DEMYSTIFYING CODE DEVELOPMENT FOR EARTHEN CONSTRUCTION IN THE UNITED STATES

Anne Galer and Ben Loescher, The Earthbuilders' Guild

Keeping up with building code changes is, perhaps, even more important to earthbuilders than the general construction industry. Because we are building in what some term as "traditional" construction methods we sometimes assume that nothing changes. But the fact is that ordinary building and energy codes are always changing, and the modifications that are well suited for conventional building often have unintended negative impacts on earthen construction. This paper aims to make the code change and development process understandable and accessible so that earthen practitioners and professionals can participate in creating codes that are appropriate for earthen construction, both locally and nationally.

For many earthen construction advocates and practitioners, building codes often present themselves as an accepted but unwelcome nuisance - a failed inspection, a set of plan check corrections, a missed deadline or a project which is for technical reasons suddenly infeasible. As a result, any proposition that suggests that as earthen construction advocates we need more building codes in our lives is going to be a tough sell. But this paper will attempt to demonstrate that not only are codes and standards important for our industry, but that all of us should be spending more of our time familiarizing ourselves with the precise language of the codes, how they interact with one another, how they are created, edited and modified, and how each of us can influence that process for the better.

Why participate in code development?

Building Codes are a pervasive part of construction in the industrialized world. They impose minimum standards for health, safety and welfare for nearly all construction, and perhaps more than anything else, they are responsible for the shape and substance of the built environment around us. Their importance is obvious and uncontroversial, but as a set of rules, they lack natural charisma: The manner in which they come to be

imposed on us can be mysterious: Code officials are routinely unsympathetic: and there is little apparent reward for participation.

All that is true. However, there are a number of great reasons why each of us should be more involved:

- The process, once de-mystified, is actually pretty straightforward and mostly requires interest and persistence.
- Code officials who at first appear aloof and unaccountable generally welcome input towards improvement of the codes, particularly when it is about subjects on which they are not expert.
- Codes are routinely updated and reevaluated. If advocates of so-called alternative construction systems don't participate, their input won't be heard, and sometimes even existing language for alternative systems will be abandoned or deleted.
- Participation refutes the persistent notion that advocates of earthen building systems are trying to popularize sub-standard or unsafe construction. By speaking in the same terms, with the same concerns as building officials, we give credibility to our industry and practices.

What code officials care about:

Believe it or not, they do care! There is little obvious reward in taking a job where your primary responsibility telling people no. But most building officials are motivated by a devotion to the public that they help protect, and believe strongly in the importance of mitigating the dangers that are inherent to the construction and occupation of buildings. Based on practical application, a few patterns of common concern emerge:

- There is a belief code language should be clear in its intent, enforceable, easy to understand, and coherent when read against other applicable standards
- Increasingly, it is expected that building codes should be underpinned by evidence and research. Just like in traditional construction practices, all building codes begin based on observation, tradition and experience. However, as codes attempt to define minimum standards for materials and performance, it is increasingly frequent for these traditional practices to require validation through testing and the establishment of standards.

- Codes need to mitigate risk. While historically building codes have focused their attention to addressing the risks of collapse and fire, in recent years, the risks addressed under building codes has broadened to address more newly acknowledged threats such as indoor air quality, carbon emissions and energy consumption.

While earthen building systems have sometimes struggled to demonstrate their equivalence to conventional building in fire and seismic safety due to necessarily different metrics for evaluation, on this last point it should be clear that earthen building has an enormous, and yet unrealized advantage as new codes are developed. Many of us became interested in adobe, rammed earth, cob and CEB because of its remarkable contributions to indoor air quality, low carbon construction, and thermal performance. As the recognition of the importance of these issues increases among code officials, earthen construction positioned to win.

Overview of Building Codes in the United States

For the most part (and with a few notable exceptions) earthen construction in the United States is governed by language developed and codified at the national level within the International Building Code (IBC), the International Residential Code (IRC) and by standards incorporated within those two codes by reference.

The IBC and IRC are what are called “model codes”. Independently, they are abstract collections of language that have no force of law on their own. But once they are adopted by States, Counties, Agencies and Cities, they gain tremendous power to influence construction. The IBC is in use or adopted by all fifty states, and the IRC is in use or adopted by forty-nine, meaning that most of the state and local codes that we know and use are in fact just these model codes with a few tweaks, additions and modifications.[1]

How this process occurs varies from State to State. In some cases, the State adopts the code with any modifications, and imposes it on all subordinate jurisdictions (counties and cities). In other cases, the State adopts the code for state activities, such

[1] Although the model codes are protected by copyright, once adopted by a local jurisdiction, they are considered regulations whose distribution cannot be restricted. Many sites on the internet, including public.resource.org, now provide access to pdf copies of locally adopted building codes.

construction of educational facilities and government buildings, and then gives discretion to subordinate jurisdictions to ignore, modify or adopt the codes. Typically, due to the nature of the process, changes at the State or local level are usually not as large in scale as those undertaken at the national level, as the trend for the last three or four decades has been to try and make language more uniform between states and jurisdictions to make design, construction and interpretation more consistent.

That being said, there are rare but notable exceptions. In some cases, States have developed their own codes to address local conditions and needs. Examples of this related to non-conventional construction include New Mexico's Earthen Materials Construction Code, and California's original straw bale code.

At each level of development and adoption (national, State, and local) there is an opportunity for an individual or organization to participate and influence the process.

Modifying the Model Codes

Because of their broad influence, we will begin our discussion with the "model codes". Including the IBC and IRC, there are some 15 individual code volumes that make up the collection of model codes which are collectively referred to as the I-Codes. The "I" representing the transnational ambitions of the International Code Council (ICC) who oversees their development and publication.

Each volume of the I-Codes is developed and published on three year cycles (most recently 2012, 2015, and 2018[2]. These triennial publications are the result of a series of submissions, hearings and votes held across the country that propose, evaluate, edit and ultimately approve or reject changes to the codes. Different portions are dealt with separately, with structural and non-structural components generally addressed on different calendars.

There are basically two manners of changing regulation within the model codes generally, and the IBC/IRC specifically: by modifying the code itself, or by inserting reference to standards outside of the code.

There are benefits and drawbacks to both schemes. Adding, deleting or

[2] The schedule for the ICC Code Development cycle is available here: https://cdn-web.iccsafe.org/wp-content/uploads/2018-2019-Code-Development-Schedule.pdf. Proposed modifications to the adobe portion of the code are due in January of 2019.

modifying specific chapters, lines or paragraphs within the actual code is generally acknowledged to be the easier of the two methods, with the following advantages:

- Modifications within the code are generally faster and less costly:
- Modifications within the code can be proposed by a single individual of any standing. One need not be an architect, engineer or ICC member in order to make a proposal or speak at a hearing
- The responsibility for updating and maintaining the language is with the entire community - someone who proposes a change has no responsibility to make sure that it remains relevant, correct or up to date.

There are however significant disadvantages, to the extent that most industry and professional organizations try not to make comprehensive changes within the code:

- Modifications within the code require the consensus of many different individual who may have no experience or sophistication in the subject matter, and while anyone may propose a code change, at the end of the day it is an assembly made up only of code officials who will ultimately approve or disapprove a code change, and there is no guarantee that a substantial number of that group will be knowledgeable in any given topic, particularly for a non-conventional building system.
- The lack of ownership of the code language with a particular group or constituency puts existing and adequate code language at risk from tampering or deletion at each code cycle. In fact, adobe construction was nearly deleted from the IBC during the 2018 code cycle because another industry group didn't think it was being used.
- The potential lack of relevant knowledge is part of the reason why many industry groups (such as The Masonry Society) prefer developing standards for incorporation by reference

There are a couple notable examples of earthen construction within the IBC and IRC that are worth knowing about:

- Since its first publication in the year 2000, the IBC has included adobe within Chapter 21, which governs masonry construction. Beginning with the 2018 edition, a new subchapter entitled "Empirical Design of Adobe Masonry" has

been created, decoupling adobe from other unrelated conventional masonry practices.[3]

- Since 2015, the IRC has included Appendix R for Straw Clay construction. As an appendix, the code language is part of the model code that is typically not adopted en masse with the rest of the code, but a la carte to the extent that the local jurisdiction thinks it is relevant or appropriate.

Unfortunately, no guidance exists in the IBC/IRC specific to Rammed Earth or Compressed Earth Block construction.

Incorporating Standards into the Model Codes

Instead of putting all of the requirements to govern use of an earthen building system into the actual body of the code, it is also possible (and sometimes preferable) to incorporate requirements by simply inserting a reference using the same process and timeline described above. Any organization can develop and propose a standard, but to be eligible for reference within the I-Codes, the standard needs to be developed in compliance with requirements set out by the American National Standards Institute (ANSI)[4]. Most notable among these:

- The committee has to be public and open to input and feedback by any person or organization with an interest in the outcomes of the process
- The ability to participate may not be restricted based on a requirement to pay dues, or unreasonable technical requirements, and the process cannot be unduly dominated by any single interest category, organization or individual
- The outcome of the standards process has to be achieved by consensus.

The development of a standard can be an extremely lengthy and formal process, and once a standard has been certified by ANSI, it still needs to be approved for inclusion in

[3] The Masonry Society (TMS) intends to retire empirical design as an accepted design methodology for conventional masonry. Empirical design must remain available for adobe construction at least for the time being as no accepted analytical design approach exists.

[4] Due Process Requirements for American National Standards: https://share.ansi.org/shared%20documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2017_ANSI_Essential_Requirements.pdf

the code through the ICC process. With that said, it has a number of advantages which is the reason why many industry groups working around technically involved subject matter (ASHRAE, The American Concrete Institute, The Masonry Society) prefer to do most of their code development through standards:

- The standards development and maintenance process is far less subject to meddling and interference by individuals not expert in the material
- Although balance in the committee is required, in practice the group is split between producers, contractors/professionals, and public or at large members. As a result, a disproportionate share of the committee representation normally being made up of individuals representing some sort of commercial interest.

There are nonetheless significant reasons why standard development is dominated by large, and well-funded organizations working in conventional construction.

- ICC referenced standards must be updated/maintained by the committee every five years. This imposes an enduring burden on stakeholders and constituents to get involved and stay involved.
- The process is costly and time consuming, requiring scheduled and agendized meetings over the entire course of the standard's development. Funding to subsidize these costs for participants can be difficult to obtain.

While there is currently no earthen standard accepted within the I-Codes, there is one example that comes close. ASTM 2392, the Standard Guide for Design of Earthen Wall Building Systems[5], was first published in 2005 to consolidate best practices for earthen wall design, and guide its use in a form recognized both nationally and internationally. Originating out of the ASTM's subcommittee for sustainability within buildings, the group was made up of a panel of international experts, notably Horst Schroeder, David Eisenberg and Bruce King. Updated once in 2010 to include additional information on earthen wall design in seismic areas, this remains the most advanced American standard addressing earthen construction. However, in its current form, ASTM 2392 does not meet all the criteria for reference within the codes, most notably because it includes guidance rather than compulsory language.

[5] http://www.ecobuilding.org/code-innovations/policy-profiles/2005-astm-standard-e2392-for-earthen-wall-systems

State and Local Codes:

In the past, building codes and code provisions began as locally specific, somewhat narrow responses to needed regulation. Today most States use the International Construction Codes as a starting place and then adopt State-specific modifications to bring the ICC provisions in line with local circumstances. State processes remain an important part of code development, particularly for traditional and non-conventional building systems. Most states also permit local authorities to create local ordinances that amend or edit state building codes to make them responsive to climatic, geologic, and economic conditions at a city or county level.

While the processes for developing earthen codes and standards at the national level can seem daunting, the state and local process can be more approachable. Here are some of the advantages of state and local processes:

- As local and State codes are designed to address specific local conditions, they can act as guardians of historic processes and traditional building methods.
- They can be incubators for alternative or new building practices that are either nascent or not widely used outside of a particular region.
- Building officials reviewing and enacting local codes are frequently locally known contractors, architects, engineers and state government officials. As such, they may be more responsive to local industry and knowledgeable about local practices.
- The costs and timelines associated with state and local code development can be much less than code development at the national level.
- In some cases, local building officials will have more direct experience with an alternative building material and be willing to assist in code writing.

Local code development also has some disadvantages relative to engaging the process at a national level.

- By design, local codes are limited in application to narrow parts of the country, and language accepted in one jurisdiction may not be relevant to or accepted by another jurisdiction just a few miles away.
- Code language developed locally may not meet the editorial or standards

requirements of other jurisdictions, limiting wider applicability to other state or national codes.

- Local codes can be subject to sudden disruption by changes in local conditions and building department staff. There are many examples of local earthen building codes being lost simply due to lack of advocacy or perceived need, or new staff's lack of familiarity with code requirements of traditional methods.

There are only a few earthen building codes today in the United States at either the state or local level. Two notable examples are Pima County Arizona's *Approved Standard for Earthen IBC Structures* and New Mexico's *Earthen Building Materials Code* and *Historic Earthen Building Code*. New Mexico's *Earthen Building Materials Code* is the most comprehensive code of its type, covering adobe, rammed earth and compressed earth block. It is free-standing in that it has few references to other codes or standards, and every aspect of the three recognized methods of earthen building is covered within the single section of code.

The process for construction code change in New Mexico can be illustrated by a small change in the stem wall provisions of the *Earthen Building Materials Code* introduced by The Earthbuilders' Guild in early 2015 and finally incorporated in the code in late 2016. Testing the waters with this small change let us learn the formal rules, introduced us to the code officials important to the process, and gave us a working knowledge of the system and its limitations.

The code process in New Mexico is a formalized one that often proceeds on an "informal" basis and pace. The current system places an emphasis on changes that protect safety and health and that come at no, or little, additional cost to the construction industry.

The formal process involves 1)submitting an official change form to the Construction Industries Division (CID), 2) defending the proposal before CID's Technical Advisory Committee (local architects/engineers, building officials and contractors chosen by CID), 3) review by public comment, 4) approval by the Construction Industries Commission

(building contractors, architects/engineers and others appointed by the state governor), 5) final approval by the governor, and 6) publication in the state legal gazette.

The informal process involves getting to know the CID bureau chief in charge of the proposal, being open to the bureau chief's guidance, being prepared to defend the proposal before the Technical Assistance Committee with factual scientific/engineering information, and keeping on top of an ever-changing timeline for CID meetings and actions relating to your proposal.

The lack of transparency in New Mexico's current system was one of the greatest challenges for a small group new to the people and process: Technical Assistance Committee meetings are not formally announced and only recently have the dates and times of the Construction Industries Commission meetings been readily available online. Additionally, there is no comprehensive posting of information on the code change process and requirements on the CID website. (The Regulation and Licensing Department, which oversees CID, is reportedly trying to make the process more transparent, but has yet to demonstrate even minimal progress.) "Constant vigilance" became our watchword in finding out dates, in contacting people in-the-know for feedback on where we stood, and for measuring when to intervene and when to step back.

TEG's stem wall code change began with submission of the CID code change form in early 2015 and finally became regulation when the change was published in November of 2016. Due to TEG's efforts, the earthen code now requires earthen walls be supported entirely by stem walls. Previously a 10-inch-wide wall required only an 8-inch-wide stem wall with 2 inches of exterior insulation--the result was basal caving because the foam insulation did not have the strength to support the weight of the earthen wall above it. A small victory, but one that will keep knowledge of the earthen code alive and help demonstrate that, with proper practices, earth is a durable and safe construction method for today's building industry.

Conclusion

As we understand more about the IBC, ASTM, state and local processes for developing and maintaining earthen building codes and standards in the United States it is clear that there is room for progress in including earthen building in all. We have learned that, on every level, change is only a little bit about tools and procedures, and a whole lot more about commitment. The Earthbuilders' Guild (TEG) has successfully defended adobe construction at the state and national level, but currently does not have the resources or constituency to effect necessary changes and improvements in the regulation of rammed earth, compressed earth block, cob or other earthen materials. The unification of experts and stakeholders within the earthbuilding community and the combining of our forces will be critical to ensuring that we keep earthbuilding relevant to today's building practices and realize earth's potential to address environmental challenges that conventional construction has failed to adequately address. We hope that EarthUSA 2017 will serve as the catalyst for future action to develop and improve earthen codes at every level.