CE1v4

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Career Episode 1

RIICWD533E - Create comprehensive plans for civil concrete buildings

Introduction

CE 1.1.1

While pursuing my Advanced Diploma in Civil Construction Design in Adelaide, I worked on a project that I'm now going into depth about. Module RIICWD533E—Prepare detailed design of civil concrete structures—included this as an essential component. It all started in (please enter beginning month and year) and ended in (please enter ending month and year) when I turned in my finished assignment.

Please make sure that the project is done in 2024. If not possible, please ask us for modifications in the document and we will do that.

Background

CE 1.2.1

This project was a comprehensive assessment carried out at the end of the study module in order to assess the students' knowledge and skill related to the civil concrete structures which we studied during the module. It was an individual assessment and was required to be submitted to the assessor (course instructor) by each student separately.

CE 1.2.2

During this project my responsibilities were all inclusive. I had to understand the requirements of the assessment, conduct the necessary research, perform the tasks mentioned in the assessment guidelines and then fill the assessment form and submit it for grading. I coordinated frequently with the assessor and tried to comply with the requirements of the assessment.

CE 1.2.3

Figure 1 below displays the project reporting.

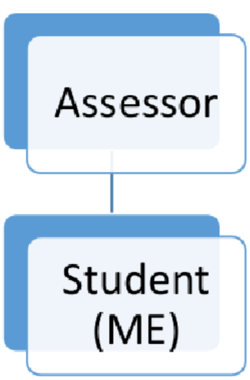

Figure 1: Project Mechanism

Engineering Activity

CE 1.3.1

Assessment required the students to first identify any five (5) legislations required to prepare detailed design of civil concrete structures. I did a research on the legislations. I compiled a list of some relevant legislations to short list from. I shortlisted the following 5 legislations.

1. The Competition and Consumer Act 2010 that regulates fair trading, consumer protection, and competition in the market. It ensures that high-quality materials are used in the construction of structures.

2. The Australian Consumer Law (ACL) guarantees that materials used in construction meet required quality standards and are suitable for their intended purpose. It protects consumers by promoting fair practices and providing accurate information about products.

3. The preservation of natural habitats and species variety is the primary goal of the Environmental Protection and Biodiversity Conservation Act of 1999. It checks that concrete designs won't harm wildlife or the environment.

4. The Environmental Protection Act 1994 and Water Act 2000 are legislations that address environmental protection and the responsible use of water resources in design. These acts require environmentally friendly designs and the use of water-efficient technologies.

5. In 1984, the Aboriginal and Torres Strait Islander Heritage Protection Act was passed for ensuring the traditional artefacts of these people would be protected. Understanding and respecting their cultural value is promoted, and designs are made to neither hurt or negatively influence their legacy.

CE 1.3.2

For the sake of the evaluation, I had to imagine that two columns supported a 5,000 mm concrete beam. The width and depth of the beam were determined by applying the rule of thumb.

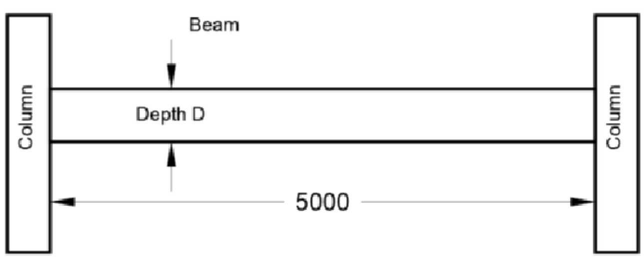

Figure 2: Depth and Width of Beam

I used the mathematical formulas given below for my calculations of the beam dimensions.

$$Depth\ (D) = \frac{Span\ (L)}{10}$$

Given that the span (L) was 5000 mm, I calculated the Depth (D) to be 500 mm. I was aware that factors like loading conditions and design constraints affect the beam's width (B). I knew that the common rule of thumb for the beam width is to use a value that is 1/16th to 1/12th of the span. I used the more conservative value 1/12th to find a more accurate estimate of the value.

$$Width\ (B) = \frac{Span\ (L)}{12}$$

I determined the value to be 416.67 mm.

CE 1.3.3

I used my mathematical abilities to perform different calculations necessary for this project. I calculated the volume of the beam.

$$Volume = Width\ \times Depth\ \times Span$$

I knew that the width was 416.67 mm, depth was 500 mm and span was 5000 mm, hence, I calculated the volume to be 1.04167 m^3. I then calculated the concrete mass considering the density to be 2400 Kg/m^3.

$$Mass = Volume\ \times 2400\ kg/m^3$$

Hence, I calculated the mass to be 2500 kg. Having understood that in any construction project, costs are a very important factor to be considered, I ensure to calculate the costs as well. I considered concrete price as \$260 / m^3.

$$Cost = Volume\ \times \$\ 260/m^3$$

Hence, the cost came out to be \$270.83/-.

CE 1.3.4

I carefully outlined the risks that could apply to this project. I mentioned exactly what information must go into the risk register. I made a risk dictionary to identify proactively what could go wrong, its probability of occurrence and the impact it might have on the overall project.

Table 1: Risk Register

ID	Risk description	Likelihood	Impact	Risk Rating	Mitigating action
1	Having mistaken in the design	Occasionally 2	Severe 4	High 8	Avoid the risk
2	Weather Delays	Often 4	Moderate 3	Moderat e 3	Develop contingency plans, monitor weather forecasts, and schedule buffer time.
3	Supply Chain Disruption	Sometimes 3	Severe 4	Moderat e 3	Diversify suppliers, maintain emergency stock, and monitor supply chain.
4	Equipment Breakdown	Occasionally 2	Severe 4	High 8	Implement regular maintenance, have backup equipment, and swift repair protocols.

Table 2: Risk Dictionary (A)

Likelihood	Impact (Consequences)				
	Insignificant 1	Minor 2	Moderate 3	Severe 4	Catastrophic 5
Never 1	Low 1	Low 2	Medium 3	Medium 4	High 5
Occasionally 2	Low 2	Medium 4	Medium 6	High 8	Extreme 10
Sometimes 3	Medium 3	Medium 6	High 9	Extreme 12	Extreme 15
Often 4	Medium 4	High 8	Extreme 12	Extreme 16	Extreme 20
Frequently 5	High 5	High 10	Extreme 15	Extreme 20	Extreme 25

Risk range	Action
From 1 to 3	Accept
From 3 to 6	Mitigate
From 7 to 10	Avoid
From 11 to 25	Transfer

Table 3: Risk Dictionary (B)

Definitions			
Likelihood Ratings		Impact Ratings	
Never	Rare and exceptional risks which have a less than 10% chance of occurrence	Insignificant	Risks that will cause a near negligible amount of damage to the overall operations or client satisfaction.
Occasionally	Risks that have a low probability of occurrence but still cannot be ruled out completely	Minor	If a risk will result in some damage, but the extent of damage is not too significant and is not likely to make much of a difference to the overall operations or client satisfaction with the project
Sometimes	Risks which have a near 50/50 probability of occurrence	Moderate	Risks which do not impose a great threat, yet cause a sizable damage can be classified as moderate
Often	Risks that have 60-80% chance of occurrence can be grouped as often	Severe	Risks with significantly large consequences which can lead to a great amount of loss are classified as severe
Frequently	A risk that is almost certain to show up during operations. If you are looking at percentages, a risk that is more than 80% likely to cause problems will fall under this category	Catastrophic	These are the risks which can make the project operations or activities completely unproductive and unfruitful, and must be a top priority during risk management

I also included the stakeholder communication requirements and environmental impacts of the project in my analysis.

CE 1.3.5

As per the guidelines of the assessment, I specifically mentioned two innovative procedures that were helpful in developing the design concept for this project. I made sure to consider the latest industry trends in my suggestions for innovative approaches. My first suggestion was the use of Building Information Modelling (BIM) for managing of information regarding the physical and functional aspects of the building. The second suggestion was the use of 3D printing for concrete structures which is a great way to save costs on labour and to increase the speed of the construction process. As per the project requirement, I also summarized the whole project idea into an email to be sent to the client to obtain their approval.

CE 1.3.6

Another assignment was set by the assessor as part of this evaluation; in this case, the client wanted to expand a concrete slab on their current building. They may choose between two major designs: one-way or two-way. Assuming the role of a construction expert, I guided the customer in developing the optimal model.

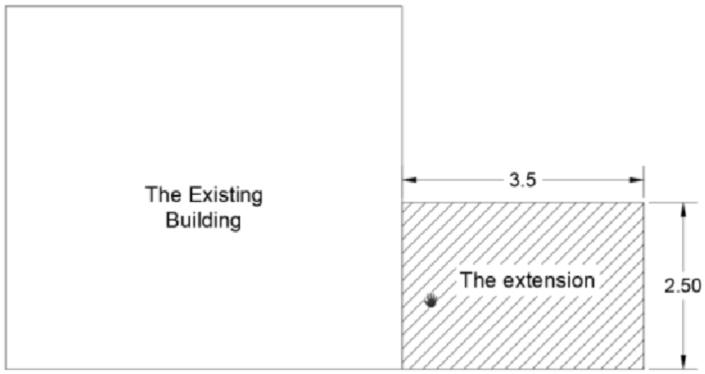

Figure 3: Extension of Concrete Slab on Existing Building

I suggested that if the length (L) was much more than the breadth (B) in the given specifications, a one-way slab was a better option, however, if L and B were comparable, a two-way slab was more appropriate. I knew that a one-way slab distributes the weight in one direction (along the larger span) and a two-way slab distributes load in both directions.

CE 1.3.7

For both one-way and two-way slabs supported by simple supports, I identified that there should be supports along all edges, hence, I recommended a minimum of four supports. I determined that the reinforcing distribution would be determined by the type of slab chosen. For one-way slabs, I knew reinforcing is mostly applied in the longer span direction while in two-way slabs, reinforcement is supplied in both directions. Furthermore, if the client decided to change the slab type, then for a one-way to two-way change, I recommended an increase in the width (B) to make it more equal to the length (L), and redistribute reinforcement. For a two-way to one-way change, I recommended a decrease the width (B) significantly, and to reinforce mainly in the longer span direction.

CE 1.3.8

In another question for this assessment, the assessor had asked to comprehend the design and construction details for a project that involved the implementation of a retaining wall system around the site’s boundaries.

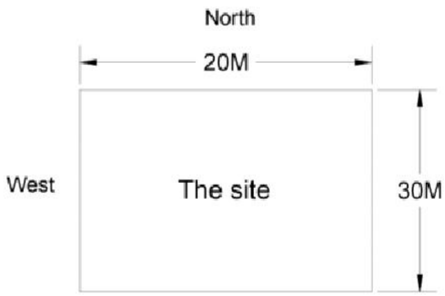

Figure 4: Capping Beam

Based on the detail provided for the retaining wall system, I calculated the total number of screw piles. I followed the procedure of counting the number of piles along each boundary of the site. In order to account for the fact that the piles were 1.5 meters apart along the southern and eastern limits and 1 meter apart along the western and northern ones, I calculated:

$$Total\ number\ of\ screw\ piles:\ \frac{20}{1.5}+\frac{20}{1.5}+\frac{30}{1}+\frac{30}{1}=86\frac{2}{3}$$

To find the excavation quantity, I multiplied the area of the site by the depth of the excavation.

$$Excavation\ quantity = 20\ \times 30\ \times 4 = 2400\ m^3$$

Multiplying the whole capping beam volume by the 2% steel content allowed me to determine the reinforcing volume. I was aware that the 100 m site perimeter, 0.45 m capping beam width, and 0.4 m capping beam depth made up the entire volume of the capping beam. Hence:

$$Reinforcement\ volume = 0.02\ \times 100\ \times 0.45\ \times 0.4 = 0.36\ m^3$$

To find the reinforcement weight, I multiplied the reinforcement volume by the density of steel, which was 7850 Kg/m3. Therefore:

$$Reinforcement\ weight = 0.36\ \times 7850 = 2826\ kg$$

CE 1.3.9

I calculated the volume of concrete by multiplying the entire volume of the capping beam by the percentage of concrete in the beam, which was 98%. I used the same formula as the capping beam's overall volume remained unchanged:

$$Concrete\ volume = 0.98\ \times 100\ \times 0.45\ \times 0.4 = 17.64\ m^3$$

To find the concrete weight, I multiplied the concrete volume by the density of concrete, which was 2400 Kg/m^3. Therefore:

$$Concrete\ weight = 17.64\ \times 2400 = 42336\ kg$$

CE 1.3.10

I was in charge of estimating how much the retaining wall system would cost to build. The following table for cost estimation is what I have completed:

Table 4: Cost Estimation

Items	**Price per unit**	**Final cost**
Prefabricated screw piles	$2700.00	$2700.00 x 87 = $234900.00
Excavation transportation (m^3)	$75.00	$75.00 x 2400 / 35 = $5142.86
Reinforcement cage of cap beam (Kg)	$0.65	$0.65 x 2826 = $1836.90
Moulding	$2650.00	$2650.00
Concrete (m^3)	$250.00	$250.00 x 17.64 = $4410.00
Grout injection	$55000.00	$55000.00
Total		**$303939.76**

The next task was for the slab shown in Figure 5, supported by three supports.

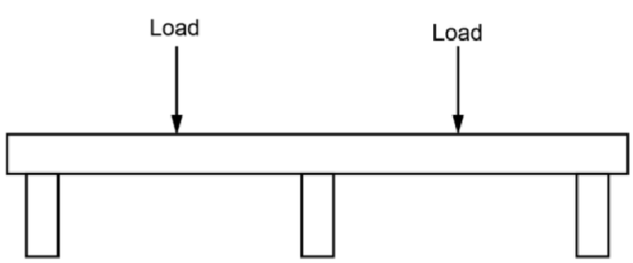

Figure 5: Slab supported by 3 supports

I drew the deflection diagram and showed the regions in tension and compression.

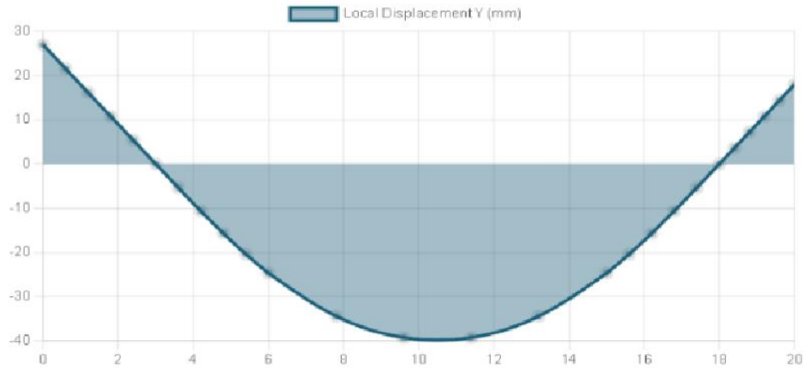

Figure 6: Deflection Diagram

CE 1.3.11

I created Shear Force Diagram (SFD) along with Bending Moment Diagram (BMD) and computed reaction forces of the supports to simply supported beam depicted below.

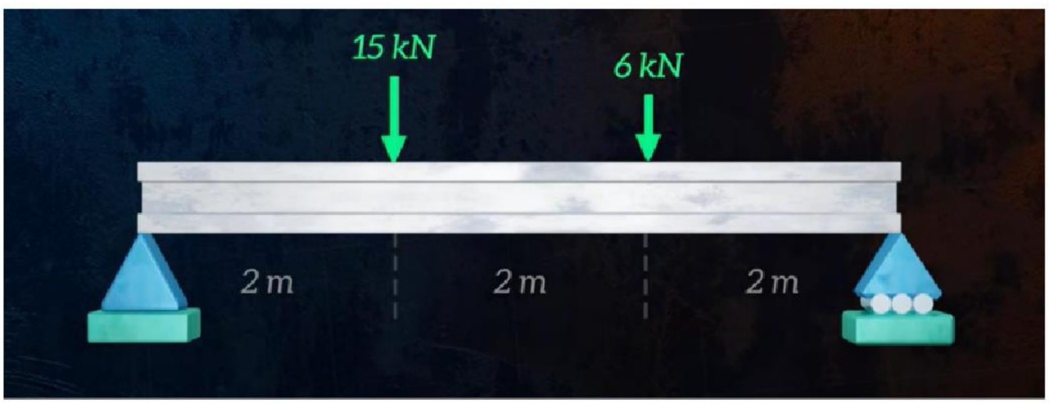

Figure 7: Simply Supported Beam

I knew that in static equilibrium, the vertical forces must sum to zero, therefore, the total reactions (RA and RB) counterbalanced the applied loads (15 kN and 6 kN). Mathematically, RA + RB = 21 kN. For Moment Equilibrium (about A), I balanced the clockwise moment of the 6 kN load with the anticlockwise moment of RB as:

$$RB \times 6m = 6\,kN \times 4m$$

Hence, the value of RB was 4 kN. Substituting RB back into the force balance equation, I found RA to be 17 kN. Therefore, support A (RA) sustained 17 kN, and support B (RB) was bearing 4 kN.

CE 1.3.12

I made the Shear Force Diagram (SFD). I commented at A, initiated with an upward shear force of 17 kN, opposing the downward load. Moving to the right, between A and the first 6 kN load, the shear force maintained a constant 17 kN. At the 6 kN Load, the 6 kN downward load prompted a shear force decrease to 11 kN. Advancing to B, between the 6 kN load and B, the shear force remained steady at 11 kN. At B, the shear force declined to 0 kN at B, given no upward support reaction.

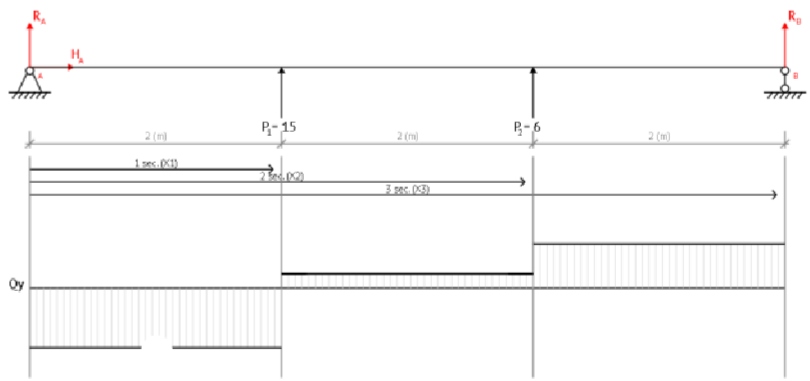

Figure 8: Shear Force Diagram

CE 1.3.13

I drew the Bending Moment Diagram (BMD). I stated at the left support (A) with a bending moment of 0 kN m (since there was no moment at the fixed support). Because the shear force was positive between A and the first load, I inferred that the bending moment would grow linearly as we moved to the right. I knew shear force was directly proportional to the slope of the bending moment diagram. There was an abrupt 6 kN decline in shear force at the location of the 6 kN load application. The bending moment would drop precipitously, as if it were a step function, I calculated. Load multiplied by distance from support (6 kN * 2 m = 12 kN m) was the magnitude of the drop. Due to the positive shear force between the load and the right support (B), the bending moment would keep growing in a linear fashion after I shifted to B. There was a complete absence of shear force at the right support (B). Resultantly, the value of the bending moment would turn out to be 0 kN on the point of the support.

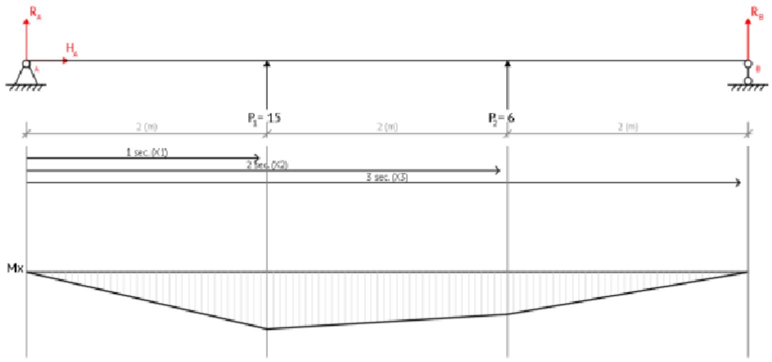

Figure 9: Bending Moment Diagram

Summary

CE 1.4.1

This assessment was a major grading criterion for this course and I was able to complete is successfully up to the satisfaction of the course instructor. It was an individual assessment given out to all students therefore we had to complete it without help. However, the instructor ad allowed us to discuss ideas with each other in the brainstorming phase. I discussed ideas with my class mates and gave them ideas regarding their projects, so it was an endeavour where we all helped each other. It was only because the instructor allowed us to discuss ideas that I went on to do it, however for all individual assessments, I make sure to complete everything on my own. Nevertheless, when we got the graded assessments, we discussed them in our class group and learnt from each other's work. The assessment itself and the whole course was a very good learning exercise for the whole class.

CE1v4

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GRADEMARK REPORT

FINAL GRADE

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GENERAL COMMENTS

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