CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1A
T2 DESIGN COMPANY
THE LEO BURNETT BUILDING - CHICAGO, IL

The project will consist of the structural design of a 1.1 million square foot, 48-story building, located in downtown Chicago (35 W. Wacker Dr.). Prior to the start of design T2 Design Co. will develop an understanding of lateral bracing systems in tall buildings (Moment-Resisting Frames, Shear Walls) via review of "Structural Analysis and Design of Tall Buildings", Taranath, along with the analysis of wind tunnel and geotechnical reports, supplied by Thornton Tomasetti. Once the review is complete, a code study of lateral forces (i.e. wind and seismic forces) will be developed using local codes, IBC 2006 and ASCE7-05.

Preliminary architectural drawings will be supplied to T2 Design Co. and typical floor layouts will be developed for floor live loadings based on these drawings. Floor loads can then be used to develop a floor framing plan (i.e. in-fill beams, girders, and decking). The floor framing plan will be evaluated for both non-composite beams and composite beams. Using the column locations dictated by the architect, a column load take-down will be created, determining the axial load each column will need to support, taking into consideration live load reduction. The lateral loads determined in the code study will be used to develop the preliminary design of a concrete core. Once a preliminary design is complete, a detailed structural analysis of the core-wall system will be completed using SAP 2000.

All information from framing plans, column take-downs, and core-wall designs will be modeled and designed in Revit Structure 2008. Revit (BIM) was selected because of its compatibility with SAP2000. The drawings created in Revit will be exported to SAP2000 for detailed analysis. With the structural analysis of the framing plan complete, typical detailing and connections will be developed, along with splices and shear wall reinforcement.

With the above ground design complete, the project will then turn to the foundation of the building. A foundation system will be selected, consisting of interior and exterior foundation components (walls, footings, slabs-on-grade, caissons, etc.). Commercial software will be used to determine reinforcement requirements.

The design will be accompanied by a white page report detailing the code study, framing plan, column, shear wall, and foundation design.

MENTORS: John Peronto, P.E., LEED® AP
Christopher Erwin, P.E.

DATE: February 12, 2008

FIRM: Thornton Tomasetti

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1B
MAP CORPORATION
SKATE PARK / BMX FACILITY DESIGN - MILWAUKEE, WI

The Menomonee Valley Community Park is central to the redevelopment in the Menomonee Valley. One component of the park plan is to make use of 53,000 square feet of space beneath the 35th Street Viaduct. There is a strong interest in using this space for a skate park. Four Seasons Skate Park may consider moving a portion or all of its operations from their current location to this park. Development underneath the viaduct poses a number of challenges. This senior design project is to assess these challenges and design constraints, and then develop conceptual design drawings, budget cost estimates, and assist with the permitting process.

The senior design team will have to review the City of Milwaukee's zoning codes, and building codes to determine the various restrictions for the proposed site and the need for special permits. The design team must also consider the possibility of building a structure underneath the viaduct that could provide year round use, and also be built to be dismantled and reassembled assuming viaduct repair and eventual replacement. The design team will also look into the geo-technical conditions of the valley to determine the soil bearing capacity. Sustainable design and the way that it can be incorporated into the park will also be considered. The team will also look at incorporating restrooms, concessions, office facilities, and the necessary utilities.

The design team will look to the City of Milwaukee to provide information on the existing site, such as a site survey, existing utility plans, soil boring reports, as well as the various restrictions that will need to be adhered to during design. The team will also tour Four Seasons Skate Park and talk with the owner to determine the design needs of a skate park.

MENTOR: Natalie Schneider, P.E. DATE: February 12, 2008

FIRM: The Sigma Group

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1C
THE BSB GROUP
STH60/CTHC INTERSECTION DESIGN - SLINGER, WI

The State Trunk Highway (STH) 60 and County Trunk Highway (CTH) C intersection redesign project is joint effort between The BSB Group (Marquette Senior Design) and the Wisconsin Department of Transportation (WisDOT). The Project will consist of designing three alterative design options, the selection of one optimal intersection variant, and the further design of that intersection configuration. Each group member will be responsible to create a design alternative, with the group working together on the final design project.

The intersection of STH 60 and CTH C is a right-angle intersection of two –lane roads. The projected use of this intersection will be vastly different than the current conditions. WisDOT has proposed that STH 60 be widened to four-lanes including space for a separating median. The area surrounding the intersection is also being redeveloped into mixed commercial and residential districts creating higher traffic flows through the area.

The project will require the use of the Highway Capacity Software package, AutoCAD, and Micro Station. Including the use of the software packages, knowledge from previous transportation design classes will be utilized.

MENTOR: Carolynn Gellings DATE: February 12, 2008

FIRM: WisDOT SE Region Office

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1D
VICTORY ENGINEERING
MAJOR MIXED USE DEVELOPMENT - WAUWATOSA, WI

A private developer in Wauwatosa, Wisconsin is seeking to gain permission to develop a mixed-use site consisting of approximately 1 million square feet of commercial and office space. Part of this process involves the analysis of how the new development will impact the local roadway system. The proposed site lies north of Burleigh Street, east of US Highway 45, and west of North Mayfair Road. The site is also bordered by railroad tracks on its northeast side. Current use of the site consists of a Roundy's truck depot and distribution center. Current land uses in the site's vicinity include two golf courses, one to the north and one to the southeast, a retail center to the west, and residential use to the southwest and east of the site.

The scope of the project will include analysis of the current traffic conditions, trip generation for the new development, expected traffic growth for the year 2035, analyzing comparable sites for shared traffic analysis, and consideration of roundabouts to existing intersections. After analysis of future traffic predictions, our team will give a conceptual level design for the geometric layout of roadway improvements and internal site traffic.

MENTORS: Pat Hawley, P.E., PTOE
John Bruggeman

DATE: February 12, 2008

FIRM: R. A. Smith & Associates

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1E
LMR ENGINEERING
CTH SR/FOX RIVER BRIDGE DESIGN

Our senior design project consists of a single span bridge along County Trunk Highway SR in the cities of Brookfield and Pewaukee and crosses the Fox River. The design will take into consideration flooding issues that occur in the spring and that the bridge has previously failed. As a design team, we will look at the current bridge design and various alternatives for preliminary design of the new bridge.

The team will look at current design plans, hydraulic and hydrologic data, surveys of the surrounding land, traffic volumes and current deficiencies. When examining the various alternatives, environmental and structural impacts will be inspected so that the best possible alternative can be presented to the client. The design team will need to determine geometries of the roadway, preliminary cross sections and an overall design study report. The new bridge design will be wider than the current design and will need to incorporate considerations for the surrounding wetland areas.

The team will be given all basic data about the current bridge including surveys, traffic volumes, wetland data, current bridge designs, and hydraulic data. This will help to initiate the design process and give the team a basis for alterations.

MENTORS: Gary Evans, P.E. DATE: February 12, 2008

FIRM: Waukesha County Public Works

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1F
SDS ENGINEERING
NATURAL ROCK FISHWAY FACILITY DESIGN - MEQUON, WI

The Milwaukee River Mequon / Thiensville Dam divides a border between the City of Mequon and the village of Thiensville and are jointly owned by both cities. It is located 20 miles upstream of the rivers discharge into Lake Michigan. The structure has also been a barrier to natural fish movement between Lake Michigan, and the Milwaukee River Estuary for its entirety. Recently there have been efforts to provide a “fish ramp”. However, the existing ramp is non-functional to many fish and only the strongest fish, such as trout and salmon, can use the ramp under ideal flow conditions.

The project requires a design of an alternative fish passage around the dam. The senior design team is tasked with connecting a small adjacent pond of water with the river upstream from the dam. The team will need to assess any plausible alternative design options, inquire and apply for any necessary permitting for the river and the surrounding areas, analyze the amounts of soil cuts and fill needed to properly maintain the fish passage, and conduct a construction feasibility study for the proposed passage. The team must also design a pipe system that will allow a mill downstream from the dam to maintain flow after a majority of the pond has been filled in.

The senior design will be provided with aid from the City of Mequon’s engineering team as well as many third party firms. The team will be provided with a hydrologic and hydraulic analysis of the river, an environmental impact analysis, and a survey of the river and surrounding areas.

MENTOR: Bill Hoppe P.E. DATE: February 12, 2008

FIRM: City of Mequon

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 1G
DJK CONSTRUCTION
SITE DEVELOPMENT – KANE COUNTY, IL

The Ridgefield Meadows project consists of a 26.7 acre parcel of land selected for a single-family home residential development. There are twelve single-family lots which require a minimum of 1.25 acres per lot. These lots are all located on Penhurst Lane near the intersection of Powers Road and Apache Lane in Unincorporated Kane County, Illinois. In addition to the twelve lots, there is a portion of the site that is designated as wetlands

The design team has a variety of tasks to complete for this design project. For one, a grading plan needs to be proposed which will include the grading of the street's centerline and curb grades, of the individual lots, and of two detention facilities. In addition, the two detention facilities must be able to manage the hundred year run-off which will be produced from the development. Since neither sanitary sewer lines nor water mains are located in proximity to the site, areas in each lot will have to be allocated for septic sewer leech fields and for wells. The design team must also include a storm sewer design. This will be accomplished by using the Rational Formula and the Manning's equation. Other tasks comprise of creating an erosion control plan utilizing Best Management Practices, performing a quantity take-off and construction cost estimate, and possibly designing a retaining wall.

In order to complete the project the design team was given a few different items: a site plan for Ridgefield Meadows, design plans, photos of existing conditions, specification book which includes all village ordinances and codes, and CAD files of existing conditions.

MENTOR: Ryan Cerniglia, E.I.T. DATE: February 12, 2008

FIRM: Cowhey, Gudmundson, Leder, Ltd.

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 2A
COMPANEROS DEL COMITE
POTABLE WATER SYSTEM DESIGN - LA GARRUCHA, GUATEMALA

La Garrucha, Guatemala is a small town in the Department of Chimaltenango with a population of 1500 residents. The town's current source of water is contaminated by surface runoff, and its size is inadequate for the population. Furthermore, not all homes are connected to the existing system, meaning that some residents must walk more than a kilometer for water. Interviews within the community indicate that diarrheal diseases are extremely common among young children, and in some cases can prove fatal. Nine years ago La Garrucha purchased the rights to the Xecoxol spring approximately six kilometers away. Three years ago the village hired a Guatemalan pipe company to design their system, but the high estimated cost kept the community from beginning construction. The construction of this system will provide potable water to every home in La Garrucha as well as assist in reducing the death rate due to contaminated water.

During an October 2007 site visit, the design team surveyed all requested tap locations and found that the distances between points were roughly 2.5 times the distances previously estimated. Water quality tests were done on the Motagua, Xecoxol and existing springs. In January 2008 additional surveying gave the exact location of the new distribution tank and the Motagua spring, as well as sites for running conduction and distribution lines over the Rio Cujil in two locations. During that trip the design team also ran a pilot test of a slow sand filter to determine its feasibility for use in the community.

Design of this system will use many components of civil engineering. Some requirements include hydraulic analysis of the pipe network, reinforced concrete design of the distribution tanks and slow sand filter, suspended cable bridge design, and drafting and development of construction plans and specifications. Sustainability, ease of use and cultural sensitivity will be of utmost importance so as to create a system which can be maintained by the residents of La Garrucha for years to come.

Construction on an approved design is scheduled to begin in the summer of 2008. The system will be constructed with unskilled labor provided by the community, skilled labor of local tradesmen and volunteers. The completion of this system is tentatively set for June 2009.

MENTOR: Mike Paddock, P.E., P.S. DATE: February 12, 2008

FIRM: CH2M Hill, Inc.

TEAM 2B
CORE ENGINEERING
SANITARY SEWERAGE SYSTEM DESIGN

This senior design project consists of designing a new sanitary district for the Town of Summit, in conjunction with the City of Oconomowoc. The new sanitary district will be located within the Town of Summit and centralized around Silver Lake area which consists of 153 non-vacant parcels that are currently served by onsite septic systems. Although the district is within the Town of Summit, it will be tied in with the existing sanitary districts which are operated and maintained by the City of Oconomowoc.

It has been determined that the current onsite septic systems have a history of chronic failures and are not ideal to service this area anymore, and a new sanitary district is required to alleviate the problems. As such, the new sanitary district will be serviced by a series of sanitary sewer pipes that will be joined with the existing sanitary sewer network of the City of Oconomowoc. The design team will explore multiple options for the new sanitary sewer and then determine the most desirable option. Once an option is chosen, the team will go into much more detail in designing this system as described and in accordance with the design documents most notably the scope of work.

The design team will be provided with all information necessary, including site maps, soil information, and sanitary sewer design information, to design a working solution.

MENTOR: Peter Muth, P.E. DATE: February 12, 2008

FIRM: Ruekert-Mielke, Inc.

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 2C
B^3 ENGINEERING
BUTLER STREET RECONSTRUCTION

The Village of Random Lake has an existing 25 mph urban asphaltic roadway that is failing. Due to the roadway failing, the village would like to reconstruct Butler Street by installing a new sidewalk, curb and gutter, base course, and asphaltic pavement. The roadway begins at a four-way intersection, has five tee intersections, and will involve replacing the existing dead end with a new cul-de-sac.

The design speed for Butler Street is 30 mph and all roadway geometry will be designed to village standards. These standards include 5 foot wide sidewalks with a 6 foot terrace and 30 inch curb and gutter.

The cross-sections will require additional consideration to accommodate the existing super elevation variations on this straight roadway. The centerline and horizontal alignment need to be redesigned as the roadway is not currently consistent. Further inconsistencies are found in the roadway width which currently varies from 33 to 35 feet. We will be redesigning the road to have a 34 foot standard width face to face of curb.

In conjunction with reconstructing the 2,500 foot roadway, the village would also like to remove and replace the existing sanitary sewer with 8 inch plastic piping to the residential lateral lines. At the end of this design process, a construction estimate will be created to show the price for materials required to make this project a reality.

MENTORS: Justin Arndt, P.E.
Aaron Groh, P.E.

DATE: February 12, 2008

FIRM: Kapur & Associates

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 3A
AJJ ENGINEERING & CONSULTING
LEO BURNETT HIGH-RISE BUILDING DESIGN PROJECT

This High-Rise building design project consists of the structural analysis of the Leo Burnett Building and the development of a complete set of structural drawings. The building is a 635 ft. tall office tower with a total square footage of 1.1 million. The building is located at 35 West Wacker Drive in Chicago, Illinois. Project tasks include: wind, earthquake, and gravity load analysis, floor layout, structural design of beams, columns, floor decks, core walls, connections, and foundations, creation of a building 3-D model using AutoDesk Revit Structure 2008, and building structural analysis of building using SAP2000.

Due to the building location in downtown Chicago and close proximity to Lake Michigan, wind and earthquake impacts can be great. Thus, the project also requires a thorough study of wind tunnel and geotechnical reports. Provided architectural drawings by Kevin Roche, John Dinkeloo & Associates determine all floor layouts and design restrictions. All design decisions will comply with the International Building Code (IBC) 2006.

Upon completion of the design project, the structural drawing set and the design decisions will be presented to the Thornton Tomasetti staff in their Chicago office in addition to the required final project presentation at Marquette University.

MENTORS: John Peronto, P.E. LEED®AP
Christopher Erwin, P.E.

DATE: February 12, 2008

FIRM: Thornton Tomasetti

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 3B
JNC & ASSOCIATES
STH 32 INTERSECTION DESIGN - MOUNT PLEASANT, WI

Within the city limits of Mount Pleasant, WI (located in Racine County) State Trunk Highway 32 (speed limit 40 mph) intersects Chicory Road (speed limit 30 mph). Immediately to the west of this intersection Chicory Rd crosses the Union Pacific Railroad. In the light that the pavement on STH 32 is in very poor condition the Wisconsin Department of Transportation has decided to move forward with the reconstruction of the highway at Chicory Rd. Traffic volume, movement, and crash data has been complied and the department has decided to expand STH 32 from two lanes to four lanes. Throughout the course of this project our team will study the information gathered, analyze potential alternative, and design the new intersection.

While studying the data from the above mentioned intersection our design team is going to follow design standards to see is a signal or roundabout system is warranted. In addition we are going to analyze the crash data in order to determine if there are any special safety concerns we need to deal with. Upon reaching consensus on the general traffic conditions of the intersection our design team shall create three possible, detailed alternatives for the intersection. These alternatives shall be examined against each other using criteria including cost, safety, railway concerns, neighborhood impact, etc. The best possible alternative, once chosen, shall then be drafted, detailed, & quantified in pay item form.

MENTORS: Bao Tran, PE DATE: February 12, 2008

FIRM: WisDOT SE Region Office

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 3C
ΣUM ENGINEERING
ONEIDA ST. INTERCHANGE AT US HIGHWAY 41 – GREEN BAY, WI

US Highway 41 is a north-south freeway route running alongside the western edge of the city of Green Bay, WI. The highway serves a traffic volume of more than 80,000 vehicles per day average. This project will focus specifically on the interchange of US Highway 41 and County Highway AAA, also known as Oneida St. and Waube Ln. Currently the interchange is experiencing delays due to large volumes of traffic and substandard geometry and roadway conditions. It requires updates to improve the flow of traffic through the interchange. The interchange also currently has an unbalanced traffic flow in which most traffic uses the north and west segments of the interchange. These issues will need to be addressed in the new design for the new interchange. The design year of the new interchange will be the year 2035.

The client has supplied a variety of information, including aerial images, existing bridge plans, current and future design year traffic volumes, and existing soil conditions. From the traffic data, we found that the critical movements that the study will focus on will be the southbound to westbound traffic movement and the westbound to northbound traffic movement. These directions have the heaviest volume movements both today and predicted in the future.

During the study of possible designs of the new interchange many options will be considered. These options include:

- The addition of a loop ramp for eastbound to northbound traffic. This option will be a tight fit with the existing northbound USH 41 exit ramp and it will require the widening of the bridge over Oneida St.

- The use of roundabouts in place of signalized intersections at the ramp termini. The benefits of roundabouts include safety and better traffic flow through the intersection.

- Ramps either on or close to the original alignment. The ramps are long and sufficiently straight right now. Shortening the ramps would create more work such as tapering on Oneida St.

- Ramp alignment modified to account for future outward pavement widening along US Highway 41. Expanding the highway inward by adding a 12' median lane for each direction with a barrier wall between and eliminating the gap between northbound and southbound traffic. This option would be easier than expanding the outer lanes due to issues with right of ways and steep slopes.

MENTORS: Nick Skiffington, PE DATE: February 12, 2008
Jason Matson, P.E.

FIRM: Graef, Anhalt, Schloemer & Associates

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 3D
CNS CONSULTANTS
3-STORY OFFICE BUILDING DESIGN – STEVENS POINT, WI

The main objective of this project is to create a structural design for a 3-story rectangular office building approximately 40,500 SF in size and located in Stevens Point, WI. This building will consists of steel framing to support a bricked-face exterior.

The building will have approximate dimensions of 150 feet by 90 feet. This will allow for 30 feet by 30 feet bays consistently throughout creating five bays in one direction and 3 bays in the other. The bay layout will stay consistent throughout all floors of the building.

The design of framing members for this building will include columns, joists and beams. The roof design will consists of wide flange roof beams and will be designed to support two 10,000 lb HVAC units and a green roof design. The floor system will consists of metal deck with a concrete floor slab. The lateral load support design will consist of X-bracing and masonry shear wall. The foundation design will include strip footings, spread footings and a core shear wall. The design will incorporate two service stair towers, a monumental stair, two mechanical shafts and an elevator shaft.

A set of design drawings will be created for this project using AutoCAD and will include a foundation plan, first floor plan, second floor plan, third floor plan, roof plan and section details. These drawings along with project descriptions, project design criteria, design calculations and a narrative of the design process will be assembled into a final design report.

MENTORS: Thomas Hildebrandt, P.E.
Anthony Raab, P.E.

DATE: February 12, 2008

FIRM: Pierce Engineers, Inc.

CEEN 189 **CIVIL ENGINEERING DESIGN**

TEAM 3E
ENVIRONMENTAL INNOVATIVE SOLUTIONS
35TH STREET CISTERN DESIGN – MILWAUKEE, WI

As a senior design project for the Marquette University students known as Environmental Innovative Solutions (EIS), the proposed 35th Street Viaduct Cistern Project (also known as "Milwaukee's Largest Rain Barrel") is intended to serve as a rain barrel for stormwater from the viaduct above Canal Street. Currently, this stormwater flows into a stormwater sewer that feeds directly into the Menomonee River as a point source. This creates pollutant problems and water level issues for the river.

As an extension of the Stormwater Park project, the 35th St. Viaduct Cistern Project seeks to perform multiple functions for the Menomonee Valley community. The primary function of the rain barrel is to improve environmental friendliness such that stormwater from the viaduct is filtered of its pollutant content and is discharged into the Menomonee River as a non-point source.

Secondly, the project intends to contribute to the beautification of the area. In the process of dripping the collected rain water into the soil of the Canal St. median, this water will become a water source for trees and plants in this median. Foliage planted in the rain shadow of the viaduct that would otherwise be unable to grow for lack of water will now be able to do so.

The rain barrel will also serve public demonstration purposes. The rain barrel concept is scalable to private buildings including homes. If the public were to be attracted to the concept, vast amounts of stormwater could be recycled to water grass or plants, rather than be directed into sewers for wasteful public treatment.

As the design team for this project, EIS presents the following expected details of the design process. This includes structural, water, plumbing, and landscaping areas of research and design as well as an overall design schedule, deliverables, and budget.

MENTOR: Natalie Schneider, P.E. DATE: February 12, 2008

FIRM: The Sigma Group