

## Portland Cement User's guide

### == Steps ==

# Plan your concrete project carefully. There is a set sequence of steps you must take to be successful, and following them will save you a lot of problems later on.

# Purchase or gather the raw materials for your concrete. You will need Portland type I or II cement, masonry or builder's sand or other clean sand, and if you want, as a filler, gravel or crushed limestone. The Portland cement usually comes in one cubic foot bags, weighing in at about 96 pounds each, so you may need help handling them, as well as a truck to haul it.

# Build a mixing box, or get a good, sturdy wheel barrow to mix the materials in. If it is a large project, rent a concrete mixer to do the hardest part of the work for you. We have mixed as much as 6 or 8 cubic feet with a mason's hoe and shovel, in a large plastic tub, so not having the best equipment shouldn't stop you from trying it.

# Allow yourself time to complete the whole process when you begin. If the concrete is a large "finished" slab, start early in the morning and gather all the help you can.

# Build the form you are placing the concrete in, brace it off securely, level and plumb it up, and then carefully measure the dimensions to determine the volume in cubic feet. This is done by multiplying width X length X height in feet. An example would be 5 ft. X 2 ft. X .5 ft. (6 inches)= 5 cubic feet.

# Mix Portland cement and sand at a 1:2 or 1:3 ratio in your mixing container. The 1:2 ratio will yield concrete with about a 3500 pound per square inch compression stress. The 1:3 ratio will yield somewhat less than 3000 PSI, which is typical for house slabs, footings, and sidewalks. NOTE: Although it says below (No.7) that gravel is "just filler" and won't affect the tensile strength, this means adding gravel won't weaken the concrete. True. Conversely, gravel strengthens concrete, and some would argue that cement + sand is just mortar, not concrete. If the outside temperature lowers to frost levels even for a few hours during the first 18 hours, the strength of cement and sand-only (1:3 as described above) will be severely compromised -- less than 50% strength, whereas adding gravel increases strength. You can add too much portland cement as well. It is usually best to use no more that 1 part Portland to 2 parts sand in a sand-only mix.

# Add gravel or crushed stone to the dry mixture to a ratio of as much as 5 parts gravel to 1 part cement and sand mixture. The gravel doesn't effect the tensile strength of the concrete unless you add so much there isn't enough cement paste to fill the voids in the finished concrete, and it merely acts as a filler, taking up space. Adding too much gravel can make it difficult to get a smooth finished surface on the cured concrete. Normal ratio is 1 part cement, 2 parts sand, and 3 parts gravel (trade the word part for shovel, bucket, or any other measuring device).

# Begin adding water to the mixture slowly, mixing continuously until it becomes plastic enough to place in your form. The plastic character of the concrete is measured in "slump", which is determined by filling a metal "slump" cone with the mixed, wet concrete, and lifting the cone off gently, then measuring how far the concrete sagged, or slumped. In inches, the typical "slump" of good structural concrete is about 3 or 4 inches.

# Mix the concrete until it is uniformly and thoroughly mixed, and continue mixing for 2 or 3 more minutes to begin the process of hydration, which ultimately is what causes the concrete to harden.

# Place the concrete in your form, tapping all the edges to remove air pockets and settle in firmly. Then, using a magnesium float or a smooth flat board, level the concrete across the top by dragging the tool, tilted slightly upward, across the surface of the concrete. This is known as floating, and it will float the cement paste to the surface, giving you material which you can finish either by brushing, brooming, or troweling when it begins to "set" or harden.

# Leave the concrete alone after you have floated it level and brought up some cement paste, or grout as it is sometimes called, until it becomes firm enough to finish without leaving tool marks. Doing this on a large slab or surface is done by crawling onto the slab with the appropriate hand tools on "knee boards", or pieces of plywood that you can walk on and not sink into the concrete. For very large slabs, you will need a "bull float" and possibly a power troweling machine, and this is an investment that is better left to professionals.

# Clean up all the tools and the mixing container as soon as you are finished with them. The cured, hard concrete is difficult to remove. Take special care of any rented equipment you use, as the rental company often will charge an additional cleaning fee when you return them.

# It takes approximately 5 Bags of Portland cement, 8 cubic ft of sand, and 20 cubic ft of gravel to make approximately 1 cubic yard (27 cubic feet) of concrete. The math does not appear to work, because the finer powder of the Portland cement fills voids in the mixture of sand and gravel.