APSC 150-2015 Hands-On Lab 2-2

February 2015
Schedule, context and additional info: http://projectlab.engphys.ubc.ca/apsc-150-2015/

- **Goggles are mandatory** at all times in this lab
- **No sandals** or open-toed shoes are allowed, no exceptions. You will likely be asked to leave, and come back for another tutorial session.
- **Dress appropriately**. You may wish to wear appropriate clothing (some of the hand tools may have some residual grease on them).
- **Prepare ahead of time by watching videos**. During labs, mute videos and use captions. See this video for what the lab will look like.

There are four parts in this two-hour lab:

1) In the first **20 to 30 minutes**, each student individually will use sheet metal hand tools to make these parts and shapes. Goal: Understanding tool purpose, learning tool names, acquiring safe operation skills.
To do so, watch this video and follow the instructions step by step as shown. Keep all parts (as many as you can manage to make in 30 minutes max.) to show to your TA/instructor at the end of lab 2.2 (discard in recycle bin after showing)

2) After **no more than 30 minutes**, start fabricating one launcher undercarriage per workbench. Use templates to outline your parts before cutting, then use sketches (rudimentary technical drawings) to locate bend lines. Watch this video ahead of time and during work for detailed instructions.
   - Devide tasks, decide as a team (of two) who will make which part(s)
   - Use the aluminum sheet metal you find on your bench
   - Go to the back of the lab to see supplies, take one blue servo motor per workbench

3) **Last 20 minutes**, and after the lab: brainstorm as a team of 8 (each row of workbenches in the lab will be one team). You have to come up with at least 3 concepts for building the rest of your satellite launcher.
See the specifications in the appendix of this document. When brainstorming, keep the following in mind:
   - All ideas should be welcomed
   - Drawing out ideas sometimes helps
   - Stay focused on the main problem
   - Do not over-specify any ideas, this can stunt the creative process
   - If you do not feel like speaking out, write down your ideas
   - Everyone should have a chance to contribute

4) **5 minutes** before the end: Clean up. Make your bench look like this.
   - Put all tools back into the tool box. Recycle metal cutoffs (look for sign “recycle”)
   - Use little hand brooms and dust bins to leave things “better than you found them”
   - Before leaving the lab, please make a list of your group members names and student numbers to send to the course instructor along with your group number. One person (the team captain) needs to send this information to the instructor after this lab.

Deliverables:

1) Small parts/shapes from half hour tool practice: Show instructor on your way out, then recycle.

2) Launcher undercarriage consisting of four parts, assembled (ideally). You can take this home to keep tinkering with it, or you can store it and retrieve it at the beginning of lab 2.3
If you choose to store it, put all parts into a ziploc bag (see "supplies" area) and label them with your name, and group number.

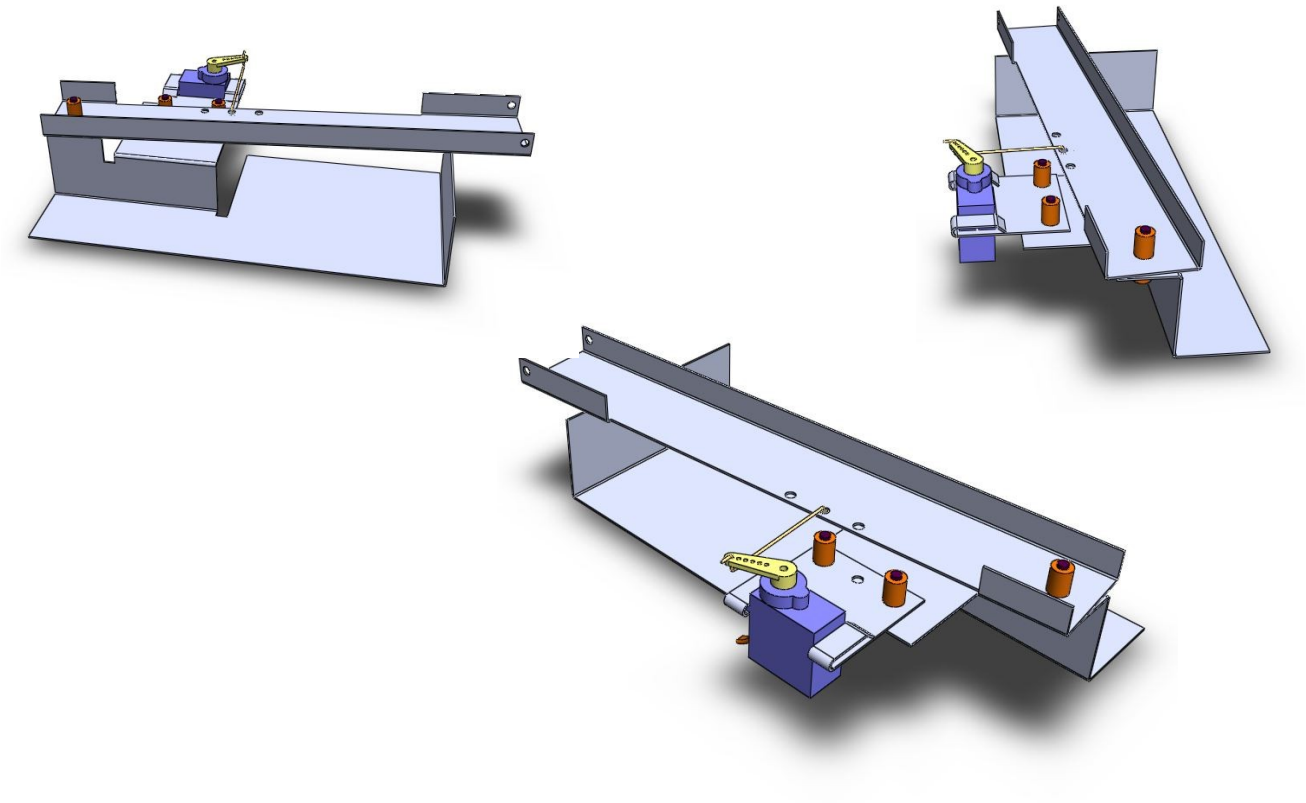
Appendix and sketches

➔ **Location** of labs 2.2 to 2.5 is the Hebb Building, Room 22. Click here for campus map.

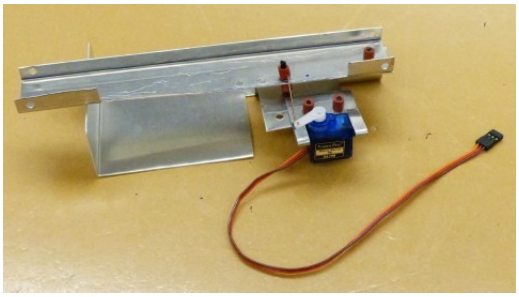
➔ **Extra tools, supplies** and metal **recycle** are located in the back of Hebb 22.

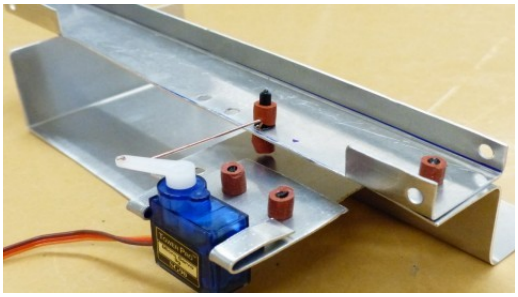
Examples of the completed launcher and launcher undercarriage are also located in this area.

➔ **Launcher undercarriage:**



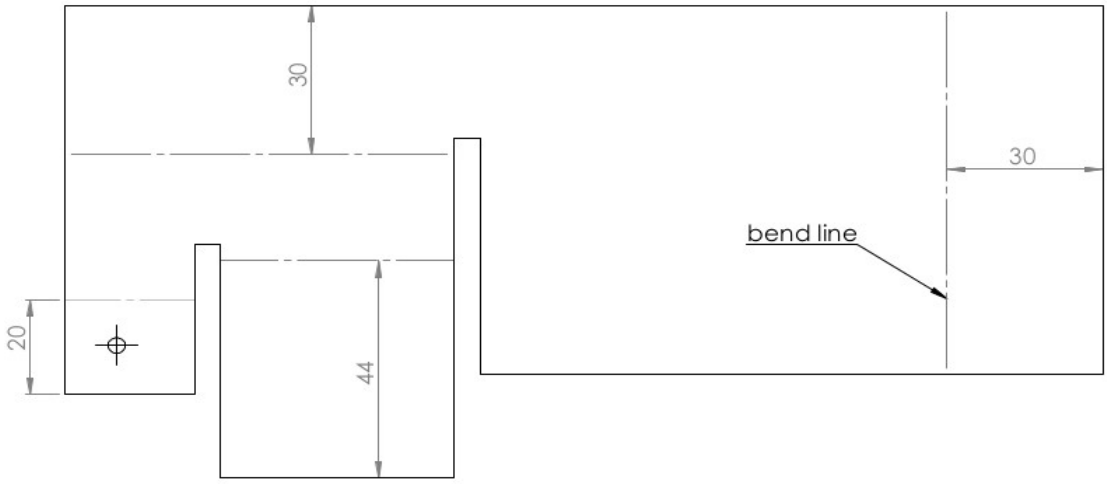
Assembly is done with black plastic rod material and red rubber tubung. This is how the finished undercarriage will look. Also have a look at the samples located with “supplies”.

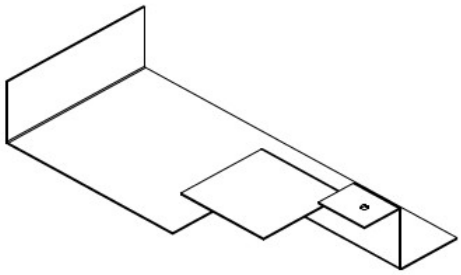




The undercarriage consists of the following parts, three of which you have to fabricate from aluminum sheet metal. Do not attempt to make these parts without knowing the video.

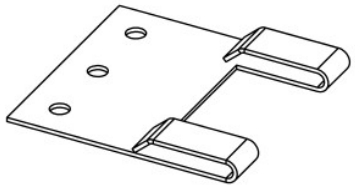
Launcher Base - all dimensions are in mm

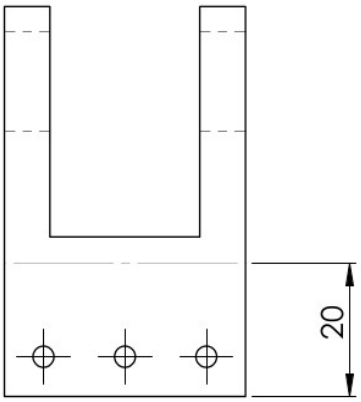




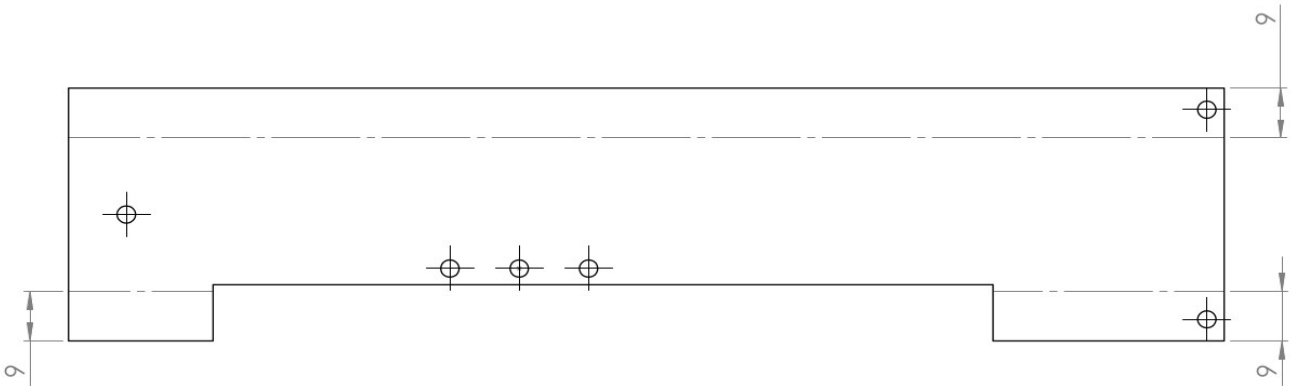
Servo Holding Bracket - dimension is in mm

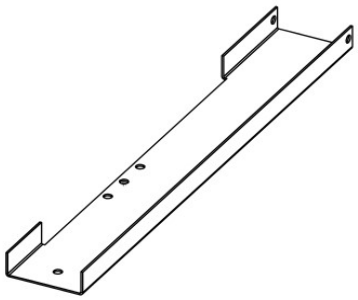
(do not bend tabs without having inserted the servo)





Lower Launch Arm - all dimensions are in mm

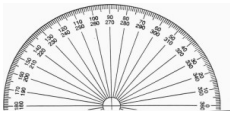




➔ **Servo motor**, one is needed (located with supplies):

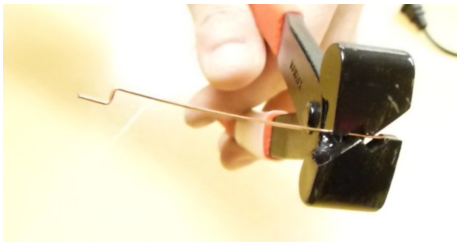
See this link to learn more about RC servo motors.

This type of RC servo has a limited angular range:



➔ **To connect the servo motor** with the arm, you will need a short piece of wire. This wire is located with tools, next to a special tool you will need make the necessary Z-bends.

Z-Bend Pliers:



➔ **Black plastic rod and red rubber tubing** (to make “fasteners”) are also located in the supplies area.

➔ **To look at 3D CAD models** of the launcher undercarriage, you have two options:

1. **Fast:** Install eDrawings viewer (Windows or OS X) and download the eDrawings files of the launcher. With eDrawings, you can look at the CAD model from all sides and zoom in and out, but you can not add or remove parts, or change the design. To do that, you need this next option:
2. **Slow:** For labs after 2-2, you can install Solidworks CAD software. The installation of Solidworks **will take one to two hours**. Do this at home if you are interested, to have it ready for labs 2-3 to 2-5
   For download and install instructions, click this link.
   Go here to download the Solidworks parts and assemblies.

➔ **Specifications for the satellite launcher:**

The robotic is a competition in which small “satellite” will be launched with minimal force. The best designs will transfer energy in the most efficient manner to precisely send the satellite into specific “orbits”. While building the "launcher mechanism" component of your launcher the following rules must be adhered to:

1. Students must only use the materials made available to them in the lab. No more than 8 pieces of sheet metal per team (=one per person) and six elastic bands per launcher should be used.
2. The launcher mechanism must have a system for holding the satellite in a "ready to launch" state without being held by a student. This can be in the form of a quick release, a trigger, a latch etc. **(This is one of the most important components to design well)**
3. The launcher mechanism must be able to launch multiple times without breaking.
4. The launcher should not be touched when launching. It is allowed to tape the launcher to the table (or tray) during launches.
5. If a counter-weight is needed, any material that will not in any other way enhance the design can be used.

- ➔ **Preliminary distance** between the launcher table and the closest card bord box during the competition: 2.1 meters. This distance can be slightly changed on competition day at the discretion of the instructors, and teams should know how to properly adjust their launchers for given distances beforehand.

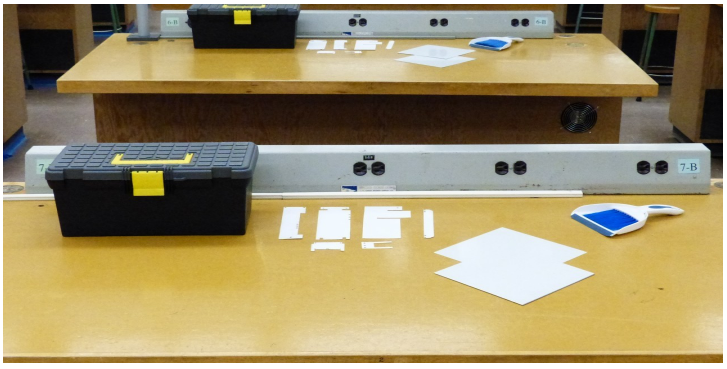
- ➔ **Ever wonder where to buy sheet metal**? Try Metal Supermarkets, our primary sheet metal vendor.

- ➔ **Feedback**: If you noticed anything that could be improved about this lab, or spotted an error of any kind, or just have ideas about how to improve things, email bzender@physics.ubc.ca

- ➔ **Homework:** Prepare for for Lab 2-3 by downloading the Arduino Software

Please help us clean up! A very large number of students is doing this lab. There is no time slot in between some of the labs that would allow us to clean up before the next group is coming.

You can help us tremendously by leaving your bench so that it can be used by the next incoming team.



Thank you very much!