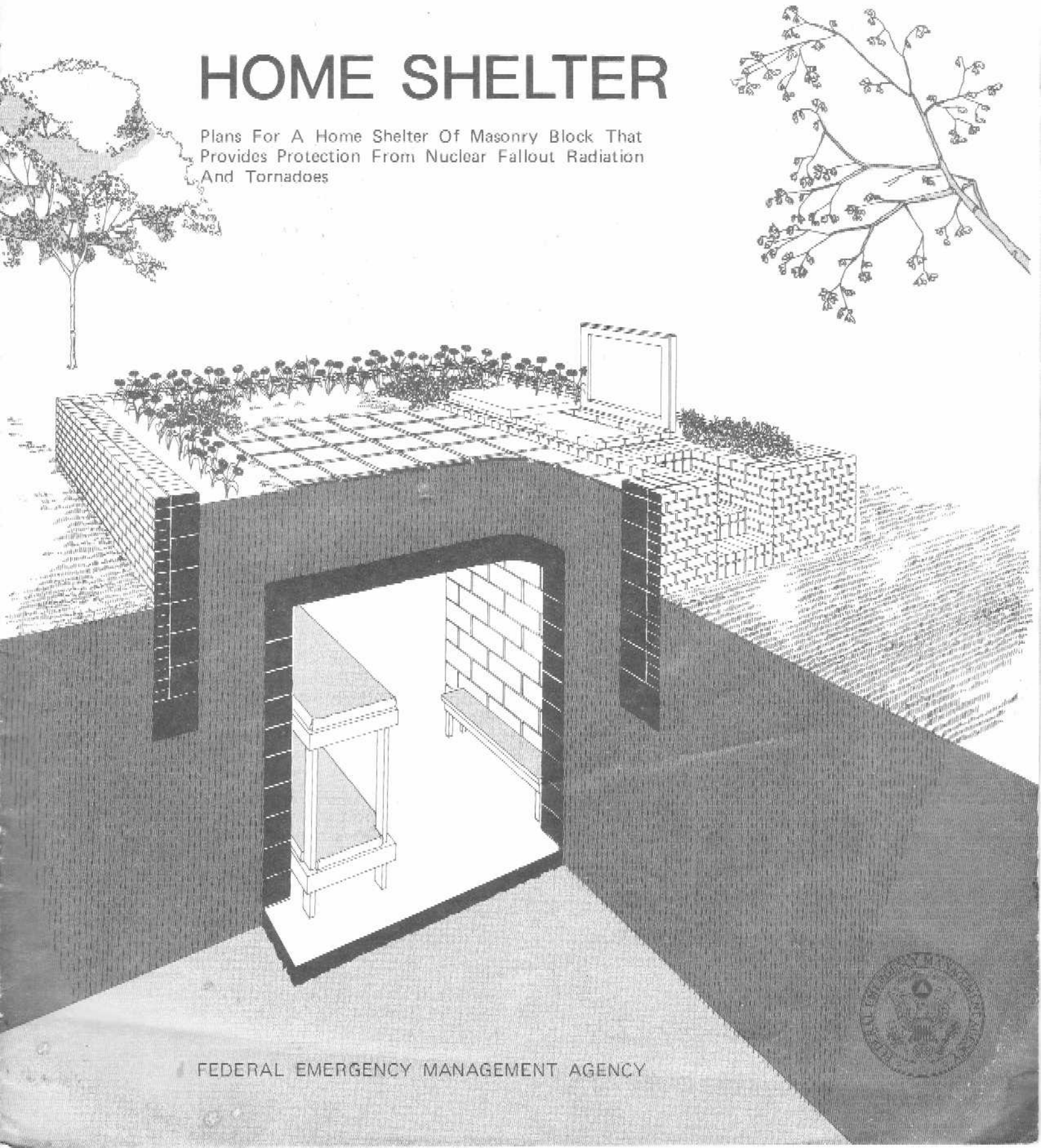
H-12-4.0 / October 1987

HOME SHELTER

Plans For A Home Shelter Of Masonry Block That Provides Protection From Nuclear Fallout Radiation And Tornadoes



FEDERAL EMERGENCY MANAGEMENT AGENCY

DESCRIPTION OF THE SHELTER

This protective shelter is designed to serve as a family fallout shelter and is suitable for other utilitarian purposes as well—including use as a tornado shelter and everyday functions of the residence. The shelter is designed for placement in the yard and primarily is for houses without basements.

To function as a fallout shelter, it is designed to have a protection factor (PF) of at least 40, which is the minimum standard of protection for family and public shelters recommended by the Federal Emergency Management Agency. The belowground location of the shelter also will provide some protection against blast and fire effects of a nuclear explosion.

The facility also can serve as a storm shelter in regions of the nation where tornadoes are common. The roof structure of the shelter is suitably strong to resist the most severe tornadoes, and the belowground location provides protection for occupants from wind-blown debris and even from possible collapse of nearby buildings.

The day-to-day use for the particular design illustrated is for housing residential swimming pool filtration equipment in a weather-protected location out of sight in the yard. Other utilitarian uses for the facility are possible that may be more suited to a particular homeowner's needs—such as use for yard equipment storage or use as a cellar for storage of perishable foods—or the facility may be used solely as a refuge from natural and man-made hazards.

An elevated brick planter placed atop the roof of the shelter creates a landscape feature in the yard and provides overhead protection against radioactive fallout and tornado forces. Attractive landscaping and enhanced protection are achieved with this arrangement without burying the shelter deeply into the ground.

Other siting arrangements besides the raised planter are possible for the basic shelter. For example, the brick planter walls can be eliminated and the concrete roof slab can be paved as a terrace at the yard level. Elimination of the soil cover atop the shelter will reduce, but not make ineffective, the overall fallout radiation protection of the space. Whatever landscape treatment may be preferred, the plans shown in this booklet are valid for construction of the basic shelter.

PLANS FOR THE SHELTER

Plans illustrated in this booklet are for a shelter to accommodate up to six adults. The shelter has reinforced concrete floor and roof slabs and reinforced masonry block walls. An elevated planting area, with brick-faced garden walls, retains a 2-ft. deep soil cover over the roof of the shelter. Access to the shelter is by means of a hatchway and wood stair. Provisions are made for ventilating the shelter space by means of a hand-operated centrifugal blower. Air intake and exhaust pipes extend above the ground level of the planter.

Dimensioned plans in this booklet provide sufficient information for a professional contractor to build the shelter. For the novice "do-it-yourself" builder, a companion booklet, H-12-4.1, is available from the Federal Emergency Management Agency that provides step-by-step instructions plus additional details for construction of the shelter.

A list of construction materials is provided on the back page of this booklet. It includes quantities for all materials needed to complete the construction except miscellaneous items such as stakes, nails, and other fasteners. The companion booklet, H-12-4.1, provides more detailed information on sizes and quantities of materials needed for each phase of the construction.

BUILDING THE SHELTER

Before commencing construction, the homeowner is advised to verify that the plans conform to requirements of the local building department. A site plan showing where the shelter would be located in the yard relative to property lines and adjacent buildings may be required by the building department before a building permit will be issued. More information on preparation of a site plan is furnished in booklet H-12-4.1.

If the shelter is to be constructed by a local contractor, the homeowner is advised to engage a reliable firm having a reputation for doing quality work and to enter into a written agreement with the contractor. The written agreement should be specific as to the work to be done, the quality of materials to be installed, the quality of workmanship, and the cost for the work. Cost terms can be a fixed-price type or actual-cost-plus-fee type. The homeowner also is advised to require that the contractor furnish proof of insurance protection against any liability or other claims (such as from materials suppliers) that might arise in the course of construction.

If the shelter is to be constructed by the homeowner, then full compliance with safety regulations that apply in the local area is advised. The homeowner also is advised to consult with his home insurer to assure that he is protected against any liability claims that might arise as a result of the construction.

Layout and Excavation

Initial layout of the shelter entails the measuring and marking necessary to correctly locate the facility in the yard. Care should be exercised in this phase of the work to assure that the shelter will be built where it is intended and at the depth intended in relationship with yard elevations.

Side walls of the excavation should be sloped sufficiently so that soil will not slough off into the work area. Alternatively, the side walls can be shored if the soil is especially loose.

During the excavation phase, do not excavate deeper than the bottom level of the slab or drainage fill (if any) to assure that the bearing soil is not disturbed.

Footings and Floor Slab

A combined footing and floor slab is designed for the shelter. By thickening the slab at its edges, support is provided for the block walls.

Underground utilities should be placed before the floor slab is poured—such as floor drain or sump, and water piping. A sump is provided for floor drainage of the shelter illustrated, but other drainage methods can be used provided that the drainage water has someplace to flow.

All concrete should have a minimum compressive strength of 2,500 lbs. per sq. inch (psi). Locations and sizes of reinforcement steel are indicated in the plans. All reinforcement indicated in the plans should be installed even though it might seem possible to omit some.

Masonry Block Walls

The walls of the shelter are constructed of standard 8" thick masonry block. The block walls are reinforced both horizontally and vertically. Prefabricated trussed wire reinforcement is used in horizontal joints, placed continuously at every second bed course. Vertical reinforcement is No. 4 steel bars spaced at 8" on centers (one bar in each block cell). Every other vertical bar (one each block unit) is secured to dowels formed in the floor slab.

Cells of the block units are grouted to provide a bond between vertical reinforcement steel and block units. Grout lifts should not be greater than 4 feet for any one pour. Type S mortar is specified for block masonry joints and for grout.

Roof Slab

A reinforced concrete roof slab 8" thick is designed for the shelter. The roof slab is supported on the masonry block walls.

Shoring and formwork for the roof slab are described in the companion booklet, H-12-4.1.

Sizes and locations of reinforcement steel for the roof slab are indicated in the plans shown in this booklet. Reinforcement consists of No. 4 bars spaced 8" o.c. running in the direction of the short dimension of the shelter (structural reinforcement) and No. 4 bars spaced at 16" in the long dimension (temperature reinforcement). Reinforcement around the hatchway opening, also No. 4 bars, is indicated in the plans.

Dampproofing / Waterproofing

Protection of the underground facility from water and moisture penetration is recommended. If soil conditions are relatively dry and if there is good surface water drainage, then dampproofing should be sufficient. If ground water is observed in the excavation and if the excavation is likely to become a collector basin for water, then waterproofing probably will be necessary to achieve a dry shelter space. Dampproofing and waterproofing concepts and techniques are described in the companion booklet, H-12-4.1.

Planter Walls

Walls of the surrounding planter are constructed after the basic shelter is completed and after backfill is placed up to a level of the footings for the planter walls. Concrete footings for the planter walls should be set below the frost line depth for the region where the shelter is built.

Planter walls consist of 4" standard face brick and 8" backup block. The planter walls are capped with brick. Type S mortar also is specified for this work.

These walls do not require grouting or vertical reinforcement bars unless the height of the walls above the surface of the yard is greater than about 3 feet. Horizontal joint reinforcement for a 12" wall should be used in alternate bed courses of the block.

Brick steps leading to the hatchway are indicated in the plans for the shelter.

Ventilation

The ventilation system for the shelter consists of a hand-operated centrifugal blower, air intake pipe with filter hood, and air discharge pipe with hood. Air intake and discharge pipes are placed on opposite or adjacent walls of the shelter space to provide optimum movement of ventilation air. Piping should be placed with outlets more or less at the heights above the floor level of the shelter as shown in the plans. Piping and fittings may

be either galvanized steel or ABS (plastic).

The air intake pipe is fitted with a hood and screen filter so that radioactive particles will not be pulled into the shelter space by the blower. The air exhaust pipe is hooded, but no filter is needed.

Centrifugal blowers can be purchased commercially. One such supplier is:

Spec Air, Inc.
13999 Goldmark Drive, Suite 401
Dallas, Texas 75240
Telephone — 214 / 644 - 6806

Electrical service for lighting and power equipment also may be added. Electrical service should be from a separate circuit and with a branch circuit breaker inside the shelter that has ground fault protection.

An electrically powered centrifugal blower may be substituted for the hand-operated blower. It should be recognized that electrical power to the shelter may be disrupted by a tornado or nuclear explosion.

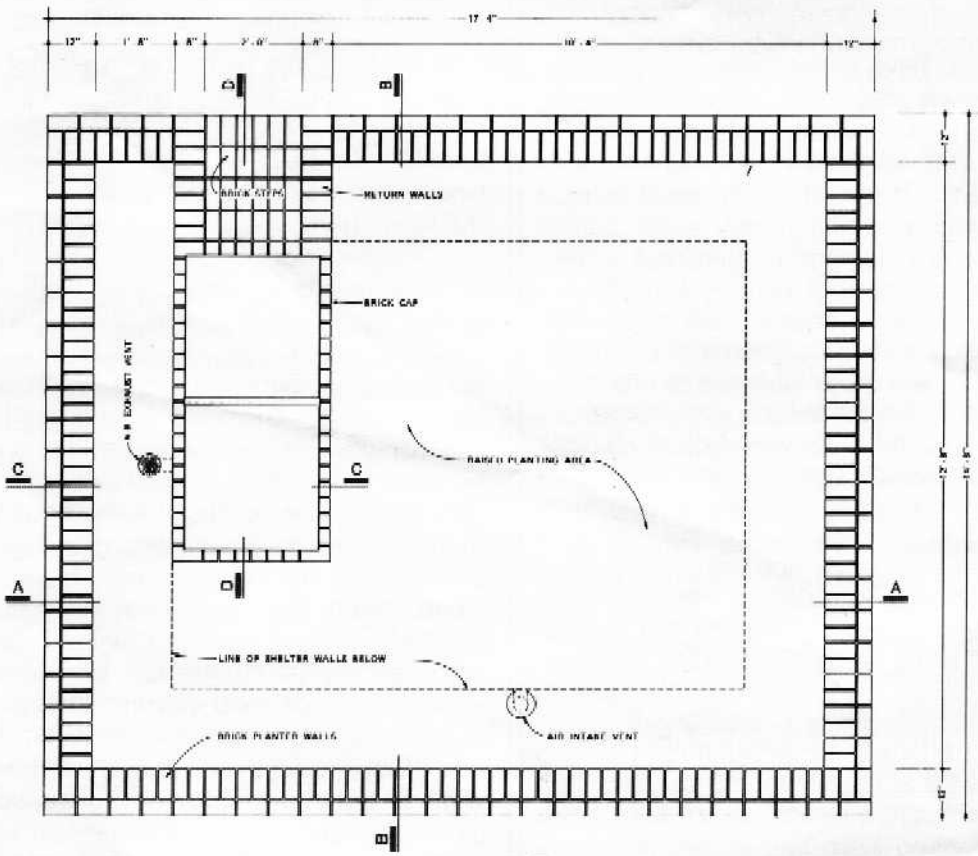
Air intake filter and exhaust hood can be fabricated by a local sheet-metal shop in the homeowner's area in accordance with details included in the plans.

MODIFICATION OF PLANS

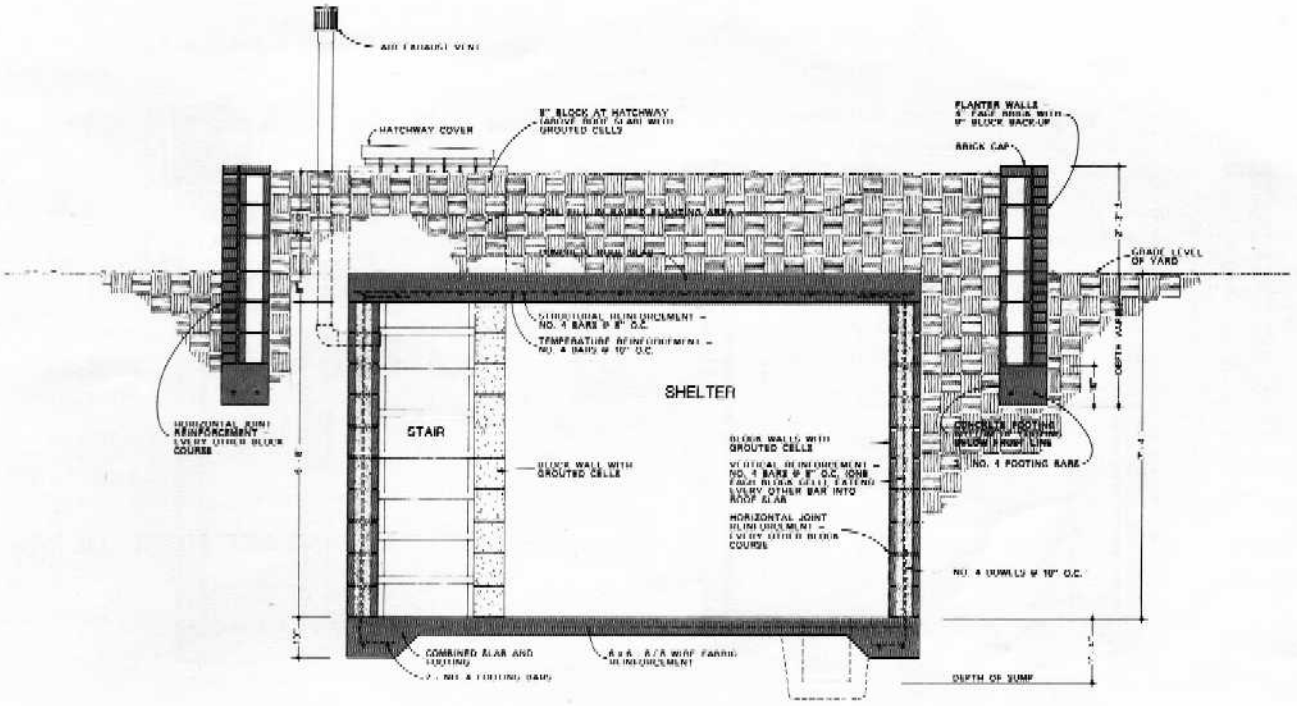
The shelter plans shown on subsequent pages may be modified within certain limitations as may be necessary to meet particular needs of the homeowner. To accommodate more than six occupants, increase the length of the shelter 2' - 8" for each two additional occupants. The width of the shelter should not be increased unless the roof structure is redesigned. The roof structure of the shelter illustrated is designed to span in the short dimension, and new engineering analysis is needed for longer spans.

Other designs for an elevated planter and for access into the shelter are possible without changing the basic shelter. Each homeowner's preference for landscape character can be met in this phase of the work.

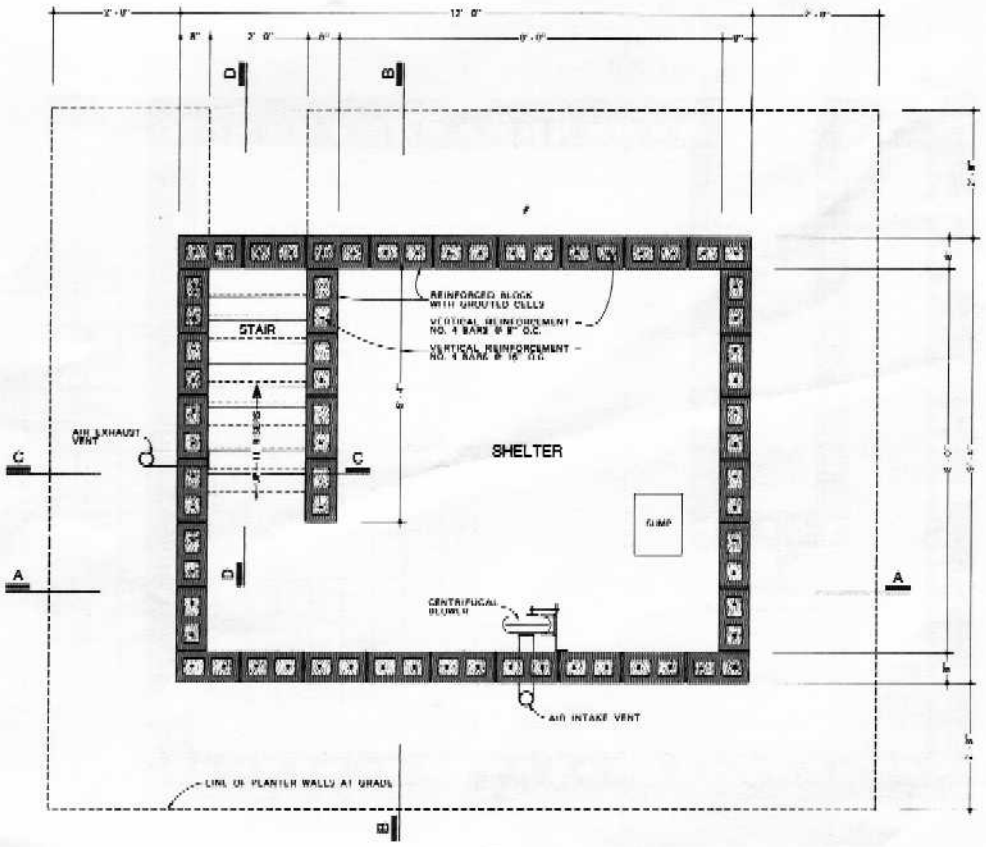
Piping for water may be added during construction—such as for the swimming pool filter equipment that is illustrated.



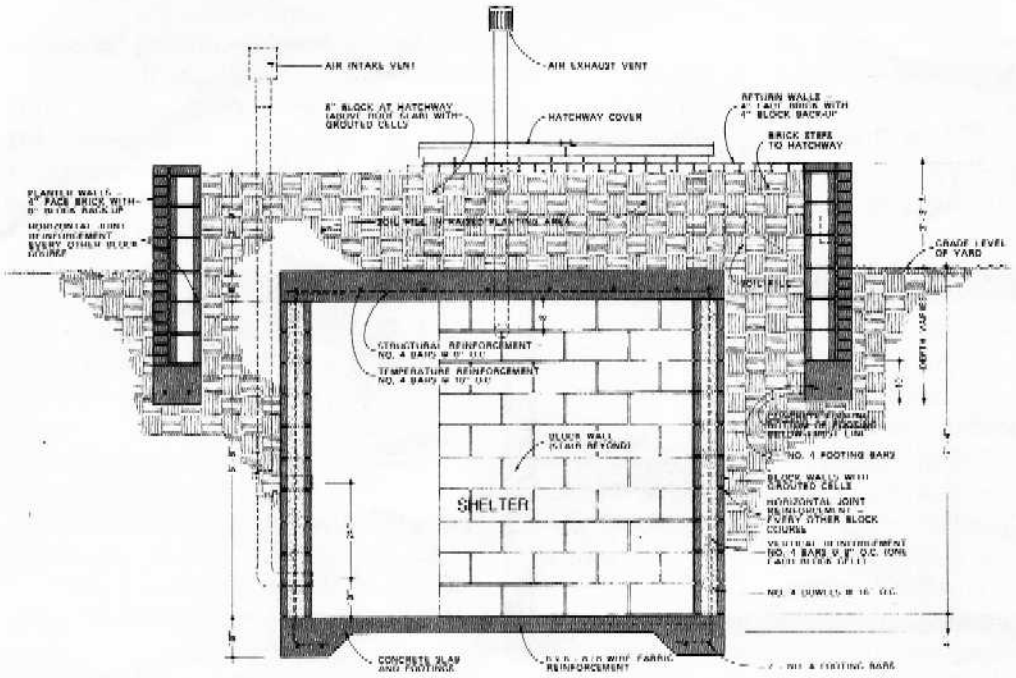
PLAN OF PLANTER AND HATCHWAY AT YARD LEVEL



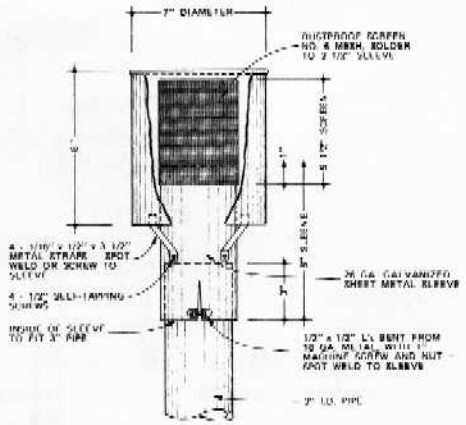
CROSS SECTION A - A



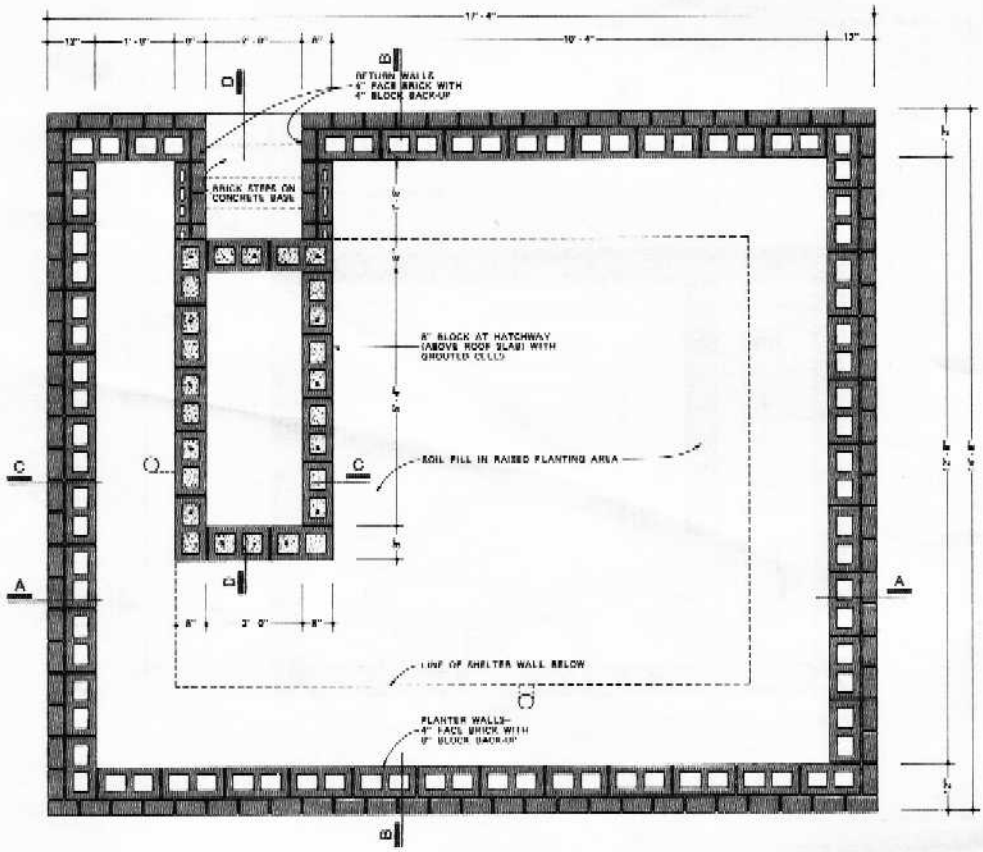
FLOOR PLAN OF THE SHELTER



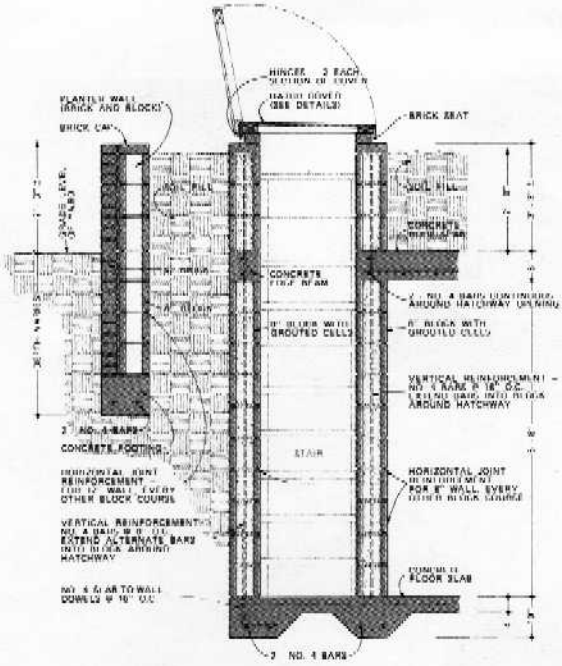
CROSS SECTION B - B



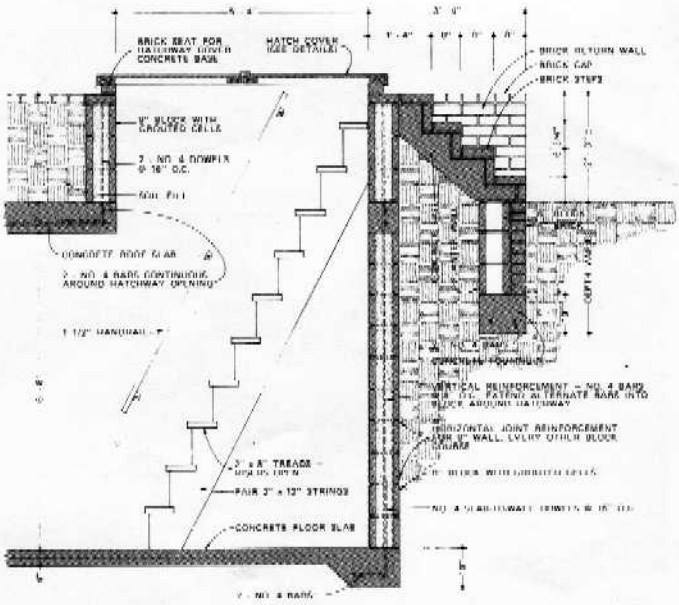
AIR INTAKE HOOD DETAIL



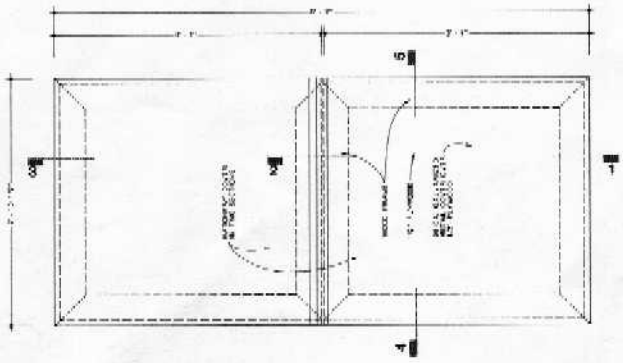
PLAN SHOWING PLANTER WALLS AND HATCHWAY WALLS



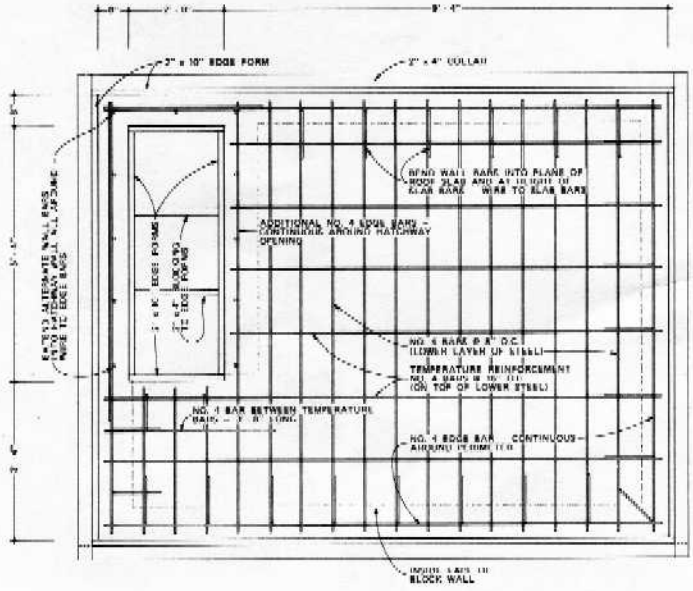
SECTION C - C AT HATCHWAY



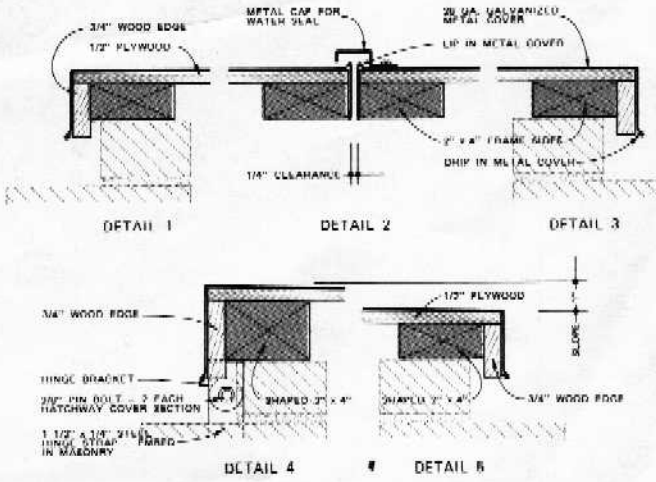
SECTION D - D AT HATCHWAY



PLAN OF HATCHWAY COVER



ROOF SLAB REINFORCEMENT PLAN



HATCHWAY COVER DETAILS

△ U.S. GOVERNMENT PRINTING OFFICE: 1988 519 357/63051

LIST OF CONSTRUCTION MATERIALS

MATERIAL	ITEM	GRADE	SIZE	QUANTITY*
FORMWORK LUMBER**	Roof Slab, Footings	Construction	2" x 10"	184 lineal ft.
	Shoring	Construction	2" x 6"	70 lineal ft.
	Edge Forms, Shoring	Construction	2" x 4"	436 lineal ft.
	Batter Boards	Construction	1" x 4"	24 lineal ft.
	Plywood	C - D	½" x 4' x 8'	4 pieces
CONCRETE	Footing / Floor Slab	2,500 psi	— —	2.75 cu. yds.
	Roof Slab	2,500 psi	— —	2.75 cu. yds.
	Planter Footings	2,500 psi	— —	2.00 cu. yds.
REINFORCEMENT	Deformed Bars	Grade 40	No. 4	1,134 lineal ft.
	Wire Fabric	ASTM A185	6 x 6 - 8 / 8	108 sq. ft.
	Joint Reinforcement	Trussed Wire	For 8" Wall	228 lineal ft.
	Joint Reinforcement	Trussed Wire	For 12" Wall	130 lineal ft.
	Prefab. Corner Reinf.	Trussed Wire	For 8" Wall	20 pieces
	Prefab. Corner Reinf.	Trussed Wire	For 12" Wall	8 pieces
MASONRY	Block	Concrete	8" Standard	636 units
	Block	Concrete	4" Standard	10 units
	Brick	— —	Standard	2,100 units
	Mortar	Type S	— —	57 cu. ft.
	Grout	Type S	— —	94 cu. ft.
HATCHWAY COVER	Lumber	Construction	2" x 4"	18 lineal ft.
	Lumber	Construction	3" x 4"	6 lineal ft.
	Plywood	C - D	½" x 4' x 8'	1 piece
	Edge Trim	No. 2 Pine	1" x 4"	24 lineal ft.
	Sheet Metal	Galvanized	26 Ga.	28 sq. ft.
	Hinges	— —	— —	4 pieces
STAIR	Strings	No. 2 Fir	2" x 12"	24 lineal ft.
	Treads	No. 2 Fir	2" x 8"	20 lineal ft.
VENTILATION	Centrifugal Blower	— —	— —	1 unit
	Wall Sleeves	Steel or ABS	8" Long	3 pieces
	Piping	Steel or ABS	3" ID	22 lineal ft.
	90° Elbows	Steel or ABS	3" ID	2 pieces
	Tees	Steel or ABS	3" ID	1 piece
	Intake Filter	— —	— —	1 unit
	Exhaust Hood	— —	— —	1 unit
MISCELLANEOUS	Stakes, String, Nails, Wire, Other Fasteners			— —
	Plumbing Piping (Optional)			
	Electrical Wiring (Optional)			— —

* Materials quantities do not include allowances for waste.

** Some forming lumber may be reused during different phases of the construction work.

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