The Old, the New and the Future

A LETTER FROM IRELAND

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The Old

Until less than 100 years ago (depending on where you live) stone walls were built thick, having two faces and a heart of stone, all laid with lime mortar. The typical wall thickness of a domestic structure was about 2 feet. This was because of the difficulty, given average sized stone, in building a wall much thinner than this. Of course older defensive structures, built to resist the onslaught of the cannon ball or prevent collapse from underground offensive mining, often had exceptionally thick walls. Many non-defensive structures such as industrial warehouses, lighthouses, public buildings, churches etc. had very thick walls as well. They were designed to be structural, to carry floors, roofs, people, machinery etc. When an opening had to be spanned, an arch was favoured because a horizontal lintel of stone is limited in the distance it can span and in the weight it can carry. If a stone lintel was used, it often had a relieving arch built over it to carry most of the weight.

Lime was used as a binding agent with sand to create a lime mortar which was used to bed and joint stones. On some structures, particularly vernacular ones, mud, variously called earth, subsoil etc. was used as a mortar. An essential element in maintaining the structural integrity of a mortared wall was to keep the stones apart. Some lime mortars such as the non-hydraulic variety that set or harden by the introduction of carbon dioxide gas from the atmosphere were very slow to set. It has been estimated that carbonation in ideal conditions can be as little as 1mm (1/25 inch) per month in from the face of the wall. The result was, thick stone walls well carbonated near their faces but with softer centers. Tremendous flexibility resulted, so that such walls could flex and move quite a lot without failing. The surface carbonation prevented leaching of the lime from the wall, from rain. Lime had one other major advantage: breathability, if there is such a word. Walls built in lime were permeable; when they got wet from rain they were able to rapidly dry out, the joints acting as drains. Solid stone buildings could then stay dry inside, most of the time, anyway.

Not all lime mortars set solely by carbonation, there were other limes, namely hydraulic limes. In parts of 19th century Europe these were classified as feeble, moderate and eminent depending on their ability to set in damp or wet conditions. Non-hydraulic limes will never set in such conditions. Hydraulic limes were essential for work underground, aqueducts, sea piers, cisterns etcetera, but were also favoured for external renders (stucco) and general bedding of stone and brick. Hydraulicity was achieved by the burning of limestones with an alumina/silica content. A limestone having an earthen content, or one with the inclusion of silica nodules could achieve this. Once burned, alumina and silica become reactive and when they are mixed with water a chemical set occurs with little or no reliance on carbonation. Kiln temperatures were also purposely varied to manipulate hydraulicity and even the ash from the kiln was used at times. The addition of brick dust (which contains reactive silicates and aluminates) to non-hydraulic lime also created a hydraulic set. The Romans knew all of this but also had made the discovery that pozzolana, a volcanic ash from Mount Vesuvius in Italy, could also create a hydraulic set, often referred to as a pozzolanic set. This was a major technical discovery, which allowed the Romans to create concrete and build in water. Traditional stonemasonry in the western world has its roots in Roman technology, not just its mortars and concretes but also its tools and techniques.

So why do we need to know all of this today? Well, without having an insight into the complexity of traditional mortars we cannot hope to understand how old masonry structures work and how we should repair them. If we attempt to do so with only the knowledge of modern construction technology we will be doing the old structure a major disservice. Previously stonemasons knew all about their mortars; they did not write it down but passed it on from father to son.

Stonemasons were aware of the vulnerability of large lime mortared joints particularly with non-hydraulic mortars. Sometimes with rubble stone large joints are inevitable. It is not always possible, or warranted economically, to cut and shape stones; some stones types will resist even minor alterations. Larger joints, particularly in non-hydraulic lime are vulnerable to being washed out before carbonation has effectively taken place. Pinning or galleting, the controlled filling of such joints

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