1. Design guidelines

2. Preliminary design

3. FEM Analysis
   a. Import model
   b. Type of study
   c. Define material
   d. Fixtures
   e. Forces
   f. Meshing
   g. Adaptive meshing (optional)
   h. Results
   i. Optimize
4. Define material

If the material is not available in the standard SolidWorks Material library,

Edit Material ➔ Create new Library ➔ Create new category ➔ Enter Material properties

5. Fixtures

![Fixtures Image]

Attention should be given to the position of mounting holes, when designing the bracket.

- Must provide adequate access for socket head cap screws
- Also provide access for hand tools to secure them
- Must design for standard screw lengths (e.g.: ½”)

![Bracket Design Image]
6. **Virtual wall**

Right click on connections ➔ Contact Set ➔ Virtual Wall (Type)

7. **Forces**

If the force acts only on a specific area of the selected surface ➔ Create split lines

A Split line divides a selected face into multiple separate faces, which enables to select the associated area

Right Click External loads ➔ Force ➔ Split ➔ Create Sketch ➔ Create split
The load will be fixed to an eye bolt and transferred to the bracket through a hex nut.

8. **Create mesh and Run**

9. **Convergence test**

Use either h-adaptive (varies the refinement level or mesh density) or p-adaptive (changes the order of shape function) methods to know the accuracy level.

   Right click on study ➔ Properties ➔ Adaptive ➔ h-adaptive/p-adaptive

10. **Factor of Safety**

You can plot the factor of safety distribution throughout the model, or you can just plot regions of the model with a factor of safety smaller than a specified value to identify weak areas of the design.

   - A FOS < 1.0 at a location indicates that the material at that location has failed.
   - A FOS = 1.0 at a location indicates that the material at that location has just started to fail.
   - A FOS > 1.0 at a location indicates that the material at that location is safe.
   - The material at a location will start to fail if you apply new loads equal to the current loads multiplied by the resulting factor of safety, and assuming that the stresses/strains remain in the linear range.

   Right click on Results ➔ Define factor of safety plot ➔ Follow the 3 steps
11. Optimize the design

Some parameters of the design could be changed to obtain an optimum design. Although setting parameters would vary with the design (thickness, distance etc.), the ultimate goal would be to optimize the design in terms of strength and mass.

Right click on Study ➔ Create new design study

Variables ➔ Add parameters (from drop down list)

Then specify minimum, maximum and step values for the variable

Constraints ➔ Add sensor ➔ Simulation Data ➔ Stress, von Mises Stress
Then select from drop down list whether: **Monitor only / is less than / is greater than / is between**

Goals ➔ Add sensor ➔ Select **Sensor Type** and **Properties** form drop down

Than select from drop down list whether to: **Minimize / Maximize / is exactly**