Pamela Jerome, AIA, LEED™ AP
Spring Semester 2014
Mondays: 11:00 AM-1:00 (or 2:00) PM
Mini Course #: A6309

# CONSERVATION OF EARTHEN ARCHITECTURAL HERITAGE

## Course Description

From ancient to modern times, building with soil has been one of the oldest and most widely used construction methods next to stone and wood. Earthen construction materials are considered sustainable, because of their local availability, insulative properties, and low carbon footprint. Approximately 50% of the world's population lives in some form of earthen architecture. Earthen architectural heritage is also recognized in over one hundred of the World Heritage Sites that are cultural or mixed sites.

Construction technologies vary from place to place depending on the quality of the local soil. From the dugouts of Tunisia to the high-rises of Yemen, earthen architecture comes in many shapes and forms. Students will learn about the major construction technologies, including hand-shaped or molded sun-baked bricks (adobe), rammed earth (pisé de terre), and puddled earth (cob). Students will learn about the different types of clays and their effect on the long-term stability of earthen structures. Some laboratory-analysis methods will be reviewed. The class will look at a multitude of case studies from around the world, from archaeological to living heritage, and various methods of conservation.

In addition to the lecture readings, the course requirements will require each student to pick a site and explore issues confronted by the site's team in terms of preservation of earthen architectural heritage.

## Syllabus

**Class 1:** **Earthen architectural heritage: variety and locations.**
1/27/14 Overview of the variety of earthen architectural heritage. From vernacular to architect-designed structures, the typologies of earthen architecture throughout the world.
Case studies: Shibam, Yemen; New Gourna, Egypt; Dogan territory, Mali; and Trujillo, Peru.

**Class 2:** **Appropriate technologies: construction using soil.**
2/3/14 Main methodologies for earthen construction – use of mud brick, rammed earth and puddled earth. Use of wood and stone for framing and foundations. Types of roofs.
Wadi Do'an and Marib, Yemen; al-Diri'yah, Saudi Arabia; Alter do Chao, Portugal; and Exeter, UK.

**Class 3:** **Soils: understanding the materials used in construction.**
2/10/14 X-ray diffraction for identifying clays. Sampling historic materials vs. archaeological. Soil gradation. Liquid and plastic limits.

Case studies: Palaikastro, Crete.

**Class 4:** **Earthen architectural heritage: causes of deterioration.**
2/17/14 Moisture, basal erosion, disaggregation, sandblasting, burrowing animals, insect damage, vegetation growth, inappropriate repairs, etc.

**Class 5:** **Archaeology: stabilization and protection of earthen ruins.**
2/24/14 (3-hour class) Differences between light and heavy interventions. Implementation of positive drainage, ground water control and the use of geodrains. Various capping techniques. Installation of protective shelters. Use of chemical consolidants.
Case studies: Huaca de la Luna and Chan Chan, Trujillo, Peru; and Mallia, Crete.

**Class 6:** **Living heritage: maintenance and reconstruction. Final report due.**
3/3/14 (3-hour class) Traditional repair methods: pros and cons. Infill bricks, mud plaster, lime plaster, lime wash. New technologies.
Case studies: Tarim, Yemen and Timbuktu, Mali.

Bibliography of Class Readings

**Class 1:** **Earthen architectural heritage: variety and locations.**

Bourgeois, Jean-Louis, Carollee Pelos and Basil Davidson, *Spectacular Vernacular. The Adobe Tradition* (NY: Aperture Foundation Inc., 1989)

Dethier, Jean, *Down to Earth. Adobe Architecture: An Old Idea, a New Future* (London: Thames and Hudson Ltd., 1982)

Jerome, Pamela, "Community building and continuity of tradition: the decoration of mudbrick surfaces in the Hadhramaut region of Yemen," *Conservation of Decorated Surfaces on Earthen Architecture* (Los Angeles: J. Paul Getty Trust, 2006), 144-151

Mecca, Saverio and Letizia Dipasquale (eds.) *Earthen Domes and Habitats. Villages of Northern Syria. An architectural Tradition Shared by East and West* (Pisa: Edizioni ETS, 2009)

Rael, Ronald, *Earth Architecture* (Princeton: Princeton Architectural Press, 2010)

Warren, John, "An overview: artwork to earthwork," *Conservation of Earth Structures* (Oxford: Butterworth-Heinemann, 1999), 1-39

Warren, John, "Introduction," *Conservation of Earth Structures* (Oxford: Butterworth-Heinemann, 1999), xi-xxiii

**Class 2:** **Appropriate technologies: construction using soil.**

Houben, Hugo and Hubert Guillaud, "Construction methods," *Earth Construction. A Comprehensive Guide* (London: Intermediate Technology Publications, 1989), 163-188

Jerome, Pamela, "After the flood: devastation of the traditional earthen architectural landscape in the Hadhramaut Valley of Yemen; can mudbrick buildings be made more resistant to climate change?" in Maria Fernandes, Mariana Correia and Filipe Jorge (eds.) *Terra em Seminario 2010. 6th Seminario Arquitectura de Terra em Portugal/9th Seminario Ibero-American de Arquitectura e Construcao com Terra* (Lisbon: Argumentum, 2010), 53-55

McCann, John, *Clay and Cob Buildings* (Aylesbury, Bucks: Shire Publications Ltd., 1983), 1-13

Pearson, Gordon T., "Methods of construction," *Conservation of Clay and Chalk Buildings* (Dorset: Donhead Publishing Ltd., 1997), 8-42

**Class 3: Soils: understanding the materials used in construction.**

Houben, Hugo and Hubert Guillaud, "Soil," *Earth Construction. A Comprehensive Guide* (London: Intermediate Technology Publications, 1989), 17-40

Houben, Hugo and Hubert Guillaud, "Soil identification," *Earth Construction. A Comprehensive Guide* (London: Intermediate Technology Publications, 1989), 45-68

Jerome, Pamela, "Analysis of Bronze Age mudbricks from Palaikastro, Crete," *Terra 93. 7th International Conference on the Study and Conservation of Earthen Architecture, Silves, Portugal, 24-29 October 1993* (Lisbon: DGEMN, 1993), 381-386

Pearson, Gordon T., "The qualities of earth walling," *Conservation of Clay and Chalk Buildings* (Dorset: Donhead Publishing Ltd., 1997), 43-65

Teutonico, Jeanne Marie, *A Laboratory Manual for Architectural Conservators* (Rome: ICCROM, 1988)

Warren, John, "Inorganic materials in conservation and repair," *Conservation of Earth Structures* (Oxford: Butterworth-Heinemann, 1999), 112-126

Warren, John, "Organic materials in conservation and repair," *Conservation of Earth Structures* (Oxford: Butterworth-Heinemann, 1999), 127-142

Winkler, Erhard and James R. Clifton, "Solvents for adobe and stone preservatives," *Deterioration and Protection of Stone Monuments, UNESCO/RILEM International Symposium, 5-9 June 1978* (Paris: UNESCO/RILEM, 1978), 1-8

**Class 4: Earthen architectural heritage: causes of deterioration.**

Brown, Paul Wencil and James R. Clifton, "Adobe I: the properties of adobe," *Studies in Conservation*, Vol. 23 (1978): 139-146

Brown, Paul Wencil, James R. Clifton and Carl R. Robbins, "Adobe II: factors affecting the durability of adobe structures," *Studies in Conservation*, Vol. 24 (1978): 23-39

Chiari, Giacomo, "Characterization of adobe as a building material. Preservation techniques," *Adobe: International Symposium and Training Workshop in the Conservation of Adobe, 10-22 September 1983* (Lima: UNDP/UNESCO/ICCROM, 1985), 31-40

Vafedari, Azadeh, "Visitor management and the development of sustainable cultural tourism and local community participation at Chogha Zanbil, Iran," *Conservation and Management of Archaeological Sites*, Vol. 10, No. 3 (2008): 264-304

Warren, John, "Agencies of failure and their identification," *Conservation of Earth Structures* (Oxford: Butterworth-Heinemann, 1999), 75-98

**Class 5: Archaeology: stabilization and protection of earthen ruins.**

Coremans, Paul, "Climate and microclimate," *The Conservation of Cultural Property* (Paris: UNESCO, 1968), 27-39

Chiari, Giacomo, “Evaluation of the preservation work on earthen architecture done in Iraq in the years 1969-71,” *Mesopotamia*, Vol. XXV (Turin: Giappichelli, 1990): 217-227

de Guichen, Gael, “Object interred, object disinterred,” in Nicholas Stanley Price, ed., *Conservation on Archaeological Sites* (Rome: ICCROM, 1984), 21-29

Demas, Martha, “’Site unseen’: the case for reburial of archaeological sites,” *Conservation and Management of Archaeological Sites*, Vol. 6, Nos. 3 and 4 (2004): 137-154

Kavazanjian, Jr., Edward, “The use of geosynthetics for archaeological site reburial,” *Conservation and Management of Archaeological Sites*, Vol. 6, Nos. 3 and 4 (2004): 377-393

Schmid, Martin, “Protective shelters at the archaeological sites of Mallia (Crete) and Kalavasos-Tenta (Cyprus),” *Conservation and Management of Archaeological Sites*, Vol. 2, No. 3 (1998): 143-153

Teutonico, Jeanne Marie, “Conclusions and recommendations of the Colloquium ‘Reburial of Archaeological Sites’ – Santa Fe, New Mexico, 17-21 March 2003,” *Conservation and Management of Archaeological Sites*, Vol. 6, Nos. 3 and 4 (2004): 395-399

Teutonico, Jeanne Marie, “Protective shelters for archaeological sites in the southwest USA. Conclusions and recommendations,” *Conservation and Management of Archaeological Sites*, Vol. 5, Nos. 1 and 2 (2001): 87-90

**Class 6: Living heritage: maintenance and reconstruction.**

Conlon, James and Pamela Jerome, “Documenting and representing the historic city of Tarim,” in Leslie Rainer, Angelyn Bass Rivera, and David Gandreau (eds.) *Terra 2008. 10th International Conference on the Study and Conservation of Earthen Architectural Heritage* (Los Angeles: J. Paul Getty Trust, 2011), 55-62

Cornerstones Community Partnerships, “Part Three. How to proceed,” *Adobe Conservation. A Preservation Handbook* (Santa Fe: Cornerstones Community Partnerships, 2006), 99-146, 179-189

Duon Naa, Paul “The Asante traditional buildings,” in Thierry Joffroy and Sébastien Moriset (eds.) *Africa 2009. Projets Situés. 10 Years of Field Experience*, (Grenoble: CRATerre Editions, 2009), 29-33

Farci, A., D. Floris, L. Massida, P. Meloni and U. Sanna, “Long-term performance evaluation of an earthen grouting mortar,” *Conservation and Management of Archaeological Sites*, Vol. 7, No. 3 (2006): 171-178

Hughes, Richard, “Problems and techniques of using fresh soils in the structural repair of decayed wall fabric,” *5th International Meeting of Experts on the Conservation of Earthen Architecture* (Grenoble: ICCROM/CRATerre/EAG, 1988), 59-69

Jerome, Pamela, “Flash floods: protecting the World Heritage Site of Shibam,” *Research & Heritage* (Jeddah: Saudi Commission for Tourism and Antiquities, 2011), 130-143

Jerome, Pamela, Giacomo Chiari and Caterina Borelli, “The architecture of mud: construction and repair technology in the Hadhramaut region of Yemen,” *APT Bulletin*, Vol. 30, No. 2-3 (1999): 39-48

Kassim, Omar, “The restoration of the Levin House,” in Thierry Joffroy and Sébastien Moriset (eds.) *Africa 2009. Projets Situés. 10 Years of Field Experience* (Grenoble: CRATerre Editions, 2009), 103-109

Ould Sidi, Ali and Thierry Joffroy, “The conservation of the Grand Mosques of Timbuktu,” in Thierry Joffroy (ed.) *Traditional Conservation Practices in Africa* (Rome: ICCROM, 2005), 23-29