Australian Government

Department of Education, Employment and Workplace Relations

NWP508A Apply principles of hydraulics to pipe and channel flow

Revision Number: 2

NWP508A Apply principles of hydraulics to pipe and channel flow

Modification History

NWP508A Release 2: Layout adjusted. No changes to content.
NWP508A Release 1: Primary release.

Unit Descriptor

This unit describes the competencies required to use hydraulic principles and calculations of theoretical flows. An understanding of the processes required to collect data accurately, interpret data, verify data and apply theoretical techniques to produce flow data are essential to performance.

Application of the Unit

This unit covers generic competency for a range of technical and operational work roles in water flow calculations.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where ***bold italicised*** text is used, further information is detailed in the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Calculate energy losses in pipe flow.	1.1 Review measurements and compare against expected trends. 1.2 Use ***standard processes and software*** to check, edit, verify and audit data. 1.3 Use standard processes to identify, estimate, adjust and justify data and review inconsistent data on ***flow conditions***. 1.4 Prepare records in a format suitable for dissemination.
2 Calculate hydraulic and energy gradient for pipelines.	2.1 Prepare pipeline design ***charts*** using standard formulae. 2.2 Identify the limitations of formulae. 2.3 Identify variations in ***roughness coefficients***. 2.4 Calculate the pressure in pipeline systems using the hydraulic gradient line. 2.5 Calculate the pipe discharge from reservoirs.
3 Calculate flow in open channels.	3.1 Identify the ***methods used for measuring flows*** in open channels. 3.2 Use the ***formulae for calculating flows*** in open channels. 3.3 Distinguish the ***characteristics of open channels***. 3.4 Distinguish the uses of different measuring instruments and devices used in open channels 3.5 Assess the ***hydraulic principles*** which apply to different ***meters***. 3.6 Identify the limitations of the meters.
4 Calculate flows through notches and weirs.	4.1 Identify the methods used for measuring flows in notches and weirs. 4.2 Use the formulae for calculating flows in notches and weirs. 4.3 Distinguish the applications and ***characteristics of notches and weirs***. 4.4 Distinguish the uses of different measuring instruments and devices used for notches and weirs. 4.5 Assess the hydraulic principles which apply to different meters. 4.6 Identify the limitations of the meters.
5 Calculate proportions for an economic section.	5.1 Calculate the proportions of rectangular, trapezoidal and circular channels for maximum discharge. 5.2 Use a partial flow chart to identify the depth of flow for maximum discharge and maximum velocity.

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills:

- draw velocity distribution curves for fluids in pipes or channels with both laminar flow and turbulent flow
- use the Moody diagram
- use data to determine the value of roughness
- use simple equations for determining pipe friction with their appropriate application
- calculate head losses in non-circular pipes
- calculate minor energy losses associated with enlargements, contractions, valves, fittings and bends
- calculate the flow in a pipe using data regarding minor energy losses
- use AS 2200 for calculating minor losses
- apply flow formulae to different open channel cross-sections in developing the proportions for an economic section
- calculate the flow in pipelines
- calculate the gradual varied flow profiles in uniform channels when the discharge is known
- use analytical tools and formulae
- interpret and apply technical documentation to the collection, analysis and reporting of hydrometric data
- identify potential or actual operational problems
- use computer systems
- use recording and reporting systems

Required knowledge:

- application of matrix algebra to systems of linear equations
- graphical and algebraic methods for solving systems of linear, quadratic, exponential, logarithmic and trigonometric equations
- principles of fluid statics, fluid dynamics and hydraulic mechanics
- Pascal's Law and hydrostatic effect on submerged surfaces
- distinction between laminar and turbulent flow
- Hagen-Poisseulle equation
- Darcy-Weisbach equation
- Bernoullii's equation
- the effect of velocity variation on velocity head
- equations for calculating the approximate value of the friction factor
- smooth and rough wall turbulent flow
- minimise pipeline losses
- the characteristics of flow through notches/weirs including the use of these in channel flow measurement

- sampling and testing procedures
- policies and standard operating procedures

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The candidate should demonstrate the ability to use a range of hydraulics principles and calculations of theoretical flows including:

- calculating energy in pipe flows
- calculating hydraulic and energy gradient for pipelines
- calculating flow in open channels
- calculating flows through notches and weirs
- calculating proportions for an economic section

Context of and specific resources for assessment

Access to the workplace and resources including:

- documentation that should normally be available in a water industry organisation
- relevant codes, standards, and government regulations

Where applicable, physical resources should include equipment modified for people with disabilities.

Access must be provided to appropriate learning and/or assessment support when required.

Assessment processes and techniques must be culturally appropriate, and appropriate to the language and literacy capacity of the candidate and the work being performed.

Validity and sufficiency of evidence requires that:

- competency will need to be demonstrated over a period of time reflecting the scope of the role and the practical requirements of the workplace
- where the assessment is part of a structured learning experience the evidence collected must relate to a number of performances assessed at different points in time and separated by further learning and practice
- a decision of competence should only be made when the assessor has complete confidence in the person's competence over time and in various contexts
- all assessment that is part of a structured learning experience must include a combination of direct, indirect and supplementary evidence
- where assessment is for the purpose of recognition (RCC/RPL), the evidence provided will need to be authenticated and show that it represents competency demonstrated over a period of time

- assessment can be through simulated project-based activity and must include evidence relating to each of the elements in this unit

Questioning will be undertaken in a manner appropriate to the skill levels of the operator, any cultural issues that may affect responses to the questions, and reflecting the requirements of the competency and the work being performed.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. ***Bold italicised*** wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Standard processes and software may include:

- standards relevant to the monitoring network including AS 3778 for discharge ratings, WMO, best practice methodology where standards are not available or applicable
- procedures for the measurement of surface slopes and flood slopes
- procedures for the development, maintenance and extension of rating curves
- computation of flow from stage data and rating curves
- software:
  - Kisters - Hydstra
  - Scientific Software Group - AquaChem,
  - Microsoft - Excel
- web-based development tools for presentation and reporting of data

Flow conditions will include:

- laminar flow
- turbulent flow
- smooth and rough pipe and channel surfaces
- full pipe flow
- submerged flow conditions
- backwater
- critical flow, sub critical and supercritical
- uniform flow
- rapidly changing flow
- weir and flumes behaviour under various flow conditions

Charts include:

- Colebrook-White charts
- Hazen and Williams charts
- Manning charts

Roughness coefficients include:

- biological growths and other obstructions
- slime deposits
- incrustations
- detritus
- general debris

- deterioration of unlined ferrous surfaces, because the bore may be diminished by oxide formations
- irregularities at joints:
  - eccentricity
  - abrupt decrease of diameter
  - protrusions of mortar or other jointing materials
  - inadequate closure, especially if this has permitted tree roots to enter
- amount and size of solids being transported
- disturbances by flow from branch lines especially in sewers

Methods used for measuring flows include:

- container method
- tilt tank method
- trajectory method

Formulae for calculating flows includes:

- Chezy equation
- Colebrook-White
- Hazen and Williams
- Darcy-Weisbach
- Manning equation

Characteristics of open channels include:

- types of open channel
- steadiness
- uniformity
- state of open channel flow
- laminar, transitional and turbulent flow
- critical, subcritical and supercritical flow

Meters include:

- mechanical meters such as:
  - the displacement type
  - the inferential type
- pressure meters such as:
  - pitot tube
  - orifice plate
  - Venturi meter

Characteristics of notches and weirs will include:

- type of the crest
- shape of the notch
- crest and conditions

Hydraulic principles will include:

- standards relevant to the monitoring network including AS 3778 Measurement of water flow in open channels and AS 2200 Design Charts for water supply and sewerage for calculating pipe and channel flows
- Archimedes's Principle

- Bernoulli's Equation
- Newton's Laws of Motion
- hydraulic gradient and total energy line
- boundary layer theory
- Reynold's Number
- Pascal's Law
- theory of gated structures
- hydrostatic pressure
- fluid dynamics
- Moody Diagram
- Manning's Formula
- Chezy's Formula
- specific energy formula
- Darcy-Weisbach Equation
- Hagen-Poisseulle Equation

Unit Sector(s)

Not applicable.

Competency field

Hydraulics.