Oide

Tacú leis an bhFoghlaim Ghairmiúil i measc Ceannairí Scoile agus Múinteoirí

Supporting the Professional Learning of School Leaders and Teachers

Engineering

Professional Learning Booklet

2025-2026

Session 1:
Engage with the specification, examining the rationale, aims and the overall structure of the subject.

Session 2:
Examine the strands in detail. Engage with a learning experience that encourages an integrated approach to the practical and theoretical aspects of the specification.

Session 3:
Explore new elements of the Engineering specification, within the Automation and Control Systems strand through an applied learning experience.

Rationale

Engineering is a dynamic field focused on designing, realising, manufacturing, and testing solutions to practical problems. It plays a pivotal role in addressing contemporary challenges, fostering innovation, and promoting sustainable living within a circular economy. Engineering requires a blend of theoretical knowledge, practical skills, and a creative mindset. It promotes active learning while fostering effective problem-solving techniques through the application of scientific principles to real-world scenarios.

As part of the technology education suite of subjects, **Leaving Certificate Engineering** enables interdisciplinary learning, enriching students' overall experience. Engineering equips students with practical, cognitive, and technical skills for today's dynamic world, fostering teamwork, communication, and innovation. It helps them understand and address local, national, and global challenges, driving societal and economic progress.

Leaving Certificate Engineering emphasises the importance of ethical responsibility and the value of repair over replacement, which are essential values, helping students to understand the social and environmental consequences of business practices, cultivating a positive attitude toward enterprise and innovation. Leaving Certificate Engineering reflects the importance of engineering in society, inspiring STEM careers and enhancing technological literacy.

Aims

Leaving Certificate Engineering aims to develop a deep appreciation and understanding of the importance of sustainable and ethical engineering solutions for society. More specifically, Leaving Certificate Engineering aims to:

- foster an awareness of the environmental, social, and economic impacts of engineering decisions and promote sustainable practices and ethical responsibility.
- enable students to learn about the core concepts, processes and principles of engineering.
- develop the students' capability, accuracy and precision using resources and equipment available in the Engineering classroom in a safe and appropriate manner.
- foster an engineering mindset, by enhancing creativity, problem-solving skills and design thinking through practical applications to engineering problems.
- develop students' capacity to effectively articulate ideas, designs, and solutions through various media, enhancing collaboration and engagement.
- encourage the development and application of theoretical knowledge in a systematic way.
- provide a broad educational experience that prepares students for future studies and the workforce as well as developing awareness of future careers and opportunities.

Strand 1: Engineering Processes

This strand explores the fundamental concepts and practices that underpin modern engineering, with a particular focus on manufacturing technologies. Through a blend of theoretical and practical application, students gain a comprehensive understanding of the processes involved in creating products, from initial design and material selection to production techniques and quality control. They explore a range of manufacturing technologies and their applications, including traditional methods as well as modern and digital technologies used in process automation.

The strong practical focus promotes the development of technical knowledge, manual skills, enabling students to approach manufacturing problems with confidence, creativity, and a forward-thinking mindset. They learn to analyse and select appropriate materials for different products, ensuring designs meet specific functional, safety, and sustainability criteria. They interpret and produce engineering drawings in compliance with drafting conventions and standards.

Students also come to appreciate the importance of optimising materials and processes to improve efficiency and reduce waste in manufacturing. This strand also promotes the problem-solving and critical thinking skills required to overcome manufacturing challenges, cultivates resilience and adaptability as students iterate their designs to meet evolving needs and constraints.

Strand 1 Learning outcomes

Students learn about	Students should be able to
• engineering developments past, present and in emerging areas. • engineering practice considering tools, equipment and materials.	**1.1** evaluate and discuss the evolution of engineering practice.
• how engineering contributes to the quality of daily life, ethics, sustainability and societal impact. • the contributions of notable engineers and scientists and the impact of their work.	**1.2** describe the impact that engineering developments have had on our world.
• engineering professions and pathways, to include an awareness of the main engineering disciplines for example mechanical engineering, materials engineering, aeronautical engineering, quality engineering or environmental engineering.	**1.3** describe the role of the engineer within a range of engineering disciplines.

Students learn about	Students should be able to
• the ethical issues involved in engineering including social, economic and environmental considerations and what measures can be put in place to promote them. • the principle of sustainable practices to include rethink, reduce, reuse, recycle, and the right to repair.	**1.4** evaluate the environmental considerations, economic, and societal impacts of engineering decisions in historical and modern times.
• manufacturing processes and technology, including machining processes, thermal and non-thermal assembly techniques and manufacturing techniques • transferring measurements and details from a working drawing to a workpiece, ensuring precision and adherence to specifications. • the skills that are applicable in the engineering classroom to include both manual and automated processes. • best practice of health and safety in the engineering classroom	**1.5** demonstrate proficiency in the use of measuring instruments, handcraft skills, machining techniques and assembly techniques on a range of materials, ensuring an adherence to precision, quality and finish. **1.6** describe and use a range of additive and subtractive manufacturing techniques. **1.7** describe the fundamental principles and theories of manufacturing processes and assembly techniques and apply appropriately to a range of contexts for required applications. **1.8** demonstrate proficiency in using hand and machine tools. **1.9** apply safe working techniques and practices and display an awareness of the importance of health and safety.
• digitally controlled manufacturing equipment and techniques	**1.10** describe the fundamental concepts and principles of computer aided manufacturing techniques. **1.11** export data from CAD software systems to manufacture components. **1.12** perform a manufacturing sequence on digitally controlled equipment. **1.13** recognise emerging trends and technologies in digital manufacturing.
• the treatment of materials to alter their properties for specific applications. • key criteria for selection of the optimum material for a particular application based on its properties.	**1.14** explain the effects of heat treatments on materials, their properties, and their applications. **1.15** select appropriate materials for required applications based on their properties, displaying an awareness for sustainable design and the impact on our environment.

Students learn about	Students should be able to
• planning and managing the manufacture of a product. • working in cooperation with others and reflecting on their own contribution.	**1.16** plan the manufacturing sequence for a range of projects and tasks. **1.17** manage time and resources within the allocated timeframe to produce a product. **1.18** evaluate and critically reflect on the outcome of work completed. **1.19** document work appropriately in tandem with a design process.
• measurement and metrology, to include application of the SI system, standardisation and calibration of measuring equipment.	**1.20** describe the necessity for a unified system of measurement.
• the use of precision measuring equipment.	**1.21** demonstrate the correct use of simple and precision measuring tools and processes.
• intelligent and sustainable manufacturing technologies and innovations. • contemporary automated manufacturing systems, and the technologies used in them.	**1.22** evaluate developments in manufacturing technologies and their impacts on manufacturing and society. **1.23** outline the features and the operations of an automated manufacturing facility.
• quality assurance in product design and manufacture. • fundamental concepts of reliability.	**1.24** describe key concepts involved in quality management, statistical process control and sampling. **1.25** explain machine maintenance intervals and outline examples of preventative maintenance.

Strand 2: Automation and Control Systems

In this strand, students will study the principles of mechatronics and control, with a specific focus on smart manufacturing and digital technologies. The strand encourages learning by doing, where students are expected to design, build, and test control systems in the engineering classroom, gaining both theoretical knowledge and practical skills. Mechanical and electronic control systems are explored, integrating learning from Strand 4 and its applications in project realisation in Strand 1.

The learning outcomes in this strand begin with system analysis, inputs, and outputs, before advancing to local, remote, and autonomous control. Students will learn system analysis techniques, enabling them to capture the behaviour and communicate the functional requirements of systems involving automation and control. They will use a structured and systematic approach to map inputs, outputs, and their interactions, establishing a clear understanding and specification for system functionality. Additionally, they will learn to design and build circuits involving sensors and actuators and employ them in practical applications.

For local and remotely controlled systems, students will learn about the design and implementation of Human Machine Interfaces (HMI) and the hardware and software required to provide local and wireless communication technologies for monitoring and control. The strand culminates in a focus on autonomous control systems, where students will learn about closed-loop control systems, Artificial Intelligence, machine learning, and robotics. They will apply this knowledge to automated systems in a design, make, and test project.

Through hands on experiences, students will identify and configure the hardware and software needed for automated systems and perform the analysis and testing required for their implementation. They will develop skills in building circuits, using test equipment, and debugging code and hardware systems.

Strand 2 Learning outcomes

Students learn about	Students should be able to
• mechatronic systems and their applications. • system analysis techniques to capture and communicate the operation of control and monitoring systems.	**2.1** determine the functional requirements of an engineering control system. **2.2** model systems inputs, processes, outputs, and the relationships between them using state machine diagrams. **2.3** recognise the key role that control and energy systems play in engineering.
• hardware and software inputs and outputs required for control and monitoring of hydraulic, pneumatic, electronic, electrical and computer-based systems.	**2.4** identify appropriate inputs and outputs for an automated system. **2.5** specify and configure sensors and actuators for a range of simple automated systems. **2.6** describe the design of a control system using an appropriate technical format.

Students learn about	Students should be able to
• selecting the energy requirements and sources for a specific control system.	**2.7** identify suitable energy sources to meet input and output requirements. **2.8** evaluate the relevant inputs and outputs for any energy requirements. **2.9** recognise the importance of energy efficiency and the necessity to use renewable energy sources.
• approaches to designing Human Machine Interfaces (HMI) to provide a system with local control and monitoring capabilities. • safety standards and protocols	**2.10** appreciate control and monitoring design practice, in terms of the user experience, safety and inclusion. **2.11** implement hardware, software, local control and monitoring interfaces using system analysis specifications.
• remote access control and monitoring facilities, using wired and/or wireless based communications.	**2.12** use wired and/or wireless communication techniques to remotely control devices. **2.13** test and debug wired and/or wireless communication control and monitoring systems.
• open and closed loop control systems. • autonomous control systems such as electromechanical and mechatronic control systems. • automation projects and how to include the design, manufacture and testing of control systems.	**2.14** describe the difference between open and closed loop control systems. **2.15** describe the advancements of autonomous control systems. **2.16** describe the role of control systems in advanced manufacturing and society. **2.17** solve design problems using suitable levels of control and automation technology.

Strand 3: Design Capability

In this strand, students will explore the creative and analytical processes involved in designing products with a manufacturing output. It emphasises the use of design principles and engineering tools to develop solutions to real-world problems, culminating in a fully developed design that can be manufactured in the engineering classroom. The strand draws on learning from Strand 4 to support design calculations, Strand 2 for the automation of designs, and feeds into Strand 1 where the design solution will be realised.

Through hands-on projects, students learn about visual communication, iterative problem-solving, and technical design, while deepening their understanding of the issues affecting the manufacture of their designs. They develop the ability to use freehand sketches and digital models to visualise concepts, document their designs, and analyse existing technical drawings, fostering both creativity and precision in representing design ideas.

A systematic and iterative approach to problem-solving is encouraged. Students apply this process to their design briefs, maintaining a portfolio to document the design from concept to solution. This approach helps students develop logical thinking and effective planning.

Students learn to incorporate environmental considerations and ethical decision-making into their designs. By exploring concepts such as product life cycles and the sustainable use of materials, they develop an understanding of how their choices in materials and processes can impact both the product and society over time.

There is a strong emphasis on the technical aspects of the design process, including specifying components, generating working drawings, and integrating CAD models with manufacturing processes. The strand explores the role of prototyping and testing in refining designs, using software and hardware for simulations, and creating physical prototypes.

Students will develop an understanding of how engineering design principles are applied from initial concept through to the final product, the trade-offs between functionality and manufacturability, and the integrated nature of the design and manufacturing processes in engineering.

Strand 3 Learning outcomes

Students learn about	Students should be able to
• communication of design principles and concepts using a range of media including sketching, digital and physical models.	**3.1** use sketching in visualising concepts and documenting designs. **3.2** create models to communicate the physical form of a design. **3.3** communicate engineering concepts and designs using appropriate media incorporating technical symbols and norms.
• interpreting, creating and transferring engineering drawings in compliance with drafting standards.	**3.4** analyse and interpret technical sketches and drawings to extract relevant information. **3.5** create engineering working drawings that adhere to established drafting standards.

Students learn about	Students should be able to
• the engineering design process as an iterative approach to a design problem. • design for manufacture and design for assembly • following a systematic process to arrive at a solution to a design brief and documentation of the process.	**3.6** describe and apply the steps involved in the engineering design process. **3.7** create a design folio to document and evaluate the engineering design process.
• sustainable and ethical design including reuse, remanufacture and modular design. • ethical sourcing, energy optimisation, and design for safe use.	**3.8** demonstrate sustainable design practices incorporating ethical design decisions and appropriate safety considerations.
• the product lifecycle.	**3.9** describe the main stages and characteristics of the product lifecycle.
• systems thinking related to product design and functionality. • human factors and ergonomics in design.	**3.10** apply principles of product functionality during the design process. **3.11** apply principles of human-centred design and universal design.
• specification of mechanical and electrical components. • principles of Engineering design including the design of machine elements, mechanisms and powered systems. • using SI units, basic and derived, for measurement and calculations, and giving due consideration to the limits of the precision and accuracy of measurement	**3.12** use engineering judgement and/or basic calculations to specify mechanical components. **3.13** select the correct electrical components for engineering applications using technical data. **3.14** calculate the specifications and dimensions required for the design of machine components and powered systems. **3.15** apply tolerances, limits and fits to the design of assembled components.
• prototyping and testing in design. • key testing concepts and terminology in engineering.	**3.16** create working prototypes to explore ideas, test functionality and refine design decisions. **3.17** appreciate the importance of testing in the engineering design and product development process.

Strand 4: Engineering Principles and Energy

In this strand, students explore the fundamental concepts that underpin engineering design, manufacturing processes, and energy systems. The focus is on understanding the properties and behaviour of materials, the application of mechanical and electrical principles, and the use of the SI system in engineering calculations. This approach ensures that students gain the necessary skills to apply theoretical knowledge in practical, hands-on projects, helping them understand how these principles influence design decisions and manufacturing outcomes.

Students will learn about the SI system of units and the importance of a standardised measurement system in engineering, providing a foundation for performing accurate calculations in various engineering contexts. They will develop their knowledge of materials and their applications in engineering, learning about the engineering properties of materials, how these properties are measured, and how to apply this knowledge in the design of engineered artifacts.

Energy management is a crucial component of this strand. Students will evaluate the energy requirements for various control systems, considering efficiency and the use of renewable energy sources. They will also use SI units to quantify energy needs and conversions, promoting a practical understanding of energy conservation.

Additionally, students will learn to apply calculations related to forces, motion, and load-bearing components, as well as the design of mechanical systems such as gears, linkages, and power transfer systems. This application of principles in the design process reinforces the importance of an analytical approach in solving real-world engineering problems.

Students will also learn about the design and troubleshooting of DC circuits, motors, and pneumatic and hydraulic systems, which they will integrate into control applications in Strand 2.

Strand 4 Learning outcomes

Students learn about	Students should be able to
• the SI system of units. • derivation and conversion of SI units.	**4.1** calculate engineering quantities using appropriate SI units for design and manufacture.
• the production of materials including metals and non-metals and their impact on the environment.	**4.2** describe the production of engineering materials.
• sustainable management of natural resources.	**4.3** explain the impact of production and disposal of materials on the environment.
	4.4 identify approaches used to conserve natural resources.
• material testing.	**4.5** describe the various tests available to assess material properties.
	4.6 interpret and communicate test data from material tests to make informed material selection choices.

Students learn about	Students should be able to
• the relationship between the microstructure and macro properties of a range of engineering materials. • creating and interpreting phase diagrams	**4.7** describe the relationship between microstructure and material properties. **4.8** explain the effects of heat treatment processes for altering the properties of metals. **4.9** identify the effects of mechanical working on material properties.
• corrosion to include galvanic corrosion, stress corrosion, intergranular corrosion, fretting corrosion, sacrificial and cathodic protection.	**4.10** explain the process of corrosion and preventative measures.
• the concepts of work, energy and power. • forms of energy and energy conversions. • the principle of conservation of energy. • energy efficiency, energy dissipation and energy storage.	**4.11** calculate the requirements for energy, work and power in the context of engineering systems. **4.12** describe the energy conversions occurring in engineering systems and processes. **4.13** analyse closed systems or steady flow systems using a simplified energy balance. **4.14** calculate mechanical and electrical power demands and the energy efficiency of engineering systems.
• fundamental principles of mechanics, including loads, forces and motion.	**4.15** describe the types and applications of forces and motion. **4.16** apply calculations of static forces in the design of load bearing elements and components.
• elements of machine design. • mechanics of machines to include the specification of machine components. • geared systems, and mechanisms. • using calculations as part of the design process.	**4.17** design linkages and mechanisms to produce given motion profiles. **4.18** describe and use different power transfer systems and drive systems. **4.19** calculate and determine friction forces for drive and braking applications. **4.20** calculate mechanical advantage, velocity ratio and efficiency for simple machines. **4.21** apply calculations for forces and power in the specification of mechanisms and motor driven systems.

Students learn about	Students should be able to
• AC electrical systems. • voltage, current and power in DC circuits. • DC circuit design, motors and power.	**4.22** identify and describe applications of AC and DC based power.
• sensor and drive systems in DC circuits.	**4.23** analyse DC circuits for sensor and drive systems.
• the functions and application of off the shelf electronic components.	**4.24** design and build circuits to integrate with control applications.
• fluid based systems. • basic concepts of pneumatic and hydraulic systems.	**4.25** calculate the forces acting on master and slave cylinders involving static fluid pressure using Pascal's Law. **4.26** interpret and apply fluid circuit diagrams involving valves, cylinders and energy supplies. **4.27** describe the applications of fluid-based systems in real life.

Teaching for student learning

Engineering practice is a blended experience of practical application supported by the theoretical principles of engineering. For the student this means behaving like an engineer through hands-on experience of design ideation, trial and error, informed by a deep understanding of engineering concepts and principles. Leaving Certificate Engineering places the student at the centre of the educational experience, emphasising practical, hands-on engagement with engineering concepts and the development of an engineering mindset. The subject supports a wide range of teaching and learning approaches, allowing teachers to adapt their methods to meet the diverse strengths, needs, and interests of students.

The development of technical and processing skills is fundamental to the subject. A central pedagogy in Leaving Certificate Engineering is problem-solving through design and manufacture. Students are encouraged to integrate theoretical knowledge with practical application, developing design solutions and refining ideas while exploring the discipline of engineering. This approach allows students to engage critically with engineering and its impact on the real world. By iterating and testing their solutions, students gain insights into the constraints and possibilities available.

Students will learn to analyse a given problem to determine specific design criteria, consider appropriate materials and manufacturing processes to create a functioning prototype. Additionally, students are encouraged to design and conduct tests, interpret test data, and reach evidence-based conclusions to inform their work. Students are encouraged to effectively communicate their work using a range of media.

The opportunity to work independently provides students with autonomy to take ownership of their learning. This builds confidence and encourages students to think and act like engineers, drawing on both creativity and critical thinking to solve problems. Projects can also be designed to include collaborative work, promoting teamwork and the sharing of ideas.

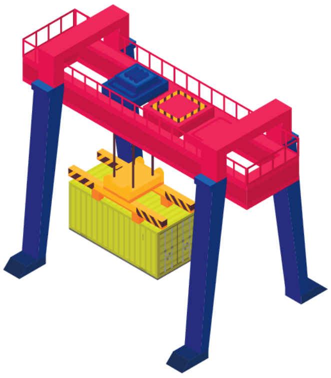
Students are encouraged to consider the environmental, social, and economic impact of engineered solutions. This includes making informed choices about materials prioritising renewable or recyclable options to ensure their designs reflect principles of sustainability.

The inclusion of modern and digital manufacturing technologies in Leaving Certificate Engineering provides a forward-looking dimension to classroom activities, ensuring the subject remains relevant in a rapidly evolving field. These technologies allow students to visualise, design, and manufacture with precision, fostering creativity and innovation while providing a tangible connection to modern engineering processes. By integrating these modern tools and processes into practical tasks, students gain hands-on experience with the technologies shaping the future of engineering.

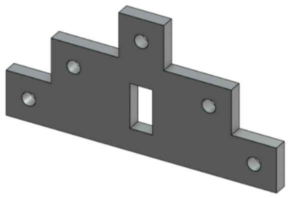
Learning experiences are designed to promote inclusivity, with varying levels of teacher intervention and differentiated activities tailored to the individual needs and abilities of students. The use of approaches such as adjusting the degree of proficiency required, varying the amount and the nature of teacher intervention, and varying the pace and sequence of learning promote inclusivity and cater for diverse needs.

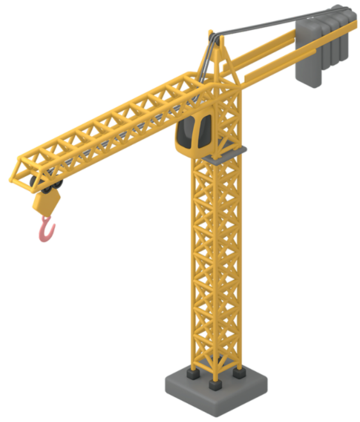
A variety of assessment strategies and instruments are used to evaluate both theoretical understanding and practical application. These assessments may include project-based work, practical demonstrations, presentations and written reflections, ensuring a holistic evaluation of student learning. Formative feedback and self-assessment are integral to this process.

The pedagogical approaches in Leaving Certificate Engineering encourage the students to develop the knowledge, skills, values and dispositions needed to approach engineering challenges with confidence. By fostering curiosity, creativity, and a sense of interconnectedness within the discipline, the learning in Leaving Certificate Engineering prepares students to think critically and contribute meaningfully to the world of engineering and beyond.



Structural Design





Problem:

Cranes are an integral part of engineering and construction industries across the globe. Their light weight design and ability to transfer considerable weight over large distances and heights is a feat of modern engineering. Each and every component of a crane has been designed based on solid engineering principle and evidence.

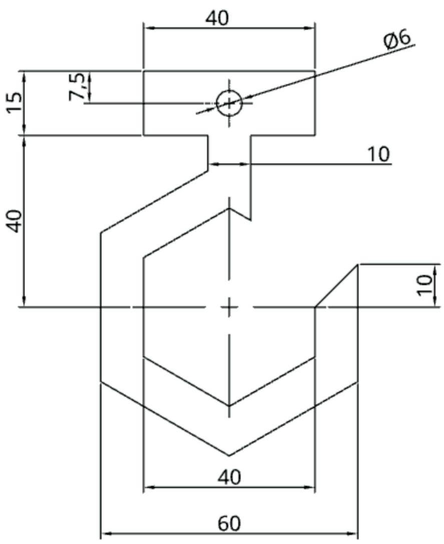
You have been tasked with designing and making 1 of 2 components of the crane design. You must document the factors that impact the structural integrity of the component and from your findings justify your final design. Your design should be based on the evidence you document through your learning journey.

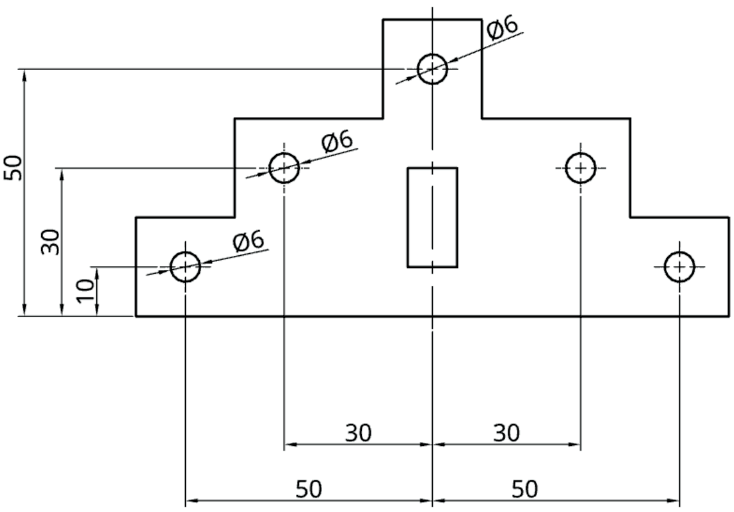
Crane Hook:

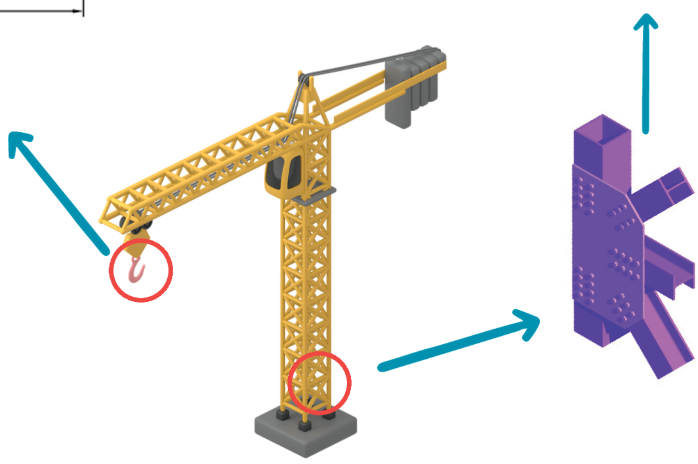
You must **design and make** a **hook** to attach to the end of the crane lift system to incorporate the **outline specifications below**. The **profile shape** must be as **structurally strong as possible.**

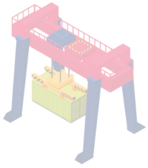
Gusset Plate:

You must **design and make** a **gusset plate** to connect and **support structural members** on the crane. The **profile shape** must be as **structurally strong as possible.** The plate must **facilitate the fixed dimensions below.**









Prediction

Before you test a basic gusset plate design, can you make a prediction?

Do you think the gusset plate profile shape will have an impact on the performance of the plate? Justify your answer.

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____

What factors do you think will have the greatest impact on the performance of the gusset plate?

1.____

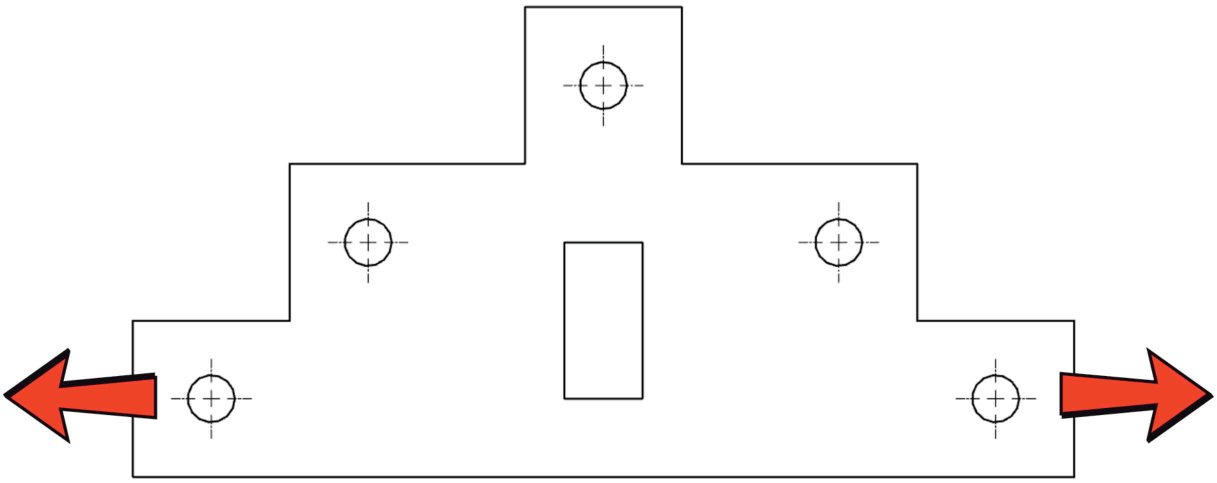
2.____

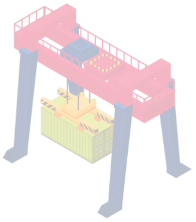
3.____

4.____

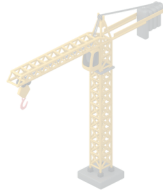
You will test the basic gusset plate by applying a tensile load to the two lower fixing holes.
Before you do the test, on the image of the gusset plate below:

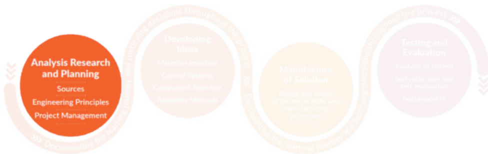
1. Shade the areas you predict where the concentration of stresses will occur on the plate.
2. Draw the fracture line where you think the part will ultimately fail.





Test

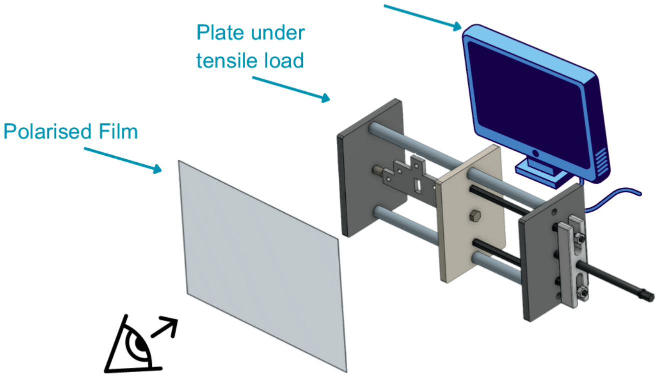




Can the profile of a part impact its performance?

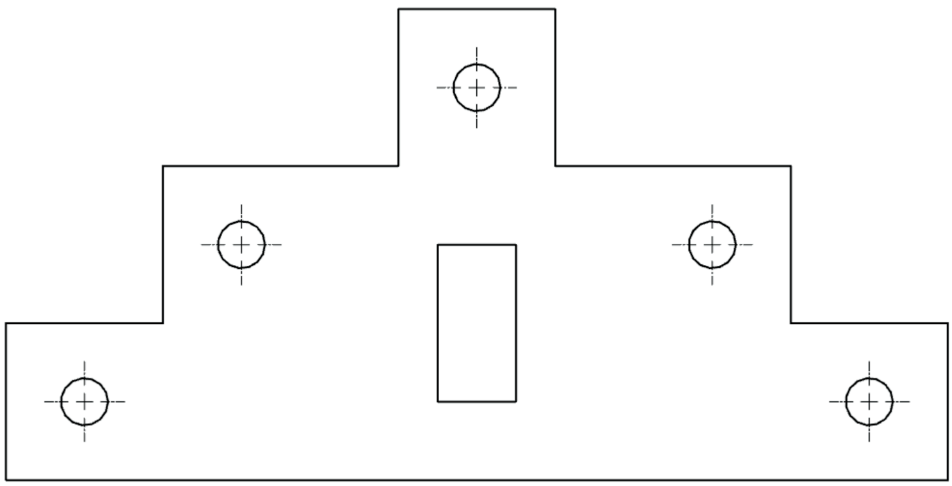
Procedure:

1. Place the acrylic gusset plate in the strain rig.
2. Place a computer monitor with a white background behind the strain rig.
3. Hold a sheet of polarised film in front of the strain rig.
4. Observe the plate through the film as a tensile load is applied, and record observations.



Results:

1. Observations from your experiment - On the outline of the test piece below, sketch what you observed as the load was applied to the test piece.
2. Identify where the concentration of stresses occurred.
3. Identify where fracture occurred and compare to your prediction.



Alternatively you could place an image of your actual test piece here and annotate it.

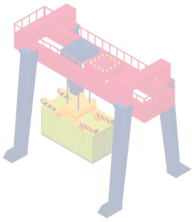
Considering your observations, what measures could you put in place to avoid point concentration of stress, that appeared in the part above, to strengthen the part and avoid premature failure:

1.____

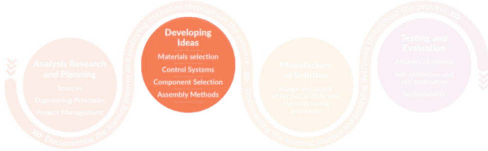
2.____

3.____

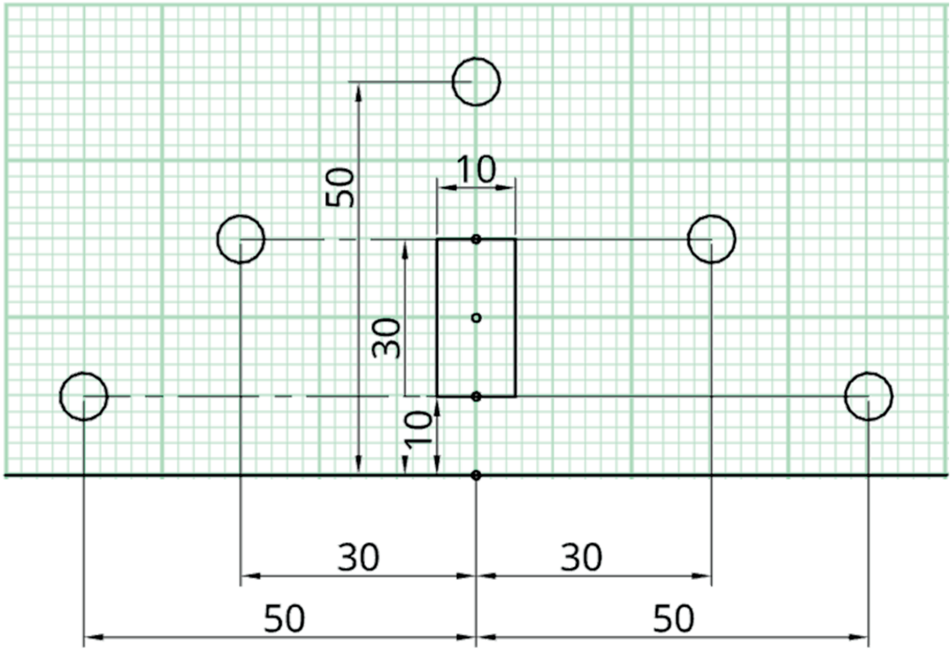
4.____



Develop Ideas



Using what you have learned from the internal stress experiment, design a new gusset plate profile shape. The critical features and measurements are shown below. Accurately draw your new gusset plate shape to include the critical features and dimensions below.



Give a short justification for your chosen design:

Material Selection:

Having designed the accurate shape of your gusset plate, you must now consider what material you will manufacture your model plate from. It is worth considering the various mechanical properties of materials and identifying what properties are important for the job your gusset plate needs to carry out.

Probing Question:

List the mechanical properties you think your gusset plate needs to have?

1.
2.
3.
4.
5.

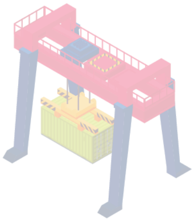
Identify a material that would satisfy the requirements you have set out above:

____

LEARN ABOUT...

MECHANICAL PROPERTIES OF MATERIALS

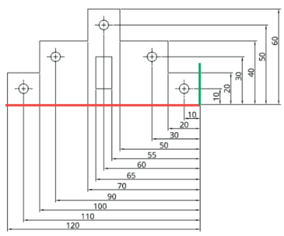
Give a short justification for your material selection:



Manufacturing

In the space below, create an accurate final working drawing of your gusset plate design to include all necessary measurements.

Have you considered using absolute dimensionsing to make it easier to mark out?



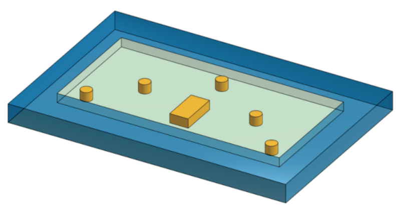
Absolute dimensioning: All dimensions are made from a datum edge or side. This makes using a vernier height gauge easier to mark out

WORKING DRAWING

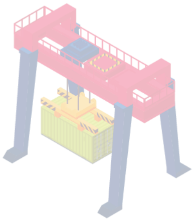
CAD CAM	CREATE CAD DRAWING →	EXPORT DXF OR STL FILE →	LOAD FILE AND SET UP CAD CAM MACHINE →	COMPLETE CAD CAM PROCESS →	EDGE AND SURFACE FINISHING
Manually	MARKING OUT →	DRILLING →	ROUGH SHAPING →	FINISH SHAPING →	EDGE AND SURFACE FINISHING

Identify which manufacturing approach will you use and give reasons why:

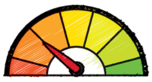
Precision when engineering solutions is always a primary consideration. To ensure a high level of **accuracy** is achieved, each gusset plate will be tested on the critical features.



Testing & Evaluation



Put your design to the test:
Having manufactured your new gusset plate design, retest your part in the polariscope.



In the space provided, sketch your part and show how the stresses appear once a load is applied.

Is there a difference in the internal stresses of your design, from the original design, when the load is applied?

Why are the results different?

Has your design improved the performance of the part?

Rate how satisfied you are with each element of your part:

	Very happy	Happy	Neutral	Unhappy	Very unhappy
• Accuracy	☐	☐	☐	☐	☐
• Polariscope performance	☐	☐	☐	☐	☐
• Edge finish	☐	☐	☐	☐	☐
• Manufacturing	☐	☐	☐	☐	☐

If you were to complete a similar project in the future, what would you change or what valuable learning would you take from this project?

Learn About... Manufacturing

Can the way a part is manufactured have an impact on the internal stresses in a component?

Experiment:

Using the 3 samples provided, the polarised film, and the monitor, evaluate the internal stresses in each sample.

Information on injection moulding

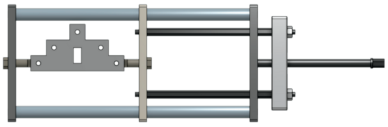
Sample 1: Set Square
In the box provided, sketch the internal stresses you observe in the set square which has been manufactured using **injection moulding.**

Sample 2: Gusset Plate 1
This gusset plate has been manufactured using acrylic which had been **extruded.**

Sample 2: Gusset Plate 2
This gusset plate has been manufactured using acrylic which has been **Cast.**

Results and findings: What did you observe in the 3 samples? Do different polymer processes have an impact on the internal stress in a part?

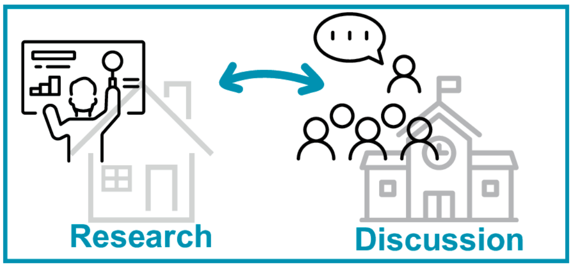
Learn About...The Test



Tensile test:

The principles used in the polariscope are based on a tensile test. A tensile load is applied to a much simpler test piece in order to establish the mechanical properties of different materials.

Flipped classroom activity:



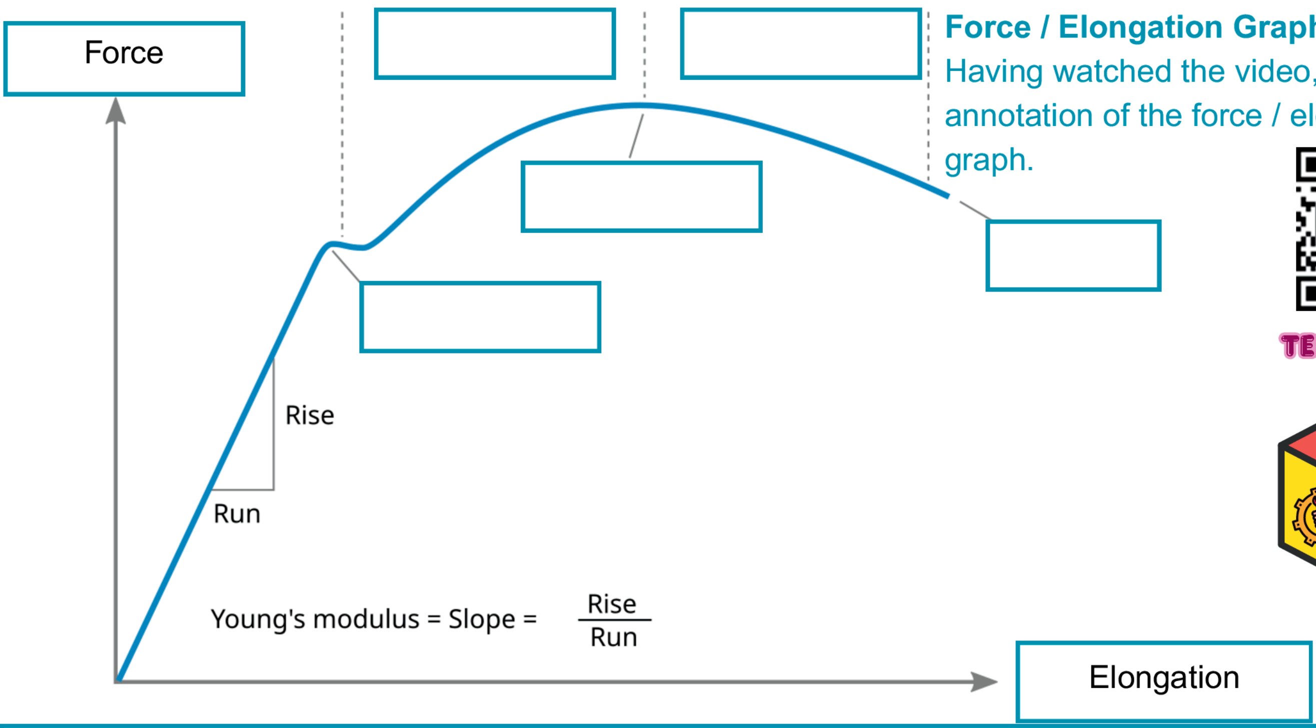
Homework:

Follow the QR code to watch a video on tensile testing and document your learning below.

Sketch and label the testing equipment:

Standard procedure for a tensile test:

1.
2.
3.
4.
5.
6.
7.



Force / Elongation Graph

Having watched the video, complete the annotation of the force / elongation graph.

TENSILE TEST

From your understanding, describe the difference in Elastic and Plastic deformation:

____

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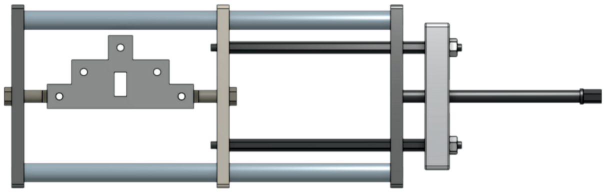
____

____

Learn About...The Test



Tensile Test

The principles used in the polariscope are based on a tensile test. A tensile load is applied to a much simpler test piece in order to establish the mechanical properties of different materials.

Homework:

Label the parts of the equipment:

Standard procedure for a tensile test:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________

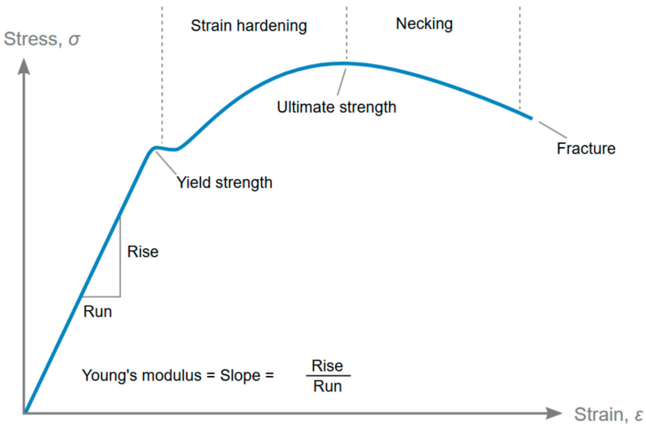
Results:

The 2 values measured and recorded during the tensile test are: **Load** (in Newtons or Kilo Newtons) and **Elongation** (in millimetres). This data can be used to find out lots of useful information.

$$Stress = \frac{Force\ (or\ load)}{Area}$$

$$Strain = \frac{Length\ of\ Stretch}{Original\ Length}$$

Stress / Strain Graph



Apply your learning:

Convert the load values below to stress values, and the extension values to strain values, using the appropriate formula.

Load (kN)	15	25	40	60	80	100	107	108	105	96
Extension (mm)	0.06	0.10	0.16	0.26	0.38	0.65	0.90	1.00	1.20	1.40

Stress (kN/mm2)									
Strain (% elongation)									

Research and identify the different mechanical properties of a material that can be found using the stress/strain graph:

What is a Human Machine Interface (HMI)?

Oide

A Human Machine Interface (HMI) is the point where a person interacts with a machine or system. It allows humans to give commands to machines and receive feedback. HMIs can be physical (like buttons or touchscreens) or digital (like apps or software controls). Good HMI design is important for safety, efficiency, and ease of use.

Task 1:

Using primary research only, insert an image of two HMIs for each of the categories below.

Setting	HMI 1 Identified	HMI 2 Identified
Kitchen		
Classroom Workshop		
Automotive		
Pastimes		

Task 2:

- Select one HMI from your list that you found interesting or important.
- Sketch the HMI below.
- Annotate the key parts, and explain how the user interacts with it.

What is its purpose?

Who uses it?

How easy or difficult is it to use?

What inputs does the user provide?

What feedback does the machine give?