**NZQA**

**Approved**

Achievement standard: 91061 Version 3

Standard title: Demonstrate understanding of basic concepts related to structures

Level: 1

Credits: 3

Resource title: A farm shed

Resource reference: Construction and Mechanical Technologies VP-1.24 v2

Vocational pathway: Primary Industries

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| Quality assurance status | These materials have been quality assured by NZQA. NZQA Approved number A-A-02-2015-91061-02-7328 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

Vocational Pathway Assessment Resource

Achievement standard: 91061

Standard title: Demonstrate understanding of basic concepts related to structures

Level: 1

Credits: 3

Resource title: A farm shed

Resource reference: Construction and Mechanical Technologies VP-1.24 v2

Vocational pathway: Primary Industries

Learner instructions

# Introduction

This assessment activity requires you to demonstrate your understanding of basic concepts related to a roof truss in a farm shed.

You are going to be assessed on how comprehensively you demonstrate understanding of basic concepts related to the structure of a roof truss in a farm shed.

The following instructions provide you with a way to structure your work so you can demonstrate what you have learnt and achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions, and modify them if necessary to suit their learners.

# Task

In this activity you need to show that you are able to process and interpret information, and prepare a presentation that discusses how the integrity of a roof truss on a farm shed is established.

Complete a presentation that demonstrates how safety factors, forces, and structural members and joints contribute towards the integrity of the roof truss (for example the use of pin-jointed columns and beams to form the perfect truss).

In your presentation:

* explain what is meant by tension, compression, torsion, and shear, for example how these forces are generated and applied
* explain how structural members and pin joints transfer forces in a roof truss, for example how a farm shed’s framework is supported and strengthened
* identify and describe how these types of structural members resist loads, for example how a roof truss absorbs and transfers loads using a triangulated framework
* explain the safety factors that relate to static loads acting on roof trusses’ structural members, specifically explaining why it is designed for structural capacity beyond the expected load, for example the effects of weather such as wind, rain and snow
* discuss how the integrity (soundness of construction) of a roof truss would be established by comparing and contrasting the impact of:
	+ the strength, weight, material type, and profile of the roof trusses’ structural members (that is framework)
	+ the combination of all the structural members, and the means by which they are joined, for example why specific materials and assembly techniques are used
	+ the safety factors that apply to the roof truss, for example what tests are carried out to calculate specific safety features.

Include any diagrams, 3D models and illustrations to support your explanations.

# Resource A

## Definitions

These definitions are reprinted from the standard (Construction and Mechanical Technologies 91061).

* Structures for this achievement standard are limited to pin-jointed columns and beams. Examples of structures may include (but are not limited to) furniture, ladders, scaffolding, and bridges.
* Forces for this achievement standard are limited to tension, compression, shear and torsion.
* Loads for this achievement standard are limited to static point loads.
* Safety factors for this achievement standard are limited to considerations of the internal loads acting on structural members.
* The integrity of a structure is reliant on (but is not limited to) the strength, weight, material and profile of structural members; the combination and means of joining structural members; and safety factors applied to the structure.

# Resource B

## Useful websites

<http://www.technologystudent.com/forcmom/force1.htm>

<http://www.diydoctor.org.uk/projects/forces.htm>

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Assessor/Educator guidelines

# Introduction

The following guidelines are supplied to enable assessors/educators to carry out valid and consistent assessment using this internal assessment resource.

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to present evidence of their comprehensive understanding of basic concepts related to the structure of a roof truss in a farm shed, including information about safety factors, forces, types of structural members and joints, and how different design components of a roof truss in a farm shed transfer forces, resist loads, and contribute to its integrity.

# Conditions

Learners could work independently or in groups to develop their understanding, but they need to create their presentation independently, and will be assessed individually.

Decide on the format of the final presentation. It could be presented through a slide show, a portfolio, a display board, or a video, and the material presented could include annotated photographs, flow diagrams, written text, drawings, website links, and functional 3D models.

You may wish to take learners’ preferences into account in deciding on the format.

# Resource requirements

Learners will require access to the internet for research and 3D modelling software.

# Additional information

Designing and making a farm shed is not part of this assessment activity. However, it may be more relevant and motivating for learners to show their understanding if they then use those understandings as part of developing a project.

The understanding expected in this standard is not at the formulaic level: it does not involve calculating units of force.

## Other possible contexts for this vocational pathway

A structural framework with pin-jointed columns such a wheelbarrow.

# Assessment schedule: Construction and Mechanical Technologies 91061 – A farm shed

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner demonstrates understanding of basic concepts related to the structure of a roof truss in a farm shed by:* describing safety factors as applied to a roof truss in a farm shed

For example:The learner describes how safety factors involved in a roof truss (i.e. timber members) require safety factors between 4 and 6 to ensure the structures can hold a weight that exceeds the maximum expected load, before failure occurs.* explaining what is meant by tension, compression, shear and torsion

For example:The learner defines these four terms and explains the impact that these forces have on structural members of a roof truss; a 3D functional model is used to enhance the explanations.* identifying the types of structural members and joints used in structures

For example:The learner identifies different types of structural members and joints used in a roof truss. A 3D model of an A-shape farm shed is used to identify the types of structural members transferring loads using a triangulated framework that is constructed using rigid members, whose ends are connected at joints to form a structure that doesn’t move or collapse.* describing how types of structural members resist loads

For example:The learner describes different types of structural members and how they resist static point loads, e.g. a tie is a structural member that has tensile force acting on it when loaded (such as the rafters and joists in a framed roof) while a strut is a structural member considered to be in compression; the simplest form of a roof truss is a single triangle due to its structural stability as static point loads acting on the roof truss are then in equilibrium.*The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates in-depth understanding of basic concepts related to the structure of a roof truss in a farm shed by:* explaining the safety factors applied to a roof truss in a farm shed

For example, the learner:* + explains different types of internal loads that act on structural members in a roof truss, and how it is designed to carry more than the maximum load it will ever be carrying, so that the structure is secure
	+ gives reasons why the structural capacity of the roof truss needs to be considered beyond actual loads, such as a farm shed using steel members in its roof trusses may have a safety factor between 3 and 5, and includes consideration of wind force, roof span and pitch
	+ includes material considerations; steel members have a lower safety factor because of their flexibility (members will move under load without breaking) while a more rigid material such as timber will have a higher safety factor for the same roof truss design.
* explaining how structural members and pin joints transfer forces in a roof truss for a farm shed

For example:The learner explains how the triangular design of a roof truss ensures the internal forces acting on the structural members are always in balance or equilibrium. When this doesn’t occur then the roof truss will fail. Each part of the roof truss (the framework that supports the roof such as the rafters and joists) and the way they are put together (nuts, bolts) all need to work together to enable the roof truss to be balanced. The A-shaped roof truss is a very simple framework which when subjected to a load (roofing materials), some members will act as either ties (be in tension) or struts (be in compression), so that all members share the load and remain in balance.* explaining what is meant by tension, compression, shear and torsion

For example:The learner defines these four terms and explains the impact that these forces have on structural members of a roof truss, a 3D functional model is used to enhance the explanations.* identifying the types of structural members and joints used in structures

For example:The learner identifies different types of structural members and joints used in a roof truss. A 3D model of an A-shape farm shed roof is used to identify the types of structural members. These transfer loads using a triangulated framework that is constructed using rigid members, whose ends are connected at joints, to form a structure that does not move or collapse.* describing how types of structural members resist loads

For example:The learner describes different types of structural members and how they resist static point loads, e.g. a tie is a structural member that has tensile force on it when loaded (such as the rafters and joists in a framed roof) while a strut is a structural member considered to be in compression; the simplest form of a roof truss is a single triangle due to its structural stability as static point loads acting on the roof truss are then in equilibrium.*The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates comprehensive understanding of basic concepts related to the structure of a roof truss in a farm shed by:* discussing how the integrity of a roof truss in a farm shed is established

For example, the learner:* + discusses how the design of a roof truss profile contributes to its overall structural integrity; the bigger the roof span the higher the pitch needs to be as a taller (higher) truss adds to the design’s overall strength
	+ includes explanations of why material type (steel, timber), weight, profile (shape) and assembly techniques of the structural members are chosen for use, and what safety factors are considered in relation to constructing different roof trusses
	+ goes on to compare and contrast ways of addressing issues relating to the strength, weight, material type, and profile of the structural members, and how the combination of all the structural members and the means by which they are joined contribute towards the success of different roof trusses. Steel members are discussed as having a lower safety factor due to being the most flexible of the possible materials to use, it is durable and allows more movement overall and is regarded as being strong and easy to use (i.e. accurate), however cost is a factor and steel may have features not required in the average farm shed.
* explaining the safety factors applied to a roof truss in a farm shed

For example, the learner:* + explains different types of internal loads that act on structural members of a roof truss, and how it is designed to carry more than the maximum load it will ever be carrying so that the structure is secure
	+ gives reasons why the structural capacity of a structure needs to be considered beyond actual loads, such as a farm shed using steel members in its roof trusses may have a safety factor between 3 and 5 and include consideration of wind force, roof span and pitch
	+ includes material considerations; steel members have a lower safety factor because of their flexibility (members will move under load without breaking) while a more rigid material such as timber will have a higher safety factor for the same roof truss design.
* explaining how structural members and pin joints transfer forces in a roof truss for a farm shed

For example:The learner explains how the triangular design of a roof truss ensures the internal forces acting on the structural members are always in equilibrium. When this doesn’t occur then the roof truss will fail. Each part of the roof truss (the framework that supports the roof such as the rafters and joists)) and the way they are put together (nuts, bolts) all need to work together to enable the roof truss to be balanced. For example the A-shaped roof truss is a very simple framework, when subjected to a load (roofing materials) some members will act as either ties (be in tension) or struts (be in compression) so that all members share the load and it remains in balance.* explaining what is meant by tension, compression, shear and torsion

For example:The learner defines these four terms and explains the impact that these forces have on structural members of a roof truss, a 3D functional model is used to enhance the explanations.* identifying the types of structural members and joints used in structures

For example:The learner identifies different types of structural members and joints used in a roof truss. For example a 3D model of an A-shape farm shed roof is used to identify the types of structural members. These transfer loads using a triangulated framework that is constructed using rigid members, whose ends are connected at joints to form a structure that does not move or collapse.* describing how types of structural members resist loads

For example:The learner describes different types of structural members and how they resist static point loads, e.g. a tie is a structural member that has tensile forces acting on it when loaded (such as the rafters and joists in a framed roof), while a strut is a member considered to be in compression, the simplest form of a roof truss is a single triangle due to its structural stability as static point loads acting on the roof truss are then in equilibrium.*The above expected learner responses are indicative only and relate to just part of what is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.