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COLLEGE LEVEL RESIDENTIAL BUILDING CODE EDUCATION: CURRENT STATUS AND BEST PRACTICE

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COLLEGE LEVEL RESIDENTIAL BUILDING CODE EDUCATION: CURRENT STATUS AND BEST PRACTICE

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Civil Engineering

by
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Accepted by:
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ABSTRACT

Community destruction and loss of life due to residential building code (RBC) violations still occur too frequently. Increasing RBC enforcement is often not possible due to lack of funds and resources. Teaching RBC to college-level construction students is another way to encourage greater code compliance and enhanced community resilience. This research assesses the current status of RBC education in accredited construction programs, identifies academic and industry perspectives of RBC education, and constructs “best practice” RBC teaching strategies.

A mix method, exploratory approach including three distinct phases explains the current phenomenon - RBC education emphasis within university curriculums. My research found that RBC is not included in most construction programs; however, both industry and academia believe the topic is important and should be taught. Industry professionals cite “on-the-job” training as how they learned RBCs. However, over 90% agreed RBC should be taught prior to industry experience – within degree programs. Academics’ believe, at minimum, students should understand the “bigger-picture” of why RBCs are important and display proficiency in recognition. The most appropriate time to integrate RBC education is after students learn design principles. Typically design principles are taught in the first year or two of programs, indicating RBC education should begin in year three of four-year programs or in the second year of two-year programs. Additionally, faculty indicated increased motivation to teach RBC if free course modules were available. Course modules would be most useful as student aids and resources during design practice. The research concludes RBC education is perceived as
valued educational information yet little is being done to address the issue. Future research should focus on overcoming the faculty barriers towards teaching RBC and developing higher cognitive RBC learning strategies related for students.
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1. INTRODUCTION

Residential design, material and construction are governed by codes ensuring life, property, and health for all citizens are protected (Dunham, 1998). Where residential building codes (RBCs) are not enforced industry professionals apply their own discretion. It is the belief that professionals who believe RBC is valuable knowledge, construction and implementation, are more likely to include RBCs into their work even when not required or enforced by law. Understanding current status and best practice for teaching RBCs to architecture, civil engineering, and construction science management majors (here in after known as “construction students”) provides the first step to understanding how to protect communities in the future (Gerber, 2009).

Students’ future beliefs are connected to the beliefs of faculty members (Matusovich, Streveler, & Miller, 2009); therefore, understanding faculty perspectives is the starting point to learning what students will find important in the future. This research examines faculty members’ perspectives of RBC education, in hopes, to learn how future industry professionals will perceive codes. Critically examining the construction education process from the educators’ perspective (both faculty members during college and industry professionals teaching new graduates after college) enables a unique voice to emerge. Are the voice of faculty and industry stating the same things? By listening to these cohorts and analyzing current curriculum structures an in depth understanding of RBC education can start materializing.
1.1. Problem Statement

During the event of a natural disaster, municipalities lacking residential building code (RBC) adoption or inadequate enforcement, risk greater chance of community destruction. For example, the investigation by the California Seismic Safety Commission into the Northridge southern California earthquake found far less destruction would have occurred if building codes had been rigorously enforced (Burby & May, 1999). However, most municipalities lacking enforcement cite deficient funds and resources. A report by Heather Way, at the University of Texas School of Law states, “Code enforcement takes time, people, and money, and there is not enough of these resources dedicated to code enforcement in Dallas” (Way, McCarthy, & Scott, 2007). The current economic environment (especially at the local government level) limits the amount of adequate funding available to improve building code enforcement. The future safety of communities will require a different solution.

Educating the next generation of building professionals regarding building code, specifically residential, is one potential solution for safer communities. As future design professionals, current construction students, hold future responsibility to apply building code regulations; “they must perform professionally and accept responsibility and potential liabilities associated with their services” (Dunham, 1998). The national accreditation board for civil engineering programs, ABET, “Code of Ethics for Engineers” states that “engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties” (ABET, 1997). With increased community destruction due to lack of residential code implementation the safety, health,
and welfare of the public seems to still be in question. Understanding the teaching process of RBCs is the first step towards increasing community safety. University construction programs follow national accreditation guidelines. Each guideline provides brief, subjective teaching topics measured through a review process; yet, none of the review topics specifically mention building codes as a direct accreditation requirement. Edward Allen, an architect and author from South Natick, Massachusetts states, “To me the [National Architectural Accreditation Board] NAAB has really fallen short on that issue [of building science detailing and building technology] and so have the schools. There needs to be more taught on the subject” (Energy Design Update, 2005).

The purpose of this study was to (1) assess the current status of residential building code education in accredited architectural, civil engineering, and construction science management programs; (2) identify the value of residential building code education from academic and industry perspectives; and (3) identify “best practice” residential building code teaching strategies.

1.2. Research Questions

To address the previously mentioned purposes, the following research questions were investigated:

1. Is RBC knowledge frequently used within industry careers?

2. Should RBC be included within accredited construction programs’ curricula? If so, when should RBC be taught?

3. Using the following variables, do differences exist between industry and academic perception of teaching RBC and proper instructional methods?
a. Course time (Number of hours) RBC should cover

b. Teaching methods

c. Depth of knowledge

4. What are motivations to include RBC in course work?

5. Are there certain learning objectives RBC courses should contain?

6. Are there barriers or reasons not to include RBC in course curricula?

7. Can we learn from current industry leaders’ building code education experiences?

1.3. Importance of this study

This information is important to establish what needs to be done, if anything, to improve the RBC education for future engineers, contractors, and architects. Better education in this area will lead to greater adoption of codes and a more resilient infrastructure.
1.4. Research Study Limitations

The following constraints define and limit the results and interpretations of this study. The scope boundary was drawn around Civil Engineering, Architecture and Construction Science Management programs with ASCE, AIA and CSA student organizations, respectively. All programs were geographically located within the United States and do not include any territory areas. The results and interpretations, some generalizable, are only the representation of those industry and academic professionals participating in this study. The results may not be representative of every faculty member of the respected universities, only of those in which participated in the study. The sample population was not random; faculty and industry members who participated are connected, in some way, to the construction and/or code industry. Additionally, the researchers are not suggesting RBC is the only skill
or the most important skill needed to become a professional within the construction industry. This research only identifies how others view the topic, current influence placed on the subject, and if professionals believe more or less should be done. No measurement is provided - ranking or scaling – comparing the depth of RBC education to other essential skills.

1.5. Summary

The safety, health and welfare of our communities are the priority and responsibility of the home building industry. Research illustrates that homes built to code are more resilient than those not built to code. However, cases of increased destruction to communities and loss of life due to code violations are still present. Increasing RBC enforcement requires additional resources – a request not possible for most communities due to current economic conditions. Teaching RBC to the next generation of construction professionals may result in greater code compliance impacting community resilience. This research addresses current university construction program curricula, the difference academia and industry place on RBC knowledge for graduates, and best teaching practices regarding RBC.

2. BACKGROUND AND LITERATURE REVIEW

The purpose of this literature review is to identify past research related to code education and evaluate the current status of residential building code (RBC) education within university curriculums. This information is important to establish what needs to be done, if anything, to improve the building code knowledge of future engineers,
contractors, and architects. The findings indicate a gap in RBC education research and a lack of teaching information in the current curricula.

The formation of the International code council (ICC) and multiple state adoption of the International Residential Code (IRC) in the early 2000’s concurrently ended research on the topic of RBC education. Previous research, prior to ICC and IRC formation and adoption, emphasize the difficulty in code integration to the curricula due to numerous code agencies, state policies, and conflicting codes. Much of the publications speculate RBC education would improve, becoming inherently easier to teach, when the IRC became recognized as the only code (Dunham, 1998).

The decade long deficiency in RBC education research and lack of RBC teaching method information presents the question: why is there a gap in literature starting when the IRC commenced? Potentially, construction programs believe RBC is now taught properly due to only one code – requiring no additional research or RBC now holds little distinction in curricula therefore research is not a priority. A report from the Journal of Energy Design Update in 2005 presents a conflicting argument suggesting: schools are not providing sufficient education regarding building science (Energy Design Update, 2005). Richard Keleher in his “Paper of Concern” to the National Architectural Accrediting Board (NAAB) states, “schools are not providing sufficient education in the areas of the building envelope/ enclosure and the relevant building science” (Energy Design Update, 2005). Recognizing building codes as a subset of the larger category – building science and envelopes – highlights the failure in current education programs (Dunham, 1998). Andre Desjarlais, an engineer and program manager for building
envelope research at Oak Ridge National Laboratory, stated, “part of the problem is that…we don’t have university-level programs in building science. We just don’t teach it” (Energy Design Update, 2005). These concerns, not addressed in the current literature, create the backdrop for which this research provides insight; essentially this research restarts the RBC education conversation after a decade sabbatical.

2.1. Building Code History and Current Status

Building codes impacting the safety and welfare of US Citizens began with George Washington and Thomas Jefferson’s policy initiative. Their influence spread from District of Columbia to surrounding cities. Each individualized community developed and adopted their own set of codes; typically only developed or enforced by communities with sufficient funding. Contemporary codes began between 1915-1940’s with the establishment of three distinct associations: Building Officials Code Administrators International (BOCA), Southern Building Code Conference International (SBCCI), and the International Conference of Building Officials (ICBO). These codes competed against each other for adoption from states and local municipalities. Often requiring builders to use multiple sets of building practices. Inconsistency made designing and constructing difficult and often hard to follow, apply and enforce (Council, 2013). During the 1990’s discussion of a uniformed building code, the International Code Council (ICC), became a reality. By 2000 the first International Building Code (IBC) was published and soon became the most adopted code in the country. Figure 2.1, illustrates the building code timeline through history– a representation of publications that reference residential building codes starting in 1940 through 2005. Figure 2.1 was developed using Google
Ngram, a mass of digitized books enabling cultural trends to emerge from quantitative data (Jean-Baptiste et al., 2011).

![Figure 2.1: Publications Referencing RBC throughout History](image)

### 2.2. Need for Residential Building Code Education

A presentation in 2011 by University of New Orleans faculty members explains, “an area of the country [New Orleans] so much at risk of coastal storms requires an educated populous to whom risk resilience comes naturally (Kiefer, Peterson, Nance, & Laska, 2011). Communities affected by Katrina are encouraged to rebuild on their own terms and in the same areas in which flooding occurred (Flynn, 2007). The goal from the Chief Planning Architect, Steven Bingler, is “to empower people to make decisions for themselves and their communities” effectively leaving future community resiliency in the hands of the construction professionals performing the work (Flynn, 2007). Building back stronger will not occur unless these construction professionals understand how to do so. A portion of learning to build back stronger includes educating to the RBCs. Coastal regions continue to be the fastest growing regions. Stephen Flynn, author of *The edge of Disaster*, reports, “nearly 90 percent of Americans are currently living in locations that
place them at a moderate-to-high risk for earthquakes, volcanoes, wildfires, hurricanes, flooding, or high wind damage” (Flynn, 2007). Given the potential for widespread community destruction across the country, affecting nearly 90% of the population, there is a strong need for societal resilience in the context of natural hazard risk beginning with systemic integration of resilience education in curriculums (Kiefer, Peterson, Nance, & Laska, 2011).

### 2.3. Curriculum Development

Understanding the basis for construction-oriented curriculums enables the reader to better delineate where and when RBCs should fit. A popular method within construction is teaching topics separately, using subdivided curriculums. The benefits to separate subjects are presented by Grigg et al. (2004): requires less collaboration between teachers, easier to teach, and student assessments can be done within each course.

Traditionally, subject material is categorized by school year. Russell and Stouffer (2005) explained the first two years are dedicated to general education requirements (i.e. liberal arts, mathematics, basic AEC synopsis) while the second two years are dedicated to specialization. However, Dunham suggests, “the specialization of information…has made the curriculum more removed from life at a time when the demands are to make the curriculum more receptive to societal requirements and issues” (1998). Tanner and Tanner (1980) suggest specialization is a narrow view for student development – actually creating student confusion rather than clarity. An evolving trend against specialization refocuses curriculums to include integration of skills and knowledge (Russell & Stouffer, 2005). Colorado State found that “after working with an integrated core curriculum for
more than 5 years, we conclude that it works but presents different challenges than traditional courses. The integrated core can enable a department to offer broad content with practical and relevant topics…it meets employers goals…[and] provides a way in which to adapt the curriculum…” (Grigg, Criswell, Fontane, Saito, Siller, & Sunada, 2004). In occurrence with Grigg et al. this research found: schools already including RBC integrate content throughout the curriculum rather than teach it through a specific topic. In support of Dunham’s theory, the few best practice RBC schools agree to its educational value and explained RBC as an applied knowledge which should not be include as a subdivided subject but an overarching concept continuously mentioned throughout students college career.

2.3.1. Theoretical Learning Approaches

Subsequent to the research phase, existing theories of learning styles and approaches were reviewed, in hopes, to discover similarities with current RBC education practices. Identifying an existing theoretical framework in which this grounded research correlates strengthens future application. Sheppard and Gilbert (1991) provide four distinct learning approaches: transferring, shaping, traveling, and growing. Of these approaches, growing and traveling are most likely to lead to a Deep Learning approach (Sheppard & Gilbert, 1991). The deep learning approach involves learning from real life situations and students forming their own opinion about a matter. Ling Ng, and Lueng suggest a Deep Learning approach should be used when the information is important, applicable to the students’ professional development (2011). The results of this study align with the suggestions of Ling, Ng, and Leung (2011).
Additional relationships from existing methods to the current in RBC education include inductive and deductive learning, as defined by Prince and Felder (2006). Inductive learning includes: inquiry learning, problem-based learning, project-based learning, case-based learning, discovery learning, and just-in-time learning (Prince & Felder, 2006). Similar research by Froyd and Ohland implies design projects, a similar approach to Prince and Felder’s project-based learning, are the best potential for students to draw connections between subject matter. This research draws similar conclusions: design projects promote student participation, interaction, and often less emphasis on right versus wrong answer sets. Teaching less about correctness; instead, emphasizing empirical knowledge implies a constructivist epistemology; where reality is constructed through interaction and experiences with others and the world rather than knowledge coming from absolute, theoretical truths. Using a Deep Learning approach to RBC provides the best hope that student in the future will use the information in their professional careers.

2.4. Summary

Supporting research evidence indicates the level of RBC education within university curriculums needs addressing – research within the last decade provides no relevant insight. Prior to ICC conception, three distinct institutions formulated code provisions with conflicting or differing standards, many building professionals and municipalities appeared confused. Re-starting the conversation at the point of ICC conception, this research, provides a glimpse at the current point in time into the university construction programs across the country. In areas affected by destruction,
building back stronger is key to success. Many cities leave reconstruction up to the private building industry due to lack of funds for enforcement. In these situations, understand how building professionals view code and its relationship to resilience is important. Looking forward at the future of the industry – current students – how we educate construction students now, impacts the future building industry’s perspective towards community resilience. Prior research makes a connection between faculty beliefs and the beliefs students construct for themselves. With this understanding, analyzing educational methods, theoretical learning frameworks, and curriculum development becomes relevant. It is here where this research starts – analyzing faculty beliefs to gain an understanding of student outcomes.
3. RESEARCH METHODS AND PROCEDURES

3.1. Research Design

Hensley’s predication in 1998 of easier RBC teaching practices with IRC adoption and the question and issues surrounding RBC education in 2005 presented by the Journal of Energy Design Update provides the background this research is trying to address. (Energy Design Update, 2005; Dunham, 1998). Grounded in theory, allowing actual and current education practices to emerge, previous theoretical teaching frameworks were intentionally ignored. The methods used, exploratory in nature, a sequential quantitative then qualitative approach. At each research phase, responses became richer in context, providing both statistical analysis of data followed by open coded response categorization. This mix methods approach increased research internal validity through triangulating initial statistical responses with follow-up interviews. Survey questions were checked through face validity ensuring responses accurately answered the research questions.

3.1.1. Grounded Theory

The overall perspective of this research is grounded in theory. Meaning the research provides an understanding of a specific situation within a social setting that previously was not well understood (Hunter, Grealish, Casey, & Keady, 2011). Grounded theory is best used to construct theory rather than studying existing theories. This approach to research is inherently different than typical scientific experiments. No hypothesis is formed prior to data collection. During data collection information is
continuously analyzed, theories developed, and reshaped. Based on the analysis, categories are defined which are only bounded and reshaped by the collected data. Theory emerges from the data analysis that “fits or works in a substantive or formal area…since the theory has been derived from data, not deducted from logical assumptions” (Hunter, Grealish, Casey, & Keady, 2011). Hutchinson claims, “grounded theory research can produce theories that closely mirror the social reality and are, therefore more useful than speculative theories that are not data based (1988).

Researching a subject like RBC education where little is known about the education process and social setting, grounded theory is the best method. Within education research, grounded theory provides the researcher freedom to “intelligently and imaginatively explore the social psychological consequences of school life” (Hutchinson, 1988). However this research is a form of social criticism, meaning, judgments are made about the social scene (Hutchinson, 1988). Judgments or drawing conclusions provide an understanding of the situation that is empirically different than most other research forms. Additionally the exact theory or judgments made about the research may not be replicable. Grounded theory is based on the interaction between data and the research and the interpretation of individual people inevitably would change (Hutchinson, 1988).

Typically, research begins with a hypothesis and then develops the research tools to best fit. This process, grounded theory, is a constant comparative approach where the chronological stages of traditional research are broken (Backman & Kyngas, 1999). Once data collection begins, analysis using coding techniques starts identifying theories. Even though judgments will be made, researchers preconceived notions must be kept out of the
process. Analyzing purely the data allows relevance, core problems and processes, to emerge (Backman & Kyngas, 1999). The techniques used in this research: curriculum review, survey, and interviews helped the researcher see the situation through the participants’ eyes. Hutchinson supports these techniques stating they “clarify the meanings participants attribute to a given situation” (1988). Once data is collected using these three stages, analysis is done through coding – a process through phrase or word identification at different categorization levels. Coding is the tool used for theory development or theory generation. Codes either define a theories boundary or reshape it by merging theories together. This is a subjective process and many grounded theory researchers use varying processes. Goldkuhl and Cronholm define four methods of theory generation: inductive coding, conceptual refinement, pattern coding, theory condensation (2010). This research uses inductive coding or often called open coding and axial pattern or pattern coding. Any preconceived ideas must be discarded allowing the data to “speak” to the researcher (Goldkuhl & Cronholm, 2010).

Challenges using grounded theory are considerable and certain hurdles need addressing. Preconceived ideas form during the data collection process – surveys and interviews. Reducing these preconceived thoughts during the coding process was difficult however necessary for the success of the open coding process. Allowing the patterns to form and then reform continuously changed the apparent theories making it difficult to see any categorical findings or theories emerging from the data set. This is where the distinction between theory generation and theory grounding became unclear. Using judgment, an open mind, and continual analysis without preconceived notions enabled
the theory development to continue. Much time and attention was spent substantiating the developed theories. Exhaustive efforts were taken ensuring all possible theories were considered; however, the framework of grounded theory – ongoing, continual search and refinement – proved challenging to find an end. Eventual dissemination of codes into broad categorical theories enabled an end and theories, some more specific than others, to emerge. The results do not extend outside this specific research social setting and are in many ways not replicable. Grounded theory provides a glimpse into the exact social scene in question; this setting is ongoing, and therefore ever changing. Reproducing the results would be difficult and findings should be seen as insightful rather than substantiating.

3.2. Procedure

The mix method approach included three research phases illustrated in Figure 3.1. Starting with phase one, every curriculum of every program with a student chapter of American Society of Civil Engineers (ASCE), Construction Science Association (CSA), and American Institute of Architects (AIA) was analyzed. This list included approximately 950 different programs, throughout the country, ranging in degree types from associate degrees to PhD programs. These degree programs combined represent 460 university departments. Curriculums were accessed through online department websites, course outlines and course descriptions. Analysis was done through reviewing each course description highlighting and recording courses related to building codes, specifically residential. Faculty members within each department from phase one were asked to participate in phase two: online survey. Additionally, members of the American
Institute of Architects (AIA) Residential sector and the International Code Council (ICC) members were asked to participate in an online survey. Participants were informed that the survey would take less than ten minutes and their responses would remain anonymous unless they agree to participate in phase three: follow-up interviews. Survey responses filtered comparison groups: (1) those agreeing RBC is an important topic and those disagreeing RBC is an important topic; (2) those with suggestive RBC teaching methods.

Figure 3.1: Research process

### 3.3. Survey Populations and Samples

The sample size for both academia and industry surveys are the entire populations. The academia population is every university with a current student chapter within ASCE, AIA, and CSA. Figure 3.2 illustrates the regional percentages across the country. The academic response rate was 14.78% (68 participants) with a completion rate of 79.41% (54 participants completed). Classifications by program types (Civil engineering, Architecture, Construction Science) and academic response rate are provided in Table 3.1. Civil engineering faculty represent the majority of university programs across the country and were the largest survey respondents.

The entire ICC residential division and AIA residential members received survey
invitations; however the ICC and AIA did not report population sizes. In total, 90 ICC and AIA members started the survey with a completion rate of 85.6% (77 completed surveys). Regional distributions of both groups are illustrated in Figure 3.3. Industry respondents by profession are highlighted in Table 3.2. Distributing the survey to only ICC and AIA members, the largest subgroups – Architects and Code Officials was expected. Experiences within these two subgroups vary greatly as identified during phase three: many code officials previously worked as contractors or tradesmen. Architects interned within the construction field prior to starting their architecture design careers.

Figure 3.2: Regional Demographic of Universities
Figure 3.3: Regional Response Distribution; Red: Academic, Blue: Industry

Table 3.1: Academic Response Rate

<table>
<thead>
<tr>
<th>University Departments</th>
<th>Number of Departments</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>266</td>
<td>13.91%</td>
</tr>
<tr>
<td>Architecture</td>
<td>157</td>
<td>6.37%</td>
</tr>
<tr>
<td>Construction Science</td>
<td>37</td>
<td>18.92%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>460</td>
<td>11.74%</td>
</tr>
</tbody>
</table>

Table 3.2: Industry Response Rate

<table>
<thead>
<tr>
<th>Profession</th>
<th>Number of Responses</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Official</td>
<td>35</td>
<td>45.45%</td>
</tr>
<tr>
<td>Architecture</td>
<td>31</td>
<td>40.26%</td>
</tr>
<tr>
<td>Construction Professional</td>
<td>3</td>
<td>3.90%</td>
</tr>
<tr>
<td>Engineer</td>
<td>2</td>
<td>2.60%</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>7.79%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>
3.4. Instrumentation

Two surveys were developed by the researcher asking both industry and faculty members throughout the United States to indicate the level of value RBCs withholds in university programs for construction students. Both cohorts were first asked should RBC be taught at the university level and if so which degree program: associate, undergraduate, graduate or any combination. Those participants answering “should not be taught” were asked to elaborate through a comment box. All participants answering any of the above provided additional information. Subsequent questions tried clarifying which student types are best suited for RBC information and how much detail/time should be applied. Additionally, participants were provided a list of common teaching practices (e.g. teaching case studies, capstones, industry speakers…and other please specify) and asked their opinions of best teaching practices for RBCs. The question regarding – the amount of time RBC education plays within the curricula or specific class, provides insight into the level of value faculty and industry place on RBCs. This topic is further addressed during phase three interviews. Finally, the survey addressed why teaching RBC is important. Questions pertained to professional responsibilities (e.g. licensing exams, uses during career) and community benefits (e.g. increased community safety, awareness). Those participants willing to participant in follow up interviews and agreeing RBC should be included in the curriculum were asked for interviews through email. Those who believed RBC should not be considered in construction curriculums were not asked for interviews as detailed explanations were prompted for survey completion. The full survey set can be viewed in Appendix 7.1 and 7.2, Faculty
Questionnaire and Industry Questionnaire, respectively.

### 3.5. Method of Analysis

Survey questions varied between multiple choice, order ranking, likert, dichotomous, and open-ended. Analysis included frequency distribution of responses, percentages, frequency of terms in open-ended responses, and ranking. Phase three involved interviewing research participants and methods of analysis shifted to open coding, described in sections 3.7-3.8.

### 3.6. Interview Participants

Academic and industry cohorts, alike, strongly indicate through survey results (phase two) RBC education in university curriculums is an important topic; the statistical analysis and findings are reported in sections 4.2-4.5. Survey findings affected phase three interview participant types. Purposeful sampling, only those pro-RBC education, were selected to provide descriptive explanation (Matusovich, Streveler, & Miller, 2009). Those against RBC education participants provide additional comments on survey comment sections explaining reasons against RBC education. Pro-RBC education participants were slated if (1) RBC should be taught within university course work and (2) participates willing to participate in follow up interviews, providing contact information. Academia survey results produced 19 potential participants; 5 were chosen for phone interviews and the remaining received email responses. Industry responses indicated 27 potential follow-up participants; 7 were chosen for semi-structured phone interviews and the remaining were sent questions through email. Phone interviews
followed a semi-structured approach with exact questions asked as to the structured email follow-up. Table 3.3 provides itemized responses for each program and professional group. Each academic and industry group provided written and/or verbal feedback influencing final coded results.

Table 3.3: Follow-Up Interview Response

<table>
<thead>
<tr>
<th>PHASE 3: Academia Follow-Up Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Type</td>
</tr>
<tr>
<td>Architecture</td>
</tr>
<tr>
<td>Construction Science</td>
</tr>
<tr>
<td>Civil Engineering</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHASE 3: Industry Follow-Up Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profession</td>
</tr>
<tr>
<td>Architect</td>
</tr>
<tr>
<td>Engineer</td>
</tr>
<tr>
<td>Code Official</td>
</tr>
<tr>
<td>Contractor</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

TOTAL INTERVIEWS 14

3.7. Interview Assessment Technique

Interview questions followed a semi-structured, open-ended response strategy. There was no set question order and additional time and/or comment space was provided to all interviewees allowing for elaborate, detailed responses. The idea was to encourage faculty and industry to reflect and report on their teaching beliefs and practices (Matusovich, Streveler, & Miller, 2009). Using an informal, natural interview process better clarifies the participants’ perspective by enabling freedom to discuss the situation and them attribute their own meaning (Hutchinson, 1988). Interview questions reflected
key variables identified in section 1.2, including: depth of RBC education in curricula, necessary depth of knowledge, teaching motivations, current status and best practice teaching methods. The structured interview question set is provided in Table 3.4. Interviews were transcribed and read numerous times then an open-coding strategy was applied to responses. Information patterns, or codes, emerged from the data itself; refining and cataloging codes by combining similarities until a remaining code set was clearly defined (Matusovich, Streveler, & Miller, 2009). High-level coding, depicted in Figure 3.4, illustrates categorization relevant to questions asked. Subset coding and results are provided in section 4.4.

![Figure 3.4: Code categories based on response](image-url)
### Table 3.4: Structured Interview Questions

<table>
<thead>
<tr>
<th><strong>Industry</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Can you elaborate with personal or professional experience on why (or why not) there is a need to teach residential building codes?</td>
</tr>
<tr>
<td>2) In some counties throughout the country residential building codes are suggested and not necessarily the law. Can you provide a statement for why a new designer, contractor, or engineer should be motivated to include residential building codes when not required by law?</td>
</tr>
<tr>
<td>3) If field visits are not possible to students interested in learning residential building codes what would you suggest for them to gain a better understanding of what residential building codes entail?</td>
</tr>
<tr>
<td>4) How did you personally learn residential building code and why were you motivated to do so?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Academic</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Can you elaborate on how (or how not) current students within your departmental programs gain an understanding of general building codes? Do you feel this is the most effective?</td>
</tr>
<tr>
<td>2) Can you elaborate on your personal experience with styles or methods used to teach subjects often considered tedious, detailed, or less engaging for students.</td>
</tr>
<tr>
<td>3) Do you feel educators should be cautious about teaching building codes in general? Is there a level of detail or emphasis that should not be over done?</td>
</tr>
<tr>
<td>4) Would you or your department find course modules related to residential building codes useful if provided to you for free?</td>
</tr>
<tr>
<td>5) Assuming you feel improvements could be made to your department’s curriculum. Do you feel there are any barriers within your department for why building codes and/or residential building codes are not better integrated?</td>
</tr>
</tbody>
</table>

### 3.8. Coding Technique

The open coding technique was the process used to identify the core categories and links between them. This process was very dynamic; categories constantly changed while vetting the interview evidence. During the open coding process, it was important to release prejudgments about potential theories however to do so
was challenging, as the coder was also the interviewer. Patterns seen during interviews were challenged by the categories emerging through coding and the final themes and theories identified were not the same as first conceived during the interviews. Axial coding compared the similarities and differences in patterns initiating the boundary lines between the categories seen in Figure 4.8: Coded themes from interviews.

3.9. Summary

A grounded mixed method approach enabled only reality to emerge from the data. Three separate stages, complementing each other, at every stage providing deeper insight. The survey populations covered both faculty and industry professionals across the country, in efforts, to better portray reality. Those interview participants strongly agreeing RBC is important or indicating current best practice methods. Interviews were conducted using non-formal, open-ended answer format. Transcribed then coded responses paint a picture of current industry and faculty beliefs, highlighting similarities and differences between them. The findings only represent a current moment in time specifically related to a unique set of participants.
4. RESULTS AND ANALYSIS

4.1. Curriculum Review

Understanding RBC education in construction university curricula could not be explained nor justified through phase one – online curricula reviews – alone. As the literature review lead to a gap in knowledge and development of this study, phase one provided supportive findings – suggesting RBCs are not sufficiently included in secondary education programs across the country. Researchers read and reviewed course descriptions from each university construction program (462 universities) documenting RBC inclusions in course titles or course descriptions. Results indicate, 6.9% of construction programs include RBCs or non-structural, dwelling codes. The depth and level of RBC knowledge varies; however RBCs occupied enough course work - time or material - to warrant identification in course title or description. Curriculum review findings support continued research towards phase two and three – identifying RBC curricula inclusion and clarifying practices.

4.2. Assessing RBC Connection to Building Industry Code of Ethics

Professional organizations within the building industry uphold ethical standards promoting community and resident safety. Organizations such as: The American Society of Civil Engineers (ASCE), American Institute of Architects (AIA), and Construction Science Association (CSA) offer student run chapters for future industry leaders to become familiar with the professional organizations. These professional codes of ethics are additionally associated with the student organizations. A similar statement between
all three organizations - professionals are liable for technical knowledge of usual undertaking of the profession and any negligence which adversely affects the public is a violation of ethical code – suggests a connection to the reason knowing building codes are essential. When assessing education of RBC, teaching ethics was considered. Little connection between ethics and code was found during curriculum review. However, once reaching phase three, interviews, the connection between topics was viewed favorably by interviewees.

4.3. Analysis of Research Questions

Statistical results and qualitative coding strategies provide an interpretivist understanding of RBCs place in curricula and teaching methods used within university construction programs. The mix method results strengthen the depth of understanding by providing descriptive responses and validating the survey analysis. Six research questions were specifically addressed in this study:

4.3.1. Question 1: Are RBC use frequently within industry careers?

The online survey established a basis for the use of RBC professionally: 92% of industry professionals surveyed indicated, “they use RBC in their careers at least monthly”. Figure 4.1, illustrates the significance. The large architect and code official survey response groups were factored into analysis to ensure accuracy of results. No significant difference occurred with removal of either group. Filtering, both code officials and architects from survey, indicate 89.9% of contractors, engineers, or other related industry professionals use RBC on a monthly basis.
Interview questions directed responses to why RBC is an important factor in their careers and depiction of experiences influencing their understanding and degree in which RBC is important. Interview responses indicate industry professionals trying to gain or keep creditability amongst professions (or with clients) continually read and update themselves with RBC. An interview quote supports the claim, “I have found that as a relatively young architect, I found that to gain credibility amongst the construction world it was absolutely imperative to do my homework and be articulate about the issues that were relevant to my clients. The building codes guide and shape everything we build regardless of one’s opinion of them”.

4.3.2. Question 2: Should RBC be included within accredited construction programs’ curricula? If so, when should RBC be taught?

Both groups believe RBC should be taught at the university level. Figure 4.2 illustrates these results and highlights the difference – degree level in which RBC should be taught. Industry response suggests the technical degree is the most appropriate while
academic response suggest undergraduate. Both degree types are preparation for entering the workforce, suggesting – RBCs are an important, fundamental concept, prior to starting an industry career. Current professionals indicated they learned RBC from work experience yet 91% of respondents expressed RBC should be taught to students prior to starting their own professional careers. The high “pro-RBC” education response suggests – professionals believe their experience learning RBC was not appropriate – focus should be placed within school course work.

Difference between academic and industry cohorts lead to further interview probing. Two constructs emerged through interviews: students at the associate degree level will be implementing/installing technical skills and therefore should be the most educated regarding RBCs; students’ graduating from four year programs will be designing and/or managing construction workers therefore must understand the origin and basis for RBC; include RBC in design and enforce RBC on jobsites. This understanding influences section 5.1 Recommendations for Curriculum Development; including both constructs. Varying degree levels and program types require a broader understanding or deeper understanding and course development must be versatile in application to meet both needs. Interview quotes provide additional support:

“the construction managers have to check it [RBC] and unless they have prior knowledge or some sort of code education they might not even know what to look for.”

“it would be best a[t] trade schools first and for most. Those are the guys putting the work in place.”
“By this answer, I don't mean that code aspects should not be taught. However, we should not be teaching to the code, but rather the basis for code provisions.”

“…The understanding of risk and potential risks can be taught without getting into specifics of residential codes.”

“I feel we should make the students aware of how codes impact design, where to find them, how to use them and how to simply respond to them.”

![RBC should be taught at what degree level?](image)

**Figure 4.2: Difference in degree emphasis**

Over 50% of those surveyed stated RBC should be taught to all construction majors. Architecture programs were found to be the most important to receive RBC education. 90% of those surveyed stated RBC should be taught to Architecture students, illustrated in Figure 4.3.
Figure 4.3: RBC education to varying construction programs

Identifying the program year or semester level in which RBC should be included varies based on program type; however, the overall themes are the same. RBC should be taught/integrated only when students show basic understanding of building system principles. Meaning, RBC is not appropriate within introductory course work. Students should first learn building stages, systems, process, and components. Including RBC prior to students’ basic understanding would have limited impact. Interview responses explain:

“if you teach a code class to a young design student the effect is minimal to the student because they don’t understand the bigger picture of how the building goes together at that point.”

“education at the 4 year university setting my opinion is that it [code] has to be later in the curriculum.”
“I think it [third year] is a great year. Been successful for our school. The first few years are tough with lots of information. It is like the marines. It is boot camp. You are breaking them down.”

“RBC is required in third year studio.”

4.3.3. Question 3: do differences exist between industry and academic perception of teaching RBC and proper instructional methods?

The amount of time and level of detail construction students should dedicate to RBC varies by group (industry or academic). Figure 4.4 illustrates the gap between academia and industry. However, further interview questioning shows perspectives are actually similar, only teaching methods differ. Academics believe RBC should be taught as a course topic (approx. 2-5 hours of study) and then integrated into all design course work – spanning the length of the program. Industry professionals survey response indicates: RBC should include more course time - approx. 40 hours of study. Survey responses alone, would suggest, industry places a higher value on RBC education than academics. However, it was found to be fairly similar. Implementing RBC in multiple courses, lecture time decreases, however RBC knowledge education does not. Additionally, faculty members suggest integration into course work is best because the amount of lecture time available is limited within in a short two or four year program. Faculty explain, reducing lecture time on RBC and integrating into several courses over final year(s) of program is also easier to do. Interview response substantiates these claims, “[code] is introduced in a technical course as a topic and then integrated in the design studios”.
Teaching methodology varied between cohorts. Working professionals highly recommend teaching RBC through case studies and real world examples. University faculty members suggest teaching through student implementation in design, estimates and final, capstone projects. Recommendations for Curriculum Development, section 5.1, suggests both methods are important both to be included. Students’ development of their own RBC understanding may require both or either forms of learning styles. Interview responses supporting each claim: case study and design integration are supported in quotes below:

“A case study of where codes have mattered.”

“Short cased studies. To give people an idea.”

“Talking about real life we talk about code ethics and current events.”

“Should be integrated into various courses and coursework”
“An outline…that included photos of some mistakes. Although they might not remember the specific part, [architecture] ours is a visual field and there's a good chance they will remember the photo.”

Figure 4.5: Teaching practices

4.3.4. Question 4: What are teacher motivations to include RBC content in course curricula?

Academic response highlighted professors’ are motivated to teach what the students want to learn. This motivational finding indicates: students first must be motivated to learn RBC because they realize the significance it will play in their professions. The role of the teacher is to help students see this significance. Explained in section 4.2. Additionally, university faculty believe RBC education will impact the future safety of buildings and their community. In the context of curriculum development and teacher motivation, reminding faculty how RBC education influences awareness to their community and safety, faculty belief in safety can become a motivation. Over 60% of
faculty agreed that free, available course modules regarding RBC would increase the
likelihood of teaching the topic. This is illustrated in Figure 4.6 and discussed during
curriculum development, Section 5.1.

**Professor Motivations to Teach RBC**

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>My department pushed for me to teach it</td>
<td>60%</td>
</tr>
<tr>
<td>My students pushed for me to teach it</td>
<td>65%</td>
</tr>
<tr>
<td>Industry partners pushed for me to teach</td>
<td>45%</td>
</tr>
<tr>
<td>I had a complete set of code books</td>
<td>60%</td>
</tr>
<tr>
<td>Lesson plans were available to me</td>
<td>65%</td>
</tr>
</tbody>
</table>

![Figure 4.6: Teacher RBC motivation](image)

**4.3.5. Question 5: Are there certain learning objectives RBC courses should contain?**

Learning objectives should be integrated into design course work. Schools’ identified
as current “best-practice” during curriculum review and interviewed in phase three
emphasized RBC integration rather than a dedicated semester course. Schools’
highlighted RBC knowledge is not significantly weighted into grading. RBC is described
as building blocks students should use during the design process rather than material
students must memorize. In this scenario, learning objectives would be: proper student
knowledge, impacting design to include code. Interview response provides supportive
claim, “I make my student make a poster that shows [RBC inclusion]… I don’t put a lot
of emphasis on it or much of a grade on it.”
4.3.6. Question 6: Are there barriers or reasons not to include RBC in course curricula?

The resistance to RBC education within university curriculums was common only among 12.1% of faculty and 8.6% of industry participants (these cohorts here in after referred to as RBC challengers). However, a low percentage, the arguments against RBC education, presented by the RBC challengers, obliging attention. The concerns presented are generalized as a whole, addressing only the common themes: time, degree of importance compared to other items, specificity of topic, and education level required to learn subject. The efforts of this research are not to debate the concerns nor provide answers but rather bring the appropriate attention, as these issues are part of the results.

Time refers to the length of the study program. Faculty and industry responses indicate students must learn large amounts of information in a short period of time. Including RBC and other topics would lengthen the time in school – an action not worth taking. A quote from a faculty member clarifies the issue, “The college degree is preparation but cannot cover everything… The civil engineering degree would require 6 years if every item that eventually needs to be learned is included in the college degree.” Additionally, an industry professional explains their university experience stating a similar approach should continue, “Architecture school has too many other more basic things to teach and there is only so much time to teach them. It is enough for the professor to say, go look it up. That is how we did it and it suffices.” Another quote describes an engineering program, “Incredibly difficult to include on top of all of the structural fundamentals and theory.”
In comparison to other topics, RBC is less important than other student outcomes. Institutions must decipher student objectives in efforts to quantify and clarify outcomes. RBC challengers believe RBC is not a necessary outcome needed to join the construction industry rather a skill learned on the job. A participant provides explanation, “Most firms that do residential work know the rudiments and teach them to the staff. Hands on and practice is the best teacher…some items have to be learned on the job.”

RBC challengers suggest RBC is an applied skill not generalizable for a well-rounded education. A portion of students will not associate with residential construction, therefore, it should not be taught. Faculty members challenging RBC suggest, “Theory of structural behavior is far more important as preparation… The understanding of risk and potential risks can be taught without getting into specifics of residential codes.” Additionally, residential factors seem limited within civil engineering programs as suggested by another faculty member, “Residential building codes are typically not included in civil engineering curriculums”.

The education level theme suggests, construction students are intelligent not requiring actual RBC education rather these types of students, once complete with the university program, inherently can read and review codes. Both faculty and industry RBC challengers provide supporting quotes: “The engineer with a good education can pick that up quickly at work” and “In general most of what is in there is common sense”. When RBC is only considered important for recall (the lowest form of knowledge) rather than evaluation or synthesis (highest forms of knowledge) less of the students’ ability is
required. Those challenging RBC education appear to view RBC as specifically recall knowledge.

Those challenging RBC education appear to highly care for students and education however only hold beliefs suggesting RBC is not a required outcome for a quality construction education. Comments such as, “Seems like something that college educated persons should be able to learn on their own” acknowledges students in a high manner but RBC is not of the caliber to be included in the curriculum. However, commonly within best practice institutions RBC is integrated within design, part of the synthesis of knowledge rather than recall. Educating to the highest form is appropriate when discussing any material for university level students and the reasons presented by challenging RBC members don’t appear to meet the synthesize context.

4.3.7. Question 7: Can we learn from current industry leaders’ building code education experiences?

Over 90% of professionals support teaching RBC in the classroom yet this same cohort cited “on the job training” as the method they used to learn RBCs. Drawing from this statistic, professionals’ believe their experience - “on the job training” - was not the best method for current students. Professionals provided comments explaining why teaching RBC over “job training” is preferred, “It would help any student (and professional for that matter) to understand the empirical nature of code development and the underlying reason for a code standard” and “All individuals in responsible positions for design and construction should be schooled in building codes.” Additionally, industry professionals provided specific suggestions on how to teach RBC: “a large project
throughout the entire curriculum”, “law and professional ethics” and “general lecture”.

Figure 4.7 provides additional statistics on how current professionals learned RBCs.
4.4. Coded Categories

Degree level to introduce RBC

• Pre-design course. Typically design begins third year of four year program or second year of technical program.

Depth of RBC education

• Broadly: Why code is important. How to use code books. How code impacts design. Professional awareness and ethics regarding home safety.
• Specifically: What to look for on jobsites. Associated terminology.

RBC teaching methods

• Application to real life
• Case studies
• Student resources for design

Teacher Motivations

• Students and department push for RBC inclusion
• Course modules availability

Recommended education improvements

• Integration during third year of four year program or second year of two year program

Figure 4.7: Industry Experience Learning RBC

Figure 4.8: Coded themes from interviews
4.5. Summary

Analysis found RBC is not included in most construction programs. However, both industry and academia believe the topic is important and should be taught. Industry professionals cite “on-the-job” training as ways in which they learned RBCs. However over 90% agreed RBC should be taught within degree programs prior to industry experience. At minimum, students should understand the “bigger-picture” of why RBCs are important and display proficiency in recognition. Deeper knowledge, technical skills, are applicable for trade career programs and should be included in their curriculum development. Integrating RBC after students understand design principles is most appropriate. Typically design principles have been taught by the beginning of year three of four-year programs or second year of two-year programs. Additionally, program teachers indicated motivation to teach RBC would increase with free, available course modules. Course modules would be most useful as student aids and resources during design practice. Varying levels of detail would provide application for differing degree seeking and program type students.
5. CONCLUSIONS

This research re-starts the building code education conversation from the late 1990’s and early 2000’s. Specifically, this research addressed the current status of residential building code education (RBC) in accredited construction programs, identified academic and industry perspectives on RBC education necessary to join the construction industry, and provided a construct for “best practice” RBC teaching strategies. Based on the statistical and descriptive findings RBC is not included in university programs; yet, those industry and academic research participants believe it should be. Depth of knowledge, teaching strategies, and appropriate year level were identified and included in Section 5.1, Recommendations for Curriculum Development. Faculty response suggests willingness to include RBC into course work and ensure this can be done through integrating RBC over multiple courses. Availability of free modules for teachers and resources for students was a concern developed through faculty interview discussions. Researchers believe RBC curriculum development would be accepted well within industry and education communities.

5.1. Recommendations for Curriculum Development

Course development was identified as a worthwhile investment to increase RBC education for construction students. Both faculty and industry believe this topic should be addressed during the second half of technical or undergraduate programs. Depth of knowledge varies between program types and industries expectations of students. The course modules should include a basic understanding, with varying degrees of knowledge
regarding code implementation. The best teaching practices varied as does student-learning styles. Multiple techniques should be incorporated: case studies, photos, online resources, technical illustrations and descriptive installation procedures of materials. Both, academic and industry, methodological teaching frameworks should try to be included. Teacher material for lecture and student material for design resources provides several uses for the course modules and increases likelihood to impact education.

5.2. Recommendations for Future Research

Prior to curriculum development, teacher pedagogy and student learning frameworks should be researched allowing curriculums to align with previously developed constructs. Additionally, distribution and marketing methods related to course publication is important for acceptance within the education community. A developed course should be available online and easily accessible; however, many formats allow for this to occur. Additional research related to format, ease of use and course settings, based on existing online courses would increase likelihood of education community acceptance.

5.3. Final Remarks

This research identified a need within the construction community and a gap in education. Understanding the need and identifying how to correct it has been a rewarding process. However, acting to correct this gap in knowledge, impacting future construction professionals and potentially increasing the safety of communities across the country is an exciting prospect. Based on survey responses, interviews, and email correspondence, it
is believed, proper course development can lead to acceptance and practice from the education community.
6. REFERENCES


7. APPENDICES
A. Faculty Questionnaire

Welcome

You are invited to participate in this survey, which aims to gain an understanding of residential building code education. Residential building codes can be defined as all building, plumbing, mechanical, fuel gas, energy and electrical regulations for one and two family residences.

The survey should take less than 5 minutes. Any personal information will be kept confidential, and there are no risks involved.

You may choose not to participate, and you may withdraw your consent to participate at any time. You will not be penalized in any way if you decide not to participate or to withdraw from this study.

Your information and responses are very important to us. Ultimately, We hope to implement your suggestions and develop education material that is relevant to current curriculums.

If you have any questions, please contact Tripp Shealy at eshealy@clemson.edu.
1. Please indicate the academic department you are most closely associated with
   - Architecture
   - Construction Management Science
   - Civil Engineering
   - Other
   Comments

2. What perils are your community and surrounding communities (50 mile radius) susceptible to?
   - wildfire
   - earthquake
   - flood
   - hurricane
   - tornado
   Other (please specify)

3. Has your community or surrounding communities been affected by at least one of the perils above within the past
   - 0-3 years
   - 4-9 years
   - 10-20 years
   - Has not been affected in the past 20 years
   Comments

4. Please provide your zip code for us to better understand participant demographics
   ZIP: ________
5. Residential building codes should be taught at the (select all that apply)

- [ ] associate degree level
- [ ] undergraduate degree level
- [ ] graduate degree level
- [ ] should not be taught at any college level

Other (please specify)
6. Residential building codes should be taught to (select all that apply)
- architecture students
- civil engineering students
- construction science management students
Other (please specify)

7. Residential building codes should be taught through (select all that apply)
- professional case studies
- final projects (capstone)
- internships
- guest speaker
Other (please specify)

8. Residential building codes should be taught as
- an entire course (approximate lecture time 40 hours)
- a course topic (approximate lecture time 2-5 hours)
- briefly mentioned in one or two classes (approximate lecture time 0-1 hour)
Comments

9. We should teach residential building codes because

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree (1)</th>
<th>Agree (2)</th>
<th>Neutral (3)</th>
<th>Disagree (4)</th>
<th>Strongly Disagree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional licensing exams cover building codes</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Industry expects my students to understand it</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other schools teach building codes</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It raises awareness for building safety</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It increases the safety of our community</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Comments
### 10. I would be highly motivated to teach residential building codes if

<table>
<thead>
<tr>
<th>Strongly Agree (1)</th>
<th>Agree (2)</th>
<th>Neutral (3)</th>
<th>Disagree (4)</th>
<th>Strongly Disagree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson plans were available to me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had a complete set of code books</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I thought it would lower mitigation costs in the future</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Industry partners pushed for me to teach it</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My students pushed for me to teach it</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My department pushed for me to teach it</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Academic accreditation boards pushed for me to teach it</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 11. I am not motivated to teach residential building codes because

<table>
<thead>
<tr>
<th>Strongly Agree (1)</th>
<th>Agree (2)</th>
<th>Neutral (3)</th>
<th>Disagree (4)</th>
<th>Strongly Disagree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other topics are more important</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It changes to frequently</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I don’t know enough about building codes myself</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other faculty don’t teach building codes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I do not believe my students will use it in their profession</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 12. Please share any additional comments or suggestions to improve residential building code education within your department

Comments: 

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53
13. Please briefly explain why residential building code should not be taught at any level.
Your personal information will be kept confidential at all times. Providing this information does not guarantee you will be selected.

**14. Are you willing to participate in a short follow up interview**

- [ ] I agree to participate
- [ ] I do not agree to participate
Your personal information will be kept confidential at all times. You may be contacted for a short follow up interview to gain a better understanding of your responses to this survey.

### 15. Please provide

<table>
<thead>
<tr>
<th>Contact Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>University:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Email Address:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Phone Number:</strong></td>
<td></td>
</tr>
</tbody>
</table>
B. Industry Questionnaire

Welcome

You are invited to participate in this survey, which aims to gain an understanding of residential building code education. Residential building codes can be defined as all building, plumbing, mechanical, fuel gas, energy and electrical regulations for one and two family residences.

The survey should take less than 5 minutes. Your personal information will be kept confidential, and there are no risks involved.

You may choose not to participate, and you may withdraw your consent to participate at any time. You will not be penalized in any way if you decide not to participate or to withdraw from this study.

Your information and responses are very important to us. Ultimately, we hope to implement your suggestions and develop education material that is relevant to current curriculums.

If you have any questions, please contact Tripp Shealy at eshealy@clemson.edu
1. Which category best describes your current position

- Architect
- Engineer
- Construction Professional
- Code Official
- Other

Comments

2. What perils are your community and surrounding communities (50 mile radius) susceptible to?

- wildfire
- earthquake
- flood
- hurricane
- tornado

Other (please specify)

3. Has your community or surrounding communities been affected by at least one of the perils above within the past

- 0-3 years
- 4-9 years
- 10-20 years
- Has not been affected in the past 20 years

Comments

4. Please provide your zip code for us to better understand participant demographics

ZIP: ________________
5. When did you originally learn residential building codes?
- High school
- University course
- Internship during college
- Work experience after college
- Never: I am not familiar with residential building codes.
Other (please specify)

6. How often do you refer to the residential building code in your line of work?
- Daily
- Weekly
- Monthly
- Yearly
- Never
Comments

7. Residential building codes
- Increase the cost of the home without adding value
- Increase the cost of the home but adds value
- Do not increase the cost of the home and does not add value
- Do not increase the cost of the home but does add value
Comments

8. Which types of issues is it most important for codes to address? (Rank with 1 being the most important)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building (structural)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plumbing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mechanical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fuel-gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy and electrical</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
9. How likely are you to recommend not meeting, meeting, exceeding the requirements in the following types of codes:

<table>
<thead>
<tr>
<th></th>
<th>not meet code</th>
<th>meet code</th>
<th>exceed code</th>
</tr>
</thead>
<tbody>
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<td></td>
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<tr>
<td>energy and electrical</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>regulations</td>
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<td></td>
<td></td>
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10. In your opinion, residential building codes should be taught at the (select all that apply)

- [ ] associate degree level
- [ ] undergraduate degree level
- [ ] graduate degree level
- [ ] should not be taught at any college level

Other (please specify)
### Education

**11. In your opinion, residential building codes should be taught to (select all that apply)**
- [ ] architecture students
- [ ] civil engineering students
- [ ] construction science management students
Other (please specify)

**12. In your opinion, residential building codes should be taught through (select all that apply)**
- [ ] professional case studies
- [ ] final projects (capstone)
- [ ] internships
- [ ] guest speaker
Other (please specify)

**13. Residential building codes should be taught as**
- [ ] an entire class (approximate lecture time 40 hours)
- [ ] a class topic (approximate lecture time 2-5 hours)
- [ ] briefly mentioned (approximate lecture time 0-1 hours)
Comments

**14. In your opinion, teaching residential building codes are absolutely necessary because**

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<td></td>
</tr>
</tbody>
</table>
Comments
15. Please share any additional comments or suggestions that you feel would improve building code education within university curriculums

| Comments or Suggestions |
Thank You for completing the survey. Please allow for a follow up interview...

Your personal information will be kept confidential at all times. Providing this information does not guarantee you will be selected.

**17. Are you willing to participate in a short follow up interview**

- [ ] I agree to participate
- [ ] I do not agree to participate
Your personal information will be kept confidential at all times. You may be contacted for a short follow up interview to gain a better understanding of your responses to this survey.

### 18. Please provide

<table>
<thead>
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<th>Name:</th>
</tr>
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<table>
<thead>
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<table>
<thead>
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<th>Email Address:</th>
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<table>
<thead>
<tr>
<th>Phone Number:</th>
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