



**University of Detroit Mercy
College of Engineering and Science
Department of Civil & Environmental Engineering**

Bachelor of Architectural Engineering

(Proposal)

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A. Summary

For many years, UDM has offered bachelor degrees in Engineering and Architecture separately. Architects and engineers often work together on teams at architecture-engineering firms. A large number of students have taken courses from both areas to get experienced working with mindset of interdisciplinary teams. Additionally, students have double majored in both programs at the bachelor or graduate level.

However, licensing requirements are going to make it harder for students to double major. Students will soon have to take the full curriculum in both programs and have no courses double count towards degrees.

At the same time, UDM is looking for new undergraduate programs. The School of Architecture and the Department of Civil & Environmental Engineering independently went to their alumni advisory councils and asked whether they should propose new programs. Both advisory councils responded clearly that we should consider Architectural Engineering (AE).

A review of programs across the country shows that there are very few AE programs. Those programs all have very high enrollments in them. Only a small number of universities across the country have the capability of offering an AE program because a crucial component is having a Civil Engineering program and Architecture program.

Since nearly all of the courses necessary for an AE program are already offered at UDM, there would be limited resources required to launch a program. Of course, if 125 freshmen were admitted to the AE program like at Kansas State University, new resources would be required for faculty and space. However, a program can be launched accommodating up to 18 freshmen without new full-time faculty or space. Two adjunct positions and marketing funds are the only new expenses requested.

The new program would take five years to complete. The students would take a large number of the existing courses required for a Bachelor of Civil Engineering. In addition, they would take about one year of architecture. The new program would help fill under-enrolled engineering courses without placing excessive demands upon the School of Architecture.

Architectural engineering would be linked to two programs at UDM with strong mission relevance. The School of Architecture, the Detroit Collaborative Design Center, and the Department of Civil Engineering each provide numerous services to the Detroit area.

The Architectural Engineering Program would be administered within the Department of Civil Engineering with a curriculum committee including representation from Architecture. Accreditation through the Accreditation Board for Engineering and Technology (ABET) will be sought after the first graduating class.

B. Description of the Program

B1. Catalog Description

Architectural Engineers (AEs) supports the building design and construction process. Architectural Engineers design the structures for buildings, determine methods to construct them, and plan the building components such as heating ventilating and air conditioning (HVAC), electrical and lighting systems.

Architectural engineers can work in architectural engineering firms, in the construction industry, and for mechanical consulting firms. The AE Program prepares the students to become licensed architectural engineers.

The Architectural Engineering program at UDM provides a broad perspective on the practice of building design. Architectural engineering is both architectural design and engineering.

Students take courses in all of the areas of architectural design, building structures, construction, and mechanical/electrical systems, but may focus in the area of their choice.

Program Educational Objectives:

1. Graduates of our program should work as practicing architectural engineers and take necessary steps to become certified or licensed as a professional engineer.
2. Graduates of our program should be able to create and contribute to comprehensive architectural engineering designs, problem solutions, detail development and/or research that is sensitive to user needs, economics, social context, community needs as well as address design functionality and aesthetics, environmental, public safety and sustainability concerns.
3. Graduates of our program should actively participate and seek leadership positions in professional societies, in other worthy organizations, and in their workplaces.

Concentrations:

After completing the core engineering courses, students take two additional courses in their area of interest within Architectural Engineering. This provides the students with an opportunity to obtain greater depth of design capabilities. The concentration areas available are: Structures, Construction / Construction Management, and Building Mechanical & Electrical Systems.

B2. Sequential Course Matrix

Freshmen Year

Fall	cr	Winter	cr	Summer	cr
MTH 1410 Calc I	4	MTH1420 Calc II	4		
ENGR1000 Engineering Ethics	2	PHY1600/1610 Physics	4		
ARCH1190 Introduction to Arch	1	ARCH2130 Structural Behavior	3		
ARCH1100 Studio	4	ARCH1200 Studio	4		
ARCH1110 Vis. Comm	3	Core Objective, Communication	3		
ENL1310:Composition	3				
	17		18		

Sophomore Year

Fall	cr	Winter	cr	Summer	cr
MTH2410 Calc III	4	PHY1620/1630 Physics	4	CTA3010 Coop	2
CEC3000 Coop Prep	1	ENGR3120 Statics	3		
ENGR1050 Engineering Design	2				
ARCH1300 Sophomore Studio	4	ARCH2340 Enviro Tech 1	3		
ARCH2160 CAD	3	ARCH1160 Graphics	3		
ARCH2120 Arch Hist 1	3	ARCH2900 Introduction to Arch II (or III)	1		
		PHL1000: Philosophy	3		
	17		18		2

Junior Year

Fall	cr	Winter	cr	Summer	cr
ENGR3260/3270 Mechanics	4	CTA3020 Coop	2	CIVE3420 Structural Analysis	4
MTH3720 Differential Equations w/ Lin. Alg.	4			ENGR3150 Thermodynamics	3
CHM1070/1100 Chemistry	4			ENGR3140 Fluid Dynamics	3
				ARCH1400/AE1400 Studio	2
ARCH2150 Construction 1	3				
ARCH2440 Enviro Tech 2	3			UDM Core: Literature	3
				UDM Core : History	3
	18		2		18

Senior Year

Fall	cr	Winter	cr	Summer	cr
CTA3030 Coop	2	CIVE4680 Structural Design (for Struct. area) or ARCH2430 (for M&E area)	4 or 3	CIVE3450 Construction Materials	3
				BIO1080 Sci. of Life	3
		ENGR3400 Heat Transfer	3	ENGR3020 Prof. World Work II	1
				MTH4270 Prob/Stat	3
		ARCH2250 Construction 2	3	ENGR4820 HVAC (for M&E area.) or CIVE4740 Adv. Steel (Struct. area) or CIVE4850 Project Management (Constr. area)	3
		ARCH2220 Arch Hist 2	3		
		UDM Core: Psy2650 Enviro Psych.	3	UDM Core : PHL / RS	3
	2		15- 16		16

Professional Year

Fall	cr	Winter	cr
ENGR3010 Prof. World Work I	1	ENGR3030 Prof. World Work II	1
ENGR3200 Principles of Electrical Engineering	3	ENGR4240 Engineering Econ	3
ENGR3170 Materials Sci	3		
ENGR3130 Dynamics	3	AE Choice: (any one of) MTH 1400, ENL 3030, ARCH 2140, CIVE 3400, ENGR 3410, or any AENG course.	3
CIVE3480/3490 Geotechnical Engin (Structures area) or AENG4350 Lighting Design (M&E area)	4 or 3	AENG4300 Electrical Systems Design (M&E area.) or ARCH4430 Masonry Design (Struct. and construction area.)	3
UDM Core: Religious Studies	3	UDM Core: Languages & Cultures	3
ARCH4590 Construction Law	3	ARCH4100/AENG4100 Integrative Design	3
	15- 16		17

B3. List of Courses

Courses were chosen for this program based on several criteria. First, UDM has a core curriculum that is essential for developing the whole person, not just engineering techniques. Second, it is necessary to accredit this program with the Accreditation Board for Engineering and Technology (ABET) so that the program has credibility and the students may become licensed engineers. Third, to become licensed the students will have to take two day-long exams. Students need to be prepared to take these exams through curriculum at UDM.

Key:

+: New courses

*: Existing courses

?: Technically are new courses, but are actually cross-listings of current courses.

General Engineering and UDM Core:

	cr.	rec.	st.
* CHM 1070 General Chemistry I	3	4	
* CHM 1100 General Chemistry Lab I	1	1	
* MTH 1410 Analytical Geometry/Calculus I	4	4	
* MTH 1420 Analytical Geometry/Calculus II	4	4	

* MTH 2410	Analytical Geometry/Calculus III	4	4
* MTH 3720	Differential Equations with Linear Algebra	4	4
* MTH 4270	Applied Probability and Statistics	3	3
* PHY 1600	General Physics I	3	3
* PHY 1610	General Physics Lab I	1	
* PHY 1620	General Physics II	3	3
* PHY 1630	General Physics Lab II	1	
* ENGR 1000	Ethics and Politics of Engineering	2	3
* ENGR 1050	Engineering Graphics and Design	2	1
* ENGR 2040	Intro. to Engineering Computing	3	3
* ENGR 3010	Professional World of Work I	1	
* ENGR 3020	Professional World of Work II	1	
* ENGR 3030	Professional World of Work III	1	
* ENGR 3120	Statics	3	3
* ENGR 3140	Fluid Mechanics I	3	3
* ENGR 3150	Thermodynamics I	3	3
* ENGR 3170	Science of Materials	3	3
* ENGR 3200	Principles of Electrical Engineering	3	3
* CEC 3000	Cooperative Education Preparation	1	
* ENL 1310	Academic Writing	3	3
* CST 1010	Fundamentals of Speech	3	3
* PHL 1000	Introduction to Philosophy	3	3
	University Core - Objective 4	6	
	University Core - Objective 5	9	
*BIO1080	The Science of Life	3	3
*PSY2650	Enviro Psych	3	3

Architecture:

		cr.	rec.	st.
* ARCH 1100	Architectural Design I	4	0	12
* ARCH 1110	Visual Communication I	3	0	8
* ARCH 1190	Introduction to Architecture I	1	2	0
* ARCH 1200	Architectural Design II	4	0	12
* ARCH 2130	Principles of Structural Behavior	3	3	0
* ARCH 1290	Introduction to Architecture II	1	2	0
* ARCH 1300	Architectural Design III	4	0	12
* ARCH 2160	Computer Aided Design	3	3	0

* ARCH 2120	Architectural History & Theory I	3	3	0
* ARCH 2330	Structures I	3	6	0
* ARCH 2140	Ecological Design	3	3	0
+% AENG 1400	Architectural Design IV (%cross-listed with ARCH1400)	2	0	6
* ARCH 1160	Intro. to Computer Graphics	3	3	0
* ARCH 2220	Architectural History & Theory II	3	3	0
* ARCH 2340	Environmental Technology I	3	3	0
* ARCH 2150	Construction I	3	3	0
* ARCH 2440	Environmental Technology II	3	3	0
* ARCH 2250	Construction II	3	3	0
+% AENG 4100	Integrative Design Studio (%cross-listed with ARCH4100)	3	0	9
+%ARCH4590	Construction Law (%cross-listed with ARCH5590)	3	3	0

Advanced Engineering

		cr.	rec.	st.	cl.	lab.
* CIVE 3420	Structural Theory	4	4			0
* CIVE 3450	Construction Materials	3	2			3
* ENGR 3130	Dynamics	3	3			0
* ENGR 4240	Engineering Economy	3	3			0
* ENGR 3260	Mechanics of Materials I	3	3			0
* ENGR 3270	Mechanics of Materials I Lab	1	0			3
* ENGR 3400	Heat Transfer	3	3			0

Proficiency Course

Students are required to have proficiency in two areas. CIVE 3450 Construction Materials provides proficiency in the Construction/Construction Materials area. In addition students are required to take all of courses in one of these sets:

For Structures Proficiency:

		cr.	rec.	st.	cl.	lab.
* CIVE 3480	Soil Mechanics	3	3			0
* CIVE 3490	Soil Mechanics Lab	1	0			3
* CIVE 4680	Design of Steel and Concrete Structures	4	4			0

For Mechanical & Electrical Proficiency

		cr.	rec.	st.	cl.	lab.
+AENG 4350	Lighting Design	3	3	0		
* ARCH 2430	Structures II	3	6	0		

Concentrations

Students are required to have depth in one design area. This is achieved through two technical elective courses. The choices are below.

For Structures Concentration:

		cr.	rec.	st.	cl.	lab.
* CIVE 4400	Structural Dynamics	3				
* CIVE 4660	Bridge Design	3				
* CIVE 4740	Advanced Steel Design	3				
* CIVE 4760	Advanced Concrete Design	3				
* ENGR 4420	Finite Element Methods	3				
+% ARCH 4430	Masonry Design (% cross-listed with ARCH 5030)	3				
* CIVE 4360	Timber Design	3				
* CIVE 4750	Precast Concrete	3				
* CIVE 4780	Foundation Engineering	3				
* CIVE 4300	Forensic Engineering	3				

For Mechanical & Electrical Concentration:

		cr.	rec.	st.	cl.	lab.
+AENG4300	Electrical Systems Design	3	3	0		
+ENGR4820	HVAC	3	3	0		

For Construction Concentration:

		cr.	rec.	st.	cl.	lab.
* CIVE 4850	Project Management	3				
* CIVE 4300	Forensic Engineering	3				
*CIVE 4320	Cost Estimating	3				
*CIVE 4390	Design-Build	3				
+% ARCH4430	Masonry Design (% cross-listed with ARCH 5030)	3				

B4. Delivery Format

This program will be a traditional day program. However, some of the new courses may be offered in the evenings.

Cross-listed courses:

ARCH4430 Masonry Design	Lecture / Same as ARCH5030
AENG4100 Integrative Design Studio	Studio / Same as ARCH4100
ARCH4590 Construction Law	Lecture / Same as ARCH5590
AENG1400 Architectural Design IV	Studio / Same are ARCH1400

New courses

AENG4300 Electrical System Design:	Lecture
ENGR4820 HVAC	Lecture
AENG4350 Lighting Design	Lecture

B5. Respect for Academic Integrity and Intellectual Merit

All courses currently in engineering and architecture programs have a long history and high standards of academic integrity and intellectual merit.

Students will be required to follow the UDM policy on academic integrity as found in the 2008-2009 Undergraduate Catalog:

As members of an academic community engaged in the pursuit of truth and with a special concern for values, students must conform to a high standard of honesty and integrity in their academic work. Instances where academic misconduct occur include, but are not limited to, falsification or misrepresentation of material used in the admission process, presenting the work of other's as one's own, theft, plagiarism and cheating. These actions pose a threat to the academic integrity of the University and its mission and will be treated accordingly. Academic misconduct is subject to disciplinary sanctions. These sanctions include, but are not limited to, reprimand, probation, suspension and dismissal. Students are required to familiarize themselves with the specific protocols of their school or college, available in each respective Dean's office or Academic Policy Handbook.

Intellectual Merit:

The curriculum was designed so that program could be accredited by the Accreditation Board for Engineering & Technology (ABET). One of their requirements is the accomplishment of proficiencies by students. Each student is to show proficiency in at least two traditional areas of architectural engineering.

B6. Unique Characteristics & History

The Architectural Engineering program is an interdisciplinary program. It will be housed in the Department of Civil & Environmental Engineering, but a large share of the course work comes from the School of Architecture. Faculty from both colleges will have a say in the future of this program.

Beginning in 1923 the Architectural faculty members were part of the School of Engineering and offered a new program in Architectural Engineering. Students graduated with an engineering degree.

The Architectural Engineering program from 1923 to 1956 was much like other historical AE programs. It focused on many of the same building design issues that the modern program would cover.

In 1957, the AE department was renamed the Department of Architecture. The curriculum was changed to resemble what is now offered in UDM's School of Architecture. Students took studio courses every year as they do now. During this time, a Construction Option was offered. This maintained a connection between the new program and the Civil Engineering program. Students graduated with a degree from the College of Engineering and Architecture with a major in Architecture.

The rationale for the change, as laid out in the Bulletin is that societal expectations had changed for the profession. One can only guess what had changed in society.

In 1963, the School of Architecture separated from the College of Engineering. The programs focused more on architectural design than engineering design.

Living alums from 1923 to 1956 are probably a very good group to get involved in the new program. They should be invited to the kickoff event.

Also Architecture alums from 1957 to 1963 may have an interest in the new AE program depending on if they had the Construction Option. There 86 living alums from this period, but there is no record about whether any of them had the Construction Option.

B7. Effects on Other Programs

Architectural Engineering students will take a number of courses from different programs: Civil Engineering, Architecture, and Mechanical Engineering. The effect on all of those programs is that enrollments in the related courses will increase.

Architectural Engineering is an interdisciplinary field. Since students are dually architects and engineers, the bond between the two colleges will increase. Students will become active in student organizations in both colleges. More events will be held in common between the colleges. Many of the faculty already engage in research relationships between the colleges. However, this will likely increase.

The new AE program may draw students out of Civil Engineering, Mechanical Engineering or Architecture. However, this could be replaced by students admitted initially to AE, but change their mind and go into one of the other areas. As such, having a menu of engineering programs is likely to attract more “Engineering Undecided” students who are uncertain of the discipline of engineering they would pursue. Students going from other majors into AE improve enrollments in many classes because the Bachelor of Architectural Engineering program is a five year program that mostly relies upon existing courses.

Specifically, the Department of Civil & Environmental Engineering will be strengthened. It will have more students. In addition, there will be increased demand for electives that difficult to offer given small enrollments, thereby benefiting both CE and AE majors.

C. Mission

The instructional mission of the Architectural Engineering program, as written by the industrial advisory council is:

The program of Architectural Engineering seeks to provide the highest quality of architectural engineering education. The mission of the program is to provide a high quality, broad-based education and design experience that enables the students to address multi-faceted engineering problems sensitive to architectural issues. The program seeks to provide the students with the fundamental tools and skills to enable them to perform and evolve in, and contribute to the profession in response to changing technology and societal needs and expectations.

C1. Fulfillment of University Mission

A primary concern in architectural systems is efficiency of heating, air conditioning, and lighting systems. Providing engineers uniquely trained in these areas as it applies to buildings would help promote sustainability, environmental responsibility and energy efficiency.

The Architectural Engineering degree would be interdisciplinary. It is the people with crossover skills that become the greatest leaders on projects that shape society. Those interdisciplinary skills might become especially useful in building rehabilitation projects which are a particular concern for the City of Detroit.

C2. Fulfillment of College Mission

The inclusion of architectural studio within an engineering program fits well with the College of Engineering & Science mission to combine theory and practice. Methods that engineering programs employ to accomplish this are project intensive curriculum and the cooperative education (coop) program where students get paid internships in the industry. Architectural engineering students would also participate in the coop program.

The college mission ties well into the University mission above through making the education relevant to the urban context. Bring architecture into the engineering curriculum will strengthen those ties.

D. Market and Need

D1. Market Study

Projected enrollment at steady state levels.

From new students: 16 to 100 freshmen per year.

From current students: 6 to 29 internal transfers per year.

Total: 22 to 129 freshmen per year.

Demand from New Students:

Nationally, the demand among students for a program in Architectural Engineering (AE) is high. Fields connected to architecture have had a cachet that attracts students. The UDM Architecture program limits the number of freshmen because they have limited number of seats.

There is great interest in architecture in high schools. Many high schools has pre-architecture or architectural drafting programs. Some focus on college preparation for an architecture field. Others have architectural drafting preparation. More diverse opportunities would help more of these students find a career path that suits them.

Despite having no program in AE and no web page related to it, Dr. Hoback gets a few calls and emails per year from students who are interested in an AE program.

There are several community colleges that could act as feeder schools to the UDM program. Of the four major metro Detroit community colleges (OCC, MCC, WCCC, and HFCC) only Wayne County Community College does not have a pre-architecture program. The others produce a large number of graduates that seek ways to continue their education. A review of courses available at OCC shows that transfers could come to the AE program at the sophomore level.

Part of establishing demand from students is to look at competing institutions. The attached table shows the existing Architectural Engineering Programs in the US.

Engineering Workforce Commission (EWC 2007)

Institution	State	Freshmen	Also offers Architecture?
Cal Poly-San Luis Obispo	CA	67	Yes
U Colorado-Boulder	CO	65	Yes
U Miami	FL	19	Yes
Illinois Inst of Tech	IL	28	Yes
Kansas State University	KS	125	Yes
U Kansas	KS	27	Yes
Missouri University of Science and Tech.	MO	(50)*	No
U Nebraska-Lincoln	NE	55	Yes
NC A&T State University	NC	33	No
Oklahoma State Univ	OK	50	Yes
U Oklahoma	OK	16	Yes
Drexel University	PA	64	No
Penn State University	PA	97	Yes
Tennessee State Univ	TN	38	No
Texas A&M Univ-Kingsville	TX	19	No
U Texas-Austin	TX	63	Yes
Washington State Univ	WA	137	Yes
Milwaukee School of Engrg	WI	139	No
U Wyoming	WY	71	No
U Hartford	CN	(Master program only)	No
20 programs		1163 freshmen	12 yes

* Missouri University of Science and Tech. <http://www.mst.edu/> The normal path of student admittance to engineering is “general engineering”. The University has 917 freshmen-undesignated engineers. “50” AE students reported above is junior class.

It is noteworthy that even schools that also have an architecture program have strong enrollments in AE. This indicates that students are not coming to those schools for AE because it is the only architecturally focused option.

Notice that low population states of Wyoming, Nebraska, Kansas and Oklahoma support a total of 6 schools and 344 freshmen students. (An average 57 freshmen per program.) They are probably not drawing from nearby higher population states because Colorado, Missouri and Texas have schools with this degree. This shows that there is high demand for this program.

Northwestern University has just added this, but is not yet in the EWC document. Lawrence Technological University also recently added Architectural Engineering. This

is a potential competitor for UDM. LTU’s program is new. No independent numbers are available for their enrollment numbers.

The only other Michigan school that offers both Civil Engineering and Architecture is the University of Michigan—Ann Arbor. They do not have an AE program.

Except for LTU the closest competitors are in Illinois, Wisconsin and Pennsylvania. There are no schools in Ohio that offer an AE program.

From the EWC data, the smallest AE program has 16 freshmen. The programs with more than 100 students are well-established programs with national reputation, so a maximum of 100 applicants is placed. So 100 freshmen seems an appropriate “stretch goal.” Based on this, UDM could get between 16 to 100 qualified new first year students.

The EWC national data indicate a strong growth pattern in freshman AE enrollments across the nation:

Year	2000	2001	2002	2003	2004	2005	2006	2007
US 1 st yr AE total	732	786	Data missing	756	877	951	1123	1090

In the seven years since 2000 freshman AE enrollments increased 49%!

Demand from Current Students:

The Architectural Engineering program is a combination of Civil Engineering, Architecture and other fields. Students who would otherwise go into Civil Engineering and Architecture might instead go into Architectural Engineering.

Different estimation methods project that from 10 to 44% of the current Civil Engineering students who came in as freshmen are interested in switching to Architectural Engineering. The upper-end number of 44% is based on a poll of current CE juniors. However, based on several years of experience, it is estimated that 10 to 20% of the students end up in elective courses in Civil Engineering that are most related to the AE field.

Some of the students interested in AE were those who started in architecture but transferred to CE. Although having those students go to AE instead of CE would have a small impact on the number of CE students, those students would still take many of the CE courses, in addition taking courses in Architecture. Therefore, a few CE class sizes would decrease when a CE becomes an AE student. However, this would probably be offset by students who are admitted to architectural engineering but then change their mind and become CE students.

It is unknown how many students coming into other engineering majors such as Mechanical or Electrical Engineering, or “engineering undecided,” would have chosen AE instead. Occasionally ME students are interested in mechanical systems in buildings and might consider AE as a major.

In Architecture, there is great interest in alternatives to the standard Bachelor of Architecture program. A poll by Stephen La Grassa of Architecture students in their senior year showed that half wanted to have a career in something other than the traditional architecture field. A large number of students leave the Bachelor of Architecture program within the first couple of years. Many of those students find that they are interested in the construction side of the field instead of the design side that the UDM School of Architecture provides. Providing another architecturally relevant program, but with more construction would help those students find a home at UDM.

Approximately, two students a year who enter Architecture at UDM take courses in engineering towards a dual degree. A poll of current Architecture students taking CE courses showed that would not have considered Architectural Engineering instead. They want to be licensed architects with an engineering background. However, changes in licensing standards that are being recommended and advanced by several key professional and regulatory organizations would make it harder to be a licensed engineer and architect simultaneously. These students would have to choose one or the other. The only blended option will be the AE program. The AE program will not qualify the student to become a licensed architect. It is not a professional degree in architecture.

An Architectural Engineering program would be more suitable to students wanting an understanding in both architecture and engineering. In addition, it would a shorter time to get the degree than if both degrees were gotten separately. If a more suitable program was available for those architecture students, then it is likely that more students would choose this program.

Since Architecture has capped enrollment limits, when more students transfer out of the program, it allows the program to admit more students. It does not harm the UDM Architecture program because they can admit more students.

Based on this, a low-end estimate is 6 internal transfer students. These would be existing dual majors, and CEs. A higher end estimate of internal transfers relies on current Architecture students seeing this as a popular alternative.

D2. Local Competition

The only competitor in Michigan, Ohio and Indiana is LTU. The proposed program at UDM is unique compared to at LTU. (There is an AE Technology program at the University of Cincinnati, but technology programs are not engineering.)

Despite having a College of Architecture at LTU, the program did not have interdisciplinary roots. According to Dean Steven Vogel, the new program was organized solely by engineering faculty. This suggests that there is less interdisciplinary interaction at LTU than at UDM. That interaction at UDM led to a proposed curriculum has a more significant rounding out of Architecture courses. UDM has 8 more credits in Architecture than LTU does. Therefore, UDM will attract more students that want more of the Architecture side.

LTU requires a 2.5 GPA from relevant high school courses in determining admission to any engineering program. While UDM has no hard requirement for a GPA independent of other indicators, we recommend a 3.0 overall GPA.

LTU's program is new. No independent numbers are available for their enrollment.

D3. Job Market

According to the Occupational Outlook Handbook (<http://stats.bls.gov/oco/home.htm>), "employment of civil engineers is expected to grow faster than the average through 2016." The same is true for Architecture.

Architectural Engineering is a niche field often considered a sub-discipline of civil engineering. Assuming that this area grows as fast as the civil engineering, there will be strong demand among employers.

Architectural Engineering graduates have a broad range of possible employers. For example Architectural Engineering (A&E) firms would hire the graduates. Currently, when AE grads are not available A&E firms instead hire civil engineers to do structural work, mechanical engineers to do mechanical work and architects to do architecture. Having a job candidate with the exact set of skills needed would mean that they would get the job.

AE grads would not be limited to just A&E firms. They would also be seen as exceptional candidates by building contractors, and in the field of facilities management.

Cooperative Education Program:

Current engineering programs at UDM have a required coop experience. The proposed AE program would also have coop.

There are a large number of local A&E firms at which UDM students could coop. Civil Engineering students haven't shown much interest in cooping at A&E firms. However, ME and EE students have co-oped with Peter Basso therefore at least one AE firm has already worked with the UDM coop office.

Close relations exist between UDM alumni at AE firms and UDM faculty. The advisory boards of the Architecture and Civil Engineering programs have members from some firms doing AE work. Those relations could be further developed to provide coop jobs to UDM AE students.

Graduate Trajectories:

Students graduating from the Bachelor of Architectural Engineering Program at UDM would be qualified to study in these graduate programs at UDM:

- Master of Engineering in Civil Engineering—Structural Concentration
- Master of Engineering in Civil Engineering—Construction Concentration
- Master of Engineering Management
- Master of Engineering in Mechanical Engineering—Thermal Sciences Concentration

D4. Market Area

The market area is regional and East Coast. Except for LTU, there are no Architectural Engineering programs in Michigan, Indiana and Ohio. With the exception of two universities in Pennsylvania, there are no programs in the northeastern states. (NB – The marketing plan and its costs are described in section L – Operating Revenue and Costs below.)

D5. Partners

In addition to the AE marketing plan, promotion of the new program can be done through the alumni of both related programs: Civil Engineering and Architecture. Keeping in close contact with alumni is a good practice. The launch of a new program will give more good news that can be sent to alumni through direct letters. The program can be launched with a common event for the engineering and architecture alumni.

Specifically, the alumni from the 1960's Architectural Engineering program can be reconnected to.

Additionally, members of the Architecture and Civil Engineering alumni advisory boards have been involved in the creation of the program. They are all local practicing professionals. It is expected that they will continue advising the program.

Ad Hoc AE Program Development Committee Members:

- Marie Haener-Patti, Haener Patti Architects
- Andrew Dunlap, Smith Group
- Aldo Colandrea, Consultant

D6. Uniqueness

See also section “D2. Local Competition” above.

In summary of section D2:

1. UDM will have a highly interdisciplinary program between two colleges that have a good working relationship.
2. UDM will recruit for a Bachelors program. LTU recruits high school students for a Masters program, which may create considerable apprehension for them.

In addition:

3. UDM does an excellent job at achieving a student-centered education. Many of the competing AE programs are at large state schools, or in the case of LTU, at a technological university. These schools usually have large class sizes and place research above the needs of the student.

E. Objectives, Learning Outcomes, and Assessment

E1. Program Educational Objectives

The program education objectives as written by the alumni/industrial advisory council are:

1. Graduates of our program should work as practicing architectural engineers and take necessary steps to become certified or licensed as a professional architectural engineer.
2. Graduates of our program should be able to create and contribute to comprehensive architectural engineering designs, problem solutions, detail development and/or research that is sensitive to user needs, economics, social context, community needs as well as address design functionality and aesthetics, environmental, public safety and sustainability concerns.
3. Graduates of our program should actively participate and seek leadership positions in professional societies, in other worthy organizations, and in their workplaces.

E2. Learning Outcomes

The learning outcomes as written by the alumni/industrial advisory council are:

- a. an ability to apply a knowledge of mathematics, science, and engineering principles and design concepts to architectural engineering problems.
- b. an ability to design and conduct experiments, and to critically analyze and interpret data.
- c. an ability to take the conclusions of their analysis and to design appropriate components and/or systems that aesthetically, and functionally meet the architectural engineering problem's parameters/criteria/goals.
- d. an ability to collaborate in the conceptualization and detail development and feasibility of architectural engineering projects within the context of multidisciplinary teams.
- e. an ability to identify, formulate and solve architectural engineering problems.
- f. an understanding of professional and ethical responsibility
- g. an ability for effective oral, graphic and written communication

- h. an understanding of their profession and their architectural engineering solutions in a global & societal context.
- i. A recognition of the need for and an ability to engage in lifelong learning.
- j. A knowledge of contemporary issues.
- k. An ability to use the techniques, skills and modern architectural engineering tools.

See Table E2.1 for the relationship between outcomes to courses.

E3. Assessment of Learning Outcomes and Objectives

The Architectural Engineering program will seek accreditation through the Accreditation Board for Engineering & Technology (ABET). Such accreditation will require that the program have an active outcome and objective assessment process.

Assessment of Program Educational Objectives:

Every three years a report will be written on the program education objectives. A primary source of information about achievement of objectives will be a survey of alumni from the AE program.

Assessment of Learning Outcomes:

A yearly report on learning outcomes will be written. Table E2.1 shows how the assessment methods correspond to the learning outcomes.

Definitions:

- a) **In-Course Assessments:** In-Course assessments are not grades. The in-course assessments are initially performed by the instructors or the course coordinators when there are multiple sections of a course. The coordinator creates a worksheet that cites various student work. The worksheets may also cite external juries as available. Next, the program curriculum committee meets and reviews the instructor's draft assessment.
- b) **Coop Employer Survey:** There is a mandatory coop training program for all UDM engineering students. The coop office visits the job site during the first placement to ensure a quality learning experience. All employers evaluate their student trainees at the end of their placement.
- c) **External Evaluators:** Industrial representatives often evaluate student work or presentations. Having external industrial representatives view student work gives greater authority to the assessment of student work.

- d) Senior Exit Survey: A survey will be given to all seniors when they graduate from the program. It will ask them about how confident they are with each of the learning outcomes.
- e) Fundamentals of Engineering Exam: It is expected that all AE seniors will take the Fundamentals of Engineering Exam to start the training processes for professional licensure. The exam statistics are available to the sponsoring program.

Table E2.1. Outcome Assessment Tools

Program Outcome	Assessment Tool				
	In Courses assessments	Coop Employer Survey	External Evaluators	Senior Exit Survey	FE Exam
a. An ability to apply a knowledge of mathematics, science, and engineering principles and design concepts to architectural engineering problems.	CIVE 3450, CIVE 4680 or ARCH 2430, CIVE 3480 or AENG 4350				
b. An ability to design and conduct experiments, and to critically analyze and interpret data.	PHY 1630, ENGR 3140, ENGR 3170, CIVE 3450, CIVE 3490 or AENG 4350				
c. An ability to take the conclusions of their analysis and to design appropriate components and/or systems that aesthetically, and functionally meet the architectural engineering problem's parameters/criteria/goals.	AENG 4100, ENGR 4721 or CIVE 4850 or CIVE 4740		AENG 4100		
d. An ability to collaborate in the conceptualization and detail development and feasibility of architectural engineering projects within the context of multidisciplinary teams.	ENGR 1050, ENGR 3020, AENG 4100		AENG 4100		
e. An ability to identify, formulate and solve architectural engineering problems.	AENG 4100, ENGR 4721 or CIVE 4850 or CIVE 4740		AENG 4100		
f. An understanding of professional and ethical responsibility.	ENGR 1000, ENGR 3020, ARCH 1190				
g. An ability for effective oral, graphic, and written communication.	CST 1010, ENL 1310, ENGR 1050, ENGR 3020, ARCH 1100, ARCH 1200, ARCH 1300, ARCH 1400, AENG 4100		ARCH 1200, AENG 4100		
h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.	UDM Core, ENGR 1000, ENGR 3020, CTA 3010-3030				
i. A recognition of the need for, and an ability to engage in lifelong learning.	ENGR 3020, ENGR 4721 or CIVE 4850 or CIVE 4740				
j. A knowledge of contemporary issues.	ENGR 1050, ENGR 3020, ARCH 1190, ARCH 2150, ARCH 2340				
k. An ability to use the techniques, skills and modern architectural engineering tools.	ENGR 1050, ENGR 2040, ARCH 1160, ARCH 2160, CIVE 3450, CIVE 4680 or AENG 4350				

F. Students

F1. Typical Student

The typical student will be a recent high school graduate, although based on room within the program transfers will be accepted.

Primarily, full-time students will be recruited.

Students will be subject to the standards of admission to an engineering program:

To be admitted as first year students to the College of Engineering & Science, applicants must meet UDM's general entrance requirements. In addition, they should have completed at least four units of mathematics, two units of laboratory science, four units of English, and three units of social studies.

The College of Engineering & Science does not admit those who, in its judgment, do not have the background to succeed in its academically demanding programs. Applicants should rank in the upper two-fifths of their high school classes and should have at least a B average in high school mathematics, sciences and English. Special note is taken of scores on the College Entrance Examination (SAT) or the American College Test (ACT).

Therefore, the students will match the high quality of academic preparation found in most engineering students.

F2. Existing Student Enrollment Impact

Students in the Engineering or Architecture programs may wish to transfer into this program once it is launched. This program is a blend of architecture and engineering courses. Any sophomore or higher engineering student transferring to AE would have to start with the freshmen architecture courses. Likewise, any sophomore or higher engineering student transferring to AE would have to start with the freshmen engineering courses. Therefore, students transferring in from another UDM program would essentially be freshmen. This is a discouragement for many upperclassmen students to transfer in to AE.

There are a handful of dual civil and architectural engineering students who would be qualified to come in to the new AE program with advanced status. However, it does not make economic sense to offer the new AE courses just for them.

The new AE courses will not be offered until the new freshmen reach the level that they need them. Therefore, there will be little effect on existing students changing majors.

According to the section above titled "*DI Market Study*", there could be a significant number of students from engineering and architecture that as freshmen change majors to

AE. Substantial numbers of Civil Engineering students and Architecture students are interested in alternatives to the traditional program.

The effect on the University as a whole is positive when a student transfers into a five-year program from a four-year program. The additional year of study adds tuition revenue. Civil Engineering students that transfer into AE would still take a large majority of the engineering courses that CEs take, with the exception of hydrology, environmental, and transportation. Therefore, the net effect on the CE, ECE, and ME programs will be neutral. Students will still take four years of engineering course work.

It is thought that the students in Architecture who are most interested in the AE program are the students who do not find their calling in traditional Architecture and transfer out of UDM or into other majors at UDM. The construction emphasis of the AE program provides another means to retain these students at UDM.

F3. Student Needs

According to the section above titled “*D1 Market Study*”, the new students will primarily be recent high school graduates.

According to the section above titled “*F1 Typical Student*”, the students will have to meet the admission standards for all UDM Engineering programs. It is not expected that these students will put an increased demand on remedial learning services.

F4. Attracting Diverse Students

Gender diversity:

The Engineering programs at UDM have a decent representation of female students compared to the national average. (22% vs. 18%)

The field of architecture has more gender diversity than within engineering. The Bachelor of Architecture program is 34% female. The Master of Architecture program is 52% female. This will help the new AE program open up engineering to greater gender diversity.

Racial diversity:

The Engineering programs at UDM have an excellent representation of underrepresented minority students compared to the national average. (24% vs. 13%) The School of Architecture minority numbers match that of UDM engineering.

Being located in Detroit, UDM has a unique authority for recruiting minority students. UDM engineering faculty members go on recruiting visits at regional high schools and

the college operates many K12 outreach programs that serve underrepresented minority populations. To recruit minority students, the faculty visits will focus on schools serving a large portion of minority students.

The program is not initially planning to hire new faculty members. However, if enrollments justified building instructional capacity, the AE program would attempt to exceed UDM requirements for encouraging diverse prospective faculty members to apply to UDM.

F5. Is this Program an Expansion of an existing Program?

The Architectural Engineering program is not an expansion of any program. It is a new interdisciplinary program. It relies heavily on existing courses from Civil Engineering and Architecture.

G. Faculty

G1. Faculty List

Below is a list of faculty who will be teaching at least two courses to be taken by the AE students. The order is roughly based on who will teach the most classes to the AE students. There are many sections of Architectural Studio. At this time, there is no way to predict which section the students will be in.

- Alan Hoback, Civil & Environmental Engineering
- James Lynch, Civil & Environmental Engineering
- Joseph Odoerfer, Architecture
- Aldo Colandrea, Architecture (adjunct)
- Wladyslaw Fuchs, Architecture
- Stephen La Grassa, Architecture

G2. New Faculty Staffing

Two Adjunct positions are requested with this proposal. No full-time faculty positions are requested.

There are three new courses for this program. (The other new courses are cross-listings with existing courses.)

AENG4300 Electrical System Design

New adjunct position requested within Dept. of Civil & Enviro. Engin.

ENGR4820 HVAC

Refocusing of full-time faculty in Mechanical Engineering will allow for offering this new course.

AENG4350 Lighting Design

New adjunct position requested within Dept. of Civil & Enviro. Engin.

Both new expenses begin in the 5th year of offering the new program.

*Note: if enrollments in the AE program exceed 22-25 per year, then many service courses will have to be split and new faculty hired or additional adjunct or overload assignments made. If demand for the program warrants offering more sections, the UDM leadership will be approached with that opportunity.

G3. Attracting Diverse Faculty

No new full-time faculty slots will be filled unless enrollment exceeds 22-25 and the UDM administration agrees to that opportunity.

However, whenever there are open faculty positions it is required that a recruitment plan be created to encourage diverse faculty to apply. Among the things that can be done are: taking advertisements in minority engineering publications, sending emails to Society of Women Engineers and African American Review listservs, submitting requests through the Society of Jesus and Sisters of Mercy, purchasing lists of recent PhD candidates, and asking around through personal contacts.

Two part-time positions will be created. These positions are usually filled through personal contacts rather than national searches. Women and minority candidates will be encouraged to apply through those contacts.

G4. Faculty Fields of Specialization

Both new courses taught by part-time faculty are in lighting and electrical systems which is in the general architectural engineering area of electrical and mechanical systems. If a new full-time faculty position was ever needed, these courses could be paired with other related courses to attract someone in this area.

H. Administration and Support

H1. Administration

The Architectural Engineering program will be housed in the Department of Civil & Environmental Engineering. The department will be renamed the Department of Civil, Architectural & Environmental Engineering. (CAE Engin.)

The chair of Civil & Environmental Engineering will be the director of the AE program unless the Dean reappoints the directorship to another faculty member.

All curricular decisions will be proposed through the AE departmental Curriculum Committee consisting of:

- Department Chair
- Structures Faculty member(s)
- Construction & Geotechnical faculty member(s)
- One representative from the School of Architecture

Currently, the subcommittee consists of Alan Hoback, James Lynch, and Steve Lagrassa. If enrollments ever warrant hiring new faculty, then they would be added to the committee.

Major curricular decisions are brought to the new AE advisory council for approval, and as appropriate to other bodies throughout the College and University.

H2. New Support Personnel

No new support personnel are required.

Secretarial: None needed since no new administrative structures are created.

IT: The AE students will use the existing IT infrastructure.

Lab support: The AE students take no new lab courses.

H3. New Remedial and Coop Personnel

No new remedial staff is expected to be needed. AE students meet the admission requirements of other engineering programs who have generally lower remedial needs.

Coop: Enrollments in the other engineering programs is below recent historical highs. Therefore, adding students will not cause any immediate need to increase staffing the coop office.

I. Library Resources

I1. Current Resources

Journal of construction engineering and management. (ASCE)
Journal of structural engineering. (ASCE)
Engineering news-record.
Journal of vibration and acoustics.
The Engineering economist.
Journal of management in engineering. (ASCE)
Noise control : a publication of the Acoustical Society of America.
Advances in materials research.
Annual book of ASTM standards
Engineering materials and design.
Journal of materials in civil engineering. (ASCE)
Journal of testing and evaluation.
Modern steel construction.
Journal of performance of constructed facilities. (ASCE)
Practice periodical on structural design and construction (ASCE)
Wood design & building.
Journal of the PCA Research and Development Laboratories.
PCI journal
Engineering journal (AISC Amer. Inst. of Steel Const.)
Journal of Geotechnical and Geoenvironmental Engineering (ASCE)
Building construction cost data (Means)
Assemblies cost data
Journal of architectural engineering. (ASCE)
ASHRAE handbook. Heating, ventilating, and air-conditioning applications.
ASHRAE journal.
ASHRAE Transactions.
ASHRAE handbook. Fundamentals.
Building systems design.
Heating, piping and air conditioning.

I2. Needed Library Funding

Response from Dean Auer: (Bold texting by A. Hoback)

The program being proposed by the College of Engineering and Science will have three new courses that the library collections need to support: Electrical System Design, HVAC, and Lighting Design. The courses overlap somewhat with some electrical engineering, general engineering (thermodynamics) and architecture courses, but the library would still need to collect resources in the following subject areas: heating and ventilation, air conditioning, lighting and illumination, electric power systems, electric equipment and wiring, and electric applications.

The library collections of three other universities that offer architectural engineering programs were reviewed to compare their holdings to what UDM has and to determine what those libraries have acquired over the last five years in these subject areas. It should be noted that all the universities are larger than UDM as there were no smaller universities listed in the report that offer a comparable program. Resources in the following call number ranges were reviewed:

TH 7005-7699 Heating and ventilation. Air conditioning
TH 7700–7975 Illumination. Lighting
TK 3001-3521 Distribution or transmission of electric power, electric wiring
TK 4001-4102 Applications of electric power
TK 4125-4399 Electric lighting
TK 4601-4661 Electric heating

The other universities are buying 3-8 books per year to support these areas, with an average cost per book of \$105. With the books the UDM library is currently buying in engineering and architecture, the library could support the new curriculum with **\$300-500 worth of books per year**. If resources are needed before these new courses are started an **upfront \$500 allocation would be required**.

There is also a serial, the ASHRAE handbook, which is absolutely essential for HVAC courses. It is a four-volume set where one volume is updated each year, so that each volume is updated once every four years. The volumes each cost \$195. This mean there need to be an **initial outlay of \$800** for the four-volume set.

The library's journals (including electronic and print journals) are comparable to other universities and should be adequate to support the proposed program.

The analysis of the resource needs for the proposed architectural engineering degree program was developed by Jill Spreitzer, a librarian consultant assigned to the College of Engineering and Science.

Please let me know if you need more information.

Response from A. Hoback:

The new courses are in the fifth year. Therefore, no upfront costs would be necessary. The yearly expenditure of \$500 is sufficient to build up the necessary resources. The \$800 ASHRAE book can be bought in volumes over multiple years.

J. Facilities

J1. Current Facilities

Administrative space:

- Chair office of Civil & Environmental Engineering, room 262 Engineering Bldg.

Classroom space:

- Engineering building classroom space.
*Most of the classes are existing sections of engineering and architecture courses. The classrooms that these courses are held in have capacity to seat the AE students.
Three new courses for the AE program will be offered per year. One course is in each of the three engineering terms (Fall, Winter, and Summer). Therefore, there will not be a noticeable increase in classroom demand.

Labs:

- Engineering labs currently have capacity for more students.

Architectural Studios:

- The architecture building currently has capacity to add another section of studio for up to 18 students. This may not be true in the future and may require a studio space in the College of Engineering and Science.
- The School of Architecture is considering switching to a 3-term plan. If they run their program over three terms then even more studio space would open up.

J2. Registrar concerns

From an email by Diane Praet on 7/6/2009:

Based on what you have described I don't believe this will create a classroom space issue in the near future as long as students in this program are enrolled in existing courses.

J3. New Facility Costs

No new facilities need to be created or renovated as long as enrollments are at a maximum of 18-22 per year. If AE enrollments exceed 22 or if Bachelor/Master of Architecture enrollments increase, then new studio space may be required.

One alternative is for the School of Architecture to considering switching to a 3-term plan. If they run their program over three terms then even more studio space would open up.

Another alternative is to do renovation in Engineering. If enrollments increase in either or both programs, there is space available in the Engineering Annex balcony for a studio for 22-28 students.

Rodney Warren in the facility department gives this guideline for facility renovation costs:

I would figure .60 sq ft for your painting. This will cover typical latex material and common wall surfaces. Exposed construction ceilings would drive this cost up. Installing a standard surface mounted light fixture to existing electric circuits would be \$300 each.

Standard VCT tile with minimum floor prep should cost \$2.00-3.00 a sq ft.

The only necessary costs are for furniture and lighting. Other costs could be added to make a nicer space by painting and covering the floor. Based on advice from the facilities department, the upper limit on the renovation cost is \$10 per sq. ft plus furniture. Depending on if the lab was renovated for 22 or 28 students, the cost would be between \$25,000-35,000. Moving a studio section to the Engineering Annex would enable 6 more AEs to enroll in that section. It would also free up 18-22 seats in the Architecture building for new Architecture or AE students there.

K. External Support

K1. Accreditation Available

Architectural Engineering programs can be accredited through the Accreditation Board for Engineering & Technology (ABET). The curriculum was design so that program could be accredited by ABET.

One of the accreditation requirements is seen through the curricular proficiencies. Each student is to show proficiency in at least two traditional areas of architectural engineering.

Accreditation is sought through ABET after the first class has graduated. Their work is the evidence used to support accreditation. The degrees granted to that first class are then accredited.

K2. External Review

This proposal was co-written by an industrial advisory board. The members are:

Marie Haener-Patti, Haener-Patti Architects
Andrew Dunlap, Smith Group
Aldo Colandrea, Consultant

Additionally, three external consultants were asked to review the curriculum. They are all graduates of AE programs, and work for Smith Group in Detroit. Their comments are below:

Amy Pelkner offered good suggestions on course sequencing. Also, she wished that UDM would have a deeper concentration in the Mechanical & Electrical area.

Eric Rushenberg expressed a need for more courses in the Mechanical & Electrical area.

Brian Noonan gave a long list of additional courses in many AE areas.

Reaction:

The proposal authors recognize that the Mechanical & Electrical area has the least course offerings. However, some other AE programs don't even offer this area. The industry advisors felt that it was necessary to have this area since it is the area of greatest need. New full-time faculty members and additional courses could be added later if the enrollments warrant it.

Also, the reviewers went through Master of Science programs, so they might be confusing the advanced design courses that they took with the Bachelor program proposed at UDM.

K3. External Funding

Warren Loranger, an alum of the original AE program, has given an oral commitment to provide \$100,000 for the launch of the AE program. The solicitation letter to him asked for the money to be used space renovation and initial marketing. It is the intent to use the money for those items although he placed no restrictions on his gift.

The CE leadership and faculty will continue to seek to identify sources for funding that would enhance the AE Program.

K4. Fund Reallocation

The only minor reallocation is that the Department of Mechanical Engineering has agreed to refocus instructional resources so that a course in HVAC could be staffed.

L. Operating Revenue and Costs

Low End Projection:

A low end projection of students is 16 new students per year after the first year. Attrition of students would be filled with transfer students from community colleges. This is seen in the current engineering programs and would be expected to happen in AE too.

		2010-11 ^a	2011-12	2012-13	2013-14	2014-15	2015-16
Head count	Fr.	8	16	16	16	16	16
	So.	-	8	16	16	16	16
	Jr.	-	-	8	16	16	16
	Sr.	-	-	-	8	16	16
	5th	-	-	-	-	8	16
Credit hrs (UDM)	280	856	1456	2024	2528	2768	
Revenue (UDM)	\$242,160 ^{b, c}	\$726,480	\$1,210,800	\$1,695,120	\$2,179,440	\$2,421,600	
Net Expenses ^e	Instr. ^f	\$11,000 ^h	\$11,000	\$11,000	\$11,000	\$17,500	\$17,500
	Lab	\$1,000 ^e	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
	Promo	\$25,000 ^d	\$10,000	\$1,000	\$1,000	\$1,000	\$1,000
	Aid ^g	\$67,805	\$203,414	\$339,024	\$474,637	\$610,743	\$678,048
	TTL	\$104,805	\$225,414	\$352,024	\$487,637	\$628,743	\$697,548
Net Margin for UDM	\$137,355	\$501,066	\$865,276	\$1,207,483	\$1,550,197	\$1,724,052	
Credit hrs in Civil E.	0 ⁱ	40	112	200	336	416	
Revenue in Civil E.	\$0	\$34,594	\$96,313	\$174,395	\$301,107	\$377,016	
CE Expense ^k	\$26,000	\$11,686	\$28,414	\$50,830	\$92,809	\$114,064	
Net Margin For Civil Engin.	\$(26,000)	\$22,908	\$67,889	\$123,565	\$208,298	\$262,952	

Notes:

- a) The year one enrollment is half of the low-end enrollment projected in the market study. This is due to the short recruiting time between program approval and the start of the first class.
- b) All tuition is based on current 2009-2010 rates. No adjustment was made for inflation. Students would pay the engineering rate for tuition. The flat rate is \$15,135 per term. To get the program revenue, total tuition is proportioned based on the ratio of engineering credits to the total credits they are taking.
- c) No external support is anticipated.
- d) The proposal specification requests that start up costs be placed in year one. However, marketing costs would be required in year zero. Per the proposal specification, those costs are shown in year one.
- e) Lab equipment for AENG 4350 is not expected to be needed until year 5. However, the proposal specification requires that all capital costs be placed in the first year.
- f) Capital improvements to the Engineering Annex are not requested here. If enrollments reach projected levels, the Annex will need to be remodeled with funds provided by the administration (unless external funds can be secured).
- g) No new scholarships are requested. The scholarships are based on what the students would most likely receive from existing scholarship programs at UDM. According to the UDM Cost Study methodology, aid is distributed by credit hours to the courses taken.
- h) Adjunct part-time compensation: \$3,250 per course.
Beginning in the 2010-2011 year, architecture courses will need to be split into two sections. (See itemization in note below.)
Beginning in the 2014-2015 year, instructors will be needed for the senior electives.
- i) AE students do not take Civil Engineering Department courses until the sophomore year.
- j) All other UDM budget line items are zero. Indirect expense will not incrementally increase. For example, additional Deans will not have to be hired to support the program, and no new classrooms will have to be heated. Even though this program will have indirect cost recovery, the net indirect cost to UDM is \$0.
- k) Includes only aid related to credits taken in CE department.
- l) Additional part-time or full-time liberal arts faculty might need to be hired. However, it is not within the capabilities or authority of the proposal authors to estimate such need or expense. Be assured that a rise in student enrollments requires it, tuition revenue will more than cover the cost of adding those instructors.

Itemization of Expenses:

The marketing plan and related estimates of expense was created in consultation with Liz Patterson. Potential students need to be informed about the new program. Visits to selected schools will reach the audience with the greatest potential, but practically are limited to about one visit per week. Advertisements on Facebook and WKQI-FM are good ways to reach the school age population. Radio advertisements on WWJ are a good way to reach the parents and others who influence student choice of schools. These radio advertisements will have an additional advantage that it could tie into a publicity campaign for 100 years of Engineering at UDM. Students outside of the Detroit Metro area would be contacted through mail marketing.

i. Marketing Expenses:

i.a Web Page Enhancements	\$	0
i.b Promotional visits to Detroit high schools	\$	0
i.c Media		
Radio:		
WKQI 95.5 FM (for students)	\$	7000
WWJ-AM (for parents, etc.)	\$	4000
Web banner ads:		
Facebook, etc.	\$	4000
i.d Mail marketing		
Midwest student and teacher mailing lists, color brochures, postage		\$10,000
		<u> </u>
Total Marketing (year one):		\$25,000

ii. AENG 4350 lab equipment

ii.a Although this is a lab experience, it is in a lecture course. No new lab space is needed. Students conduct an investigation of an existing lighted space and make recommendations of improvements and energy savings.

This is a one-time expense. If the program were granted an equipment budget, this would easily fit within that.

10	Mastek Luxmeter	\$35 ea.	\$	350
10	ABC Advance Ballast Checkers	\$60 ea.	\$	<u>600.</u>
	Total:		\$	950

iii. Instruction

New instructional staff will be necessary for teaching the couple new AENG senior level courses. There may also be a need for additional faculty members in the school of architecture. Some sections sizes could become too large and would need to be split.

Enrollments in the Bachelor of Architecture program fluctuate, which means that the number of open slots in those courses fluctuates. Therefore, it is not possible to express the number of needed faculty slots solely upon the Architectural Engineering enrollments, but must include the Bachelor of Architecture enrollments too.

iiia. AENG Adjuncts

Two new slots are necessary to teach the two new upper level electives in Architectural Engineering. These positions would be filled through the Civil Engineering department process. This would be needed beginning in the 2014-2015 year.

2 @ \$3250 / yr

iiib. Architecture Adjuncts

If the enrollments stay at the low-end projection, two new adjunct positions would need to be filled. (However, this is highly dependant upon architecture enrollments per the rationale above.) These positions would be filled through the School of Architecture processes. This would be needed beginning in the 2011-2012 year. It is highly likely that these adjuncts would be needed for a studio course which has higher credit hours.

2 @ \$5500 / yr

iiic. Full-time faculty position

If the enrollments increase to the mid-range estimate, then in addition to the items above, one new full-time faculty position would be necessary in the School of Architecture. This expense is not expected for the low-end estimate budget. However, this is highly dependant upon architecture enrollments. These positions would be filled through the School of Architecture processes. This would be needed beginning in the 2011-2012 year of the mid-range enrollment plan only.

One instructor position.	Salary: \$65,000
	Benefits rate: 34% of base salary.
	Total: \$87,100

Mid-range enrollment projection:

A mid-range enrollment projection is for 28 students. In this scenario, additional studio space would be necessary, so the Engineering Annex balcony would need to be renovated.^j This expense is not requested now, but only upon proving need.

Additionally, a new full-time faculty slot in architecture would need to be opened to handle the increased number of student in their studio and lecture courses.

		2010-11 ^a	2011-12	2012-13	2013-14	2014-15	2015-16
Head count	Fr.	14	28	28	28	28	28
	So.	-	14	28	28	28	28
	Jr.	-	-	14	28	28	28
	Sr.	-	-	-	14	28	28
	5th	-	-	-	-	14	28
Credit hrs (UDM)	490	1498	2548	3542	4424	4844	
Revenue (UDM)	\$423,780 ^{b,c}	\$1,241,370	\$2,118,900	\$2,966,460	\$3,814,020	\$4,237,800	
Net Expenses^e	Instr.^l	\$11,000 ^h	\$98,100	\$98,100	\$98,100	\$105,100	\$105,100
	Lab	\$1,000 ^e	\$36,000	\$1,000	\$1,000	\$1,000	\$1,000
	Promo	\$25,000 ^d	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
	Aid^g	\$118,658	\$347,583	\$593,292	\$830,609	\$1,067,926	\$1,186,584
	TTL	\$155,658	\$482,683	\$693,392	\$930,709	\$1,175,026	\$1,293,684
Net Margin for UDM	\$268,122	\$758,687	\$1,425,508	\$2,035,751	\$2,657,394	\$2,944,116	
Credit hrs in Civil E.	0 ⁱ	70	196	350	588	728	
Revenue in Civil E.	\$0	\$60,540	\$168,548	\$305,191	\$526,937	\$659,777	
CE Expense^k	\$26,000	\$53,951	\$49,193	\$87,453	\$156,042	\$193,237	
Net Margin For Civil Engin.	\$(26,000)	\$6,589	\$119,355	\$217,738	\$370,895	\$466,540	

High-range enrollment projection:

An upper end of enrollment projection is 100 students per year. Significant new facilities and new faculty hires would be necessary to accommodate this.

If the first few years experience show demand for an expansion, a follow-up proposal will be sent to the UDM administration. Therefore, it is requested that an admissions cap of 30 be placed on this program.

M. Approval Process

M1. Approval Bodies

Approval Body	Date	Result
Department of Civil & Environmental Engineering	8/3/09	approved
Department of Civil & Environmental Engineering Advisory Board	8/07/09	approved
College of Engineering & Science Leadership Team	9/16/09	approved
Dean, College of Engineering & Science	8/20/09	approved
Faculty and Dean, School of Architecture	9/18/09	approved
Undergraduate Program Review Committee of the McNichols Faculty Assembly	Fall	
McNichols Faculty Assembly		
Academic Vice President		
Academic Leadership Team		
President's Council		
Board of Trustees		

M2. Support Letters

None sought.

M3. Additional information

Not applicable.

N. Appendices

N1. Syllabi

See next pages.

N2. Suggested Improvements in the Approval Process

1. Discussion of the items here in N2 should not further delay this program proposal, but should become agenda items of future meetings of the relevant bodies.
2. It is a large investment of time for all parties. A preliminary approval process based on the Summary, Market Study, and Mission would give the proposal writers encouragement that the investment may pay off.
3. Marketing costs might be incurred before year one. Therefore, a pre-start up year is recommended for section L.
4. Section L: Operating Cost and Revenue
Examples need to be provided. There is no attached spreadsheet. Upon finding the budget categories, it does not help to know the categories if there are no examples. One point that need to be cleared up is whether only program revenue and expense need to be considered.

There is a good reason to go beyond the revenue of the host program because the host colleges are extensively affected.

Scholarship expense is based on previous years. Although faculty writing proposals would have no idea whether the University is planning to increase or decrease scholarships. Directions should be provided to calculate this.

5. The long approval process kills the ability to quickly enact a new program. Some streamlining must be considered.
 - a) Can MFA and the ALT simultaneously review the proposal? Can MFA and the college(s) simultaneously review? Although program alumni advisory bodies are an important step, they meet infrequently. Can the advisory bodies' review be simultaneous with any other steps?
 - b) The MFA clearinghouse sends program proposals go to the program review committee of the MFA, but it is obvious that proposals go there. Can proposals be submitted directly with notification of the MFA?
 - c) The MFA Program Review committee is the biggest logjam in the process. It is already heavily loaded with its annual task of reviewing existing programs. The size of the committee should be increased and the members divided onto two sub-committees for reviewing old or new programs. After making a decision, the subcommittee reports to the whole committee what they have forwarded on to the MFA, but not rehash the entire discussion in front of the whole review committee.

6. A clarification is needed as to what sort of revisions require reapproval by previous approvers in the chain. Likewise, who needs to be notified of changes? This proposal lists an eleven step approval process. If each body had to provide reapproval for any change, then the number of total approvals and reapprovals would be in the hundreds. Generally, changes deal with tightening the language or expanding the budget. It is not expected that any academic body would object to tightening of a proposal. Therefore, changes of this nature should not be a concern. However, the program proposers direct report should be notified of any budget changes after he/she has approved it.

Curricular changes might require reapproval. These changes are less likely at the upper levels where programs are judged less upon precise course outcomes. Only when a courses is added or removed would this require reapproval of previous bodies.

7. Nowhere does the form ask whether UDM core requirements are satisfied if it is a new Bachelor program. We recommend section B2. (This AE program does satisfy UDM core.)

AENG 4300 Electrical Systems Design

CATALOG:

Design of electrical systems for residential, commercial and industrial applications. Electrical construction materials and methods. Safety systems. Design subject to the National Electric Code.

PREREQUISITES:

ENGR 3200 Principles of Electrical Engineering

PREREQUISITES BY TOPIC:

- Basic linear network theory
- Electronics
- Electromechanical Energy Conversion

REQUIRED TEXTS:

Electrical Systems Design, Theodore Bosela, Prentice Hall

INSTRUCTOR:

TBD

COURSE OUTCOMES:

After taking this course, students will be able to:

1. Determine load flow
2. Determine the power factor
3. Design an electrical grounding system
4. Specify electrical construction materials and methods
5. Design overcurrent protection.
6. Size a branch circuit and feeder conductor
7. Design the power distribution for HVAC systems
8. Specify life safety systems
9. Creating working drawings for an electrical design.

ACADEMIC INTEGRITY: Everything submitted for grading is expected to be a student's own work. Anything suspected otherwise will be dealt with according to the College policy - see the Engineering Science Student Handbook.

AENG 4350 Lighting Design

CATALOG:

Light quality, investigating current conditions, conceptual design, expressing concepts through graphics, design of lighting systems, selection of materials. A course that could be taken by a range of professionals working in the lighting field. Includes an evaluation of existing lighting conditions using sensors. Estimation of energy costs. Specifying energy saving measures.

PREREQUISITES:

ARCH 2440 Environmental Technology II

PREREQUISITES BY TOPIC:

- Physical Theory of Light and Color
- Subjective measures of light

REQUIRED TEXTS:

The Architecture of Light: Architectural Lighting Design Concepts and Techniques, Sage Russell, Concept-Nine.

INSTRUCTOR:

TBD

COURSE OUTCOMES:

After taking this course, students will be able to:

1. Evaluate an existing lighted space for light quality and existing equipment.
2. Interpret and critically analyze data from an existing lighted space.
3. Create a lighting concept
4. Express a lighting concept through use of computer graphics
5. Design lighting system including material specification
6. Produce construction working drawings or bid documents for a light design.

ACADEMIC INTEGRITY: Everything submitted for grading is expected to be a student's own work. Anything suspected otherwise will be dealt with according to the College policy - see the Engineering Science Student Handbook.

ENGR 4820 HVAC

COURSE DESCRIPTION: An introduction to the heating, ventilating, and air conditioning of buildings. The course will cover the application of thermodynamic, fluid, and heat transfer principles to the design and analysis of HVAC systems and components. Coverage includes determination of building heating and cooling loads, indicators for indoor environmental quality, analysis and specification of heating and cooling equipment, performance of air distribution systems, and characterization of heat exchangers. Emphasis is placed on energy conservation and system efficiency through coverage of topics such as heat pumps, thermal energy storage, and heat recovery systems.

PREREQUISITES: E314 (Fluid Mechanics), E315 (Thermodynamics I), and E340 (Heat Transfer)

PREREQUISITES BY TOPIC: Conservation of mass and energy for pumps, heat exchangers, and compressors; energy equation for pipe flow; conduction, convection, and radiation heat transfer principles; thermodynamic property tables; solution of first order ordinary differential equations.

REQUIRED TEXT: McQuiston, Parker, and Spitler, *Heating, Ventilating and Air Conditioning: Analysis and Design*, 6th edition, Wiley 2005.

MISCELLANEOUS: You should check the course website at <http://knowledge.udmercy.edu/> regularly for homework solutions, old exams, and important announcements.

INSTRUCTOR: Mark Schumack, Room E273, Telephone: 993-3370, e-mail: schumamr@udmercy.edu, fax: 993-1187.

OFFICE HOURS: Monday, Wednesday 1 – 2 PM; Tuesday, Thursday 12 noon – 3 PM; anytime my office door is open; or by appointment (email or call me).

LECTURE: TR 3:30 – 4:45, room E134

COURSE OBJECTIVES: To introduce HVAC fundamentals and the skills necessary for the design of systems to ensure indoor human comfort and health.

COURSE OUTCOMES: After taking this course, students will be able to:

- 1) Estimate building heating and cooling loads.
- 2) Identify design conditions for human indoor health and comfort.
- 3) Identify options and specify equipment for heating and cooling systems.
- 4) Calculate power requirements for HVAC components.
- 5) Apply psychrometric principles to air conditioning processes.

COMPUTER USAGE: Students should be familiar with spreadsheet packages, particularly with entering cell formulas, graphing and mathematical functions.

TOPICS:

- Classification of HVAC systems: all air, air-and-water, and all water systems
- Overview of HVAC heat transfer components: boilers, furnaces, cooling units, heat exchangers
- Indoor comfort and health
- Heat transmission in buildings
- Heating and cooling load estimation, including solar radiation
- Pumps and piping design
- Fans and building air distribution
- Humidity control

GRADING: Homework, inclass quizzes and projects	30%
Term Project	15%
3 75-minute exams	55%

GRADING SCALE: A 95-100, A- 90-94, B+ 85-89, B 80-84, B- 75-79, C+ 70-74, C 65-69, C- 60-64, D+ 55-59, D 50-54

EXAM SCHEDULE (TENTATIVE):

TBD

HOMEWORK POLICIES: Homework will typically be assigned and due every two weeks (there will be some exceptions to this). You may do your homework with others if you like, but your motivation must be to understand the material and not simply to copy what someone else has struggled with (exam grades are a strong reflection of how well you understood homework problems). Although it is an ugly situation and occurs infrequently, if you copy another's work you will receive (as a minimum) a zero on the assignment.

IMPORTANT DATES:

TBD

ACADEMIC INTEGRITY: Everything submitted for grading is expected to be a student's own work. Anything suspected otherwise will be dealt with according to the College policy - see the Engineering Science Student Handbook.