

➤ Whale-sized 3D printed art

Although 3D printing is mostly used for industrial manufacturing, it is also an emerging sculptural technique. In Turin, Italy, two artists chose robotically 3D printed stainless steel to realize a near-life-sized whale sculpture; the roopy structure of the printed welds mimics the texture of a humpback whale's skin. The 2% molybdenum in Type 316L stainless steel help keep the whales' rough surface stain-free.



During 2022, in the gardens of Turin's Royal Palace, a trio of stone and metal humpback whales break through a sea of grass. Much like the play of whales in real life, only parts of them are visible above the surface, leaving the enormity of their size to one's imagination. The sleek breaching head of one of the whales reaches 5 meters – how much more hides under the surface? This installation showcases the immense size and variety of shapes possible with a 3D printing technique called wire arc additive manufacturing, or WAAM. Unlike the powder stock used in most 3D printed metal applications, the robotically controlled process builds three-dimensional structures with layers of melted weld wire. Weld wire is approximately 1/5th the cost of comparable powder and deposits faster. The speed and lower cost of WAAM offer exciting possibilities in manufacturing, from energy to maritime applications and art to architecture.

Mixed media brings the giant to life

The artists who designed the installation, Paolo Alberti and Mariagrazia Abbaldo of Studio C&C, were inspired by seeing humpback whales while scuba diving in Tonga. They felt the cetacean's massive backs resembled burnished metal. To realize the whales' glistening bodies in sculpture, they used Type 316L stainless steel. The humpback's flashing white underside is captured with marble, which contrasts boldly with the dark printed metal alloy.

The layered weld ropes are shiny yet weathered like the skin of a whale. However, such rough textures also increase the likelihood of corrosion by providing more nooks,

▶ A close up of the whale's blowhole shows the rough layered surface hallmark to wire arc 3D printing.



▶ The whales are part of a larger sculptural exhibition that took place in 2022 in Turin's Royal Gardens called *Animals on Parade*.

crannies, and surface area for corrosive particles to adhere to. The molybdenum-containing Type 316L alloy better protects the sculpture from rust stains than lower alloyed grades, so the illusion of wet, glistening skin remains intact. A rough surface is inherent to the WAAM process. To compensate, components made with WAAM require the selection of more corrosion resistant grades of stainless steel in all relevant applications that remain unfinished.

3D printing saves material and weight

WAAM-pioneering manufacturer MX3D produced the whales at their workshop in Amsterdam. The pieces were printed in the largest production cells available, in sections as long as 3 meters, and then welded together manually. In contrast, most metal powder-based objects made with additive manufacturing are much smaller, due to cell size restrictions of the printer. By using a robot to deposit welded metal layer by layer in an open or enclosed space, WAAM overcomes this limitation. Built up of ultra-thin, rigid layers these beautifully crafted whales also use considerably less material than a comparably sized, conventionally produced stainless steel sculpture and are much lighter. These whale-sized sculptures exemplify the literally growing possibilities of 3D printed metal structures. (Karlee Williston)