1:1 inclination extending out from the bottom edge of the existing footing, underpinning will be required. As a general rule no more than 25 percent of a pad footing or an 8-foot length of a continuous footing should be exposed at any one time during excavation. The exposed foundation should be immediately underpinned after exposure. Helical piers may be used to underpin existing footings prior to excavation. It may be desirable to excavate test pits prior to construction to determine the size, depth, and location of the existing foundation.

Retaining Structures: We understand the east wall of the addition will be designed as a retaining structure. The magnitude of the lateral earth pressure depends on the natural and backfill soil types and acceptable wall movements, which affect soil strain and mobilize the shear strength of the soil. More soil movement results in the development of greater internal shear stresses thereby lowering the lateral pressure on the wall. In most cases, a triangular pressure distribution is satisfactory for design and is usually represented as an equivalent fluid unit weight or pressure.

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Foundation walls that are laterally supported can be expected to undergo only a slight amount of deflection. These walls should be designed for an "at-rest" lateral earth pressure computed on the basis of an equivalent fluid unit weight of 60 pcf for backfill consisting of the site granular soils. Walls that can deflect sufficiently to mobilize the full active lateral earth pressure may be designed for an equivalent fluid unit weight of 42 pcf. Lateral loads may be resisted using a coefficient of friction for sliding of 0.40 and a passive earth pressure of 350 pcf. Due to the relatively large movements required to mobilize the passive pressure, we recommend a factor of safety of 2 to 3 be utilized. Fill against foundation walls should be placed in thin lifts, adjusted to moisture content within 2 percent of optimum, and compacted to 95 percent of the maximum standard Proctor density. Care should be taken when placing backfill so as not to damage the walls. Compaction of each lift adjacent to and near the walls should be accomplished with hand-operated tampers or other lightweight compactors. Over-compaction may cause excessive lateral earth pressures, which could result in wall movements and potential damage to the walls. The above pressures are based on horizontal backfill and should be adjusted for the anticipated sloping backfill. In addition, the pressures assume drained conditions behind the wall. We recommend a drain be placed at the bottom of the wall.

Considering the proximity of the addition to the emergency room access drive, a temporary shoring system may be required along the east side of the excavation. Excavations on the order of 10 to 15 feet in depth, which is expected for this site, may be retained by a cantilevered structure that utilizes steel soldier piles formed in drilled piers and walers. Soil is prevented from entering the excavation with wood lagging inserted between the piles.

A triangular pressure distribution based upon an equivalent fluid pressure is typically used for cantilevered walls. The lateral earth pressures give above may be used in shoring design. In our opinion, the upper 2 feet of material exposed in the excavation should be neglected when calculating passive earth pressure.

Floor Slabs: It appears the existing fill was placed with some compactive effort and is probably adequate for floor slab support. There is some risk of slab settlement, although it appears to be minor. As a precaution, we recommend the upper 12 inches of the fill be removed, moisture conditioned to within 2 percent of optimum moisture, and recompacted to at least 95 percent of standard Proctor density. If weak or loose areas are detected during excavation, they should be removed to firm material, replaced, and compacted.

To reduce damage due to differential slab movement, slabs should be separated from all bearing walls and columns with a positive expansion joint. The slabs should be provided with frequent control joints to reduce damage due to shrinkage cracking. We suggest joints on the order of 12 to 15 feet on center.

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Surface Drainage: Grade the area surrounding the addition so that surface water drains readily from the foundation area as quickly as is practical. This is especially important along the east side of the addition where the ground surface slopes up to the upper building level. We recommend a minimum slope of at least 8 percent in the initial 50 feet adjacent to the building in unpaved areas and a minimum slope of 2 percent in the first 10 feet in paved areas. Carry roof downspouts and sill cocks across backfilled areas so they discharge well away from the building. We do not recommend that roof drainage be buried, because of the potential of clogging problems and subsequent wetting of the subsurface. Promptly fill settled areas to prevent water ponding near the building, and provide adequate slopes for proper drainage away from the structure and off site at all times. Take all practical measures to maintain the site soils at their current moisture, both during and after construction. Pervious geofabric may be used beneath decorative bark or gravel adjacent to foundation walls. Plastic membranes should not be used to cover the ground surface as this will impede soil moisture evaporation.

LIMITATIONS

The recommendations in this report are based on our field observations, laboratory testing, and our present understanding of the proposed construction. It is possible that subsurface conditions can vary between or beyond the points explored. If the conditions found during construction differ from those described in this report, please notify us immediately so that we can review our report in light of those conditions and provide supplemental recommendations as necessary. We should also review the report if the scope of the proposed construction, including the proposed loads or structure locations, changes from that described in this report.

Kleinfelder has prepared this report for the exclusive use of HCA Management Services, L.P. for the South Entry addition to the Medical Center of Aurora in Aurora, Colorado. The report was prepared in substantial accordance with the generally accepted standards of practice for geotechnical engineering as exist in the site area at the time of our investigation. No warranty is expressed or implied. The recommendations in this report are based on the assumption that Kleinfelder will conduct an adequate program of construction testing and observation to evaluate compliance with our recommendations.

This report may be used only by the Client, and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors may change over time, so that additional investigation or revision of our recommendations may be required with the passage of time. It is the Client's responsibility to see that all parties to the project including the designer, contractor, and subcontractors, are made aware of this report in its entirety. The use of information contained in this report for bidding purposes shall be at the Contractor's option and risk. Any party other than the Client who wishes to use this report must notify Kleinfelder of such intended use. Based on that intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Noncompliance with these requirements by the Client or anyone else will release

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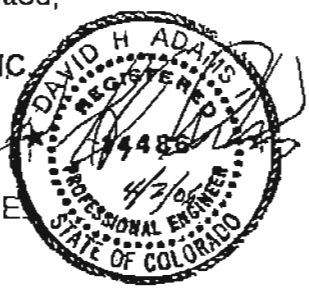
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Kleinfelder from any liability resulting from the use of this report by an unauthorized party.

Please contact us at your convenience if you have any questions or require more information.

Respectfully submitted,

KLEINFELDER, INC.



David H. Adams, P.E.
Senior Professional

Rev. By: DLH

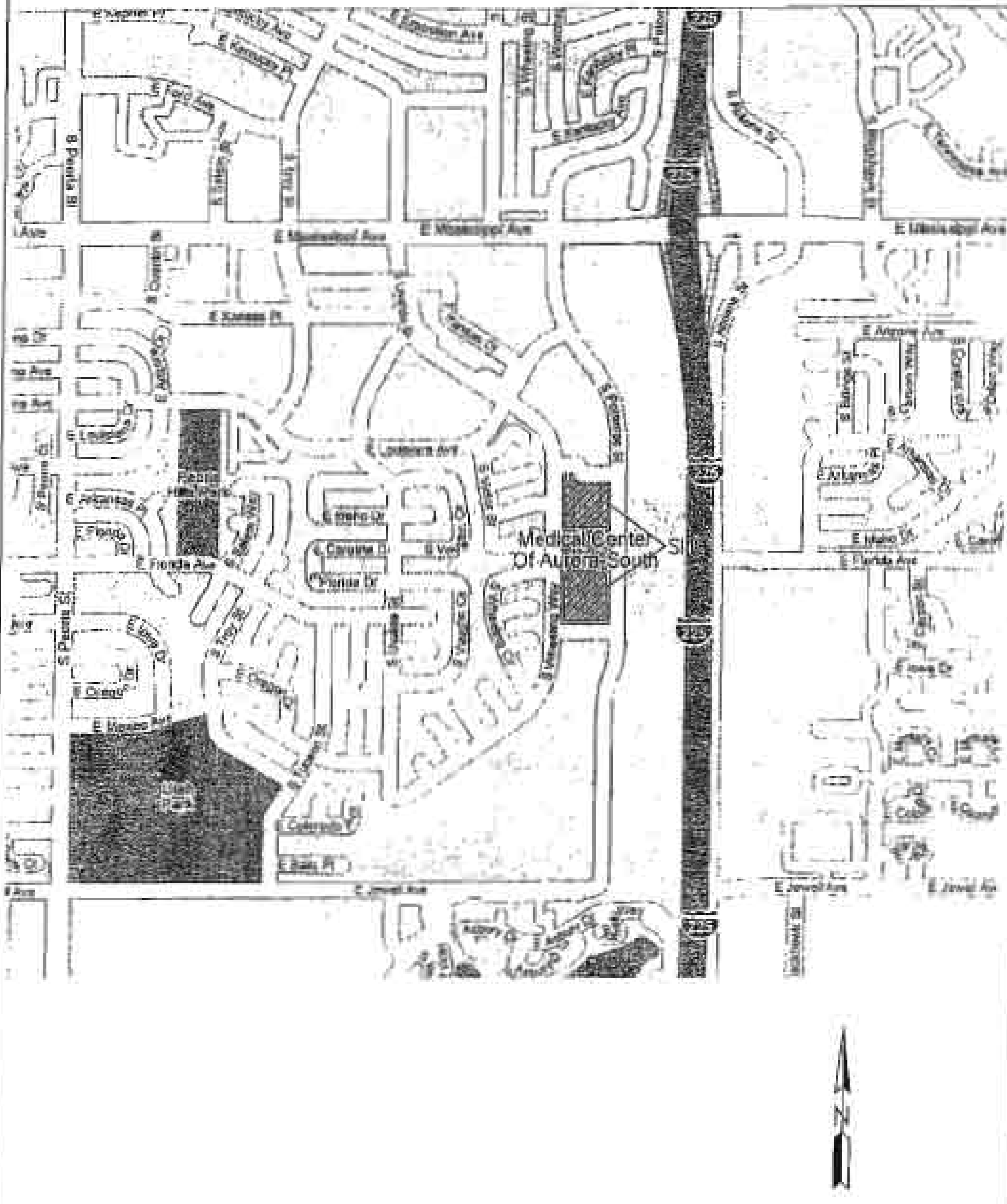
DHA/xr

Cc: Davis Partnership
Perkins + Will

Attachments

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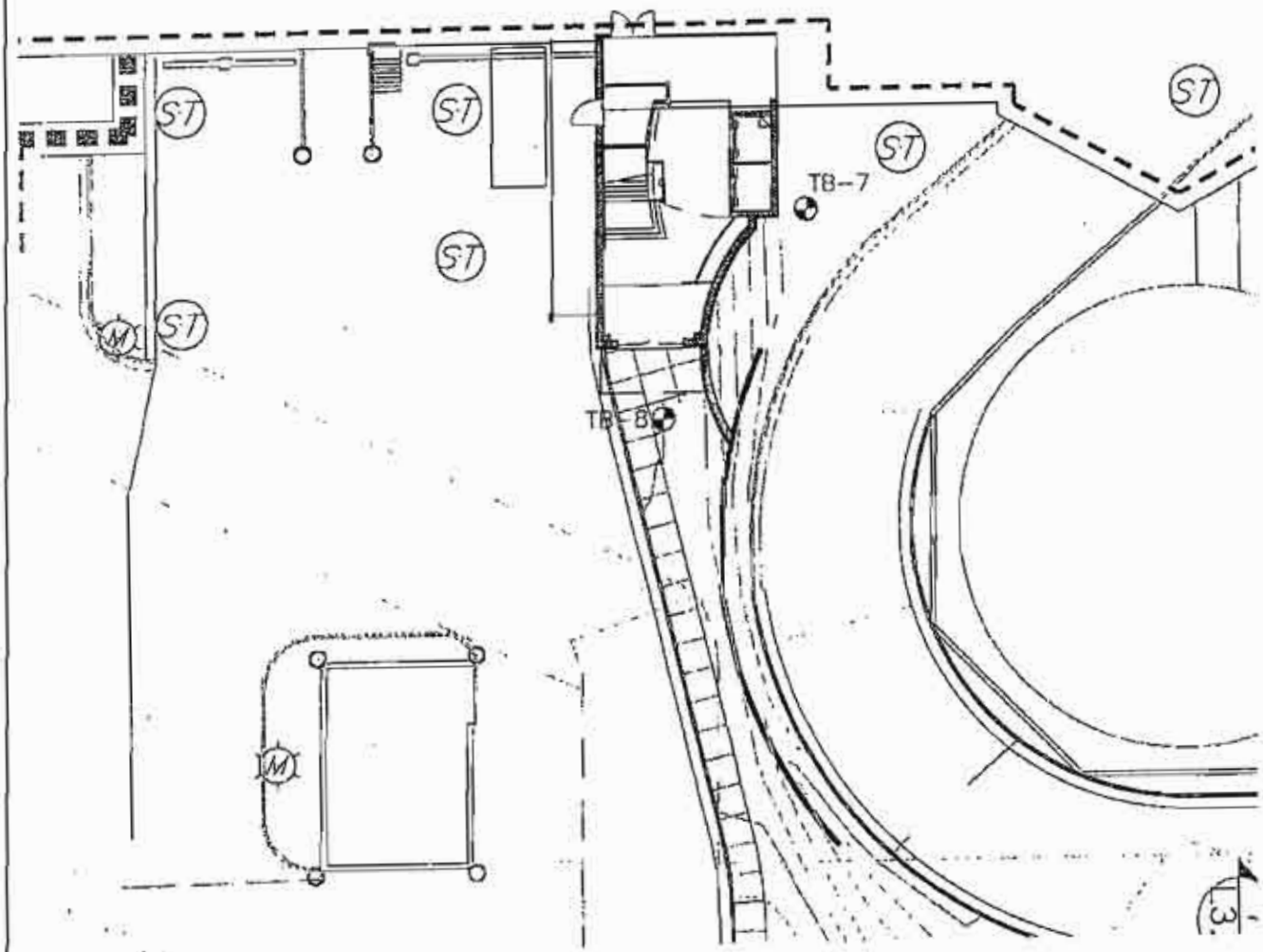
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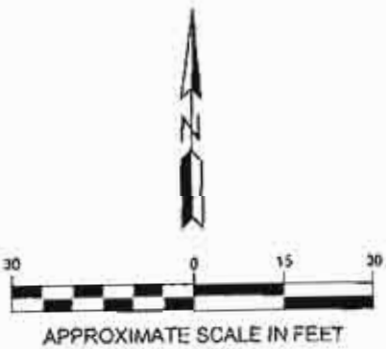
MAP REPRODUCED FROM GOOGLE - MAP DATA ©2006

NOT TO SCALE

KLEINFELDER An employee owned company	VICINITY MAP	Figure
Checked By: D. Adams / Drafted By: J. Edwards	MEDICAL CENTER OF AURORA	1
Project Number: 66295 / Date: March 20, 2006	AURORA, COLORADO	



TB-7 = TEST BORING



APPROXIMATE SCALE IN FEET

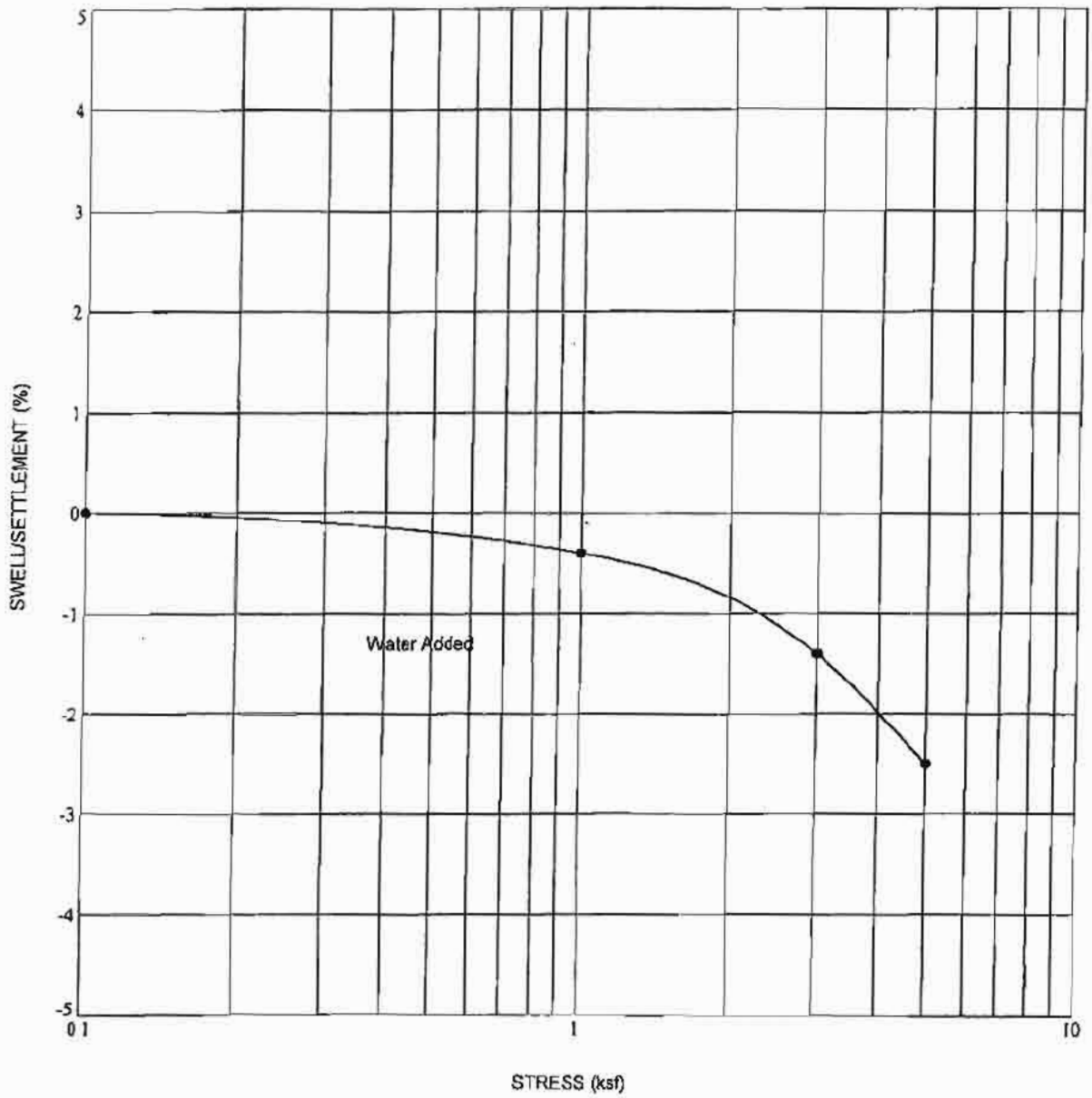
KLEINFELDER
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Checked By: D. Adams	Drafted By: J. Edwards
Project Number: 66295.2	Date: March 28, 2006

BORING LOCATION PLAN

MEDICAL CENTER OF AURORA
SOUTH ENTRY
AURORA, COLORADO

Figure 2



		Before	After
SOURCE: TB-8	Total Unit Weight (pcf) =	120 3	
At a depth of approximately 4 0 feet	Moisture Content (%) =	11 8	
Exp = 0.0%	Dry Unit Weight (pcf) =	107 6	
Silty sand			

KLEINFELDER

Drafted By:	L. Klotz	Project Number:
Date:	April, 2006	66295-2

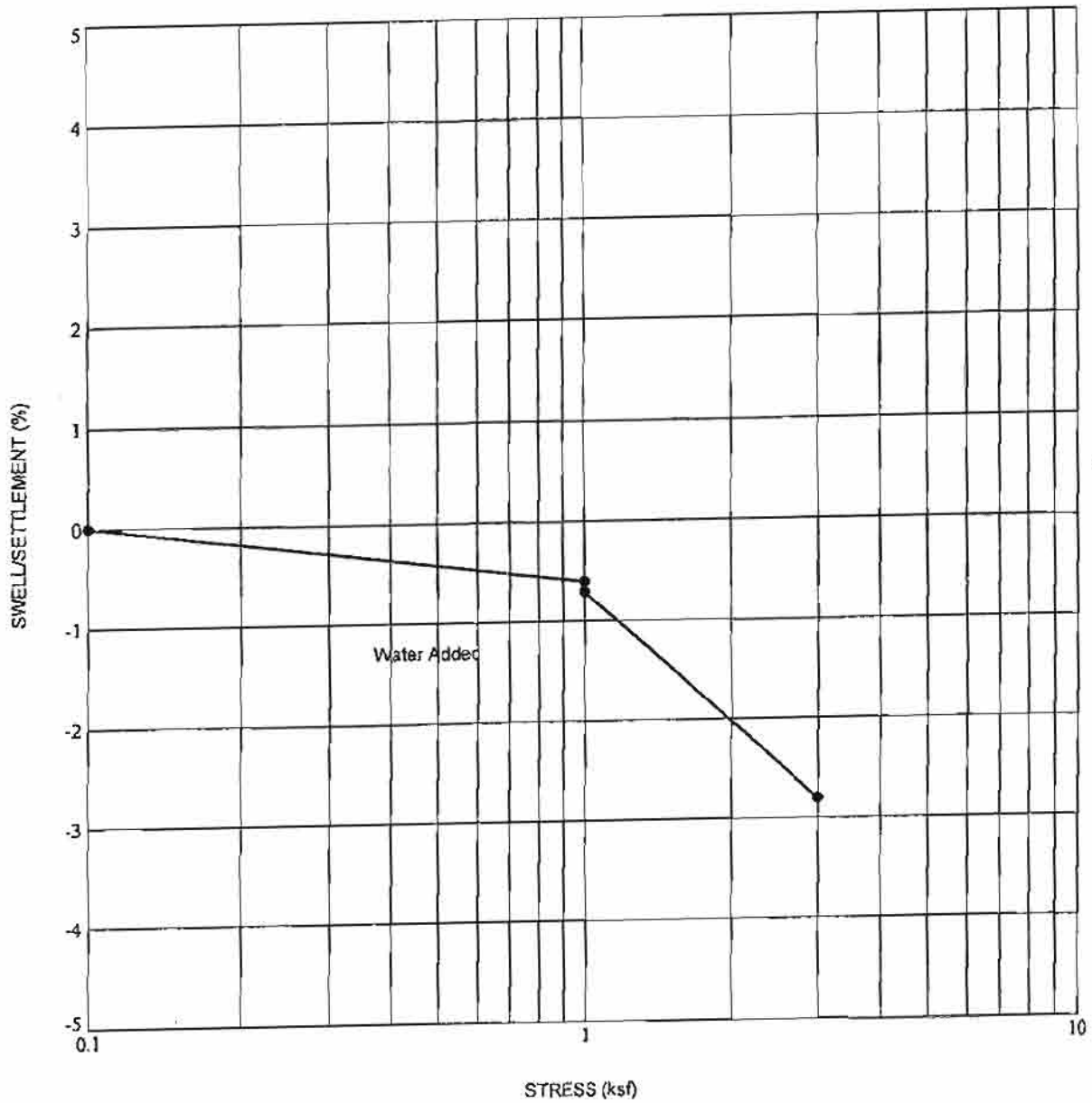
SWELL/SETTLEMENT TEST

Medical Center of Aurora, South Entry
Aurora, Colorado

Figure 3

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ZDONSOI ID 66295-2 AURORA MEDICAL CENTER.GPJ 4/7/2006



	Before	After
Total Unit Weight (pcf) =	121.1	
Moisture Content (%) =	17.8	
Dry Unit Weight (pcf) =	102.8	

SOURCE: TB-8

At a depth of approximately 9.0 feet

Com = 0.1%

Sandy clay

KLEINFELDER

Drafted By:	L. Klotz	Project Number:
Date:	April, 2006	66295-2

SWELL/SETTLEMENT TEST

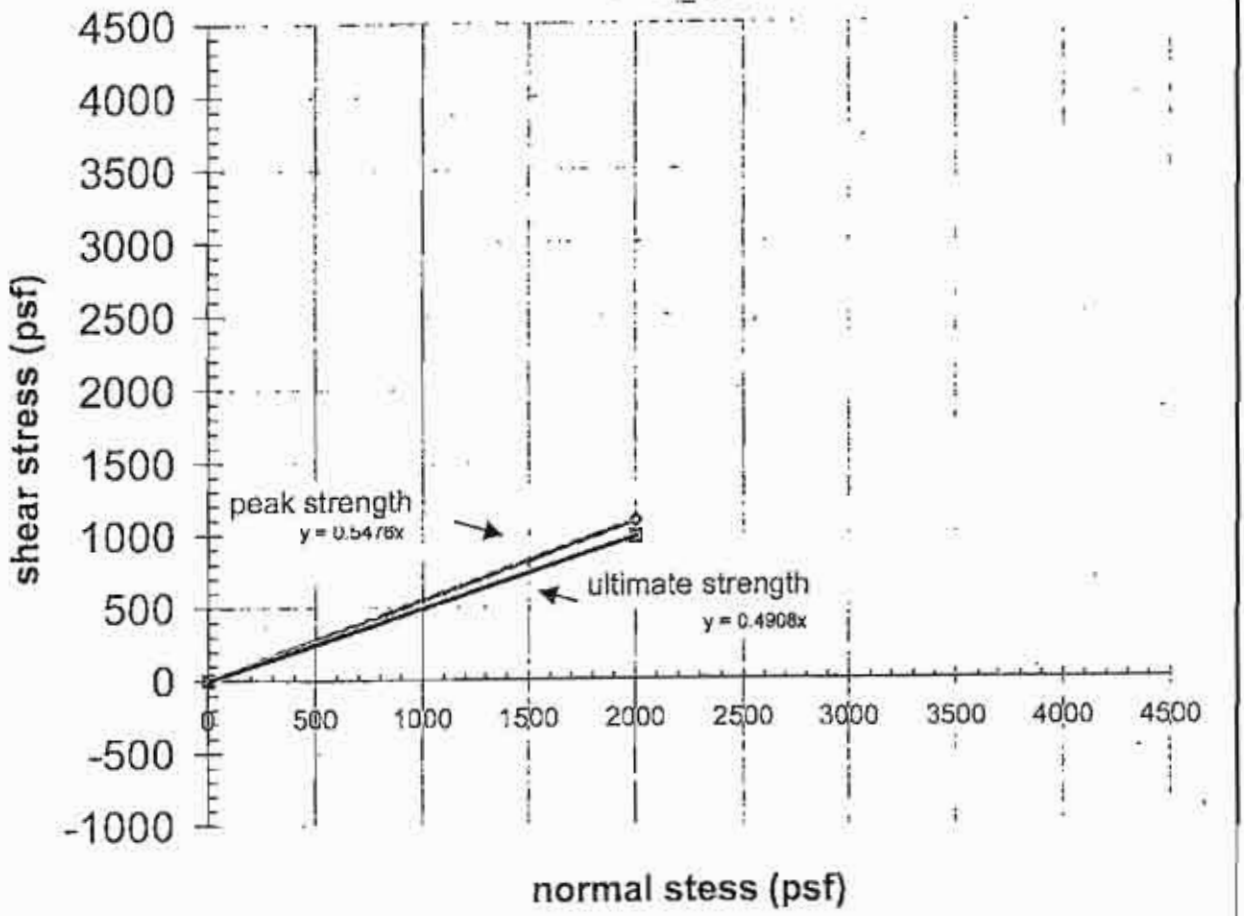
Medical Center of Aurora, South Entry
Aurora, Colorado

Figure 4

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ZCONSOLID 66295-2 AURORA MEDICAL CENTER.GPJ 4/7/2006

Direct Shear Results
Aurora Medical Center
B8 @ 4'



Normal Stress [psf]	Peak Shear Stress [psf]	Ultimate Shear Stress [psf]
0	0	0
2000	1095.1	981.5

	peak	ultimate
Slope (y)	0.5476	0.4908
Angle of Internal Friction Φ (degr):	28.7	26.1
Cohesion (psf):	0	0

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Project No. 66295	
Date: 3/2006	Figure No. 5

LEGEND OF SYMBOLS USED ON BORING LOGS

LOG SYMBOLS



BULK / GRAB SAMPLE



MODIFIED CALIFORNIA SAMPLER
(2.5 inch inside diameter)



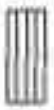
STANDARD PENETRATION
SPLIT SPOON SAMPLER
(2.0-inch O.D. X 1.4-inch I.D.)



SHELBY TUBE
(3 inch outside diameter)



BOBCAT SIZE CORE BARREL
(1.65-inch I.D.)



NX SIZE CORE BARREL
(3.873-inch I.D.)



HQ-3 SIZE CORE BARREL
(2.4-inch I.D.)



WATER LEVEL
(level where first encountered)



WATER LEVEL
(level after completion)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were based on visual classification in the field and were modified where appropriate by visual classifications in the office, and/or laboratory gradation and index property testing.
5. MV = No Value; NA = Not Analyzed; NP = Non Plastic
6. Exp = percent expansion under defined surcharge pressure.
7. Com = Percent compression under defined surcharge pressure
8. 50/X indicates number of blows required to drive the identified sampler X inches with a 140 lb hammer falling 30 inches

USCS SYMBOL	SOIL DESCRIPTIONS
GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
--	INTERBEDDED SANDSTONE/CLAYSTONE
--	LIMESTONE
--	CLAYSTONE
--	SHALE
--	SANDSTONE
--	SILTSTONE
--	FILL

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve, require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.

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BORING LOG LEGEND

Drafted By: H. Geraban | Project Number:

Date: 9/6/2005

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Location:	South Entry			Date Started:	3/17/2006
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	3/17/2006
Drilling Company:	H.P. Geotech	Equipment:	Boart Longyear-51	Logged By:	R. Kowalski
Hole Diameter (in):	4	Drilling Method:	Solid Flight Auger		
Hammer Type:	Cathead			Total Depth (ft):	20.0

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Sample Type	FIELD: Continuous Penetration Resistance	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests
			Appx. Surface Elevation (ft): 103.00 Surface Condition: Grass											
			FILL: sand, silty w/ small gravel, loose, moist, brown, occasional brick debris		8 7	MCAL		112	6.4					
100	5		SAND (SM): clean to silty, loose, moist to very moist, brown		7 12	MCAL			11.9					
95	10				5 6	MCAL		112	8.5				18	
90	15		CLAY (CL): sandy, stiff, moist, brown											
85	20		CLAYSTONE: sandy, m. hard, moist, brown		9 25	MCAL								
80	25													

KLEINFELDER

Drafted By: L. Klotz
Date: March 20, 2006
Project Number: 66295-2

BORING LOG

Medical Center of Aurora, South Entry
Aurora, Colorado

BORING
TB-7
Page 1 of 1

DENVER_GEO 66295-2 AURORA MEDICAL CENTER.GPJ 4/7/2006

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Location:	South Entry	Date Started:	2/27/2006
Groundwater (ft):	No Free Groundwater Encountered	Date Completed:	2/27/2006
Drilling Company:	Dakota Drilling	Equipment: CME-55	Logged By: J. Edwards
Hole Diameter (in):	4	Drilling Method: Solid Flight Auger	
Hammer Type:	Cathead		Total Depth (ft): 20.0

Elevation (feet)	Depth (feet)	Graphical Log	DESCRIPTION	FIELD: Sample Interval	FIELD: Blow Counts per 6" interval	FIELD: Sample Type	FIELD: Continuous Penetration Resistance	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests
			Appx. Surface Elevation (ft): 98.00 Surface Condition: Grass											
			FILL: sand, silty, medium dense, moist, dark brown to brown											
					14 16	MCAL								WSS = 0.0%
95			SAND (SM): silty, loose, moist, brown to light brown											
	5				5 7	MCAL		108	11.8					Exp = 0.0%
90			CLAY (CL): slightly sandy to sandy, stiff, moist, brown, calcareous, porous											
	10				7 7	MCAL		103	17.8					Corr = 0.1%
85														
	15				8 10	MCAL								
80			CLAYSTONE: medium hard, moist, brown-olive											
	20				50/11	MCAL								
75														
	25													

KLEINFELDER

Drafted By: L. Klotz
Date: March 20, 2006
Project Number: 66295-2

BORING LOG

Medical Center of Aurora, South Entry
Aurora, Colorado

BORING
TB-8
Page 1 of 1

DENVER_GEO 66295-2 AURORA MEDICAL CENTER.GPJ 4/7/2006

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R.S.N 232867

06-126/126

STRUCTURAL
CONSULTANTS
INCORPORATED

STRUCTURAL CALCULATIONS

FOR

AURORA MEDICAL CENTER EMPLOYEE ENTRANCE ADDITION

AURORA, CO

SCI #06-024

PREPARED FOR

DAVIS PARTNERSHIP

JUNE 30, 2006



STRUCTURAL
CONSULTANTS
INCORPORATED
3400 E. Bayaud Avenue
Suite 300
Denver, Colorado 80209

STRUCTURAL CONSULTANTS INCORPORATED	Job Title	Aurora Medical Center Employee Entrance			Job No.	06-024 A 01
	Client	Davis Partnership	By MAK	Date 6/20/06	Sheet	1 of --

STRUCTURAL DESIGN CRITERIA

REFERENCES

A. INTERNATIONAL BUILDING CODE - 2003 EDITION
B. ACI BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE AND COMMENTARY : 2002
C. AISC MANUAL OF STEEL CONSTRUCTION, ASD, 9th ED. PLUS SUPPLEMENT NO. 1
D. GEOTECHNICAL ENGINEERING STUD BY KLEINFELDER #56295-1
DATED: April 7, 2006
E. ACI BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES : 530-02

DESIGN LOADS

A. LIVE LOADS

1. Roof, Typical : 30 psf snow + drifting, see calculations following

4. Lobby, Stairs, Corridors : 100 psf

B. DEAD LOADS

1. Roof:

fully adhered EPDM		5	psf
insulation		2	psf
suspended ceiling		2	psf
mechanical		2	psf
electrical		1	psf
miscellaneous		3	psf
	Superimposed	15	psf
Steel deck		3	psf
structure		7	psf
	TOTAL	**25**	**psf**

2. Floor:

floor finish		3	psf
suspended ceiling		2	psf
mechanical		4	psf
electrical		3	psf
miscellaneous		3	psf
	Superimposed	15	psf
Concrete slab on steel deck:		57	psf
structure		13	psf
	TOTAL	**85**	**psf**

MATERIALS

A. CONCRETE

1.	Foundation Walls and Footings :	3,000	psi
2.	Interior Slab-on-Grade :	3,000	psi
3.	Exterior Slabs :	4,000	psi
4.	Concrete on Suspended Slabs and Metal Deck :	3,500	psi
5.	All other concrete :	3,000	psi
6.	Reinforcing steel, ASTM A615 :	60,000	psi
7.	WWF Reinforcing, ASTM A185 or ASTM A497		

B. STEEL

1.	Structural shapes :	ASTM A992, Grade 50
2.	Channels, plates, angles :	ASTM A36
3.	HSS Structural tubing :	ASTM A500, Grade B
4.	Bolts, nuts :	ASTM A325

C. MASONRY

1.	Masonry units :	Lightweight, ASTM C90, Grade N-1
2.	Assembly strength, f'm :	1,500 psi
3.	Grout, 28 days :	3,000 psi
4.	Mortar :	ASTM C270, Type S - 2,000 psi compressive strength
5.	Special inspection will be required.	

FOUNDATIONS

A. Foundation type : Foundation Walls with Strip and Pad Footings
B. Frost depth : 36 inches
C. Foundation Design Capacities and Recommendations :

1.	Sub-excavation should be performed 12" feet below floor elevation		
2.	Maximum soil bearing pressure to resist gravity loads:	2,000	psf
3.	Maximum soil bearing pressure to resist lateral loads:	2,000	psf
4.	Minimum Dead Load Pressure:	n.a.	
5.	Coefficient of sliding friction to resist lateral loads:	0.4	
6.	Passive earth pressure used to resist lateral loads: (for compacted backfill)	350	pcf
7.	Equivalent fluid pressure for soil against laterally supported walls :	42	pcf
8.	Strip footings should have a minimum width of at least 16 inches.		
9.	Isolated pad footings should have a minimum dimension of at least 24 inches on all sides.		

STRUCTURAL CONSULTANTS INCORPORATED	Job Title	Aurora Med Center Employee Entrance		Job No.	06-024
	Client	Davis	By MAK	Date 6/10/06	Sheet A of 03

SEISMIC DESIGN CRITERIA

SEISMIC RESPONSE COEFFICIENT (PER 2003 IBC & ASCE 7/02)

Ordinary Reinforced Masonry Shearwalls

Seismic Design Category : C **Soil Site Classification :** D **Seismic Factor, I_E :** 1.50

Seismic Use Group : III **Ductility Coefficient, R :** 2.5 **Overstrength Factor, Ω_0 :** 2.5

S_s : 0.188 F_a : 1.6 $S_{MS} = (F_a)(S_s)$ = 0.301 $S_{DS} = (2/3)S_{MS}$ = 0.201

S_1 : 0.057 F_v : 2.4 $S_{M1} = (F_v)(S_1)$ = 0.137 $S_{D1} = (2/3)S_{M1}$ = 0.091

Structure Period : C_t : 0.02 h_n : 30 feet x: 0.75 $T_a = (C_t)(h_n)^x$ = 0.256

C_u : 1.7 Maximum Period, $T_{max} = (C_u)(T_a)$ = 0.436

Use $T = T_a$ = 0.145

$Cs = S_{DS}/(R/I_E)$ = 0.120 (Equation 9.5.5.2.1-1 ASCE 7/02)

$Cs = S_{D1}/((R/I_E)T)$ = 0.377 max (Equation 9.5.5.2.1-2 ASCE 7/02)

$Cs = 0.044(S_{DS})(I_E)$ = 0.013 min (Equation 9.5.5.2.1-3 ASCE 7/02)

Therefore, Use Seismic Response Coefficient, Cs = 0.120

mak
Date and Time: 6/10/2006 9:11:29 AM

A 04

MCE Ground Motion - Conterminous 48 States
Zip Code - 80012 Central Latitude = 39.699718
Central Longitude = -104.837353

Period (sec)	MCE Sa (%g)	
0.2	018.8	MCE Value of Ss, Site Class B
1.0	005.7	MCE Value of S1, Site Class B
Spectral Parameters for Site Class D		
0.2	030.1	Sa = FaSs, Fa = 1.60
1.0	013.7	Sa = FvS1, Fv = 2.40

STRUCTURAL CONSULTANTS INCORPORATED	Job Title	Aurora Medical Center Addition		Job No.	06-025
	Client	Davis	By MAK	Date 6/12/06	Sheet ___ of ___

STRUCTURAL WIND DESIGN CRITERIA

REFERENCES

A. INTERNATIONAL BUILDING CODE EDITION : 2003
B. ASCE MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES: 7-02
C. ASSUMPTIONS: WORK SHEET IS VALID FOR FLAT ROOF BUILDINGS ONLY, AND COMPUTES MWFRS AND COMPONENTS AND CLADDING WIND PRESSURES AT WALL ELEMENTS ONLY.

WIND LOADS

Method used for wind analysis:	2	
Low-rise Building?:	yes	
Basic wind speed, V :	105 mph	(re: Table 1609.3.1; IBC)
Importance factor, I_w:	1.15	(re: Table 1604.5; IBC)
Topographic factor, K_{zt}:	1.00	(re: Section 6.5.7.2; ASCE)
Enclosure classification:	enclosed	(re: Section 6.5.9; ASCE)
Wind directionality factor, K_d:	0.85	(re: Table 6-4; ASCE)
Exposure :	b	(re: Section 1609.4; IBC / Section 6.5.6.3; ASCE)
Building height (h):	30.0 ft	
Effective wind Area (A):	10.0 ft^2	

A. Method 2 (Analytical method)
Using section 6 of ASCE 7-02

1. Exposure and Pressure Variables (Determined from Exposure Category) α= 7, z_g= 1200 (re: Table 6-2; ASCE)

$K_z=2.01*(z/z_g)^{2/\alpha}$

$K_h=2.01*(h/z_g)^{2/\alpha}$

Case 1—> K_h= 0.70

Case:	1
z	Kz
0-15	0.70
20	0.70
25	0.70
30	0.70
40	0.76
50	0.81

(re: Table 6-3; ASCE)

2. Velocity pressure:

$q_z= 0.00256\ K_z\ K_{zt}\ K_d\ V^2\ I_w$

$q_h= 0.00256\ K_h\ K_{zt}\ K_d\ V^2\ I_w$

Case 1—> q_h= 19.3 psf

Case:	1
z	qz
0-15	15.9 psf
20	17.2 psf
25	18.3 psf
30	19.3 psf
40	21.0 psf
50	22.4 psf

(re: Eq. 6-15; ASCE)

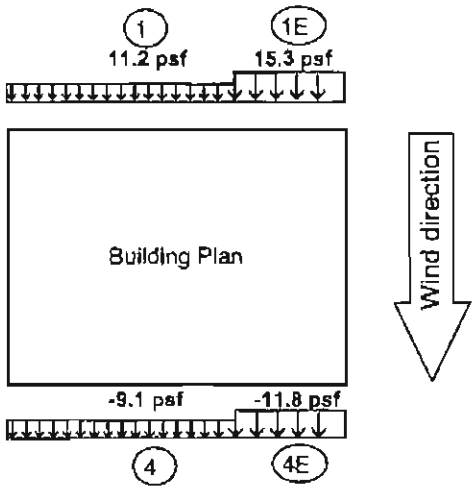
3. Gust Effect factor:

G= 0.850 (re: Section 6.5.8.1; ASCE)

4. **Main Wind Force-Resisting System:**
(for low-rise buildings, see definitions ASCE, sec. 6.2)

$p = q_h[(GC_{pf}) - (GC_{pi})]$ (re: Eq. 6-18; ASCE)

(windward zone 1) GCp= 0.40 (re: Figure 6.10; ASCE)
(windward zone 1E) GCp= 0.61 (re: Figure 6.10; ASCE)
(leeward zone 4) GCp= -0.29 (re: Figure 6.10; ASCE)
(leeward zone 4E) GCp= -0.43 (re: Figure 6.10; ASCE)
(GC_{pi})= +/- 0.18 (re: Figure 6.5; ASCE)



Net Main Wind Force-Resisting System:
(internal pressures cancel)

$p = q_h[(GC_{pf(windward)}) - (GC_{pf(leeward)})]$

(windward zone 1) p= 11.2 psf at the interior surfaces.
(windward zone 1E) p= 15.3 psf at the exterior surfaces.
(leeward zone 4) p= -9.1 psf at the interior surfaces.
(leeward zone 4E) p= -11.8 psf at the exterior surfaces.

COMPONENT AND CLADDING DESIGN CRITERIA

Buildings with height under 60 ft

REFERENCES

A. INTERNATIONAL BUILDING CODE EDITION : 2003
B. ASCE MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES: 7-02
C. AISI STANDARD: 2001

WIND LOADS (per reference B, Method 2)

Basic wind speed, V :	105 mph	Exposure :	B
Importance factor, I_w:	1.15		(re: Table 6-1, p. 73)
Topographic factor, K_{zt}:	1.00		(re: Section 6.5.7.2)
Enclosure classification:	Enclosed		(re: Section 6.5.9)
Gust effect factor, G:	0.85		(re: Section 6.5.8.1)
Wind directionality factor, K_d:	0.85		(re: Table 6-4, p. 76)
Velocity Pressure Exposure Coefficient, K_z:	0.7		(re: Table 6-3, p. 75)

Reduce numerical constant 0.00256 for altitude?	Y	(re: Section 6.5.10, C6.5.10,
Altitude?	5000 ft	Table C6.1, p. 306)
Average Ambient Air Density:	0.0659	(re: Table C6-1, p. 306)
Constant:	0.00220	(re: C6.5.10, p. 286)

A. **Wall element wind loads for buildings 60 ft or less in height:**

Zone 4:

(GC_p) = -1.1 (re: Fig. 6-11a, p. 57)

(GC_{pi}) = 0.18 (re: Fig. 6-5, p. 49)

$q_h = 0.00220\ K_z\ K_{zt}\ K_d\ V^2\ I_w$ (re: Eq. 6-15, p. 31)

$= 16.6$ psf

$P = q_h[(GC_p) - (GC_{pi})]$ (re: Eq. 6-22, p. 33)

$= \boxed{-21}$ psf

Zone 5:

(GC_p) = -1.4 (re: Fig. 6-11a, p. 57)

(GC_{pi}) = 0.18 (re: Fig. 6-5, p. 49)

$q_h = 0.00220\ K_z\ K_{zt}\ K_d\ V^2\ I_w$ (re: Eq. 6-15, p. 31)

$= 16.6$ psf

$P = q_h[(GC_p) - (GC_{pi})]$ (re: Eq. 6-22, p. 33)

$= \boxed{-28}$ psf

Note:
External pressure coefficients above have been selected from tabulated information assuming an effective wind area of 10 sq. ft. or less. Where effective wind area of a member exceeds 10 sq. ft., external pressure coefficients may be reduced in accordance with code as follows:

Eff. Wind Area	Zone 4 (psf)	Zone 5 (psf)
20 S.F.	-20	-25
50 S.F.	-19	-22
100 S.F.	-18	-20
200 S.F.	-18	-19
500 S.F.	-16	-16

Note: For structures with roof slopes of less than 10 degress, wind pressures may be reduced by 10%

$\left(\frac{243 - 200}{500 - 200}\right) \times (19 - 16) = .43$ PSF $\Rightarrow$ 18.6 PSF - 10% $\Rightarrow$ 16.7 PSF

STRUCTURAL CONSULTANTS INCORPORATED

Job Title AURORA ENTRANCE Job no. 02-024

Client DAVIS By MAK Date 6/10/02 Sheet A of 08

ROOF JOISTS - 31'

W_{DL} = 25 PSF × 4'-0"
= 150 PLF

W_{LL} = 30 PSF × 4'-0"
= 180 PLF

W_{TL} = 330 PLF => USE 20K6 @ 6'0" o.c.

ROOF JOIST - 26' => USE 18K4 @ 4'-0" o.c.

ROOF DECK

MAX SPAN ONE FOR 71 PSF ∴ OK

∴ USE 1.5 B 22

USE 1.5 B 20 FOR DIAPHRAGM SHEAR REQ'MTS

NET WIND UPLIFT ON DECK & JOISTS:

P = 16.6 PSF [(-1.8) - (.18)] = 33 PSF (ZONE 2,3)*

P = 16.6 PSF [(-1.0) - (.18)] = 20 PSF (ZONE 1)

NET WIND = 33 PSF - 15 PSF = 18 PSF (ZONE 2,3)*

NET WIND = 20 PSF - 15 PSF = 5 PSF (ZONE 1)

* PARAPET HEIGHT ≥ 3'-0", ∴ ZONE 3 IS ZONE 2 P. 50, ASCE 7-02

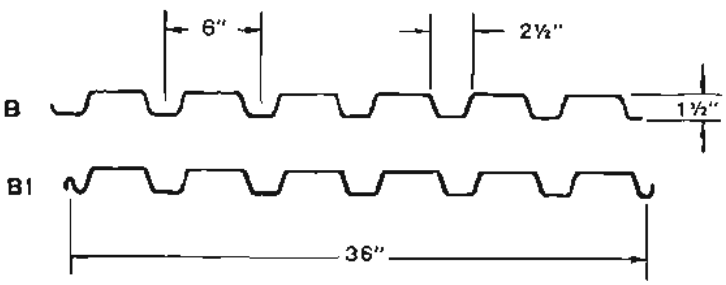
STANDARD LOAD TABLE/OPEN WEB STEEL JOISTS, K-SERIES
Based on a Maximum Allowable Tensile Stress of 30 ksi

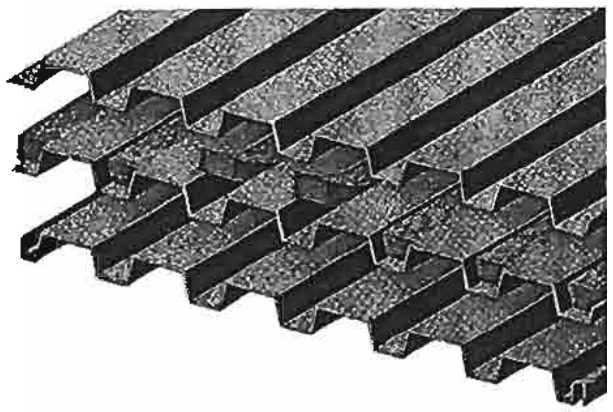
A 09

Joist Designation	18K3	18K4	18K5	18K6	18K7	18K9	18K10	20K3	20K4	20K5	20K6	20K7	20K9	20K10	22K4	22K5	22K6	22K7	22K9	22K10	22K11
Depth (in.)	18	18	18	18	18	18	18	20	20	20	20	20	20	20	22	22	22	22	22	22	22
Approx. Wt. (lbs./ft.)	6.6	7.2	7.7	8.5	9	10.2	11.7	6.7	7.6	8.2	8.9	9.3	10.8	12.2	8	8.8	9.2	9.7	11.3	12.6	13.8
Span (ft.) ↓																					
18	550 550	550 550	550 550	550 550	550 550	550 550	550 550														
19	514 494	550 523	550 523	550 523	550 523	550 523	550 523														
20	463 423	550 490	550 490	550 490	550 490	550 490	550 490	517 517	550 550	550 550	550 550	550 550	550 550	550 550							
21	420 384	506 426	550 460	550 460	550 460	550 460	550 460	468 453	550 520	550 520	550 520	550 520	550 520	550 520							
22	382 316	460 370	518 414	550 438	550 438	550 438	550 438	426 393	514 461	550 490	550 490	550 490	550 490	550 490	550 548	550 548	550 548	550 548	550 548	550 548	550 548
23	348 276	420 323	473 362	518 393	550 418	550 418	550 418	389 344	469 402	529 451	550 468	550 468	550 468	550 468	518 491	550 518	550 518	550 518	550 518	550 518	550 518
24	320 242	385 284	434 318	473 345	526 382	550 396	550 396	357 302	430 353	485 396	528 430	550 448	550 448	550 448	475 431	536 483	550 495	550 495	550 495	550 495	550 495
25	294 214	355 260	400 291	435 305	485 337	550 377	550 377	329 266	396 312	446 350	486 380	541 421	550 426	550 426	438 381	493 427	537 464	550 474	550 474	550 474	550 474
26	272 190	328 222	369 249	402 271	448 299	538 354	550 361	304 236	368 277	412 310	449 337	500 373	550 405	550 405	404 338	455 379	496 411	550 454	550 454	550 454	550 454
27	252 169	303 198	342 222	372 241	415 267	498 315	550 347	281 211	339 247	382 277	416 301	463 333	550 369	550 369	374 301	422 337	459 367	512 406	550 432	550 432	550 432
28	234 151	282 177	318 199	346 216	386 238	463 282	548 331	261 189	316 221	355 248	386 269	430 298	517 353	550 375	348 270	392 302	427 328	475 364	550 413	550 413	550 413
29	218 136	263 159	296 179	322 194	359 215	431 254	511 296	243 170	293 199	330 223	360 242	401 268	482 317	550 359	324 242	365 272	398 295	443 327	532 387	550 399	550 399
30	203 123	245 144	276 161	301 175	335 194	402 229	477 269	227 153	274 179	308 201	336 218	374 242	450 286	533 336	302 219	341 245	371 266	413 295	497 349	550 385	550 385
31	190 111	229 130	258 146	281 158	313 175	376 207	446 243	212 138	256 162	289 182	314 198	350 219	421 259	499 304	283 196	319 222	347 241	387 267	465 316	550 369	550 369
32	178 101	215 118	242 132	264 144	294 159	353 188	418 221	199 126	240 147	271 165	295 179	328 199	395 235	468 278	265 186	299 201	326 219	363 242	436 287	517 337	549 355
33	168 92	202 106	228 121	248 131	276 145	332 171	393 201	187 114	226 134	254 150	277 163	309 181	371 214	440 251	249 164	281 183	306 199	341 221	410 261	486 307	532 334
34	159 84	190 98	214 110	233 120	260 132	312 156	370 184	176 105	212 127	239 142	261 149	290 165	349 195	414 229	235 149	265 167	288 182	321 202	386 239	458 280	516 314
35	149 77	178 90	202 101	220 110	245 121	294 143	349 168	166 96	200 118	226 126	246 137	274 161	329 179	390 210	221 137	249 153	272 167	303 185	364 219	432 257	494 292
36	141 70	169 82	191 92	208 101	232 111	278 132	330 154	157 88	189 103	213 115	232 125	259 139	311 164	369 193	209 126	236 141	257 153	286 169	344 201	408 236	467 269
37								149 81	179 85	202 106	220 115	245 128	294 151	349 178	198 116	223 130	243 141	271 156	325 185	388 217	442 247
38								141 74	170 87	191 93	208 105	232 118	279 139	331 164	187 107	211 119	230 130	256 144	308 170	386 200	418 228
39								133 69	161 81	181 91	198 98	220 109	265 129	314 161	178 98	200 110	218 120	243 133	292 157	347 185	397 211
40								127 64	153 75	172 81	188 91	209 101	251 119	298 140	169 91	190 102	207 113	231 123	278 146	330 171	377 195
41															161 85	181 95	197 103	220 114	264 135	314 159	359 181
42															153 79	173 88	188 96	209 106	252 126	299 148	342 168
43															146 73	165 82	179 89	200 99	240 117	285 138	326 157
44															139 68	157 76	171 83	191 92	229 109	272 128	311 148

1.5 B, BI, BA, BIA

Maximum Sheet Length 42'-0
Extra Charge for Lengths Under 6'-0
Factory Mutual Approved (No. 0C847.AM, 0G1A4.AM, and 3Y1A6.AM) **
ICBO Approved (No.3415)





SECTION PROPERTIES

Deck Type	Design Thick.	Weight (PSF) Pld.	Galv.	I in⁴/ft	Sp in³/ft	Sn in³/ft	Fy KSI
B24	0.0239	1.36	1.46	0.121	0.120	0.131	60
B22	0.0295	1.68	1.78	0.169	0.166	0.192	33
B21	0.0329	1.87	1.97	0.192	0.213	0.221	33
B20	0.0358	2.04	2.14	0.212	0.234	0.247	33
B19	0.0418	2.39	2.49	0.253	0.277	0.289	33
B18	0.0474	2.72	2.82	0.292	0.318	0.327	33
B16	0.0598	3.44	3.54	0.373	0.408	0.411	33

ACOUSTICAL INFORMATION

Deck Type	Absorption Coefficient 125	250	500	1000	2000	4000	Noise Reduction Coefficient*
1.5BA, 1.5BIA	.11	.20	.63	1.04	.66	.36	.65

* Source: Riverbank Acoustical Laboratories — RAL™ A94-185. Test was conducted with 1.5 inches of 1.65 pcf fiberglass insulation on 3 inch EPS Plaza deck for the SDI.

Type B (wide rib) deck provides excellent structural load carrying capacity per pound of steel utilized, and its nestable design eliminates the need for dieset ends.

1" or more rigid insulation is required for Type B deck.

Acoustical deck (Type BA, BIA) is particularly suitable in structures such as auditoriums, schools, and theatres where sound control is desirable. Acoustic perforations are located in the vertical webs where the load carrying properties are negligibly affected (less than 5%).

Inert, non-organic glass fiber sound absorbing batts are placed in the rib openings to absorb up to 65% of the sound striking the deck.

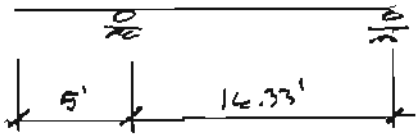
Batts are field installed and may require separation.

VERTICAL LOADS FOR TYPE 1.5B

No of Spans	Deck Type	Max. SDI Const. Span	Allowable Total (Dead + Live) Uniform Load (PSF) Span (ft.-in.) C. to C. of Support 5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	9'-6	10'-0
1	B 24	4'-6	88	82	42	36	30	27	24	21	20		
	B 22	5'-7	91	71	57	47	40	34	30	27	24	22	20
	B 21	6'-0	104	81	64	53	44	38	33	29	26	24	22
	B 20	6'-5	116	89	71	58	48	41	36	31	28	25	23
	B 19	7'-1	139	107	85	69	57	48	41	36	32	29	26
	B 18	7'-8	162	124	98	79	65	55	47	41	36	32	29
	B 16	8'-8	206	157	123	99	81	68	58	50	44	39	34
2	B 24	5'-10	126	104	87	74	64	55	47	41	36	32	29
	B 22	6'-11	102	85	71	61	52	46	40	35	32	28	26
	B 21	7'-4	118	97	80	70	60	52	46	41	36	33	29
	B 20	7'-9	132	109	91	78	67	59	51	46	41	36	33
	B 19	8'-5	154	127	107	91	79	69	60	53	48	43	39
	B 18	8'-1	174	144	121	103	89	78	68	60	54	48	44
	B 16	10'-3	219	181	152	130	112	97	86	76	68	61	55
3	B 24	5'-10	150	100	70	55	45	38	34	31	27	25	
	B 22	6'-11	128	106	89	76	65	57	50	44	39	34	31
	B 21	7'-4	147	122	102	87	75	65	56	49	42	38	34
	B 20	7'-9	165	136	114	97	84	72	61	53	46	41	36
	B 19	8'-5	193	159	134	114	98	84	71	61	53	47	41
	B 18	9'-1	218	180	151	129	111	96	81	69	60	52	46
	B 16	10'-3	274	226	190	162	140	119	100	85	73	64	56

Notes: 1. Load tables are calculated using sectional properties based on the steel design thickness shown in the Steel Deck Institute (SDI) Design Manual.
2. Loads shown in the shaded areas are governed by the live load deflection not in excess of 1/240 of the span. A dead load of 10 PSF has been included.
3. ** Acoustical Deck is not covered under Factory Mutual

BEAM DESIGNS



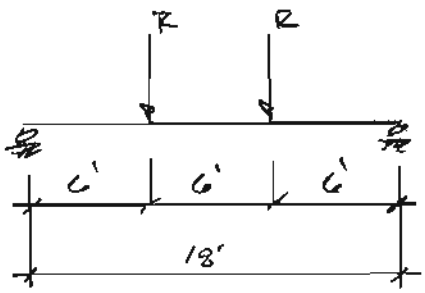
W_{DL} = 35 PSF × 7' = .6 KLF

W_{LL} = 100 PSF × 7' = .7 KLF

FROM ENERCALC: W12×19 OK

GIRDER ALONG GRID C/B

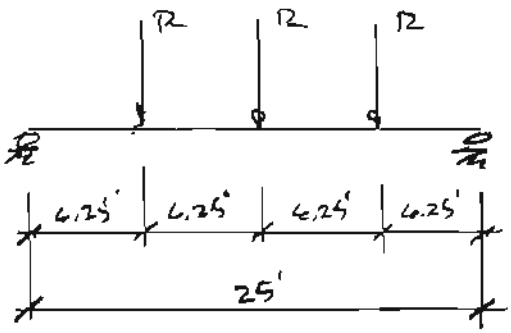
R_{TL} = 10.3^K (FROM BEAM DESIGNS)



FROM ENERCALC: W14×22 OK

GIRDER ALONG GRID C

R_{MAX} = 10.4^K (FROM BEAM DESIGN)



FROM ENERCALC: W21×57 OK

Title :
Dsgnr:
Description :

Job #
Date: 8:39AM, 20 JUN 06

A 12

Scope :

Steel Beam Design

Description cantilevered beams - full live

General Information

Code Ref: AISC 9th ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Steel Section : W12X19

		Pinned-Pinned		Fy	50.00 ksi
Center Span	16.33 ft	Sm Wt. Added to Loads		Load Duration Factor	1.00
Left Cant.	5.00 ft	LL & ST Act Together		Elastic Modulus	29,000.0 ksi
Right Cant	0.00 ft				
Lu : Unbraced Length	0.00 ft				

Distributed Loads

Note! Short Term Loads Are WIND Loads.

	# 1	# 2	# 3	# 4	# 5	# 6	# 7	
DL	0.600							k/ft
LL	0.700							k/ft
ST								k/ft
Start Location	-5.000							ft
End Location	16.330							ft

Summary

Beam OK
Static Load Case Governs Stress

Using: W12X19 section, Span = 16.33ft, Fy = 50.0ksi, Left Cant. = 5.00ft, Right Cant. = 0.00ft
End Fixity = Pinned-Pinned, Lu = 0.00ft, LDF = 1.000

	Actual	Allowable		
Moment	40.181 k-ft	58.575 k-ft	Max. Deflection	-0.501 in
fb : Bending Stress	22.637 ksi	33.000 ksi	Length/DL Defl	858.6 : 1
fb / Fb	**0.686 : 1**		Length/(DL+LL Defl)	276.9 : 1
Shear	11.243 k	57.152 k		
fv : Shear Stress	3.934 ksi	20.000 ksi		
fv / Fv	**0.197 : 1**			

Force & Stress Summary

<<— These columns are Dead + Live Load placed as noted —>>

	Maximum	DL Only	LL @ Center	LL+ST @ Center	LL @ Cants	LL+ST @ Cants	
Max. M +	40.18 k-ft	16.94	40.18		13.21		k-ft
Max. M -		-7.74	-7.74		-16.49		k-ft
Max. M @ Left		-7.74	-7.74		-16.49		k-ft
Max. M @ Right							k-ft
Shear @ Left	11.24 k	5.53	11.24		6.48		k
Shear @ Right	10.30 k	4.58	10.30		4.04		k
Center Defl.	-0.501 in	-0.204	-0.501	-0.501	-0.139	-0.139	in
Left Cant Defl	0.433 in	0.140	0.433	0.433	0.004	0.004	in
Right Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
...Query Defl @	0.000 ft	0.000	0.000	0.000	0.000	0.000	in
Reaction @ Left	18.37	8.62	14.34	14.34	12.66	12.66	k
Reaction @ Rt	10.30	4.58	10.30	10.30	4.04	4.04	k

Fa calc'd per Eq. E2-1, K*Lr < Cc
I Beam Passes Table B5.1, Fb per Eq. F1-1, Fb = 0.66 Fy

Steel Beam Design

Description cantilevered beams - full live

Section Properties W12X19

Depth	12.160 in	Weight	18.92 #/ft
Web Thick	0.235 in	Ixx	130.000 in4
Width	4.005 in	Iyy	3.760 in4
Flange Thick	0.350 in	Sxx	21.300 in3
Area	5.57 in2	Syy	1.880 in3
Rt	1.000 in	R-xx	4.820 in
Values for LRFD Design....		R-yy	0.822 in
J	0.180 in4	Zx	24.700 in3
Cw	131.00 in6	Zy	2.980 in3
		K	0.650 in

Title :
Dsgnr:
Description :

Job #
Date: 8:39AM, 20 JUN 06

A 14

Scope :

Steel Beam Design

Description cantilevered beams - full live on cantilever

General Information

Code Ref: AISC 9th ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Steel Section : W12X19

		Pinned-Pinned	Fy	50.00 ksi
Center Span	16.33 ft	Rm Wt. Added to Loads	Load Duration Factor	1.00
Left Cant.	5.00 ft	LL & ST Act Together	Elastic Modulus	29,000.0 ksi
Right Cant.	0.00 ft			
Lu : Unbraced Length	0.00 ft			

Distributed Loads

Note: Short Term Loads Are WIND Loads.

	#1	#2	#3	#4	#5	#6	#7	
DL	0.800	0.800						k/ft
LL	0.700							k/ft
ST								k/ft
Start Location	-5.000							ft
End Location		16.330						ft

Summary

Beam OK
Static Load Case Governs Stress

Using: W12X19 section, Span = 16.33ft, Fy = 50.0ksi, Left Cant. = 5.00ft, Right Cant. = 0.00ft
End Fixity = Pinned-Pinned, Lu = 0.00ft, LDF = 1.000

	Actual	Allowable		
Moment	16.944 k-ft	58.575 k-ft	Max. Deflection	-0.204 in
fb : Bending Stress	9.546 ksi	33.000 ksi	Length/DL Defl	858.6 : 1
fb / Fb	**0.289 : 1**		Length(DL+LL Defl)	858.6 : 1
Shear	6.461 k	57.152 k		
fv : Shear Stress	2.268 ksi	20.000 ksi		
fv / Fv	**0.113 : 1**			

Force & Stress Summary

	Maximum	DL Only	LL @ Center	LL+ST @ Center	LL @ Cants	LL+ST @ Cants	
		<<-- These columns are Dead + Live Load placed as noted -->>					
Max. M +	16.94 k-ft	16.94	16.94		13.21		k-ft
Max. M -		-7.74	-7.74		-16.49		k-ft
Max. M @ Left		-7.74	-7.74		-16.49		k-ft
Max. M @ Right							k-ft
Shear @ Left	6.48 k	5.53	5.53		6.48		k
Shear @ Right	4.58 k	4.58	4.58		4.04		k
Center Defl.	-0.204 in	-0.204	-0.204	-0.204	-0.139	-0.139	in
Left Cant Defl	0.140 in	0.140	0.140	0.140	0.004	0.004	in
Right Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
...Query Defl @	0.000 ft	0.000	0.000	0.000	0.000	0.000	in
Reaction @ Left	12.66	8.62	8.62	8.62	12.66	12.66	k
Reaction @ Rt	4.58	4.58	4.58	4.58	4.04	4.04	k

Fa calc'd per Eq. E2-1, K*Lb/r < Cc
I Beam Passes Table B5.1, Fb per Eq. F1-1, Fb = 0.66 Fy

Description cantilevered beams - full live on cantilever

Section Properties	W12X19		
Depth	12.160 in	Weight	18.92 #/ft
Web Thick	0.235 in	Ixx	130.000 in4
Width	4.005 in	Iyy	3.760 in4
Flange Thick	0.350 in	Sxx	21.300 in3
Area	5.57 in2	Syy	1.880 in3
Rt	1.000 in	R-xx	4.820 in
Values for LRFD Design....		R-yy	0.822 in
J	0.180 in4	Zx	24.700 in3
Cw	131.00 in6	Zy	2.980 in3
		K	0.650 in

Title :
Dsgnr:
Description :
Scope :

Job #
Date: 8:39AM, 20 JUN 06

A 16

Steel Beam Design

Description cantilevered beams - full live on backspan

General Information

Code Ref: AISC 9th ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Steel Section : W12X19

		Pinned-Pinned		Fy	50.00 ksi
Center Span	16.33 ft	Bm Wt. Added to Loads		Load Duration Factor	1.00
Left Cant.	5.00 ft	LL & ST Act Together		Elastic Modulus	29,000.0 ksi
Right Cant	0.00 ft				
Lu : Unbraced Length	0.00 ft				

Distributed Loads

Note! Short Term Loads Are WIND Loads.

	# 1	# 2	# 3	# 4	# 5	# 6	# 7	
DL	0.600	0.600						k/ft
LL		0.700						k/ft
ST								k/ft
Start Location	-5.000							ft
End Location		16.330						ft

Summary

Beam OK
Static Load Case Governs Stress

Using: W12X19 section, Span = 16.33ft, Fy = 50.0ksi, Left Cant. = 5.00ft, Right Cant. = 0.00ft
End Fixity = Pinned-Pinned, Lu = 0.00ft, LDF = 1.000

	Actual	Allowable		
Moment	40.181 k-ft	58.575 k-ft	Max. Deflection	-0.501 in
fb : Bending Stress	22.637 ksi	33.000 ksi	Length/DL Defl	858.6 : 1
fb / Fb	0.686 : 1		Length/(DL+LL Defl)	276.9 : 1
Shear	11.243 k	57.152 k		
fv : Shear Stress	3.934 ksi	20.000 ksi		
fv / Fv	0.197 : 1			

Force & Stress Summary

<<-- These columns are Dead + Live Load placed as noted -->>

	Maximum	DL Only	LL @ Center	LL+ST @ Center	LL @ Cants	LL+ST @ Cants	
Max. M +	40.18 k-ft	16.94	40.18		16.94		k-ft
Max. M -		-7.74	-7.74		-7.74		k-ft
Max. M @ Left		-7.74	-7.74		-7.74		k-ft
Max. M @ Right							k-ft
Shear @ Left	11.24 k	5.53	11.24		5.53		k
Shear @ Right	10.30 k	4.58	10.30		4.58		k
Center Defl.	-0.501 in	-0.204	-0.501	-0.501	-0.204	-0.204	in
Left Cant Defl	0.433 in	0.140	0.433	0.433	0.140	0.140	in
Right Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
...Query Defl @	0.000 ft	0.000	0.000	0.000	0.000	0.000	in
Reaction @ Left	14.34	8.62	14.34	14.34	8.62	8.62	k
Reaction @ Rt	10.30	4.58	10.30	10.30	4.58	4.58	k

Fa calc'd per Eq. E2-1, K*L/r < Cc
I Beam Passes Table B5.1, Fb per Eq. F1-1, Fb = 0.66 Fy

Description cantilevered beams - full live on backspan

Section Properties	W12X19		
Depth	12.160 in	Weight	18.92 #/ft
Web Thick	0.235 in	Ixx	130.000 in4
Width	4.005 in	Iyy	3.760 in4
Flange Thick	0.350 in	Sxx	21.300 in3
Area	5.57 in2	Syy	1.880 in3
Rt	1.000 in	R-xx	4.820 in
Values for LRFD Design....		R-yy	0.822 in
J	0.180 in4	Zx	24.700 in3
Cw	131.00 in6	Zy	2.980 in3
		K	0.650 in

Title :
Dsgnr:
Description :
Scope :

Job #
Date: 8:39AM, 20 JUN 06

A 18

Steel Beam Design

Description Girder design along C.8

General Information

Code Ref: AISC 9th ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Steel Section : W14X22

		Pinned-Pinned		Fy	50.00 ksi
Center Span	18.00 ft	Bm Wt. Added to Loads		Load Duration Factor	1.00
Left Cant.	0.00 ft	LL & ST Act Together		Elastic Modulus	29,000.0 ksi
Right Cant	0.00 ft				
Lu : Unbraced Length	6.00 ft				

Point Loads

Note! Short Term Loads Are WIND Loads.

	# 1	# 2	# 3	# 4	# 5	# 6	# 7	
Dead Load	10.300	10.300						k
Live Load								k
Short Term								k
Location	6.000	12.000						ft

Summary

Beam OK
Static Load Case Governs Stress

Using: W14X22 section, Span = 18.00ft, Fy = 50.0ksi
End Fixity = Pinned-Pinned, Lu = 6.00ft, LDF = 1.000

	Actual	Allowable
Moment	62.693 k-ft	67.454 k-ft
fb : Bending Stress	25.942 ksi	27.912 ksi
fb / Fb	**0.929 : 1**	
Shear	10.498 k	63.204 k
fv : Shear Stress	3.322 ksi	20.000 ksi
fv / Fv	**0.166 : 1**	

Max. Deflection	-0.647 in
Length/DL Defl	333.6 : 1
Length/(DL+LL Defl)	333.6 : 1

Force & Stress Summary

<<-- These columns are Dead + Live Load placed as noted -->>

	Maximum	DL Only	LL @ Center	LL+ST @ Center	LL @ Cants	LL+ST @ Cants	
Max. M +	62.69 k-ft	62.69					k-ft
Max. M -							k-ft
Max. M @ Left							k-ft
Max. M @ Right							k-ft
Shear @ Left	10.50 k	10.50					k
Shear @ Right	10.50 k	10.50					k
Center Defl.	-0.647 in	-0.647	0.000	-0.647	0.000	0.000	in
Left Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
Right Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
...Query Defl @	0.000 ft	0.000	0.000	0.000	0.000	0.000	in
Reaction @ Left	10.50	10.50		10.50			k
Reaction @ Rt	10.50	10.50		10.50			k

Fa calc'd per Eq. E2-2, K*Lr > Cc
I Beam, Major Axis, (102,000 * Cb / Fy)^.5 <= Lr/T <= (510,000 * Cb / Fy)^.5 , Fb per Eq. F1-6

Section Properties W14X22

Depth	13.740 in	Weight	22.04 #/ft
Web Thick	0.230 in	Ixx	199.000 in4
Width	5.000 in	Iyy	7.000 in4
Flange Thick	0.335 in	Sxx	29.000 in3
Area	6.49 in2	Syy	2.800 in3
Rt	1.250 in	R-xx	5.540 in
Values for LRFD Design....		R-yy	1.040 in
J	0.210 in4	Zx	33.200 in3
Cw	314.00 in6	Zy	4.390 in3
		K	0.735 in

Title :
Dsgnr:
Description :
Scope :

Job #
Date: 8:39AM, 20 JUN 06
A 19

Steel Beam Design

Description Girder along C

General Information

Code Ref: AISC 9th ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Steel Section : W21X57

		Pinned-Pinned		Fy	50.00 ksi
Center Span	25.00 ft	Bm Wt. Added to Loads		Load Duration Factor	1.00
Left Cant.	0.00 ft	LL & ST Act Together		Elastic Modulus	29,000.0 ksi
Right Cant	0.00 ft				
Lu : Unbraced Length	6.25 ft				

Point Loads

Note: Short Term Loads Are WIND Loads.

	# 1	# 2	# 3	# 4	# 5	# 6	# 7	
Dead Load	18.400	18.400	18.400					k
Live Load								k
Short Term								k
Location	6.250	12.500	18.750					ft

Summary

Beam OK
Static Load Case Governs Stress

Using: W21X57 section, Span = 25.00ft, Fy = 50.0ksi
End Fixity = Pinned-Pinned, Lu = 6.25ft, LDF = 1.000

	Actual	Allowable		
Moment	234.432 k-ft	277.500 k-ft	Max. Deflection	-0.739 in
fb : Bending Stress	25.344 ksi	30.000 ksi	Length/DL Defl	405.9 : 1
fb / Fb	0.845 : 1		Length/(DL+LL Defl)	405.9 : 1
Shear	28.309 k	170.586 k		
fv : Shear Stress	3.319 ksi	20.000 ksi		
fv / Fv	0.166 : 1			

Force & Stress Summary

<<– These columns are Dead + Live Load placed as noted –>>

	Maximum	DL Only	LL @ Center	LL+ST @ Center	LL @ Cants	LL+ST @ Cants	
Max. M +	234.43 k-ft	234.43					k-ft
Max. M -							k-ft
Max. M @ Left							k-ft
Max. M @ Right							k-ft
Shear @ Left	28.31 k	28.31					k
Shear @ Right	28.31 k	28.31					k
Center Defl.	-0.739 in	-0.739	0.000	-0.739	0.000	0.000	in
Left Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
Right Cant Defl	0.000 in	0.000	0.000	0.000	0.000	0.000	in
...Query Defl @	0.000 ft	0.000	0.000	0.000	0.000	0.000	in
Reaction @ Left	28.31	28.31		28.31			k
Reaction @ Rt	28.31	28.31		28.31			k

Fa calc'd per Eq. E2-2, K*L/r > Cc
I Beam, Major Axis, (102,000 * Cb / Fy)^.5 <= L/rT <= (510,000 * Cb / Fy)^.5 , Fb per Eq. F1-6
I Beam, Major Axis, Fb per Eq. F1-8, Fb = 12,000 Cb Af / (l * d)

Description Girder along C

Section Properties	W21X57		
Depth	21.060 in	Weight	56.72 #/ft
Web Thick	0.405 in	Ixx	1,170.000 in4
Width	6.555 in	Iyy	30.600 in4
Flange Thick	0.650 in	Sxx	111.000 in3
Area	16.70 in2	Syy	9.350 in3
Rt	1.840 in	R-xx	8.360 in
Values for LRFD Design....		R-yy	1.350 in
J	1.770 in4	Zx	129.000 in3
Cw	3,190.00 in6	Zy	14.800 in3
		K	1.150 in

STRUCTURAL CONSULTANTS INCORPORATED

Job Title AURORA MEDICAL CENTER Job no. 06-024

Client DAVIS By MAK Date 6/12/06 Sheet A 21 of

STEEL COLUMN DESIGN

COLUMN @ C-4: GIRDER REACTION: 29^k

COLUMN @ CB-4: GIRDER REACTION: 11^k

NO ECCENTRICITY DUE TO CONNECTIONS:

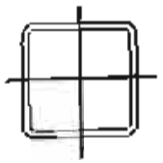
USE HSS 4 x 4 x 1/4

FROM ENERCALC:

BASE PL 3/4" x 10" x 0'-10" sq

USE 4'-4" ϕ x 12" FOOTING REINFORCED W/ 4 - #5 EW BOTTOM

COLUMNS
Square structural tubing
Allowable concentric loads in kips

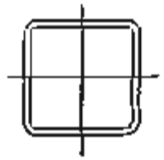


Nominal Size	6 × 6						5 × 5				
Thickness	5/16	1/2	3/8	5/16	1/4	3/16	1/2	3/8	5/16	1/4	3/16
Wt./ft	36.86	35.24	27.48	23.34	19.02	14.53	28.43	22.37	19.06	15.52	11.97
F_y	46 ksi										
0	316	287	223	189	154	118	231	182	155	127	97
2	283	257	201	171	140	107	200	159	136	111	86
3	275	251	196	167	137	105	193	153	131	106	83
4	268	244	191	163	133	102	186	148	127	104	80
5	259	237	186	158	130	99	178	142	122	100	77
6	251	229	180	154	126	96	169	135	116	96	74
7	242	221	174	149	122	93	160	128	111	92	71
8	232	212	168	143	117	90	151	122	105	87	67
9	222	203	161	138	113	87	141	115	99	82	64
10	212	194	154	132	108	83	131	107	93	77	60
11	201	185	147	126	104	80	120	99	86	72	56
12	190	175	140	120	99	75	109	90	79	66	52
13	178	164	132	113	94	72	97	82	72	60	47
14	166	153	124	107	88	68	87	73	64	54	43
15	153	142	116	100	83	64	78	65	58	49	39
16	140	131	107	93	77	60	70	59	52	44	35
17	127	119	98	85	71	56	64	54	47	40	32
18	118	108	89	78	65	51	58	49	43	36	29
19	98	91	75	65	55	43	49	41	36	31	24
20	83	77	64	56	47	36	41	35	31	26	21
21	72	67	55	48	40	31	36	30	27	22	18
22	62	58	48	42	35	27	31	26	23	20	16
23	56	54	45	39	33	26		25	22	18	14
24	55	51	42	37	31	24				17	14
25	49	45	37	33	27	21					
26	43	40	33	29	24	19					
27			32	27	23	18					
28				26	22	17					
29						16					
Properties											
A (in.^{2})	11.40	10.40	8.06	6.86	5.59	4.27	8.36	6.58	5.61	4.59	3.52
I (in.^{4})	54.1	50.5	41.6	36.3	30.3	23.8	27.0	22.8	20.1	16.9	13.4
r (in.)	2.18	2.21	2.27	2.30	2.33	2.36	1.80	1.86	1.89	1.92	1.95
B Bending factor	0.633	0.615	0.583	0.567	0.553	0.539	0.773	0.722	0.699	0.677	0.656
$a/10^6$	8.07	7.52	6.20	5.40	4.52	3.54	4.03	3.39	2.99	2.52	2.00

Heavy line indicates Kl/r of 200.

F_y = 46 ksi

COLUMNS
Square structural tubing
Allowable concentric loads in kips



Nominal Size	4 × 4					3 × 3		
Thickness	1/2	3/8	5/16	1/4	3/16	5/16	1/4	3/16
Wt./ft	21.83	17.27	14.63	12.21	9.42	10.58	8.81	6.87
F_y	46 ksi							
0	176	140	120	99	76	86	71	56
2	168	134	115	95	73	80	67	53
3	162	130	112	92	71	77	64	50
4	156	126	108	89	69	73	61	48
5	150	121	104	86	67	68	57	45
6	143	116	100	83	64	63	53	42
7	135	110	95	79	61	57	49	39
8	126	103	90	75	58	51	44	35
9	117	97	84	70	55	44	38	31
10	106	89	78	65	51	37	33	27
11	98	82	72	60	47	31	27	22
12	87	74	65	55	43	26	23	19
13	75	65	58	49	39	22	19	16
14	65	57	51	43	35	19	17	14
15	57	49	44	38	30	16	15	12
16	50	43	39	33	27	14	13	11
17	44	38	34	29	24	13	11	9
18	39	34	31	26	21		10	8
19	35	31	28	24	19			
20	32	28	25	21	17			
21	29	25	23	19	16			
22	26	23	21	18	14			
23	24	21	19	16	13			
24		19	17	15	12			
25				14	11			
Properties								
A (in.^{2})	6.36	5.08	4.36	3.59	2.77	3.11	2.59	2.02
I (in.^{4})	12.3	10.7	9.58	8.22	6.59	3.58	3.16	2.60
r (in.)	1.39	1.45	1.48	1.51	1.54	1.07	1.10	1.13
B Bending factor	1.04	0.949	0.910	0.874	0.840	1.30	1.23	1.17
$a/10^6$	1.83	1.59	1.43	1.22	0.983	0.533	0.470	0.387

Note: Heavy line indicates Kl/r of 200.

Title :
Dsgnr:
Description :

Job #
Date: 8:21AM, 12 JUN 06

Scope :

A 23

Rev: 580000
User: KW-0602110, Ver 5.8.0, 1-Dec-2003
(c)1983-2003 ENERCALC Engineering Software

Steel Column Base Plate

Description

General Information

Code Ref : AISC 9th Ed ASD, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Loads

Axial Load	30.00 k
X-X Axis Moment	0.00 k-ft

Plate Dimensions

Plate Length	10.000 in
Plate Width	10.000 in
Plate Thickness	0.125 in

Support Pier Size

Pier Length	48.000 in
Pier Width	48.000 in

Steel Section HSS4x4x5/16

Section Length	4.000 in
Section Width	4.000 in
Flange Thickness	0.291 in
Web Thickness	4.000 in

Allowable Stresses

Concrete f'c	3,000.0 psi
Base Plate Fy	36.00 ksi
Load Duration Factor	1.330

Anchor Bolt Data

Dist. from Plate Edge	2.000 in
Bolt Count per Side	2
Tension Capacity	5.500 k
Bolt Area	0.442 in2

Summary

Baseplate OK

Concrete Bearing Stress	**Bearing Stress OK**	
Actual Bearing Stress		300.0 psi
Allow per ACI318-95, A3.1 = 0.3 * f'c * Sqrt(A2/A1) * LDF		2,394.0 psi
Allow per AISC J9		2,793.0 psi
Plate Bending Stress	**Thickness OK**	
Actual fb		32,881.8 psi
Max Allow Plate Fb		35,910.0 psi
Tension Bolt Force	**Bolt Tension OK**	
Actual Tension		0.000 k
Allowable		5.500 k

Full Bearing : No Bolt Tension

Title :
Dsgnr:
Description :

Job #
Date: 8:23AM, 12 JUN 06

A 24

Scope :

Square Footing Design

Description

General Information

Code Ref: ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Dead Load	10.000 k	Footing Dimension	4.330 ft
Live Load	20.000 k	Thickness	12.00 in
Short Term Load	0.000 k	# of Bars	4
Seismic Zone	4	Bar Size	5
Overburden Weight	0.000 psf	Rebar Cover	3.250
Concrete Weight	145.00 pcf	f'c	3,000.0 psi
LL & ST Loads Combine		Fy	60,000.0 psi
Load Duration Factor	1.000		
Column Dimension	10.00 in	Allowable Soil Bearing	2,000.00 psf

Note: Load factoring supports 2003 IBC and 2003 NFPA 5000 by virtue of their references to ACI 318-02 for concrete design. Factoring of entered loads to ultimate loads within this program is according to ACI 318-02 C.2

Reinforcing

Rebar Requirement

Actual Rebar "d" depth used	8.438 in	As to USE per foot of Width	0.259 in2
200/Fy	0.0033	Total As Req'd	1.122 in2
As Req'd by Analysis	0.0011 in2	Min Allow % Reinf	0.0014
Min. Reinf % to Req'd	0.0015 %		

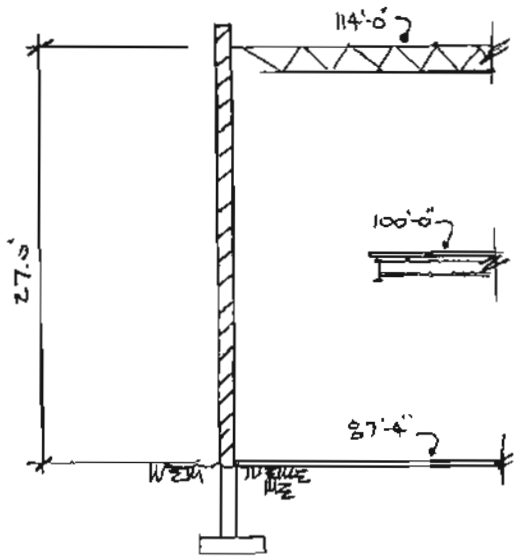
Summary

Footing OK

4.33ft square x 12.0in thick with 4- #5 bars

Max. Static Soil Pressure	1,745.09 psf	Vu : Actual One-Way	28.52 psi
Allow Static Soil Pressure	2,000.00 psf	Vn*Phi : Allow One-Way	93.11 psi
Max. Short Term Soil Pressure	1,745.09 psf	Vu : Actual Two-Way	72.77 psi
Allow Short Term Soil Pressure	2,000.00 psf	Vn*Phi : Allow Two-Way	186.23 psi
Mu : Actual	4.22 k-ft / ft	Alternate Rebar Selections...	
Mn * Phi : Capacity	10.51 k-ft / ft	6 # 4's 4 # 5's 3 # 6's	
		2 # 7's 2 # 8's 2 # 9's 1 # 10's	

WALL/FOUNDATION DESIGN



- CRITICAL CASE IS WEST WALL WHERE WALL IS UNSUPPORTED ±27.0' HIGH & SUPPORTS ROOF

ROOF LOADS:

W_{DL} = 25 PSF × 30'/2
= 375 PLF

W_{LL} = 30 PSF × 30'/2
= 450 PLF

WIND LOAD:

A_{eff} = 27' × 27'/3
= 243 SF, => WIND = 16.7 PSF

FROM ENGRAVALC:

USE 12" CMU W/ #7 @ 32" O.C. VERT.

LOAD TO FOUNDATION:

ROOF:

W_{DL} = 375 PLF

W_{LL} = 450 PLF

WALL:

W_{DL} = (75 + 40) PSF × 29'
= 3335 PLF

W_{TL} = 4160 PLF

WIDTH = 4160 PLF / 2000 PSF
= 2.08' MIN. WIDTH => USE 2'-6" MIN FOR GEOMETRY

Title :
Dsgnr:
Description :

Job #
Date: 7:58AM, 12 JUN 06

A 26

Scope :

Masonry Wall Design

Description 12" masonry wall - steel centered

General Information

Code Ref: ACI 530-02

Wall Height	27.00 ft	Seismic Factor	0.3300	f'm	1,500.0 psi
Parapet Height	2.00 ft	Calc of Em = f'm *	900.00	Fs	24,000.0 psi
		Duration Factor	1.000	Special Inspection	
Thickness	12.0 in	Wall Wt Mult.	1.000	Grout @ Rebar Only	
Rebar Size	7			Lightweight Block	
Rebar Spacing	32 in			Equivalent	
Depth to Rebar	5.750 in @ Center			Solid Thickness	5.258 in

Loads

Uniform Load		Concentric Axial Load		Wind Load	16.700 psf
Dead Load	375.000 #/ft	Dead Load	0.000 #/ft		
Live Load	450.000 #/ft	Live Load	0.000 #/ft		
Load Eccentricity	2.000 in	Roof Load			
Roof Load					

Design Values

E	1,350,000 psi	Rebar Area	0.225 in2	np	0.07005	j	0.89642
n : Es / Em	21.481	Radius of Gyration	4.366 in	k	0.31074	2 / kj	7.17985
Wall Weight	74.000 psf	Moment of Inertia	1,202.580 in4				

Max Allow Axial Stress = 0.25 f'm (1-(h/140r)^2) * Spinsp	269.62 psi
Allow Masonry Bending Stress = 0.33 f'm * Spinsp =	495.00 psi
Allow Steel Bending Stress =	24,000.00 psi

Load Combination & Stress Details Summary

	Moment	Axial Load	Bending Stresses Steel	Masonry	Axial Compression
Top of Wall	in-#	lbs	psi	psi	psi
DL + LL	1,650.0	973.0	1,422.7	29.9	15.42
DL + LL + Wind	1,150.8	523.0	992.3	20.8	8.29
DL + LL + Seismic	1,336.1	523.0	1,152.1	24.2	8.29
Between Base & Top of Wall					
DL + LL	825.0	1,972.0	711.4	14.9	31.25
DL + LL + Wind	18,436.0	1,522.0	15,896.7	333.6	24.12
DL + LL + Seismic	26,785.2	1,522.0	23,095.9	484.7	24.12

Summary

27.00ft high wall with 2.00ft parapet, Lt Wt Block w/ 12.00in wall w/ #7 bars at 32.00ino.c. at center

Max. Bending Compressive Stress	508.85	N.G	2.8% OVERSTRESS OK
Allowable	495.00	N.G	
Max. Axial Only Compressive Stress	31.25	psi	
Allowable	269.62	OK	
Max Steel Bending Stress	23,095.87	psi	
Allowable	24,000.00	OK	

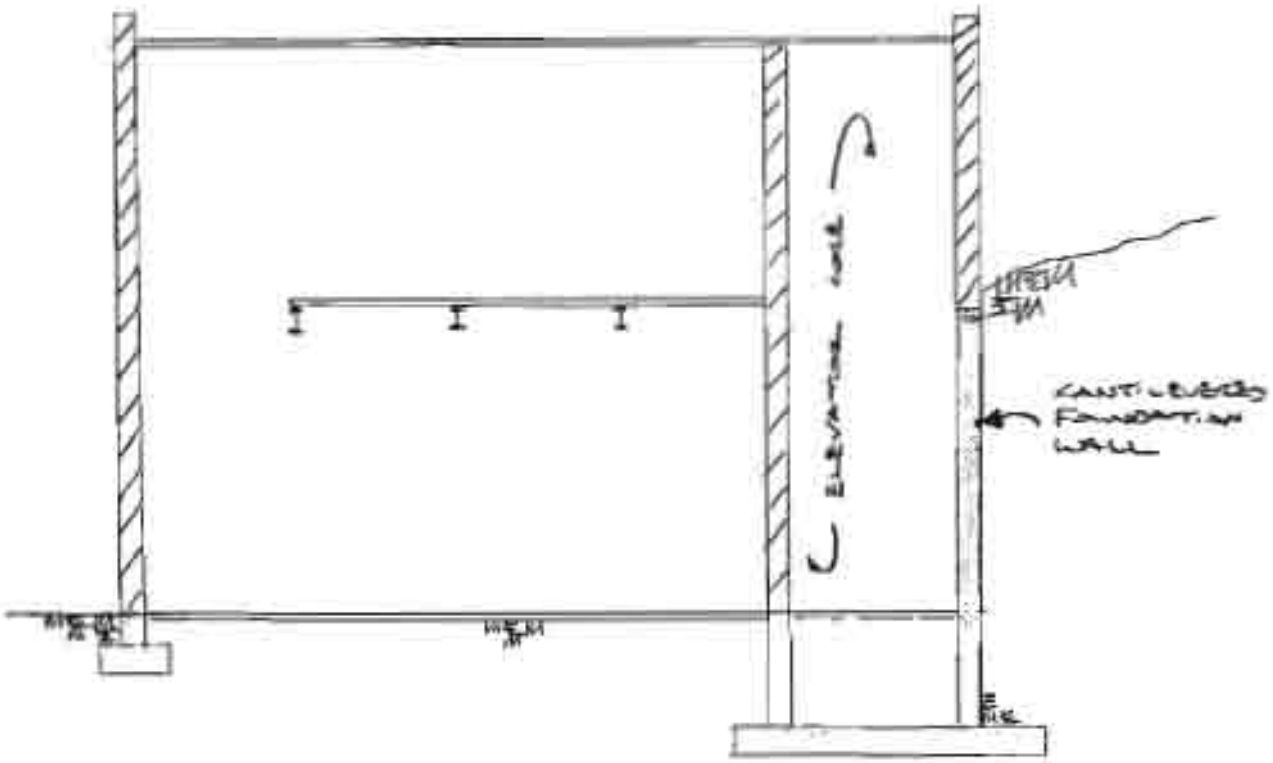
Description 12" masonry wall - steel centered

Final Loads & Moments

Wall Weight moment @ Mid Ht	1,147.00	lbs	Wind Moment @ Mid Ht	18,061.59	in-#
			Seismic Moment @ Mid Ht	26,411.03	in-#
Dead Load Moment @ Top of Wall	750.00	in-#			
Dead Load Moment @ Mid Ht	375.00	in-#	Total Dead Load	375.00	lbs
			Total Live Load	450.00	lbs
Live Load Moment @ Top of Wall	900.00	in-#			
LiveLoad Moment @ Mid Ht	450.00	in-#			

Maximum Allow Moment for Applied Axial Load = 27,353.11 in-#
Maximum Allow Axial Load for Applied Moment = 17,012.02 lbs

LATERAL ANALYSIS



SECTION THRU ADDITION

CONCRETE FOUNDATION WALL ACTS AS A CANTILEVERED FOUNDATION WALL TO RESIST EARTH PRESSURE.

CONCRETE CORE WALL RESIST WIND PRESSURE/SEISMIC.

SEISMIC FORCES

BUILDING MASS:

Roof	=	25 PSF × 1280 SF	=	32 k.ips
Floor	=	85 PSF × 520 SF	=	44 k.ips
Walls	=	(75 + 40) PSF × 2080 SF	=	308 k.ips
				385 k.ips

$$V = C_s W$$
$$= .12(385)$$
$$= 46 \text{ k.ips}$$

$$V_{design} = 46/1.4 = 33^{k}$$

WIND FORCES

BUILDING HAS FLEXIBLE ROOF DIAPHRAGM & 1ST LEVEL FLOOR SLAB IS NEGLECTED AS A DIAPHRAGM SINCE IT IS MINIMALLY CONNECTED TO WALLS; ∴ DETERMINE AVERAGE WIND PRESSURE:

$$W_{WIND} = \frac{(15.3 + 11.3) + (11.2 + 9.1)}{2}$$

$$= 23.7 \text{ PSF}$$

$$P_{WIND} = 23.7 \text{ PSF} \times (116'-0" - 87'-4")/2 \times 44'$$

$$= 15 \text{ KIPS}$$

∴ SEISMIC FORCES CONTROL LATERAL DESIGN

THE MAJORITY OF THE BUILDING MASS IS EXTERIOR WALLS & ROOF; ASSUME ALL MASS IS DISTRIBUTED TO CORE WALLS AT ROOF:

$$V_{DIAPHR.} = 33^K/(4 \times 9'-4") / 1.4$$

$$= 630 \text{ K/FT}$$

∴ USE 1.5B20 ROOF DECK FOR DIAPHRAGM SHEAR STRENGTH OF 630 PLF

1.5 (B, BI, F, A) 20 ALLOWABLE DIAPHRAGM SHEAR STRENGTH (PLF)

SUPPORT FASTENERS: 5/8" puddle welds[1]

SIDELAP FASTENERS: welded[2]

Factor of safety = 2.75

Fastener Layout	*	SPAN (FT.-IN.) 3'-0	3'-6	4'-0	4'-6	5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	10'-0	K1
36/7	0	496	431	377	333	298	270	246	226	209	193	180	168	158	141	0.537
	1	647	566	503	455	412	373	341								0.317
	2	777	681	615	560	511	468	433	401	371	345	322	302	285		0.225
	3	886	796	722	658	603	556	515	479	448	421	394	370	342	277	0.174
	4	981	891	813	746	687	636	591	552	517	487	433	384	342	277	0.142
	5	1068	971	894	825	764	711	663	621	568	493	433	384	342	277	0.120
	6	1122	1040	964	895	834	778	730	656	568	493	433	384	342	277	0.104
	7	1175	1096	1025	959	897	842	770	656	568	493	433	384	342	277	0.092
	8	1219	1147	1079	1014	954	898	770	656	568	493	433	384	342	277	0.082
	9	1256	1190	1125	1063	1005	875	770	656	568	493	433	384	342	277	0.074
	10	1287	1226	1165	1106	1050	916	770	656	568	493	433	384	342	277	0.068
	11	1313	1257	1200	1146	1091	916	770	656	568	493	433	384	342	277	0.062
				DB = 97		DF = 169		DA = 268		K2 = 1056						
36/5	0	435	380	344	306	276	249	226	209	192	179	168	155	146	130	0.644
	1	663	584	494	412	377	347	321								0.352
	2	658	599	547	502	463	428	399	372	349	328	308	288	272		0.252
	3	731	679	624	578	537	501	468	439	413	390	369	350	333	277	0.164
	4	786	735	687	642	602	564	531	500	473	447	424	384	342	277	0.149
	5	828	782	736	695	656	620	586	555	526	493	433	384	342	277	0.125
	6	859	819	779	740	703	667	634	603	566	493	433	384	342	277	0.108
	7	884	849	813	777	742	708	676	646	566	493	433	384	342	277	0.094
	8	904	872	840	807	775	743	713	656	566	493	433	384	342	277	0.084
	9	919	892	862	833	803	773	744	656	566	493	433	384	342	277	0.076
	10	932	907	881	854	827	799	770	656	566	493	433	384	342	277	0.068
	11	942	920	897	872	847	821	770	656	566	493	433	384	342	277	0.063
				DB = 167		DF = 883		DA = 708		K2 = 1056						
36/4	0	336	298	264	233	208	188	171	157	145	134	125	118	111	100	0.805
	1	453	408	370	337	308	285	265								0.395
	2	535	492	454	418	386	362	338	317	298	284	265	250	235		0.261
	3	592	554	518	485	454	425	401	378	357	338	321	305	291	265	0.195
	4	631	598	566	536	507	480	454	431	409	389	371	354	338	277	0.156
	5	658	631	603	575	549	523	499	475	455	434	416	384	342	277	0.130
	6	679	655	631	607	583	559	536	514	493	473	433	384	342	277	0.111
	7	694	674	653	631	610	588	567	546	526	493	433	384	342	277	0.097
	8	705	688	670	651	631	612	592	573	554	493	433	384	342	277	0.086
	9	713	699	683	666	649	631	614	596	566	493	433	384	342	277	0.078
	10	720	707	694	679	663	646	631	615	566	493	433	384	342	277	0.071
	11	726	714	702	688	675	661	646	631	566	493	433	384	342	277	0.065
				DB = 802		DF = 905		DA = 968		K2 = 1056						
36/9	0	281	251	226	206	186	169	154	141	129	119	110	102	95	84	1.074
	1	365	337	312	289	268	250	234								0.450
	2	414	391	369	348	328	310	293	277	262	250	237	225	216		0.285
	3	442	424	406	388	371	354	338	323	308	295	282	271	260	240	0.208
	4	460	446	431	416	401	386	372	358	344	330	319	307	296	276	0.164
	5	471	460	448	436	423	411	398	385	373	361	349	338	327	277	0.135
	6	479	470	460	450	440	429	417	406	395	384	374	363	342	277	0.115
	7	484	477	469	461	452	442	433	423	413	403	393	384	342	277	0.100
	8	488	482	476	469	461	453	444	436	427	418	409	384	342	277	0.089
	9	491	486	481	475	468	461	454	446	438	430	423	384	342	277	0.080
	10	494	489	485	479	474	468	461	454	448	441	433	384	342	277	0.072
	11	496	492	488	483	478	473	467	461	456	449	433	384	342	277	0.066
				DB = 1652		DF = 1818		DA = 1927		K2 = 1056						

* = number of sidelap fasteners per span

1 A 3/8" x 1 1/4" arc seam weld shall be used with F deck or A deck.

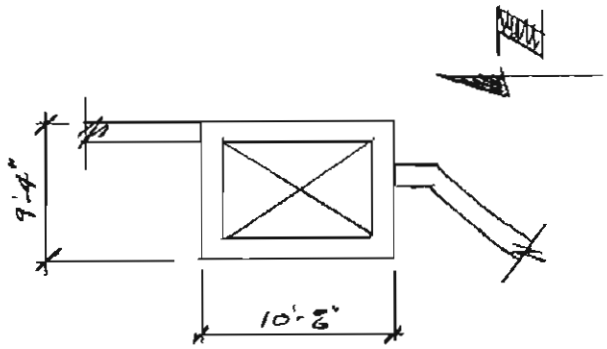
2 The shaded values do not comply with the minimum spacing requirements for sidelap connections and shall not be used except with properly spaced button punched sidelaps with 1.5BI deck.

$$S' = \frac{K_2}{3.78 + \frac{3.2 * D_x}{SPAN} + 3 * K_1 * SPAN}, \text{ Kips/inch}$$

SPAN is in feet. Substitute D_B, D_{BI}, or D_A for D_x.

DIAPHRAGM

SHEARWALL DESIGN



CRITICAL CONDITION IS EAST-WEST DIRECTION.

$V = 33^k / 1.4 \;/\; 2$ WALLS

$= 12^k$

FROM ENERCALC:

NO SHEAR REINFORCING REQ'D

OVERTURNING STEEL REQ'D = 0.205 IN^2

⇒ USE 3-#5 @ CORNERS

FOOTING DESIGN

$V = 33^k / 1.4$

$= 23.6^k$ (EQUIV. SERVICE)

$h = 29.67'$

$M_{OT} = 23.6^k \times 29.67'$

$= 677$ FT·K

FROM ENERCALC:

GRAVITY LOADS

$P_{CORE\ WALLS} = 75\ PSF \times 40' \times 29.67'$

$= 860$ KIPS DL

$P_{ROOF} = 25\ PSF \times 32/2 \times 10.67'$

$= 4.3$ KIPS DL

$= 5.1$ KIPS LL

$P_{VENEER} = 40\ PSF \times 10.67' \times 29.67'$

$= 12$ KIPS DL

$P_{FLOOR} = 86\ PSF \times 236\ S.F.$

$= 20$ KIPS DL

$= 24$ KIPS LL

$\Sigma P_{DL} = 122^k$

$\Sigma P_{LL} = 29^k$

Title :
Dsgnr:
Description :

Job #
Date: 1:40PM, 12 JUN 06

A 32

Scope :

Masonry Pier Analysis & Design

Description

General Information

Code Ref: ACI 530-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Total Lateral Force	12.00 k	Modulr: Em = f'm *	900.00
Seismic Zone	4	Modulr: Ev = Em *	0.40
Load Duration Factor	1.00		

Shear Pier Data

	Pier #1
Pier Height	28.67 ft
Pier Length	9.33 ft
Wall Thickness	12 in
"j" : Depth Mult.	0.90
Pier Fixity	Fix-Fix
f'm	1,500 psi
Fs	24,000 psi
Sp Insp	Yes
Grout Spacing	32 in

Analysis Data

	Pier #1	
Height/Length	3.0729	
(H/L)^3	29.0160	
Rel. Defl	2.3602	
Sum Rigidity	423.70	
Rigidity = .001/Defl	423.699	
% Force to Pier	1.00	
Shear to Pier	12.000 k	
Relative Defl * 10^5	0.00 in	
M / (V*Depth)	1.707	
Em	1350,000.0	psi
Ev	540,000.0	psi

Summary

	Pier #1	
Shear Reinforcing...		
fv=V/(12*est*jd)	33.97 psi	✓
Fv: w/o Reinf.	35.00 psi	✓
Fv: w/ Reinf.	58.09 psi	
Horiz. Shear Av Req'd	Not Req'd in^2/ft	
Bending Reinforcing...		
Moment @ End	172.02 k-ft	
"d" to tension As	8.40 ft	
Bending As Req'd	0.85 in2	✓

Title :
Dsgnr:
Description :
Scope :

Job #
Date: 8:39AM, 20 JUN 06

A 33

General Footing Analysis & Design

Description Core footing

General Information

Code Ref: ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Allowable Soil Bearing	2,000.0 psf	**Dimensions...**	
Short Term Increase	1.330	Width along X-X Axis	14.670 ft
Seismic Zone	4	Length along Y-Y Axis	13.330 ft
		Footing Thickness	14.00 in
Live & Short Term Combined		Col Dim. Along X-X Axis	75.00 in
f'c	3,000.0 psi	Col Dim. Along Y-Y Axis	75.00 in
Fy	60,000.0 psi	Base Pedestal Height	0.000 in
Concrete Weight	145.00 pcf		
Overburden Weight	0.00 psf	Min Steel %	0.0014
		Rebar Center To Edge Distance	3.50 in

Loads

Applied Vertical Load...			
Dead Load	122.000 k	...ecc along X-X Axis	0.000 in
Live Load	29.000 k	...ecc along Y-Y Axis	0.000 in
Short Term Load	k		

Applied Moments...	Creates Rotation about Y-Y Axis (pressures @ left & right)	Creates Rotation about X-X Axis (pressures @ top & bot)
Dead Load	k-ft	k-ft
Live Load	k-ft	k-ft
Short Term	677.000 k-ft	k-ft

Applied Shears...	Creates Rotation about Y-Y Axis (pressures @ left & right)	Creates Rotation about X-X Axis (pressures @ top & bot)
Dead Load	k	k
Live Load	k	k
Short Term	k	k

Summary

Caution: X(short)ecc>Widt

14.67ft x 13.33ft Footing, 14.0in Thick, w/ Column Support 75.00 x 75.00in x 0.0in high

	DL+LL	DL+LL+ST
Max Soil Pressure	941.3	2,517.3 psf
Allowable	2,000.0	2,660.0 psf
'X' Ecc. of Resultant	0.000 in	44.133 in
'Y' Ecc. of Resultant	0.000 in	0.000 in
X-X Min. Stability Ratio	No Overturning	1.500 :1
Y-Y Min. Stability Ratio	1.994	

	Actual	Allowable
Max Mu	25.535	
Required Steel Area		0.571
Shear Stresses....	Vu	Vn * Phi
1-Way	77.089	93.113 psi
2-Way	45.397	159.993 psi

Footing Design

Shear Forces	ACI C-1	ACI C-2	ACI C-3	Vn * Phi
Two-Way Shear	39.69 psi	45.40 psi	23.62 psi	159.99 psi
One-Way Shears...				
Vu @ Left	27.59 psi	77.09 psi	41.12 psi	93.11 psi
Vu @ Right	27.59 psi	-6.27 psi	-4.03 psi	93.11 psi
Vu @ Top	19.66 psi	21.55 psi	11.16 psi	93.11 psi
Vu @ Bottom	19.66 psi	21.55 psi	11.16 psi	93.11 psi

Moments	ACI C-1	ACI C-2	ACI C-3	Ru / Phi	As Req'd
Mu @ Left	8.74 k-ft	-2.09 k-ft	-1.35 k-ft	88.1 psi	0.30 in2 per ft
Mu @ Right	8.74 k-ft	25.54 k-ft	13.62 k-ft	257.3 psi	0.57 in2 per ft
Mu @ Top	6.18 k-ft	6.77 k-ft	3.52 k-ft	68.2 psi	0.30 in2 per ft
Mu @ Bottom	6.18 k-ft	6.77 k-ft	3.52 k-ft	68.2 psi	0.30 in2 per ft

Description Core footing

Soil Pressure Summary

Service Load Soil Pressures	Left	Right	Top	Bottom
DL + LL	941.34	941.34	941.34	941.34 psf
DL + LL + ST	0.00	2,517.27	941.34	941.34 psf
Factored Load Soil Pressures				
ACI Eq. C-1	1,188.93	1,188.93	1,188.93	1,188.93 psf
ACI Eq. C-2	0.00	3,524.18	1,317.88	1,317.88 psf
ACI Eq. C-3	0.00	1,908.63	713.74	713.74 psf

ACI Factors (per ACI 318-02, applied internally to entered loads)

ACI C-1 & C-2 DL	1.200	ACI C-2 Group Factor	0.750	Add'l "1.4" Factor for Seismic	1.400
ACI C-1 & C-2 LL	1.600	ACI C-3 Dead Load Factor	0.900	Add'l "0.9" Factor for Seismic	0.900
ACI C-1 & C-2 ST	1.600	ACI C-3 Short Term Factor	1.300		
....seismic = ST * :	1.100 Used in ACI C-2 & C-3				

Rev: 580002
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Rebar Embedment Lengths

Description

Bar #1 Per ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Bar Size	# 5	Rebar Area	0.310 in
f'c	3,000.00 psi	Class A Splice	16.43 in
Fy	60,000.00 psi	Class B Splice	21.36 in
		Compression Splice	18.75 in

Straight Embedment

Reinf. Location Factor (alpha)	1	Tension Embedment...	
Coating Factor (beta)	1	**Final after adjustments**	16.432 in
Lightweight Factor (lambda)	1		
As req'd / As actual	1.000	Compression Embedment...	
Spacing/Diameter Ratio	2.500	**Final after adjustments**	**13.693 in**

Hooked Embedment....

Adequate Cover ?	Yes	Basic Before Adjustments	13.693 in
Epoxy Coated ?	Yes	**Final after adjustment**	**11.502 in**
Lightweight Concrete ?	No		

Bar #2 : Per ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Bar Size	# 5	Rebar Area	0.310 in
f'c	3,000.00 psi	Class A Splice	21.36 in
Fy	60,000.00 psi	Class B Splice	27.77 in
		Compression Splice	18.75 in

Straight Embedment

Reinf. Location Factor (alpha)	1.3	Tension Embedment...	
Coating Factor (beta)	1	**Final after adjustments**	21.361 in
Lightweight Factor (lambda)	1		
As req'd / As actual	1.000	Compression Embedment...	
Spacing/Diameter Ratio	2.500	**Final after adjustments**	**13.693 in**

Hooked Embedment....

Adequate Cover ?	Yes	Basic Before Adjustments	13.693 in
Epoxy Coated ?	Yes	**Final after adjustment**	**11.502 in**
Lightweight Concrete ?	No		

Bar #3 : Using ACI 318-91 Methods

Bar Size	# 6	Rebar Area	0.440 in
f'c	3,000.00 psi	Class A Splice	24.65 in
Fy	60,000.00 psi	Class B Splice	32.04 in
		Compression Splice	22.50 in

Straight Embedment

ACI 12.2.3.1 :	1	Tension Embedment...	
Lightweight Concrete ?	No	Basic Before Adjustments	19.280 in
Is it a TOP Bar ?	No	Final after adjustment	24.648 in
As req'd / As actual	1.000	Compression Embedment...	
Within Ties/Stirrups ?	No	Basic Before Adjustments	16.432 in
		Final after adjustment	16.432 in

Hooked Embedment....

Adequate Cover ?	Yes	Basic Before Adjustments	16.432 in
Epoxy Coated ?	Yes	Final after adjustment	**13.803 in**
Lightweight Concrete ?	No		

Description

Bar #4 : Per ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Bar Size	# 7	Rebar Area	0.600 in
f'c	3,000.00 psi	Class A Splice	37.38 in
Fy	60,000.00 psi	Class B Splice	48.60 in
		Compression Splice	26.25 in

Straight Embedment

Reinf. Location Factor (alpha)	1.3	Tension Embedment...	
Coating Factor (beta)	1	Final after adjustments	37.382 in
Lightweight Factor (lambda)	1		
As req'd / As actual	1.000	Compression Embedment...	
Spacing/Diameter Ratio	2.500	Final after adjustments	19.170 in

Hooked Embedment....

Adequate Cover ?	Yes	Basic Before Adjustments	19.170 in
Epoxy Coated ?	Yes	Final after adjustment	16.103 in
Lightweight Concrete ?	No		

Bar #5 : Using ACI 318-91 Methods

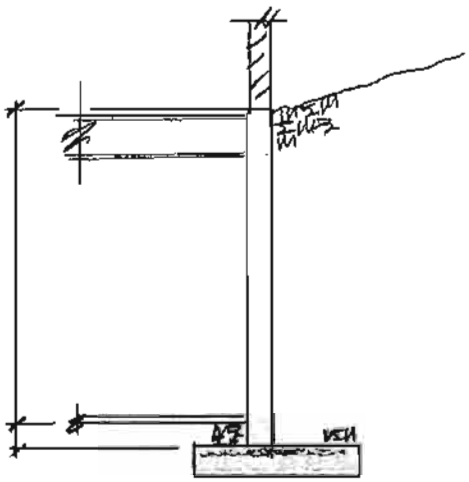
Bar Size	# 8	Rebar Area	0.790 in
f'c	3,000.00 psi	Class A Splice	34.62 in
Fy	60,000.00 psi	Class B Splice	45.00 in
		Compression Splice	30.00 in

Straight Embedment

ACI 12.2.3.1 :	1	Tension Embedment...	
Lightweight Concrete ?	No	Basic Before Adjustments	34.616 in
Is It a TOP Bar ?	No	Final after adjustment	34.616 in
As req'd / As actual	1.000		
Within Ties/Stirrups ?	No	Compression Embedment...	
		Basic Before Adjustments	21.909 in
		Final after adjustment	21.909 in

Hooked Embedment....

Adequate Cover ?	Yes	Basic Before Adjustments	21.909 in
Epoxy Coated ?	Yes	Final after adjustment	18.403 in
Lightweight Concrete ?	No		



FOUNDATION WALL DESIGN

NOTE: DESIGN AS CANTILEVERED RET. WALL TO RESIST EARTH PRESSURE.

ROOF LOAD:

$W_{DL} = 25 \text{ PSF} \times 30'/2$
$= 375 \text{ PLF}$

$W_{LL} = 30 \text{ PSF} \times 30'/2$
$= 450 \text{ PLF}$

FLOOR LOAD:

$W_{DL} = 85 \text{ PSF} \times 24'/2$
$= 1020 \text{ PLF}$

$W_{LL} = 100 \text{ PSF} \times 24'/2$
$= 1200 \text{ PLF}$

WALL WEIGHT:

$W_{DL} = (75 + 40) \text{ PSF} \times 14'$
$= 1610 \text{ PLF}$

$W_{DL} = 3000 \text{ PLF}$
$W_{LL} = 1650 \text{ PLF}$

Title :
Dsgnr:
Description :
Scope :

Job #
Date: 8:39AM, 20 JUN 06
A 38

Code Ref: ACI 318-02, 1997 UBC, 2003 IBC, 2003 NFPA 5000

Cantilevered Retaining Wall Design

Description

Criteria

Retained Height	=	8.50 ft
Wall height above soil	=	4.17 ft
Slope Behind Wall	=	6.00 : 1
Height of Soil over Toe	=	8.00 in
Soil Density	=	110.00 pcf
Wind on Stem	=	0.0 psf

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	42.0
Toe Active Pressure	=	0.0
Passive Pressure	=	350.0
Water height over heel	=	0.0 ft
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	0.00 in

Footing Strengths & Dimensions

f'c = 3,000 psi	Fy =	60,000 psi
Min. As %	=	0.0014
Toe Width	=	2.75 ft
Heel Width	=	4.50
Total Footing Width	=	7.25
Footing Thickness	=	14.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

Cover @ Top = 3.00 in @ Btm.= 3.00 in

Axial Load Eccentricity = 0.0 in

Axial Load Applied to Stem

Axial Dead Load	=	3,000.0 lbs
Axial Live Load	=	1,650.0 lbs

Design Summary

Total Bearing Load	=	12,922 lbs	
...resultant ecc.	=	1.52 in	
Soil Pressure @ Toe	=	1,595 psf	OK
Soil Pressure @ Heel	=	1,970 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,094 psf	
ACI Factored @ Heel	=	2,586 psf	
Footing Shear @ Toe	=	26.9 psi	OK
Footing Shear @ Heel	=	53.5 psi	OK
Allowable	=	93.1 psi	
Wall Stability Ratios			
Overturning	=	6.81	OK
Sliding	=	2.35	(Vertical Co
Sliding Calcs (Vertical Component Used)			
Lateral Sliding Force	=	2,170.6 lbs	
less 100% Passive Force	= -	588.2 lbs	
less 100% Friction Force	= -	4,508.8 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 : 1 Stability	=	0.0 lbs	OK

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,094	2,586 psf
Mu' : Upward	=	8,153	0 ft-#
Mu' : Downward	=	1,315	13,132 ft-#
Mu: Design	=	6,838	13,132 ft-#
Actual 1-Way Shear	=	26.93	53.55 psi
Allow 1-Way Shear	=	93.11	93.11 psi
Toe Reinforcing	=	# 5 @ 16.00 in	
Heel Reinforcing	=	# 6 @ 14.00 in	
Key Reinforcing	=	None Spec'd	

Stem Construction

Top Stem

			Stem OK
Design height	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Thickness	=		18.00
Rebar Size	=		# 6
Rebar Spacing	=		14.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		0.282
Total Force @ Section	lbs =		2,579.3
Moment....Actual	ft-# =		7,308.1
Moment....Allowable	=		25,888.5
Shear.....Actual	psi =		13.8
Shear.....Allowable	psi =		93.1
Bar Develop ABOVE Ht.	in =		25.63
Bar Lap/Hook BELOW Ht.	in =		6.00
Wall Weight	=		217.5
Rebar Depth 'd'	in =		15.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Special Inspection	=		
Modular Ratio 'n'	=		
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

Description

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,170.6	3.39	7,355.9	Soil Over Heel	= 2,805.0	5.75	16,128.8
Toe Active Pressure	=		0.61		Sloped Soil Over Heel	= 82.5	6.25	515.6
Surcharge Over Toe	=				Surcharge Over Heel	=		
Adjacent Footing Load	=				Adjacent Footing Load	=		
Added Lateral Load	=				Axial Dead Load on Stem	= 3,000.0	3.50	10,500.0
Load @ Stem Above Soil	=				Soil Over Toe	= 201.7	1.38	277.3
SeismicLoad	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 2,755.7	3.50	9,645.0
					Earth @ Stem Transitions	=		
					Footing Weight	= 1,268.7	3.63	4,599.2
					Key Weight	=		
					Vert. Component	= 1,158.5	7.25	8,398.8
Total	=	2,170.6	**O.T.M.** =	7,355.9	**Total** =	11,272.1 lbs	**R.M.**=	50,064.7

Resisting/Overturning Ratio = **6.81**

Vertical Loads used for Soil Pressure = 12,922.1 lbs

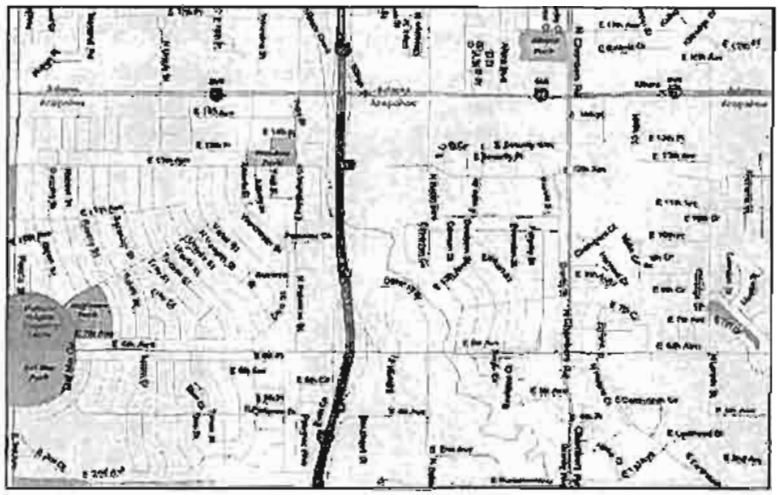
Vertical component of active pressure used for soil pressure

TRC International Ltd.,
Consulting Engineers
217 Ward Circle
Brentwood, Tennessee 37027

AURORA HOSPITAL R.S.N. 251428

Location: Aurora, Colorado

Zip Code: 80012



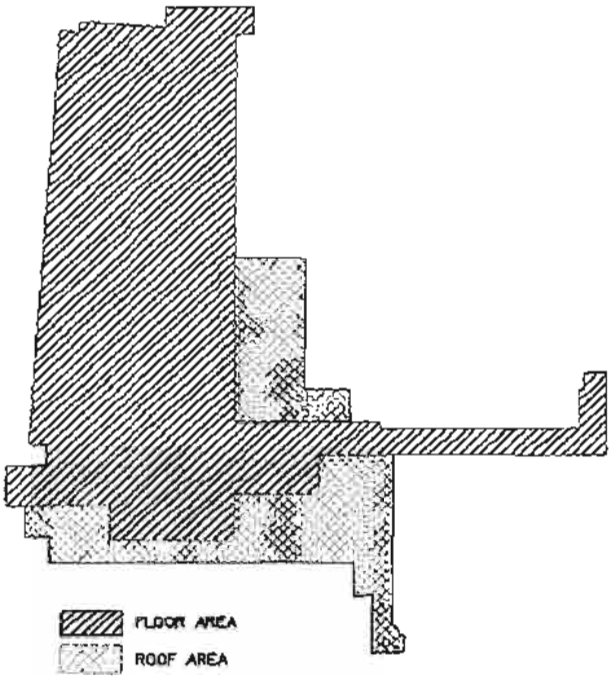
Design Code: International Building Code-2003, ASCE 7-02

Geometry of the structure:

Elevations:

Floor	Level	Floor Height	
Ground / First	0	0	
Second	14.00	14.00	
Third	28.00	14.00	
Fourth Floor	42.00	14.00	
Fifth Floor	56.00	14.00	
Roof / Future Sixth Floor	70.00	14.00	
Future Roof/Future Seventh Floor	84.00	14.00	
Future Penthouse Roof	98.00	14.00	(main roof height)

2007172604



Max Height of structure	98.00	ft	(main roof height)
Width of structure	49	ft	(At One story elevation) Betn A3 & A19
Length of structure	157.25	ft	(At One story elevation) Betn 1T and 1BB
Width of structure	105	ft	(At Typical Floor) Betn A1 and stairwall
Length of structure	244	ft	(At Typical Floor) Betn stairwall & 1AA

Classification of structure for Importance Factors:

Nature of Occupancy: As per IBC Buildings and other structures designated as essentail facilities including,

Hospitals and other health care facilities having surgery or emergency treatment facilities is categorized IV

Category IV

Importance factors for Category IV Structure is as follows:

Seismic Factor I_E 1.5

Snow Factor I_S 1.2

Wind Factor I_W 1.15

Load Calculations:

Dead Load:

Typical Uniform Dead Loads:

Structural component uniform weights:

6 1/2" LW composite slab on 3" composite deck	50 psf
Other:	
Ceiling/ Lights / Mech	5 psf
Partition	20 psf
Miscellaneous	2 psf
Other:	psf
Total Structural Uniform Weights:	27 psf
Total Uniform Dead Load:	77 psf

Superimposed DL @ roof level 20 psf

Live Load:

1	Patient Rooms	100 psf	(all loads reducible uno)
2	Operating Rooms	100 psf	
3	Corridors Above First Floor	100 psf	
4	Floor Corridors, All Lobbies, Stairs, and Exit ways	100 psf	
5	Mechanical Rooms	150 psf	unreducible
6	Stairs	100 psf	
7	Storage	125 psf	unreducible
8	Roof	20 psf	< snow load

Determination of flat roof snow load as per ASCE 7-02

Determination of flat roof snow load

Ground snow load		p_g	34	psf
Exposure factor(Table7-2, p90)	Terrain category C (Fully exposed)	C_e	0.9	
Thermal factor (Table 7-3, p91)		C_t	1.0	
Importance factor(Table 7-4, p91)		I	1.20	
Flat roof snow load-1($p_f = 0.7 * C_e * C_t * I * p_g$)		p_{f1}	25.704	psf
Flat roof snow load-2(If $p_g < 20$, ($p_f = I * p_g$) , else, $p_f = 20 * I$)		p_{f2}	24	psf
Value of flat roof snow load viz. design roof snow load		p_f	25.704	psf
If, $0 < p_g < 20$ psf, we need to consider 5 psf of rain on snow surcharge	No surcharge needed			
The design roof snow load = p_f + 5			25.704	
If $p_{f2} > p_{f1}$, difference of these should be reduced in design value, limiting to 5 psf			0	psf
Hence, value of flat roof snow load viz. design roof snow load		p_f	30.704	psf

Wind Load: (As structure Height is greater than 60 ft ASCE 7-02 is used for wind loads)

Basic Wind Speed =	105 mph	
Exposure category =	C	
Terrain Exposure Constant from Table 6-2, p74 α =	9.5	
Nominal ht. of the atmospheric boundary layer, Table 6-2, p74 z_g =	900	
Classification of Building for Wind, Snow & Seismic loads =	Category IV	
Importance factor Iw =	1.15	
Topographic Factor Kzt, Cl 6.5.7.2, p30 =	1	???
Gust Factor for Rigid Structure G, Cl 6.5.8, p30 =	0.85	

Value of Cp from Fig 6-6 (inserted below) for

Windward Wall

Both Directions Cpw=0.8

Leeward Wall

X direction Cp lx =	Cplx=-0.5	Lx =	105	ft	Lx/Ly= 0.434
Y direction Cp ly =	Cply= -0.2850	Ly =	244	ft	Ly/Lx= 2.302

The wind loads as per ASCE7-02 has been calculated as follows:

Computation of Wind Loads on MWFRS as per ASCE 7-02 (Mean Roof Height > 60 ft)

Wind Velocity	V	105	mph	
Exposure Type		C		
Enclosure type		Enclosed Building		
Category		IV		Terrain Exposure Coefficients (Table 6-2, p74)
Topographic Factor	Kzt	1		a = 9.5 Zg = 900
Directionality Factor	Kd	0.85		
Roof Angle	θ	0	deg	
Importance Factor I, Table 6-1, p73	I	1.15		
Mean Roof Height	h	98.00	ft	
Building width (@ Typical Level)				
X direction	Bx	106	ft	
Y direction	By	244	ft	

This building is classified as Rigid Building
& Gust factor shall be calculated as per Cl. No: 6.5.8.1.

Gust Effect Factor

X direction	Gfx =	0.85
Y direction	Gfy =	0.85

External Pressure Coefficient (Fig. 6-3) on windward wall Cpw = 0.8

The parapet level	Np =	1
The parapet height	Hp =	3 ft
Number of Stories	Sn =	7

Eccentricity to determine the torsion about the vertical axis of the building at each level

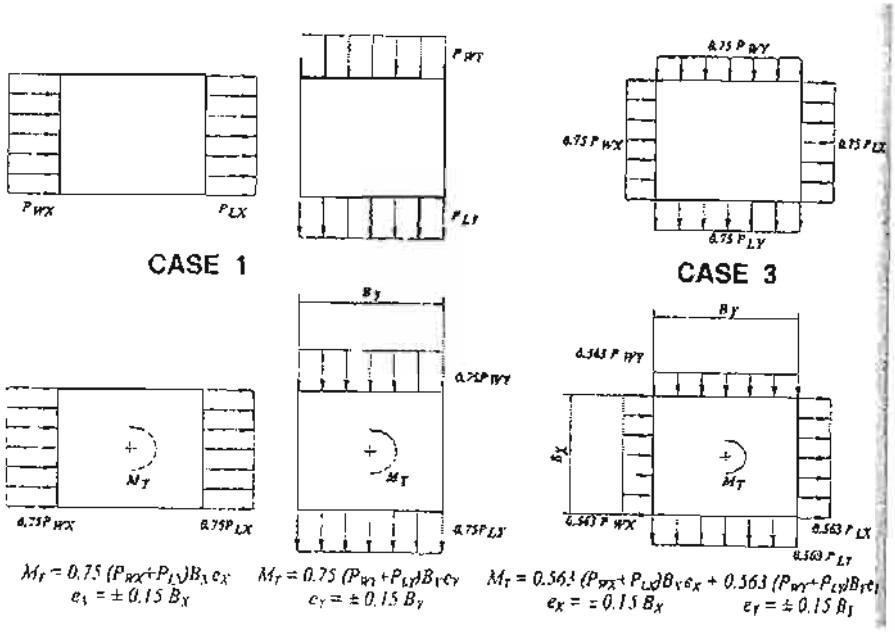
Eccentricity in x-direction = $e_x = (0.15 * B_x)$ 15.9 ft

Eccentricity in y-direction = $e_y = (0.15 * B_y)$ 36.6 ft

Elv.	Bx	By	Cpw	Cplx	Cply	Kz	qz	Pwx	Pwy	Plx	Ply
ft	ft	ft					psf	psf	psf	psf	psf
98.00	106	244	0.8	-0.5	-0.285	1.26	34.85	23.56	23.56	-14.73	-8.39
84.00	106	244	0.8	-0.5	-0.285	1.22	33.71	22.93	22.93	-14.73	-8.39
70.00	106	244	0.8	-0.5	-0.285	1.17	32.28	21.95	21.95	-14.73	-8.39
56.00	106	244	0.8	-0.5	-0.285	1.11	30.73	20.90	20.90	-14.73	-8.39
42.00	106	244	0.8	-0.5	-0.285	1.05	28.97	19.70	19.70	-14.73	-8.39
28.00	106	244	0.8	-0.5	-0.285	0.96	26.60	18.09	18.09	-14.73	-8.39
14.00	106	244	0.8	-0.5	-0.285	0.85	23.45	15.95	15.95	-14.73	-8.39
0	106	244	0.8	-0.5	-0.285	0.85	23.45	15.95	15.95	-14.73	-8.39

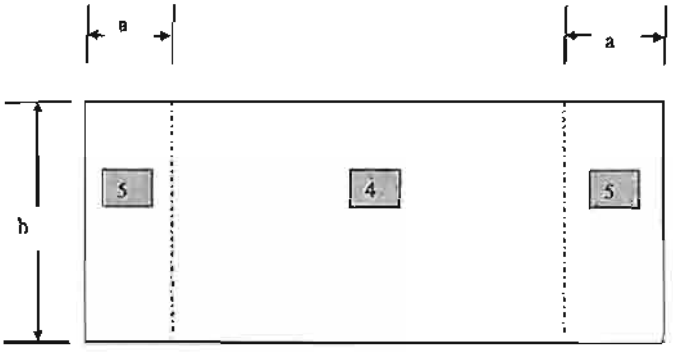
Note: Wind load is determined at a particular floor level and considered to be uniform upto the lower level

Case 1A	Case 1B	Case 2A		Case 2B		Case 3		Case 4		
Fx	Fy	Fx	Mz	Fy	Mz	Fx	Fy	Fx	Fy	Mz
Kips	Kips	Kips	Kips-ft	Kips	Kips-ft	Kips	Kips	Kips	Kips	Kips-ft
65.4	23.7	49.0	779.9	17.8	650.9	49.0	17.8	36.8	13.4	1074.1
128.6	46.5	96.5	1533.8	34.9	1275.8	96.5	34.9	72.4	26.2	2109.1
125.3	45.0	94.0	1494.1	33.8	1236.1	94.0	33.8	70.5	25.4	2049.4
121.7	43.5	91.3	1451.3	32.6	1193.3	91.3	32.6	68.5	24.5	1985.2
117.6	41.7	88.2	1402.4	31.3	1144.4	88.2	31.3	66.2	23.5	1911.6
112.1	39.3	84.1	1336.6	29.5	1078.7	84.1	29.5	63.1	22.1	1813.1
104.8	36.1	78.6	1249.5	27.1	991.5	78.6	27.1	59.0	20.3	1682.3
52.4	18.1	39.3	624.8	13.5	495.8	39.3	13.5	29.5	10.2	841.1
827.9	293.9	820.9	9872.2	220.4	8056.5	620.9	220.4	466.1	165.4	13466.0

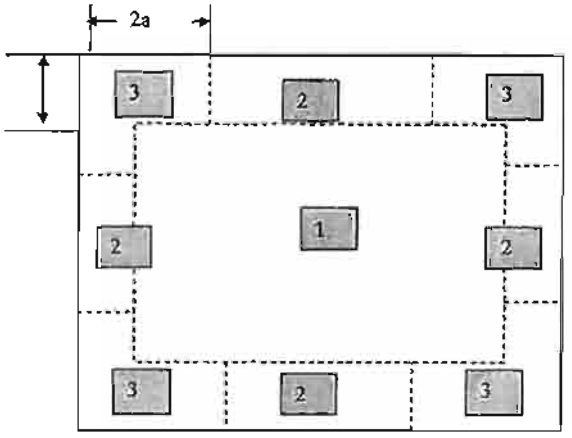


Component & Cladding:

Effective Wind Area = 10 sq.ft



WALL ELEVATION



ROOF PLAN

Wind Coefficients as per Figure 6-17, p67				
Zone	GCp	GCp (-)	Gcpi +ve	Gcpi -ve
Zone – 1	-	-1.4	0.18	-0.18
Zone – 2	-	-2.3	0.18	-0.18
Zone – 3	-	-3.2	0.18	-0.18
Zone – 4	0.9	-0.9	0.18	-0.18
Zone – 5	0.9	-1.8	0.18	-0.18

Design pressure for Components and cladding is obtained by the following equations:

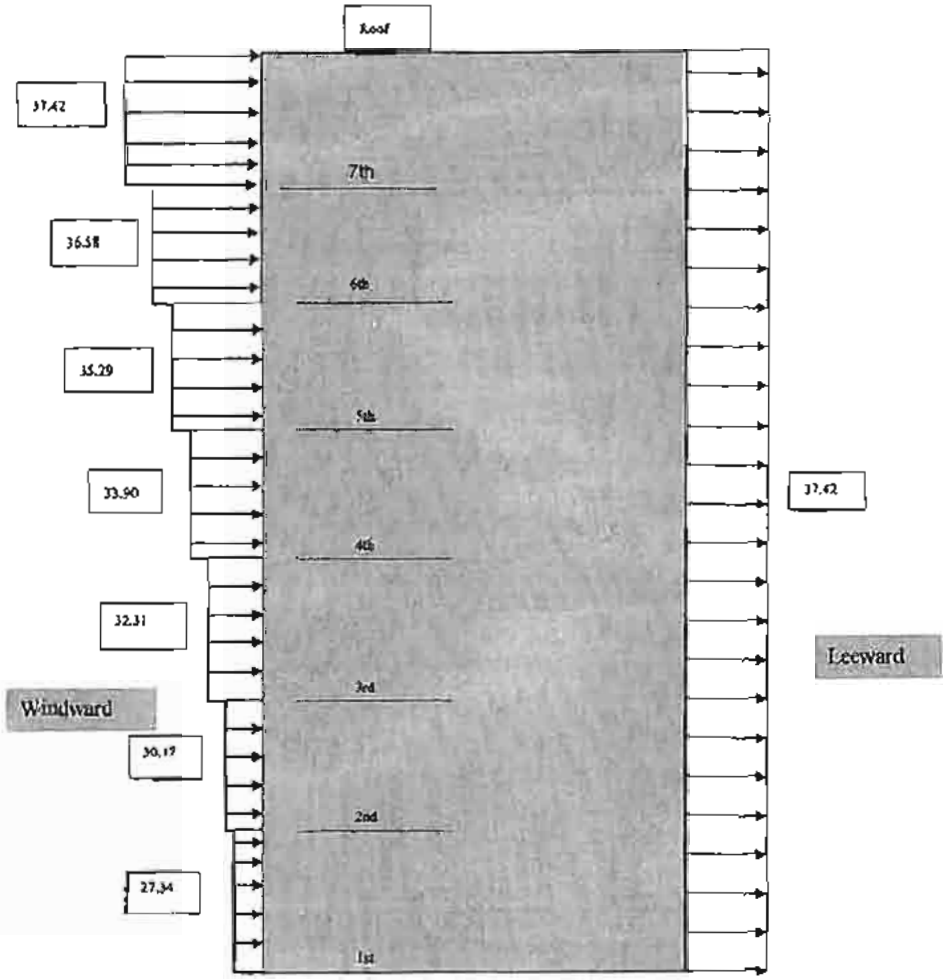
p = q (GCp) - qi (Gcpi) Refer Eq. 6-23 ASCE 7-02, p33

Component and cladding pressures for roof zones :

qz (psf)	qh (psf)	Zone 1	Zone 2	Zone 3
34.65	34.65	-54.7	-85.9	-117.1

Component and cladding pressures for wall zones :

			Windward Pressure (psf)		Leeward Pressure (psf)	
			Positive Pressures		Negative Pressures	
Floor height in ft	qz (psf)	qh (psf)	For Zone – 4	For Zone 5	For Zone – 4	For Zone 5
98	34.65	34.65	37.42	37.42	-37.42	-68.61
84	33.71	34.65	36.58	36.58	-37.42	-68.61
70	32.28	34.65	35.29	35.29	-37.42	-68.61
56	30.73	34.65	33.90	33.90	-37.42	-68.61
42	28.97	34.65	32.31	32.31	-37.42	-68.61
28	26.60	34.65	30.17	30.17	-37.42	-68.61
14	23.45	34.65	27.34	27.34	-37.42	-68.61
0	23.45	34.65	27.34	27.34	-37.42	-68.61



Wind pressure on Components and Cladding in Wind Zone 4 (Windward & Leeward)

Seismic Loads as per ASCE 7-02

Seismic Parameters

PROBABILISTIC HAZARD LOOKUP FROM USGS National Seismic Hazard Mapping Project Website

The input zip-code is 80012

ZIP CODE 80012

LOCATION 39.6982 Lat. -104.8313 Long

DISTANCE TO NEAREST GRID POINT 2.8948 kms

NEAREST GRID POINT 39.7 Lat. -104.83 Long

Probabilistic ground motion values, in %g, at the Nearest Grid point are:

For Site Class B

	10%PE in 50 yr	5%PE in 50 yr	2%PE in 50 yr
PGA	3.0119	4.662362	8.325429
0.2 sec SA	7.22773	11.22715	18.63782
0.3 sec SA	5.80275	8.638938	15.07405
1.0 sec SA	2.21524	3.458242	5.667101

Acceleration based Site coefficient Fa = 1.2 Table 9.4.1.2.4a, p129

(For Site Class C assumed)

Velocity based site coefficient Fv = 1.7 Table 9.4.1.2.4b, p130

(For Site Class C assumed)

Spectral accelerations for Short period from Fig9.4.1.1(a) Ss = 0.186

(For Site class B)

Spectral accelerations for a 1-S period S1from Fig 9.4.1.1(b) S1 = 0.057

(For Site class B)

Response Modification Coefficient R = 5

(Basic Seismic Force Resisting System Building frame system

" Ordinary reinforced concrete shear walls" from Table 9.5.2.2, p132)

Category (Seismic Use Group) = III (From Table 9.1.3), p95 building category IV

Seismic Importance Factor IE = 1.5 (From Table 9.1.4), p97

Seismic Base Shear: V = Cs x W

Where Cs shall be determined in accordance with Cl 9.5.5.2.1, p146

CS = SDS / (R/Ie) Where SDS = (2/3) x SMS

Where SMS = Fa x Ss = 0.2160

Therefore, SDS = (2/3) x SMS = 0.1440

CS = SDS / (R/Ie) = 0.0432

But Cs need not exceed (Eqn 9.5.5.2.1-2) CS = SDI / [(R/Ie) x T]

To Find T:

Max height of structure = 98.00 ft

	Ct = 0.02	x= 0.75		(Table 9.5.5.3.2)
T=	Ct x hn ^ x =		0.823	(Eq. 9.5.5.3.2-1)
T=	0.1N =		0.8	(Eq. 9.5.5.3.2-1a)

SM1 = Fv x S1 = 0.0935

SD1 = (2/3) x SM1 = 0.062

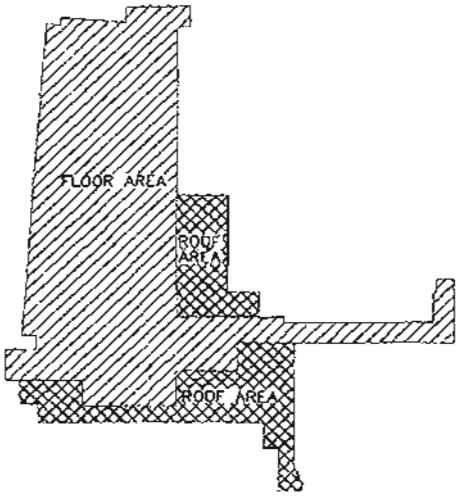
CS = SDI / [(R/Ie) x T] = 0.0300 < 0.0432

Also, Cs should not be less than CS = 0.044 x SDS x Ie = 0.0095 < 0.0432
(Eq. 9.5.5.3.2-1a)

Therefore, Cs = 0.0300

Seismic Base Shear: V = Cs x W = 0.0300 x W

To Find Dead Load of Structure:



Low Roof Area = 4030 sq.ft

Floor Area = 19520 sq.ft

Dead Load of Slab @ typical floors =	9018	kips	(6 floors - 75 psf)
Dead Load of Roof Deck @ Roof =	390	kips	
Dead Load of Low Roof =	121	kips	
Weight of Beams =	630	kips	Approximate
Weight of Columns =	300	kips	Approximate
-		kips	-
-		kips	-
Weight of Brick + LMF wall =	3210	kips	(40+10) PSF
Weight of One Story Brick Cladding =	0	kips	Directly supported on ground
Partion Load at @ typical floors =	2342	kips	(6 floors - 20 psf)
Total Dead Load =	16012	kips	

Seismic Base Shear: V = Cs x W = 0.0300 x W

= 481 kips

Seismic Distribution along each level: $F_x = C_{vx} V$ (9.5.6.4)

I	Hi(ft)	Hx(ft)	Wi(kips)	Wi*hi^k	Cvx	Fx(kips)
First	0.00	0	21	0	0.00	0.00
Second	14.00	14.00	2641	43487	0.04	19.94
Third	28.00	14.00	2520	86605	0.08	39.71
Fourth	42.00	14.00	2520	133186	0.13	61.07
Fifth	56.00	14.00	2520	180750	0.17	82.87
Roof/ Future Sixth	70.00	14.00	2520	229059	0.22	105.02
Future Seventh	84.00	14.00	2520	277968	0.27	127.45
Future Roof	98.00	14.00	748	97268	0.09	44.60
		Total	16012	1048324	1	481

To find Distribution Exponent K, related to the building period:

for T = 0.5	K =1	
For T = 2.5	K = 2	
Therefore for T =	0.623	< 1
K =	1.061	

Determination of Seismic design category;

S_{DS} = 0.144

From Table 9.4.2.1a, p131

SDS <0.167g

The Seismic Design Category is A

S_{D1} = 0.0623

From Table 9.4.2.1b, p132

S_{D1} <0.067g

The Seismic Design Category is A

Hence the structure based on the above analysis falls under

"SEISMIC DESIGN CATEGORY IS A"

AURORA HOSPITAL SNOW LOAD CALCULATIONS

Location: Aurora, Colorado
Zip Code: 80012
Design Code: IBC 2003, ASCE 7-02

1. snow load calculation on low roof of connector

1) Ground snow load (Figure 7-1)			p_g =	34.0 psf
2) Exposure factor (Table 7-2)	Terrain category	C		
	Roof exposure	Partially exposed		
			C_e =	1.0
3) Thermal factor (Table 7-3)			C_t =	1.0
4) Importance factor (Table 7-4)	building category **IV**		I_s =	1.2
5) Flat roof snow load -1	$P_f = 0.7C_eC_tI_sp_g$		P_{f1} =	28.6 psf

6) minimum p_f for low-slope roof

a) If p_g is 20 psf or less	Pf (min) = I_sp_g =		40.8 psf
a) if p_g exceeds 20 psf	Pf (min) = I_s*20psf =		24.0 psf
Thus, flat roof snow load - 2	Pf (min) =	P_{f2} =	24.0 psf
updated flat roof snow load	$P_f = \max(p_{f1}, p_{f2})$		28.6 psf

7) Rain-on-snow surcharge load

If p_g is 20 psf or less, roof slope less than W/50			5.0 psf
If not			0.0 psf
	thus,	rain-on-snow surcharge	0.0 psf
updated flat roof snow load	Pf =		28.6 psf

8) if $p_{f2}>p_{f1}$, their difference should be reduced from design value, limiting to 5 psf

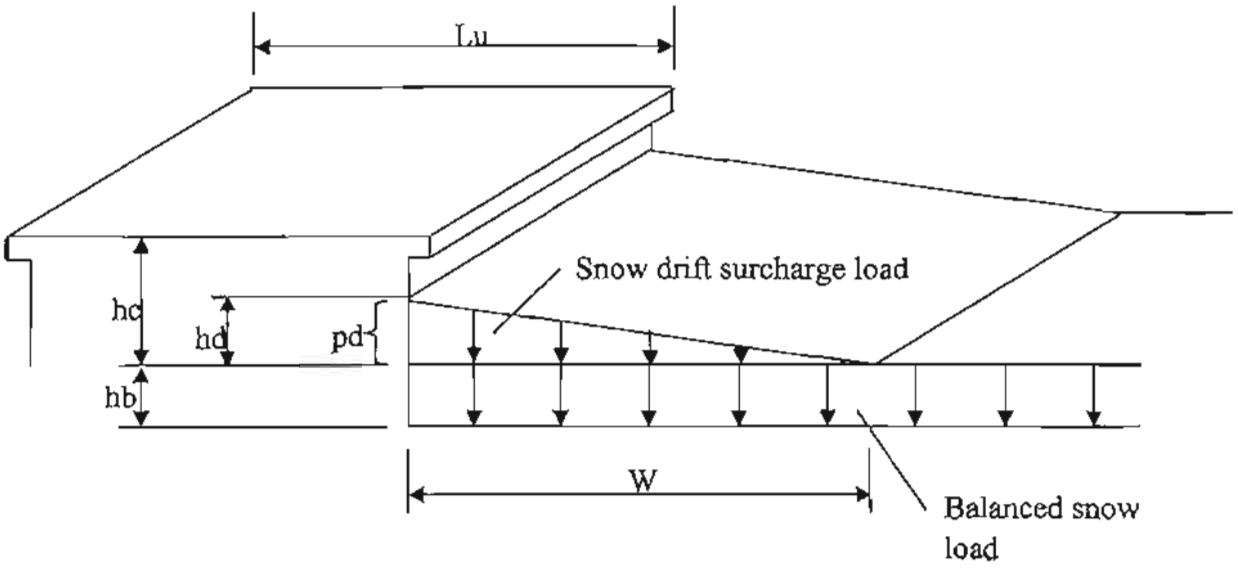
updated flat roof snow load	Pf =	28.6 psf

2. snow drift calculation on low roof of connector (west part in north-south direction)
Roof shall be designed to sustain localized loads from snowdrifts that form in the wind shadow of
a) higher portions of the same structure
b) adjacent structures and terrain features

snow drift comes from a higher roof or, with the wind from the opposite direction, from the roof on on which the drift is located. thes two types of snow drifts (leeward and windward) are shown in Fig. 7-7.

the geometry of the surcharge load due to snow drift shall be approximated by a triangle as shown in Fig. 7-8.

drift loads shall be superimposed on the balanced snow load.



Length of the upper roof of the drift		Lu (upper) =	13.40 ft	(Axis 1N-1U)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	25.00 ft	**(Leeward drift)**
Length of the lower roof of the drift		Lu (lower) =	48.46 ft	(Axis 1U-1BB)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	48.46 ft	**(Windward drift)**

Height of snow drift (Figure 7-9)
If Lu>600 ft, use equation $h_d = 0.43\sqrt[3]{L_u}\sqrt[4]{p_g + 10} - 1.5$

Ground snow load	p_g =	34.00 psf	
for leeward drift	h_d = Figure 7-9 value		1.70 ft
for leeward drift	h_d = Figure 7-9 value x 0.75		1.88 ft
thus, **drift height**	h_d = max(leeward, windward)		
	=	1.88 ft	

snow density (Equation 7-3) $\gamma = \begin{cases} = 0.13 p_g + 14 \\ \leq 30 \quad pcf \end{cases}$

thus, γ = 18.42 pcf

height of balanced snow $h_b = \frac{p_f}{\gamma} =$ 1.55 ft

clear height from top of balanced snow load to closest point on adjacent upper roof

$h_c = \Delta H - h_b =$ 54.45 ft

h_c/h_b = 35.12 >0.2

thus, snow drift should be considered

drift width W

$$\begin{cases} w = 4h_d \quad and \quad h_d = h_d \quad (h_d \leq h_c) \\ w = 4h_d^2 / h_c \quad and \quad h_d = h_c \quad (h_d > h_c) \\ w \leq 8h_c \end{cases}$$

w = **7.50** ft

Height of snow drift h_d = **1.88** ft

the maximum intensity of the snow drift surcharge load

$$p_d = h_d \cdot \gamma \qquad \textbf{34.54} \text{ psf}$$

3. snow drift calculation on low roof of connector (west part In east-west direction)
Roof shall be designed to sustain localized loads from snowdrifts that form in the wind shadow of
a) higher portions of the same structure
b) adjacent structures and terrain features

snow drift comes from a higher roof or, with the wind from the opposite direction, from the roof on on which the drift is located. thes two types of snow drifts (leeward and windward) are shown In Fig. 7-7.

the geometry of the surcharge load due to snow drift shall be approximated by a triangle as shown in Fig. 7-8.

drift loads shall be superimposed on the balanced snow load.

Length of the upper roof of the drift		Lu (upper) =	97.50 ft	(Axis A1-A13.1)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	97.50 ft	**(Leeward drift)**
Length of the lower roof of the drift		Lu (lower) =	65.80 ft	(Axis A13.1-A19.1)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	65.80 ft	(Windward drift)

Height of snow drift (Figure 7-9)
If Lu>600 ft, use equation $h_d = 0.43\sqrt[3]{L_u}\sqrt[4]{p_g + 10} - 1.5$

Ground snow load p_g = 34.00 psf
for leeward drift h_d = Figure 7-9 value 3.50 ft
for leeward drift h_d = Figure 7-9 value x 0.75 2.06 ft
thus, **drift height** h_d = max(leeward, windward)
= 3.50 ft

snow density (Equation 7-3) $\gamma \begin{cases} = 0.13\ p_g + 14 \\ \leq 30\ pcf \end{cases}$

thus, γ = 18.42 pcf

height of balanced snow $h_b = \frac{p_f}{\gamma}$ = 1.55 ft

clear height from top of balanced snow load to closest point on adjacent upper roof

$h_c = \Delta H - h_b$ = 82.45 ft

h_c/h_b = 53.18 >0.2
thus, snow drift should be considered

drift **width W**

$$\begin{cases} w = 4h_d \quad and \quad h_d = h_d \quad (h_d \le h_c) \\ w = 4h_d^2 / h_c \quad and \quad h_d = h_c \quad (h_d > h_c) \\ w \le 8h_c \end{cases}$$

	w =	**14.00** ft
Height of snow drift	h_d =	**3.50** ft

the maximum intensity of the snow drift surcharge load

$$p_d = h_d \cdot \gamma \qquad \textbf{64.47} \text{ psf}$$

4. snow drift calculation on low roof of connector (east part in north-south direction)
Roof shall be designed to sustain localized loads from snowdrifts that form in the wind shadow of
a) higher portions of the same structure
b) adjacent structures and terrain features

snow drift comes from a higher roof or, with the wind from the opposite direction, from the roof on on which the drift is located. thes two types of snow drifts (leeward and windward) are shown in Fig. 7-7.

the geometry of the surcharge load due to snow drift shall be approximated by a triangle as shown in Fig. 7-8.

drift loads shall be superimposed on the balanced snow load.

Length of the upper roof of the drift		Lu (upper) =	97.50 ft	(Axis A1-A13.1)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	97.50 ft	**(Leeward drift)**
Length of the lower roof of the drift		Lu (lower) =	28.96 ft	(Axis A13.1-A14.1)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	28.96 ft	**(Windward drift)**

Height of snow drift (Figure 7-9)
If Lu>600 ft, use equation $h_d = 0.43\sqrt[3]{L_u}\sqrt[4]{p_g + 10} - 1.5$

Ground snow load p_g = 34.00 psf
for leeward drift h_d = Figure 7-9 value 3.50 ft
for leeward drift h_d = Figure 7-9 value x 0.75 1.31 ft
thus, **drift height** h_d = max(leeward, windward)
= 3.50 ft

snow density (Equation 7-3) $\gamma = 0.13\ p_g + 14 \le 30\ pcf$

thus, γ = 18.42 pcf

height of balanced snow $h_b = \frac{p_f}{\gamma}$ = 1.55 ft

clear height from top of balanced snow load to closest point on adjacent upper roof

$h_c = \Delta H - h_b$ = 82.45 ft

h_c/h_b = 53.18 >0.2
thus, snow drift should be considered

drift width W

$$\begin{cases} w = 4h_d \quad and \quad h_d = h_d \quad (h_d \le h_c) \\ w = 4h_d^2 / h_c \quad and \quad h_d = h_c \quad (h_d > h_c) \\ \qquad\qquad w \le 8h_c \end{cases}$$

w = **14.00** ft

Height of snow drift **h_d =** **3.50** ft

the maximum intensity of the snow drift surcharge load

$$p_d = h_d \cdot \gamma$$ **64.47** psf

5. snow drift calculation on low roof of connector (east part in east-west direction)
Roof shall be designed to sustain localized loads from snowdrifts that form in the wind shadow of
a) higher portions of the same structure
b) adjacent structures and terrain features

snow drift comes from a higher roof or, with the wind from the opposite direction, from the roof on on which the drift is located. thes two types of snow drifts (leeward and windward) are shown in Fig. 7-7.

the geometry of the surcharge load due to snow drift shall be approximated by a triangle as shown in Fig. 7-8.

drift loads shall be superimposed on the balanced snow load.

Length of the upper roof of the drift		Lu (upper) =	10.00 ft	(Axis 1R-1U)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	25.00 ft	**(Leeward drift)**
Length of the lower roof of the drift		Lu (lower) =	18.33 ft	(Axis 1R-1K)
Minimum of Lu		Lu (min) =	25.00 ft	
	Thus,	L_u =	25.00 ft	**(Windward drift)**

Height of snow drift (Figure 7-9)
If Lu>600 ft, use equation $h_d = 0.43\sqrt[3]{L_u}\sqrt[4]{p_g + 10} - 1.5$

Ground snow load p_g = 34.00 psf
for leeward drift h_d = Figure 7-9 value 1.70 ft
for leeward drift h_d = Figure 7-9 value x 0.75 1.28 ft
thus, **drift height** h_d = max(leeward, windward)
= 1.70 ft

snow density (Equation 7-3) $$\gamma \begin{cases} = 0.13\ p_g + 14 \\ \leq 30\ pcf \end{cases}$$

thus, γ = 18.42 pcf

height of balanced snow $h_b = \frac{p_f}{\gamma}$ = 1.55 ft

clear height from top of balanced snow load to closest point on adjacent upper roof

$h_c = \Delta H - h_b$ = 54.45 ft

h_c/h_b = 35.12 >0.2
thus, snow drift should be considered

drift width W

$$\begin{cases} w = 4h_d \quad and \quad h_d = h_d \quad (h_d \le h_c) \\ w = 4h_d^2 / h_c \quad and \quad h_d = h_c \quad (h_d > h_c) \\ w \le 8h_c \end{cases}$$

	w =	**6.80** ft
Height of snow drift	h_d =	**1.70** ft

the maximum Intensity of the snow drift surcharge load

$$p_d = h_d \cdot \gamma \qquad \textbf{31.31} \text{ psf}$$

Permit #

Permit Date

COMcheck Software Version 3.1 Release 1

Envelope Compliance Certificate

2003 IECC

Report Date: 02/09/07

Data filename: C:\DOCUME~1\johns\Desktop\AURORA~1.CCK

Section 1: Project Information

Project Title: Medical Center of Aurora

Construction Site:	Owner/Agent:	Designer/Contractor:
1501 South Potomac Street Aurora, CO 80012	Medical Center of Aurora	

Section 2: General Information

Building Location (for weather data):	Aurora, Colorado
Climate Zone:	13b
Heating Degree Days (base 65 degrees F):	6020
Cooling Degree Days (base 65 degrees F):	679
Project Type:	Addition
Glazing Area Percentage:	24%

Activity Type(s)	Floor Area
Medical and Clinical Care	122401

Section 3: Requirements Checklist

Envelope PASSES: Design 16% better than code

Climate-Specific Requirements:

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor
Roof 1: Non-Wood Joist/Rafter/Truss	10000	0.0	19.0	0.051	0.057
Roof 2: Structural Slab	19000	—	19.0	0.049	0.057
Skylight 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.31	70	—	—	0.500	0.057
Exterior Wall 1: Metal Frame, 16" o.c.	15050	19.0	0.0	0.114	0.087
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.31	4450	—	—	0.480	0.586
Door 4: Glass, Clear, SHGC 0.30	100	—	—	0.500	0.586
Exterior Wall 2: Metal Frame, 16" o.c.	13340	19.0	0.0	0.114	0.087
Window 2: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.31	3080	—	—	0.480	0.586
Door 1: Solid	125	—	—	0.200	0.138
Exterior Wall 3: Metal Frame, 16" o.c.	8900	19.0	0.0	0.114	0.087
Window 3: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.31	2720	—	—	0.480	0.586
Door 2: Solid	25	—	—	0.200	0.138
Exterior Wall 4: Metal Frame, 16" o.c.	6731	19.0	0.0	0.114	0.087
Window 4: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.31	200	—	—	0.480	0.586

Door 3: Solid	25	—	—	0.200	0.138
Floor 1: Slab-On-Grade:Unheated, Vertical 3 ft.	550	—	10.0	—	—

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

Air Leakage, Component Certification, and Vapor Retarder Requirements:

- ☑ 1. All joints and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
- ☑ 2. Windows, doors, and skylights certified as meeting leakage requirements.
- ☑ 3. Component R-values & U-factors labeled as certified.
- ☑ 4. Stair, elevator shaft vents, and other dampers integral to the building envelope are equipped with motorized dampers.
- N/A ☐ 5. Cargo doors and loading dock doors are weather sealed.
- ☑ 6. Recessed lighting fixtures are: (I) Type IC rated and sealed or gasketed; or (II) installed inside an appropriate air-tight assembly with a 0.5 inch clearance from combustible materials and with 3 inches clearance from insulation material.
- ☑ 7. Building entrance doors have a vestibule and equipped with closing devices.
  Exceptions:
  Building entrances with revolving doors.
  Doors that open directly from a space less than 3000 sq. ft. in area.
- ☑ 8. Vapor retarder installed.

Section 4: Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2003 IECC requirements in COMcheck Version 3.1 Release 1 and to comply with the mandatory requirements in the Requirements Checklist.

DMITRI ENGLERT — Principal Envelope Designer-Name

Signature

8/12/07 — Date

Project Notes:

Previously saved project information:
Medical Center of Aurora
Cary Garner, Dimitri Englert - Perkins + Will - Architects
Abigail Lipperman - cord partners - Electrical Engineer
John Skinner - cord partners - Mechanical Engineer
Abigail Lipperman - cord partners

Permit #
Permit Date

COMcheck Software Version 3.2.0
Lighting Compliance Certificate

2003 IECC

Report Date: 02/09/07

Data filename: C:\DOCUME~1\shaung\LOCALS~1\TEMPOR~1\OLK26\AURORA~1.CCK

Section 1: Project Information

Project Title: Medical Center of Aurora

Construction Site:	Owner/Agent:	Designer/Contractor:
1601 South Potomac Street Aurora, CO 80012	Medical Center of Aurora	

Section 2: General Information

Building Use Description by: **Activity Type**
Project Type: **Addition**

Activity Type(s)	Floor Area
Medical and Clinical Care	122401

Section 3: Requirements Checklist

Interior Lighting:

☐ 1. Total actual watts must be less than or equal to total allowed watts.

Allowed Watts	Actual Watts	Complies
146881	130974	YES

☐ 2. Exit signs 5 Watts or less per side.

Exterior Lighting:

☐ 3. Efficacy greater than 45 lumens/W.

Exceptions:

Specialized lighting highlighting features of historic buildings; signage; safety or security lighting; low-voltage landscape lighting.

Controls, Switching, and Wiring:

☐ 4. Independent controls for each space (switch/occupancy sensor).

Exceptions:

Areas designated as security or emergency areas that must be continuously illuminated.
Lighting in stairways or corridors that are elements of the means of egress.

☐ 5. Master switch at entry to hotel/motel guest room.

☐ 6. Individual dwelling units separately metered.

☐ 7. Each space provided with a manual control to provide uniform light reduction by at least 50%.

Exceptions:

Only one luminaire in space;
An occupant-sensing device controls the area;
The area is a corridor, storeroom, restroom, public lobby or guest room;
Areas that use less than 0.8 Watts/sq.ft.

☐ 8. Automatic lighting shutoff control in buildings larger than 5,000 sq.ft.
☐ 9. *Photocell/astronomical time switch on exterior lights.*
Exceptions:
Lighting intended for 24 hour use.

☐ 10. Tandem wired one-lamp and three-lamp ballasted luminaires (No single-lamp ballasts).
Exceptions:
Electronic high-frequency ballasts; Luminaires on emergency circuits or with no available pair.

Section 4: Compliance Statement

Compliance Statement: The proposed lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2003 IECC, Chapter 8, requirements in COM*check* Version 3.2.0 and to comply with the mandatory requirements in the Requirements Checklist.

Shaun Grimm — Principal Lighting Designer-Name

Signature

2-9-07 — Date

Project Notes:

Previously saved project information:
Medical Center of Aurora
Cary Garner, Dimitri Englert - Perkins + Will - Architects
Abigail Lipperman - ccrd partners - Electrical Engineer
John Skinner - ccrd partners - Mechanical Engineer
Abigail Lipperman - ccrd partners

Permit #
Permit Date

COM*check* Software Version 3.2.0

Lighting Application Worksheet

2003 IECC

Report Date:

Data filename: C:\DOCUME~1\shaung\LOCALS~1\TEMPOR~1\OLK26\AURORA~1.CCK

Section 1: Allowed Lighting Power Calculation

A Area Category	B Floor Area (ft2)	C Allowed Watts / ft2	D Allowed Watts (B x C)
Medical and Clinical Care	122401	1.2	146881
		Total Allowed Watts =	146881

Section 2: Actual Lighting Power Calculation

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
T8 / T12 Fluorescent 1: A1: 2x4 D/I Lay-in / 48" T8 32W / Electronic	2	341	65	22165
T8 / T12 Fluorescent 2: A1D: 2x4 D/I Lay-in Dim / 48" T8 32W / Electronic	2	21	65	1365
T8 / T12 Fluorescent 2 copy 2: B1: 2x4 Lens Lay-in / 48" T8 32W / Electronic	2	115	65	7475
T8 / T12 Fluorescent 2 copy 3: B2: 2x4 Lens Gyp / 48" T8 32W / Electronic	2	2	65	130
T8 / T12 Fluorescent 2 copy 3: B3: 2x4 Lens Lay-in / 48" T8 32W / Electronic	3	10	95	950
T8 / T12 Fluorescent 2 copy 4: B3D: 2x4 Lens Lay-in Dim / 48" T8 32W / Electronic	3	1	95	95
T8 / T12 Fluorescent 2 copy 5: B4: 2x4 Lens Gyp / 48" T8 32W / Electronic	3	8	95	760
T8 / T12 Fluorescent 2 copy 4: B5: 2x4 Lens Lay-in / 48" T8 32W / Electronic	4	44	124	5456
T8 / T12 Fluorescent 2 copy 5: B6: 2x4 Lens Gyp / 48" T8 32W / Electronic	2	3	65	195
T8 / T12 Fluorescent 12: D1: 2x2 D/I Lay-in / 24" T8 17W / Electronic	2	95	33	3135
T8 / T12 Fluorescent 12 copy 1: D3: 2x2 D/I Lay-in / 24" T8 17W / Electronic	3	83	54	4482
T8 / T12 Fluorescent 12 copy 2: F1: 2x2 Lens Lay-in / 24" T8 17W / Electronic	2	2	33	66
T8 / T12 Fluorescent 12 copy 3: F3: 2x2 Lens Lay-in / 24" T8 17W / Electronic	3	20	54	1080
T8 / T12 Fluorescent 12 copy 4: F4: 2x2 Lens Gyp / 24" T8 17W / Electronic	3	85	54	4590
T8 / T12 Fluorescent 17: H1: Undercab lt / 8"-13" T5 8-13W / Electronic	2	265	28	6890
T8 / T12 Fluorescent 17 copy 2: H3: Undercab lt, low pro / 8"-13" T5 8-13W / Electronic	2	27	28	702
T8 / T12 Fluorescent 1 copy 1: J1: Strip / 48" T8 32W / Electronic	2	140	65	9100
T8 / T12 Fluorescent 1 copy 2: J2: Strip / 48" T8 32W / Electronic	3	15	95	1425
T8 / T12 Fluorescent 1 copy 3: K1: up/down wall basket / 48" T8 32W / Electronic	2	22	65	1430
Compact Fluorescent 1: M1: 6" down lt, horz / Triple 4-pin 26W / Electronic	1	102	28	2958
Compact Fluorescent 1 copy 1: M3: 6" down lt, vert / Triple 4-pin 26W / Electronic	1	35	29	1015
Compact Fluorescent 1 copy 2: M3D: 6" down lt, vert, dim / Triple 4-pin 26W / Electronic	1	32	29	928
Compact Fluorescent 4: M4: 6" down lt, vert / Triple 4-pin 42W / Electronic	1	81	45	3645
Compact Fluorescent 1 copy 1: M5: 6" down lt, horz. lens / Triple 4-pin 26W / Electronic	1	62	29	1798
Compact Fluorescent 1 copy 2: M5D: 6" down lt, horz. lens, dim / Triple 4-pin 26W / Electronic	1	449	29	13021
Compact Fluorescent 1 copy 3: N1: 6" wall wash / Triple 4-pin 26W / Electronic	1	17	29	493
Compact Fluorescent 4 copy 1: R2: 6" shower lt / Triple 4-pin 42W / Electronic	1	72	45	3240
LED: T1: LED night lt / LED	1	84	10	840
T8 / T12 Fluorescent 23: U1: Elev plt lt / 48" T8 32W / Electronic	3	8	95	760

LED: X1: Single face LED exit lt / LED	1	114	10	1140
LED: X2: Double face LED exit lt / LED	1	23	10	230
HID 3: Z1: Wall mnt. cutoff lt / Metal Halide 70W / Electronic	1	3	70	210
Compact Fluorescent 8: LF1: Sconce / Twin Tube 13W / Electronic	1	43	13	559
T8 / T12 Fluorescent 24: LF2: Sconce / 24" T8 17W / Electronic	1	97	22	2134
Incandescent 6: LF3: Pendant / Incandescent 60W	1	9	60	540
T8 / T12 Fluorescent 25: LF4: wall D/I / 48" T8 64W / Electronic	2	12	108	1296
Compact Fluorescent 10: LF5: Drum Pendant / Triple 4-pin 26W / Electronic	2	3	56	168
HID 2: LF7: 4" Down lt / Metal Halide 39W / Electronic	1	6	39	234
T8 / T12 Fluorescent 26: LF8: Wall wash / 48" T8 32W / Electronic	1	18	32	576
T8 / T12 Fluorescent 27: LF10: 2x4 3 mode lay-in / 40W Max / Electronic	7	84	280	23520
Incandescent 8: LF11: 4" Accent / Incandescent 50W	1	2	50	100
Compact Fluorescent 11: LF12: Sconce / Quad 4-pin 13W / Electronic	1	6	13	78
			Total Actual Watts =	130974

Section 3: Compliance Calculation

If the Total Allowed Watts minus the Total Actual Watts is greater than or equal to zero, the building complies.

Total Allowed Watts =	146881
Total Actual Watts =	130974
Project Compliance =	15907

Lighting PASSES: Design 11% better than code.

Permit #

Permit Date

COM*check* Software Version 3.1 Release 1

Mechanical Compliance Certificate

2003 IECC

Report Date: 02/09/07

Data filename: C:\DOCUME~1\johns\Desktop\AURORA~1.CCK

Section 1: Project Information

Project Title: Medical Center of Aurora

Construction Site:	Owner/Agent:	Designer/Contractor:
1501 South Potomac Street Aurora, CO 80012	Medical Center of Aurora	

Section 2: General Information

Building Location (for weather data):	Aurora, Colorado
Climate Zone:	13b
Heating Degree Days (base 65 degrees F):	6020
Cooling Degree Days (base 65 degrees F):	678
Project Type:	Addition

Section 3: Mechanical Systems List

Quantity	System Type & Description
1	AHU-06-5: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-1F: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=240 - <760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-06-4: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=240 - <760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-06-3: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=240 - <760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-06-2: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=240 - <760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-06-1: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=240 - <760 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	AHU-06-A: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=135 - <240 kBtu/h, Water-Cooled Condenser / Multiple-Zone
1	FCU-06-1: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Hydronic Coil, Capacity >=90 - <135 kBtu/h, Water-Cooled Condenser / Single Zone
1	FCU-06-2: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Split System, Capacity >=65 - <90 kBtu/h, Air-Cooled Condenser / Single Zone
1	FCU-06-3: Heating: Hydronic or Steam Coil, Hot Water / Cooling: Split System, Capacity <65 kBtu/h, Air-Cooled Condenser / Single Zone
1	UH-06-1, 2, 3, 4, 5, 6: Heating: Unit Heater, Electric
1	UH-06-7, 8, 9, 10, 11, 12: Heating: Unit Heater, Electric
1	Plant 1: Heating: Steam Boiler, Capacity >=600 kBtu/h, Gas / Cooling: Water Chiller, Capacity >300 tons, Condenser Water-Cooled, Non-Standard Centrifugal Chiller, with Propeller or Axial Fan Cooling Tower
1	WH-06-1 & 2: Service Water Heater w/ Circulation Pump

Section 4: Requirements Checklist

Requirements Specific To: AHU-06-5 :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Leak testing >3 per in. static pressure - report submitted showing CL <6.0
- ☐ 3. Discharge dampers prohibited with fan motors >25 hp
- ☐ 4. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 5. Water economizer is included and calculations required
- ☐ 6. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 7. Single-duct VAV terminals reduce primary air before reheating
- ☐ 8. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 9. Fan equipped with electrical variable-speed drive
- ☐ 10. Separate hot and cold water supply and returns
- ☐ 11. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 12. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 13. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-1F :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Discharge dampers prohibited with fan motors >25 hp
- ☐ 3. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 4. Water economizer is included and calculations required
- ☐ 5. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 6. Single-duct VAV terminals reduce primary air before reheating
- ☐ 7. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 8. Fan equipped with electrical variable-speed drive
- ☐ 9. Separate hot and cold water supply and returns
- ☐ 10. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 11. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 12. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-06-4 :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Leak testing >3 per in. static pressure - report submitted showing CL <6.0
- ☐ 3. Discharge dampers prohibited with fan motors >25 hp
- ☐ 4. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 5. Water economizer is included and calculations required
- ☐ 6. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 7. Single-duct VAV terminals reduce primary air before reheating
- ☐ 8. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 9. Fan equipped with electrical variable-speed drive
- ☐ 10. Separate hot and cold water supply and returns
- ☐ 11. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 12. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 13. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-06-3 :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Leak testing >3 per in. static pressure - report submitted showing CL <6.0
- ☐ 3. Discharge dampers prohibited with fan motors >25 hp

- ☐ 4. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 5. Water economizer is included and calculations required
- ☐ 6. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 7. Single-duct VAV terminals reduce primary air before reheating
- ☐ 8. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 9. Fan equipped with electrical variable-speed drive
- ☐ 10. Separate hot and cold water supply and returns
- ☐ 11. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 12. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 13. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-06-2 :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Leak testing >3 per in. static pressure - report submitted showing CL <6.0
- ☐ 3. Discharge dampers prohibited with fan motors >25 hp
- ☐ 4. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 5. Water economizer is included and calculations required
- ☐ 6. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 7. Single-duct VAV terminals reduce primary air before reheating
- ☐ 8. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 9. Fan equipped with electrical variable-speed drive
- ☐ 10. Separate hot and cold water supply and returns
- ☐ 11. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 12. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 13. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-06-1 :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Discharge dampers prohibited with fan motors >25 hp
- ☐ 3. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 4. Water economizer is included and calculations required
- ☐ 5. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zone cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4
- ☐ 6. Single-duct VAV terminals reduce primary air before reheating
- ☐ 7. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
- ☐ 8. Fan equipped with electrical variable-speed drive
- ☐ 9. Separate hot and cold water supply and returns
- ☐ 10. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 11. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 12. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: AHU-06-A :

- ☐ 1. Minimum one temperature control device per zone
- ☐ 2. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 3. Water economizer is included and calculations required
- ☐ 4. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: 75% of reheating/recooling energy achieved through site recovered or site solar

- Exception: Zones with humidity requirements for special processes
- Exception: Zone cfm <300 and flow rate <10% of total design flow rate
- Exception: Outside air needed to meet IMC Chapter 4

☐ 5. Single-duct VAV terminals reduce primary air before reheating
☐ 6. Controls capable of resetting supply air temp (SAT) by 25% of SAT-room temp difference
☐ 7. Separate hot and cold water supply and returns
☐ 8. Multiple boilers must have automatic controls that sequence operation with load
☐ 9. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
☐ 10. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: FCU-06-1 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices
☐ 2. Separate hot and cold water supply and returns
☐ 3. Multiple boilers must have automatic controls that sequence operation with load
☐ 4. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
☐ 5. Two-pipe changeover heating/cooling controls must have: a) 15 degrees F deadband where boiler and chiller can not operate, b) allow operation in either heating or cooling for at least 4 hrs. and c) prevent difference between heating and cooling set points greater than 30 degrees F

Requirements Specific To: FCU-06-2 :

☐ 1. Equipment minimum efficiency: Split System: 10.3 EER
☐ 2. Balancing and pressure test connections on all hydronic terminal devices

Requirements Specific To: FCU-06-3 :

☐ 1. Equipment minimum efficiency: Split System: 10.0 SEER
☐ 2. Balancing and pressure test connections on all hydronic terminal devices

Requirements Specific To: UH-06-1, 2, 3, 4, 5, 6 :

Requirements Specific To: UH-06-7, 8, 9, 10, 11, 12 :

Requirements Specific To: Plant 1 :

☐ 1. Equipment minimum efficiency: Boiler Thermal Efficiency >= 75% Et
☐ 2. Equipment minimum efficiency: Chiller: COP >= 6.86, IPLV = 5.86
☐ 3. Newly purchased heating equipment meets the efficiency requirements - used equipment must meet 80% Et @ maximum capacity
☐ 4. Closed-circuit cooling tower has: a) automatic bypass valve for condenser water loop or b) dampers that shut-off air flow through the cooling tower
☐ 5. Open-circuit cooling tower has automatic bypass valve for condenser water loop
☐ 6. Open-circuit cooling tower with heat exchanger must have automatic shut-off controls for cooling tower
☐ 7. Cooling tower performance >38.2 gpm/hp
☐ 8. Systems with multiple boilers have automatic controls capable of sequencing boiler operation
☐ 9. Hydronic heating systems comprised of a single boiler and >500 kBtu/h input design capacity include either a multistaged or modulating burner
☐ 10. Air cooled condenser and cooling tower fan motors > 7.5 HP equipped with multiple-speed motors or single speed motors and variable speed drives

Generic Requirements: Must be met by all systems to which the requirement is applicable:

☐ 1. Load calculations per 1997 ASHRAE Fundamentals
☐ 2. Plant equipment and system capacity no greater than needed to meet loads
- Exception: Standby equipment automatically off when primary system is operating
- Exception: Multiple units controlled to sequence operation as a function of load

☐ 3. Minimum one temperature control device per system
☐ 4. Minimum one humidity control device per installed humidification/dehumidification system
☐ 5. Thermostatic controls has 5 degrees F deadband
- Exception: Thermostats requiring manual changeover between heating and cooling

☐ 6. Automatic Controls: Setback to 55 degrees F (heat) and 85 degrees F (cool); 7-day clock, 2-hour occupant override, 10-hour backup
- Exception: Continuously operating zones
- Exception: 2 kW demand or less, submit calculations

☐ 7. Automatic shut-off dampers on exhaust systems and supply systems with airflow >3,000 cfm
☐ 8. Outside-air source for ventilation; system capable of reducing OSA to required minimum

- ☐ 9. R-5 supply and return air duct insulation in unconditioned spaces R-8 supply and return air duct insulation outside the building R-8 insulation between ducts and the building exterior when ducts are part of a building assembly
  - Exception: Ducts located within equipment
  - Exception: Ducts with interior and exterior temperature difference not exceeding 15 degrees F.
- ☐ 10. Ducts sealed - longitudinal seams on rigid ducts; transverse seams on all ducts; UL 181A or 181B tapes and mastics
  - Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches w.g. pressure classification
- ☐ 11. Mechanical fasteners and sealants used to connect ducts and air distribution equipment
- ☐ 12. Hot water pipe insulation: 1 in. for pipes <=1.5 in. and 2 in. for pipes >1.5 in. Chilled water/refrigerant/brine pipe insulation: 1 in. for pipes <=1.5 in. and 1.5 in. for pipes >1.5 in. Steam pipe insulation: 1.5 in. for pipes <=1.5 in. and 3 in. for pipes >1.5 in.
  - Exception: Piping within HVAC equipment
  - Exception: Fluid temperatures between 55 and 105 degrees F
  - Exception: Fluid not heated or cooled
  - Exception: Runouts <4 ft in length
- ☐ 13. Operation and maintenance manual provided to building owner
- ☐ 14. Balancing devices provided in accordance with IMC 603.15
- ☐ 15. Chilled water distribution systems >=600 kBtu/h must have one of the following: a) controls that reset supply water temperature by 25% of supply/return delta T b) mechanical or electrical adjustable-speed pump drive(s) c) two-way valves at all heating coils d) multiple-stage pumps e) other system controls that reduce pump flow by at least 50% based on load - calculations required
- ☐ 16. Newly purchased service water heating equipment meets the efficiency requirements
- ☐ 17. Water heater temperature controls: 110 degrees F for dwelling units or 90 degrees F for other occupancies
- ☐ 18. Hot water distribution systems >=300 kBtu/h must have one of the following: a) controls that reset supply water temperature by 25% of supply/return delta T b) mechanical or electrical adjustable-speed pump drive(s) c) two-way valves at all heating coils d) multiple-stage pumps e) other system controls that reduce pump flow by at least 50% based on load - calculations required
- ☐ 19. Chilled water distribution systems >=300 kBtu/h must have one of the following: a) controls that reset supply water temperature by 25% of supply/return delta T b) mechanical or electrical adjustable-speed pump drive(s) c) two-way valves at all heating coils d) multiple-stage pumps e) other system controls that reduce pump flow by at least 50% based on load - calculations required
- ☐ 20. Stair and elevator shaft vents are equipped with motorized dampers
- ☐ 21. Three-pipe systems not used

Section 5: Compliance Statement

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2003 IECC requirements in COMcheck Version 3.1 Release 1 and to comply with the mandatory requirements in the Requirements Checklist.

JOHN SKINNER — Principal Mechanical Designer-Name

Signature

9 FEB 07 — Date



COMcheck Software Version 3.1 Release 1

Mechanical Requirements Description

2003 IECC

Report Date:

Data filename: C:\DOCUME~1\johns\Desktop\AURORA~1.CCK

The following list provides more detailed descriptions of the requirements in Section 4 of the Mechanical Compliance Certificate.

Requirements Specific To: AHU-06-5 :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. The specified distribution system is designed to operate at static pressure over 3 in. water column. The system must be leak tested in accordance with SMACNA standards. The contractor or engineer must submit a report to the enforcing jurisdiction documenting that a minimum of 25% of all duct surfaces have been tested and that tested ducts have a SMACNA rated air leakage class of <6.0.
3. Fans with motors >25 hp may not be equipped with discharge dampers.
4. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
5. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
6. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
7. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
8. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
9. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
10. Fan system terminal units must have separate hot and cold water supply and return piping.
11. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
12. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
13. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-1F :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. Fans with motors >25 hp may not be equipped with discharge dampers.
3. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
4. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45

degrees F wet bulb.

5. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
6. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
7. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
8. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
9. Fan system terminal units must have separate hot and cold water supply and return piping.
10. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
11. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
12. Two-pipe changeover heating/cooling controls musta) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-06-4 :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. The specified distribution system is designed to operate at static pressure over 3 in. water column. The system must be leak tested in accordance with SMACNA standards. The contractor or engineer must submit a report to the enforcing jurisdiction documenting that a minimum of 25% of all duct surfaces have been tested and that tested ducts have a SMACNA rated air leakage class of <6.0.
3. Fans with motors >25 hp may not be equipped with discharge dampers.
4. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
5. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
6. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
7. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
8. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
9. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
10. Fan system terminal units must have separate hot and cold water supply and return piping.
11. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
12. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
13. Two-pipe changeover heating/cooling controls musta) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-06-3 :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. The specified distribution system is designed to operate at static pressure over 3 in. water column. The system must be leak

tested in accordance with SMACNA standards. The contractor or engineer must submit a report to the enforcing jurisdiction documenting that a minimum of 25% of all duct surfaces have been tested and that tested ducts have a SMACNA rated air leakage class of <6.0.

3. Fans with motors >25 hp may not be equipped with discharge dampers.
4. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
5. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
6. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
7. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
8. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
9. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
10. Fan system terminal units must have separate hot and cold water supply and return piping.
11. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
12. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
13. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-06-2 :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. The specified distribution system is designed to operate at static pressure over 3 in. water column. The system must be leak tested in accordance with SMACNA standards. The contractor or engineer must submit a report to the enforcing jurisdiction documenting that a minimum of 25% of all duct surfaces have been tested and that tested ducts have a SMACNA rated air leakage class of <6.0.
3. Fans with motors >25 hp may not be equipped with discharge dampers.
4. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
5. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
6. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
7. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
8. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
9. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
10. Fan system terminal units must have separate hot and cold water supply and return piping.
11. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
12. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
13. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode

(heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-06-1 :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. Fans with motors >25 hp may not be equipped with discharge dampers.
3. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
4. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
5. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
6. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
7. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
8. Fans over 25 hp on a variable-flow system must have electrical variable-speed drives.
9. Fan system terminal units must have separate hot and cold water supply and return piping.
10. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
11. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
12. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: AHU-06-A :

1. Each zone of a multiple-zone system must have its own temperature control device.
2. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
3. A water economizer is required with the specified system. Calculations must be submitted demonstrating that the water economizer is capable of meeting the entire cooling load at an outside air temperature of 50 degrees F dry bulb and 45 degrees F wet bulb.
4. Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams.
   - Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
   - Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
   - Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.
5. The specified multiple-zone system is equipped with single-duct VAV terminals. These terminals must be equipped with dampers, air valves, or other means to reduce the supply of primary supply air to a minimum prior to reheating.
6. Multiple-zone systems must include controls capable of resetting the supply air temperature by at least 25% of the difference between the design supply air temperature and the design room temperature.
7. Fan system terminal units must have separate hot and cold water supply and return piping.
8. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
9. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
10. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperaturesb) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other modec) allow heating and cooling supply temperatures at the changeover

point to be no more than 30 degrees F apart.

Requirements Specific To: FCU-06-1 :

1. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.
2. Fan system terminal units must have separate hot and cold water supply and return piping.
3. Multiple packaged boilers must have automatic controls capable of sequencing the operation of the boilers.
4. A single boiler with >500 kBtu/h input capacity must have a multistaged or modulating burner.
5. Two-pipe changeover heating/cooling controls must:a) allow a deadband between changeover from one mode (heating/cooling) to the other of at least 15 degrees F outside temperatures:b) allow operation in one mode (heating/cooling) for at least 4 hours before changing over to the other mode:c) allow heating and cooling supply temperatures at the changeover point to be no more than 30 degrees F apart.

Requirements Specific To: FCU-06-2 :

1. The specified heating and/or cooling equipment is covered by ASHRAE 90.1 Code and must meet the following minimum efficiency: Split System: 10.3 EER
2. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.

Requirements Specific To: FCU-06-3 :

1. The specified heating and/or cooling equipment is covered by ASHRAE 90.1 Code and must meet the following minimum efficiency: Split System: 10.0 SEER
2. Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.

Requirements Specific To: UH-06-1, 2, 3, 4, 5, 6 :

Requirements Specific To: UH-06-7, 8, 9, 10, 11, 12 :

Requirements Specific To: Plant 1 :

1. The specified heating and/or cooling equipment is covered by the ASHRAE 90.1 Code and must meet the following minimum efficiency: Boiler Thermal Efficiency >= 75% Et
2. The specified heating and/or cooling equipment is covered by ASHRAE 90.1 Code and must meet the following minimum efficiency: Chiller: COP >= 6.86, IPLV = 5.86
3. The specified heating equipment is covered by Federal minimum efficiency requirements. New equipment of this type can be assumed to meet or exceed ASHRAE 90.1 Code requirements for equipment efficiency. Used equipment must meet 80% Et @ maximum capacity.
4. Closed-circuit cooling tower has either an automatic bypass valve for condenser water loop or dampers that shut-off air flow through the cooling tower.
5. Open-circuit cooling tower has automatic bypass valve for condenser water loop.
6. Open-circuit cooling tower with heat exchanger must have automatic shut-off controls for cooling tower.
7. New equipment of this type must have a performance rating of 38.2 gpm/hp in accordance with CTI ATC-105 and CTI STD-201.
8. Systems with multiple boilers have automatic controls capable of sequencing the operation of the boilers.
9. Hydronic heating systems comprised of a single boiler and >500 kBtu/h input design capacity include either a multistaged or modulating burner.
10. Each fan motor of 7.5 hp or larger in a separate piece of heat rejection equipment must have the capability to operate that fan at two-thirds of full speed or less, and must have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Generic Requirements: Must be met by all systems to which the requirement is applicable:

1. Design heating and cooling loads for the building must be determined using procedures equivalent to those in Chapters 27 and 28 of the ASHRAE Handbook of Fundamentals or an approved equivalent calculation procedure.
2. All equipment and systems must be sized to be no greater than needed to meet calculated loads. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.
   - Exception: The equipment and/or system capacity may be greater than calculated loads for standby purposes. Standby equipment must be automatically controlled to be off when the primary equipment and/or system is operating.
   - Exception: Multiple units of the same equipment type whose combined capacities exceed the calculated load are allowed if they are provided with controls to sequence operation of the units as the load increases or decreases.
3. Each heating or cooling system serving a single zone must have its own temperature control device.
4. Each humidification system must have its own humidity control device.
5. Thermostats controlling both heating and cooling must be capable of maintaining a 5 degrees F deadband (a range of temperature where no heating or cooling is provided).

- Exception: Deadband capability is not required if the thermostat does not have automatic changeover capability between heating and cooling.

6. The system or zone control must be a programmable thermostat or other automatic control meeting the following criteria:a) capable of setting back temperature to 55 degrees F during heating and setting up to 85 degrees F during coolingb) capable of automatically setting back or shutting down systems during unoccupied hours using 7 different day schedulesc) have an accessible 2-hour occupant overrided) have a battery back-up capable of maintaining programmed settings for at least 10 hours without power.
   - Exception: A setback or shutoff control is not required on thermostats that control systems serving areas that operate continuously.
   - Exception: A setback or shutoff control is not required on systems with total energy demand of 2 kW (6,826 Btu/h) or less.
7. Outdoor-air supply systems with design airflow rates >3,000 cfm of outdoor air and all exhaust systems must have dampers that are automatically closed while the equipment is not operating.
8. The system must supply outside ventilation air as required by Chapter 4 of the International Mechanical Code. If the ventilation system is designed to supply outdoor-air quantities exceeding minimum required levels, the system must be capable of reducing outdoor-air flow to the minimum required levels.
9. Air ducts must be insulated to the following levels:a) Supply and return air ducts for conditioned air located in unconditioned spaces (spaces neither heated nor cooled) must be insulated with a minimum of R-5. Unconditioned spaces include attics, crawl spaces, unheated basements, and unheated garages.b) Supply and return air ducts and plenums must be insulated to a minimum of R-8 when located outside the building.c) When ducts are located within exterior components (e.g., floors or roofs), minimum R-8 insulation is required only between the duct and the building exterior.
   - Exception: Duct insulation is not required on ducts located within equipment.
   - Exception: Duct insulation is not required when the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15 degrees F.
10. All joints, longitudinal and transverse seams, and connections in ductwork must be securely sealed using weldments; mechanical fasteners with seals, gaskets, or mastics; mesh and mastic sealing systems; or tapes. Tapes and mastics must be listed and labeled in accordance with UL 181A or UL 181B.
    - Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches w.g. pressure classification.
11. Mechanical fasteners and seals, mastics, or gaskets must be used when connecting ducts to fans and other air distribution equipment, including multiple-zone terminal units.
12. All pipes serving space-conditioning systems must be insulated as follows: Hot water piping for heating systems: 1 in. for pipes <=1 1/2-in. nominal diameter 2 in. for pipes >1 1/2-in. nominal diameter. Chilled water, refrigerant, and brine piping systems: 1 in. insulation for pipes <=1 1/2-in. nominal diameter 1 1/2 in. insulation for pipes >1 1/2-in. nominal diameter. Steam piping: 1 1/2 in. insulation for pipes <=1 1/2-in. nominal diameter 3 in. insulation for pipes >1 1/2-in. nominal diameter.
    - Exception: Pipe insulation is not required for factory-installed piping within HVAC equipment.
    - Exception: Pipe insulation is not required for piping that conveys fluids having a design operating temperature range between 55 degrees F and 105 degrees F.
    - Exception: Pipe insulation is not required for piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
    - Exception: Pipe insulation is not required for runout piping not exceeding 4 ft in length and 1 in. in diameter between the control valve and HVAC coil.
13. Operation and maintenance documentation must be provided to the owner that includes at least the following information:a) equipment capacity (input and output) and required maintenance actionsb) equipment operation and maintenance manualsc) HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions; desired or field-determined set points must be permanently recorded on control drawings, at control devices, or, for digital control systems, in programming commentsd) complete narrative of how each system is intended to operate.
14. Each supply air outlet or diffuser and each zone terminal device (such as VAV or mixing box) must have its own balancing device. Acceptable balancing devices include adjustable dampers located within the ductwork, terminal devices, and supply air diffusers.
15. Chilled water distribution systems with total system capacities of 600 kBtu/h and greater must have controls that:a) automatically reset the chilled water supply temperature, based on cooling load, by at least 25% of the design supply-to-return water temperature difference orb) reduce pump flow by at least 50% of design flow rate by using- adjustable-speed drive(s) on pump(s)- multiple-stage pumps allowing at least 1/2 of the total pump horsepower to be automatically turned off- control valves designed to modulate or step down and close as a function of load- other approved means (supporting documentation or calculations must be submitted).
16. Service water heating equipment must meet minimum Federal efficiency requirements included in the National Appliance Energy Conservation Act and the Energy Policy Act of 1992, which meet or exceed ASHRAE 90.1 Code. New service water heating equipment can be assumed to meet these requirements.
17. Water-heating equipment must be provided with controls that allow the user to set the water temperature to 110 degrees F for dwelling units and 90 degrees F for other occupancies. Controls must limit output temperatures of lavatories in public facility restrooms to 110 degrees F.
18. Hot water space-heating systems with a capacity exceeding 300 kBtu/h supplying heated water to comfort conditioning systems must include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature. Exceptions: - Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidification, or dehumidification systems. - Hydronic systems that use variable flow to reduce pumping energy.
19. Chilled water space-cooling systems with a capacity exceeding 300 kBtu/h supplying chilled water for comfort conditioning systems must include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature. Exceptions: - Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidification, or dehumidification systems. - Hydronic

systems that use variable flow to reduce pumping energy.

20. Stair and elevator shaft vents must be equipped with motorized dampers capable of being automatically closed during normal building operation and interlocked to open as required by fire and smoke detection systems. All gravity outdoor air supply and exhaust hoods, vents, and ventilators must be equipped with motorized dampers that will automatically shut when the spaces served are not in use. Exceptions: - Gravity (non-motorized) dampers are acceptable in buildings less than three stories in height above grade. - Ventilation systems serving unconditioned spaces.
21. Hydronic systems that use a common return system for both hot water and chilled water must not be used.