

# Tech Wars 2019

Niagara County  
Community College

**Competition Category:** Seismic Design Competition

**Level of Competition:** High School

**Event Coordinator:** Mark Voisinet [mvoisine@niagaracc.suny.edu](mailto:mvoisine@niagaracc.suny.edu)

## Objective of Competition:

Your team has been hired to submit a design for a multi-level commercial office building. To verify the seismic load resistance system, a scaled model must be constructed from **PINE or SPRUCE**. It will be subjected to severe earthquake excitations. The seismic performance of the structure will be evaluated according to the rules described in the following sections of this document.

## Rules of Competition:

### Structure Dimensions:

The structure must comply with the following dimensions.

### **Maximum floor plan dimension:**

**10" x 10"**

Minimum individual floor dimension:

6" x 6"

Minimum number of floor levels:

15 levels

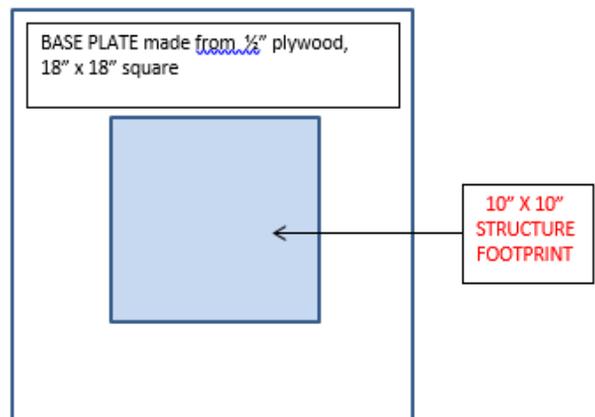
Minimum building height:

60"

Structure height shall be measured from the top of the base floor to the uppermost beam member of the top level. The base floor is defined as the top of the base plate.

### **Structural Model Base Plate:**

A square plywood base plate will be used to attach the structure to the shake table. Each team will be responsible for manufacturing their base plate. An engineering diagram depicting the manufactured base plate is shown below:



### **Structural Model Roof Plate:**

A square plywood roof plate is needed to supply the dead-weight load. Teams are responsible for fabricating and installing their roof plates. The roof plate needs to be centered and aligned with the base plate. It must be securely attached to the structure. Roof plate must have a 3/8" diameter hole through its center to accept a bolt for the roof weight.

Minimum Dimensions for roof plate:

6" x 6"

Maximum Dimensions for roof plate:

10" x 10"

### **Structural Frame Members:**

Structures shall be made of Number 2 pine and the maximum members cross sectional dimensions are:

Rectangular column:

1/4" x 1/4"

Beam:

1/8" x 1/4"

Diagonal:

1/8" x 1/4"

### **Structural Mass:**

The total mass of the structural model, including the base and roof plates, will be measured and recorded before testing. A strength to mass ratio will be used to determine efficiency in the event a structure(s) does not fail during testing.

### **Column Connections:**

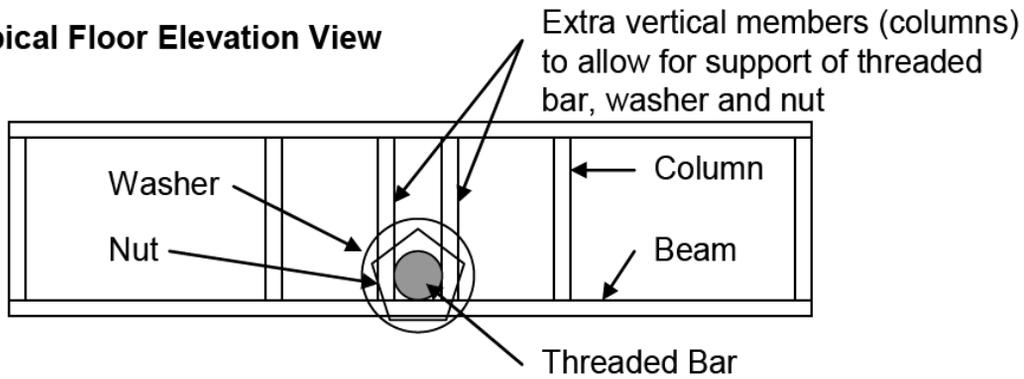
All columns on the first floor must be connected directly to the baseboard.

### **Structural Connections:**

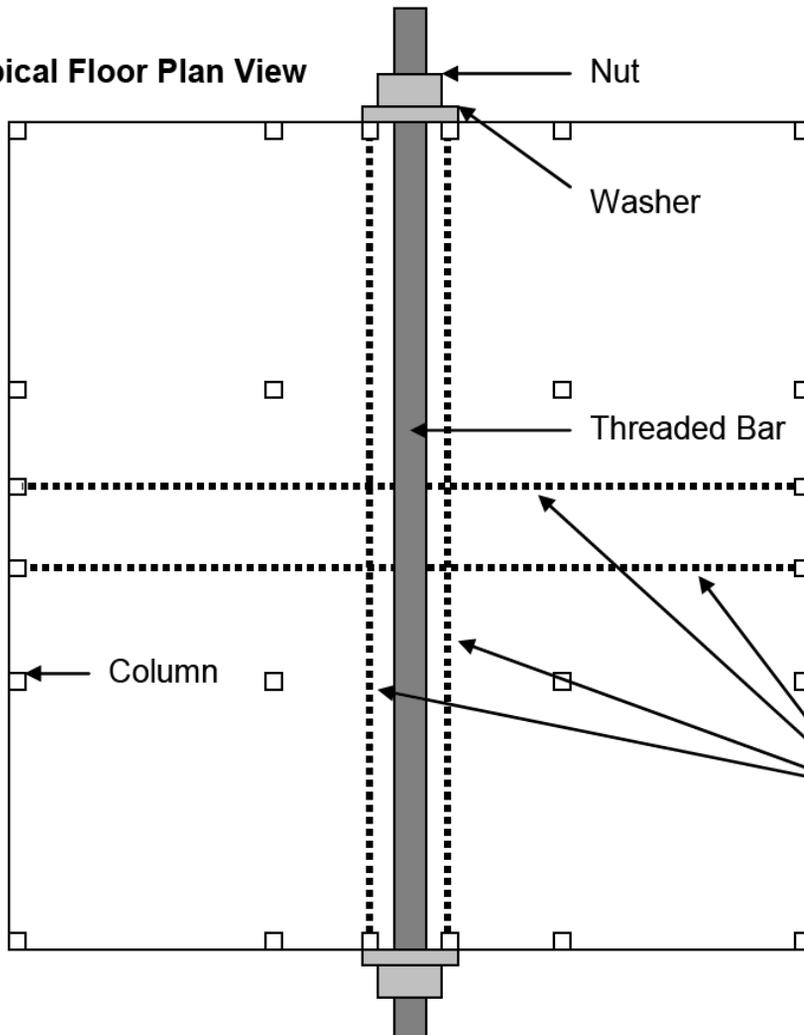
Connections of structural members can be made only from yellow carpenters glue. Glue may only be used at joints. Coating of structure members will result in disqualification. **No lamination is permitted.** Common woodworking joinery such as lap, half lap, and mortise-and-tenon are permitted. **No gusset plates may be used.**

See below the two diagrams that illustrate how their dead loads were applied:

**Typical Floor Elevation View**



**Typical Floor Plan View**



Nut and washers will be tightened by hand to secure weights for testing – this will cause the frame to deflect inwards, if not properly braced



Direction of shaking (to be decided by judges)

Recommended locations for extra beams to prevent deflection of frame due to clamping action of weight attachment

### **Structural Loading:**

Dead loads and inertia masses will be installed (TBD).

Floor mass:	2.6 lbs
Roof mass:	3.5 lbs
Total weights to be attached to the structure:	26.9 lbs

### **Scaled Earthquakes:**

Structures will be subjected to 3 scaled and modified ground motions named EQ1, EQ2, and EQ3.

EQ1 is a scaled and heavily modified version of the 1940 El Centro earthquake.

EQ1 is a relatively mild earthquake and the structure is expected to remain nearly linear-elastic during the motion.

EQ2 and EQ3 are also scaled and modified ground motions based on historic earthquakes and designed to be more intense motions than EQ1.

