
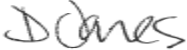



2D CAD Protocol

This document identifies the minimum requirements for the production and formatting of electronic drawings, their control and electronic filing for the University of Reading Estates and Facilities.

Document Approval

Originator	Approved for Issue	Authorised for Issue	Next review date
			
<i>Signature</i>	<i>Signature</i>	<i>Signature</i>	<i>Signature</i>
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Date	Date	Date	
26 May 2016	26 May 2016	26 May 2016	

Document Issue Record

ISSUE	DATE	DESCRIPTION OF AMENDMENT
B	23 April 2012	Inclusion of Service Drawing Information
C	27 June 2014	Amend all text referring to FMD to E&F
D	26 May 2016	Updated layering, CAD folders and file conventions
E (1.4)	14 October 2016	Clarify File Saving Name

Previous issues of this document are to be destroyed or marked SUPERSEDED

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2D CAD Standards

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2D CAD Standards

1 Introduction

This document describes the University of Reading's requirements with respect to the production, format, structure and generation of electronic drawings to ensure that electronic drawings are produced in a uniform manner and conform to industry standard conventions.

This document has been produced for the benefit of the Universities framework partners including any third party specialist supplier or sub-contractor that may be employed.

2 Definitions

2.1 Architect, Consultant or Contractor

Framework partners may mean any Architects, Consultants, Main Contractors or sub-contractors that are required to make any changes to the University of Reading's electronic drawings or produce their own drawings for The University of Reading. Herein called 'Design', 'Working' or 'Record Drawings.'

2.2 Master Building Drawings

Master Building Drawings are a set of Adobe pdf drawings of a building footprint showing the windows, doors, interior wall details and room numbers of each floor of each building on all campuses. Master Building drawings are controlled and maintained by Estates and Facilities.

2.3 "As Fitted" / "As Laid" / "As Built" Drawings

Drawings are required as AutoCAD .dwg and PDF versions. As Fitted, as laid and as built drawings are any AutoCAD drawings that are to be edited for works such as remodelling, extending, partially demolishing, or removing any part of the building or its associated services. Underground utility services and supplies shall also be in AutoCAD format and be called 'As Laid'.

Where required, a Project shall produce the following (minimum) as fitted, as laid and as built drawings:

- Floor and roof plans (GA)
- Elevations
- Fire plans
- Structural layouts
- M&E schematics
- M&E layouts
- Public health schematics and GA
- Above & below ground drainage
- Hard & soft landscaping
- Site services

The Project shall deliver those drawings appropriate to the scale and complexity of the work involved sufficient to adequately describe and detail the construction works and enable the safe and efficient operation and maintenance of the building.

The Project team shall be responsible for ensuring the adequacy and accuracy of the as fitted, as laid and as built record drawings in accordance with the Universities hand over requirements.

2.4 Non “as fitted” Drawings

Non “as fitted” drawings may be required to produce the Operation and Maintenance Manual (O&M.) There is no requirement to provide those drawings as a separate AutoCAD drawing or Adobe format. It is not necessary to provide manufacturing drawings and standard details for fixings, brackets and BWIC etc.; these should be included as PDF drawings within the O&M and do not need registering on the E&F portal.

2.5 Attribute Box

Room data is required for all new rooms created as part of a new construction or building alteration project. A room attribute box is available which enables the room space data to be extracted from the AutoCAD drawing into a spread sheet for use by the Space Manager. The area is to be calculated using poly lines, central to the inner walls and inside of the outer walls. This information is to be provided in conjunction with the space data revision form.

The attribute box can be down loaded from [EDMS](#).

Each new room or altered room will have an attribute box referencing:

Building Number

Room Number

Room Area (m²). The appropriate layers for space attribute and polyline must be used.

The University has established Room Numbering and Naming Policy which can be found here:

[Standard room numbering system](#)

[Standard room descriptions](#)

The dedicated layers must be used for:

Space Polyline: Z-Space polyline

Space Attribute: Z-Space Attribute

Room Description: Z-Room Description-T

Room Number: Z-Room numbers-T

The University measures the room areas according to RICS Code of measuring.

Note that room areas should be measured to the inside of external walls and the centre of internal walls, and W* numbers no longer used.

2.6 External Reference for As Built Drawings

An external reference (Xref) is a drawing which is imported and attached into a host drawing. The Individual elements of this drawing cannot be altered within the host drawing, however layers applying to the Xref may be turned ON/OFF as required.

1. Xref's must be inserted into files as an attachment, using the relative path as the path type. By setting the xref to relative path, drawings can be moved as needed and still maintain their links eliminating any further maintenance to re-link the Xref's. Xref's must be inserted using the 0,0,0 reference point and in any case should not be moved, scaled, stretched or rotated.
2. Xref's should not be bound. The E-transmit command should be used to enable the X-Ref to be transmitted along with the drawing.
3. The dedicated layer must be used for the Xref's – Z-XREF (Colour 8)

3 Drawing Production

To enable the University of Reading to operate and maintain buildings and assets, it is essential that drawings are produced in a consistent and disciplined manner across all construction disciplines.

It is recommended that projects should initiate a meeting with the CAD Manager as early as possible with the programme to ensure that UoR requirements regarding the implementation of CAD standards are clear and will be followed.

3.1 Drawing Units

All drawings shall be drawn in Model Space at a scale of 1:1 where one drawing unit = 1mm. Angles shall be shown in decimal degrees and measured anti-clockwise with 0 measured as a horizontal line drawn to the right.

The preferred scales for use are: 1:1, 1:10, 1:20, 1:50, 1:100, 1:200, 1:250, 1:500 and 1:2000.

3.2 Drawing Revisions

Drawing revisions shall be given according to [4.2](#). Revisions to drawings shall be clouded to outline clearly the changes and this shall be placed on its own layer called Z-RevCloud-G which is not plotted. Revisions shall be described in sufficient detail to enable the nature of the revision to be identified and shall be located above the title block.

3.3 Text Styles

The text shall be standardised to Arial. All drawings are to have standard text heights of 2.5mm, 3.5mm, 5.0mm and 7.0mm and a width no greater than 1 at a scale of 1:1. For example a drawing drawn at 1:100 would have a text height (in Model Space) of 250mm, and the height of the text in Paper Space would be 2.5mm. Blocks and title blocks should be left in the text style they were made in and not changed to Standard Arial. Place text on a separate layer following UoR Layering Convention. (Discipline-Layer Name-T (Text)).

3.4 Line Types

Standard AutoCAD line types must be used. Site survey drawings showing main service supply routes may use special line types such as:

- GAS__GAS
- CCTV__CCTV

These special line types must be supplied with the drawing files. All objects in the drawings must keep their 'by layer' properties.

3.5 Hatch:

1. Do not explode hatches
2. Only standard Autocad hatch patterns must be used.
3. Do not associate hatch patterns to entities that are part of an Xref.
4. Place hatch on a separate layer following UoR layering convention. (Discipline-Layer Name-H (Hatch)).

3.6 Blocks:

1. Wherever applicable, use the provided blocks from [UoR blocks library](#).
2. If a new block needs to be used, it should be created in layer '0'.
3. The new block must be sent to CAD team, informing them of its usage.
4. All symbols inserted into model space will need to be scaled in at the scale of the drawing and be inserted on the right layer.

3.7 Layer and Pen Selection

Basic Pen and colour convention as in [Appendix A](#).

3.8 Basic Layer Convention

Consistency in layers and pen weights allows opening and printing drawings from multiple consultants with the same result and quality.

The University has adopted a simplified version of British Standards Layer Control System for layer naming. A list of typical layers can be found below and are provided also with the drawing template file. The following list is an example of typical layers used by the CAD team. If there is a need to create a new layer, UoR layering convention must be followed. The CAD office must be informed to include the new layer in the template file.

Layer Convention System can be found in [Appendix B](#).

All layers included in UoR Template file which can be found [here](#):

3.9 Model Space and Paper Space

Model/paper space must be utilized in every drawing. All entities, text, symbols etc will be added to model space. All title blocks, legends, revision notes, overall general notes etc must be added in paper space.

Paper space must be set up to:

- Right paper size
- Plot area-Layout
- Scale 1:1 (Right scale to viewport)
- UoR Plot Styles

3.10 Standard Notes

Further information to be included in the standard drawing format, or an inclusion into a contract, is as follows:

“No information on this drawing will be shared with a third party without the written authority of the University of Reading Estates and Facilities Department”.

A standard Disclaimer note will be included on all Master Drawings ([Appendix C](#))

3.11 Drawing frame set-up (Consultant’s title block)

All drawings shall be drawn within the bounds of the University of Readings drawing title block available from the [‘EDMS’ web page](#).

Please see [Appendix D](#)

4 Drawing numbering and file naming

To enable efficient management of drawings all “As Built” drawings are to be produced in both AutoCAD and PDF versions.

4.1 Folders and files naming (based on BS1192:2007+A1:2015)

Please see [Appendix E](#)

4.2 AutoCAD Drawing .dwg version

All As Built drawings produced on behalf of the University of Reading must strictly comply with UoR File naming convention.

The AutoCAD file name shall be identical to the AutoCAD drawing number using the building number as prefix :

Building Number-Project-Originator-Volumes-Levels-Type-Role-Classification-Number

4.3 Adobe drawing .pdf version

A further adobe.pdf version of each “As Built” drawing is to be produced,

- The Adobe.pdf drawing file names shall be identical to the AutoCAD drawing number

5 Master Drawings

5.1 Attachment

Master Drawings including campus plans and maps will be attached to “As Laid / As Built” drawings as XRefs. All XRefs will be placed into the drawing in a view which will allow the drawing to stay at its original scale by zooming to its scale within the view. Under no circumstances should the Master Drawing (XRefs) scale be increased or decreased by the Architect, Consultant or Contractor, other than by zooming. Model space/paper space should be used on every drawing. All master drawings, text, symbols, charts, diagrams etc. will be added to a drawing in MS (Model Space.) All title blocks, legends, revision notes, overall general notes etc. will be added to a drawing in PS (Paper Space.)

Note

1. Attach any XRefs on to the appropriate layer(Z-XRef). Future alterations to an XRef will alter any other drawings with the same XRef attached.
2. Project Managers/Leaders can request existing AutoCAD format master building floor plans from the master drawing files. THEY MUST HOWEVER rename and copy the drawing to his/her desk top or to the current project folder.
3. Project Managers/Leaders may ‘forward’ a copy of the AutoCAD master building floor plans to appropriate design team/Project team member.
4. Design Teams/Project teams may use the copied AutoCAD master building floor plans as basis for their new drawing.
5. An amended general arrangement or master building floor plan drawing shall be returned to the CAD office to allow the University’s Project department’s drawings database to be updated.

5.2 Master site plan building, road and footpath Outline base X-Ref update

The Project Architect shall provide the university with sufficient information for the site master plan.

(W998-Whiteknight Campus Plan) is to be updated to show changes in buildings, roads, footpaths and other essential detail. This drawing set will have the old pre-existing services included on each which will need extending, modifying, or removing by the contractor.

Master plan MUST NOT in any case be moved, scaled, stretched or rotated.

5.3 External services & University Infrastructure plan updates

When section 5.2 is complete the contractor shall then update all the University's services master drawings and return them to E&F. These will then be verified for correctness and any errors and omissions will be referred back to the contractor for correction. When all the contractor's drawings have been signed off, E&F will save the CAD & PDF copies in the correct folders on the E&F network and upload further PDF copies to be viewed on the E&F drawings' database.

The O&M and H&S File documents shall contain signed off copies of these drawings in both AutoCAD & PDF formats, as described in section 6.2. Where further clarification is necessary, it should be sought from the University's Project Manager.

5.4 Building master plans:

When a project involves changes to a small area in a building then the whole building plan/model should be updated. The contractor should liaise with the project manager to obtain the relevant Building master plan/model per discipline and update it following the guidelines given in the CAD Standards document.

6 Submission of Record Drawings

6.1 Two Weeks Prior to Completion

- 1 CD containing a preliminary set of AutoCAD as installed / “As Built” drawings shall be submitted 2 weeks prior to completion of the project in accordance with the “Capital Projects Manual”.
- Binding X-Ref’s should be avoided.
- **eTransmit should be used to submit the Autocad files to the University. This enables all the relevant files (xrefs, ctb, text) to be transferred with the drawing.**
- All drawings for the project including GA's, sections, elevations, details, schematics and services.
- Drawings should be in AutoCAD .dwg format electronically on the CD and in accordance with the “Capital Projects Manual.”
- AutoCAD Files are named as per [section 4](#).

6.2 Final Handover

In order for the University’s drawing database to accurately reflect all building changes, the following is required:

- 1 CD of the final “As Built” drawings in AutoCAD format including room numbers and space polyline/attributes sent to The University of Reading Projects administration staff for updating the database.
- 1 CD of the final set of Adobe format drawings shall be required.

Please ensure that the GA floor plans within the set are clearly marked as GAs and all drawings are to an appropriate scale.

It is the Project Manager’s responsibility to co-ordinate this process and to ensure that the finalised GA drawings and As Built drawings are delivered to the Project at or before Practical Completion.

It is the Design Team's duty and all Consultants and/or Contractors involved to comply with The University of Reading numbering and layout system and in the preparation of GAs and as built drawings.

6.3 Submission of Files

The Architect, Consultant or contractor shall provide all drawing files in standard AutoCAD file format (.dwg) and as Adobe format (pdf.) File transfers shall be by CD as well as ‘drop box’ as agreed with the Project Manager. All CD’s should be clearly named and labelled with the campus name, building name, project name and University of Reading project number. The Project number (Wren Number) can be obtained from Project Leader. A relevant index/issue

sheet should be submitted along with the CD's. The UoR drawing Issue register can be found [here](#).

6.4 CAD Standards Checklist

All consultants must provide the following checklist with all CAD drawings delivered to the University. The signed and submitted checklist ensures that all materials adhere to the standards and guidelines set in the 'CAD Standards' document. [Appendix F](#)

Appendix A

Pen settings

Colour	Pen Thickness
Red	1.3
Green	0.25
White	0.7

Colour	Pen Thickness
Yellow	1.8
Cyan (light blue)	0.35
Dark Red (border)	1.0

Colour	Pen Thickness
Blue	0.25
Magenta (purple)	0.5

Appendix B

Layering standard

Layer naming:

The layer name will consist of three fields:

DISCIPLINE-DESCRIPTION-CODE

A-WALL-G Architect-Wall-Graphical
A-WALL-T Architect-Wall-Text
A-WALL-H Architect-Wall-Hatch
A-WALL-D Architect-Wall-Dimension

An indicative list of disciplines includes:

A Architect
AL Landscape Architects
B Building Surveyors
C Civil Engineers
E Electrical Engineers
F Facilities Managers
G GIS Engineers & Land Surveyors
GA Aerial Surveyors
H Heating and Ventilation Engineers
I Interior Designers
J Telecommunications
K Client
L Lift Engineers
M Mechanical Engineers
ME Combined Services
P Public Health Engineers
Q Quantity Surveyors
S Structural Engineers
SF Façade Engineers
SR Reinforcement Detailers
W Contractors
X Sub-Contractors
Y Specialist Designers
YF Fire Engineers
YL Lighting Engineers (Non-Building Services)
Z General (Non-Disciplinary)

The full list of layers can be found in [UoR Template file](#).

Appendix C

Standard Disclaimer

Estates and Facilities

The information shown on this drawing is given without obligation or warranty. The accuracy therefore cannot be guaranteed and it must never be used for calculation or setting out of works.

General Changes

The accuracy of these drawings relies on feedback from the users. If any anomalies are discovered, please immediately inform the Project Manager.

Appendix D

University title block

Figure 1 - Example of a Consultants Title Block

Rev	Description	Date
 <div style="display: inline-block; vertical-align: middle;"> <h1 style="margin: 0;">University of Reading</h1> <p style="margin: 0;">Estates and Facilities Whiteknights, PO Box 235, Reading, RG6 6BW Tel. 0118 378 8958 Fax. 0118 378 6928</p> </div>		
Consultants/Contractors Logo		
Building Building No.-Name		
Project Project Name		
Title Drawing Title Drawing Title		
Drawn NAME	Date DATE	Scale SCALE@A0
Project (WREN No.-Originator-Building No.-Level-Type-Role-Classification-Number)		Suitability-Rev.
XXXXXXXX-XXX-XXXX-XX-XX-X-XXXX-XXXXX		XX-XX

- Sized to suit the scale shown on the drawing.
- University of Reading Title block is scaled at 1:1 and comprise of:
 - Building name block,
 - Project name block,
 - Title block,
 - Drawn by and Date,
 - Scale,
 - Revisions block
- All shall have the University of Readings logo.
- Consultants/Contractors Logo should be replaced by '**AS BUILT/AS LAID**' text for as built drawings.
- All drawings will have a title block, which will be inserted into a drawing in Paper Space at an origin of 0, 0 in Z-Titleblock-G layer
- While in paper space a view must be made up under a layer called Z-Viewports so that any XREFS or drawings will be in Model Space to scale.
- All title blocks will be in an attribute format allowing all information to stay the same, but with editing facility.

Appendix E

Naming convention

Project	Originator	Volumes or System	Levels	Type	Role	Classification	Number
XXXXXXX	XXX	XX	XX	XX	X	XXXX	XXXXXX

Project: 7digit WREN Project Number

Originator: 3 digit File Originators' Initials

Volume or System: As defined in BS1192:2007+A1

Levels:

Code	Description
ZZ	Multiple Levels
XX	No level applicable
GF	Ground floor
00	Base level of building (where GF is not appropriate)
01	First floor
02	Second floor, etc.
M1	Mezzanine above level 01
M2	Mezzanine above level 02,etc
B1	First level below ground,etc.
RF	Roof Level

Type Standard:

Code	Description
DR	2D Drawing

Roles Standards:

Code	Description
A	Architect
B	Building Surveyor
C	Civil Engineer
D	Drainage,Highways Engineer
E	Electrical Engineer
F	Facilities Manager
G	Geographical and Land Surveyor
H	Heating and Ventilation Designer
I	Interior Designer
K	Client
L	Landscape Architect
M	Mechanical Engineer
P	Public Health Engineer
Q	Quality Surveyor
S	Structural Engineer
T	Town and Country Planner
W	Contractor
X	Subcontractor
Y	Specialist Designer
Z	General(non-disciplinary)

Classification:

Each drawing should be classified by a code, taken from Uniclass 2015 TABLE Ee (elements), to accurately describe the construction assets represented. The latest version of the tables may obtain [here](#).

The code should be exactly four characters. Models predominately consist of Multiple Classification Elements and therefore would be represented by the Classification code 'ZZZZ'.

A single code from the following table should be used.

For example:

Code	Description
XXXX	not implemented on current project
ZZZZ	Multiple Classification Elements
20XX	Structural elements
2005	Substructure
2010	Frames
2020	Beams
2030	Columns
2050	Bridge abutments and piers
25XX	Wall and barrier elements etc.

Numbers: The drawing number it is compiled by five digits and should always be unique.



Drawing Code -Sequential Number

The first two digits indicate the Drawing Code and should be defined by the following table for the as built drawings:

<u>Code</u>	<u>Description</u>
10	Plans (General)
11	Setting out
12	Details Plans
13	Reflected Ceiling Plans
14	Fire Strategy
15	Acoustic Strategy
16	Area Plans
17	Substructure
18	Site Plans
19	Location Plans
20	Elevations (General)
21	External elevations
22	Internal Elevations
23	Door Elevations
24	Window elevations
25	Louvre elevations
26	Curtain wall elevations
27	Glazing/Screen elevations
28	Framing Elevations
30	Sections (General)
31	Strip Sections
32	Detail Sections
35	Circulation (General)
36	Staircases
37	Lifts
38	Escalators
40	Detailing (General)
41	Plan Details
42	Section Details
43	Assembly Details
45	Finishes (General)
46	Floor Finishes
47	Wall Finishes
48	Ceiling Finishes
50	Schedule (General)

51	Door Schedules
52	Window Schedules
53	Finishes/ Material Schedules
54	COBie Schedules
55	BREEAM Schedules
60	Furniture, Fittings, Equipment (General)
61	FFE Kitchen
62	FFE Bedroom
63	FFE Office
64	FFE Sanitary
65	FFE Loose
66	FFE Fixed
67	FFE Speciality
70	Services Mechanical/Non Electrical (General)
71	Heating Services Layout
72	Domestic services Layout
73	Ventilation Services Layout
74	Cooling Services Layout
75	Plant room Layout
76	Above Ground Drainage
77	Below Ground Drainage
78	Schematics
80	Services Electrical (General)
81	Containment Layout
82	Lighting
83	Small Power & Data
84	Fire Alarm
85	Security
88	Schematics
90	External Works (General)
91	External Works Plans
92	External Works Elevations
93	External Works Sections
94	External Works Details (General)
95	External Works Plan Details
96	External Works Section Details

The three last digits are sequential starting from 01 for each category defined by the first two digits.

Example:

21001-External elevation-sheet 01

78002-Mechanical Schematic-sheet 02

Appendix F

CAD Standards Checklist

File format and setup

Electronic File is in correct Format
Layout /Plotting Settings and pen assignments are correct
Scale and Drawing Units are correct
Block are inserted on the right layer
Border/Title Blocks comply with UoR standards
Policy on Model Space and Paper Space is adhere to
Policy on Xrefs is adhere to

Layering

Layers comply with UoR standards
Attributes (Colours, Pens and Line types) are correct

Drawing file and sequence number

Drawing Files are named correctly
Drawing File Name is the same with Drawing Number
Drawing Files indicate building name and number
Drawing set indicates release status (i.e. As Built)
WREN Number is correct
Fire symbols from UoR Library have been used

Space policy

Room number complies with UoR standards
Room names/numbers adhere to UoR Policy
Space attribute has been used
Area polyline according to UoR Policy

Name:

Signature:

Contact details:

Date:.....

Appendix G:

Declaration of Compliance with

2D CAD Protocol, Guidelines for producing drawings for Estates & Facilities , The University of Reading.

Name of Contractor:

.....

Address:

.....

.....

.....

Tel No:

.....

Designated Senior Manager:

.....

I hereby confirm that this guide has been brought to the attention of, read and understood by all staff, including sub-contractors, working on behalf of our company on University projects and will be adhered to.

Signed on behalf of the Contractor:

.....

Position

.....

Print Name:

.....

Dated:

.....

This form is to be completed and forwarded to Penelope Tsounou, CAD & Project documentation Officer at p.tsounou@reading.ac.uk , before any work is carried out as part of the preferred contractors' list application.