

Math 2280
Earthquake project answer template
March 2001

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  with(DEtools):with(plots):with(linalg):
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1) Enter your name and student number.

2) You will be using your student number to construct your building. As the book instructs on page 334, let the weight in tons of each story be given by the largest digit of your I.D. number, and let the spring constant k (tons/foot) be the smallest digit of your I.D. number. Deduce the mass of each floor (in slugs), and then define the mass and spring constant values for your building.

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3) Define the mass matrix M for this system, the spring constant matrix K , and find the matrix "A" as in equation (1), page 333.

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4) Find the natural angular frequencies (the omegas) for your seven story building, as well as the corresponding periods. Hint: MAKE SURE THAT AT LEAST ONE ENTRY IN "A" IS IN DECIMAL (RATHER THAN FRACTION OR WHOLE NUMBER) FORM. OTHERWISE MAPLE TRIES FINDING EIGENVALUES AND EIGENVECTORS ALGEBRAICALLY INSTEAD OF NUMERICALLY, AND CAN FAIL.

Exhibit this data in a table like figure 5.3.17 on page 333.

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5) Study approximate resonance by studying the (undetermined coefficients) particular solution to (2), page 334, for your building. The method is outlined on page 329 of the text, and in the project notes which accompany this template. Choose the vector \mathbf{b} appropriately in (2) so that it corresponds to a ground shaking amplitude of 3 inches (as suggested by the warmup problem #4). Find the vector \mathbf{c} (depending on w) so that $\mathbf{c} \cdot \cos(wt)$ solves (2):

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6) Create an approximate resonance picture like Figure 5.3.18, for your building. Note that in this graph you are to compute the norm of the \mathbf{c} -vector as a function of period, not of angular frequency.

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7) Is your particular building susceptible to likely damage from an earthquake having its period in the 2 to 3 second range? Explain.