

Creating an Advanced Residential Construction Course

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Abstract

After five years of teaching residential construction courses it became apparent there was insufficient coverage of several major topics that are crucial for advanced training in residential and light commercial construction management and operations. This paper discusses the creation of an advanced residential construction course that picks up where an introductory course leaves off. More specifically, this developed course covers knowledge and skills required beyond front-line project management.

Typically, residential construction companies require both upper-level and front-line managers with a broad range of knowledge that enables them to manage diverse tasks. Front-line managers such as site superintendents manage employees, subcontractors and schedule. Senior level leadership such as owners and executives often function as sales managers, human resource managers, accountants, and attorneys all at once.

To address this diversity of needs, a special topics class titled “Advanced Residential Construction” was created to provide a broader scope of skills and perspectives to prepare students for advancement in their residential construction careers beyond front-line management. The course is designed for academic juniors or seniors in a construction-focused degree track that have already completed the junior-level Residential Building Construction course.

Advanced Residential Building Construction topics include:

- light commercial construction utilizing wood light frame construction methods
- use of cutting edge technology in the area of building science such as water and vapor management
- complex wood framing methods
- building codes
- customer warranties and liability

- managerial accounting
- corporate and payroll taxes

The course's first offering was a technical elective and was well-received with full enrollment. Limited assessment data is considered along with suggested improvements.

Introduction

The construction industry has a great diversity of specializations that often seem unrelated to students. It is the goal of the University of Akron's Construction Engineering Technology program to enable students to understand the various sectors of the industry and through coursework and co-op work experience, choose a career path. This is in part accomplished by offering a wide range of specialized courses spanning residential, commercial and industrial.

Residential construction is in part distinguished from commercial construction by the personal investment of the client. After recovering from the burst of the housing bubble in 2008, there has been an increasing demand for residential properties. At least part of the increased demand has been driven by historically low interest rates. Nationally property developers bought up vacant land at a record pace, and investors bought land cheaply in bankruptcy proceedings from cash-strapped builders and foreclosed banks. These companies and investors are now selling off "shovel-ready" with existing construction approvals.¹ The exploding housing market has created a huge shortage of labor specifically in skilled trades that has been plaguing contractors for a number of years now. A current study by the Associated General Contractors of America found that 75% of companies want to increase their workforce in 2018.²

UA's introductory Residential Building Construction course was developed to serve this industry workforce demand. However, it is an overview of the residential construction process and a number of crucial topics are left unaddressed due to time constraints. This paper outlines the UA Advanced Residential Construction course designed to cover subjects beyond the introductory Residential Building Construction course. Its goal is to provide the student more knowledge and confidence to assume the role of residential field superintendent and to prepare them for career progression beyond their position at initial hire into middle and upper management.

Course Description

The **course format** is a three credit hour class that fits into a 15-week semester, meeting twice a week for 75 minutes each meeting. It is assumed students have previously taken the Residential Building Construction course though it is not currently a prerequisite. Due to being offered initially as a "special topics" class there was no provision for an additional separate laboratory section as with the introductory Residential Building Construction course. To accommodate this, several regular lecture sessions were designated as labs that gave a balance of about 90% lecture and 10% lab.

Since the vast majority of homes today are still built in a traditional style, the course began with several lectures on architecture focusing on the **classical architectural styles** as. Interior details were initially emphasized because exterior architecture was previously covered in the Residential Building Construction course. Classical architecture principles are taught primarily because they emphasize proportionality, drawing the eye to specific areas, and creating a feeling of flow and balance.

Discussion of **historical preservation and adaptive reuse** followed the architectural styles segment. These subjects are often two sides of the same coin taking disused building in urban centers and turning them into specialized retail spaces and upscale housing in the city centers where jobs are. This creates a walkable environment where most amenities are easily accessible without the concerns of driving and parking associated with an automobile. It appeals to those who are environmentally aware and fosters the sense of community.

Engineering topics including lumber grades and statics were reviewed as a segue to International Residential Code span tables. Analyses and application of floor joists and span tables were part of this section that included floor sheathing. This segment's progression 'ascended' above the floor through the structure, with the next subject being walls with particular attention paid to shear walls and shear nailing. Related subjects included in this section were fireblocking, draft stopping, headers and header sizing, gypsum board installation, and exterior covering.

Next up was roofs and ceilings starting with ceiling joists, which follow span tables similar to floor joists. Rafters and trusses were also addressed. The more complex span tables for rafter was a focus. Architects often create designs based on floor layout and expect that a roof will easily integrate. However, how to make all of the pitches and angles flow together while still meeting code requirements often is determined by the framing carpenter. This level of awareness and appreciation of competent trades became a recurring theme throughout the course.

Understanding how roof rafters are calculated or "laid out" based on a framing or floor plans was subject of the **first lab**. A simple "L"-shaped structure was assumed and then created in the space available. Students were given a rafter square and its use was demonstrated. Students cut and assembled common, hip and jack rafters under the supervision of a master carpenter who was engaged as a guest lecturer. Also covered in the first lab:

- Trusses and applicable codes
- An examination of published articles on issues with properly installing and sealing windows to prevent structural deterioration and moisture intrusion.
- Installation of moment frames which are now being required by code in seismic zones.

The next segment of the course covered **accounting and finance**. This topic is often referred to as engineering economics which is a crash course in what accounting majors call managerial accounting. UA's program requires a course in finance so some familiarity with accounting and finance is already there. The difference between financial accounting (keeping track of money) and managerial accounting (analysis of the financial position of the company) was reinforced and developed through this segment. With an emphasis on tracking, debits, credits, income, loss and operating expenses were then discussed. The purpose of this review was to introduce financial statements that are crucial to obtaining credit or financing of any type. The income statement with its revenues and costs and the balance sheet with assets liabilities, and owner's equity were explained.

Without these financial statements, the next step in the progression, **financial analysis**, could not be performed. This is the point at which managerial accounting is introduced. Gross profit and cash flow reports were followed by several financial ratio analyses such as liquidity ratios, profitability ratios, and efficiency ratios; at the end, return on investment was addressed and suggestions on how to improve these ratios was given.

The important subject of **taxes** was also discussed. Virtually all building companies are for-profit businesses whether they make one or not. When one thinks of the subject of taxes, the first thought is of income tax, so this was the starting point. The corporate tax form was introduced with its tax rate schedule and some general tips regarding filing. Often overlooked, but very important to any employer is the Employer's Tax Guide. The construction industry has notoriously abused and outright circumvented the IRS regulations defining who is an employee. With the IRS cracking down on this, it was considered valuable to spend some time on this issue. Once the determination of employment is made, the next step is that of employee withholding, what the amount is, how it is computed and what must be done with the funds that were withheld. Again, there is no intention of making tax experts out of anyone because most companies enlist an outside firm to do both taxes and payroll; here the objective was simply to have an understanding of how the system works.

Next, the focus changed to fundamentals of **quality control**. A considerable amount of time was spent discussing causes of poor quality. This tends to be a goal that many builders find difficult to achieve and as a result their reputation in the industry is not what it could be. While not as popular as it used to be, the concepts of Total Quality Management or TQM were introduced. W. Edward Deming created TQM for a manufacturing environment so the specific application to construction was explained. Training of workers and measuring their performance is also part of TQM. Following that in the construction process is the subject of inspections, both internal by company personnel and external by building officials. The proper method for correction of inferior work was stressed as part of customer satisfaction. Common in many companies throughout the industry is the presence of a management person during the inspection, the logging of the details of the inspection and any corrective action that needs to be taken. The

final step in this process is the homeowner's walk-through and inspection, which at best can resolve outstanding issues before the customer move-in date.

The subject of **trade contractors** was then discussed. All building companies utilize trade contractors at some point during the construction process. The advantages and challenges of trade contractors was examined along with insight into locating and vetting potential trade partners. Discussion of the contract structure highlighted how essential a good contract is to the success of trade contractor arrangements. A 'contracts and specifications' class is a requirement in the UA program, so course discussion built on that by focusing on issues specific to residential construction.

As part of the construction engineering technology curriculum, students are required to take two construction estimating classes which follow a course in plan reading and also a course in scheduling. So quantity takeoff skills have already been developed. This course addressed **more nuanced and subjective construction estimating factors**. These included:

- site access
- working space
- room dimensions and shape
- age and condition of the structure
- work area location and occupancy
- allowance pricing
- changes to the scope of work
- residential-specific construction scheduling concerns
- markup, margin, sales and costs
- overhead and profit
- final sales price
- how to transition out of a system that is not meeting the desired target profit margin
- supplier discounts and who should get the advantage of them and how they are calculated
- cash flow and strategies for increasing cash flow

Because **customer relations** in the residential construction industry is so unique, it received attention in this course. From most homeowners, buying a home is the largest purchase of their lifetime and one of their top five most important decisions. It is vitally important that everyone in the company work to reassure them that they have made the correct decision by choosing that company. With that as a goal, several points of view from the customer's perspective are evaluated. Additionally, the issue of who can address the homeowner's concerns is examined along with policies about how field personnel should respond when approached with questions. What happens when customers want to make changes or when they can visit the site is addressed

in this section as is subject of the periodic customer walkthroughs. Good communication and methods for conflict resolution are stressed at this stage along with written warranties.

The **warranty and liability** aspect of the customer segment is a segue into the topic of what the warranty contains. For this segment the National Association of Home Builders (NAHB) Residential Construction Performance Guidelines was examined very carefully as this is often a point of contention with homeowners after the sale. It was stressed that how warranty claims are handled is as vital to customer satisfaction as the construction process itself. Satisfied customers mean referrals for the contractor. The NAHB document is long and detailed so an attempt was made to find examples of the defects through pictures from the internet.

The **final lab** section of the semester once again included a visit by a master carpenter and stair builder since the subject of stairs was addressed. This time an emphasis was on codes relating to stairs. Calculations and layout were demonstrated, and each student participated in constructing the small set of stairs.



Figure 1 Student working with master carpenter building stairs in final lab.

Student assessment included three written exams. Most exam questions required detailed narrative responses. Several in-class assignments, in conjunction with in-class projects, were filled out during lectures.

Student Course Evaluations

A brief course survey was sent out electronically to the members of the Advanced Residential Construction class to gauge satisfaction and effectiveness. Three responses were received. A third of the responses found the course “extremely effective” in preparing the students for their current positions (which was unknown). The remainder found it “somewhat effective”. All respondents found the labs to be the part of the course that was “particularly helpful”. One

suggested “less accounting” would improve the course. All found the homework assignments “very helpful”.

Conclusion

There was significant student demand for the Advance Residential Construction course, as noted by its first offering being filled to capacity. The development of this course was driven by industry demand and a pronounced need for well-trained supervisory and management personnel. This course may help distinguish a construction technology or construction management program as one that is addressing these industry needs. More feedback from students and more interaction with industry will help gauge effectiveness of this particular course structure. Such assessment and subsequent course improvements are ongoing.

Bibliography

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