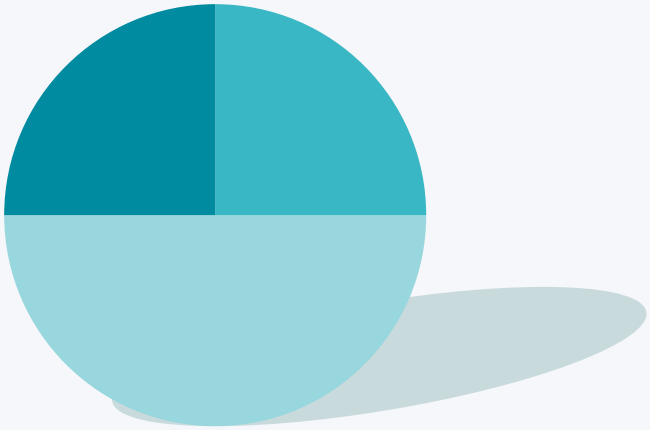
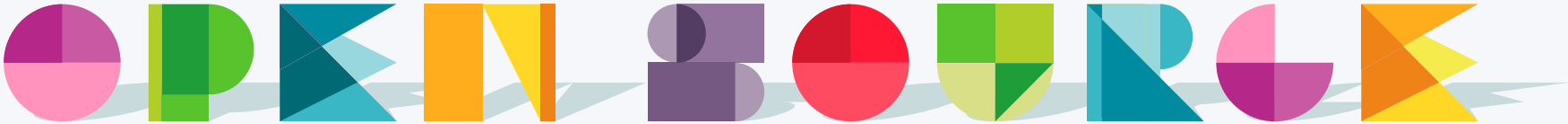


WASTED OPEN SOURCE REPORT

CITIES FOUNDATION
AMSTERDAM

2015



This is the Open Source Report from CITIES Foundation's WASTED project. WASTED locally address global plastic waste problems through a neighborhood Laboratory for plastic waste upcycling in Amsterdam Noord. For more on WASTED, visit wastedlab.nl.

The purpose of this document is to share the blueprints, designs and process so that others can give feedback, build on and implement local plastic waste upcycling schemes.

The Open Source Report is globally accessible for others to use and build on, pushing new social, material and economic design on the local level.

Be part of localizing global solutions. Get WASTED.


WASTED
A Neighborhood Laboratory for Plastic Waste Upcycling

PLASTIC: FROM GLOBAL PROBLEM TO LOCAL SOLUTION

Plastic. A material created to simply and cheaply suit our needs. Now, it's everywhere. I'm a Plastic-a-holic. Are you? Do you consume, use and waste plastic everyday?

This is an inescapable reality across the globe. It doesn't mean we cannot do anything in our own neighborhoods to lessen the negative damages unsustainable plastic consumption puts on the environment at home and worldwide, as well as on ourselves and our communities.

Just think: How are products created? Where does plastic go after we use it? What happens to it? What does it do to the environment?

Can we reprocess plastic and create new, useful products ourselves, in our own neighborhoods and for our own good?

WASTED is a local solutions initiative addressing global troubles caused by plastic waste. Bringing this vision into reality, we implemented the small-scale, neighborhood-based WASTED Laboratory for plastic collection and reprocessing in Amsterdam Noord.

The Laboratory spurs new sustainable standards and practices, while hosting co-creation workshops that generate new, up-cycled WASTED Blocks used to create new objects by and for the neighborhood.

OPEN SOURCE DESIGN

The WASTED Laboratory is not only a project to locally address plastic waste, but also exists to generate open sourced documents available for the world to use and build on. In this way, open sourcing WASTED design gives everyone the opportunity to implement a WASTED Laboratory in their neighborhood, and further advance sustainable material design and (re)production on the local level.

CONTENTS

1
WASTED: THE PROJECT

WASTED is a neighborhood Laboratory for plastic waste upcycling in Amsterdam Noord. Now a reality, this vision began with over a year of research and planning before the project gained funding and began coming to life in January 2015. The experimental pilot phase ran through August 2015. During this time, project goals focused on realizing a functional Laboratory for plastic waste upcycling using local plastic waste.

The intention was to design a modular Block that could be created using small-scale machinery and used to build objects by and for community, such as benches and planters for the park and stages for local markets and events. The intention was also to make our designs and lessons learned open source for public and design communities to access and build on to advance sustainable design and recycling practices. To these ends, the process is low-tech making it is easier to implement and more likely to empower communities.

WASTED is more than the Laboratory. It is a comprehensive, community-driven local solution initiative addressing global issues of plastic waste and urban waste management. Community goals coincide with our designs, as neighborhood activation fuels the Laboratory's dual engine of social and material design. For instance, we collect local plastic waste from residents and businesses and created a Reward System to accelerate local plastic waste recycling and generate a waste-valued form of alternative local currency. For more, visit WASTED online at wastedlab.nl.

PROJECT INITIATOR

WASTED is a project of CITIES Foundation, an Amsterdam based foundation that researches, communicates and initiates local solutions to global urban problems. To learn more about CITIES' work, visit online at www.citiesfoundation.org.

2
OPEN SOURCING DESIGNS: THE PROCESS

Our process of open sourcing designs started in January 2015. This report concludes our second phase of design and material research. For design files and to contribute to the further development and application of WASTED Block, machine and process design, you can refer to the WASTED project on Openthings wiki.

INITIAL OPEN SOURCE REPORT

In January 2015, CITIES held an intensive weeklong Design Club together with designers Alexander Wiefel of Project Re, Bastiaan Tolhuijs of NEWASTE and Roos Meerman of Studio Roos Meerman, along with partnering architectural studios Overtreders W and Bureau SLA.

During this week, we formulated initial designs for the Block, machine and Laboratory layout, as well as the necessary steps to realize the upcycling process. The resulting first Open Source Report (OSR) was largely based on computer-assisted design and calculated assumption.

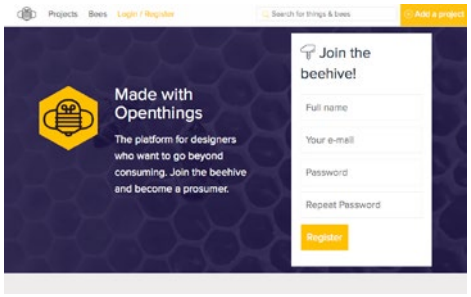
THIS REPORT

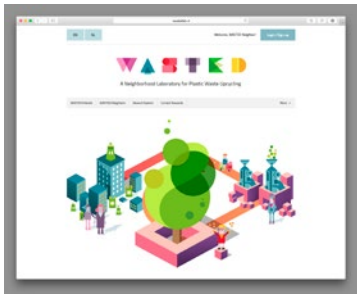
You're now reading an updated Open Source Report based on work by the WASTED designers. As makers, their work focuses on practicality and applied design. They have revised initial designs outlined in the initial OSR to build actual machinery and devise a process design that enables us to upcycle local plastic waste into WASTED Blocks at the Laboratory.

Consequently, the following presents essential information for creating an operational small-scale plastic waste upcycling laboratory on your own.

After introducing the project, the designers and design challenge, the report will discuss the WASTED Block, machines necessary to make one, and the process for using the machines to build a Block.

This report is text and image dense. It does not include design files or the ability for others to contribute feedback and build on the design process. Although you can always contact us, we also created an open source WASTED project on Openthings wiki.





OPENTHINGS WIKI

Openthings is an open source design wiki platform created by Martin Risseeuw. You can view our open source designs, texts and documents on Openthings.

As a wiki, you are welcome to comment and contribute yourself. Visit the WASTED project on Openthings.

MORE INFO

We hope you find all you need to know. If you don't find the information you're looking for, check out the WASTED Contact page and get in touch.

3
WASTED DESIGNERS

From left to right: Stijn, Alessandro, Bob

Three select designers led the final development and realization of the WASTED Block, machines and process design. Through their work, the Laboratory is equipped and ready to make Blocks and host workshops.

We present the WASTED Designers.

ALESSANDRO IADAROLA

Alessandro studied Product Design and Communication in Italy and Interior design and Photography in Belgium before moving to Amsterdam, where he specialized in Digital Manufacturing and Open Design in collaboration with the Waag Society and FabLab Amsterdam. In 2015, he founded his Amsterdam based studio, Studio Iadarola, where he focuses on design for social innovation and sustainability, investigating the potential of co-design and fabrication for economic development.

Contact Alessandro at ale@studioiadarola.com

BOB VOS

Bob graduated from DesignLAB, Gerrit Rietveld Academy with the RAW plastic project, He believes that it is time for plastics to transform from a purely industrial material to a crafts material. In examining the inherent value of plastic, he enjoys challenging cultural connotations related to plastic.

Contact Bob at info@bobvos.com

STIJN VAN KERVEL

Stijn graduated cum laude with “De Knopendoos” from the industrial design department at the Gerrit Rietveld Academie. With a background in architectural engineering, he works as a freelancer on design projects to develop his growing portfolio of applied work that is juxtaposed with autonomous work focused on narrative techniques and the dichotomy between function and form.

Contact Stijn at svk88@live.com

4
DESIGN GOALS AND GUIDELINES

Design and create a modular block using locally collected plastic waste. What does it look like? How does it connect? How do you start with plastic waste and end with a finished product? We established a set of project boundaries to guide design.

The Block must be durable, strong, light, and have unlimited functionality. By this we mean plastic will not be used once and thrown away, but rather produce upcycled Blocks that can be used, reused and reprocessed again and again to make new benches, flower pots and more by and for local communities. This inclusive accessibility and small-scale co-production is essential to WASTED.

Foundational design guidelines are as follows:

1 Everyone from kids to elderly should be able to participate in the production of the WASTED Block.

2 It should be possible for anyone to create a useful object with WASTED Blocks/upcycled plastic waste.

3 Blocks must be able to produce:

a. Stages
b. Benches
c. Flower and tree planters (based on neighborhood preferences).

4 Block application (actually building with the Block) and feasibility of different production techniques (machines, process) need to be taken into consideration.

In line with these guidelines, we decided the Block must be:

- Modular
- Light weight
- Multi-functional
- Possible to dismantle

5
BLOCK: OBJECT OF DESIGN

In this section, we work through materials, explain the initial design, resulting final design, finishing process, connecting elements and pros and cons of Block design.

TYPE OF PLASTIC

The Block itself is made entirely of LDPE (low density polyethylene – SPI Resin Identification Code 4). Initially, as you'll find in this report, we considered using harder plastics, such as HDPE and PP (e.g. milk jugs and shampoo containers, or Tupperware, yogurt containers and prescription bottles. In the end, these proved more difficult to work with because of higher melting points and the need to wash, dry and shred hard plastic into ready-made chips or pellets for reprocessing. We never considered using plastics such as PVC, which has a significantly higher melting point and emits more toxins.

LDPE is most commonly found as plastic bags and packaging. Important for Block production, LDPE has a low melting point, is more workable and can be used 'as is', meaning it does not require further reprocessing such as shredding before use.

In addition, LDPE contains no concerning toxins in regards to health or environment when melted. As the most wasted plastic, it is an ideal resource: abundantly available and calling for better management in regards to environment and pollution.

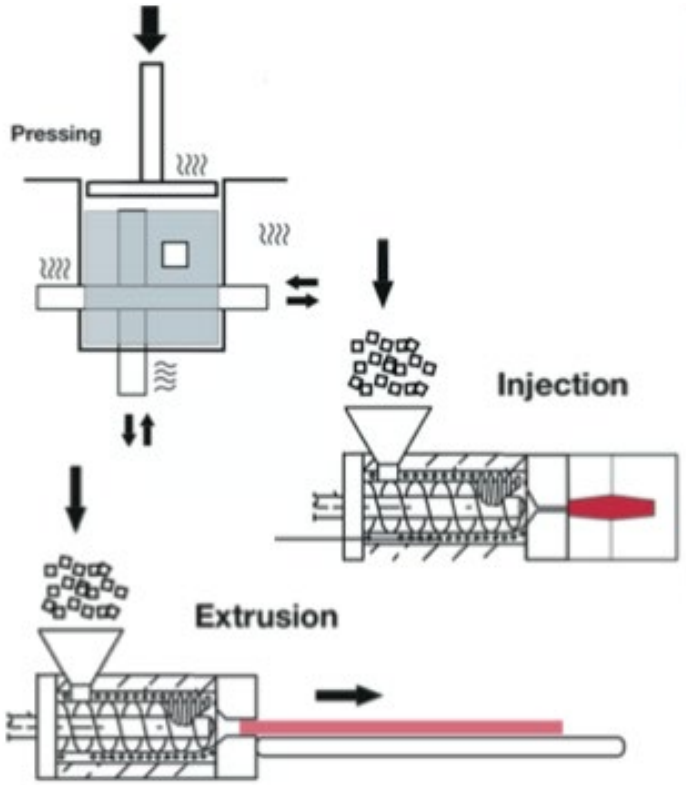
*Note: while LDPE itself is proved to be non-toxic, we continue researching to find proof that the process design (see VII. Process) is completely safe. This refers primarily to the process of melting and cooling LDPE, as well as ink used to color many plastic bags. Until we gain the necessary

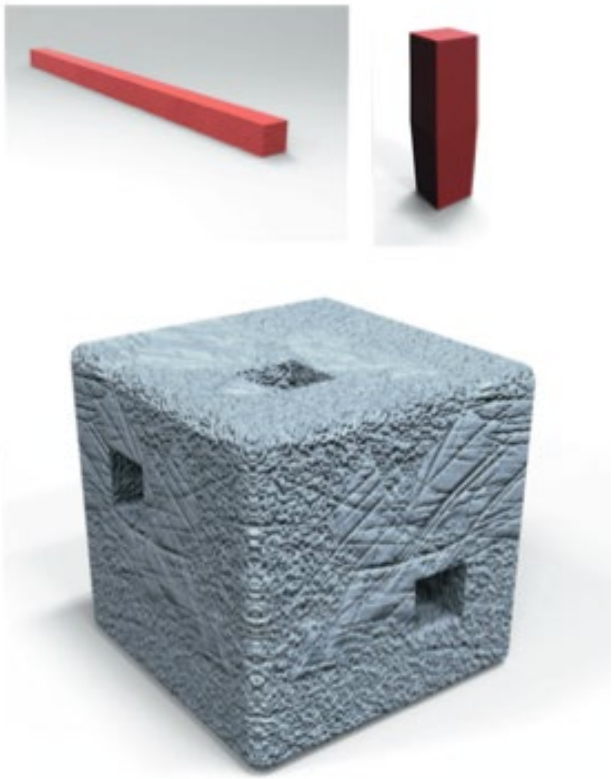
INITIAL DESIGN

The first OSR laid out designs for a Block with two connecting rods running through it, created in a heated press using HDPE and PP. Like the diagram on the right.

Primary problems with this design were threefold:

1. Melting and removing: it is difficult to place plastic evenly around the connecting rods in the mold and to remove them once cooled.
2. Connecting and structural integrity: Blocks are tempted to spin and twist when stacked next to one another along a connecting element, sacrificing structural integrity.
3. Machinery and process: this design required further machinery to extrude connecting elements, including further separation of HDPE and PP, capacity to shred into ready made material, and time melt a harder plastic into a workable substance.





Touching on the first point above, designers tried this design approach using HDPE and PP. The result was two steel rods stuck in a Block, unable to be removed once cooled.

Consequently, after experimenting with different materials and designs, we decided to make Blocks entirely of LDPE. On a practical design level, switching to LDPE was in large part due to the four points highlighted above, and supported by availability and the plastic's non-toxic nature.

FINAL DESIGN

The final WASTED Block is a 10x10x10cm modular cube created from locally collected and upcycled plastic waste (LDPE). The plastic is melted in an oven and press-formed in a steel mold, self-constructed by the WASTED designers. In this section, we spotlight the Block itself. Later in this report, you will find details on Machines (VI), and under Process Design (VII), you will find specific construction procedures and details.

This final design presents the Block itself, as it is straight out of the mold. Rough and unable to connect to other Blocks at this stage, two steps remain: finishing and connecting Blocks.

Once out of the mold, each flat surface of the Block is planed to become smooth and exactly 10x10x10cm; edges are rounded; and holes are drilled for connecting elements.

CONNECTING BLOCKS

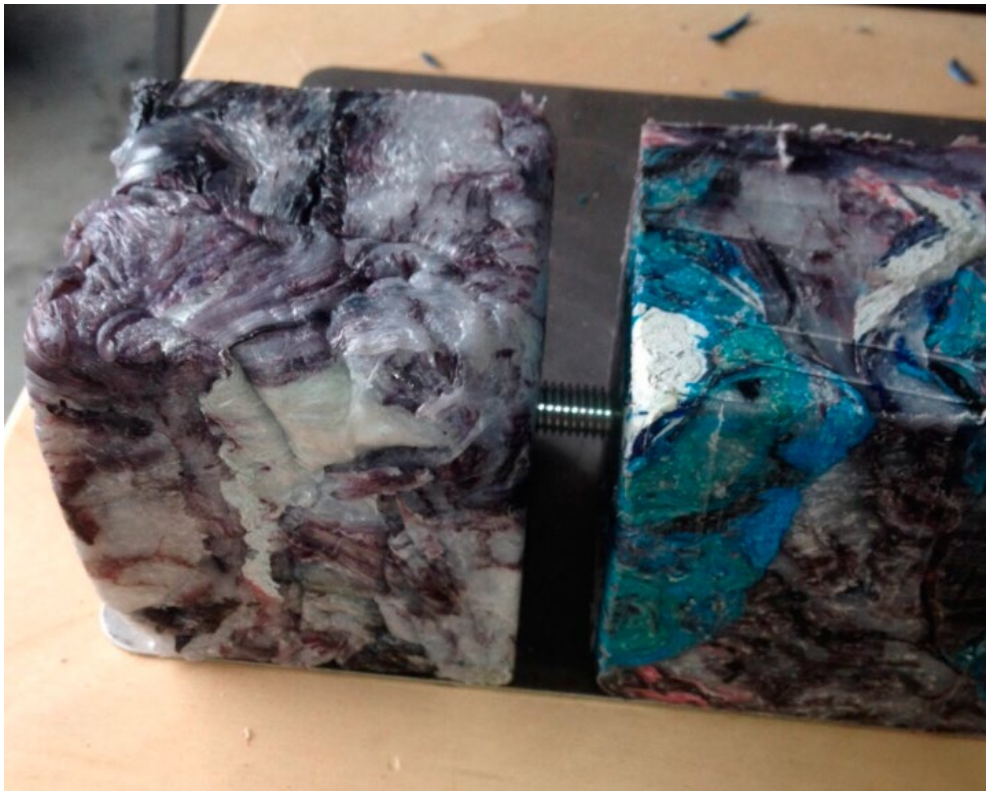
As noted, initial connecting rod designs (extruded HDPE and PP) were thrown out. Rethinking connection, designers began by drilling a shallow hole in the center of each side of the Block, then inserting a plastic bottle cap, such as those found on a one liter bottle of water. Blocks would then screw together using a two-sided screw made of epoxy. While this design catalyzed further development in the connection process, it had many flaws; for instance, connection was weak, screwing too hard would 'strip' the caps' threads, and if caps were not completely straight, they would not connect. A final downside was that we would have to buy material in order to produce this connector.

In the end, we are now using steel connecting elements: standard M14 rods. We had a company cut them to 7cm in length (connector length can change, depending on application/needs).

Connectors are 14mm wide (hence the name M14) with 12mm wide holes drilled 35mm deep into the center of each face of the Block. With this design, connectors simply screw Blocks together. See as pictured here:

We can build with Blocks using this design. It works. However, connecting elements remain a concern in design and application. We are still considering different connection options in order to increase the practicality and ease of building with Blocks; for instance, putting together and taking apart more easily and more time and energy efficient.

Connecting Blocks from the center also creates a problem when connecting corner Blocks when building. For example, if you have an L shape and wish to add another Block within the elbow of the L, you cannot screw the Block; it will not twist when cornered by other Blocks. We are still exploring this issue and experimenting with different connection methods in order to fit pieces; however, at this stage the process is ad hoc, adjusted to specific problems.



BLOCKS: THE GOOD AND THE BAD

PROS

Most importantly, the Block:

- **Exists**
  We turned plastic waste into an upcycled new object.
- **Is created entirely from locally wasted LDPE**
  We are addressing local plastic waste issues, and more specifically collecting and reprocessing the most wasted plastic – LDPE.
- **Is solid and strong**
  Blocks are modular and strong enough to build with.
- **Is visually appealing (subjective)**
  Blocks have different patterns and colors, each being unique.
- **Is relatively easy to make**
  The process is low-tech, enabling community to participate in the process and learn more about re/upcycling waste.
- **Can be used to build new objects for the community**
  Blocks give community a new, locally sourced and produced material to build with.

CONS

Drawbacks of design revolve primarily around two points:

- **Connection**
  Connecting Blocks in order to build objects is currently doable, yet remains a challenge because we wish it would be more time and energy efficient.
- **Application**
  We need to expand on what else Blocks and the process can be used for, aside from, for instance, benches, planters and stages.

These two points are interconnected: better connection design will open newfound possibilities

6
MACHINES: THE TOOLS

Block construction requires three primary machines: oven, mold and press. These give the ability to melt, shape and press Blocks into form.

OVEN

The oven is only used to melt LDPE. We us a non-stick Teflon pot with additional PTFE. You can use any oven, with a few requirements. It must be able to:

- Fit a 15L cooking pot
- Maintain a temperature of 200 C

We use a second hand bakery oven that runs on 380V. This is high voltage requiring extra equipment. We use it because it is faster and bigger, allowing larger production. You can, however, melt the plastic using a regular 220V oven.

You want to ventilate fumes. We set up a ventilation exhaust hose running from the top of the oven to the outdoors.

*Note: Do not melt plastic in the oven you cook food with at home.

MOLD

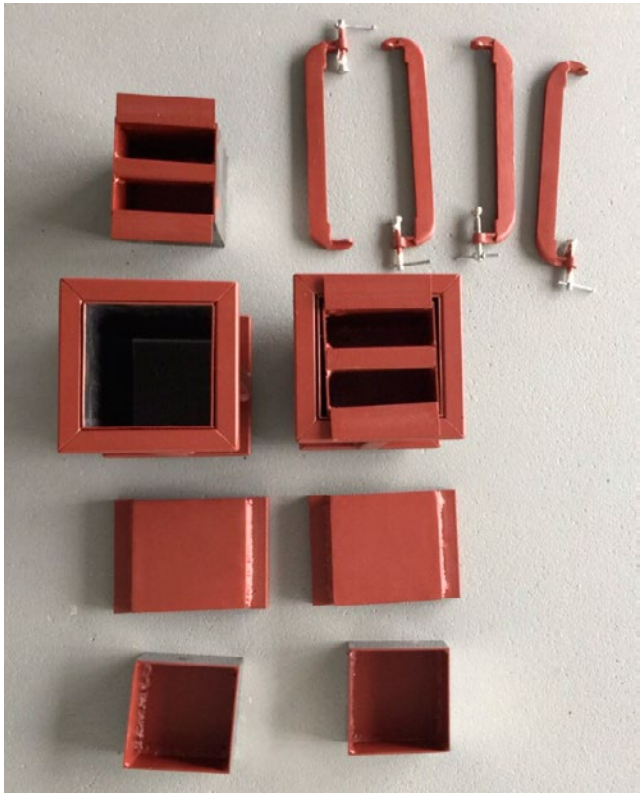
Designers created the mold specifically to create a 10x10x10cm finished Block. This means the mold is slightly larger than desired size, allowing the finishing process to produce an exact 10x10x10cm Block. The mold is steel and rectangular. Standing upright there is one opening at the top where melted plastic is inserted. Another piece slides into the top of the press, built to stop at 10cm depth. Using an additional piece, the mold is able to produce half Blocks, at 10x10x5cm. With an experimental wooden mold, we can also produce triangular Blocks equaling half a 10x10x10 Block cut from corner to corner.

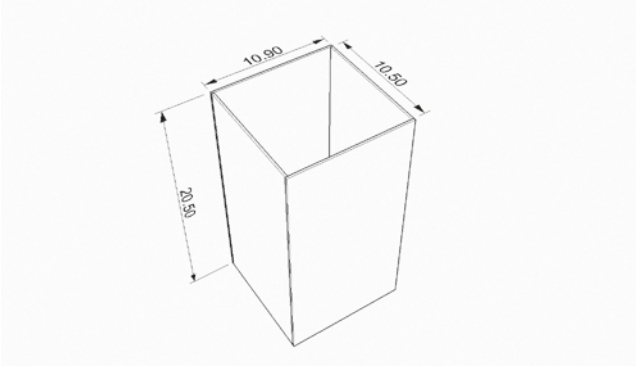
Our steel mold creates two shapes:

- 10x10x10cm Block
- 10x10x5cm half-Block

Our experimental wooden mold creates one shape:

- Triangular half Block – diagonal half of 10x10x10cm Block

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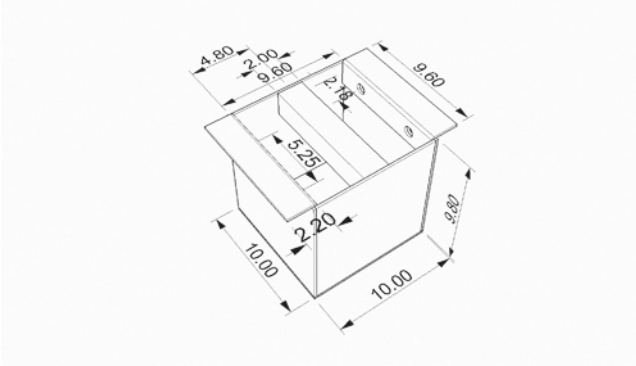
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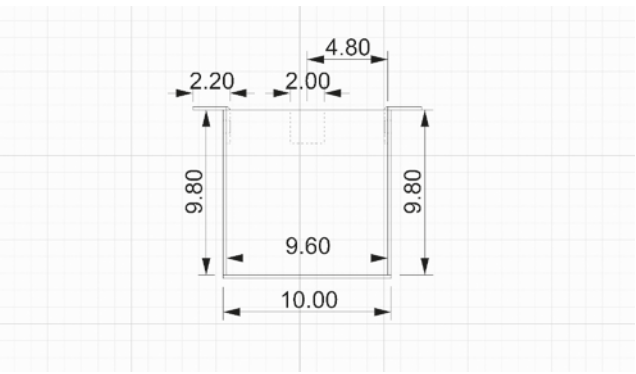
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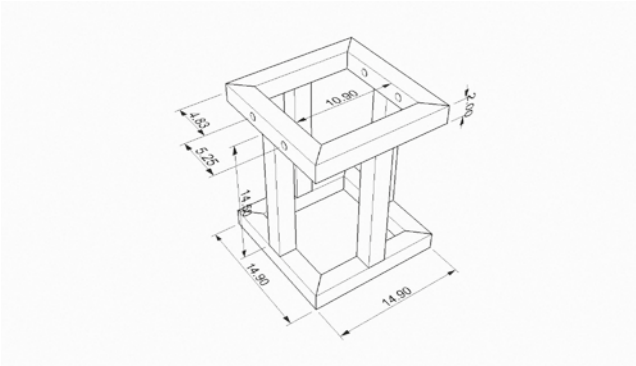
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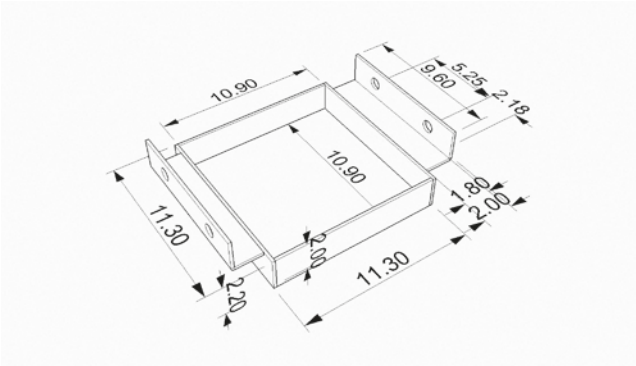
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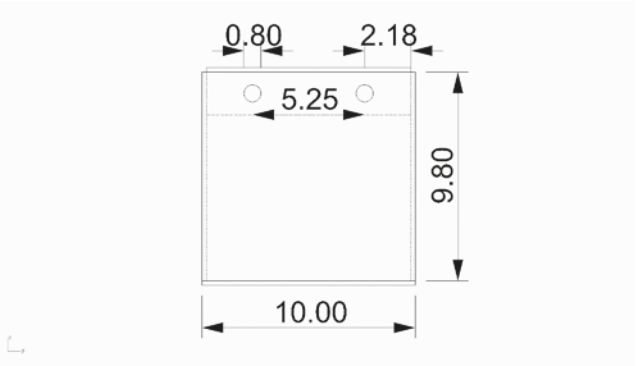
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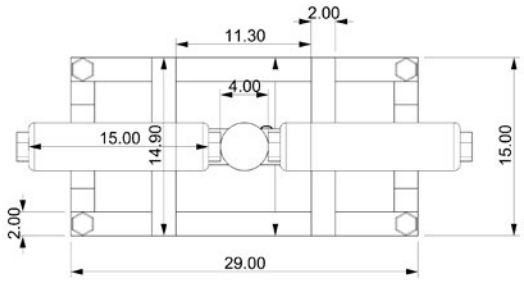
PRESS

The press-molded Block cannot be produced without a press. Therefore, designers created the press specifically to fit the Block's mold.

The purpose of the press is to compact the melted plastic in the mold. Once plastic is in the mold and top piece inserted, plastic must then be pressed to create a compact, solid cube. Force is necessary. This requires a press. Ours is mechanical. The resulting process is quite low-tech and simple for someone to do with his or her hands. Basically, the press is a rectangular steel arch with a tightening screw mechanism on the top. While this is adequate for our needs, a hydraulic press is necessary for better results.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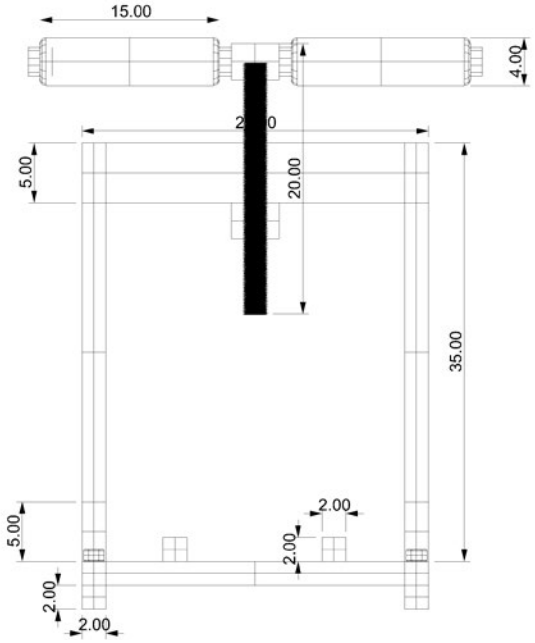
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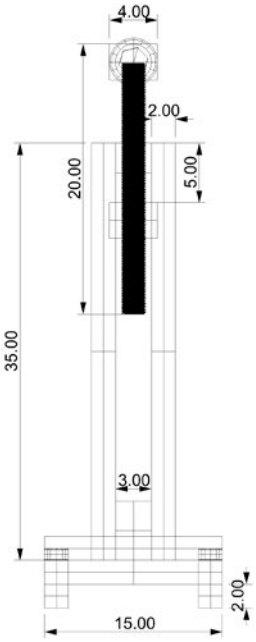
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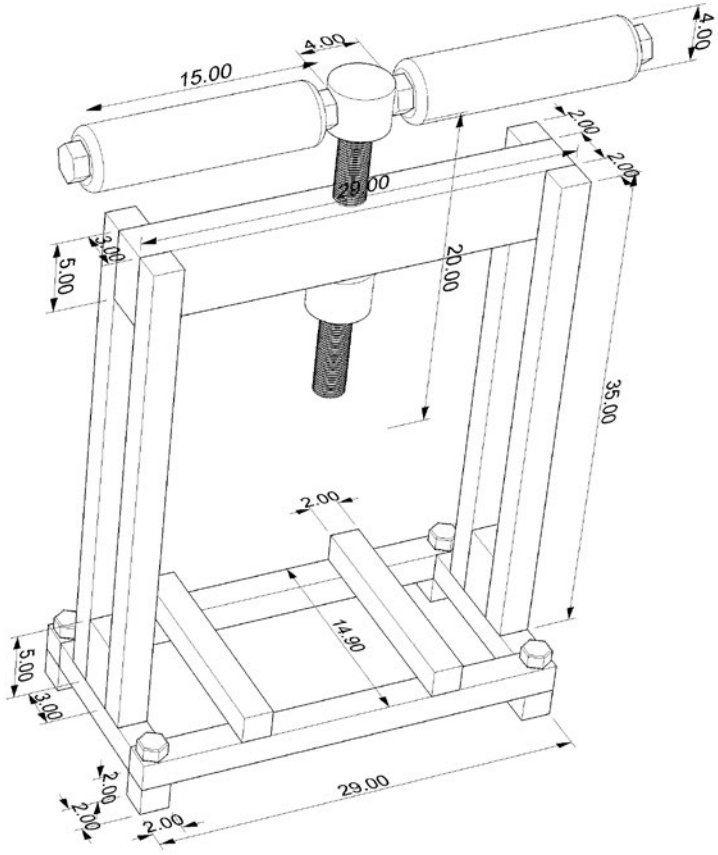
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FINISHING TABLE

We use a self-constructed, wooden finishing table. We clamp the Block on this table and use a planer (power tool) to plane each surface to render it smooth and accurately 10x10x10cm. The table is also rigged with a router (power tool). Two bits are used in the router: rounding and straight, in order to round edges and drill holes for connection. To align the Block for drilling connection holes in the center of each face, the table features a vertical guide made from wood.

MACHINES: THE GOOD AND THE BAD

PROS

Oven size and temperature requirements are average and accessible. Relatively small industrial and professional ovens found secondhand are adequate.

The mold is low-tech and hands on; it is accessible and autonomous. Steel makes it strong and durable. The metal also accelerates cooling (metal is an excellent heat conductor). With proper materials, tools and skills, one can make a similar mold themselves. The mold, however, does not need to be steel. While more difficult to work with, we found wood also works, making it even easier to produce your own mold, and to experiment with other molds.

The press is also low-tech and hands on, making it equally accessible and autonomous to the mold. Made from steel, the press is sturdy. When pressed with the proper amount of material and force, it creates a consistent product.

CONS

Ovens can be heavy and harder to move; however, this problem is solved if/when set up in one location. Ovens require electricity. Ours needed high voltage equipment. In addition, some form of ventilation for fumes, such as a hood or exhaust, must be set up.

The mold is limited in what it creates It also requires access to steel and specific tools and expertise to create. These cons go for the press, as well. While our mechanical press works for our needs, in order to achieve better results a hydraulic press is required.

7
PROCESS: USING MACHINES TO BUILD BLOCKS

Now you know the Block design and are familiar with the oven, mold and press. You may already be able to imagine how you would proceed to use the machines to create a Block; however, questions remain: how much plastic do you use? What temperature do you set the oven? How long do you melt the plastic for? How long does it need to cool?

Here, we take you through the equipment needed and step-by-step Block production process.

EQUIPMENT

1. **Plastic: LDPE**
   We use 850g of clean, dry LDPE per Block.
2. **Oven**
   We use a 380V bakery oven. You can also use a 220V.
3. **Mold**
4. **Press**

5 **Clamps that fit around mold**

6 **Teflon coated pot**
We use a regular Teflon coated soup pot.

7 **Teflon/PTFE non-stick lubricant**
We use car-polishing wax with PTFE. Other oils can work. We used pine nut oil during prototype sessions.

8 **Scale**
We use a hanging scale to weigh plastic before melting.

9 **Professional heat resistant gloves**
Welding gloves work well

10 **Finishing table**
We constructed ours from wood

11 **Power tool: Planer**
See (How to use planer: video)

12 **Power tool: Router**
We use a 6mm rounding bit and a 12mm straight bit.

MAKING A BLOCK

1 **Set oven to 200 degrees Celsius**

2 **Wax the pot with Teflon/PTFE**
This is where we apply car-polishing wax.
Note: Teflon/PTFE is a polymer, and PTFE has one of the lowest friction coefficients against any solid.

3 **Collect 850 grams of LDPE**
Be sure that the plastic is clean and not contaminated with paper, tape, organic waste, etc., which could create a fire inside the oven and will reduce quality of final Block.

4 **Fold the plastic, making it as flat as possible in order to take out air trapped between layers**
Note: In this step, we can pre-decide the Block's color and final look

5 **Insert the plastic into the pot**

6 **Let it melt in oven for approximately 30 minutes, set at 200 C**

7 **Wax inside of the mold**

8 **Remove pot from oven**
Use professional heat resistant gloves

9 **Place the melted plastic on a table and press/knead it in order to get out any air left inside**
In this step, you can also manipulate the plastic to define the final texture and color

10 **Put the plastic into the mold and insert lathe/top piece of mold in position**

11 **Place mold into press**

12 **Turn mechanical tightening mechanism to tighten press**

13 **Clamp the mold so the plastic can cool inside the mold without changing shape**

14 **Loosen press and extract clamped mold from press**

15 **Place clamped mold in bucket of cold water for approximately 15 minutes**

16 **Remove mold from water and let air dry for approximately 10 minutes**

17 **Remove clamps from mold**

18 **Remove lathe/top piece inserted into mold**

19 **Remove Block**

20 **Finish Block: plane, round, drill**


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FINISHING A BLOCK

Finishing the Block consists of three steps in order to
1) smooth the sides and adjust size,
2) round edges and
3) create holes for connecting elements:

1 **Surface**
Use the planer to plane sides of Block a few millimeters, or less, to produce a smoother surface and adjust the Block to proper size (10x10x10cm).

We clamp the Block to a table in order to hold it in place while planning each side.

2 **Round edges**
Using a router with the rounding bit, carefully round Block edges to make a smoother, safer and more appealing final Block.

3 **Drill holes for connectors**
Using a router with a 12mm straight bit and the self-designed guide on the finishing table, drill holes 35mm deep in the center of all six faces of the Block.

These procedures follow general safety guidelines:

- Wear protective glasses
- Headphones or earplugs
- Mask to protect from inhaling plastic dust

*Note: Plastic dust is collected and recycled, as it remains a valuable material.

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ADVANCING DESIGN: EXPANDING APPLICATION

Application remains both a central area of concern and platform of possibility for design and use. We created a modular Block that can be used to build objects local people asked for, such as planters for the park, and which can be created in hands-on community workshops at the WASTED Laboratory. What else can Blocks be used for? How can connectivity be made simpler and more practical? What else can our process design be used for? Questions such as these ignite possibilities. They are design problems calling for solutions.

In considering design and application potential, we introduce the parameters and possibilities outlined in our initial Open Source Report:

PARAMETERS AND POSSIBILITIES

1 Scale (small – large)
How large should a single module be to be an effective tool in creating objects of different size and with different uses, e.g. jewelry, vase, chair or table?

2 Quantity (one – multiple)
How many parts are needed to construct an object? Can the block be a single module, or will it need multiple parts to combine into large objects?

3 Connectors (yes – no)
Does the block require an additional element to be combined into a larger unit? What are the structural requirements of such elements?

4 Size (whole – shredded)
Can the plastic that is collected be used whole, or does it have to be shredded into granulate that will be our resource?

5 Dependency (autonomous – co-dependent)
Does a single WASTED Block have utility, or does it require a combination of blocks to create a useful object?

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CONCLUSIONS

First and foremost, we are happy with results so far. We started with an idea and turned it into a reality: creating Blocks and giving back to the community, reducing pollution, and re/upcycling waste to advance sustainable social and material design at the neighborhood level.

At this stage, we feel the need to conduct additional research on materials, process, products, applications and further possibilities in upcycling and reusing waste resources. In order to develop ideas in these areas, we intend to organize a new design club* that involves the open source community even more.

*Interested participating in the next WASTED Design Club? We'd like to hear from you. Contact us.

CITIES

Gemeente Amsterdam Noord

Fred Foundation

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