PETRA PHYSICAL PLANT

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The choice of ring tunnel construction and shielding, soil setting due to the overhead load and the arrangement of the machine in the tunnel are discussed, including special aspects such as bus bars and piping, ventilation and alignment. The main features of the experimental halls are given and the accomodation of special experimental requirements, e.g. pits and heavy foundations. Construction of the buildings started in January 1976 and has been completed to more than 95 % within 15 months, according to schedule.

Site

For the construction of PETRA, the original DESY-premises had to be expanded into areas with elevation differences of up to 15 meters. These differences made it necessary to place 50 % of the ring circumference under ground, and 50 % on ground level or embankments, respectively. The ring crosses underneath the DESY main access road, and the ring height was chosen as to have, at that point, the required 3 m of earth shielding on top of the tunnel. Before starting the detailed planning, soil probes were taken along the whole ring circumference. Nearly everywhere, dense to very dense miocene sand strata were found, exept for some layers of glacial marl deposit in NE and NW. Here, soil replacements were made. The replaced soil and the sand embankments required in the lower part of the site were densified by heavy vibrators up to the stiffness of the virgin soil (~ 1000 kg/cm^2). The subsoil water level lies about 17 m under tunnel level, so the ring requires no sealing against pressure water.

Choice of construction method

Due to the elevation differences of the site, two construction methods were investigated. The first was a pure cut and cover method with open-pit construction all around the ring, while the second consisted of boring the fully underground part of the tunnel instead (SW to NW, clockwise). Detailed cost estimates gave a clear advantage for the cut and cover method with savings of ~ 40 %. Another aspect of the choice of construction method was the tight schedule for completion within 17 months from the start. Here, a construction method with prefabricated and/or equivalent structures become necessary.

Layout of buildings

The ring consists of 8 tunnel octants. Inserted between the octants are 4 long straight sections (N, S, E, W) and 4 short straight sections (NE, NW, SE, SW). There is a pair of rf-buildings next to the tunnel in the long straight sections N and S, and an experimental hall in the center of each of the other six straight sections. The two injection tunnels from the synchrotron join the PETRA ring at both sides of the hall SE.

The main dimensions of the buildings are

circumference = 8 x DORIS	= 2304 m
maximum diameter	~ 740 m
radius of octants	~ 257 m
long straight section length	~ 110 m
short straight section length	~ 65 m
normal tunnel cross section (wxh)	3.1 x 2.5 m^2
enlarged cross section in straight sections	4.1 x 2.5 m^2
area of experimental halls	20 x 30 m^2
area of one pair of rf-buildings	~ 720 m^2
total length of injection channels	~ 300 m
beam height in tunnel	1,25 m

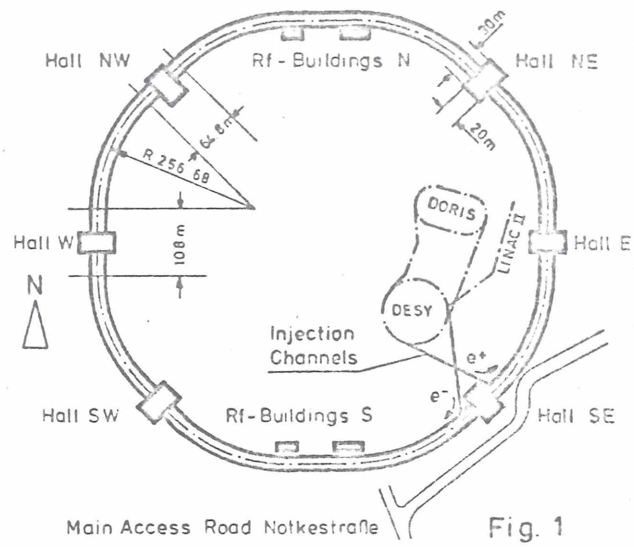


Fig. 1

Arrangement of machine and supplies in the tunnel

Due to the asymmetric beam line position in the ring tunnel, and the fact that no crane is installed, the inner tunnel part must provide the space required for transports. Machine alignment is done by distance and angle measurements between magnets, without special surveying pillars. Also, no air conditioning is provided. The tunnel itself is the air duct for fresh cooling air or, if necessary, for preheated air from the experimental halls. Reversely, the halls can be partly heated by the warmed-up tunnel air.

In the lower corner of the outer tunnel wall, the aluminium cooling system for magnets and absorbers, as well as the piping for pressure air and nitrogen is installed. Power cables in form of blank aluminium bus bars and cable trays for further electric power fill the rest of the wall. Control cables are positioned at the inner wall in order to minimize interference with the power cables (Fig.2).

The installation layout is similar in the enlarged tunnel parts around the straight sections.

PETRA Tunnel Cross Section

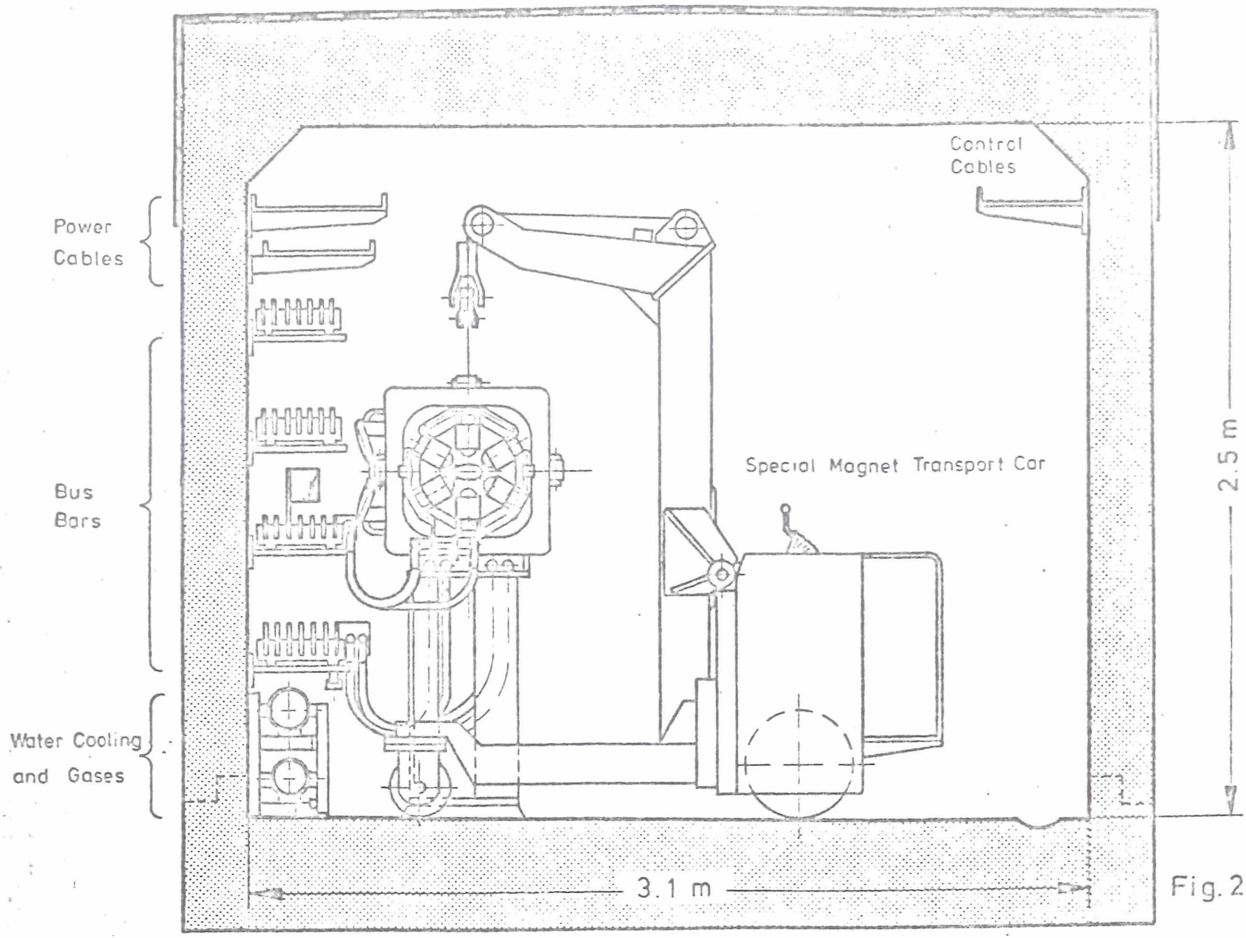


Fig. 2

In the rf straights N and S the tunnel is, in addition, filled with rf cavities and with a waveguide rf power distribution system that is mounted under the ceiling. Coming from the separate rf power buildings at the inner side of the ring, the waveguides reach the ring tunnel via staircases (S) and access tunnels (N). The rf power buildings also house the water cooling system for magnet and absorbers and the power supplies for the getter pumps.

Main features of experimental halls

The experimental halls within the straight section have the following main dimensions:

length in beam direction	= 20 m
height of interaction point above floor level	= 2.3 m
height of crane hook above floor level	∿ 9 m
level difference between floors of ring and hall	1.05 m
maximum crane load in hall SE	30 Mp
maximum crane load in other halls	20 Mp

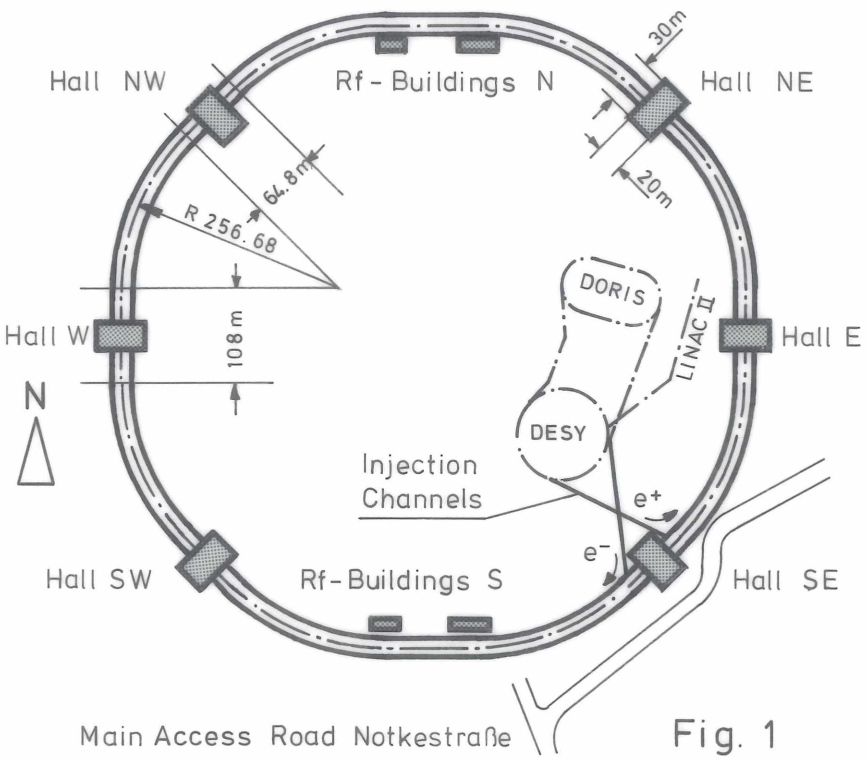
In present optics, the machine leaves a free space of ± 7.5 m around the interaction point. The hall floor consists of moveable concrete slabs (loading 30 Mp/m^2), which will later allow a simple construction of experimental foundations and pits. In general the beam line divides the halls into two equal parts with a width of 15 m each. An exception is hall NW, where the beam crosses asymmetrically, dividing it into parts 20m wide inside an 10 m outside the ring. It is being considered to double the size of hall NE in order to facilitate installation of two large experimental setups that can be alternately moved into the beam.

The first generation of experiments will be located in the halls NE, NW, SE and SW.

Time schedule and construction procedure

The ring tunnel with a total length of 2184 meters was cast in 24 m long units with the help of 3 gliding moulds, each 24 m long. With an average working speed of 2.5 units/week, each week 60 m of tunnel were built. Parallel to the tunnel casting, foundations of the halls were laid and the concrete and steel skeletons as well as the wall slabs and roofs were prefabricated outside by subcontractors. Due to splitting the work into several nearly independent lots it was possible to complete the whole ring tunnel including all halls within the scheduled construction time. Since September '76 installation of components in the ring tunnel is in progress.

The location of the ring tunnel is being surveyed continously. When the overhead shielding was put on, vertical tunnel movements of 1 - 2 cm were observed, in good agreement with calculations. Subsequent changes were in the order of 1 - 2 mm and are settling down.



30m
Hall NW
Rf-Buildings N
Hall NE
64.8m
20m
R 256.68
DORIS
LINAC II
Hall W
108 m
Hall E
N
DESY
Injection
Channels
e+
e−
Hall SW
Rf-Buildings S
Hall SE
Main Access Road Notkestraße

Fig. 1

PETRA Tunnel Cross Section

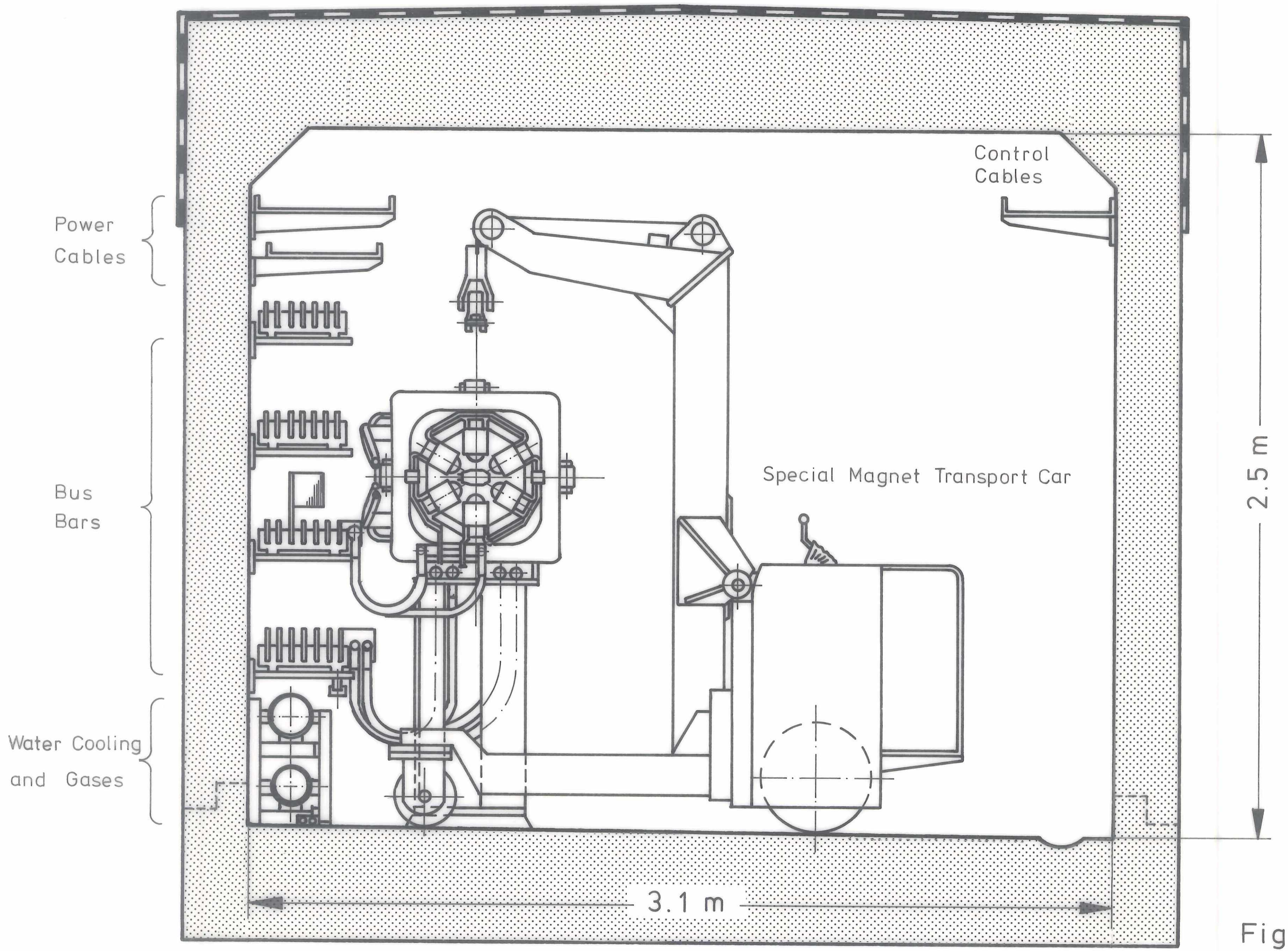


Fig. 2