

## FEEDLOT DESIGN AND CONSTRUCTION

# 46. Design drawings and technical specifications

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## Introduction

Design documentation is prepared to a level that allows the works to be constructed accurately. The design documentation includes design drawings, bill of quantities and technical specifications.

Design drawings are developed to a level of detail necessary to prepare a clear, coordinated visual depiction of all aspects of the works. Major project elements including overall layout, earthworks equipment, mechanical, electrical, structural, and water supply systems are designed and depicted through coordinated scale drawings and detailed elevations and plans. The lot feeder may engage consultants to ensure well-coordinated drawings and bill of quantities are prepared.

Technical specifications are prepared to provide consistency and to instruct construction contractors on how the works are to be carried out, the quality of the workmanship and methods of quality assurance for the construction. Technical specifications describe the project design and construction practices, technical standards, specifications and principles to be followed during construction.

Technical specifications may specify a performance goal (a performance specification) or procedures used to meet the performance goal (design specification). A performance specification permits flexibility and change. For example, a performance specification for a feed processing system may specify that the capacity be a nominated tonnes per hour at a particular standard of quality.

In general, the scope and detail of technical specifications will depend on the nature and complexity of the project. Technical specifications should form part of all construction projects.

The level of adherence to the design drawings and technical specifications ultimately determines the quality of the project and influences the performance of the constructed works.

## Objectives

The objectives of the design drawings and technical specifications are to

- provide a detailed record of the design of the project
- set standards for the technical aspects required in the construction
- set standards for the execution of the construction
- set standards for documenting the design, tendering and construction process.

## Mandatory requirements

All work performed pursuant to specifications shall comply with the requirements of the relevant local Acts, Regulations, Standards and Codes of Practice of all authorities having jurisdiction over the work.

## Technical data

The design drawings and technical specifications should include

- Design drawings – these set out design information and procedures which are required to be used on the works.
- Bill of Quantities – this itemises the quantity of materials to enable a tenderer to accurately cost the work for which they are bidding.
- Material specifications – such as diameter, type and grade of material for pipes (e.g. polyethylene pipes or UPVC), joining methods (e.g. electro-fused or compression fittings etc), or 28-day compressive strength of concrete.
- Requirements for Material Testing e.g. testing required for earthworks (i.e. minimum required compaction and moisture range to be achieved), frequency of testing (e.g. one soil density test per 1,000 m<sup>3</sup> of bulk earthworks) or the number of tests per 1,000 m<sup>2</sup> of area for hydraulic conductivity tests in sedimentation ponds.
- Construction and installation methods.
- Development approval conditions that have to be complied with throughout the construction.

## Design documents

Design documents relate to the design, construction and commissioning of the project works. Typically, the documents should include

- design drawings
- construction specifications

### Design drawings

Design drawings for construction contain all the information necessary for the construction contractor to bid on and build a particular project. Typically, the preparation of design drawings provides a detailed record of the design and structural requirements of the works. A contract or tender document often references design drawings.

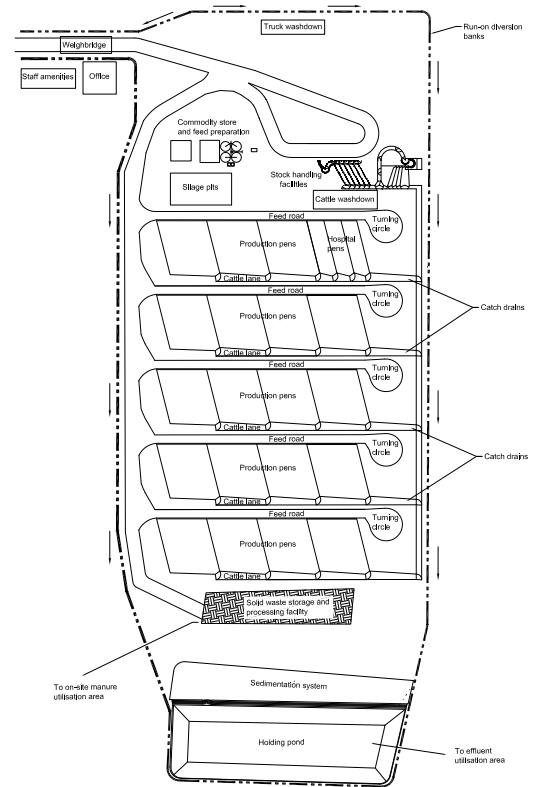
Design drawings should show details on layout, measurements, plan, cross-sectional and vertical profiles. This information is prepared as scale drawings of the works to be constructed.

Design drawings should be presented in such a way that

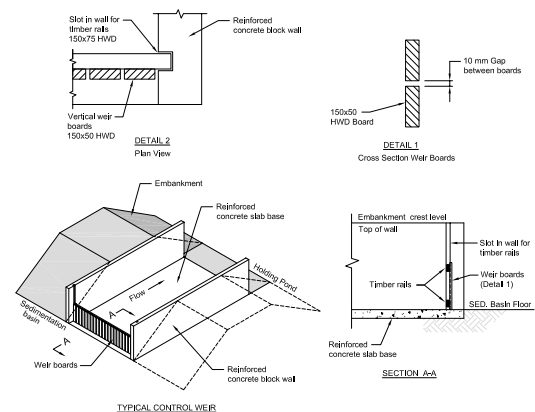
- the project can easily be understood
- they visually communicate the concept to the lot feeder and the construction contractor
- they are legible
- they include all information from previous revisions and updates.

The design drawings should include the following aspects

- site layout and the location of the works to be constructed
- plan views



Plan of controlled drainage area for a feedlot



Plan of typical vertical timber weir

- detailed designs and cross-sectional profiles of the works
- dimensions and units gradients
- titles and scales that meet the required standards and units
- adequate labelling
- elevations that are referenced to metres Australian Height Datum (m AHD)
- be dated and signed by the designer.

The lot feeder should ensure that all parties responsible for the creation, processing or supply of drawings and diagrams standardise the layout and content of these drawings. This will preclude the need to incorporate specific instructions on the engineering content of drawings and diagrams in project documentation and other specifications.

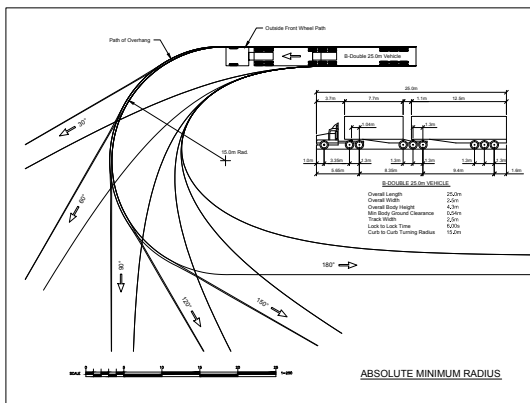
To define the content of design drawings and standardise the approach and terminology used, drawing specifications may be followed. Various standards and codes of practice have been prepared to guide engineers and drafters on technical drawings and these are detailed in Table 1.

The adoption of a drawing standard into a design shall be accompanied by a statement of compliance for that standard, confirming that the drawings are fit for purpose and meet all current legislative and Australian Standards requirements. This shall be accompanied by all design calculations as required to confirm compliance.

Computational devices and computer aided drafting and design (CADD) packages have made the creation of project design information in digital form commonplace. Construction machine guidance is now a widely adopted tool in the construction industry, particularly in earthwork operations, due to its accuracy and ease of use. This is an important consideration for the transfer of engineering design data in electronic form for import into these global positioning system (GPS) guidance software and systems.

This approach is a new paradigm of project delivery and requires a move from a 2D view paper-based process to a 3D electronic-based model. Hence, it is important to facilitate construction contractor access to electronic project design files. Typically, real time kinematic (RTK) GPS-based construction equipment guidance systems require input data from a 3D model of the existing and planned surfaces topography, to allow horizontal and vertical control.

This requires that all parties are responsible for the creation, processing or supply of drawings and diagrams, document details of the software, hardware and process solutions that are used. Most importantly, this includes clarification of the interface hurdles between companies and systems.



Plan of swept path for B-double truck

Table 1. Relevant Australian and International Standards and Codes of Practice

Document NO.	Document title
AS1100	Technical drawing 1100.101 Part 101: General principles 1100.201-1992 Technical drawing - Mechanical engineering drawing 1100.301 Part 301: Architectural drawing 1100.401 Part 401: Engineering survey and engineering survey design drawing 1100.501 Part 501: Structural engineering drawing
AS1101	Graphical symbols for general engineering 1101.1 Part 1: Hydraulic and pneumatic systems 1101.3 Part 3: Welding and non-destructive examination
AS1102	Graphical symbols for electrotechnical documentation 1102.101: General information and general index 1102.102: Symbol elements, qualifying symbols and other symbols having general application 1102.103: Conductors and connecting devices 1102.104: Basic passive components 1102.105: Semiconductors and electron tubes 1102.106: Production and conversion of electrical energy 1102.107: Switchgear, control gear and protective devices 1102.108: Measuring instruments, lamps and signalling devices 1102.109: Telecommunications – Switching and peripheral equipment 1102.110: Telecommunications – Transmission 1102.111: Architectural and topographical installation plans and diagrams
AS2536	Surface texture
AS ISO 128.1-2005	Technical drawings – General principles of presentation – Introduction and index
AS ISO 128.20-2005	Technical drawings – General principles of presentation – Basic conventions for lines
AS ISO 128.21-2005	Technical drawings – General principles of presentation – Preparation of lines by CAD systems
AS ISO 128.22-2005	Technical drawings – General principles of presentation – Basic conventions and applications for leader lines and reference lines
AS ISO 128.23	Technical drawings – General principles of presentation – Lines on construction drawings
AS ISO 128.24	Technical drawings – General principles of presentation – Lines on mechanical engineering drawings
BS 1553 Parts 1-3	Specification for Graphical Symbols for General Engineering
HB 3-1996	Electrical and electronic drawing practice for students
HB 20-1996	Graphical symbols for fire protection drawings
HB 24-1992	Symbols and abbreviations for building and construction
ISO 14617 Parts 1-11	Graphical symbols for diagrams



*Specifications ... for soil testing*



*... for earthworks*



*... for concrete works*

## Technical specifications

A contract or tender document often references technical specifications about the specific requirements and construction standards for various elements of a project. This includes how the work will be done, the quality of workmanship and methods of testing. Typically, construction projects require construction of various elements and use of various materials. More than one technical specification may be required for the whole project. For example, a construction project may require individual technical specifications for

- earthworks
- erosion and sediment controls
- concrete works
- fencing
- building works
- roads
- electrical systems
- water reticulation systems.

For small projects, the material and construction specifications may be documented in the form of notes on the design drawings. For larger projects, a separate specification document is more practical.

Designers will usually have suitable standard technical specification documents. However, as a guide a specification might include

- descriptive title, number, identifier etc. of the specification
- date of last effective revision and revision designation
- a logo or trademark to indicate the document copyright, ownership and origin
- Table of Contents (TOC) if the document is long
- person or office responsible for questions on the specification, updates and deviations
- the significance, scope or importance of the specification and its intended use
- terminology, definitions and abbreviations to clarify the meanings of the specification
- references and Standards used or to be complied with
- test methods for measuring all specified characteristics
- material requirements: physical, mechanical, electrical, chemical
- targets and tolerances
- acceptance testing, including performance testing requirements and tolerances
- workmanship
- certifications required
- safety considerations and requirements
- environmental considerations and requirements
- approval authority considerations and requirements
- quality control requirements, acceptance sampling, inspections, acceptance criteria
- person or office responsible for enforcement of the specification
- completion and delivery
- provisions for rejection, reinspection, rehearing, corrective measures

A typical Table of Contents for an earthworks and concrete specification is shown below.

Earthworks specifications	Concrete work specifications
Scope of works	Extent of work
Description of the work	Code requirements
General specifications	Supervision
Interpretation of terms	Inspection
Geotechnical information	Steel reinforcement
Tolerances	Supply of concrete
– the need for tolerances	Quality of concrete
– edges and alignments	Stabilised sand
– earthworks quantities	Preparation of other than rock surfaces before placing concrete
– setting out	Concrete blinding layer
Site preparation	Formwork
– topsoil stripping	Formwork ties
– topsoil stockpiles	Preparation of formwork surfaces before placing concrete
Cuttings	Placing of concrete
– stockpiling topsoil	Pumping
– excavation	Finish of concrete surfaces
– batter tolerances	Curing of concrete
Benching	Sampling and testing
– transition from cut to fill	Rejection of concrete
Spoil	Removal of formwork
– unsuitable material	Construction joints
Embankment construction	Core holes and building-in
– suitable material	Anchor bolts
– placing fill	Joint fillers
– borrow	Joint sealers
– compaction and quality control	Tolerances for slab surfaces
– compaction and moisture requirements	Special placing conditions and special mixes
– test locations	– concreting in hot weather
Completion	– concreting in windy conditions
References	– concreting in cold weather

Technical specifications may specify a performance goal (a performance standard) or procedures used to meet the performance goal (design standard). A performance standard permits flexibility and change. For example, a performance specification for a feed processing system may specify that the capacity be a nominated tonnes per hour.

## Quick tips

- Technical specifications are an integral and important component of a construction project.
- For small projects, the material and construction specifications may be documented in the form of notes on the design drawings.
- For larger projects, the preparation of a separate specification document is more practical.
- Ensure adherence to the technical specifications as this determines the quality of the project and influences the performance of the constructed facility.
- Ensure that all parties responsible for the creation, processing or supply of drawings and diagrams standardise the layout and content of all drawings.
- Ensure that electronic design data is compatible with construction contractor GPS-based machine control systems.

## Further reading

Numerous Australian Standards have been developed for the building and construction industry.

Australian standards for technical drawing can be found at [www.saiglobal.com](http://www.saiglobal.com)

A number of the building and construction standards are referenced in regulations, including the Building Code of Australia, which means it is compulsory to undertake work in the way in which it is specified.

Australian Building Codes Board, 2013, National Construction Code (NCC) Volume 1, Volume 2 and Volume 3. Australian Building Codes Board.