

BEng in Civil Engineering
Unit Title: Highway Engineering
Detailed Design and Construction of All – purpose single carriageway Highway

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1. Objectives

- To promote independent, creative and strategic thinking.
- To provide deeper insights into the conceptual and strategic nature of the design process, relevant to highway design and construction and professional practice.
- To be able to appraise a highway engineering brief in a professional manner and offer technical solutions to the problems identified within the brief.
- Demonstrate analytical, experimental and interpretative skills with respect to highway design and maintenance.
- Write a formal report including the use of simple annotated sketches and scale drawings.
- Tackle and solve calculations related to drainage design, alignments (horizontal and vertical) and pavement design.
- To gain knowledge knowledge of the:
 - Types of pavements and their structural behaviour.
 - Principles and practices of pavement construction techniques.
 - Materials and specification.
 - Empirical methods of pavement design
- Principles and practice of bridge construction, maintenance and design.

2. Coursework Tasks and Requirements

This coursework consist of two parts Part A and Part B.

Part A weights 80% of the coursework total Marks. Part A focuses on the Design of the Highway including the following tasks:

- Highway Alignment
- Horizontal Layout
- Vertical Layout
- Superelevation Diagrams
- Cross Sections
- Section Area Calculation
- Earthworks Volume Calculation
- Earthworks Diagrams
- Pavement Design

Part B weights 20% of the coursework total Marks. Part B is a 2000 words report (80%) and 20 min presentation followed by a 5min question/answer

session (20%). Part B focuses on the Construction and Maintenance of Highway projects covering the following topics:

- Engineering Surveying works before and during the construction process.
- Environmental impact report during construction and during service stages. Methods for minimisation of these impacts.
- Cutting and Embankment Slopes, Earth retaining works – Types, Construction methods and methods for Improving Stability.
- Pavement design – Types of pavements, Subbase, Base Asphalt concretes and bituminous materials; methods of Construction – Advantages and Disadvantages.
- Tunnels for highways, types and methods of construction
- Health and safety aspects, methods for temporary signals, road signs and traffic control during construction.
- Methods for maintenance during service time.

Detailed Coursework requirements and assessment strategy are included in Page 3 and Page 5.

3. Submission and Requirement

Your coursework submission should follow the requirements set out in the question paper; typically comprising a written report, drawings and calculations. A high standard of work is expected in terms of presentation, technical and information content.

Learning on this unit is student centred. You are expected to find information and research the topics more independently than at levels 1 and 2. The assignments provide the 'need to know'. However, completed hand-outs will be available for you in the VLE in advance and are prepared to address most of the design aspects.

You must be prepared to do your own research in the Library, the Internet Resources and elsewhere. Extensive reading lists are provided and selected books are available from local bookshops

You are not expected to tackle these assignments based, solely on what you already know. Learning for the first time is fundamental to any successful design. The assignments provide a simulation of the design process conducted in professional practice.

4. Learning outcomes:

- To be able to interpret, analyse and understand the requirements of a professional highway design brief.

- To be able to identify the key design problems in such a brief and offer reasoned alternatives for their solution.
- To be able to prepare highway design.
- To be able to present highway construction methods.

Reading / References:

- Refer to handout list.

5. ASSESSMENT STRATEGY:

Assessment is based on this Coursework (50%) and two in Class test designed to cover the taught subject (25% and 25% each). Detailed design and calculations, quality report and AutoCAD drawings are essential for the successful competition of this module. Detailed hand-outs for the use of AutoCAD are available in the VLE for you aide.

6. Coursework Brief

6.1 Part A Highway Design (80%) [or 100% for the BSc Civil Engineering]

Use the contour Map provided and the following technical characteristics to design An All – purpose single carriageway to connect Villages A and B as part of a highway construction project.

The geometrical and technical characteristics of the single carriageway are as follow:

Total Number of lanes:	2
Width of Lane:	3.75m
Speed Design:	65km·h ⁻¹
Maximum Vertical gradient:	±6%
Crossfall at straight lines:	-2.0%
Crossfall of solders:	-4%
Width of solders:	1.00m
Slop of cuttings:	3:1 (H: D)
Slop of embankments:	3:1 (H: D)

For drainage use typical triangular section ditch

The contractor also requires that excavations and filings at the axis of the highway should not exceed the following values, for economical purposes.

Maximum depth of excavation at the axis:	-3 m
Maximum height of filing at the axis:	+3 m

Based to geological investigations on the site it found that the existing ground consists by: Gravel 25%, Soil 40% and the rest 35% is flint material.

Using the requirements of the contractor, the data given above and the contour map provided, Draw/Calculate:

1. The Horizontal Layout of the Highway.

2. Draw the Plan view of the highway. Indicate total width of the highway (including width of Cutting slopes and embankment)
3. Draw the ground profile.
4. The Longitudinal Section of the highway (sections every 40mm at straights, 20m at curves and the characteristics sections).
5. Vertical Alignments. **Produce at least one vertical curve.** Failure to present at least one vertical alignment will result in 0% Marks for this particular aspect and will also influence the overall marks of the Coursework.
6. Superelevation Diagrams.
7. Cross sections of the highways (Cross sections only between A and Δ_1).
8. Using the cross section from stage (7) and ground profile, calculate cutting and filling areas for each section. (use coordinates method)
9. Draw Earthwork Volumes Diagram and calculate the volume of earthworks.

6.2 Part 2 Highway Constructions (20%) [Not required for the BSc Civil Engineering]

Choose one of the following topics and prepare a 2000 words essay. A 20 min presentation followed by a 5min question/answer session is also required.

List of Topics:

1. Engineering Surveying works before and during the construction process.
2. Environmental impact report during construction and during service stages. Methods for minimisation of these impacts.
3. Cutting and Embankment Slopes, Earth retaining works – Types, Construction methods and methods for Improving Stability.
4. Pavement design – Types of pavements, Subbase, Base Asphalt concretes and bituminous materials; methods of Construction – Advantages and Disadvantages.
5. Tunnels for highways, types and methods of construction
6. Health and safety aspects, methods for temporary signals, road signs and traffic control during construction.
7. Methods for maintenance during service time.

8. Coursework Assessment Requirements/Strategy

Part A – Design of a New Highway (Weight: 80%)		
Section	Requirements	Marks
Horizontal Layout	<ol style="list-style-type: none"> 1. Calculations of the horizontal curves (Points, Transition etc.) 2. Drawing of the horizontal layout 3. Overall width of structure 	Max. 20%
Vertical Alignment	<ol style="list-style-type: none"> 1. Appropriate use of the contour map (spacing between sections, ground levels etc.) 2. Appropriate vertical alignment. Vertical gradients of the highway such as to produce: minimum cutting and filling areas, low depth/heights of cuttings and embankments etc. 3. Detailed Calculations of the vertical curves presented 4. Longitudinal Section Drawing. All required information/values booked in the correct position in the appropriate table, -ground/highway levels, distances between sections, gradients etc. 	Max. 20%
Superelevation Diagram	<ol style="list-style-type: none"> 1. Calculations of the superelevation diagram clearly presented (transition length, max/min superelevation/crossfall etc.) 2. Superelevation Diagram drawing (All required information/values booked in the correct position in the appropriate table, -ground/highway levels, distances between sections, sketches of cross sections at each position, elevation/crossfalls of the highway edges etc.) 	Max. 20%
Highway Cross Sections	<ol style="list-style-type: none"> 1. Highway Cross Sections drawings (All required information/values booked in the correct position, Coordinates tables and summary label of the sections etc.) 2. Detailed calculations cutting and filling cross sections areas. 	Max. 20%
Earthworks Volume	<ol style="list-style-type: none"> 1. Earthwork volumes calculated using appropriate table 2. Detailed calculation and use of swelling factor 3. All required values were calculated and booked in the correct position in the table (mean areas etc.) 4. Earthwork Volume diagram. 	Max. 15%
Overall Presentation	<ol style="list-style-type: none"> 1. Table of contents, 2. Correctly Labelled and folded drawings 3. Electronic submission of the coursework included (CD) 	Max. 5%
Total Marks from Part A (weight 80%)		100%
<p>Part B – Highway Embankments and Slope Stability – Design and Methods of Construction (Weight: 20%)</p>		

Report	<ol style="list-style-type: none"> 1. <i>Appropriate use of references</i> 2. <i>Evident of in depth Understanding and coverage of the subject</i> 3. <i>Presentation of the report including figure and table labelling, Table of contents, word count</i> 		Max. 80%
20 Minutes Presentation	<ol style="list-style-type: none"> 1. <i>Work Presented within the time limits</i> 2. <i>Aspects of the work were fully covered</i> 3. <i>The slides were well presented and of a high standards</i> 4. <i>The group was able to diffidently present the topic</i> 5. <i>The group was able to engage the audients and</i> 6. <i>Group was able to answer any the students questions after the completion of the presentation</i> 		Max. 20%
Total Marks from Part B (weight 20%)			100%
Additional Comments			
<p>Additional Requirements</p> <p>Part A Full word processed technical report is essential Detailed word processed/ equationer processed calculations. Excel speed sheet is not accepted and handwrite calculations will affect your marks AutoCAD processed drawings folded and labelled in Civil Engineering Standards Table of Contents Electronic Submission of your coursework is essential.</p> <p>Part 5 Full word processed report Presentation should be carried out with MS PowerPoint Groups and topics will be appointed in week one and cannot be changed.</p>			
Final Mark (weight 50%)			<u>100%</u>