APPLICATION OF VIBRTION-SPECIFIC ANALYTICAL TOOLS

The work described in the preceding sections is based on the traditional methods for the evaluation of vibration characteristics of a floor system, or a specific region of a floor deemed to be sensitive to motion. The trend in structural engineering is to rely on a three dimensional model of a structure that serves other professionals too. While a full model of a floor system has its advantages in portability among the various trades of construction, the complete reliance on a full 3D model can pose draw backs for structural engineering, in particular when evaluating the vibration of a sensitive floor region. The following explains.

ADAPT-Floor Pro has pioneered a method, whereby from the full 3D model of a building generated for overall design of a structure, a sub-region can be isolated for vibration analysis. The central advantage of this procedure is that it excludes the analytical disturbances of other regions in the vibration characteristics of the floor region of interest. The method is based on selecting a specific region of a floor within the original 3D model, and limiting the analysis to the selection. The selection is delineated by a boundary drawn around it. The support conditions along this boundary are user defined. In most cases, simple support, or no support is applicable. For better results, the boundary is drawn somewhat larger than the slab region of interest, in order to minimize the impact of the user imposed conditions on the vibrations of the interest region. The following example illustrates the point.

Consider the vibration of the panel identified in Figure EX1. For ease of reference, the figure is reproduced below. The objective is to determine whether the likely vibration of the identified panel is acceptable.

For illustration, the traditional method of considering the entire floor system is used first. This is followed by isolating the region of investigation, using the Floor Pro’s “Excluder” feature.

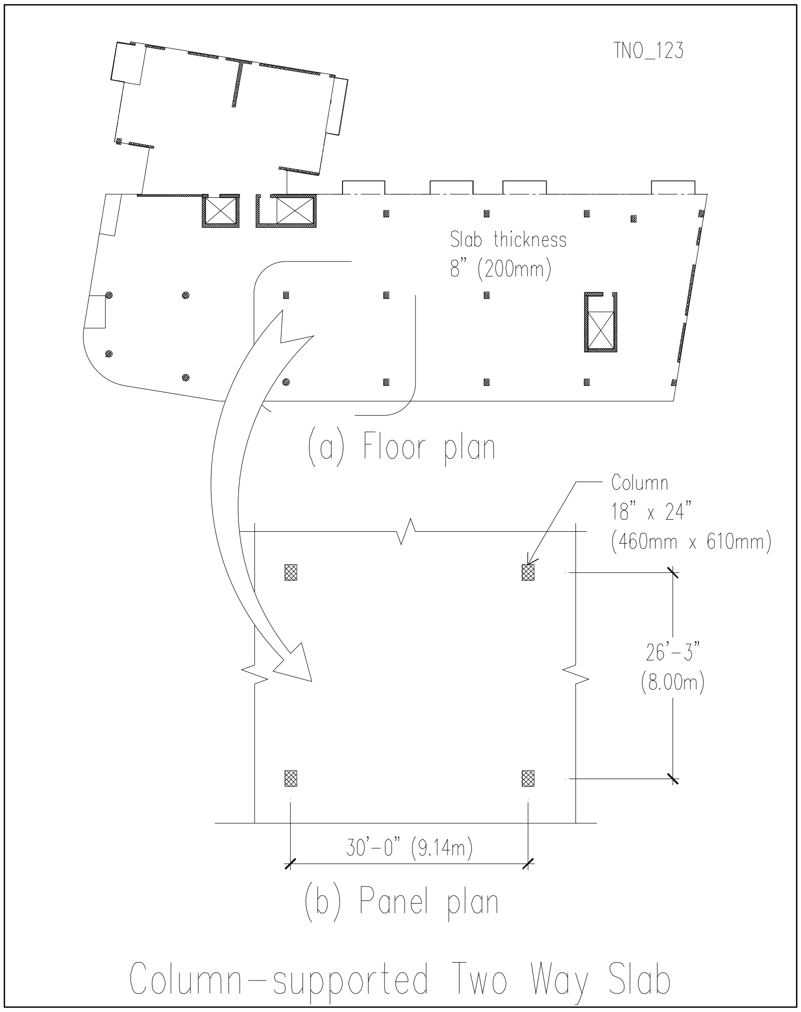
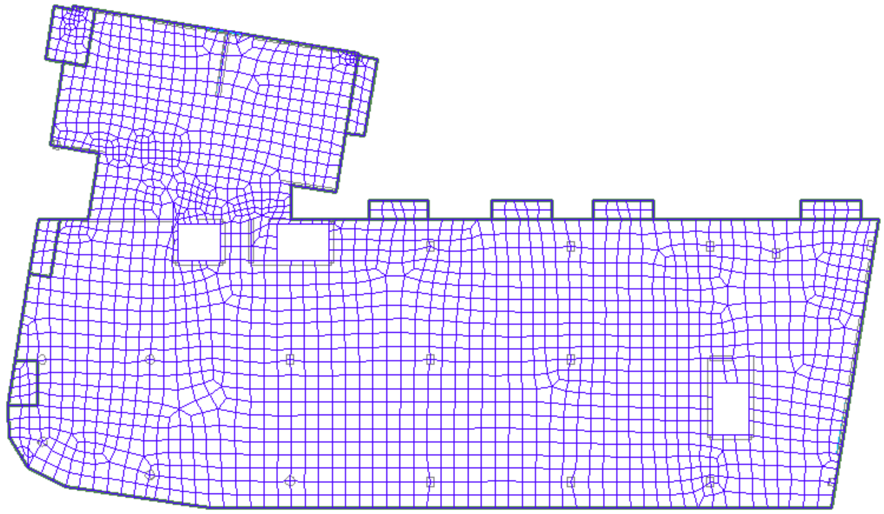


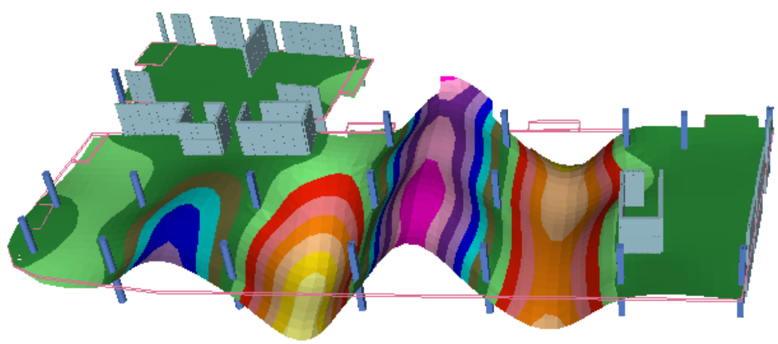
FIGURE EX1

Analysis Using the Entire Floor

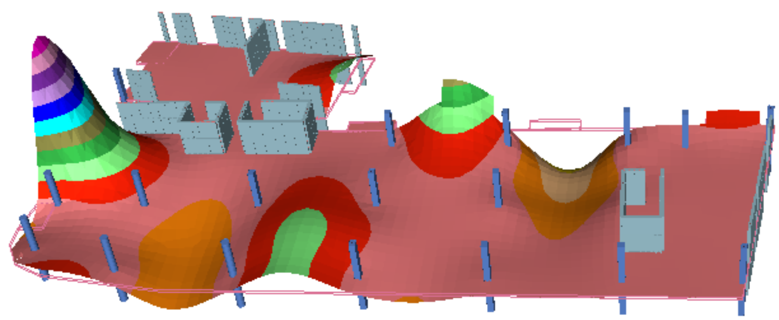
The entire 3D floor model is discretized (Fig. EX4) and analyzed to extract its first few frequencies and modes of vibration. Its first three modes of vibrations and frequencies are illustrated in Fig. EX5. It is noted that in all three cases, the primary excitation of the floor is in regions other than the panel of primary interest. Thus casting doubt whether any of the three could be considered as the primary mode of vibration of the interest region.



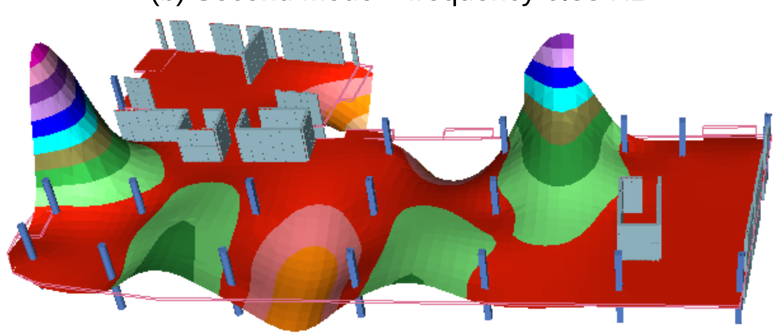
FIGIRE EX4 – DISCRETIZATION OF THE ENTIRE FLOOR MODEL



(a) First mode – frequency 5.97 Hz



(b) Second mode – frequency 6.33 Hz

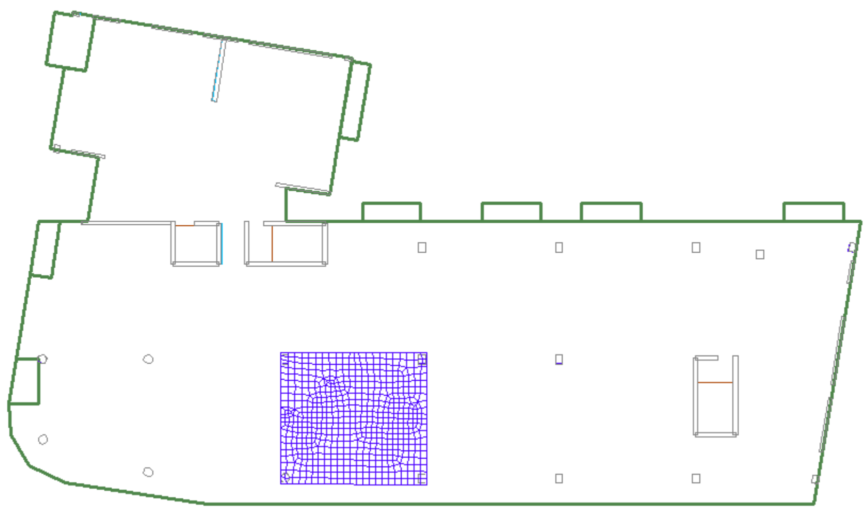


(c) Third mode – frequency 6.44 Hz

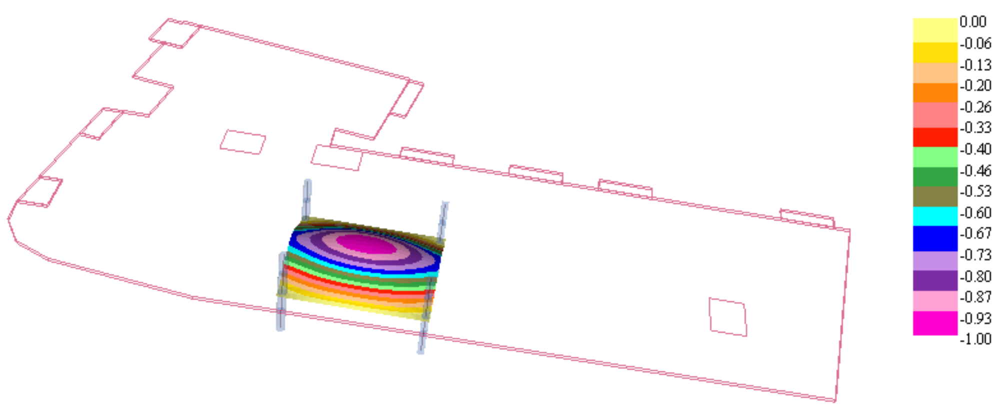
FIGURE EX5 THE FRIST THREE MODES AND FREQUENCIES

Analysis Using the Region of Interest Only

In this case the region selected is limited to the panel of interest. The panel is isolated from the rest of the floor system by the boundary lines drawn around it. The support conditions assumed for the boundary can have a significant impact on the frequency of the sub-region. In Fig. EX6, the boundaries are assumed to be simple supports (zero translational displacement, free to rotate). This boundary condition can be too restrictive and results in a higher frequency. To obtain a more reliable solution, the boundary of the selected region should be extended farther away from the panel of interest, in order to minimize the impact of the user selected boundary restraints. This is illustrated in the next treatment.



(a) Identification of sub-region of interest

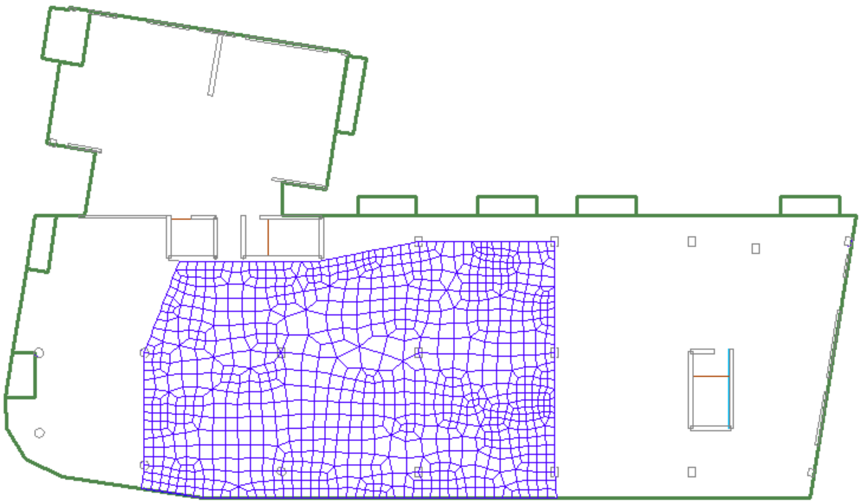


(b) First mode of vibration – frequency 7.95 Hz

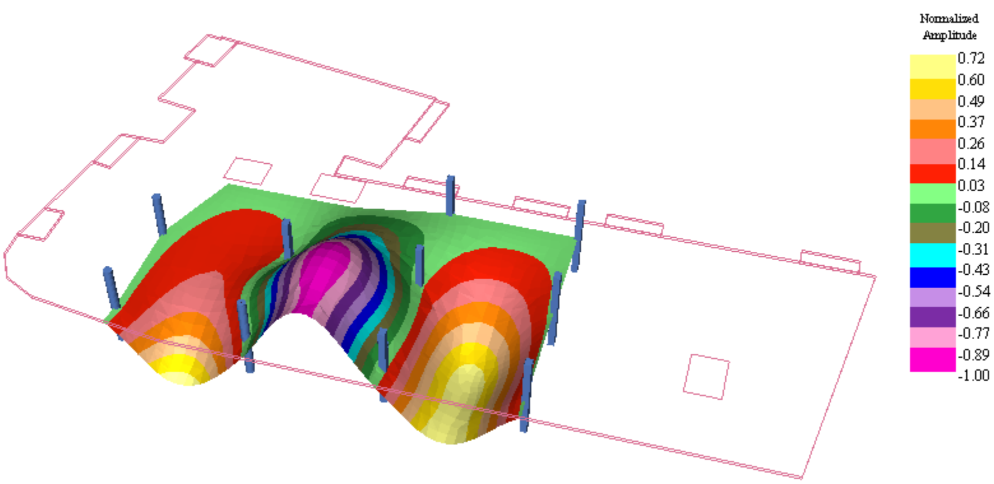
FIGURE EX6 IDENTIFICATION OF SUB-REGION AND ITS FIRST MODE OF VIBRAITON

Analysis Using the Extended Region of Interest

The extended region selected (Fig. EX7-a) stretches one span on each side beyond the panel of interest. The associated frequency and mode shape are reported in part (b) of the figure. The frequency obtained in this modeling is deemed to be more reliable to form the basis for acceptability of probable vibrations to be experienced by the panel of interest.



(a) Selection of an extended region



(b) First mode of vibration – Frequency 6.07 Hz

FIGURE EX7 SELECTION AND VIBRATION OF AN EXTENDED REGION