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# A MESON FACTORY BUILDING DESIGN

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In the planning of the structures for a linear accelerator, we have assumed a site for which subsoil data are available, although we have tried to make our plans such that they can be adapted to any other location which is suitable. The weight of heavy shielding dictates that the soil at any site should be, at least, good sand or gravel rather than silt or clay because of the cost of piling to provide proper support on weak and cohesive soils.

Figure 1 shows a plan of one arrangement for the structures, together with roads and some accessories. A descriptive north is indicated on the figure. There is a long fairly level shelf of native sandstone on a hillside. This rock is covered by about 5 or 6 ft. of good sandy soil below which is about 5 ft. of very firm disintegrated sandstone. This level shelf is narrow at the north end where the injector building is located but it is sufficient for our purposes. The shelf widens as it extends southward until it attains a width of some 500 ft. in the vicinity of the target and experimental areas at the south end.

The injector building is shown at the right. This is about 100 ft. long and 80 ft. wide with a full basement. The accelerator building is a narrow structure about 2,200 ft. long. At the south end is shown one plan for the target and experimental areas, together with the offices and laboratories. There is a switch room just beyond the end of the accelerator building. This is intended to permit a future extension southward if desired (shown by the dotted central tunnel), an initial target area and experimental area on the western side, and a second such installation at the east. Two separate beam stops are to be used. The circles indicate water reservoirs which are on a second shelf about 50 ft. above the yard. Near these are a central cooling tower and pumphouse, with facilities for water treatment. The narrow building near the southeast corner is for handling radio-active materials and equipment from the target areas, with a series of covered "soaking" pits. At the west side of the site are a garage and service station, a switch yard, a series of transformers, two septic tank systems with tile fields down in the adjoining valley, and a water-treatment plant and pumping station to handle water from wells or from a municipal supply.

Several studies of the accelerator building have been made. Figure 2 shows one of the latest plans for the main portion of this structure housing the iris-loaded waveguide portion of the accelerator. It is basically a mill building construction with one or more 10-ton cranes having a 24 ft. lift. This portion is about 1,800 ft. long and is divided into 200 ft. units by expansion joints. The structure is made on the basis of 20 ft. modules. The roof is steel decking covered with a vapor seal, rigid insulation, and built-up roofing. The sides of the upper portion are covered with sandwich panels. There is a 20 ft. clear aisle

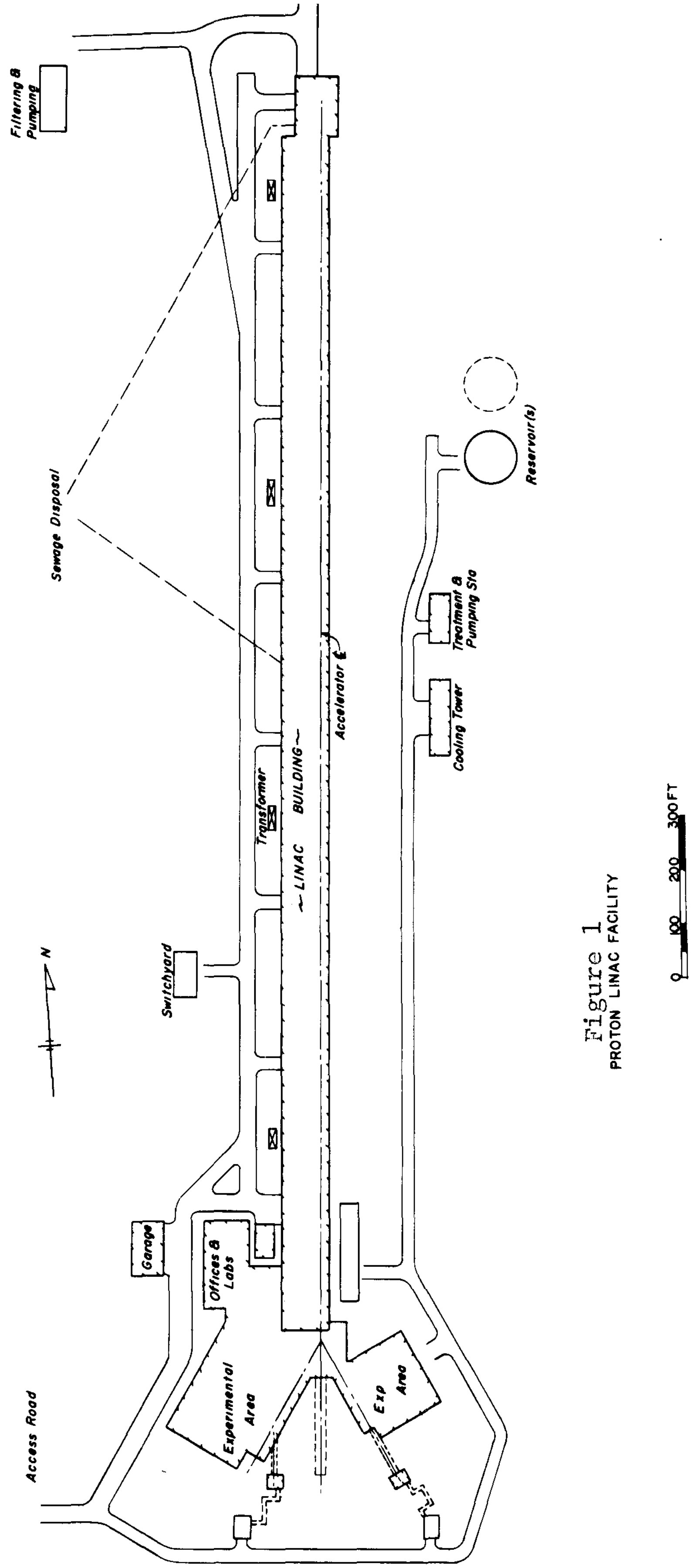


Figure 1
PROTON LINAC FACILITY

for equipment and working space.

At the right in Fig. 2 is a fireproof room for equipment. It provides a space 25 ft. wide and 12 ft. high which is to be divided into any desired length of rooms or compartments by cross-walls. There are steel columns along the inside wall with steel cross-beams 20 ft. on centers connecting them to the main columns. The outer wall of this room is 12 in. concrete block. The other walls are 8 in. blocks filled in between the steelwork. The roof is composed of pre-stressed-concrete double tees placed on shelves on top of encased longitudinal steel beams. At intervals there will be truck passageways between the ends of the compartments so that trucks can be brought under the crane.

The accelerator tunnel is shown at the left of Fig. 2. It is 12 ft. from the center of the accelerator to the outer wall so that there is room for the necessary equipment next to the accelerator and still provide a clear aisle adjacent to the east wall for handling equipment. The tunnel is equipped with 2 ton underhung cranes. The walls and roof of the tunnel are concrete. The shielding at the east and overhead is mostly earth fill. Between the tunnel and the crane aisle there is a continuous compartment with concrete walls and roof, concrete diaphragms about 13 ft. on centers to tie the sides together, and a special compacted fill, all making the equivalent of 11 ft. of concrete shielding. The inner wall of this compartment is extended upward to serve as a retaining wall to hold back the soil, a support for the crane rail, and a seat for the roof trusses. All of this concrete is protected by membrane waterproofing

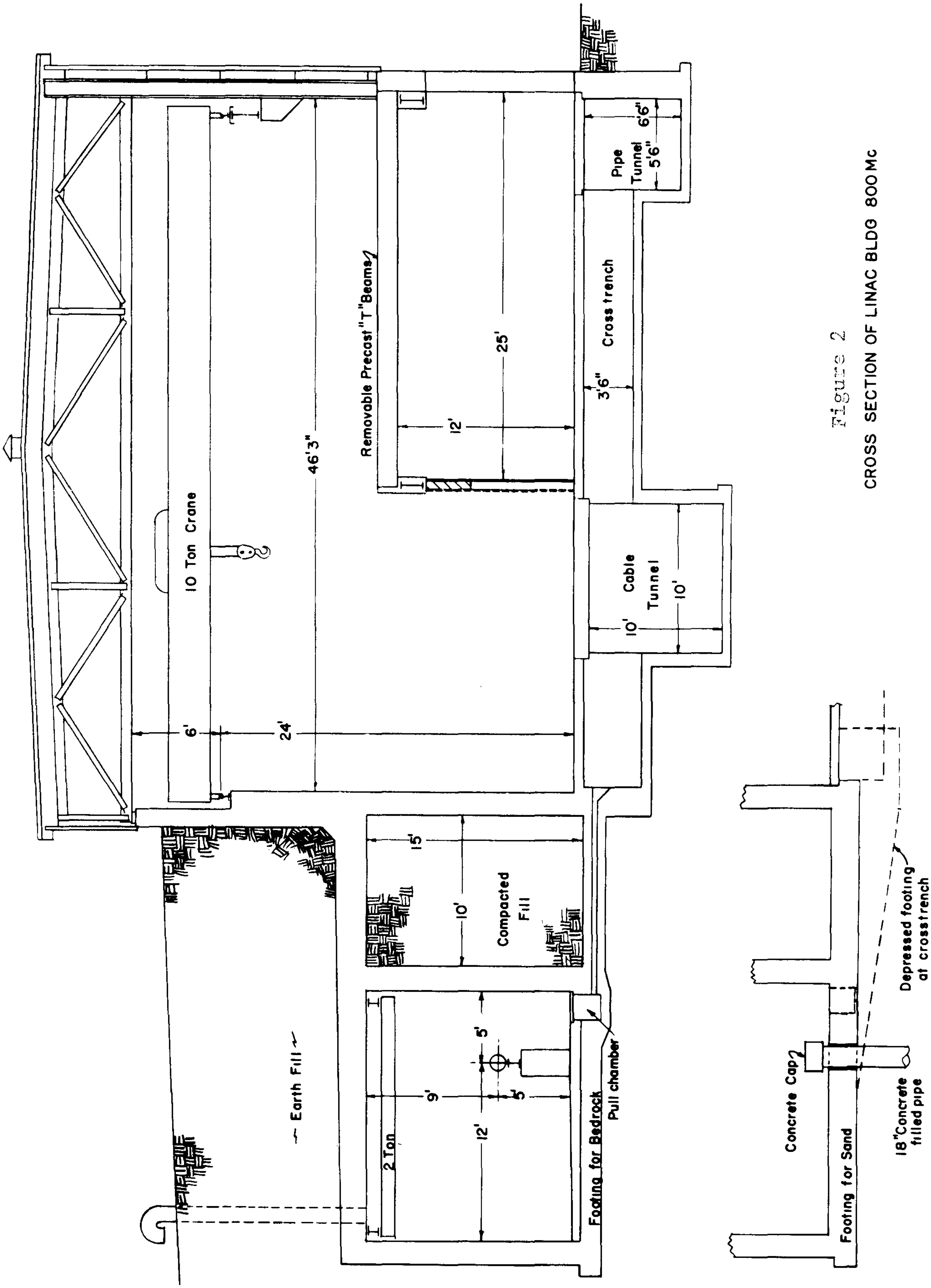


Figure 2
CROSS SECTION OF LINAC BLDG 800 Mc

when in contact with the outside earth above or alongside, and it is divided into 40 ft. sections by transverse contraction joints, thus forming an articulated structure. There are no openings through the shielding along the west side of the tunnel.

The foundations for the accelerator are shown as individual concrete piers supported on the dense soil overlying rock or on the bedrock itself. However, the lower sketch shows what might be used if the structure were on good sand. The tunnel and filled compartment are to be placed on a wide, heavy concrete mat. The center of this mat is only about one foot from the center of gravity of the applied loads so that the pressure on the soil is fairly uniform and not in excess of approximately 2,500 lb. per sq. ft. If the conditions seem to make it necessary, pipe caissons with concrete filling can be used to support the piers under the accelerator. These can be isolated from the tunnel floor so that they will not be affected by settlement of the tunnel. In Fig. 2 there is shown a man-size electrical tunnel running the full length of the structure under the crane aisle. At intervals there are cross-trenches for conduits connecting this tunnel with equipment in the equipment room and along the crane aisle. There are conduits extending from the eastern end of each trench to pull-chambers in the accelerator tunnel floor. In addition, there is a continuous, man-size pipe tunnel along the west wall for water and heating pipes. Again there are separate cross-trenches for piping to serve the accelerator and other equipment, with the pipes crossing through the top part of the electrical tunnel. Thus, the electrical and mechanical services will be accessible in the future.

This is designed for the iris-loaded waveguide section of the accelerator and the decisions have been made on the basis that if coaxitrons are used they can be put in the tunnel with the accelerator instead of being left outside the shield wall as we would want to do with the externally circuited type of amplifiers. There is nothing that can be done to tune a coaxitron once it is in the socket so it might as well be inside the tunnel. This eliminates the problem of getting the high power waveguide through the very thick shield wall. The feeling is that there will not be very much radiation while the machine is in normal operation. However, in the case of abnormal situations where the beam might get dumped for a full 2 msec pulse, you have one of two choices. Either you can put in heavy shielding around the machine, or else you can exclude people from the entire building during operation. In the latter case, one would exceed a safe tolerance level for anyone near the machine in the event of spilling a full pulse.

A cross section of the drift tube section - approximately 400 ft. long - is shown in Fig. 3. Here the superstructure is offset toward the east so that the accelerator tunnel comes under the 15 ton crane. This crane, incidentally, also serves the injector building. The accelerator tunnel has removable shielding on top so that the equipment can be erected and later handled by the crane as necessary. The thicknesses of the top and inner shielding are variable, the

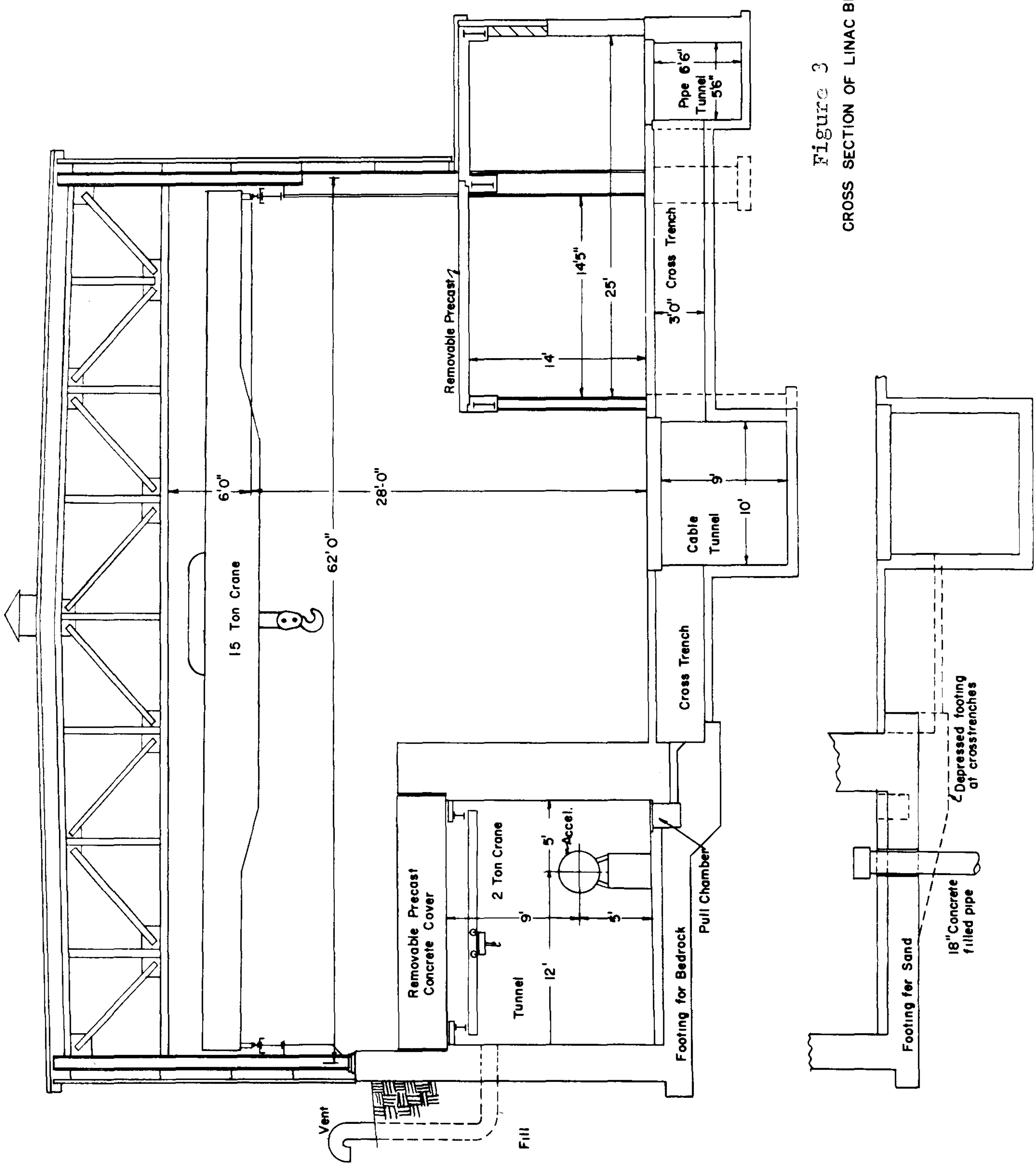


Figure 3
CROSS SECTION OF LINAC BLDG-200Mc

latter being from 2 to 7 ft. thick. The east side of the tunnel now becomes an L-shaped retaining wall with membrane waterproofing on the outside. The equipment room is similar to that already described but only part of the roof is removable. The electrical and pipe tunnels, with their cross-trenches, are similar to those previously described. So are the foundations of the accelerator. The lower picture shows the construction if on sand or gravel. Notice that the mat is to be thickened at the trenches and pull boxes by warping down the bottom so as to maintain strength and good bearing.

Figure 4 shows the arrangement for personnel and material access from the crane aisle of the accelerator building to the accelerator tunnel. The upper left view is a plan at the tunnel floor. There is a hatch and ship ladder in the crane aisle, a passageway under the tunnel to stairs and a shaft east of the tunnel, then an offset passage and door connecting with the aisle in the tunnel. The crane can lower a load onto a hand-truck, this load can be pushed through the passageway to the east hatch where a hoist on a trolley beam can raise it and place it on another truck, then it can be taken into and along the tunnel. The view at the right shows this arrangement in a vertical section. The third view is a plan of the floor of the passageway. Notice the maze arrangement for protection.

Although the construction in Fig. 4 seems to be costly, it avoids the use of big plug doors in the shielding. These would be costly and rather difficult to operate and would provide access to the wrong side of the accelerator, for

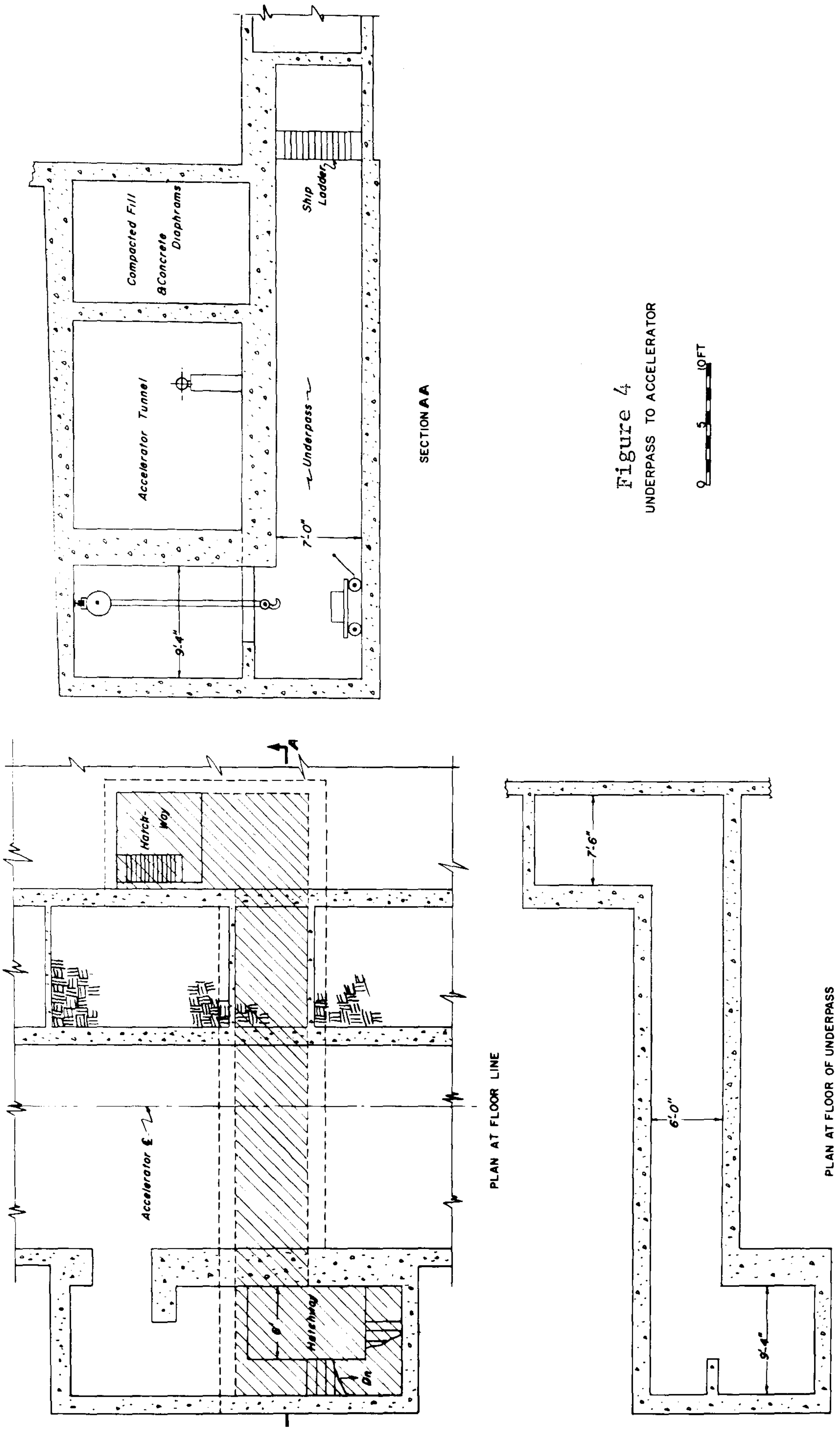


Figure 4
UNDERPASS TO ACCELERATOR

one would have to climb over or under the machine to reach the tunnel aisle. There is one direct access to the tunnel from the injector building without an underpass. There will be an underpass like that in Fig. 4 at the target end of the accelerator building and probably two of them along its length.

Figure 5 illustrates one of a number of studies of the target and experimental areas. In this case the beam is to pass straight through the switch room to the target area, then it is deflected to the southeast through a future switch room and on to the beam stop. Experimental rooms with fixed side shielding and removable ceilings and an open experimental area are shown west of this first target area, all being served by a 104 ft. span, 25 ton crane. In the future, the beam is supposed to be deflected in the first switch room to a second target area as shown, then it is to be deflected to the second switch room and there again deflected to the beam stop, if all this can be done. The second experimental area is to be served by a 25 ton crane with skewed trucks. Access through the fixed shielding is by mazes with plug or heavy hinged doors. Material to or from the target areas is handled by underhung cranes in the target areas. These can handle materials through a hatch to or from cars running in tunnels to a cross tunnel which has a rail-mounted, power-driven transfer car that takes the first car and its load to a shaft under the service building where the load can be hoisted by crane. As shown in the figure, additional hatches and tunnels provide access to various experimental areas and to the second switch room.

BLEWETT: I should like to make a general comment about the

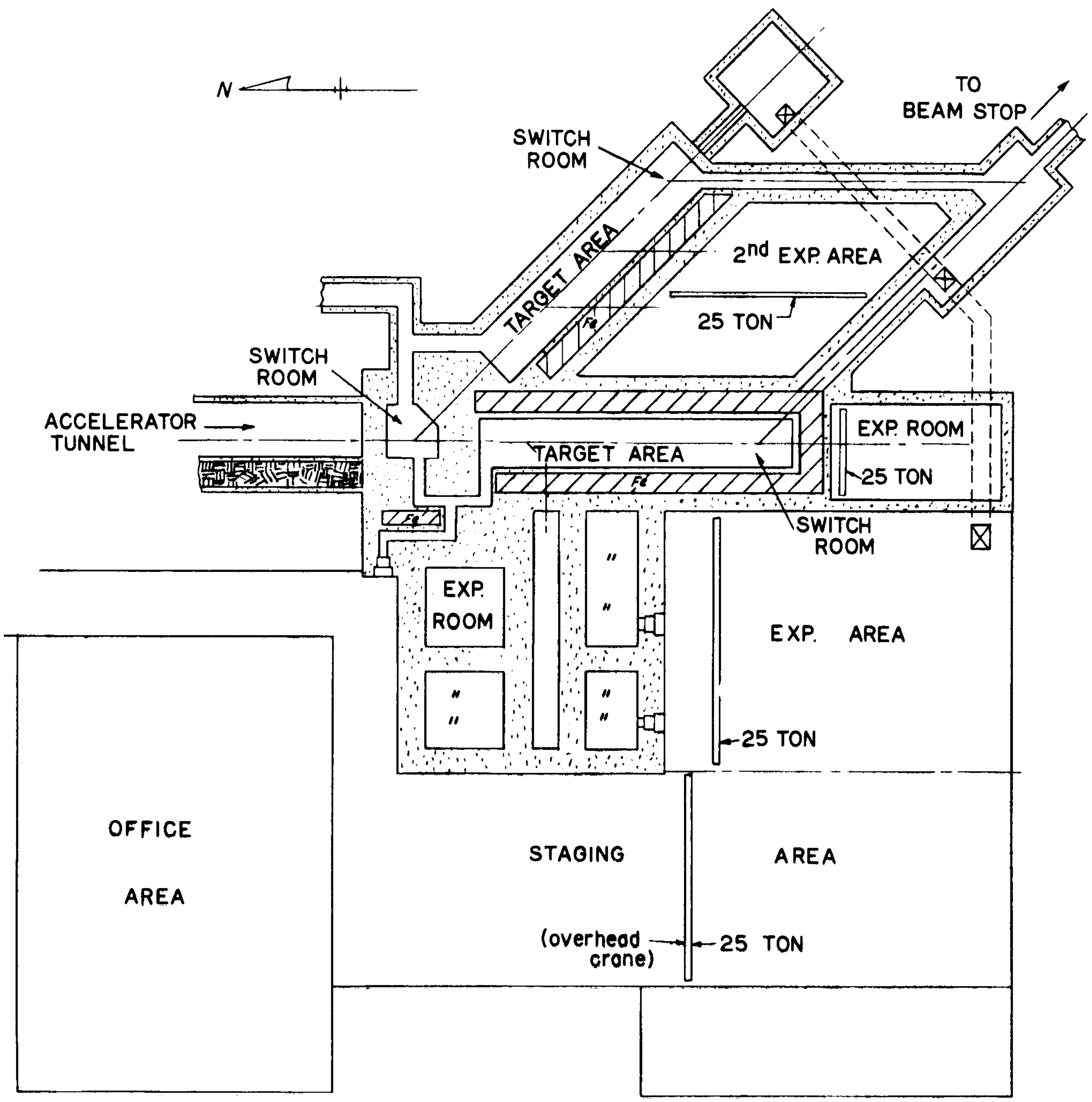
N
TO
BEAM STOP
SWITCH
ROOM
TARGET AREA
2nd EXP. AREA
25 TON
SWITCH
ROOM
ACCELERATOR
TUNNEL
TARGET AREA
EXP. ROOM
25 TON
Fe
SWITCH
ROOM
EXP.
ROOM
EXP. AREA
25 TON
OFFICE
AREA
STAGING
AREA
(overhead
crane)
25 TON

FIGURE 5

shielding in experimental areas. If you lay out the shielding the first time around, sooner or later you want to change it all the way down to the floor. Insofar as possible it seems to me that these heavy shield walls should be constructed of blocks that could be torn down and rearranged. This leads to another consideration which is that in order to do this fast, you want to make the blocks as big as possible. This means that you want to put in a really oversized crane to handle them.

QUESTION: How do you plan to provide access to the target area?

DUNHAM: That's why we went through all this subterranean tunnel and underpass study. Men can get in through a maze from the experimental area. Materials can get in through tunnels from the back.