Basketball Backstop

Team 47

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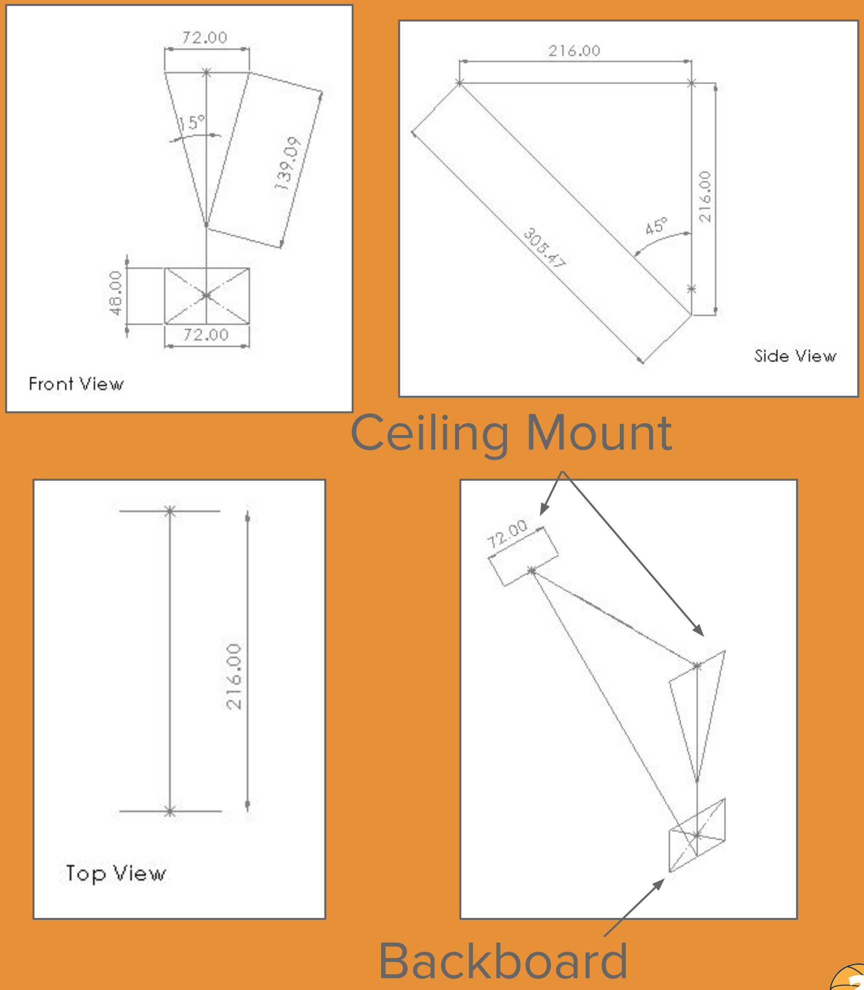
Motivation and Objectives

Structure Description

Rear Braced Ceiling-Mounted Basketball Hoop



Structural Analysis

Rear Braced Ceiling-Mounted Basketball Hoop

- Completed via determination of stress and displacement values
  - Displacement and Reaction Forces used
  - Conducted at each joint (node) in the Truss System
- All Members are assumed to behave as typical bar elements
  - Elastic Modulus, E
  - Area, A
  - Length, L
- Stiffness Matrices for individual members are to be combined into full matrix for the truss

$$\mathbf{K} = \frac{EA}{L}\begin{bmatrix} c_x^2 & c_xc_y & c_xc_z & -c_x^2 & -c_xc_y & -c_xc_z \\ c_xc_y & c_y^2 & c_yc_z & -c_xc_y & -c_y^2 & -c_yc_z \\ c_xc_z & c_yc_z & c_z^2 & -c_xc_z & -c_yc_z & -c_z^2 \\ -c_x^2 & -c_xc_y & -c_xc_z & c_x^2 & c_xc_y & c_xc_z \\ -c_xc_y & -c_y^2 & -c_yc_z & c_xc_y & c_y^2 & c_yc_z \\ -c_xc_z & -c_yc_z & -c_z^2 & c_xc_z & c_yc_z & c_z^2 \end{bmatrix}$$

$$C_x = \frac{x_2 - x_1}{L}; C_y = \frac{y_2 - y_1}{L}; C_z = \frac{z_2 - z_1}{L}$$

- Boundary Conditions applied at specific nodes depending on placement and mounting with respect to environment

Failure Criteria

Deflection Criteria Applied to the Contact Point Between the Backboard & Truss to Determine System Failure

- Analyze truss system to determine stress and displacement values at different joints (nodes). Multiply displacement value with desired factor of safety to obtain failure criteria under deflection.

$\emptyset_u |U_{y_n}| \leq U^*$ n=member #, ϕ =safety factor, U_{yn}=deflection at member, U*=failure value

- Ideal factor of safety for basketball backstops = 55
- The displacement value will be in terms of load applied, area of the beam, elastic modulus of the beam material, and length of the beam.
- Plug in the values including the load to determine if the beam will fail using the inequality.
- Obtain maximum strain value before deformation and multiply length of member, and compare

Failure Criteria

Buckling and Yield Criteria Applied to Truss System

- If applied axial load is negative (compression) yielding & buckling must be considered. If positive (tension), only yielding will be considered.
- Multiply the obtained stress value at the nodes with a factor of safety of 55
- Determine if member will buckle or yield after plugging in force, cross-sectional area of the beam, FOS, and comparing against material yield strength.

$\emptyset_{\sigma}|\sigma_n| \leq \sigma^*$ n=member #, ϕ =safety factor, σ_n=stress at member, σ*=max yield strength

Minimum Mass Design

In Terms of the Dimensions of Structural Members and the Materials Used

We'll have the most control over cross-section area, which we solve using failure criteria. From there, find the mass using:

$$m = \rho * A * L$$

(A and L may vary for each member)

Furthermore, we can minimize the mass by selecting materials according to density.

*Results

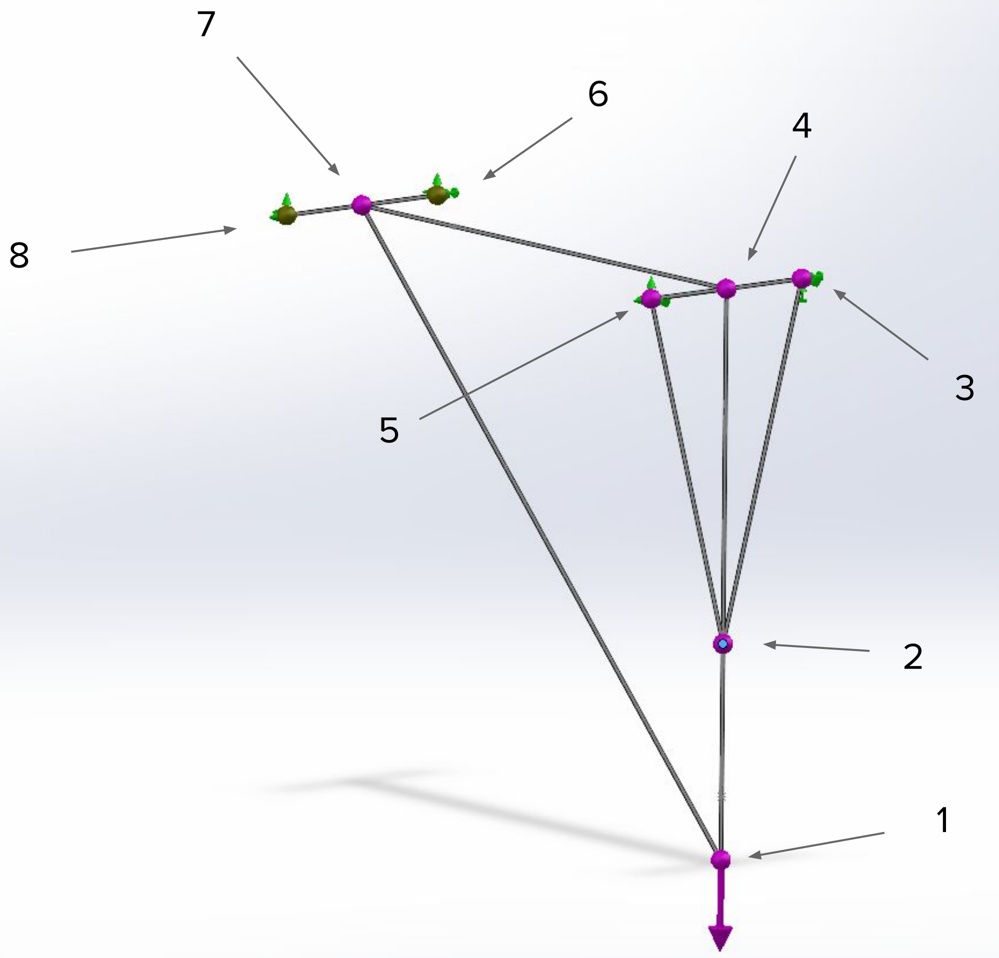
- Expectations: All members of the truss system will be in tension as a result of the player interacting with the rim from dunking - this could cause failure by deflection, buckling or yielding to an allowable limit that is yet to be calculated.
- Calculations from the previous slides mentioned would be solved and compared to either support or defer this claim.

*In Progress

*Conclusion

Our concluding remarks will summarize our findings detailing any important calculations that led to a change in the system.

*In Progress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