PERTEMUAN ILMIAH TAHUNAN - III
Tunnels and Deep Excavation 23rd & 24th April 1996

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Dutch Tunnelling; A matter of engineering in soft clay and peat.

The need for tunnels; Now and in the near future.

The increased ship traffic shared with the growth of traffic with motor vehicles in the beginning of this century raised the need for motor vehicle tunnels crossing the waterways in the Dutch Delta. Soil conditions however were prohibitive to use the USA concept of submersed tunnels until the construction of the Maastunnel in Rotterdam which started in 1937 with a completely new idea of dealing with soft soil problems in immersed tunnelling.
With an interruption of the second world war the motor vehicle traffic again started to grow in the early sixties and more immersed tunnels, crossing Dutch Delta rivers followed, improving technical features of the first one, the Maastunnel in Rotterdam.
Further Road tunnels will mainly consist out of extensions of present Motorways to increase capacities, like the Heinenoordtunnel, where for local traffic the first large diameter bored tunnel will be made in the Netherlands.
Increased demand for public transport in cities started to require subways in the growing Randstad Holland cities from the early sixties onwards. As traffic intensified, people preferred their own car to the bicycle, the distances in between living and working increased and more people started to participate in the economy, the traditional streetcars, trolley busses and busses were not sufficient any more.
Consequentially the first Dutch subway was constructed in Rotterdam in the sixties, including Cut-and Cover tunnels, immersed tunnels in the city centre and crossing the river. The Southbank part was constructed as a prefabricated concrete viaduct. The same happened in Amsterdam, where soil conditions were even worse and narrow streets with historic buildings had to be crossed. The result was the construction of pneumatic caissons and the "roof and wall" method using compressed air through the city centre. In new urban areas viaducts were used again.
In the mean time the Rotterdam and Amsterdam Metro's have been extended to all together ....? km altogether at present. Plans are however there to increase the length with another ..... ? km's in the next .... 10 ? years.
It took quite some years after the second world war before new railway lines were planned to be constructed. The access to Schiphol, Netherlands International airport, claiming to be a Mainport with over 40 million passengers annually, required a railway line, which was constructed in the seventies and is presently doubled to increase the capacity.

The railways further invested in the improvement of 19th century steel railway bridges, by replacing them by tunnels, like the Hemspoortunnel in the Noordzeekanaal and the Willemspoortunnel through the river Maas and the innercity of Rotterdam. The latter also addresses the datedness of busy railway lines going through cities.
The Dutch railways will be the main investors in the future tunnels in the Netherlands. The railways are going to take an increasing share of an increasing amount of traffic.
Main activities are the increase of existing lines by extension from two to four tracks, partly replacing old railway dikes and bridges by tunnels, the execution of the "HSL" (Hoge Snelheids Line or Fast Railway Line) from Brussels to Amsterdam and later East-West and a new line

) the transport of containers, the Betuwelijn, from Rotterdam-Maasvlakte to

s in Dutch tunnelling.

ieans a real confrontation with the geotechnical environment. This means in the a confrontation with soft alluvial soils, like peat, soft clays and fine sands all being saturated with water.
und water has long been prohibitive for a couple of reasons. Settlements, rotting of getting dry, damage to vegetation and ingress of deeper salt water into agricultural ne of the reasons why.
nstruction and access to construction sites is getting more and more difficult.
:onstruction equipment, pollution by exhaust of equipment and debris of construc- of contaminated excavated ground are some of the headaches tunnel planners are /ith.
nand for tunnels at present calls for new methods of tunnelling, requiring research, t and investments in new techniques that may decrease the costs and improve the ibility addresses this point of quality most effective. It is materialized as longer and technical life, for less maintenance costs, using materials with low environmen-

ogies used in Dutch tunnels

raction of soils and tunnel many improvements have been made in the past. nnels have been founded on sand flow injected layers, being improved by a sand n from the inside. sometimes immersed tunnels have been founded on piles.
er tunnels have been founded on underwater driven concrete piles being anchored er concrete. For these piles tests and experiments have contributed to new s. A precast prestressed pile, being inserted in a hole driven with a steel casing tube d, is one of the latest developments here. It guarantees a most economic, durable e tensile anchor for underground construction, not being vulnerable for corrosion nd water or stray-currents. The technique of underwater concrete placement and lso been improved to a high standard, addressing standard deviations in geometry, f segregation and ease and economy of placing.
tunnels is mostly affected by ingress of water by leaks, cracks and permeable dvanced programs to control the actual quality of the concrete have been carried ulted in measures improving mix-design, treatment of concrete by cooling, econo- work and predicting the behaviour of hardening concrete. For the latter several rograms are available, such as one, developed in the Netherlands, based on the on PC available FEM programme ANSYS, called FeC_3S (Finite Element Concrete rol System).

n Holland; The way ahead.

chieve these goals, a centre for underground construction, COB, has recently been