



HIGH SPEED TWO PHASE ONE INFORMATION PAPER

D8: TUNNEL SHAFTS AND PORTALS

This paper outlines the need for shafts along tunnels and porous portals on the HS2 project. It also describes design principles to minimise the effects of the visible headhouses at the top of shafts on the local area.

It will be of particular interest to those potentially affected by the Government's proposals for high speed rail.

This paper was prepared in relation to the promotion of the Bill for Phase One of the scheme which is now enacted. Although the contents were maintained and updated as considered appropriate during the passage of the Bill (including shortly prior to the enactment of the Bill in February 2017) the contents are now historic and are no longer maintained.

. If you have any queries about this paper or about how it might apply to you, please contact the HS2 Helpdesk in the first instance.

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D8: TUNNEL SHAFTS AND PORTALS

1. Introduction

- 1.1. High Speed Two (HS2) is the Government's proposal for a new, high speed north-south railway. The proposal is being taken forward in two phases: Phase One will connect London with Birmingham and the West Midlands and Phase Two will extend the route to Manchester, Leeds and beyond.
- 1.2. HS2 Ltd is the non-departmental public body responsible for developing and promoting these proposals. The company works to a Development Agreement made with the Secretary of State for Transport.
- 1.3. In November 2013, HS2 Ltd deposited a hybrid Bill¹ with Parliament to seek powers for the construction and operation of Phase One of HS2 (sometimes referred to as 'the Proposed Scheme'). The Bill is the culmination of nearly six years of work, including an Environmental Impact Assessment (EIA), the results of which were reported in an Environmental Statement (ES) submitted alongside the Bill. The Secretary of State has also published draft Environmental Minimum Requirements (EMRs), which set out the environmental and sustainability commitments that will be observed in the construction of the Proposed Scheme.
- 1.4. The Bill is being promoted through Parliament by the Secretary of State for Transport (the 'Promoter'). The Secretary of State will also appoint a body responsible for delivering the Proposed Scheme under the powers granted by the Bill.
- 1.5. This body is known as the 'nominated undertaker'. There may well be more than one nominated undertaker – for example, HS2 Ltd could become the nominated undertaker for the main railway works, while Network Rail could become the nominated undertaker for works to an existing station such as Euston. But whoever they are, all nominated undertakers will be bound by the obligations contained in the Bill and the policies established in the EMRs.
- 1.6. These information papers have been produced to explain the commitments made in the Bill and the EMRs and how they will be applied to the design and construction of the Proposed Scheme. They also provide information about the Proposed Scheme itself, the powers contained in the Bill and how particular decisions about the project have been reached.
- 1.7. This paper outlines the need for shafts along tunnels and porous portals on the HS2 project. It also describes design principles to minimise the effects of the visible headhouses at the top of shafts on the local area.

¹The High Speed Rail (London – West Midlands) Bill, hereafter 'the Bill'.

2. Tunnel shafts

- 2.1. Tunnel shafts are vertical openings connecting underground tunnels to the surface and open air.
- 2.2. The purpose of tunnel shafts are to:
 - enable the smoke produced in the event of a fire to be extracted in a controlled manner, and to provide fresh air in order to create smoke-free evacuation routes;
 - provide access for the emergency services; and
 - meet the comfort requirements of passengers and staff in tunnels by keeping the air quality and temperature within prescribed limits.
- 2.3. The figure below is a sketch of a typical tunnel shaft.

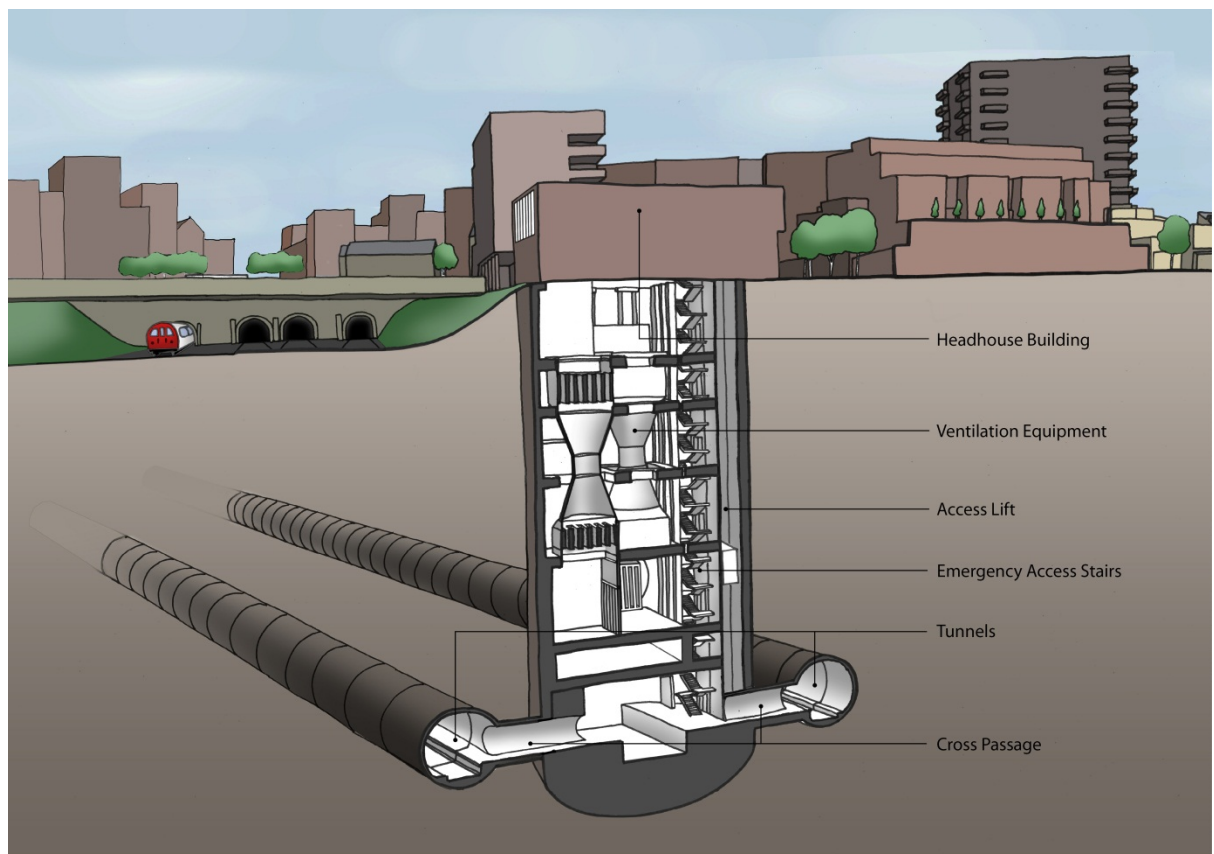


Figure 1. A typical tunnel shaft

- 2.4. The tunnel is ventilated with the aid of the 'piston effect' (the forced airflow as a vehicle moves through a tunnel). As the train moves through the tunnel, the air is pushed out of the tunnel shaft ahead of the train, and air from the surface is drawn in through the tunnel shaft behind the train.

3. Tunnel shaft locations

Spacing requirements

- 3.1. Tunnel shafts are only required in tunnels more than 3 km long.
- 3.2. The distance between shafts is determined by operational considerations. Only one train can be in a section between shafts at any one time. This ensures that in the event of a fire, smoke can be drawn away from the direction of escape. Therefore, the spacing between the shafts needs to support the proposed frequency of service. Closer shafts also reduce the time needed by the emergency services to reach an incident on foot, carrying breathing apparatus and other equipment.
- 3.3. The requirement for access for emergency services is set out in the Technical Standards for Interoperability (TSI):

"The design of a tunnel shall take into account the need for provision of facilities to allow the self-rescue and evacuation of train passengers and staff and allow the rescue services to rescue people in the event of an incident in a tunnel."²
- 3.4. A number of technical solutions fulfil this requirement. These include:
 - emergency exits to the surface every kilometre;
 - cross-passages to the other bore of a twin-bored tunnel or box of a cut-and-cover tunnel; and
 - alternative technical solutions that provide an equivalent safety level, agreed with the relevant national authority³.
- 3.5. In relation to the HS1 scheme, an alternative technical solution was adopted. This solution required shafts approximately every 3km, with cross-passages between the tunnel bores every 380m along the tunnel. It is a proven and technically compliant arrangement. Following discussions with the Department for Transport and the Fire and Rescue Services, the alternative technical solution adopted for HS1 will be the scheme adopted for HS2.

Locations

- 3.6. Three of the tunnels on the HS2 route require shafts. These are the Euston, Northolt and Chiltern tunnels. The shaft locations have been based on the above spacing requirements, access to the road network and environmental impact:
 - the Euston tunnel (7.4 km / 4.6 miles long) will have shafts at Adelaide Road, Alexandra Place and Salusbury Road;

² 'Safety in railway tunnels' TSI, Section 4.2.2.6.2.

³ The national authority in the UK is The Office of Rail Regulation (ORR)

- the Northolt tunnel (13.5km / 8.4miles long) will have shafts at West Gate, Greenpark Way, Mandeville Road and South Ruislip; and
- the Chiltern tunnel (15.9km / 9.9miles long) will have shafts at Chalfont St Peter, Chalfont St Giles, Amersham, Little Missenden and Chesham Road.

4. Tunnel shaft design

- 4.1. The shafts will be designed to be:
 - safe, efficient, and consistent with the requirements of whole-life operation and maintenance alongside initial buildability;
 - sympathetic to their context, environment and social setting; and
 - consistent with the requirements for the control of noise from stationary systems, as set out in Appendix SV-001-000, Annex E of the Environmental Statement.
- 4.2. The tunnel shafts have buildings on the surface, called headhouses, which will be openly visible and will be designed in accordance with the above principles.
- 4.3. The final designs of the tunnel headhouse buildings will be approved by local authorities in accordance with the planning regime established in the Bill.

5. Porous portals

- 5.1. A portal is the entry or exit section of a tunnel. A 'porous portal' is a section at either end of a tunnel which has openings to the outside air.
- 5.2. The purpose of a porous portal is to ensure that the micro pressure waves produced by the 'piston effect' of the train moving through the tunnel, which can result in noise as the train exits the tunnel, are controlled and kept at a level which does not affect the surrounding area.
- 5.3. The figures below are generic sketches of porous portals:



Figure 2. typical porous portals

- 5.4. As a train enters a tunnel at one end, it generates a pressure wave, which can produce noise at the other end of the tunnel. This effect is mitigated by adding a 'porous portal'. The porous portal slows the build-up of the pressure wave in the tunnel, reducing the resulting effect.
- 5.5. Porous portals are not required for the Euston tunnel or at the London end of the Northolt tunnel, as the trains will not be travelling fast enough to require one.
- 5.6. All other tunnels built for HS2 will have porous portals.

6. More information

- 6.1. More detail on the Bill and related documents can be found at: www.gov.uk/HS2