Requirements

1. Redesign of the structure
2. Floor of the Hut is 8 meters from the ground

Assumptions

1. The Wind is blowing at a constant speed and has a worst-case force considered for the design optimization.
2. The Weight of the Hut is uniformly distributed on the floor and a constant force/area is applied on the top surface of the design domain
3. The effect of the Wind on the structural support design is negligible – The structure will mainly comprise trusses.
4. The Sand at the bottom has a solid foundation and is considered to be fixed support that can hold an infinite amount of load.
5. The Structure is made of wood – considering wood has isotropic nature – properties same in all directions

Setup

1. Defining the Objective Function – **Minimize stress**
    a. The main objective behind replacing the trusses is to make sure that the for the height of 8m, the truss doesn't buckle (from hut's weight) or bend(from wind's loading)
    b. Since this is a one-time static assembly, mass is not too big of a problem. Further, for an 8m long structure, stiffness is a required factor but is not that major of an issue if the structure does not fail.
    c. Thus, Failure is the key thing that we want to make sure doesn't happen, which we can predict based on the equivalent von-mises stress of the arrangement.
2. Deciding the Design Domain – **Cuboidal Box**
    a. We want a structure that can handle the four loads with minimal stresses. This can result from any possible combination of three-dimensional trusses.
    b. Thus, the design domain is the entire cuboidal block below the hut, out of which any three-dimensional truss can originate.
    c. Though it is ideal for the bounding box to be as large as possible, it significantly increases computational time, it is better to stick with a cuboidal box, with the top surface dimensions same as the floor of the hut (on which a uniform distributed load is applied).
3. Deciding the support constraints, and loads – UDL on top, Fixed support at the bottom
    a. As mentioned in the assumptions, it is assumed that the force from the hut is uniformly distributed at the top surface, and thus, a uniformly distributed load, force/area will be applied at the top of the design domain
        i. This force will be a three-dimensional vector, with a Z-directional force for the weight and x/y-directional force for the wind loading
    b. As mentioned in the assumptions, it is mentioned that sand has a solid foundation, and thus, fixed support is assumed at the bottom.

c. **Additional Constraints –** I would also like to add an additional constraint to keep the compliance below a certain level – stiffness above a certain level – the deformation of the structure shouldn't exceed a certain level.

Anticipating problems

1. The setup does not accurately replicate the physical conditions of the problems – the parts where the floor of the hut is a bit extended outside (as can be seen in the picture)
2. The Output of the solution can't directly be used as there will be stair steps and post-processing to remove stair-steps (after removal of grey areas) is a problematic solution) might make it suboptimal.
3. Since the manufacturing is done with wood, the final optimal design might not be feasible to manufacture, thus, need to change it making it suboptimal.
4. The Design Domain is quite big, making the computational expense a real problem when trying to optimize the design using a personal computer
5. Proper choice of parameters is a key problem – better parameters lead to better solution, but to what level are these parameters to be tuned??