This assignment will reinforce what you have learned about **static failure theories**. You are to design a storage rack that will hold a paper roll as shown in the accompanying figure. Your job is to find suitable values for the dimensions a and b that will yield a **static** factor of safety of at least 1.5. The mandrel is solid and inserts halfway through the paper. Your design should examine using two different materials: a **ductile material** with a yield strength, S_y, of 300 M Pa and a **brittle material** with an ultimate tensile strength, S_{ut}, of 150 M Pa, and an ultimate compressive strength, S_{uc}, of 570 M Pa. Assume that the mandrel is solid and inserts halfway into the paper roll.

Other relevant information:

density of paper = 984 kg/m3

paper roll dimensions:1.5 m O.D., x 0.22 m ID X 3.32 m long.

- Clearly state all assumptions your team makes regarding analysis and design procedures
- Draw a free body diagram of the loading your team assumes
- Draw shear and bending moment diagrams
- Draw stress patches with appropriate loadings at points your team determines to be critical sections
- Calculate **applied stresses** on all sections you consider critical
- Draw **failure envelopes** for the failure theories your team deems most appropriate and indicate critical section principal stresses on the diagrams
- Submit an **executive summary** which reports the dimensions a and b and submit supporting documentation that demonstrates the integrity of your analysis.