T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Design and Development for Engineering and Manufacturing (8730-14)

8730-035 Employer-Set Project

Exemplar – E Grade

Summer 2023

City & Guilds | eal

Contents

Introduction **2**

Task 1 Research **5**

Task 2 Design **11**

Task 3 Plan **15**

Task 4 Present **18**

Introduction

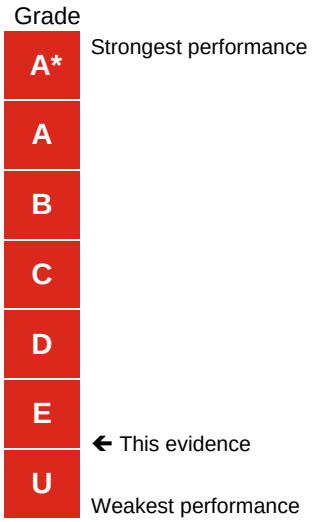
Summer 2023 Results

This document is aimed at providers and learners to help understand the standard that was required in the summer 2023 assessment series to achieve an E grade for the 8730-035 Design and Development for Engineering and Manufacturing Employer-Set Project (ESP).

Providers and learners may wish to use it to benchmark the performance in formative assessment against this to help understand a potential grade that may be achieved if a learner was to attempt the next summative assessment series.

The Employer-Set Project is graded A* to E and Unclassified.

The exemplar evidence provided for the E grade displays the holistic standard required across the tasks to achieve the E grade boundary for the summer 2023 series. A slightly weaker performance would have resulted in an Unclassified (U) result being issued.



The Employer-Set Project brief and tasks can be downloaded from here.

Important things to note:

- We discussed the approach to standard setting/maintaining with Ofqual and the other awarding organisations before awarding this year. We have agreed to take account of the newness of qualifications in how we award this year to recognise that students and teachers are less familiar with the assessments (Vocational and technical qualifications grading in 2023 – Ofqual blog), whilst also recognising the standards required for these qualifications.

- The exemplar evidence presented, as a whole, was sufficient to achieve the E grade. However, performance across the tasks may vary (i.e. some tasks completed to a higher/lower standard than an E grade).

Marking of this Employer-Set Project is by task and Assessment Objective, below is a summary of these along with the mark achieved by the evidence presented and the maximum mark available for each aspect.

Task	Assessment Objectives	Mark achieved	Max mark available
Task 1 Research	- AO1 Plan their approach to meeting the project brief - AO2a Apply core knowledge - AO3 Select relevant techniques and resources to meet the brief	3	9
	- AO2b Application of core skills	2	6
Task 2 Design	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	2	6
	- AO2a Apply core knowledge	2	6
	- AO2b Application of core skills	2	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	2	6
Task 3 Plan	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	2	6
	- AO2a Apply core knowledge	1	6
	- AO2b Application of core skills	1	6
Task 4 Present	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	2	6

	- AO2a Apply core knowledge	2	6
	- AO2b Application of core skills	2	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	1	6
Maths	- AO4a Use of Maths skills	2	3
English	- AO4b Use of English skills	1	3
Digital skills	- AO4c Use of digital skills	1	3

What evidence was being assessed for the maths, English and digital skills:

Maths:

- Annotations on sketches (Task 2)
- Dimensioning and scaling CAD drawing (Task 2)
- Hydrostatic pressure calculations (Task 2)
- Calculation of timescales and critical path within the Programme of work (Task 3)

English:

- Technical brief (Task 1)
- Notes detailing how the designs meet the brief requirement (Task 2)
- Supporting statement for the programme of work (Task 3)
- Presentation delivery (orally) and materials to support presentation (e.g. slides etc) (Task 4)

Digital:

- Types of sources used for Research (Task 1)
- CAD Drawing (Task 2)
- Presentation of the programme of work (Task 3)
- Presentation materials (slides, handouts, notes etc) (Task 4)

Task 1 Research

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1
Evidence title / description	**Evidence expected for marking:** Technical brief (typically 1500 words) Research notes List of references/sources **Evidence submitted for marking:** Research notes Technical brief (typically 1500 words) List of references/sources
Date submitted by candidate	DD/MM/YY

Task 1

Mechanisms

Rack and Pinion can be used to open and close the gate. They are also very efficient as they have 90 percent a efficiency rate. Actuators can be used to help control the vales that the system will use. It will help the water flow out of the lock at the right time.

Technologies

Hydraulic gate closers can be used to close the gate automatically. It will use the pressure of the water to close the gate. An electromagnetic gate could also be used to close the gate remotely. Another way to remotely open the gate is by a transmitter or remote control. The number of buttons usually corresponds with the number of channels the remote has and, therefore, the number of different systems it can operate

Usually, pressing the same button will tell automatic gates to fully open or close depending on their status when the button is pressed. When the relevant button is pressed, the fob sends a signal to a receiver connected to the gate motor controls.

Materials

The lock chamber will either be made out of metal, brick or stone. They can also be made out of oakwood. The gates are made by welding together steel plates and reinforcement beams. The vertical edges of the gates are fitted with effective sealing materials such as white oak. Neoprene rubber can be used for the seals as it is excellent for outdoor use and is highly resistant to water. The EPDM rubber compound is also perfect for this application. The most common material used for hinges in stainless steel. Brass and bronze are also suitable.

Technical Brief

There are different mechanisms that can be used to open and close he gate. One mechanism is the rack and pinion. It can be used for the paddle/valves in which the water enters or leaves the lock. One reason it is effective is because it is suitable to carry high loads up steep slopes. On the rack and pinion type there is a safety catch or pawl which stops the gears from slipping down and keeps the paddle raised when the windlass is removed. They are also very efficient as they have 90 percent a efficiency rate. Systems virtually have no limit on travel length as long as the rack can be made long enough. The max travel length is instead limited by its support structure. The difference in the design and machining quality of the racks makes a difference in performance in noise or accuracy. Ball screws can also be be used as the gates are also very heavy. Motorized slides with ball screws typically carries the load on a carriage that moves along the outside of screw; therefore additional moment load considerations may be necessary for heavier loads. However, the moving speed of the rack and pinion is not as fast as the moving speed of the ball screw. Although ball screws can still move quickly rack and pinion systems can usually provide greater linear speeds, usually with large amplitudes. Rack and pinion systems can reduce the need for external support while increasing transportable mass for vertical applications.

https://commons.wikimedia.org/wiki/File:Lock_gate_ cogs,_Montgomery_Canal_-geograph.org.uk_-_1806427.jpg

A hydraulic system could also be used.. Hydraulic gate systems use hydraulic fluids and high pressure tubing to generate large amounts of power, typically more than enough to open and close a gate of any size. The advantages of a hydraulic system include that fact that there are fewer moving parts. This means that there are less components to wear over time. Gates with hydraulic systems can be made with non-locking capabilities. This means that when they are not in operation the gates are not 'locked' in place by the hydraulics. The notion behind this feature is that non-locking hydraulics protect the system from accidental damage. Some of the advantages are that hydraulics are more powerful which is good because the canal lock gate itself is heavy. They are also easy to maintain which means they will save money on having to repair it all the time. And it will mean that it will not inconvenience boat drivers because the canal gate is not working. They also have a tidy, clean appearance which means it will be aesthetically pleasing to look at. They also have a good cold weather operation which is good because the weather maybe poor on somedays which may normally make it more difficukt to open the gate. A gate valve is generally used to completely shut off fluid flow or, in the fully open position, provide full flow in a pipeline. Thus it is used either in the fully closed or fully open positions. A gate valve consists of a valve body, seat and disc, a spindle, gland, and a wheel for operating the valve. An electrical gate may work if the motors aren't fully submerged. Electromechanical gate systems are great for durability and reliability, with options to install a back-up battery that trickle- charges from the mains supply. This means that even when the national grid isn't capable of delivering power to your gates, the gates can look after themselves. Not only is this very convenient, it's a brilliant safety feature, should you need to exit the property quickly during a power outage.

Automatic Systems

- There are different types of automatic systems that can be used to open or close the gate. For example,

Remote control

Approaching a lock, once pushes the upstream or downstream button. If the signal is received a light will flash and/or the lock's traffic lights will change. Once in the lock operation will be initiated through rods or lines

- **Sensor**

Approaching a lock, the boat passes through a detector beam that signals to the lock machinery in a similar way. It is important not to pass the detector too fast or the beam may be skipped.

- **Perche rod**

- In the lock

Once in the lock there are two rods rods (rarely, lines) set vertically into the lock wall, connected to a gantry at the lock edge. One is red, the other blue. The red is for emergency use only, to stop any operation and communicate the situation to the waterway authority. The blue is lifted sharply to throw a switch in the gantry and start the gate/filling/emptying sequence. On a very few canals there is a control box at the lock side with red and blue buttons to press.

https://www.french-waterways.com/practicalities/canal-locks/
www.bywaterholidays.co.uk
www.sciencedirect.com
blog.orientalmotor.com
www.ecsengineeringservices.com
www.abcboathire.com
www.andersenboats.com

The remote control is a good option because it makes it easy to communicate and signal with the person that is controlling the locks. However, it may not always be reliable as a remote can die at any given time. A sensor is also another good option because it will relay the information to the beam. The role of a sensor in a control and automation system is to detect and measure some physical effect, providing this information to the control system. It is a fully automatic process. The emergency routine is also effective because it allows there to be a process that can be followed instead of erratic decision making. As for the seals the EPDM rubber compound is perfect for this application since it is renowned for being weather-resistant, long-lasting and ozone resistant. This is important because there will be times where the weather is bad and it will be put under a lot of pressure.

The key Requirements

It is important to make sure it the closing mechanism is durable. Durable materials are materials such as steel or stone. They need to be able to withstand strong weather conditions as they maybe be storms or even a flood. They need to be able to withstand corrosion which is another reason stainless steel is good. Wood is good because it can be repurposed at the end of its life. It should also have reliable security such as security cameras and sensors so that no unauthorised person or boat will be able to pass through the canal lock. It shouldn't also be to difficult to use because if it is, if there is an emergency, vital time might be wasted trying to operate the machine. If it is easy to use then there is a lower chance of an accidents occurring. It is very important that the gate is compatible with the boat and it follows the requirements which are; it is fitted with an opening of 4.2 m wide and an overall height of 6m. It must also be able to support a head of water between 2 metres and 5.5 metres during the operation of the lock. If these requirements are not met, the boat might not be able to go through the lock or not be able to reach a suitable enough height to pass onto the other side. The boat might also be drowned. The closing mechanism must also provide adequate strength to make sure it closes properly especially in bad weather conditions. If the gate is not closed properly, the lock would lose all the water and the boat wouldn't be able to make it from one specific section to another.

https://www.martinchilds.com/lock-gates/

Task 2 Design

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

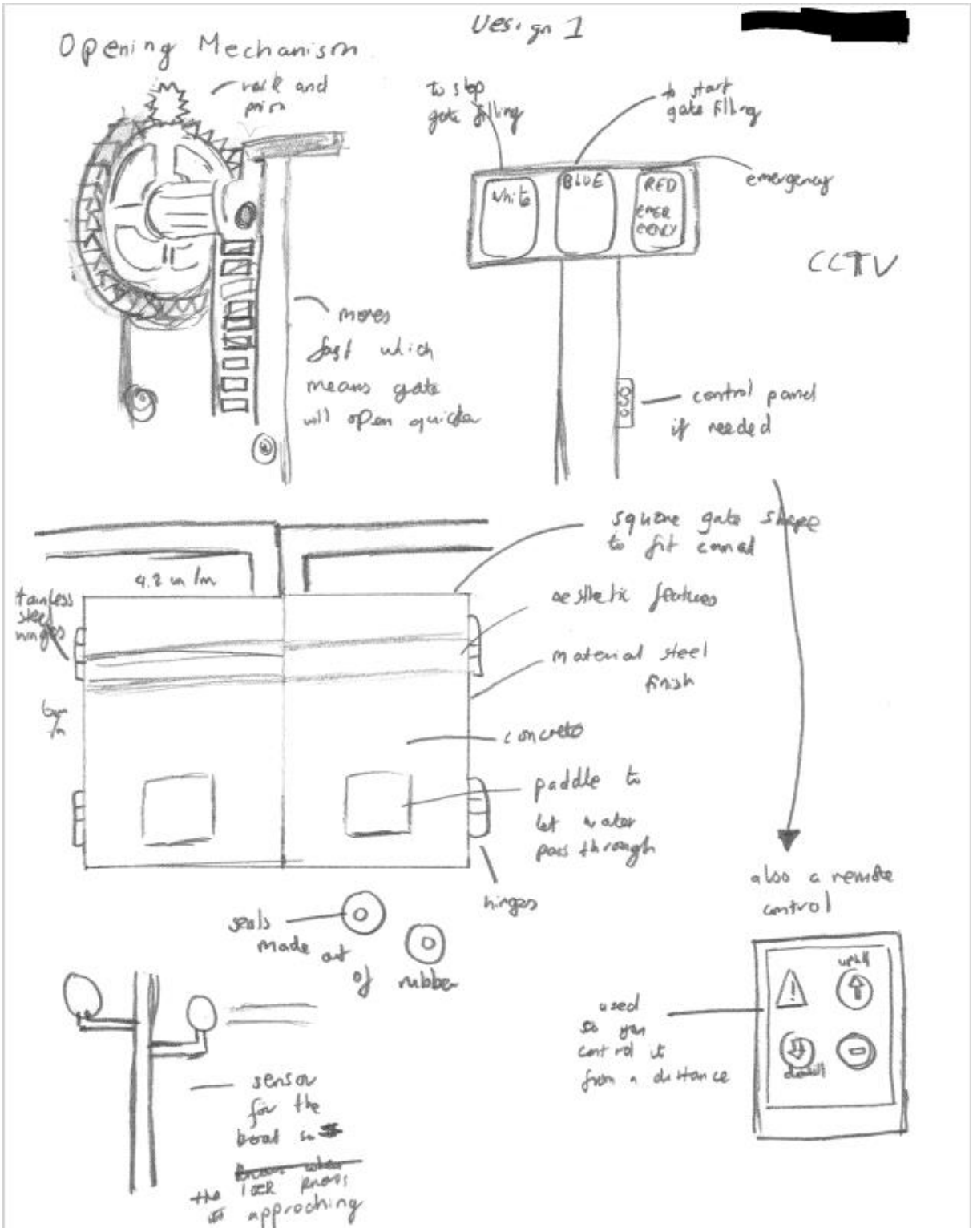
Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	2
Evidence title / description	**Evidence expected for marking:** Sketches for two designs and a CAD drawing Supporting calculations Notes **Evidence submitted for marking:** Sketches for two designs Support calculations (on drawing) Notes
Date submitted by candidate	DD/MM/YY

The canal lock gate will be made out of concrete as it is very durable and strong and can withstand harsh and bad weather conditions. It will operate using a rack and pinion system which is good because it is efficient, works fast and doesn't cost a lot to maintain. It will also have a steel finish and steel joints. Steel is a good material to use as it has high corrosion resistance which means that the gate won't need to be changed or need to keep having maintenance fixes. It is also very durable and has high strength which would help if a collision was to occur. It can also be aesthetically pleasing when a lot of it used as it will shine brighter as opposed to a dull material like wood. There will also be a procedure that happens once the boat enters the lock. There are two rods set vertically connected to the lock wall with a gantry. It will have a red emergency button in case there is an incident that occurs, a blue button that will tell the lock to start filling up and a white button that will tell it to stop filling up. There will also be a control panel on the side of the structure for each button. It can also be controlled by a remote control which would make it significantly easier to use. A phone box will be attached to the side of the control panel so that the lock keeper can be called in case of an emergency. There will also be ways to try to prevent collisions from happening such as having buoys, lights and markers. These will make it easier for people to navigate and see where they are going much more clearly. Traffic control can also be implemented because if a lot of

boats are going to be travelling at once. they could clash. There should also be speed limits so that if people do end up crashing into each other, the damage won't be too significant. One way systems can also be installed. Another way that collisions can be prevented is by having regular maintenance checks on the gates. A sensor will also be installed on land that has a detector beam that the boat slowly has to pass through which will let the locks know that it needs to open automatically. The area needs to 4 by 6.2 metres and it also needs to support a head water of a volume of 11 metres. There are also some sustainable features of the key lock gates components such as the steel. It has a positive impact on the environment which makes it a more positive material to use. I'm also non toxic coatings to prevent the gate from corroding and be more eco friendly. This will help by not destroying the surrounding eco systems. The sensors are new and smart technology that can detect any incoming problems before they even occur.

Such as a boat that is in an unauthorized area. It also reduces the need for the gate to keep being repaired. For my second design, it will use a hydraulic pressure system to open the gate. This is a good system to use because it is very eco friendly and minimises greenhouse emissions. It also has curved edges to make it look aesthetically pleasing. It will be made out of wood because it is a sustainable material and can last for a very long time. The hinges will also be made out of rubber to withstand strong forces. It will be finished with aluminium to give it a nice vibrant look. Overall, I will be choosing the first design. It is more efficient and is more aesthetically pleasing.


Opening Mechanism
Design 1
[redacted]
rack and pin
moves fast which means gate will open quicker
to stop gate filling
to start gate filling
emergency
White
BLUE
RED
emergency
CCTV
control panel if needed
square gate shape to fit canal
4.2 m / m
stainless steel hinges
aesthetic features
material steel finish
concrete
paddle to let water pass through
hinges
also a remote control
seals made out of rubber
used so you control it from a distance
up
down
sensor for the boat so the lock knows the approching

[redacted]

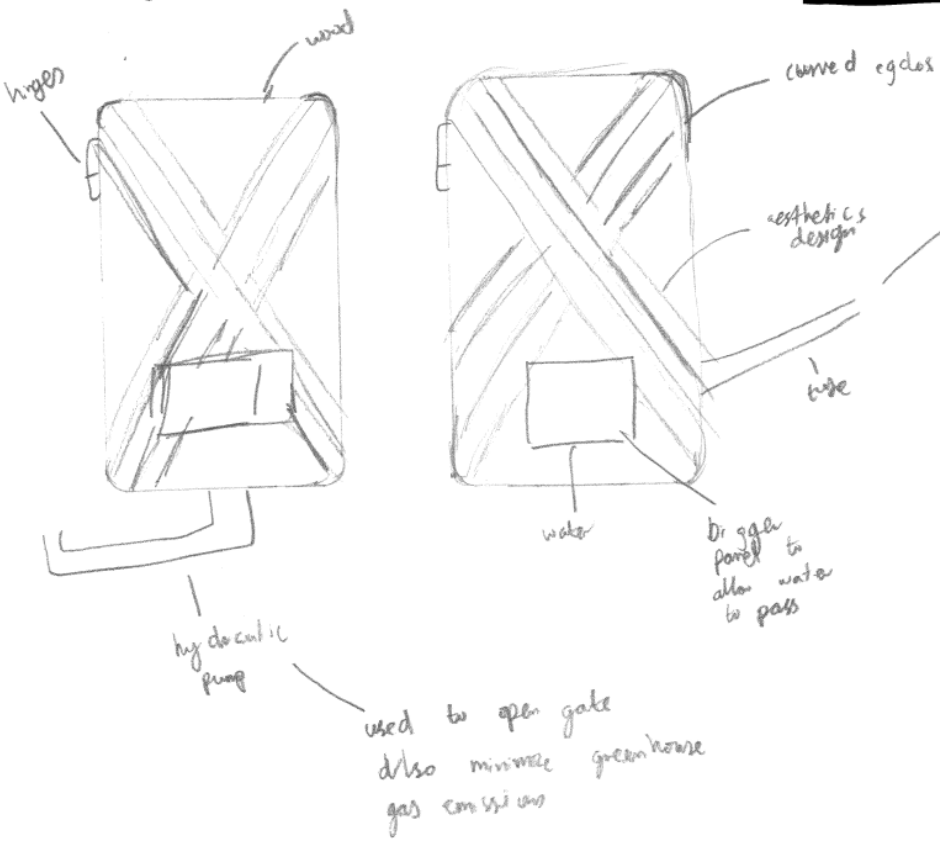
To work out hydrostatic calculations:

~~4 × 6 m~~ $4.2 \times 6 = 25.2\ m^2$

$2 \times 5.5 = 11\ m^2$

Design 2

[redacted]



water recycling system to save water

Hydrostatic calculations

$42 \times 6 = 25.2m$

~~9*~~ $9.81 \times 2m \times 1000 = 19620\ m^2$

Force = pressure x area

~~berg~~ gravitational potential energy

Task 3 Plan

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	3
Evidence title / description	**Evidence expected for marking:** Programme of work plan (one side of A4) Supporting statement (typically 1000 words) **Evidence submitted for marking:** Programme of work plan (one side of A4) Supporting statement (typically 1000 words)
Date submitted by candidate	DD/MM/YY

Programme of work plan

There are 4 key stages for any project. The first is the actual designing of the product. The designing of the product is extremely important because you need to know exactly what you want your product to look like. It details everything about the lock gates specifications, material and etc. The next important stage is the development of the design. This will be where the lock gate is constructed and all the materials and resources that are needed to make the gate will be gathered. The next stage is the stage where the gate undergoes testing to see whether it is fit for use. Testing is important because it could save a lot of time and money in the long run. For instance, if an accident where to occur, you would already know how much impact the gate can take and whether the gates material is suitable for the environment or not. The next stage is where the gate is actually installed and ready for use. At this point you can also add any extra pieces to the gate and make modifications. There are many different technologies and resources that will be required to install the lock gate. For example, a crane may need to be used to lift different parts in and out of the water. There may be need of other lifting equipment as well. Welding equipment will be needed and vehicles will also be needed to transport different parts of the gate between places. Vans and boats will be needed to carry materials and other resources. A boat will be needed when constructing the gate in the water. Harnesses, ropes and a life boat may be needed in case of an emergency.

These are all important and crucial items to have because they will help prevent bad situations and injuries such as drowning or dying. The correct materials and components will also need to be gathered such as steel, concrete, hinges and seals. The duration of the activities will be as follows.

Design- 12 weeks

Development- 14 weeks

Testing – 5 weeks

Installation- 22 weeks

The critical path happens during the installation stage and if it goes overtime, it could interfere with the rest of the project.

Supporting statement

The design of the lock gate is a crucial part of the water industry as it helps to move a vehicle such as a boat from one place to another. Because of this, many things need to be considered such as health and safety risks, waste management and environmental considerations. This statement is going to justify the programme of work plan considering all these things listed. Firstly, the health and safety of the workers is important to the success of this project. A risk assessment should be carried out before anything is made or installed to mitigate the risk of injuries happening and to make sure that the workers are operating in a safe environment. The risk assessment is necessary as it will protect workers and ensure that all problems are addressed before moving on. Workers must be provided with suitable PPE to ensure their safety and to mitigate the risk of injuries happening. If the workers are not provided with the suitable PPE required to carry out the

job, the company would be at fault and would face serious consequences. If no risk assessment is carried out then people could get injured and the lock gate wouldn't be able to be constructed. There are also standards and regulations that need to be met such as the Health and Safety at Work (1974), the Construction Design legislations, and The Management of Health and Safety at Work. These legislations/regulations must be met to make sure that the process of building the lock gate is safe and it will also ensure that it is fully functional. This also means that any equipment that is used has to match the regulations. If they don't comply with the regulations, accidents and injuries could occur which would damage the company's reputation and could get them into legal problems. The specialist equipment that is being used also needs to be suitable for the making of the lock gate. It will involve using cranes, harnesses, helmets, ropes, vehicles such as vans and boats and welding and fabricating equipment. All of these pieces of equipment are needed for the lock gate to be made successfully. Without specialised equipment like the ones mentioned above, the lock gate will not be able to be constructed safely and successfully. If someone were to do the job if one of these pieces of machinery or without it, they would be at a great risk of being injured or even possibly dying. At the same time, the equipment needs to meet all of the projects requirements or it could be unsuccessful and also cause injuries and accidents. If the requirements are not followed, the company could lose money on purchasing the wrong equipment and still not have a lock gate built at the end of the day. Waste management is a very crucial part to the design of functionality of the lock gate. The project must make sure to follow all regulations concerning waste management and consider the environmental impacts the gate would have in the area. This needs to be done so that local authorities don't ask for the gate to be taken down. If this were to happen, all of the money that was put into the project would have gone to waste. The environmental impact that the gate will have should be considered before the project starts. This will allow the gate to be made in such a way that it doesn't have a negative impact on the environment. The materials used affect the environment so it is best to use materials such as steel that have a low environmental impact. It would also be preferred to use water saving devises to reduce the money spent on energy and to also minimize water wastage. It must also be energy efficient so as to save money and reduce the environmental impact. The gate should also be monitored during its construction to see how it affects its surroundings in order to make sure it doesn't have a negative impact on its surroundings. The assumptions related to resources must be looked at carefully before starting the project. It is important to make sure that there is a plan in place that identifies how the resources such as the materials, hinges and seals, PPE, cranes, harnesses and welding equipment are going to be acquired. The availability of the resources needs to be confirmed before commencing with the project otherwise a lot of time would be wasted. This would also create a loss of money. It is important to carefully examine your budget covers the resources that you need. In conclusion, it is important to consider the design, development and installation of the lock gate to make sure that it is fully functional and doesn't pose as a danger to the environment or to others. It must follow all the relevant standards and regulations, comply to all risk assessments, health and safety risk assessment requirements and consider waste management and environmental considerations. This will allow the project to be successful and run smoothly. It will also help to identify where mistakes were made along the line (if there are any). The successful construction of the lock gate will allow boats or any other vehicles to pass through safely.

Task 4 Present

Assessment number (eg 1234-033)	8730-035
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	4
Evidence title / description	**Evidence expected for marking:** Presentation materials **Evidence submitted for marking:** Presentation materials
Date submitted by candidate	DD/MM/YY

Canal Lock Gate Presentation

The Key Features of the Design

The lock gate is made out of concrete which is very durable and strong. This will allow it to withstand harsh weather conditions.

It will also operate using a rack and pinion system which is good because it is efficient, works fast and doesn't cost a lot to maintain. It will also have a steel finish and steel joints. Steel is a good material to use as it has high corrosion resistance which means that the gate won't need to be changed or need to keep having maintenance fixes.

Employer-Set Project – Presentation Q & A Record (Task 4)

8730-12 T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing

8730-033 Employer-Set Project (Summer 2023)

Candidate name	8730-035
City & Guilds candidate No.	ABC1234
Date	DD/MM/YY

Provider name	<provider name>
City & Guilds Provider No.	999999a

Record observation notes below to inform external marking. **Notes must be detailed, accurate and differentiating.**

Tutor questions to candidate	Candidate responses
What will be most problematic about maintaining the new gate and mechanisms?	The rack and pinion if that broke would be hard to fix.
What part of the design project did you find most challenging?	Working out the hydraulic calculations for the pressure of water at the gate
How sustainable is your design	The materials are environmentally friendly

Any other comments

Tutor signature	Date
X _____	DD/MM/YY

If completing electronically, double click next to the ‘X’ to add an electronic signature once the record is **finalised**.

Get in touch

The City & Guilds Quality team are here to answer any queries you may have regarding your T Level Technical Qualification delivery.

Should you require assistance, please contact us using the details below:

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W: **http://www.cityandguilds.com/tlevels**

Web chat available **here**.

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