Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Queensland Curriculum and Assessment Authority

Engineering 2025 v1.2

IA1: Sample assessment instrument

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name	sample only
Student number	sample only
Teacher	sample only
Issued	sample only
Due date	sample only

Marking summary

Criterion	Marks allocated	Provisional marks
Symbolising and Communicating	7	
Determining and Generating	9	
Synthesising and Evaluating	9	
Overall	**25**	

Conditions

Technique	Extended response — engineered solution
Unit	Unit 3: Civil structures
Topic/s	Topic 1: Civil structures in society Topic 2: Civil structures and forces Topic 3: Civil engineering materials
Duration	Approximately 10 hours of class time

Mode / length	Written and visual:
	• up to 10 A4 pages including
	  – up to 2000 words
	  – images, graphs, calculations and diagrams

Individual / group	Individual
Other	Students can develop their responses in class time and their own time.

Context

A civil construction company requires an electronic variable message sign support structure to upgrade a section of busy arterial roadway. Once constructed and commissioned, a traffic management centre will operate the electronic sign to provide motorists with travel information about upcoming events, hazards and traffic delays. The concept requires a cantilever truss-type gantry support structure to be installed to maximise motorist visibility on the upgrade of a straight roadway section.

Requirements of the sign gantry support structure are:

- the foundation of the cantilever gantry is to be positioned 3 m from the left roadway kerb with a safety barrier installed to reduce the risk of high-speed collision with the structure
- the geographic location receives a very high yearly rainfall, has high humidity during the summer months and experiences quite low temperatures in winter, i.e. minimums of 5–10 °C
- the structure should be developed considering the Wind Region B ultimate design wind speed of 51.9 m/s or 186.84 km/h experienced at the location
- the sign must be positioned at least 6.5 m above the roadway to allow clearance for oversize vehicles and span 6 m to provide road kerb clearance and an over-lane sign location
- the fixed electronic sign, with a mass of 200 kg, will cover an area 6 m wide x 1.5 m high on the oncoming traffic side of the gantry structure
- the cantilever sign gantry must efficiently withstand the weight force of the electronic sign, and a 1.5 factor of safety loading as judged using the beam performance index
- the geological engineers have not yet received the results of the borehole logs and geotechnical soil testing for the sign's location. Therefore, the type of footings needed for the new structure have not been supplied with the concept.

Task

Your task is to develop and propose an engineered solution that meets the civil construction company's requirements, in response to the sign gantry support structure problem.

In your response, document the problem-solving process used to develop and propose an engineered solution.

The solution will include the use of a virtual or physical prototype sign gantry and include only a consideration of the Region B wind loading on the structure. (**Note**: Detailed calculations of the torsional forces resisted by the structure are not required.) A physical prototype should be constructed using balsa wood and limited amounts of other materials, as required to withstand the specified weight force of the electronic sign and the factor of safety loading, each scaled to 1:20 for prototype development. Given the geotechnical uncertainty of the foundation, the base of the prototype gantry will be mounted securely to a fixed location to be no greater than 200 mm x 200 mm x 19 mm plywood.

To complete this task, you must:

- symbolise and explain ideas and the solution to the structural problem using, e.g. annotated sketching, drawings including basic drawing standards (hand or CAD), force vectors, free-body diagrams, graphs, tables and/or schemas
- determine success criteria, considering the identified elements, components and features, and their relationship to the structural problem
- synthesise engineering mechanics, materials science, technology and ideas to propose a possible real-world solution to the structural problem
- evaluate ideas and solution using success criteria and refine solution using data, including
  - test of materials and processes
  - calculate using mechanics concepts and principles to propose prototype and real-world solution performance
  - evaluate prototype solution performance data and the reliability of the prototype solution
  - resolve uncertainties to refine the prototype solution
  - evaluate the real-world solution using success criteria and prototype performance data
- generate the prototype solution for testing, including
  - virtual and/or physical prototyping processes, e.g. 3D modelling and simulation, scaled modelling, 3D printing, laser cutting or manual processes
  - annotations on photographs or screen captures of the prototype solution prior to and after testing
  - performance of destructive or non-destructive testing of the prototype solution to provide performance data to determine the feasibility of the structural real-world solution
- recommend and justify modifications to the solution to the structural problem
- communicate
  - the development of ideas and the solution for the structural problem using written and visual features, e.g. annotations, PMI (plus, minus, interesting) charts, sketches, drawings, diagrams, photographs, graphs, tables and/or schemas
  - data using diagrams, tables, graphs and/or spreadsheets.

Checkpoints

☐ Term 1 Week 7: Submit a draft demonstrating success criteria determined from the problem, the development of ideas and an indication of a proposed solution.

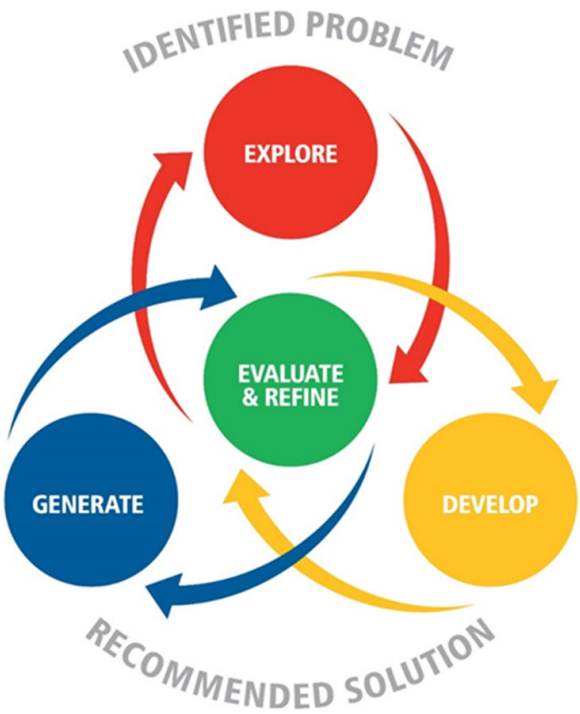
Authentication strategies

- You will be provided class time for task completion.
- Your teacher will collect and annotate a draft.
- You must acknowledge all sources.
- You must submit a declaration of authenticity.
- Your teacher will conduct interviews or consultations as you develop the response.
- Your teacher will ensure class cross-marking occurs.
- You will provide documentation of your progress at the indicated checkpoint.

Scaffolding

You are required to document how you apply the problem-solving process in response to the real-world-related structural problem.

The problem-solving process in Engineering



Your response should include the following conventions:

- headings that organise and communicate your thinking throughout the iterative phases of the problem-solving process
- a table of contents
- a reference list and a recognised system of in-text referencing.

Instrument-specific marking guide (IA1): Engineered solution (25%)

Symbolising and communicating	Marks
The student response has the following characteristics:	
• adept symbolisation and discerning explanation of ideas and a solution in relation to structures with – sketches and drawings – tables and graphs – diagrams and/or schemas • discerning decision-making about, and proficient use of – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – referencing conventions	6–7
• effective symbolisation and considered explanation of ideas and a solution in relation to structures with – sketches and/or drawings – tables and/or graphs – diagrams and/or schemas • effective decision-making about, and fluent use of – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – referencing conventions	4–5
• competent symbolisation and appropriate explanation of some ideas and a solution in relation to structures with – sketches and/or drawings – tables and/or graphs – diagrams and/or schemas • appropriate decision-making about, and use of – written and visual features to communicate about a solution – suitable language – grammatically accurate language structures – referencing conventions	2–3
• inconsistent symbolisation or superficial explanation of aspects of ideas or a solution in relation to structures • inconsistent decision-making about, and inconsistent use of – written and visual features – grammar and language structures – referencing conventions.	1
The student response does not satisfy any of the descriptors above.	0

Determining and generating	Marks
The student response has the following characteristics:	
• astute determination of essential success criteria for the structural problem • proficient generation of a structural prototype solution • provide valid performance data to critically determine the feasibility of the structural real-world solution	8–9
• reasoned determination of effective success criteria for the structural problem • effective generation of a structural prototype solution • provide valid performance data to effectively determine the feasibility of the structural real-world solution	6–7
• logical determination of appropriate success criteria for the structural problem • adequate generation of a structural prototype solution • provide relevant performance data to determine the feasibility of the structural real-world solution	4–5
• reasonable determination of some success criteria for the structural problem • partial generation of a structural prototype solution • provide elements of performance data to partially determine the feasibility of the structural solution	2–3
• statements about some success criteria for the structural problem • generation of elements of a structural prototype solution.	1
The student response does not satisfy any of the descriptors above.	0

Synthesising and evaluating	Marks
The student response has the following characteristics:	
• coherent and logical synthesis to propose a possible structural solution of ideas and the relevant – engineering mechanics – materials science – technology – research information • critical evaluation of ideas and a solution using success criteria • discerning refinement of a solution using success criteria to make astute recommendations for enhancements justified by data and research evidence	8–9
• logical synthesis to propose a possible structural solution of ideas and the relevant – engineering mechanics – materials science – technology and/or research information • reasoned evaluation of ideas and a solution using success criteria • effective refinement of a solution using success criteria to make considered recommendations for enhancements justified by data and research evidence	6–7
• simple synthesis to predict a possible structural solution of ideas and – engineering mechanics – materials science	4–5

Synthesising and evaluating	Marks
– technology and/or research information • feasible evaluation of ideas and a solution using some success criteria • adequate refinement of a solution using some success criteria to make fundamental recommendations for enhancements justified by data and research evidence	
• rudimentary synthesis to propose a structural solution of partial engineering mechanics, materials science, technology or research information, or ideas • superficial evaluation of ideas or a solution using some success criteria • superficial refinements of a solution to make elementary recommendations for enhancements	2–3
• unclear combinations of information or ideas • identification of a change about an idea or the solution.	1
The student response does not satisfy any of the descriptors above.	0