**NZQA**

**Approved**

Achievement standard: 91061 Version 3

Standard title: Demonstrate understanding of basic concepts related to structures

Level: 1

Credits: 3

Resource title: On your bike!

Resource reference: Construction and Mechanical Technologies VP-1.24 v2

Vocational pathway: Manufacturing and Technology

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| Quality assurance status | These materials have been quality assured by NZQA. NZQA Approved number A-A-02-2015-91061-02-7329 |
| 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: On your bike!

Resource reference: Construction and Mechanical Technologies VP-1.24 v2

Vocational pathway: Manufacturing and Technology

Learner instructions

# Introduction

This assessment activity requires you to demonstrate your understanding of basic concepts related to a cardboard bike structure.

You are going to be assessed on how comprehensively you demonstrate your understanding of basic concepts related to a cardboard bike structure.

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 the cardboard bike is established.

Complete a presentation that demonstrates how safety factors, forces, and structural members and joints contribute towards the integrity of the cardboard bike.

In your presentation include the following:

* 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 cardboard bike, for example how the cardboard bike stays upright while moving forward by keeping its centre of mass over the wheels
* identify and describe how these types of structural members resist static point loads, for example how the design of the cardboard bike absorbs and transfers these loads
* explain the safety factors that relate to static loads acting on structural members of a cardboard bike, specifically explaining why it is designed for structural capacity beyond the expected load, for example bikes may be subjected to increased loads through strenuous braking or pedalling
* discuss how the integrity (soundness of construction) of a cardboard bike would be established by comparing and contrasting the impact of:
	+ the strength, weight, material type, and profile of the structural members of a cardboard bike
	+ 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 cardboard bike, 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.diydoctor.org.uk/projects/forces.htm>

<http://www.fastcodesign.com/1670753/this-9-cardboard-bike-can-support-riders-up-to-485lbs>

<http://www.stuff.co.nz/science/7823272/Cardboard-fully-recyclable-bike-made>

<http://library.thinkquest.org/J002670/parts.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 cardboard bike, including information about safety factors, forces, types of structural members and joints, and how different design components of the cardboard bike 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

The assessor/educator will provide learners with multiple learning opportunities to explore information about basic concepts related to structures, for example as a group discuss how these concepts apply in relation to different structures, such as playground equipment, climbing frames etc.

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

# Additional information

Designing and making a cardboard bike 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 to create a 3D computer model of the cardboard bike.

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

# Assessment schedule: Construction and Mechanical Technologies 91061 – On your bike!

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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 cardboard bike by:* describing safety factors as applied to a cardboard bike

For example:The learner describes safety factors that are used to ensure structures can hold a load that exceeds the maximum expected weight it will carry. The safety factor of bikes is high as they are built with a greater strength than the normal load (a person riding on a smooth road surface) calls for.* 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 the structural members of a cardboard bike. A 3D computer model is used to enhance the explanations.* identifying the types of structural members and joints used in a cardboard bike

For example:The learner identifies different types of structural members and joints used in the cardboard bike’s frame. This is comprised of two triangular frames constructed with straight members whose ends are connected at joints. The learner demonstrates on a 3D model of the cardboard bike how the truss (consisting of the front and rear triangles) shares the expected load.* 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. the truss on a cardboard bike resists the static load acting on it through external forces and their reactions. These forces are considered to act only at the pin joints, and result in the structural members of the frame being either in tension or compression.*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 cardboard bike by:* explaining the safety factors applied to a cardboard bike

For example the learner:* + explains how most structures are built to carry more than the maximum load they will ever be carrying so that the structure is secure. The safety factor of bikes is high as they are built with a greater strength than the normal load (a person riding on a smooth road surface) calls for
	+ explains how the cardboard bike is designed with materials (cardboard) being treated and folded to increase its strength, yet still maintain its flexibility (will move under load without breaking). Any increase of this normal load (sudden braking, pedalling or riding over bumps) has also been considered in its safety factor. The selection of recycled materials, and the combination and means of joining the structural members is also important as this can also increase the strength expected of the cardboard bike in normal situations.
* explaining how structural members and pin joints transfer forces in a cardboard bike

For example, the learner:* + explains how cardboard bikes are designed so that the internal forces acting on the members are always in balance or equilibrium, and when this doesn’t occur then the cardboard bike will fail; each part of a cardboard bike (frame, gears, wheels) and the way it is assembled (truss, pin joints) work together so that all members share the load and it remains in balance
	+ gives an example of the front triangle of the cardboard bike’s frame that contains the headset, a set of bearings that allows the fork to turn smoothly for steering and 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 the structural members of a cardboard bike. A 3D computer model is used to enhance the explanations.* identifying the types of structural members and joints used in a cardboard bike

For example:The learner identifies different types of structural members and joints used in the cardboard bike’s frame. This is comprised of two triangular frames constructed with straight members whose ends are connected at joints. The learner demonstrates on a 3D model of the cardboard bike how the truss (consisting of the front and rear triangles) shares the expected load.* 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. the truss on a cardboard bike resists the static load acting on it through external forces and their reactions. These forces are considered to act only at the pin joints, and result in the structural members of the frame being either in tension or compression.*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 cardboard bike by:* explaining the safety factors applied to a cardboard bike

For example the learner:* + explains how most structures are built to carry more than the maximum load they will ever be carrying so that the structure is secure. The safety factor of bikes is high as they are built with a greater strength than the normal load (a person riding on a smooth road surface) calls for
	+ explains how the cardboard bike is designed with materials (cardboard) being treated and folded to increase its strength, yet still maintain its flexibility (will move under load without breaking). Any increase of this normal load (sudden braking, pedalling or riding over bumps) has also been considered in its safety factor. The selection of recycled materials, and the combination and means of joining the structural members is also important as this can also increase the strength expected of the cardboard bike in normal situations.
* explaining how structural members and pin joints transfer forces in a cardboard bike

For example, the learner:* + explains how cardboard bikes are designed so that the internal forces acting on the members are always in balance or equilibrium, and when this doesn’t occur then the cardboard bike will fail; each part of a cardboard bike (frame, gears, wheels) and the way it is assembled (truss, pin joints) work together so that all members share the load and it remains in balance
	+ gives an example of the front triangle of the cardboard bike’s frame that contains the headset, a set of bearings that allows the fork to turn smoothly for steering and 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 the structural members of a cardboard bike. A 3D computer model is used to enhance the explanations.* identifying the types of structural members and joints used in a cardboard bike

For example:The learner identifies different types of structural members and joints used in the cardboard bike’s frame. This is comprised of two triangular frames constructed with straight members whose ends are connected at joints. The learner demonstrates on a 3D model of the cardboard bike how the truss (consisting of the front and rear triangles) shares the expected load.* 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. the truss on a cardboard bike resists the static load acting on it through external forces and their reactions. These forces are considered to act only at the pin joints, and result in the structural members of the frame being either in tension or compression.* discussing how the integrity of a structure is established

For example the learner:* + discusses how the materials used in a cardboard bike have been manipulated to contribute towards its structural integrity; the cardboard is folded in several different directions to increase its strength, and then coated in a resin that makes it both water and fireproof
	+ includes explanations of why material type (cardboard, recycled rubber), profiles (shape) and assembly techniques are chosen for use in the cardboard bike, and what safety factors are considered in its development
	+ goes on to compare and contrast ways of addressing issues relating to its strength, weight, type of materials being chosen, 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 the cardboard bike.

*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.