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Ts Exercise on Materials, Term 2

TIMBER in Tottenham Court Road Tube Tunnels:
the traditional technique.

timber waffle slab frames

(in central line tunnel, currently undergoing construction)
'they shore them up with lengths of wood, shaping the timber elegantly around the curved cast iron rings of the capital's Central Line.'

'It seems an anachronistic display of manual skill in an age of laser-guided, automated tunnelling. Yet these centuries-old techniques have been made necessary by the increasingly crowded nature of London's underworld.'

reference: http://www.ft.com/cms/s/0/7b94fe80-1c9c-11e3-a8a3-00144feab7de.html#axzz3RY13l3OL

Timber as a Structural Support: Background

Unlike steel and concrete, timber is a natural material, it is not manufactured with consistent structural properties. It does not behave equally in all directions. Strength parallel to the grain is vastly different to strength and stiffness normal to the grain. (Stronger along grain, weak across grain. Timber is also weakened by knots, wanes, fissures, defects, splits etc.

Grade of timber used: SC3/C16 timber (for structural support, engineering)
(spruce or pine typically)
bending parallel to grain= 5.3N/mm2
tension parallel to grain= 3.2 N/mm2
Compression parallel to grain= 6.8N/mm2
Compression normal to Grain= 2.2 N/mm2
Shear Parallel to Grain= 0.67N/mm2
Modulus of Elasticity= 8800N/mm2
Dimensions(estimated) 20cm by15cm thick, lengths vary from 0.8m to 1.6m.

Density= 370 kg/m3
The density of is a very important factor affecting the strength of wood. The densest woods are generally the strongest. The density is also related to the stiffness and hardness e.g both these properties increase as the timber density increases.

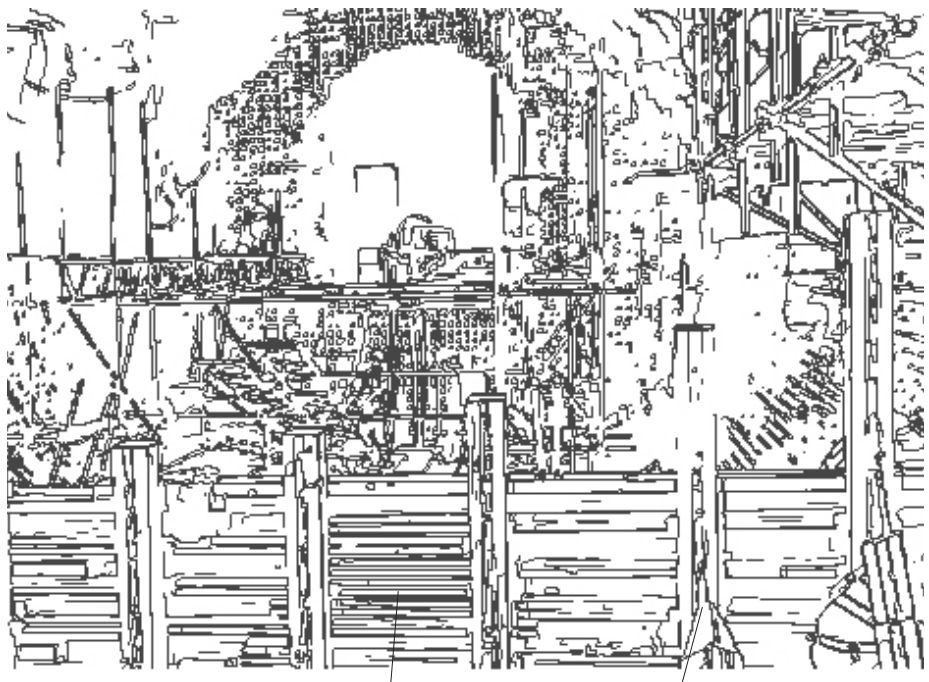
Timber beams are all under compression, functions as a waffle slab that also acts an arch, directing force of load below and to the sides.
Beams positively connected screwed, nailed using steel or iron parts as shown in photo) to a top and/or bottom sheet material. Together the beams (web) and sheeting (flange) make for a highly efficient spanning element

Engineered timber
- Reduces effect of defects
- Glues and mechanical fixing have played important role
- Different types:

Layer – Glulam, Plywood, CLT, LVL
Particle – Chipboard, PSL, OSB Fibre – MDF, Hardboard

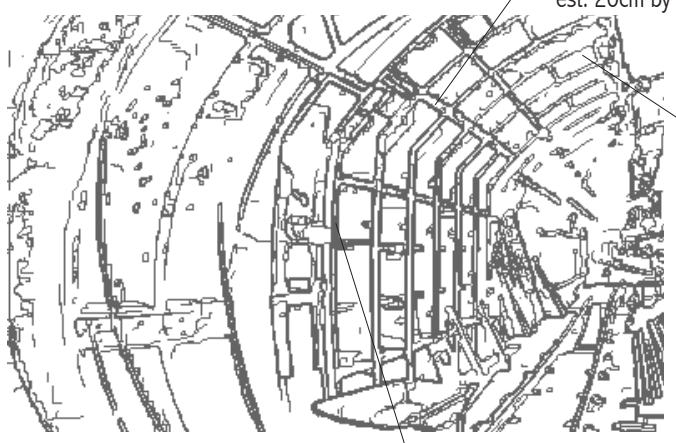
During construction: If soft ground was encountered or penetrating water caused material above to become loose, the main support timbers started to take the weight and would bow under the load.

short spans: timbers did not span so far and were therefore much stiffer, producing less sag under load.



steel vertical bars joined to rods, strength runs both horizontally and vertically.

steel rods backing to add strength to timber boards.



secondary support in waffle slab formation, provides strength in horizontal direction for wooden slab in between the vertical slabs.
est. 20cm by 15cm by 80cm.

top of arch, est. 20 cm by 15cm by 160cm, bending slightly.
under compression

est. 20cm by 15 cm by 160cm.
under compression