

Morphological Analysis

Construct a morphological chart using the concepts your team worked on during your last class/meeting. Show 2 possible concepts for your team to evaluate, along with your rationale for why you think each would be a productive choice. This is a graphical submission, so post a link to your individual work on your team's confluence page.

	Possible ways									
Concrete Extrusion	Gravity pulls concrete through, valve controls flow	Spring is fixed with concrete then compressed	MotORIZED auger pushes concrete through tube	Concrete is manually pushed through by hand	Piston pump pushes concrete through	Concrete and water are mixed at the nozzle reducing pumping needs	Peristaltic pump (squeezing pump) pushes concrete through	Extrude a dry powder, then spray the powder with water	Use cold water when mixing concrete to slow the curing process, heat the nozzle to hasten the curing time after extrusion	Rotary gear pump pushes concrete through
Keeping Concrete at right moisture level	Put concrete into a sealed reservoir	Constantly mix concrete and add water at defined rate	Extrude a dry powder then spray with water, eliminating the need for moisture level maintenance	Have students check concrete at a time interval and add water by hand if needed	Put a wet "curing blanket" over that top of the concrete in the reservoir to prevent it from curing too quickly	Mix concrete at the nozzle so curing before extrusion isn't a concern	Chill the concrete reservoir to slow the rate of evaporation, heat the nozzle to reduce curing time once extruded	Use a mucus membrane like a snail to prevent water from evaporating from the concrete	Use a programmed moisture monitor to alert the students if more water needs to be added to the concrete mixture	Print all the concrete quickly enough where there isn't time a significant amount of moisture to evaporate
Concrete Delivery	Attach reservoir directly to extruder	Manually fill extruder	Gravity fed	Pump fed	Auger fed	Dosing pump	Open shoot to basket on extruder	Using a motorized plunger forcing the concrete into the extruder	Magnets	Using air pressure in the reservoir to push the concrete through the system
Concrete Mixing	In Extruder	User mixed in the reservoir	In a purpose made concrete mixer (off the shelf)	User mixed in a bucket	Using an auger in the reservoir	Using a drill attached concrete mixer	Is a concrete truck	Kitchen stand mixer	Is a separate team design mixing apparatus	Using compressed air to agitate water and dry concrete together
Receive instructions for print	Receive G-code from SD card	Retrieve model/code from USB flash drive	Uploaded model via direct USB connection	Transmit file via wifi	Transmit files via bluetooth	Have raspi do download the file from internet	Have a pc attached to create models	Punch card processing	Have micro-controller download it from internet	User input G-code
Motion in XYZ Axis	Robotic arms	Spring mechanism	Tension mechanism	Pulley system	User controller (like a host)	Magnetic system	Moving bed instead of moving extruder, using a strong motion platform	Using a motor, moving extruder along a threaded rod	Rollers/wheels to facilitate movement	Use stepper motors and some threaded rods for all axes, controlled by MCU

Red Plan

- Extrusion-Syringe filled with concrete
- Moisture Level- Concrete in sealed reservoir
- Concrete delivery- using pressure plate on top
- Mixing- Kitchen Aid Mixer
- GCode- USB uploadable
- Motion- motor on threaded rods

Explanation:

A giant syringe could be used as the reservoir. Once loaded a cap will be put on to lock in moisture. The cap will have the mixer attached. The motor will be turned on for the lid. This will begin mixing the material and put pressure on the top layer of the concrete. This will push the concrete through the system. Once some material has flowed the machine will be initiated by the team members and it will follow the path provided in the USB file. The machine will use motors and grooved tracks to move about the plane.

Green Plan

- Extrusion- auger pushes through tube
- Moisture Level- have students check and spray with water bottle on hand
- Concrete delivery- gravity
- Mixing- spiral drill

- GCode- pc provided (with templates)
- Motion- sliding mechanism

Explanation:

Students will use a template on a computer near the machine to create and upload the GCode. Concrete will be placed in a funneled reservoir. A Drill will be placed over the reservoir to mix the materials. Gravity will be used to push the material from the funnel into the extruder system. Students will check moisture levels. If the mixture is getting dry, students will spray water on top. The printing will start. The machine will slide on tracks to move about the plane.