

ADOBE, ITS PERMITTED USES
AND
RESEARCH NEEDS

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ABSTRACT Abstract: The uses of adobe or unburned clay units as allowed by several California building codes are described. Suggestions are made for research needs for the acceptance of adobe are also provided.

As suggested by the committee for this workshop, this author was requested to present his views on the following three issues:

1. California Use of Adobe
2. Codes and Specifications
3. Research Needs and Gaps

In order to place these viewpoints in proper perspective, it should be pointed out that this author has, for many years, been enforcing the California statutes concerning public school buildings and hospital construction for seismic safety. To explain this a bit further a brief description of our process will be described.

The Education Code Section 39140 through 39156, (1) requires that public school buildings be designed and construction "... for the protection of life and property." Whereas the Health and Safety Code Section 15000 through 15023 (2) requires that hospitals "... must be completely functional to provide all necessary services to the public following a disaster...". This clearly points out the higher level of performance or damage control required by the legislation for hospitals. Both occupancies require the design to be prepared by architects or structural engineers. In the case of hospitals it requires the structural design by a structural engineer. In both cases geologic investigations are required and the drawings and specifications are reviewed by the Structural Safety Section in the Office of the State Architect for conformance with the adopted regulations. Continuous construction inspection is required and the architect, engineer, inspector and contractor must provide reports verifying, under oath, that the construction conforms to the approved construction documents. False reports on schools carry a felony penalty and hospitals carry a misdemeanor penalty.

California Use of Adobe

The use of unburned clay products is not permitted for structural use in hospital and public school construction. However, it has been used occasionally on schools as veneer for architectural reasons. This is not to say that adobe will always be unaccepted for structural purposes in California school and hospital construction. It has always been the attitude of the Structural Safety Section that if it can be demonstrated by the responsible designer that a new product will provide the same level of safety and performance as that of specified products or that the new product will meet all of the adopted performance criteria, the new product could then be acceptable.

The use of adobe is acceptable in other jurisdictions. This is further described below; however, it currently is limited to one-story dwellings or in some locations it may be acceptable in one story buildings.

Codes and Specifications

Title 24, California Administrative Code (CAC)

This is the code used for hospital and public school construction and as indicated above, these codes do not permit the use of adobe. However, other codes do permit the use of adobe or unburned clay units which is the term used in the codes. The reason the Structural Safety Section has found that this material is not acceptable for California public schools and hospitals is because of its low strengths and poor performance during earthquakes. Part of the problem also relates to the variability of its physical properties. One of the keys to the acceptance of material is its dependability of properties. Materials having a wide range of properties must be classified or grouped into defined limits. In order to accomplish this, the controls such as those developed in the Standards of the American Society for Testing and Materials and the controls for job testing and inspections must be clearly established. These strongly relate to the construction technologies and the practice or ability of the trades.

This can be summed up into the statement that "Allowable code values will result with dependable performance". A general policy in the Structural Safety Section is:

"Let the industry tell us what they will produce and provide us with its physical properties and we will establish where they can use it."

Tentative Provisions for the Development of Seismic Regulations For Buildings (ATC 3-06)

These provisions will permit the use of unburned clay units under certain provisions. They are:

1. It can be used throughout any occupancy of a one story building located in the most inactive seismic geographical areas, that is, Seismic Performance Category A in areas with Seismicity Index of 1. These areas are defined in ATC 3-06.
2. It can be used in any occupancy of a one story building only for non-structural purposes in areas with a bit more seismic activity, Seismic Performance Category B in areas with Seismicity Index of 2.

In all other areas and seismic performance categories, unburned clay units are not permitted.

Where it is permitted, type M or S mortar is required and the allowable compressive stress is 30 psi and the shear or flexural tension is 8 psi where inspection is provided and 4 psi where no inspection is provided. For structural uses the ratio of unsupported height or length to thickness shall not exceed 10 and where there is no structural significance to its use the ratio shall not exceed 16. Foundation supporting walls of unburned clay units shall extend at least 6 inches above the adjacent ground at all points. Bolt values are also given.

Tests for the units and mortar are required. Also cores must be taken from the finished wall and shall be tested to not less than 100 psi in shear.

1979 Uniform Building Code

The physical properties, allowable stresses and bolt values in the 1979 Uniform Building Code (79 UBC) are basically the same as those given in ATC-3. The limitation to the use of unburned clay units to only one story building is also contained in the 79 UBC.

Section 2312(J)(2)(B) 79 UBC requires that all masonry elements within structures located in Zones 2, 3 and 4 must be reinforced so as to qualify as reinforced masonry. As such, generally accepted forms of reinforced masonry of unburned clay units are not available to the design profession. Therefore unburned clay units may be used in bearing or non-bearing walls of one story buildings in Zone 1.

City and County of San Francisco Building Code

The City and County of San Francisco Building Code does not permit the use of unburned clay units within its jurisdiction. That is, Section 2405 of the 79 UBC has been deleted from its enforcement provision and Section 2312(J)(2)(B) is maintained.

Los Angeles Municipal Code

The Los Angeles Municipal Code commonly known as the Los Angeles City Building Code has the same limitation as the 1979 UBC; however, they will permit the use of unburned clay units in one story buildings. That is, they will not enforce the provisions of 79 UBC, Section 2312(J)(2)(B) for one story buildings. However, designers in the Los Angeles area have used very little of this material.

County of Los Angeles Building Code

The County of Los Angeles Building enforces the provisions of 79 UBC, Section 2312(J)(2)(B), therefore unreinforced masonry construction will not be permitted in the county of Los Angeles.

City of Sacramento

The City of Sacramento will accept the use of adobe only for one story dwellings. It will not accept it in commercial construction.

City of San Diego

The City of San Diego will not accept adobe construction.

County of San Diego

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Research Needs And Gaps

There is a considerable amount of information needed to justify the use of unburned clay units in buildings located in seismic areas.

For instance, this author is not aware of any shear wall or bearing wall tests on specimens fabricated from unburned clay brick.

Tests should be performed to determine the f'_m values and shear values on ordinary unreinforced adobe, and on various forms of reinforced grouted adobe construction. Cyclic load-deflection information is needed as well as height, width and thickness. Influences must be determined. Bolt values on these assemblies should also be verified. The durability of the product must also be investigated and established.

The influence of wire mesh load both in the horizontal joints or plastered onto the surface of the wall should be explored. The influence of such reinforcing on the bolt values should also be determined. The detail of such reinforced plaster connection to the foundation must be addressed. The crushing strength of adobe under concentrated loads from bending members such as beams and headers should be determined.

References

1. California Education Code, Section 39140 through 39156 and Section 81130 through 81141.
2. California Health and Safety Code, Section 15000 through 15023.
3. Title 24, California Administrative Code, Part 6, Division T21 and T22.
4. Tentative Provisions for the Development of Seismic Regulation for Buildings, ATC 3-06, Chapter 1, 3, 12 and 12A.
5. 1979 Uniform Building Code, Chapter 23 and 24.
6. City and County of San Francisco Code, 1975.
7. Los Angeles Municipal Code, 1980
8. County of Los Angeles Building Code, 1977.