

Cutting Edge Sculpture - Sheffield



Customer:	Sheffield City Council
Location:	Adjacent to Sheffield Main Line Railway Station
Main Contractor:	Interserve Plc
Value:	£??
Duration:	? Month



Project Profile

Project Description:

The “Cutting Edge” project is part of the Sheffield mainline railway station redevelopment programme. This element of the project comprised redevelopment of the area outside the railway station. A design was prepared that made attractive use of the natural slope of the land. It comprises a pedestrian area, a series of cascading ponds and waterfalls edged on one side by a substantial stainless steel sculpture – the “Cutting Edge”. The sculpture separates the waterfalls and pedestrian area from the adjacent road. The other side of the pedestrian area is flanked by the redeveloped station facade.

The sculpture is intended to depict the fashioning of a billet of stainless steel into a knife blade, fine cutlery being the pride and heritage of Sheffield. The sculpture is thought to be one of the largest horizontal sculptures in Europe and represented an onerous task to design and build. It was essential that the structural elements of the work were not visible and it was to be constructed from mirror finished (highly polished) stainless steel.

Design

The sculptor’s vision necessitated the design of the Cutting Edge to be developed in three dimensions, conventional 2D design not being adequate or practical. A computerised 3 dimensional model was prepared. The shape of the sculpture is complex being best described as an 81 metre long “S” shaped body. At one end it is a 1 metre diameter circular shape. This changes continuously and smoothly along its 81 metres length to a 5.2 metre high vertical “eye” shape at the other end. As the site at which the sculpture was to be placed slopes, the change in height dimension from 1 metre to 5.2 metres compensated for the slope in the lie of the land. The top of the Cutting Edge had to be absolutely level as this was to form a weir over which water cascades, the spilled water being collected in a lower trough formed in the finished ground work. The design demanded that no water supply or distribution pipework should be visible.

Each end of the Cutting Edge is fitted with a glass closure. The sculptor’s design showed the smaller round “billet” end of the sculpture to be blue to represent cold metal and the thinner, taller “blade” end in red to depict the hot formed product. The entire length of the Cutting Edge was to be lit by concealed lights in the underside of the sculpture. The light source was not to be visible to spectators.

Finally, from an engineering viewpoint, access had to be provided to the internal lighting and pipework to allow maintenance. The access points also should not be visible to spectators.

The final design presented a demanding manufacturing and construction project. Sheffield City Council approached the BSSA (The British Stainless Steel Association) to gain advice on which companies should be approached to manufacture such a significant work of art. After due consideration, the BSSA suggested that Jordan Manufacturing Ltd would be a likely candidate.

Design and Development for Manufacture

As no such construction had ever been built before, there were no patterns to base the manufacturing procedures on. Jordan’s Project Team set about developing sections of the sculpture to test ways to conceal the sculpture frame, pipework, etc and ways to connect the polished stainless steel cladding to the sculpture’s frame. Jordan has been responsible for cladding on structures such as Canada Square – Canary Wharf, London amongst many others.

There was also a technical issue that was a concern. This was expansion and contraction of the polished cladding in summer and winter temperatures. It was going to be necessary to have expansion gaps between the cladding panels so that they did not buckle in higher temperatures. Highly polished surfaces when buckled present undesirable, distorted reflections. However, as water was to flow over the cladding and there was electrical equipment inside the sculpture, concerns

Project Description:

emerged with respect to water leakage through the expansion gaps and the related safety issues.

The “billet” end section and a mid section of the sculpture were constructed to assess the design development. Jordan’s engineers had established that up to a 2.4mm expansion gap could be employed without water ingress due to the meniscus (surface tension) of the water.

The Sculptor, Designers and City Council members reviewed the sections to ascertain faith to the sculptor’s artistic vision and agree the weir/water feed arrangements and other technical issues. Once the test sections had been refined and agreed, it was then necessary to design a sculpture arrangement that would allow the full-sized completed version to be transported to site for installation.

Furthermore, Jordan’s main factory at Yate, near Bristol is 4,500 M2 and reasonably long but the shear length of the Cutting Edge meant that it could not be built in one continuous length without significant rearrangement of the factory. A manufacturing methodology had to be devised to ensure all levels remained true, that joints between the sections remained aesthetically pleasing and to ensure the overall “S” arrangement remained smooth and followed the correct path. Jordan’s team decided that it would be necessary to divide the Cutting Edge into 8 sections for two reasons; the first being to make it easier to construct in Jordan’s workshop and secondly, to make transportation to site safer and more manageable.

Adjustable manufacturing jigs were designed by Jordan’s so that even though the sections were not actually connected during manufacture, the critical top weir edges and lower mounting feet locations would be constructed at true levels corresponding to the intended site. Employing this method enabled the levels to be continuously monitored by laser levelling equipment.

To ensure the geometry remained faithful to the approved computer model, Jordan’s engineers interrogated the model and took hundreds of cross-sections through the model to establish precise dimensions for the internal frames. A similar method was employed to establish the precise shape of every single unique cladding panel. These were then cut by Jordan’s Laser Division on their 6.5M x 2.5M capacity laser machine.

Transport and Installation

The time arrived to develop method statements detailing how the near completed sculpture sections would be safely transported to site 170 miles away. The height of the taller sections meant that they would have to be laid down sideways to a degree so that they could traverse under bridges on route. This raised the question, how would damage to the polished surfaces be prevented? The polished finish is applied after the stainless steel sheet is rolled to the required thickness. After the finish is applied it is protected with a low-tack adhesive film that is not removed until manufacture and installation cycles are complete. However, the film will not withstand severe abrasions or knocks.

Jordan’s engineers developed cradles that would allow the sections to be safely laid down in the factory without risk of damage. The cradles also simplified securing the sculpture sections to the transport trailers and furthermore made off-loading on site a much safer and controlled exercise. The computer model had also been used to set the sculpture support positions in relation to the concrete support pads on site. The precision with which this was able to be achieved was greatly helped by the existence of the computer model. Following delivery to site and installation it is not surprising that some cladding panels had become slightly misaligned. However, there had been a number of adjustment features built in during the design and manufacturing process, which allowed adjustment of the frames and panels on site. Conventional surveying equipment and lasers were employed once again on site to monitor levels and alignment.

Before the Cutting Edge could be commissioned with respect to the hydraulics and water feature aspects, the protective film had to be removed. This would also

Project Description:

enable the sculpture to be inspected before being taken over by the client. An unexpected and potentially disastrous situation developed. During the exceptional heat of the summer 2006 the cladding protection film adhesive had become hardened and the film was securely stuck to the sculpture panels. This was a major concern as any force needed to remove the film would easily destroy the unforgiving polished surface beneath. After much consideration a specialist company was found who recommended a number of methods to remove the stuck fast film.

After trying a number of the methods, it was discovered that by spraying the film with dry ice, it and the adhesive became more easily detached from the cladding panels.

Commissioning

Commissioning required the sculpture to be finally levelled and trimmed ready for the water feature to be tested.

At first, only the city's mains water pressure was available and this was insufficient flow and pressures to test the Sculpture's water feature properly. This raised some temporary anxiety as it appeared the sculpture may not be level over parts of its length. However, once the water feature pumps were commissioned, the water feature operated reasonably well. There were however, some gaps in the water layer flowing over the cladding panels from the weir. This was partly due to minor inconsistencies in the weir edge and partly due to the inner water trough feeding the weir not being perfectly sealed in a small number of places.

To perfect the water flow, the weir edge was dressed in relevant places to even the flow and the inner feed trough was resealed at some of the sculptures segment joints.

There are of course a number of natural issues which can disturb the water flow that cannot be easily resolved, wind being one of them but when these influences are not present the water blanket is consistent.

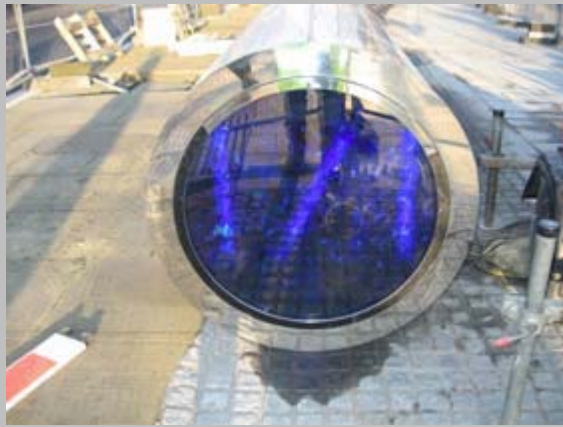
Conclusions

Jordan has manufactured many civic sculptures and architectural features from stainless steel in over 40 years of business. During this time it has become clear that sculptures and architectural features are usually the product of a person who is striving to design something unique. Consequently the designs are always different and there are nearly always one or more technical challenges to overcome. As recorded above, the Cutting Edge was no exception in this respect. However, it is the methods employed to overcome the challenges both from personality and the technical points of view that defeat the challenges.

To convert a vision or drawings of a new sculpture or architectural feature into a reality often requires a significant coming together of minds. Flexibility to accommodate what is possible and to navigate around what is not possible is a prime requirement of all parties involved. Structural, Civil and Mechanical Engineers and Craftsmen will always be able to accommodate the artist and in fact companies like Jordan positively thrive on that. The secret of the success of a project like this one is the desire to achieve, team spirit and sheer "cutting edge" experience.

Jordan Manufacturing Ltd is honoured to have served the City of Sheffield in such an important art work and engineering feat. It will be a constant reminder to all, of Sheffield's important heritage and a monument to those companies that worked together to build it.

Images:



Project Profile