# Making Recycled Plastic Bricks with Optimized Accessibility

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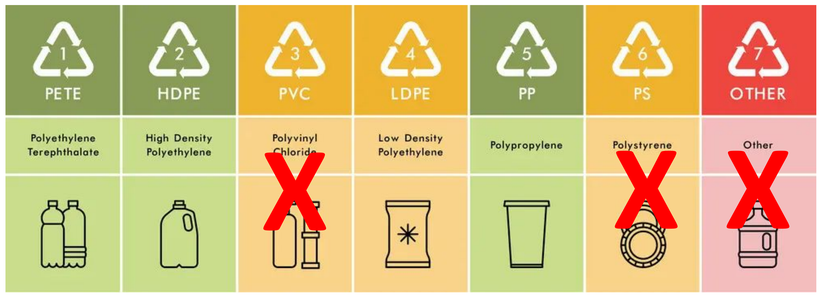
## Abstract

In this project, we designed an accessible plastic recycling system that uses scraps of plastics #1,2,4,and 5 to create building bricks. We found that bricks containing a combination of plastics #1,2,4,and 5 are able to support more than 5000 N of compression force (5000 N was the maximum limit of the machine), and an ultimate tensile strength up to about 37 MPa. The high structural strength and accessibility in creating these recycled plastic bricks make them an attractive building block option for a variety of small-scale structural projects.

## Background and Motivation

- Overproduction and poor management of waste endangers ecosystems and organisms around the world.
- Most plastic waste is landfilled, while a small proportion is recycled.
  - In 2018, the recycling rate of plastics was 8.7%.[1]
- Large barriers to recycling plastic:
  - Sorting plastic types (expensive machinery and labor)
  - Lack of demand for recycled plastics
  - Virgin plastic as a cheaper alternative for manufacturers
- Plastic recycling methods often require large, expensive machinery for shredding, melting, and molding, making it economically infeasible on a smaller scale
- **Our goal: to extend the life cycle of plastics and create incentives to sort and recycle by making recycled plastic bricks at a smaller and more economical scale.**

## Which Plastics Did We Use?




- The plastics used in this project: #1, 2, 4, 5.
- Plastics #3, 6, and 7 emit toxic fumes when heated, rendering them unsafe to melt into bricks and generally unrecyclable.[2]
- Plastic #4 is considered unrecyclable as films/bags get tangled in shredding machines. We overcame this obstacle and included #4 plastics in our bricks.

## Technical Design and Process

Shredding
- Scissors
- Guillotine Trimmer (Picture 2) (works with bags/film)
- Credit Card Shredder (Picture 3)

Extruding/Melting
- Toaster Oven (in fume hood)

Molding
- Bread Pan (Picture 5) w/ Parchment Paper

**Picture 1.** Completed Recycled Brick. Brick 4 containing 36% #1, 6% #2, 10% #4, 48% #5, total weight of 225.15g.

**Picture 2,3.** Shredding Process: Guillotine Trimmer and Credit Card Shredder.

**Picture 4,5.** Melting and Molding. Toaster and Bread Pan with Parchment Paper and Plastics.

## Results

| Brick | Dimensions l x w x h (in) | Composition | Ultimate Tensile Strength (MPa) |
|---|---|---|---|
| 1 (210 g) (non-uniform) | 8 x 4.5 x 1 | Plastics #1,2,4,5, Mostly #1, 2 | 2.92 |
| 2 (49 g) (uniform) | 4.5 x 3 x .5 | Plastics #1,2,4,5 (25% of each plastic) | 2.03 |
| 3 (48 g) (uniform) | 4.5 x 3 x .5 | Plastics #1, 2 | 1.55 |
| 4 (225 g) (uniform) | 8 x 4.5 x .5 | Plastics #1,2,4,5, (Picture 1), Mostly #5, 1 | 37.19 |

**Table 1. Composition and Ultimate Tensile Strength of Tested Bricks**

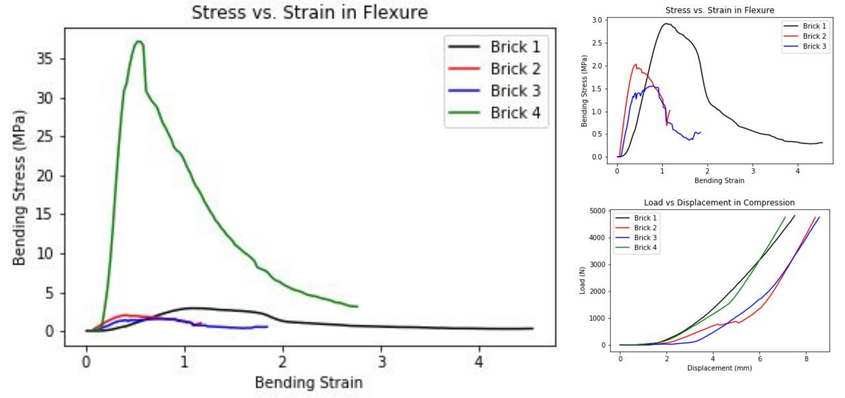



**Figure 1. Graph of the Tensile Strengths of 4 Plastic Bricks, from a 3-Point-Bend Test.** The top right graph shows the tensile strengths of the first 3 bricks. The bottom right graph shows the compression strengths of all 4 bricks from a Compression Test.

## Compared to Standard Bricks?

- The total cost of materials was $248.84. Larger scale projects, such as the Precious Plastic Project's kit for creating bricks, costs $10,200. While expensive, such a kit is more time and labor efficient.
- Potential competition: Clay/concrete bricks cost $0.30-$0.90 per brick. Plastic bricks would cost more, but could be preferable as they are:
  - Thinner, lighter, have heat insulating properties 5x greater than standard bricks, are highly effective at noise insulation, and are better for earthquake zones due to the flexibility of the material.[3]
- More research is needed to understand how they withstand heavy structural loads, exposure to sun, interactions with other materials and contamination, as well as the effect of additives (fire retardants).
- Plastic crediting, plastic offsetting, market incentives, and government funding will support the production of plastic bricks.[4]

## Conclusions

- We learned more about the difficulties of the recycling process.
- We created a cheap and accessible process for making plastic bricks.
- We found that multiple types of plastic can be used in one brick (#1, 2, 4, 5), which relieves the pressure of sorting.
  - Limitation of mixing plastics: differing melting points – it is important to avoid burning plastics because dangerous toxins can be emitted.[5] However, this can be avoided with careful melting and fire retardant additives.
- Our research can motivate people to continue recycling, push for the elimination of unrecyclable plastics (#3, 6, 7), and encourage mass production of recycled products (such as bricks).
- Further testing: differing percentages of each plastic and their corresponding strengths, effects of additives (such as fire retardants).

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