Walking Box: Design Report

Franklin W. Olin College of Engineering

ENGR2330: Introduction to Mechanical Prototyping

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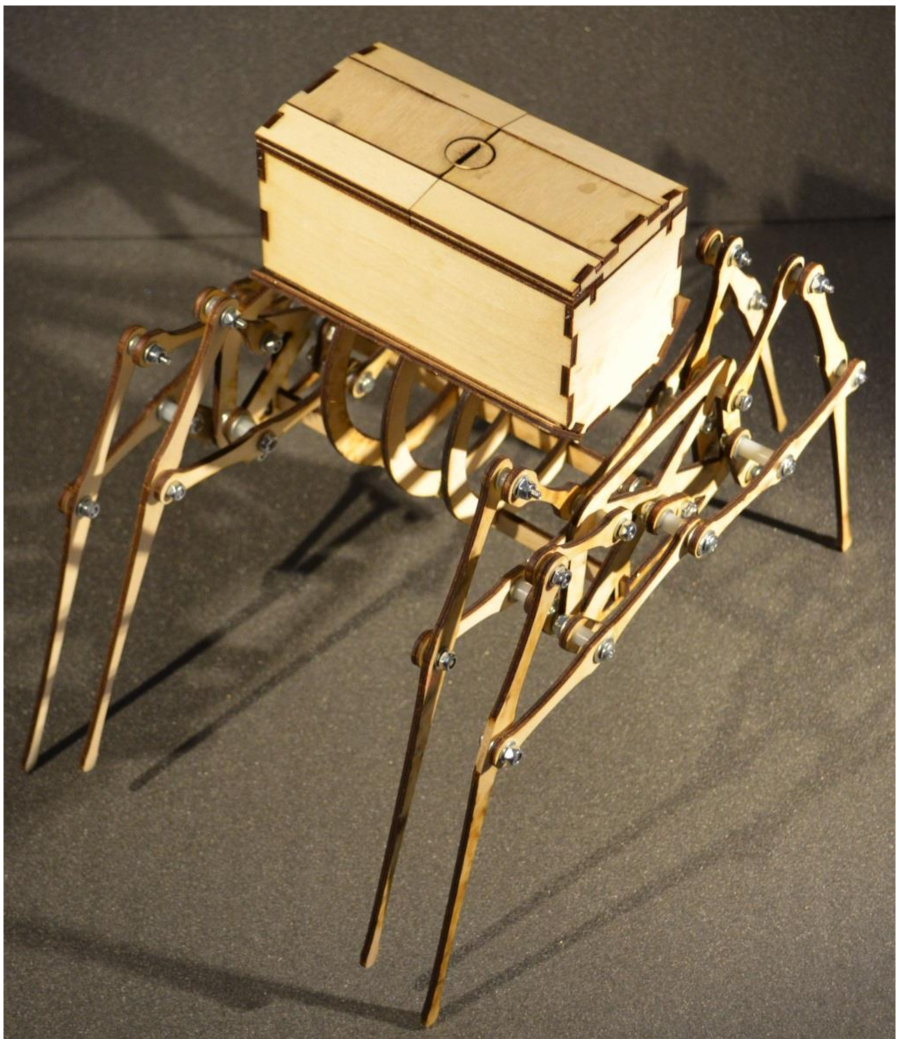

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2. Executive Summary:

The purpose of the OlinBox was to introduce the students to common joining techniques and the variety of fasteners commercially available for mechanical design products. Through the project students were also required to create detailed design and engineering drawings and thereby learn the standards and techniques involved in that process. The box was required to have five different joints and five different fasteners. In addition the materials were restricted to one 12x24 sheet of 1/8 in. plywood and the materials on the cart which included various machine screws and bolts as well as washers, spacers, music wire, etc. Within the previously stated restrictions, students were free to design anything they could build within the timespan of the assignment.

The personal goals of the project of the walking box team were to create a box (following all the requirements above) that passively walked if pushed or placed on an inclined plain. There were three sub-assemblies: the Klan linkage (legs), the cradle, and the box itself. Unfortunately, the friction buildup in the forty-six joints of the Klan linkage is greater than the friction of the legs on the surface on which it rests, therefore the passive walking functionality is severely impaired. Fortunately the legs can still be driven from the camshaft which could possibly be an addition in a later iteration. Also it became apparent that redrilling 0.32 in. holes right next to one another on a 1/8 in. edge was difficult to accomplish without having the bit slide into the previous hole. Despite these setbacks the final product fulfills all of the assignments requirements, if not the personal design goals.

It was also learned that engineering drawings should not have auxiliary and/or redundant views upon which there are no measurements.

3. Structure:

The entire assembly is constructed out of 1/8 inch laser plywood and whatever joining techniques are stated below.

3.1 Box:

The box consists of a simple 2.5x2.5x5 container with the bottom edges of the long side cut off at a 45 degree angle (fig. 1), a split lid (fig. 3), and a lock between the two halves of the lid (fig. 4).

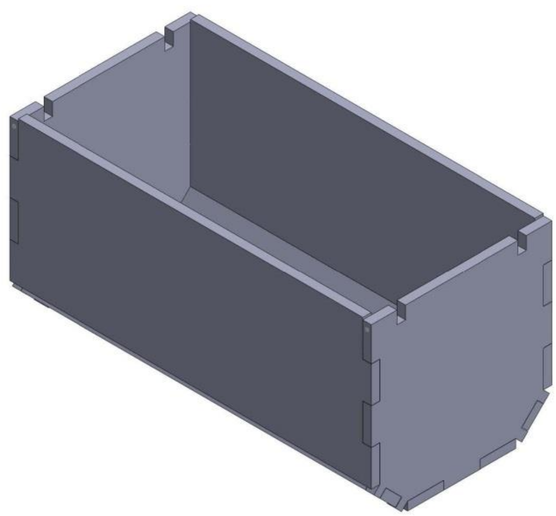

Figure 1. Box Main Body

All of the joints in the main body of the box are finger joints fastened with five-minute, quick-cure epoxy. The lid is fastened to the main body of the box with a dowel hinge. The lid has two layers; the top is fixed to the bottom via finger joint at one end, and held up in the middle by a support fixed to both top and bottom with an epoxied butt joint. The lid is fixed to the main body via dowel hinge.

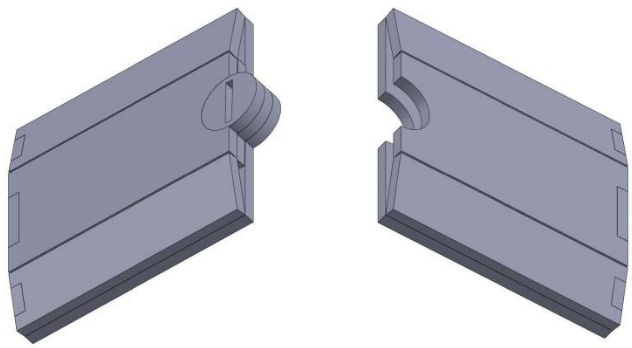

Figure 2. Split Lid

The lock consists of a circular plate epoxied to a semicircular plate of twice the radius and a screw through the center that make the plates concentric with a hole in left lid. When the semicircular section is twisted such that it is on the side of the box to which it is not fixed, it jams between the top and bottom preventing the box from being opened.

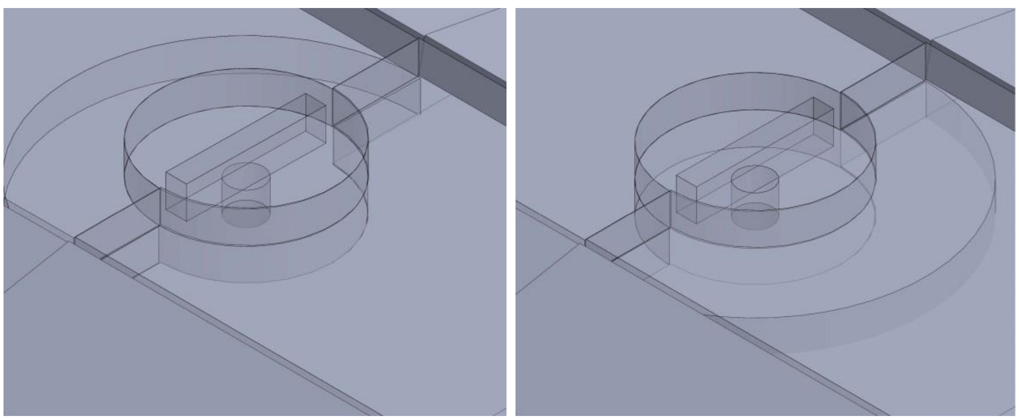

Figure 3: Lid Unlocked (left), Lid Locked (right)

3.2 Cradle:

The cradle (fig. 4) is comprised of three ¾ circular rib the open section of which is attached via mortis and tenon joint to two plates upon which the angled part of the box rests. The bottom, closed section of the ribs are attached via dado joint to two parallel runners that, in turn attach to the Klan linkage plate via mortis and tenon joint.

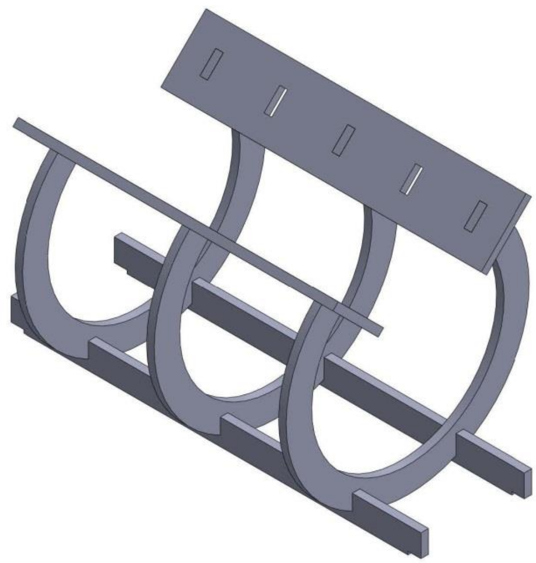

Figure 4. Cradle assembly

4. Power:

There are no powered systems in the assembly although in the event of future iterations this is liable to change.

5. Transmission:

Klan linkage (fig. 5) was meant to transfer the energy from either position on an inclined plane or from a push given by the user into lateral motion. Unfortunately, as previously stated, the buildup of friction in the joints became greater than the friction of the legs on the surface upon which it rests. This excess friction is possibly due to a lack of spacers between the plywood and the bolts(#4, #6, and #8). This could be fixed in later iterations with the addition of a spacer or possibly with the liberal application of WD-40. It is still possible to drive the legs from the cam which may make it possible to incorporate a power system in a later iteration.

Figure 5. Klan Linkage

5. Photos:

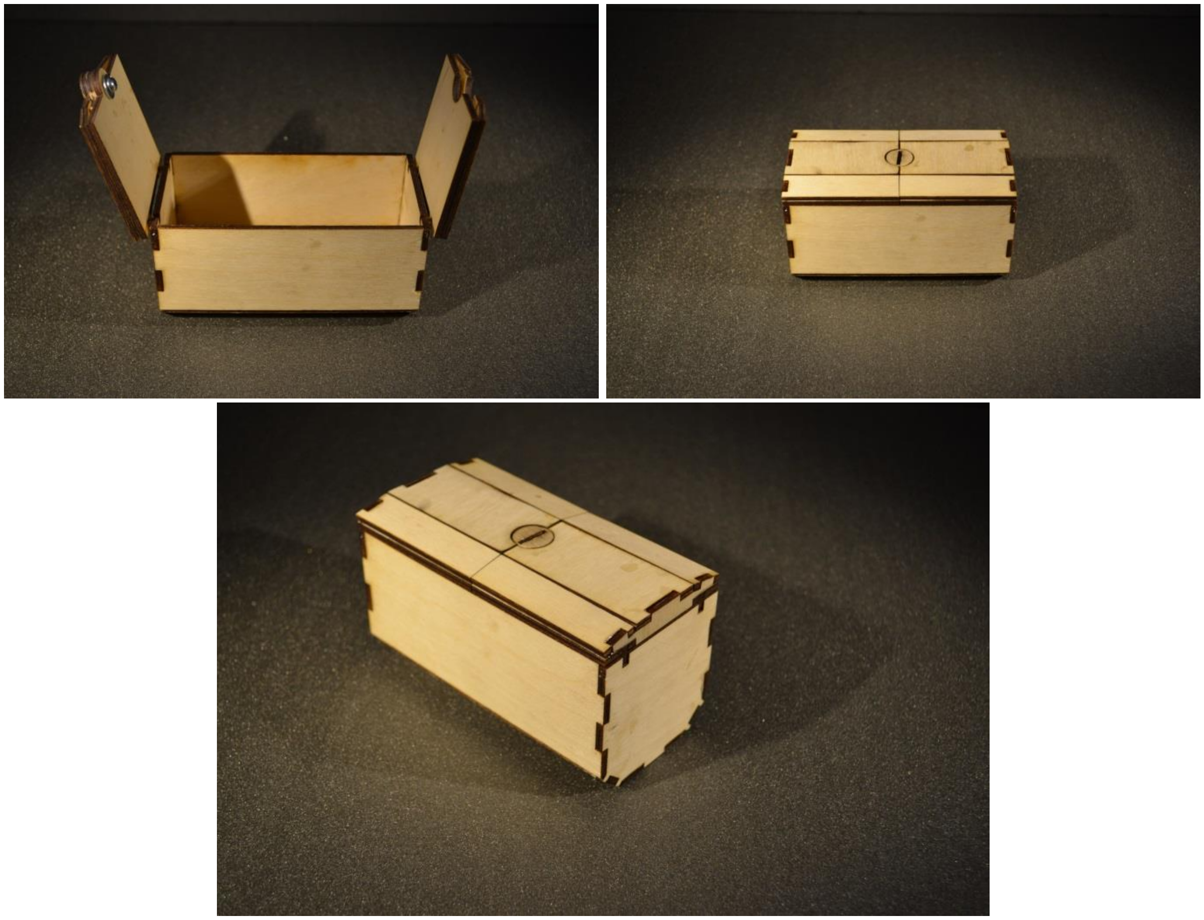

Figure 6. Open view of box sub assembly (top left), closed view (top right), and isometric view (bottom center)

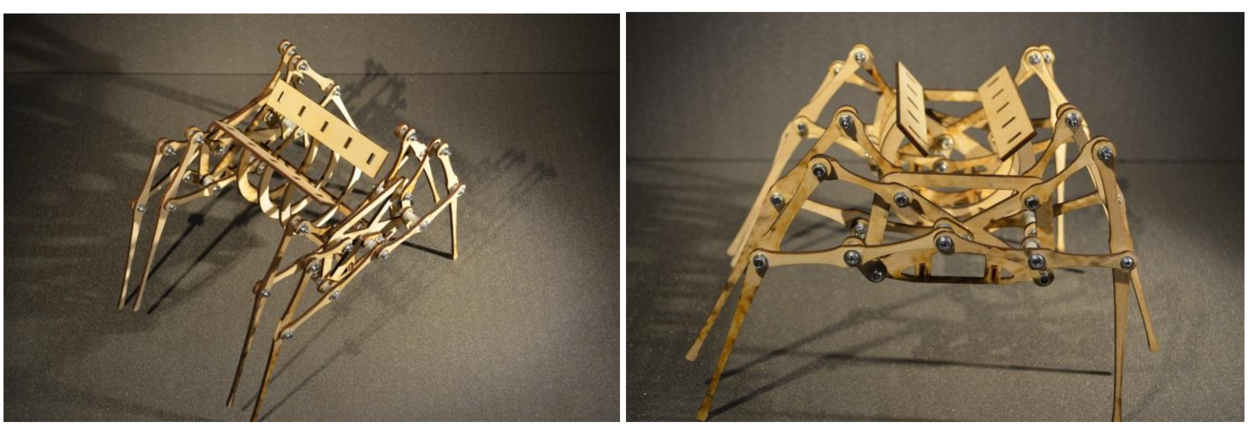

Figure 7. Klan and Cradle assemblies

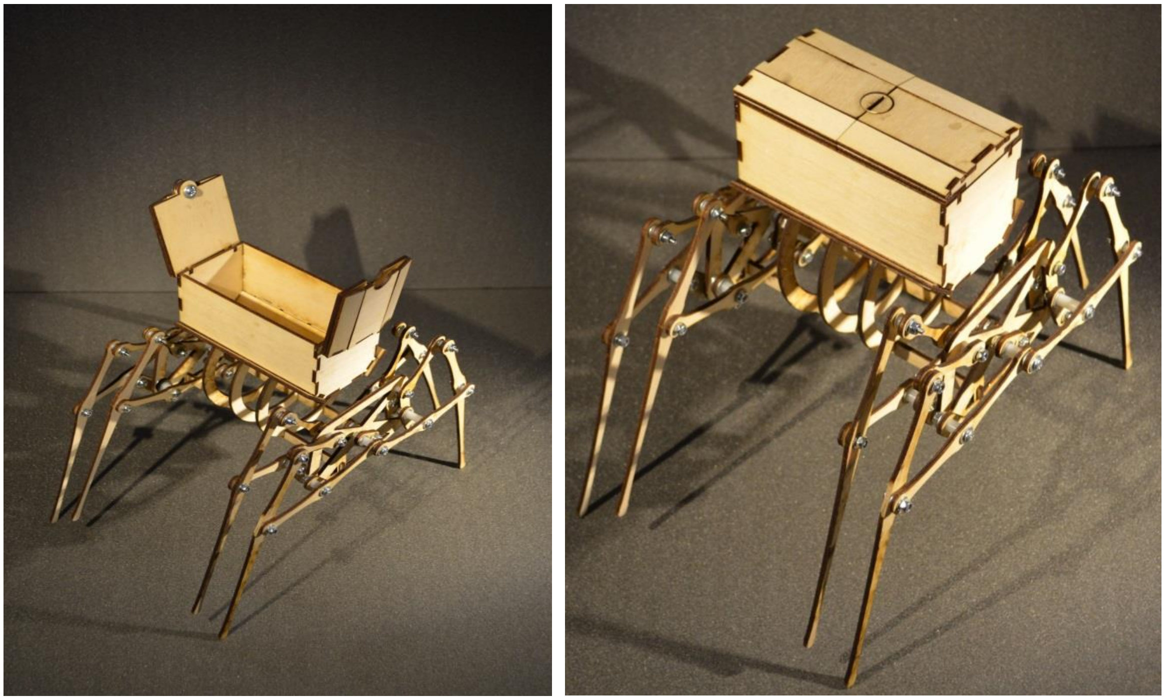

Figure 8. Open and Closed views of full assembly