

IMAGINEERING ENGINEERING KS4 DESIGN & TECHNOLOGY THE ERECTOR ARMS CONCRETE & COMPOSITE MATERIALS

Specification

The tunnel lining segments are made from steel fibre reinforced concrete. This is a composite material made from concrete and steel fibres, which improve the properties of the concrete as a tunnelling material. Each one is put in place by the erector arms, hydraulically operated robotic arms that lift tunnel segments into place.



Fig 1. The erector arms connecting tunnel segments into a tunnel ring.

In this lesson, you will learn to:

- identify composite materials and understand why they are useful
- understand how composite materials are used in tunnel construction.

Explore the Tunnelworks AR app or use your teacher's guidance to help complete the challenges below.

Challenge 1: Composite Materials and Modifying Properties

a) Use the Tunnelworks AR app to fill the blanks.

Properties are the _____ of a material, such as strength, hardness, or corrosion resistance. Sometimes these properties can be modified by _____ the material, such as _____ to make a metal easier to work with. Some materials can however be with other materials to give advantageous properties. Adding fibres to a _____ or concrete can increase its structural integrity or _____ whilst timbers can be mixed turned into composite boards such as plywood which have increased _____. Adding fibres to plastics can result in an incredibly tough _____ material.

- toughness**
- characteristics**
- processing**
- polymer**
- stability**
- annealing**
- lightweight**
- combined**

b) What are the advantages of combining materials as composites?

c) What are the advantages of fibre reinforced concrete over concrete alone?

Challenge 2: Properties Research

Using your research skills, find out the properties, uses and qualities of the following composite materials.

Name	Description	Properties	Uses
Glass fibre reinforced polymers (GRP)			
Carbon fibre reinforced polymers			
Steel fibre reinforced concrete			
Steel cage reinforced concrete			
Polyester fibre reinforced concrete			
Birch plywood			
Kevlar			

Challenge 3: Fibre Reinforced Concrete

Using the *Tunnelworks* AR App and the information you have researched, explain why fibre reinforced concrete is a suitable material for building tunnels such as the Thames Tideway Tunnel.

EXTENSION:

Transport & logistics

Every tunnel segment of the Thames Tideway Tunnel has to be transported to one of the 24 drive sites, located across London. Managing this operation is the Transport and Logistics team, who see that all materials, tools and workers have a properly coordinated transport plan.

In this extension you will learn to:

- understand the role of a transport and logistics agent
- analyse transport data from one of the drive sites.

Explore the Tunnelworks AR app or use your teacher's guidance to help complete the challenges below.

Challenge 1: Being a Logistics Agent

Read the passage below, from Chris, a Logistics Agent working on the Thames Tideway Tunnel, and answer the questions below.

"It's great being a Logistics Agent. Every day is different and I am always meeting different people, from members of the construction team to Marine and Traffic Managers. As part of my job I organise the movement of materials and machinery between the drive sites, ensuring that everything is where it needs to be, when it needs to be, using boats and lorries. I also manage the impact of workers journeying to and from the drive sites.

In one day I may have to attend meetings, organise the hiring of boats and lorries, and write a report of monthly transport statistics. I am also responsible for the writing of logistics plans, which help to monitor how many vehicle deliveries come to each site to minimise impacts on the local traffic and environment.

I work with a fantastic team. I work hard to maintain positive working relationships, by making sure that I am a reliable, respectful and communicate well with the group. We often work to tight deadlines and we support each other.

I am always well-presented and on time, as this sets the standard for the team and is important when meeting clients and customers.

To become a Logistics Agent I studied a higher education diploma in transport management."

a) What are the main responsibilities of Chris's job?

b) What are the main methods used to transport tools and materials to the drive sites?

c) What could be the impact of too many vehicles visiting the drive sites?

d) How is this monitored?

e) Chris is a good at teamwork. What qualities does Chris demonstrate that show good teamworking skills?

f) Find five other skills qualities that are useful as a Logistics Agent.

1) _____

2) _____

3) _____

4) _____

5) _____

Challenge 2: Analysing Data

Logistics Agents must help to produce logistics plans, to monitor the impact of the Thames Tideway Tunnel project on the areas around drive sites. The following data shows the modes of transport used by Tideway workers to get to work at the Victoria embankment drive site in central London.

Mode of transport	Number of workers	% of workers
Bus	7	
National Rail	27	
Underground	26	
Car driver	0	
Car passenger	0	
Cycle	1	
Walk	3	
River	0	
Other (taxi/motorcycle)	2	
Total	65	

- a) Using your maths skills, calculate the percentage of workers for each category.
- b) Using graph paper, draw a bar chart showing the number of workers that use each mode of transport.
- c) Which mode of transport is the most popular?

- d) What percentage of workers use public transport?

- e) Suggest three reasons why it might not be a good idea to drive to the drive site.

1) _____

2) _____

3) _____