Bachelor of Science in Building Construction

MYERS-LAWSON SCHOOL OF CONSTRUCTION
BUILDING CONSTRUCTION
VIRGINIA TECH™

Quality Improvement Plan
(2022)

Revision May 2022

Introduction

Continuous improvement is essential for any program at an institution of higher education to continuously review and adjust our teaching practices to an ever changing world around us. This document reflects how the Department of Building Construction within the Myers-Lawson School of Construction engages in this process, which is presented in the form a Quality Improvement Plan (QIP).

The Building Construction Program is accredited by the American Council for Education (ACCE) , which prescriptively outlines the necessary elements of a plan under Section 9 “Academic Quality Planning Process and Outcome Assessment” of the ACCE Document 103 (July 25, 2021).

As defined by the ACCE, outcome assessments should be a systematic process of gathering and interpreting information to verify, and potentially improve, that a program is meeting its self- defined goals. The process should support and lead to program enhancement over time.

Educational Unit Strategic Plan

The Department of Building Construction as an integral part of the Myers-Lawson School of Construction has had a central role in the development of a common Strategic Plan for the entire School. The School has collectively formulated the following strategic identity statements:

Vision Statement

Our vision inspires our future in serving a rapidly developing industry:

"We will produce the future transformative leaders of the built environment, will lead design and improvement of the future construction supply chain, and will develop a better tomorrow through our service to society, and the world."

Mission Statement

Our mission describes our purpose, what we deliver in terms of products and services:

"We are a constant beacon for innovation and excellence in construction discovery and research; outreach and engagement; and education and training."

Core Values

Our core values are the guiding principles behind our desired attitudes and behavior:

- That we may serve our students first.
- That we may serve our students, faculty, and staff by building a family culture within MLSoC.
- That we may serve and shape the industry through engagement and outreach.
- That we may serve safety, health, and equitable well-being through hazard controls and culture change.
- That we may serve by crossing traditional boundaries.
- That we may serve the future through discovery and innovation."

Strategic Priorities

Our strategic priorities are defined as follows:

1. Assist the Industry with needed diversification.
2. Rightsize the MLSoC infrastructure and culture.
3. Enhance the experience of industry partners.
4. Advance the School's brand of excellence and innovation.
5. Become a recognized leader of smart design and construction.

Degree Program Assessment Plan

This section references the MLSoC School Strategic Plan 2021 – 2025 (adopted May 15, 2021) and Section 9 of the ACCE Document 103 (July 25, 2021).

The Department of Building Construction conducts annual surveys of graduates, employers, and industry advisory board members, as evidence of its effectiveness in preparing students to become successful construction practitioners.

Mission Statement of the Building Construction Degree Program

The vision of the MLSoC is “to produce the future transformative leaders of the built environment, who will lead design and improvement of the future construction supply chain, and will develop a better tomorrow through our service to society, and the world.”

The mission of the Department of Building Construction to support the MLSoC’s vision is to

> "Partner with industry in the co-evolution of our curriculum to meet future demands and needs of building construction while remaining as current as feasible in technology, processes, and delivery methods."

Building Construction Degree Program Goals

The Department of Building Construction’s goals as the managing unit of the B.S. in Building Construction degree program are to:

- Provide multiple avenues of opportunities for students to successfully gain employment in the construction industry upon graduation.
- Provide opportunities for students to establish an area of current and/or emerging specializations in the construction domain to become front runners in the industry.
- Place students in industry positions, where they can obtain leadership positions in both, field and office roles.

Building Construction Degree Program Objectives (or Program Outcomes)

To achieve the above goals the Department of Building Construction has developed the following Degree Program Objectives (DPOs):

- DPO 1: Provide students with opportunities to participate in Career Fairs that specifically focus on employment in the construction industry.
- DPO 2: Expose students to a variety of construction and engineering companies outside dedicated career fairs.
- DPO 3: Maintain adequate enrollment in at least three current and highly-relevant specialization areas in building construction.
- DPO 4: Support job placement for students interested in entering the construction industry within three months after graduation
- DPO 5: Provide students the opportunity to engage in experiential learning through participation in an internship or co-op experience.

(List of previous evaluated POs by SACS reviews)

- DPO 1 (18): Student employment in the construction industry within 3 months of graduation.
- DPO 2 (18): Maintain adequate enrollment in areas of tracks/concentrations.
- DPO 3 (18): Prepare students for field and office leadership

- DPO 1 (20): Student employment in the construction industry by graduation.
- DPO 2 (20): Maintain adequate enrollment in areas of tracks (concentrations).
- DPO 3 (20): Students will participate in experiential learning through participation in an internship or co-op experience

The formulation, evaluation, and review processes for the above listed Degree Program Objectives were developed as part of Virginia Tech's accreditation under the Southern Association of Colleges and Schools (SACS).

The DPOs relate to the University's higher-level learning Program Outcomes (POs). The POs were formulated with appropriate participation of parties including university administration, faculty, staff, and industry. The University's SACS PO evaluation cycle mirrors the educational unit's assessment cycle. This evaluation also requires for each program to

- have a total of 5 to 8 SLOs, unless otherwise specified by a discipline-specific accrediting body,
- provide findings and comments on your findings for at least 2 to 3 of our SLOs each year, and
- Provide an action plan for at least one SLO each year, even if all SLO targets were met.

Assessment Tools

The assessment tools used to gather, maintain, and ensure compliance data for learning outcomes consists of a set of different surveys, where responses can be merged into a set of tables for further evaluation. The tables are made accessible to the faculty responsible for entering the assessment results. The data sets include the benchmarks set for evaluating each criterion.

Performance Criteria

The performance measures for the degree program outcomes and student learning outcomes are listed below along with the associated assessment. Assessment data are collected annually and can be compared and tracked by faculty using a data visualization tool.

CODE	Criterion	Associated Assessment
DPO 1	Provide students with opportunities to participate in Career Fairs that specifically focus on employment in the construction industry.	
DPO 2	Expose students to a variety of construction and engineering companies throughout the year outside of dedicated career fairs.	# of guest speakers # company blitz visits, etc.
DPO 3	Maintain adequate enrollment in at least three current and highly-relevant specialization areas in building construction.	adequate enrollment > 25 per concentration.

DPO 4	Support job placement for students interested in entering the construction industry within three months after graduation	employment reports
DPO 5	Provide students the opportunity to engage in experiential learning through participation in an internship or co-op experience.	SLICES program
SLO 1	Create written communications appropriate to the construction discipline	
SLO 2	Create oral presentations appropriate to the construction discipline	
SLO 3	Create a construction project safety plan	
SLO 4	Create construction project cost estimates	
SLO 5	Create construction project schedules	
SLO 6	Analyze professional decisions based on ethical principles	
SLO 7	Analyze construction documents for planning management of construction processes	
SLO 8	Analyze methods, materials, and equipment used to construct projects	
SLO 9	Understand the role of the construction manager as a member of different multi-disc.project teams	
SLO 10	Apply electronic-based technology to manage the construction process	
SLO 11	Apply basic surveying techniques for construction layout and control	
SLO 12	Understand different methods of project delivery and the roles of all constituencies involved in the process	
SLO 13	Understand construction risk management	
SLO 14	Understand construction accounting and control	
SLO 15	Understand construction quality assurance and control	

SLO 16	Understand construction project control processes	
SLO 17	Understand the legal implications of contract & laws to manage a construction project	
SLO 18	Understand the basic principles of sustainable construction	
SLO 19	Understand the basic principles of structural behavior	
SLO 20	Understand the basic principles of mechanical, electrical, and piping systems	

Evaluation Methodology

For criteria evaluation a series of data management tools are used:

1. A shared set of data tables that allow for collection and reporting of required data is used for faculty input. These data sheets also allow for visual verification of stages in the data collection process. At the same time it allows for individual faculty to reflect upon the assessment tool for the course learning outcomes. This collection information is tracked and presented at curriculum committee meetings throughout the year. Compliance emails are sent at the end of the semester.

2. Industry reviews are collected through alumni surveys and industry advisory board member discussions. The surveys are set up to capture responses from different alumni classes, anywhere between 1 and 20+ years out of college, and assess which of the SLOs are perceived as being successful based on the stage in their respective careers.

3. During annual faculty retreats, faculty and staff review the compliance data and industry notes regarding all SLO's and course overviews at the start of every fall semester.

Table below shows cadence and SLO DA review detail.

Degree Program Assessment Implementation Plan

Annual Data Collection to Ensure Comprehensive Assessment

The BC program data tables are set to collect SLO data for each course by semester. Faculty are requested to be compliant with fall data by within two weeks of the start of the spring semester and compliant with spring data no later than prior to the start of the fall semester. SLO compliance is monitored through undergraduate meetings and any faculty reflections are addressed throughout the academic year.

PLO data are collected annually before the start of the fall semester for the past academic year.

Assessment of ACCE SLO's (not to exceed three years)

The assessment of the individual SLO's is done in a collaborative setting of faculty during the fall retreat. Results of these assessments are then reported and discussed with the program's IAB members. During reviews with IAB members and school directors the members of the curriculum committee present the SLO's and collect feedback regarding application and rigor.

Starting with Group 3 in 2016-17 faculty within each class cohort presented their course work in addition the SLO assessments.

Evaluation of Degree Program Objectives

The results in alumni survey tables allow program administrators to evaluate and reflect on the larger program objectives, and how they support achieving goals set in the strategic plan.

Results of DPOs are presented and discussed to the MLSoC Leadership Team and subsequently adjusted, if projections fall short of goals. Results will also be presented to faculty and IAB members in discussions during the bi-annual IAB meetings.

Review Cycles

The assessment process is under continuous review to improve and communicate results.

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Appendix A — Academic Program Information (BC Section)

The Myers-Lawson School of Construction houses two undergraduate degrees, a Bachelor of Science in Building Construction (BS-BC) administered through the CAUS and a Bachelor of Science in Construction Engineering and Management (BS-CEM) administered by COE. MLSOC also houses two graduate degree programs, a Master of Science in Building Construction Science and Management (MS-BCSM), and a Doctorate of Philosophy in Environmental Design and Planning (PHD-EDP) degree.

Bachelor of Science in Building Construction (BS-BC)

1. A brief summary of the degree.

The Department of Building Construction (BC) is within the College of Architecture and Urban Studies (CAUS) at Virginia Tech. The college grew out of a program of architectural engineering, which was a department within the College of Engineering. In 1963, the department became part of the College of Architecture and Urban Studies. The Department of Building Construction has functioned as an integral partner in the Myers-Lawson School of Construction since the spring of 2006. Students who successfully complete the 131 credit hours required for degree are awarded a Bachelor of Science (BS-BC) in Building Construction through the College of Architecture and Urban Studies.

The mission of the Department of Building Construction is to build leaders for the construction industry and our society. Our ongoing vision is to have a world-class program to educate integrators, leaders, and thinkers who will transform the construction industry to sustainably meet the needs and aspirations of society. Our guiding principles are:

- To provide an education that allows graduates to interface and integrate technically and practically with engineers, architects, business leaders, planners, and politicians to improve our construction industry.
- To educate for leadership.
- To produce problem solvers who think critically and who can continue to learn through life and teach others.

The undergraduate and graduate degrees are only offered on Virginia Tech's Blacksburg campus. Pre-COVID, only 1 BC course was offered fully online and 1 course was offered hybrid.

BC was first accredited in 1991 and has retained accreditation status since that date. The department was last renewed in 2017 for a 6-year accreditation.

2. *Description of the curriculum for the degree.*

The Bachelor of Science in Building Construction focuses on the business and process of making buildings, and the performance of buildings including operations, finance, energy, and sustainability. These degree options are meant to better equip construction industry professionals with the necessary tools for excellence in all phases of the built environment. The building construction degree incorporates science and efficiency at all levels; from planning, designing, estimating, procuring, scheduling, implementing, and maintaining buildings necessary for the way our world will need to build, and live, in the future.

The 5 (five) tracks of study offer opportunities to students who wish to lead in this challenging, changing world. Separate options include integrative elements: leadership, non-technical skills, entrepreneurship, and best practice management principles to prepare graduates for the challenges of tomorrow. Core questions that bind us - how buildings perform in the world of limited energy and resources, how people will live and interface within this world and technology, how information will be managed for the life of these facilities, how communities will develop to better adapt to the realities of the 21st century - are all themes across the options as well.

All degree options in our undergraduate program begin with a common core during the first three semesters of study. This core is a science-based curriculum that provides a basis for ACCE accreditation requirements. All transcripts are designated with the appropriate tracks. Tracks include:

- Residential Construction and Development
- Restricted Elective Track (suitable for students pursuing double majors)
- Structural Design
- Sustainable Building Performance
- Virtual Design Construction

The BC curriculum focuses on team-based and project-based learning. This has always been the department's philosophy as our students actively transform knowledge to practice through labs and the platform of the integrated studios. The "Integrated Construction Studio (ICS)" series, which is unique among contemporary institutions, is an example of integrative learning. Each semester, the ICS series brings together Construction Engineering and Management juniors and seniors and Building Construction sophomores, juniors, seniors, and graduate students to conduct pre-construction management of a real project. Students within each grade level form teams of three to six members, which are then paired in larger teams of one sophomore team (structural sub-contractors), one junior team (mechanical sub-contractors), and one senior/graduate team (general contractors). Teams work together throughout the semester, culminating in a competitive, formal bid for a construction project similar to the bidding process construction companies undertake. The studio environment for the ICS series allows it to be catered to teams and also each individual student.

A typical first and second-year curriculum is as follows.

YEAR 1							
FALL SEMESTER				SPRING SEMESTER			
BC	1214	Intro to BC	3	BC	1224	Intro to BC + Lab Pre: 1214	3
COMM	1015	Comm Skills	3	PATHWAYS 2		Elective	3
	or	ENGL 1105 First-Year Writing		COMM	1016	Comm Skills	3
MATH	1225	Calc of a Single Variable (C-)	4		or	ENGL 1106 First-Year Writing	
GEOS	1004	Intro to Earth Science	3	Pathways 5A		Elective	3
GEOS	1104	Phys Geo Lab	1	TRACK SELECTION* (SD track MATH 1226 (4cr), all other MATH 1114 (2cr))			2-4
		TOTAL CREDIT HOURS	14			TOTAL CREDIT HOURS	14-16

YEAR 2							
FALL SEMESTER				SPRING SEMESTER			
BC	2014	Constr Principles I Pre: 1224	3	BC	2024	Constr Principles II Pre: 1224, 1214, 2014	3
BC	2114	IT in Construction (C- min) Pre: 1224 or CEM 2104	3	BC	2064	Integrated Cnst Series I Pre: 2014	3
Pathways 6 A		Elective	3	BC	2214	Why Bldgs Stand Up Pre: MATH 1225 or MATH 1025	3
PHYS	2305	Found of Physics I (C-) min Pre: (MATH 1205 or 1205H or 1225) or (1206 or 1206H or 1226)	4	3ECON	2006	Prin of Econ II Pre: ECON 2005	3
ECON	2005	Prin of Econ I	3		or	AAEC 1006 Econ of Food & Fiber	
	or	AAEC 1005 Econ of Food & Fiber		ACIS	1004	Accounting Foundations	3
				TRACK SELECTION*			3
		TOTAL CREDIT HOURS	16			TOTAL CREDIT HOURS	18

Most of the Pathways (General Education) courses are completed during the first four semesters. BC courses are started immediately within the first semester through the Introduction to BC courses (BC 1214, 1224). These courses give students an introduction to the world of construction with an overview of the important areas of contracting and the inner-workings of the construction industry. Second-year courses cover the fundamentals of construction technology and processes emphasizing materials,

methods, techniques, and sequences for the construction of buildings (CSI Divisions 1-6). Planning, scheduling, and quantity surveying for the management of construction resources are among the topics studied. During the second year, students also take BC 2114 which explores building delivery and project management improvements through the use of computer applications, including scheduling software, building information modeling (BIM) tools, and virtual design and construction (VDC) simulation software. BC 2214 - Why Buildings Stand Up is taken after students finish Calculus I and their engineering-based Physics. BC students must complete the math and science requirements before moving into 3rd and 4th year. A typical third and fourth-year curriculum is as follows.

YEAR 3							
FALL SEMESTER				SPRING SEMESTER			
BC	3114	Building Systems Tech Pre: 2024 or CEM 2104, PHYS 2305	3	BC	3064	Integrated Cnst Series II Pre: (2064, 3114, PHYS 2305) or (CEM 2104, PHYS 2305)	3
BC	2044	Building Materials Pre: 2214 or CEM 2104	3	BC	3134	Temporary Structures Pre: (2044, 2024, MATH 1225) or CEE 3684	3
BC	2134	Const Data Analytics	2	MGT	3304	Mgt Theory & Lead Practice	3
BC	2104	Bldg Effect Const Teams Pre: 1224, (COMM 1016 or ENGL 1106)	3	ENGL	3764	Technical Writing Pre: Jun Standing	3
3Pathways 2 + 7 Directed Elective1			3	3Pathways 6 D		Elective	3
TRACK SELECTION*			3	TRACK SELECTION* (SD does not need another course, all other tracks = 3 credits)			0-3
		TOTAL CREDIT HOURS	17			TOTAL CREDIT HOURS	15-18

Year 4							
FALL SEMESTER				SPRING SEMESTER			
BC	4064	Integrated Cnst Series III Pre: 3064	3	BC	4444	Constr Practice II Pre: 4434	4
BC	4434	Constr Practice I (2044, 3064) or CEM 2104	3	FIN	3054	Leg & Eth Env Business Pre: Jun Standing	3
CEM	3084	Constr Economy Pre: BC 1224	3	TRACK SELECTION *			3-4
BC	4164	Planning Proc / Design Pre: 3114, 3064	3	TRACK SELECTION*			3
TRACK SELECTION*			3	TRACK SELECTION*			3
TRACK SELECTION*			3				
		TOTAL CREDIT HOURS	18			TOTAL CREDIT HOURS	16-17

Table 8

In third year, students move into their systems course, BC 3114, where emphasis is placed on the integration and physical installation of passive and active environmental control systems including heating, ventilation, air conditioning, lighting, acoustics, plumbing, and fundamentals of thermal loads. They also continue with their Integrated Construction series along with courses in data analytics, materials, production planning and process design, and a non-technical class, BC 2104 Building Effective Construction Teams. This is an introduction to tools and techniques to help build effective construction teams including building trust, managing conflict, and embracing innovative change and ethics. Temporary structures, BC 3134, is an introduction to temporary structure systems used to support construction operations; concrete formwork, scaffolding systems, excavation shoring systems, dewatering techniques, and hoisting operations. The last sequence of BC courses is BC Practices I and II, (BC 4434, 4444) which are considered the capstone courses in that they explore and apply the business and construction practices related to the operation of a construction company to a capstone experience. Construction operation is examined as it relates to construction, financial, and personnel management.

The business and management courses taken are an important aspect of this degree. This curriculum category involves fundamental courses to provide a foundation for contemporary business practices for the construction manager. This aspect of the curriculum prepares students to manage the principal resources of the industry, i.e., people and money. It also prepares students to have a broad understanding of the fundamentals of the free enterprise system, accounting, finance, business regulations, contract law, and marketing. BC recognizes that diverse exposure to other curriculum areas is an important part of the overall educational experience and for that reason, this curriculum category is taught outside the construction unit. These are separate and distinct from construction business and management topics contained within BC specific courses.

It is during the third and fourth year that students delve into their track-specific courses. These are 26 credit hours specific to their track of study. This enables students to concentrate and delve deeper into an area of interest within the subject area. These concentrations include Structural Design, Sustainable Building Performance, Virtual Design, and the Directed Elective track. Residential Construction has been recently added to give students an additional track choice as many have expressed a desire in learning more about residential construction within today's market.

An example of the curriculum from the Virtual Design track is as follows.

Virtual Design Construction (VDC)			
BC	4114	3	BIM in Design and Construction
BC	4124	3	Digital Construction and Manufacturing
BC	4364	3	Lifecycle BIM for Facility Management
MATH	1114	2	Elementary Linear Algebra
		3	Business & Management Elective
		3	Business & Management Elective

		3	Free Elective
		3	Free Elective
		3	Free Construction Elective
	Total Credits	26	

For the purposes of this track example, there are 3 specific BC courses that were developed to allow students the opportunity to gain more knowledge, beyond BC 2114 (the first IT class in year 2). In BC 4114, students are introduced to means and methods to enrich the geometric information of a building model with semantic data such as material, structural and performance values. BC 4124 is exploration and experimentation with construction from the perspective of digital information, computer numerical control (CNC), and computer-aided manufacturing (CAM) processes. BC 4374 builds on the previous courses to a more involved use of BIM (Building Information Modeling) concepts and tools for identifying, capturing, analyzing, and delivering facility life cycle data for data-centric and model-centric workflows for data handover. The completion of these 3 track-specific courses builds a deeper understanding and knowledge of Virtual Design Construction. The students also have an unofficial cognate of 9 credits (6 credits free electives and 3 credits of a construction election) to further customize their degree. They can use these 9 credits to complete a second track in BC, to use towards a minor, or to even use to explore other areas of interest, (Spanish, Leadership, Design, etc.). This gives them flexibility and a sense of ownership in courses chosen.

3. *The program's contribution to general education.*

The first-year experience (FYE) content had previously been incorporated across the BC 1214/1224 series of courses, (Introduction to Building Construction). Because of substantial student growth within Building Construction and the copious amount of change of majors and external transfers into BC 1214/1224, the FYE metric was removed from BC 1214/1224. A newly proposed stand-alone course is being proposed this Fall semester 2020. This course was taught as a special study course Fall 2019 and Fall 20 and this will be the first stand-alone FYE course in the BC department that is dedicated entirely to first-year content and first-year students.

First-Year Experience is a program designed for first-year students with the intent of equipping students with the appropriate tools necessary to engage in substantive exploration and discovery of themselves and the world around them. Along with the traditional FYE content of university resources and campus engagement, students will explore career opportunities within the built environment with a focus on communication and teamwork. Emphasis on professional development, reflection on self as a learner, digital and information literacy, and the ability to present ideas visually, orally, and in writing.

Another proposal being considered is converting BC 2134 Construction Data Analytics from a 2 to a 3 credit course with additional content then submitting it for approval for a Pathways 5A course. All other Pathway Requirements are incorporated across the curriculum with Pathways 2, 6, and 7 being non-directed electives so students can choose their own courses.

5. *Successes and challenges related to student recruitment, enrollment, and retention.*

The challenges for the department are much the same as the challenges for the school. Unprecedented growth and lack of resources to hire adequate faculty to support growth are the foremost challenges faced. The chart below illustrates the growth that has occurred between 2012 and 2020. Factors for this growth include a more robust recruiting program with the creation of student ambassadors for the program, the move from faculty to professional advisors to coordinate open houses, information sessions, school visits, etc., an increase in change of majors within the university through partnerships with various schools and departments across campus, community college recruitment, and use of industry partners to recruit within their own regions of influence.

The first to second-year retention rates are interesting to the department in that until 2019 when second-choice major was removed from the University Admissions Application, BC was a common second choice option, especially for those students interested in Engineering or Architecture. The high retention rates indicate that even those students who did not intend to become a BC major found value in the program and chose to continue. Often called the University's best-kept secret, the discovery of Building Construction as a rewarding and profitable career choice attributes to the high satisfaction of our students within the major.

Continuation & Graduation - University					
BC Bachelor's Degree-seeking Freshmen First to Second Year Retention					
	2015	2016	2017	2018	2019
% Continued to 1st Spring	**98.0%**	**98.0%**	**97.5%**	**97.7%**	**97.7%**
% Continued to 2nd Year	**93.4%**	**93.0%**	**92.8%**	**92.6%**	**92.9%**

Time to Degree has been a concern of the department in that until last year, BC was a 134 credit hour degree and as such cadets and change of majors often had a hard time achieving that in a four-year time frame. Measures taken to reduce this includes offering BC 1214 in the winter semester. BC 1214, 1224, and 2014 are also taught in the summer sessions as a means for transfer and change of major students to catch-up on the introductory courses and be ready for second-semester sophomore classes in the fall. All of this is intended to allow a shorter time to degree for students coming in from another major or even another institution. Another measurement taken is with the addition of our track selections in which cadets and change of majors can use 9 credits of a cognate for a cluster of related courses. After an extensive review from the curriculum committee, a reduction of credit hours from 134 to 131 will take place for the graduating class of 2022.

Time To Degree - College-Dept-Major					
Freshmen					
Majors	2014-15	2015-16	2016-17	2017-18	2018-19
Building Construction	4.68	4.61	4.58	4.35	4.32