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The Rest of My Family, for pretending to understand what I'm talking about. That read, I'll be proud if you get this far!

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And last, but not least,

My Fellow AE's, for making the past four years the most enjoyable experience of my life. Thanks for all the friendships, the laughs, the help, the parties, and putting up with me. May the future hold nothing but good things for all of you!

THANK YOU!

A. STRUCTURAL APPENDIX

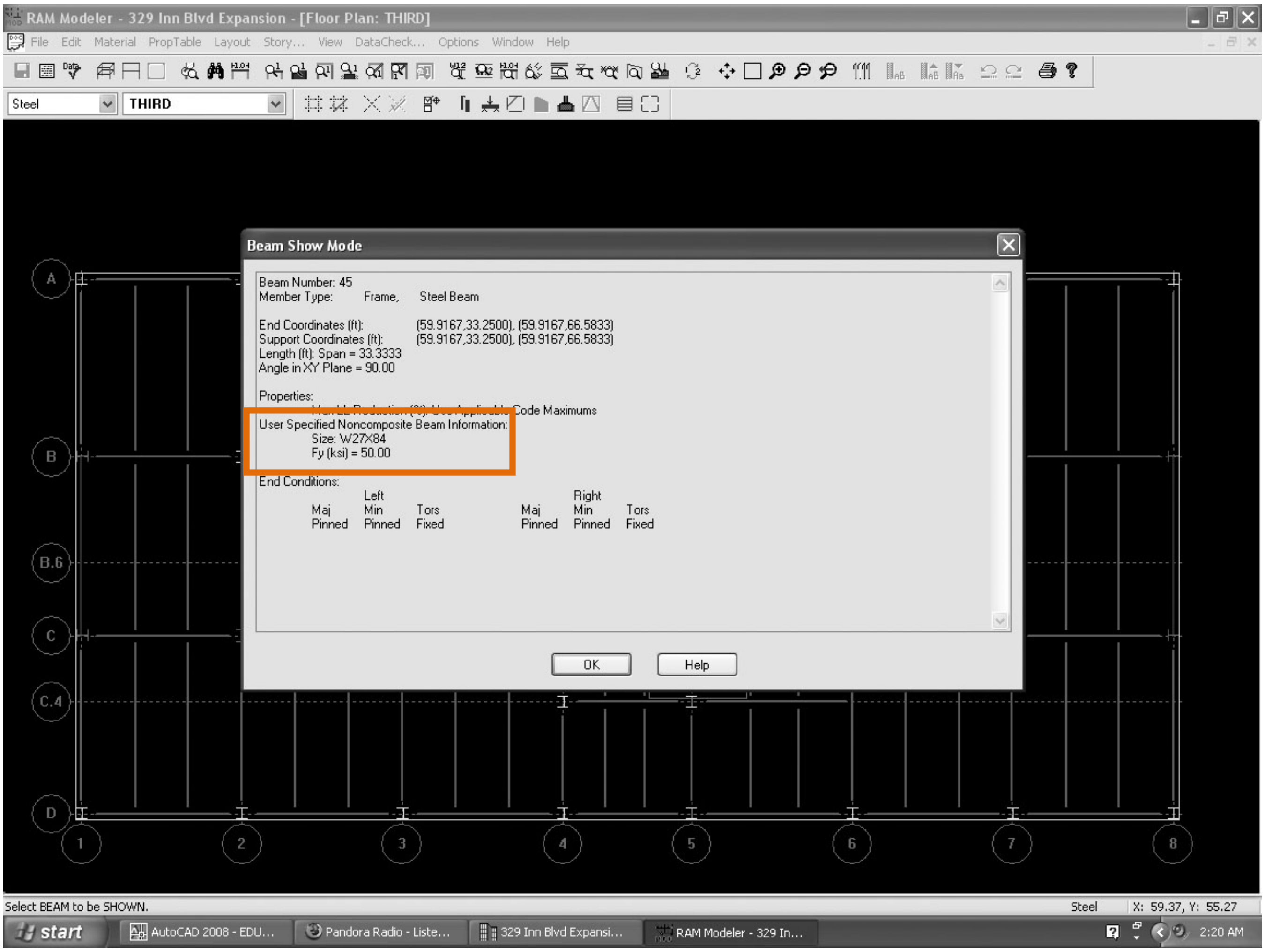
CALCULATIONS

Numerous calculations are available upon request, they include:

- Lateral Loads
    - Story Forces
    - Story Shears
- RAM Structural System Output
- RAM Structural System Models
- RAM Structural System Hand Calcs (Spot-Checks)
- Connection Hand Calculations
- Trace 700 Output

This Appendix includes RAM Output utilized in the report.

RAM DESIGN PARAMETERS



```
Beam Number: 45
Member Type:        Frame,     Steel Beam

End Coordinates (ft):          (59.9167,33.2500), (59.9167,66.5833)
Support Coordinates (ft):      (59.9167,33.2500), (59.9167,66.5833)
Length (ft): Span = 33.3333
Angle in XY Plane = 90.00

Properties:
          Max LL Reduction (%): Use Applicable Code Maximums
User Specified Noncomposite Beam Information:
          Size: W27X84
          Fy (ksi) = 50.00
End Conditions:
                    Left                                Right
          Maj       Min       Tors            Maj       Min       Tors
          Pinned    Pinned    Fixed           Pinned    Pinned    Fixed
```

THE BEAMS WERE DESIGNED AS <u>NONCOMPOSITE</u>.

ASCE SEISMIC VALUES

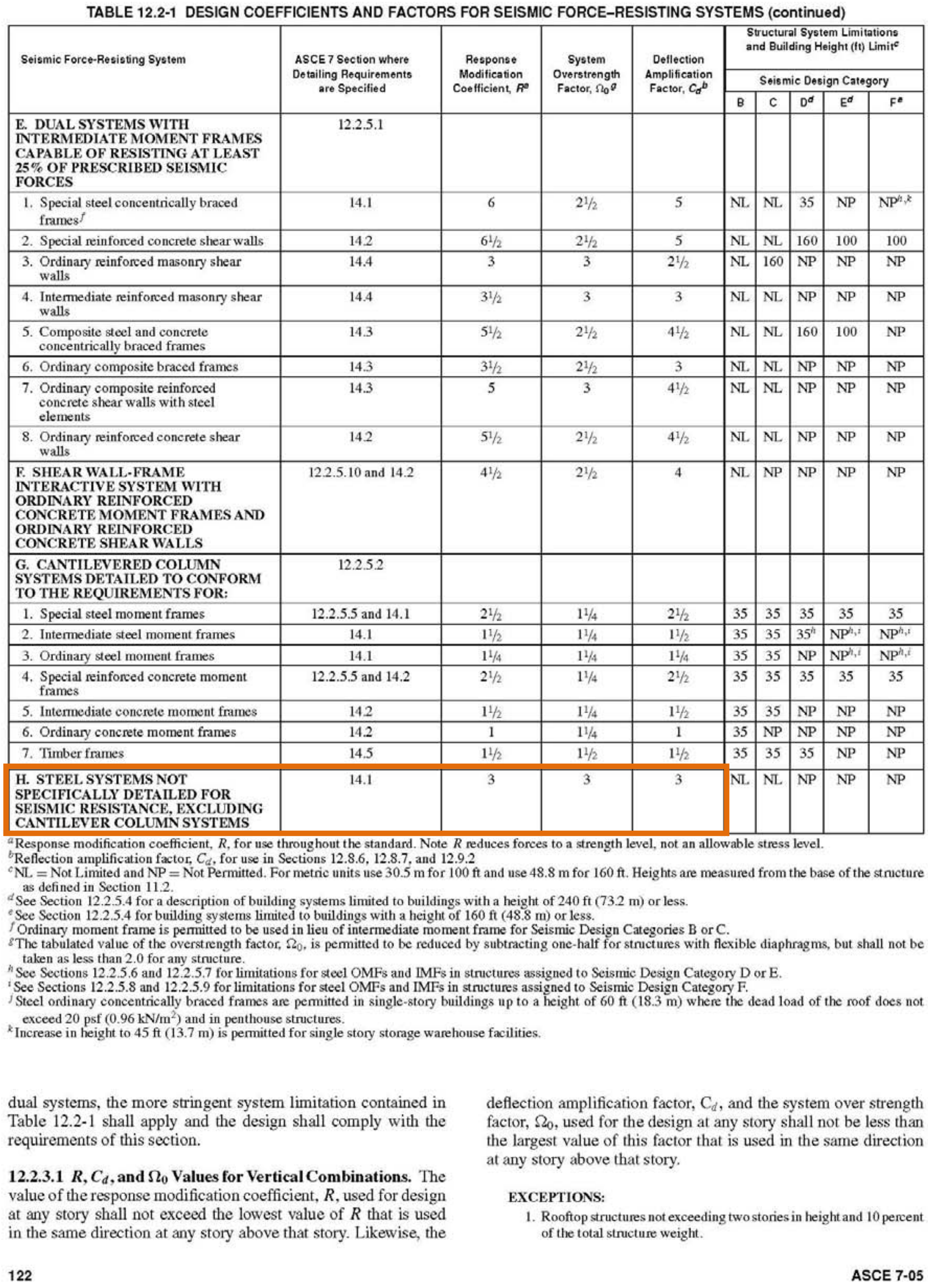


TABLE 12.2-1 DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC FORCE–RESISTING SYSTEMS (continued)

Seismic Force-Resisting System	ASCE 7 Section where Detailing Requirements are Specified	Response Modification Coefficient, R^a	System Overstrength Factor, $\Omega_0{}^g$	Deflection Amplification Factor, $C_d{}^b$	Structural System Limitations and Building Height (ft) Limit[c]				
					Seismic Design Category				
					B	C	D[d]	E[d]	F[e]
E. DUAL SYSTEMS WITH INTERMEDIATE MOMENT FRAMES CAPABLE OF RESISTING AT LEAST 25% OF PRESCRIBED SEISMIC FORCES	12.2.5.1								
1. Special steel concentrically braced frames[f]	14.1	6	2½	5	NL	NL	35	NP	NP[h,k]
2. Special reinforced concrete shear walls	14.2	6½	2½	5	NL	NL	160	100	100
3. Ordinary reinforced masonry shear walls	14.4	3	3	2½	NL	160	NP	NP	NP
4. Intermediate reinforced masonry shear walls	14.4	3½	3	3	NL	NL	NP	NP	NP
5. Composite steel and concrete concentrically braced frames	14.3	5½	2½	4½	NL	NL	160	100	NP
6. Ordinary composite braced frames	14.3	3½	2½	3	NL	NL	NP	NP	NP
7. Ordinary composite reinforced concrete shear walls with steel elements	14.3	5	3	4½	NL	NL	NP	NP	NP
8. Ordinary reinforced concrete shear walls	14.2	5½	2½	4½	NL	NL	NP	NP	NP
F. SHEAR WALL-FRAME INTERACTIVE SYSTEM WITH ORDINARY REINFORCED CONCRETE MOMENT FRAMES AND ORDINARY REINFORCED CONCRETE SHEAR WALLS	12.2.5.10 and 14.2	4½	2½	4	NL	NP	NP	NP	NP
G. CANTILEVERED COLUMN SYSTEMS DETAILED TO CONFORM TO THE REQUIREMENTS FOR:	12.2.5.2								
1. Special steel moment frames	12.2.5.5 and 14.1	2½	1¼	2½	35	35	35	35	35
2. Intermediate steel moment frames	14.1	1½	1¼	1½	35	35	35[h]	NP[h,i]	NP[h,i]
3. Ordinary steel moment frames	14.1	1¼	1¼	1¼	35	35	NP	NP[h,i]	NP[h,i]
4. Special reinforced concrete moment frames	12.2.5.5 and 14.2	2½	1¼	2½	35	35	35	35	35
5. Intermediate concrete moment frames	14.2	1½	1¼	1½	35	35	NP	NP	NP
6. Ordinary concrete moment frames	14.2	1	1¼	1	35	NP	NP	NP	NP
7. Timber frames	14.5	1½	1½	1½	35	35	35	NP	NP
H. STEEL SYSTEMS NOT SPECIFICALLY DETAILED FOR SEISMIC RESISTANCE, EXCLUDING CANTILEVER COLUMN SYSTEMS	14.1	3	3	3	NL	NL	NP	NP	NP

[a] Response modification coefficient, R, for use throughout the standard. Note R reduces forces to a strength level, not an allowable stress level.
[b] Reflection amplification factor, C_d, for use in Sections 12.8.6, 12.8.7, and 12.9.2
[c] NL = Not Limited and NP = Not Permitted. For metric units use 30.5 m for 100 ft and use 48.8 m for 160 ft. Heights are measured from the base of the structure as defined in Section 11.2.
[d] See Section 12.2.5.4 for a description of building systems limited to buildings with a height of 240 ft (73.2 m) or less.
[e] See Section 12.2.5.4 for building systems limited to buildings with a height of 160 ft (48.8 m) or less.
[f] Ordinary moment frame is permitted to be used in lieu of intermediate moment frame for Seismic Design Categories B or C.
[g] The tabulated value of the overstrength factor, Ω_0, is permitted to be reduced by subtracting one-half for structures with flexible diaphragms, but shall not be taken as less than 2.0 for any structure.
[h] See Sections 12.2.5.6 and 12.2.5.7 for limitations for steel OMFs and IMFs in structures assigned to Seismic Design Category D or E.
[i] See Sections 12.2.5.8 and 12.2.5.9 for limitations for steel OMFs and IMFs in structures assigned to Seismic Design Category F.
[j] Steel ordinary concentrically braced frames are permitted in single-story buildings up to a height of 60 ft (18.3 m) where the dead load of the roof does not exceed 20 psf (0.96 kN/m^2) and in penthouse structures.
[k] Increase in height to 45 ft (13.7 m) is permitted for single story storage warehouse facilities.

dual systems, the more stringent system limitation contained in Table 12.2-1 shall apply and the design shall comply with the requirements of this section.

12.2.3.1 R, C_d, and Ω_0 Values for Vertical Combinations. The value of the response modification coefficient, R, used for design at any story shall not exceed the lowest value of R that is used in the same direction at any story above that story. Likewise, the deflection amplification factor, C_d, and the system over strength factor, Ω_0, used for the design at any story shall not be less than the largest value of this factor that is used in the same direction at any story above that story.

EXCEPTIONS:

1. Rooftop structures not exceeding two stories in height and 10 percent of the total structure weight.

12.7.4 Interaction Effects. Moment-resisting frames that are enclosed or adjoined by elements that are more rigid and not considered to be part of the seismic force–resisting system shall be designed so that the action or failure of those elements will not impair the vertical load and seismic force–resisting capability of the frame. The design shall provide for the effect of these rigid elements on the structural system at structural deformations corresponding to the design story drift (Δ) as determined in Section 12.8.6. In addition, the effects of these elements shall be considered where determining whether a structure has one or more of the irregularities defined in Section 12.3.2.

12.8 EQUIVALENT LATERAL FORCE PROCEDURE

12.8.1 Seismic Base Shear. The seismic base shear, V, in a given direction shall be determined in accordance with the following equation:

$$V = C_s W \tag{12.8-1}$$

where

C_s = the seismic response coefficient determined in accordance with Section 12.8.1.1

W = the effective seismic weight per Section 12.7.2.

12.8.1.1 Calculation of Seismic Response Coefficient. The seismic response coefficient, C_s, shall be determined in accordance with Eq. 12.8-2.

$$C_s = \frac{S_{DS}}{\left(\frac{R}{I}\right)} \tag{12.8-2}$$

where

S_{DS} = the design spectral response acceleration parameter in the short period range as determined from Section 11.4.4

R = the response modification factor in Table 12.2-1

I = the occupancy importance factor determined in accordance with Section 11.5.1

The value of C_s computed in accordance with Eq. 12.8-2 need not exceed the following:

$$C_s = \frac{S_{D1}}{T\left(\frac{R}{I}\right)} \quad \text{for } T \le T_L \tag{12.8-3}$$

$$C_s = \frac{S_{D1}T_L}{T^2\left(\frac{R}{I}\right)} \quad \text{for } T > T_L \tag{12.8-4}$$

C_s shall not be less than

$$C_s = 0.01 \tag{12.8-5}$$

In addition, for structures located where S_1 is equal to or greater than $0.6g$, C_s shall not be less than

$$C_s = \frac{0.5S_1}{\left(\frac{R}{I}\right)} \tag{12.8-6}$$

where I and R are as defined in Section 12.8.1.1 and

S_{D1} = the design spectral response acceleration parameter at a period of 1.0 s, as determined from Section 11.4.4

T = the fundamental period of the structure (s) determined in Section 12.8.2

T_L = long-period transition period (s) determined in Section 11.4.5

S_1 = the mapped maximum considered earthquake spectral response acceleration parameter determined in accordance with Section 11.4.1

TABLE 12.8-1 COEFFICIENT FOR UPPER LIMIT ON CALCULATED PERIOD

Design Spectral Response Acceleration Parameter at 1 s, S_{D1}	Coefficient C_u
≥ 0.4	1.4
0.3	1.4
0.2	1.5
0.15	1.6
≤ 0.1	1.7

12.8.1.2 Soil Structure Interaction Reduction. A soil structure interaction reduction is permitted where determined using Chapter 19 or other generally accepted procedures approved by the authority having jurisdiction.

12.8.1.3 Maximum S_s Value in Determination of C_s. For regular structures five stories or less in height and having a period, T, of 0.5 s or less, C_s is permitted to be calculated using a value of 1.5 for S_S.

12.8.2 Period Determination. The fundamental period of the structure, T, in the direction under consideration shall be established using the structural properties and deformational characteristics of the resisting elements in a properly substantiated analysis. The fundamental period, T, shall not exceed the product of the coefficient for upper limit on calculated period (C_u) from Table 12.8-1 and the approximate fundamental period, T_a, determined from Eq. 12.8-7. As an alternative to performing an analysis to determine the fundamental period, T, it is permitted to use the approximate building period, T_a, calculated in accordance with Section 12.8.2.1, directly.

12.8.2.1 Approximate Fundamental Period. The approximate fundamental period (T_a), in s, shall be determined from the following equation:

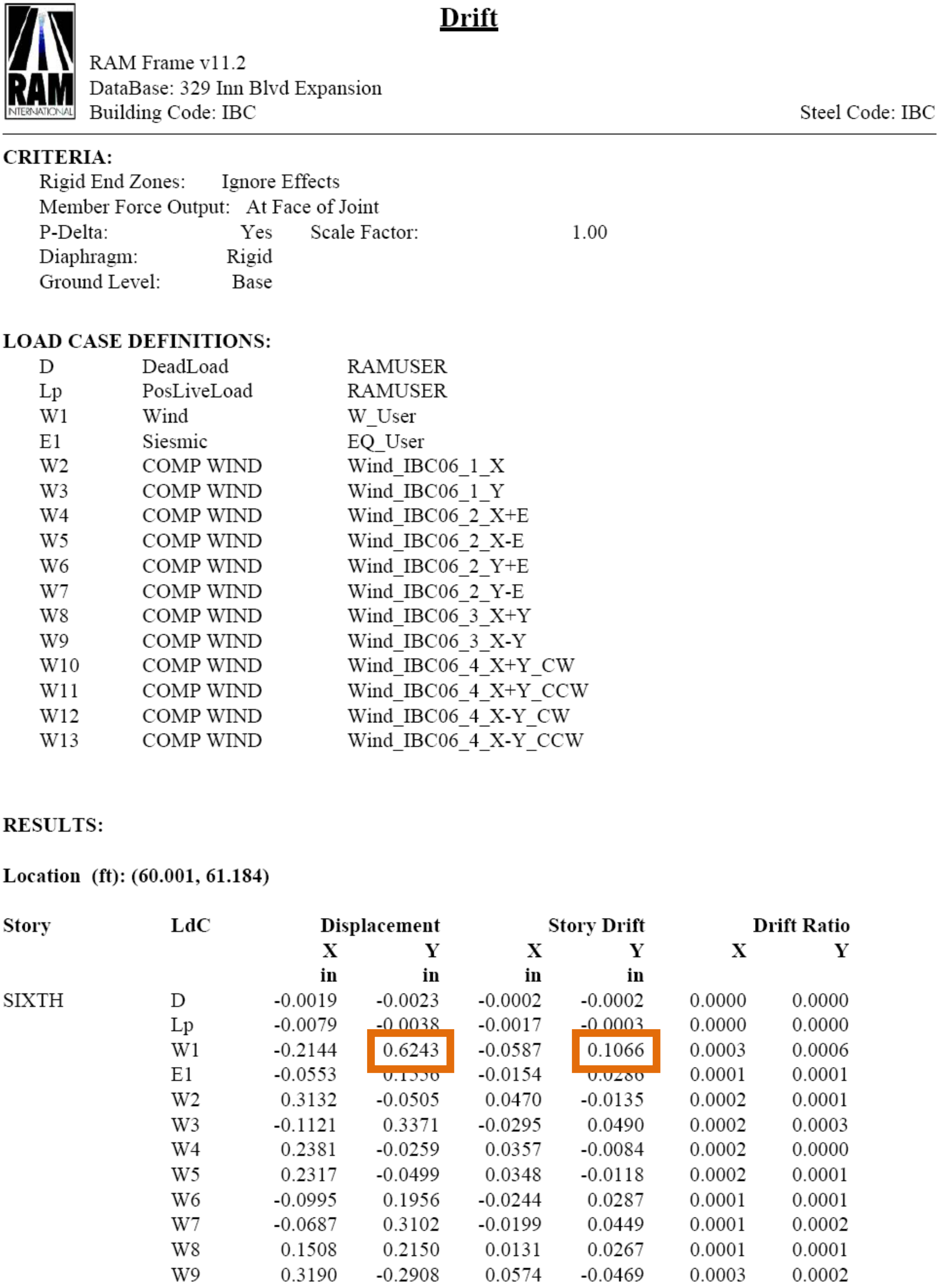
$$T_a = C_t h_n^x \tag{12.8-7}$$

where h_n is the height in ft above the base to the highest level of the structure and the coefficients C_t and x are determined from Table 12.8-2.

TABLE 12.8-2 VALUES OF APPROXIMATE PERIOD PARAMETERS C_t AND x

Structure Type	C_t	x
Moment-resisting frame systems in which the frames resist 100% of the required seismic force and are not enclosed or adjoined by components that are more rigid and will prevent the frames from deflecting where subjected to seismic forces:		
Steel moment-resisting frames	0.028 (0.0724)[a]	0.8
Concrete moment-resisting frames	0.016 (0.0466)[a]	0.9
Eccentrically braced steel frames	0.03 (0.0731)[a]	0.75
All other structural systems	0.02 (0.0488)[a]	0.75

[a] Metric equivalents are shown in parentheses.



Drift

RAM Frame v11.2
DataBase: 329 Inn Blvd Expansion
Building Code: IBC

Steel Code: IBC

CRITERIA:

Rigid End Zones:	Ignore Effects		
Member Force Output:	At Face of Joint		
P-Delta:	Yes	Scale Factor:	1.00
Diaphragm:	Rigid		
Ground Level:	Base		

LOAD CASE DEFINITIONS:

D	DeadLoad	RAMUSER
Lp	PosLiveLoad	RAMUSER
W1	Wind	W_User
E1	Siesmic	EQ_User
W2	COMP WIND	Wind_IBC06_1_X
W3	COMP WIND	Wind_IBC06_1_Y
W4	COMP WIND	Wind_IBC06_2_X+E
W5	COMP WIND	Wind_IBC06_2_X-E
W6	COMP WIND	Wind_IBC06_2_Y+E
W7	COMP WIND	Wind_IBC06_2_Y-E
W8	COMP WIND	Wind_IBC06_3_X+Y
W9	COMP WIND	Wind_IBC06_3_X-Y
W10	COMP WIND	Wind_IBC06_4_X+Y_CW
W11	COMP WIND	Wind_IBC06_4_X+Y_CCW
W12	COMP WIND	Wind_IBC06_4_X-Y_CW
W13	COMP WIND	Wind_IBC06_4_X-Y_CCW

RESULTS:

Location (ft): (60.001, 61.184)

Story	LdC	Displacement		Story Drift		Drift Ratio	
		X	Y	X	Y	X	Y
		in	in	in	in		
SIXTH	D	-0.0019	-0.0023	-0.0002	-0.0002	0.0000	0.0000
	Lp	-0.0079	-0.0038	-0.0017	-0.0003	0.0000	0.0000
	W1	-0.2144	0.6243	-0.0587	0.1066	0.0003	0.0006
	E1	-0.0553	0.1556	-0.0154	0.0286	0.0001	0.0001
	W2	0.3132	-0.0505	0.0470	-0.0135	0.0002	0.0001
	W3	-0.1121	0.3371	-0.0295	0.0490	0.0002	0.0003
	W4	0.2381	-0.0259	0.0357	-0.0084	0.0002	0.0000
	W5	0.2317	-0.0499	0.0348	-0.0118	0.0002	0.0001
	W6	-0.0995	0.1956	-0.0244	0.0287	0.0001	0.0001
	W7	-0.0687	0.3102	-0.0199	0.0449	0.0001	0.0002
	W8	0.1508	0.2150	0.0131	0.0267	0.0001	0.0001
	W9	0.3190	-0.2908	0.0574	-0.0469	0.0003	0.0002

Drift

RAM Frame v11.2
DataBase: 329 Inn Blvd Expansion
Building Code: IBC

Steel Code: IBC

Story	LdC	Displacement		Story Drift		Drift Ratio	
	W10	0.1271	0.2132	0.0118	0.0274	0.0001	0.0001
	W11	0.0991	0.1093	0.0078	0.0126	0.0000	0.0001
	W12	0.2533	-0.1661	0.0450	-0.0278	0.0002	0.0001
	W13	0.2253	-0.2700	0.0410	-0.0425	0.0002	0.0002
FIFTH	D	-0.0017	-0.0021	-0.0006	-0.0010	0.0000	0.0000
	Lp	-0.0061	-0.0035	-0.0021	-0.0020	0.0000	0.0000
	W1	-0.1556	0.5178	-0.0471	0.1061	0.0003	0.0006
	E1	-0.0399	0.1270	-0.0122	0.0283	0.0001	0.0002
	W2	0.2662	-0.0371	0.0505	-0.0115	0.0003	0.0001
	W3	-0.0826	0.2881	-0.0246	0.0546	0.0001	0.0003
	W4	0.2024	-0.0175	0.0384	-0.0067	0.0002	0.0000
	W5	0.1969	-0.0381	0.0374	-0.0105	0.0002	0.0001
	W6	-0.0752	0.1669	-0.0209	0.0317	0.0001	0.0002
	W7	-0.0488	0.2653	-0.0160	0.0501	0.0001	0.0003
	W8	0.1377	0.1883	0.0194	0.0323	0.0001	0.0002
	W9	0.2617	-0.2439	0.0563	-0.0495	0.0003	0.0003
	W10	0.1153	0.1858	0.0168	0.0326	0.0001	0.0002
	W11	0.0913	0.0966	0.0123	0.0159	0.0001	0.0001
	W12	0.2082	-0.1383	0.0445	-0.0288	0.0003	0.0002
	W13	0.1843	-0.2275	0.0400	-0.0455	0.0002	0.0003
FOURTH	D	-0.0011	-0.0011	-0.0006	-0.0009	0.0000	0.0000
	Lp	-0.0041	-0.0015	-0.0019	-0.0017	0.0000	0.0000
	W1	-0.1085	0.4116	-0.0466	0.1142	0.0003	0.0007
	E1	-0.0276	0.0986	-0.0121	0.0298	0.0001	0.0002
	W2	0.2157	-0.0256	0.0553	-0.0108	0.0003	0.0001
	W3	-0.0580	0.2335	-0.0243	0.0606	0.0001	0.0004
	W4	0.1640	-0.0108	0.0420	-0.0059	0.0003	0.0000
	W5	0.1596	-0.0275	0.0409	-0.0103	0.0002	0.0001
	W6	-0.0542	0.1352	-0.0211	0.0350	0.0001	0.0002
	W7	-0.0328	0.2151	-0.0155	0.0559	0.0001	0.0003
	W8	0.1183	0.1560	0.0232	0.0374	0.0001	0.0002
	W9	0.2053	-0.1943	0.0597	-0.0536	0.0004	0.0003
	W10	0.0984	0.1532	0.0199	0.0375	0.0001	0.0002
	W11	0.0790	0.0807	0.0149	0.0185	0.0001	0.0001
	W12	0.1637	-0.1095	0.0473	-0.0307	0.0003	0.0002
	W13	0.1443	-0.1820	0.0422	-0.0496	0.0003	0.0003
THIRD	D	-0.0006	-0.0001	-0.0003	-0.0002	0.0000	0.0000
	Lp	-0.0022	0.0002	-0.0012	-0.0002	0.0000	0.0000
	W1	-0.0619	0.2975	-0.0310	0.1126	0.0002	0.0007
	E1	-0.0155	0.0689	-0.0078	0.0281	0.0000	0.0002
	W2	0.1605	-0.0148	0.0567	-0.0080	0.0003	0.0000
	W3	-0.0337	0.1729	-0.0169	0.0641	0.0001	0.0004

Drift

RAM Frame v11.2
DataBase: 329 Inn Blvd Expansion
Building Code: IBC

Steel Code: IBC

Story	LdC	Displacement		Story Drift		Drift Ratio	
	W4	0.1220	-0.0049	0.0432	-0.0036	0.0003	0.0000
	W5	0.1187	-0.0173	0.0419	-0.0084	0.0002	0.0000
	W6	-0.0332	0.1001	-0.0157	0.0366	0.0001	0.0002
	W7	-0.0173	0.1592	-0.0096	0.0595	0.0001	0.0004
	W8	0.0951	0.1186	0.0299	0.0421	0.0002	0.0003
	W9	0.1456	-0.1408	0.0552	-0.0540	0.0003	0.0003
	W10	0.0785	0.1157	0.0251	0.0419	0.0001	0.0002
	W11	0.0641	0.0622	0.0196	0.0212	0.0001	0.0001
	W12	0.1164	-0.0788	0.0441	-0.0302	0.0003	0.0002
	W13	0.1020	-0.1324	0.0386	-0.0509	0.0002	0.0003
SECOND	D	-0.0002	0.0001	-0.0002	0.0001	0.0000	0.0000
	Lp	-0.0010	0.0004	-0.0009	0.0004	0.0000	0.0000
	W1	-0.0308	0.1849	-0.0297	0.1041	0.0002	0.0006
	E1	-0.0077	0.0408	-0.0075	0.0246	0.0000	0.0001
	W2	0.1038	-0.0068	0.0606	-0.0064	0.0004	0.0000
	W3	-0.0168	0.1088	-0.0162	0.0602	0.0001	0.0004
	W4	0.0789	-0.0014	0.0460	-0.0028	0.0003	0.0000
	W5	0.0768	-0.0089	0.0449	-0.0069	0.0003	0.0000
	W6	-0.0175	0.0635	-0.0148	0.0354	0.0001	0.0002
	W7	-0.0077	0.0997	-0.0095	0.0549	0.0001	0.0003
	W8	0.0652	0.0765	0.0333	0.0403	0.0002	0.0002
	W9	0.0904	-0.0868	0.0576	-0.0499	0.0003	0.0003
	W10	0.0534	0.0738	0.0274	0.0391	0.0002	0.0002
	W11	0.0445	0.0410	0.0226	0.0214	0.0001	0.0001
	W12	0.0723	-0.0487	0.0456	-0.0286	0.0003	0.0002
	W13	0.0634	-0.0815	0.0408	-0.0463	0.0002	0.0003
FIRST	D	-0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000
	Lp	-0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000
	W1	-0.0011	0.0808	-0.0011	0.0808	0.0000	0.0005
	E1	-0.0003	0.0162	-0.0003	0.0162	0.0000	0.0001
	W2	0.0431	-0.0004	0.0431	-0.0004	0.0003	0.0000
	W3	-0.0006	0.0487	-0.0006	0.0487	0.0000	0.0003
	W4	0.0328	0.0014	0.0328	0.0014	0.0002	0.0000
	W5	0.0319	-0.0020	0.0319	-0.0020	0.0002	0.0000
	W6	-0.0027	0.0282	-0.0027	0.0282	0.0000	0.0002
	W7	0.0018	0.0449	0.0018	0.0449	0.0000	0.0003
	W8	0.0319	0.0362	0.0319	0.0362	0.0002	0.0002
	W9	0.0328	-0.0368	0.0328	-0.0368	0.0002	0.0002
	W10	0.0260	0.0347	0.0260	0.0347	0.0002	0.0002
	W11	0.0219	0.0196	0.0219	0.0196	0.0001	0.0001
	W12	0.0266	-0.0201	0.0266	-0.0201	0.0002	0.0001
	W13	0.0226	-0.0352	0.0226	-0.0352	0.0001	0.0002

Criteria, Mass and Exposure Data

RAM Frame v11.2
DataBase: 329 Inn Blvd Expansion

CRITERIA:

Rigid End Zones: Ignore Effects
Member Force Output: At Face of Joint
P-Delta: Yes Scale Factor: 1.00
Ground Level: Base
Wall Mesh Criteria :
    Wall Element Type : Shell Element with No Out-of-Plane Stiffness
    Max. Allowed Distance between Nodes (ft) : 8.00

DIAPHRAGM DATA:

Story	Diaph #	Diaph Type
SIXTH	1	Rigid
FIFTH	1	Rigid
FOURTH	1	Rigid
THIRD	1	Rigid
SECOND	1	Rigid
FIRST	1	Rigid

Disconnect Internal Nodes of Beams: Yes
Disconnect Nodes outside Slab Boundary: Yes

STORY MASS DATA:

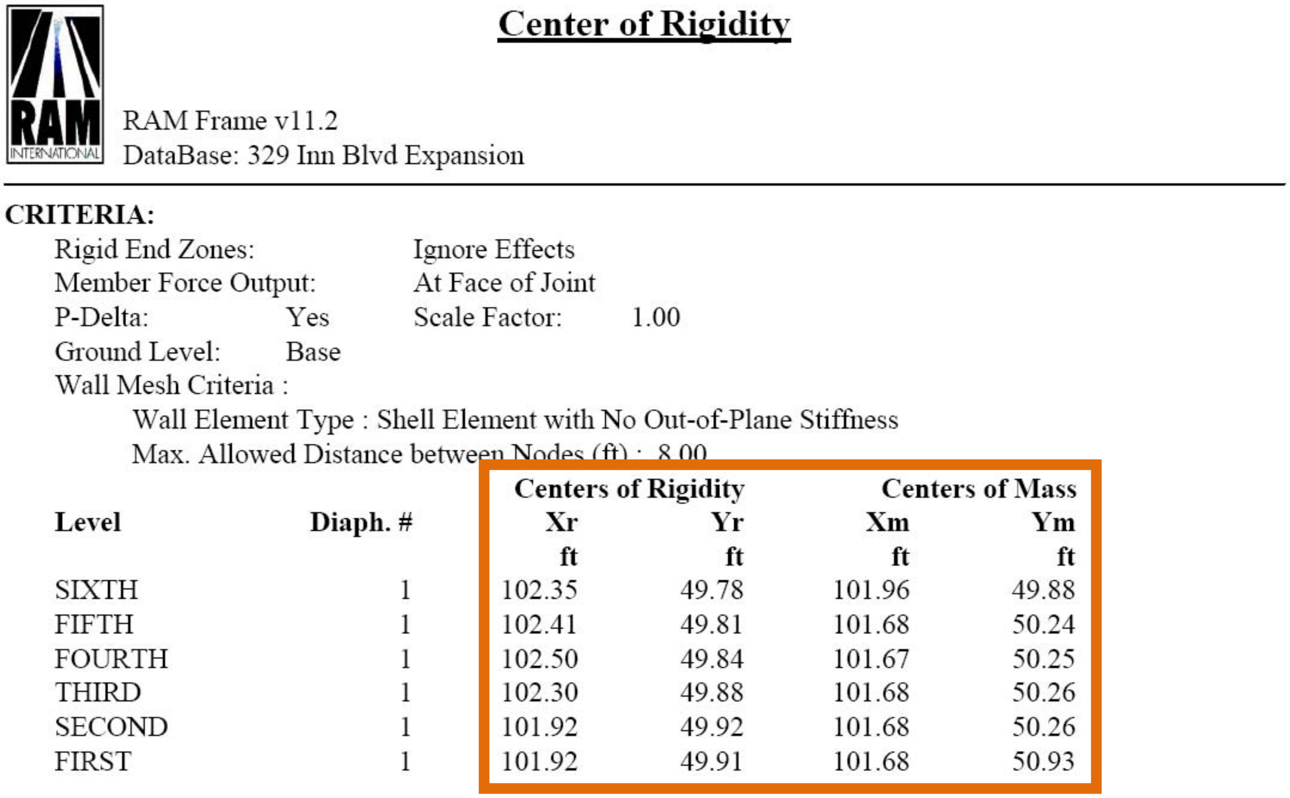
Includes Self Mass of:

Beams
Columns (Half mass of columns above and below)
Walls (Half mass of walls above and below)
Slabs/Deck

Calculated Values:

Story	Diaph #	Weight kips	Mass k-s2/ft	MMI ft-k-s2	Xm ft	Ym ft	EccX ft	EccY ft
SIXTH	1	1070.0	33.23	145572	101.96	49.88	10.25	5.05
FIFTH	1	1114.1	34.60	156587	101.68	50.24	10.30	5.10
FOURTH	1	1113.5	34.58	156433	101.67	50.25	10.30	5.10
THIRD	1	1168.5	36.29	164603	101.68	50.26	10.30	5.10
SECOND	1	1172.9	36.43	165325	101.68	50.26	10.30	5.10
FIRST	1	1158.6	35.98	164444	101.68	50.93	10.30	5.10

Story	Diaph #	Combine
SIXTH	1	None
FIFTH	1	None
FOURTH	1	None
THIRD	1	None
SECOND	1	None
FIRST	1	None



Center of Rigidity

RAM Frame v11.2
DataBase: 329 Inn Blvd Expansion

CRITERIA:

Rigid End Zones:		Ignore Effects	
Member Force Output:		At Face of Joint	
P-Delta:	Yes	Scale Factor:	1.00
Ground Level:	Base		

Wall Mesh Criteria :
Wall Element Type : Shell Element with No Out-of-Plane Stiffness
Max. Allowed Distance between Nodes (ft) : 8.00

Level	**Diaph. #**	**Centers of Rigidity** **Xr** **ft**	 **Yr** **ft**	**Centers of Mass** **Xm** **ft**	 **Ym** **ft**
SIXTH	1	102.35	49.78	101.96	49.88
FIFTH	1	102.41	49.81	101.68	50.24
FOURTH	1	102.50	49.84	101.67	50.25
THIRD	1	102.30	49.88	101.68	50.26
SECOND	1	101.92	49.92	101.68	50.26
FIRST	1	101.92	49.91	101.68	50.93

ABP Wall Panel Specifications

Thermal Properties - Test Data

Description:	The ABP Wall Panel is similar in appearance to the IPP panel. The exterior profile is asymmetrical with expanded flat areas to reduce shadow lines. As with all IPS panels, the interior skin is fabricated in the Mesa profile.
Dimensions:	The product is available in 2", 2-1/2", or 3", thick and can achieve R-Values to 23.9. The manufactured net width can be 36" or 42". Typical embossed exterior skins are provided in 24 or 22 gauge steel. The maximum recommended length for the ABP Panel is 30'0". Contact IPS for panel length options. Panel connections are made into structural members with concealed clips and fasteners.
Material:	Exterior - 24 ga. steel (std). 22 ga. also available. Interior - 26 ga. steel (std). 24 and 22 ga. also available.
Finish Options:	Exterior - Signature® 200 (silicone polyester) Signature® 300 (Kynar 500®/Hylar 5000®) Interior - USDA White (standard) Signature® 200 (silicone polyester)
Colors:	IPS Panel Color and Finish Guide
Texture:	The exterior and interior skins are embossed only.
Length:	The maximum recommended length is 30' 0". Contact IPS for panel length options. IPS offers standard details for stack joint applications for walls over 30' 0" high.
Fasteners:	Concealed, 14 ga. steel clip.

Thermal Properties

ABP Wall Panel			
Product Code	Thickness	"U" Factor	"R" Factor
ABP 200	2"	.063	16.0
ABP 250	2 1/2"	.050	19.9
ABP 300	3"	.042	23.9

Note: Insulation values determined by tests conducted in accordance with ASTM C236 at a mean temperature of 75 degrees F., winter condition corrected to 15 mph outside and still inside.

5500 ISOWEB® WINDOW

NOVEMBER, 2007

THERMAL TRANSMITTANCE

E.C. 97902-08

For some regions and projects there may be minimum energy efficiency requirements for the building envelope, and its components, including windows. The shading coefficient (SC) and the thermal transmittance (U - value) of the window is then required to determine whether the building design complies with the specified energy requirements. Shading coefficient depends on the glass selected and should be obtained from the glass supplier. The U - value of the window varies with the type of glass and sealed unit edge construction, the window frame, and the relative areas of these components.

The window thermal transmittance values (U - values) shown in the chart below are based on CSA - A440.2 "Energy Performance Evaluation of Windows and Sliding Glass Doors." U - values of the centre of glass, edge of glass, and frame areas were computed using the VISION and FRAME thermal simulation programs. Overall window U - values were calculated using the following relationship:

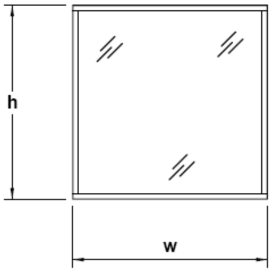
$$U_w = (U_c A_c + U_e A_e + U_f A_f)/A_w$$

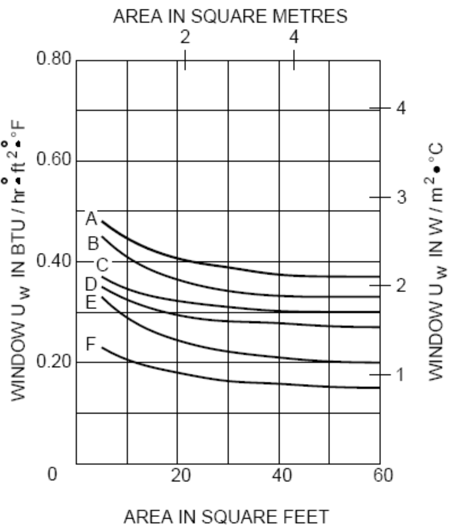
where

U_w = U-value of complete window product
U_c = calculated centre of glass U-value
U_e = calculated edge of glass U-value
U_f = calculated frame U-value
A_c = centre of glass area
A_e = edge of glass area
A_f = frame area
A_w = total window area

OVERALL WINDOW U-VALUE (U_w)

For fixed and operating window configurations as shown with height (h) equal to width (w).





SEALED UNIT GLAZING TYPE

A = 6mm clear / ½" air / 6mm low-e[1] / metal spacer
B = 6mm clear / ½" argon / 6mm low-e[1] / metal spacer
C = 6mm clear / ½" argon / 6mm low-e[1] / warm edge spacer[3]
D = 6mm clear / ½" argon / 6mm low-e[2] / warm edge spacer[3]
[illegible]
F = 6mm clear / ½" argon / 6mm low-e[2] / ½"argon / 6mm low-e[2] / warm edge spacer[3]

1 - low-e coating emittance = 0.1
2 - low-e coating emittance = 0.03
3 - Edgetech Super "U" Spacer ®

NOTES: THE ABOVE SEALED UNIT GLAZING OPTIONS ARE PRESENTED FOR THE PURPOSES OF ILLUSTRATING THERMAL PERFORMANCE CAPABILITIES.

FOR WINDOWS WITH HEIGHT NOT EQUAL TO WIDTH, WHEN ADDING INTERMEDIATE VERTICALS OR HORIZONTALS, OR DIFFERENT GLASS INFILL, THE OVERALL WINDOW U - VALUE MAY VARY.

THE SPECIFIER SHOULD SELECT GLASS TO MEET THE PERFORMANCE REQUIREMENTS OF THE PROJECT.

HVAC Equipment Sizing Calcs

"Genius is the infinite capacity for taking pains."
- Jane Ellis Hopkins

"Problems are messages."
Shakti Gawain

Sam Dardano, a Boulder-based code official who chairs the committee of statewide mechanical and plumbing inspectors, reports that by early next year roughly 75 percent of the building jurisdictions in Colorado will be operating under the International Codes. If that's true, here's a key item from the code that can help, not just hurt.

The International Energy Conservation Code (IECC) requires that load calculations be used to size heating and cooling equipment. 11' properly implemented, this could reduce the widespread tendency to oversize equipment. Yet both builders and code officials are uncertain how to evaluate such calculations to assure the results are accurate.

This article presents 10 top items to look for when evaluating HVAC sizing calcs.

Background

An article titled "Bigger is Not Better," Published in the May-June 1995 Home Energy magazine, was one of the first to draw attention to the widespread problem of residential equipment oversizing. A study of design. construction and performance issues in northern Colorado hones built in the mid- to late1990S (fcgov.com/utilities/es-performancestudy.php) was the most recent to confirm that heating and cooling equipment tends to be oversized by substantial margins in this part of the country. The Colorado study showed heating systems were moderately oversized while air conditioning systems were nearly twice as large as needed - averaging 158 percent and 208 percent of design loads, respectively.

Furnace sizing ratios ranged from 106 percent to 234 percent of design heating requirements. Greater oversizing factors were typically observed in homes with insulated basements versus homes with uninsulated basements, suggesting that furnace-sizing practice had not yet reflected the reduction in heating loads due to basement insulation.

Cooling systems ranged from about 143 percent to 322 percent of design cooling requirements.

Note that for every hour of the year when heating and cooling requirements are less demanding than design conditions, the equipment is even further oversized.

Over-sized equipment requires more air flow and larger ductwork; without this, equipment will not operate within manufacturer specifications. Even if ductwork sizing is increased, the oversized equipment will short-cycle. These problems decrease efficiency and equipment life while compromising homeowner comfort. Utilities may be burdened with higher summer peak loads and more blown transformers. Builders and homeowners pay more for oversized systems.

Over-sizing typically occurs when contractors use "rules of thumb," such as "I toil of AC needed per 600 square feet" or other simple sizing approach based on their own experience. In 2000, Hank Rutkowski. author of ACCA Manual J: Residential Load Calculation, estimated that only 5 to 10 percent of' HVAC systems had calculations performed to help size systems. Furthermore, even when load calculations were performed, contractors were inclined to include fudge factors based on past customer complaints about comfort. "I've never been sued for installing too large a system," contractors have stated repeatedly.

In the 8th edition, published in April 2002, Rutkowski wrote, "Manual J calculations should be aggressive, which means the design should take full advantage of legitimate opportunities to minimize the size of estimated loads. In this regard, the practice of manipulating the outdoor design temperature, not taking full credit for efficient construction features, ignoring internal and external window shading devices, and then applying an arbitrary 'safety factor' is indefensible."

It should be noted that oversizing does not address many other related problems that cause homeowners to complain. As noted in the Colorado study. these include problems with excessive solar gain, insulation and air sealing flaws, lack of' ductwork design and many compromises in duct installation (constrictions. leakage, pressure imbalances, no way to balance air flow among branch ducts).

Does the above sound a little academic" It doesn't have to be. Aspen Homes now installs 40,000 Btu to 60,000 Btu furnaces in all their high-performance homes, replacing 100,000 and 120,000 Btu units, respectively, saving $40 to $50 a pop: their air conditioners are similarly downsized, saving at $250-$500.

Ten key sizing factors

1. Use acceptable sizing calculation tool: Most jurisdictions allow calculations based on Manual J (Air Conditioning Contractors of America - an industry trade group). Manual J methods are based on the ASHRAE Handbook of Fundamentals. The 8th Edition of Manual J is the most current; it has been modified to reduce Manual Fs past tendency to enable over-sizing.

2. Outdoor design temperatures: There is considerable room for error here; check to assure the proper winter/summer outdoor design temperatures are used. The IECC specifies using `°97.5 percent values for winter and 2.5 percent values for summer, from tables in the ASHRAE Handbook of Fundamentals." (97.5 percent means during the average winter, the temperature will remain above that temperature 97.5 percent of the time.) Unfortunately, 97.5 percent and 2.5 percent values aren't available in the ASHRAE Handbook any longer. Contact E '-Star (see contact info below) for the comparable list of design temperatures.

In most Denver areas. the winter design temperature should be within a few degrees of 0 (leg. F, and the summer design temperature should he about 92 degrees.

3. Indoor design temperatures: Check to assure that proper indoor design temperatures are used (70 deg. F winter and 75 deg. F summer).

4. Window orientation: While heating equipment sizing is unaffected by window orientation. the impact of orientation on cooling loads can be substantial. In fact, in a new home built to the TECC standard, solar gains through windows are typically the home's largest contributor to peak cooling load up to 50 percent. For production builders, orientation should he considered when calculating cooling equipment size for the same model home placed on lots with different orientations. It should he noted that some homes with predominantly west-facing glass will not be comfortable. during some climate conditions. regardless of system size, without very smart window choices.

5. Reasonable air infiltration assumptions. A few jurisdictions insist that high air-leakage rates be assumed. Many contractors assume high leakage rates. Often, projected house leakage is overestimated, again contributing to over-sizing. House tightness testing results for geographic locations and specific builders should he factored in. A reasonable air leakage assumption: between 0.35 to 0.50 natural air-changes per hour, Unless a builder has data specific to their construction practices indicating they build tighter (or looser). (Engle Homes averages 0.12 air changes - four times tighter than the average home.)

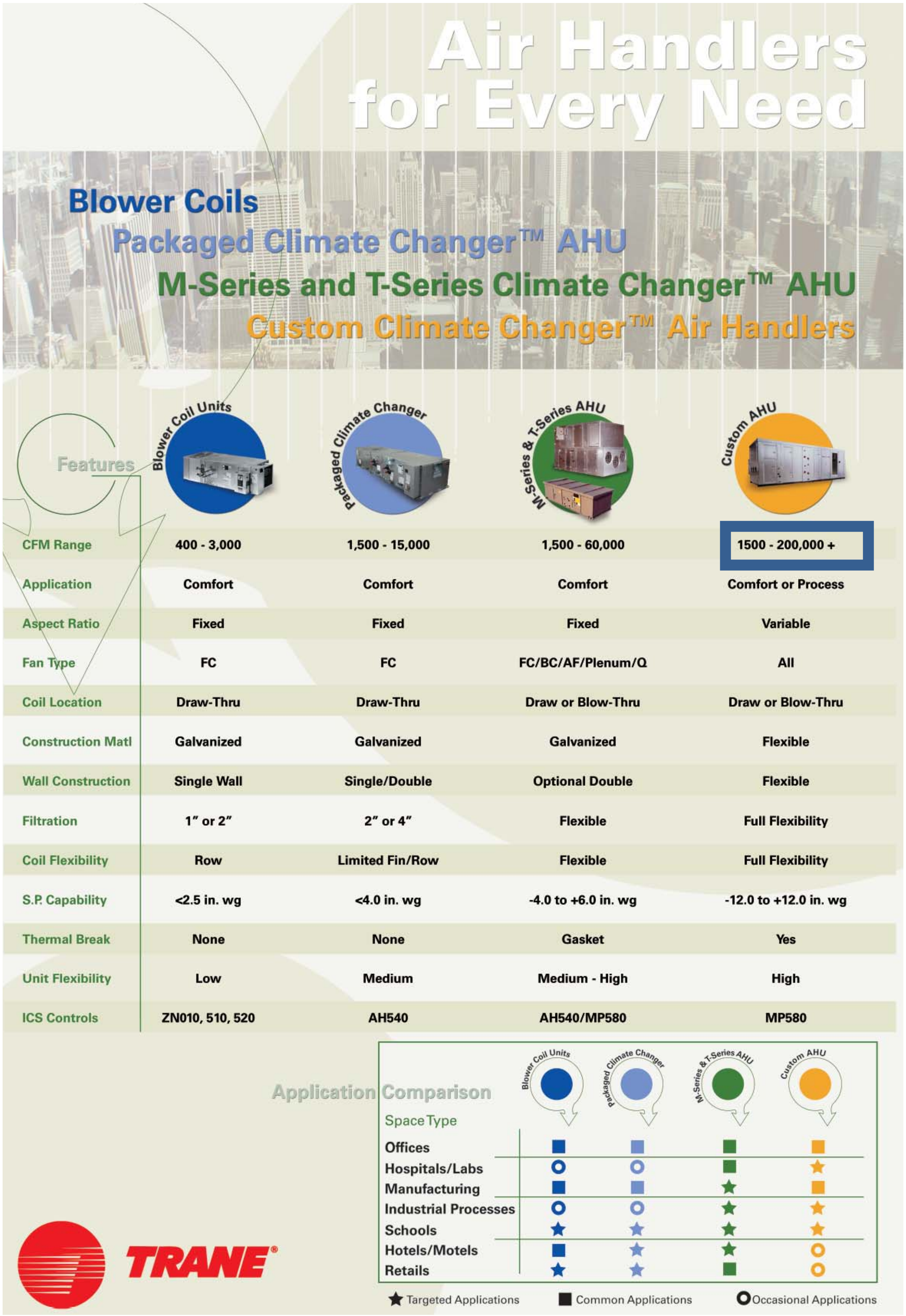
6. Proper energy features. The R-values. U-values and window Solar Heat Gain Coefficients (SHGC) specified on the plans should match those used in the calculations. Foundation insulation and window values are prone to incorrect entry.

7. Duct losses. One figure is entered in the calculation to represent conductive losses from ducts in unconditioned spaces. It is otherwise specified and assumed that ductwork will be "substantially leak free," per code. (The IECC specifics this as being, "5 percent or less of the air handler's rated air-flow when the return grilles and supply registers are sealed off' and the entire distribution system-including the air handler cabinet is pressurized to 0.1-inch w.g. 125 pascals. Unfortunately, random testing in the northern Colorado showed that ductwork leakage averaged 130 percent of the average air-handler's rated air flow). Today, a small but growing number of Colorado HVAC contractors are developing the expertise to design and build tight ductwork. then buying equipment to perform pressure measurements that confirm their results. Duct losses are highly dependent on duct location. The number of ducts in exterior walls, garage ceilings, vented crawl spaces and attics is a critical factor, with respect to losses from both duct leakage and air infiltration. Ducts in the exterior of the envelope must be effectively insulated to a minimum of R8. (IECC 2003)

8. Climatic moisture load factor. The difference between the moisture content of the outdoor air and desired interior humidity is referred to as "design grains." Calculations should use "design grains" applicable to a particular jurisdiction (see Manual J). Latent loads are typically a tiny part of the design cooling load in this climate. In the metro area. designs grains are approximately -40. Latent loads for summer cooling typically in the 1.000 to 2.000 Btu/hr range (varying with house size).

9. Assume shading devices. Even for new homes. the presence of reasonable internal shading devices should be assumed. People can he expected to close their window cover day. Built-in external shading (overhangs, adjacent buildings, etc.) should also be factored in.

10. Capacity margin of selected equipment. This maximum sizing guideline should be followed: "The total capacity (sensible plus latent) of the cooling equipment should not exceed the total load (sensible plus latent) by more than 15 percent for cooling-only applications and warm-climate heat pump applications: or by more than 25 percent for cold-climate applications." (Manual J. 8th Edition)



Air Handlers for Every Need

Blower Coils

Packaged Climate Changer™ AHU

M-Series and T-Series Climate Changer™ AHU

Custom Climate Changer™ Air Handlers

Features	Blower Coil Units	Packaged Climate Changer	M-Series & T-Series AHU	Custom AHU
CFM Range	400 - 3,000	1,500 - 15,000	1,500 - 60,000	1500 - 200,000 +
Application	Comfort	Comfort	Comfort	Comfort or Process
Aspect Ratio	Fixed	Fixed	Fixed	Variable
Fan Type	FC	FC	FC/BC/AF/Plenum/Q	All
Coil Location	Draw-Thru	Draw-Thru	Draw or Blow-Thru	Draw or Blow-Thru
Construction Matl	Galvanized	Galvanized	Galvanized	Flexible
Wall Construction	Single Wall	Single/Double	Optional Double	Flexible
Filtration	1″ or 2″	2″ or 4″	Flexible	Full Flexibility
Coil Flexibility	Row	Limited Fin/Row	Flexible	Full Flexibility
S.P. Capability	<2.5 in. wg	<4.0 in. wg	-4.0 to +6.0 in. wg	-12.0 to +12.0 in. wg
Thermal Break	None	None	Gasket	Yes
Unit Flexibility	Low	Medium	Medium - High	High
ICS Controls	ZN010, 510, 520	AH540	AH540/MP580	MP580

Application Comparison

Space Type	Blower Coil Units	Packaged Climate Changer	M-Series & T-Series AHU	Custom AHU
Offices	■	■	■	■
Hospitals/Labs	○	○	■	★
Manufacturing	■	■	★	■
Industrial Processes	○	○	★	★
Schools	★	★	★	★
Hotels/Motels	■	★	★	○
Retails	★	★	■	○

★ Targeted Applications ■ Common Applications ○ Occasional Applications

TRANE®

KQFP DISCHARGE SOUND PERFORMANCE DATA

▼ KQFP, DISCHARGE SOUND DATA

						Primary @ 0.5" Δ Ps							Primary @ 1.0" Δ Ps							Primary @ 2.0" Δ Ps						
Unit Size	Inlet Size	Flow Rate		Min Δ Ps		Octave Band Sound Power, Lw						Lp	Octave Band Sound Power, Lw						Lp	Octave Band Sound Power, Lw						Lp
		CFM	(L/s)	"WG	(Pa)	2	3	4	5	6	7	NC	2	3	4	5	6	7	NC	2	3	4	5	6	7	NC
2	**6**	100	(47)	0.013	(3.1)	32	31	27	23	23	24	-	35	31	28	24	26	29	-	37	32	28	25	29	34	-
		200	(94)	0.050	(12.4)	44	43	39	33	30	28	-	47	44	39	34	33	32	-	49	45	40	36	36	37	-
		300	(142)	0.113	(28.0)	51	51	45	39	34	30	-	54	51	46	40	37	35	-	56	52	47	41	40	39	-
		400	(189)	0.200	(49.8)	57	56	50	43	36	31	-	59	57	51	44	40	36	-	61	57	51	46	43	41	-
		500	(236)	0.313	(77.8)	60	60	54	46	39	33	-	63	61	54	47	42	37	-	65	61	55	49	45	42	-
3	**8**	180	(85)	0.013	(3.3)	35	41	40	31	26	23	-	39	43	42	33	29	28	-	43	46	45	36	33	33	-
		360	(170)	0.053	(13.2)	47	49	45	38	32	28	-	51	52	47	40	36	33	-	55	55	50	43	39	37	-
		540	(255)	0.119	(29.6)	54	54	48	42	36	31	-	58	57	50	45	39	35	-	62	60	53	47	43	40	-
		720	(340)	0.212	(52.7)	59	58	50	45	39	33	-	63	60	53	48	42	37	-	67	63	55	50	46	42	-
		900	(425)	0.331	(82.3)	63	60	52	47	41	34	-	67	63	54	50	44	39	-	71	66	57	52	48	44	**23**
4	**10**	290	(137)	0.014	(3.5)	40	41	40	33	26	20	-	43	43	42	36	29	23	-	45	46	45	38	32	27	-
		580	(274)	0.056	(13.8)	53	51	47	43	37	30	-	56	53	49	45	40	34	-	58	56	52	48	43	37	-
		870	(411)	0.125	(31.1)	61	57	51	48	43	36	-	63	59	54	51	46	40	-	66	62	56	53	49	43	-
		1160	(547)	0.222	(55.3)	66	61	54	52	48	41	-	69	64	57	55	51	44	**20**	71	66	59	57	54	48	**23**
		1450	(684)	0.348	(86.5)	70	64	57	55	51	44	**22**	73	67	59	58	54	48	**25**	75	69	61	60	57	51	**28**
5	**12**	420	(198)	0.014	(3.4)	38	41	42	33	25	20	-	43	45	45	37	29	26	-	48	49	49	40	33	31	-
		840	(396)	0.055	(13.7)	48	47	47	42	35	28	-	53	51	51	45	39	34	-	58	55	54	48	43	39	-
		1260	(595)	0.124	(30.9)	54	51	50	46	41	33	-	59	55	54	49	45	38	-	64	59	57	53	49	44	-
		1680	(793)	0.221	(54.9)	58	53	53	50	45	36	-	63	57	56	53	49	42	-	68	61	59	56	53	47	-
		2100	(991)	0.345	(85.7)	61	55	54	52	48	39	-	66	59	57	55	52	44	-	71	63	61	59	56	50	**23**
6	**14**	570	(269)	0.015	(3.7)	45	41	39	34	27	21	-	49	46	44	38	31	26	-	54	50	48	42	35	32	-
		1140	(538)	0.059	(14.7)	54	48	46	43	37	31	-	59	53	51	47	42	36	-	63	58	56	51	46	41	-
		1710	(807)	0.133	(33.0)	59	53	51	48	44	36	-	64	58	56	52	48	41	-	68	62	60	56	52	47	-
		2280	(1076)	0.236	(58.7)	63	56	54	52	48	40	-	68	61	59	56	52	45	-	72	66	63	60	56	50	**24**
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	**16**	740	(349)	0.014	(3.5)	47	43	43	38	31	23	-	52	47	47	42	35	28	-	56	51	51	45	38	32	-
		1480	(698)	0.056	(13.9)	58	52	50	47	42	35	-	62	56	55	51	46	39	-	67	60	59	54	49	44	-
		2220	(1048)	0.126	(31.3)	64	57	55	52	49	42	-	68	61	59	56	52	46	-	73	65	64	60	56	50	**25**
		2960	(1397)	0.224	(55.6)	68	61	58	56	53	46	-	73	65	63	60	57	51	**25**	77	69	67	63	60	55	**31**
		3700	(1746)	0.349	(86.9)	71	64	61	59	57	50	**23**	76	68	65	63	60	55	**29**	80	72	70	66	64	59	**35**

► *All sound data is based on tests conducted in accordance with ARI 880-98. ΔPs is the difference in static pressure from inlet to discharge. Sound power levels are in dB, re 10^{-12} watts. Discharge sound power is the sound emitted from the unit discharge. NC application data is from ARI Standard 885-98 Appendix E, as a function of flow rate shown. Dash (-) indicates a NC is less than 20. See K-Select for specific sound data for optional liners; 1/2" dual density liner shown. See Engineering section for reductions and definitions. ARI rating points based on 0.25" WG external pressure.*

▼ ARI CERTIFICATION RATING POINTS

Unit Size	Inlet Size	Primary CFM	Min. Δ Ps	Sound Power @ 1.5" Δ Ps					
				2	3	4	5	6	7
2	6	400	0.200	61	57	51	45	41	38
3	8	700	0.200	64	62	53	49	44	39
4	10	1100	0.200	69	65	57	55	50	44
5	12	1600	0.200	68	61	57	55	52	45
6	14	2100	0.200	69	62	60	57	53	46
7	16	2800	0.200	75	67	65	61	58	52

ARI PERFORMANCE CERTIFIED™
ARI Standard 880

KQFP RADIATED SOUND PERFORMANCE DATA

▼ KQFP, RADIATED SOUND DATA

						Primary @ 0.5" Δ Ps							Primary @ 1.0" Δ Ps							Primary @ 2.0" Δ Ps						
Unit Size	Inlet Size	Flow Rate		Min Δ Ps		Octave Band Sound Power, Lw						Lp	Octave Band Sound Power, Lw						Lp	Octave Band Sound Power, Lw						Lp
		CFM	(L/s)	"WG	(Pa)	2	3	4	5	6	7	NC	2	3	4	5	6	7	NC	2	3	4	5	6	7	NC
2	**6**	100	(47)	0.013	(3.1)	35	29	26	23	23	23	-	37	31	29	26	27	28	-	39	33	31	29	31	33	-
		200	(94)	0.050	(12.4)	43	37	34	29	27	25	-	45	39	37	32	31	30	-	47	41	39	35	35	35	-
		300	(142)	0.113	(28.0)	48	42	39	33	30	27	-	50	44	41	36	34	32	-	52	46	44	39	38	37	-
		400	(189)	0.200	(49.8)	51	46	42	36	31	28	-	54	47	44	39	36	33	-	56	49	47	42	40	38	**21**
		500	(236)	0.313	(77.8)	54	48	44	38	33	28	-	56	50	47	41	37	33	**21**	58	52	49	44	41	38	**24**
3	**8**	180	(85)	0.013	(3.3)	35	33	32	26	22	21	-	39	37	36	30	26	28	-	42	40	40	33	30	34	-
		360	(170)	0.053	(13.2)	44	40	38	33	29	26	-	47	44	42	36	33	33	-	51	47	46	40	38	39	-
		540	(255)	0.119	(29.6)	49	44	41	37	33	29	-	52	48	45	40	38	36	-	56	51	49	44	42	42	**23**
		720	(340)	0.212	(52.7)	52	47	44	39	36	31	-	56	51	48	43	41	38	**21**	59	54	51	47	45	44	**26**
		900	(425)	0.331	(82.3)	55	50	45	42	39	33	-	59	53	49	45	43	39	**24**	62	56	53	49	48	46	**28**
4	**10**	290	(137)	0.014	(3.5)	39	34	32	25	19	16	-	43	37	35	29	22	21	-	47	40	38	32	26	26	-
		580	(274)	0.056	(13.8)	47	42	40	33	28	24	-	51	46	43	37	31	29	-	56	49	46	40	35	34	-
		870	(411)	0.125	(31.1)	52	47	44	38	33	29	-	57	51	47	42	37	34	**21**	61	54	50	45	40	39	**25**
		1160	(547)	0.222	(55.3)	56	51	47	42	37	32	**21**	60	54	51	45	41	37	**25**	64	58	54	48	44	42	**28**
		1450	(684)	0.348	(86.5)	59	54	50	44	40	34	**24**	63	57	53	48	43	39	**27**	67	61	56	51	47	44	**31**
5	**12**	420	(198)	0.014	(3.4)	38	37	34	32	26	20	-	41	40	38	35	30	25	-	44	43	42	38	33	30	-
		840	(396)	0.055	(13.7)	49	45	41	38	33	28	-	52	48	45	41	37	33	-	55	51	49	44	40	38	**23**
		1260	(595)	0.124	(30.9)	55	49	45	42	37	32	-	58	53	49	45	40	37	**23**	61	56	52	48	44	42	**27**
		1680	(793)	0.221	(54.9)	59	53	47	44	40	35	**21**	62	56	51	47	43	40	**26**	66	59	55	51	47	46	**30**
		2100	(991)	0.345	(85.7)	63	55	49	46	42	38	**26**	66	58	53	49	45	43	**30**	69	61	57	52	49	48	**34**
6	**14**	570	(269)	0.015	(3.7)	44	39	37	32	26	22	-	48	44	41	35	30	28	-	53	48	46	39	34	34	-
		1140	(538)	0.059	(14.7)	53	47	44	39	34	28	-	57	51	48	42	38	34	**22**	62	56	53	46	42	40	**27**
		1710	(807)	0.133	(33.0)	58	51	48	43	39	32	**22**	63	55	52	47	43	38	**27**	67	60	57	50	47	44	**32**
		2280	(1076)	0.236	(58.7)	62	54	51	46	42	35	**25**	67	58	55	50	46	41	**30**	71	63	60	53	50	47	**36**
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	**16**	740	(349)	0.014	(3.5)	49	43	40	36	31	27	-	54	49	46	43	39	37	-	60	55	52	50	46	47	**27**
		1480	(698)	0.056	(13.9)	57	50	48	44	39	34	**22**	63	56	54	51	47	44	**28**	68	62	60	58	55	54	**35**
		2220	(1048)	0.126	(31.3)	62	55	52	48	44	38	**26**	68	60	58	55	52	48	**33**	73	66	64	62	60	58	**40**
		2960	(1397)	0.224	(55.6)	66	58	55	51	48	41	**30**	71	63	61	58	56	51	**37**	77	69	68	65	63	61	**44**
		3700	(1746)	0.349	(86.9)	68	60	58	54	51	44	**33**	74	66	64	61	58	54	**40**	80	72	70	68	66	64	**47**

► *All sound data is based on tests conducted in accordance with ARI 880-98. ΔPs is the difference in static pressure from inlet to discharge. Sound power levels are in dB, re 10^{-12} watts. Radiated sound power is the sound transmitted through the casing walls. NC application data is from ARI Standard 885-98 Appendix E, as a function of flow rate shown. Dash (-) indicates a NC is less than 20. See K-Select for specific sound data for optional liners; 1/2" dual density liner shown. See Engineering section for reductions and definitions. ARI rating points based on 0.25" WG external pressure.*

▼ ARI CERTIFICATION RATING POINTS

Unit Size	Inlet Size	Primary CFM	Min Δ Ps	Sound Power @ 1.5" Δ Ps					
				2	3	4	5	6	7
2	6	400	0.200	54	48	45	39	37	35
3	8	700	0.200	62	55	50	44	40	32
4	10	1100	0.200	63	57	51	45	42	40
5	12	1600	0.200	65	58	53	48	44	41
6	14	2100	0.200	70	60	56	50	47	42
7	16	2800	0.200	74	67	65	62	61	59

ARI Standard 880

Figure 1: Overview of Design Brief Contents

This Design Brief is organized around key design considerations and components that affect the performance of VAV systems.