**Purposes of assessment**

The purposes of assessment are to:

- promote, assist and improve student learning
- inform programs of teaching and learning
- provide information for those people — students, parents, teachers — who need to know about the progress and achievements of individual students to help them achieve to the best of their abilities
- provide information for the issuing of certificates of achievement
- provide information to those people who need to know how well groups of students are achieving (school authorities, the State Minister for Education and Training and the Arts, the Federal Minister for Education).

It is common practice to label assessment as being formative, diagnostic or summative, according to the major purpose of the assessment.

The major purpose of formative assessment is to help students attain higher levels of performance. The major purpose of diagnostic assessment is to determine the nature of students’ learning, and then provide the appropriate feedback or intervention. The major purpose of summative assessment is to indicate the achievement status or standards achieved by students at a particular point in their schooling. It is geared towards reporting and certification.

**Syllabus requirements**

Teachers should ensure that assessment instruments are consistent with the requirements, techniques and conditions of the Technical Engineering syllabus and the implementation year 2010.

**Assessment instruments**

High-quality assessment instruments:

- have construct validity (the instruments actually assess what they were designed to assess)
- have face validity (they appear to assess what you believe they are intended to assess)
- give students clear and definite instructions
- are written in language suited to the reading capabilities of the students for whom the instruments are intended
- are clearly presented through appropriate choice of layout, cues, visual design, format and choice of words
- are used under clear, definite and specified conditions that are appropriate for all the students whose achievements are being assessed
- have clear criteria for making judgments about achievements (these criteria are shared with students before they are assessed)
- are used under conditions that allow optimal participation for all
- are inclusive of students’ diverse backgrounds
- allow students to demonstrate the breadth and depth of their achievements
- only involve the reproduction of gender, socioeconomic, ethnic or other cultural factors if careful consideration has determined that such reproduction is necessary.

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2. Assessment instruments are the actual tools used by schools and the QSA to gather information about student achievement, for example, recorded observation of a game of volleyball, write-up of a field trip to the local water catchment and storage area, a test of number facts, the Senior External Examination in Chinese, the 2006 QCS Test, the 2008 Year 4 English comparable assessment task.
Engineering Technology (2010)

Sample assessment instrument

Technical engineering report

Compiled by the Queensland Studies Authority

November 2010

About this assessment instrument

A technical engineering report is a response to an engineering design challenge that requires the application of the engineering design process. Appropriate tasks would encourage modelling and simulation of engineering principles and applications.

A typical design challenge would require student to:

- identify the elements of the problem
- recall, select and apply relevant engineering knowledge
- interpret and analyse engineering data
- propose possible solutions
- analyse solutions
- select and evaluate a solution
- prototype and test the solution
- draw conclusions and make recommendations.

Integral to this process is the communication of engineering knowledge.

As an assessment technique, the technical engineering report is used to determine student achievement in all three dimensions.

While reports vary in the type of information they present (e.g. original research, the results of an investigative study, or the solution to a design problem), they are based on a similar structure. Reports are designed for quick and easy communication of information and for selective reading. They use sections with numbered headings and subheadings, and figures and diagrams to convey data.

This sample assessment instrument is intended to be a guide to help teachers plan and develop assessment instruments for individual school settings.
Technical engineering report

Pasta bridge design

Year 12

Context:
Construction (Section 3.4.6 of the syllabus)

Study topics:
Engineering graphics, materials properties, statics

Time available:
Completed over an extended period of time (approximately 4–10 weeks) depending on the allocation of class time

Teacher input:
Combination of in-class and unsupervised time

Length of report:
Compilation of materials which may include mathematical calculations, models, and annotated graphical and diagrammatic responses, supported by 1000–1500 words

Ensure:
- Students are aware of the hazards of using glue and materials
- Any testing equipment is safe to use. A plastic bucket with a rope tied to the handle allows the bucket to be suspended 1cm above the ground and a loop with a clip at the other end allows easy attachment over any beams or structures

Design challenge
Design, construct and test a model pasta bridge that will span a gap in a theoretical roadway. The pasta used may include lasagne sheets, macaroni, spaghetti strands etc. The pasta will be joined using suitable glue. The choice of each type of pasta must be justified and evaluated, referring to test data and relevant engineering principles or techniques.

Letting students choose any type of pasta allows students to demonstrate the I&AP criterion “effective interpretation…”

Many students will be looking at strength and attempt to use thicker plates, stronger strands, etc. This is the reason that the upper breaking point (see under Design constraints, next page) is so important — it makes selection so much more challenging and requires thoughtful justification.
Setting upper and lower breaking points changes the focus of the project from a “who can build the strongest bridge” to a more challenging “design to the given limits”. This makes the project suitable for Year 12.

It may be argued that no-one designs bridges to fail at a certain weight; however, the CONCEPT of design failure is relevant to the course and is used in design of shear pins, crumple zones in cars, roadside poles, etc.

Design constraints:
- span a 400mm gap
- weigh less than 400g
- hold at least 6kg
- break if the weight exceeds 10kg
- be as cheap as possible to build (both in materials used and construction techniques. Labour to be costed at $200 per hour)
- include an area at the centre of the upper structure designed to support the testing equipment.

Preliminary class investigation (initial material testing)

Mechanical properties
Students will work in small groups to investigate the mechanical properties of the material (spaghetti strands). Each group will be provided with 10 strands of spaghetti and glue. All 10 strands must be used to create a specified cross-sectional beam. Groups will be allocated one of the following beams to construct and test: I Beam, triangular beam, tube, flat beam, hollow square beam. The beam will be tested by placing it between two supports spaced 200mm apart. The load of a 5L bucket will be placed on the beam and water added until destruction or partial failure of the test item. All information regarding the construction and testing of the beams will be shared with all students.

Report overview
The report should be succinct, with information presented in the most appropriate mode and technical and spatial literacy demonstrated by use of a wide variety of literacy forms.

Typically the report would contain:
- Title page
- Table of contents
- Introduction
- Investigation
  - information gathered in the class and individual testing of materials
  - investigation of relevant engineering knowledge (material properties, statics and data)
- Design ideas
  - demonstration of the application of engineering knowledge and principles
  - refinement and optimisation of the design solution
- Final solution
The concept of non-linear development, i.e. testing, is important. Students should be encouraged to show signs of on-going development.

- representation of the solution using appropriate engineering graphics
- a photograph of the final model

- Test results
  - a table showing final material (pasta) and labour costs
  - all results of classroom testing of beams, trusses, models, etc.
  - description of any failures or testing which later proved to be redundant
  - testing and modifications made to ensure the bridge met the upper and lower load bearing limits

- Conclusions and recommendations
  - a simplified 2-dimensional side view or free body diagram of the model indicating where and how the bridge broke
  - calculation of the reaction forces at both supports and the turning moment of the testing mass at failure
  - performance comparison with other models, including comment on at least two other designs and explanations of the seen and unseen problems (e.g. labour costs) these designs encountered. A Performance Index (PI) can be calculated in whatever way the student feels is valid. An example would be

  \[
  \text{PI} = \frac{\text{Newtons held at point of failure}}{\text{Bridge mass + Cost (in dollars)}}
  \]

  Any method of calculating PI should be justified

  - future improvements, including comments on how the design could be improved (e.g. structure, reduction of material and/or labour costs, better use of materials, different choice of material)
  - evaluation of the solution (materials and design) as well as other students’ designs based on investigation, data and engineering principles

- References

- Appendices
The application of mathematical concepts and techniques in the dimension of *knowledge and application* (K&A) and the mathematical validation of solutions in the dimension of I&AP are not assessed in this project. They have therefore been removed from the instrument-specific criteria sheet.

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<th>A</th>
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| **Knowledge and application** | The student work has the following characteristics:  
- critical elements of the bridge design are clearly identified and prioritised  
- discerning selection and correct, efficient application of engineering knowledge (materials, statics and data) to the bridge design problem. | The student work has the following characteristics:  
- significant elements of the bridge design are identified  
- appropriate selection and correct application of engineering knowledge (materials, statics and data) to the bridge design problem. | The student work has the following characteristics:  
- obvious elements of the bridge design are identified  
- selection and application of engineering knowledge (materials, statics and data) to the bridge design problem. | The student work has the following characteristics:  
- basic aspects of the bridge design are recognised  
- application of basic engineering knowledge (materials, statics and data) to the situation. | The student work has the following characteristics:  
- use of basic engineering knowledge. |

Please note that not all K&A criteria can be assessed in this project. An individual assessment instrument cannot cover all the objectives in each dimension. Therefore, it is important to ensure that all objectives are addressed in the overall summative assessment package.

The descriptors on the criteria sheet have been drawn from the standards matrix of the syllabus (p. 30 onward). Syllabus standards matrices cannot be used “as is” because some criteria may not be relevant and/or specific to the task. Remember the criteria sheet is designed to help students know how their response to the task will be judged.
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<td>Investigative and analytical processes</td>
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<td>• effective interpretation and thorough analysis of relevant engineering data</td>
<td>• correct interpretation and detailed analysis of obvious relevant engineering data</td>
<td>• explanation of basic engineering data</td>
<td>• factual statements are made about data</td>
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<td>• efficient, validated engineering bridge design solutions based on engineering principles and techniques are proposed</td>
<td>• effective bridge design solutions based on engineering principles and techniques are proposed</td>
<td>• bridge design solutions related to engineering principles or techniques are proposed</td>
<td>• ideas related to aspects of the problem are suggested</td>
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<td>• bridge design solutions are analysed in depth and detail from multiple perspectives to identify relevant engineering principles</td>
<td>• bridge design solutions are analysed in detail to identify relevant engineering principles</td>
<td>• bridge design solutions are analysed in relation to engineering principles</td>
<td>• an incomplete model bridge is produced.</td>
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<td>• an optimal model bridge that validates the solution is developed and refined.</td>
<td>• an effective model bridge that tests the solution is developed and modified.</td>
<td>• a model bridge that tests aspects of the solution is developed.</td>
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### Evaluation and technical communication

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<td>- comprehensive evaluation of solutions in relation to the critical elements of the bridge design</td>
<td>- considered evaluation of solutions in relation to the significant elements of the bridge design</td>
<td>- evaluation of solutions in relation to obvious elements of the bridge design</td>
<td>- comparison of solutions in relation to the bridge design</td>
<td>- comparison of ideas</td>
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<tr>
<td>- valid, well-reasoned conclusions and recommendations based on investigations and justified by relevant engineering knowledge and data</td>
<td>- valid conclusions and recommendations based on investigations and supported by engineering knowledge or data</td>
<td>- conclusions and recommendations are based on investigations</td>
<td>- conclusions are stated and recommendations made</td>
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<td>- effective organisation and succinct presentation of information in the most appropriate modes relevant to engineering situations</td>
<td>- logical organisation and clear presentation of information in appropriate modes relevant to engineering situations</td>
<td>- organisation and presentation of information in modes relevant to engineering situations</td>
<td>- presentation of engineering information</td>
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<td>- consistent and proficient demonstration of technical and spatial literacy through the discerning selection and appropriate use of a wide range of literacy forms.</td>
<td>- demonstration of technical and spatial literacy through the selection and use of a range of literacy forms.</td>
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