

BUILDING THE SHELTER

Concrete has long been recognized as a suitable barrier against radiation. In fact, considering its cost and convenience, concrete surpasses all other materials for general-purpose shielding. The concrete shelter is easy to build and is virtually free of maintenance problems. It therefore is not surprising that many shelters are made of concrete.

Many concrete shelters are adaptations of existing facilities (basements, for example). But for maximum protection the concrete fallout shelter is an independent structure especially designed for civil defense. The underground concrete shelter not only shields its occupants against radiation but also furnishes some protection against blast and heat. Properly constructed, it provides comfortable quarters for a bombed-out family.

An experienced concrete man will have no trouble in building a fallout shelter. He merely applies the same principles of good concreting that apply to the construction of basements, foundations, walls, and floor slabs.

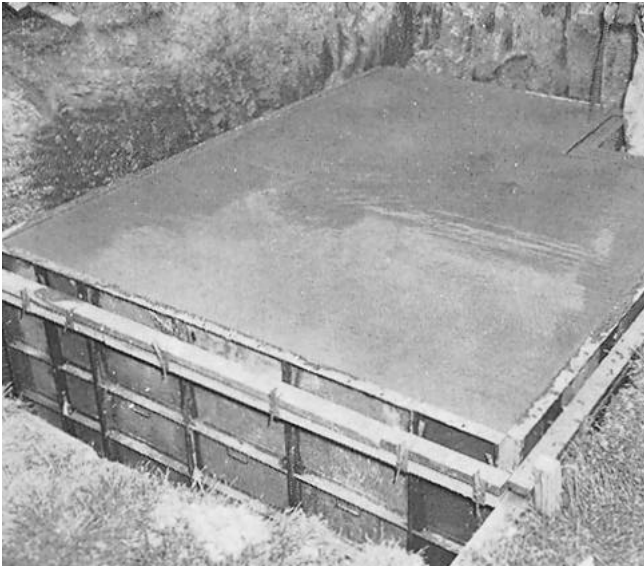
There are no special tricks involved. A regular crew can build the shelter without the services of a "fallout specialist." Any concrete contractor can tackle the job with confidence. He has all the skill and resources that are needed to deliver the finished product.

Few trends in recent years have placed the building contractor in a more responsible position than has the drive for the construction of fallout shelters. Newspapers and general-circulation magazines have taken up the cause in recent weeks with great vigor and with a crusading spirit. Engineers and professional builders meanwhile have looked with alarm on the way many shelters are being constructed. They have warned that a shelter is useless unless it is properly constructed.

Many shelters have failed to pass the inspection of municipal building authorities. Professional engineering groups have cited numerous instances of structural weaknesses and poor job practices. Thus the responsible builder faces a challenge. If he is called upon to build a



Shown here is a fairly monolithic underground survival shelter being constructed in Excelsior, Minnesota.



The walls and roof of this underground shelter, photographed while the water sheen was still plainly visible on the slab, were cast all at one time using prefabricated forms.

shelter, he should do his best to achieve the maximum in workmanship and engineering standards. Otherwise he casts a shadow on the entire industry.

There are many kinds of fallout shelters, but the preferred material by a wide margin is concrete. Some shelters are tucked into basements, others adjoin garages, and some are placed in their own locations underground. Many shelters are dual-purpose rooms. That is they provide fallout protection but also can serve as family rooms or basement playrooms until the awful day when the bombs begin to fall.

The concrete underground shelter in its own location surpasses all others in many respects. It provides absolute protection against radiation. The cost is reasonable, and the design is simple. The contractor may be called upon to remodel a basement or to build a dual-purpose addition. But if he is seriously interested in building shelters, he will give a great deal of attention to the plans and specifications for underground shelter. An underground facility is what most people have in mind when they speak of a bomb shelter.

In building a fallout shelter, the experienced contractor turns instinctively to prefabricated forms. The prefabs simplify planning and eliminate time-consuming details at the construction site. Form manufacturers have rallied to the needs of both the contractor and the civil defense authorities. The manufacturers furnish complete kits for the construction of fallout shelters. Some form manufacturers also offer furnishings and accessories as a service to the builder.

The manufacturers' kits, for the most part, are based on specifications of the Office of Civil Defense and Mobilization. A kit consists of drawings, a materials list, and the necessary forming equipment. Along with their kits form manufacturers give a complete cost breakdown for a concrete shelter. Most shelters are priced to the consumer in the \$1,500 to \$2,000 range. A shelter of course can be as elaborate as the buyer wants to make it. Some

affluent persons have put thousands of dollars into luxuriously appointed shelters.

A typical OCDM six-person shelter has an inside measure of 12 feet by 9 feet. Structural walls are eight inches thick—the standard thickness for a concrete radiation shield. Half-inch reinforcing rods run through the walls vertically and horizontally. Corner reinforcing bars are lapped two feet three inches. The rods extend to within three inches of the outside face of the walls.

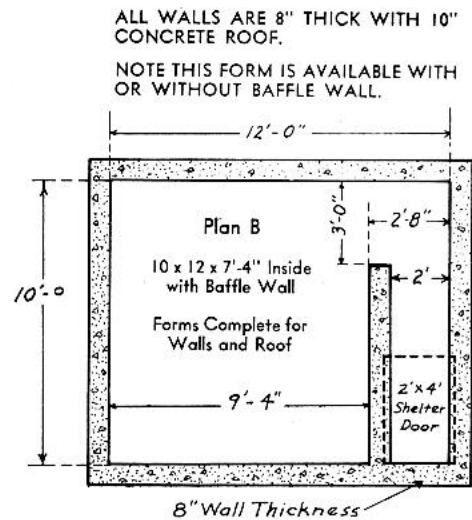
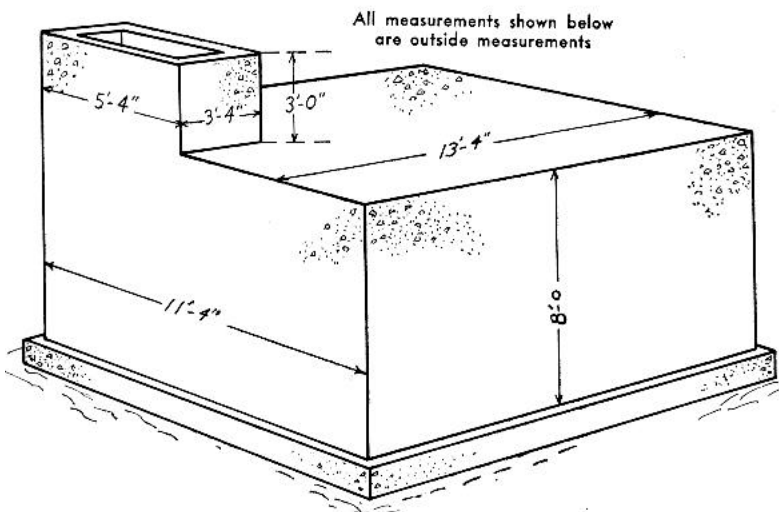
Box outs and sleeves for ventilation pipes are inserted between the forms before the concrete is placed. Two pipes extending no more than three feet above the ground ventilate the shelter. One pipe brings fresh air into the shelter, and the other pipe exhausts stale air. The pipes, as a rule, protrude at opposite ends of the shelter.

The intake pipe is covered with a hood and a screen. It is connected at the wall in two places. At one point it feeds into an ordinary outlet. It is connected to a blower at the other opening. A cap covers the ordinary opening when the blower is being used. Only one opening is used for the exhaust pipe.

The floor can be sloped one fourth inch per foot to allow proper drainage. It is also suggested that a steel pipe be extended into the ground to release moisture from the faces of the walls and from the interior of the shelter. Moisture tends to accumulate when the hatch is open. A sump pump with an auxiliary hand crank should be provided to keep the shelter dry at all times.

Other form manufacturers have developed plans for a six-person underground shelter. The drawings show two types of shelters, one with a hatchway and the other with a stairway. (The stairway/hatchway option is included in OCDM plans.) Forms for the shelter can be purchased outright or rented.

Whatever the specifications, no underground shelter is worth its salt unless it is free of flooding. In building the shelter the contractor should abide by all the rules that assure watertight construction. It is always a good



This shelter form design, shown here in isometric and plan views, has been developed for use with a particular manufacturer's forming system. The same concern also offers such accessories as steel access doors, ventilating fans and brackets for the mounting of beds, tables and shelves. It is recommended that this shelter be covered with 24 to 36 inches of earth.

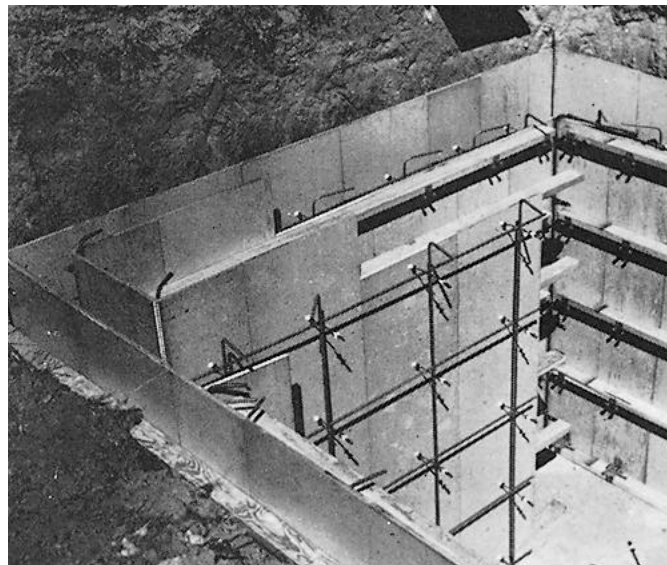
idea to cover the ground level with a vapor barrier material. Malleable asphalt hardboards, polyethylene film, and rigid plastic foam are effective materials to use for this purpose.

The floor itself has much to do with holding moisture content to a minimum. A typical shelter floor slab is six inches thick. In placing the floor the contractor should bear in mind that shelter construction demands the best in workmanship and quality control. Be particularly careful with the curing. Proper curing goes a long way toward reducing cracks and weaknesses in floor slabs.

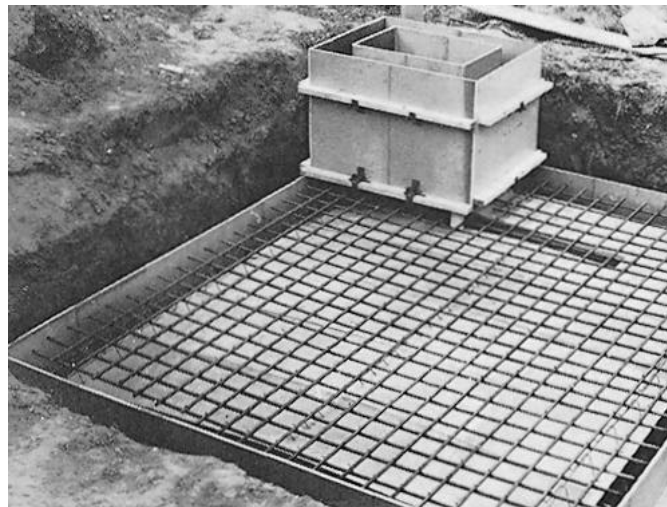
Waterproofing applies to the walls and roof as well as to the floor. The OCDM suggests that contractors coat the walls of underground shelters with hot asphalt paint. It advises builders to cover the shelter with two layers of roofing felt or other vapor sealing materials. Each layer should be cemented in place and then covered with hot asphalt paint.

The roof of an underground shelter, if it meets OCDM standards, must be at least six inches thick. If the forms permit, the roof can be thicker than six inches. Some forms allow a thickness of up to eighteen inches. The roof should be at least three feet below the ground surface. Earth above the roof adds to the shielding.

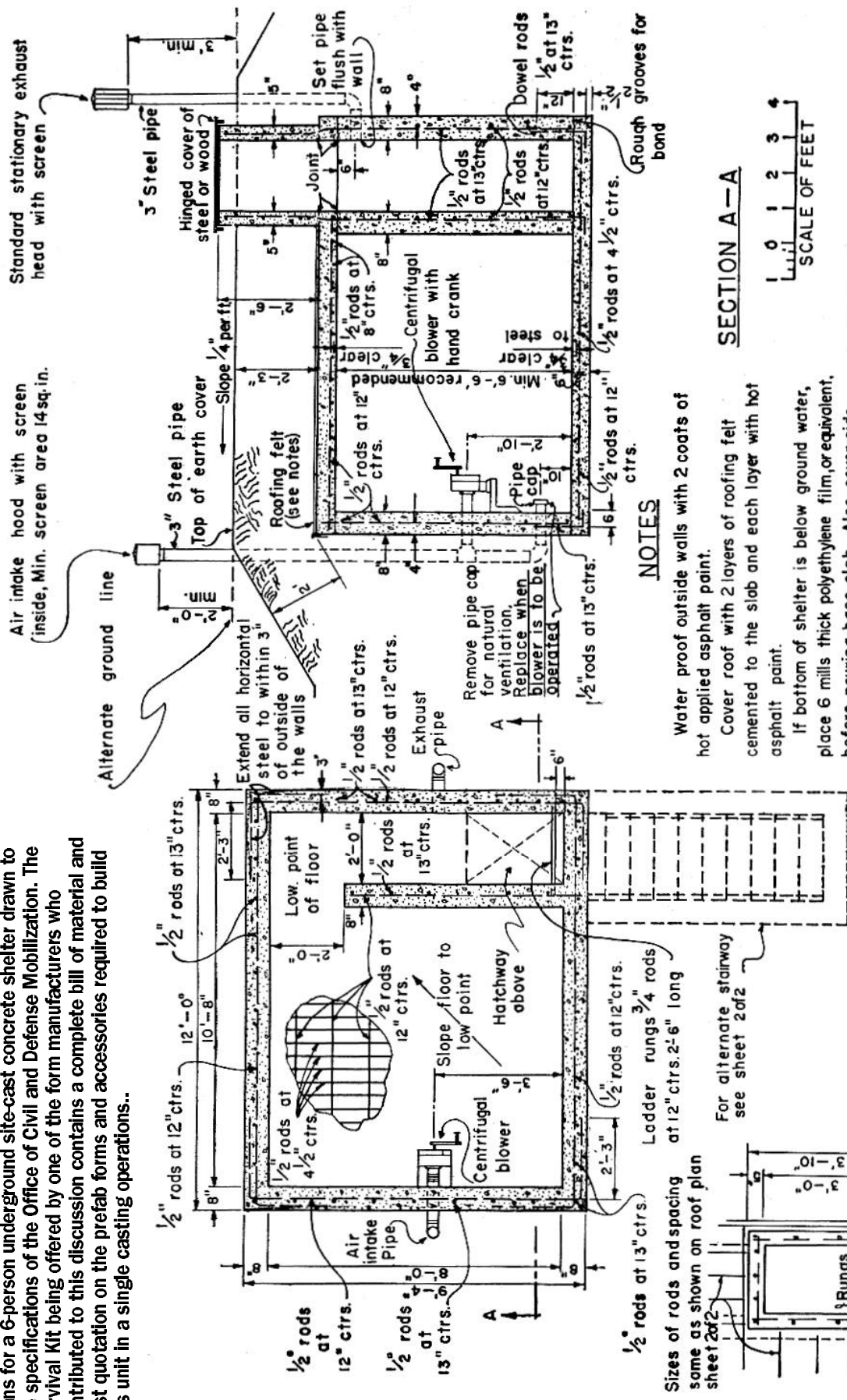
In ordering your concrete, make it clear to the ready mix dealer that you need a mix that meets the specifications for an underground shelter. Avoid at all costs the addition of extra water to your mix. Extra water invariably reduces strength and causes shrinkage and cracks. Such defects, in turn, result in a leaky shelter.



Prefab forms supplied by one manufacturer are shown above in position for casting an underground survival shelter. The scuttle entrance and baffle wall are partially formed in this view. Below, the completed form system with heavy steel reinforcing mat is shown ready for the concrete to be placed.



Plans for a 6-person underground site-cast concrete shelter drawn to the specifications of the Office of Civil and Defense Mobilization. The Survival Kit being offered by one of the form manufacturers who contributed to this discussion contains a complete bill of material and cost quotation on the prefab forms and accessories required to build this unit in a single casting operations..



Sizes of rods and spacing same as shown on roof plan sheet 2 of 2

PLAN

DETAIL OF HATCHWAY

NOTES

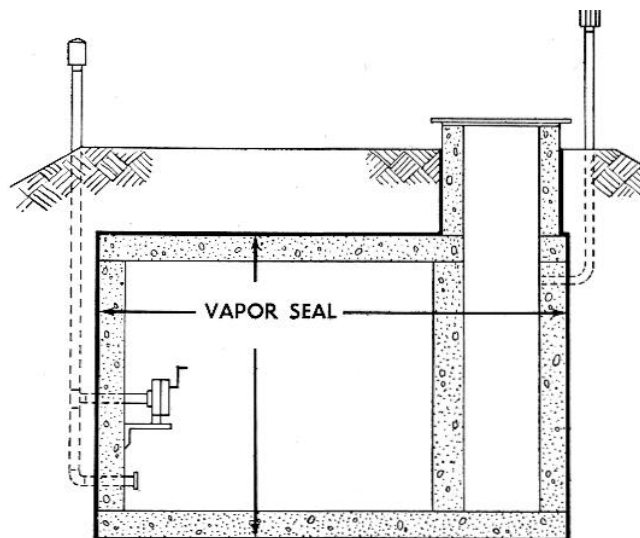
- Water proof outside walls with 2 coats of hot applied asphalt paint.
- Cover roof with 2 layers of roofing felt cemented to the slab and each layer with hot asphalt paint.
- If bottom of shelter is below ground water, place 6 mills thick polyethylene film, or equivalent, before pouring base slab. Also cover side walls and lap film under roofing.
- Splice film by overlapping and cementing.
- Hold film against walls when placing and compacting backfill.
- Bevel all exposed corners of concrete $\frac{3}{4}$ " at 45°.

SECTION A-A



OFFICE OF CIVIL AND DEFENSE MOBILIZATION
FALLOUT SHELTER CONCRETE UNDERGROUND-SIX PERSONS HATCHWAY ENTRANCE
Dwg. No. S.O.-5 April 14, 1959 Sheet 1 of 2

The drawing at right illustrates the application of a vapor seal which completely isolates a shelter from soil and moisture. An effective vapor seal assures edible food supplies, mildew-free blankets and clothing, rust-free radios and other equipment. Proper installation of vapor seals gives complete protection against moisture and seepage



Try to get the concrete delivered as close to the forms as possible. A long haul from the truck to the forms jolts the mix and causes segregation. Power buggies will speed up the delivery if the shelter is located in a spot inaccessible to the ready mix truck.

The mix for an underground shelter needs no special aggregates to provide adequate shielding. High-density concrete is commonly used for shielding in laboratories and reactors. Such aggregates as barite and magnetite increase the density of concrete. But for purposes of a fallout shelter ordinary sand and gravel will do the job almost as well.

Avoid segregation as you place the mix. Apply the concrete in even layers that are no more than 12 inches deep. Vibrate each layer enough to settle the concrete against the forms. Proper settlement and distribution will eliminate honeycombing.

Obviously the strength of the finished product is of utmost importance in a fallout shelter. Curing, more than any other factor, determines the ultimate strength of concrete. Therefore give the walls and slabs plenty of time to cure. In this instance the buyer can afford to be patient. There is every reason to hope that he won't be in a hurry to use the shelter.

You will find the shelter no more difficult to build than a foundation or an ordinary basement. One manufacturer of forming systems reports that a three-man crew using its kit and forms can set up the equipment and place the concrete in a single day. The package includes hardware, bathe wall, steel slab ports and necessary dimensional lumber.

Detailed plans are furnished for setting the forms and installing reinforcing steel. In addition this firm makes available to contractors a 16-mm sound motion picture of an actual shelter construction. Accessories such as bunk beds, shelf brackets, ventilating fans, and steel access doors are also available. Tie-ends extend into the shelter to provide attaching points for bunks and shelf brackets.

The contractor would do well to acquaint himself with all the details of furnishing a fallout shelter. His customers, in all likelihood, will ask questions about food, water, power, communications and first-aid supplies. The curious homeowner will probably demand a short course in atomic energy along with the usual curbstone lecture the builder must invariably deliver to side walk supervisors.