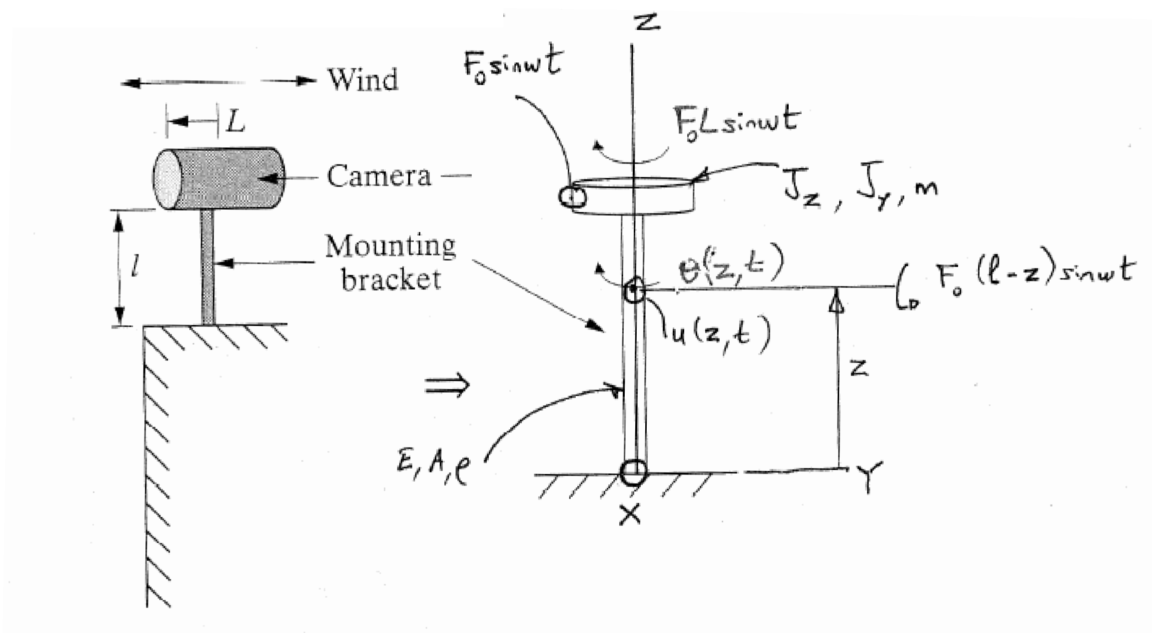
AME 560
ADVANCED VIBRATIONS
Spring 2008
Term Design Project
Due May 8, 2008

Consider a camera mounted on a mounting bracket of circular cross-section as shown in the figure below. A wind load of magnitude $F_0 = 15$ N (in the X direction) and frequency ω acts on the camera. Because of the geometry of the camera the wind load produces both a torsional (around Z axis) and a bending load (around Y axis) on the mounting bracket which may be modeled as a continuous vertical cantilevered beam. The camera has a mass of $m = 3$ kg and its geometry is such that the wind load acts at a distance of $L = 0.2$ m from the centerline of the bracket. The rotational inertias of the camera in the Y and Z directions can be assumed to be $J_y = J_z = mL^2$. Operational requirements for the camera are such that it has to be mounted at a height of $l = 0.55$ m. It is also desired to limit the steady-state vibratory displacement of the camera to 1 degree in rotation and 2 mm in displacement (at its front end).



a) Assume that the bracket will be made of solid round aluminum of diameter 2 cm. Determine and plot the response of the camera (in bending and torsion) for wind frequencies of 0 to 30 Hz. Make sure natural frequencies resulting from continuous mass distribution of the bracket are taken into account.

b) Determine if the bracket diameter and material are adequate for the peak responses observed assuming a factor of safety of 2 (note that combined stresses are present). You can use published data for allowable stresses for any type of aluminum. If the diameter and material are not adequate recommend an adequate diameter and material (making sure that you have performed your vibration analyses for the new parameters).

Bonus points will be assigned for additional work that may involve one or more of the following possible tasks:

a) Perform the analysis in (a) including the compressive effect of the static weight of the camera and the shaft.

b) Change the geometry of the bracket such that its mass remains the same but it steps or tapers to larger diameters toward the bottom.

c) Include the effect of damping resulting from air friction between the overall structure and the air (you need to do some research to identify possible damping models for this situation).

You may also include your own additional tasks for bonus credit. <u>Please consult with the instructor before you decide on your own additional tasks.</u>

In your report:

i) Show all models you use to simplify the problem. Clearly state all the assumptions you make.

ii) Clearly identify the sources you use for any formulas, equations, parameters, physical constants, properties, or assumptions you include in your analysis

iii) Show by charts, tables, and/or other output from any programs you write or any commercial software you use to justify your conclusions. Do not include any results that are not discussed or used to support any conclusions.

iv) Discuss any limitations of your analysis and any additional work that may be required to improve it.

v) Include all your programs and hand calculations in an appendix at the back. <u>Do not submit outputs of long lists of numbers from your programs</u>. All such output should be presented in the form charts and tables in the body of the report.

The reports will be graded on the basis clarity of problem statement and restatement, the justifications given for the assumptions and the validity of results, and the presentation of results to support conclusions.