SERVICING THE MILLENNIUM DOME

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ABSTRACT

With a diameter of 320m, and a height of 50m the Millennium Dome is one of the World's largest enclosed spaces, probably the largest among those intended for public use. This paper briefly discusses some of the Building Services issues involved in the design and construction of the Dome, concentrating on the ventilation, and heating / cooling of the building.

Buro Happold are the engineers for the Dome responsible for Structural, Building Services, Fire and Access Engineering of the main structure and many of the exhibitions within it. We are also monitoring the performance of the building to provide data for comparison with the models used to help design it.

INTRODUCTION

The Millennium Dome is the most conspicuous of the many projects being built in the UK to mark the Millennium. Entirely paid for through National Lottery funds, sponsors and ticket sales to the public, it has not received Government money.

The purpose of the Dome is to give a very large number of people an enjoyable and informative day out; a chance to reflect on the changes that have affected societies over the last two thousand years and to think about the future. This is not the purpose of this paper, which seeks only to discuss the challenges posed by the Exhibition and the solutions being used.

The main design challenge was to provide a space that could contain the range of Exhibitions planned by the creative designers, in an environment that would be sufficiently comfortable throughout a whole year of London weather. This had to be achieved on a tight budget, and with an absolutely fixed deadline!

With up to 35,000 people in the Dome at any time, the main issues are air quality and thermal comfort, particularly in summer. The building can only be partly conditioned, to be cool in winter and warm in summer. It is vital for the success of the project that the internal environment is acceptably comfortable for visitors.

THE BASIC CONCEPT

The starting point for the design is the recognition that, within an affordable budget, the building was inevitably going to have to be a lightweight structure, essentially a huge umbrella see Figure 1, to keep the wind and rain out. This has resulted in the Dome we see today, Figure 2, with 100,000 m^2 of fabric hung from twelve 100m tall masts, using around 75 km of cable.

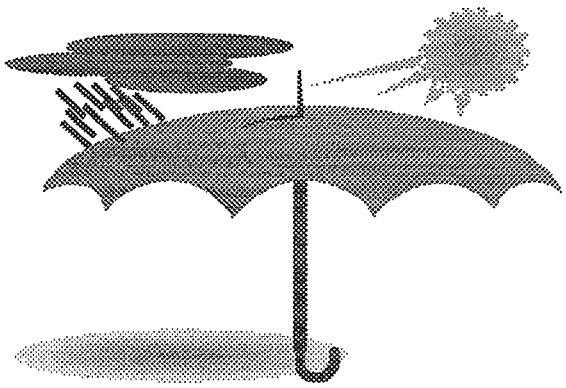

Figure 1: The concept

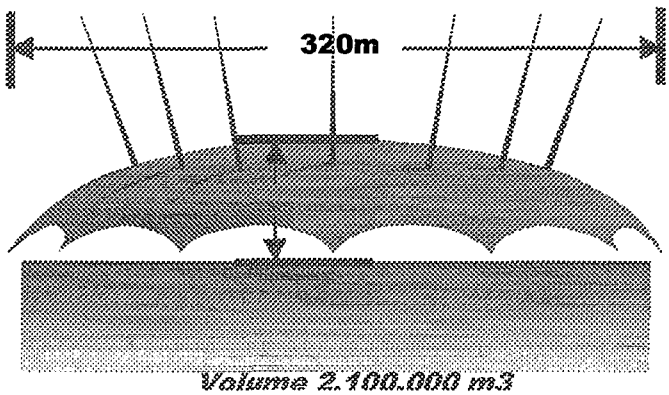

Figure 2: The solution

The fabric is Teflon coated, which makes it waterproof, easy to clean and long lasting. However it is not a particularly good insulator, and allows light to pass through it. Hence the thermal modelling of the Dome in use was a key issue to be addressed.

It was also necessary to ensure that the air quality would be acceptable throughout the occupied areas. In a general sense this will be covered by the thermal requirements for ventilation, but particular care was needed to deal with any potentially stagnant areas.

MODELLING STUDIES

Ideally the Dome would have been purely naturally ventilated. However a mixture of simple thermal and CFD modelling studies showed that this would leave a stagnant zone in the centre, so that the final solution adopted can be described as a mixed mode solution, Figure 3:

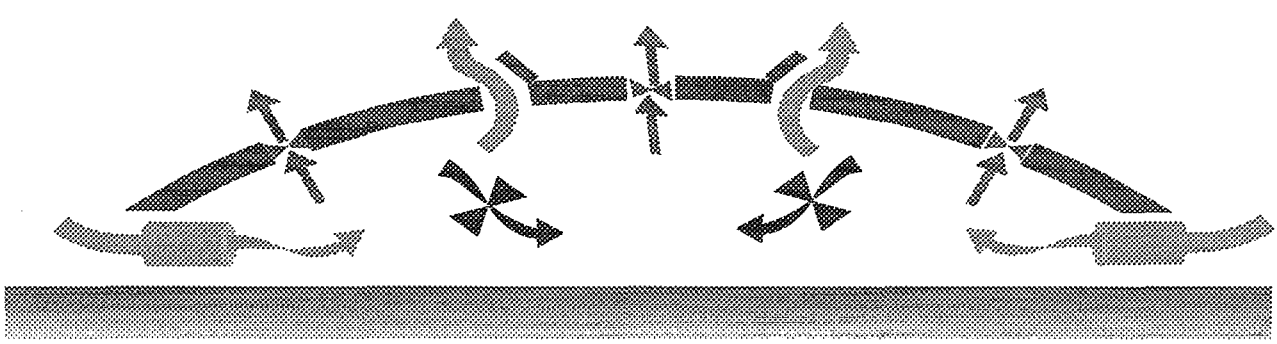

Figure 3: The built ventilation solution

This final design includes:

- 12 air movement fans to circulate air within the centre of the Dome
- 24 air handling units supplying air to the main circulation area
- 12 fans in the main masts and 12 fans in the central area of the roof to extract air
- Controllable outlets in the roof, with an open area of 500 m^2 and inlets in the walls

PLANNED EXPERIMENTS

We are gathering data on the internal environment in the Dome, along with the external conditions, now that the main building work is complete. This will allow later comparison with the modelling solutions, and the full operational conditions.