

DEVELOPMENT OF A MULTI-USE CONSTRUCTION ENGINEERING AND MANAGEMENT CLASSROOM/LABORATORY

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Introduction and Overview

Engineering education requires a combination of classroom training, hands-on experience, and industry participation. In addition, students must become fairly well versed in the use of the technological tools of the trade. In order to accomplish these goals, engineering programs must develop innovation use of space and provided state-of-the-art technologies that can be used by both the students and the instructional staff. Traditional classrooms are usually configured for lecture-based instruction and are limited in their functionality for group work. The Division of Construction Management and Engineering (CME) at North Dakota State University (NDSU) has developed a reconfigurable multi-use classroom / laboratory that is the primary meeting space for most CME courses.

The Department of Civil Engineering and Construction at North Dakota State University consists of two divisions, the Division of Construction Management and Engineering and the Division of Civil Engineering. The Construction Management and Engineering (CME) Division has accredited degree programs in construction engineering and construction management. Based on our most recent Accreditation Board for Engineering and Technology (ABET) and the American Council for Construction Education (ACCE) accreditation reviews, it was recommended that the CME Division acquire additional space dedicated primarily for construction education, i.e., a construction classroom / laboratory (CCL). Based on this recommendation we developed a plan to acquire additional space for the dedicated CCL.

The contents of this paper describe: 1) the overall conceptual plan of the CCL, 2) the required technology systems, 3) the phased construction schedule, 4) the funding mechanisms used to construct the classroom/laboratory, and 5) student and faculty assessments concerning the overall use classroom/laboratory.

Conceptual Plan

After consulting with the Vice President of Academic Affairs, representatives from Informational Technology Services (ITS), and various Department Heads, it was decided that the existing classroom designated as CIE (Civil and Industrial Engineering) 102 should be the space dedicated to the CCL. At that time CIE 102 was designated as a university classroom which could be used for any class from any department or college. The room consisted of permanently floor-mounted tables with fixed chairs. Seating capacity was listed at 60.

Our conceptual plan called for a complete remodel of the entire room. This renovation would include new reconfigurable furniture, high-end classroom instructional technologies, storage facilities, and portable wireless computer technologies (explained later). The basic conceptual plan was created in AutoCAD, as shown in Figure 1.

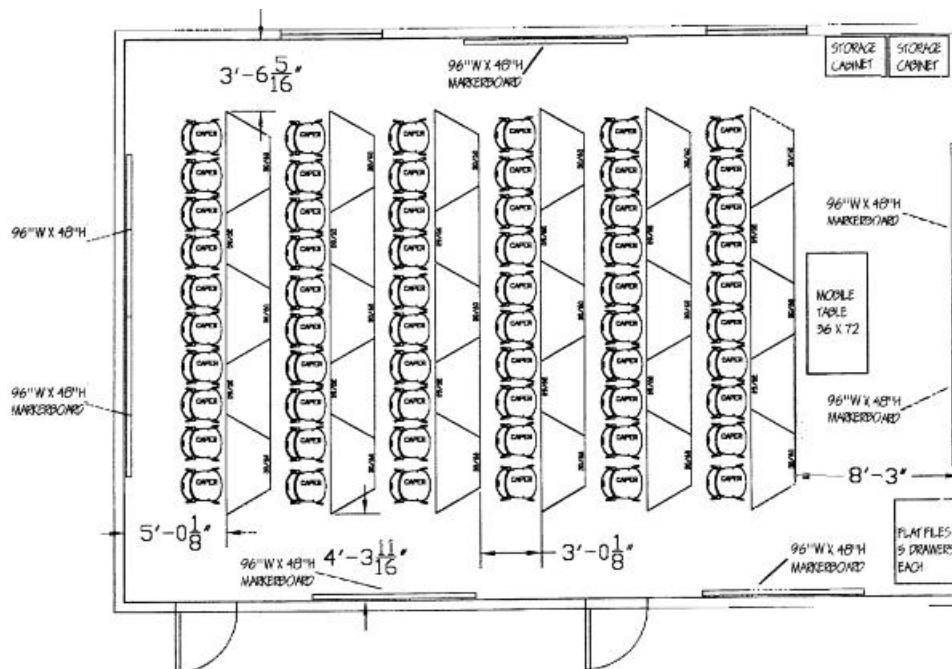


Figure 1. Conceptual Plan for the CCL

After creating the conceptual plan, we had to develop a “use plan” that would and could be used to justify the costs associated with the conceptual plan.

Use Analysis

Figures 2 and 3 on the following page, illustrate the proposed use analysis for CCL. The primary use of the CCL is for construction courses, however, as indicated in the tables other Departments will have access to the room, as part of the agreement between the CME Division and the Provost. The use analysis was required in order to develop a CCL budget and to justify the costs which would come from the budgets of the CME Division, the Provost, and the Dean of the College of Engineering.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:00 – 9:00	CE 309		CE 309		CE 309
9:00 – 10:00	CME 403/603	CME 403/603	CME 403/603	IME 310	CME 403/603
10:00 – 11:00					
11:00 – 12:00	CME 450	ME 423	CME 450	ME 423	CME 450
12:00 – 1:00	CME 430/630		CME 430/630		CME 430/630
1:00 – 2:00	ME 351	ECE 403	ME 351	ECE 403	ME 351
2:00 – 3:00	CE 204	CE 204	CE 204	CE 204	
3:00 – 4:00	CME 320		CME 320		CME 320
4:00 – 5:00	CME 370	CAPSTONE	CME 370	CAPSTONE	

Figure 2. CCL Use Analysis - Fall Semesters

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:00 – 9:00	CME 325		CME 325		CME 325
9:00 – 10:00	CME 205		CME 205		CME 205
10:00 – 11:00	CE 445/645	CE 483	CE 445/645	CE 483	CE 445/645
11:00 – 12:00		CME 453		CME 453	
12:00 – 1:00	ME 352		ME 352		ME 352
1:00 – 2:00	CME 409 16	CSCI 374	CME 409 16	CSCI 374	
2:00 – 3:00	CME 385	CAPSTONE	CME 385	CAPSTONE	
3:00 – 4:00	CME 301 CE 796		CME 301 CE 796		CME 301 CE 796
4:00 – 5:00	CME 411/611	CME 301 35 CE 796 1	CME 411/611		
5:00 – 6:00	CME 412	CME 412	CME 412	CME 412	

Figure 3. CCL Use Analysis - Spring Semesters

Equipment and Technologies

The CME Division developed a three-phase plan for renovating and updating CIE 102 into the CCL. This renovation is required in order to meet the space allocation needs of the Division, as mandated by our accreditation boards (ABET and ACCE). Most CME courses will be offered in the CCL, however, the room will be designated and used as a general education class room, as indicated in the use analysis.

This three-phase effort is outlined as follows:

- Phase 1 Removal of existing blackboards, fixed furniture, and front platform; cleaning & painting; installation of dry boards; installation of new multiple use modular furniture (used in standard lecture format or as reconfigured team tables). It is anticipated that this work will be completed by the start of the Spring 2002 semester. The completion of Phase 1 guarantees that the room will be “installation ready” for the ITS classroom technology (Phase 2).
- Phase 2 Replace the existing classroom technology with a permanent installation (ceiling-mounted projector, computer (floppy drive, CD-ROM, zip), laptop connection, document camera, and VCR). It is anticipated that this phase will be completed during the summer of 2002.
- Phase 3 Purchase and install portable computer system and a wireless network installation (15 laptop computers with a recharging storage cabinet, a wireless network for printing and Internet connection, additional storage cabinets for student plans and files). It is anticipated that this work will be completed after Phase 2. The work for Phase 3 could be completed during the summer of 2002, but work may be continuing into the Fall 2002 semester. Work for Phase 3 will not interfere with any scheduled classroom activities.

For Phase 1, the CME Division has committed approximately \$20,000 for renovations and equipment purchases. The anticipated costs for Phase 2 are approximately \$13,500. The actual costs for Phase 2 may be lower, since the electrical connections and all of the cabling for the projection system are in place. The CME Division is prepared to match an amount of \$5,000 toward the completion of Phase 2, which should significantly reduce the amount that ITS typically allocates for upgrading a classroom. The budget for Phase 3 (laptops, charging station, network, etc.) is estimated at \$60,000. Funding for Phase 3 will be provided through “student activity fees.”

Table 1, on the following page, gives a detailed breakdown of the CCL project cost estimate. Table 2 presents a summary of the conversion activities and overall schedule for the CCL.

Table 1. CCL Phased Cost Estimate

Phase 1 - Furnishings			
Item	No.	Cost	Comments
Chairs	60	4,714.20	Stacking
Tables	30	9,144.60	Trapezoidal
Table	1	363.21	Front Table
Flat File Cabinets	2	2,217.86	10 drawers each
Low Base, Lock Kits	1	169.65	
Marker Boards	7	2,761.89	Whiteboards
Storage Cabinets	2	452.22	
Freight		345.00	
	Subtotal	\$20,168.63	CME funded
Phase 2 - Estimated Cost for Instrumentation			
Projector		4,886	
Document Camera		2,650	
*Partial Sound System		2,526	
Computer		1,299	
Cabinet		1,109	
Cables & Misc. Supplies		200	
Projector Bracket		280	
VGA Splitter/Booster		162	
Wireless Remote Mouse		99	
VCR		98	
Software		53	
	Subtotal	\$13,362	Provost funded
Phase 3 - Laptop Cluster			
Computers - Laptops	15	18,000	
Wireless Network	1	5,000	
Charging Station	1	2,500	
	Subtotal	\$25,000	Student Act. Fees
GRAND TOTAL		\$58,530.63	

Table 2. Conversion Activities and Schedule

Semester	Furnishings	Instrumentation
Fall 2001 (refer to 1.)	Before the start of the spring semester: change out furniture to new modular furniture that can be used in traditional lecture format or team tables, depending on class needs. Room capacity reduced to 60 due to addition of new storage cabinets and flat files for plan storage.	The current projection system is the old CME projector and VCR. Projector will have a new bulb installed (bulb is on order \$500 cost is split between CE and CME).
Break (F 02) (refer to 2.)	Dry erase boards installed, Front platform removed, Floors waxed, Room to be painted Additional new furniture installed.	Replace Projector Bulb and Refocus on screen.
Spring 2002 (refer to 3.)	None during semester, seating capacity temporarily at 72 due to Spring class enrollments (temp. furniture added).	Install ITS Classroom Instrumentation (Phase 2). Final pricing wireless network options and laptop cabinet charging cluster.
Summer 2002 (refer to 4.)	End of spring semester remove remaining long tables.	
Fall 2002 (refer to 5.)		Purchase Laptops and Wireless Network (Phase 3)
Spring 2003		End of Semester - Install Laptops and Wireless Network

Referenced Comments:

- 1. Fall 2001: Research in the fall did not show any classes exceeding this number in the past semesters that were going to continue using the room. All room changes were made based on this basis. Due to latest information from CE, it will be necessary to retain some of the old tables at the back of the room for Spring 2002.*
- 2. Break (F 02): Timing of the changes - Storage/disposal options on old furniture, 12 chairs 3 tables to stay in CCL for Spring. Contact other College Chairs to see if they are interested in any tables, move remaining to salvage.*
- 3. Spring 2002: Install instrumentation prior to the start of the semester.*
- 4. Summer 2002: No work scheduled, need to wait until Fall 2002 and Spring 2003 to secure funding for Phase 3.*
- 5. Fall 2002: For registration, room Capacity is 60 to allow installation of additional cabinets etc. Quotes for laptops and wireless network.*

Project Update and Conclusions

At the conclusion of the 2002 Fall Semester Phases 1 and 2 of the CCL have been completed. All moveable furniture and accessories have been purchased, as well as, the installation of the classroom instrumentation station. All applicable software programs have been installed on the Windows XP operating system (M.S. applications: Word, Excel, Media Player, etc.; Internet options: IE Explorer, Netscape, access to Blackboard, etc.: and all Construction related software: Primavera, Project, Expedition, etc.). Figure 4 shows the classroom instrumentation station and Figure 5 gives a perspective of the CCL completed through Phase 2.



Figure 4. Classroom Instrumentation Station



Figure 5. Overview of the CCL

Phase 3 which is the installation of the Laptop Cluster has yet to be completed and consists of the purchase and installation of the laptop computers, wireless network, and charging station. Quotes were obtained during the 2002 Fall Semester. These items will soon be purchased and installed at the end of the 2003 Spring Semester.

Biographies

Charles McIntyre is an Assistant Professor in the Department of Civil Engineering and Construction at North Dakota State University. Dr. McIntyre is an advanced FIEL fellow and has developed several faculty seminars dedicated to enhancing student learning. He attended the PBL workshop at the University of Delaware and has worked on implementing PBL into his course offerings. Dr. McIntyre has received several awards and university recognition for teaching efforts.

Gary Smith is a Professor and CME Division Head in the Department of Civil Engineering and Construction at North Dakota State University.