

CHANNEL TUNNEL FRENCH TERMINAL AT COQUELLES SITE

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Functions

The terminals, where road traffic will transfer onto rail before crossing the Channel, provide airport-type services: passengers handling, catering, administration, customs and immigration.

They provide facilities to receive payment from travellers, to deal with all frontier operations, and to receive, assemble and load vehicles into rakes with minimum delay.

The three main classes of vehicle are: tourist coaches, private cars and lorries. Heavy goods vehicles (HGV) will be carried onto single-deck rakes, coaches and larger cars will be mixed in single-deck tourist rakes and smaller cars in double-deck rakes. All frontier formalities are completed in the country of departure. Drivers load their own vehicles onto the shuttle trains and are free to exit in the country of destination.

The French Terminal fulfills three main functions:

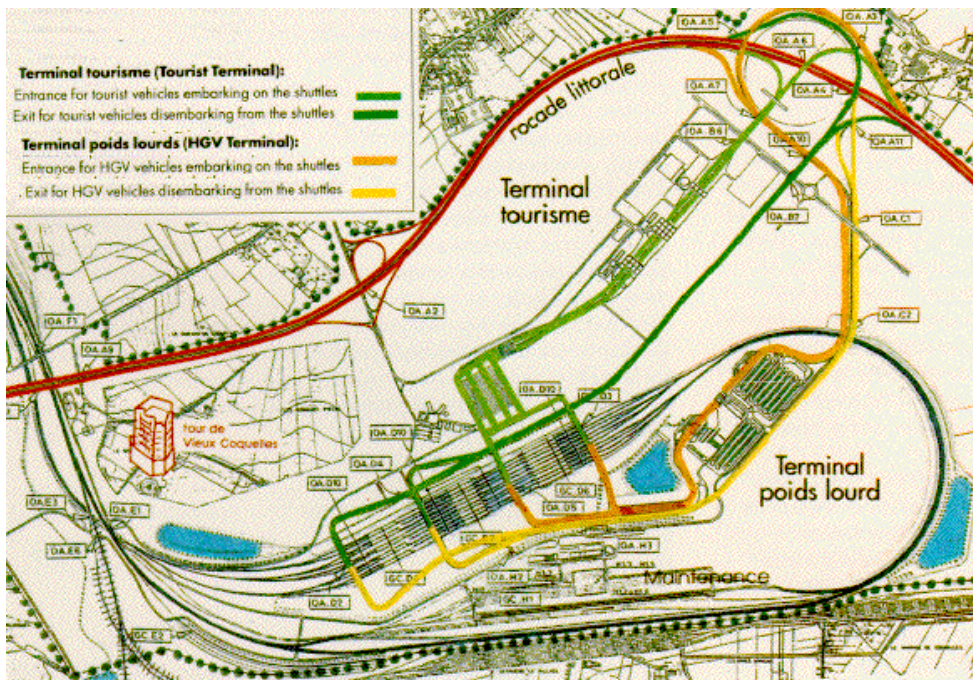
- a funnel which enables the transfer of the traffic of a 3-lanes highway (3455 vehicles per hour) onto a rail shuttle transportation system, after various formalities such as customs, tolls and immigration, are accomplished.
- an injector which takes the shuttles inside the tunnel allowing a transit time from platform to platform of 35 minutes; provision was also made for intercontinental mainline trains whose passage will be slotted in between those of the shuttles (20 trains and shuttles per hour including 5 TGV's).
- a maintenance centre for rolling stock.

The three functions of the French Terminal impacted on its general organisation:

- the funnel function determined the design criteria of access roads, tourist wagons, HGV terminal, and loading platforms.
- the injector function defined the geographical location of the Terminal and the dimensions of the rail loop.
- the maintenance function, through the number and kind of maintenance operations, determined the extent of the maintenance area.

Design criteria

Performance requirements and development studies enabled to define the layout. Main elements were road and track layout. Parameters considered are:



Above : Plan view of the French Terminal at Coquelles site. Below : view during construction



- transit time from terminal to terminal: 35 minutes.
- cycle time: 110 minutes (tourist shuttles).
- road traffic throughput at opening and at year 2003.
- rail traffic throughput at opening and at year 2003.

- rail traffic speeds.
- ride index of rolling stock.

Geography, environmental issues, legal and programme constraints, contractual and financial issues, operating requirements, safety and local interests were the key factors which determined the design and construction of the terminals.



Above, left: Entrance of the Coquelles Terminal. Cars will then pass through tolls (above right) before arriving to the platforms area (below right) where they will eventually embark on shuttles which will cross the Channel in 35 minutes from platform to platform.

The French Terminal has unique features: Coquelles site includes over 700 Ha of land (size of Orly Airport) mostly unsuitable for building and agriculture. Development has not been restricted by space constraints as imposed in British Terminal, which covers 140 Ha only (size of Heathrow Airport, Terminal 4).

Therefore, rolling stock maintenance is concentrated on French side, because of space availability which has been used for the provision of separate amenity facilities.

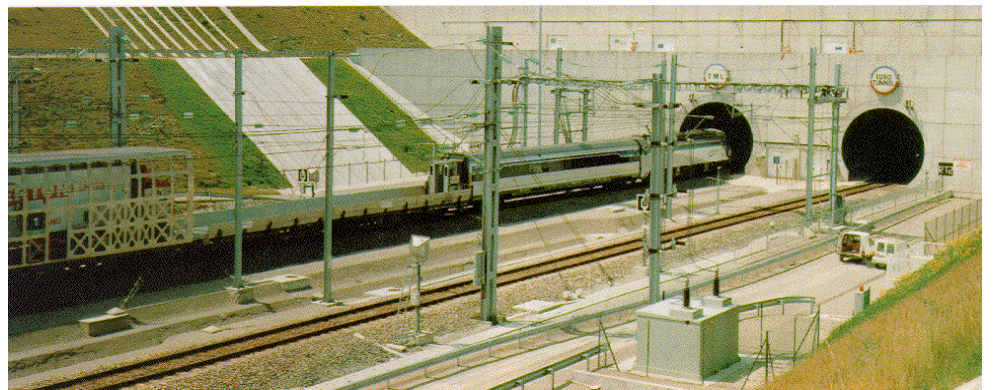
In summary, there are different national characteristics, appropriate to each site, but co-ordinated design resulted in similar operational modes and user experiences.

The overall programme of work allowed for a reasonable construction time (five full years); but a few critical paths, due to various tasks such as design, construction, electro-mechanical equipment erection and rolling stock assembly, plus commissioning, contributed to make the works even more challenging. It was therefore necessary to give priority to flexibility with other constraints taking a secondary role.

The construction works could be compared with a large international airport. However, the development and optimization of a project as complicated, international, and multi-disciplinary as the Channel Tunnel Fixed Link was not achieved through the optimization of each individual discipline. The aim was to create an integrated design for a transport system project, the whole being greater than the sum of the parts.

Control centre

On each side of the Channel, a control centre is able to deal with all traffics, including local maintenance and road activities. Rail and engineering functions are normally controlled from Folkestone, with the French centre on standby for immediate handover if necessary.



Each centre includes Rail Traffic Management (RTM), Engineering Management of fixed equipments (EMS) such as power, pumping and ventilation, fire detection, and Terminal Traffic Management (TTM) of site access and road traffic within terminals.

A 28 m-long mimic of the Fixed Link (tunnels and terminals) provides, in Folkestone, constant information including trains locations, and mechanical and electrical systems status. Over 40,000 informations allow to determine instantaneously the effect of any individual event on the rest of the system, and how to react accordingly.

Road Traffic Management (TTM)

Flow of vehicular traffic to and from the shuttles is remotely directed from each control room. The Terminal Traffic Management computer system, divided into two sub-systems - one for tolls and one for traffic - uses information provided by video cameras. Its peak capacity is 3,455 vehicles per hour, with a transit time of 15 minutes only between tolls and shuttles.

Rail Traffic Management (RTM)

Shuttles and other trains within the Fixed Link are controlled by the advanced TVM 430 signalling equipment, based on the system developed for the French TGV's.



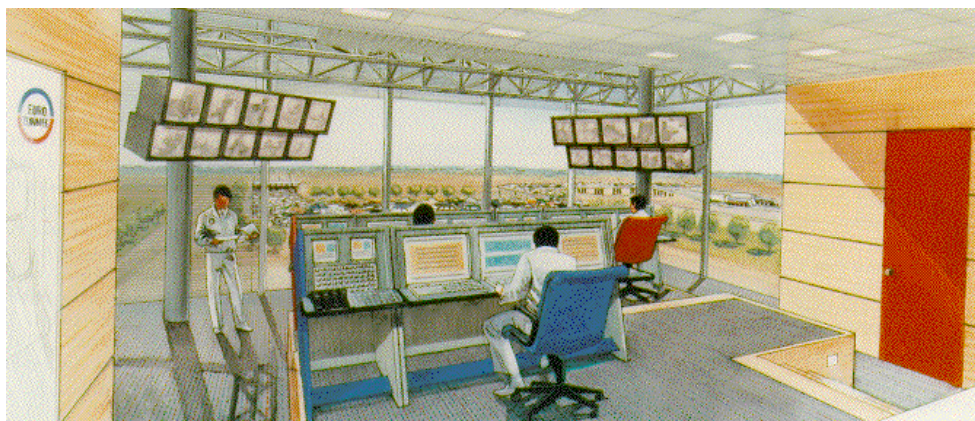
The latest developments regarding Automatic Train Protection, relaying instructions and data to loco drivers via video monitors in their cabs, allow to travel at national rail network speeds (up to 160 km/h) but with the kind of headway (3 minutes between 2 trains) only found on much slower urban subways.

Maintenance

On the UK side, the maintenance area comprises two zones: a 750 m² light workshop and a 115 m long garage. Rolling stock maintenance is concentrated at Coquelles in a 11,000 m² workshop called « F40 », designed for day-to-day maintenance, heavy repair works and logistical needs. Hydraulic jacks, and in-trench lathe, allow to access to any part, lift 3 wagons or locos together, and reshape wheels without dismantling. This concept, avoiding long standby periods, allows maximum availability of trains during peak periods.

STTS vehicles facilities

An advanced Service Tunnel Transportation System (STTS) has been developed to provide fast and reliable means of access to any part of the tunnel for inspection, maintenance and emergencies. It comprises diesel engined bi-directional rubber-tyred vehicles, 10.2 m long and 1.4 m wide, with a driving cabin at each end. Each



Above : The underground Rail Traffic Management main mimic at Folkestone, UK side.
Below : The Terminal Traffic Management at Coquelles, French side.

frame is fitted with purpose-built containers, such as maintenance, ambulance or fire-fighting. The vehicles can be steered manually but are generally guided automatically by an electronically-controlled hydraulic system; instructions are relayed to on-board computers from a cable buried in the concrete floor of the tunnel. With a maximum speed of 80 km/h, a vehicle can reach any part of the tunnel within thirty minutes. There are 24 vehicles, 12 on each side of the Tunnel.

Construction of the French Terminal

Excepting the massive ground consolidation and sophisticated drainage system, mostly traditional techniques were used during 3 main phases :

- consolidation of the ground and build up of earthworks platforms.
- construction of structures and buildings.
- tracklaying and erection of electro-

mechanical equipment.

Due to the time for reaching the designed consolidation, these three phases have been closely linked in terms of both programme and space, adding to the complexity of the design/construction interface.

Earthworks

Since 70 % of the constructed surface area was marsh land, with 3 to 10 m of peat overlying firm ground, over **12,000,000 m³ of material had to be shifted**, due to the need to transform the soil into a solid foundation. Part of the stabilising process involved placing huge layers of earth on the wet ground to squeeze out the water. Vertical drains were driven into the peat where structures were planned, then the whole site was covered with horizontal drains and 1,000,000 m³ of drainage sand. The ground was then preloaded with some 6 m of sand and chalk (equivalent to 4,000,000 m³ of materials) that in six months settled up to 1 m, in line with the anticipated figures. Over the entire duration of the project 1,000,000 m³ has disappeared due to the settlement process.

Earthworks were associated with the management of drainage water flows on a rather flat area with a very high water table. Traditional methods involving underground reservoirs at low points were discarded for practical reasons. 5 elevated water reservoirs with a total surface of 100,000 m² have been build in addition to some 10 km of canals or large culverts. Gravity takes the water to the foot of the reservoirs from where it is pumped inside.



Left : The Control Centre building at Coquelles site.
Below : a STTS maintenance vehicle





Above, left : The maintenance area. Right: inside the « F40 » workshop.
Below : Construction programme of the French Terminal.



Gravity then takes over again, and so on, until the fluid reaches the outflow point.

The high storage capacity of the water tanks (**250,000 m³**) and their interconnections enable both optimum safety and flexibility to the system.

Utility works included over **180 km** of canals, culverts and pipes. Track and road-works covered over **1,000,000 m²** (1,200,000 tonnes of materials) : 2/3 for roads, 1/3 for rail tracks.

Structures and Buildings

Platforms area

The platforms area, designed to ensure a flexible traffic, consists of 8 tracks associated with 8 platforms, 4 overbridges (2 for access and 2 for egress) and 24 ramps. Total length of platforms is 4,300 m. The **deck surface of overbridges and ramps is 40,000 m²**.

Maintenance area

The « F40 » workshop is founded on piles driven 16 m deep, offers a **12 m high** and **11,000 m²** working area, and required 7,500 m³ of concrete and 445,000 kg of structural steel.

Other constructions

The total volume of concrete reached **185,000 m³** divided into 60,000 m³ for bridges (representing 55,000 m² of deck structure), 105,000 m³ for utilities (networks and miscellaneous structures), and 20,000 m³ for **60 buildings** (representing a total surface area of 33,500 m²). Roads, and cars/HGV parkings represent over 1,000,000 m².

Track and Fixed Equipment

The railway system on the Terminal consists of 90 km of tracks and 86 switches, with associated overhead catenary and signalling. The main **160 MW** substation, located near the tunnel portal, provides power for traction (25 kV) and auxiliary power (21 kV) for both tunnels and terminal. 13 secondary substations (21 kV / 3.3 kV / 400 V) have been installed, supplying power for buildings, plants, and external lighting (700 lighting masts). The total length of cables is over **1,400 km**.

Coquelles Terminal		86	87	88	89	90	91	92	93
Design	basic detailed								
Civil works	Earthworks Structures Roads Buildings								
Mech&Elec	Power Tracks Catenary Signalling Lighting C & C								
Commissioning	Partial tests Rolling stock System test								

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