

TRANSPORT AND COMMUNICATION

Modern transport depends mainly on fossil fuels and is likely to remain so for a long time to come. It requires infrastructure including roads, parking areas, tramways, railways, canals, ports and harbours and airports. The relevance of geoscience to some of these may not be so immediately obvious.

Cities create transport problems – mass travel and, with urban expansion, further travel distances. Large volumes of raw materials, goods and products must be delivered within and between cities. So urban living depends on well-planned transport. But most major cities developed over many years – an old core, with narrow streets surrounded by districts added at intervals. These seldom fit modern needs, so improvements are imposed, disrupting communities and destroying heritage buildings. Subway systems are built. Even pedestrianisation of city centres creates more demand for nearby parking.

Bulk transport of heavy and bulky commodities by sea, canal or rail requires space for loading and unloading. So it is necessary to build and safeguard wharf and depot sites. But deliveries to, and from, these are mainly undertaken by road, shifting the traffic burden to roads at the beginning and end of the journey. Some agricultural produce and materials are secured locally and there is no economical alternative to road transportation for these.

Infrastructure depends on sound civil engineering. Roads, railways and canals need safe and stable cuttings and embankments. Safe construction requires a good understanding of the physical properties of the ground. Penalties for mistakes include hazards from rock-fall or landslides and high economic costs. Bridges, flyovers, viaducts and aqueducts require sound foundations and suitable construction materials. Careful design is required to reduce vulnerability of these from flooding, erosion, subsidence or earthquakes.

road constructive



A badly chosen route can disrupt ecosystems or, for example if associated drainage works alter surface and groundwater flows.

Crowded urban areas often require transport tunnels and underground parking facilities. Excavation of underground spaces requires detailed understanding of ground conditions so that flooding by groundwater can be avoided and the right type of support can be used. Creation of spaces beneath existing structures can lead to distortion or subsidence of the ground and resulting damage if this is not anticipated and allowed for.

Roads or railways are leveled by cutting through hills and infilling hollows with the excavated materials but even so large amounts of good quality construction aggregates such as sand, gravel and crushed rock must be quarried for road pavements and track ballast. These need to be both physically strong and chemically inert to avoid reactions and damage.

Ports and harbours, essential for landing of goods, fish and minerals, may take up large areas of coastal land or riverbanks, often in areas that are potentially vulnerable to floods or erosion. Defence works are constructed. However these may simply protect one area and displace erosion to another, or may deflect sediment into access channels that then require expensive dredging. The disposal of dredged sediments may raise other problems if these are contaminated by industrial pollution. There is also potential for pollution of waters and shores by fuel, waste, water from ballast tanks, and cargo spillages.

Airport runways have to be engineered to high standards with selected suitable materials. While construction has to take account of the ground characteristics, it is also prudent to locate airports where they are not vulnerable to natural disasters. Airports may be crucial to the delivery of rapid assistance, medical aid and supplies.

Many potentially hazardous substances are transported. Most arrive safely but accidents and spillages occur. Resulting contamination of surface and groundwater or of soils may be difficult to clean up. Leakage of oil from accidents at sea can cause major ecological damage.

A less obvious link between geoscience and transport is the dependence of modern navigation guidance systems on an understanding of continuous small variations in the strength and direction of the Earth's magnetic field. This requires careful monitoring of geomagnetism.



underground transport systems are crucial to many densely occupied urban centres



an old city with narrow central streets and wider streets in the outskirts



The modern world also depends on rapid communications – essential to developed economies and a lifeline to economically disadvantaged and remote areas. Transmission and reception facilities need to be carefully located and constructed. In addition, specific scarce minerals are needed for equipment. For instance, the present generation of mobile telephones requires a rare mineral that is only obtainable at present from limited areas in Africa.

Improvement of transport infrastructure therefore depends on selection of suitable routes and areas that are not vulnerable to major problems and precautions to make sure that natural or man-made events do not occur or can be quickly dealt with. This requires a detailed understanding of ground conditions, earth surface processes and the potential for hazards. Construction materials, mainly minerals, have to be located and tested. Where accidents occur there must be the means of quick reaction to prevent pollution and contamination... and everything from navigation to communications satellites require understanding and monitoring of the intricacies of the Earth's magnetic field.



© LESTARI-UKM. These leaflets may be downloaded or copied and circulated for educational or information purpose provided that they are distributed free of charge. If non-commercial organisations wish to adapt these leaflets for use in specific parts of the world text files can be provided on application to LESTARI. Enquires about the content should be sent to brian@amarker.freeserve.co.uk

These leaflets have been prepared by Dr B R Marker OBE (UK) in collaboration with Professor Dr J J Pereira (Malaysia) and Professor I A Nyambe (Zambia)

www.lestari.ukm.my
www.iugs-gem.org
www.iugs.com

Transport and Communication