ANSYS Mechanical Getting Started

Module 03 Student Workshop: Modeling Approach

Release 2023 R1

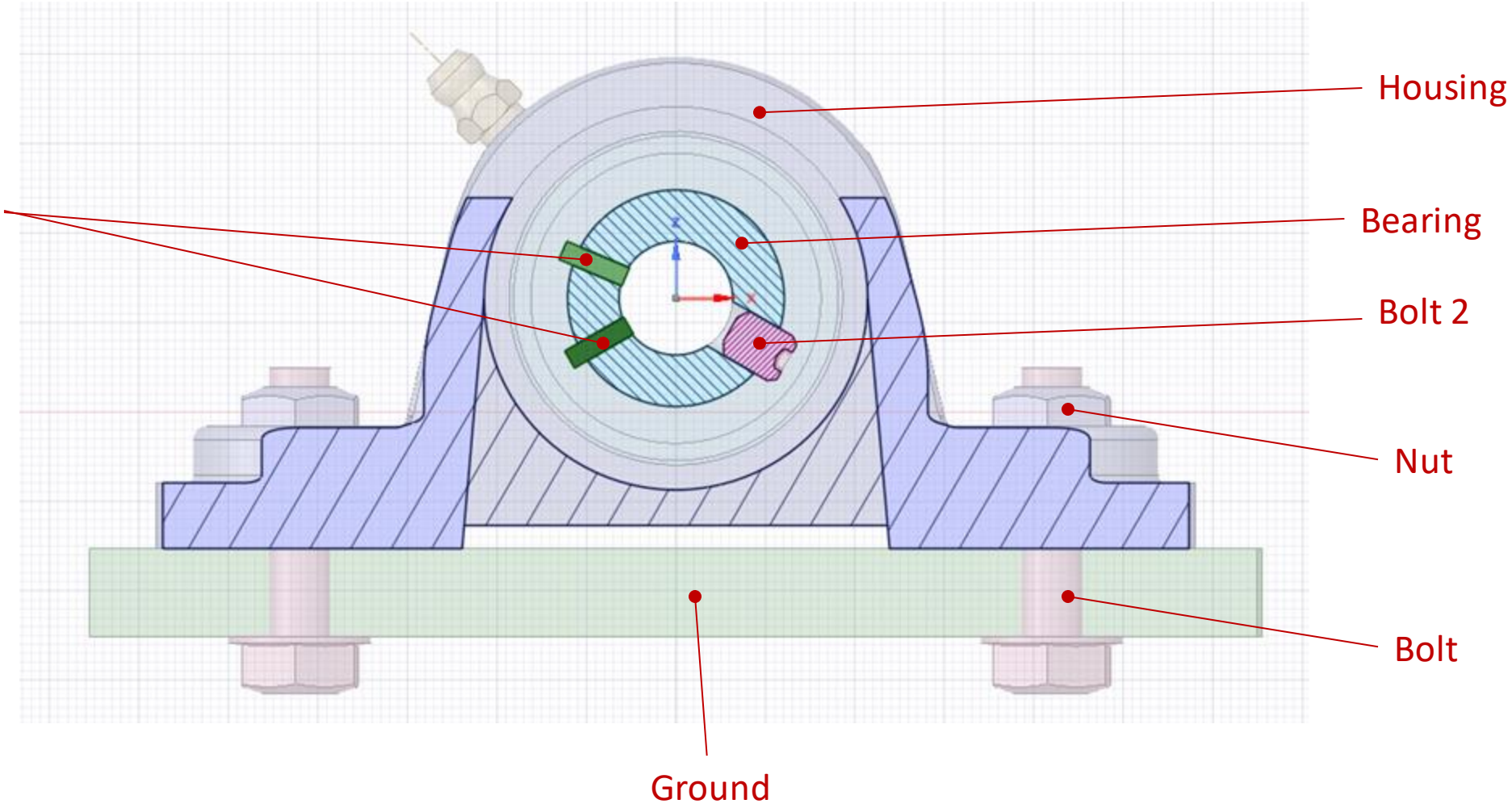
Please note:

- These training materials were developed and tested in Ansys Release 2023 R1. Although they are expected to behave similarly in later releases, this has not been tested and is not guaranteed.
- The screen images included with these training materials may vary from the visual appearance of a local software session.

Workshop 03: Modeling Approach

- Some of the preliminary decisions that will lead us to the proper analysis approach:
  - What components to include in the model and why?
  - How will I characterize those components from a geometry and material standpoint?
  - How will I model the interfaces among the components?
  - How will I characterize the operating environment?
  - How will I validate both my model and my design?
- Review of the assembly components and their purpose (in the design and in the simulation model)

Workshop 03: Modeling Approach



Workshop 03: Modeling Approach

- Isolating the bearing assembly, we can browse the bodies to make decisions about how they will be treated:
  - The ground deformation is not of interest here. It is assumed to be fixed. So, we will use it only as a body for defining supports. One suggestion is to define the ground parts as rigid bodies, and use remote displacement supports. Another is to keep it flexible with a relatively coarse mesh. We'll keep it flexible.
  - Nut/Bolt: Their mass is not significant. However, we'll include them in the model. This will add local stiffness behavior in the bearing housing sides. Later in the course, we'll study the effect of pretension in the bolts on the bearing housing. For the first approach, we'll study them as solids. Later, we'll see that they can also be represented with beams or beam connections.
  - The shafts, Bolt 2, and plug: They don't have a significant mass compared to other components of the assembly. These components play a role in the proper functioning of the system (lubrication or gap adjustment). They don't add significant stiffness to the bodies they are fixed to. They will be suppressed from the assembly.
  - Bearing and Housing: They have a significant mass in the assembly. They play the role of transmitting the pulley loads from the principal shaft to the ground. They are essential and we need to keep these bodies for simulation. They will be meshed.

Workshop 03: Modeling Approach

- Isolating the principal shaft assembly, we can browse the bodies to make decisions about how they will be treated:
  - The pulleys have a negligible mass in the assembly. However, we are going to include them because they will be used for the force application. As we are not interested in the pulley deformation, one suggestion is to model them as rigid bodies. Another is to replace them with a remote boundary condition.
  - Principal Shaft: This body is essential in our simulation. It transmits pulley forces to the bearings so it will be kept and meshed.

Workshop 03: Modeling Approach

- What material properties do we need?
  - For linear static structural analysis, the only required material properties are Young's Modulus and Poisson's ratio. We're also going to supply tensile yield and/or ultimate strengths, as we may use that information in evaluating safety factors for the model.
- Material assignments:
  - Ground: Gray Cast Iron
  - Bolts/Nuts: Steel
  - Bearing Housing: Stainless Steel
  - Principal Shaft: Steel
  - Pulleys: Aluminum
  - Bearing: Copper

Workshop 03: Modeling Approach

- Important interfaces in the model (loads are transferred through the various interfaces among the assembly components):
  - Browse all interfaces in the model. All interfaces will be considered as bonded contact as a first approach.
  - The shaft is not rotating, so, we can make the assumption that it is fixed to the bearing.
  - Housing separation from the ground part will be considered in a subsequent course.

Workshop 03: Modeling Approach

- Loads and boundary conditions necessary to adequately characterize the external environment:
  - Each belt tension will be represented by a force as a first approach. A suggestion is to replace the force with a bearing load that better represents the force distribution between the belt and the pulley.
  - A point mass will be used to represent the mass near the motor pulley.
  - Bolt preload will be neglected for the first approach. The preload effect will be studied later in the course.
  - Fixed supports will be applied to the ground to constrain movement in the three spatial directions.

Workshop 03: Modeling Approach

- Postprocessing techniques and results quantities that will help validate the design and the simulation model:
  - Our design criterion is to check the shaft misalignment value with housings made for polycarbonate and compare them against the existing misalignment in the stainless steel housings. We'll need to postprocess deformations of the shaft. Then, what stress component will we use to base our decision upon (von Mises, Max/Min Principal, Normal Stress)? How will we know the location of the governing stress, and how will we ensure its accuracy?
    - Checking reaction forces to ensure static equilibrium
    - Confirming that deformation shape agrees with expectations
    - Checking that maximum stress for each component is below yield stress
    - Animation of results
    - Refining mesh and solving again

End of presentation