Appendix 3
Investigation of the Adobe Remains

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FORT SELDEN'S EXTANT REMAINS

The extent of the adobe walls at Fort Selden vary from some walls in the area of the company quarters (Figure A3.1) that are 10 feet above grade to standing walls in fragments (Figure A3.2) to walls in the corral area that are only inches high and inches thick (Figure A3.3). The remains of adobe walls that exist at grade also continue to erode. Grade level stone features include the foundations of the commanding officer's quarters (Figure A3.4) and subsurface features that have yet to be explored fully.

Figure A3.1. Walls of the company quarters. These walls are the largest walls remaining.

Figure A3.2. Adobe walls of the hospital. These walls are typical in size of most of the structure's remaining walls

Figure A3.3. Fragments of adobe walls that are only inches high and thick.

Figure A3.4. Stone foundations of the commanding officer's quarters.

THE DECAY PROCESS

Adobe deteriorates more rapidly than other inorganic porous building materials; bonds between individual particles are different in the different materials. The primary source of adobe degradation is water, since the actual binding together of the soil particles, sand, silt and clay, is primarily a process of dehydration. Consequently, as water again gains access to the soil, material degrades. The soil particles are bound together by cohesion, and when they lose cohesion, they fail.

At Fort Selden water accesses the material primarily from rainfall to the tops, sides and ends of all the adobe walls. A secondary access is through capillary action at the wall bases. Water mechanically erodes the material on the surface as the surface becomes wet, looses cohesion, and is carried down the surface as a liquid. Water also degrades the materials as it moves into a wall;, if the moisture content is high enough, the material loses cohesion, resulting in different cracking patterns. Loss of cohesion of Fort Selden's adobes occurs on all exposed surfaces, including wall tops and ends, where failure is most obvious.

Since abandonment of Fort Selden in 1891, 109 years of erosion have resulted in the loss of approximately 85 percent of the adobe walls. The loss began not only through natural processes of material decay, but also through the

reduction of the integrities of the building systems and the loss of the ability of buildings to act and react as systems rather than as individual building parts systematically were removed. Workers salvaged all wood elements, such as roofs, floors, lintels over openings, and doors and windows, from the buildings immediately after the fort was abandoned. The loss of these parts accelerated the rate of deterioration. Without the loss of these wood elements, most likely many buildings would have remained intact and recognizable well into the twentieth century.

Still more deterioration occurred until initiation of preservation in the early 1970s. Of the approximate overall loss of 85 percent, at least 75 percent occurred from the 1890s until the 1970s, or during an 80-year period. The remaining 10 percent occurred over the next 25-period. This deterioration estimate includes collapsing and thinning of walls as well as erosion of wall lengths and heights.

Deterioration occurring after the earliest available photographs in the 1920s (Figure A3.5) easily can be seen. Since that time walls have collapsed, wall openings that represented previous doors and windows have been reduced to low walls connecting higher wall fragments, wall heights have reduced greatly, and the wall thicknesses have eroded differentially, often to less than half the original thicknesses (Figure A3.6). The actual rate of decay appears to be relatively constant over the past hundred years, but certainly times have occurred when wall collapses resulted in greater losses over relatively short periods. Nevertheless, adobe typically decays relatively constant over long periods, followed by accelerated decay over relatively short periods. Eventually the overall loss of cohesion at the building features results in accelerated losses until the features no longer exist. A majority of the wall fragments at Fort Selden appear to be rapidly approaching this phase.

At present, decay at Fort Selden primarily occurs in the deterioration of the tops of walls, the exposed ends of walls, and the overall wall surfaces. In simplest terms, the decay of wall tops reduces the heights, the decay of wall ends reduces the lengths, and the decay of vertical wall surfaces reduces their thicknesses. The erosion of wall bases also is important, but is not as critical at Fort Selden now as it may have been at one time. The overall weathering patterns are distinct and appear to be related directly to the direction of the rainfall, which has occurred primarily from the northwest over the long period of exposure. Weather patterns have changed from year to year and local rainstorms

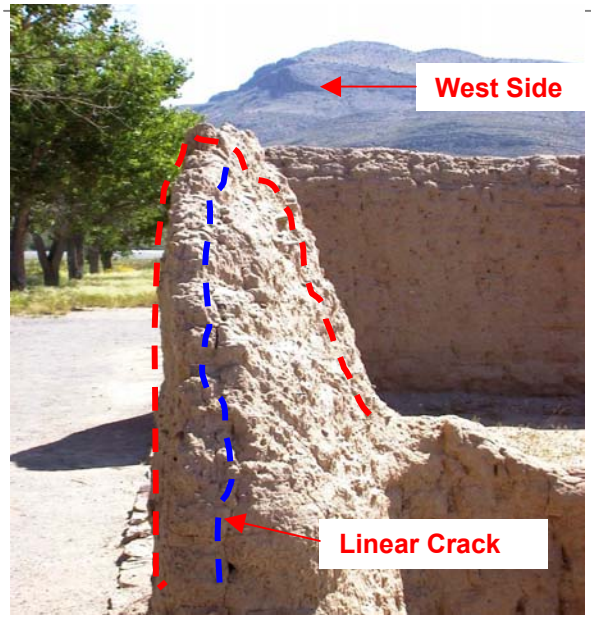
Figure A3.5. Photograph of Fort Selden in the 1920s. Note the door and window openings.

Figure A3.6. Present typical condition of the adobe walls of the officers quarters.

have exhibited different patterns, but the overall patterns are reflected in the differential erosion on the west- and north-facing surfaces.

The effects of the weather have caused greater degrees of surface undulations on the west- and north-facing surfaces and tapered shapes at the tops of wall surfaces facing north and west. A3.7 demonstrates the tapered west side at the more vertical east surface of a wall. The deterioration of the wall end also can be seen in the photograph. A linear crack reflects the loss of cohesion of a mortar joint; holes in the overall wall also normally occur at the mortar joints.

The surface erosion of the adobe walls is the most obvious evidence of past and potential future loss, but clumping of the wall tops and the wall ends will result in much greater traumatic loss. Loss in these two areas occurs in large clumps rather than through slower erosion that results from rain falling on the surface.



Clumping (Figure A3.8) results when wall portions that are not restrained by surrounding adobe wall mass are subjected to more water absorption. Without the retraining effect of the wall mass, the wall tops and ends can crack more severely and consequently become separated from the surrounding material, resulting in "clumps" of adobe material. The clumps are then subject to displacement by combinations of wind and rain, by side-loading such as high winds, and from human-related factors such as leaning or shoving. On the wall ends the portion below the clumps often cannot support the weight of the clumps, will fall from their own weight (see Figure A3.9). Someone pushing on the walls probably displaced the ends of several walls in the officers quarters.

Figure A3.8. Example of typical clumping of an adobe wall top.

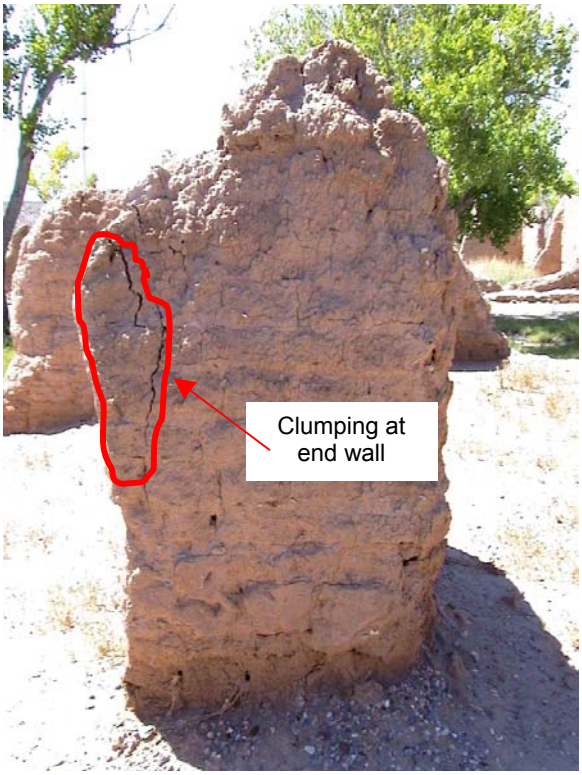


Figure A3.9. Clumping of an end wall that soon will result in loss.

Another critical condition presently causing material loss is the detachment of adobes in layers between ½ and 2 inches thick. The condition appears to exist on all vertical wall surfaces regardless of the visual difference of the surfaces and does not appear related to the particular direction the wall surface faces. This detachment does not have a distinct visual character; rather it is determined by "sounding" or lightly tapping on the wall surface. When the surface is tapped lightly, a hollow sound results; the degree of the relative hollow sound indicates the relative thickness of the detachment and the degree to whic l has become detached.

The condition can be visualized by thinking of the wall scaling off in layers as if is continually shedding small pieces of its skin. The analogy of skin flaking ends here, however; the detachment phenomenon of the adobe wall continues and the wall gets thinner and thinner. During field investigation and condition recording, I identified several areas where material recently had scaled or flaked off the wall surface. In some cases a pattern of surface cracks also are associated with the detachment, particularly on the north and east walls. The detachment indicated by sounding also exists in walls with relatively few surface cracks. The south- and west-facing walls definitely have fewer surface cracks presently, which may have resulted from the most recent heavy rains that occurred from the northeast in June 2000.

Mud drips also occur on wall surfaces facing east and north. These drips also probably result from that most recent heavy rain and do not represent a multiyear pattern. Drips occur on the west and south walls in isolated areas, whereas the drips on the east- and particularly the north-facing walls exist on the entire wall surface, from top to bottom. Mud drips also can be seen beneath the tops of walls, where rainwater has turned the soil into a liquid that dried quickly as it flowed down the wall.

PRESENT PRESERVATION TREATMENTS

Present preservation treatments consist of applying sacrificial coatings to some wall surfaces, repairing basal erosion, filling cracks in plaster and in walls, backfilling low walls, applying mud to the tops of some walls, controlling rodents, and grading the ground at the wall bases to insure positive drainage. The actual location of walls where these treatments are carried out normally depends on their condition or their location in relationship to the interpretive trail. Treatments may vary if one wall is interpreted differently from another. These basic treatment approaches should continue to some degree in any future preservation plans, although the treatments will be modified to satisfy the overall preservation and interpretive intents. Unfortunately, nature dictates that the walls cannot be preserved indefinitely, regardless of the amount of effort expended. A comprehensive preservation maintenance plan can, however, help retard the rate of loss.

Although protective shelters may be considered in the future, increased preservation maintenance will continue to be an important part of the preservation efforts. Walls covered by any shelter also will have to be protected, but perhaps to a lesser degree