City University London

School of Engineering and Mathematical Sciences

Engineering Drawing and Design, ME1110

Exercise code: DE-2
Exercise type: Individual – Design Exercise
Exercise title: Design Process - Satellite hinge

Exercise Assignment:

Task:

Conduct the preliminary design process to select an optimal hinge for a small satellite panel deployment.

Specification:

- Satellite has 8 solar panels (Fig.1). Inner panels (PI) are held by 90^o hinge (A) to the satellite body. Outer panels (PO) are held to the inner panels by 180^o hinge (B).
- The solar panels are stowed during launch.
- The solar panels are deployed when the satellite is stable in orbit.
- The movement of the panels has to be strictly controlled. No damage to the panels should be made. Panels should be brought to rest and locked when fully deployed.
- Reliability is very important. If the hinge fails, the whole satellite is unusable.Weight and strength are also important.
    - Max. panel acceleration/deceleration 200 deg/sec/sec
    - Max. angular velocity 40 deg/sec
    - Max. weight of individual 200 g
    - Max. cost per hinge £400

The examples of possible solutions are given in Fig. 3:

A. Constant torque hinge with mechanical spring
B. Hinge with electric motor, micro switches and batteries
C. Hinge driven by a cylinder containing compressed gas.

WHAT and HOW to do:

Use as many A3 paper with border and title block as necessary. Submitting them stapled together.
Assume that the problem is identified as explained in the assignment above.

1. *Define the problem* in one sentence
2. *Define objectives for the product* half page
3. List *all functions* which hinge must perform
4. Using above design specification, define design *constraints*.
5. *Make graphs angle-time*, velocity-time, acceleration-time, torque-time for both hinges (A) & (B) (Fig.2)
6. Based on available information *specify 4 design criteria* which will later be used to make decision.
7. Make *morphological chart* for each identified function
8. *Draw three alternative solutions* and make accurate *sketches* with the most important functional dimensions. You should use Fig 3. ONLY as a guide, not as the solution. YOU ARE NOT ALOWED TO COPY any part of Fig. 3 in your drawing.
9. Make an *analysis* of all three solutions: weight, size, approximate cost of material.
10. Make the *decision matrix* for 3 alternatives based on earlier specified criteria and state which solution you select as the best according to your criteria.

Exercise tips:

Always read exercise assignment carefully and act accordingly. Use lecture notes for reference (Lectures 13 & 14) Scales, compass and other drawing tools should be used for this exercise. Arrange drawings neatly and ensure that all letters and lines are made according to BS8888.
This is two-week exercise (week 2 and week 3). It is worth 20 marks.
Hand in finished report on as many A3 drawing as necessary to U/G Mechanical & Aeronautical office, C108, in week 5 (check the deadline on the web).
Ensure to your name, group and other relevant data are filled in the title block.

Figure 1 Solar panel deployment

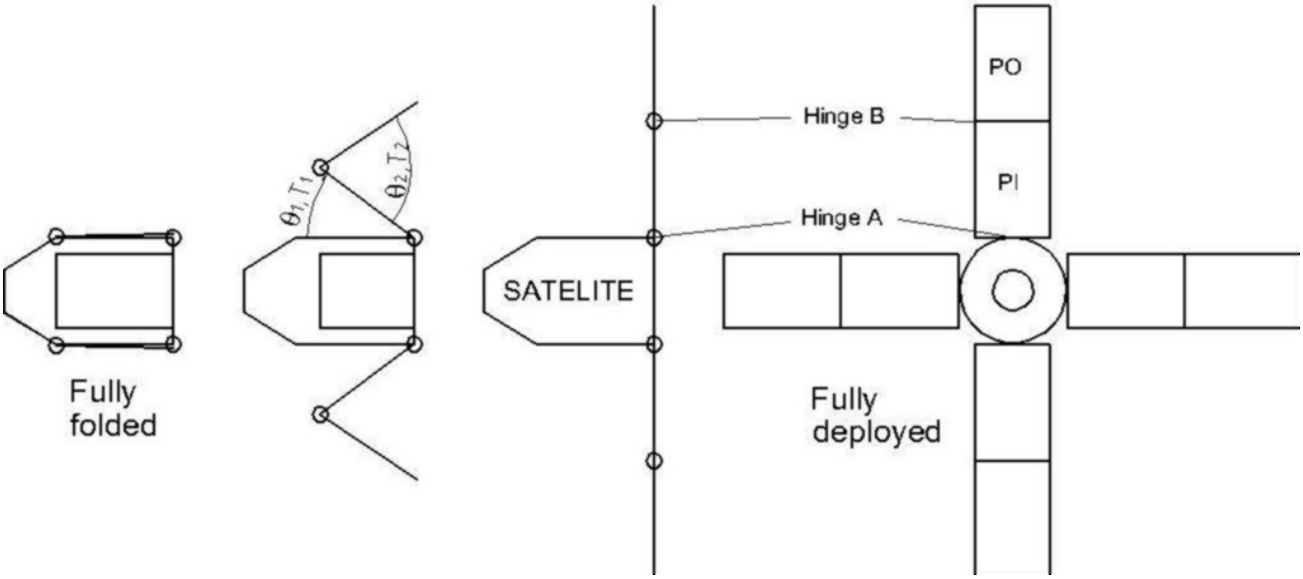
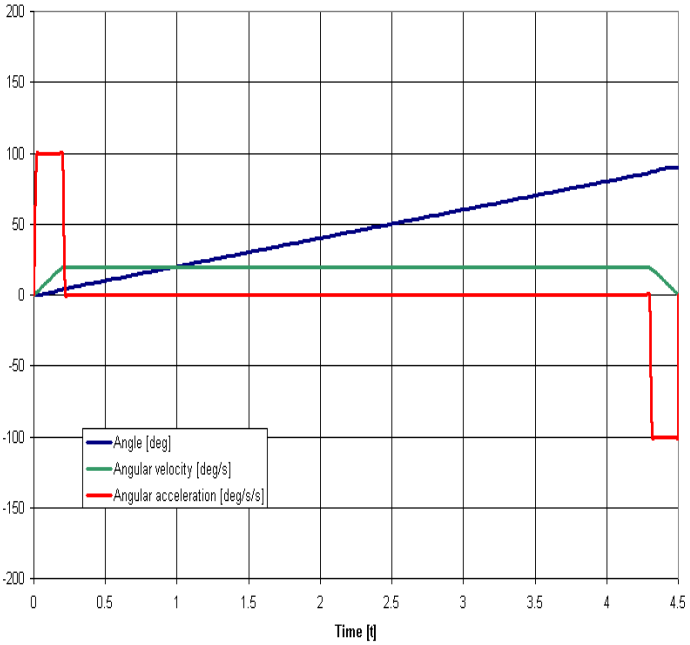
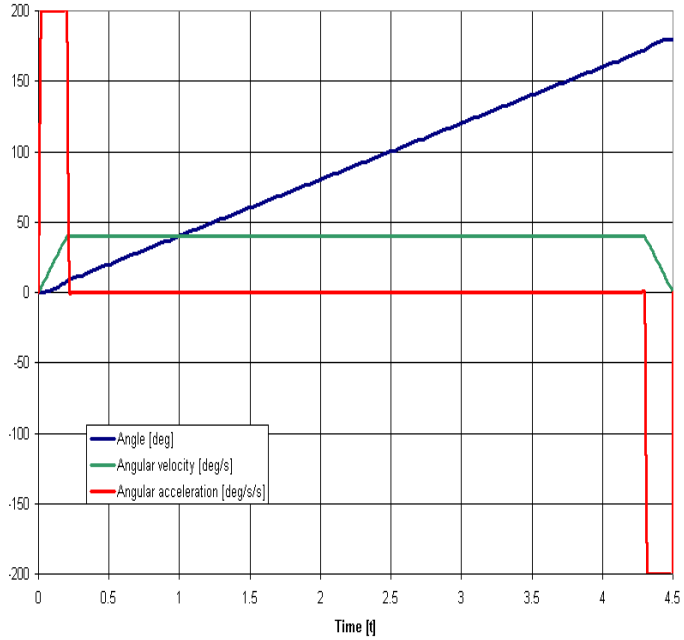


Figure 2 Graphs

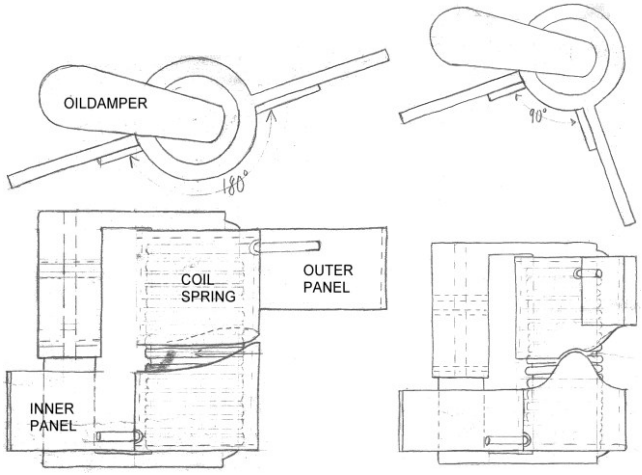


Hinge **A**

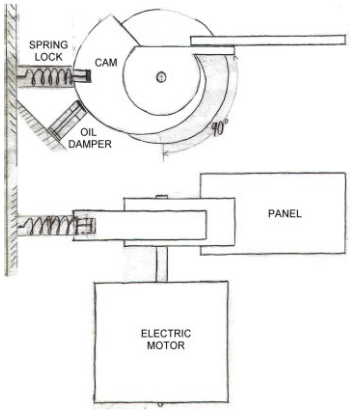


Hinge **B**

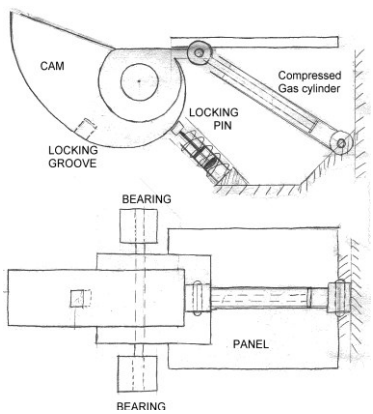
Figure 3 Alternative solutions:



A) Mechanical coil spring



B) Electric motor



C) Cylinder with compressed gas