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| Courses | **ENCI413 Integrated Civil Engineering Design**  **ENNR413 Integrated Natural Resources Engineering Design** |
| **Topic** | **Expansion of Waipara Hills Winery** |
| **Assessment** | **Team Developed Design** |
| **Due Date** | **Oral presentation (team): 25 September**  **Calculations and Drawings report (individual): 9 October**  **Team report: 16 October** |

**Aims**

This assessment will enable you to

* Understand the value of integration in engineering design,
* Develop the ability to work on “complex” (as defined by Engineering NZ) engineering problems and appreciate this uniqueness,
* Identify constraints and requirements given a client-focused design brief (including appropriate consideration for public health and safety, cultural, societal, environmental, sustainability and resilience considerations),
* Ability to integrate economic, social, cultural and environmental concerns within the context of civil engineering design projects,
* Identify information requirements and select appropriate information,
* Creatively develop and then evaluate systematically alternative solutions in all relevant contexts (e.g. economic, aesthetic, health and safety, environmental, cultural, and ethical),
* Undertake analysis to confirm robustness of a proposed solution,
* Describe the preferred solution in an oral presentation, with appropriate client focus, and defend those findings,
* Apply engineering management principles (e.g. project timeline) to a design project,
* Apply economic decision-analysis processes to a design project,
* Prepare engineering drawings of sufficient detail for cost estimates and funding decisions,
* Prepare an estimate of cost for a civil engineering project,
* Demonstrate an ability to be bi-culturally competent and confident in a project typical for civil engineers,
* Understand how an engineer functions effectively within a diverse design team in a multi-disciplinary setting,
* Develop professionalism as an engineering team member
* Recognise the need for, and have the preparation and ability to engage in, independent learning in the broadest context of technological change.

**1. Project Brief**

Your consulting company has been issued with the contract to undertake the developed design for the expansion of the Waipara Hills Winery. Your team has been allocated to the project by the senior management of your company. You are to work out the required design calculations and drawings, thereby including appropriate economic, aesthetic, health and safety, environmental, sustainability, resilience, cultural, and ethical considerations. The client asks for an update at the end of project week 9 in the form of an oral presentation. Upon completion you are required to present your team concept design to the client in the form of a written report in two parts: a ‘calculations and drawings’ report at the end of project week 11, and a team report at the end of project week 12.

The background to, and objectives of, the project are provided in the ‘Design Project Background and Objectives’ document on LEARN.

**2. Scope**

The presentation of your proposed team developed design should at a minimum include the items listed in Table 1. This table is not meant to be a complete list of what is needed. It is not meant to indicate the order or relative importance of items. It is provided to help ensure some items that might be overlooked are included. Use the checklist per discipline in the Appendix as guidance for your work.

Table 1. A list of minimum requirements for the proposed Waipara Hills Winery expansion design at developed design phase.

| ***Section*** | | ***Contents*** | |
| --- | --- | --- | --- |
| **Executive summary** | | A clear concise summary of the key objectives, qualitative and quantitative findings and recommendations. | |
| **Introduction** | | Background information including key aspects from the ‘project background and objectives’ document, the design brief and client requirements. Design goals. | |
| **Design overview**  **and layout** | | Design plans, descriptions and rationale for the design approach, including:   * Zoning of land and open spaces, size, location of built environment, * Layout of new parking, roads and transportation links, * Size and location of infrastructure services. | |
| **Structures, infrastructure servicing and geotechnical requirements** | | Options for   * Structural, * Geotechnical, * Transport/Roading, * Water supply, * Wastewater and solid waste, * Stormwater engineering,   thereby including a cultural narrative.  [Note that a given team may not necessarily cover all these disciplines]. | |
| **Alternatives considered** | | Overview of design alternatives considered with discussion of why one was chosen over the others, and how these alternatives might become more desirable if particular circumstances change. | |
| **Relevant sketches** | | Relevant sketches for built environment, geotechnical aspects, roading, parking and transportation links as well as infrastructure services. | |
| **Integration of relevant aspects** | | Considerations of economic, aesthetic, public health, safety in design, environmental, sustainability, resilience, cultural, and ethical aspects. | |
| **Environmental**  **Effects** | | Description of effects of development and proposed land use restrictions in terms of:   * Transport * Noise * Neighbourhood amenity * Water quality * Natural hazards * Consultation strategy * Anything else | |
| **Regulatory and Consent Requirements** | | Briefly describe the main regulatory and consenting requirements for the expansion including Environment Canterbury, Regional Plans, District Plans, the RMA and the Mahaanui Iwi Management Plan. | |
| **Cost Estimate** | | * Prepare an estimate of the development (capital costs), including land, infrastructure and buildings. * Include maintenance and operational costs for new facilities and systems. | |
| **Programme** | | Prepare outline programme of works. | |
| **Risk Assessment** | | Analysis of risks to project completion after acceptance of proposal by the client. | |
| **Conclusions, recommen-dations** | | Summary of the key findings and recommendations to the client. Outline next steps for the developed design phase. | |

**3. Requirements**

You have been allocated to a team. The teams are listed on LEARN.

Deliverables:

*Oral presentation (25 September)*

You are to prepare and deliver a formal oral presentation for the client that describes the developed design that you have worked out as a team. Depending on the total number of team members, two or three team members will present the draft developed design (those that did not present the concept design on 20 August must present this time). The time allocated for the presentation depends on the total number of team members (max. 12.5 minutes for a team of five and max. 15 minutes for a team of six). The presentation is followed by questions from the panel and feedback from the panel. All team members are expected to engage in the Q&A.

You must submit the presentation as a pdf-file in the ‘Submissions’ section on LEARN by 6pm on 25 September (One upload per team only; Filename convention: 413Team\_xy\_DraftDevelopedDesignPresentation.pdf).

*Individual report (‘calculations and drawings’)*

Each team member must prepare a report detailing the calculations, drawings and other elements listed in the checklist in the Appendix related to the very discipline that this team member has covered during the concept and developed design phases.

Deadline: You must submit the report as a pdf-file in the ‘Submissions’ section on LEARN by 5pm on 9 October (One upload per student; Filename convention: LastName\_FirstName\_413\_DevelopedDesignReport.pdf).

*Team report*

You are to prepare and deliver a formal client report that describes the developed design that you have worked out as a team. See Table 1 and the checklist in the Appendix for guidance.

Deadline: You must submit the report as a pdf-file in the ‘Submissions’ section on LEARN by 5pm on 16 October (One upload per team only; Filename convention: 413Team\_xy\_DevelopedDesignReport.pdf).

**4. Grading**

The presentation and reports will be assessed by a panel. While the presentation does not count towards your final grade, the panel may ask you to refine your work and present again one week later in case insufficient progress has been made.

You will be marked on the following (marking rubrics will be released separately):

Design Concept

* Overall design quality
* Design meets the client’s requirements
* Design integration
* Alternatives considered
* Clear conclusions/recommendations

Design Work

* Technical considerations
* Consideration of economic, aesthetic, public health, safety in design, environmental, sustainability, resilience, cultural, and ethical aspects
* Required consents

Communication Skills

* Quality of communication
* Presentation

**Late Submissions**

A team failing to submit the presentation file will receive reduced marks for professionalism.

Late report submissions: Up to 24 hours late will receive a 50% reduction of marks. Later submissions receive zero marks.

**5. Working on the Presentation and Reports**

Teams are encouraged to exchange ideas and discuss common issues; however, teams must not exchange files or copy materials from other teams, and they must cite any work not developed by them. Teams must acknowledge all contributions, failing to do so is plagiarism.

Your team will need to seek additional information from various sources in order to be able to complete the project. You can find information on the course LEARN page, in libraries or on the internet, you can and should ask questions on the LEARN forum, and industry professionals working with you in tutorial sessions will be an invaluable source of advice on what information may be useful and where you might find it. Be sure to use your tutorial sessions productively.

If your team wishes to contact individuals or organisations off-campus, you should first get approval by email from the course coordinator, explaining the purpose of the communication. It would not be suitable for all teams to contact the same person off-campus for similar information; where there is common interest in information, this will be provided to all students. Contact the course coordinator when there is any doubt about how to obtain outside information.

For this assignment, the clients’ representative is your course coordinator. You are allowed to communicate with the client through the course coordinator, but this must be done in a manner expected by professional engineers. You can make an appointment for a meeting, or you can send an email (to a high grammatical standard). You will need to carefully consider the purpose of your communication. In many cases, it is valuable to communicate with your client to ensure that you are able to meet the project brief - the client does not want to pay for a report that does not meet their needs. On the other hand, communication with the client that becomes a repeat of what has been stated in the brief, or asks for information that the engineer should have available, will lead the client to doubt the merit in hiring the engineer. Important issues raised in these meetings will be explained to all students via LEARN.

**Appendix: Checklist of design tasks per discipline for developed design**

The client has requested the following:

Concerts at the designated concert site will be limited to max. 1,500 persons so that physical distancing can be practiced under Covid-19 conditions.

Note: A given team will not necessarily cover all disciplines listed below. Since phase 2 concept design each team member has been allocated to mainly work on a certain discipline, next to aspects that a team must develop in a collaborative and concerted manner (even more so during the current phase 3, the developed design phase). Please take note that key to a successful design is to integrate the different disciplines.

EACH TEAM COVERS THOSE DISCIPLINE ONLY THAT THE INDIVIDUAL TEAM MEMBERS HAVE BEEN ALLOCATED TO. If one or more of the disciplines below is/are not among those disciplines that the team members were allocated to then the team omits this discipline/those disciplines. If necessary, relevant information on such a discipline/disciplines will be provided.

**Geotechnical**

* Analyse the results of the further geotechnical investigations/testing that have been carried out and revise/refine the geotechnical and groundwater model based on this new information. Assess if further geotechnical constraints have been identified as a result of this new information and analysis (e.g. liquefaction/lateral spreading, shallow groundwater, soft/compressible soils, contaminated land/uncontrolled fill).
* With the project team, agree upon preferred foundation solution(s) for the buildings.
* For each soil unit/layer identified in the geotechnical model, assign parameters including: angle of internal friction, interface friction angle, unit weight (total and effective), static and seismic pressure coefficients (at rest, active, passive) (based on the SLS/ULS design loadings provided by the structural engineer), Young’s modulus. For all of these parameters, provide a likely “best estimate” value, as well as likely “upper and lower bound” values.
* Calculate a California Bearing Ratio (CBR) value(s) to enable pavement design.
* Based on the preferred foundation solution identified for the buildings, calculate: buoyancy forces acting on the basement, earth pressures acting on the basement walls (static and seismic), bearing capacity and expected footing settlements (total and differential) due to building loads (static and seismic), modulus of subgrade reaction values, geotechnical pile design parameters (if applicable) such as end bearing and shaft friction, pile moment and shear demands from lateral soil displacements.
* Decide on a basement construction methodology, e.g. construction of temporary and permanent retention structures, installation of dewatering measures etc. Illustrate this in a series of schematics.
* Calculate the factors of safety against slope instability for significant slopes within the development (e.g. wetland area, free-face to river).
* Oral presentation of draft developed design to include:
  + Any relevant geotechnical drawings (e.g. basement wall earth pressures, slope stability calculations, settlement plots, pile moment and shear demands).
  + Explain how the designs work; cover the key points showing how the systems meet design requirements and are adapted to site constraints.
* Individual report (calculations and drawings/sketches):
  + Prepare a geotechnical design features report summarising the above analyses and information (with technical appendices as required).
* Team report:
  + How do you communicate any risks/uncertainties associated with late changes in structural/architectural form or building/infrastructure locations to the project team/client?
  + How have you considered safety in design (and construction)?
  + What considerations should be considered in a geotechnical specification for the development?
  + What sort of geotechnical construction observations will need to be undertaken and how does this correspond to the Engineering NZ construction monitoring levels?

**Structural – General Notes**

The client has made the following decision: EBF & structural walls for the tower building and timber portal frames for the processing building. Furthermore, the client would like to see design solutions using different floor systems for the different teams, i.e. each team will be given the task to work with a different floor system.

Also note that the client has decided that half of the office space must be designed to become additional space for accommodation.

Tower Building (steel and concrete)

* Lateral (same for all teams)
  + EBF in one direction
  + Concrete structural walls in other direction
* Gravity (steel with one of the following floor systems)
  + Comflor with composite secondary beams
  + Rib and infill
  + Precast flat slab (smaller grid spacing??)
* Bridge
  + Steel truss each side
  + Comflor

Processing Building (Timber and concrete)

* Lateral/Gravity
  + Timber portals (short direction)
  + Timber or steel braces (long direction)
  + Plywood diaphragm or tension only bracing
  + Timber girts
* Gravity
  + Timber purlins
* Basement
  + Concrete basement walls
  + Columns and beams - Concrete (precast or insitu)
  + Floor system - Rib and infill floor system

**Structural**

Undertake structural engineering design of your preferred option to a Developed Design Stage standard. To include:

* Finalisation and confirmation of the loads to be applied to each building area and to each structural design element.
* Undertake structural analysis (by hand or analysis software as appropriate) and design checks to the relevant NZ material standards for each of the Structural Design Elements listed below:
  + Process Area - Portal frame (columns and rafter) member sizing and connections
  + Process Area – Portal frame foundations including base rotational capacity/foundation flexibility
  + Process Area – Roof cross bracing (tension only)
  + Process Area – Wall cross bracing
  + Process Area - Ground floor slab-on-grade
  + Basement Area - Floor slab (consider buoyancy as appropriate)
  + Basement Area – Retaining walls (consider buoyancy as appropriate; consider angled design)
  + Basement Area – Slab and beams above basement area and supporting columns
  + Restaurant/Office Area – Suspended first floor slab and beams
  + Restaurant/Office Area – Typical gravity column
  + Restaurant/Office Area – Steel cross braced frame including connections and base connection to foundations (EBF or CBF)
  + Restaurant/Office Area – Concrete shear walls (precast or in-situ)
  + Restaurant/Office Area – Foundations for gravity only columns
  + Restaurant/Office Area – Foundations for braced frames and shear walls
  + Any mass flow forces from pipelines that may require specific engineering design

Prepare Develop Design Stage Structural Drawings for your design. To include:

* Overall Plans Sections and Elevations
  + Foundation and Basement Plan
  + Ground Floor Plan
  + First Floor Plan
  + Roof Plan
  + Typical Sections through each building area
  + Elevations on steel cross braced frames and concrete shear walls
* Key Details
  + Process Area - portal frame knee connection
  + Process Area - portal frame rafter splice (if required)
  + Process Area - portal frame foundation
  + Process Area – ground floor slab-on-grade detail
  + Process Area – wall cross bracing connection
  + Basement Area - floor slab including construction sequence and jointing
  + Basement Area – retaining Wall
  + Basement Area – suspended floor slab and beam
  + Restaurant/Office Area – first floor slab and beams
  + Restaurant/Office Area – first floor beam-column connection
  + Restaurant/Office Area – gravity column foundation
  + Restaurant/Office Area – steel braced frame and concrete wall foundations
  + Restaurant/Office Area – ground floor slab
  + Update the Concept Stage - Structural Design Features Report to become a Developed Design Stage - Structural Design Features Report with technical appendices as required.
* Oral presentation of draft developed design to include:
  + Include the drawings in the presentation. Explain how the design works; cover the key points showing how the system meets the design requirements and is adapted to the site constraints, key load paths and constructability.
* Individual report (calculations and drawings/sketches):
  + Include the detailed explanations of how the design meets the structural requirements (suggestion – these may be easiest to present in table format)
  + Include the calculations as appendices but summarise the overall system function in the report.
  + Include the drawings as appendices (including an overall Site Plan)
  + Specifications should be provided with the construction sketches. This set of notes should be provided to the contractor for the purpose of understanding the drawings. Think weld symbols and abbreviations. It may provide clarification on material use and limits.
  + Identification of 'Hot Spot Vulnerabilities' (e.g. weakest links of the chain )
  + Diaphragm discontinuities
  + Plan Irregularity
  + Vertical Irregularity
  + Pounding
  + Site Characteristics
* Team report:
  + How is the design of structural elements meeting architectural requirements?
  + If alteration to the architectural plans is required, is it necessary? What are the cost implications? How do you communicate these to the architect, and subsequently the client?
  + How are safety in design considered in construction and during normal use?
  + How is sustainability considered in design?
  + Inspection Schedule with an appropriately identified Construction Monitoring Level

**Structural 1 – Tower Building (includes the Link Bridge)**

COPY RELEVANT PARTS HERE

**Structural 2 – Process Building (includes basement Cellar)**

COPY RELEVANT PARTS HERE

**Water Supply**

Take the selected options and develop these to the next level of detail. This should include:

* Provide plan drawings and sketches of relevant details to show how the system works.
* Size the water supply pipes and select a pipe material and pressure class. Show the layout of the water supply pipes on the site, including connection points to buildings, storage, the irrigation system, etc.
* Identify where backflow prevention devices are required on the site. Recommend the types of backflow prevention devices that are necessary, and provide supporting information to support your choice.
* Size any pump(s) required for the system, and provide supporting calculations to show how you selected pump(s), including showing how you calculated the pump duty point(s). Show where pumps will be located on the site, and provide a sketch showing any site works (paving, underground or aboveground chambers for the pumps, electrical supply, etc.) required for the pumps.
* Size any storage included in the system, and show on a sketch where this will be located. Provide several details for the storage facility (tank/reservoir/dam etc.) showing any incoming/outgoing pipes, valve arrangement, overflow point, etc.
* Prepare calculations to show that the system can achieve the required pressure and flow and meet the water demand(s). Consider at least two design cases (i.e. scenario 1 = peak demand; scenario 2 = 50% of potable demand + firefighting flow). Show how long your storage will last under the different design cases.
* Design a water treatment system for the building(s), or identify proprietary system(s) which can meet the water treatment needs. Show where the water treatment facility will be located on the site. Indicate how any treatment chemicals or equipment will be delivered to the treatment facility. Include sketches showing the location of the water treatment facility, any site works (parking, power, drainage facilities) to serve the water treatment facility, and sketches (process diagrams or similar) to show how the water treatment process works.
* Calculate the energy consumption of your water supply system and estimate the yearly cost to supply power to the system.
* Identify consents required for the water supply system, including a detailed assessment provided in an appendix. Identify what consultation must occur (if any). Provide an assessment of the water supply system against the Iwi Management Plan. Identify the key effects of the system and show how these are mitigated.
* Explain how the system is adapted to the site constraints.
* Explain how the system meets the client preferences (if any).
* Show how the system works with the constraints/requirements of the other disciplines.
* Explain how you have included resilience in the water supply design. How will the system cope if a key component breaks? How have you allowed for climate change? How will the system cope in a major natural disaster (earthquake, large fire event, etc.)? Summarise the key resilience/redundancy aspects and the Safety in Design components that you have considered.
* Prepare an Engineer’s Estimate for the water supply system. Communicate this in terms of NPV over 50 years (allowing for both construction costs and operational costs).
* Prepare an Operations & Maintenance checklist for the water supply system
* Oral presentation of draft developed design to include:
  + Please provide pointers
* Individual report (calculations and drawings/sketches):
  + Please provide pointers
* Team report:
  + Please provide pointers

**Wastewater and Solid Waste**

* Estimate quantities/composition of non-winery solid waste (average and at peak) including events; devise facility-wide management strategy.
* Design a winery wastewater treatment train composed of: gross suspended solids removal, anaerobic pond, wetland, irrigation.
* Size storage by considering flow equalisation and waste mixing.
* Design a winery solids treatment train composed of: in-vessel composting, odour control, land application of stabilised solids.
* Consider mixing of wastes for composting and variety of land applications.
* Look into minimisation of wastewater and solid waste, review impacts on other disciplines (roading, site layout).
* Look at system components like pH adjustment, particle removal, odour control measures.
* Consider extreme weather conditions.
* Conduct overall mass/material balances.
* Refine design (e.g. seasonally varying decay rates, Potassium loading, harvesting of wetland plants).
* Consider segregation or changes in client’s chemical use to improve re-use options.
* Consider operation and maintenance issues and consider life-cycle costs.
* Conduct sensitivity analysis to identify critical design assumptions that will need checking before detailed design.
* Identify key sub-system risks.
* Develop draft start-up and operations plan.
* Identify the ‘next steps’ for the project
* Oral presentation of draft developed design to include:
  + Please provide pointers
* Individual report (calculations and drawings/sketches):
  + Please provide pointers
* Team report:
  + Please provide pointers

**Roading and Transportation**

Note that the client has decided that half of the office space must be designed to become additional space for accommodation.

* Traffic impact assessment for the proposed situation
  + INSERT DETAILS
* Traffic generation for development
  + Finalise the expected trip generation from the development on the site.
  + Calculate the expected traffic generation in the site peak hour(s) and for a typical day.
  + Express the expected traffic generation in equivalent car movements (ECM).
  + Add to existing trip generation and determine the overall impact from the site.
* Developed design for upgraded access/ intersection
  + Intersection design of Stockgrove Road and Glasnevin Road - State Highway 1 intersection.
* Developed design for parking facilities
  + Drawing of proposed car park layout with all relevant aspects included.
* Developed design for road cross-section and internal road layout
  + Detailed design of typical internal road cross section.
  + Proposed internal road layout.
* Oral presentation of draft developed design to include:
  + Please provide pointers
* Individual report (calculations and drawings/sketches):
  + Please provide pointers
* Team report:
  + Please provide pointers

**Stormwater**

Take the selected option and develop this to the next level of detail. This should include:

* Size all elements of the design, including providing your supporting calculations.
* Calculate the total earthworks volume required for the stormwater system, road and new building. Check if an earthworks consent or discharge to air consent is required for the project.
* Update your stormwater design plans to include all relevant site features, levels at key points (i.e. top and bottom of system, to demonstrate gradient available), and any other information necessary to show how the system works and how it will be constructed. Include typical construction details for all elements of your design (i.e. trench details; typical swale cross-section; etc.).
* Prepare calculations to demonstrate how attenuation is achieved by the system, including considering a range of storm events. Show that the system has enough hydraulic capacity (primary and secondary).
* Prepare calculations (or other supporting evidence) to demonstrate how the system will treat stormwater. Include an estimate of the contaminants of concern and their concentrations prior to treatment, the effectiveness of treatment, % reduction of contaminants and a comparison to relevant receiving environment guideline values.
* Following on from your earlier advice about the Waipara River, your client is interested in installing a surface water intake within the river bed, to supplement the water supply to the site. Prepare a short memo to your client outlining the main engineering, environmental and cultural considerations for this activity. You should include a typical sketch for a surface water intake, fish passage (if required), a list of any consents that may be required, a list of who would need to be consulted, and your recommendations to your client on the costs vs. benefits of this option (including how much water could be available from this source). Limit your memo to 4 pages, with any additional material appended.
* Prepare an Engineer’s Estimate for the stormwater system. Communicate this in terms of NPV over 50 years (allowing for both construction costs and operational costs).
* Identify consents required for the stormwater system and what consultation must occur. Provide an assessment of the stormwater system against the Iwi Management Plan. Identify the key effects of the stormwater system and show how these are mitigated.
* Explain how the system works with or is adapted to the site constraints.
* Explain how the system meets the client preferences (if any).
* Prepare an Operations & Maintenance checklist for the stormwater system.
* Oral presentation of draft developed design to include:
  + Please provide pointers
* Individual report (calculations and drawings/sketches):
  + Please provide pointers
* Team report:
  + Please provide pointers