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FOUNDATIONS OF HISTORIC STRUCTURES

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Most 19th century foundations were of either stone or brick masonry laid directly on the subsoil in an excavated trench. The foundation masonry was laid about twice as wide as the upper foundation wall, and the width was diminished slightly as each course was laid, resulting in a wedge-shaped cross-section at the bottom of the foundation wall. The wider bottom of the foundation masonry served to distribute the weight of the building walls over a wider soil area, thus reducing the pressure on the soil and lessening chances of building settlement.

Concrete "tee" foundations serve the same function without varying the wall thickness and in addition have more linear stiffness if they are steel-reinforced. This linear stiffness helps to bridge softer spots in the soil thus reducing "differential settlement" due to varying strength of the soil. Concrete for foundations for other purposes was generally not used or was not available until the late 1880s.

The science of "soil mechanics" (types, stability and strengths of various soils) was also not well understood generally in the 19th century. This led to many buildings being built with their foundations bearing on soil not strong enough for the loads imposed, or on stiff but unstable soil which swells and shrinks with varying ground-moisture levels (called "plastic soils" by soils engineers), causing heaving and dropping of different parts of the walls at different times, locations and degrees, resulting in cracking and unevenness of the walls and floors.

If diagonal cracks or leaning is observed in brick or stone foundation walls, or if a wood building on masonry piers is out of level or out of plumb, this usually indicates a foundation problem of some sort. It could be that (1) the soil is good but the foundation is not wide enough to properly distribute the building load, (2) the soil is unusually weak, with the same result as (1), or (3) the soil is strong but "plastic", heaving the building up and down irregularly in wet and dry weather respectively. Leaning walls in a frame building could be the result of wind and poor bracing, but if the floors are also significantly out of level this points to foundation problems.

It should be borne in mind that the solution to a "foundation problem," begins with an exploration and analysis of the type and characteristics of the soil under the foundation. It would be "treating the symptom instead of the disease" to repair a cracked, sloped, or leaning foundation wall without correcting the problem at the bearing soil that caused the situation. Soils cannot be reliably assessed "by eye". There are several companies in Alabama who can drill, sample and test soils and give professional recommendations for foundations that these soils can bear. If a significant settlement problem is involved, these services should be utilized. Their cost is cheap compared to a "rule of thumb" correction that fails to work.

In buildings which have settled on poor soil slowly for a century or more, it will be found that the windows, doors and walls are parallelograms instead of rectangles, and have in the past been adjusted by former occupants to function in this out-of-square shape. It is therefore frequently best not to think of "jacking the building back straight" for this can cause still more havoc with plaster, trim, sashes and doors which have adapted to their out-of-square condition. If jacking is found to be feasible and

desirable it must be done very slowly and consistently using many jacks at perhaps one turn per day (see following Old House Journal article).

Masonry buildings cannot be jacked level and must be stabilized as they are. The only alternative is to dismantle all the masonry walls, level the framing, correct the foundation and bearing soil, and re-erect the masonry. This alternative would be almost total "reconstruction", poor preservation, and very expensive.

A method of stabilizing weak or plastic soil is (after testing the soil) to inject cement under high pressure into the soft soil under the footings to strengthen and/or stabilize it. There are several companies in Alabama and Mississippi which can do this. If the weak soil is found to be a shallow layer it may be less expensive to deepen the footings by supporting the settled walls with "pins" (short heavy timber beams penetrating the foundation wall every six feet or so and supported on the ground) so that the foundation wall can be actually removed in short sections and rebuilt deeper down to good soil. This is technically much easier than it may sound, but obviously the "pins" must be properly designed and built and knowledgeable, experienced personnel must be used. By the same technique a footing can be widened or replaced by reinforced concrete if the case is that of an inadequate footing on good soil.

In masonry buildings, out-of-level floors are not necessarily a sign of foundation settlement. In historic masonry structures the wooden floor joists have their ends built into sockets in the masonry walls. This can subject the joist ends to moisture and insect attack particularly at the exterior walls. Frequently the ends of the joists have partly deteriorated due to dryrot, insect damage or both, thus allowing the wooden joist ends to crush or compress vertically, resulting in a dropped, sloping floor. Luckily most pre-1870 buildings are framed in heart-woods which are strongly resistant to insects and rot, such as heart pine, yellow poplar, cypress, etc. so this problem is not as prevalent as one might expect.

The joist-ends of masonry-wall buildings should always be checked for this condition, and weakened joists reinforced by attaching "scabs" of pressure-treated pine of a proper size and length, and separated form direct contact with the masonry by a moisture barrier such as patented copper-fabric flashing (don't use polyethylene, which deteriorates rather quickly). Treating the soil for termites etc. is also advisable, in addition to making sure the crawl space is well-ventilated and the yard is graded as described in the following paragraph.

Masonry foundations which are constantly wet will deteriorate. The mortar goes first (to dust) and the brick or stone follows shortly thereafter, to powder. Poor site drainage is the usual cause of wet foundations. The dead grass, roots and leaves of one to two centuries accumulation in a yard by the foundation will build up from six to twelve or more inches (twelve inches accumulation has been frequently observed). Wooden foundation vents that once were above ground are found to be half-buried. This accumulation usually causes rainwater to be trapped against the foundation, or to run under the building via the foundation vents (the usual cause of wet basements as well).

In most historic buildings, an early task is to determine the original level of the yard, excavate the yard back to that level if practicable, and in any case regrade the yard to drain away from the foundations. Also, check the rood drainage system. Leaking or overflowing out-of-level gutters and stopped-up downspouts are a usual cause of wetting of foundations, and consequent "rising damp" in the foundation masonry. Moss, powdery mortar or blistered masonry paint are the symptoms of rising damp at a foundation wall.

If your historic building was not "built upon a rock" as advised in the Bible, don't despair. There are ways to determine the cause of the problem and to stabilize the structure.