



Transport  
Roads & Maritime  
Services

# CADD M 001

# CADD MANUAL

## Section 3.5 – Road Design

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## About this release

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## Glossary

**3D modelling** – Process of using computer software to create a 3D representation of an object or feature in an electronic model.

**AFC drawing set** – Drawing set that is ‘Accepted for Construction’.

**AFC model** – Design model used to prepare the ‘Accepted for Construction’ drawing set, represents the finished design surface.

**CAD** – Computer Aided Drafting.

**CADD** – Computer Aided Design and Drafting.

**Chainage** – (Austroads) – Distance of a point along a control line, measured from a datum point.

**Design Brief** – Roads and Maritime Services Model Design Brief, used to specify design requirements for a project.

**Design Stage** – Stage of completion of a design phase, typically 20%, 80%, 100%.

**Design Phase** – Design development process, delivered in 3 phases. 1. - Strategic Design phase – develop options, establish preferred solution. 2. - Concept Design phase – further develop preferred solution and finalise the design. 3. - Detailed Design phase – detail the design for construction.

**Design Project Manager** – Road and Maritime Services representative assigned to provide design information relating to the project.

**DesignLine** – Road Design Engineering process management framework.

**DGNlib File** – (Microstation) – Drawing library file that contains data to be shared across Microstation files and users. Used to define standards for various resources such as line styles, text styles, cells, symbols, level names etc.

**Focal Point** – Next city, town or suburb of importance along a route, used on guide signs and in Roadloc, locations are defined on the Roads and Maritime Services Focal Point list and maps, Appendix A and B of ‘Roads and Maritime Services Guide Signposting manual’.

**GENIO File** – (MX) – A text file used for the general input and output of MX model data.

**Input File** – (MX) – A text file used for the input of MX linemode commands to create and modify MX model data.

**Issued drawings set** – Drawing set that is released or ‘Issued’ at the end of a Design Stage.

**Level** – (Microstation) – Used for grouping elements in a Microstation model, levels are named according to content.

**Linear Referencing System** – System used to accurately measure and define locations along a road network based on road segments.

**Model** – (Microstation) – A container for Microstation elements, can be either 2D or 3D, stored as a discrete object in the Microstation drawing file, a drawing can contain multiple models.

**Model** – (MX) – A container within an MX model.fil used to store point and string data in related sets.

**Model.fil** – (MX) – a file used to store MX models related to a project.

**Objective** – Roads and Maritime Services electronic document management system for storage of Drawing Sets, project documentation and CADD file archives.

**Roadloc** – Roads and Maritime Services linear referencing system used to accurately locate assets and features on the road network.

**String** – (MX) – Series of points each joined to its predecessor and successor by a straight or curve-fitted line. A string may be multidimensional, 2D, 3D, 5D, etc. depending on data stored for each point.

**Style set** - (MX) – A file that controls how features in an MX model are drawn or displayed.

# 1. Introduction

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## 1.1 Scope

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The purpose of Section 3.5 of the CADD Manual is to detail requirements for the preparation of Road Design data and drawings for projects being undertaken by, or on behalf of, Roads and Maritime Services (subsequently referred to as Roads and Maritime).

## 1.2 Data Format

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All project data must be delivered in a format compatible with the Microsoft Windows operating system. Currently supported versions are Windows XP and Windows 7.

Files may be compressed, if required, using the ZIP compression format.

## 1.3 Data Delivery

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Acceptable data delivery systems are email, FTP or via a receipt based delivery system.

The current Roads and Maritime email attachment size limit is 25Mb.

## 1.4 Data Ownership

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All project data prepared on behalf of Roads and Maritime remains the property of organisation in accordance with Roads and Maritime Services 'Contract Document C72 - Panel Deed for Professional Services' – Section 17 – 'Ownership of documents and intellectual property'.

Project related data or information may not be given to a third party without prior consent from Roads and Maritime.

## 1.5 CADD Software

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Roads and Maritime does not limit the use of CADD software packages for the preparation of designs and drawings, however, designs and drawings must be delivered to Roads and Maritime in a format that can be read into and used in the principal Roads and Maritime CADD software systems.

The current principal Roads and Maritime CADD software systems used for road design are:

**MX – Version V8i** – Three-dimensional surface modelling package used for surveying, road and civil engineering design, supplied by Bentley Systems.

**Microstation – Version V8i** – General purpose three-dimensional Computer Aided Design and Drafting package used mainly for drawing preparation, two dimensional design and 3D conflict analysis, supplied by Bentley Systems.

Terminology used in this section of the manual will be relevant to the principal Roads and Maritime CADD software.



## 1.6 CADD File Types

Table 1.1 - CADD File Types shows file types that are acceptable to allow designs, drawings and model data to be read into Roads and Maritime CADD software systems, for the purpose described. Drawing sets are to be delivered in the PDF format.

**Table 1.1 - CADD File Types**

Software	File Type	Purpose	Version
12d Model	12D Ascii	Model data format produced by 12d Model software, which can be read into MX.	9.0 or 10.0
Acrobat Reader	PDF	Adobe Portable Document Format to be used for the delivery of drawings and drawing sets.	V1.6 or greater
AutoCAD	DWG	AutoCAD drawing format, which can be read into Microstation	2007 to 2014
AutoCAD	DXF	AutoCAD drawing exchange format, which can be read into Microstation.	2007 to 2014
MicroStation	DGN	Microstation design file used for drawing production.	V8i – SS2
MX	model.fil	Database file used by MX to store all model data.	V8i – SS2
MX	Input (.inp)	Model data input format used by MX.	V8i – SS2
MX	GENIO	Model data format, ' <u>GEN</u> eral <u>I</u> nput and <u>O</u> utput', which can be created by various software packages. This data can be read into MX.	V8i – SS2

Other file types are not to be used.

The acceptable software/file version will change over time. The current acceptable version should always be confirmed with the Roads and Maritime Design Project Manager prior to commencing design or drawing production.

## 1.7 Road Design Model Data Delivery Format

The road design model data is to be delivered in GENIO format, unless otherwise approved by the Roads and Maritime Design Project Manager.

Refer to section 5.10 MX GENIO Formats for further details of requirements for GENIO files.

The MX model.fil and Input file formats are acceptable with prior approval.

The 12D Ascii format is only acceptable with prior data transfer testing and approval.

## **1.8 Drawing Delivery Format**

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All drawings produced as part of a drawing set are to be delivered in PDF format.

Drawing sets are to be delivered as multi sheet PDFs. Drawing sets may be delivered as several separate multi sheet PDF packages.

All CAD drawing files and other associated files used to produce the drawing set PDFs are to be delivered. CAD drawing files are to be either Microstation .DGN or AutoCAD .DWG format.

## **1.9 CADD Resources**

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Roads and Maritime will make resource files, used for road design drawing production, available from the current principal Roads and Maritime CADD website.

Roads and Maritime will endeavour to make resource files available in a suitable format for use with AutoCAD and 12D Model.

A change log will be maintained on the Roads and Maritime CADD website. Updates to CADD resource files should be downloaded as required.

## **2. Data Management**

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This chapter covers the management of road design data and drawings. It details drawing registration, drawing issue stages, amendment requirements, drawing sign-off and approval, PDF requirements and archiving requirements for road design data and drawings.

### **2.1 Registration and Drawing Set Numbers**

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All road construction drawings require a drawing registration number allocated by Roads and Maritime Plan Management Centre. This number is created in the Objective document management system and is identified as the Drawing Set (DS) number.

The drawing set number will be in the form:

DSYYYY/NNNNNN

eg

DS2014/000123

The drawing set number is used as the Drawing Registration Number and can be arranged by completing the form Request for Drawing Set Number and emailing to [planmanagementcentre@rms.nsw.gov.au](mailto:planmanagementcentre@rms.nsw.gov.au)

A different DS number will be allocated for the different discipline drawing sets required for a project, ie the road design drawings will have a different DS number to the drawings used for the bridge design.

All PDF versions of issued drawing sets, which are sent to Roads and Maritime Plan Management Centre, are stored in Objective under the drawing set number.

### **2.2 Design Project Number**

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All Roads and Maritime road design projects will be allocated a Standard File (SF) number when the project is initially created in Objective, along with the drawing set number. This SF number is to be used as the Design Project Number.

The Design Project Number will be in the form SFYYYY/NNNNNN, eg SF2014/000987 and will be issued upon request for a drawing set number.

All design documentation will be stored in Objective under the SF number. CADD data will also be archived in Objective under the SF number.

Professional Services Contractors may allocate their own Design Project Number for use on their internal systems.

### **2.3 Drawing Issue and Amendments**

---

The details of all drawing issues and amendments are to be documented using the form in Appendix C – Issue and Amendment of Road Design Drawings.

A Drawing Issue and Amendment Register spread sheet is to be maintained for each drawing set detailing the drawing issue history.

PDF files for the issued drawing sets are to be sent to Roads and Maritime Plan Management Centre so that they can be stored in Objective under the drawing set number.

All CADD files, and associated data, for issued drawings are to be packaged for archiving and sent to the Roads and Maritime Plan Management Centre so that they can be stored in Objective under the standard file number.

A copy of the Drawing Issue and Amendment Register spread sheet is to be sent to the Roads and Maritime Plan Management Centre with each drawing set issue so that it can be stored in Objective under the standard file number.

### **2.3.1 Design Phase Drawings**

Drawings at the various review stages of the Strategic, Concept and Detailed Design phases are to be issued using numeric issue notation, ie 0,1,2,3,4,5 etc.

Drawing amendment numbers are to start at '0' for each design phase.

Drawings are issued as a complete set at each design review stage and all sheets in the drawing set will have the same issue number.

The individual drawing sheet Issue/Amendment boxes on all sheets in the drawing set are to contain the same issue number, date and issue description, eg:

Issue 0, 21/02/2012, Concept Design Issued for 20% Review.

Issue 1, 05/06/2012, Concept Design Issued for 80% Review.

Issue 2, 11/09/2012, Concept Design Issued for 100% Review.

Issue 3, 07/10/2012, Accepted Concept Design

Additional issues may be required between 100% and the Accepted design phase issue. For the Strategic and Concept designs the 100% stage drawings are re-issued with the next issue number. For Detailed designs the Pre-AFC issue is used.

### **2.3.2 Pre-AFC Drawings**

Following the review of 100% Detailed Design drawings a Pre-AFC drawing set may be issued so that drawing amendments can be made prior to the final AFC release.

Pre-AFC drawings are to use the numeric issue notation, ie 0,1,2,3,4,5 etc.

Amendments made to the Pre-AFC drawings are recorded on the individual sheet.

The initial Pre-AFC drawing set will be issue '0', for all sheets. The first amendment to a sheet will be issue '1' for that sheet, the second amendment to a sheet will be issue '2', and so on.

The individual drawing sheet Issue/Amendment box on each amended sheet in the drawing set is to contain the next issue number for the sheet, the date and issue description, eg:

Issue 0, 04/10/2012, Pre-AFC Issue

Issue 1, 12/11/2012, Pavement Design Changed

Amendments made to the Pre-AFC drawings are to be highlighted with a red amendment cloud around the amended drawing area and a triangle containing the amendment issue number next to the cloud.

### **2.3.3 Construction Drawings (AFC)**

The construction issue drawings, or Accepted For Construction (AFC) drawings, are to use alpha issue notation, ie A,B,C,D,E etc.

Amendments made to construction drawings are recorded on the individual sheet.

The first issue of the approved construction issue drawing set will be issue 'A', for all sheets. The first amendment to a sheet will be the 'B' issue for that sheet, the second amendment to a sheet will be the 'C' issue, and so on.

The individual drawing sheet Issue/Amendment boxes on all sheets in the drawing set are to contain the issue letter, date and issue/amendment description, eg:

Issue A, 04/12/2012, Construction Issue

Issue B, 12/02/2013, Stopping Bay added CH 23500.00 LHS

Amendments made to the construction drawings are to be highlighted with a red amendment cloud around the amended drawing area and a triangle containing the amendment issue letter next to the cloud.

The drawing issue and amendment register is updated to show the issue date at the top of the column with and the current issue letter for each sheet in the drawing set listed below.

If the full construction drawing set is re-issued following an amendment, the drawing set at this issue will be the original issue with the current amended sheets substituted.

### **2.3.4 Drawing Issue and Amendment Register**

A Drawing Issue and Amendment Register spread sheet is to be maintained as a record of the current drawing issue for all sheets in a drawing set at each stage during the design phases and with each amendment of the Pre-AFC and construction drawings.

The Drawing Issue and Amendment Register spreadsheet is to contain a list of all sheets in the drawing set, the issue number/letter for each sheet and the issue date.

The issue date for the current issue/amendment is to be shown at the top of the issue column with the current sheet issue amendment number/letter below the date. Refer to Figure 2-1 - Sheet Issue and Amendment Register for an example.

	A	B	C	D	E	F	G	H	I	J	K	L
1	PROJECT	HW15 - BARTON HIGHWAY		ISSUE AND DATE								
2		SHIRE OF YASS VALLEY		DD	25	15	7	19				
3		GOUNYAN CURVE REALIGNMENT		MM	10	1	2	2				
4	SHEET NUMBER	SHEET DESCRIPTION	DRAWING FILE	YY	2012	2013	2013	2013				
29	RD-0006	DETAIL DESIGN CH2650 - CH2900	DS2012-000342-FC-RD-0006.DGN		A	B	C	D				
30	RD-0007	DETAIL DESIGN CH2900 - CH3150	DS2012-000342-FC-RD-0007.DGN		A	B		C				
31	RD-0008	DETAIL DESIGN CH3150 - CH3400	DS2012-000342-FC-RD-0008.DGN		A		B					
32	RD-0009	DETAIL DESIGN CH3400 - CH3650	DS2012-000342-FC-RD-0009.DGN		A	B	C					
33	RD-0010	DETAIL DESIGN CH3650 - CH3900	DS2012-000342-FC-RD-0010.DGN		A	B		C				
34	RD-0011	DETAIL DESIGN CH3900 - CH4150	DS2012-000342-FC-RD-0011.DGN		A			B				
35	RD-0012	DETAIL DESIGN CH4150 - CH4400	DS2012-000342-FC-RD-0012.DGN		A							
36	RD-0013	DETAIL DESIGN CH4400 - CH4650	DS2012-000342-FC-RD-0013.DGN		A							
37	RD-0014	DETAIL DESIGN CH4650 - CH4900	DS2012-000342-FC-RD-0014.DGN		A							

**Figure 2-1 - Sheet Issue and Amendment Register**

### 2.3.5 Index Sheet

The index sheet for the Pre-AFC and construction drawing set is to show the current issue number/letter in the 'Issue' column for each sheet in the drawing set.

### 2.3.6 Title Block

The title block 'Issue' box on each sheet in the drawing set is to show the current issue number/letter for that sheet.

The title block 'Issue/Amendment' box on each sheet in the drawing set is to show the details of the current sheet issue or amendment, along with previous issue/amendment details.

### 2.3.7 Amendment Clouds

Amendments made to the Pre-AFC or construction drawing set sheets are to be highlighted with a red amendment cloud around the amended drawing area and a triangle containing the amendment issue number/letter next to the cloud.

Only the amendment clouds for the current issue is to be shown on the drawing, amendment clouds from previous issues are to be removed prior to re-issuing the sheet.

Refer to section 6.16 Drawing Amendments for details of amendment cloud presentation on drawings.

## 2.4 Design Phase/Stage

The requirements for the design outputs and drawings deliverables at the various design stages/phases are detailed in chapter 5 – Design Process Outputs and chapter 8 – Drawing Outputs.

The title block for each drawing sheet is to show the current design stage/phase for the drawing issue. The following format is to be used:

STRATEGIC

X% CONCEPT, eg 20% CONCEPT

X% DETAILED, eg 80% DETAILED

PRE-AFC

FOR CONSTRUCTION

AS BUILT

## 2.5 Drawing Status Stamps

---

All drawings issued prior to the construction issue, or AFC issue, must have the words 'NOT FOR CONSTRUCTION' in boxed red text above the title block.

All construction issue drawings, or AFC drawings, must have the words 'ACCEPTED FOR CONSTRUCTION' in boxed blue text above the title block.

The standard Roads and Maritime cover and border sheet drawings in Microstation have these 'stamps' on separate levels which can be turned on and off as required.

## 2.6 Drawing Signatures and Approvals

---

Road design drawings are to be signed as part of the Roads and Maritime design approval process to indicate that the appropriate design review, integration and verification procedures and checks have been carried out during the design phase. This is done in conjunction with the Design Finalisation Certificate.

Further approval is then required for design validation and acceptance prior to the design and drawings being issued at the end of the design phase.

Three signature boxes are required on the drawing set cover sheet for the sign-off of the drawing set. The signature boxes on the drawings are to be labelled:

- Designed
- Reviewed
- Verified

The 'Designed' box is to show the Designer who produced the design, the 'Reviewed' box is to show the Lead Designer who reviewed the design and the 'Verified' box is to show the Design Manager who verified the design.

The same person cannot sign on the drawing sheet as designer, reviewer and verifier.

A fourth box is required containing the Roads and Maritime Project Managers name and title, no signature is required in this box.

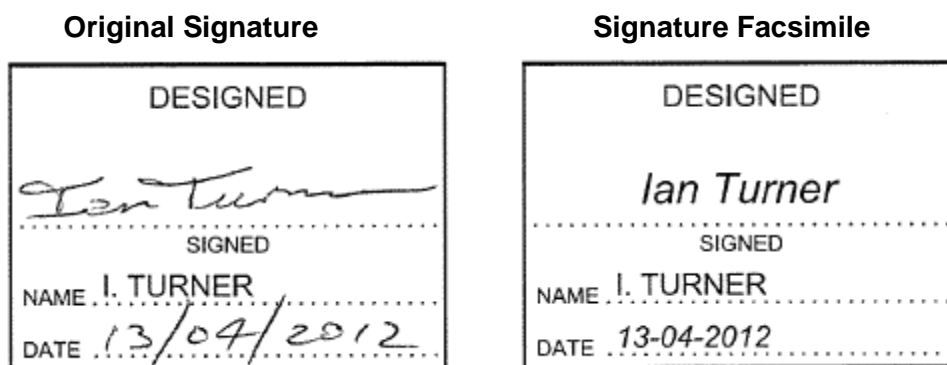
Signed cover sheets are to be scanned as PDF files and sent to the Roads and Maritime Plan Management Centre to be added to the drawing set in Objective. Once the scanned signature drawing has been verified in Objective the signature boxes on the cover sheet drawings are to be updated with a signature facsimile.

### 2.6.1 Signature Facsimile

A signature facsimile is used in the CAD drawing file to indicate that a paper copy of the drawing has been signed, scanned to PDF and verified in Objective.

The person responsible for compiling the issued drawing set PDFs following sign-off, must ensure that the signature facsimile and sign-off date are correct and must document that they have been checked.

The signature facsimile must be italicized text. The use of scanned or digitised versions of a real signature is not permitted for legal reasons.



**Figure 2-2 - Signature Facsimile**

## **2.7 As Built (WAE) Drawings and Data**

As built, as constructed, or work-as-executed (WAE), drawings and model data are required for all Roads and Maritime construction projects so that there is a record of what was actually constructed and how it differs from the design shown on the approved construction drawings.

WAE information is used for the ongoing maintenance of the road asset.

WAE drawing mark-up and certification is based on the requirements set out in Roads and Maritime 'QA Specification G2-C2 General Requirements (Major Contracts)'.

A certified WAE drawing set is to be supplied at the completion of the construction contract. The drawing set cover sheet containing the certification signature is to be scanned and included with the drawing set PDF files.

The PDF files for the certified WAE drawing set are to be sent to the Roads and Maritime Plan Management Centre so that they can be stored in Objective under the drawing set number.

All CADD files, and associated data, used to produce the WAE drawing set are to be packaged for archiving and sent to the Roads and Maritime Plan Management Centre so that they can be stored in Objective under the standard file number.

Refer to chapter 8 Drawing Outputs for details of requirements for WAE drawings.

## **2.8 Design Report Documentation**

All design and drawing process reports and checklists are to be attached to the project Design Report as Appendix 1 – Design Outputs. Outputs to be included in the appendix include:

- Alignment Details Reports
- Surface Checker Report
- Conflict Analysis Report
- Design Model and Drawing Checklist

A Design Report including Safety by Design and other project documentation shall be in accordance with Professional Service Contract – Description of Services.



## **2.9 PDF Creation and Printing**

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All issued drawing sets are to be delivered in PDF format.

Any hard copies of issued drawing sets must be created from the PDF file, they are not to be created directly from the CAD drawing.

### **2.9.1 Printing PDFs**

All PDF files must be printed without page scaling in order to obtain the correct drawing scale. The 'Fit to Printable Area' option should not be used unless a different paper size is required.

## **2.10 Archiving**

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All model data and drawings are to be 'packaged' for archiving at each design review stage and at the end of each design phase. Model data and drawing 'packages' are also to be created for the Pre-AFC, Construction and As Built (WAE) drawing set issues.

The model data and drawing 'package' is to include all design files, data and drawings used to create the PDFs for the issued drawing set. The 'package' is to be delivered in ZIP file format.

The 'packages' are to be sent to the Roads and Maritime Plan Management Centre for archiving in Objective under the standard file number.

For details of how to prepare a model data and drawing 'package' for archiving in the Objective system, please refer to the Roads and Maritime Plan Management Centre 'Filing Guide for Archiving CADD Files'.

## 3. Naming Conventions

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This chapter details the naming conventions to be used for project folders, design files, design models, design features (strings), drawing set numbers, drawings files, drawing models, drawing levels and PDF files.

Alternate folder and file naming conventions are permitted where document management systems and information management workflows are in place that automate the naming process.

### 3.1 Project Folder Naming

---

The project folder name and sub-folder names will depend on the document management system and network drive being used for the project.

The following folder naming structure shows an example based on RMS network drive usage, it is used in conjunction with the RMS Objective document management system.

#### 3.1.1 Project Number

Project folder names are based on the Objective standard file number (SF number) allocated by the Roads and Maritime Plan Management Centre.

The SF number is used as the project number, eg SF2013-003845.

#### 3.1.2 Project Folder

The project folder should be created using a Project Folder Template in order to obtain a standard base folder structure which is consistent for all projects.

Project folders should be in the form:

*drive:\Design-Projects\Road No\project number\*

eg

K:\Design-Projects\HW1\SF2013-003845\

The project folder contains sub-folders based on the type of files and data being stored, eg the folder name for MX data for the Concept design would be:

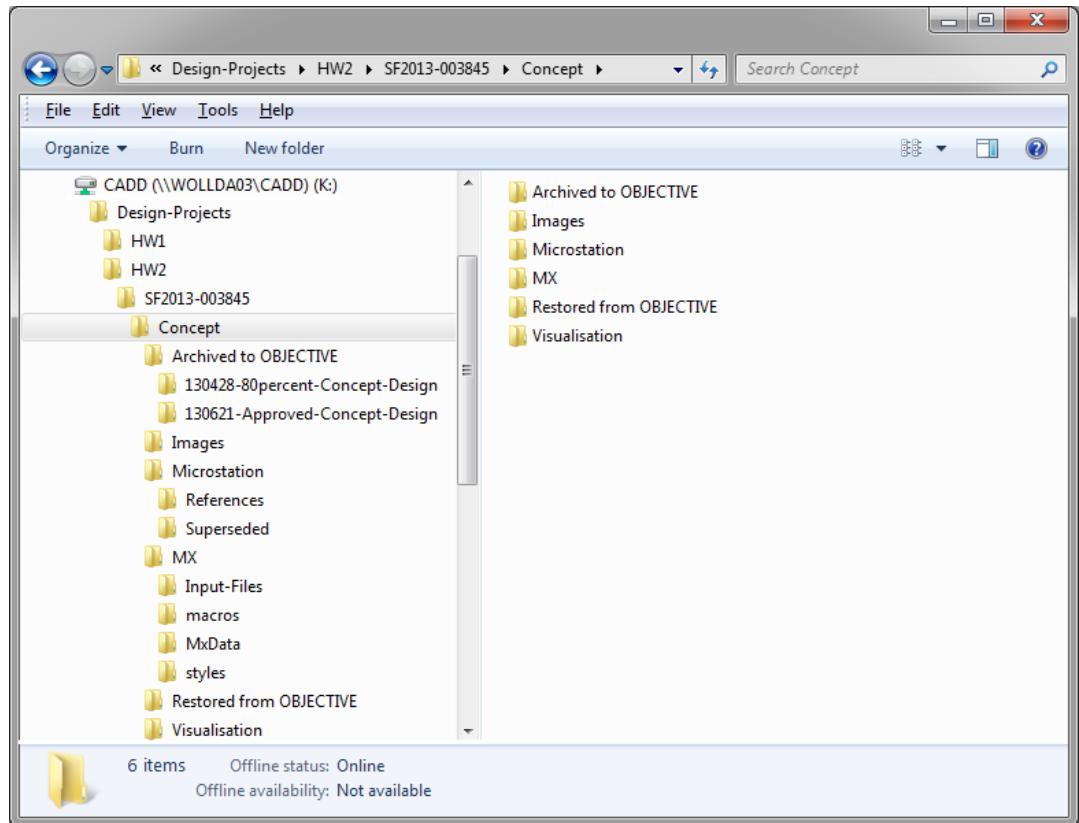
K:\Design-Projects\HW1\SF2013-003845\Concept\MX

Where multiple designers are working on a design project, it may be necessary to create separate folders for each designer, eg where multiple designers are creating MX data the folders could be named:

..\MX (master design folder)

..\MX-JoeB (design folder for Joe)

..\MX-MaryJ (design folder for Mary)



**Figure 3-1 - Example Project Folder Structure**

### 3.1.3 Project Folder Template

The Project Folder Template contains a standard folder structure and default file content for a Road Design project.

### 3.1.4 Project Folders for Design Options

Where a project requires the development of several design options, separate folders should be created to store each option's drawings and design files, eg:

..\Microstation-Opt1  
..\MX-Opt1

## 3.2 Design File Naming

This section details the naming of files in the '..\MX' project folder.

### 3.2.1 MX Project .mmd File

The MX project name, ie .mmd file, is to be based on a brief project description, eg:

Kempsey-Bypass.mmd.

Where there are multiple MX option folders the option number should be appended, eg:

Kempsey-Bypass-Opt1.mmd.

### 3.2.2 MX Input Files

Design input files are to be named according to their purpose. MX input files should be named so that the running order is clear.

Input files should be named using the following format:

*nn-purpose.inp* where

nn - running order number

purpose - purpose or model name created

eg

02-Survey.inp, 06-Design-Control.inp, 07-Design.inp, 16-Draw-Long-Sections.inp

Refer to Table 3.1 - Example MX Input File List for an example list of input files that may be required for a design project.

MX input files are to be stored in the '..\MX\Input-Files' sub folder.

**Table 3.1 - Example MX Input File List**

Prefix	Input File Purpose	Description
01	Index/Nest	Index and nest input file (runs other inputs)
02	Survey	Creates ground model
03	Survey Triangles	Creates ground triangles
04	Utility (existing)	Creates existing utility model
05	Cadastral (existing)	Creates existing cadastral model
06	Design Control	Design master control strings
07	Design	Main design input file
08	Design Triangles	Creates design triangulation
09	Design Contours	Creates design contour model
10	Transverse Drainage	Creates transverse drainage strings
11	Longitudinal Drainage	Creates longitudinal drainage strings
12	Pavement Drainage	Creates pavement drainage strings
13	Utility (design)	Creates new/relocated utility strings
14	Cadastral (design)	Creates new property boundaries
15	Draw Plan Views	Draws various plans and annotations
16	Draw Long Sections	Draws various long sections
17	Draw Cross Sections	Draws cross sections
18	Draw Profiles	Draws various profiles
19	Volumes	Generates volumes
20	Outputs	Creates various design outputs

### 3.3 Design Model Naming

Standardised naming of models provides consistency across design projects and allows model content to be easily identified.

MX style sets, standard input files, macros, Microstation drawing tools and workflows developed by Roads and Maritime will use the standard model names.

Design models should be named in accordance with the Roads and Maritime Design model naming convention set out in Table 3.2 - Design Model Names below.

**Table 3.2 - Design Model Names**

MX Model Name	Content	Use
CONT DESIGN	Final design surface contours	Drawings, design verification
CONT SURVEY	Survey surface contours	Drawings
DESI BARRIERS	Proposed safety barrier strings	Drawings, clash detection
DESI BASINS	Proposed drainage basin strings	Drawings, clash detection
DESI BOUNDARY	Strings defining extent of the design model	Limiting design triangulation
DESI BRIDGE ###	Strings for bridge ###	Drawings, sections, visualisation
DESI CADASTRAL	Digitised property boundaries, proposed bdys	Drawings
DESI CHAINAGES ###	Design strings for chainage annotation of plan type ###, or plan scale ###	Drawings
DESI CHECK ###	Design model issued for review at date ###	Design review
DESI CONTROL	Control strings not part of the design surface	Drawings, construction
DESI CULVERTS	Proposed drainage pipe culvert and box culvert strings	Drawings, clash detection
DESI DRAINAGE	Proposed drainage network strings	Drawings, clash detection
DESI EXIST PAVE	Existing pavement strings (copied from survey model)	Drawings
DESI FINAL	Final design surface strings	Drawings, sections, volumes, clash detection, construction
DESI GISDATA	Carriageway strings for output to GIS system	GIS system road database
DESI LINEMARKING	Proposed linemarking strings	Drawings
DESI PAVEMENT	Pavement design strings	Drawings, volumes
DESI SLOPESIG	Slope signature strings	Drawings
DESI TUNNEL ###	Strings for tunnel (or underpass) ###	Drawings, sections, volumes, clash detection, construction, visualisation
DESI TURNPATH	Strings used for turning vehicle path analysis	Design analysis
DESI VIZ	Design strings used for creating visualisations	Design visualisation, review
DESI VOLUMES	Proposed volume strings	Volumes
DESI WORKING	Working design strings	Design development
LSEC MCxx	Long Section strings along MCxx	Drawings
TRIA DESI FINAL	Triangulation of final design surface strings	Contours, volumes
TRIA DESI PAVE	Triangulation of design pavement strings	Volumes
TRIA DESI VIZ	Triangulation of design visualisation model	Design visualisation, review

TRIA SURVEY	Triangulation of survey surface strings	Contours, sections, volumes
UTIL DESIGN	Designed utilities and services strings	Drawings, clash detection
XSEC MCxx	Cross Section strings along MCxx	Drawings, volumes

For Survey model names please refer to CADD Manual - Section 3.2 – Surveying.

The CONT SURVEY and TRIA SURVEY models are created by the designer for use in the design process.

### 3.3.1 Default MX Style Sets for Models

Standards model naming allows the automatic assigning of an MX style set to the model. The Roads and Maritime software customisations for MX uses the first four characters of the model name to automatically assign a default style set that is appropriate for the model type. Refer to Table 3.3 - Default Style Set Names for details.

**Table 3.3 - Default Style Set Names**

Model Prefix	Description	Default Style Set Name
DESI	DESIGN	RMS-MXROAD.pss
CONT	CONTOUR	RMS -Contours.pss
TRIA	TRIANGULATION	RMS -Triangulation.pts
XSEC	CROSS SECTIONS	RMS -CrossSection.pss
LSEC	LONG SECTIONS	RMS -LongSection.pss
SURV	SURVEY	Survey_2009.pss
UTIL	UTILITY SURVEY	Survey_2009.pss
CADA	CADASTRAL	Cadastral_2010.pss

### 3.3.2 Design Scheme Options

Where more than one design scheme option is being developed in the same MX model.fil file, the design model names are to have an 'OPT' option identifier added, eg:

DESI OPT1 WORKING  
DESI OPT2 WORKING  
DESI OPT2 DRAINAGE  
CONT OPT2 DESIGN  
LSEC OPT2 MC10

Where sub-options are required, eg for different intersection options within an option, model names are to have an 'OPTx' identifier added, eg:

DESI OPT2A WORKING

### 3.3.3 Design Project Zones and Project Acronyms

Where a design project needs to be broken into separate zones, usually on large projects, a single letter zone code may be added to the model name, eg:

DESI A FINAL

DESI B FINAL

A project acronym may be used to differentiate design model data, in this case a 3 or 4 character code may be added to the model name, eg Gerringong to Berry model would use G2B:

DESI G2B FINAL

### 3.3.4 GENIO File Model Names

The output of design models in MX GENIO format is required for design review, project documentation and transferring model data at each stage of the design process (eg 20%, 80% and 100%) for Strategic, Concept, Detailed and at Pre-AFC and AFC stages.

Design models output using the MX GENIO export option, or Roads and Maritime MX GENIO Output tool, are to have the output date appended to the Design model name in the GENIO file using the following format:

designmodelname YYMMDD

eg

DESI FINAL 120522

This process provides version control of design model outputs.

Refer to section 3.5.1 Design Model Output File Names for naming of GENIO files.

## 3.4 Design Feature (String) Naming

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Refer to Appendix D - Design Feature Names for a list of the Roads and Maritime standard design string labels and example drawings detailing their use.

The different design feature types are placed on separate drawing levels according to the definitions in the Roads and Maritime MX plan style sets, one feature type per drawing level.

The Roads and Maritime String Naming Convention (SNC) generally follows the MX standard string naming convention, which is:

- 1<sup>st</sup> character - the string type
- 2<sup>nd</sup> character - the specific road feature
- 3<sup>rd</sup> character - the associated master control alignment (string group)
- 4<sup>th</sup> character - the side of the master control alignment on which the string was created

The MX standard SNC uses the 4<sup>th</sup> characters 0-9 and A-J for left of the master string and I-Z for right of the master string.

The Roads and Maritime SNC uses a modified convention for the 4<sup>th</sup> character to address various string naming issues and allow for consistent string naming at intersections.

MX provides design modules that automatically generate string names based on the MX standard SNC. When these tools are used the designer will need to manually edit the string names in order to comply with the Roads and Maritime convention.

All string names are to be limited to 4 characters. Strings output from other design packages for use in MX (eg 12d Model) are to have string names converted to 4 characters.

### 3.4.1 String Naming Issues

AS1100.101-1992 – 4.1.5 Use of characters, states that :

*‘The letters ‘O’ and ‘I’ should not be used in combination with numbering owing to the liability of confusion with the numerals ‘0’ and ‘1’.*

While this is mainly an issue on drawings, it is particularly an issue on some survey equipment as the letters and numbers look the same.

To avoid these issues Design strings should not contain 3<sup>rd</sup> and 4<sup>th</sup> characters that have letters either I (i) or O. Automatically generated string names will need to be manually edited to avoid this.

The DESI FINAL model and any other design models used for construction purposes, or used to create the construction drawings, must have the strings renamed prior to drawing creation or outputting of the design model.

### 3.4.2 String Names at Intersections

Strings designed from the side road master control MC string should basically follow the Roads and Maritime SNC, ie same 3<sup>rd</sup> character, but with 4<sup>th</sup> characters 0-9 for strings on left and P-Z for strings on right of the MC string, eg MC30, CE30, CF30, CT30, CE3P, CF3P, CT3P etc.

For the kerb returns and islands 4<sup>th</sup> characters the left/right convention can be dropped and A-H and J-M can be used.

For the kerb return on the entry side of the intersection MK3A, CF3A, CT3A, etc.

For the kerb return on the exit side of the intersection MK3B, CF3B, CT3B, etc.

For traffic island on the entry side MT3C,C33C, CT3C, CB3C etc, MT3D etc, MT3E etc. (note – allows for island to be split into 3 sections for set-out).

For traffic island on the exit side MT3F, C33F, CT3F, CB3F etc, MT3G etc, MT3H etc. (note – allows for island to be split into 3 sections for set-out).

For median traffic island MT3J, C33J, CT3J, CB3J etc, MT3K etc (note – allows for island to be split into 2 sections for set-out).

Refer to Appendix D – Design Feature Names for further details.

### 3.4.3 Use of Existing Strings for Design

Where an existing surface string, or survey string, is copied into the design model for use in the design process, the existing string should be renamed with an appropriate design string label.

## 3.5 Design Output File Names

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### 3.5.1 Design Model Output File Names

Design model output files, generally GENIO files, are to be named using the following format:



*project number-model name-output date.txt*

eg

SF2012-008523-DESI-FINAL-120723.txt

The file is to be edited and the following information added/changed:

- Add file header containing project details and designer information
- Add the date created to the design model name for version control, eg:  
DESI FINAL 120723

### **3.5.2 Design Model Surface Checker Report File Names**

Design model Surface Checker reports are to be output in PDF format and are to be named using the following format:

*project number-Surface Checker Report-model name-output date.pdf*

eg

SF2012-008523-Surface Checker Report-DESI-FINAL-120723.pdf

### **3.5.3 Alignment Details Report File Names**

Output report files for master alignment strings are to be named using the following format:

*project number-Alignment Details-output date.txt (.xls)*

eg

SF2012-008523-Alignment Details-120723.txt

### **3.5.4 Design String Output File Names**

MX design string output files to be used in tables, schedules and spread sheets, are to be named using the following format:

*model name-string name(optional)-report purpose-output date.txt (.prn)*

eg

DESI-DRAINAGE-DI09-Pipe Schedule-130125.txt

DESI-DRAINAGE-Pit Schedule-130125.txt

### **3.5.5 Design Drawing Output File Names**

Drawings created for design purposes in MX are to be named with the model name and drawing purpose, eg:

DESI-WORKING-ACCESS-DESIGN.dgn (.dpw).

Drawings created in MX that are to be used as external reference files in the drawing set are generally output as 2D drawings and are to be named in accordance with section 3.10 External Reference File Names. These drawings are to be copied from the '..\MX' folder to the '..\Microstation\References\MX-Output' folder.

## 3.6 Drawing Set Numbers

Drawing set numbers are allocated by the Roads and Maritime Plan Management Centre. Refer to section 2 Data Management for details.

Drawing set numbers are in the following format:

DSYYYY-NNNNNN

eg

DS2013-003845

Drawing set numbers replace the old NNNN-NNN-XX-NNN format plan registration numbers. The title block on Road Design drawings should show the drawing set number in the Registration Number area.

Drawing set numbers do not replace TCS numbers or Model Drawing numbers, they should be used in conjunction with these numbers. Title blocks for TCS drawings and Model Drawing should show both numbers.

## 3.7 Drawing Names

This section details the naming of files in the project '..\Microstation' folder. Files in this area are used to create the various drawing sheet outputs in PDF format.

### 3.7.1 Drawing Set Drawing Names

The drawings used to create the drawing sheet PDF outputs for the drawing set are to use the following format:

*drawing set number-design phase code-sheet group code-sheet series number.dgn*

eg

DS2013-003845-DD-GE-0102.dgn

### 3.7.2 Drawing Design Phase Codes

The design phase code is a 2-letter code that reflects the design phase, or project phase, at which drawings have been produced.

**Table 3.4 - Design/Project Phase Codes for Drawing Names**

Design/Project Phase Code	Description
DS	Design drawings for the Strategic design phase
DC	Design drawings for the Concept design phase
DD	Design drawings for the Detailed design phase
PC	Pre-AFC drawings – drawings prior to construction release
FC	Accepted For Construction (AFC) drawings – construction release
AB	As Built or Work-As-Executed (WAE) drawings – as constructed

### 3.7.3 Drawing Sheet Group Codes

Drawing sheets of the same type are to be grouped together.

Where drawings sets are divided into Packages, all drawings within a Package may use the same Sheet Group Code. Refer to section 7.3 Drawing Set Parts and Packages for details of using drawing set Packages.

**Table 3.5 - Sheet Group Codes for Road Design Drawing Sets**

Sheet Group Code	Name	Drawings in Group
GE	General	Cover Index Sheet Location / Overview Plan General Notes
RD	Road Alignment and Detail	Typical Cross Sections and Typical Details Alignment Plans and Alignment Schedules Plan Sheets Long Sections
RC	Road Cross Sections	Cross Sections
UT	Utilities	Public Utility Plans
SM	Stormwater Management	Stormwater Management Plans Drainage Profiles and Drainage Schedules Drainage Structure Details Erosion and Sedimentation Control Details Subsurface Drainage
PV	Pavement	Pavement Plans Pavement Details and Concrete Jointing
RF	Roadside Furniture, Signposting and Pavement Marking	Roadside Furniture, Fencing and Safety Barrier Plans Signposting and Pavement Marking Plans Road Furniture Schedules Signposting Schedules Pavement Marking Schedules
LT	Road Lighting	Road Lighting Plans and Schedules
IT	Intelligent Transport Systems	ITS Plans and Schedules
SC	Site Clearing and Spoil Sites	Site Clearing, Vegetation Removal Plan and Spoil Sites Plans
LS	Landscaping and Sight Envelope	Landscaping Plans and Schedules Sight Envelope Plans and Profiles
ST	Structure Details	Structural Detail Drawings, Noise Walls, Footings
PW	Property Works	Property Works Plans, Acquisition/Adjustment Plans, Details, Sections and Schedules
CS	Construction Staging	Construction Staging Plans
MS	Miscellaneous/Supplementary	Miscellaneous Plans Supplementary Information Drawings Maintenance Plans Review Information Plans
GT	Geotechnical	Geotechnical Information Plans

### 3.7.4 Sheet Numbers

Individual drawings sheets are to have a unique sheet number within the drawing set.

The sheet number is to be shown in the drawing title block and should be in the following format:

*sheet group code-sheet series number*

eg

GE-0102

### 3.7.5 Sheet Series Numbers

The sheet series number is a 4-digit number used in combination with the sheet group code to create a unique sheet number within the drawing set.

The sheet series number can be sequential throughout the drawing set, sequential within the sheet group, or sub-grouped within the sheet group.

#### Sub-Grouping

Sheet series numbers allow for the sub-grouping of sheets within the sheet group. It also allows for the same final two digits to represent the same plan area in different sheet groups.

Sub-groups, eg:

UT-0001 to UT-0019 – utility plan sheets

UT-0030 to UT-0055 – utility profile sheets

In this case sheets UT-0020 to UT-0029 are not used.

Same plan area, eg:

UT-0006 – utility plan sheet, plan area 06

SM-0106 – stormwater management sheet, plan area 06

RF-0306 – road furniture sheet, plan area 06

In this case the Location/Overview Plan sheet would show the plan area and common sheet number label, eg +06, the Location/Overview Plan legend would show the sheet groups covered.

The use of the same final 2 digits also allows for the same drawing type in different drawing set Packages to have the same last 2 digits, eg:

Same drawing type, eg:

RD-0041 – General Notes sheet for RD drawing package

UT-0041 – General Notes sheet for UT drawing package

Use of sheet group codes and sheet series numbers allows additional sheets to be added to the group without affecting other sheet numbers in the drawing set.

## 3.8 Amended Drawing Names

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The current version of a drawing should always be the original drawing name without an amendment number/letter added. Refer to section 2 Data Management for details of drawing issue and amendment numbers/letters.

When a new drawing amendment is to be done, the current drawing is to be copied and renamed with the issue numbers/letter. Amendments are then made to the current version, eg:

DS2013-003845-DD-GE-0102-B.dgn (issue B)

DS2013-003845-DD-0102.dgn (current version – issue C)

The previous issue, or old issue, of the drawing is to be moved to the ‘..\Microstation\Superseded’ folder.

### **3.9 Drawing Issue and Amendment Register Name**

---

The drawing set Drawing Issue and Amendment Register spreadsheet is to be located in the ‘..\Microstation’ folder along with the drawing files. The spreadsheet file should be named using the following format:

*drawing set number-Drawing-Issue-Register.ext*

eg

DS2013-003845-Drawing-Sheet-Register.xls

### **3.10 External Reference File Names**

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External reference drawing files and image files used in the drawing set are to be located in the ‘..\Microstation\References’ folder area.

Reference drawings created from MX are to be located in the ‘..\References\MX-Outputs’ sub-folder.

External reference file names are to be in the following format:

*reference file type-content type(-usage scale)(-2D).ext*

eg

x-Aerial-Photo.dgn

x-Aerial-Photo.ecw

x-UT-base.dgn

mx-desi-final-2D.dgn

mx-chainages-500-2D.dgn

#### **3.10.1 Reference File Types**

x = general external reference file (other design or reference data)

mx = external reference created using MX (contains MX model data or sections)

#### **3.10.2 Content Types**

The content type is a brief one or two word description of the reference file contents, drawing purpose, sheet type base or the MX model name.

#### **3.10.3 Usage Scale**

Showing the usage scale in the external reference file name is optional.

It is used where the reference file is created for use with a particular scale drawing only, eg chainage annotation text.

### 3.10.4 2D Output (2D)

Drawing files output from MX that are to be used as reference files in the drawing set should be output as a 2D file. This allows the reference file display order to be set as required, eg design linework on top of survey linework.

### 3.10.5 File Extension (ext)

This is the file extension according to the reference file type. Typical file extensions are:

Drawings - .dgn, .dwg

Images - .ecw, .tif, .jpg, .pdf

## 3.11 Drawing Model Names

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The following drawing file model naming convention applies to Microstation drawings. It has been developed for internal Roads and Maritime use and is required for the Roads and Maritime drawing tools to function correctly.

The Roads and Maritime project folder template contains Microstation drawings that use a default referencing structure based on these drawing file model names.

#### *SheetType* – cccc

- sheet model within the drawing sheet file
- represents the printed drawing sheet
- references XREF and TitleBlock drawing models for plan drawing sheets
- references external MX drawings for long and cross sections drawing sheets
- used to create drawing sheet PDF files for printing
- name (*SheetType*) based on drawing type, (cccc) based on drawing details and content range
  - eg DETAIL PLAN – 80250 TO 80500, CROSS SECTIONS – PRINCES HWY - MC10 – 80300 TO 80400
- name is used to create the drawing file model Sheet Name property used in the sheet title block

XREF - drawing model within the drawing sheet file  
- used for referencing the sheet type base drawing into the drawing file sheet model to create plan sheets

TitleBlock - sheet model within the drawing sheet file  
- used to reference the drawing set title block drawing

MX - drawing file model created by MX for 3D data

2D MX - drawing file model created by MX for 2D data

Page xx - drawing file model created by MX multi page cross section and long section output, (xx) page number

Default - default Microstation drawing file model

Refer to section 7 Drawing Production for details of drawing production and drawing file model referencing.

## 3.12 Drawing Level Naming

The format for level names in all drawings is:

D-GGGG-DESCRIPTION

Where:

D = Discipline Code

GGGG = Feature Group (4 characters)

DESCRIPTION = Concise feature description (eg Bitumen Edge, Kerb Top, Northpoint, etc.)

### 3.12.1 Discipline Codes

D – Design, features/elements that are part of the design or design drawings

E – Existing, features/elements that are existing, eg from survey

C – Cadastral, features/elements

### 3.12.2 Feature Groups

**Table 3.6 - Roads and Maritime Feature Group Codes**

Code	Code Description
BARR	Safety barriers
BDGE	Bridge features
BDYS	Cadastral boundaries
BUIL	Building features
COMM	Communications conduits and pits
CONT	Contour lines
CULT	Cultural features
CWAY	Surface features within the road carriageway (between kerbs or edges of shoulder)
DRAI	Stormwater drainage features
ELEC	Underground and overhead power, signal and lighting conduit and pits
ENHA	Drawing enhancements (notes, legends, text, dimensions, north points, border, title block, etc)
EWKS	Design earthworks features
FOTO	Photogrammetric features
FUEL	Fuel, oil and gas pipes, pits, etc.
FURN	Street furniture and other man made features (fences, signs, posts, bins, etc.)
HERI	Heritage features
KERB	Kerb, kerb and channel features

LSCP	Landscaping features (trees and other vegetation, water features, etc.)
LSEC	Longitudinal section drawing elements, drainage profiles elements
LNMK	Pavement marking features (lines, chevrons, arrows, etc.)
MARK	Survey marks
MAST	Master control, alignment and geometry features
MISC	Miscellaneous features that do not fit within another group.
PAVT	Pavement design features (subgrade strings, saw cut strings, etc.)
RAIL	Rail features
ROAD	Existing roadway features
SETO	Construction set out and conformance strings
SEWR	Sewer pipes, pits, etc.
STNS	Survey stations
TEXT	Text features (MX text strings)
TOPO	Existing topographical features (footpaths, banks, waterways, etc. outside the carriageway)
TSIG	Traffic signal features (posts, lanterns, control boxes, etc.)
TURN	Vehicle turning paths
VERG	Design surface features in the verge ( between the carriageway and earthworks)
WATR	Water reticulation and irrigation features.
XSEC	Cross section drawing elements

### 3.12.3 Concise Feature Descriptions

Refer to Appendix D – Design Feature Names for a list of concise feature descriptions to be used in Road Design drawing level names.

### 3.12.4 Creating New Level Names

Standard level names may be extended to sub-divide feature groups further as required eg:

D-ENHA-Northpoint

D-ENHA-Northpoint-Sh1

D-ENHA-Northpoint-Sh2

Where a standard level name or a sub-divided level name does not cater for a feature, a new level name may be created. The Discipline Code and Feature Group code must be selected from the standard lists above.



## **3.13 Drawing Set PDF File Names**

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### **3.13.1 Individual PDFs for sheets**

Where sheets in the drawing set are to have an individual PDF file created, the PDF file name is to be in the following format:

*drawing set number-design phase code-sheet group code-sheet series number.pdf*

eg

DS2013-003845-CD-GE-0102.pdf

### **3.13.2 Multi-sheet PDFs**

Where sheets in the drawing set are combined into a single PDF file, or several PDF files grouped by sheet group code (ie package), the PDF file name is to be in the following format:

*drawing set number-design phase code(-sheet group code).pdf*

eg

DS2013-003845-CD.pdf

DS2013-003845-CD-GE.pdf

### **Drawing Parts**

Where sheets in the drawing set are combined into several PDF files grouped by part, the PDF file name is to be in the following format:

*drawing set number-design phase code-part code.pdf*

eg

DS2013-003845-CD-PT1.pdf

## **4. Design Model Requirements**

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This chapter details requirements for design models and various data used in the design process. The terminology relates to the MX software package, however, the design model data requirements are to be applied to all design data regardless of the software used to create it.

### **4.1 General Requirements**

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#### **4.1.1 Co-ordinate System and Height Datum**

All model data is to be produced using the Geocentric Datum of Australia 1994 (GDA-94), and the projected co-ordinate system Map Grid of Australia 1994 (MGA-94).

Within New South Wales MGA-94 will be either zone 54, 55 or 56.

The height datum to be used for all model data is the Australian Height Datum (AHD).

#### **4.1.2 Existing Surface Model**

The existing surface model will generally be created from data provided by a third party, eg Roads and Maritime Survey, Contract Survey, Land and Property Information (LPI) contours.

Survey models can sometimes contain strings for underground or above ground features that do not constitute the existing surface and the surveyor will mask out these features when creating the existing surface triangulation model.

In order to maintain accuracy the designer should not manipulate the existing surface data provided in the survey model. Existing surface triangulation models must always be created using the survey string masking provided with the survey.

Where a merged or composite model is to be created using part of the survey model, eg for drainage design or visualisation, the designer must ensure that the survey string masking is applied when generating the triangulation model from the merged/composite model.

#### **4.1.3 Non-Tangential Alignments**

MX has a project setting that allows the use of non-tangential alignments, ie horizontal or vertical alignments can be constructed with 2 connecting straights. MX generates discontinuities at all changes of direction in non-tangential alignments and addition points are added to strings.

Normal design project input files are not compatible with non-tangential alignment project input files due to the differences in methodologies for creating strings.

Generally, Roads and Maritime design projects should not be created using the non-tangential alignments project setting.

If a non-tangential alignment is required, eg for a retaining wall design or car park layout, then a new temporary design project must be created. Once the non-tangential alignment has been created and levelled, the string should be output to a GENIO file, and transferred back to the original design project.

#### **4.1.4 3D Modelling**

The design model should represent the complete road design in 3D; the design needs to address the interface between existing infrastructure/services/features as well as the interface with other designed components within the project. Therefore, all road design elements are to be modelled and should not be added to the drawings as line work.

While modelling in MX produces 3D points, strings and surfaces it does not produce 3D entities or solid objects. Some interpretation of the MX design model is required in order to create a full 3D model for visualisation, design review and verification, and clash detection.

### **4.2 Design Model Usage**

---

Different design models fulfil different purposes. It is important to understand the expected usage and contents of various design models where it may not be immediately obvious by the model name.

#### **4.2.1 DESI WORKING model**

This is the design 'work in progress' model. It can contain any features required to create the 'final design' models.

The DESI WORKING model should not be used for drawing production or design data output.

Strings in the DESI WORKING model should be copied to the relevant 'final design' models as the design progresses.

#### **4.2.2 DESI FINAL model**

The DESI FINAL model should only contain strings that define the design surface and convey the design intent. Elements in this model represent the finished design surface or final surface.

The DESI FINAL model should not contain features that do not represent the design surface, ie barriers, pavement layers, pipes, bridges, tunnels etc.

The DESI FINAL model should be used for drawing production at all stages of the design process and for design data output.

### **4.3 Design Surface (AFC model)**

---

This section details requirements for the DESI FINAL model at the 100% stage of the detailed design phase. At this phase of the design, the DESI FINAL model is used for preparation of the construction drawings. It will also be used as the main 'Accepted For Construction' design model, ie AFC model, which is used for construction set-out and machine guidance to represent the finished design surface.

The design surface represented in the AFC model must be homogenous to allow the design plane to be extended, extrapolated, and interrogated at any random location independent of string points.

Strings in the AFC model should not contain null levels.

### 4.3.1 String Point Intervals

Strings in the AFC model should contain points at a sufficient interval so that the design surface is accurately represented during the construction process.

Generally, the point interval along design strings is determined by the chainage interval on the master string that was used to create the string.

Where a separate master string is used to model medians, median noses, kerbs, kerb returns, lane widening and roundabouts, additional points are required in the strings to correctly define the design surface and provide adequate point density so that a triangulation created from the design model does not contain large or flat triangles. Refer to Table 4.1 - String Point Intervals.

**Table 4.1 - String Point Intervals**

Feature	String Point Interval
Feature Strings (General)	5m
Median	1m
Median nose	0.2m
Kerbs	1m
Kerb Returns	0.5m
Lane Widening	1m
Roundabouts	0.5m

### 4.3.2 Crossing and Intersecting Strings

It is not desirable for the AFC model to contain crossing or intersecting strings. These can cause issues with the triangulation of the design surface and problems with survey set-out and machine guidance systems during construction.

If crossing strings or string intersections cannot be avoided then the designer must ensure that both strings contain the coincident intersection point and have the same level at this point.

Strings representing road features on bridges, tunnels and underpasses should not be stored in the DESI FINAL model in order to avoid crossing strings in these situations.

### 4.3.3 Coincident Points and Strings

The AFC model should not contain coincident points or coincident strings, ie points with the same x, y values, and different z values, or parallel strings with zero offset.

A design feature should only have one string defining it, eg a median edge MK01 string would not require a corresponding carriageway edge CE01 string at zero offset.

Where the end of one string coincides with the start of an adjacent string, ie the same x, y values, the z value must be the same in both strings.

#### **4.3.4 String Discontinuities**

The AFC model must not contain feature strings with any discontinuities or gaps in them.

Current survey equipment software and machine guidance systems cannot adequately deal with string discontinuities and they will be treated as a string link instead of a gap.

The construction surveyor will generally remove discontinuities from design strings. This process may impact on the design intent and introduce additional string labels into the design model leading to inconsistencies with the string labels shown on the construction drawings.

#### **4.3.5 Strings at Intersections**

Additional hinge strings may be required at intersections to correctly define the design surface though the intersection where there are no other design feature strings. These strings are required in the middle of the intersection to define the through carriageway, on the centreline and the carriageway edges.

#### **4.3.6 Roundabouts, Traffic Islands and Medians Noses**

Any master string in the AFC model should only have one normal intersection with a string created from it, or with a string to be set out from it, and should not loop back on itself.

This is particularly an issue for the design of roundabouts, traffic islands, median noses and kerb returns. Multiple master strings and feature strings should be used so that looping does not occur.

#### **4.3.7 Bridge and Tunnel Strings**

The AFC model should not contain road feature strings that continue across bridges or through tunnels and underpasses. These strings should be stored in separate models to avoid crossing strings in the AFC model.

In order to correctly define the design surface the DESI FINAL model should contain strings that represent bridge abutments and spill-through batters, and portals on tunnels and underpasses.

#### **4.3.8 Line marking Strings**

Any line marking features stored in the DESI FINAL model must have design surface levels applied.

Line marking features that do not represent the design surface or do not have design surface levels should be stored in the DESI LINEMARKING model.

### **4.4 Roadway GIS Data Strings**

---

Road carriageway centreline data is required for input into Roads and Maritime GIS system to capture changes to the road network. This data is also used for mapping by other government departments and various third parties.

For single carriageway designs, the road centreline is to be output.

For dual carriageway designs, the centre of each carriageway is to be output. Additional strings will need to be designed for the carriageway centreline of dual carriageways, ramps and slip lanes. These strings are to have design surface levels applied. Strings to be output to the GIS system are to be stored in the DESI GISDATA model.

## 4.5 Master Control (MC) Strings

The Master Control string, or MC string, is the string used in MX to control the horizontal and vertical alignment of the road carriageway and the carriageway chainages.

### 4.5.1 Geometry Control (GC) String

For each MC string in the design, a corresponding geometry GC string is required. The GC string contains the geometric information for the MC string and is used to accurately calculate points along the MC string.

### 4.5.2 Location of MC String

The location of the MC string within the design cross section varies depending on the type of roadway being designed. Refer to Table 4.2 - General MC String Location for general location details.

**Table 4.2 - General MC String Location**

Roadway Type	MC String Location
One way, ramp or slip lane, single lane	Left hand / nearside edge of travel lane
Two way, no median	Road centreline
Two way, raised median or safety barrier	Roadway centreline
Dual Carriageway	Roadway centreline (single MC) or inside / offside edge of median lanes (twin MC's).
Dual Carriageway, independently graded	Inside/offside edge of median lanes

Refer to Appendix D - Design Feature Names for sample cross sections showing examples of MC sting location.

### 4.5.3 Plan Transition Curves

Horizontal alignment plan transition curves on MC strings are to be based on the Austroads Guide to Road Design Part 3 Geometric Design as amended by the Roads and Maritime Supplement.

### 4.5.4 Chord to Arc Tolerance

MX creates horizontal alignment strings as a series of points calculated at the specified chainage interval, with chords between each point. The chord to arc

tolerance is used to add extra points into horizontal alignment curves where the offset from the curve to a chord between chainages exceeds the tolerance.

The chord to arc tolerance to be used on MC strings and other master alignment strings used for set-out is 0.01.

The chord to arc tolerance may be increased on master alignment strings used for chainage annotation to maintain the required chainage interval.

#### **4.5.5 Chainage Interval**

The maximum chainage interval for MC strings used in a Detailed design model is 5m. Refer to section 4.3.1 String Point Intervals for details of locations where the chainage interval and string point interval will need to be reduced.

MC strings used in Strategic and Concept designs may have a larger chainage interval to reduce the amount of data and increase processing speed.

The chainage interval used will have an effect on the accuracy of quantities produced from the design model.

#### **4.5.6 Start Chainage**

For projects on the existing road network the start chainage for the MC string on the main road alignment is the existing road Linear Reference chainage at the start of the MC string. The chainage is measured from the focal point.

The direction of chainages along the MC string should follow the Linear Reference chainages in the prescribed direction.

Linear Reference chainages are to be obtained from the Roads and Maritime Roadloc database. Relevant road segment chainage details will be provided in the Professional Services Contract – Description of Services document.

Projects that represent new roads in the network may require the use of local chainages until the Roads and Maritime Roadloc database has been updated.

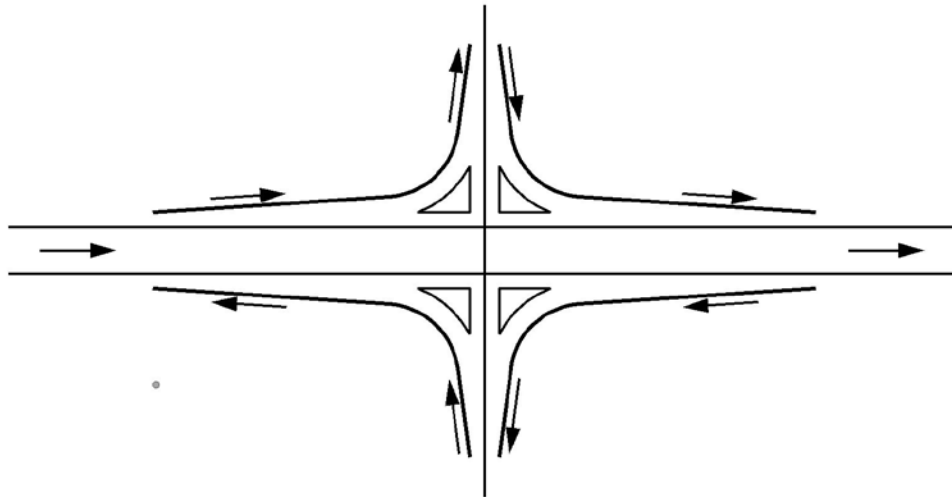
#### **4.5.7 Intersection and Side Road Chainages**

Chainages on intersecting roads and side roads that are covered in the Roads and Maritime Roadloc database are to be the Linear Reference chainages. Refer to section 4.5.6 Start Chainage above for details.

Chainages used for side road alignments that are not covered by the Roads and Maritime Roadloc database are generally to start with Ch. 0.000 at the junction with the main road alignment. This may be varied when the side road alignment and junction location are likely to change during the design process, in order to preserve design integrity on the side road.

#### **4.5.8 Ramps and Slip Lane Chainages**

Chainages on ramps and slip lanes should run in the same direction as traffic flow. Refer to Figure 4-1 - Ramp and Slip Lane Chainage Direction for details.



**Figure 4-1 - Ramp and Slip Lane Chainage Direction**

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## **4.6 Chainage Annotation String**

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The chainage annotation string is a copy of the MC string but with a chainage interval to suit annotation of chainages on various plan drawings.

The Chord to Arc tolerance for the chainage annotation string will need to be increased to at least 1.0, so that additional chainages are not automatically added around curves.

The chainage annotation string should be stored in the DESI CHAINAGES ### model.

Refer to Appendix A – Road Design Drawings for details of the chainage annotation interval required on drawings.

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## **4.7 Property Boundaries**

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To allow property boundaries to be shown on the cross sections, existing and proposed boundaries will need to have levels applied in MX by sectioning or draping on the existing surface or design triangulation.

When the draping method is used in MX the 'Insert extra points at triangle edges' option should be used.

Strings should be stored in the DESI CADASTRAL model.

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## **4.8 Existing Pavement**

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In order for the existing pavement area to be shown on cross sections and plan drawings the designer should copy the strings representing the existing pavement from the survey model into the DESI EXIST PAVE model. This model can then be used to create cross section hatching annotation and plan shading annotation areas.

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## **4.9 Pavement Design**

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The top of subgrade layer is to be designed in MX for use in quantity calculations, cross sections and conflict analysis.



Pavement edge strings and pavement joint strings are to be created for set-out and pavement area shading of drawings.

Pavement strings are to be stored in the DESI PAVEMENT model.

## **4.10 Drainage Design Details**

---

Strings are to be created in the DESI DRAINAGE model for proposed pipe networks, culverts, drainage pits and subsurface drains (trench drains). These will be used for drawing production, drainage schedules, integration review and conflict analysis.

Subsurface drainage pipes only need to be modelled to allow checking of the grading and general alignment of pipes in the run. All pipes in each run do not need to be modelled.

Existing pipes and drainage structures are to be modelled as required for integration review and conflict analysis.

## **4.11 Utilities**

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Strings representing proposed utilities are to be modelled so that they can be used for integration review and conflict analysis. Proposed utility models are not to be used for construction or maintenance purposes.

Proposed utility strings are to be stored in the UTIL DESIGN model.

Existing utilities are to be modelled as required for integration review, conflict analysis and drawing annotation.

## **4.12 Earthworks**

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The Detailed design models should be designed in accordance with the Roads and Maritime specification D&C R44 – Earthworks.

Earthwork volumes should be calculated using 2 different methods, one as the primary method and the second as a check.

## **5. Design Process Outputs**

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This chapter details the requirements for the output of data from the design process at various phases of a design project.

### **5.1 Design Phase Outputs**

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#### **5.1.1 Strategic Design**

- Design Models (options)
- Design input files
- Alignment Details reports (options)
- Preliminary Drawings (options)
- Preliminary Quantities
- Design Model Verification

#### **5.1.2 Concept Design**

- Design Models (preferred options)
- Design input files
- Alignment Details reports
- Concept Drawings
- Supplementary Information Drawings
- Detailed Quantities
- Integration review
- Design Model Verification
- 3D visualisation

#### **5.1.3 Detailed Design**

- Design Models (for construction)
- Design input files
- Alignment Details reports
- Construction Drawings
- Supplementary Information Drawings
- Construction Quantities
- Integration review
- Design Model Verification
- Drawing Presentation Review

## 5.2 Design Model Output

---

An electronic copy of the complete project model, including survey, geometric design data, and roadway GIS data is to be supplied at the completion of each design project phase.

All survey and design models used to create the design, and the roadway GIS data model, are to be provided in MX GENIO format. Refer to section 5.10 MX GENIO Formats for details of creating output data in the correct GENIO format.

## 5.3 Design Input Files

---

All input files used to create the design models are to be supplied at the completion of each design phase.

All design input files are to contain a header showing the general project information, design phase, the designer responsible for the file, the file purpose and comments detailing the current design status.

### 5.3.1 MX Input File documentation

MX input files used in the design process can broadly be grouped into three categories, survey input files, design input files and draw input files. Survey input files are used to create the existing feature models. Design input files are used to create the design feature models. Draw input files are used to display strings and annotation in either plan view or section view.

MX input files are required to document the design process. MX input files are to contain sufficient documentation of the design process so that another designer could follow or take over the project.

Where the design has been carried out using interactive MX options, MX input files still need to be created to record the design process.

The Roads and Maritime design project folder template contains a base design input file with some default/example documentation.

## 5.4 Alignment Details Reports

---

An alignment report detailing horizontal and vertical geometry is required for all master alignment strings in the design models.

Where a horizontal alignment string has levels applied but no vertical geometry, eg median edge, then a report of all string points is required.

Reports are to be delivered in a single document file or spread sheet.

### 5.4.1 Horizontal Alignment Geometry

Horizontal alignment reports are to include the following details:

- Model Name
- String Label
- Straight Chainages, Co-ordinates and Bearings
- Curve Chainages, Co-ordinates and Radius

- Curve Centre Co-ordinates
- Transition Curve Chainages, Co-ordinates and Length
- Output date and time

#### **5.4.2 Vertical Alignment Geometry**

Vertical alignment reports are to include the following details:

- Model Name
- String Label
- Vertical I.P. Chainages, Co-ordinates and Levels
- Vertical Curve Chainages, Co-ordinates and Length
- Output date and time

#### **5.4.3 Vertical String Points**

Vertical string point reports are to include the following details:

- Model Name
- String Label
- Point Chainages, Co-ordinates and Levels
- Output date and time

### **5.5 Drawings**

---

The drawings required at each design phase are detailed in section 8 – Drawing Outputs.

Drawings output from MX that are to be used as drawing set base reference drawings are to be created using the standard Roads and Maritime style sets. Refer to Appendix A – Road Design Drawings for details of the Roads and Maritime style set to be used for each drawing sheet type.

### **5.6 Quantities**

---

Design model output data is to be provided for all model data used to determine quantities. The schedule of quantities is to contain the details of design model data used.

The same version of the design models used to prepare the construction drawings must also be used to determine the construction quantities.

Design model verification should be carried out prior to calculating quantities.

The model data to be used to determine quantities, and level of detail required, depends on the design phase.

#### **5.6.1 Preliminary Quantities (Strategic Design phase)**

Preliminary quantities are used to determine feasibility and produce preliminary costings for the various options.

The strategic design needs to be developed to a level so that details of the following can be provided and quantified, but not limited to:

- balanced earthworks (bulk cut/fill volumes)
- overall pavement area
- general intersection treatments
- major structure sizes (bridge lengths)
- footprint for land acquisition

### **5.6.2 Detailed Quantities (Concept Design phase)**

Detailed quantities are used to produce an estimate of cost for the preferred option.

The concept design needs to be developed to a level so that details of the following can be provided and quantified, but not limited to:

- detailed intersection treatments
- staging work (constructability)
- erosion and sedimentation control (soil and water management)
- stormwater drainage (pipes, culverts and structures)
- kerb and gutter
- sub-surface drainage
- earthwork volumes
- retaining walls and structures
- pavement volumes
- safety barrier systems
- pavement marking
- signposting
- property acquisition
- noise walls

### **5.6.3 Construction Quantities (Detailed Design phase)**

Construction quantities are required to allow tender documents to be prepared and allow tenderers to calculate accurate construction cost estimates.

The detailed design needs to be developed to a level so that all relevant contract documents and specifications can be quantified as per the Roads and Maritime Model Contract Document and Specification List. The specification list is available on the Roads and Maritime web site.

<http://www.rms.nsw.gov.au/business-industry/partners-suppliers/specifications/specifications-list.html>

## **5.7 Integration Review**

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The interface between the various existing and design elements in the project are to be reviewed for space allocation issues and conflict analysis.

A 3D drawing model of the design elements from all the disciplines involved in the project, along with the existing elements and utilities, is to be created for integration review and conflict analysis.

Refer to section 8.7 Integration Review and Conflict Analysis for details of requirements for Integration Review.

## **5.8 3D Visualisation**

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3D visualisation is generally required for most design projects. The level of detail required depends on the scope of the project, the design review requirements at various stages and the requirements for design presentations. Specific project requirements for the level of 3D visualisation output will be detailed in the design brief.

## **5.9 Design Model Verification**

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Design model verification is to be carried out at each design hold point during all design phases.

Design model data is to be checked in accordance with the requirements detailed in chapter 4 – Design Model Requirements.

The MX Surface Checker tool (Analysis menu) is to be used to check the design models for the following:

- Null Levels
- Zero Levels
- Single Point Strings
- Coincident Points
- Intersection Points

Once any issues have been resolved, a Surface Checker report is to be generated in PDF format. Appendix E – Design Model and Drawing Checklist is to be completed as evidence that design model verification has been carried out.

### **5.9.1 Design to Survey Verification**

A design model verification check is to be carried out prior to any design model data being released for survey use. This is a specific requirement at the end of the Detailed Design phase.

Appendix E – Design Model and Drawing Checklist is to be completed as evidence that a design to survey verification has been carried out.

## 5.10 MX GENIO Formats

The input and output of MX model data requires the correct GENIO format to be used depending on the string type. The following table lists MX string types and their dimensions:

**Table 5.1 - MX String Types and Dimensions**

No. Dim	String Type	Dimensions
<b>General strings</b>		
2D	Contours	X, Y (The elevation is stored with the string header)
3D	General features	X, Y, Z
3D	Point	X, Y, Z
4D	Survey control	X, Y, Z, station name
4D	Text	X, Y, character height, text bearing
5D	Interface	X, Y, Z, offset, bearing normal to point
5D	Profile	X, Y, Z, offset, interpolation method
5D	Cross section	X, Y, Z, offset, interpolation method
6D	Master alignment	X, Y, Z, chainage, tangential bearing, radius
12D	Geometry string	X, Y, Z, chainage, tangential bearing, radius, grade, curve parameter, H code, V code, H elem, V elem
<b>Volume strings</b>		
6D	Simple Volume	X, Y, Z, chainage, cut volume, fill volume
10D	Project Volume	X, Y, Z, chainage, fill, cut1, cut2, cut3, cut4, cut5
10D	Mass ordinate	X, Y, Z, chainage, mass ordinate, cut1, cut2, cut3, cut4, cut5
<b>Triangulation strings</b>		
33D	Triangles	X, Y, Z, etc.

The GENIO format used for the input and output of strings must match the string type and dimensions, otherwise data integrity will be lost.

Refer to section 3.3.4 GENIO File Model Names for details of re-naming models when creating GENIO output files.

### 5.10.1 Design Models

Generally design models should be output using the default MX GENIO format. The following MX input file options can be used:

```
GENIO,DESI FINAL
081
999
```

In this case the default settings are used which will export the various design string types with their corresponding string dimensions.

### 5.10.2 Roadway GIS Data Model

Strings in the DESI GISDATA model are to be output as 3 dimensional strings using the following MX GENIO format and order statements:

```
GENIO,DESI GISDATA
001,FORMAT (6F12.3)
```

003, ORDR, 4=1, 5=1, 6=2, 7=3

081

999

ie one point per line, dimension 1 - Easting, 2 - Northing, 3 - Level



## 6. General Drawing Presentation Standards

This chapter contains details of general drawing presentation standards for Road Design drawings. For specific sheet content requirements and examples of each of the drawing sheet types, refer to section 8 Drawing Outputs and Appendix A - Road Design Drawings.

### 6.1 Drawing Sheet Sizes

All Road Design construction drawings prepared for Roads and Maritime are to be on A3 size sheets.

100% Concept design, Detailed design, Pre-AFC and Construction drawings are only to be delivered as A3 size drawings and PDFs.

Other drawing sheet sizes are permitted for Strategic designs, 20% and 80% Concept designs and Supplementary Information drawings.

Roads and Maritime has adopted the standard cut sheet sizes shown in Table 6.1 - Standard Cut Sheet Sizes below. These sheet sizes are based on AS1100.101-1992, Table 2.1 - Dimensions of Preferred Sheets and Table 2.3 - Dimension of Elongated Preferred Sheets.

**Table 6.1 - Standard Cut Sheet Sizes**

Sheet Designation	Cut Sheet Dimensions
A3	297 x 420
A1	594 x 841
A2	420 x 594
A4 x 3	297 x 630
A4 x 4	297 x 841
A4 x 5	297 x 1051

Roads and Maritime has also adopted the following sheet sizes for roll plots.

**Table 6.2 - Standard Roll Plot Sizes**

Sheet Designation	Cut Sheet Dimensions
A1 R1	594 x 1500
A1 R2	594 x 2000
A1 R3	594 x 2500

The Roads and Maritime standard Microstation printer drivers contain these sheet sizes. Additional roll plot sizes may be used where longer plots are required.

## 6.2 Drawing Scales

Drawing scales are to be selected from the list in Table 6.3 - Drawing Scales and Plan Length. The drawing scale required will depend on the type of project, the type of drawing and the type of detail being shown.

Plan sheets are to show a set length on an A3 sheet, according to the scale of the drawing.

Longitudinal (Long) Sections are to have a vertical exaggeration of 5:1.

Cross Sections are to be at natural scale, except for overlay and rehab projects where a 2:1 vertical exaggeration may be used to show additional detail.

**Table 6.3 - Drawing Scales and Plan Length**

Drawing Type	Scale	Length of Plan on A3 Drawing Sheet
Strategic or Concept Plan	1:4000	1000m
	1:2000	500m
Detailed design / Construction Plan	1:1000	250m (with legend)
		340m (no legend)
Long Section <sup>(1)</sup>	1:2000 Horiz, 1:400 Vert	500m
	1:1000 Horiz, 1:200 Vert	250m, 340m
	1:500 Horiz, 1:100 Vert	125m
Cross Sections	1:500, 1:200	N/A
	1:200 Horiz, 1:100 Vert <sup>(2)</sup>	
Set-out Plan	1:500, 1:250	As needed
Locality / Overview Plan	1:8000, 1:5000, 1:4000, 1:2000	As needed
Drainage Profiles	1:1000 Horiz, 1:200 Vert	N/A
	1:500 Horiz, 1:100 Vert	
Drainage Sections	1:1000 Horiz, 1:200 Vert	N/A
	1:500 Horiz, 1:100 Vert	
	1:200 (Natural)	
Details	1:100, 1:50, 1:20	N/A
Typical X Sections	1:200, 1:100	N/A

(1) Where the Plan and Long Section are shown on the same sheet the horizontal scale of the Long Section must match the Plan scale.

(2) Overlay and Rehab projects only.

## 6.3 Plan Orientation and Length

Plan drawings are to be oriented with chainages on the main road alignment running left to right across the drawing sheet.

Plan sheets are to show a set length on an A3 sheet, according to the scale of the drawing.

Additional plan sheets may be added at large intersections if required.

To allow detail from the adjacent plan sheet to be seen, an overlap is to be added to the clipping area at each end of the plan sheet.

Refer to Table 6.3 - Drawing Scales and Plan Length for the length of plan to be shown on a sheet.

## **6.4 Drawing Covers, Borders and Title Block**

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The standard Roads and Maritime Road Design drawing cover sheets, borders and title blocks are to be used on road design drawings sets to provide consistency of information and visual appearance.

Where drawings are being prepared under contract for Roads and Maritime, minor changes may be made to the cover sheets, borders and title blocks to show additional information. A typical change to be made to the title block would be to modify box content, or add boxes, for specific contractor needs. Any changes must be authorised by the Roads and Maritime Design Project Manager.

Roads and Maritime sheet borders and title blocks are available for all the standard sheet sizes for Roads and Maritime Road Design drawings.

### **6.4.1 Title Block Text Fields and Text Tags**

The title block in the standard Road Design sheet borders use text fields to substitute various text extracted from the Microstation sheet model and drawing file information. These fields are either embedded in the Microstation border seed file or are added to the drawing sheet in Microstation using the Roads and Maritime drawing tools.

Text fields include:

- Sheet number
- Sheet name
- Drawing name
- Produced date (print date)

Text fields are to be updated prior to printing the drawing.

Microstation Text Tags may also be used to substitute various text in the title block. Text tags may be used instead of, or in conjunction with, text fields. Text tag sets will be provided to suit the Road Design sheet border title blocks.

## **6.5 Line Styles**

---

Appendix F – Line Styles Symbols Shading and Hatching shows the line styles to be used on Roads and Maritime Road Design drawings.

Appendix D - Design Feature Names shows the line styles used in the Roads and Maritime version of the MXROAD style set for the display of Design strings in MX. Refer to the Appendix A – Road Design Drawings for details of style sets to be used in drawing production.

## 6.6 Line Weights and Colours

The Microstation line weights, and corresponding line thicknesses, to be used on A3 Road drawings are shown in Table 6.4 - Line Weights for A3 Road Design Drawings.

**Table 6.4 - Line Weights for A3 Road Design Drawings**

Microstation Line Weight	Drawing Line Thickness
0	0.09 mm
1	0.13 mm
2	0.18 mm
3	0.25 mm
4	0.35 mm
5	0.5 mm
6	0.7 mm
7	1.0 mm
8	1.4 mm
9	2.0mm

Drawing sheets are to be created using the final output colours, line styles and line weights required on the PDF or print, ie drawing sheet files should be 'what you see is what you get'. Microstation pen tables that substitute colours, line styles and line weights, ie re-symbolise the drawing, should not be used.

MX output drawings to be used in drawing sheet production should be drawn using the appropriate Roads and Maritime MX style set to obtain the correct line style. Refer to Appendix A – Road Design Drawings for details of style sets to be used in drawing production.

Microstation ByLevel Symbology may be used to adjust the line style, weight and colour of reference files to achieve required final output. Refer to Appendix A – Road Design Drawings for drawing output examples of the various drawing sheet types.

## 6.7 Text

### 6.7.1 Font

The standard font to be used for all drawings is Arial Narrow (True Type), regular typeface ie upright, not bold, not italic.

Italicised Arial Narrow font is to be used for labelling named water bodies ie lakes, dams, rivers, creeks etc. and signature facsimiles.

Tables and schedules that contain lists of numbers, eg co-ordinates, should have the numbers aligned vertically down the column. Arial Narrow is to be used where these are produce using spread sheets or the Roads and Maritime drawing tools. Where they are produced manually from a text file, the mono-spaced font Lucida sans Typewriter (True Type) is to be used.

**Table 6.5 - Standard Fonts for Road Design Drawings**

Font	Typeface	Use
Arial Narrow	Regular	All drawing text, except cases below
Arial Narrow	Italic	Named water bodies Signature facsimiles
Arial Narrow	Regular	Tables and schedules produced from spreadsheets or Roads and Maritime drawing tools
Lucida sans Typewriter	Regular	Tables and schedules produced manually from text files

### 6.7.2 Size

Roads and Maritime has adopted the ISO standard for text sizes for use on all A3 road design drawings.

Text heights to be used are:

1.3mm, 1.8mm, 2.5mm, 3.5mm, 5.0mm, 7.0mm, 10.0mm

Refer to Table 6.6 - Text Height Usage, as a general guide to text height usage. Refer to Appendix A - Road Design Drawings, for text height usage on specific drawings.

**Table 6.6 - Text Height Usage**

Usage	Text Height
General text	1.8mm
Section text	1.8mm
Section box labels	1.8mm
Section titles	2.5mm
Legend labels	1.8mm
Legend title	2.5mm
Notes and Callout text	1.8mm
Notes title	2.5mm
Detail titles	2.5mm
Plan chainages	2.5mm
Profile and Long section chainage box text	1.8mm
Cross section chainages	2.5mm
Road names	2.5mm
Callout text	1.8mm
From/To text	1.8mm
Limit of Works/ Adjoins Sheet text	1.8mm

Contour labels	1.3mm
Named water bodies (italic text)	1.8mm or 2.5mm
Title block box labels/file name	1.3mm
Title block general text	1.8mm
Title block drawing Issue Status	1.8mm
Title block Part/Issue/Sheet No.	2.5mm
Title block Registration No.	3.5mm
Drawing status stamp	3.5mm
Cover sheet LGA name	7.0mm
Cover sheet project text	7.0mm
Cover sheet stage/phase/part	7.0mm
Cover sheet road name/No.	10.0mm
Cover sheet volume text	10.0mm
Signature facsimiles (italic text)	3.5mm

### 6.7.3 Width Ratio

The text height to width ratio for all text is 1.0.

### 6.7.4 Line Spacing

The minimum line spacing for multi-line text is 0.6 x text height.

### 6.7.5 Case

All text is to be uppercase except where a recognised convention dictates otherwise.

Exceptions include:

- SI units (eg mm, kg, kPa)
- Plant species names (eg *Eucalytus pauciflora*) and scientific names
- Trade names (eg TriAx)

### 6.7.6 Orientation

Generally, text shall be oriented so that it can be read from either the bottom or right hand side of the drawing sheet.

Chainages for the main road alignment shown on plan drawings should be drawn to follow this rule. Chainages on side roads may vary.

Exceptions are permitted where the text has been generated by the CADD software and extensive manual editing would be required to change it, eg MX drawing outputs.

Exceptions include:

- Text embedded in line styles
- Plan drawings where text is on a rotated reference drawings.

Contour values should be drawn so they are read in the direction of ascending height.

### 6.7.7 Justification

Generally, text is to have justification left bottom.

This may be varied where placement of text is automated or where the text needs to be aligned correctly, eg chainages, text in section boxes and schedules, title block text etc.

## 6.8 Chainage Annotation

The chainage interval used for the purpose of design is different to the interval required for the annotation of chainages on drawings. Refer to section 4 Design Model Requirements for details of chainage intervals and point intervals required for MX design strings.

The regular interval required for placing chainage annotation text along Master Control strings on drawings varies depending on the plan scale and sheet type being created. Refer to the Appendix A – Road Design Drawings for the chainage annotation intervals required for each sheet type.

Separate MX base drawing reference files should be created for chainage annotation at different plan scales.

### 6.8.1 Tangent Point Codes

On plan drawings, in addition to the regular chainage interval, Master Control string chainages are also to be annotated at horizontal alignment tangent points. The chainages at these locations are to have horizontal alignment tangent point codes added in accordance with the codes shown in Table 6.7 - Horizontal Alignment Tangent Point Codes for Master Control Strings. These are based on the Austroads codes for the following individual components:

T = Tangent (straight)

C = Circular Curve

S = Spiral Curve

**Table 6.7 - Horizontal Alignment Tangent Point Codes for Master Control Strings**

Tangent Point Code	Location
TS	Point between a tangent and spiral curve
ST	Point between a spiral curve and a tangent
CS	Point between a circular curve and a spiral curve
SC	Point between a spiral curve and a circular curve
TC	Point between a tangent and a circular curve
CT	Point between a circular curve and a tangent
CTC	Point between a circular curve and a circular curve
STS	Point between a spiral curve and a spiral curve

## 6.8.2 Drawing Tangent Point Codes in MX

The Tangent Point Codes listed above have been added to the RMS\_metric.prm parameter file for MX. The RMS\_metric Default Project Settings file needs to be selected when creating an MX project.

On plan drawings the horizontal alignment Tangent Point Codes can be drawn adjacent to master control Geometry string chainages (ie GC string chainages) using either of the following methods:

1. MX Draw code

809,1=HTPS,2=ONES,7=1.3,9=0.000  
869,GCnn,2=IC00,4=-46,10=-270.000

2. Roads and Maritime MX Chainages Style Set

The Roads and Maritime drawing tools for producing MX output drawings use these methods.

MXTips files do not provide this facility as they can only use standard MX tangent point codes.

## 6.9 Shading and Hatching

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Standard shading colours and hatching styles for Road Design drawings are shown in Appendix F – Line Styles Symbols Shading and Hatching.

Shading and hatching are to be placed in a separate Microstation model and referenced into the drawing. Reference file Update Sequence and Element Priority are to be used to make shading or hatching appear behind other drawing elements.

## 6.10 Legends and Symbols

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Generally, on plan sheets the legend is to be shown on the right hand side of the drawing. Refer to the A3 Drawing Plan Sheet Dimensions drawing in Appendix A – Road Design Drawings, for details.

A separate legend sheet may be used for sheets other than plan sheets, or where legend content requires a large area.

Standard symbols to be used are shown in Appendix F – Line Styles Symbols Shading and Hatching.

## 6.11 Notes

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Notes are to be shown on the right hand side of plan drawings below the legend. General notes may be shown on a separate sheet.

### 6.11.1 Public Utility Notes

All Public Utility drawing sheets should contain the following note:

‘Utility information shown on the plans does not depict any more than the presence of a service, based on available documentary evidence. The



presence of a utility service, its size and location should be confirmed by field inspection, prior to the commencement of roadworks and the relevant utility plans obtained by dialling Ph 1100 or Fax 1300 652 077 (DIAL BEFORE YOU DIG). Caution should be exercised when working in the vicinity of all utility services'

All other drawings sheets that may show public utilities must contain one of the following notes with the appropriate reference to the Public Utility drawing sheets or package:

'DRAWING TO BE READ IN CONJUNCTION WITH SHEETS UT-xxxx to UT-yyyy' or

'DRAWING TO READ IN CONJUNCTION WITH UTILITIES DRAWING PACKAGE DSnnnn-nnnnnn-cc-UT'

## 6.12 Labelling Styles

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Labelling styles to be used on drawings for callout notes and symbols are shown in Appendix F – Line Styles Symbols Shading and Hatching and Appendix A – Road Design Drawings.

Generally dimensions and callouts are to draw in accordance with AS1100.101 – 1992, Section 4.3 – Symbols and Terminators.

Dimension terminators are to be closed arrowheads.

Callout leader terminators can either be an arrowhead or a dot depending where they terminate. Arrowheads are to be used when pointing to an item edge or line, dots can be used when terminating within an area.

Where possible, callout leaders are to be at the same angle as adjacent labels. The preferred angle range for callout leaders is between 45° and 60°.

The Roads and Maritime drawing tools for Microstation contain tools that use the standard labelling styles.

## 6.13 Adjoins Sheet Line

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All plan drawings are to clearly show where adjacent sheets join.

Drawings are to show a heavy dashed line across the drawing and the text 'ADJOINS SHEET *gg-nnnn*', with the appropriate sheet number substituted for '*gg-nnnn*'. Refer to Appendix A – Road Design Drawings for an example.

## 6.14 Limit of Works

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Plan drawings are to clearly show the limit of works to indicate the extents of the project.

On Construction Issue drawings the limit of works location is to be approved by the Roads and Maritime Design Project Manager.

Drawings are to show a solid/continuous heavy line across the drawing and the text 'LIMIT OF WORKS'. Refer to Appendix A – Road Design Drawings for an example.

## 6.15 From and To Text

Plan drawings are to show from and to text adjacent to the main carriageway at either end of the sheet and at the extent of major side roads.

Text is to be in the format 'FROM *location*' or 'TO *location*'.

Appropriate focal point names are to be used as the '*location*' text. These are to be obtained from either the Roads and Maritime Roadloc database or Appendix A and B of the Roads and Maritime Guide Signposting manual. This information can be sourced from the Roads and Maritime Design Project Manager.

Refer to Appendix A – Road Design Drawings for an example.

## 6.16 Drawing Amendments

### 6.16.1 Amendment Clouds

Amendments made to the Pre-AFC or construction drawing set sheets are to show a red amendment cloud around the amended drawing area and a triangle containing the amendment issue number/letter next to the cloud.



**Figure 6-1 - Drawing Amendment Cloud Example**

Only the amendment clouds for the current drawing issue are to be shown, amendment clouds from the previous drawing issue are to be removed prior to re-issuing the sheet.

### 6.16.2 Issue/Amendment Boxes

The issue/amendment box should contain the current issue number or letter and the issue/amendment date and description. Previous issue/amendments should also be shown. When the issue/amendment box becomes full, the oldest issue/amendment can be dropped from the list.

## **6.17 Asset Information**

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Stormwater management schedules for drainage pits, pipes and culverts are to show Roads and Maritime Asset culvert number or bridge number, as assigned.

### **6.17.1 Culvert Asset Numbers**

A list of culvert asset numbers to be used for the project, and guidance on the appropriate protocols for assigning culvert asset numbers, is to be obtained from the regional Roads and Maritime Corridor Maintenance Planner. This information can be sourced from the Roads and Maritime Design Project Manager.

Special purpose culverts which do not carry water (Fauna, Pedestrian etc) are to be considered as bridges.

### **6.17.2 Bridge Asset Numbers**

Structures which have openings of more than 6m when measured along the road centreline, or extreme ends of openings for multiple cells, are considered bridge size structures and should be allocated a bridge number in accordance with Roads and Maritime Asset Management Policy Number: PN 158 - Bridge inventory, inspection and condition rating.

Special purpose culverts which do not carry water (Fauna, Pedestrian etc) are to be considered as bridges in accordance with Policy Number PN 158 and therefore are entered into the Roads and Maritime Bridge Information System (BIS) with a B-number regardless of size. The B-number is to be obtained from the regional the Roads and Maritime Corridor Maintenance Planner and shown on the drawings. This information can be sourced from the Roads and Maritime Design Project Manager.

## **6.18 Survey Marks**

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All survey control marks, permanent marks and state survey marks are to be clearly shown on all plan sheets.

Permanent marks and state survey marks are to be identified on the Alignment and Set Out drawing with a boxed callout note containing the text 'THIS MARK MUST BE PRESERVED'. If the survey mark is located off the drawing sheet then the note is to be placed on the nearest sheet extremity and also show the mark ID and distance to the mark.

The Survey Control Plan detailing survey marks and co-ordinates will be provided by the surveyor.

## **7. Drawing Production**

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This chapter details requirements for creating drawing sets with regard to the order of drawings, sheet grouping, the general structure of drawings, referencing of drawings and drawing symbology. An overview of the Roads and Maritime Microstation workspace is also provided.

### **7.1 Order of Drawings**

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The order of drawings within a drawing set should follow the list order of drawings required for Detailed Design, refer to section 8.3 Construction Drawings – Detailed Design Phase.

### **7.2 Drawing Sheet Grouping**

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Within the drawing set, sheets of the same type are to be grouped together.

The various sheet groups are assigned a group code. All sheets in the group use the group code as part of the sheet number, eg:

PV – Pavement group – contains pavement plans and pavement detail sheets – sheet numbers would use the format:

PV-nnnn

eg

PV-0201, PV-0202, PV-0203 etc.

Refer to Table 3.5 - Sheet Group Codes for Road Design Drawing Sets for details of sheet group codes and sheet types in each group.

### **7.3 Drawing Set Parts and Packages**

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Drawing sets may be divided into manageable size sub-sets depending on the size and scope of the project.

The drawing set for smaller projects may be delivered as single set of drawings, using one drawing set Part.

Larger projects can use either Parts or Packages depending on project delivery requirements and requirements specified in the design brief.

#### **7.3.1 Drawing Set Parts**

Drawing set Parts provide for the drawing set on larger projects to be broken up into smaller sub-sets based on the physical size of the stack of printed sheets in the Part.

The division of the drawing set into Parts is to be based around sheet group codes.

Smaller projects may be delivered as a single Part containing all sheet groups.

Guidelines for the compilation of sheet groups for drawing sets in Parts are as follows:

- Drawing set sheet groups are not to be split across Parts, ie a drawing set Part must contain all the sheets for each sheet group in the Part. The only exception is for the cross sections sheet group which may need to be split.
- Each drawing set Part should have its own Cover sheet and an Index sheet specific to that Part.
- The Cover sheet for each Part must contain the Part number in the heading and all sheets in the Part are to show the Part number in the title block.
- The Cover sheet for each Part should also contain a Part/Group Code Index table containing a full list of drawing set groups. The sheet groups covered in the Part are to be listed in black text, the sheet groups in other Parts are to be shown in grey text.

Refer to Appendix A – Road Design Drawings for examples of detailing drawing set Part numbers.

### 7.3.2 Drawing Set Packages

Drawing sets for major projects may be split into Packages, this is usually done for efficiency in timing of the road design and allows for different aspects of the design to be prepared by separate groups of designers.

The following is an example of packages that could be used for road design:

- Road Geometry and General Arrangement
- Drainage, Stormwater Management
- Pavement
- Utilities
- Road Furniture
- Road Lighting
- Intelligent Transport Systems (ITS)
- Property Adjustment
- Landscape
- Clearing limits and spoil sites
- Bridgeworks
- Supplementary drawings (large projects)
- Construction Staging, Temporary works or Information Only

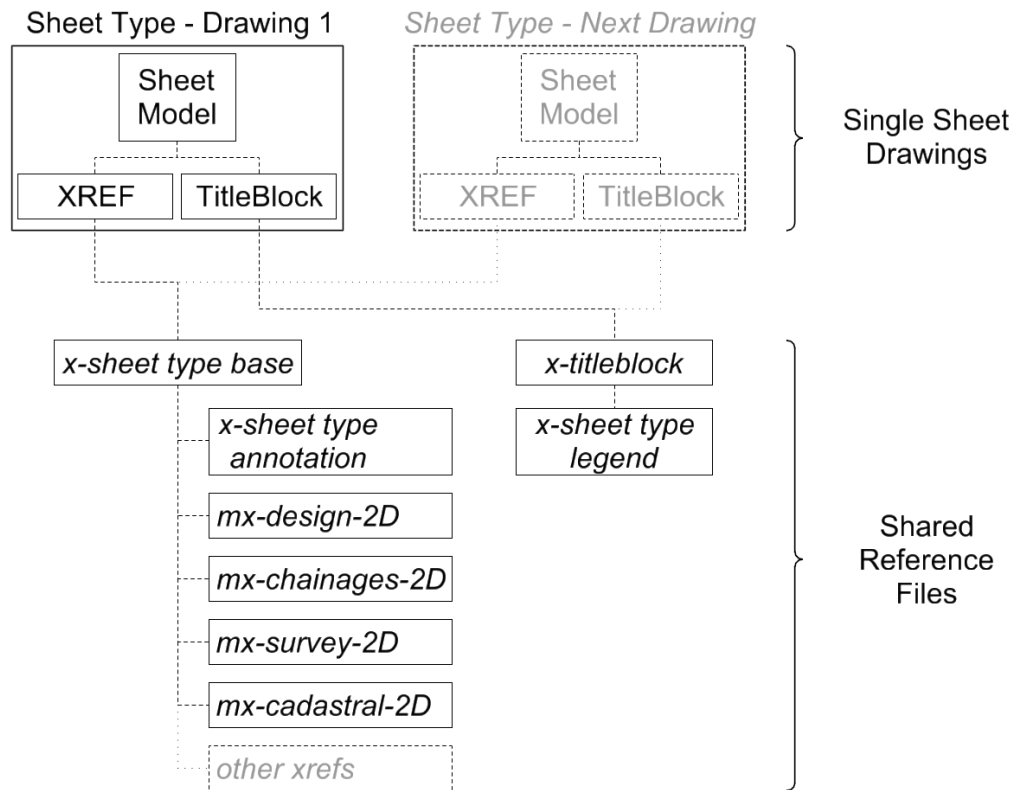
The compilation of sheet groups for drawing set Packages are to follow the guidelines for drawing set Parts.

## 7.4 Drawing Sheet Structure

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Drawing files representing the drawing set sheets are to be stored in the project .\Microstation folder and sub-folders.

Figure 7-1 - Drawing Sheet Structure below shows the drawing sheet structure that may be used for a single sheet per drawing file structure as required by Roads and Maritime.



**Figure 7-1 - Drawing Sheet Structure**

The drawing sheet structure is repeated as required for the various drawing sheet types within the drawing set.

The '*x-titleblock*' reference drawing can be shared across all drawing sheet types.

Refer to chapter 3 Naming Conventions for details of naming drawings, external reference files and drawing models.

## 7.5 Reference Files

Drawings files and aerial photo images used as references for other drawings are to be stored in either the project '*.\Microstation\References*' or '*.\Microstation\References\MX-Outputs*' sub-folders.

The 'Save Relative Path' option should be used when referencing drawings so that the overall drawing structure can be moved or renamed. This also allows projects to be archived and restored to a different location.

The 'Live Nesting' option should be used with the required nesting depth set to ensure reference files with sub-references are displayed correctly.

Drawing files created from MX should be saved as 2D files to allow the reference file display order, or priority, to be adjusted as required. Generally the design line work is displayed on top of other line work, such as survey.

## **7.6 Drawing Symbology**

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### **7.6.1 Drawing Sheet Symbology**

The drawing sheet model used to create the drawing output should be created as 'what you see is what you get' so that the colours, line weights and line styles used in the drawing sheet file are representative of the final PDF output or print.

Roads and Maritime printer configuration files for Microstation only substitute the CAD line weight with the Roads and Maritime standard line weight for printing, they do not 're-symbolise' the drawing.

### **7.6.2 Reference File Symbology**

Reference files created from MX should use the Roads and Maritime style sets to produce the base MX drawings with the appropriate symbology. Microstation ByLevel Symbology may then be used to adjust the line style, weight and colour of reference files, as required for the drawing sheet.

The '*x-sheet type base*' reference drawing can be used to 're-symbolise' MX drawing output, eg to obtain the correct line colour for utility drawings.

## **7.7 Roads and Maritime Microstation Workspace**

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The 'RMS-Civil-2014' project workspace contains the various seed files, standards, cells and tools for Road Design drawing set production using Microstation.

### **7.7.1 Cell Libraries**

The Microstation cell libraries contain the various cells and symbols to be used on the Road Design drawings. Cells are grouped in the following themes:

- Annotation
- Civil symbols
- Drainage
- Hatching
- Kerbs
- Landscaping
- Logos
- Pavement Marking
- People
- Road Furniture
- Transport
- Utilities

## 7.7.2 DGNLib Files

Microstation DGN Library (DGNLib) are used to control various Roads and Maritime standards and tools.

The 'RMS-Civil-2014' project workspace contains DGNLib files for the following:

- Line styles
- Text styles
- Drawing levels
- Drawing tools

## 7.7.3 Printer Configuration Files

Printer configuration files are used for creating PDF files, HPGLRTL plot files and direct hard copy output from Microstation.

These files contain Roads and Maritime standard line weight mapping and various settings for Microstation printing.

## 7.7.4 Drawing Seed Files

Drawing seed files are provided for use in the creation of MX drawing outputs, drawing sheet files, reference files, A3 cover sheets, and title block/sheet borders in all the standard Roads and Maritime sheet sizes.

The Roads and Maritime Project Folder Template contains base Microstation drawings created using the Roads and Maritime drawing seed files. These drawings have been set up with a drawing reference structure already in place.

## 7.7.5 Drawing Colour Table

The colour table used for the preparation of Road Design drawings in Microstation is based on the standard MX colour table, with some modified colours for use on Roads and Maritime drawings.

All Roads and Maritime seed files for Road Design drawings use this colour table.



Figure 7-2 - Drawing Colour Table



### **7.7.6 Microstation VBA Files**

Microstation visual basic (MVBA) files are provided for the various Roads and Maritime drawing tools.

### **7.7.7 Roads and Maritime Drawing Tools**

The 'RMS-Civil-2014' project workspace for Microstation contains task menus for the Roads and Maritime drawing tools.

These tools are provided to assist with Road Design drawing set production and automate various tasks. Tools include :

- MX model output in GENIO format
- MX plan output
- Plan sheet layout
- Cross/Long section sheet setup - import MX sections
- Callouts for labelling, sheet annotation and notes
- Create sheet index – Excel output
- Hatching and shading tools
- Place north point
- Place scale bar
- Drop and unlock MX output drawings

## **8. Drawing Outputs**

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This chapter details requirements for 2D drawing outputs and 3D drawing model outputs for the various road design phase drawings, construction drawings, as built (WAE) drawings and the requirements for integration review and conflict analysis.

Road design drawings are to be prepared in accordance with requirements detailed in chapter 6 – General Drawing Presentation Standards, chapter 7 – Drawing Production and Appendix A - Road Design Drawings.

Appendix A - Road Design Drawings contains specific details of content requirements for each drawing sheet type and the CADD resources to be used to create the drawing sheet content.

### **8.1 Strategic Drawings – Strategic Design Phase**

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The following drawings may be used to show details of various design options developed for the Strategic design phase:

- Alignment plans (including road corridor boundary)
- Longitudinal sections
- Typical cross-sections
- Preliminary Cross Sections
- Supplementary information drawings

The Alignment plan, Longitudinal section and typical cross-sections may be presented on the same drawing sheet or roll plan.

#### **8.1.1 Supplementary Information Drawings for Strategic Design**

- Design Constraints plan showing cadastral boundaries, land usage and various design constraints
- Google Earth overlay
- DBYD drawings (from suppliers)

#### **8.1.2 Drawing sizes for Strategic Design**

Any standard Roads and Maritime drawing size may be used, unless otherwise specified.

### **8.2 Concept Drawings – Concept Design Phase**

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The following drawings may be used to show details of preferred design options for Concept design phase:

- Cover
- Index
- Typical cross-sections
- Alignment plans

- Longitudinal sections
- Detail plans
- Detailed cross-sections
- Drainage design, including pipe long-sections and pit schedules
- Public Utilities
- Property acquisition plans
- Supplementary information drawings
- 3D drawing models

Drawings from the Construction Drawings – Detailed Design Phase list may be included as required.

### **8.2.1 Supplementary Information Drawings for Concept Design**

- Overview Plan and Long section for review and meeting discussion
- Google Earth overlay
- Plan detailing drainage catchment areas
- Plan detailing pavement flow paths for aquaplaning check
- Plan showing vehicle turning paths used for design layouts and at critical locations for review
- Plan showing geotechnical investigation locations (bore holes, inspection pits, etc)
- Kerb profiles for design review
- Cross sections detailing pavement and earthworks areas
- Design Information drawings for bridge design, structure design, environmental documentation, etc.
- Sight line drawings for design review
- Safety barrier point of need diagrams for design review
- Constructability Review drawings

### **8.2.2 Drawing sizes for Concept Design**

20% Concept design drawings may use any standard Roads and Maritime drawing size.

80% and 100% Developed Concept design drawing sets are to be delivered as A3 sheets.

Supplementary Information Drawings and Integration Review Drawings may use any standard Roads and Maritime drawing size, unless otherwise specified.

## **8.3 Construction Drawings – Detailed Design Phase**

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The drawing set used for construction will develop through the various stages of the Detailed Design, from 20% to 80% to 100%, Pre-AFC and finally the approved AFC drawing issue.

The following Detailed Design drawings are to be used as required for producing the construction drawing set:

- Cover
- Index
- Location / Overview Plan
- General Notes
- Typical Cross Sections
- Typical Detail Sheets
- Alignment Control Plan and Set-out Strings
- Alignment Schedules
- Plan Sheets
- Long Section Sheets
- Cross Sections
- Public Utilities
- Drainage Plans
- Drainage Profiles
- Drainage Schedules
- Drainage Structure Details
- Erosion and Sedimentation Control Details
- Subsurface Drainage
- Pavement Plans
- Pavement Details and Concrete Jointing
- Roadside Furniture, Signs and Markings (and schedules)
- Road Lighting (and schedules)
- Intelligent Transport Systems (ITS)
- Clearing and Spoil Sites
- Landscaping and Sight Envelope details
- Structure Details
- Property Works plans
- Construction Staging
- Maintenance Plan (show Roads and Maritime asset numbers on structures)
- Supplementary information drawings

### **8.3.1 Supplementary Information Drawings for Detailed Design**

- Overview Plan and Long section for review and meeting discussion
- Plan detailing drainage catchment areas

- Plan detailing pavement flow paths for aquaplaning check
- Plan showing vehicle turning paths used for detailed design
- Kerb profiles for design review
- Cross sections detailing pavement and earthworks areas
- Safety barrier point of need diagrams
- Survey Control plan (from surveyors)

### **8.3.2 Drawing sizes for Detailed Design**

All Detailed Design drawing sets are to be delivered as A3 sheets.

Supplementary Information Drawings may use any standard Roads and Maritime drawing size, unless otherwise specified.

### **8.3.3 Pre-AFC Issue Drawings**

Following the review of 100% Detailed Design drawings a Pre-AFC drawing set may be issued so that drawing amendments can be made prior to the final AFC release.

The drawing output and review requirements for the Pre-AFC drawing set are the same as the 100% Detailed Design drawings with the exception that amended drawings may be re-issued individually.

Amended drawings are to show amendment clouds and the next issue/amendment number and details.

### **8.3.4 AFC Issue Drawings**

The AFC drawings are only to be created once the 100% Detailed Design review or Pre-AFC review processes are complete and the drawings have been accepted for construction.

The 100% Detailed Design or Pre-AFC drawing set may require some amendments prior to final approval and acceptance for construction. Once this process is complete the following is done prior to issuing the AFC drawing set:

- Drawings are renamed with AFC design phase code 'FC' (Accepted For Construction drawings)
- 'AFC' text added to the Stage/Phase box in the title block
- ACCEPTED FOR CONSTRUCTION stamp added to each sheet
- signature boxes show Signature Facsimile text and date signed
- letter 'A' added to the issue box
- amendment clouds removed from all sheets
- issue/amendment box cleared and AFC details added as issue A

The AFC drawing set PDFs are then created.

## 8.4 As Built (WAE) Drawings

The As Built, or Work-As-Executed (WAE), drawing set is based on the accepted construction (AFC) drawing set. Any changes to the design that occurred during construction are to be marked up in red with a red amendment cloud around the changed area.

WAE drawing mark-up and certification is based on the requirements set out in Roads and Maritime QA Specification G2-C2 General Requirements (Major Contracts).

If there is insufficient room on the drawing to clearly show the WAE changes then a new drawing is to be added to the drawing set and the index sheet updated.

The WAE drawing set is to be supplied in both CAD format and PDF format.

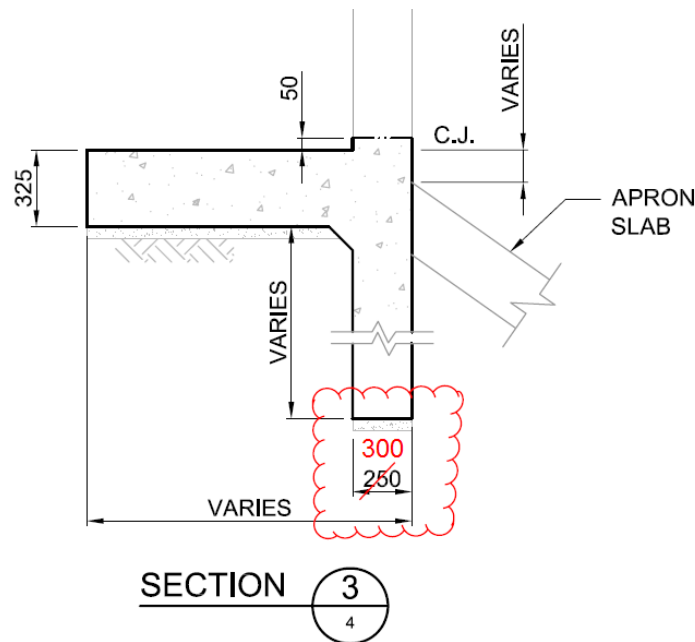
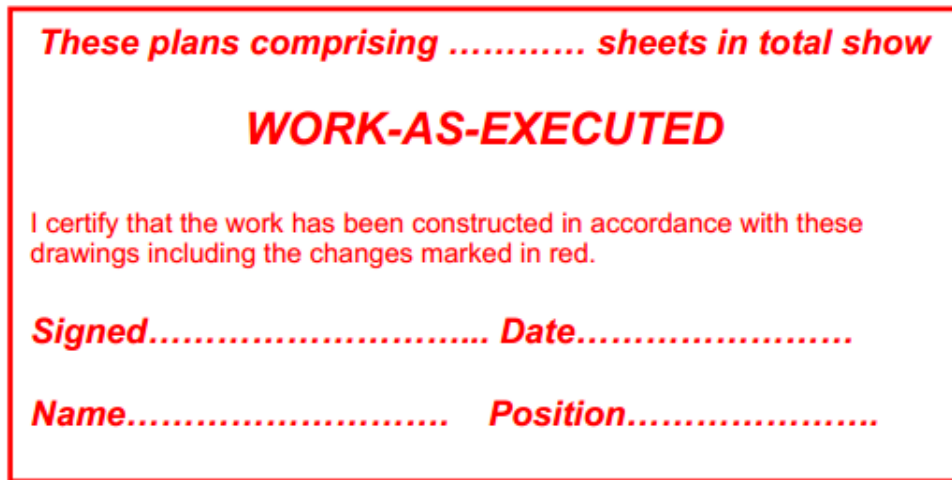


Figure 8-1 - Example WAE Drawing Mark-up

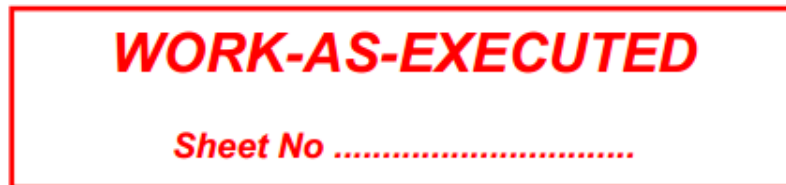
### 8.4.1 WAE Certification

The Roads and Maritime G2-C2 specification states that the WAE drawing set 'must be certified and signed by a person employed by the Contractor who is in a position to know the details of the WAE changes'.

The drawing set cover sheet should contain the stamp shown in Figure 8-2 - WAE Certification Signature Stamp with following sheets in the drawing set to contain the stamp shown in Figure 8-3 - WAE Certification Sheet Stamp.



**Figure 8-2 - WAE Certification Signature Stamp**



**Figure 8-3 - WAE Certification Sheet Stamp**

## **8.5 Supplementary Information Drawings**

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Supplementary information drawings are drawings that are obtained or created as part of the design process and are required for a variety of purposes. They are a valuable source of background information and are often needed for future reference.

While these drawings do not form part of the drawing set used for construction, they are to be provided as part of the design quality assurance process. They are required for design review and verification purposes.

Supplementary information drawings created during the design process are to use Roads and Maritime standard sheet sizes with the relevant title block and border.

Refer to Appendix B – Supplementary Information Drawings for examples of these drawings and details of content requirements.

## **8.6 3D Drawing Models**

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While the outputs from the road design model are 3D elements, they are just 3D lines (strings) and 3D surfaces (triangulations). In order to be used for 3D integration review and conflict analysis, the design elements from all disciplines associated with the project, along with existing elements, need to be converted to 3D objects within a 3D drawing model in CAD.

3D drawing models are to be created for all project elements.

## **8.7 Integration Review and Conflict Analysis**

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An integration review is required to check the interface between elements from all disciplines associated with the project.

A Conflict Analysis report is to be provided as part of the design verification and integration review process.

### **8.7.1 Integration Review**

A 3D model check of the detailed design is to be undertaken using an integrated model of relevant design elements for space allocation issues and conflict analysis. This is to ensure there are no conflicts or clashes (either underground or above ground) between all project elements, either existing or designed.

Relevant design elements to be integrated in the design for conflict analysis must include at least the following:

- Pavement and kerbing envelopes.
- Elements of Bridges, retaining walls and other structures that interact with road design elements including foundation envelopes
- Longitudinal and Cross drainage networks and structures including foundation envelopes
- Subsurface drainage pipes, systems and structures.
- Utility service assets.
- Road lighting and Intelligent Transport System conduits and structures including foundation envelopes
- Sign and sign support structures including foundation envelopes
- Safety barrier systems including terminal foundation envelopes and post footing envelopes

### **8.7.2 Conflict Analysis Report**

Conflict analysis and clash detection is to be carried out as part of the project design verification and integration review process using the project drawings and 3D drawing models.

Conflict analysis can be carried out in 2D using the project drawings, either on paper or on-screen using the PDF or the CAD drawing.

For 3D conflict analysis the project 3D drawing models can be examined visually on-screen or analysed using CAD software clash detection tools.

A report detailing the following is to be provided:

- Project details and date of analysis
- Type of conflict analysis – 2D or 3D or both
- List of project elements used for analysis
- 3D analysis method - visual or software clash detection
- List of 3D element groups analysed
- List of issues for immediate action



- List of issues for further action during next design phase
- List of issues to be addressed during construction

Where no issues are found, the report is to confirm this.

## **8.8 Drawing Presentation Review**

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Drawing presentation review is to be carried out at each design hold point during all design phases, prior to drawings being issued.

All drawings prepared for issue are to be reviewed in accordance with the requirements detailed in section 6 – General Drawing Presentation Standards and section 7 – Drawing Production.

Appendix E – Design Model and Drawing Checklist is to be completed as evidence that drawing presentation review has been carried out.

## References

AS1100.101-1992 Technical drawing, Part 101: General principles

AS1100.101-1984 Technical drawing, Part 401: Engineering survey and engineering survey design drawing

AS ISO 128.21-2005 Technical drawings-General principals of presentation, Part 23: Lines on construction drawings

Austrroads Guide to Road Design, Part 3: Geometric Design - Roads and Maritime Supplement

Austrroads Guide to Road Design, Part 8: Process and Documentation

Austrroads Glossary of Roads and Maritime

Roads and Maritime Contract Document C72 - Panel Deed for Professional Services (Construction Industry)

Roads and Maritime Plan Management Centre, Filing Guides

Roads and Maritime Asset Management Policy Number: PN 158 - Bridge inventory, inspection and condition rating

Roads and Maritime QA Specification G2-C2 General Requirements (Major Contracts)

Roads and Maritime Specification D&C R44 - Earthworks

Roads and Maritime Professional Services Contract – Description of Services

Roads and Maritime Guide signposting manual