WAST3D POTENTIAL

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Abstract

Waste is obsolete. Standard building industry practices are harmful to the environment. Non-traditional construction methods were examined as alternatives. Circular design logic was the guiding principle in material choice. Additive manufacturing is a proven modern method for building construction. Research on 3D printing case studies revealed that recycled plastic is a proven material and readily available. Removing plastic waste from the environment and sequestering it in architectural components gives the material a new purpose. The component of focus was a building block for a wall assembly. Inspiration was taken from the hexagonal Basalt rock formations found near volcanic fault lines. The final design included interlocking hexagonal block pieces linked and stacked together to form a wall. Additional structural support is provided by driven pilings that pass through shafts in the wall blocks. A full scale assembly would use filament made from recycled plastic to print all necessary blocks. A kit assembly was proposed that included the quantities of each block type required to build an example structure plus additional store-bought hardware.

Organic - Agricultural waste, soil, plant fibers
Clay - Fine-grain soil/mineral sourced from the ground
Concrete - Ideally sourced from demolition site for processing and reuse, usually a proprietary slurry
Metal - Can be melted down and reused
Polymer - Thermoplastic that is difficult to recycle or break down efficiently
Biodegradable Polymer - Plastic compounds that break down from biological/microbial action
Recycled Polymer - Repurposed plastic waste that is turned into filament or pellets

BILL OF MATERIALS FOR KIT ASSEMBLY

PRINTED BLOCKS (1 block = 24 hour print time)
• 437 Basic Unit blocks
• 436 Piling Shaft Unit blocks
• 53 Ground/Cap Unit blocks
• 73 Crossbar Mounting Unit blocks
• 73 End Condition Unit blocks (½ print time)

HARDWARE COMPONENTS
• 24 Pilings (10’ x 1-¾” diameter)
• 6 joist beams (8’) and 4 joist beams (12’)
• 2 Standard 3’ door frames
• Roof material of choice (~150 sq-ft)
• Assorted hardware for beam assembly

Time to Print and Build:
Total Blocks = 1036 x (1 block/day) = 1036 days = 2.8 years (~3)
With 100 printers (farm) = less than 2 weeks to full assembly

WASTE PLASTIC REQUIREMENT

THE WASTE COLLECTION CENTER PLAN:
1 Block uses ~385 grams of filament = .385 kg
1036 Blocks needed
(.385kg)*1036 Blocks = 400 kg filament

What does that translate to in plastic bottles? (Assume no lost material)
1 bottle (PET) ~20g = .02kg
400kg/.02kg = 20,000 bottles (waste plastic)
400g/block = 20 bottles recycled/block

Background on Additive Manufacturing
Block Study #1: Stacked Peg Connection (Lego)

+ Starting point that uses geomimicry inspiration
+ **Connection** that prevents horizontal movement
+ Printable without any post-processing

- Limited stacking pattern flexibility
- Assembly system does not allow for corners

Model Scale: 3 inch = 1 ft
Block Study #2: Frame and Plate Connection

+ Pattern closer to original **geomimicry** inspiration
+ Hollow frame allows for insulation or other infill
+ Plate connections prevent horizontal movement
+ Greater variety and flexibility in stacking pattern
+ Printable without any post-processing

- Weak connections, difficult to create corners

**Model Scale:** 3 inch = 1 ft
Block Study #2 Alt: Frame and Plate Connection

+ Vertical arrangement requires less material per sq. ft. of wall
+ Plate connections prevent vertical and horizontal movement
+ Orientation takes advantage of shapes **structural strength**
+ Printable without any post-processing

- Assembly system does not allow for corners
- Weak connections without adhesive

Model Scale: 3 inch = 1 ft
Block Study #3: Transformation and Tessellation

+ Morphology showcases 3D printer capabilities
+ Variety of possible translations are endless
+ Sculptural and functional aesthetic suits column design
+ Printable without any post-processing

- Lacks physical connection points
Block Study #4: Rectilinear Voided Truss

+ Minimizes material use while retaining structural strength
+ Hollow frame allows for insulation or other infill
+ Channels for mechanical connections (duct/pipe/wire)
  > Floor or wall applications
  > Potential as screen wall

- Requires additional material layers for weather resistance

Model Scale: 3 inch = 1 ft
Block Study #5: Kit of Parts

+ Greater freedom of construction and assembly
+ **Flexibility** of pattern, form, and scale
+ Variable wall depth possible
+ Ability to turn corners
+ Printable without any post-processing

- Lacks physical connection points, relies on adhesive

Model Scale: 3 inch = 1 ft
Final Block Design and Wall System

> Features modular interlocking pieces made from recycled plastic.
> Incorporates vertical pilings for additional structural support.

+ No heavy machinery required to assemble
+ Customizable texture and patterns can be functional and ornamental
+ Scalability of assembly
+ Configurable to accommodate rectangular openings or other hardware
+ Retains elements of original geomimicry
+ Strong in compression
+ Block cavity can be filled with insulative material via infill pattern

- High quality recycled plastic filament requires tedious material collection and processing
- Assembly is not fully weather resistant without additional layers

Tectonic Model Scale: 3 inch = 1 ft