## Interdisciplinary Design: Challenges and Rewards

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**Abstract**

A new capstone design course has been created for seniors in Civil & Environmental Engineering at the University of Detroit Mercy. Architecture and Civil Engineering students work together on interdisciplinary projects. The most recent project was a redevelopment plan for an urban Detroit neighborhood and a land bridge design. The projects are initiated by local community groups who need feasibility studies of proposed projects. The community groups assume the roll of the client in the engineering design.

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**I. Introduction**

Multidisciplinary or interdisciplinary projects involve students from more than one major or more than one focus area. Multidisciplinary design projects produce better designs than single discipline projects.[1,2,3,4] The students rate the design courses more highly if multidisciplinary work is involved.[5]

The new Civil & Environmental Engineering design course emulates the workings of an Architecture-Engineering (A/E) firm. This capstone course is a major design experience.[6] The architecture and engineering students work on an interdisciplinary project that uses real examples provided by community group clients. Each student has the opportunity to work in his or her area of interest. Senior projects considered only structural design in former years. Previously, the Architecture and Engineering students never had an opportunity to work together professionally. The interdisciplinary projects allow each student to work in their focus area.

The project is followed through all phases of design. A real client approaches the students' A/E firm. The client identifies a need. The architects clarify the need and produce the architectural plans. The engineering students act as consultants to produce the engineering design. Then the project may be constructed.

**II. Background: The Design Center**

The senior project ideas are solicited from the local community through the Detroit Collaborative design center (DCDC). The Design Center is located in the UDM College of Architecture. The Design Center has completed several architectural design projects. A recent project involved converting a church into a community center. This project has actually been constructed. This project did not involve engineering work.

The Design Center is approached by community groups who need technical work. Grassroots groups typically have very limited resources. Therefore, they greatly appreciate student feasibility studies.

One Design Center project was to create a linear park in an area with many abandoned homes. A group is trying to get the local government to finance the park. Grassroots organizations have improvement ideas such as the park but they do not have the power to influence the civic government to build the projects. This is the benefit of student feasibility studies. Students can produce realistic architectural and engineering plans and present their ideas very professionally. The student work empowers the community by providing the tools that they need to seek support for their projects.

**III. The Project**

The most recent project was a neighborhood redevelopment plan and a land bridge design as shown in Fig. 1. The project locale was the Gratiot Ave and Harper Ave intersection with US I-94 in Detroit. This is an urban area. The neighborhood was fractured into two parts when Interstate 94 was constructed many years ago. The area south of the interstate is chiefly residential. This neighborhood has remained stable. The area north of the interstate is residential with a mixed business district of restaurants, services and industrial. The northern neighborhood has become unstable as it now has typical urban problems. For example, half of the residents do not own cars. Many residents are on government assistance. This is in part because they have no cars to get to work. The local businesses have suffered from a lack of a stable clientele. The housing is in generally poor condition. Finally, there are no neighborhood parks.

The sponsor for the redevelopment project is the Carmelite Care Facility and the Mt. Carmel Tabernacle Church. They have highlighted the needs of the community. The redevelopment plan includes the creation of a transit center and park over the

expanded I-94 interstate. The land bridge is a beam bridge supporting the park. The plan also involves creating a central pedestrian mall and a day care facility.

The transit center will provide transportation to the underemployed residents. The student designers considered two options for the transit center. The first option was that High Occupancy Vehicle (HOV) lanes would be added to the interstate. The second option was that a light rail system would be constructed in the interstate median.

The goal of the project is to create one center of the community. The residents walk to the day care facility to dropoff their children. Then they hop on a bus or train to commute. Upon returning, the residents pick up their children and patronize the pedestrian mall. The land bridge has the function of reconnecting the community. The land bridge is also the platform for the light rail station.

**IV. Technical Work**

The architecture and engineering students met with the community sponsor. The students conducted a site visit and toured an existing land bridge. They collected demographic and socioeconomic data about the people in the nearby neighborhoods by using the US Census. The neighborhood's needs were enumerated and the impact of the proposed project was identified.

The architecture students decided where to place the land bridge and pedestrian mall. The current city zoning plan is disorganized. The students created a uniform zoning plan that was consistent with their proposed redevelopment. The result of the architecture work is a model that is on display.

The architecture students shared their ideas with the engineers and the engineers provided a response about the feasibility of the architectural plans. The project emphasizes communication between students to promote team-based work. The

engineering students found design work in several focus areas. The structures students designed the land bridge using the AASHTO and MDOT design specifications. The geotechnical students designed the foundations and retaining walls. The transportation students redesigned the neighborhood traffic flow patterns and worked on the timed transit center. The hydrologists worked on the design of the drainage of the land bridge and improved areas. The project could have involved environmental engineering students if it was thought that hazardous waste would be an issue in this area.

The result of the work is the creation of design drawings, cost estimates and construction schedules. The students were required, as part of the courework to present the completed design in a professional setting to a panel of evaluators. The evaluators consisted of design professionals and professors from Architecture and Civil & Environmental Engineering. In this effort the students develop professional presentation skills and demonstrate their design skills in their areas of concentration.

**V. Challenges**

The interdisciplinary project demonstrated some of the same problems that are present in real life work. Professional architects and engineers do not know how to communicate with each other. This is demonstrated in the work place when architects and engineers create design drawings that are incompatible with each other. Fortunately the students' final designs seemed to fit well together.

It was challenging to get the architecture and engineering students to work together. The students in either major typically do not take courses with any of the students in the other major. They may not be aware of the services that the other professional provides, or they may undervalue those services.

There were numerous faculty involved in this project. One problem with the project was that the faculty had differing visions

of how the interdisciplinary work would be completed. One vision was that the students would form one team that would regularly meet. The major design issues would be decided in these meetings. The other vision was that two design teams would meet separately but have ad hoc interaction. The problem with meeting separately is that the students are susceptible to the communication problems that professionals demonstrate.

Individuals from both teams communicated with each other. The individual conversations can be compared to a chaotic network. Communication between the students was hard to measure. The faculty are considering using classroom assessment techniques in future years to measure the communication.

**VI. Summary**

The Architecture and Civil & Environmental Engineering students worked together on an interdisciplinary design project. The students emulated the workings of an A/E firm. The advantage of interdisciplinary work is that students become familiar with the services of other design professionals.

Architects and engineers are typically trained separately. Upon graduation they are thrown together and are expected to understand each other. Interdisciplinary projects provide an opportunity for them to learn each other's languages.

The projects were real projects provided by community groups who sensed a need. The student work is used by these groups to lobby for civic approval. It was rewarding to the students to work on a project that could benefit society. Some student projects have been built. This benefits the students' self esteem.

**References**

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**Author Biographies**

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Alan S. Hoback, Sc. D., P.E., is an Assistant Professor of Civil & Environmental Engineering at the University of Detroit Mercy. His expertise is in the area of structural engineering. His research is in the areas of prestressed concrete, optimization, and piles. Before joining the University of Detroit Mercy he was an engineer with the US Army Corps of Engineers.

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**Terrence Curry**

Terrence Curry, SJ, AIA (Director) specializes in Architecture and Urban Design. Fr. Curry holds a B. Arch from Pratt Institute, a Th. M., from the Institute for Black Catholic Studies, Xavier University of Louisiana, a M. Div., from the Jesuit School of Theology at Berkeley. He has taught at the University of California, Berkeley, the University of Michigan, and is currently an Associate Professor at the University of Detroit Mercy. A award winning designer, his range of research, publication and professional practice includes the cultural adaptation of space, liturgical design, affordable housing, urban issues, multi-cultural and participatory design and construction methodologies, cabinet making and the application of advanced visualization technologies for architectural space and urban design process. For Fr. Curry, design is a means to uplift and dignify the human person.

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Dr. Aldo F. Colandrea is an adjunct professor of civil engineering at the University of Detroit for the School of Architecture

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Utpal Dutta , Ph.D., PE, is an Associate Professor and Chairperson of Civil & Environmental Engineering at the University of Detroit Mercy. He teaches courses in Transportation engineering, constructional materials, engineering economics and optimization. Dr. Dutta's publications and professional presentattions both here and abroad have dealt with transportation planning, use of waste materials in highway construction and transportation safety and control. He is currently doing research on the use of Automotive Shredder Residue in asphalt pavement. In 1994, he was awarded the President's award for academic excellence.

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**List of Figure Captions:**

Figure 1 Model of a Land Bridge.