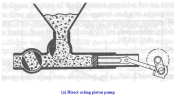
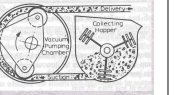
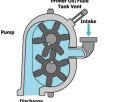










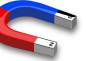


Concrete Extrusion	Gravity pulls concrete through, valve controls flow		Syringe is filled with concrete then compressed		Motorized auger pushes concrete through tube		Possible ways Concrete is manually pushed through by hand		Piston pump pushes concrete through https://en.wikipedia.org/wiki/High-density_solids_pump#Types_of_piston_pumps 		Concrete and water are mixed at the nozzle reducing pumping needs		Peristaltic pump (squeeze pump) pushes concrete through 		Extrude a dry powder, then spray the powder with water. https://newatlas.com/berkeley-researchers-pioneer-powder-based-concrete-3d-printing/36519/		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 reducing 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	In a concrete truck 	A kitchen stand mixer 	In a separate team design mixing apparatus	Using compressed air to agitate water and dry concrete together	Have premixed concrete poured in	Vertical Auger in reservoir to mix concrete	Dropping dry materials into a whirlpool of water	Separate reservoir for wet and dry materials to common basin	Multiple sticks to stir the mixture	Horizontal augers, snowblower style	User stirred	User use a concrete vibrator & handheld drill to stir and get rid of air	Spin entire reservoir that has fins in it	User premeasured materials and adds to mixture
Receive instructions for print	Recieve 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				Have micro-controller download it from internet		User input G-code 	
Motion in XYZ Axis	Robotic arms		Sliding mechanism		Pulley system		Motion in XYZ Axis		User controller (like a hose)		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 acme threaded rods for all axes, controlled by MCU	

Rationale: This method allows the user to predetermine the mixture before inserting it into the system and test the concrete's slump and consistency before hand. It also avoids a complex system of mixing the concrete at the extruder

Rationale: This method prevents premature setting of the concrete and allow for change in mixture as the print progresses, if that is deemed to be a valuable trait. The upload to the printers memory means easier repeatability of prints, even with extended amount of time between prints.