

Introduction to Capstone Design Project

Prof. M. Iqbal Khan
Department of Civil Engineering
King Saud University





Outline

- Definition of Capstone Design Project (CDP)
- Purpose and Scope of CDP
- CDP at Civil Engineering, KSU
- CDP Learning Outcomes
- CDP – CE496 and CE497
- Plagiarism
- Artificial Intelligence (AI) in Engineering Education
 - Engineering Ethics, Integrity, and Compliance in AI Use
 - Risks and Mitigation in AI Use
- Grading System
- Homework – Proposal
- Samples of Previous CDPs



Definition of Capstone Design Project (CDP)

Academic Definition — Engineering Education

- In engineering programs, the **Capstone** is the **culminating academic experience** that integrates all major learning domains.
- It serves as the **crowning achievement** of the curriculum, combining technical knowledge, analytical skills, design methodology, ethics, teamwork, and professional practice.
- The Capstone provides the **final professional preparation**, demonstrating that graduates are ready to enter the engineering field and meet industry, regulatory, and accreditation expectations.

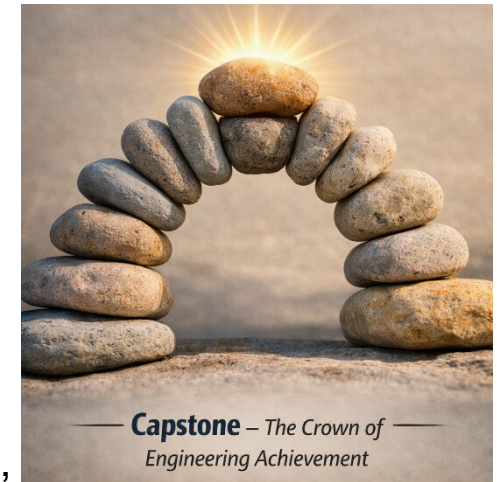


Definition of Capstone Design Project (CDP)

Capstone is the finishing or protective stone placed at the top of a masonry wall or structure, signifying completion and integrity.

In civil engineering:

- Represents the **culminating design** experience
- Integrates structural, geotechnical, transportation, construction, water resources and environmental engineering knowledge
- Produces **code-compliant**, resilient infrastructure solutions
- Operates under **real-world constraints** such as safety, budget, sustainability, and constructability
- Demonstrates professional readiness to design and deliver enduring public infrastructure





Purpose and Scope of the CDP

Student Prospective

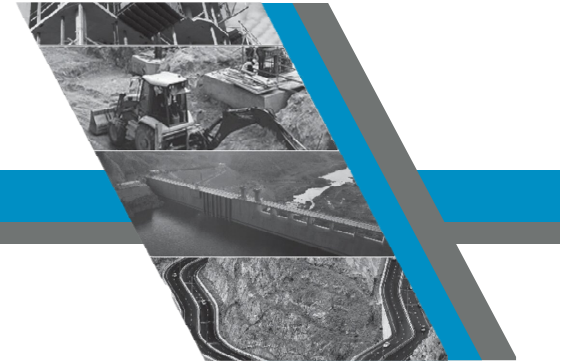
- Demonstrates my full capability as an emerging engineer
- Integrates the complete range of technical, analytical, and design skills gained across my coursework and learning experiences
- Produces a polished, high-impact engineering solution
- Addresses a real-world problem with originality and rigor
- Showcases my professional readiness and engineering excellence



Purpose and Scope of the CDP

Capstone projects are selected to encourage students;

- Foster advanced **critical** and **analytical thinking**
- Guide students in **designing and developing** complete **engineering systems**
- Engage students in **solving complex, real-world engineering challenges**
- Strengthen key professional **competencies**, including:
 - Oral communication
 - Public speaking
 - Research and inquiry skills
 - Teamwork and collaborative problem-solving
 - Strategic planning and project organization



CDP at Civil Engineering, KSU

Be interdisciplinary, in the sense that they require students to apply skills or investigate issues **across many different subject areas or domains of knowledge, at least 3 different disciplines**

Encourage students **to connect their projects to community issues or problems, and solve real-life engineering problems**

Be subjected to realistic “real-life” constraints (e.g. economy, environmental, architectural, safety, health, global, society and contemporary issues)



CDP Learning Outcomes

CE 496 CLOs	
CLO1	Identify real-life engineering complex problems addressing various civil engineering specialties.
CLO2	Formulate the problem, covering the methodology of integrating knowledge drawn from previous courses and information.
CLO3	Recognize alternative design method/s covering the design viability and evaluation criteria and select the preferred alternative.
CLO4	Recognize ethical and professional responsibilities in the context of global, economic, environmental, and societal situations.
CLO5	Work effectively as a member of the project team, providing a conducive environment and good leadership.
CLO6	Establish goals and plan tasks to accomplish objectives for the project using planning techniques to ensure proper project timing and budgeting.
CLO7	Prepare technical reports and present the results orally to the audience.



CDP Learning Outcomes

CE 497 CLOs	
CLO1	Design preferred alternatives based on calculations and/or experimental tools using modern engineering tools.
CLO2	Evaluate the impact of the selected design on public health, safety, welfare, and global, cultural, social, economic, and environmental factors.
CLO3	Work effectively as a member of the project team, providing a conducive environment and good leadership.
CLO4	Acquire and apply new knowledge beyond taught courses, using appropriate learning strategies, including updated Codes, Software, webinars, etc., to complete the project.
CLO5	Prepare professional technical reports, including necessary design reports and drawings, as well as make an oral presentation to the audience.



CDP – CE496 and CE497

CDP is divided into two parts:

Part 1 : Graduation Project – I CE 496

It includes project selection, data collection, identification of real-life constraints (e.g. economy, environmental, global, and contemporary issues), involved disciplines, generation of possible design alternatives considering client needs, selection of the preferred alternative, and preparation of a work plan for implementing and completing the project. Initial report will be submitted with oral presentation to include; project description, objectives , constraints, data and assumption, design alternatives, and the preferred alternative.

Part 2 : Graduation Project–II CE 497

It is the implementation phase of the capstone design project. It includes necessary design calculations and/or use of experimental tools to design the preferred alternative that was selected in CE 496. The final report to be submitted by the team includes the details of preferred design along with pertinent drawings, and summary and conclusions. In addition, the student team should orally present the project to the examining committee.



For the preparation of your reports and presentations, you are required to produce a **comprehensive final report** and a **complete PowerPoint presentation** covering the entirety of your Capstone Design Project, including both CE496 and CE497.

This Capstone Project spans two courses (CE496 and CE497). Upon completion of all project components, you must prepare:

- A full written report covering the entire project (CE496 + CE497)
- A full PowerPoint presentation covering the entire project (CE496 + CE497).

However, during the oral presentation, your main focus should be on the work completed from the midterm onwards, specifically the parts not previously presented to the examination committee.

Both the report and the presentation must still reflect the complete scope of your project.



Plagiarism?

Plagiarism means:

- copying words or ideas from someone else as one's own
- to steal and pass off (the ideas or words of another)
- to present as new and original an idea or product derived from an existing source
- to use (another's production) without crediting the source

In other words, plagiarism is an act of fraud. Plagiarism is considered **academic dishonesty** and a **breach of ethics**.

How to Avoid Plagiarism:

Most of the cases of plagiarism can be avoided by:

- ▶ by citing sources and acknowledging that certain material has been borrowed and
- ▶ providing the necessary information to find that source.



Artificial Intelligence (AI) in Engineering Education

Academic & Professional Integration

- **Learning Enhancement:** Concept clarification, modelling support, coding assistance
- **Design & Analysis:** Optimization, parametric studies, simulation guidance
- **Documentation:** Technical writing, reporting, and communication refinement
- **Professional Skills:** Decision support, productivity tools, engineering workflows

Ethical & Responsible Use

- Validate AI outputs using engineering principles
- Ensure compliance with codes (SBC, ACI, ASTM, AASHTO)
- Protect confidential data and project information
- Maintain academic integrity and transparency

AI is a professional aid, not a substitute for engineering judgment.

- Students must demonstrate mastery of fundamentals, validate AI-generated outputs, and ensure compliance with course and program requirements.



Engineering Ethics, Integrity, and Compliance in AI Use

Academic & Professional Integrity:

- **Unauthorized** use of AI in assignments, reports, or capstone projects constitutes **academic misconduct**.
- AI-generated content must be **transparently acknowledged** when required by course policy.

Engineering Responsibility:

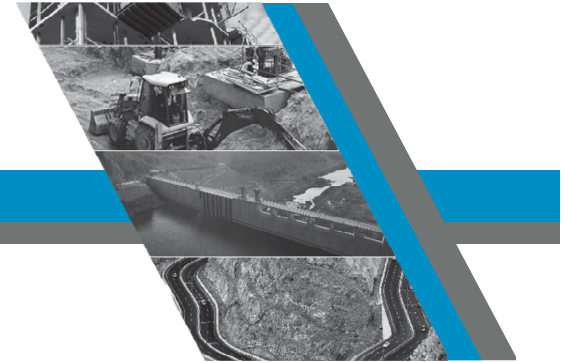
- AI outputs may contain **technical inaccuracies, unsafe assumptions, or non-compliant design recommendations**.
- Students must **apply** engineering principles, codes, and standards to **verify correctness and safety**.

Ethical Conduct:

- **Avoid** entering **confidential project data, or sensitive institutional details** into AI tools.
- **Maintain fairness**, avoid bias, and **uphold ethical decision-making** in design and analysis.

Alignment with National and Institutional Policies:

- AI use must **comply with KSU academic regulations** and the professional expectations of engineering **practice in the Kingdom of Saudi Arabia**.



Risks and Mitigation in AI Use

Key Risks:

- **Technical Errors:** Incorrect calculations, unsafe assumptions, non-compliant designs
- **Bias & Reliability:** Algorithmic bias, incomplete datasets, misleading outputs
- **Over-Dependence:** Reduced critical thinking and weakened analytical skills
- **Privacy & Security:** Exposure of confidential or proprietary information
- **Academic Misconduct:** Unauthorized use in assignments or capstone work

Mitigation Strategies

- Cross-check AI outputs with engineering fundamentals
- Apply relevant codes, standards, and safety factors
- Use AI as a support tool—not a replacement for engineering judgment
- Maintain transparency and follow KSU academic policies

CAPSTONE DESIGN PROJECT

CIVIL ENGINEERING PROGRAM

A real-life civil engineering practicing d design-based course.

Made with AI

THE RED SEA PROJECT

DESIGNING SUSTAINABLE INFRASTRUCTURE FOR THE KINGDOM'S FUTURE

ABOUT THE CAPSTONE PROJECT

The culminating course applying civil engineering knowledge to solve real-world challenges in Saudi Arabia.



TEAMWORK



PRACTICE



IMPACT



IDENTIFY THE PROBLEM



RESEARCH & PLANNING



CONSTRUCTION PLANNING



ENVIRONMENTAL ENGINEERING



ENVIRONMENTAL ENGINEERING



SAUDI CODES & STANDARDS



PROFESSIONAL DELIVERABLES

1

2

3

4

5

6

6

Bridges, highways, on and structural design

Project scheduling

Analysis and Design

Construction Management

Environmental Evaluation

Environmental Evaluation

Present & Deliver

BRIDGES & INFRASTRUCTURE



CONSTRUCTION MANAGEMENT



ENVIRONMENTAL ENGINEERING



TRANSPORTATION & URBAN DEVELOPMENT



VISION 2030 • BUILDING A BETTER FUTURE



Apply technical knowledge



Solve complex engineering problems



INNOVATION



SUSTAINABILITY



QUALITY



Uphold environmental and social responsibility



Pay attention to detail

DESIGN TODAY. BUILD TOMORROW. SUSTAIN SAUDI ARABIA



Grading System (CE 496 & CE497)

Supervisor:

40%

Based on Student's Semester Work
(Motivation, Progress, Participation and Overall performance)
(Final Report (Report Organization and Main Body))

Examination Committee:

60%

Midterm exam (20%)

Presentation of work done and work progress

Final Exam and Presentation (40%)

Presentation

(Style, Organization, Technical Content and Presentation Skills and Student's competency)

Report Evaluation

(Report Organization, Writing Quality, Main Body of the Report, Design Methodology, Results and Discussions, Capstone Aspect)



Deadlines: CE 496

S.No.	Assignment	Due Date
1.	Submission of CDP Proposal Form, Saturday	Week # 3
2.	Midterm Exam	Week # 8
3.	Submission of Final Report, Thursday	Week # 15
4.	Final Exam	Week # 16

Actual dates will be provide in the Instruction Sheet



Homework - Proposal

Attendance of first lecture and submission of CDP Proposal Form – 5% marks

CDP Proposal Form

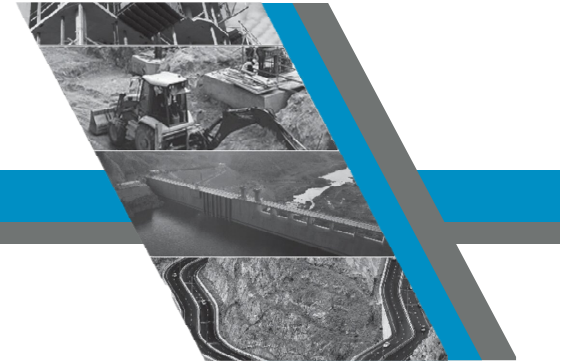
CDP Proposal Form is available on my website at <http://fac.ksu.edu.sa/miqbal/>

Each project must have at least three specializations involved as follows
Structural, Geotechnical, Environmental, Transportation, Water Resources,
Construction Management, Surveying – (any three)

You must fill-in all items of the form in consultation of your Supervisor/s

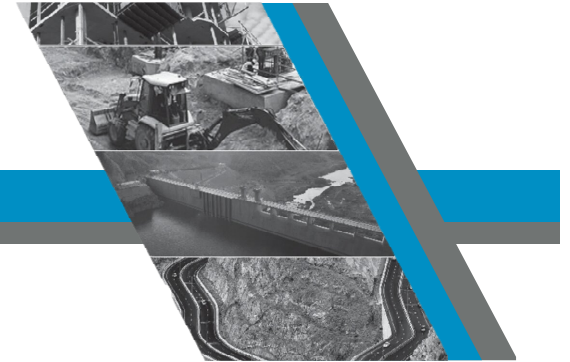
Submission deadline –Week#3, Saturday

This lecture is available at: <http://fac.ksu.edu.sa/miqbal/>
Password 6264



Samples of Previous CDPs

- *Public Fallout Shelter Eligible to Resist Missile*
- *Design of tunnel connecting between NEOM in KSA and Sharm El-Sheikh in Egypt , with design of 30 floors high rise administrative building*
- *Designing a High Security Data Center*



Questions ???