LONDON CABLE CAR

Student Briefing Pack

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INTRODUCTION

In this design project your team will take on the role of a structural design consultancy that has been asked to develop the concept design for a cable car to link the two banks of the River Thames between the Millennium Dome and Greenwich Peninsula on the South Bank and the Excel Centre and residential areas at the Royal Victoria Dock on the North Bank.

The client has asked for a presentation of you initial ideas to be produced as soon as possible.

THIS BRIEFING PACK

This briefing pack has been produced by Expedition Engineering in collaboration with the University of Edinburgh. The images used in the pack are of the London Cable Car, as built. The design parameters in this pack have been altered, so your solution will not necessarily look the same as the version that was actually built.

It is assumed that students have an understanding of common construction materials and can carry out simple equilibrium and deflection calculations.

View from one of the cars. Image courtesy of Luke Hayes

BRIEF

The client, Transport for London, needs to make some urgent decisions about the project, and needs you to answer some specific questions. You need to produce a maximum of four sheets of A3 to present your work. The information you produce must include:

- The best locations for the cable car towers. TfL need to secure the land needed for the project as soon as possible.
- The primary loads that the cable car structural system will need to resist
- Sketches of the structural layout of a tower showing how it will resist the loads applied to it
- Initial estimates of the sizes for all the main structural elements of one of the towers and the size of the cables
- A construction sequence for one of the towers

The aim is that you consider the key structural design decisions that must be made to ensure that the concept you produce is viable. This is a high-profile public project, the success or failure of which is very important to London and its image. It must be an example of the best of British design. Furthermore, your firm would really like to be appointed to do the detailed design for this project – you need to demonstrate that you are a safe pair of hands and can deliver a structurally and economically viable and exciting design.

GENERAL ARRANGEMENT DRAWING

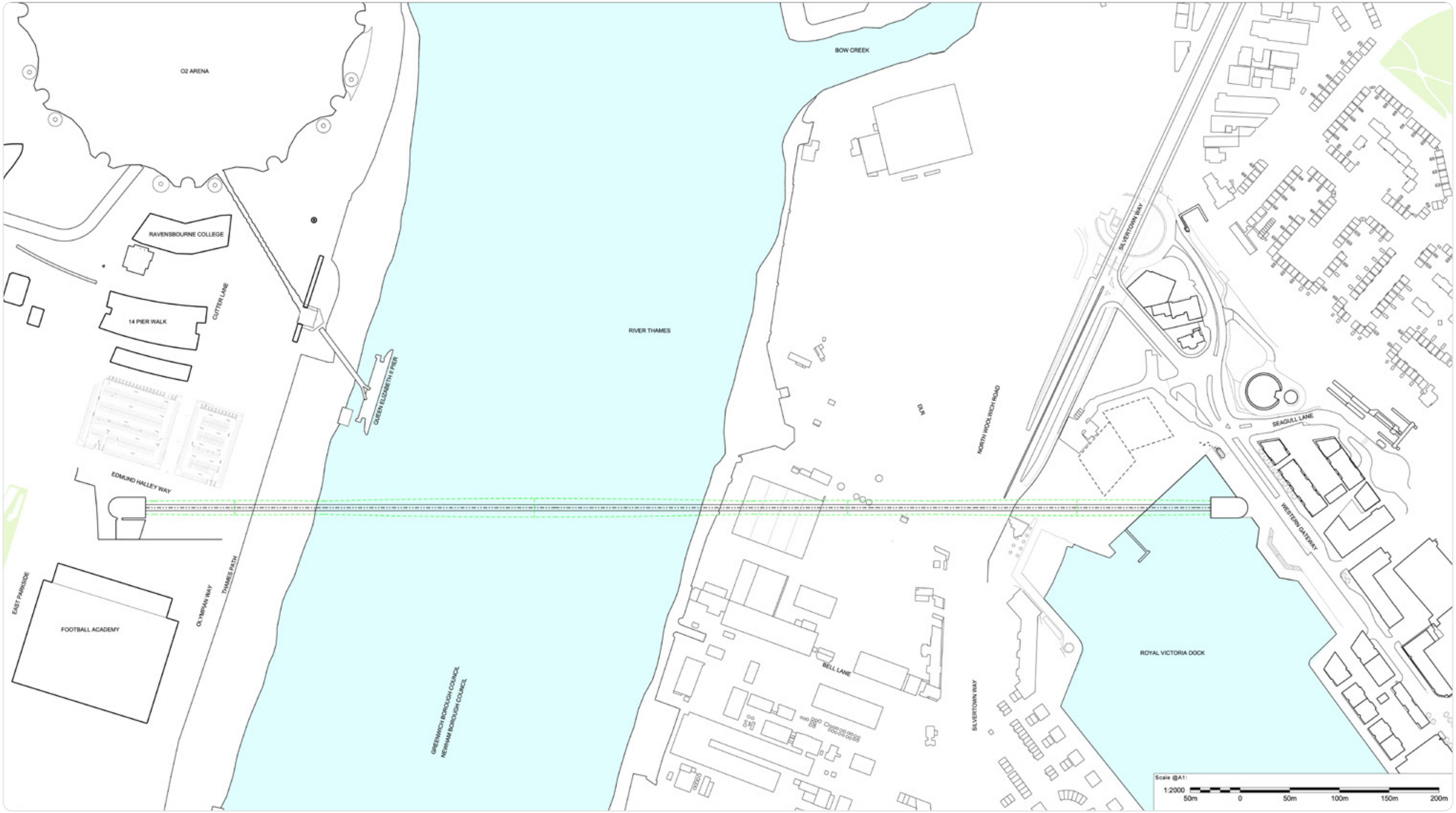


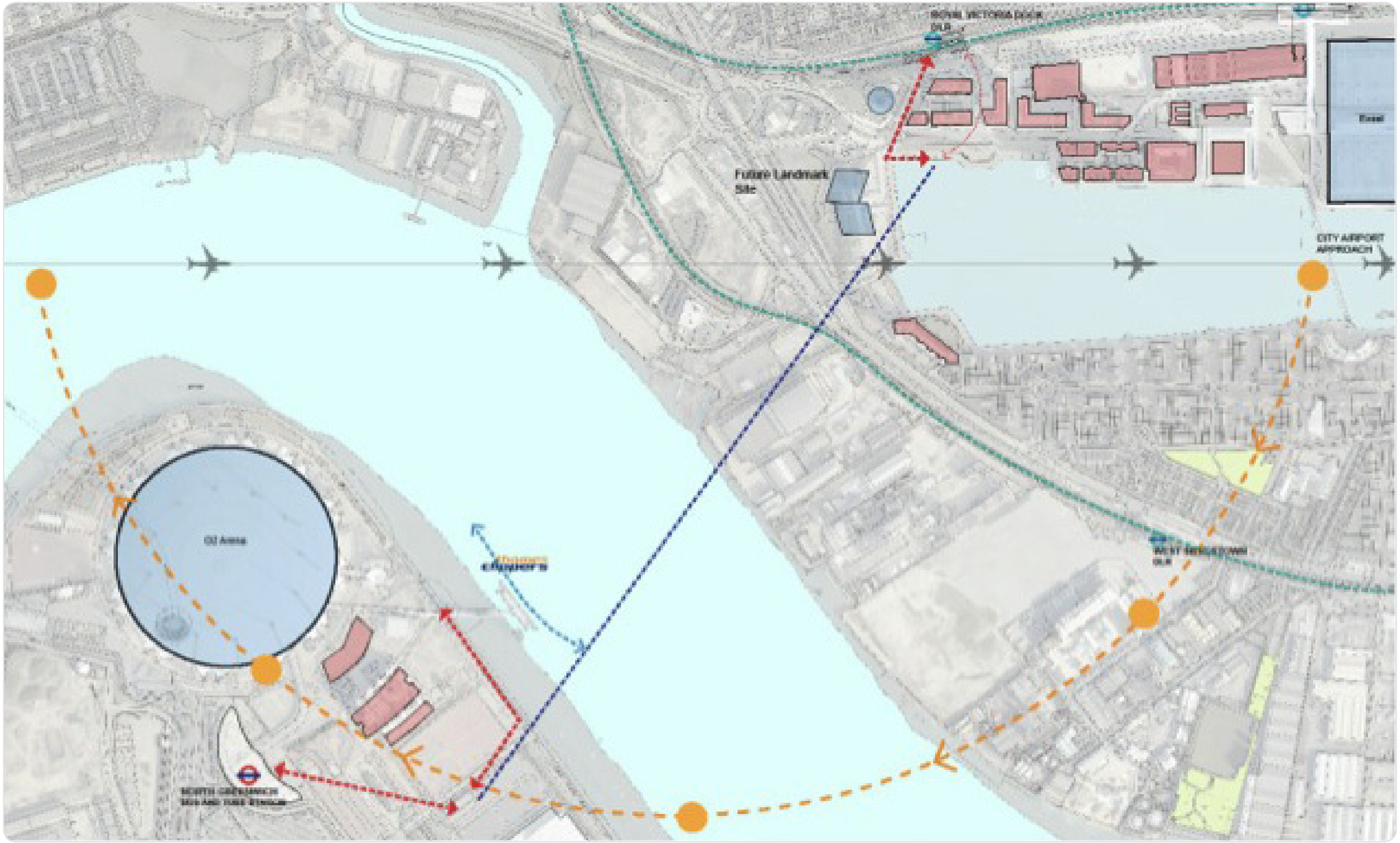
Image courtesy of Wilkinson Eyre Architects

REQUIREMENTS & RESTRICTIONS

TfL have secured land and planning permission for the landing points of the cable car, and these are shown on the general arrangement drawing. The cable car must run on the alignment shown between these landing points.

City Airport is very nearby, adjacent to the Royal Victoria Dock. The cable car development cannot obstruct the approach to City Airport, so there is a strict maximum height limit of 100m. The River Thames is a little over 400m wide at the cable car location. Over the central 300m a minimum clearance of 40m must be achieved to allow shipping access.

The top of the towers may not sway more than H/200 under any loading combination.



Location of cable car showing flight path. Image courtesy of Wilkinson Eyre Architects.

DESIGN INFORMATION

A cable hanging between two support points assumes a shape called a catenary. The forces a uniformly loaded catenary cable exerts on its supports are:

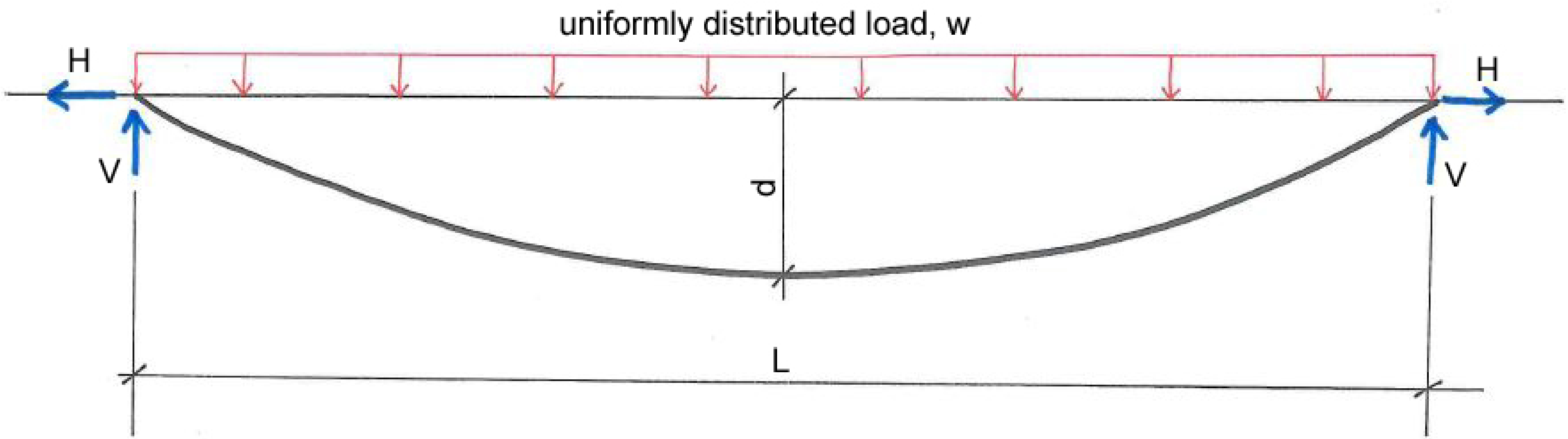
$$V = \frac{wL}{2} \qquad H = \frac{wL^2}{8d}$$

The tension in the cable is:

$$T = \sqrt{V^2 + H^2}$$

The expressions above are for statically loaded cables. The cables and the loads on the cables will be moving, and dynamic affects will increase the peak forces. You should think about how to account for this.

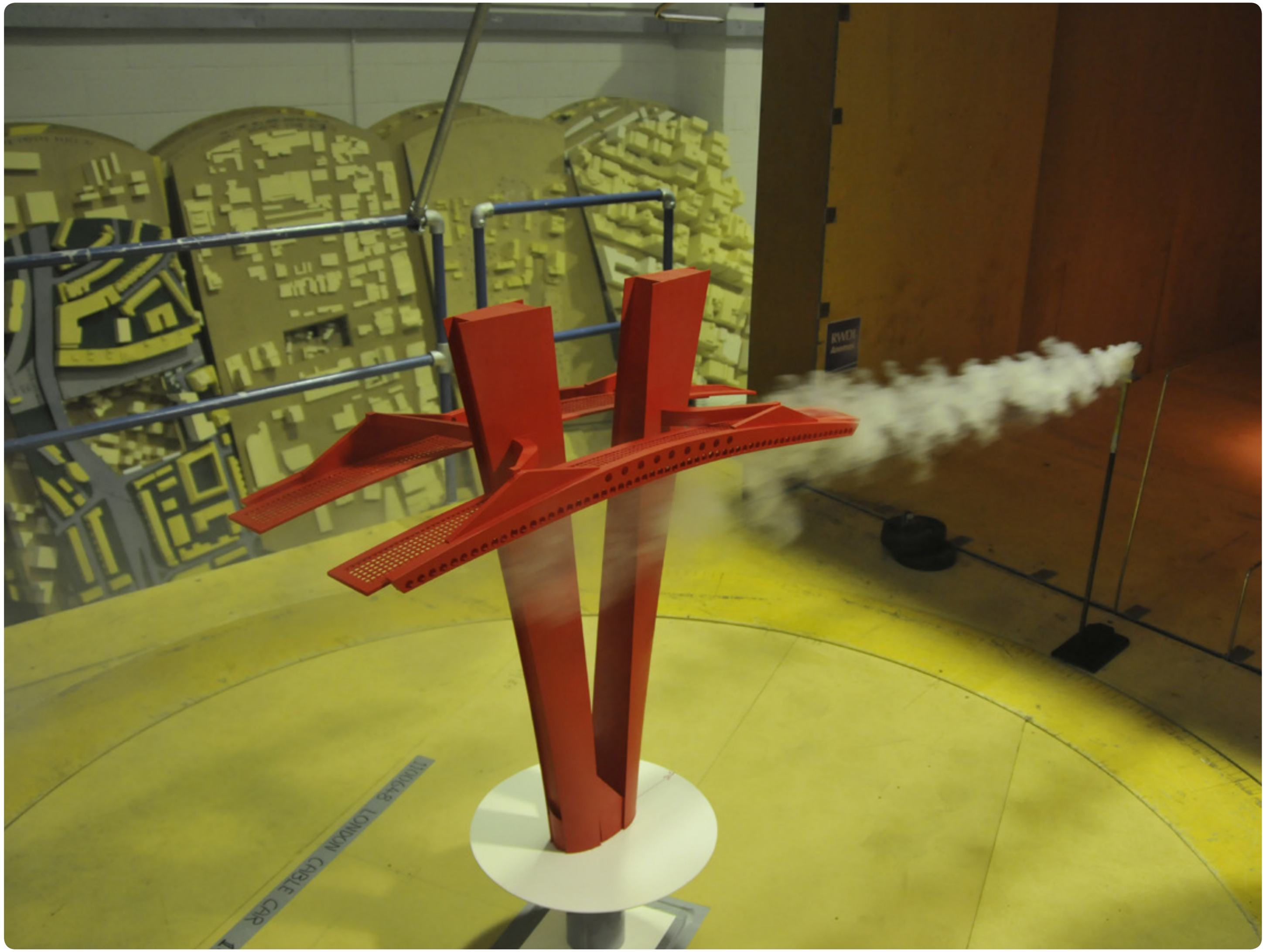
Note that you can find useful rules of thumb for Structural scheme development in the Engineers Toolbox, available in the Tools section of Workshed.



WIND

In due course a full wind tunnel assessment would be done to understand the wind loading on the towers. For now, you need to make some reasonable assessment of the wind loading.

The normal way to do this would be to use Eurocode 1 part 4 to calculate a design wind profile, but this is a very special structure and the dynamic effects of wind on the towers and cables might be important. You've spoken to wind specialist and they have suggested you use an initial wind pressure of 2.0kN/m^2 as a conservative value for what the equivalent static wind loading on the cable car towers may be.



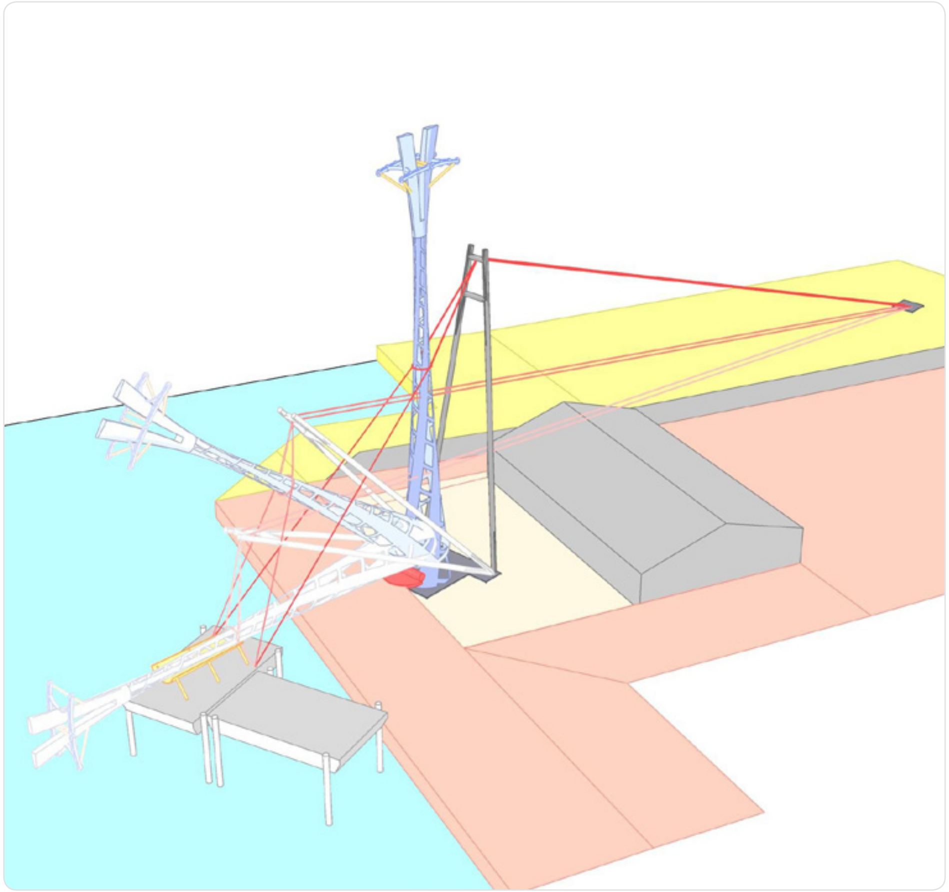
Wind tunnel testing of the tower tops. Image courtesy of Expedition Engineering

CONSTRUCTION

To be sure that the project is viable, TfL need to know there is a way it can be built. In producing your construction sequence, you should consider the following:

- Obstructing the Thames shipping paths requires months of planning and can be extremely costly
- Having people working at height is dangerous – falls from height are the most common cause of fatality on construction sites.
- Welding on site is expensive and difficult to control. Welding on site at height should be avoided if at all possible.
- The maximum length of a low-loader trailer is 16m. Any road-transported loads longer than this require escorts and highways agency notification.

Steel fabrication of the towers in Bolton.
Image courtesy of George Oates, Expedition Engineering



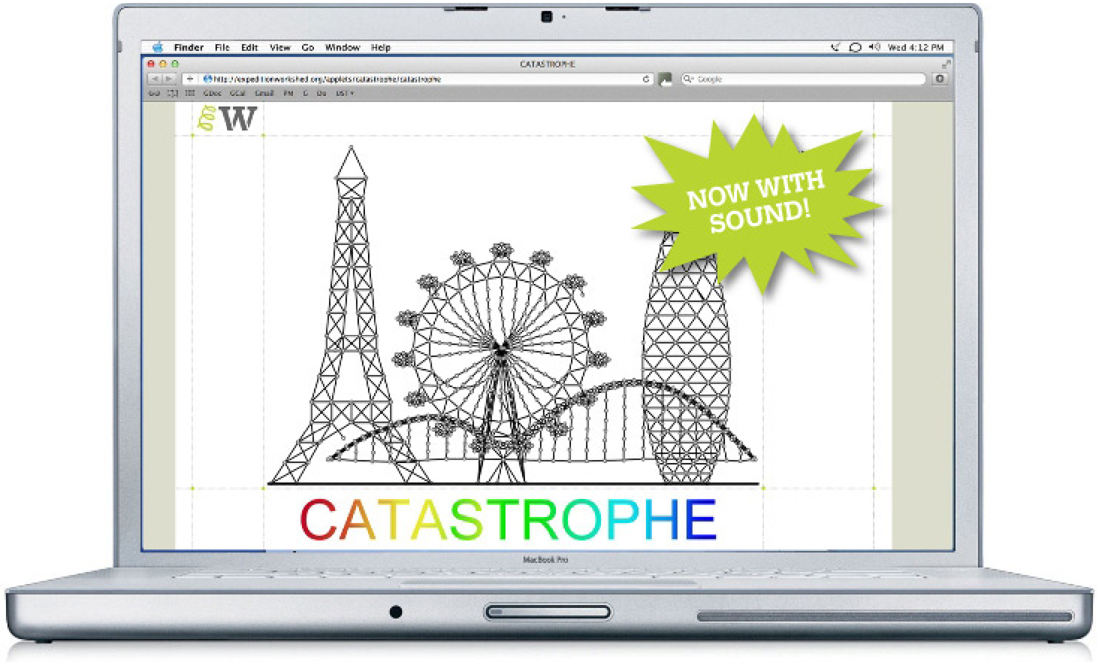
One of the tower erection methods considered for the London Cable Car. Image courtesy of Expedition Engineering

SUPPLEMENTARY ACTIVITY

Model the towers

Use the Catastrophe application, available online through Expedition Workshed, to create a structural model of one of your cable car towers. Use the pull function to simulate the pull of the cables on the tower, and to identify which element is most stressed. Would you have predicted the behaviour that you see on the screen.

Use print screen to produce an image of your tower model for use in your presentation of your designs.



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