Floor vibration due to human footfalls

Structural vibrations which result from human footfalls may be modeled in ETABS using modal time-history analysis. A simplified beam example is presented to demonstrate the process. Please note that these parameters are not intended to be realistic. It is up to the engineer to determine load magnitude, stride length, load frequency, and other input values.

Floor vibration due to human footfalls may be modeled as follows:

1. Define a load case for each simulated footfall position. It may be convenient to name each after its order in the sequence, such as Step 1, Step 2, etc.

2. For each load case, apply a point load at the footfall location. It may be best to assign a unit load, then adjust magnitude when defining the scale factor.

3. Define a single time-history function to represent the footfall impulse. If unit loading is applied, magnitude may be set in the function definition. To consider multiple loading scenario, additional footfall functions may be defined.

4. Go to Define>Mass Source and uncheck “Include Lateral Mass Only”.

5. Define a time-history analysis case using either of the following two methods:

   - **Modal time history based on Eigen modes**, in which modal time-history analysis proceeds according to an Eigen formulation. A sufficient number of modes should be captured for analysis.
   - **Modal time history based on Ritz modes**, which should be better suited for modal time-history analysis because of its condensed formulation. However, each of the footfall loads will need to be used as a starting load vector, therefore a mode will be needed for each load case (100 footfall locations will require 100 modes).

6. Each footfall load case must then be added to the Load Assignments section (Figure 1). Each load case requires an impulse function, a scale factor, and an arrival time, which defines when load is applied. Finally, ensure that the Number of Output Time Steps and the Output Time Step Size cover the duration of the time history.
See Also

Watch and learn video:

- Human-induced vibrations SAP2000 test problem
- Ritz vs. Eigen vectors article
- Power-spectral-density FAQ