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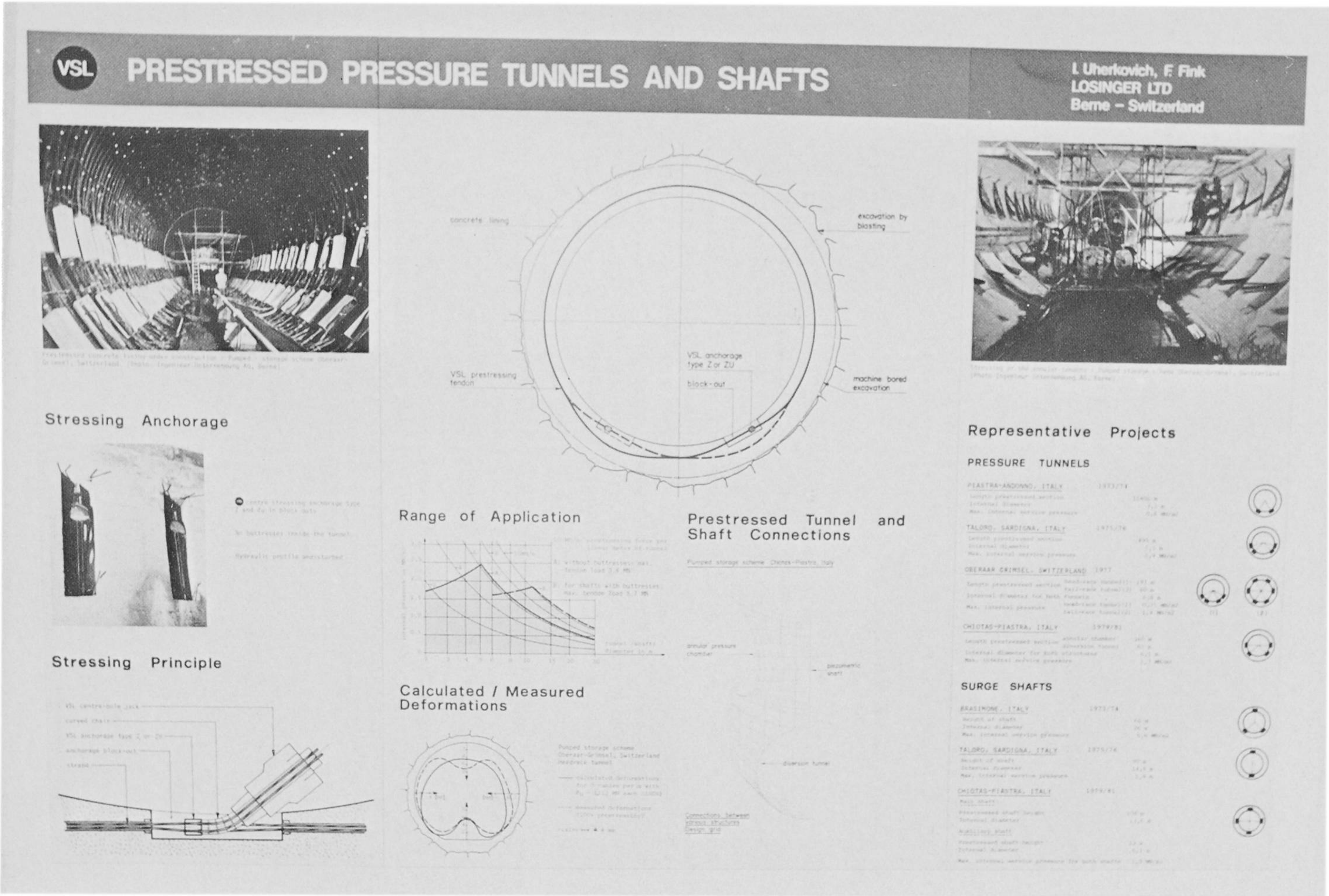
VSL
PRESTRESSED PRESSURE TUNNELS AND SHAFTS
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concrete lining
excavation by blasting
VSL anchorage type Z or ZU
block-out
VSL prestressing tendon
machine bored excavation
Stressing Anchorage
Stressing Principle
Range of Application
Calculated / Measured Deformations
Prestressed Tunnel and Shaft Connections
Representative Projects
PRESSURE TUNNELS
SURGE SHAFTS

PRESTRESSED PRESSURE TUNNELS AND SHAFTS

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Where in tunnels and shafts the lack of sufficient overburden does not permit the rock to accept the internal pressure, or where this pressure is so high that the watertightness is in doubt although the stability of the tunnel shell is not in question, the structure is usually provided with a steel lining. Very often, however, transportation to remote sites as well as difficult installation condition make such a lining very expensive. The idea was to use the already existing concrete backfill as an autonomous lining without the need of a steel shell. This is possible with the help of the prestressing technique, using annular tendons acting like barrel hoops. To avoid the need of buttresses to anchor the tendons a special "floating" type of anchorage and the relevant stressing equipment as shown on the opposite page have been developed.

Many problems in the structural design and the construction had to be solved since in view of the often unpredictable behaviour and embedment the design and construction of underground constructions cannot entirely be carried out on the basis of the principles applied for open-air structures. Prestressed tunnel linings subject to high water pressures require a special treatment of the contract surface between rock and concrete. After pressing the resulting gap between rock and concrete has to be filled using the traditional grouting techniques. Also important is the use of a suitable formwork construction to ensure a complete concrete filling.

The proposed solution is not only limited to straight cylindrical sections of tunnels and shafts but can also be applied economically for tunnel and shaft connections, by-passes, etc.

A number of prestressed pressure shaft and surge chamber projects have been carried out successfully using this method. Noticeable reductions in construction time and cost savings were achieved. Although all completed projects were done in highly developed countries, still further advantages can be expected by using this solution in developing countries.