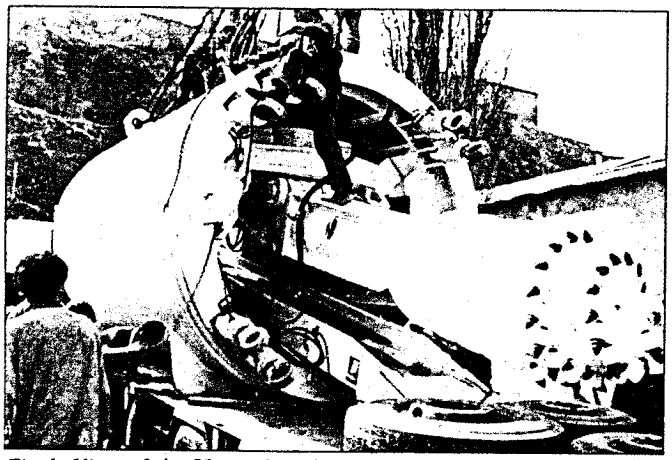

Fig 1. View of the Herrenknecht roadheader.

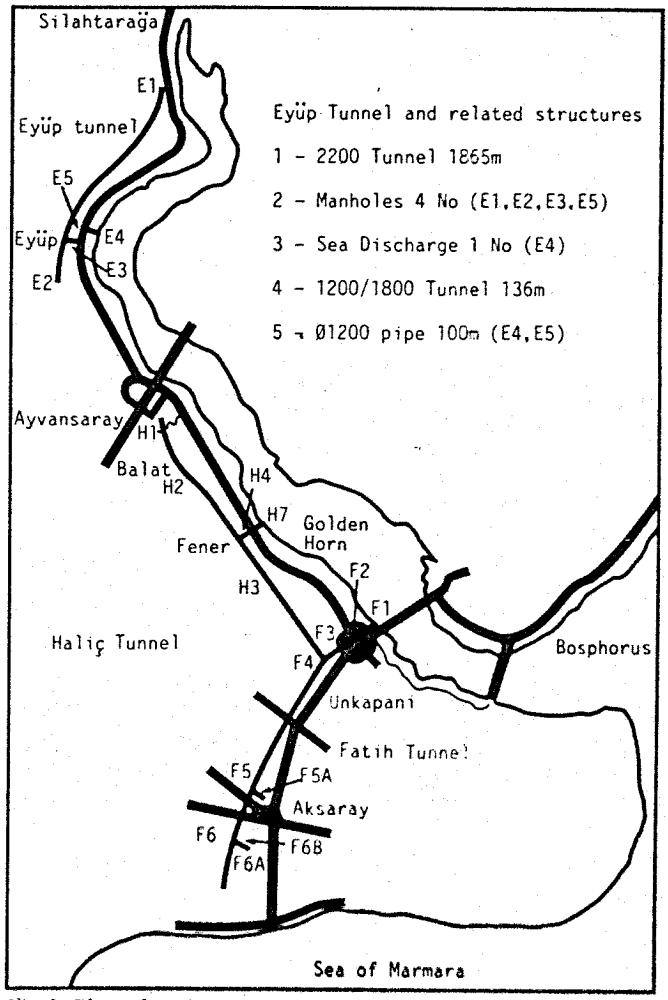

Fig 2. Plan of project area.

Golden Horn clean-up contributes valuable data

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Information gathered from roadheader performance in a sewer tunnel along the Golden Horn will be of immense value in assessing methods to be used in future tunnelling projects in Istanbul.

Geotechnical factors affecting roadheader performance in the Eyüp sewer tunnel will have far-reaching effects on the future. Analysis of shift data, overall machine performance and geotechnical properties of the rock formations in the zones examined are first presented. A statistical analysis has been carried out in order to find a correlation between machine cutting performance and rock mass properties. It is concluded that the rock mass cuttability index defined as a product of rock compressive strength and RQD is the main factor governing the roadheader advance rate. Values predicted by the statistically derived equation are compared with the previously obtained results in a coalmine and it is concluded that the predictor equation is quite reliable for a range of roadheaders examined.

The Eyup Tunnel is part of a new combined interceptor sewerage system for the South Haliç (Golden Horn). The project is being prepared by the Istanbul Water and Sewerage Authority (ISKI) to renew Istanbul's inadequate sewerage network and to clean the very polluted Golden Horn. The system comprises 13km of gravity-fed sewer and a new 750 000 m^3/day capacity sewerage treatment plant. It was decided to construct 6.6km of the 13km of new sewer in three tunnels where the sewer was located beneath roads and buildings (Fig 2).

The master design of the system was completed by Turkish consultant U B M and UK consultant Binnie and Partners. The plan was supported by the World Bank which has agreed to finance 75% of the project. In June 1985 the Turkish civil engineering Company STFA (Sezai Türkes Fevzi Akkaya) was awarded the tunnelling work with technical assistance from Edmund Nuttall. Some other details of the sewerage system are given by Shani Wallis in an article published in *Tunnels & Tunnelling* (May '87 p22 (1)). Tunnel driving began on June 25 '86 and had finished by May 7 '87. During the tunnelling work machine performance was carefully recorded and several shift data and rock samples were collected for further studies.

Tunnelling activities were carried out on a three shift/day working programme. Staffing for one shift usually consisted of 17 men as follows: one foreman, one roadheader operator, three men for segment erection, one erector operator, two locomotive drivers, three men for concrete injection, one man to supervise the belt conveyor, two men charged with the security in shaft top and bottom, one man for water discharge, one surveyor and one for miscellaneous works.

Energy consumption for $1m^3$ of excavated material was about 42kwh.

Road header and support system

A shield mounted roadheader was considered most appropriate for the rock formation encountered in the area, and in July 1985 the DM4 million ($US2.4 million) order for the three tunnelling machines was awarded to Herrenknecht. The main features of the machine can be seen in Fig 1. The machines were supplied with 95hp hydraulically driven booms giving a variable cutting speed up to 90