

# DEMYSTIFYING MORTAR

By Carl Hagstrom



If you've ever spent time as a mason's tender, you'll swear at times that there are only two words the mason knows: "More mud!"

Mud is the mason's word for mortar. And even if you manage to keep mixing it fast enough, it seems the mud is always too wet, too dry, or just too bad!

Constant attention is essential to the mason's work. Different jobs require different mortars. The work will go more smoothly, and the results will be more professional, if the right mortar is matched to the job.

## What is Mortar?

Mortar is the "glue" that holds masonry units together. It has four basic components: portland cement (type 1), hydrated lime, masons' sand, and water.

All four ingredients can be mixed at the job site, or, as an alternative, "masonry cement" can be used to slightly simplify the process. Masonry cement consists of lime or other plasticizing materials pre-mixed with cement.

All sand must be free of dirt or any

other organic matter. In my area, quarries wash sand before trucking it.

There are detailed specifications available for grading sands, but in general, to qualify as masons' sand, 95 to 100 percent of the sand should pass through 1/8-inch hardware cloth.

In all of the specifications I've read

as well as the working properties of the mortar. The five standard mixtures are represented by the letters M, S, N, O, and K; every other letter in the term "mason work." The mixtures are described in the table below.

## Workability and Plasticity

A workable mortar is one that spreads easily and works well on the trowel. A plastic mortar clings to vertical surfaces and stays on the trowel.

Have you ever watched a mason swipe a head joint on the ear of a concrete block? He's got to have a mud that's both workable and plastic for that move.

The biggest factor affecting workability is the amount of water in the mixture. Generally speaking, the wetter the mortar,

the easier it is to work with. Keep in mind, however, that some masonry projects (ceramic counter tile, for example) require relatively dry mortar.

Sand gives body to the mortar. It allows the proper release from the trowel. Mortar without sand would be like

Standard Mortar Mixes: Ratio of Components

Type	Cement	Lime	Sand	Compressive Strength (PSI)
M	1	1/4	3	2,500
S	1	1/2	4	1,800
N	1	1	6	750
O	1	2	9	350
K	1	3	12	75

The five standard mortar mixes, shown in the table above, vary dramatically in compressive strength. As a rule of thumb, tensile strength is a little less than 1/10 the compressive strength.

regarding the water used in mortar, the standard requirement is that it be potable. This is a good rule to follow, although I will admit to building a few projects using clean pond water.

By blending these components at different ratios, you can vary the strength

## Masonry jobs will go smoother and perform better if you start with the right mix of mud

handling a trowel full of caulk. It would be highly plastic, but what a gummy mess!

Plasticity is affected by the amount of lime in the mixture. Lime makes it possible for the mortar to stick to the trowel or the surface, so high-lime mortar is plastic and easy to work with.

Cement is used primarily to add strength, but it also adds a small degree of plasticity to the mortar.

### The Effect Of Each Component On Strength

Cement is what gives mortar its strength. Before the advent of cement, around the late 1800s, mortar was made from lime and sand, and served as a leveling medium that held masonry units (stones or bricks) apart. With the addition of cement, the compressive strength (the ability to bear a load) was increased. More significantly, it added tensile strength (the ability to bond the masonry units together). This property was lacking in the older mortars.

Lime weakens the mix, but the mortar makes a more watertight joint by sealing cracks and voids more readily. The loss in strength is more than offset by the increased sealing properties in situations where excessive loads aren't expected.

Sand's function is to control shrinkage. Resist the temptation to cut back on the sand in the mix. That would make the mix more plastic, and perhaps easier to work with, but the increased shrinkage would come back to haunt you. This is particularly true with stucco base coats. A "rich" mix (high in cement and lime) goes on the wall easily, but you may come back the next day to a wall full of shrinkage cracks.

Increased amounts of water weaken the mix. Generally, this is not a problem if you keep the mix within the workable range. A slight loss of strength is preferable to the poor bond that would result from a dry, stiff mud.

### Bonding

The tensile strength of mortar is referred to as bonding. There are two basic types of bonds.

1. **Mechanical Bond.** This is best described as the way mortar forms an interlocking shape that ties it to its mate. Examples are: the first coat of



Mortar should be workable enough to spread easily, and plastic enough to extrude from joints without dropping.



When mortar stiffens due to evaporation, you can "retemper" it by adding water and mixing thoroughly. If it stiffens from hydration - especially if it has been sitting for more than 2 1/2 hours - discard it.

stucco over expanded wire lath, laying bricks with core holes, and horse-hair plaster keyed to wooden lath.

2. **Chemical Bond.** This bond is developed predominantly by the cement in the mix as it is absorbed with the water. Try putting a dry brick into a bucket of water, and you'll understand how it works. As the air bubbles pour out of the brick, water is being drawn in. In the case of mortar, cement is drawn in along with the water. The water evaporates during the curing process, and the cement remains, forming the bond.

Volumes have been written about the properties of portland cement, but a

simplified explanation should suffice here. Before it goes into a bag for your use, portland cement has been passed through a sieve containing 40,000 openings per square inch. I've seen a photograph of highly magnified cement particles after being mixed with water, and they appear as if they've sprouted interlocking hairs, forming a cementitious velcro. That 'velcro' is the basis for chemical bonding.

Obtaining a good chemical bond is influenced by a number of factors. Fresh cement is a must, especially in humid climates. Proper curing is essen-

tial. As with concrete, the slower the mud dries, the better. Those 95-degree August days when the humidity is low cause problems. When the weather is hot and dry, the best advice is to cover your work and keep it wet.

The moisture content of the masonry units is equally important. Bricks that have been uncovered and exposed to a two-inch rain will not absorb the water necessary for a good bond. Conversely, bricks that are too dry will dry water too quickly from the mortar, creating a poor curing condition. If the bricks are too dry, soak them in a bucket of water for 5 to 15 seconds prior to laying them.

### Mixing

When mixing mortar, use the freshest cement possible. That bag left over from last fall would make better backfill than mortar. Lime lasts a little longer, but use your old lime for lining out excavations.

Keep all of your materials protected from moisture. The reasons are obvious for cement and lime, but equally important for sand. Dry-mixing the components (which should be done before adding water) is a tough chore when using uncovered sand that is soaking wet. Uncovered sand can also provide some undesirable additions to your mortar. (The local cats come to mind as one example.)

Pay attention to the weather when mixing mortar. Turn your back on that wheelbarrow full of mortar on a hot, dry August day, and you may be using a crowbar instead of a shovel to get it out. The same batch might last 2 1/2 hours on a cold, drizzling March day.

Adding water to bring mortar "back to life" (called re-tempering) is acceptable, as long as the mortar mixed is used up within 2 1/2 hours, according to the Portland Cement Association. The key issue here is whether the mixture is stiffening because of hydration (chemical hardening) or evaporation. If it's hydration, the batch should be discarded. It's often hard to tell the difference, so the 2 1/2-hour time limit is important to keep in mind. In any event, during hot weather, several smaller batches are preferable to one large one.

### Coloring

Coloring mortar is a straightforward procedure. All it requires is mixing dry coloring material thoroughly with the rest of the components before adding water. I use True Tone colors (Frank D. Davis Co., Beltsville, Md.).

The difficult part is ending up with the color you want. The most foolproof method is to prepare trial mixes using carefully-measured volumes. I would avoid using coloring if a large number of mixes will be used, as maintaining consistent coloring is difficult.

Premixed finish coats for stucco are available in a wide range of colors, and there are some colored masonry cements available as well. These are easy to use, and do maintain a consistent color.

### Perfect Mud

I hope this article helps you on your next masonry project. If it turns out that your mortar doesn't seem quite right, take heart. Many good masons have spent years trying to mix that elusive batch of perfect mud.

Also, keep in mind that workability is a function not only of the mud, but of the hand that is holding the trowel. ■

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## Cold Weather Mortar Application

It's possible to work with mortar in subfreezing temperatures, but additional steps and precautions are required. The object is to keep the mortar and masonry units warm enough so that they can obtain sufficient strength before they freeze.

The first line of defense against cold weather problems is protecting your materials. Pile your sand over a length of metal culvert pipe and keep it well covered. Before using it, uncover the sand and use a kerosene torpedo heater directed into the pipe to heat the sand. Remember that in frozen sand, moisture turns to ice particles, which must be thawed before the mortar is mixed.

Keep your masonry units well covered also. A cube of bricks exposed to an inch of rain, then subjected to a weekend of 15-degree weather will be useless. Refuse any deliveries that have been exposed to excessive moisture.

As average temperatures drop, additional measures need to be

taken to extend the working range of the mortar. Cover your work with tarps, or better yet, insulating blankets (available from construction rental companies). Then use hot mixing water.

A calcium chloride admixture can be used to accelerate the setting time. The Portland Cement Association specifies a maximum of one pound per bag of cement. However, calcium chloride should never be used in mortar that has metal embedded in it. Therefore, avoid it if you are using metal ties, anchors, reinforcement, flashing, electrical conduit, or door frames.

Enclosing and heating your work area is the most effective option. Logically, it's also the most expensive. Keep in mind that it is necessary to provide adequate ventilation, particularly when heating with kerosene torpedo heaters.

Certain types of masonry work are more difficult to perform in cold weather than others. Stuccoing a building at sub-freezing tempera-

tures may require an enclosed scaffolding with supplemental heat. By contrast, laying a block frost wall that will be backfilled on both sides may simply require frost-free block and heated mortar with calcium chloride added.

Each individual situation requires its own evaluation. The ideal temperature for mortar is between 60 and 80 degrees F. The lowest permissible temperature at the time of application is 40 degrees. Sufficient hardening time is essential before the winter temperatures fall below freezing for extended periods.

Keep in mind that the colder it gets, the higher your labor costs become. When you bid the job, take into consideration the expected temperatures and increase your labor costs accordingly. If it is a time-and-material agreement, make sure your client is aware of the additional costs of cold-weather masonry. - C.H.