Solutions

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How we cracked it

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The challenge: To create a 25m-high sculpture that would collapse in a controlled manner and burn safely

The solution: Steel posts and timber members with different sizes and char rates

Engineer: Elliottwood Partnership

Client: Artangel

Designer: Antony Gormley

Site: Margate

Project type: Live event

Step 1: the brief ▸

We were appointed by arts facilitator Artangel to provide engineering back-up to Antony Gormley's studio for the design of a 25m-high sculpture of a man constructed from waste. The sculpture was to be burnt as part of a live event called The Margate Exodus, and as a focal point of aChannel 4 film re-telling the Exodus story. The sculpture itself symbolises "the unwanted detritus of consumer society".

The key requirements were that the arms and head of the sculpture were to be dragged through the streets of Margate and then lifted into place on to the sculpture before burning. The sculpture had to disappear during the burn.

To add drama during the burning, a series of articulations were to be incorporated. Both arms were to rotate downwards during the burn and the head and upper torso were to collapse forwards.

The challenges were therefore to produce a temporary structure that would withstand potentially substantial wind loads up to the time of the burning, support the vertical loads of the waste, but that would collapse in a given sequence during the burning.

Antony Gormley's original sketch of the waste man.

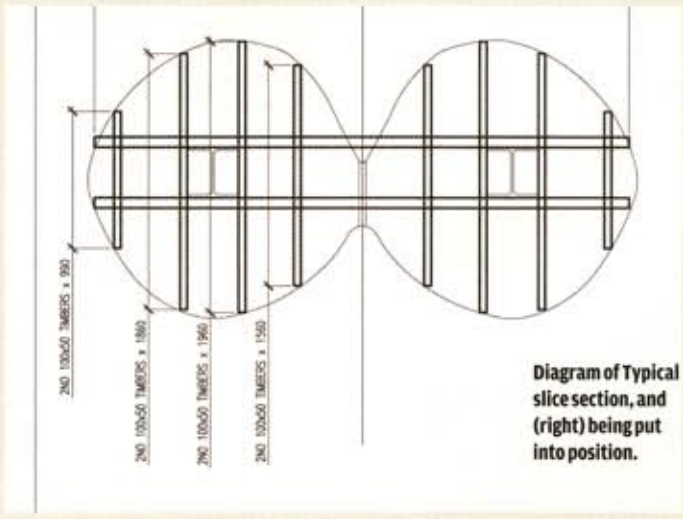


Diagram of Typical slice section, and (right) being put into position.

Step 2: Sculptural form ▲

The dimensions of the body were taken from a casting of the sculptor's own body.

The body profile was achieved by using a series of platforms shaped to replicate the cross section of the body at the height of the platform. As well as defining the shape, these platforms were to be used to provide access to operatives during construction and support the loads from the waste.

Antony Gormley's studio provided templates to sit at regular intervals for the body, arms, legs and head, defining the cross-section perpendicular to a theoretical "stick" line on the approximate centre of the body and limbs.

The maximum forces anticipated in the sculpture converge at the base - or ankles - where the cross section is at a minimum. But the sculptor considered it essential that the legs followed the real profile of the human body, and that "flaring" the sculpture at the base to relieve the high stresses was not permitted.

Step 3: Structural form ▾

Early concepts for the structure itself involved creating a three-dimensional framework using recycled telegraph poles which would be bolted together to form a vertical truss approximately following the profile of the body. A possible option for initiating the collapse of the structure was to use electronically activated exploding bolts, but this was rejected on health and safety grounds.

When we investigated the cost, the complexity of connecting the elements, and the fact that the creosote used on the telegraph poles was considered potentially carcinogenic, we soon decided that this concept was unviable.

Fortunately, as part of the narrative of the film, a very large sign of 'Dreamland' was required. This sign was to be supported on two large steel posts. By stripping the sign from the posts, they could then be used as primary structural elements for the sculpture, extending from chest level down through the legs and in to the ground as piles

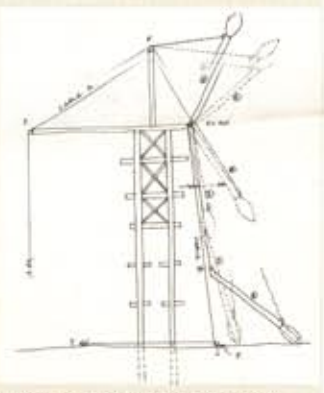
Step 4: Designing for collapse ▸

To allow the sculpture to collapse in the required way, we connected a three-dimensional timber A-frame to the top of the columns to form the upper torso, with suitable extensions to support the arms, neck and head.

These were structured so that the timbers to the front of the frame were thinner than those to the back, allowing the chest to fall forwards during the burn.

We also fabricated three dimensional timber trusses to support the loads of the arms, replacing the large pieces of timber used in earlier versions. We realised these large section timbers would be unlikely to fully burn and therefore numerous, much thinner, elements were used creating hollow structures that would burn at a similar rate to the remainder of the sculpture.

The arms, neck and head were all rigged in position with steel cables. These were attached to a large steel block to resist the tension forces. The movements were initiated by cutting the cables during the burn.



Elliotwood sketch showing the cable arrangment used to articulate the sculpture's movement

Step 5: The big day ▲

Saturday September 30 marked the day of the burn. A series of events were held around Margate culminating in the burning of the sculpture.

The burn began around 6.30 and lasted for half an hour. A tense moment occurred towards the end of the burn when the A-frame looked like it would not burn through and collapse, but the fears proved unfounded. A few minutes later the burn was completed, and with the night closing in, the steel columns disappeared from view.

George Georgiou is an engineer at Elliottwood partnership