D-SHAPE - REFERENCE DOCUMENT

Enrico Dini and his D-Shape company are well known names in 3D Construction printing, as one of its first pioneers and the only binder jetting technology at a construction scale on the market, respectively.

Binder jetting is based on deposing, or "printing", a layer of binder on top of a thin layer of powder, similarly to ink being deposited on paper. This process is then repeated for many layers, which are stacked on top of each other. The final object is remains inside this volume of powder, which needs to be cleaned to reveal it. In the case of D-Shape the powder is a mix of magnesia cement and sand, while the binder is made of very salty water (brine), which activates the magnesia cement upon contact, and starts solidifying it into concrete.

The D-Shape printer is a gantry system, that uses a large swiping motion to move a long array of nozzles that spray the binder. The same motion is also used to level the powder layers. Its current models can reach a size of 6 x 6 x 6 meters.

There is a wide variety of highly complex projects produced with this technology, including various furniture, a small house (4 x 2,4 m), various restoration project of archeological findings, a project for printing lunar bases, and most importantly the first 3D Printed bridge in the world.

The company has gained wide media attention for years now, but apart from some important but sporadic projects, it has troubles with gaining widespread acceptance. While being praised for the high level of complexity that this technology can achieve, it is mostly suited for prefabrication of elements, which can be tightly placed in the printable area, and then assembled on site. Furthermore, the cleaning and handling process turns out to be very difficult, which make this technology prohibitively expensive for general use.

Company: Monolite UK (Dinitech SpA)

Technology: D-Shape

Issued by: Anes Jakupovic, 3D Printhuset A/S

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Category	Attribute									
Company & development	Year of establishment	2006								
	Year of entering into construction 3D-Printing	2008								
	Number of employees	Less than 10	Less than 25	Less than 50	Less than 100	Less than 500	Less than 1000	More than 1000	Unknown/Undefined	
	Targeted market	Printers	Printer parts	Materials	Furniture/Sculptures	Building components	Building projects	Other	Unknown/Undefined	
	Development stage of printers	Conceptual	Protoypes	Working products	Commercial products	Other	Unknown/Undefined			
	Development stage of printed materials	Conceptual	Prototypes/Test prints	Usable products	Commercial products	Other	Unknown/Undefined			
	Patent(s) status	Not patented	Patent pending	Patent granted	Other	Unknown/Undefined				
	Patent coverage	Printer design	Printing technology	Material	Nozzle/Deposition system	Material feeding system	Movement system	Software/Firmware	Other	Unknown/Undefined
	Largest print up to date (size)	Less than 1m3	Less than 5m3	Less than 10m3	Less than 25m3	Less than 50m3	Less than 100m3	More than 100m3	Unknown/Undefined	
	Largest print up to date (category)	Minor test prints	Furniture/Sculptures	Building elements	Less than 50m2 buildings	Less than 100m2 buildings	More than 100m2 buildings	Multiple storey building	Other	Unknown/Undefined
Technology	Additive Manufacturing technology type	Material Extrusion (Layered)	Material Extrusion (Suspended)	Binder Jetting	Other	Unknown/Undefined				
	Form Freedom	2D freedom	2.5D freedom	3D freedom	Full 3D freedom	Other	Unknown/Undefined			
	Fabrication location	In situ	On-site prefabrication	Off-site prefabrication	Partial prefabrication	Other	Unknown/Undefined			
	Fabrication approach	Direct fabrication	Semi-direct fabrication	Component fabrication	Formwork fabrication	Stay-in-place formwork fabrication	Cover/Engulfing fabrication	Other	Unknown/Undefined	
Printer	Movement system	Cartesian gantry	Delta gantry	Robotic arm	Mobile robotic vehicle	Cable suspension	Other	Unknown/Undefined		
	Maximum printable volume	Less than 1m3	Less than 5m3	Less than 10m3	Less than 25m3	Less than 50m3	Less than 100m3	More than 100m3	Unknown/Undefined	
	Maximum printable area	Less than 1m2	Less than 2m2	Less than 5m2	Less than 10m2	Less than 25m2	Less than 50m2	More than 50m2	Unknown/Undefined	
	Deposition method	Jetting	Pressure extrusion	Mechanical extrusion	Mechanical movement	Gravity deposition	Sintering/Welding	Other	Unknown/Undefined	
	Number of print heads	Single	Multiple	Array	Other	Unknown/Undefined				
	Print Head/Nozzle diameter	Less than 1mm	Less than 5mm	Less than 10mm	Less than 25mm	Less than 50mm	Less than 100mm	More than 100mm	Unknown/Undefined	
	Print head/Nozzle features	Three axis motion	Rotational/Tangential motion	Omni-directional motion	Troweling mechanism	Other	Unknown/Undefined			
	Material feeding system	Manual	Included, semi-automated	Included, fully automated	Separate, semi-automated	Separate, fully automated	Other	Unknown/Undefined		
	Theoretical printing speed	Less than 0.1m3/h	Less than 0.5m3/h	Less than 0.1m3/h	Less than 2m3/h	Less than 5m3/h	Less than 10m3/h	Less than 20m3/h	More than 20m3/h	Unknown/Undefined
	Actual printing speed	Less than 0.1m3/h	Less than 0.3m3/h	Less than 0.5m3/h	Less than 1m3/h	Less than 2m3/h	Less than 5m3/h	Less than 10m3/h	More than 10m3/h	Unknown/Undefined
	Accuracy	Less than 5mm	Less than 10mm	Less than 50mm	Less than 100mm	More than 100mm	Unknown/Undefined			
	Printer (diss) assembly speed	Less than 1 hour	Less than 10 hours	Less than 24 hours	Less than 2 days	More than 2 days	Other	Unknown/Undefined		
	Price per printer unit	Less than 10.000$	Less than 50.000$	Less than 100.000$	Less than 250.000$	Less than 500.000$	More than 500.000$	Unknown/Undefined		
Material	Material possibilities	Single material	Multiple materials	Structure/Support material	Other	Unknown/Undefined				
	Material type	Traditional concrete	Alternative concrete	Clay	Soil	Plastic	Metal	Resin	Other	Unknown/Undefined
	Price	Less than 50$/m3	Less than 100$/m3	Less than 150$/m3	Less than 300$/m3	Less than 500$/m3	Less than 1000$/m3	Less than 2000$/m3	More than 2000$/m3	Unknown/Undefined
	Compression strength	Less than 5MPa	Less than 15MPa	Less than 25MPa	Less than 50MPa	Less than 100MPa	Less than 200MPa	More than 200MPa	Unknown/Undefined	
	Tensile strength	Less than 1MPa	Less than 3MPa	Less than 5MPa	Less than 10MPa	More than 10MPa	Unknown/Undefined			
	Aggregate size	No aggregates (Paste)	Up to 2mm (Fine mortar)	Up to 4mm (Rough mortar)	Up to 6mm (Fine concrete)	Up to 16mm (Concrete)	Up to 40mm (Rough concrete)	Over 40mm (Rough concrete)	Other	Unknown/Undefined
	Aggregate weight (kg/m3)	Ultralight (<500)	Lightweight (500-1000)	Normal weight (1000-2000)	Normal weight (1000-2000)	Heavyweight (<2000)	Unknown/Undefined			
	Material verification	Conceptual	Prototype	Partially tested	Extensively tested	Certified	Other	Unknown/Undefined		
	Material hardening time	Less than 1 hour	Less than 10 hours	Less than 24 hours	Less than 2 days	Lees than 5 days	Less than 10 days	More than 10 days	Other	Unknown/Undefined
	Material usability time	Less than 15 minutes	Less than 60 minutes	Less than 2 hours	Less than 5 hours	Less than 10 hours	More than 10 hours	Other	Unknown/Undefined	
	Raw material price	Less than 50$/m3	Less than 100$/m3	Less than 150$/m3	Less than 300$/m3	Less than 500$/m3	Less than 1000$/m3	Less than 2000$/m3	More than 2000$/m3	Unknown/Undefined
	Raw material availability (in construction)	Industry standard	Extensively used	Partially used	Niche usage	Not used	Other	Unknown/Undefined		