

A rendering of what the Central Kowloon Route's Yau Ma Tei section is expected to look like.

## PUBLIC KEY FOR BRIDGES OVER TROUBLED WATERS

Most railways and highways involve tunnels and bridges, but why is that so?

Very simply, level ground is preferred for railways and highways, so to get over hills and valleys, tunnels and bridges are necessary.

It is preferable to limit slopes to a rise of one meter for every 10 for highways and less than a 3 percent slope for railways.

Traditionally, bridges were built to go over rivers and streams, but with the wider application of these transport links, viaducts are also widely built to pass over valleys and highway junctions.

The rule of thumb for relative costs is one to three to 10 for ground surfaces, viaducts and tunnels. Obviously, the ratio will vary for special applications.

Immersed tube tunnels (widely used in Hong Kong for crossing the harbor) are more expensive than bored-tube tunnels.

For bridges and viaducts, suspension bridges (such as the Lantau Link) cost much more than cable-stayed ones and viaducts (elevated structures supported by columns).

But the choice is dependent on terrain.

It is not practical to put many columns on a long-span bridge crossing a deep harbor, and for aesthetic reasons and land-use limitations, columns cannot be placed in areas where the land can be used for other purposes.

Recently, the need to preserve land due to environmental reasons has also required viaducts to be built on land where it would have been cheaper and easier to build on level ground.

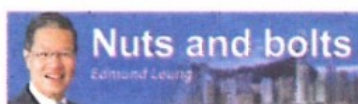
The northern section of the West Rail is a classic example.

The railway alignment forced the use of tunnels and viaducts instead of ground level, where it would interfere with the wetland.

This has resulted in a substantial increase in costs and delays to the construction program.

Another example is our High-Speed Railway link to Shenzhen.

In theory, we could have built it on level ground, along the western coastline of the



New Territories, or other alignments with far shorter tunnels. But to get through land resumption hurdles and other issues, it would have incurred a lot of time and costs.

And even if we were to build tunnels instead of surface railways, they are not completely problem-free, as we see in the design and construction of the Central Kowloon Route.

It is relatively easy to go from north to south, with the West Kowloon Highway and the Kwun Tong Bypass. But to go from east to west, apart from battling through the various traffic-light crossings along the crowded Boundary Street, Argyle Street, Waterloo Road, Jordan Road or Austin Road routes, Lung Cheong Road along the Kowloon foothills is the only other route, and as motorists know well, none of these are convenient and fast links.

To clear land for building approach roads and entrance portals at the two ends of the tunnel, the Central Kowloon Route had been in the planning process for the last 30 years, but we are still waiting to see actual construction commencing, and it's a long way from completion.

We have already seen the relief effect of the Central-Wanchai Bypass on road traffic of the island's north and are most eager to see similar relief in Kowloon soon.

As population increases in a city, commuting needs put undue stresses on the transport network, exerting strong demands on more highways and railways.

Striking the right balance to meet various demands and desires makes the job of engineers challenging but satisfying when these needs are met.

It is a matter of compromising between costs, convenience and environmental protection, and the people must decide on their priorities.

**Veteran engineer Edmund Leung Kwong-ho casts an expert eye over Hong Kong's iconic infrastructure**