Specifications of Laboratory scale 3D concrete printer

1. **General:**
   1.1 **Printer type**: **Gantry-based 3D printer**
   1.2 The printer should have an automated printing system to be used in laboratory space
   1.3 **Print Volume (minimum)** : 1000 mm(L) x 1000 mm(B) x 500 mm(H)
   1.4 **Print speed:** Minimum 10-100 mm / sec
   1.5 **Coating:** All the parts of the printer should be coated for rust protection.
   1.6 **Print Bed** - Removable Sliding Pallet

2. **Motion System for Gantry**
   2.1 **Precision:** +/- 0.5 mm
   2.2 **Motion axes of Gantry:** (X, Y, Z, rotation)
   2.3 **Max. movement Speed** - 100mm/sec(X), 100mm/sec (Y), 40mm/sec(Z), 50 rpm (rotation)
   2.4 **Motor:** Stepper / Servo Motor
   2.5 **Motion mechanism:** Linear guide / Rack & Pinion

3. **Delivery system**
   3.1 **Material delivery system type:** Positive displacement pump
   3.2 **Delivery pressure:** 0-15 bar
   3.3 **Flow rate:** Minimum 1000LPH
   3.4 **Hose Pipe:** Min 1.5-inch diameter

4. **Cleaning system**
   4.1 **Hose connection:** Quick coupling
   4.2 **Hose cleaning:** Using 2/3-inch hose cleaning ball
   4.3 **Water flushing:** Water purge cleaning
   4.4 **Water jet:** High-pressure washer jet, 125 bar (minimum)

5. **Nozzle System**
   5.1 **Nozzles:** Interchangeable
   5.2 **Screw Extruder** with integrated hopper *10 – 15 kg* material storage capacity.
   5.3 **Nozzle control mechanism:** Automatic shut-off of material with screw control
   5.4 **Circular Nozzle:** 10mm, 20mm, 30mm, 40mm & 50mm.
   5.5 **Square Nozzle:** 10 mm, 20mm, 30mm, 40 mm & 50mm.
   5.6 **Rectangular Nozzle:** 20 mm x 40 mm & 15 mm x 30 mm
   5.7 **Additive Mixing:** System to mix additives or admixtures at the nozzle assembly

6. **Software - Should have the following functions**
   6.1 **Slicer:** Custom dedicated slicer for concrete 3D printing
   6.2 **Parameters:** Print Speed, Layer height, Nozzle selection, Flow rate multiplier
   6.3 **Printer and Printing Management:** Software controlled
   6.4 **Connection to the machine:** USB/Ethernet
   6.5 **Supporting OS:** Windows 11 and higher Windows OS versions
   6.6 **Input 3D model file format:** stl
   6.7 **Functions:** Loading 3D model, slicing 3D model, Manual Control, Monitoring the printing parameters,
   6.8 **Manual Control:** X, Y, Z, C, Pump and extrusion
   6.9 **Layer Height:** Minimum 10mm
   6.10 Should simulate and display the entire 3D printing operation (before the actual printing) and its associated parameters such as time of printing, material consumption rate, print rate, and all other relevant information.
   6.11 Software should communicate with the operator regarding the necessary safety information and errors in the entire process appropriately.

6.12 Allows for a single point and integrated control of all the sub-components such as the print head unit and others for a synchronized printing mechanism/action.

6.13 Allows for start-pause-change-resume workflow.

7. Sensors
   7.1 Limit switches/Proximity sensors: X, Y, Z, C, Hopper
   7.2 Concrete Pressure: Concrete Pressure Gauze

8. Mixer
   8.1 Type: Pan mixer
   8.2 Blades: Minimum 4 nos
   8.3 Capacity: 100 kg minimum
   8.4 Number of mixers: 1 no of Pan mixer

9. Printing materials:
Capable of printing any cementitious systems which includes the following or a combination thereof –
   9.1 Concrete / Mortar / Clay / Ceramic Paste
   9.2 Supplementary cementitious materials
   9.3 Alternative cementitious materials
   9.4 Aggregates (used in cement concrete) have a maximum size of *4 mm*
   9.5 Commonly used fibers (secondary reinforcing materials i.e. steel fibers, PP fibers, GFR & CFR etc.) in cement concrete.

10. Computer Requirement
   Workstation with following specifications:
   10.1 Operating System: Windows 11 Professional 64 bit
   10.2 Processor: Intel Core i7 or Ryzen equivalent (9th gen) or latest
   10.3 Graphic card: NVIDIA/AMD or equivalent with a minimum of 8GB.
   10.4 RAM size – 32GB minimum
   10.5 Storage capacity
   10.6 HDD: 1TB minimum
   10.7 SSD: 512 GB minimum
   10.8 No. of Core Processor: 8 minimum
   10.9 Display Size: 69 -75 cm
   10.10 Keyboard and Mouse: wired/wireless
   10.11 MS Office

11. Service, Maintenance, and other terms:

   11.1 The concrete 3D printer will be accepted for delivery only after it successfully passes the 3D printing tests at the vendor's workshop, using the materials which is compatible for 3D printing
   11.2 Warranty - 2 years
   11.3 AMC - 2 Years with appropriate cost associated beyond warranty period.
   11.4 Complete operation/ working manual should be provided.
   11.5 After installation,10 Days training should be provided at CSIR-CBRI.

12. Scope of supply & incidental services: As per the above specification.