You will learn how to make 3D CAD models in GE 101–Engineering Graphics & Design.
1 How to Use this Document

- It is recommended that you first read this document on a computer. Once you have a good understanding of the written assembly instructions, print pages 5 to 12 and bring them to the when you need to assemble or adjust the trebuchets. These are the more simplified pictorial assembly instructions. (However, feel free to print the entire document if you wish)

- Red underlines in the digital PDF are hyperlinks to locations in the PDF or website. You can link these to jump to the hyperlinked location. The example here goes to the 3D model on the first page: Click Me

- The first page of the digital PDF contains an embedded 3D model of the trebuchets. For best viewing experience, please open in Adobe Reader. This software can be downloaded at: http://get.adobe.com/reader/

- Parts will be labeled as (A) and a complete list is on page 5. Fasteners will be labeled as (1) and a complete list is on page 6. Be sure to print this page at the actual size so you can align up the fasteners directly to the page to identify their numbers.

- Pay attention for Note: Design Variable! as this explains how to make the adjustments to the design variables.

2 Assembly Instructions

2.1 Castors (Wheels)

Illustrated Version: Page 7

1. Note: Design Variable! This step is optional. You only need to attach the wheels (C) if your group decides to use them.

2. Find the four castors (C) and short bolts (8). They should already by attached to one another.

3. Orient the base (B) such that the short bolt (8) can be placed through the bottom pointing towards the top. The bottom of the base as countersunk holes. Insert each castor (C) also ensuring that the additional metal bolts attached to the castor fit into the predrilled holes. Ensure that the bolts (8) line up so that the all the castors (C) are flush with base (B) before fastening the bolts.

4. Fasten the nut (4) and washer (1) with the nutdriver such that the castors (C) are now secured to the base (B).
2.2 Shoulder Attachment

Illustrated Version: Page 8

1. Bolts should be installed with the bolt head near the ground. Fastening the bolts in the other direction will protrude unsafely from the bottom of the base.

2. Loosely bolt each shoulder (A) to the base (B) with 3 bolts (10). There will be one washer (1) on each side of the bolt and a nut (4) on the opposite of the bolt’s head. Align the shoulders (A) by inserting the shaft (6) through the metal tubing at the top of the shoulders. Once everything is aligned, you can use the nutdrivers to tighten the bolts.

3. Please ensure that the side pieces are attached such that the 2 x 4 is flush with the outside edge. Also, note that there are two shoulders to install.

2.3 Throwing Arm

Illustrated Version: Page 9

1. Install the center fulcrum guide pipe (7) into the throwing arm slot (G) and install the two large nuts (5) with washers (3). Tighten these nuts with the adjustable wrenches. **Note: Design Variable!** Loosen these nuts to adjust fulcrum position, but be sure to retighten the nuts. Please see Page 13 to learn how to measure this design variable.

2. Install the counterweights (D) by sandwiching the large end of the throwing arm (G) between the two weights. Slide the weight dowel (H) through the weights (D) and throwing arm (G). Once the large dowel is in position with the holes visible on each side, tap the dowels (12) into the holes far enough to center them.

   (a) If you have difficulty installing a dowel (12), the fit may be too tight. If this is the case, use the sheet of sandpaper to reduce the pin diameter slightly so that it can be installed with light tapping.

   (b) If you need to remove one of the dowels (12), use the provided small metal punch. Do not use the screwdriver to remove the dowel; it will damage the wooden dowel pin.

2.4 Finger Assembly

Illustrated Version: Page 10

1. Start with a bolt (9). Slide the following parts onto the bolt in the following order: washer (1) → wooden finger assembly (F) → washer (1) → throwing arm (G) → larger washer (2) → plastic sling adjuster (E) → washer (1) → nut (4)

2. Use the nutdrivers to tighten the nut (4) and bolt (9). **Note: Design Variable!** Loosening this assembly allows you to adjust the finger angle by rotating the wooden finger assembly (F). Please see Page 13 to learn how to measure this variable.
2.5 Attaching Arm to Shoulders

Illustrated Version: Page 11

1. Have one person hold the throwing arm (G) with the counterweights (D) pointed down. Move the throwing arm so that the center fulcrum guide (7) is between the other two fulcrum guides on the shoulders (A).

2. Slide the shaft (6) through all three guide pipes securing with the hitch pins (11).

3. You may need to squeeze the shoulders (A) together and adjust the location of the shaft to expose both hitch pin holes (6).

4. If the guide pipes are not aligned (i.e., the shaft (6) will not go through the guide pipes), first try loosening the bolts (10) used in Step 2.2 and make small adjustments to the shoulder (A) positions to get the guide pipes aligned.

2.6 Attaching the Sling Cord

Illustrated Version: Page 12

1. Create a moderately sized loop in the sling cord such that this loop is larger than the diameter of the finger angle adjuster (F).

2. Make sure the sling cord is threaded through the pouch. This pouch will hold the ball that will be thrown.

3. Take the opposite end of the sling cord without the loop and feed this through the hole closest to the center of the sling adjuster (E).

4. Continue threading with the sling cord by feeding the same end as the previous step through the second hole furthest from the center of the sling adjuster (E).

**Note: Design Variable!** At this point you can adjust the sling cord such that it is at a desired length. To measure the current sling cord length, attach the loop to finger angle adjuster (F) and lightly pull on the sling cord into it is in a straight line. Then sling length is measured from the center of the sling adjuster (E) to the middle of the pouch.

5. To fix the sling cord, take the unlooped end that has been looped through the sling adjuster (E) and tightly wrap it around the protruding knob. When pulling on the pouch, the sling cord should no longer move.
Parts

A
Shoulder

B
Base

C
Castor (wheel)

D
Counterweight

E
Sling Adjuster

F
Finger Angle Adjuster

G
Throwing Arm

H
Weight Dowel
Step 1: **Castors (Wheels)**

* This figure is missing the washer (1) that should be attached before the nut (4)
Step 2: Shoulder Attachment
Step 3: **Throwing Arm**
Step 4: **Finger Assembly**
Step 5: Attaching Arm to Shoulders
Step 6: Attaching the Sling Cord

Loop
Sling Cord
F
Sling Length
Pouch
Clay Ball
E
Sling Length
Design Variables

Finger Angle
\(-40^\circ \leftrightarrow 40^\circ\)

Pivot Position
\(0 \text{ in} \leftrightarrow 8 \text{ in}\)

Sling Length
\(5 \text{ in} \leftrightarrow 35 \text{ in}\)

Wheels (On/Off)