**Engineering Firm Name:** _____ **Date:** _____

**Team Members:** _____

# Boom Construction Activity – Boom Construction Contract Form

**The rules listed below cannot be changed; any questions or disputes must be resolved *prior to* construction.**

## Competition Rules

1) Each team will have the opportunity to use as much of the materials as they want, but some materials do have a cost. Other materials are free, but may add unnecessary weight.
2) Each bridge/boom should span (go across) an 11-inch space. Tip: This distance can be increased but doing so may make the bridges fail sooner.
3) Each bridge will be loaded at increments of 5g-20g, until it fails.
4) Each bridge is considered to fail once it has "sagged" or deflected by the ratio shown below. A ratio is used in civil engineering to measure acceptable deflections in the real world. This ratio is modified to allow greater sag to allow more competitiveness among teams.

   **L/22 =.5in → 11in/22 =.5in** (in real-life the ratio is L/360)

   This means once your bridge has sagged by .5-in., it is considered to fail at the weight that it is currently holding. About 5 sec should be given at the initial point of sagging to consider a bridge as failed, due to wave and spring motion (bridge bouncing up and down from the weight being loaded into the cup).

   *NOTE: If an EV3 sensor is used to measure this distance, it should be done in centimeters with a value of 2. The sensor already has this value built into the program.*

5) ONLY the following materials, sold at the stated costs, can be used to construct bridges:
   - Construction Paper @ $0.145/sheet *(This should be reduced to the same cost as copy paper, if construction paper is not stiffer than printing paper)*
   - Printer Paper (11x8) @ $0.065/sheet
   - Index Cards @ $0.035/card
   - Tape: Free
   - Glue stick: Free
   - Scissors: Free
6) The team that wins the competition is the team with the highest Final Ratio (FR). The FR consists of the following four ratios:
   - Weight Ratio (WR) – ratio between final weight and self-weight of the boom
   - Cost Ratio (CR) – ratio of final cost and a constant
   - Cost Estimation Ratio (CER) – determines the accuracy of cost estimation
   - Weight Estimation Ratio (WER) – determines the accuracy of self-weight estimation

   **FR = (WR+CR)(WER)(CER)**
   **WR = 4xWeight Held (g) / Self Weight (g)**
   **CR = 2 / Cost of Boom ($)**
   **CER= 1 – [ |Cost of Boom ($) – Estimated Cost of Boom ($)| / Cost of Boom ($) ]**
   **WER= 1 – [ | Self Weight (g) – Estimated Weight of Boom (g)| / Self Weight (g) ]**

   *NOTE: Both CER and WER should be 0<CER&WER<1, thus reducing CR by the error percentage. Both CER and WER are accuracy equations that use absolute value.*
7) The estimated cost and estimated weight has to be provided to the teacher by each team **prior to** the start of Part II and cannot change. Teams may only alter these values during Phase I, Planning.
8) The boom **cannot** be taped to the table (or supporting structures).

**Our company understands that ordering any materials during construction will affect our boom's CER value. Our company order:**

_____ (# of sheets) copy paper _____ (# of sheets) construction paper _____ (# of) index cards

**Our boom weight estimate is: _____ grams**

**Our boom cost estimate is: $ _____**