The Challenge

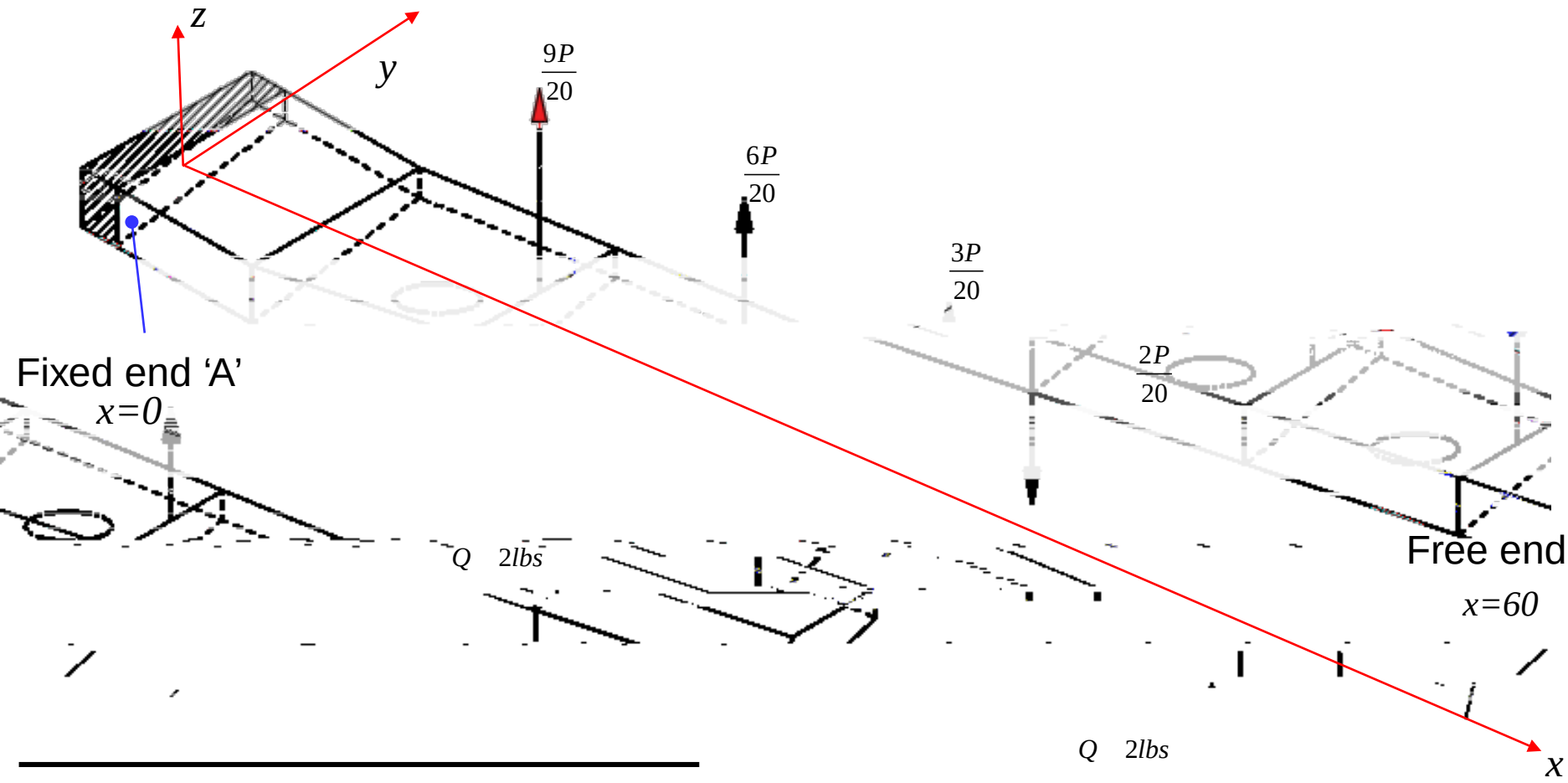
- Wings are a critical part of airplanes
  - They carry the weight of the plane
  - They are necessarily long and skinny
  - The wingbox is the core structure of the wing
- Engineers work very hard to make the wingbox light, strong, and stiff
- Here is a chance for you to do the same, & more
  - Work with Airbus & WSU engineers
  - Start your future with WSU & with Airbus
  - Win prize money!

Teams

- The competition is open to the public and the team members can include hobbyists, practicing engineers, faculty, and students (high school, university, etc.).
- As part of the competition, you will be required to conduct structural analysis and predict the deflections and failure loads. You may use classical methods or numerical tools. It would be in the best interest of the teams to have at least one member who is proficient in structural analysis.

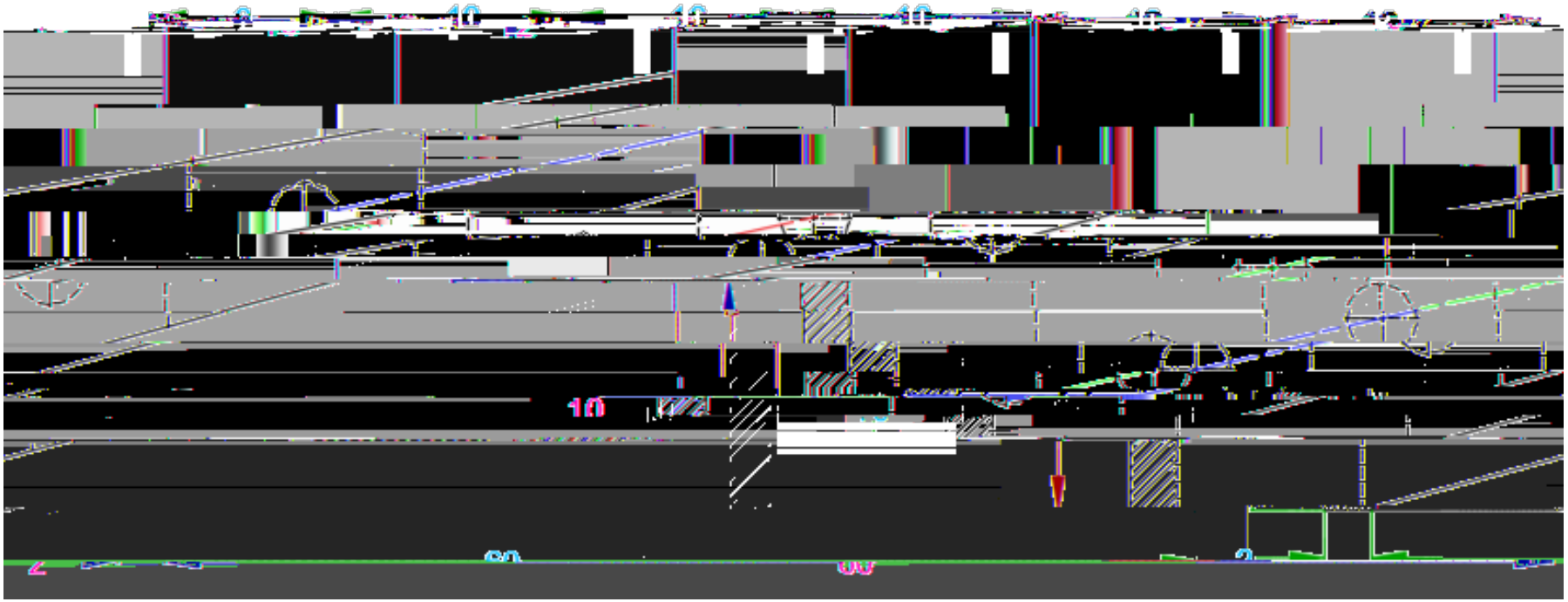
The Challenge

Using balsa sheets and sticks, , and the performance of the lightest[A], strongest[B], andstiffest[C] wingbox Thewingboxshould withstand a minimum P=20 lbs. to qualify.



A. Minimize the weight
B. How much force it can withstand
C. Higher stiffness implies smaller deflections and twist

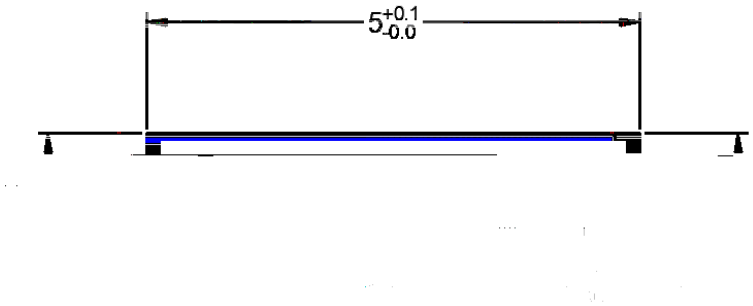
Geometry: Rib Locations



- 1/8in thick balsa ribs are mandatory at stations S_8, S_{18}, S_{28}, S_{38}, S_{48}

Crosssection geometry

Exterior dimensions not to be exceeded between stations S_{-2} and S_{8}

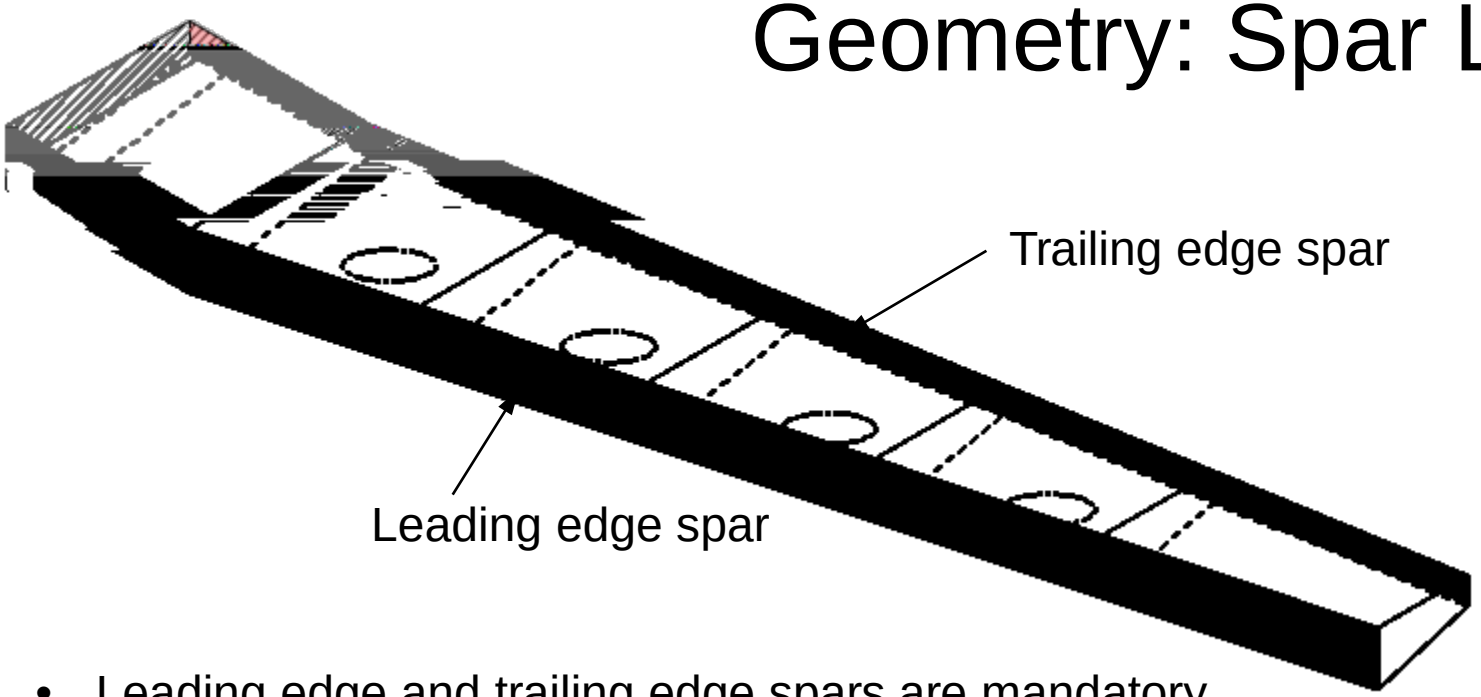


Exterior dimensions not to be exceeded at station S_{60}

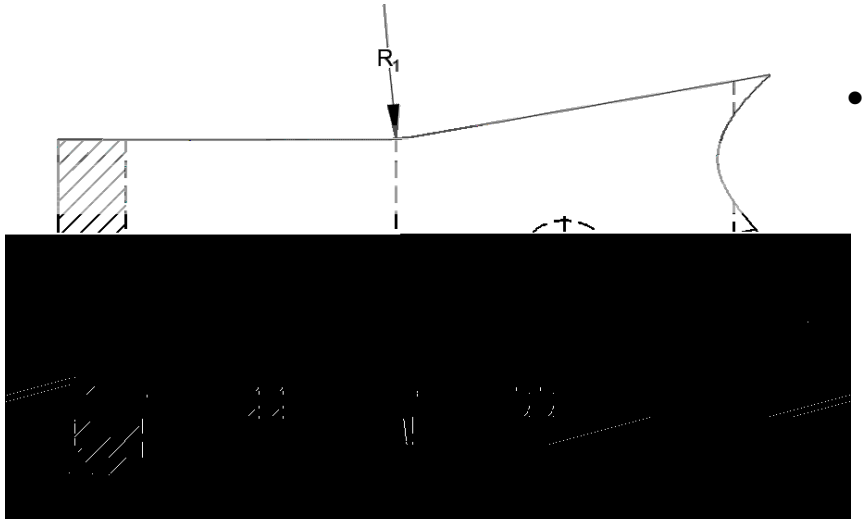
Note: The spar, skin and stiffeners shown in the figure are for illustration only.

All dimensions in INCHES

Geometry: Spar Locations

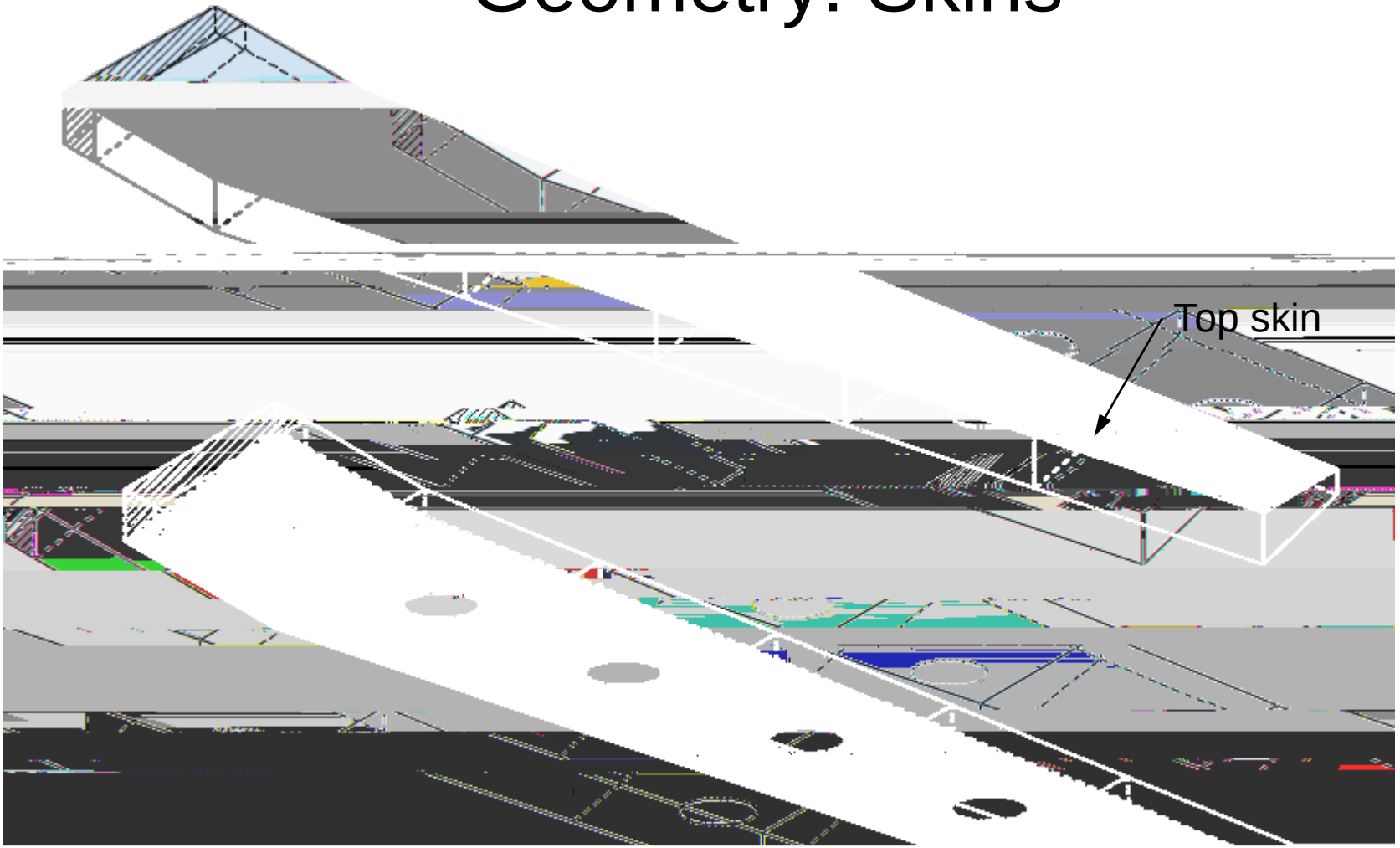


- Leading edge and trailing edge spars are mandatory.
- Additional spars may be used as necessary.
- The spars should extend to station S_2 to provide end fixity.



- Transition radii R_1 and R_2 not to exceed 4 inches.

Geometry: Skins



- Top and bottom skins are mandatory.
- Bottom skin contains access holes

NOTES

1) The balsa sticks (extending the length of the wingbox) must pass through recesses cut in the ribs as illustrated in the figure below.
2) You may cut lightening (weight saving) holes in the ribs.
3)

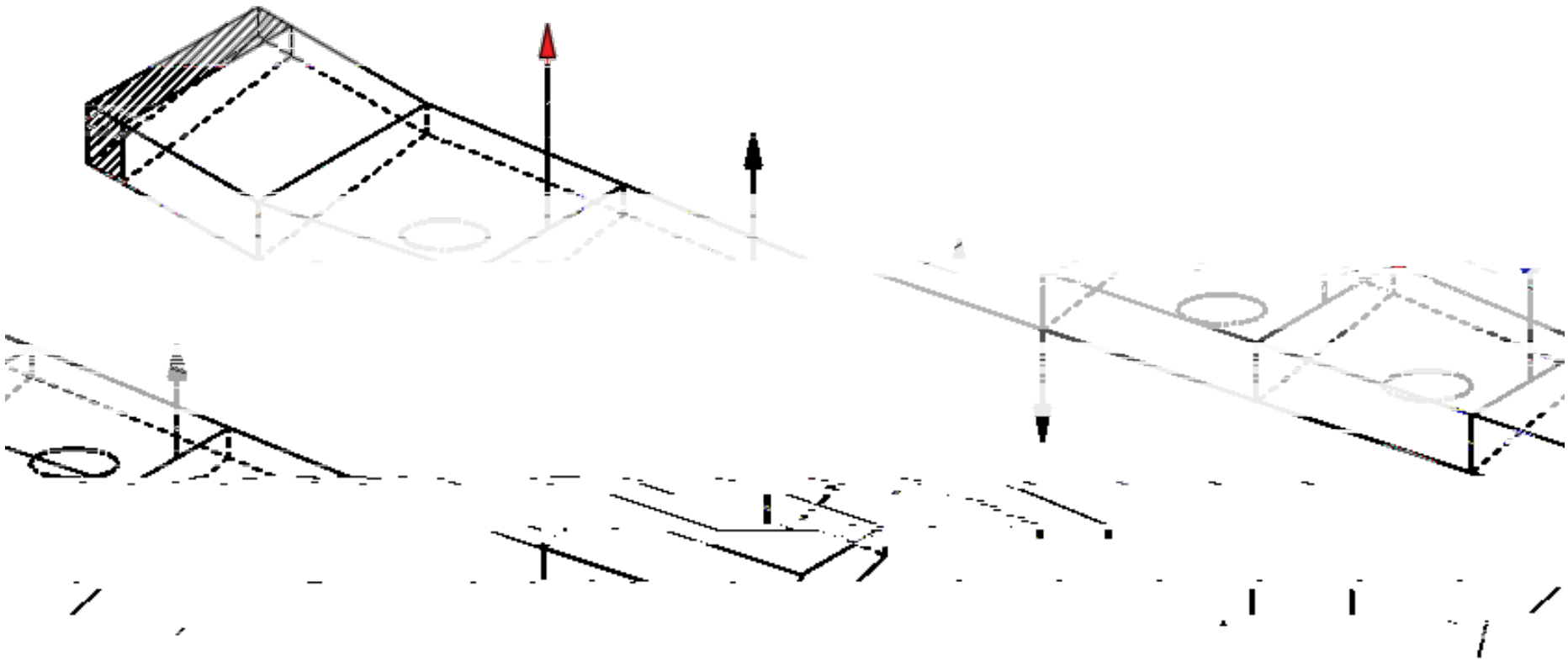
Geometry: Access ports

1) Circular access ports measuring 3

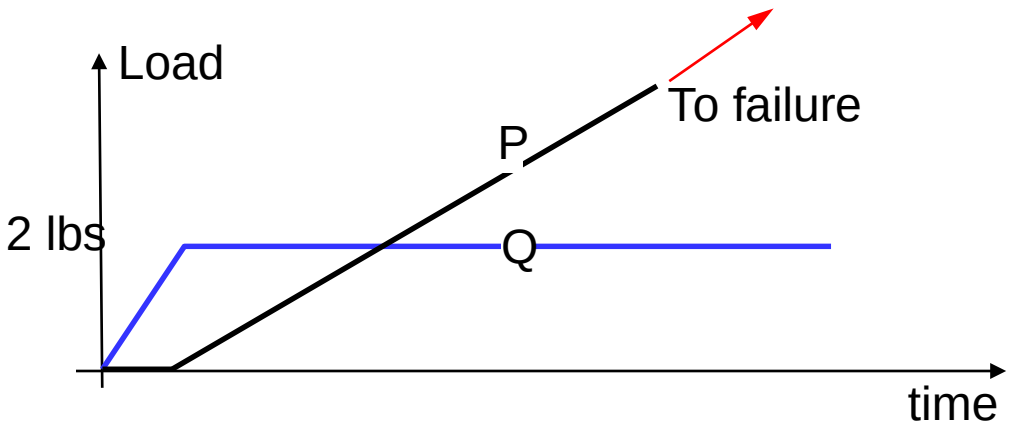
Materials

- The balsa skins should be no more than 1/16 inches thick.
  - You may laminate thinner sheets together as necessary
  - The skin thickness may be varied as required without exceeding the above limit
- The balsa spars should be no more than 1/8 inches thick.
  - You may laminate thinner sheets together as necessary
  - The spar thickness may be varied as required without exceeding the above limit
  - Apart from the mandatory leading edge and training edge spars, you may use additional spars in between.
- Balsa sticks with only 1/8 inch or 1/16 inch square cross-section dimensions are allowed. (May not be laminated)
  - The balsa sticks(stringers) must be placed on the interior of the structure.
  - Any combination of balsa sticks may be used
  - The balsa sticks may run in any direction (lengthwise, diagonal, etc)
  - The stringers can be terminated ahead of the free end if required
- The balsa ribs must be no greater than 1/8 inch thick.
- The rib at the fixed end (which will be encased in potting compound) must be 2 inches thick. You may use balsa or other wood for this rib.
- Use hobby store adhesives for bonding (Superglue, epoxy, etc.)

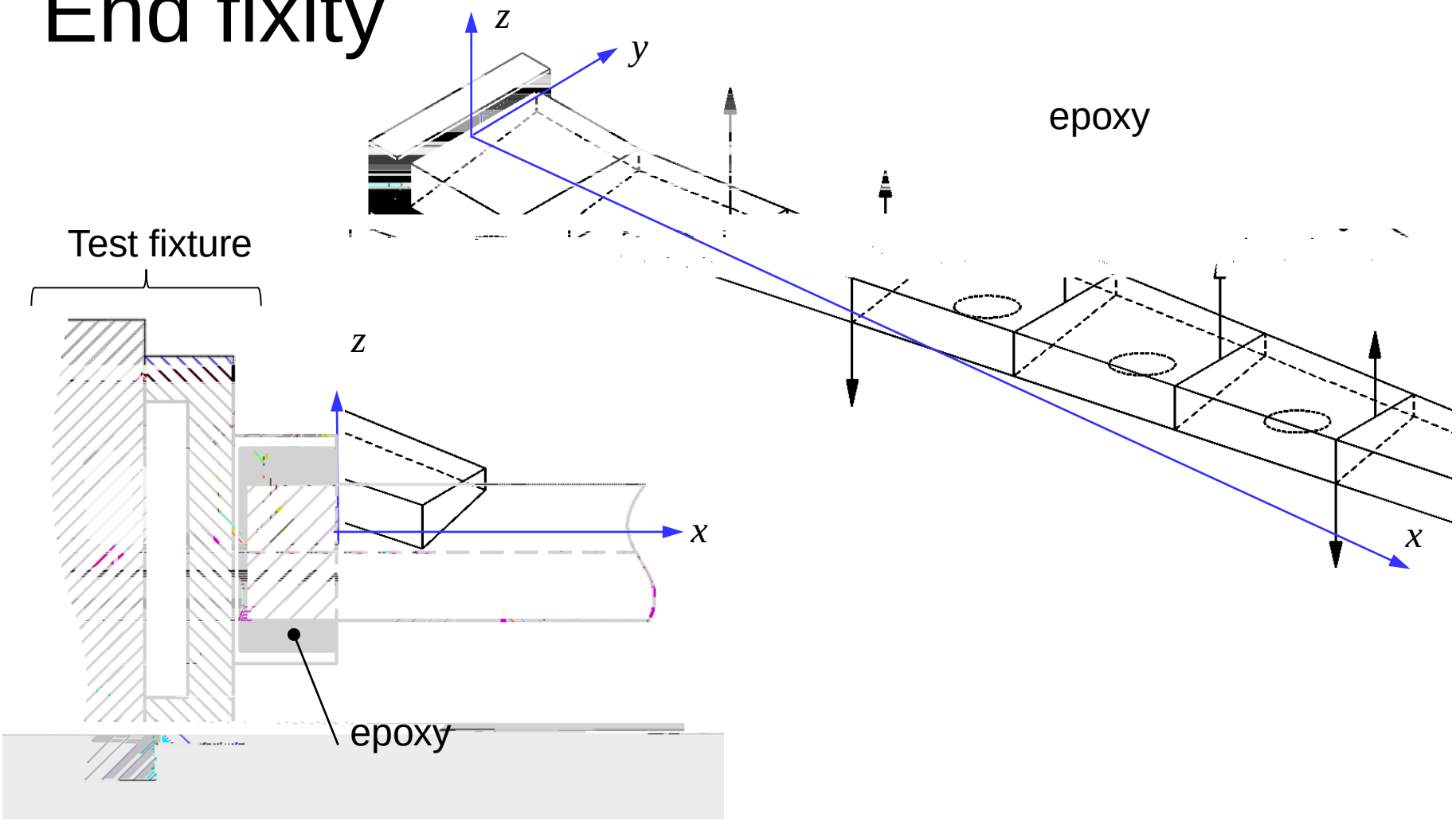
Loads



Initial loads of Q=2lbs will be applied. While holding this load,



End fixity



- The extension behind station S_0 will be cast (potted) in epoxy resin to provide the necessary end support condition. You should NOT do the end casting. This will be do by WSU
- The skins, spars and stringers must extend behind station S_0 until S_2. Failure to do so will result in rejection of wing box from the competition.

Wingbox Challenge Rubric

max		20	20		
		20	20		

max

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Wingbox Challenge Rubric…

- W_{glue} is the weight of the glue(adhesive) used. You may weigh each of the balsa parts used before assembling them and their sum gives you the total weight of balsa wood. This should be documented in your report. Weigh the completed WingBox and use it to estimate W_{glue}. If the weight of glue is not repoirted, for scoring purposes, $W_{glue}=0.25W_{wing}$ will be used.

  - S_{report}: (Maximum of 50 points for the report). The report shall include,
    - Drawing with dimensions and list of parts (10 points)
    - Itemized weight of Balsa/wood parts and glue (10 points)
    - Details of analysis (eqns, FEA models, etc) (20 points)
    - Summary of activities (5 points)
    - Design philosophy (5 points)

Deliverables

- A summary report (not exceeding 10 pages in Word format, 12pt font, single spacing, 1” margins) outlining the following:
  - Team name, affiliation, list of Team members, & mentors (1 page)
  - Summary of your design (why you decided to build the wingbox a certain way) and dimensioned drawings identifying the various parts (3 pages)
  - Summary of activities (materials used, time spent in design, constructing, testing, etc.). Photographs of activities are also welcome. (2 pages)
  - Details of Wingbox analysis, and a summary of your predictions (free end deflections and rotations, failure locations) at the following loads (5 pages)
    - With Q=2lbs loads
    - With Q=2lbs loads and P= 20 lbs
    - With Q=2lbs loads and your predicted failure load
- Deliver your fully constructed Wingbox to WSU
  - The teams are responsible for delivery of the Wingboxes to the below address

- TheWingboxes will be tested during the
- The results will be announced during the first week of June, 2019.