EXAMPLE 3

Three-Story Plane Frame, Code-Specified Static Lateral Load Analysis

Problem Description

The frame is modeled as a two-column line, single bay system. This three-story plane frame is subjected to the following three code-specified lateral load cases:

- UBC 1997 specified seismic loads (International Conference of Building Officials 1997)
- ASCE 7-02 specified seismic loads (American Society of Civil Engineers 2002)
- UBC 1997 specified wind loads (International Conference of Building Officials 1997)

Geometry, Properties and Loads

Kip-inch-second units are used. Other parameters associated with the structure are as follows:

All columns are W14X90
All beams are infinitely rigid and 24" deep
Modulus of elasticity = 29500 ksi
Poisson's ratio = 0.3
Typical story mass = 0.4 kip-sec^2/in

The frame geometry is shown in Figure 3-1.

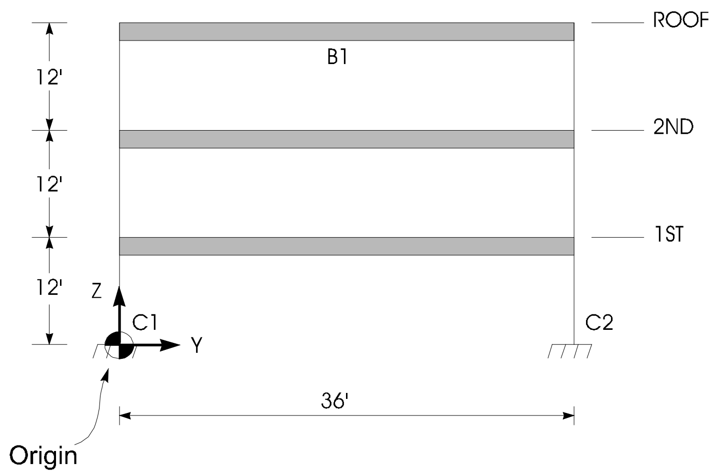

Figure 3-1 Three-Story Plane Frame

For the UBC97 seismic load analysis, the code parameters associated with the analysis are as follows:

UBC Seismic zone factor, Z	= 0.40
UBC Soil Profile Type	= SC
UBC Importance factor, I	= 1.25
UBC Overstrength Factor	= 8.5
UBC coefficient C_t	= 0.035
UBC Seismic Source Type	= B
Distance to Source	= 15 km

For the ASCE 7-02 seismic load analysis, the code parameters associated with the analysis are as follows:

Site Class	= C
Response Accel, S_s	= 1
Response Accel, S_1	= 0.4
Response Modification, R	= 8
Coefficient C_t	= 0.035
Seismic Group	= I

For the UBC97 wind load analysis, the exposure and code parameters associated with the analysis are as follows:

Width of structure supported by frame	= 20 ft
UBC Basic wind speed	= 100 mph
UBC Exposure type	= B
UBC Importance factor, I	= 1
UBC Windward coefficient, C_q	= 0.8
UBC Leeward coefficient, C_q	= 0.5

Technical Features in ETABS Tested

- Two-dimensional frame analysis
- Section properties automatically recovered from AISC database
- Automatic generation of UBC 1997 seismic loads
- Automatic generation of ASCE 7-02 seismic loads
- Automatic generation of UBC 1997 wind loads

Results Comparison

For each of the static lateral load analyses, the story shears can be computed using the formulae given in the applicable references. For the seismic loads, the fundamental period computed by ETABS can be used in the formulae. From ETABS results, this fundamental period is 0.5204 second. (Note the difference between the calculated fundamental period for this example and Example 2, which neglects shear and axial deformations.)

Hand-calculated story shears are compared with story shears produced by the ETABS program in Table 3-1 for UBC seismic loads, Table 3-2 for ASCE 7-02 seismic loads and Table 3-3 for UBC wind loads.

Table 3-1 Comparison of Results for Story Shears - UBC 1997 Seismic

Level	**ETABS** (kips)	**Theoretical** (kips)
Roof	34.07	34.09
2nd	56.78	56.82
1st	68.13	68.19

Table 3-2 Comparison of Results for Story Shears - ASCE 7-02 Seismic

Level	**ETABS** (kips)	**Theoretical** (kips)
Roof	19.37	19.38
2nd	32.23	32.25
1st	38.61	38.64

Table 3-3 Comparison of Results for Story Shears - UBC 1997 Wind

Level	**ETABS** (kips)	**Theoretical** (kips)
Roof	3.30	3.30
2nd	9.49	9.49
1st	15.21	15.21

Computer File

The input data file for this example is Example 03.EDB. This file is provided as part of the ETABS installation.

Conclusion

The results comparison shows an exact match between the ETABS results and the theoretical data.