APPENDIX C
DESIGN GUIDE PREDICTION DATA

EXAMPLE FLOORVIB 2 ANALYSIS

Notes:

1) Example is for LH-90 test floor.
2) All example analysis values are “nominal”.

Knowledge Base FLOORVIB2 Version 1.1B2

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Date: 06/27/01 By: Page 1
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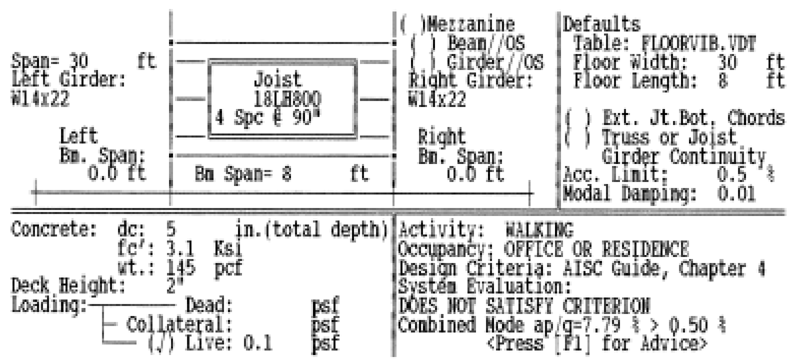


VIBRATION ANALYSIS:

Activity: Walking
Occupancy Category: Office or Residence
Evaluation Criterion: Walking, AISC Design Guide, Chapter 4
Reference: Murray, T.M., Allen, D.E. and Ungar, E.E, "Floor Vibrations Due To Human Activity", Design Guide, June 1997

Constant Force, P_o = 65 lb
Modal Damping Ratio, β = 0.01
Acceleration Limit, a_o/g x 100% = 0.50 %
Joist bottom chords are not extended
Girders are not continuous at columns

	Section	w, plf	I_{tr}, in4	f, Hz.
Joist	18LH800	371.9	59.0	24.99
Left Girder	W14x22	220.4	496.8	6.70
Right Girder	W14x22	220.4	496.8	6.70
Bay (Using smaller girder frequency)				6.47

Combined mode a_p/g= 7.79 % > 0.50 %

The system DOES NOT SATISFY THE CRITERION.

LOADING DATA:

Slab + 1.0 psf Deck = 49.3 psf
Dead loads = 0.0 psf
Collateral loads = 0.0 psf
Live loads = 0.1 psf
Actual beam and girder weights

Tributary width for girder = 8.00/2 = 4.00 ft.

CONCRETE/SLAB DATA:

Concrete d_c= 5.00 in. f_c'= 3.1 Ksi
w_c= 145 pcf E_c= 3074 Ksi

Modular ratio, n= Es/(1.35 Ec) = 6.99

Deck height: 2 in.
Effective concrete thickness in deck: 1 in.

JOIST CALCULATIONS:

Joist: 18LH800 (1.4 plf)
d= 18.00 in. A= 0.339 $in.^2$ I_x= 24 $in.^4$ y_c= 8.06 in.

Spacing: S = 90 in.
Span: L_j = 8.00 ft.
Uniform load: w_j = (49.3 + 0.0 + 0.0 + 0.1) x 90.00/12 + 1.4
= 371.9 plf

Transformed moment of inertia:
Effective concrete width = min(0.4 L_b, S) = 38.400 in.
Effective concrete depth = 3.000 in.
Transformed concrete width = 5.495 in.
Transformed concrete area = 16.485 $in.^2$
Distance to neutral axis = 11.323 in. (Above beam c. g.)
Transformed moment of inertia = 80.9 $in.^4$
$\gamma = (1/C_r) - 1$ = 0.111
Effective moment of inertia = $1/[\gamma/I_{chords}+1/I_{comp}]$ = 59.0 $in.^4$

δ_j

$$= 0.18 \times \left[\frac{386}{0.020}\right]^{0.5} = 24.99 \text{ Hz.}$$

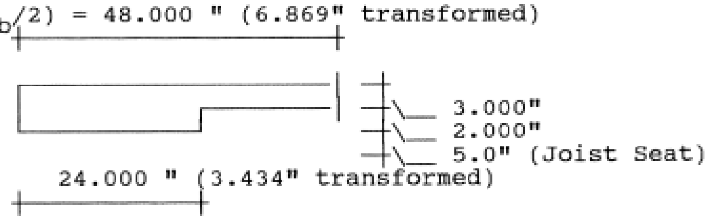
C_j = 2.0
Floor Width= 30.00 ft.
D_s = (12 d_e^3)/(12 n) = (12 x 4^3)/(12 x 6.99) = 9.16 in^4/ft.
D_j = I_{tr}/S = 59.0/7.5 = 7.87 in^4/ft.
B_j = min[C_j (D_s/D_j)^0.25 L_j= 16.62 ft.; 2/3 x 30.00 ft.= 20.00 ft.]
= 16.62 ft.
Continuity Factor=1.0 since joist bottom chords are not extended
W_j = 1.0 x (0.372/7.50) x 16.62 x 8.00 = 6.6 Kips

LEFT GIRDER CALCULATIONS:

Girder section: W14x22 d= 13.740 in. A= 6.49 in.^{2} I_x= 199 in.^{4}

Tributary width = 4.00 ft.
Span: L_g = 30.00 ft.
Equivalent uniform load: w_g = 4.00 x (371.9/7.50) + 22.0
= 220.4 plf

Transformed moment of inertia:
min(0.2 L_g, L_b/2) = 48.000 " (6.869" transformed)



Effective concrete width	=	48.000 in.	and	24.000 in.
Transformed concrete width	=	6.869 in.	and	3.434 in.
Transformed concrete area	=	20.606 in.^{2}	and	6.869 in.^{2}
Joist seat depth	=	5.0 in.		
Distance to neutral axis	=	11.928 in. (Above girder c. g.)		
Transformed moment of inertia	=	1390.3 in.^{4}		
Effective moment of inertia	=	$I_g+(I_{tr}-I_g)/4$ = 496.8 in.^{4}		

5 w_ L_^4 5 x 220.4 x 30.00^4 x 1728

$$= 0.18 \times \left[\frac{386}{0.279}\right]^{0.5} = 6.70 \text{ Hz.}$$

C_g = 1.6
Floor Length= 8.00 ft.
$D_j = I_{tr}/S$ = 59.0/7.5 = 7.87 in^4/ft.
$D_g = I_{tr}$/Avg. L_j = 496.8/4.00 = 124.21 in^4/ft.
B_g = min[C_g (D_j/D_g)^0.25 L_g= 24.08 ft.; 2/3 x 8.00 ft.= 5.33 ft.]
= 5.33 ft.
Continuity Factor= 1.0 since Not Continuous
W_g = 1.0 x (0.220/4.00) x 5.33 x 30.00 = 8.8 Kips

RIGHT GIRDER CALCULATIONS:

Girder section: W14x22 d= 13.740 in. A= 6.49 in.^{2} I_x= 199 in.^{4}

Same as Left girder.

COMBINED MODE CALCULATIONS:

Using girder with smaller frequency:

δ_j = 0.020 in. δ_g = 0.279 in.

$$\text{System frequency, } f_n = 0.18 \sqrt{\frac{386}{\delta_j + \delta_g}} = 6.47 \text{ Hz}$$

W_j= 6.6 Kips W_g = 8.8 kips

$$W_c = \frac{\delta_j}{\delta_j + \delta_g} W_b + \frac{\delta_g}{\delta_j + \delta_g} W_g$$

$$= \frac{0.020}{0.299} \times 6.6 + \frac{0.279}{0.299} \times 8.8 = 8.7 \text{ Kips} = 8666 \text{ lbs}$$

ß = modal damping ratio = 0.01

(a_/g) = P_ exp(-0.35 f_)/(ß W_)

The floor system does not satisfy the specified criterion.

-- End --

Table C. 1—Predicted Stiffness and Frequency Values

Test Identification	I_g (in^4)	I_{gm} (in^4)	I_{comp} (in^4)	I_{eff} (in^4)	f_j (Hz)	f_g (Hz)	f_n (Hz)
K-30-B	199.0	225.1	945.1	405.1	23.04	5.83	5.65
K-30-BL	199.0	225.1	945.1	405.1	20.11	5.18	5.02
K-30-W	199.0	225.1	945.1	405.1	23.04	5.83	5.65
K-30-WL	199.0	225.1	945.1	405.1	20.11	5.18	5.02
K-30-R	199.0	225.1	945.1	405.1	23.04	5.83	5.65
K-30-RL	199.0	225.1	945.1	405.1	20.11	5.18	5.02
K-60-B	199.0	218.2	907.6	390.4	17.00	6.18	5.81
K-60-W	199.0	218.2	907.6	390.4	17.00	6.18	5.81
K-60-WL	199.0	218.2	907.6	390.4	14.57	5.40	5.06
K-60-R	199.0	218.2	907.6	390.4	17.00	6.18	5.81
LH-60-B	199.0	217.9	1234.0	472.0	26.96	6.86	6.65
LH-60-W	199.0	217.9	1234.0	472.0	26.96	6.86	6.65
LH-60-WL	199.0	217.9	1234.0	472.0	23.06	5.99	5.80
LH-60-R	199.0	217.9	1234.0	472.0	26.96	6.86	6.65
LH-60-RL	199.0	217.9	1234.0	472.0	23.06	5.99	5.80
LH-90-B	199.0	211.4	1402.7	509.2	24.99	6.57	6.35
LH-90-BL	199.0	211.4	1402.7	509.2	21.91	5.85	5.65
LH-90-W	199.0	211.4	1402.7	509.2	24.99	6.57	6.35
LH-90-WL	199.0	211.4	1402.7	509.2	21.91	5.85	5.65
LH-90-R	199.0	211.4	1402.7	509.2	24.99	6.57	6.35

Note: Predictions are adjusted for bare girder measured moment of inertia.

Table C. 1 (Continued)

Test Identification	I_g (in^4)	I_{gm} (in^4)	I_{comp} (in^4)	I_{eff} (in^4)	f_j (Hz)	f_g (Hz)	f_n (Hz)
JG-K-30-B	254.0	247.6	856.6	399.5	22.90	5.98	5.79
JG-K-30-BL	254.0	247.6	856.6	399.5	19.99	5.32	5.14
JG-K-30-W	254.0	247.6	856.6	399.5	22.90	5.98	5.79
JG-K-30-WL	254.0	247.6	856.6	399.5	19.99	5.32	5.14
JG-K-30-R	254.0	247.6	856.6	399.5	22.90	5.98	5.79
JG-K-30-RL	254.0	247.6	856.6	399.5	19.99	5.32	5.14
JG-LH-60-B	254.0	245.4	1138.6	468.3	26.96	6.96	6.74
JG-LH-60-BL	254.0	245.4	1138.6	468.3	23.06	6.10	5.90
JG-LH-60-W	254.0	245.4	1138.6	468.3	26.96	6.96	6.74
JG-LH-60-WL	254.0	245.4	1138.6	468.3	23.06	6.10	5.90
JG-LH-60-R	254.0	245.4	1138.6	468.3	26.96	6.96	6.74
JG-LH-60-RL	254.0	245.4	1138.6	468.3	23.06	6.10	5.90
JG-LH-90-B	254.0	241.9	1304.9	507.3	25.09	6.65	6.43
JG-LH-90-BL	254.0	241.9	1304.9	507.3	22.00	5.93	5.73
JG-LH-90-W	254.0	241.9	1304.9	507.3	25.09	6.65	6.43
JG-LH-90-WL	254.0	241.9	1304.9	507.3	22.00	5.93	5.73
JG-LH-90-R	254.0	241.9	1304.9	507.3	25.09	6.65	6.43
JG-LH-90-RL	254.0	241.9	1304.9	507.3	22.00	5.93	5.73
JG-LH-90-T	254.0	243.0	1263.8	497.8	23.77	6.61	6.37
JG-LH-90-TL	254.0	243.0	1263.8	497.8	20.85	5.87	5.65

Note: Predictions are adjusted for bare girder measured moment of inertia.