IANC-2025 DESIGN-A-THON

Honeywell

DESIGN-A-THON RULES

- **A group of not more than 4 members per team**
- **Max. Duration: 10 days**
- **From a given set of four problems, a team can choose any one problem**
- **Multiple teams can work on the same problem**
- **Any software or open sources can be used, but need to be referenced/acknowledged**
- **Complete solution along with the journey needs to be presented during the event**
- **Team score will depend on,**
  - ❑ Problem understanding
  - ❑ Planning
  - ❑ Execution
  - ❑ Final outcome
  - ❑ Presentation
- **Team with maximum points will be awarded the first, second and third prizes**
  - ❑ First prize: 75,000/- INR
  - ❑ Second prize: 55,000/- INR
  - ❑ Third prize (Team 1): 35,000/- INR
  - ❑ Third prize (Team 2): 35,000/- INR

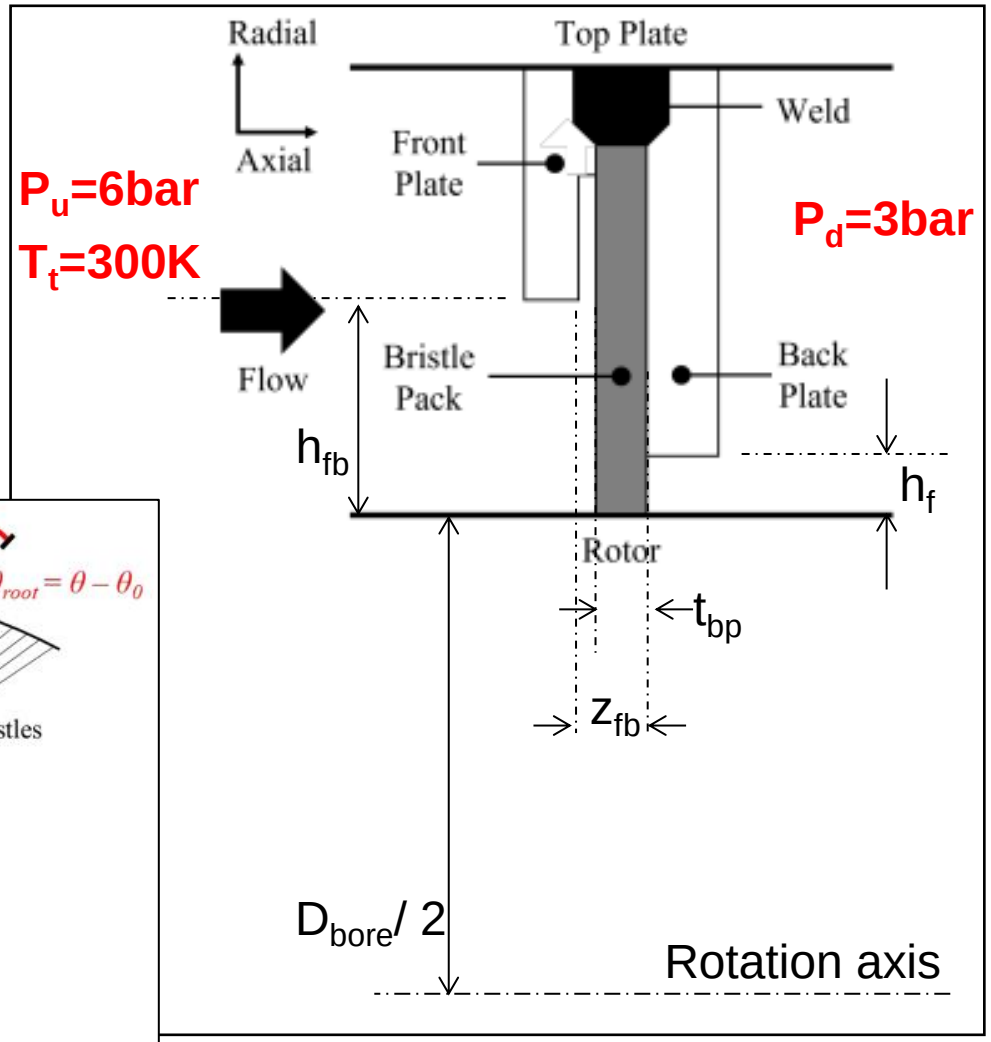
DP1: BRUSH SEAL LEAK CALCULATION

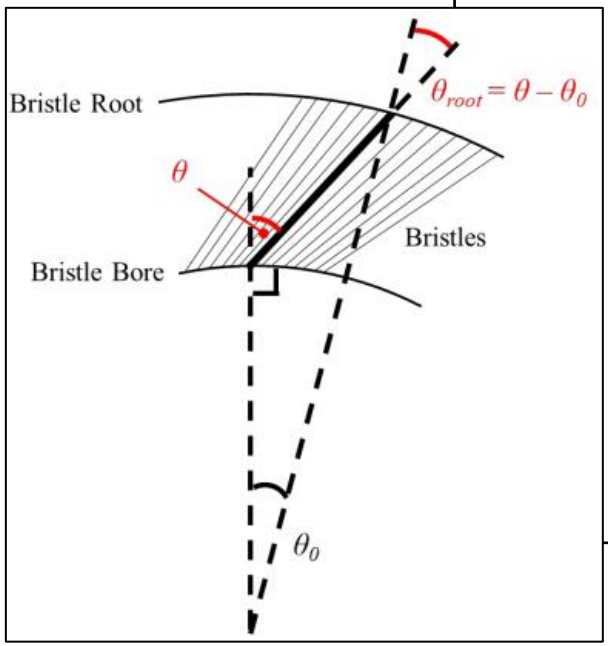
Develop a model and find out flow through the brush seal whose parameter values are given below and shown in figures. For other parameters make the assumptions with engineering judgement.

Typical brush seal geometry and principal can be seen in video published by MTU in https://youtu.be/xqbH6Kyoj8k?feature=shared

Seal parameters:

Axial clearance between front & back plate (z_{fb}) = 2mm
Fence Height (h_f) = 1.88mm
Free bristle height (h_{fb}) = 13.9mm
Bristle pack thickness (t_{bp}) =1.15mm
Bristle tip diameter (d) = 0.102mm
Lay angle (θ) = 45°
Number of bristle rows (N_b)= 11
Packing density (N) = 78.7 /mm
Bristle bore diameter (D_{bore})= 150mm
Bristle material Young's modulus (E) = 229 Gpa
Shaft speed (N_{rpm}) = 30000 and 15000 rpm
Upstream high pressure (P_u) = 6 bar
Downstream low pressure (P_d) = 3 bar





Fluid Dynamic Behavior of Conventional and Pressure Relieving Brush Seals, Joshua P. Bowen et. al, J. Eng. *Gas Turbines Power*. Jun 2024, 146(6): 061001 (https://doi.org/10.1115/1.4063775)

DP2: EQUIVALENT STIFFNESS IN BEAM MODEL: 3D V/S 1D

3D modeling of bolted flange joints is not always possible especially if the models are big. Hence engineers often model the equivalent of a bolted flange to connect the mating parts using a spring with translational and rotational stiffness based on engineering judgement. It is the objective of the current problem statement to find an equivalent stiffness of the bolted flange joint, which will be used in a 1D representation of the structure. The equivalent stiffness should help to ensure that the results from both 3D models and 1D models match closely.

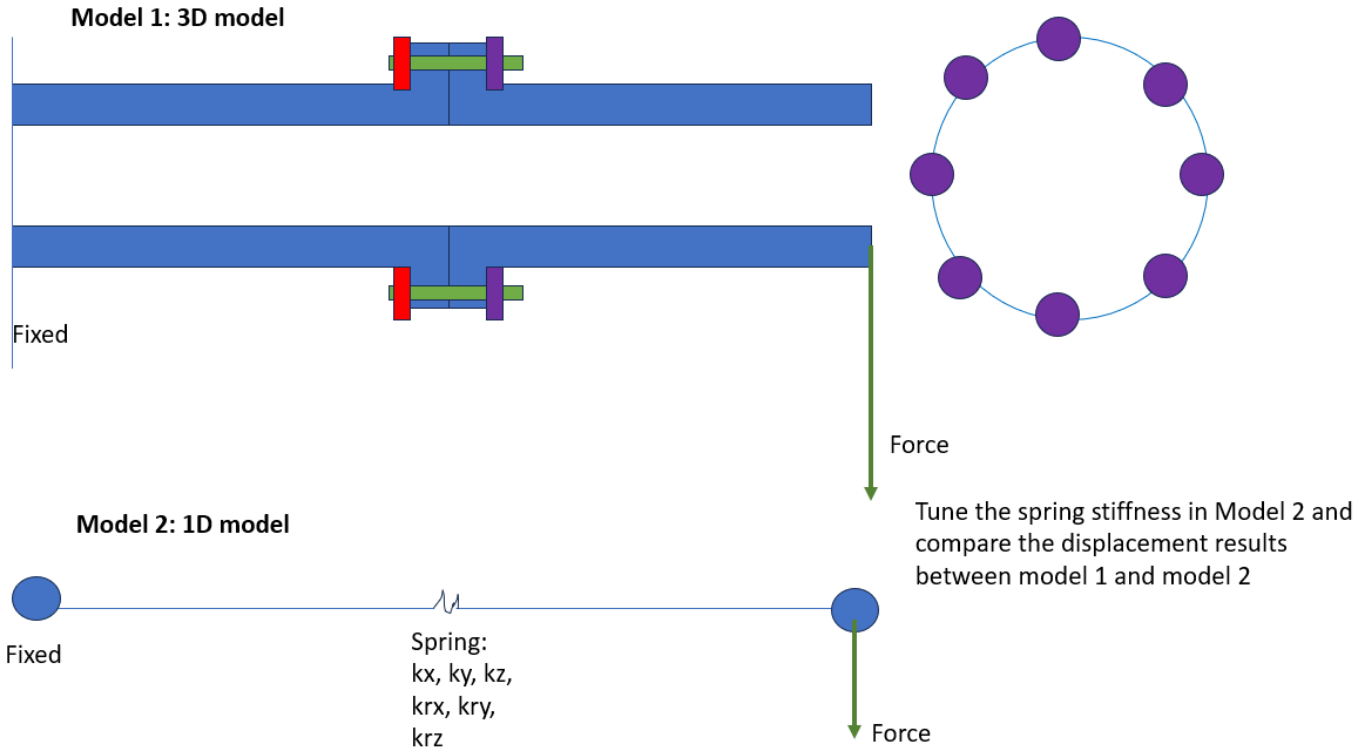
Dimensions:

- Two concentric cylinders with 40 inch diameter; Cylinder thickness: 0.15 inches;
- 10 standard bolts and nuts around the circumference to connect the cylinders
- Flange height ~1.5 inch
- Bolt diameter ~0.25 inches (model nuts and bolts with approximate dimensions); bolt preload: 1500 lbf;
- Flange thickness 0.25 inches

Materials: Steel

Boundary conditions:

- Fixed one end of the cylinder in directions
- Apply 1000 lbf force on the free end of the second cylinder



DP3: ARM OPTIMIZATION

Problem Statement: Minimize the thermal growth of the ring at locations ‘A’ & ‘B” by designing the arm, which is connect at the center of the ring and constrained axially at radius ‘Ro’ as shown in the figure.

Requirement:

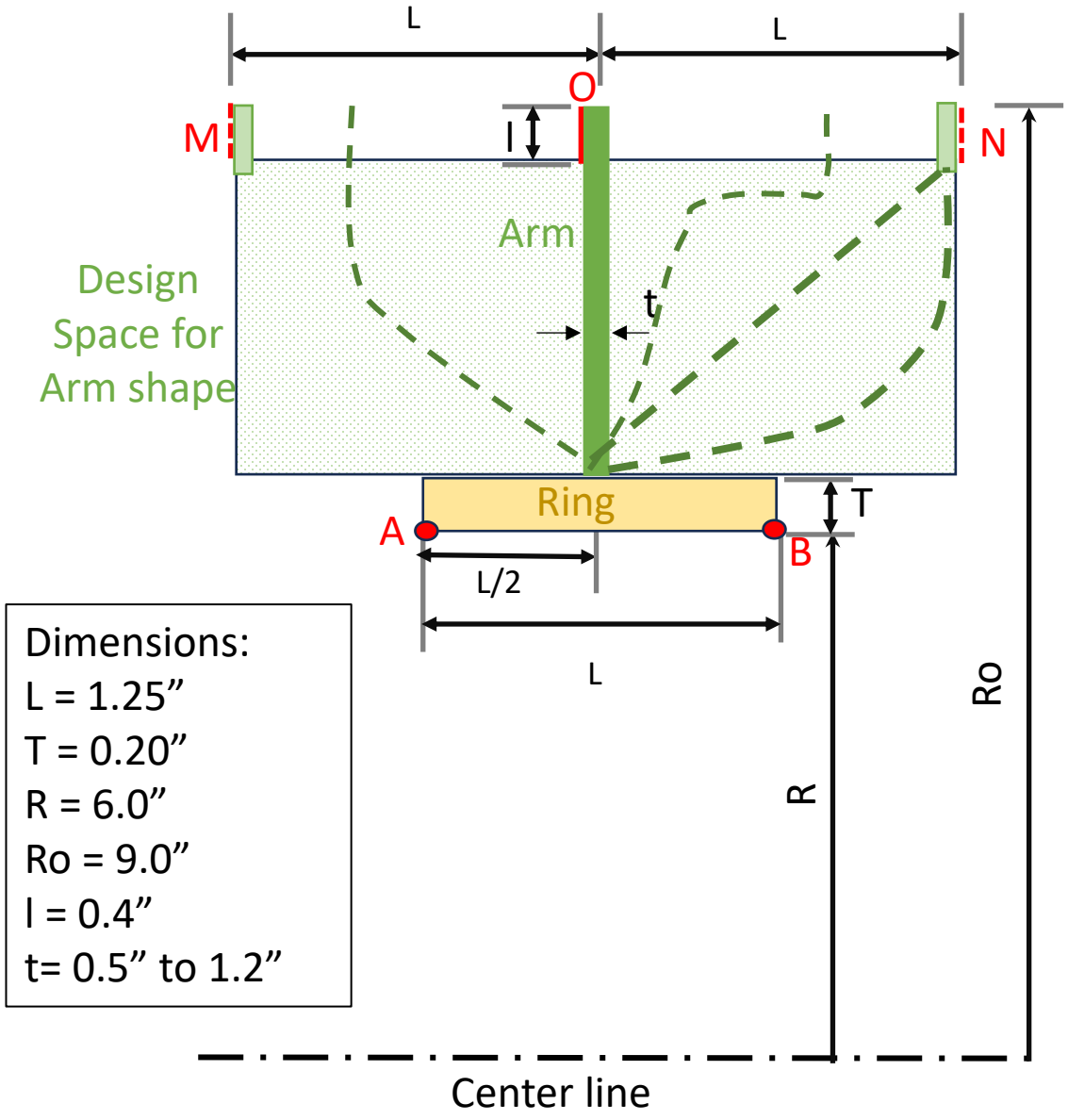
- Design an arm, with varying the thickness, t (0.5” to 1.2”), shape and position of the axial constraint at a radius of ‘Ro’. The arm outer position can move any where between locations M & N.
- Arm shape can vary and should fit in the design space. Some example shapes of the arms shown in dotted line in the picture

Model: Consider it as axisymmetric model

Boundary Conditions:

Temperature of ring and arm : 1000F uniform

Material of ring and arm: Inconel 718

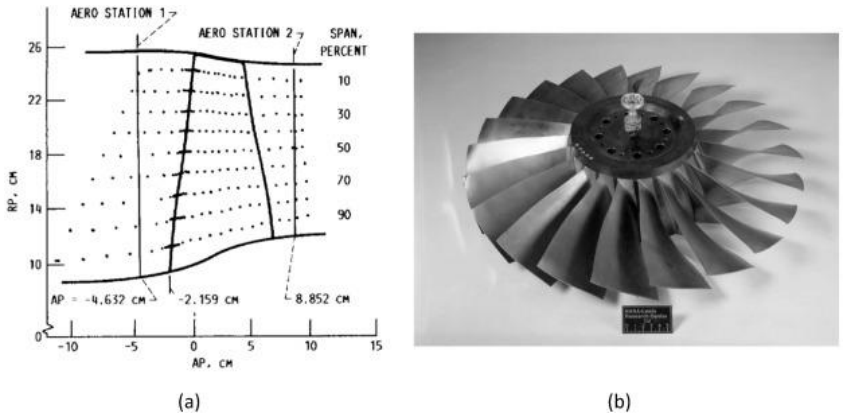


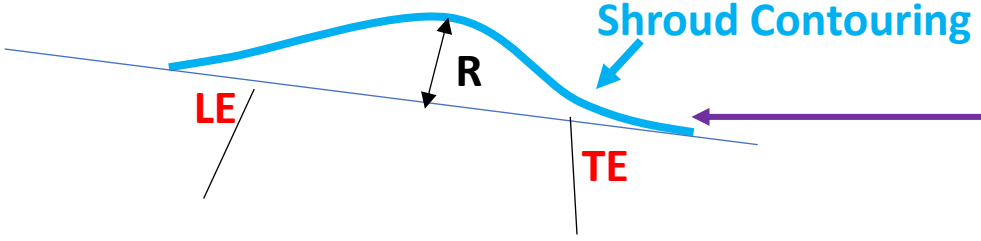
Dimensions:
L = 1.25”
T = 0.20”
R = 6.0”
Ro = 9.0”
l = 0.4”
t= 0.5” to 1.2”

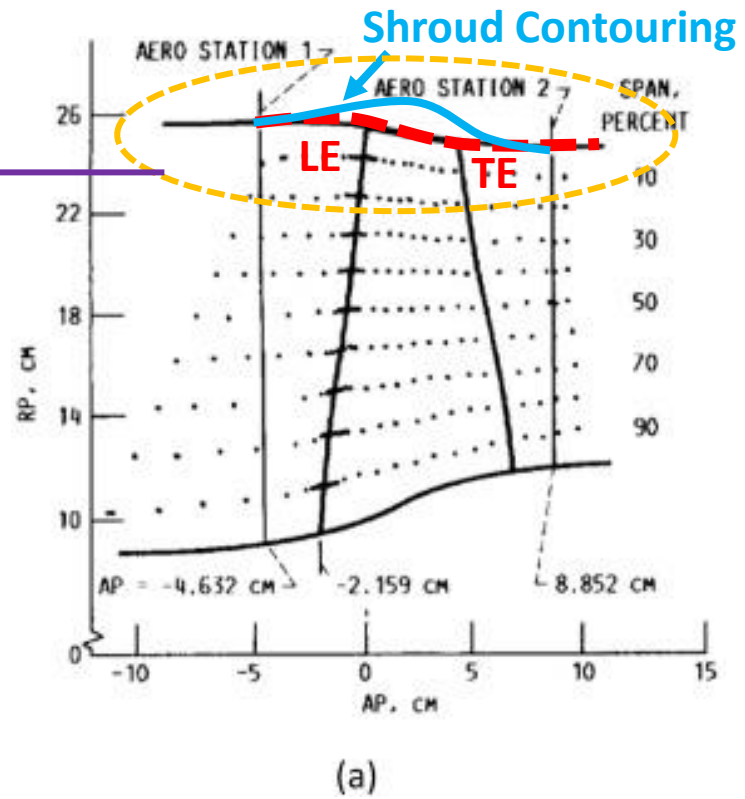
DP4: Tool to Design Shroud Contouring Shape for Stators

- Tool should be able to read coordinates of points from NACA 67 Rotor Shroud Curve or .txt file which contains shroud line co-ordinates in R,θ,Z co-ordinate system.
- The tool allow user to constrain upstream of leading edge (LE) and downstream of trailing edge (TE) points
- The tool should start shroud contouring from LE to TE and the contouring need to have smooth transition
- The tool should have option available to start and end of the contouring
- Tool should be able to provide final contoured curve file in the .csv or .txt format with R,θ,Z co-ordinate system.

Representative image NACA 67 Rotor







DP5: DESIGN OF EM ACTUATOR

Problem statement: Design the EM actuator for 50N-m Torque output, With output speed of 1000RPM.

The design process shall have

1. Concept (30% weightage) Idea / Innovate

2. Trade studies (30% weightage)

3. Detail design with actual gear box design(Preferred Harmonic gear drive)(30% Weightage)

4. A design which is printable (10%)

Strain wave gearing - Wikipedia

The basic components of a harmonic drive gear. | Download Scientific Diagram