**NZQA**

**Approved**

Achievement standard: 91348 Version 3

Standard title: Demonstrate understanding of advanced concepts related to structural frameworks

Level: 2

Credits: 3

Resource title: Playing around with structures

Resource reference: Construction and Mechanical Technologies VP-2.24 v2

Vocational pathway: Construction and Infrastructure

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91348-02-8231 |
| 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

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Learner instructions

# Introduction

This assessment activity requires you to demonstrate your understanding of advanced concepts related to structural frameworks of playground equipment.

You are going to be assessed on how comprehensively you demonstrate understanding of advanced concepts related to structural frameworks of playground equipment.

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

The playground equipment you will focus on is a pin-jointed structure. Investigate the design of this playground equipment so that you understand the basis of its structural integrity. You need to show that you are able to process and interpret information, and prepare a presentation that includes the playground member profiles and forms and where they are used, along with how safety factorshave been applied to ensure the integrity of the playground equipment.

Create a presentation in which you do the following:

* Describe where pin and moving joints are used in the playground equipment, and the effects of load on fixed joints.
* Explain types of framework members used in structural frameworks, and how members combine to resist loads and transfer forces.
* Explain forces that work within framework members:
  + for example you could explain how a geodesic climbing frame uses connectors, pin joints, multi-strand cable (rope) and anchor points to remain in a state of equilibrium
  + include calculation of forces using vector diagrams.
* Explain the framework member profiles and forms, and where they are used in your focus playground equipment.
  + For example you could explain the profile and use of rectangular box channel used as a horizontal member combined with round steel vertical posts found in certain types of playground construction methods.
* Discuss how safety factors would have been applied to ensure the integrity of your focus playground equipment.
  + For example you could compare and contrast examples of structural frameworks found in different playground equipment
  + Discuss safety factors such as considerations due to static and dynamic loadings, and the possible effects of failure due to lack of maintenance, corrosion, metal fatigue, wind or earthquake
  + You could also discuss the difference between working load and the load at failure, and the formulas that are used to determine the working load.

Refer to relevant New Zealand Building Code and publications for weather, wind and earthquake resistance requirements.

Collect evidence that explains the relevant concepts, for example annotated sketches, mock-ups, models, photographs, quotes, etc. Keep a record of all sources so that you can acknowledge them in your presentation.

# Resource A

These definitions are reprinted from the Standard (Construction and Mechanical Technologies 2.24).

* Structural frameworks are made up of combinations of pin jointed members acting as struts and/or ties.
* Framework member profiles may include but are not limited to: I-beam, channel, round, and rectangular.
* Framework member forms may include but are not limited to: solid, tube, linked, and multi-strand cable.
* Forces are limited to tension, compression, torsion and shear forces.
* Loads acting on a framework are limited to static point loads.
* Explanation of forces that exist within framework members includes calculation of the forces acting in members using vector diagrams.
* Safety factors may include but are not limited to considerations due to static and dynamic loadings, and the effects of wind and earthquake.
* The integrity of a framework is reliant on but is not limited to the form and profile of framework members, and the combination and means by which framework members are joined.

# Resource B

## Useful websites:

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

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

<http://www.pbs.org/wgbh/buildingbig/lab/forces.html>

<http://www.mos.org/etf/force.html>

<http://www.archive.org/details/elementarygraphi00wighrich>

<http://myweb.dal.ca/rl910766/downloads/ARCH4211/04PinJointedSystems.pdf>

## Useful books:

Jackson, E, 1975, *Advanced Level Technical Drawing*, Longman, United Kingdom.

Sinclair, R and Guy, T, 1974, *Technical and Professional Drawing*, book 2, Hicks Smith, Wellington, New Zealand.

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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 demonstrate their comprehensive understanding of advanced concepts related to structural frameworks focusing on a pin-jointed playground equipment structure.

# Conditions

The learners could gather and analyse their evidence independently or in groups, but they need to create their presentation independently and will be assessed individually.

Decide on the format of the final presentation. You may wish to take learners’ preferences into account when deciding on the format.

# Resource requirements

The assessor/educator will provide opportunities for learners to develop their evidence.

Learners will require access to the internet for research.

# Additional information

Visiting playgrounds that have a range of structural frameworks may be helpful to support learners in developing their understanding.

## Other possible contexts for this vocational pathway

These include a structural framework with pin-jointed columns, beams and ties, for example furniture, ladder, climbing frame, scaffolding, geodesic dome, roofing, transmission tower, robots or gazebo, etc.

# Assessment schedule: Construction and Mechanical Technologies 91348 – Playing around with structures

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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 advanced concepts related to structural frameworks by:   * describing where pin and moving joints are used   For example the learner describes:   * + examples of where pin joints are used such as pin joints that may be found in certain types of climbing frame   + a moving joint found in playground equipment such as certain types of swing and seesaw assembly   The learner may need to go beyond playground equipment, and describe examples such as pin joints found in a folding camp chair, collapsible gazebo frame, etc.   * describing the effects of load on fixed joints   For example the learner describes:   * + the effect of load on structural frameworks found in playground equipment, and how loads are shared between framework members   + how some members are placed in tension and others in compression.   Diagrams are included to assist descriptions.   * explaining types of framework members and how members combine to resist loads and transfer forces   For example the learner uses:   * + structural framework examples found in playground equipment to explain different types of framework members (e.g. struts, ties, beams, columns)   + vector diagrams to explain how framework members resist and transfer loads, through graphical analysis and representation of framework members that include: notations, polar diagrams and/or shear force diagrams to explain the types of forces acting. * explaining how safety factors are determined   For example:  The learner explains how safety factors may include considerations due to static and dynamic loadings, and the possible effects of failure due to lack of maintenance, corrosion, metal fatigue, wind or earthquake. The learner explains the difference between working load and the load at failure, and the formulas that are used to determine the working load. This will cover at least one application of the safety factor. Reference may be made to relevant New Zealand Building Code or relevant playground safety publications for weather, wind and earthquake resistance requirements.  *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates in-depth understanding of advanced concepts related to structural frameworks by:   * explaining forces that exist within framework members   For example the learner explains:   * + where pin and moving joints are used, and the effects of loads on framework members in the playground equipment; the learner uses vector diagrams to assist with the explanation of how the equipment achieves equilibrium when under load from the children using it   + how members react to the load to ensure that the equipment maintains its integrity (e.g. how a geodesic climbing frame uses connectors, pin joints, multi-strand cable and anchor points to remain in a state of equilibrium).   The learner may need to go beyond playground equipment, and describe examples such as pin joints found in a folding camp chair, collapsible gazebo frame, etc.   * explaining framework member profiles and forms, and where they are used   For example:  The learner explains the profiles and forms of framework members in relation to the load they carry (e.g. the profile and use of a rectangular box channel used as a horizontal member combined with round steel vertical posts found in certain types of playground construction).   * explaining how safety factors are determined   For example:  The learner explains how safety factors may include considerations due to static and dynamic loadings, and the possible effects of failure due to lack of maintenance, corrosion, metal fatigue, wind or earthquake. The learner explains the difference between working load and the load at failure and the formulas that are used to determine the working load. This will cover at least one application of the safety factor. Reference may be made to relevant New Zealand Building Code or relevant playground safety publications for weather, wind and earthquake resistance requirements.  *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates comprehensive understanding of advanced concepts related to structural frameworks by:   * explaining forces that exist within framework members   For example the learner explains:   * + where pin and moving joints are used, and the effects of loads on framework members in the playground equipment; the learner uses vector diagrams to assist with the explanation of how the equipment achieves equilibrium when under load from the children using it   + how members react to the load to ensure that the equipment maintains its integrity (e.g. how a geodesic climbing frame uses connectors, pin joints, multi-strand cable and anchor points to remain in a state of equilibrium).   The learner may need to go beyond playground equipment, and describe examples such as pin joints found in a folding camp chair, collapsible gazebo frame, etc.   * explaining framework member profiles and forms, and where they are used   For example:  The learner explains the profiles and forms of framework members in relation to the load they carry (e.g. the profile and use of a rectangular box channel used as a horizontal member combined with round steel vertical posts found in certain types of playground construction).   * discussing how safety factors have been applied to ensure the integrity of a structural framework   For example:  The learner compares and contrasts examples of structural frameworks found in different playground equipment, and discusses safety factors such as considerations due to static and dynamic loadings, and the possible effects of failure due to lack of maintenance, corrosion, metal fatigue, wind or earthquake. The learner discusses the difference between working load and the load at failure, and the formulas that are used to determine the working load. This will cover at least one application of the safety factor. Reference may be made to relevant New Zealand Building Code or relevant playground safety publications for weather, wind and earthquake resistance requirements.  *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.