move gradually upward as the concrete is being placed, thus giving a continuous monolithic concrete shell without any construction joints whatever. In addition to this particular advantage in construction, the cylindrical tower furnishes a housing for the riser pipe which protects it from low temperaturess and may even be utilized for storage or office purposes.

In the design of concrete standpipes, and in fact in the design of such structures of any material, the critical point is usually found in the junction of the shell with the base.

The Fulton tank above referred to is an example of a successful method that has been used to take care of the expansion and contraction at the bottom of a standpipe shell due to variations in water level and temperature. The central portion of the foundation for this tank was constructed higher than the point of contact between the bottom of the shell and the foundation. Thus, space was formed between the inside of the shell and the central raised portion of the foundation. This space was filled with an asphaltic material. The shell of the standpipe proper was not connected to the foundation but rested on a slip joint which allowed movement at the base of the shell to provide for change in the diameter of the standpipe due to variations in pressure. The top of the concrete foundation on which the shell rests was first covered with graphite paste, and sheet copper was laid immediately on top. The walls of the standpipe thus rest upon the sheet copper plate, which is free to move on the graphite.

This standpipe was constructed with sliding forms and was completed from foundation to overflow in 52 working days. It has been in constant use since 1913 and has proven entirely satisfactory.

Filters

Filters, whether of the intermittent or mechanical type, have quite generally employed concrete. The intermittent type requires large areas of filter beds, much attention and a very considerable first cost. I believe also that it is safe to say that a mechanical system of filtration is the one usually adopted in modern water works construction. A very complete and extensive plant of this kind was installed some years ago for the city of Baltimore at Lake Montebello.

Special features of the Montebello filters include handling of wash water at settling reservoirs, head house arrangement, pumping station and covered reservoirs. Complete accounts of this notable water supply development have been previously published in the technical press, and I shall therefore confine myself to a very general description of certain portions of it.

About 50,000 cu. yds. of concrete were used in the construction of the filtration plant, and most of this concrete withstands water pressure or heavy loads. All buildings are of similar design and have reinforced concrete framework.

No waterproofing compounds were used in these structures, as good workmanship and materials were relied upon for securing waterproof work. Steel forms were used in the construction of the groined arches and walls and columns, but were not found to be entirely satisfactory for columns and arches on account of difficulty in erecting and removing them. The steel forms for walls were entirely satisfactory.

It is worth while to note in passing that at the present time steel forms are available for construction of this sort, which add a great deal to the ease with which it can be accomplished, and I feel quite sure that in the design of such a filtered water reservoir at the present time, a flat slab construction would be used in place of the groined arches and that standard steel forms for columns and slabs would be used.

The concrete filter tanks of the Montebello filters are 32 to 35 ft. outside dimensions and are supported on the reinforced arches forming the roof of the filtered water reservoir.

The head house of the Montebello filters is also of concrete and a feature of it is the elevated tower 4 ft. square and 80 ft. high, containing the chemical storage bins. This tower has 15 bins which will each hold about two carloads of chemicals.

The pumping station is circular in plan, 84 ft. in diameter, with its walls concentric with the intake shaft and 16 ft. in diameter. The intake shaft is located with its centre over the axis of a 12-ft. tunnel that brings the city water supply from Lock Raven. The bottom of this tunnel is 49 ft. below the floor of the pump pit, or 72 ft. below the surrounding ground level.

Pump Houses

The use of concrete in the construction of buildings of a general nature is too well known to need any particular comment. A pumping station, of course, has some special features required by the fact that it houses machinery and boilers. A pump house best adapted to its purpose, therefore, is one which will be free from vibration, furnish adequate light and afford security against fire. These requirements are all most ideally met by concrete.

An interesting example of pump house construction is that recently completed for the city of Louisville, Ky. This pumping station is located on the bank of the Ohio river just east of the city's old pumping station. As the structure had to rest on sand and gravel, and as it was necessary to build the foundation so as not to affect the adjacent buildings, the open-dredging-well caisson method was used. Outside dimensions of the caissons were 90 ft. square by 33 ft. deep, with a bay on the river side 61 by 22 ft. and 33 ft. deep. Interior cutting edges were 5 ft. 2¼ ins. above outside cutting edges, thus allowing room for a working chamber in case obstructions were encountered, compelling conversion of the caisson from the open well to the pneumatic type.

However, this contingency did not arise and the caisson was sunk to its final resting place without mishap. After filling the dredging wells, the foundation became a solid block of concrete 90 ft. square by 28 ft. thick under the main house, and 51 by 22 ft. by 16 ft. thick under the bay.

On this foundation the substructure, extending to the main floor level, was built. This is 83 ft. square at the bottom and tapers to 75 ft. square at the main floor level, which is 7 ft. 6 ins. above high water. The inside of this part of the structure is cylindrical, 67 ft. in diameter, and forms the pump pit. Cylindrical pump pit walls were designed to resist external water pressure, and the construction has resulted in an absolutely dry pump well.

The superstructure is 48 ft. high to the under side of the roof. The walls between the large windows form a series of piers supporting, in addition to the roof loads, runway girders for a 30-ton crane.

No concrete shows on the face of the superstructure, but back of the 6 and 9-in. ashlar surface is a concrete wall 30 ins. thick, which in reality amounts to piers between the high windows and, as previously noted, supports the runway girders for the 30-ton crane. Stone facing was used in order to make the new station as much like the old one as possible in external appearance.

Fuel Oil Tanks

At the present time there is a very marked tendency to use fuel oil in the place of coal for the generation of power. There are certainly many advantages to be derived from the use of this fuel. It does away with a considerable amount of the handling expense, leaves no ashes and cinders to be disposed of, and produces but relatively little smoke. Firing with fuel oil is a simple matter and effects economy in labor.

In order that fuel may always be available and that the purchasers of it may have the opportunity to take advantage of market conditions, storage capacity should be provided. The storage of fuel oil has been, and is still, subject to considerable discussion, especially in regard to the effect that the presence near buildings of such combustible material has on the fire hazard. It is my understanding that there is an almost universal practice to add a very heavy penalty because of the presence of fuel oil in open tanks above ground. This penalty, however, is not added when the oil is stored