

AERODYNAMIC OF SPRAYED CONCRETE

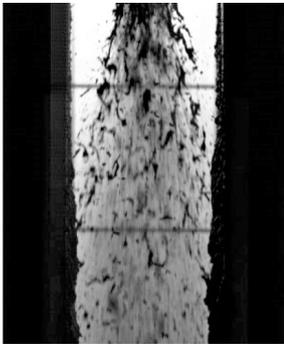


Image 1: standard nozzle



Image 2: Mobbot nozzle stage 1



Image 3: Mobbot nozzle stage 2

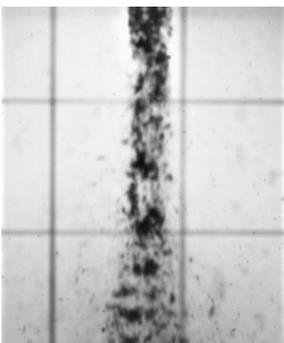


Image 4: Mobbot nozzle stage 3

OBJECTIVES

We integrated the traditional technique of sprayed concrete in 3D printing. Sprayed concrete is a technology that has been used for more than 100 years on infrastructure sites, especially for the construction of tunnels. However, it is very demanding in terms of energy and generates nearly 30% of waste. We improve the weaknesses of this technique by automating the entire system.

The technology of sprayed concrete is optimized by controlling the interaction between air and concrete in the spraying nozzle. As a result, the mechanical performances of the finished product are enhanced, and the waste generated during the spraying is reduced.

HIGH PERFORMANCE CONCRETE

The speed control of the spraying ensures an accurate projection. The sprayed element has similar properties as a monolithic element. Its mechanical performances are increased thanks to a good cohesion between the successive layers of the spray, a homogeneous surface and concrete density.

WASTE REDUCTION

Another important optimization is the reduction of waste during projection. The amount of concrete which is sent out of the spraying nozzle is minimized. An optimization study, experimental and theoretical, has been led to maximize the efficiency of concrete propulsion with compressed air.

Waste was drastically reduced by modifying the nozzle geometry, compressed air supply, speed and angle of projection.

PREDICTION TOOL

The high concrete spraying performance have been theoretically corroborated. We use a numerical simulation tool developed precisely for spraying concrete. This tool calculates the speed of the concrete stream for any geometry of nozzles. It considers air dynamics, the interaction between speed-concrete and the properties of the concrete type.

The strength tests results demonstrated that the mechanical properties of the sprayed concrete are higher than the traditional spraying technique. The design of our nozzles and the high velocity of the concrete has been enhanced. The high-speed camera and numerical models confirmed these measurements.