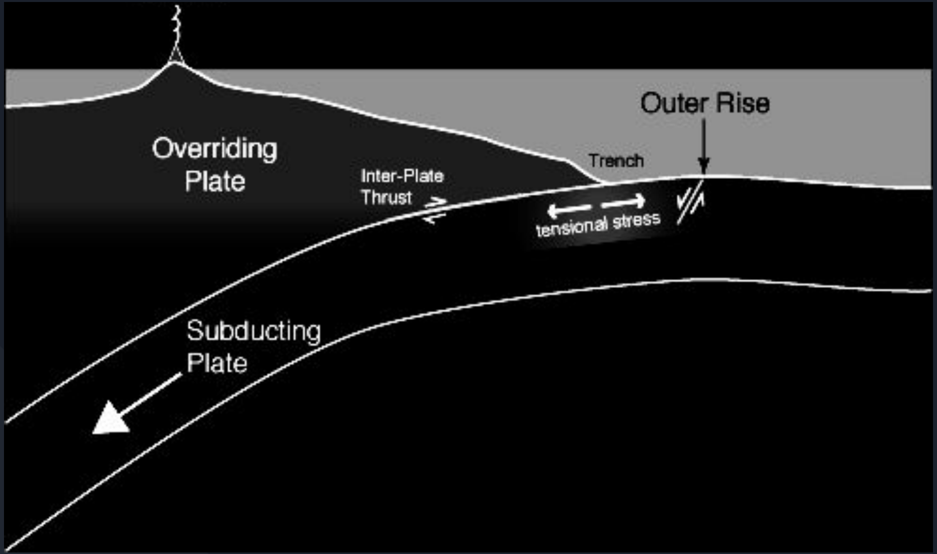
Subduction Zone Earthquake Simulator



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Introduction

Our project is a model of a subduction plate boundary where we simulate earthquakes under stress. It does this through a belt that transfers stress energy into a spring system that will eventually fail, modeling an earthquake from the release of built up strain energy in the locked plate.

What did we do?

Using primarily plywood and 3D printed aspects, we designed and build a physical model to display the effects of a subduction zone. We assembled a main frame out of plywood, and inserted two 3D printed wheels and a duck tape belt to create the tectonic plate movement. Two small pieces of wood were then attached to the main frame, touching the moving duct tape belt, to create the friction seen at a subduction zone.

Community

- Serving the NWACC community; Students and Teachers
- This community being served by providing a physical model to display the processes of a subduction zone before, during, and after creating an earthquake.
- Community Contact:
  - EMPACTS Lab Director - Caden Biscub
  - EMPACTS Lab Staff

Curriculum

Learning objective addressed:

"Describe and explain the effects of tectonic plate movement on natural hazards such as volcanoes, landslides, earthquakes, hurricanes, waves, and floods, and the effects of these hazards on humans and the environment."

Technology Used

- 3D Printer
- CAD Software
  - AutoDesk Inventor
- Wood
- Hand Saw
- Drill
- Nails/Screws/Bolts
- Files (varying sizes)
- Measuring Tape/ Ruler
- Clamps
- Duct Tape

All technology used for this project was already familiar to our team members, though new techniques were used to create the 3D printed aspects.

Methodology

Division of labor

- Caden - Designing all 3D printed material and operating software
- Will - Assembly and manual labor
- Josie - Organizing/writing presentation

Methodology - Process and Timeline

April 5th, 2023 -

- The planning process began, all initial designs were made and labor division assigned. All materials needed were listed and pulled from EMPACTS Lab and/or team members' homes.

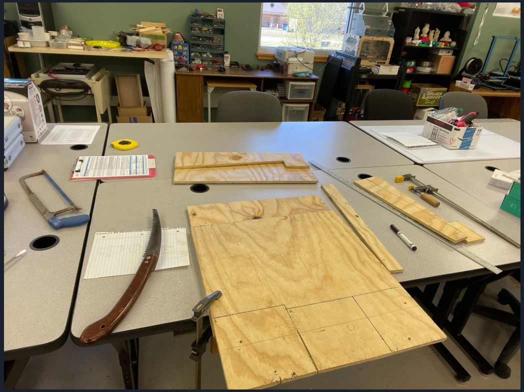
Methodology - Process and Timeline

April 12th, 2023 -

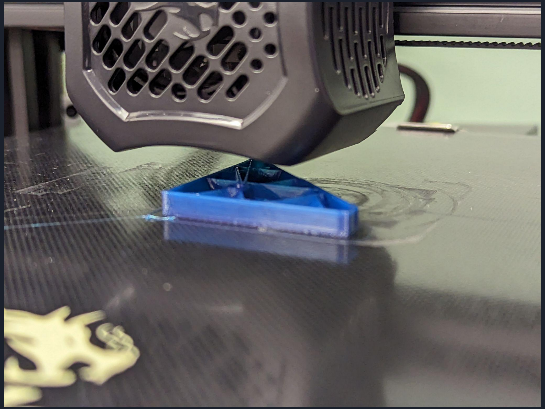
- Main frame of model is sketched out on plywood.

April 12th, 2023 -

- All sketched out pieces are cut out using a hand saw.

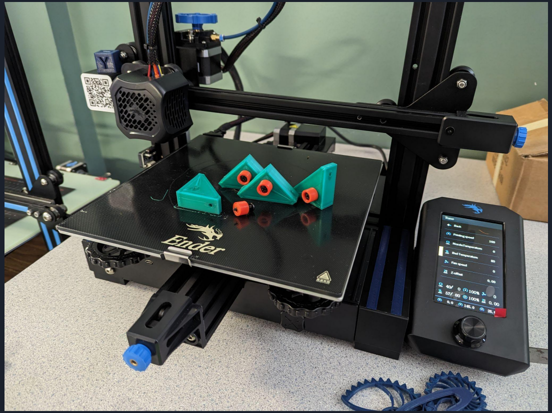


Methodology - Process and Timeline



April 12th, 2023-

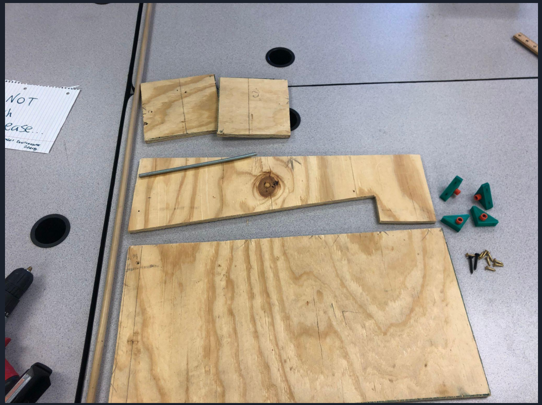
- Caden began 3D printing process of corner brackets for model footing.



April 18th, 2023 -

- Corner brackets have completed printing. Caden then started the printing process of wheel inner workings for the model.

Methodology - Process and Timeline



April 24th, 2023 -

- All necessary pieces have been cut out and 3D printed, ready for assembly. All final measuring and sanding is being done.

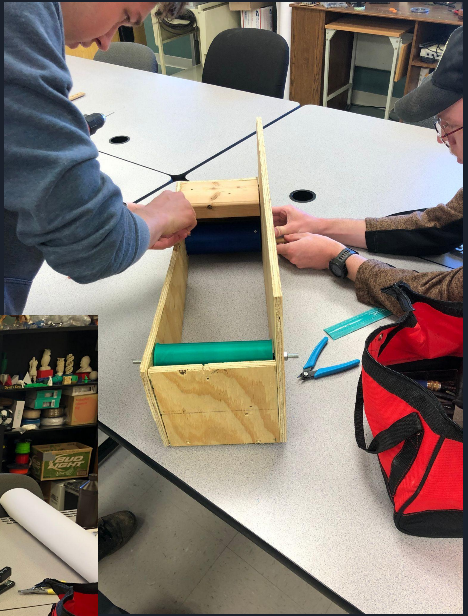
April 26th, 2023-

- Assembly begins, Will screwed main frame together and attached footing pieces.

Methodology - Process and Timeline

May 1st, 2023 -

- Assembly of inner working wheel pieces begins, both wheels are inserted and screwed in.



Methodology - Process and Timeline

May 1st, 2023 -

- During wheel assembly, two of our footing pieces had to be removed and sanded down to keep them from intercepting the wheel’s movement.

Methodology - Process and Timeline

May 1st, 2023 -

- A duct tape conveyer belt was added around each wheel inside of the model.

May 3rd, 2023 -

- All final adjustments were made, more friction was added to the belt to create a more pronounced “bouncing back” effect and the model was decorated with paint.

Project Results

A physical model to display the process of an earthquake created by a subduction zone.

Skills Gained:

- Teamwork - deciding a division of labor based on existing skills and knowledge.
- Problem solving - adjusting certain pieces to fit into the model correctly to ensure proper function.
- Precise measuring and hand saw skills.
- Drilling - using to screw pieces together, create pilot holes, and create slots for the wheels to be inserted.
- Sanding by hand to smooth and even out slots, edges, and 3D printed pieces.
- Furthering knowledge of 3D printer and designing software.

Future Plans

Incorporate base isolation on a small scale in the physical model to increase the model's potential. Introducing both subduction zone behavior and base isolation together could expand the learning capabilities from the model.

Acknowledgements

- EMPACTS Lab
- EMPACTS Lab Staff
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- Professor C. Dianne Phillips, EMPACTS Program Facilitator

Citations

https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/thumbnails/image/SubductionFaultsSmall.gif