

The University of Hong Kong  
Department of Civil Engineering

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**CIVL4101 Capstone Design Project**  
**2024 – 25**  
**Group FI to Group FR**

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Design Brief for  
Northern Metropolis Highway – Tin  
Shui Wai Section

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## **Appendix A** Conceptual Scheme of the Northern Metropolis Highway

## 1. INTRODUCTION

### 1.1 Objectives

The objective of this capstone design project is to provide professional training to final year students to work on civil engineering projects through synergistic teamwork within a realistic working environment. Students are required to participate in the conceptual formulation of general arrangement, foundation and structural schemes, appraisal of the schemes and construction sequence, as well as traffic impact assessment, environmental impact assessment, and drainage impact assessment where appropriate, followed by preliminary design, preparation of drawings/figures, preliminary cost estimation for the selected scheme in the first semester and also preparation of drawings and calculations for detailed design in the second semester.

### 1.2 Project Schedule

The schedule of the design project is set out in Table 1 below.

Table 1 Project Schedule

Milestone Date	Component	Page Limit	Weight
26 Sep 2024 (Thu) by 5pm	Inception report	30	10%
29/30 Nov 2024 (Fri/Sat)	Oral presentation 1	-	10%
10 Jan 2025 (Fri) by 5pm	Report on feasibility study and preliminary design	100	25% *a
14 Jan 2025 (Tue) by 5pm	Poster & BIM video	-	*a
	Peer review	-	*b
25/26 Apr 2025 (Fri/Sat)	Oral presentation 2	-	10%
2 May 2025 (Fri) by 5pm	Report on detailed design	100 (excl. calculations)	25% *a
6 May 2025 (Tue) by 5pm	Poster & BIM video	-	*a
	Peer review	-	*b
See Moodle	Seminar reports	-	20%

\* Notes:

- The report on feasibility study and preliminary design or the report on detailed design is assessed together with posters and BIM videos by staff tutors and moderators and progress meetings by industrial tutors in the same semester. It is also used for mark adjustment of the report in the same period among various groups working on the same project. The assessment results of various reports posted on Moodle are therefore tentative only and subject to subsequent adjustments.
- Peer review is used for possible adjustment of individual marks among group members at the discretion of staff tutor and moderator for report on feasibility study and preliminary design or detailed design.
- Students are required to attend regular progress meetings to report their progress and to consult the industrial tutors and staff tutors/moderators for advice. The detailed schedule is shown in the course arrangement.

## **2. PROJECT DESCRIPTION**

### **2.1 Background**

The approximately 23-km Northern Metropolis Highway consists of four sections, namely the Tin Shui Wai Section, San Tin Section, Kwu Tung Section and the New Territories North New Town Section, from west to east, linking the core developments in the Northern Metropolis, enhancing the east-west connections of the New Territories North and forming a new east-west corridor. It will significantly improve transport efficiency of the strategic road network in the northern part of the New Territories while laying a solid foundation for transport infrastructure development in the New Development Areas.

### **2.2 Proposed Highway Development**

The Tin Shui Wai Section of the Northern Metropolis Highway is a dual-three lane carriageway. Students are required to propose road alignment, longitudinal profile, structural form and arrangement at existing at-grade roads for Tin Shui Wai Section, which connects Tin Tsz Road at Tin Shui Wai in the west and San Tin Highway near Kam Tin in the east. The following site constraints should be considered:

- The Tin Shui Wai Section falls into Wetland Conservation Area, ecologically sensitive sites and Schedule Area No. 2.
- Existing facilities and utilities including box culverts near Tin Wah Road.
- Existing fishponds in Nam Sang Wai.
- Permitted Burial Ground (PBG).
- Pile foundation of existing buildings in Yuen Long Industrial Estate.
- Natural terrain catchments.

Impacts on existing facilities, existing buildings, environmental, traffic, utilities should be assessed and incorporated in the feasibility study and design of the proposed works. The construction planning and methodology should take into account of the geology, alignment, and vertical profile of the proposed highway.

A schematic alignment of Northern Metropolis Highway is shown in Appendix A.

More information can be found at the following websites:

Legislative Council Panel on Transport Northern Metropolis Highway – Investigation

<https://www.legco.gov.hk/yr2024/english/panels/tp/papers/tp20240216cb4-180-2-e.pdf>

### **2.3 General Ground Condition**

The ground information of the site can be retrieved in the Geotechnical Information Infrastructure system <https://www.geomap.cedd.gov.hk/GINFOINT2/>. The highest possible ground water level may be taken as the ground surface if no such information can be found.

### 3. CLIENT'S REQUIREMENTS

The project team shall meet, but not limited to, the following design requirements: -

- a. Outline potential alignments of the Northern Metropolis Highway – Tin Shui Wai Section and recommend the preferred alignment.
- b. Design the connections with Tin Tsz Road at Tin Shui Wai and San Tin Highway near Kam Tin.
- c. Preliminary and detailed design of the new highway and its connections.
- d. No adverse effects on adjacent roads and structures and underground structures should be incurred due to the proposed highway development during construction and operation stages.
- e. Temporary traffic arrangement is required throughout the construction period.
- f. Provide construction method with graphical illustration.
- g. All the structural plans shall be generated and prepared by BIM-based techniques. A short video of not less than **30 seconds** by BIM-based techniques to demonstrate the overall design and construction of the proposed highway development in the preliminary stage and detailed design stage, respectively.

### 4. SCOPE OF WORKS

#### 4.1 Inception report

- a. The project team shall identify all the site constraints and the particular concerns as far as possible in environmental, geotechnical, structural, drainage, transportation and constructability aspects.
- b. The project team shall present the methodology for developing feasible schemes for the new highway and its connections.
- c. The project team shall report the progress of any work done.
- d. The project team shall develop a working plan and identify important milestones of the project with proposed dates.
- e. A task list and a duty roster indicating the apportionment of tasks among project team members shall be included in the report.

#### 4.2 Report on feasibility study and preliminary design

- a. The project team shall develop feasible schemes for the new highway and its connections. The design scheme shall satisfy the Client's requirements as set out in this brief.
- b. Due considerations shall be given to the suitability, construction programme, cost, material, environment and safety.
- c. The project team shall submit a report on feasibility study and preliminary design which includes, but not limited to, the following details: -
  - The scope, purpose and background of the study;
  - An executive summary of the study;
  - A general description of the excavation and lateral support (ELS) system for the foundations and/or tunnels;
  - Engineering considerations including consideration of different options;
  - A preliminary assessment of traffic, drainage, environmental and visual impact, etc.;
  - Development and evaluation of alternative design solutions;
  - Schematic plans and sections showing viable structural and foundation layouts;

- Recommendation, with sound engineering justifications, of a preferred alignment of the new highway and its connections;
  - Proposed project schedule for implementation;
  - Estimates of costs;
  - A project file including all letters, minutes, agenda, etc. in the Appendix; and
  - A task list and a duty roster indicating the apportionment of tasks among project team members.
- d. The project team shall produce drawings showing the preliminary design of the proposed highway development. These include, but are not limited to, the following: -
- General layout plan that shows the vertical and horizontal alignments of the new highway and its connections;
  - General structural plans; and
  - Foundation layout plans and sections with geological profiles.
- e. The project team shall deliver a 45-min. oral presentation at the end of the feasibility study and preliminary design followed by a 15-min. question and answer session. The schedule shall refer to the course arrangement. The presentation shall set out design considerations and illustrate key findings of the feasibility study and preliminary design. The recommendation and justification for the preferred scheme shall be fully covered in the presentation for the Client's agreement.
- f. The project team shall also prepare a poster which includes the most important findings of your feasibility study and preliminary design. Format of the poster shall refer to Section 4.5.

### **4.3 Report on detailed design**

- a. The project team shall prepare a detailed design report for submission to the Client. The final design report shall include, inter alia, the following items: -
- An executive summary;
  - Layout, sections, and elevations of the new highway and its connections;
  - Design memorandum including design criteria, geotechnical parameters, loading analysis, safety and environmental considerations, standard codes and references, etc.;
  - A general description of the proposed works and construction sequences;
  - Demonstration of the overall stability of the new highway and its connections;
  - Structural design calculation for critical structural elements only;
  - Ground movements, if any, due to any foundation, ELS and geotechnical works;
  - Impact assessment reports for structure, traffic, drainage and environmental;
  - A risk assessment of the project;
  - Construction method and sequence of the new highway and its connections;
  - Overall construction programme and cost estimation;
  - A project file including all letters, minutes, agenda, etc. in the Appendix; and
  - A task list and a duty roster indicating the apportionment of tasks among project team members.
- b. The project team shall produce drawings for the proposed highway development. These include, but are not limited to, the following: -
- General layout plan that shows the vertical profile and horizontal alignments of the new highway and its connections;
  - General structural design for key structural elements with reinforcement (for reinforced concrete structures) and connection (for steelworks) details;

- Foundation layout plans and sections with geological profiles;
  - Construction sequences of the new highway and its connections; and
  - Traffic diversion plans.
- c. The project team shall deliver a 45-min. presentation at the end of the final detailed design and the schedule shall refer to the course arrangement. The presentation shall be followed by a 15-min. question and answer session.
- d. The project team shall also prepare a poster which includes the most important elements of the detailed design. Format of the poster shall refer to Section 4.5.

#### 4.4 Format of submissions

Submission	Type of file	Limit
Inception Report	One PDF file (Normal)	30 pages 100 MB
Report on FS & PD AND Report on DD	Main content: One PDF file (Turnitin)	100 pages 100 MB
	Appendices: One PDF file (Normal)	No page limit 100 MB
Poster / Peer review	One PDF file (Normal)	100 MB

- a. Just ONE PDF file shall be submitted in the sub-class Moodle site for each group. Students should combine all the materials into ONE PDF file (for each part) with the consideration of the reading sequence of the markers.
- b. In Moodle, the maximum size allowed for normal and Turnitin submissions is 100 MB. For Turnitin submissions, there is a page limit of 100 pages, and students should only include the main content in this submission for plagiarism checking. All appendices should be grouped together in a single PDF file and submitted through a separate link, which does not undergo plagiarism checking.
- c. If the PDF file exceeds the size limit, students are required to resize it before submission. In cases where the file size cannot be reduced to 100 MB, students may divide the submission into multiple parts and appropriately name them, such as "Part 1," "Part 2," and so on. These parts should then be uploaded to Moodle using different student accounts.

#### 4.5 Poster & BIM video

Each group shall submit a poster after the two milestones (feasibility study and preliminary design and detailed design). The use of posters is quite common in design competitions, research conferences, exhibitions, public engagement, etc. For the Capstone Design Project, the 8 or 10 groups who are working on the same project are similar to 8 or 10 consultant firms competing for an engineering job. The judging panel would be your client and relevant experts. Posters shall include the most important findings of your report and they are used for mark adjustment of the report in the same period among various groups working on the same project.

Students shall use Microsoft PowerPoint or equivalent to design the poster with the following requirements.

- a. Size - A1 (594 × 841 mm)
- b. Image resolution: 300 dpi
- c. Main Title: recommended font size between 54 to 60 pt
- d. Sub-heading: recommended font size between 40 to 44 pt
- e. Normal text: recommended font size of at least 28 pt

All the Architectural Plans & Framing Plans shall be generated and prepared by BIM-based techniques. And a short video of not less than **30 seconds** by BIM-based techniques to demonstrate the overall design & construction of the proposed development. in the preliminary stage and detailed design stage, respectively.

## 5. SITE VISITS

In order to familiarize with the site conditions, site visits to the proposed highway development shall be arranged in the early design stage, if necessary.



## 6. RECOMMENDED DESIGN STANDARDS AND REFERENCES

The following codes of practice, standards and references shall be used in the design of the development as applicable:

- a. Hong Kong Buildings Ordinance, Chapter 123
- b. Hong Kong Building (Planning) Regulations, Chapter 123F
  - i. B(P)R 24 & 39 on "storey & staircase height"
  - ii. B(P)R 29 to 37 on "lighting & ventilation"
  - iii. B(P)R 39 to 43 on "means of escape"
  - iv. B(P)R 72 on "use by persons with a disability"
- c. Hong Kong Building (Construction) Regulation 1990.
- d. Code of Practice for Foundations 2017, Buildings Department.
- e. Code of Practice for the Structural Use of Concrete 2013, Buildings Department.
- f. Code of Practice for the Structural Use of Steel 2011, Buildings Department.
- g. Code of Practice on Wind Effects 2019, Buildings Department.
- h. Code of Practice for Fire Safety in Buildings 2011, Buildings Department.
- i. Code of Practice for Dead and Imposed Loads 2011, Buildings Department.
- j. Code of Practice for Structural Use of Glass 2018, Buildings Department.
- k. Code of Practice on Design for Safety – External Maintenance 2019, Buildings Department.
- l. Code of Practice for Site Supervision 2009, Buildings Department.
- m. Code for Seismic Design of Buildings: GB-50011-2016
- n. EN 1998-1:2004 Eurocode 8: Design of Structures for Earthquake Resistance. CEN.
- o. Design of Buildings and Structures in Low to Moderate Seismicity Regions – Professional Guide: PG-002.
- p. Foundation Design and Construction, GEO Publication No. 1/2006.
- q. Engineering Geology Practice in Hong Kong, GEO Publication No. 1/2007
- r. Review of Design Methods for Excavation, GCO Publication No. 1/90.
- s. Guide to Retaining Wall Design, GEOGUIDE 1, 1993.
- t. Guide to Site Investigation, GEOGUIDE 2, 1987
- u. Guide to Soil Nail Design and Construction, GEOGUIDE 7, 2008
- v. Structures Design Manual for Highways and Railways 2013.
- w. Highways Department Standard Drawings.
- x. Geotechnical Manual for Slopes, 2nd Edition (1984).
- y. Transport Planning and Design Manual.
- z. Stormwater Drainage Manual, Planning, Design and Management, Fourth Edition, May 2013, Drainage Services Department.
- a. Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP), Buildings Department.
- b. Code of Practice 101 for Distribution Substation Design (COP101)
- c. Design recommendations for multi-storey and underground car parks (Fourth edition) 2011, The Institution of Structural Engineers.
- d. Technical Circular (Works) No.2/2020, Development Bureau
- e. (1) BIM Standards – General (Version 2.1), CIC;  
(2) BIM Standards for Architecture and Structural Engineering (Version 2.1), CIC;  
(3) BIM Standards for Underground Utilities (Version 2), CIC;  
(4) BIM Standards for Mechanical, Electrical and Plumbing (Version 2), CIC;  
(5) BIM Standards for Preparation of Statutory Plan Submissions, CIC.

## 7. COMMONLY USED DESIGN SOFTWARES

The following design softwares are commonly used in the industry:

- a. ANSYS – structural analysis
- b. ETABS – structural analysis
- c. FREW – geotechnical analysis of deformation and stability of soil structures
- d. MIDAS – structural analysis
- e. PLAXIS – geotechnical analysis of deformation and stability of soil structures
- f. REVIT – Building Information Modeling
- g. PROKON – structural element design
- h. SADS – structural element design
- i. SAFE – analysis and design for concrete slabs and basement/foundation structures
- j. SAP 2000 – structural analysis
- k. SPACE GASS – structural analysis
- l. STAAD Pro – structural analysis
- m. STRAND7 – structural analysis

**End of Text**

## **Appendix A**



Figure 1. Conceptual Scheme of the Northern Metropolis Highway