PART III

TECHNICAL DESCRIPTION OF ATLAS F OPERATIONAL FACILITIES
Adapted and Abridged from
Bechtel Corporation Technical Description of Facilities, Undated.

The two basic structures at a site are the launching silo and the launch control center. The launch control center and silo are 100 feet center to center distance. (See Figure 1 for operational site plan and Figures 2 and 3 for views of silo launcher and launch control center). The launching silo is a reinforced concrete cylinder with its top flush with the ground surface. It has a 52 foot inside diameter and is 174 feet from ground surface to the top of the base slab. The doors at the top open to allow raising and firing of the missile. The roof and upper walls are 9 feet thick for resistance to atomic attack. The overhead door is constructed of reinforced concrete 2 foot 6 inches thick and has two leaves each of which is hinged at its outer edges. The door is operated by a single hydraulic cylinder. The 2½ foot door thickness provides necessary nuclear radiation protection for silo equipment. The doors are provided with rubber seals which provide protection from the over-pressure generated by explosion.

The lower walls of the silo are 2 foot 6 inches thick. Two types of foundation may be used. The first is a reinforced concrete dome 3 foot 6 inches thick, designed to resist the forces of ground water around the silo. The second type is a flat reinforced concrete slab 6 foot thick with drainage material under the slab. This second type will drain groundwater into a pump from which it is pumped to a safe disposal area at the surface. The choice of which type of foundation to use is based on an economic study of all factors involved at each site.

The silo crib is constructed of structural steel. It is suspended within the silo shell by four pairs of coil springs which attenuate the ground shock from a weapon explosion. The acceleration limit of this crib is 0.4 g vertical and 0.1 g horizontal. The springs are locked in an extended position immediately prior to raising the missile. The crib is equipped with three hydraulic positioning cylinders located at the top which place the rib exactly under the door before the missile is raised. The steel frame work of the crib is 150 feet high and is octagonal in plan. It has a large truss between the fourth and fifth levels which distributes the load from the four support points of the springs to the columns. Three open spaces extend from the top to the bottom of the crib. These spaces contain the facility elevator, launch platform and missile and the launch platform counterweight. (See Figure 4 for the equipment located at each level of the crib).

The major components of the crib are as follows:

1. The launch platform - a structural steel framework which supports the missile and contains certain items of equipment directly associated with the missile. The platform is raised and lowered by a drive system equipped with electric motors, gear reducers, cable drums, steel cables and counterweights. The counterweight is sized to minimize power requirements during missile raising.

2. Thermal insulation paneling - for isolation of the missile area and for maintenance of constant temperature. The RP-1 fuel is stored within the missile constituting a hazardous area.

3. Multi-level work platforms - hinged and operated by hydraulic cylinders which fold out of the way when the missile is being raised.

The missile is equipped with an all internal guidance system. During ready periods in the silo, gyroscopes which provide the reference plane during flight, are kept from drifting by an optical alignment system. The main component of this system is a collimator mounted on the silo wall which shines a light beam to the missile thereby providing a reference beam for the missile guidance system. Bench marks on the silo wall and an auxiliary theodolite at ground surface are used to check the collimator for proper alignment. A sight tube connects the collimator and the theodolite at ground surface.

The silo shell is penetrated at two points by an air intake and an air exhaust port. Incoming and outgoing air are conducted to and from the ground surface by reinforced concrete shafts on the outside of the silo. The interior of the silo is protected from overpressure by vent closures mounted on the silo shell. A weapon explosion actuates a sensing device by either light or radio waves generated. The sensing device relays a signal to the air cylinders at the vent closures causing the cylinders to close the vents before arrival of overpressure. Total closing time takes 0.20 second. Timing devices keep the vents closed for a set period of time and then allow them to reopen after the overpressure wave has passed.

The overhead doors are operated by hydraulic cylinders. Nitrogen gas is pumped to a high pressure and stored in accumulators. The gas is used to pressurize hydraulic fluid which, in turn, drives the hydraulic cylinders. This system also actuates the work platform cylinders and the cylinders used to lock the launch platform in its raised and lowered positions.

The silo is connected to the launch control center by a tunnel. The tunnel has flexible connections at its ends to provide for differential settlement between the launch control center and the silo. The tunnel is equipped with two interlocked blast doors at its silo end to protect occupants of the launch control center from overpressure when the silo is open. The tunnel also carries all

interconnecting utilities between the silo and the launch control center.

The main entrance to the facility is at the launch control center. The entrance is protected from overpressure by two interlocked blast doors at the top of the shaft adjacent to the launch control center. The stairway portion of the entrance is not designed to resist a weapon explosion; however, the bends provide nuclear radiation protection for the occupants of the launch control center. An emergency escape hatch is provided in the roof of the launch control center so that occupants can leave if the entrance stairway is destroyed. The escape hatch is blast proof.

The launch control center is also a reinforced concrete cylinder. Its top is approximately 6 foot 6 inches below ground surface. It has a ten foot inside diameter and is 27 feet from ceiling to floor. Dimensions and configuration of the launch control center are shown in Figures 5 and 6. The floors in the launch control center are suspended from four shock hangers. Shock attenuation is provided by air spring cylinders. The acceleration transmitted to the floors is limited to 0.4 g vertical and 0.1 g horizontal. All of the operations necessary to load, raise, and fire the missile can be controlled from the launch control center. This control is concentrated in two consoles - one for facility equipment and one for ground support equipment.

The function of OSTF-2 is to test the operation of equipment in the complex. As such, it has devices installed which are able to raise the silo crib and drop it to simulate ground shock conditions. Normal day to day operation of the OSTF is on commercial power. However, it is equipped with one diesel operator to be used during simulation exercises. In the layout of the OSTF site the interconnecting tunnel is eliminated due to increased hazard of missile explosion in the silo. Also, the OSTF has two auxiliary buildings -an instrumentation building for housing instruments necessary to monitor the extensive testing program, and a utilities building.

The propellant loading system serves to transfer and store the propellants and auxiliary fluids from the supply source to the missile. The propellant loading system starts at grade level with the fill lines and vents and terminates at the elevator disconnect assemblies. The propellant consists of liquid oxygen and RP-1 fuel. Auxiliary fluids are liquid nitrogen, gaseous nitrogen, gaseous helium, and compressed air. The propellant loading system has the following design features:

1. Fuel is stored in the missile.
2. Liquid oxygen is loaded rapidly from hard storage in the silo.
3. Pressure is used to transfer cryogenic fluids and gases.
4. The missile is filled with RP-1 directly from surface trailers.
5. High cleanliness
6. High reliability

In order to achieve the above design features the propellant loading system is supplied to subassemblies which can be fabricated under controlled conditions not obtainable in field fabrication. Materials of construction are stainless steel for cryogenic lines stainless steel and copper for cleanliness, and structural steel and plate for non-critical areas. Prefab and subassembly items are listed as follows:

1. Liquid oxygen fill prefab
2. Liquid oxygen control prefab
3. Liquid nitrogen prefab
4. Pressurization prefab
5. Instrument air prefab
6. Fuel prefab
7. Vessels for storing auxiliary liquids
8. Helium heat exchanger
9. Inter-connecting piping, valves, and fittings.

In installation the liquid oxygen fill, liquid oxygen control, liquid nitrogen, pressurization and instrument air prefabs are located in the crib structure on the seventh level. The fuel prefab is located at the bottom of the missile enclosure between the seventh and eighth level. There is interconnecting piping between prefabs, between crib and silo wall and for surface connections.

The mechanical systems are composed of the following:

1. Heating, ventilating and air conditioning for heat removal and environmental control (See Figure 7)
2. Outside air system for cleaning and cooling of engine generator rooms and silo.
3. Air conditioning systems for the launch platform, control cabinets and the launch control center.
4. Chilled water system for air-conditioning and pod cooling.
5. Cooling water system - refrigeration condensers, diesel jacket water, cooling tower and emergency supply.
6. Heating system - recirculated air. Diesel exhaust boilers to provide hot water to launch control center and thrust section heater.
7. Exhaust system - for general use and to purge gases and fuel.
8. Water supply system - for utilities, drinking and storage.
9. Fire protection consisting of a fog system and hose stations.
10. Compressed air system for use in blast closures, launch control center suspension and diesel starting.

The electrical work for each silo site includes a diesel power plant, power distribution feeders, motor controls, lighting, communication raceways, grounding

and alarm systems for the launching silo, launch control center and site facilities. (See Figures 8 and 9).

The power plant consists of two diesel generators, located on the fifth and sixth levels of the launching silo. Each generator is rated at 500 KW 480 volt, three phase, 60 cycles at 0.8 p.f. Each is capable of supplying the complete load requirements for the silo and launch control center. The second unit serves as a 100% standby source. Synchronization and control of the generators is possible both locally and at the power remote control panel located in the launch control center.

The 480 volt generator and feeder switch gear located on the fifth level of the silo contains the following:

1. Two electrically operated, drawout type, air-circuit breakers for generator feeders.
2. One electrically operated air circuit breaker for the non-essential motor control center feeder. This breaker provides disconnection of non-essential loads during launch platform rise, thereby considerably reducing the generating capacity required. The breaker will be controlled by Convair's logic units, also at the 480 volt switch gear and at the power remote control panel.
3. Three manually operated circuit breakers serve the launch control center, launch platform and essential motor control center feeders.
4. Electrically operated air circuit breakers utilize 48V d.c. tripping and 120V a.c. closing.

The station battery is rated at 48 V d.c. and provides power to trip the switch gear breakers and operate the diesel engine controls.

Power feeders to the essential non-essential and launch platform motor control centers in the silo and the motor control center in the launch control center are interlock armored cables in trays.

The motor control centers contain all controllers for 480V facility and ground support electrical equipment except for the 50HP water chillers which have their controllers integral with the equipment.

The essential motor control center feeds the following silo equipment.

1. Control cabinet air conditioning and the dehumidifying unit.
2. One air conditioning water chiller and pump.
3. Thrust section heater coil and fan, 120/208Volt critical power for launch control equipment.
4. Battery charger supplying power to the facilities 48V d.c. distribution panel and batteries.

5. Ground support equipment consisting of 28 Volt d.c. power supply, 400 cycle motor generator set, nydraulic pumping unit and missile pod coolings.

The non-essential motor control center feeds the following silo equipments, the launch platform and the main silo supply and exhaust fan, standby air conditioning chiller, air conditioning water pumps, cocling tower, silo sump pumps, vacuum pumps, air compressors, defueling pump, facility elevator, silo lighting transformer and receptacles for checkout trailers and propellant trailers.

The motor control center in the launch control center supplies power to the ventilation system, lighting, sewage pumps, and water wells.

The missile platform motor control center contains controllers for the missile lifting system.

The grounding system for the silo and the launch control center consists of a network of vertical 4/0 ground cables at the perimeter of the silo with ground rods laid horizontally. The cables are connected to the crib structure. The steel crib structure is a basic element of the ground system and all equipment, piping, and electrical raceways are bonded to this structure. The ground systems at the silo and the launch control center are similar and interconnected.

The facilities interface cabinet, (see Figure 10) combines all facilities, propellant loading system and launch platform interface signals with the Convair missile logic system at one panel on the third level adjacent to the logic units. The panel contains the shake-proof terminals and matching receptacles to enable Convair to plug in their own connections.

Lighting in all areas of the silo is supplied from general purpose incandescent fixtures except the missile enclosure which has vapor tight fixtures. Flourescent flighting is used in the launch control buildings.

Emergency lighting is supplied from self-contained units consisting of storage battery and charger.

The fire alarm system consists of detectors, manual stations, alarm bells, and a fire alarm panel in the launch control center. Detection of fire at any station causes all alarms to sound.

Communication raceways are provided for the communications systems in the launch control center and the silo. Outlets are provided for installation of telephones and public address speakers.

Vent closure devices in the supply and exhaust air systems for both silo and launch control centers for blast protection are controlled from a blast

sensing device.

Hazard classifications in the silo are Class 1, Division 2, for the missile enclosure area; and Class 1, Division 1, at the fuel prefab. All other areas in the silo and launch control building are non-hazardous.

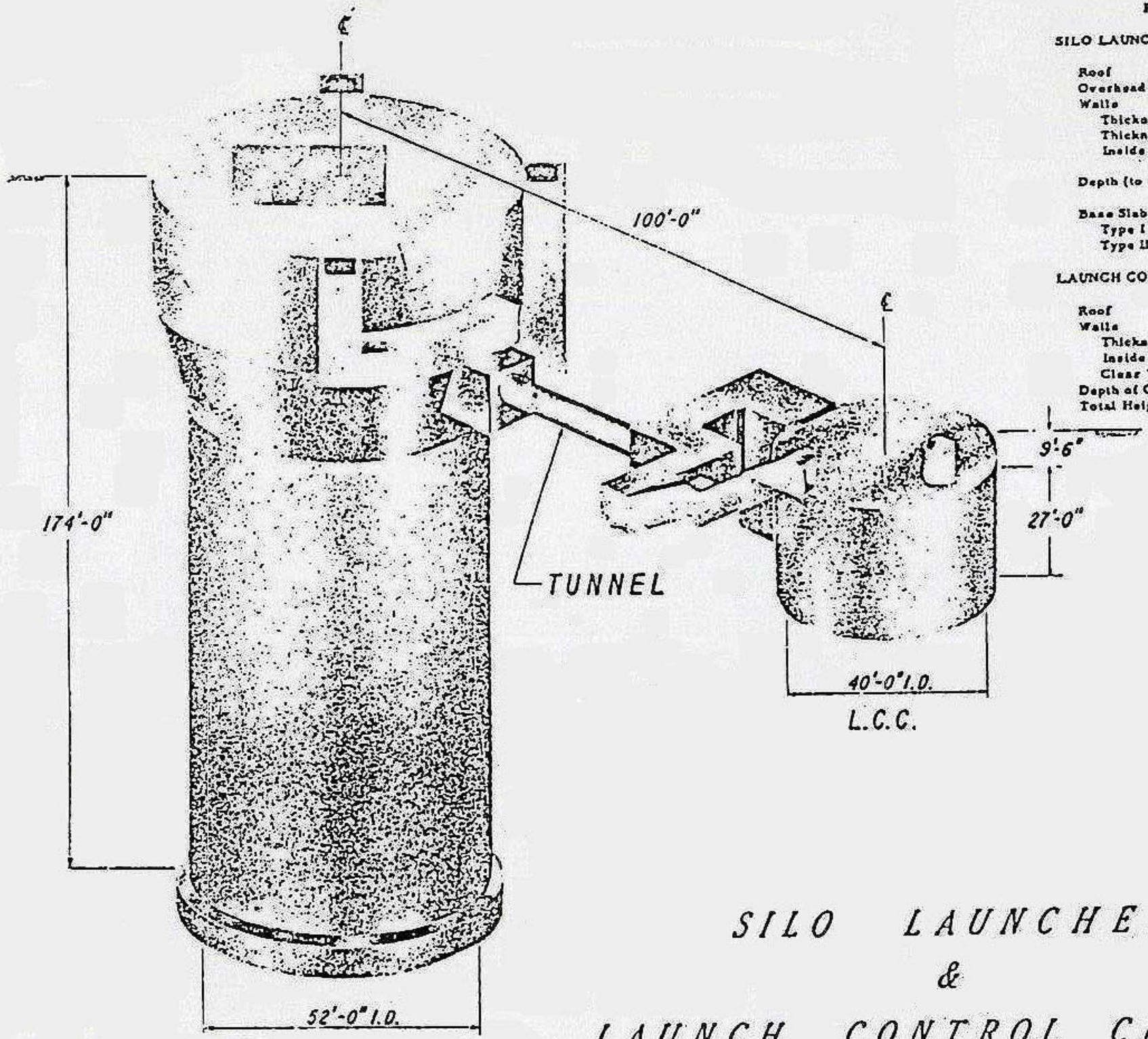
Gas detection systems for RP-1 fuel, liquid oxygen, and diesel fuel vapor are located in the silo and are interconnected to their various ventilating and purge systems.

Television for area surveillance is provided with the camera located on a pole adjacent to the entrance to the launch control center. The camera is soft, therefore, is not for post-blast use. Another camera is located at the gate for personnel identification. Monitors for these cameras are located in the control room of the launch control center.

The water supply is controlled automatically to keep the storage tanks full.

Security gate is controlled electrically from launch control center.

The facility remote control panel contains a trouble section, a ready section and a control section. The trouble section contains annunciators for the diesels, control cabinet air conditioning and hazard detectors. The ready section monitors the air intakes and exhausts, doors, power, and fog system. The control section operates the diesels, non-essential M.C.C., area warning system, security lighting, blast door test and missile area fans.



PHYSICAL DIMENSIONS

SILO LAUNCHER

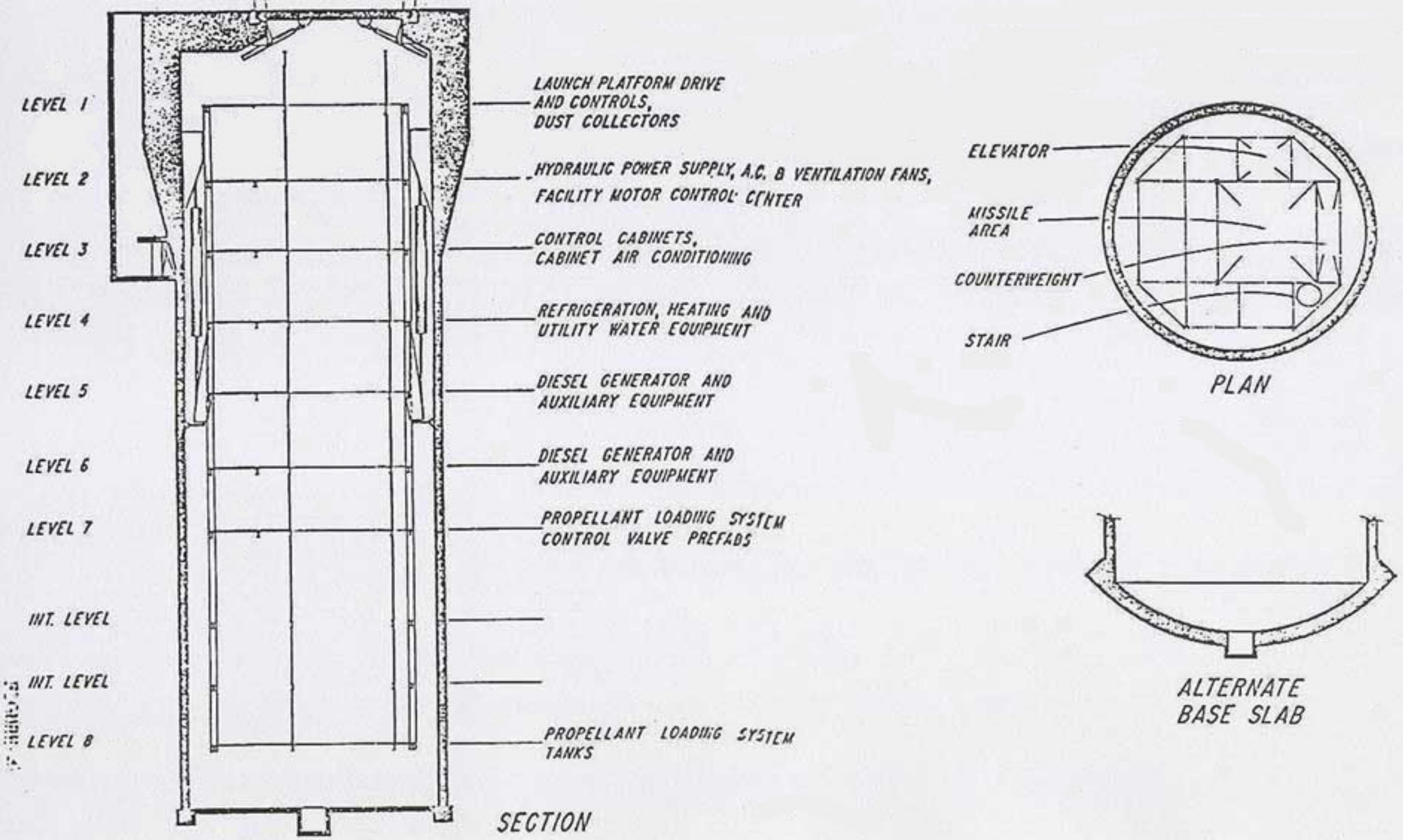
Roof	9'-0"
Overhead Door	2'-6"
Walls	
Thickness Upper 29'-0"	9'-0"
Thickness Below 55'-0"	2'-6"
Inside Diameter	52'-0"
Depth (to top of base slab)	174'-0"
Base Slab Thickness	
Type I Porous Slab	6"
Type II Dome	3'-6"

LAUNCH CONTROL CENTER

Roof	3'-0"
Walls	
Thickness	2'-3"
Inside Diameter	40'-0"
Clear Vertical Span	27'-0"
Depth of Overburden	6'-6"
Total Height	33'-6"

SILO LAUNCHER & LAUNCH CONTROL CENTER

FIGURE 3

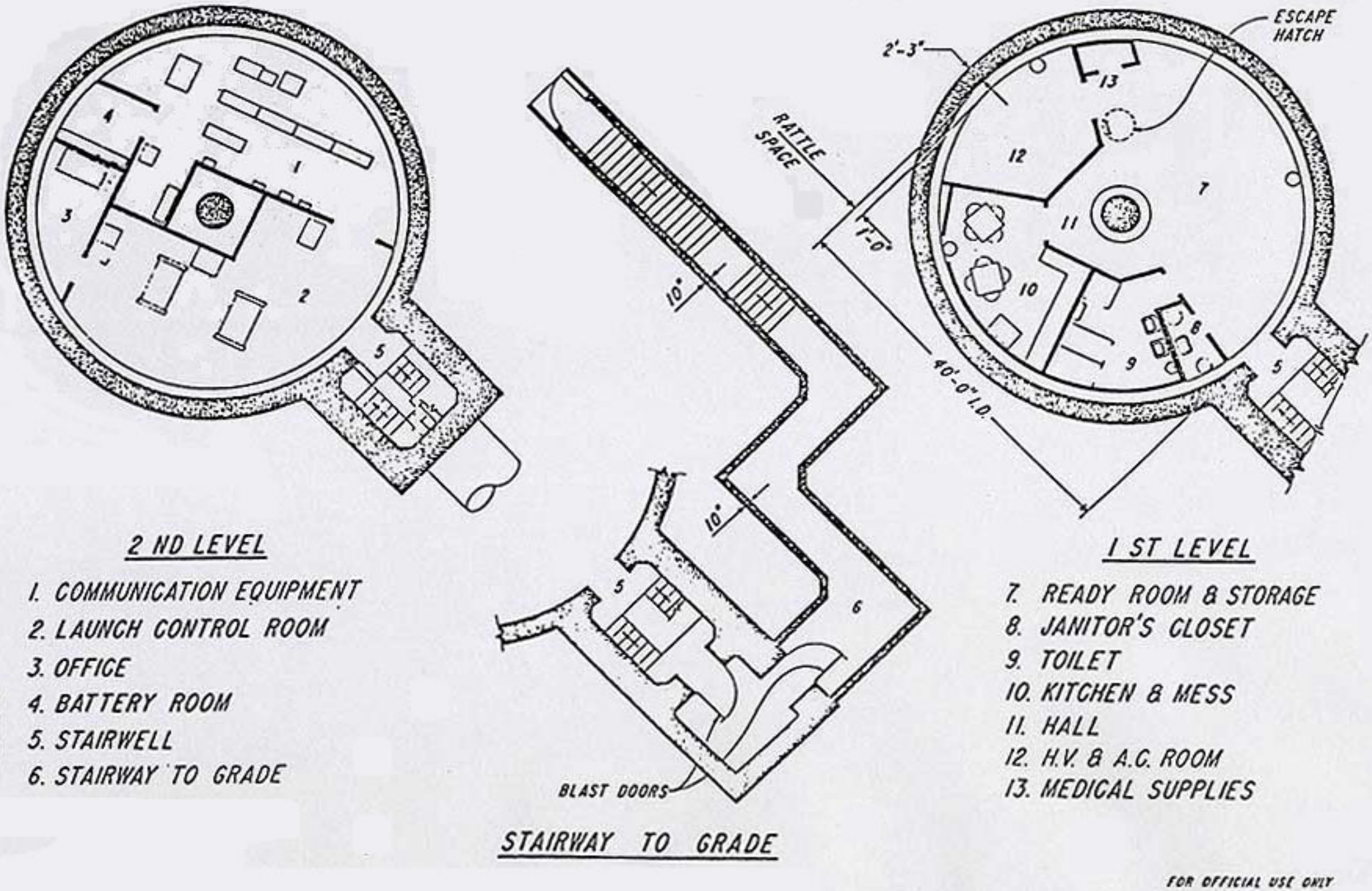


SECTION

PLAN

ALTERNATE BASE SLAB

LAUNCH CONTROL CENTER — OPERATIONAL SITE



2 ND LEVEL

1. COMMUNICATION EQUIPMENT
2. LAUNCH CONTROL ROOM
3. OFFICE
4. BATTERY ROOM
5. STAIRWELL
6. STAIRWAY TO GRADE

1 ST LEVEL

7. READY ROOM & STORAGE
8. JANITOR'S CLOSET
9. TOILET
10. KITCHEN & MESS
11. HALL
12. H.V. & A.C. ROOM
13. MEDICAL SUPPLIES

STAIRWAY TO GRADE

FIGURE 5

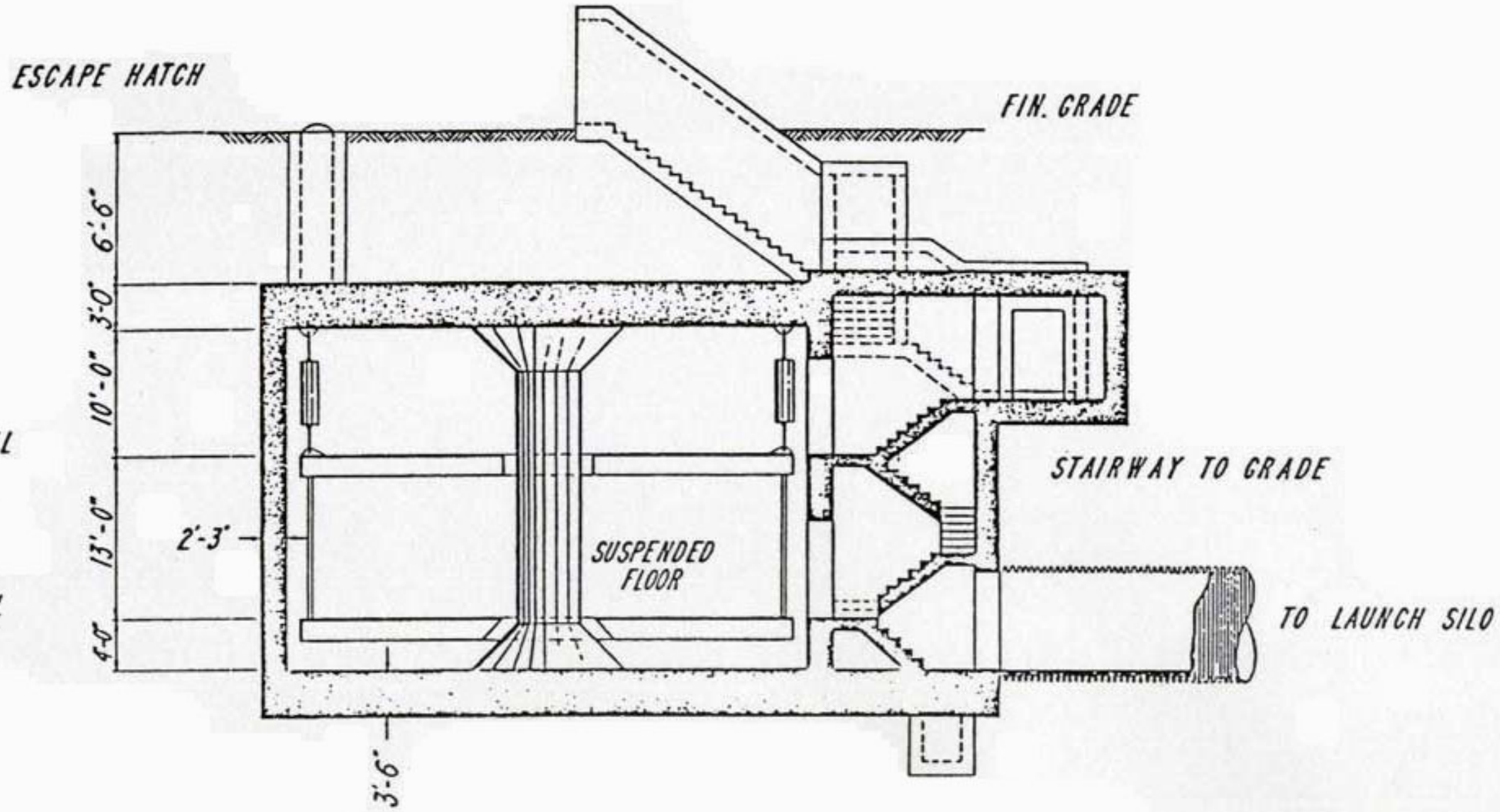

ESCAPE HATCH
FIN. GRADE
1ST LEVEL
2ND LEVEL
6'-6"
3'-0"
10'-0"
13'-0"
4'-0"
2'-3"
SUSPENDED FLOOR
STAIRWAY TO GRADE
TO LAUNCH SILO
3'-6"

FIGURE 6