CONSTRUCTION BUILDING TECHNOLOGY PROGRAM

Academic Program Review

2000-2001

The Office of Instruction
The Office of Institutional Planning, Research, and Assessment
Yavapai College

CONSTRUCTION BUILDING TECHNOLOGY PROGRAM

Academic Program Review

2000-2001

Committee Members:
- Eric Eikenberry
- Tony Grahame
- Bonnie Sandleben
- Laurel Riedel
- Kurt Holmes
- Mark Williams
- Dave Weed
- Ed Stahl
- Patricia Olson
- Greg Snyder
- Robert Helgesen

Robert O. Salmon, Executive Dean and Chief Academic Officer
Barbara Wing, Dean of Instruction and Curriculum
Dr. John W. Quinley, Director of Institutional Planning, Research, and Assessment
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Overview and Scope of this Review</td>
<td>1</td>
</tr>
<tr>
<td>A. The Approach</td>
<td>1</td>
</tr>
<tr>
<td>B. The Committee</td>
<td>1</td>
</tr>
<tr>
<td>II. History</td>
<td>1</td>
</tr>
<tr>
<td>III. Program Profile</td>
<td>2</td>
</tr>
<tr>
<td>A. Construction Program Mission and Purpose</td>
<td>2</td>
</tr>
<tr>
<td>B. Program Goals</td>
<td>2</td>
</tr>
<tr>
<td>C. Community Benefits</td>
<td>3</td>
</tr>
<tr>
<td>D. Centrality to the College Mission</td>
<td>3</td>
</tr>
<tr>
<td>E. Program Content</td>
<td>4</td>
</tr>
<tr>
<td>F. Course Outlines and Syllabi</td>
<td>5</td>
</tr>
<tr>
<td>G. Facilities and Equipment</td>
<td>5</td>
</tr>
<tr>
<td>H. The Budget</td>
<td>6</td>
</tr>
<tr>
<td>I. Program Faculty and Staff</td>
<td>6</td>
</tr>
<tr>
<td>J. New Outcomes and Programs</td>
<td>8</td>
</tr>
<tr>
<td>K. Additional Findings from the Review Committee</td>
<td>8</td>
</tr>
<tr>
<td>IV. The Students</td>
<td>9</td>
</tr>
<tr>
<td>A. Statistics on Students and Classes</td>
<td>9</td>
</tr>
<tr>
<td>V. Job Forecasts, Trends, and Training Requirements</td>
<td>10</td>
</tr>
<tr>
<td>A. Jobs and Skills</td>
<td>10</td>
</tr>
</tbody>
</table>
B. Job Forecast-Nationwide 10
C. Job Forecast-State and Local 11
D. Job Training 11
E. Trends 11

VI. Recommendations 12
CONSTRUCTION BUILDING TECHNOLOGY
PROGRAM REVIEW

I. Overview and Scope of this Review

A. The Approach

This review was initiated in the spring semester of 2001. Construction Building Technology (CBT) student completers of the various CBT sequences of courses responded to surveys for this review. The program budget, full-time student equivalent and headcount, course information and other statistics were assessed. The findings of these assessments are included in this report. Additionally, evidence was gathered from people who have purchased homes built by the CBT program as well as information gathered from leaders in the construction field. All CBT program equipment, facilities, and instructors were evaluated for their adequacy in meeting the demands of the curriculum.

B. The Committee

A broad-based committee of individuals with several different perspectives on the program was appointed to complete the evaluation of the program. That committee consisted of the following individuals:

Mr. Eric Eikenberry Division Associate Dean
Mr. Tony Grahame Program Director of Construction Technology
Mrs. Bonnie Sandleben Yavapai College CBT Adjunct Faculty
Mrs. Laurel Riedel Yavapai College CBT Adjunct Faculty
Mr. Kurt Holmes Yavapai College CBT Instructional Specialist
Mr. Mark Williams Yavapai College Graduate (3 degrees) / Contractor
Mr. Dave Weed Yavapai College Graduate (3 degrees)
Mr. Ed Stahl Contractor
Ms. Patricia Olson, M.S. Architect, Ecological by Design
Mr. Greg Snyder Yavapai College CBT Adjunct Faculty
Mr. Robert Helgesen Yavapai College Technology Lab Manager

II. History

The Construction Building Technology program began in 1969, with only drafting courses offered in mechanical drafting. In the early 1970s, the drafting program was based on a program from the University of Ohio. At this time the curriculum was expanded to include architectural drafting. In the late 1970s, the program expanded to include the solar program, due mainly to the energy crisis of the period. The solar program was offered through both the Technology Division and the Science Division. At this time the program began the full construction of a solar house, designed by the students, as part of the curriculum. The solar
program began to wane in the early 1980s as the federal and state tax credits were cut. These events lead to the disbanding of the solar program and the start of the construction program.

The construction program included Construction Graphics and Construction Technology. The graphics students designed the house and the technology students built the house. This was done in partnership with funding from the Yavapai College Foundation. Today, the Construction Technology program has been expanded to include Residential and Commercial Construction Management, as well as Architectural Graphics and Residential Building Technology. All of these programs emphasize energy efficient design and techniques.

III. Program Profile

A. Construction Technology Program Mission and Purpose
   1. The Construction Technology program is one of the most progressive and innovative building science and technology programs in the country to utilize practical, hands-on skills training in the construction of a residential house. The purpose of the program is to teach students how to design, manage, and build quality houses for the 21st century that are energy efficient, healthy, and sustainable. The completers in the various degrees within the program are prepared to design and build a house that integrates current building science practices with mainstream construction practices.

B. Program Goals

1. Provide high quality, accessible skill training opportunities for students to develop expertise in the construction and the architectural industry.

2. Deliver learner-centered, hands-on education with lifelong learning options.

3. Instill competencies that lead to employment and better job opportunities.

4. Encourage and prepare students to seek opportunities for advancement in the construction field.

5. Provide advanced course work for construction practitioners who seek further training and skills enhancement.

6. Serve as a community resource for the dissemination of cutting edge, residential building science and technology information.
C. Community Benefits

1. The college house, designed and built by students, serves as a state of the art showcase of new and leading building technologies. The building community is exposed to these technologies and their practical application throughout all phases of the building project. To date, the Construction Technology program has built 21 houses in the local community.

2. The community benefits from skilled workers with higher levels of expertise who can integrate new building science principles into the actual construction of the house. These principles drive mainstream construction practices that affect the performance of residential buildings. Consequently, builders and architects in the community are challenged to design and build houses that perform better for the occupants.

3. Community workers benefit from course offerings designed to challenge their creative and intellectual abilities to solve problems, to upgrade their technical skills, and to establish credentials to further enhance employment opportunities.

4. Yavapai College construction technology students partnered with Habitat for Humanity to completely build a house for a local family in need (2000/2001). This was an exceptional, unselfish gesture of giving to the community by the students.

5. Yavapai College Foundation has generously funded the construction of the college houses for over 20 years. Hundreds of students have benefited from scholarships derived from the profits generated from the sale of the college houses.

6. Yavapai College has gained significant recognition both regionally and nationally because of the many awards students have won competing with VICA/Skills-USA.

D. Centrality to the College Mission

1. The State Board of Directors for Community Colleges of Arizona, Rules and Regulations #R7-1-702-A1 states: “Occupationally oriented curricula – Each college district shall offer occupationally oriented programs designed to lead to an associate degree.”

2. The Construction Technology program meets the criteria in the Yavapai College Board of Governors Community Benefits Statements and is supportive of the mission and strategic initiatives of Yavapai College. The program is a competency-based occupational program, which prepares students for entry into the workforce as well as advanced levels of instruction.
E. Program Content

1. Architectural Graphics Advanced Certification – prepares students with the fundamental skills of architectural planning, designing, sketching and drawing using both the drawing board and computer. Students learn to recognize both historical and contemporary architectural styles, and to identify distinct characteristics of each style. Energy efficient building designs, use of building materials, methods, and techniques necessary to build structures for the 21st Century are emphasized.

2. Architectural Graphics AAS Degree – prepares students as designers of residential and light commercial structures. The program emphasis is on practical drafting and design skills in drawing a complete set of working drawings using both the board and the computer. Students will design energy efficient buildings, learn how to use building materials, and obtain techniques to build sustainable structures for the future.

3. Residential Building Technology Advanced Certification – prepares students for entry-level employment in the construction industry. This is a hands-on program in which students build a house each year in a local subdivision. Students learn skills in all phases of the residential construction process. They undertake a complete building experience from conception, through design and implementation.

4. Residential Building Technology AAS Degree – prepares students for employment in various areas of the construction industry. Students receive instruction in various trades, quality and use of building products, energy efficient building techniques, cost estimating, blueprint reading, building codes, planning, scheduling and house site management. This program provides students with a complete building experience from the concept through design and implementation.

5. Residential Construction Management Advanced Certification – prepares students for contractor licensing and construction supervision. The program is designed for the student who already has experience in light construction and wants to establish credentials for management positions. The program provides students with advanced training in progressive construction practices that emphasize project management skills, resource efficiency and environmentally responsive building.

6. Residential Construction Management AAS Degree – prepares students for a career in construction supervision. It provides advanced training in residential construction practices and business management for students who already possess some practical construction experience. The program builds on field experiences gained in actual construction and applies advanced skills in
blueprint reading, estimating, inspection practices, code requirements, accounting, computerized drafting, contracting and scheduling. A major emphasis of the program is recognizing and incorporating quality and energy efficiency in all phases of the construction process.

7. Commercial Construction Management AAS Degree –prepares students for a career in the commercial construction industry. The program prepares students for decision-making, problem solving, and leadership capacities in construction companies and affiliated industries. Northern Arizona University has approved this program for transfer into their Bachelor of Science in Construction Management Degree program.

F. Course Outlines And Syllabi

1. Recent studies have brought to the foreground the necessity to change the review procedure for course outlines and syllabi. The CBT division is in the process of implementing changes to this review procedure to ensure that all course outlines and syllabi are up to date and meet current Yavapai College standards.

G. Facilities And Equipment

1. Courses are conducted across the district in various types of facilities. On the Prescott campus the CBT classes are held in the computer technology lab, classrooms, drafting room, distance-learning room and the college house job-site. The Verde Campus holds most construction classes in the distance-learning room. Most classes are offered at night due to student and adjunct faculty schedules. This requires innovative scheduling. There is no construction technology lab at this time, that is, a place where students can practice specific trade skills.

2. The current facilities are minimally adequate. Recent moves have reduced computer spaces from 22 to 15 seats and drafting spaces from 25 to 16 seats as well as smaller classroom spaces. Other facility concerns are as follows:
   - Spaces are crowded / classrooms are too small
   - Poor ventilation / poor HVAC / mold in building 10
   - ADA issues – door widths, hallways
   - Copy room not vented – blueprint machine out gases ammonia

3. The current blueprint machine was “used” equipment when purchased in 1996, and the print quality is starting to fade. The CBT classes use this piece of equipment heavily for both class project blueprints and construction documents. A new, non-ammonia diazo machine is needed.
4. The CBT program needs additional funding for equipment such as a Bobcat (skid steer loader) with a backhoe attachment.
   - Equipment will speed up the overall construction of college house projects.
   - Students gain experience with light heavy construction equipment typical of most construction sites.
   - Students’ manual excavation on site takes up valuable class time and discourages students from class participation.

H. The Budget

1. The CBT budget for the 2001/02 school year is $151,280. In addition, this program heavily utilizes the computer technology lab.

2. In 2000, the CBT program received $32,000 to upgrade its computer lab. This upgrade was necessary to accommodate $78,000 worth of new computer aided drafting software that was donated to the school providing students with a revolutionary architectural design and development tool.

3. The CBT program, with funding support from the Yavapai College Foundation, builds one house per year, which is sold on the open market after completion. Monies from the sale are used in the following ways:
   - 25% deposited into the Construction Technology scholarship endowment fund.
   - Purchase of future residential lots.
   - Fund next years’ college house construction costs.
   - A large part of Yavapai College Foundation’s profit is generously given for student scholarships throughout all programs offered at Yavapai College.

I. Program Faculty And Staff

1. The program staff consists of the Division Associate Dean for Technology, his Division assistant and the faculty, who will be described later in this section. The Associate Dean is responsible to the Executive Dean of the Prescott Campus for all budgetary and administrative issues. The Associate Dean interacts with other faculty and staff members to ensure the overall quality of the program and the student outcomes.

2. The program has one full-time faculty member who is responsible for coordinating the every day operation of the Construction Technology Department. The full-time faculty member has instructed in the program for over 5 years. He teaches a minimum of 18 load hours each semester- (24 contact hours per week). This includes classroom instruction and hands-on construction of the College House with the assistance of the students.
3. The program has one instructional specialist who assists in coordinating the every day operations at the college construction house site, and also assists in teaching the students construction assembly skills. He helps to estimate materials needed, organize and schedule necessary sub-contractors, and to assist students in additional make-up lab times.

4. The Technology Division currently has one unfilled vacancy for an instructional specialist. Until two years ago, this position provided expertise and instruction in the areas of:
   - Solar energy
   - Computerized cost estimating
   - Energy 10 Design Software program
   - CADD (computer aided drafting and design)
   - Technical math
   - Construction technology computer lab support
   These subject areas are currently being covered by adjunct faculty and part-time staff paid by vacant salary line item.

5. The program also employs 16 adjunct faculty members in various subject areas:
   - Construction Management
   - Plumbing
   - Electrical
   - ICBO Uniform Building Code
   - CADD – (AutoCad, Archicad)
   - Architectural Graphics I, II, III, and IV
   - Blueprint Reading
   - Solar and Renewable Energy
   - Energy Efficient Building and Design
   - Alternative Building Design and Materials
   - Surveying
   - Landscaping
   - Cost Estimating
   - Materials of Construction
   - Southwest Landscape Design
   All adjuncts meet state certification requirements.

6. In surveys of CBT completers, students reported that they were satisfied or very satisfied with instruction and program aspects, including quality of instruction (94.4%), availability of instructors (94.7%), helpfulness of instructional support staff (94.8%) and helpfulness of instructional administrators (72.2%).
J. New Outcomes and Programs

1. In recent years, the building sciences have developed the concept of “the house as a system.” This incorporates the idea of making an energy efficient building envelope, as well as making a home affordable, comfortable, healthy and safe. In the past five years, most of the construction courses have changed their outcomes to reflect this practice. The houses built by the college students have become a showcase to this building science model.

2. In the spring of 2001, the division upgraded the computer lab to include both state of the art computers and a new computer program. This program is a virtual building software package that brings a revolutionary approach to the drafting process. The building is actually constructed in a 3-D model allowing for a complete visual presentation to a client. It is a leading CADD program in the industry and is specifically designed for architecture.

K. Additional Findings from the Review Committee

The committee appointed to participate in the completion of this review made the following observations and statements:

1. It is very difficult for a student to graduate in two years for the following reasons:
   - Classes required for graduation often overlap in scheduling
   - Classes do not follow degree sequences.
   - Independent or directed study is necessary due to class cancellations or scheduling difficulties.
   - General education courses should be offered that are designed to meet the objectives and interests of technology Associate of Arts and Science degree-seeking students.
   The above result from evening classroom shortages, adjunct faculty schedules and classroom load hours.

2. Due to the fact that most of the Architectural Graphics Degree courses do not articulate, we have found that the students either change degrees to Commercial Construction Management, which is transferable to NAU or drop the degree program altogether.

3. Students from the CBT program seeking the aid of a counselor have encountered the following difficulties:
   - Not placed in correct degree path or courses.
   - Not given correct information regarding general education core requirements for degrees.
   - Counselors need to be more familiar with construction technology course and program requirements.
   - General lack of knowledge of construction technology program.
4. In CBT 204, Construction CAD Practice, the current software is making it necessary for the students to have knowledge of basic building structure prior to taking Construction CAD, therefore, Architectural Graphics I and II needs to be looked at as a prerequisite for this course.

5. With the addition of the new CAD software, we need to look at reorganizing CBT 204 into specific sections of CAD drafting, which include the following:
   - Civil drafting (Autocad)
   - Mechanical drafting (Autocad)
   - Beginning architectural CAD drafting (Archicad)
   - Advanced architectural CAD drafting (Archicad)
This would allow the student to become multi-platform (competent in two or more software packages). An advanced certificate in Cadd Design is being considered.

IV. The Students

A. Statistics On Students And Classes

1. Forty-two percent of the students had full-time (30+ hours a week) employment while attending classes at Yavapai College, 21% had part-time employment and 26% were unemployed. Fifty-nine percent of students said their short-term goal was to receive a degree or certificate, 24% to acquire and improve job skills.

2. According to college records from 1995 to 1999, the age of the students in this program range from 17 to 59 years, with the majority being in the 17-24 year range (48.8%) with the 35-59 age group at (29.0%) and 25-34 at (20.5%). The students are 72.5% male and 26.8% female, and are 79.5% white non-Hispanics. Seventy-seven percent lived in Yavapai County and 76.2% attend classes on a part-time basis.

3. The current student survey for the Technology division shows that 16.3% of the students live in the dorms and 44.9 % of the students travel less than 9 miles to attend class. 28.6% of the students travel 10-24 miles to attend class.
4. From academic years 1995-96 to 1999-2000, there were 169 classes offered. The average attendance was 9 students per class for a total enrollment of 1,524 student registrations. Semester FTSE earned for those students were 374.2.

5. The number of unduplicated students enrolled in CBT courses during fall semesters ranged from 92 in 1998 to 105 in 2001.

6. In the academic year 2000-01, 30 sections were offered with 336 registrations that generated 40.2 semester FTSE.

V. Job Forecasts, Trends, And Training Requirements

A. Jobs and Skills:

Types of jobs requiring skills and competencies, including incomes per hour, covered in the curricula of the CBT department include the following:

<table>
<thead>
<tr>
<th>Median incomes for:</th>
<th>Yavapai</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Managers</td>
<td>$19.90</td>
<td>$24.57</td>
</tr>
<tr>
<td>Contractors</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cost Estimators</td>
<td>18.45</td>
<td>20.78</td>
</tr>
<tr>
<td>Building Officials</td>
<td>N/A</td>
<td>20.80</td>
</tr>
<tr>
<td>Drafters</td>
<td>10.38</td>
<td>16.34</td>
</tr>
<tr>
<td>Designers</td>
<td>8.23</td>
<td>13.52</td>
</tr>
<tr>
<td>Architects</td>
<td>N/A</td>
<td>26.19</td>
</tr>
<tr>
<td>Carpentry/Framers</td>
<td>12.32</td>
<td>13.24</td>
</tr>
<tr>
<td>Electricians</td>
<td>13.70</td>
<td>14.59</td>
</tr>
<tr>
<td>Plumbers</td>
<td>N/A</td>
<td>15.83</td>
</tr>
<tr>
<td>HVAC</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Tile Setters</td>
<td>N/A</td>
<td>15.39</td>
</tr>
</tbody>
</table>

B. Job Forecast-Nationwide:

1. According to the National Association of Home Builders (NAHB), employment in the construction trades grew by 1.1 million or 22%, between the years 1995 and 2000, while overall U.S. employment for the same period was only 8%.

2. Following this trend, statistics from the Bureau of Labor’s “Occupational Outlook Handbook” (April, 2000), point to a continued increase in construction jobs. This is due to increasing population and the demands it places on the infrastructure; new housing, updating and refurbishing the existing buildings, roads, bridges, etc.
3. In addition, the “Occupational Outlook Handbook” states that the jobs for construction management will increase 10% to 20% through the year 2008.

C. Job Forecast-State and Local:

1. The Arizona Department of Economic Security shows a steady increase in the number of construction related jobs per year through the year 2006 for the following: construction managers by 206, cost estimators by 146, drafters by 211, designers (except interior) by 357, construction related supervisors by 178, and building inspectors by 60.

2. According to the “Prescott Sourcebook,” compiled by Yavapai College Professional Development Center, in Yavapai County, construction is listed 4th in the number of jobs held, right behind trade, services, and government.

3. Job opportunities will continue to be plentiful due to population growth, especially in the Southwest. Prescott will more than double its population from 1980 to 2004 and Yavapai County has quadrupled its population since 1970.

D. Job Training:

1. Job opportunities for drafters are best for individuals who have at least two years of post-high school training in a technically strong drafting program. Employers are most interested in applicants who have well-developed drafting and mechanical drawing skills as well as: knowledge of standards, mathematics, science, engineering technology, and a solid background in computer-aided drafting and design (CADD). In addition, communication and problem solving skills are required.

2. According to “The Occupational Outlook Handbook,” employers of construction managers prefer applicants who combine a strong building technology background with communication and supervisory skills. Construction management positions also require understanding contracts, plans, and specifications; knowledge of construction methods, materials, and codes; and familiarity with computers and software programs for job costing, scheduling, and estimating.

E. Trends:

1. Today most drafting and architectural firms use CADD systems to prepare drawings. The architectural profession has recognized the National CADD standards (NCS). Students who master NCS will have an advantage in the job market (“Occupational Outlook Handbook”).
2. In the building trades such as carpentry/framing, etc., work is strenuous and has certain risks from: prolonged standing, climbing, bending; injury from the use of sharp tools and power equipment; and injury from slips and falls. Along with these risks, the work force for construction is aging due to a limited supply of young workers, an effect of the baby bust of the 1960s and 1970s.

3. As of 1999, 15% of all workers in the construction trades and 25% of all construction laborers were Hispanics, compared to 10% of workers in the rest of the economy. According to the NAHB: “The increasing reliance on Hispanic construction workers, most of whom are foreign-born, has been extremely helpful to the industry…language problems have sent construction supervisors back to school for crash courses in Spanish.”

4. An increasing level of construction activity and the complexity of new projects, has spurred the demand for construction supervisors and managers with multi-talents. Included in those talents is the knowledge of computers and software programs to make the jobs run more smoothly.

VI. Recommendations

► The program is serving the college and community needs and should be continued.

► Enrollment has grown and consideration should be given to hiring one full-time faculty member to teach, and help manage the Architectural Graphics program. This person would also assist in overseeing the construction technology computer lab and possibly teach some of the computer based construction management courses. Note: NCA recommends a fulltime faculty member for each degree offered.

► The program needs a full-time counselor that is not only familiar with all of the technology degree programs, but is also capable of recruiting and marketing for the technology programs.

► To meet trends in the global construction marketplace, suggested curricula is as follows:

♦ Redevelopment of the CADD program. Restructure classes to meet current needs, i.e. Beginning and advanced architectural (ArchiCAD).and civil (AutoCAD).

♦ Offer a community class or weekend seminar in home repair and remodeling.

♦ Offer various home performance workshops – designed to educate consumers, builders, sub-contractors, designers and architects,
building inspectors, and others in the construction industry to design and build houses that are energy and resource efficient, healthy, safe, comfortable, durable, and environmentally friendly.

♦ Integrate applied communication skills, math and problem solving skills, with vocational/technical interests into core education requirements.

♦ With the growing Hispanic workforce, add a class in Spanish for construction supervisors.

► Create a resource library for both students and the community at the new Agribusiness and Science Technology Center in Chino Valley.

► Purchase a new bobcat for construction technology classes.

► Purchase a new non-ammonia blue print machine for architectural graphics classes.

► Monitor the transition and impact on students in regards to the move to the new Chino Valley Technology facility.