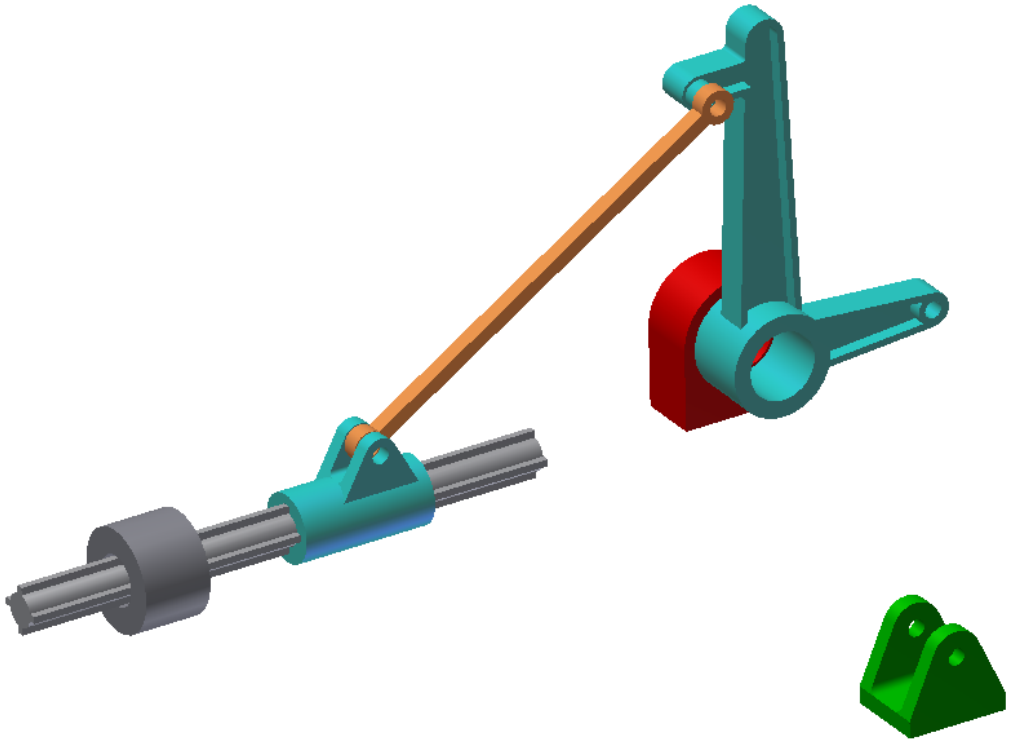
ME 24-688 – Week 12

Problem Set Assignment

1 Crank Slider Mechanism Concept Validation Project

As part of a new industrial machine design, we are reviewing a design concept early in the design cycle to achieve the best design possible. The design engineer created a concept model of a proposed design and also completed a basic rigid body motion path analysis to ensure general positions and movement are as desired. To ensure that the design will function as planned and to provide guidance on improvements a Mechanical Event Simulation (MES) with nonlinear materials analysis needs to be conducted in Autodesk Simulation. This will allow the motion and strength of the parts to be analyzed.

The goal of the design is to push and pull the clevis block (cyan) along a rail by extending an actuator component that is connected to the pivot bracket. This is accomplished by connecting a universal joint link between the clevis and pivot bracket. The pivot bracket is then connected to the link bar (orange) to slide the block along the rail. The actuator will extend 1.0" and then retract back. During this movement the clevis block will be pressed against the stop, applying a force. The goal of the analysis is to determine the best material to use for the link bar and determine if the link bar will be bent. Additional information about the project assignment is listed in the following sections.



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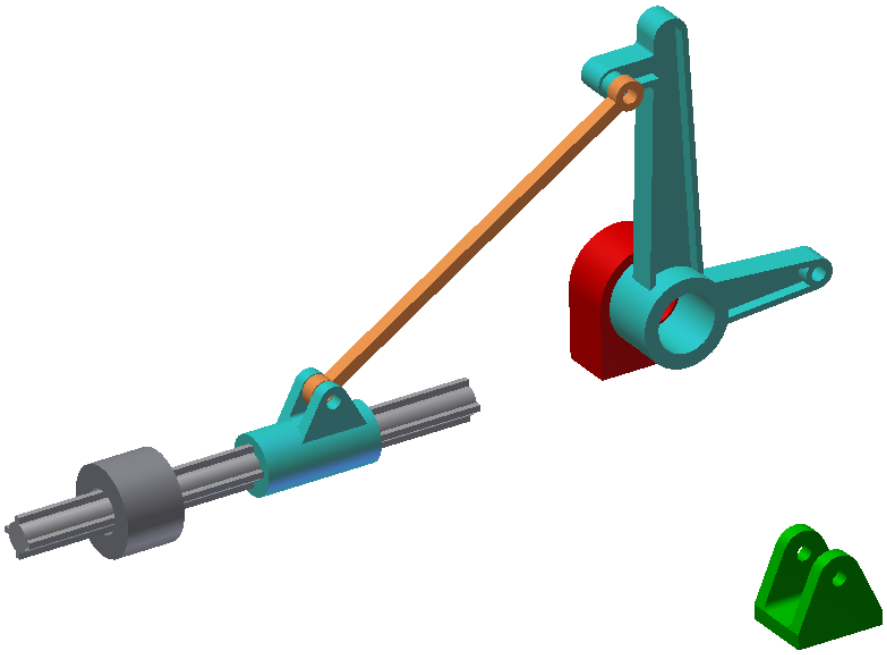
1.1 Provided Items

The following items are provided to complete the assignment.

Autodesk Inventor Assembly File

The "*Crank Slider Mechanism.iam"* file is provided as a starting point to complete the analysis. Open this provided 3D model file in Autodesk Simulation.



Link Bar Materials

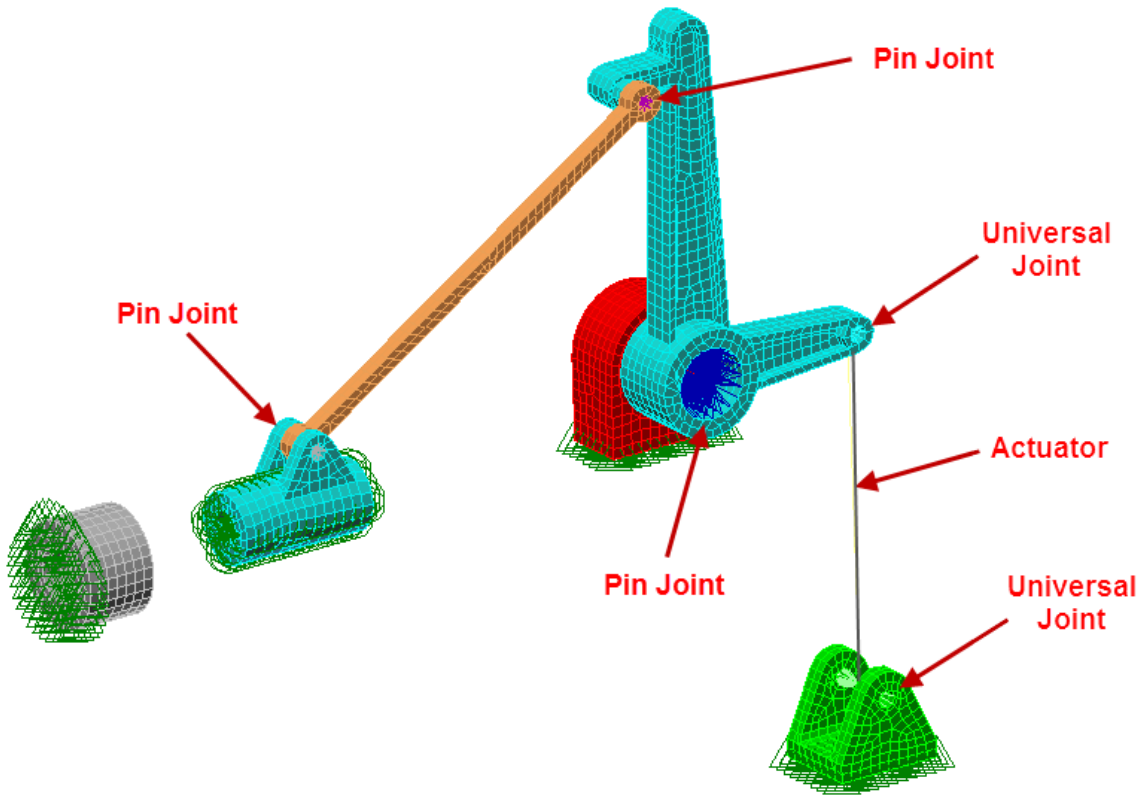
The following two materials are under consideration for the Link Bar (orange) part.

- *Aluminum 6061-T6; 6061-T651*
  - (Yield Strength 40,030 psi)
- *Steel AISI 1018, Cold Drawn*
  - (Yield Strength 53,363 psi)

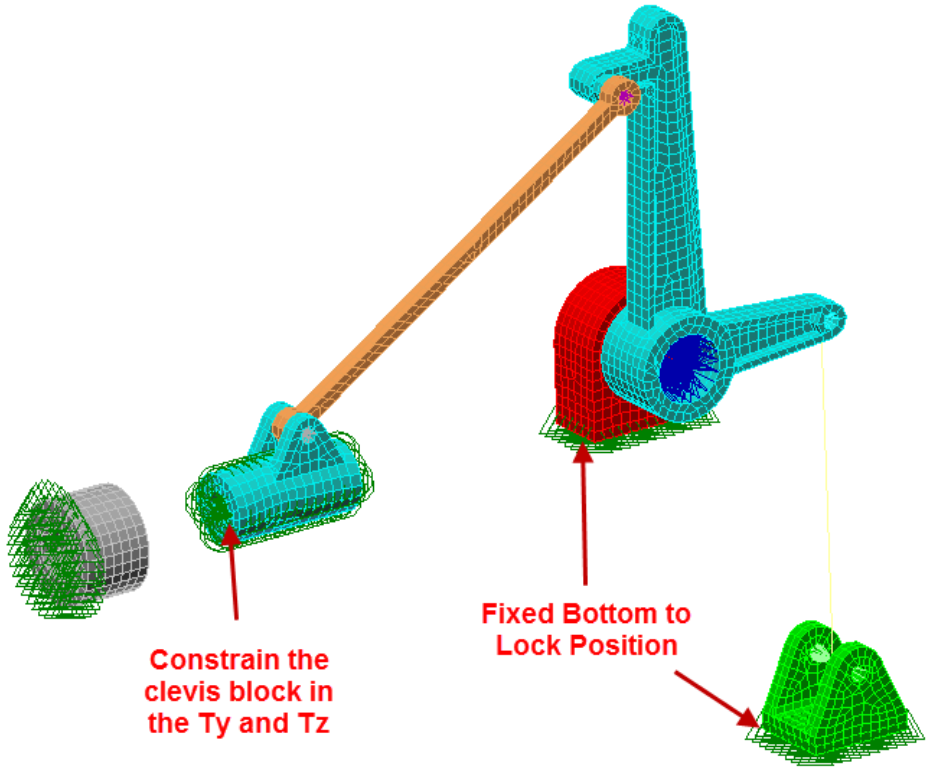
1.2 Requirements

Outlined below are the assignment requirements for the analysis. Each of the noted items is required to complete the mechanism setup for proper results.

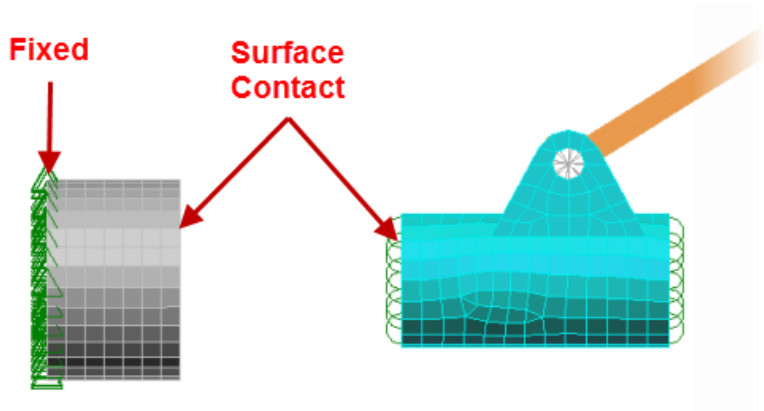
Linkage



Environment



Contact



1.3 Instructions

Outlined below is a series of different instructions and guides for completing the project.

- The mesh size should be set to an absolute value of 0.15 inches.
- Analysis total time duration is 2.0 seconds.
- The capture rate for the analysis is 10/sec (You may also use a higher rate if you have enough computational power on your computer)
- The analysis may take approximately 10-20 minutes to solve depending on your computer resources.
- The actuator needs to extend out by 1.0 inch over a 1.0 second period of time. Then return back to the original position within another 1.0 second. The total simulation duration will be 2.0 seconds.
- The mounting bracket for the Pivot Bracket part and actuator clevis part can use 3D Kinematic elements to improve processing time.
- The Material for all joints needs to be Steel (AISI 4130).
- The Cross-sectional area for all joints needs to be 1 in^2
- Change the Element Definition for link-2 to von Mises with Isotropic Hardening

Tips

- Watch the first couple time steps as the analysis solves to determine if everything looks setup correctly before continue. If you happen to notice an issue you can stop the analysis and return to the FEA Editor environment to make the required updates.

1.4 Final Deliverable

To complete the problem set provide a completed Autodesk Simulation report in PDF format with the answers to the following questions in the executive summary section. Also please include your name in the author field of the PDF report files.

- Save each report using the following naming convention:

  ps10_FirstName_LastName_Description

- Exclude the Processor Log Files from both reports.

Report 1
Simulation completed using the *Aluminum 6061-T6; 6061-T651* material for the Link Bar (Orange) part.

- Provide a Contour Presentation of the minimum Safety Factor for just the Link Bar throughout the simulation.
- Provide a graph with data labels of the minimum Safety Factor for just the Link Bar throughout the simulation.
- Provide a graph of the sum of all the nodes Reaction Force in the X direction for just the face of the Collar Clevis that has the impact.
- Provide a Contour Presentation of the maximum Displacement for just the Con-arm throughout the simulation.
- Provide a graph of the maximum Displacement for just the Con-arm throughout the simulation.

Report 2
Simulation completed using the *Steel AISI 1018, Cold Drawn* material for the Link Bar (Orange) part.

- Provide a Contour Presentation of the minimum Safety Factor for just the Link Bar throughout the simulation.
- Provide a graph with data labels of the minimum Safety Factor for just the Link Bar throughout the simulation.
- Provide a graph of the sum of all the nodes Reaction Force in the X direction for just the face of the Collar Clevis that has the impact.
- Provide a Contour Presentation of the maximum Displacement for just the Con-arm throughout the simulation.
- Provide a graph of the maximum Displacement for just the Con-arm throughout the simulation.

1.5 Grading

The problem set grading level will be established from the following items:

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Problem Set Assignment

- 40% = Correct Report 1 Values and Presentations
- 40% = Correct Report 2 Values and Presentations
- 20% = Analysis Setup