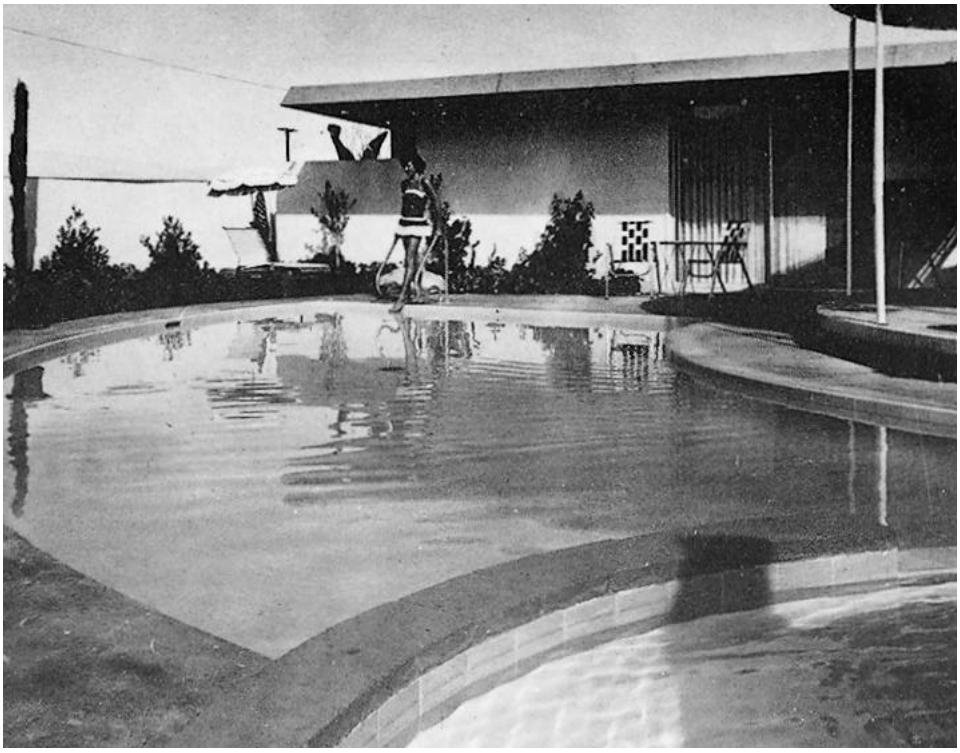

POOL MATERIALS. In 1957 pneumatically applied concrete accounted for 72 percent of all the pools built; in 1959 this method of application accounted for only 54 percent. Cast-in-place concrete accounted for 23 percent of all the pools built in 1959 (up from 11 percent in 1957); in the same year vinyl or nylon liner accounted for 15 percent, and fiber glass, steel, aluminum and other materials for 8 percent.

SWIMMING POOLS . . .

Another rapidly expanding construction market in which concrete has no serious competition

The swimming pool business makes a greater splash in the national economy each year. Right now, more than 170,000 American families enjoy recreation in their own pools. Before the end of 1960, according to estimates, around 50,000 more families will have joined the throng. In addition, thousands of municipal and club pools, and pools for motels, apartment buildings, schools, hotels, and neighborhood groups have been or are being built. It is small wonder that constructing swimming pools and supplying accessories for them has become a better than $700 million business since 1948. And this seems to be only the beginning.

During the past twelve years, ready mixed concrete has proved the most popular material for pool construction. Cast-in-place and pneumatically applied concrete has accounted for about 85 percent of all pools built. The durability and beauty of concrete are two reasons for this. Another is the infinite variety of shapes into which concrete can be molded.

Rectangular pools are by no means outmoded. But many buyers want oval, circular or free form shapes such as the kidney. Some pools require unusual combinations of curves and straight lines to fit specific sites.

It is, of course, both possible and quite economical to produce concrete in a wide variety of pleasing colors. Not only can pool walls and slabs be cast with integral color right in the concrete, but surrounding decks may also be colored to harmonize with settings and help eliminate glare. Abrasive grains of various types may also be worked into pool decks during finishing to produce safe, non-slip concrete surfaces. These plus values should, of course, always be provided by the contractor at the time a pool is installed, for experience indicates that later surface treatments may be both costly and unsatisfactory.

There are three ways to use ready mixed concrete to construct a swimming pool. The builder or contractor may cast the concrete into rigid forms. He may use any one of a number of machines to spray a relatively dry concrete on the sides and bottom of an excavation. Or he may use a similarly dry mix and pack the concrete against the excavation. The dry pack method, which demands that the installer have a great deal of experience and know-how, as well as a crew of genuine craftsmen, probably accounts for a very small percentage of all the concrete pools installed. Each of these methods has its own problems and techniques and each will be discussed generally here.

A few concrete pools are built above the ground, but the majority consist of a shell placed in an excavation. Consequently, pools must be designed to withstand water pressure from within. When pools are empty they must also resist earth pressures from without. Soil type, climate, and other local conditions will influence pool designs, the need for anchorage, and the thickness of walls and floor.

Many soils will require a subsurface drainage system. A line of tile under the deepest portion of the pool and around the outside of the wall footings affords good protection. For large pools, additional tile should be placed under the floor. Where subsoil drainage is slow, a bed of sand or cinders can be laid as the floor base. The bed should be thoroughly wetted, tamped and rolled.

Pool builders should be aware of such problems as expansive soils and frost upheaval. Expansive soil, particularly clay which is normally dry, can produce lifting forces as high as 400 pounds per square inch—more than enough to crack even reinforced concrete. Where either soil expansion or severe frost upheaval are likely to occur, consideration should be given to the possibility of overexcavating the pool area to provide for about 12 inches of gravel or permeable sand between soil and the structure at all points. An asphalt liner may also be used between the concrete and the gravel.

The durability and watertightness of concrete depend on the water/cement ratio. For swimming pools, concrete containing not more than 6 gallons of water to each sack of cement is recommended. In regions where freezing winter weather is the rule, the amount of water should be reduced to 5 _ gallons per sack. The sand, cement and aggregate ratios should be such that they provide a workable texture, neither too harsh nor over-sanded. The consistency of the concrete mix, as measured by the slump test, will depend primarily on the amount of water it contains. A common mix design for swimming pools is 1:2 1/2: 3 1/2. However, soil conditions, climate, and temperature will influence the exact proportion.

There appears to be considerable agreement that all swimming pool concrete should be air entrained for winter freeze-thaw resistance and because air entrainment actually reduces permeability. Air entrained concrete is also somewhat more workable, exhibits less segregation and bleeding, permits a reduction in water content, and has better finishing characteristics.

Some authorities also believe that a water reducing agent should be used in conjunction with the air entraining agent in pool work to provide further reduction in the amount of water needed for placement and resultant higher strengths in the finished job. Permeability can also be further reduced by the proper use of a water reducing agent.

Large pools for communities, clubs or schools are almost always built with cast-in-place concrete. Generally they are rectangular in shape and must be carefully designed and engineered to fit local conditions.

A common type of large pool design consists of cantilever walls and a separate floor. Walls for this type of pool are usually 10 inches thick; the floor should be 6 to 8 inches thick. The amount of steel used to reinforce a concrete pool will depend on factors such as temperature range, distance between joints, and the quality of the concrete. As a rule horizontal steel should be .0025 times the cross-sectional area of the walls. If the subsoil and drainage is good, about one-half this amount will be sufficient for the floor.

Expansion joints are used in large pools to allow for expansion and contraction of the concrete due to temperature and moisture changes. The most common types of joints consist of polyvinyl acetate or rubber waterstop or mastic fill, or combinations of waterstop and mastic fill. Some builders prefer to use waterstop and mastic fill. Some builders prefer to use waterstop with a piece of non-extruding-type premolded expansion joint filler placed in both the top and bottom of the waterstop. An advantage of the mastic fill type of joint is that defects can be easily located and repairs quickly made without the removal of a large volume of concrete.

Local conditions to a large extent

NUMBER OF POOLS BY AREA

	Jan. 1956	Jan. 1958	Jan. 1960
Pacific Coast	29,000	62,400	102,400
Texas & Mid-South	9,000	21,900	45,900
Arizona, New Mexico & Mountain States	3,200	5,9001	5,600
Florida	3,800	10,100	24,500
Midwest	5,000	15,000	30,000
East	6,000	17,700	35,800
Totals	5 6,000	133,000	254,200

dictate the location and spacing of expansion joints. However, 60 feet should be the maximum distance between the joints. They should be placed where the tendency to crack will be greatest. These places are at the junctures of walls and floor and where there is a sharp change in the floor grade.

It is possible to schedule concrete placing operations to avoid the need for construction joints within the walls and the floors. Horizontal joints between the floor and the walls can be made by bonding the new to the hardened concrete. For a lasting bond, the hardened surface should be roughened, thoroughly cleaned, and wet down. Then the surface should be slushed with a coating of cement grout and the new concrete placed before the grout has begun to set. Where fresh concrete must be bonded to hardened concrete, many builders prefer to install a mastic sealer-type of joint. The old and new sections should be keyed together by embedding a chamfered strip in the plastic concrete, rather than by cutting a keyway in the hardened concrete.

Hand spading, rodding, tamping or mechanical vibration will place and compact the concrete satisfactorily. Mechanical vibration works especially well with mixes stiffer than those ordinarily placed by hand.

Curing is a particularly important step in swimming pool construction. Proper curing reduces shrinkage of the concrete and increases its strength and watertightness. The exposed surfaces should be kept moist for at least 7 days, and in some cases, twice that long.

Small pools for residences and for hotels and motels account for the majority of pools built each year. In 1958, nearly 80 percent of these pools ranged in size from 15 by 30 feet by 20 by 40 feet. Private and semi-public pools are more likely than the larger municipal pools to be of the round, oval, or free form shape.

The use of flexible, reusable forms of steel or wood has made it possible to cast various curved shapes with concrete. However, in any shape plastic concrete exerts considerable pressure against formwork, which must therefore be as rigid as possible to prevent uneven wall surfaces. Curved forms to construct kidney and similar shapes will need special cross-bracing.

Reinforcing steel for a small pool need not be as heavy as for a large one. As a rule, 3/8-inch diameter intermediate grade billet steel on 6- to 12-inch centers is adequate. Some of the vertical rods will be bent and tied into the bond beam. These rods should be _ inch in diameter and somewhat longer than the others.

Forms for small pools should be set for casting walls at least 8 inches thick; floor should be at least 6 inches thick. Because of their size, small pools are often cast monolithically, dispensing with expansion and construction joints. Often the floors curve into radius corners instead of meeting the walls at 90 degrees. In the deeper parts these curves are often as much as 30 degrees. The walls in the deeper parts are placed first and the bottom of the inside forms left open. The concrete is dammed until it stabilizes and the excess mix is used to begin the curve in the floor. Concrete for the floor is dumped directly into the excavation, spread with shovels, and worked in with the concrete at the base of the walls. The corners will have about an 8-inch build up.

In cases where the floor is cast before the walls, the addition of a plasticizer will retard setting sufficiently to permit a monolithic pour. Many builders cast a one-foot high section of the walls before casting the floor. They then unite the bottom of the wall with the floor and complete the wall.

After the forms are removed and the plumbing completed, the walls should be trimmed. At this point, the skimmer opening can be cut in, if it was not provided for earlier by a wooden frame fitted between the forms. Equipment to keep the water clean is fitted in the skimmer opening. The pool is then backfilled and the placing of the bond beam completes the construction.

Pneumatic application is believed to account for about 60 percent of the pools constructed with concrete. This technique requires forms only for the bond beam. The reduction in formwork represents a considerable saving in labor and materials, but this advantage is at least partially offset by the special equipment and the skilled craftsman required to do the job. Pneumatic application should be limited to soils that can be shaped to the contour desired and which will retain the shape until the work is completed.

In shaping an excavation for applying concrete pneumatically, the excavating equipment should not remove the final 6 inches of soil around the edge. Finishers begin work with shovels and mattocks to smooth and trim the excavation once the equipment has reached a depth of two feet. The excavating machine then can remove all loose material before it leaves.

While finishing is in progress, forms can be laid for the bond beam. The bond beam forms mark the level of the pool and guide the operator. These forms must be absolutely level.

If the excavation is in unstable material such as fill or sand, it is wise to give it a flash coat of concrete before laying the reinforcing steel. Many builders prefer 3/8-inch

VOLUME TREND. For seven consecutive years the number of pools constructed has increased by one-third each year; the dollar volume by 25 percent. In 1959 more than 70,000 in-the-ground pools were built, of which 46,200 (or about 2 out of 3) were residential. Trade estimate for 1960 is for 85,000 new pools at a volume of about one billion dollars. Estimates for 1970 run as high as 250,000 installations.

PRICE AND SIZE TRENDS. Today the average selling price for a residential pool is $4,160, down somewhat from a year ago. Nine out of 10 residential pools built in 1959 were 20 by 40 feet or smaller. A trend towards pools 15 by 30 feet and smaller is now in evidence, with prices ranging from $2,500 to $5,00, fully equipped. In general it is believed sound to limit the investment in a residential swimming pool to 15 percent of the value of the house.

deformed steel on 12-to 16-inch centers. The steel is extended to the top of the walls. One-half inch rods are best for reinforcing the bond beam and for the rods to be tied into the pool deck. The vertical bond beam reinforcers are often bent to form a stirrup around the horizontal rods. Beyond the 4-foot depth, it is a good idea to add vertical wall rods to have reinforcement on 6- to 8-inch centers. There should be 2 inches of clearance between the steel and the earth.

For additional floor strength, 6-by 6-inch 10-gage mesh reinforcing can be laid and extended well into the corners before the steel rods are placed. All rebound must be removed from under the reinforcement to prevent weak spots. A layer of crushed rock under the reinforcing will keep workmen from tramping the steel into the soil. It will also aid drainage under the pool and provide a firm, level base on which to spray the concrete.

Concrete for pneumatic application is a dry mix and, properly applied, it slumps very little. But the texture is rough and hand finishers must begin work as soon as the placing crew leaves.

Besides troweling the walls and floor, finishers have other responsibilities. They must clear the light niche and dry pack any small crevices that appear. They must also cut the skimmer opening.

The dry, or hand-packed pool is the third type which may be constructed with concrete. These pools can be built without forms, or with forms which simply cover the top 2 or 3 feet of the walls. Concrete slump will prevent the construction of truly vertical walls on a dry packed pool. But if no forms are used, the concrete will slump to a 10 percent grade or more.

Only inside steel or wooden forms are used. The sides of the excavation serve as the outside forms. To keep the floor area clear for workmen, the 2- or 3-foot deep forms should be supported by beams at grade level. Forms of this type are difficult to handle if they are more than 20 feet long because of the possibility of sag which will produce irregular walls. Consequently forms are usually impractical for dry packed walls more than 20 feet long.

The placement of reinforcing steel for a dry packed pool with forms is essentially the same as for a conventionally cast pool. The steel should be 3 inches away from the earth.

A 1:2:3 _ mix with 4 _ to 5 gallons of water per sack may be used, although the exact proportions will be influenced by such factors as the type of soil and the temperature. The crew must pack the mix against the excavation up to the bottom of the inside forms. Beyond the 4- to 5-foot depth, the crew will have to stack the concrete with shovels. Dry packed walls should be 8 inches thick and the floor should be at least 6 inches thick, with 10- to 12-inch buildups at the corners.

The shaping crew works each load as it is dumped directly into the excavation, shoveling and compacting the concrete to eliminate all weak points and air holes. Slump becomes a problem past the 5-foot mark. It is best to stack the concrete with the shovel turned upside down in order to pack the mix firmly and achieve an even wall build up.

As the shaping crew works past a section, finishers take over to trowel the concrete smooth. The hand packing crew will be working on the floor as the finishers complete the walls.

When the walls have been stacked to the bottom of the forms, concrete is placed directly into the forms to complete the top. If this is done while the wall concrete is still workable, there should be no danger of a cold joint forming. If the concrete has set, then a coating of cement grout should be applied first.

Some buyers prefer a dry packed pool with definitely sloping walls to give the pool a bowl-like shape. In such cases, forms are needed only for the bond beam. The excavation is finished in the same way as one for a Gunite pool and reinforcing steel placed in a similar fashion. Then the concrete is placed and worked down the sides and across the floor. The concrete is troweled as the job progresses. Casting the bond beam and curing the concrete completes the job.

Concrete pools of all sizes and types usually go through one final step before they are ready for use. The walls and floor are coated with paint or plaster.

Which of the three methods of building pools with concrete is best? That depends on the buyer's desires and needs, site conditions, and the builder's equipment and experience. For large pools cast concrete has definite advantages. For small and medium sized pools, any one of the three methods will give good results if the work is carefully done.

One thing appears certain: the demand for pools will continue strong. The movement to the suburbs, increased income, and the American liking for outdoor recreation will see to that.

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