# Pellet 3D Printer

Technical Report — Research & Development

Sanskar 0day

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# The Problem: The Filament Tax

Standard FDM printers rely on **filament** — a pre-processed plastic strand.

- High Cost: $20–$50/kg for basic materials.
- Supply Chain: Dependency on third-party manufacturers.
- Waste: Supports and failed prints are non-recyclable in standard setups.

**Filament is essentially "plastic with a middle-man tax."**

# The Solution: Direct Pellet Extrusion

Printing directly from raw granular feedstock (pellets).

- 10x Cost Reduction: Pellets cost $1–$5/kg.
- Industrial Scale: Same feedstock used in injection moulding.
- Circular Economy: Prints can be granulated back into pellets and reused.

- Bypasses the filament production stage.
- Enables use of engineering-grade materials (Carbon Fiber, PC, PA12).
- Opens doors for large-format construction printing.

# System Architecture

## Motion System

- CoreXY Gantry: Decoupled X/Y motion for high acceleration.
- MGN12 Rails: Precision linear motion.
- Z-Axis: Lead-screw driven bed.

## Control Stack

- MCU: BTT SKR Mini E3 (32-bit STM32).
- Firmware: Klipper (Python-based motion planning).
- Drivers: TMC2209 (Silent / Sensorless).

## Extruder Design: The Core Challenge

The pellet extruder must perform three tasks simultaneously: Convey, Melt, and Compress.

- Screw Geometry: 20mm compression screw with 2.5:1 ratio.
- Thermal Zones: Dual-zone heating (Feed Throat vs. Melt Zone).
- Drive: NEMA 23 stepper with 10:1 worm gearbox for high torque.

*Status: Mechanical assembly and barrel machining in progress.*

# Build Status: IN PROGRESS

| Phase | Status |
|---|---|
| Frame & CoreXY Assembly | ✓ Complete |
| Kinematic Bed Mount | ✓ Complete |
| Screw Barrel Machining | ⚙ In Progress |
| Hot-end Integration | ⚙ In Progress |
| Electronics Wiring | ◯ Pending |
| Klipper Configuration | ◯ Pending |
| First Extrusion Test | ◯ Pending |

Next: Finalizing extruder mount and feed system.