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TYPES OF WELLS

There are many types of wells in use, and the type that is chosen by a builder, home owner, or architect is often determined by local conditions. For example, shallow wells are not always an option. And when they are, they may not be the best choice. Drilled wells can be used in all building plans, but they are expensive. This can be a drawback.

Pump selection often depends on the type of well the pump will serve. A submersible pump can be used in a shallow well, but it rarely is. A single-pipe jet pump is not suitable for installation with a deep well. It is important to install the right pump for the job. To do this, you must understand wells and the requirements associated with them.

DUG WELLS

Dug wells were very common a hundred years ago. They are still used occasionally in today's building world, but they are rare. A dug well is used when ground conditions allow the well to be dug to a suitable depth. Most of these wells range in depth from 20 to 35 feet. Deeper wells are possible, but the deeper they are, the more difficult it is to keep them from caving in.

As a young plumber I worked with dug wells in Virginia. Back then the piping installed in the well was galvanized steel. The process required to remove such piping was labor intensive. It was not possible to attach the piping to a motorized reel and wind it up out of the well. We had to set up a tripod and lift the heavy steel piping up, section by section, until we could secure a portion of it in the tripod. Then we would use pipe wrenches to unscrew the threaded joints. We repeated the process until the last piece of piping was out of the well. That was hard, heavy work.

The dug wells I used to work on were lined with rocks. Brave—or stupid—plumbers would sometimes use the rock walls to climb down into the wells. I never did that, but on two occasions I watched another plumber do it. He put his back against one wall and placed his feet on the rocks used to secure the opposite side of the well. Little by little he wiggled his way down into the well. The rocks were damp and slippery, and it was not uncommon for snakes to inhabit the rock lining. To say the least, this was hard-core plumbing.

It has been more than 30 years since I worked with a dug well, but they still exist. I know where three such wells exist in Maine today, in spite of the fact that much of Maine is too rocky or sandy to support dug wells. Many of them have been decommissioned and replaced with drilled wells.

Dug wells are generally shallow and have a diameter of 3 to 4 feet. They are not a great water source. First of all, they can run dry when there is a lack of rain. When they are in operation it is fairly common for them to become contaminated. All in all, dug wells can be used as a water supply for livestock, but they should not be considered a viable option for a modern plumbing system.

SHALLOW WELLS

Shallow wells are a more modern cousin of dug wells. These wells are constructed by boring, adhering to the same principles that were used for dug wells. Instead of rock walls being used to support them, preformed concrete sections line modern shallow wells. Sections of concrete are positioned in the well so that they stack on top of each other.

Once the concrete casing is installed it must be grouted to prevent groundwater from entering the well. Surface water and water near the ground surface can contaminate a well, which is why grouting is so important. A large concrete cover is placed over the well casing once all well and pump work is completed. The cover is sized to fit the casing that rises to a point above ground level. Gravity holds the cover in place.

Because of the limited depth of a shallow well there is a risk that it will not maintain a suitable water level during dry weather conditions. As a home builder in Virginia I had many shallow wells installed. They normally worked fine. But there were some hot, dry summers when the water table dropped to a point where the wells had difficulty recovering from use. There was basically nothing that could be done about this situation. It is possible to haul potable water in by truck and fill the well, but I can't recall this ever being done.

Another problem that I have seen with shallow wells is that, over time, they can fill in with sand. There is space below the concrete casing that can allow sand to seep into the well, which causes problems in the plumbing system.

Sand that builds up in a well can come through the water service piping and enter the water distribution system. Obviously, nobody wants sand in their drinking water. The grit does a lot of damage to the fittings, pumps, faucets, and fixtures in a plumbing system.

If a shallow well is deep enough, the drop pipe that contains the foot valve can be shortened when sand invades the well. This raises the level of the foot valve and gets it out of the sand. If a builder suspects sandy soil, then a drilled well is a better option than a shallow well.

Aquifers shift for various reasons. One thing that is known to change underground water flow is road construction during which the blasting of rock is required. There are entire geographic areas in which heavy blasting resulted in wells failing.

Shallow wells depend on specific aquifers in many cases. If the aquifer changes direction and no longer passes within range of the well, the well will dry up. Because of their shallow nature, these wells are susceptible to many potential failure possibilities.

DRILLED WELLS

Drilled wells are more expensive to install than shallow wells, but they are far more dependable. Well drillers can drill through solid bedrock when creating a drilled well. Depths for these wells vary, but most are at least 125 feet deep. My personal well is a little over 300 feet deep, and there are some that are far deeper. An average depth would probably be somewhere in the range of 200 to 250 feet.

The diameter of the casing for a drilled well is normally about 6 inches. This steel casing extends a little above ground level and is covered with a steel cap. The depth to which the casing is installed varies. Essentially, steel casing is installed until the well is encased with bedrock. Grouting is pumped in around the casing to seal the annular space where the casing meets bedrock. This type of construction provides very good protection from well contamination.

Because of the depths of drilled wells, they are rarely affected by dry weather conditions. Shallow wells use a large diameter to store water. Drilled wells use a tall column of water to maintain a suitable water reserve. Both methods work, but drilled wells are the most dependable type of well used for habitable structures.

DRIVEN WELLS

Driven wells, also known as *well points,* are not widely used. They are unreliable and subject to water contamination. People do use driven wells, however, to obtain potable water. Personally, I would not trust the water taken from a well point.

Driven wells are simple in structure. A well point is installed on a drive pipe, which is then driven into the earth. Sections of piping are added as the point is driven deeper. The well point is equipped with a strainer through which water is drawn.

There are many problems associated with well points. The only water available from them is the water that surrounds the point. There is no well system holding a water reserve. Sand can clog the strainer on a well point and render it essentially useless. Depth is another factor. It is not uncommon for well points to stop at a depth of around 20 feet. Others never reach this depth. All in all, I do not consider well points a suitable solution for obtaining potable water.

JETTED WELLS

Jetted wells are not often talked about. The diameters of these wells can range from 2 to 12 inches. Particular soil conditions might prohibit the use of a jetted well. For example, jetted wells cannot be installed in bedrock, limestone, or sandstone. Even boulders and large, loose gravel can prevent the installation of a jetted well. When the soil contains clay, sand, or silt, a jetted well can be used. In 30 years of plumbing I have never seen a jetted well.

ALTERNATIVE WATER SOURCES

Not every home or building is supplied with water from a municipal pipeline or well. Some people get their drinking water from springs. Others obtain water from lakes and cisterns. None of these options are ideal, and contamination is a serious risk with any of these water sources. Although they work fine for irrigation or watering livestock, they are not good choices for potable water. Of the three, springs are generally the best option.

RECOVERY RATE

The recovery rate of any water source must be known in order to size a plumbing system appropriately for the situation. A plumber can determine the minimum daily usage for a plumbing system. A plumber must also size a plumbing system based on the minimum flow rate and the quantity of water required for various types of plumbing fixtures. This is done using tables and information found in the local plumbing code. Table 1.1 is an example of such a table.

The two types of wells used most often are drilled wells and bored wells. A bored well uses a large diameter to store water. Drilled wells use

Table 1.1: Flow Rates and Quantity of Water Required

Plumbing Fixture or Fitting	Maximum Flow Rate or Quantity
Private lavatory	2.2 gpm at 60 psi
Public lavatory	0.25 gal per metering cycle
Public lavatory (unmetered)	0.5 gpm at 60 psi
Showerhead	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Urinal	1 gal per flushing cycle
Water closet	1.6 gal per flushing cycle

a deep column of water as a water reserve. Both types of wells rely on their recovery rates to keep up with the demands of the plumbing system they serve.

Plumbing systems are sized based on maximum peak demands. For example, a single-family home is assigned a certain demand quantity, while a commercial building has a very different demand factor. The same could be said for a farm application, where the peak demand is based on the number and type of livestock using water.

For a residential scenario, the minimum recovery rate would likely be no less than 3 gallons per minute, and 6 gallons a minute or more is preferable. In simple terms this means that as reserve water in a well is used, the well can replenish it at the prescribed rate.

The sizing of a pump depends on the recovery rate of the well it serves. For example, a pump that delivers water at a rate of 8 gallons a minute would not be a suitable installation for a well that has a recovery rate of 5 gallons per minute. Under constant demand, the pump would drain the well faster than the water reserve could be replaced.

WATER STORAGE TANKS

Some wells have low recovery rates. One way to work around this is to install a large water storage tank. Consider this example: You have a shallow well that recovers 2 gallons per minute, which is a low rate and could cause problems when several plumbing outlets are being used simultaneously. Assume that the well described serves a large family in a home with three bathrooms, and that the family members all shower at approximately the same time each morning. The showerheads being used have a flow rate of 3 gallons per minute. With three showers running at the same time, the result is a flow rate of 9 gallons per minute. The well recovers at a rate of only 2 gallons per minute.

Say that each person spends five minutes in each shower. That is 15 minutes at 9 gallons per minute. Now factor in that the automatic dishwasher and the automatic clothes washer are being used in close conjunction with this timing. It doesn't take long for such usage to put an overwhelming demand on the well.

If there is adequate water reserve in the well, a problem will not be noticed. Once the people leave home for work and school, the well recovers over the course of the day. But apply this same reasoning to a situation where the usage is more constant for a sustained period of time. It would not take long to put a serious strain on the well if the water reserve was not substantial.

One way of getting around this is to install large, aboveground water storage tanks. The tanks provide the first water used when water is demanded at a plumbing outlet. As the reserve in the tank is depleted, the well pump cuts on and refills it. This provides a buffer against draining the well. As soon as the water demand ceases, the well can replenish its water reserve and everything functions normally. This extreme solution is rarely needed or used, but it is an option for situations where the well's rate of recovery is simply not adequate.