

Rudiments of architecture, practical and theoretical

Joseph Gwilt January 1, 1839
Priestley and Weale

OF THE MATERIALS EMPLOYED IN BUILDING.

LIME, SAND, WATER AND CEMENT. Lime is found always united to an acid, as to the carbonic acid in chalk. By exposing chalk to a red heat the acid is driven off, leaving the lime in a state of purity, which is then called caustic or quick lime. It dissolves in six hundred and eighty times its weight of water....(p44)

Before burning any of these for lime, there is no external character by which the simple lime-stones can be distinguished from the argillo-ferruginous ones ; but the former, whatever be their colour in a crude state, become white when burnt, the latter possess more or less a slight ochrey tinge. Brown lime is much the best for all kinds of cements, but the white varieties being more abundant are more general in use. To those uninformed on chemical operations, it may be useful to know, that every stone which will ferment with an acid, as aquafortis, is capable of being burnt into lime, but the harder the stone the better the lime. Chalk is not so good as stone, for reasons which will be hereafter given, that of shells the worst: neither should be used for work under water. (p45)

... Lime-stone loses four-ninths of its weight by burning, though it shrinks but little ; when fully burnt it falls freely into powder on slaking, and gives about double the bulk it occupied before that process. (p46)

... Lime is also burnt in sod-kilns, which are made by excavating the earth in the form of a cone, and then building up the sides as the earth may require. In this case the lime-stone is laid in with alternate layers of fuel to the top of the kiln, and the top being covered with sods to prevent the escape of the heat, the fire is lighted, and the lime-stone burnt, and not removed till thoroughly cool. This is a tedious process, and expensive from the quantity of fuel consumed. (p46)

Lime which slakes the quickest and heats most in slaking is best, this also falls into the finest powder ; if it contain many coarse lumps of core that do not pass through the screen, it is a sign either that the stone has not been sufficiently burnt, or that it contains extraneous matter, which will not only render it inefficient, but also more costly in

use. The experiments of Dr. Higgins and Mr. Smeaton have proved, **that if chalk and stone-limes be used equally fresh, their cementitious properties will be equal ; but as quick-lime absorbs carbonic acid with greater or less rapidity, in proportion to its spongy or solid texture, so it gradually parts with its cementing nature, and at length becomes totally unfit for the purpose of mortar.** Hence, though stone and chalk-limes be equally good when perfectly burnt and fresh from the kiln, yet there is an important practical difference between them, because the latter takes in the carbonic acid with much greater facility than stone-lime.

In the metropolis, there is now no excuse for the use of chalk-lime, except for the commonest purposes. It is received from Kent and Essex, and **often lies at the different wharfs under open sheds long enough to lose every good property it originally possessed:** whereas the stone-lime may be had at a short distance from the metropolis, not only in abundance, but of the best quality.

The lime, when slaked, must be **passed through a sieve so as to leave only a fine powder;** this is usually performed by means of a screen made of wire, set at an inclination to the horizon, against which the lumps of slaked lime are thrown. That which ought to pass through it, the remainder or core falls on the side of the screen against which the lime is thrown. For mortar the core must be entirely rejected ; it is, nevertheless, excellent as dry rubbish for filling in the sides of foundations, under wood floors, where they would otherwise lie next the earth, and the like.

The sifted or screened lime is now added to the sand, *the lime still hot?* whose proportion to the lime must vary as the strength of the latter.

It is however most important that **the lime and sand be well tempered and beat together after the water is added to them,** and the better this is effected the smaller will be the necessary consumption of lime. For this purpose, what is called a pug-mill, is the best calculated, being of the same nature as the clay-mill used for making bricks. When, however, this is not at hand, **it should be well tempered with wooden beaters, and turned over repeatedly, so as to be thoroughly well mixed.** [*beating allowed less lime to be used and was a cost saving, primarily?*]. This is an affair of no small consequence, because as the sand being by far the cheapest article of the two, it will be profitable to use as large a proportion of it as can with propriety be admitted. It is also to be noted that when the sand (p48) predominates, less water is required, and the mortar therefore sets sooner ; the work, moreover, settles less, for as the lime will shrink in drying, while the sand continues to occupy the same bulk, it follows that the thickness of the mortar-beds will be less variable. In

general no more lime is required than is necessary to surround the particles of sand. *[Gillmore would disagree].*

In London, with the common chalk lime, it is usual to mix one hundred and a half, that is, one hundred and fifty pecks or thirty-seven and a half struck bushels with two loads of sand (30 bushels); but with stone- lime one hundred to two and a half loads of sand is enough. Each of these proportions will give mortar sufficient for a rod of brickwork, which is a superficial measure of two hundred and seventy-two and a quarter square feet of one and a half brick or fourteen inches in thickness. When the tempering, however, is not well attended to, the first-named in the proportion of one hundred, or even less, of lime to two and a half of sand will suffice, and in respect of the latter, it has lately become, and properly, the practice to mix one hundred of lime with three and even four loads of sand. Dr. Higgins, in his experiments, goes so far as to recommend seven parts of sand to one of lime. **The experiments of the laboratory, however, are not always proper foundation for practice.**

... WATER, the medium through which the other ingredients of mortar are incorporated, should be soft and pure. Dr. Higgins recommends lime-water for this purpose. **The screened lime and sand are shovelled and mixed together, then the water is added, the less in quantity the better; afterwards it is tempered by beating and chafing or by passing through a pug-mill, as above mentioned. When mortar is made, it should be used immediately, that is, supposing the lime to have been well burned.**

In respect of that used by plasterers, who employ an inferior lime, it is the practise to **make a large quantity of mortar at a time, and either bury or cover the fresh lime with a yard or so in thickness of sand, and then pour on as much water as will slake it, but not reduce it to dust.** If the sand open, and the smoke rise through the openings, these should be closed up...(p50)

CEMENT. So far with respect to common mortar: but in **works under water** it is necessary to use a cement that will harden quickly in those situations, **which common mortar will not do**, though it may stand the water well enough when entirely dry, and set.

No cement answers the condition so well as that known by the name of Parker's cement, which is burnt from a lime stone found on the Isle of Sheppey. This becomes, in a few minutes, exceedingly hard, either in or out of the water; and wherever the work is exposed to agitated water, the outer beds should be laid in this cement. In many parts of England a lime-stone is found which, when burnt and used in mortar, gives it the property whereof we are speaking. The best species of these (p51) lime-stones is the Aberthaw from the Welch side of the

Bristol Channel. Mr. Smeaton found the stone of Watchet, in Somersetshire, also excellent in this respect, and traced it through the counties of Monmouth, Worcester, Leicester, by the Vale of Belvoir into Nottinghamshire, in Lincolnshire at a place called Long Bennington, also in the counties of Dorset, Hants, Sussex and Surrey ; in Lancashire it goes by the name of Sutton Lime. When burnt all the water lime-stones fall into a buff-coloured tinge, and contain a considerable portion of clay. If neither of these can be procured, burnt and pounded iron stone, scales from an iron forge, hard burnt tiles, ground and mixed with quick lime, all become hard under water and in damp situations. In the composition of cements advantage has been derived from using water which contained a solution of iron of a dark red colour approaching to black. Clean sharp sand whose particles are angular must likewise be used ; gravel small and well washed will do in rubble work.

Pozzolana and Dutch Tarras are now little used in this country, Parker's cement having superseded them. The Mastic, an oil cement, invented near a century since by P. Lorient, for which, extraordinary as it may appear, a patent has been recently granted, is only fit for coating buildings, but it is far inferior to Parker's cement, as also to one for which a patent has lately been granted to Mr. Chambers,