



IPMG
PUBLICATIONS

CAD DRAWING

GUIDELINES

DRAFT

UNOPS CAD Drawing

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1 Introduction

This CAD Guidance document highlights the fundamental best practice requirements which needs to be considered and incorporated in order to develop a technically and visually correct drawing. Applying the guidance within the drawing development process provides a common platform that all may work from in achieving this goal. This in turn reduces confusion, increases efficiency and cuts out obvious mistakes.

Applicability

The guidance set out in this manual can be applied to all drawing work submitted to and prepared in house within the United Nation Office for Project Services (UNOPS). It covers the minimum CAD requirements to be implemented for all infrastructure work undertaken by UNOPS. Its contents are applicable to all new work as well as any revisions to existing work.

2 Awareness

This section discusses the core elements an engineering drawing must adhere to and shall form the basis on which all drawing work is to be developed and completed.

2.1 ISO compliance

UNOPS is ISO 9001 certified and is committed to upholding the ISO quality system. ISO compliant procedures are a requirement in all drawings submitted to and prepared within UNOPS. This guidance note serves as part of the UNOPS ISO compliance framework and should be read in conjunction with all CAD work undertaken for and within UNOPS.

2.2 Clarity

2.2.1 Scope

The project scope must be defined in all relevant drawings. The scope of works shall be clearly distinguishable between new and existing conditions. This may be achieved through labels, notes, headings, hatching, greyscale etc.

2.2.2 Specifications

All project specifications must be noted within the drawing and shall be easily referenced when read in conjunction with the Bill of Quantities and other supporting documents. This is achieved through preparing sufficiently detailed construction drawing which include descriptive annotations such as dimensioning, labelling and notes.

2.2.3 Attributes of the subject

Certain attributes are associated to discipline specific drawings. A drawing showing a section through a proposed building for example, will have structural, material and utilities elements attributed to it, whilst a sewer pipe long section will provide ground and pipe levels, gradients, distance intervals and pipe flows in its content*. The draughtsperson must strive to achieve consistency in approach, method and content within their work.

* Attributes listed in paragraph 2.2.3 are not exhaustive and should not be used as a reference when producing similar drawings.

2.3 Non-ambiguity

An engineering drawing should convey enough information as to clearly define the required end product without ambiguity. This guidance note outlines the requirements and best practices involved in achieving this.

2.4 Information sharing

The nature of an engineering project often deals with collaborations between differing disciplines and/or teams. In this regard sharing of information amongst project collaborators will be required at various stages. Standardising the methods of sharing this information, as well as standards applied to the content of such information, will create a uniformity to which project teams can communicate.

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3 Format

3.1 Print scales

The purpose of scale is to accurately represent spaces, objects or graphics to a smaller, more practical size than the original.

Clearly indicate the original scale under the title of each drawing element if the scales differ from one another or the general scale used. Where more than one scale is used on a drawing, the scale stated in the title block should correspond to the global plotting scale of the drawing. The text "As shown" should never be used on any drawing title block. Always state the most generally used scale.

Objects should never be scaled to fit inside a drawing frame as this results in unintelligible scales. Scale bars should be incorporated into drawings which depict layout plans, site plans and key plans.

Scale guidelines for drawings should be selected from the list provided in **Table 1**.

3.2 Paper size, Text and PDF scales

3.2.1 Paper Size

Considerations when planning the paper sizing for project drawings should be practicality (ease of handling), content (type of drawing) and scaling (fit).

An A0 printed sheet is large and cumbersome to handle, especially for site conditions where a drawing is often utilised to examine and record information. When selecting the project paper size, consider the readability when the drawing is printed to a smaller scale, usually half of the original paper size.

Based on halving the original paper size, the reduced size for an A0 print is A2, whilst an A1 drawing is reduced to an A3 print. Planning of scales is therefore important as the reduced print will halve the original scale. For example, a scale of 1:500 at A0 will print to 1:1000 at an A2 paper size. **Table 2 and Figure 1** show examples of paper sizes and recommended scale reductions.

SCALE	EXAMPLE APPLICATIONS
1:1	Detail Drawings
1:5	
1:10	
1:20	
1:25	
1:50	
1:100	Layout Plans General Arrangements
1:200	Floor Plans Elevations and Sections
1:250	Site Plans
1:500	
1:1000	Road Layouts and Longitudinal Sections Civil Utilities
1:2000	
1:2500	
1:5000	Locality Plans
1:10000	Key Plans Topographical Maps Geotechnical Maps
1:25000	
1:50000	

Table 1: Acceptable Drawing Scales

PAPER SIZE	WIDTH AND HEIGHT (mm)	REDUCED SIZE (50% scale factor)
A0	841 x 1189	A2
A1	594 x 841	A3
A2	420 x 594	A4
A3	297 x 420	A5
A4	210 x 297	A6

Table 2: Original and Reduced Paper Size

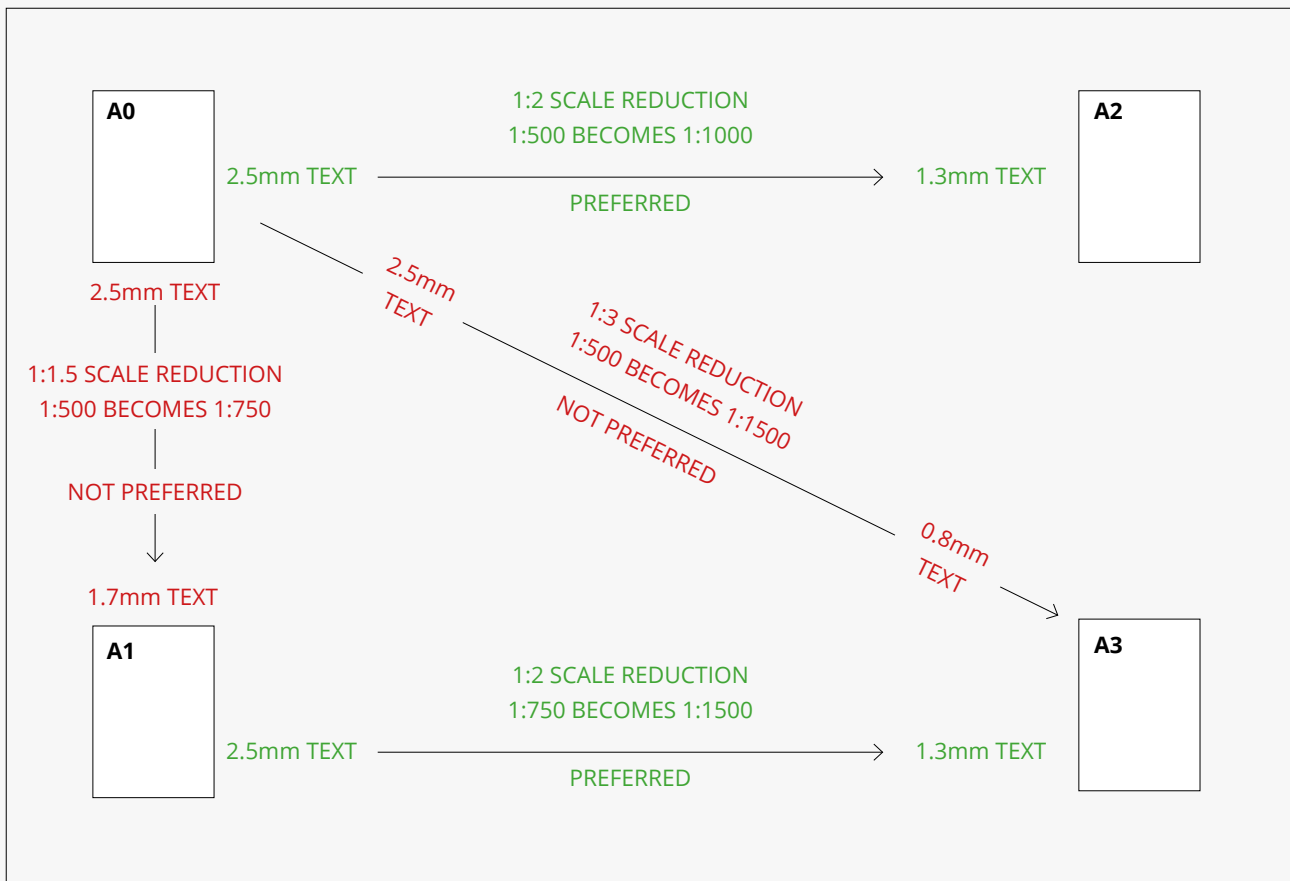


Figure 1: Paper and Text Size Ratios

3.2.2 Text

All annotations, including dimension text, should be readable from the bottom and/or right-hand side of the drawing sheet. **Figure 2** demonstrates the text angle convention. Exceptions to this rule are contour values and kilometre markers.

The standard font for all annotations in is ARIAL. Text height for final printed drawings is:

- General annotations, dimensions and labels - 2.5mm
- Critical annotations – 3.5mm
- Titles and headings - 5.0mm

Reduced size paper prints, as discussed in [section 3.2.1](#), will print the above text height conventions to half their original size. For this reason, a minimum text height of 2.5mm is to be used on all drawings.

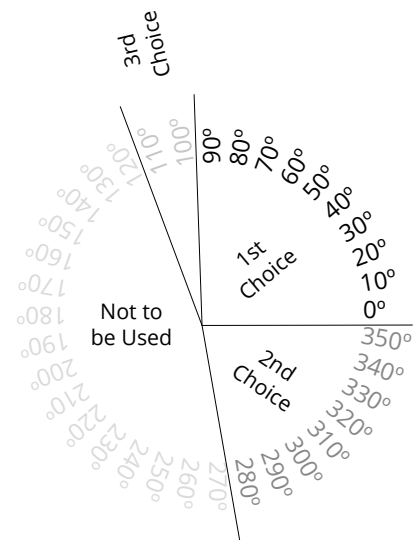


Figure 2: Appropriate Text Angles

3.3 PDF Scales

Printing to pdf is a widely adopted form of file sharing. When printing to pdf from CAD software, the draughtsperson should always print the drawing using the original paper size that the drawing was created. This enables the created pdf file to be printed with the “no scaling” option chosen within the pdf print options. The print preview within the pdf print options should display the whole drawing without omitting any detail of the original paper size.

3.4 Copy-able

Site conditions often see the need for drawing reproduction by means of scanning or copying. Considerations in this regard should be taken by the draughtsperson in ensuring the information provided is clearly visible when a drawing is reproduced.

Work to be done needs to stand out over the survey backdrop for example. Greyscale should not be used to convey design information. The use of thicker line types should be used on smaller scale drawings, emphasizing key attributes within the drawing.

3.5 Colours VS Grey-scale

The use of colours in a drawing may range from displaying company logos to distinguishing between different types of information. The unavailability of a colour printer is a drawback to any colourised elements in a drawing and confusion may arise from undefinable elements as a result reproducing black and white prints.

Working and detail drawings should avoid using colour to define drawing objects, as these drawings are used in the field where colour printers are not always available. Drawings utilised for presentation purposes such as catchment maps, key plans, and geotechnical maps, are not often reproduced for site and the use of colour is encouraged in defining the content.

Methods to distinguish information in grey-scale drawings include:

- Line types
- Line weights
- Hatching
- Line Grey-Scale Colouring

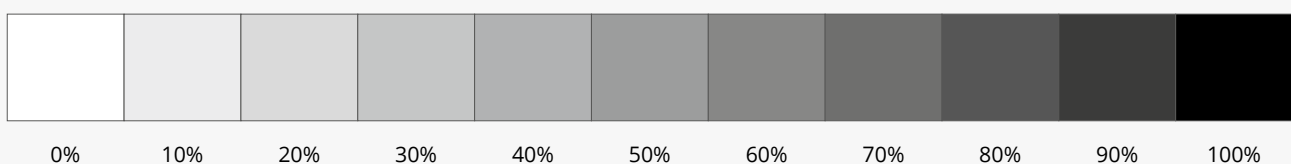


Figure 3: Grey Scale Range

3.6 Key information

Engineering drawings are an integral part of the project documentation which require a high level of consistency in the provision of mandatory project specific information. Templates containing key information common to an engineering drawing are created with the purpose of avoiding repetition in future work.

The following list provides guidance on key information consistently applied to drawings

- Title block showing all relevant information
- History of drawing revisions
- Headings with Scales
- List of reference drawings
- Labels and Dimensions
- Descriptive notes
- North Arrow (Location specific drawings)
- Coordinated grid (Location specific drawings)
- Legends (where specific line types, hatching or symbols are used)

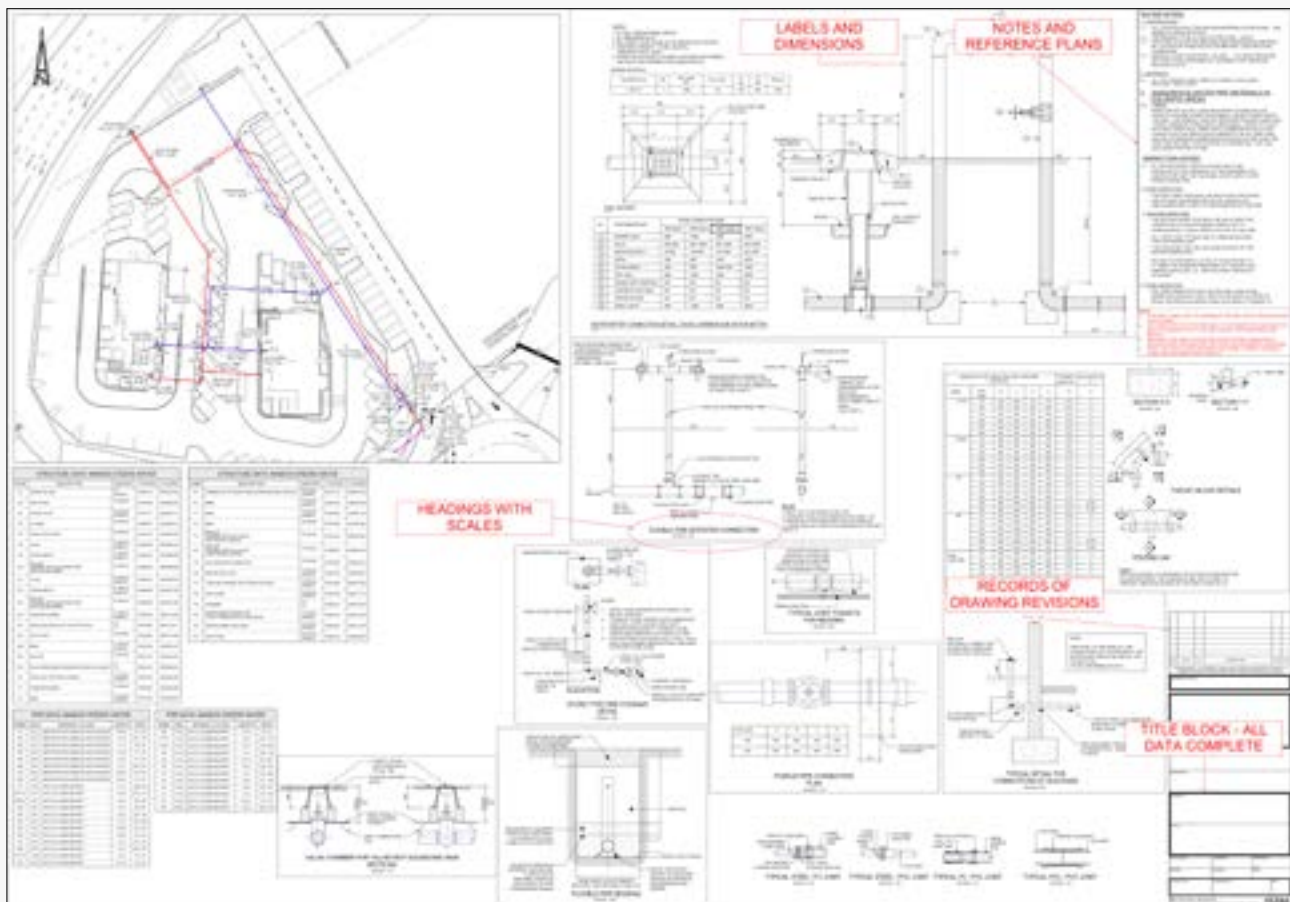


Figure 4: Key Information Common to all Drawings

3.7 Language

Engineering drawings are technical documents and this must be reflected in the language style used. All annotations should be simple, clear, and to the point in defining the drawing content. As drawing space may be limited, short concise descriptions are often required to define drawing elements.

3.8 Title blocks

All submitted drawings shall incorporate a title block. The title block must display data including the project description, revision history, project participants and the authors details. This information assists in the quality control required for tracking the project life cycle.

Title blocks should be planned and set up from the project outset. Decisions on size, content and appearance should be made prior to the commencement of drawing production. Space should be reserved for the drawing subjects and headings as well as legends and annotations.

Title block information is generally positioned along either the bottom border (lengthways), or right hand side border. Drawings requiring more than one sheet utilise the bottom (lengthways) layout, as they are a continuation to each other. Drawings containing multiple views may utilise the right hand border template as this layout allows a dedicated space for notes and specification lists. **Figures 5, 6 and 7** show examples of title block layouts as well as information to be shown.

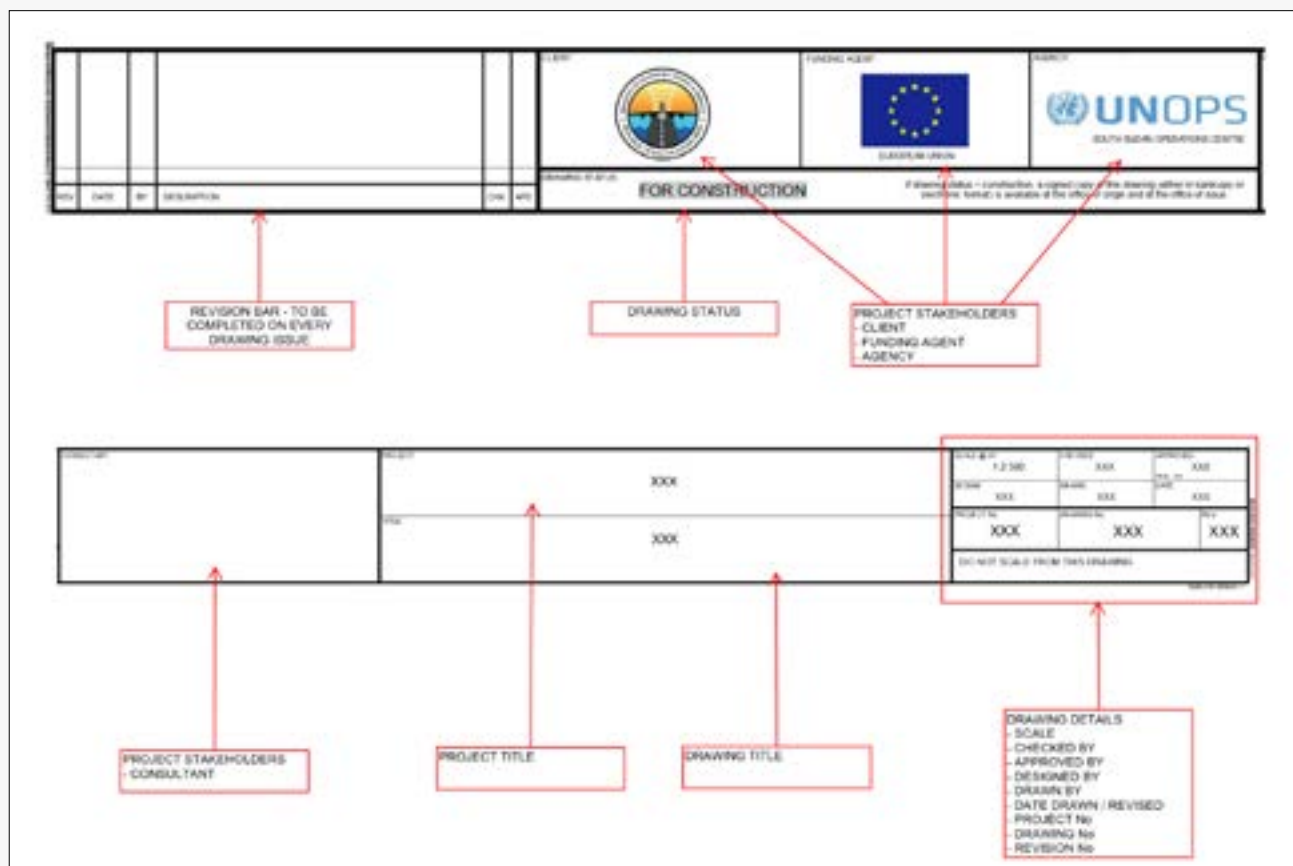


Figure 5: Minimum Information to be Shown on Title Block

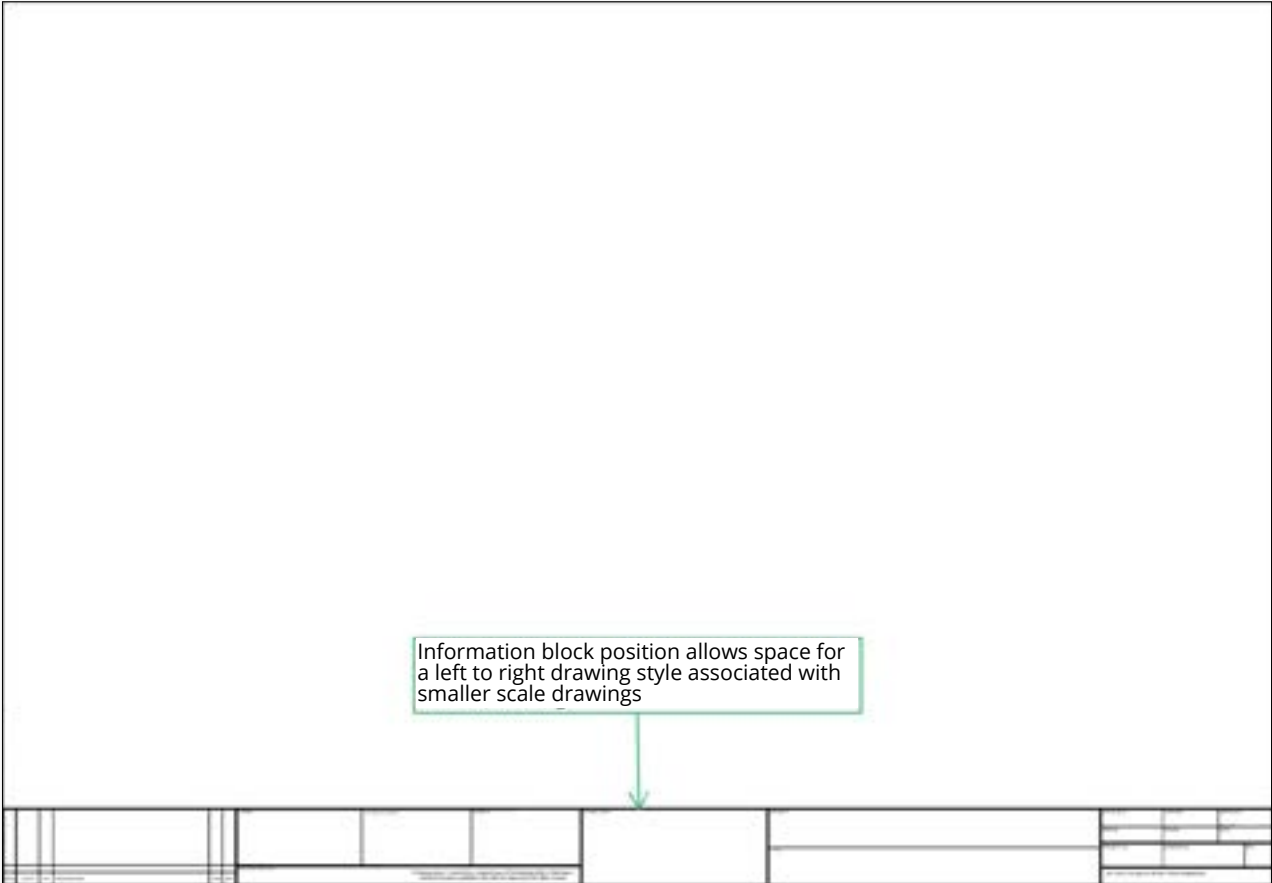


Figure 6: Title Block – Bottom Border (Lengthways) Information Display

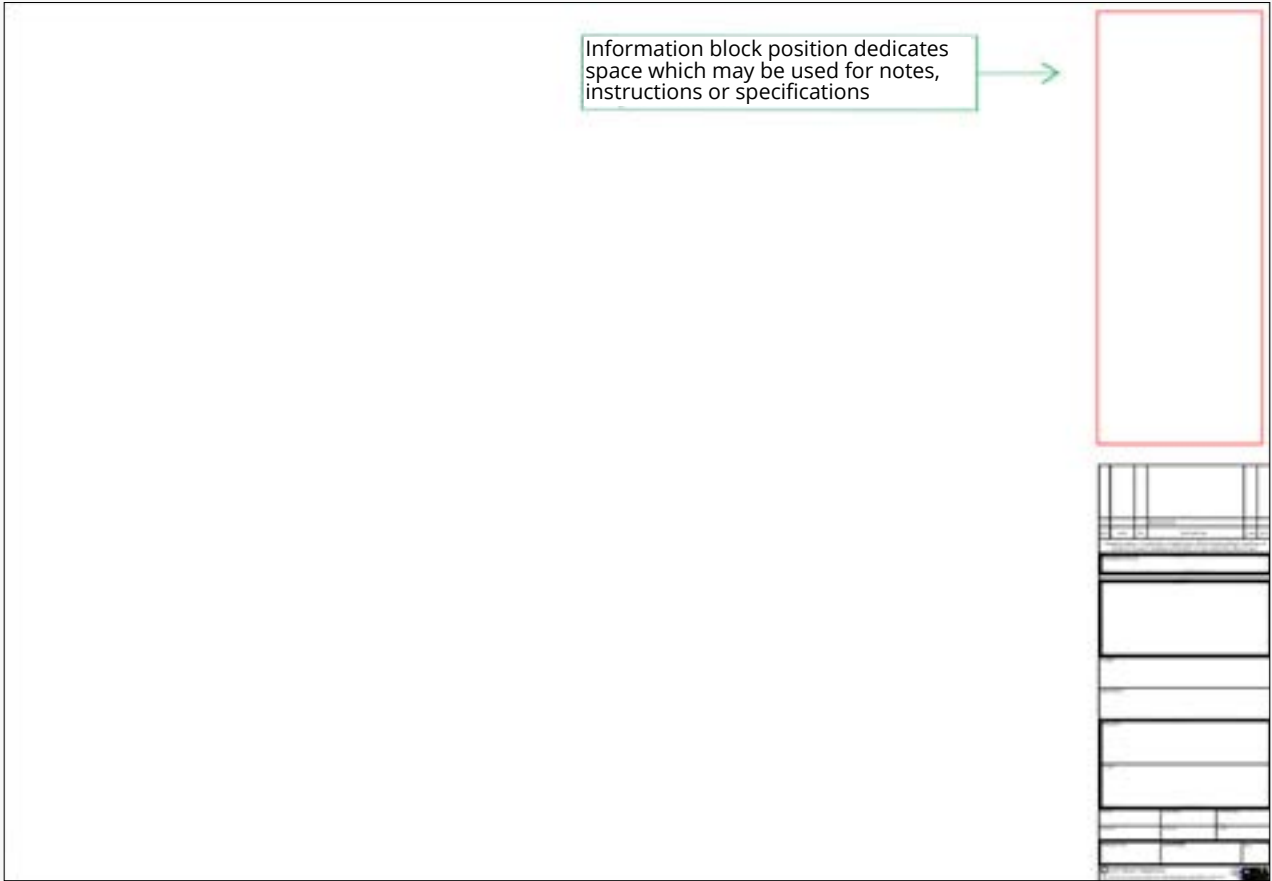


Figure 7: Title Block – Right Hand Side Border Information Display

3.9 Sheet numbering convention

a sheet numbering convention is utilised in the event of multiple drawings being needed to display the required content. This is due to the project paper size being insufficient to manage the required content at the preferred scale. Typically, roads and civil utilities that cover a large surface area require the need of multiple sheets to encapsulate the extent of works.

A robust sheet numbering system is required to record such cases where multiple sheets are necessary. The system will be recorded on all drawing title blocks as well as within the paper space where reference is to be made to previous and successive drawing numbers. The annotations will contain the drawing numbers (**refer to section 6.3**) paired with the sheet number, for example sheet 1 of 5, sheet 2 of 5 etc.

All sheet numbers must be clearly shown within the project list of drawings.

3.10 Legends

Legends describe the meanings of line-types, blocks, symbols, hatching and colour banding in a tabular style format. A legend will contain drawing objects along with a brief description of what is being displayed for example an electrical underground line with its relevant line type. The legend should be grouped with the general notes section. **Figure 8** shows a typical legend associated with an electrical drawing. A legend is generally required on all submitted drawings where confusion may arise due to misinterpreted information. Certain software packages incorporate legend style tools to standardise the presentation of legends throughout a project.

3.11 Styles – Custom styles

Styles are used for standardising text, dimension and line-type behaviour and appearance.

Custom styles must be created utilising this CAD standards guidance note as a reference and then saved for utilisation in all future projects. Planning is necessary to ensure that what is created is sustainable for use in future projects of varying scope.



















































LEGEND OF SYMBOLS- ELECTRICAL		
LIGHTING SYMBOLS	LIGHTING SYMBOLS continued.....	POWER SYMBOLS continued.....
 1 way light switch  2 way light switch  Intermediate light switch  Emergency lighting key switch  6A Ceiling pull cord  Time lag switch  External lighting photocell mounted externally at high level  Ceiling mounted bulkhead refer to luminaire schedule  Non Maintained emergency bulkhead outside each final exit  Shaver Light positioned above sink refer to luminaire schedule  Disabled alarm pull cord CTEC NC887C  Mode Tiger 12 channel dimmer rack WS-06-12-Marstons  Unswitched fused connection unit at H Level for Disabled alarm panel as CTEC NC 551  Ceiling mounted twin fluorescent light fitting refer to luminaire schedule  Ceiling mounted single fluorescent light fitting refer to luminaire schedule  Triple pole fan isolator mounted at high level  Ceiling Mounted PIR Sensor CP Electronics EBDSPR  Wall mounted PIR Sensor CP Electronics SPR-F	 Maintained emergency bulkhead c/w 3hr battery back up and euro legend  Non maintained emergency bulkhead c/w 3hr battery back up  3 Compartment dado trunking mounted at 1200mm AFRL  Disabled alarm reset button CTEC NC802 DB  Disabled alarm over door light/ sounder CTEC NC806 CS POWER SYMBOLS  Twin switched socket outlet with mounted at 450mm aff unless otherwise indicated  Single switched socket outlet mounted at height as indicated  TV aerial isolated coaxial outlet plate mounted as indicated  Single RJ45 Outlet plate first and second fix by V-T services  Twin RJ45 Outlet plate first and second fix by V-T services  Un-switched fused spur mounted as indicated for hand dryer  Switched fused connection unit above counter @1150mm aff c/w SSSO at L Level  25 A Triple Rotary Isolator to cellar condensor height to be confirmed on site  25A DP Switch mounted as indicated  New incoming electrical supply complete with CT metering	 Switched fused spur mounted at 1150 aff. Washer Dryer  Three phase & neutral 12 way MCCB panel board C/W 250A main switch  Three phase & neutral distribution board C/W 125A switch disconnector  Three compartment dado trunking Mk prestige mounted at 1000mm aff  32A DP cooker switch mounted as indicated, with cooker connection unit at Low Level  BT Incoming DP position FIRE ALARM SYMBOLS  FIRE ALARM PANEL  FIRE ALARM BREAKGLASS POINT  SMOKE DETECTOR  SMOKE DETECTOR C/W SOUNDER  SMOKE DETECTOR C/W SOUNDER BEACON  HEAT DETECTOR  HEAT DETECTOR C/W SOUNDER  HEAT DETECTOR C/W SOUNDER BEACON  XENON BEACON  POWER SUPPLY UNIT TO DRIVE INTERFACE UNITS FOR MECHANICAL PLANT SHUTTING DAMPER CLOSER  DPHE SWITCH WITH MECH ADJACENT FOR ISOLATING FIRE ALARM RELAYS UNDER TEST CONDITIONS

Figure 8: Symbols Legend

4 CONTENT

4.1 Discipline specific generalisations

Engineering is a broad field divided into various disciplines which in turn are sub-divided into further specialised fields. Each engineering discipline is associated with general information that should be contained within the drawings.

A Roads drawing for example, will provide different generic information when compared to a Buildings drawing. The client will expect to see layouts and longitudinal sections when receiving a Roads drawing. Similarly, elevations and sections will be anticipated for a Buildings drawing. **Table 3** provides guidance to discipline specific content associated within this guidance note.

4.2 Recommended drawings per discipline

the following section prescribes the drawings and contents required per drawing discipline. It furthermore provides a framework for all work submitted to UNOPS.

The key attributes provided in Table 3 are supplementary to the discipline specific drawing content listed within the correspondent Annex for this section.

The information listed in Annex 1 should be used as a guideline where, during earlier stages of a project, certain information will not always be available.

The draughtsperson should however strive to ensure the submitted drawing contains as much information as possible to achieve a clear understanding of the task to be undertaken.

The drawings listed in Annex 1 are general in nature. Additional project specific drawings are often required and draughtspersons may use the following information as a guideline to the detail and content that should be shown.

It remains the responsibility of the design engineer whether a Consultant Engineer or a UNOPS engineer if the work is "in house" to ensure completeness of all drawings.

DISCIPLINE	DRAWING COMPOSITION	KEY ATTRIBUTES
Airports / Aviation	Locality plan, Layout, Cross Sections	North Arrow, Legend, Survey Background, construction notes
Roads	Locality plan, Layout, Longitudinal Sections, Cross Sections	North Arrow, Legend, Survey Background, construction notes
Civil Utilities	Locality plan, Layout, Longitudinal Sections, Structural details	North Arrow, Legend, Survey Background, construction notes
Buildings	Site plan, Floor plan, Elevations and Sections	North Arrow, Legend, Material lists and schedules, construction notes
Building Services	Site plan, Floor plan, Elevations and Sections	North Arrow, Legend, Material lists and schedules, specifications
Bridges and Culverts	Locality plan, Layout, Longitudinal Sections, Structural details	North Arrow, Legend, Survey Background, construction notes
Waste / Wastewater	Locality plan, Layout, Longitudinal Sections, Structural details	North Arrow, Legend, Survey Background, construction notes

Table 3: Guidelines to Discipline Specific Drawing Content

5 Drawing composition

5.1 Aesthetics of a drawing

The importance of an aesthetically pleasing drawing is an often overlooked aspect in the engineering process. Working without applied standards usually results in a drawing that appears unorganised, unclear and unsightly. This could lead to the sharing of ambiguous information and subsequent delays and wasteful expenditure.

Listed below are methods to assist the draughtsperson in presenting an aesthetically pleasing drawing.

- Title blocks should be standardised and prepared to cater for all discipline specific content
- Use styles to standardise text, dimensions and common drawing elements
- Plan drawing content to fully utilise the paper space available
- Group notes and legends in a predefined allocation
- Keep presentation styles simple, such as minimising hatch patterns and use of colours
- Align drawing objects relevant to each other ie elevations and sections
- Make use of correct scales
- Make use of line-types and line-weights to highlight important features of a drawing element

5.2 Dimensioning

Dimensioning is critical to the objective of an engineering drawing. It is not an acceptable practice to scale off a drawing, especially for construction purposes. All dimensions must be clearly shown, providing enough information for the intended scope of the drawing.

Dimension styles must be created and saved within the project template. Creating a dimension style ensures consistency in appearance and content. This need be done only once as the style will be saved into a template for future use. Sharing of these standards, which is critical, is then easily achieved between various disciplines or project teams.

Dimensions comprise of four components as shown in **Figure 9:**

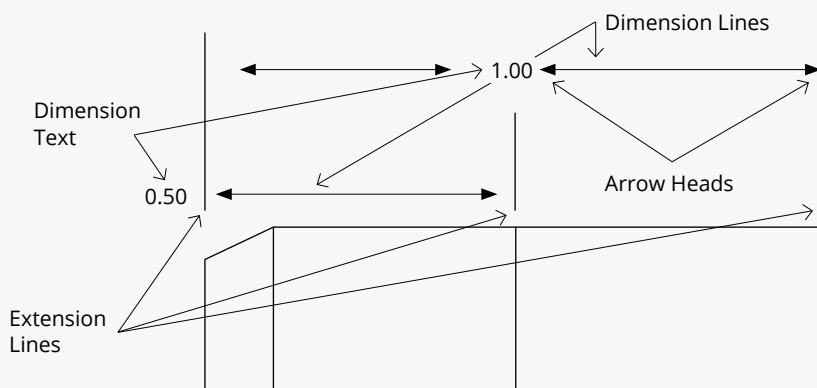


Figure 9: Dimension Components

Dimensions are generally style based on user or client preference.
General rules to follow with dimension styles are:

Dimension Text

- Text height of 2.5mm minimum
- Standardise text position in relation to dimension lines
- Show dimension text in metres or millimetres – not a mix
- A visible gap from the view so they are not confused with the visible lines

Extension Lines

- To continue 2.5mm past the dimension line, or the height in mm of the text size being used
- Extended from the view to indicate the edges referenced
- A visible gap from the view so they are not confused with the visible lines

Dimension Lines

- Should be parallel to the dimensioned surface
- When stacked they should be at least 6mm apart

Arrow Heads

- To point directly to the object being dimensioned or the extension lines at the end of the dimension
- Made three times as long as they are wide
- Architectural ticks are used for architectural and building drawings

5.3 Hatching

Hatching comprises of an object infill, making use of various patterns to express how a drawing object is used, made or composed. Hatching is also used to depict various materials, object thicknesses, construction packages etc.

A legend must be used to denote hatching styles, patterns and definitions within the drawing. The overuse of hatching must be avoided as it negatively affects drawing file size and printing costs. Hatching styles utilising voided patterns are preferred over a solid infills in this regard.

Figures 10, 11 and 12 show examples of hatching used to specify different information.

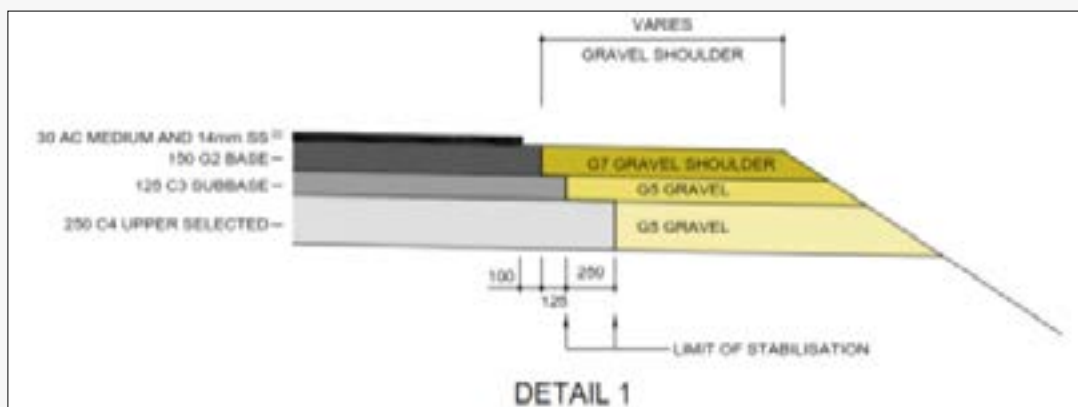


Figure 10: Road pavement layers identified through hatching

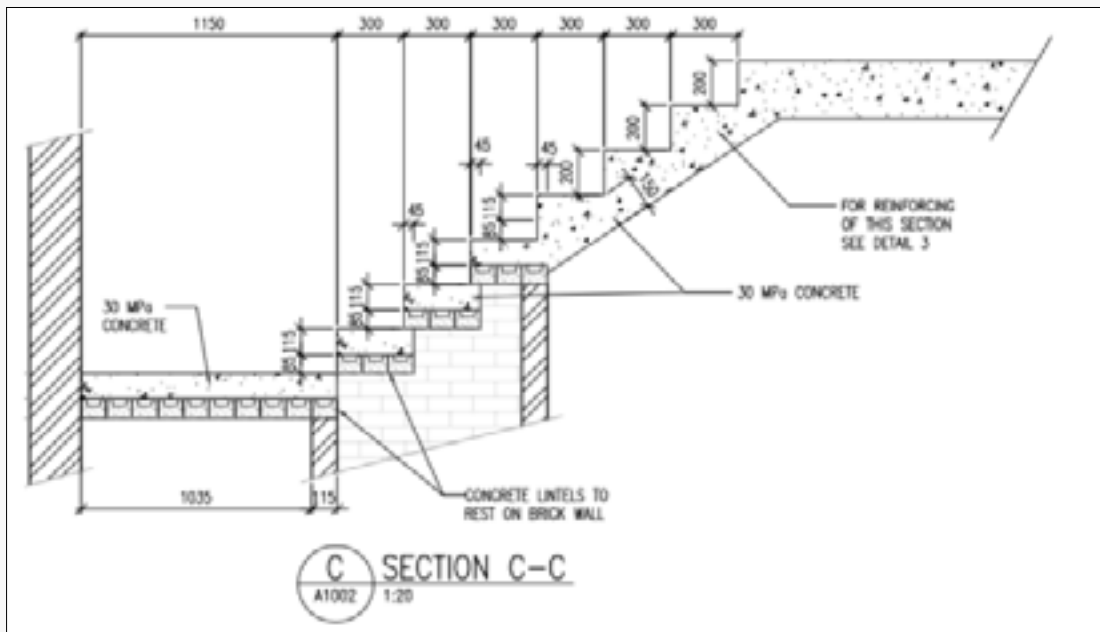


Figure 11: Various hatching styles used in Building section

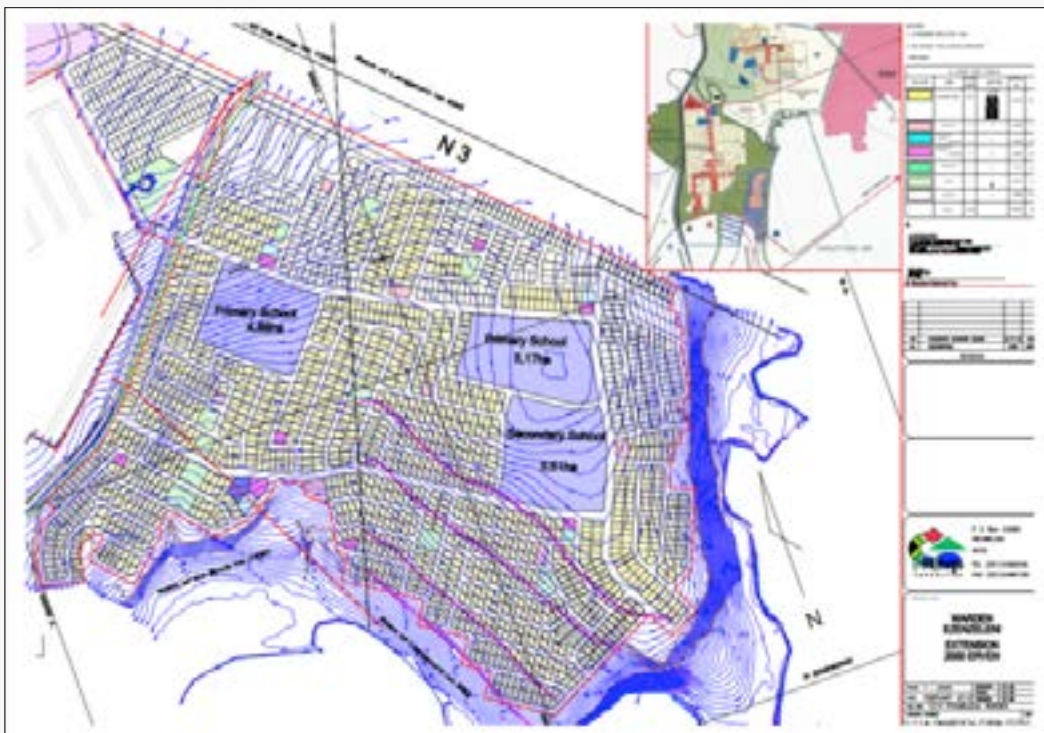


Figure 12: Hatching used to identify land use

5.4 Blocks and attributes

Blocks with their derivative the “attributes” together with their special form “the Dynamic Blocks” are often overlooked during the drafting phase. Using these features will not only make the creation of a drawing faster, it will also make the drafting process more effective by making the modifying and editing processes much easier. The use of the blocks and attributes would:

- Reduce repetitive tasks
- Reduce file size
- Maintain organization's standards
- Simplify library and process
- Create reports automatically

The usual applications of the blocks with the drafting process varies depending on the required information to be represented. While normal blocks can be used for furniture, equipment and landscaping, attributes on the other hand would be used to represent data sets that join both geometrical shapes and fixed texts with variable texts, good example application for this kind of blocks are the Tags in general and the sheet's titles block.

Dynamic blocks are advanced solution of the attributes. In attribute, the editable part is text only, while in dynamic blocks the geometry itself could be represented based on pre-set modifications on the block's geometry, good example on this are Doors Dynamic Blocks, and the Tags.

5.5 Tags

Tags are also special cases of the attributes, they hold important information within the drawing. Sometimes they represent the grouping based on type for the features within the drawing such as the Doors and Windows tags. And also, they could be used as reference information block such as the sections and detail tags. Other applications for the tags are when representing element's information such as the Column Grid Call Out or information like the level and room tags.

Figure 13 represents some applications where the tags are usually used within a drawing







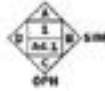





	
BUILDING SECTION	WALL SECTION
Top Line = Drawing Number Bottom Line = Sheet Number	Top Line = Drawing Number Bottom Line = Sheet Number
	
DETAIL SECTION	EXTERIOR OR BUILDING ELEVATION
Top Line = Drawing Number Bottom Line = Sheet Number	Top Line = Drawing Number Bottom Line = Sheet Number
	
PLAN DETAIL CALL OUT	COLUMN GRID CALL OUT
Top Line = Drawing Number Bottom Line = Sheet Number	Horizontal Lines = Letters Vertical Lines = Numbers
	
INTERIOR ELEVATIONS	WALL OR PARTITION TAG
Top Line = Drawing Number Bottom Line = Sheet Number Letters = Sub-drawing Number SIM = Similar & OPH = Opposite Hand	Number = Partition type
	
DOOR TAG	WINDOW OR GLAZING TAG
The number identifies the door type or number	The number identifies the window type or number
	
ROOM ID	PLAN LEVEL TAG
Top Lines = Room Name Inside Box = Room Number	Top line = Level from ± 0.00 of the building (cm) Bottom line = Level from Sea level or datum (m)

Figure 13: Some Applications of Tags ¹.¹ Source: <https://www.archtoolbox.com>

5.6 Images

Imagery, if available, is a useful medium in depicting the project site, visually enabling the viewer to better grasp existing conditions. Software permitting, an image can be attached as an external reference into the working drawing. An example of this is an image being an accompaniment to a survey backdrop as shown in **Figure 14**.

The image resolution will determine the suitability for use as backdrops in drawings. Low resolution imagery will be smaller in file size but may become pixelated when printed from large scale drawings. Small scale drawings, such as key plans and locality plans, are more suited for low resolution images. High resolution imagery, while good for large scale detail, are larger in file size and may cause a drawing to become slow and unresponsive. It is advisable to unload the image reference when using larger file sizes, only attaching the image when printing.

Drawings with images should always be printed, to both the original scale and reduced scale (see [section 3.2](#)), for checking prior to submission. This checking exercise should include prints in colour and grey scale.



Figure 14: Image background with contours and Floodlines

5.7 Survey formats

Survey data is available in varying file formats depending on the source and type of information at hand. Conceptual and feasibility level drawings are generally able to use coarser survey information such as SRTM data which may be readily available from various websites. Although easier to obtain, the SRTM data is of a low quality, limiting its applications. Projects at a preliminary or detail design phase require higher accuracy data commonly provided by a professional surveyor.

The project surveyor should be made aware of compatible file formats for submitting the processed data. A file containing xyz ground point values is commonly accepted by the majority of CAD packages. Although generally accommodated by most CAD platforms, point files are considered as unprocessed data. It is preferable to obtain the survey data in a Digital Elevation Model (DEM) format which contains a pre-processed surface model.

See **Table 4** for common survey formats and descriptions.

Setting out data is a requirement of the detail design and construction phases of a project. Benchmark or control points must also be supplied with the survey data and included on all setting out drawings. Benchmarks are necessary in referencing the design to the survey system being used and then translating the design to the real world placement on the ground during construction. All references to benchmarks or control points as well as setting out data, must include the geographical coordinate system in which the survey was done. **Figures 15 and 16** show examples of benchmark and setting out tables respectively.

SOURCE	DESCRIPTION	EXAMPLE FILE FORMAT	DATA CONTENT
Shuttle Radar Topography Mission (SRTM)	Satellite data – low detail gridded points	Survey data.xyz Survey data.csv	Coordinated point values
Light Detection and Ranging (Lidar)	Laser measured ranges - equipment attached to aircraft, drones or vehicles	Survey data.las Survey data.xyz	Point Cloud (high density coordinated point values)
Topographical Survey	Field survey - standard survey equipment	Survey data.tot Survey data.xml	Pre-processed digital model representing existing conditions

Table 4: Survey Formats

BENCHMARK CO-ORDINATES (WGS 84) LO 29 ▲				
CODE	Y	X	LEVEL	DESCRIPTION
TPA85	-5678.062	2995648.750	1290.624	12mm Iron Peg in Concrete
TPA86	-5378.006	2995480.191	1284.391	12mm Iron Peg in Concrete
TPA87	-5101.661	2995256.516	1278.624	12mm Iron Peg in Concrete

Figure 15: Table Showing Benchmark Coordinates

SETTING OUT CO-ORDINATES (WGS 84) LO 25			
POINT	Y COORD	X COORD	ELEVATION
1	-17512.593	3001251.667	1367.676
2	-17569.334	3001271.602	1367.118
3	-17628.823	3001287.753	0.000
4	-17618.731	3001294.274	1366.738
5	-17619.837	3001295.792	1366.749
6	-17621.124	3001297.160	1366.755
7	-17622.572	3001298.357	1366.782
8	-17624.159	3001299.363	1366.801
9	-17625.859	3001300.163	1366.793
10	-17627.645	3001300.744	1366.783
11	-17629.490	3001301.098	1366.770
12	17631.365	3001301.218	1366.756
13	-17633.240	3001301.102	1366.745
14	-17635.086	3001300.754	1366.730
15	-17636.873	3001200.177	1366.716
16	-17638.575	3001299.381	1366.704
17	-17640.164	3001298.379	1366.696
18	-17641.615	3001298.379	1366.695
19	-17642.906	3001295.822	1366.691
20	-17644.016	3001294.306	136.695

Figure 16: Table Showing Setting Out Coordinates

5.8 Labelling and notes

Labelling is used to annotate drawing objects, providing clear descriptions of the design. Labels must be used in defining all construction methods, components, materials, naming conventions etc.

A label style should be created denoting text font, height and leader structure ensuring a common standard is upheld. Correct spacing of labels is important for both aesthetics and relaying information.

Notes are used to describe drawing specific content in more detail than a conventional label. Examples of content that may be provided in the drawing notes are:

- Survey details such as coordinate reference system and datum
- Construction methods
- Specifications
- Site instructions

The draughtsperson must ensure that the labelling and notes on a drawing do not overlap or obscure important information. Occasionally, annotations are placed over existing drawing objects (eg survey background), which may cause confusion and impact the aesthetics of the drawing. The use of background text masks or a white/grey hatching underneath the text provides a neater appearance to the drawing as shown in **Figure 17**.

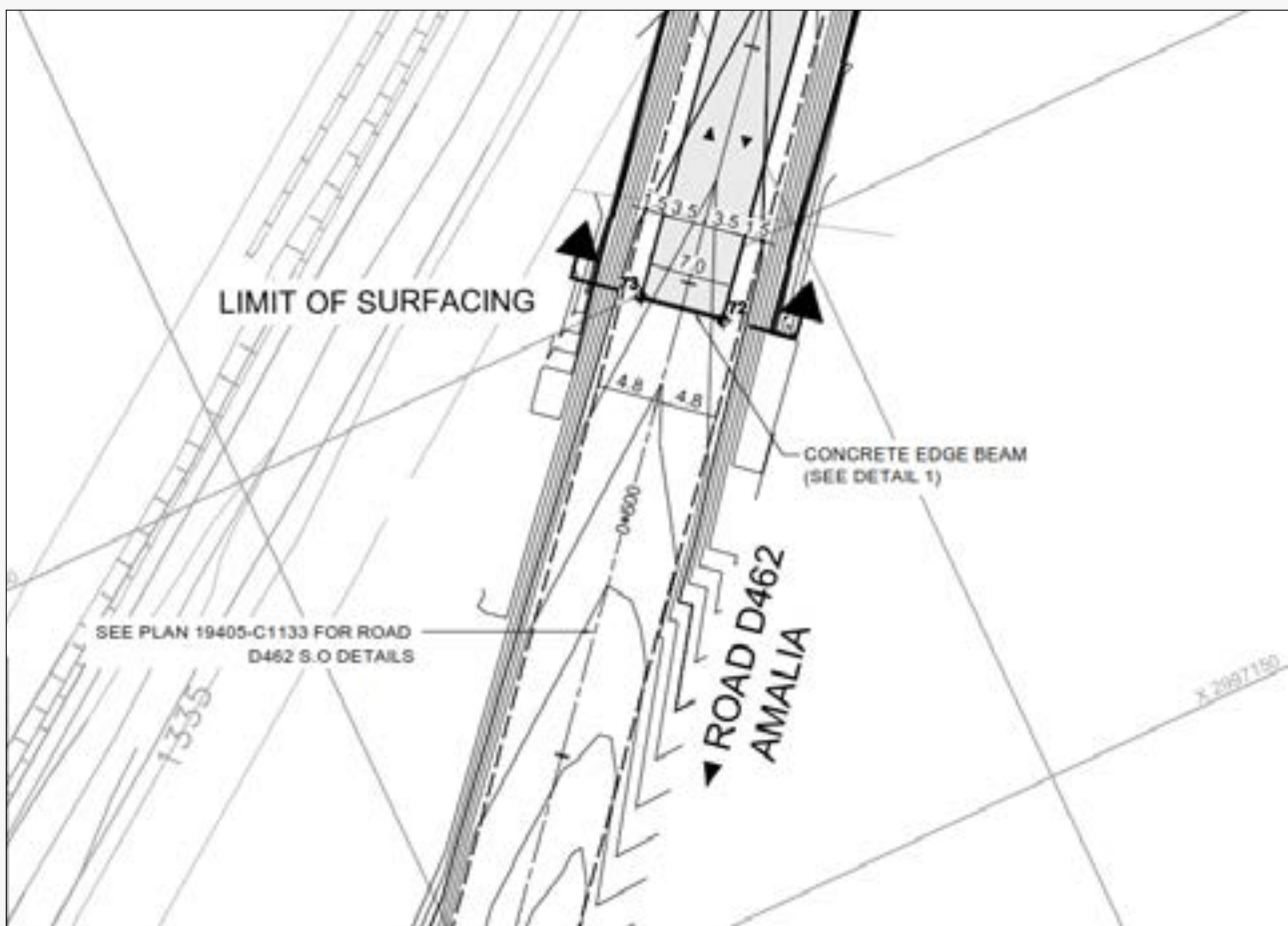


Figure 17: Labels and Dimensions with Background Masking

5.9 Headings

Each drawing element is to be accompanied with a descriptive heading, using 5mm text height (refer to section 3.2.2) along with the applicable scale shown beneath the heading. References to specific views or drawings can be included in the heading (See Figure 18).

5.10 Linetype and line weight conventions

Linetype conventions can be used as a method to distinguish between contrasting elements such as water, sewer and electrical lines, and define hidden objects or centrelines. All line types should be shown in a legend if used to denote a specific component. Figure 20 and 21 show examples of linetypes and their applications.

Layers saved in drawing templates must be used in standardising linetype naming and appearance. Generic legends should be created with the purpose of being utilised on further projects.

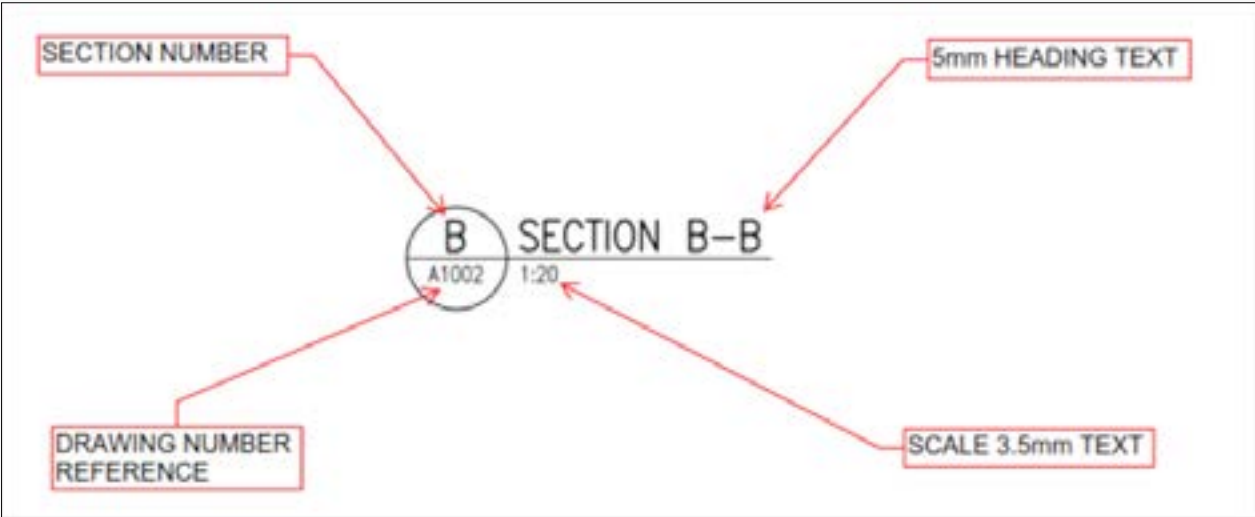


Figure 18: Heading Text and Text Size

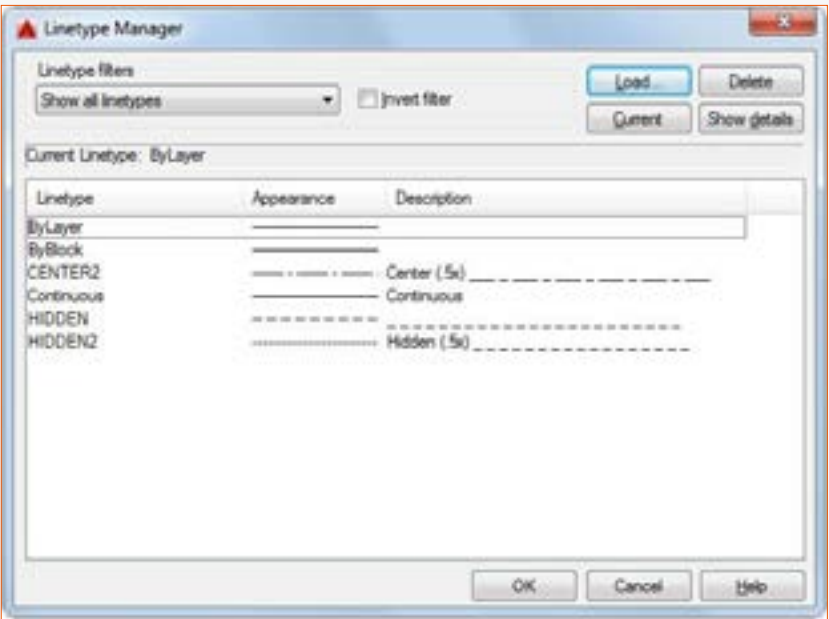


Figure 19: AutoCAD Linetype Manager

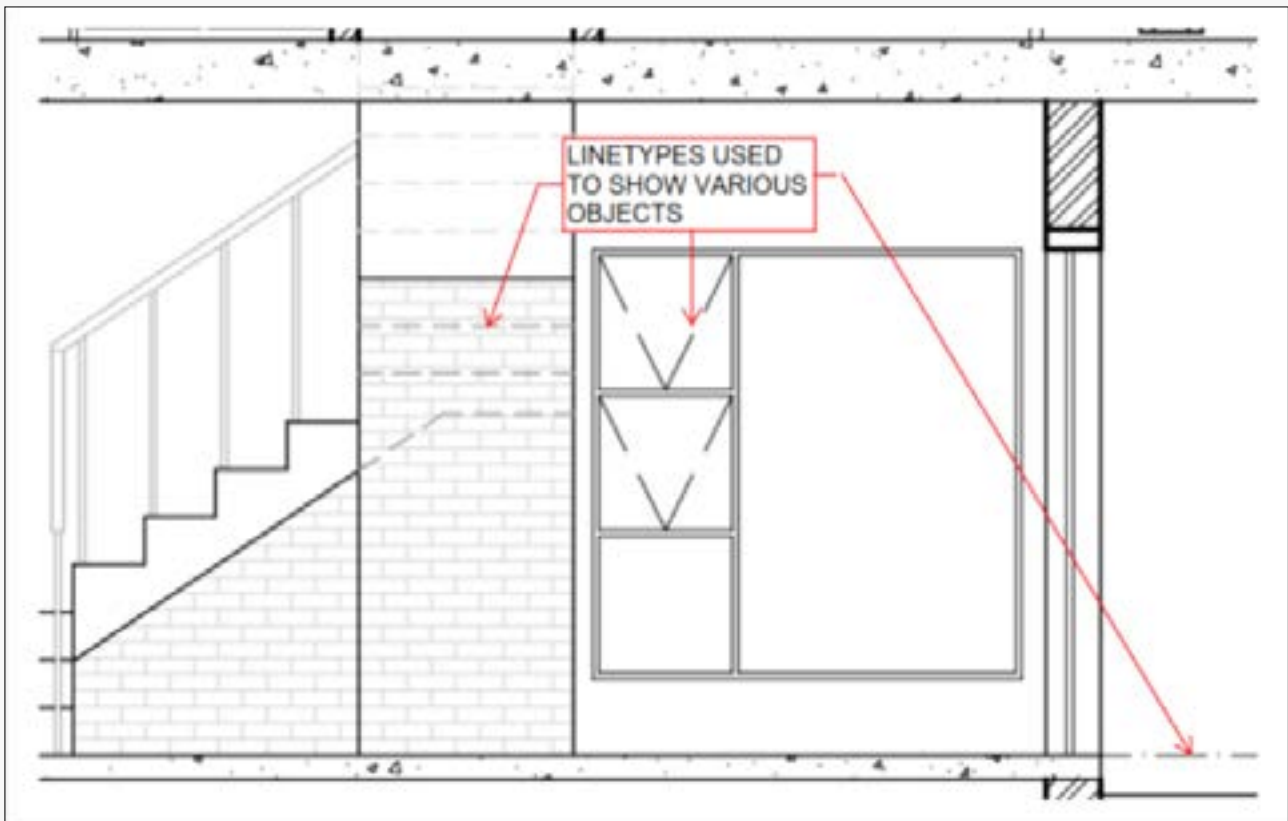


Figure 20: Use of Linetypes in Building Drawing

Line weights are useful in highlighting various elements within a drawing object with the purpose of making specific information stand out. For example, thicker lines should be used to show new work, while thinner lines or even grey-scales can be used to show existing objects.

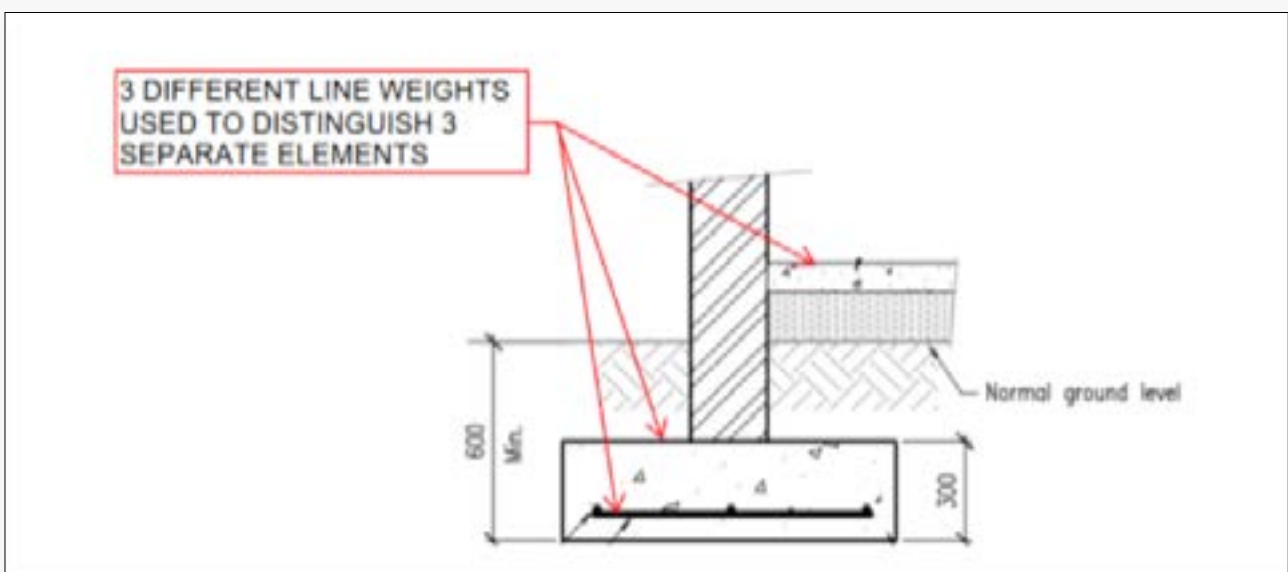


Figure 21: Use of Line-weights in a Drawing

E-ELEC-LIGHTMST				12	Continuous	0.25 mm	Color_12		Elec: Lightmasts and poles
E-ELEC-MH				12	Continuous	0.25 mm	Color_12		Elec: Manholes and boxes
E-ELEC-MST				12	Continuous	Default	Color_12		Elec: Elec masts, poles
E-ELEC-SLEEVES				12	DASH TRIPLE-DOT	0.50 mm	Color_12		Elec: Sleeves
E-ELEC-SLEEVES-TXT				blue	Continuous	Default	Color_5		Elec: Sleeves text and annotation
E-TEL-CL				142	TEL_LINE WSP	0.25 mm	Color_142		Elec: Telkom centerlines
E-TEL-MH				142	Continuous	0.25 mm	Color_142		Elec: Telkom manholes and boxes
E-TEL-MST				142	Continuous	0.25 mm	Color_142		Elec: Telkom masts, poles
E-TSIGNAL-MISC				82	HIDDEN	Default	Color_82		Elec: Traffic signal controllers and misc
E-TSIGNAL-MST				82	Continuous	Default	Color_82		Elec: Traffic signal masts - relocated or new
E-TSIGNAL-SLEEVES				82	HIDDEN	Default	Color_82		Elec: Traffic signal sleeves
E-TSIGNAL-TXT				white	HIDDEN	Default	Color_7		Elec: Traffic signal text, dims

Figure 22: Layer Style Convention

5.11 Layer management

Layers are used to define the appearance, naming conventions, colour, linetype and thickness and identity of objects in a CAD drawing. When sharing drawings, layers enable the draughtsperson to identify objects thus avoiding confusion as to what is being portrayed.

Predefined layers must be created and saved within a drawing template.

This should be done prior to beginning with a drawing. Linetypes, line weights and colours should be defined according to the appropriate layer.

Figure 22 illustrates an example of predefined layers and their style attributes. The layers should be named as to clearly define what object will be found on a particular layer style.

Correct layer management is essential in multidisciplinary projects where file sharing is common. If missing, project teams will need to identify what a drawing is depicting when received from an outside source.

A layer management style enables clear identification of drawing objects as well as standardising the appearance of drawings.

5.12 Furniture and equipment presentation

When producing an architectural floor plan, it is important to remember the purpose of such drawings and hence the required information to be shown. The floor plans are diagrams showing the relationships between rooms, spaces and other physical features at one level of a structure. They are prepared by the architect and used by all other disciplines as main background layer to develop their different systems' design.

In addition to the dimensioning which should be applied where applicable on all of the drawings compositions, floor plans particularly and sections drawings in general should include furniture and equipment representation elements.

The guidelines for including furniture on the drawings are:

- Accurately scaled
- Suitable lineweight, usually fainter than the walls for better visualization
- Emphasis on using blocks for the representation of these items
- Well positioned and oriented, taking into consideration the comfort utilization space, circulation space as well as the required clearances between the piece of furniture or equipment with the adjacent walls and fixtures.

Figure 23 shows good and poor practices of this.

Note that if there is a significant and complex floor plan such as for an operating theatre in a hospital a separate furniture and equipment plan may be needed at a larger scale commonly 1:50 rather than 1:100.

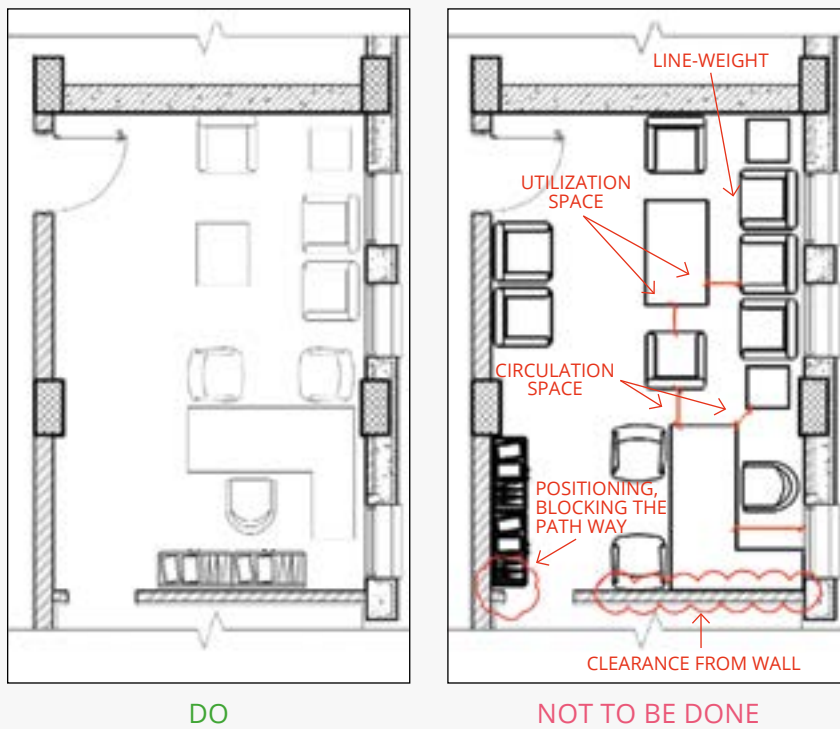


Figure 23: Good and poor furnishing practices

These sheets should also include details of fixtures like sinks, water heaters, furnaces, and other fixed equipment. Their representation may be stronger than furniture depending on the type of equipment. Where it is "plug + play" such as photocopiers, microwave ovens, gym equipment then it may be the same as for furniture. However, if it is fixed in place, such as sinks, stoves, hot water cylinders, X-ray equipment, air conditioning consoles then it is commonly shown at a stronger lineweight.

The guidelines for including equipment on the drawings are:

Accurately scaled

Emphasis on using blocks for the representation of these items

Well positioned and oriented, taking into consideration the utilization and service spaces requirements. This is particularly important to ensure the equipment is properly accessible and functional reducing the need for on site changes during construction.

Note that these become critical issues when dealing with services installations of elements such as water pumps, balance tanks, switchboards, transformers and any representation on architectural drawings should be discussed and agreed with services design engineers.

Figure 24 identifies some of these issues and their implications if incorrectly drawn.

ADD DIAGRAM SHOWING ISSUES
ELLIAN will send it

Figure 24:

5.13 Site plans and roads presentation

Features on the drawings sheets for site plans and roads are very important, and showing these features is often neglected by the draftsman.

Most construction and building projects include site plans which are equipped with some traffic and roads designs.

In addition to all the information and sheets required for the roads projects which are described in Annex 1, the following information should be considered on the drawings sheets for inclusion.

5.13.1 Swept Path Analysis

Swept Path is a term that is frequently used in combination with vehicles calculating the swept path of a specific vehicle.

Swept Path is defined as the: envelope swept out by the sides of the vehicle body, or any other part of the structure of the vehicle during the turning motion of the vehicle.

There is special software which calculates and draws this swept path, the most common ones are Transoft AutoTURN® and multiples of BENTLEY® products. A typical service vehicle assessment is shown in **Figure 25**.

This is particularly important on tight parking areas for service vehicle access, fire engine access into confined site areas or truck/trailer combinations for warehouse, transport depot or crossing point movement.



Figure 25: Swept path analysis is not only valid for traffic design and junctions, but even for small site vehicle manoeuvring

5.13.2 Roadway Markings and Sign Placement

Road markings and traffic signs are used as a means of controlling and guiding traffic. They are highly important on urban roads and intersections as they promote road safety and bring out smooth and harmonious flow of traffic along guided paths of travel.

Road surface markings are the devices on a road surface in order to convey official information. Road surface markings are used on paved roadways to provide guidance and information to drivers and pedestrians. Uniformity and standardization of the markings is an important factor in minimizing confusion and uncertainty about their meaning.

The main functions of the road markings and traffic signals are to guide the safe and smooth flow of traffic in the following ways:

- Segregation of traffic
- Stop and go
- Give way instruction
- Overtaking or not
- Two lanes to one lane/ lane traffic
- Inter-vehicle distance
- Parking zone or no parking
- Speed indication
- Direction
- One way
- Pedestrian crossing
- Type of vehicles allowed

These features should be shown on the output drawings sheets for the roads and bridges projects and where applicable in other projects. In some situations it is helpful to have dedicated sheets for road signage so it improves clarity of information as shown in **Figure 26**.

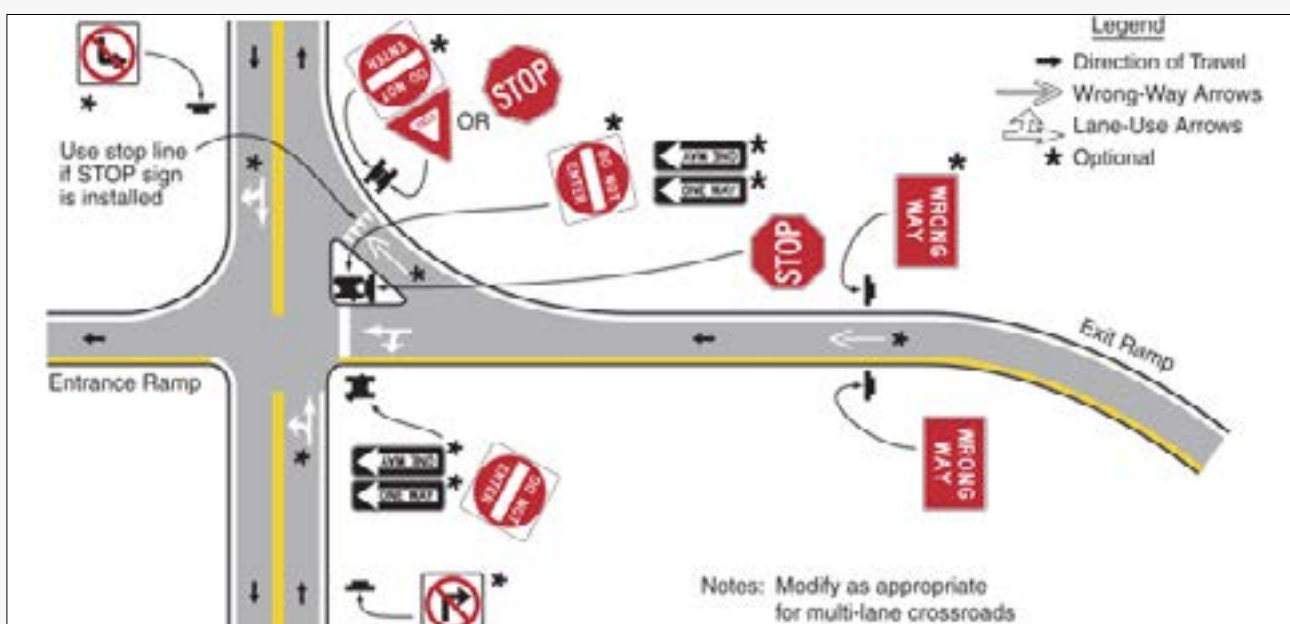


Figure 26: Road Marking and Traffic Signs placement layout plan



Figure 27: Site-Finishes and Landscaping Layout Plan Example

5.13.3 Site-Finishes and Landscaping

Site finishes are important information to be visualized on the drawings sheets. Usually "Hatching" is being used to represent different finishing materials for the different surfaces including the roadway pavement, curbs, gutters, gabions, street shoulders, walkways, landscaping and flowerbeds.

The landscape is also an important element. It should be considered in all planning, design, construction projects, and therefore shown on the drawings sheets.

Usually, this information is not shown on the general roads and bridges layout plans, but they are presented on a separate set of drawing sheets for clarity.

Colour can be useful to define the various elements as shown in **Figure 27** but symbols with either number or alphabetical references are useful for non-colour drawings.

6 File Management and Sharing

6.1 File management

In principle; File management describes the fundamental methods for naming, storing, handling and sharing files. This requires appropriate file and folder naming strategies, along with good metadata practice and software.

All UNOPS projects must have a "Project Folder" that can accommodate all project related files, taking into consideration the variety of versions:

- Raw data Files (As received)
- Working Data Files (in process)
- Finished Data Files
- Revisions
- Archive and Backup

This guidance will concentrate on methods that uses a "Master File" of data which contains most if not all of the information required, then sheet related information can be shown on separated sheets extracted (linked) from the Master File.

6.1.1 External Reference Files (XREFs)

External References (XREF) are one of the most important concepts to understand in a CAD environment. The idea is simple enough: "link one file to another so that any changes made to the source file, will show up in the destination file as well".

The use of Xrefs is very useful, even in small projects that contain one floor. It's common to reference the existing conditions plan into the site plan so the draftsman can draw the proposed site features on top of the surveyed items.

Once that's complete, it is possible to can reference the site plan into the utility plan so that the storm sewer could be tied to the new design and the existing pipes because the reference will display both plans.

In the architectural field, floor plans are commonly referenced into other plans such as HVAC and reflected ceiling plans, so that any changes made to the floor plan are immediately displayed in those plans, making it easier to adjust designs. In all industries, title blocks and other common drawing information are regularly drawn separately and referenced into every drawing in the plan set to make for simple, single point modifications to elements common to every plan.

Using the Xrefs can be useful in many ways:

- Reduces host file size.
- Automatic update of Xref data on re-load of host file.
- Allows subdivision of work, and enhance effective information and file sharing between all disciplines during the design process
- One Xref file may service several host files.
- Reduces duplication of drawing.
- Reduce repeated works

Usually, the XREFs are developed by the architect, and then used as background information for the other disciplines. Thus, in construction projects the architect has the main role of developing, updating and maintain the XREFs depending on the evolving needs by the design development from all disciplines.

The project folder must take into consideration accessibility requirements for XREF files and be designed based on:

- If the project files are maintained by a server or on separate desktops
- If the disciplines of the design are located relatively within the same space or if some design disciplines are provided remotely.

6.2 PDF – Read only printed format

All completed drawings are to be printed to pdf file format and saved as a read only copy of the working drawing. Pdf file formats are widely supported and therefore a sustainable method of file sharing as well as version control.

6.3 Common exchange formats

File sharing is commonplace during a project lifecycle. Compatibility issues arise due to the various CAD software packages in use. A dxf format file is a widely accepted exchange format between software platforms.

Care should be taken to check that the transferred file is correct with little or non-graphic data corruption with issues such as missing data, different linetypes, scale issues. In the transfer: it is preferable to send a pdf, as per 6.2, as a copy to confirm the original drawing content.

6.4 Drawing naming and numbering

6.4.1 Drawing naming conventions

It is fundamental for effective drawing and file management to develop and maintain naming conventions. As UNOPS projects are wide ranging in scope and sophistication: it is not possible to define a "one size fits all" framework for global use.

There are specific elements that should be common to all drawings produced for a project and used within a Country Office. This enables handover of projects between PMs, common file storage, naming and numbering protocols to be used.

The simplest form of drawing naming should still consider the following elements:

This is suitable for nominally 60% of the drawings produced for and by UNOPS offices.

Project No.	Discipline	Number	Revision
08027	AR	001	01

The elements consist of:

Project No.

The Project number from "oneUNOPS"

Discipline

A shorthand code abbreviation for common discipline types defining the subject matter:

GE	General
AR	Architectural
ST	Structural
ME	Mechanical

Number

Three or Four characters defining the sequence of drawings. These are generally in reserved sequences to make it simpler to add drawings to specific disciplines rather than a simple ascending order for all drawings. A typical example for a building building document set may include:

000-009 Cover sheet, Notes, General

010-099 Site Plans, Surveys

100-199 Architectural Floor plans, elevations, sections

200-299 Architectural details

300-399 Structural drawings and details

400-499 Mechanical drawings and details

500-599 Electrical drawings and details

600-699 Hydraulic (sanitary plumbing) drawings and details

700-799 Spare, for other disciplines if needed

Revision

This is needed to track changes to the drawing during its development. A common approach is to use alphabetical sequence prior to issue in the ITB and a numerical sequence starting with '00' from the ITB version.

More complex naming conventions may be required for sophisticated projects and those with hundreds of drawings to develop, manage and file. These elements may include:

Project No.	Phase No	Stage	Discipline	Subject	Number	Revision
08027	00	PR	AR	GL	001	01

An explanation of this is included in Annex 8.2

The necessity for planning and submitting a draft list of drawings is important in defining the project scope and in clarifying the approach as to what is required of the drawing team. Allowances within the file name management and subsequent drawing list must be made for possible unforeseen scope changes.

6.4.2 XREF Naming conventions

An effective file naming strategy should be applied on both the XREFs and the Drawings Sheets.

The XREF name should be descriptive containing the information about the content and their stage. Also, it MUST contain the word "XREF" within it at the start of the sequence to simplify finding and using the XREF drawings. Note that generally there are only a small number of XREFs in use, which means the naming convention can be more descriptive than the normal drawing naming.

The following are examples of XREFs names for a multistorey building:

XREF NAME	DESCRIPTION
XREF_AS-BUILT_L1	Master File (XREF) for the As-Built Level 1
XREF_AS-BUILT_L2	Master File (XREF) for the As-Built Level 2
XREF_SITESURVEY	Master File (XREF) for the site survey
XREF_PROPOSED_L3	Master File (XREF) for the proposed Works on Level 3

6.4.3 REVISIONS

All drawing revisions are recorded within the drawing title block and the drawing revision number will be updated accordingly (refer to section 6.4.1).

Any time a drawing is officially issued to or from UNOPS a drawing and revision number is required. A file will remain original with ongoing modification or development until an issue is required. At that point the issue should be recorded. The reason for all drawing revisions is noted within the title block by means of short but clear description along with the date of the revision.

All issued drawings should have a pdf copy saved alongside the CAD file. It is important for file management that when the drawing is to be revised, a copy of the file is copied and pasted into a Superseded folder. The corresponding pdf copy will be moved into the superseded folder at the same time with only the latest revision CAD file and pdf copy available in the master folder.

6.5 Drawing review

Engineering drawings are ultimately issued for construction purposes. For this reason, all drawings must be checked and approved prior to issuing as a quality check. The initials and surname of the person responsible for checking, as well as the person approving the drawing, must appear on all issued drawings. Title blocks must accommodate space for the recording and approving of drawings.

This internal review by the team developing drawings is NOT the same as the mandated Design Review process in UNOPS. It should be a thorough review of all aspects of the design and documentation, including file and drawing naming/numbering, to ensure that the documents are suitable for issue. If they are not, further revisions may be required.

7 Drawing composition in AutoCAD environment

7.1 Units and scales

Among the most important concepts that draftspersons need to get to grips with are those of drawing scale and drawing units. A sensible drawing cannot be created with AutoCAD until the scale, units and the related commands are set.

Units and drafting scales represents the attributes of the drawing's geometrics in relation to the real world. Units and drafting scales are always linked to each other and the determination of one dimension of them without the other is meaningless.

When drafting at 1:1 scale with the drawing's units set to meters, this means that each unit on the drawings model-space represents one meter on the real world.

7.1.1 Drawing's Units

Drawings units should be set before the creation of the drawing. However, modifying or changing the units can be done while drafting process, but it is important to pay attention to the changes in the geometry as well as the dimensioning, annotations, annotations scales and pre-set plotting scales after performing this command. When changing the drawing units, the draftsperson has the option to specify whether existing objects in the drawing are scaled to the new units or retain their original size. They can also specify whether objects inserted from a drawing that uses different units are scaled to the units in the current drawing, or retain their original size.

7.1.2 Drafting Scale

As a general rule, everything drawn with AutoCAD will be drawn full size. When starting a drawing with AutoCAD; contrary to the common understanding of drafting using a drawing board, draftspersons do not have to decide upon a drawing scale upfront as this is controlled with multiple other features of AutoCAD.

In AutoCAD; the scaling of the drawing takes place at the printing stage, or at other pre-set methods "on the layout" level of the drawing.

This has particular advantages because it is then possible to measure lengths, areas and volumes within an AutoCAD drawing and not need to compensate for any scale factor.

The other features that would be considered and based on the drawing scale are the presentation features for these drawings, such as:

- All Annotations
- Dimensioning
- Headings and Labels
- Text
- Linetype
- Tagging scale
- Hatching scale

Most of these features with their different scaling cases are available on a pre-set AutoCAD Template to be provided.

7.1.3 Annotation Scale

Annotation objects include dimensions, notes, and other types of explanatory symbols or objects commonly used to add information to a drawing.

Annotation objects provide information about a feature, such as the length of a wall, the diameter of a fastener, or a detail callout.

AutoCAD had the feature of creating annotative objects, where Annotation scale is used to determine text height or the overall scale of an annotation object. The approach used to calculate an annotation scale depends on whether the object is placed in model space or on a layout.

Typically, annotation objects are scaled differently than the views of the drawing, and depend on the scale of how they should appear when plotted.

The pre-set AutoCAD Template include pre-set by scale annotation features.

Each plot scale would have its dedicated annotations created to be used solely for this plotting scale. The following examples in **Figure 28** show annotations with their different scale impacts on the model space.

ANNOTATION	MODEL SPACE ANNOTATION SCALE	APPEARANCE ON MODEL SPACE	PLOT OUTPUT
Text	1:100	Office Room	Office Room
	1:250	Office Room	Office Room
	1:50	Office Room	Office Room
	1:20	Office Room	Office Room
Door Tag	1:100	D3	D3
	1:50	D3	D3
	1:20	D3	D3
Dimension Line	1:100	150	150
	1:250	150	150
	1:20	150	150
Section Label	1:100	A A-15	A A-15
	1:50	A A-15	A A-15
	1:20	A A-15	A A-15

Figure 28: Annotation Scales appearances on the model space and the plot output based on the plotting scale

7.2 Layers

Layers are similar to transparent overlays, basically they are the computer equivalent of tracing overlays on a drawing board. Draftperson can create as many layers as needed. The layers can be used to control the colour, line type, line weight and plot style for the geometry (amongst other things) as well as the visibility of all of the geometry on that layer.

This level of control is useful for organizing the objects in the drawing on layers that are associated with a specific function or purpose. A very simple example is shown in **Figure 29** for layers in a simple building.

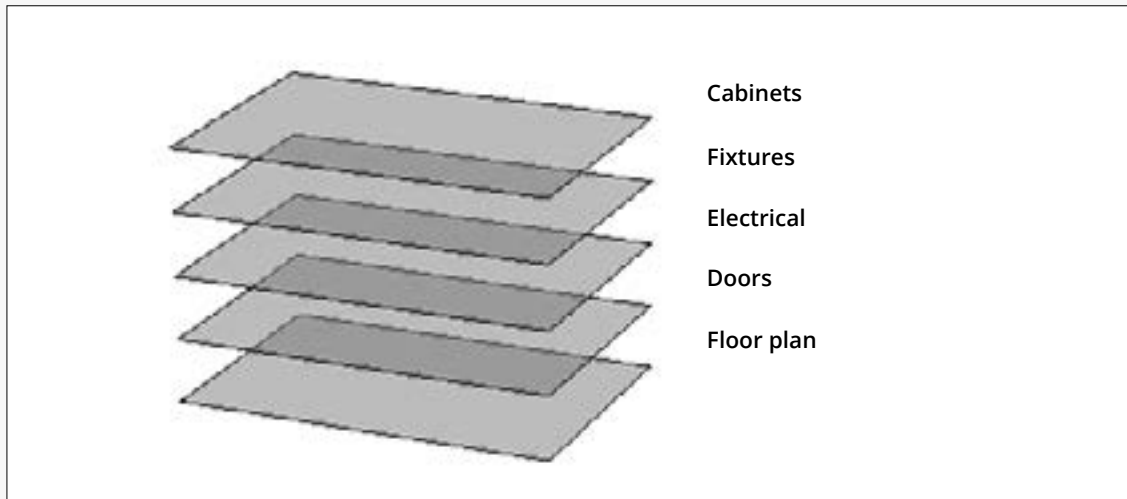


Figure 29: Visual illustration of the layers concept in AutoCAD

7.2.1 The use of layers

Layers are a very important component of working with AutoCAD. They control the properties and visibility of the objects. Since layers organize the drawings, using layers inefficiently is a time waster and negatively effects the productivity.

When a drawing becomes visually complex, layer controls can hide the objects that currently do not need to be seen.

Layers has the capabilities of:

- Associate objects by their function or location
- Display or hide all related objects in a single operation
- Enforce linetype, colour, and other property standards for each layer
- Important: DO NOT create everything on one layer. Layers are the most important organizing feature available in AutoCAD drawings.
- Layer 0 is the default layer that exists in all drawings and has some esoteric properties. Instead of using this layer, it's best to create your own layers with meaningful names.
- Any drawing that contains at least one dimension object automatically includes a reserved layer named Defpoints.
- Create a layer for behind-the-scenes construction geometry, reference geometry, and notes that usually do not need to be seen or printed.

7.2.2 Layers Settings

A well-managed drawing, especially by layers is a drawing that is easy to use, modify and deal with. Using the layers correctly allows the draftsman to use layers setting effectively. These layers' settings are used for:

- Enabling multi discipline works on the drawing efficiently
- Simplifying the selection process
- Facilitating the modifying and editing processes
- Creating multi drawings sheets from one Master file drawing

The following are the most commonly used layer settings in the Layer Properties Manager. By clicking the icon, drafter can turn the setting on and off.

- Turn off layers. Drafter turn off layers to reduce the visual complexity of the drawing while working.
- Freeze layers. Drafter can freeze layers that do not need to be accessed for a while. Freezing layers is similar to turning them off, but improves performance in very large drawings.
- Lock layers. Lock layers are used when drafter wants to prevent accidental changes to the objects on those layers. Also, the objects on locked layers appear faded, which helps reduce the visual complexity of the drawing.
- Layer Isolate. All layers except the layers of the selected objects are either turned off, frozen in the current layout viewport, or locked, depending on the current setting. The layers that remain visible and unlocked are called isolated.

7.2.3 Layers Naming Convention

The intent of the layering system is to have an intelligent naming structure that will allow any item/object to be turned off, freeze or isolated in AutoCAD without affecting any other information on the drawing.

It is important to highlight that the drawing's elements which match with their properties, representation and purpose should be put within one unique layer.

All properties of drawing entities shall be assigned by layers and defined "BYLAYER". In AutoCAD, colours and line types are to be defined "BYLAYER". The assignment of these entities from the elements properties tabs is never to be used.

The layer name is to be a descriptive name and not a layer/level number only. All layer names are to be representative of the function or element type. However, other basic information should be seen within the layer name.

The layering system for UNOPS projects should be developed through the following guidelines. Note that the pre-set template provides multiple layers already configured for use.

- Differentiate by stage; i.e. Surveys, As-Built, Demolish and Proposed stages should appear within the layer name to represent the layers content stage status.
- Differentiate by discipline; most of the projects designs and documentations for building may include:
 - Architectural
 - Structural
 - Mechanical
 - Electrical
 - Civil; mainly for site components and site finishes that are not part of the disciplines above
 - In addition to a General discipline which its layers would accommodate all general drawings' elements and representations

However, based on the project's scope, other required disciplines might be needed; such as Medical discipline for Clinics and Hospitals. It is the responsibility of the design practitioner and the drafter to provision for these disciplines layers based on this document's guidelines.

- Differentiate by Elements Representation; such as elements that represent "External Walls" or "Doors".
- Differentiate by required Presentation, Subtopic or Importance (required Lineweight) This differentiation will be used for layers representations or subtopic that requires this level of description, this is depending on the representation topic, for example, the use of hatching or heavier outline in elevations/sections.

This can generally take the following format for use.

Stage	Discipline	Representation	Presentation
ST	D	REPRESENTATION	PRES

STAGE	Category; Two Characters, UPPERCASE referring to the stage, phase or the status of the drawing's elements. A hyphen (-) is used to separate the STAGE and the next category, the DISCIPLINE.
DISCIPLINE	Category; One Character, UPPERCASE referring to the drawing's elements Discipline. A hyphen (-) is used to separate the DISCIPLINE and the next category, the REPRESENTATION.
REPRESENTATION	Category; Multi Characters as many as required, Proper Case referring to the drawing's elements representation. If an abbreviation is well known for this representation, then it can be applied instead of the full referral. An underscore (_) is used to separate the REPRESENTATION and the next category, the PRESENTATION.
PRESENTATION	Category; Maximum of Six Characters, Proper Case referring to the drawing's elements presentation, subtopic or an integer for the Lineweight value.

Examples:

STAGE	DISCIPLINE	REPRES.	PRES.	RESULTED LAYER NAME	LAYER DESCRIPTION
As-Built	Architectural	Windows Sill	N/A	AB-A-Windows Sill	Representing the existing windows Sills
As-Built	Mechanical	Sanitary	Fixtures	AB-M-Sanitay_Fixt	Representing the existing sanitary Fixtures
As-Built	Structural	Sheer Wall	N/A	AB-S-Sheer Wall	Representing the existing Sheer Walls
As-Built	Electrical	Distribution Board	Main	AB-E-DB_Main	Representing the existing main distribution boards
DeMolish	Architectural	Internal Partition	Hatch	DM-A- Int. Part._ Hatch	Representing the hatch of the internal partitioning to be demolished
DeMolish	Mechanical	HVAC	Piping	DM-M-HVAC_Piping	Representing the HVAC piping to be dismantled
PRoposed	Architectural	Doors	N/A	PR-A-Doors	Representing the proposed doors
PRoposed	Architectural	Elevation	35	PR-A-Elevation_35	Representing proposed Elevations' features which would have a lineweight of 35
PRoposed	Mechanical	Fire Fighting	Equipment	PR-M-FF_Equip.	Representing proposed firefighting equipment
PRoposed	Electrical	Lighting	Fixtures	PR-E-Lighting_Fixt.	Representing proposed lighting fixtures

7.3 Hatching:

The use of one layer that would accommodate all hatches is not a good practice from a drawing management point of view. Instead hatches must be drawn within dedicated layers where each represent the hatching subject, for example the hatching for the external walls should not be the same layer as for floor finishes. The naming conventions should comply with **section 7.2**.

7.3.1 Hatching Style

Each material to be used in the drawing should have its own unique hatching pattern. It is important to highlight that the hatching per material might vary depending on the view of the drawing containing the hatch, such as Plan view, Section or Elevation. The hatching patterns must consider this issue.

The pre-set AutoCAD Template includes the common materials only with their associated hatching patterns. For others that may be needed the following consideration should be adopted:

- Use within the respective layer
- Do not duplicate hatches for multiple different materials to avoid confusion.
- Use colors by layers, and the associated color by hatch colors should be printed in a faded shape compering to the hatching boundary elements.
- Linetype by layer, and the use of an appropriate linetype for the hatch.
- Possibility to used custom created patterns other than the ones available in the AutoCAD default patterns.

All used materials hatch patterns should be clear, easy to understand, represented and explained within the respective legends.

The following example in **Figure 30** defines some of the Hatching patterns within the pre-set AutoCAD Template:


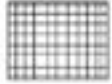







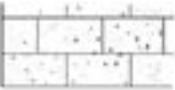

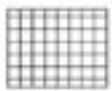

Material	Plan	Elevation	Section
Batt insulation		None	Same as plan
Rigid insulation		None	Same as plan
Glass			Small scale  Large scale 
Concrete			Same as plan view
Concrete block			Same as plan view
Earth	None	None	
Floor tile		None	

Figure 30: Common materials hatching patterns

7.3.2 Hatching Scale

It is important while performing the hatching to pay attention to the output scale for the drawings. **Section 7.1.2** refers that all drawing elements to be drawn at full size, however, this is applied on the drawing elements and not the presentation feature.

The concept is to allow for visually accepted hatching on the output depending on the printing scale, and not to have either too dense or too large hatching on the finished drawing. If it is too dense it can dominate the drawing, if it is too large it becomes meaningless and can cause confusion.

Note that if too much hatching is applied, this can have a significant impact on file size and make the finished drawing harder to read and understand. The draftsperson should use hatching carefully with a good sense of its suitability and impact on the drawing.

7.4 Paperspace and Layouts

AutoCAD presents two modes of drawing, also called "SPACE." The normal mode and the default is called "Model Space." This is the space being used almost all of the time. It is the normal 3D world in which all of the design elements are drawn, both in 2-dimensions (plans, elevations, sections) and in 3-dimensions (perspectives or axonometric). In this space, objects should always be drawn in real world units, full size.

The other mode of drawing or space is called "Paper Space." This space permits only a 2-dimensional world, and can be visualized as a flat sheet of paper. Paper Space is a mode in which draftsperson can group various "views" of a 3-dimensional drawing in "holes" on the paper called "viewports" for plotting. It is useful for plotting several views of an object at different scales, or for putting orthogonal drawing titles on a perspective or axonometric drawing.

7.4.1 Viewports

A "Viewport" is a rectangular area or hole in the paper through which the draftsperson can view the "Model." There is no limit to the number of viewports in the drawing. Viewports can be copied, moved, erased, and stretched to give the right appearance. The most important feature is the ZOOM FACTORS which can be scaled to reflect the plotting scale of the view port.

As the general rule in **section 7** notes objects to be drawn at their actual size these are in the model space, and all sheets are created for plotting in the paperspace with the desired viewports scale

There is no other method in AutoCAD of combining drawings of different scales on the same sheet of paper, without changing the actual size of the objects or plotting each detail separately.

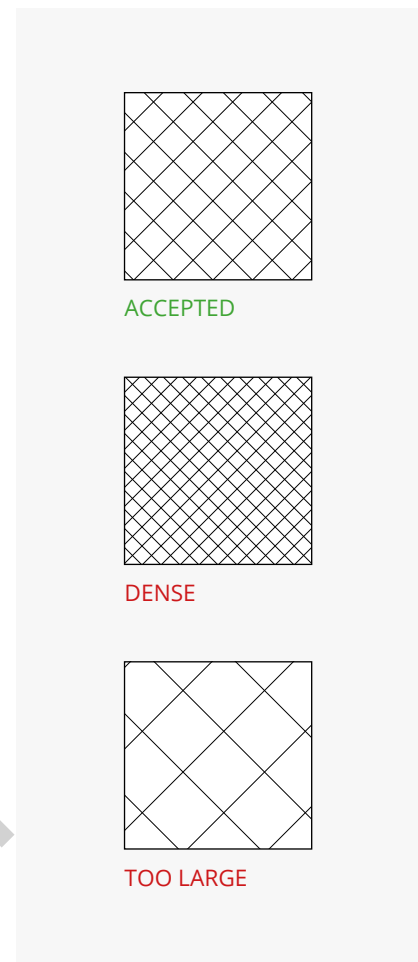


Figure 31: Hatching Scales plot output

7.4.2 Paperspace (Layout) Contents

The following is a list of entities which are typically drawn in Paper Space where they are either created or inserted on distinct layers for each group:

- Viewports
- Sheet border or Frame; a pre-set XREF drawing attached on the paperspace model for the frame
- Titles Block, pre-set attributes used on the paperspace model
- Legends within the frame could be inserted either as a viewport if they are custom to this specific sheet (to be drawn/created then on the model space), or if they are general ones they could be included either as a part of the frame XREF file, or as a separate XREF, this is dependent on the relevance of the legend for all of the sheets
- Revision "clouds", revision numbers and revision text

Although individual drawing's titles, scales, headings, labels and North Arrows could be drawn on paperspace this is NOT a preferred practice as all features and annotations should be drawn on the model space.

It is important to pay attention that the linetype scale should match the one at the model space, as paperspace limits and scales are by default different from the model space, the linetype scales would appear as per the paperspace setup.

7.4.3 Frame XREF

The pre-set AutoCAD templates contains 10 frame drawings based on two aspects:

- Size; A4, A3, A2, A1 and A0
- Orientation; Portrait and Landscape

However, the frame block contents are the standard ones within frame drawings, which are editable on the XREF file level so it can be used by all projects as shown in **Figure 32**.

Any other specific fields required by the projects that were not covered within the pre-set templates might be added or modified on the XREF file by the draftsman.

7.4.4 Titles Block Attribute

The titles block contains a pre-set attributes specific for the sheet, which are editable and to be changed based on the sheet's content.

The titles block within the pre-set AutoCAD templates are based on this guidance as shown in **Figure 33**.

Notes Area

Legend Area

Revisions

Project Name & Phase

Client / Beneficiary

Donor

Implementer & Designer

Titles Block Area

FOR STAGING ONLY

Revision	Date	Description	Author
1		EXTERNAL WALL (YELLOW BLOCK)	
2		EXTERNAL RENOVATED (CONCRETE) WALL	
3		EXTERNAL RENOVATED (CONCRETE) COLUMN	
4		EXTERNAL RENOVATED (PAINTED) (YELLOW BLOCK)	
5		EXTERNAL EXTERNAL (PAINTED) (YELLOW BLOCK)	
6		EXTERNAL EXTERNAL (PAINTED) (YELLOW BLOCK)	
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100		EXTERNAL EXTERNAL (PAINTED) (YELLOW BLOCK)	

Figure 32: Frame XREF Content

Drawing Title:						
<h1>Architectural</h1> <h2>GF PROPOSED FURNITURE PLAN</h2>						
Project No.:	SUB No.:	Stage:	Discipline:	Subject:	Seq No.:	
825001	00	PR	AR	GL	0501	
Drawn:	Checked:	Approved:	Size:	Scale:	Date:	Rev.:
TM	MAA	AA	A2	1:100 @ A2	18/09/2017	0

Figure 33: Titles Block Attribute Content, the RED fields are the editable ones

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Annexes

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ANNEX 8.1

COMPLEX NAME CONVENTIONS

Complex or multi phase, multi disciplinary projects may require a more substantial naming and numbering protocol.

Project No.	Sub. No	Stage	Discipline	Subject	Serial No.
08027	00	PR	AR	GL	0001

All to be **UPPERCASE**

Project No. Integer string, represents the project's no. within UNOPS "oneUNOPS" Database.

Sub no. Two characters of Integer String.

The first integer would reflect the phase,

The second integer would represent the packages or buildings

Sub No values:

00 Non-Project Sub Part, only one phase and one phase

01 Project with only one phase, package or building No. 01

02 Project with only one phase, package or building No. 02, etc

21 Project phase No. 02, package or building No. 01

34 Project phase No. 03, package or building No. 04

Stage; Two Characters, referring to the design stage of the drawing.

Stage Values:

AB As-Built, only for actual situation on the site

IN Intervention

CP Concept Only

PR Proposed

TN Tendering only

CN Construction

AS As-Built, Prior Construction Copy

Discipline Two Characters, referring to the drawing's discipline.

Discipline Values:

AL All disciplines

GE General

SV Surveying

AR Architectural

CC Accessibility

SS Safety, Security & Blast Resistance

ST Structural

SM Seismic Engineering

WS Water Services (Supply and Sewers)

HY Hydraulics, Stormwater

ME Mechanical

FF Fire Fighting

EL Electrical

DT Data, Telecommunication

AQ Acoustic

PR Process Piping

AC HVAC

LD LEED®

QS Quantity Survey

MD Medical

RD Road Engineering

TR Traffic

BR Bridges

LS Landscaping

AG Archaeological

WT Waste Management

AD Administration

Subject; Two Characters, referring to the design subject of the drawing. Subjects might be used across different disciplines;

Subject Values:

General:

CV Cover Sheet, Title page

DL Drawing List

DR Drawing or Document Register

BD Border Drawing

MF Master File

SV Survey Plan

GN General Notes

TR Transmittal

Multi-Disciplinary:

PP	Site Plan, Plot Plan (Existing, New, Proposed)
EX	Excavation Layout
DD	Details (nonstandard)
TD	Typical Details (standard)
CN	Construction Details
SH	Schedules
SC	Schematics
BM	BMS System
SP	Specifications, Project Drafting Standards
BQ	Bill of quantity, or Quantities sheets
RP	Report, Calculation Report
CT	Contract
MU	Project Manual
PN	Preamble Note
PC	Procedures
TC	Tender Document/Conditions
RS	Raisers

Architectural:

GL	General Layout
MD	General Layout, Modifications Plan
DP	General Layout, Demolition or Dismantling Plan
DM	General Layout, Dimensioning
FE	General Layout, Furniture and Equipment
TG	General Layout, Tagging
FN	General Layout, Finishes
GM	General Layout mixed with Sections & Elevations
SF	Safety/Fire Escape Plan
EV	Elevations
LM	Elevations & Sections mixed
SN	Sections
WL	Schedule of Openings
FL	Schedule of Finishes
CP	Ceiling Plan
CC	Colour Scheme
PL	Planning, Program
SK	Sketch

Structural:

BH	Soil Test Bore Hole Plan
PI	Piling Plan

FP	Foundations Plan
TB	Tie Beams Plan
WC	Sheer Walls/Columns Coordinates Layout
CL	Sheer Walls/Columns Layout
FR	Framing layout, Slab Layout
SR	Stairs Details
FD	Foundations Details
CD	Columns Details
BE	Beams Details
SD	Slabs Details
ST	Stairs Framing

Mechanical & Plumbing:

DS	Drainage & Sanitary
SW	Stormwater Drainage
WT	Water Piping
IR	Irrigation Piping
FF	Fire Fighting
AV	Air conditioning & Ventilation
AC	Air conditioning only
VE	Ventilation only
EQ	Equipment Schedule

Electrical:

LT	Lighting
LP	Lightening Prevention System
ET	Earthing System
PO	Power
PM	Power for Mechanical
LV	Low Voltage
FA	Fire Alarm
CS	Access Control & Intercom System
IN	Intrusion Prevention System
TV	CCTV
PV	Public Address & Voice Alarm
DB	Distribution Boards

Roads:

SM	Simulations
VM	Pavement Construction Layout plan & Details
LI	Lining layout Plan & Details
TS	Traffic Signing Layout Plan & Details

RG	Rail guards Layout plan & Details	0801-0899	Finishes Plans
		0900	General Layout, Finishes Colouring Plans
Serial No.;	Four Characters of Integer String, referring to the sequence of drawings order.	0901-0999	Finishes Colouring Plans
These numbers are reserved by stages, discipline and subjects, and would be used as required by the project's scope. For example; if a subject wouldn't be required by the project's scope, its reserved values of serial numbers would remain and not to be used for other sheets.		1000-1099	Elevations
		1100-1199	Sections
		1200-1299	Detailed Sections
		1400-1399	Staircases Sections & Details
		1400-1499	Internal Elevations Details
		1500-1999	Spare
		2000	Details
		2000-2099	Construction Details
		2100-2199	Fabrication Details
		2300-2399	Installation Details (Factory-Made features)
		2400-2499	Site Details
		2500-2999	Spare
		3000	Structural
		3000-3099	General (List of Drawings, Typical Details, Etc.)
		3100-3199	Soil Test Bore Hole Plan
		3200-3299	Foundations and Piling
		3300-3399	Tie (Ground) Beams
		3400-3499	Sheer Walls and Columns Layout
		3500-3599	Framing layout, Slab Layout
		3600-3699	Framing Details
		3700-3799	Schedules
		3800-3899	Schematics
		3900-3999	Details Site Details
		4000	Mechanical & Plumbing
		4000-4099	General
		4100-4149	Site Mechanical Layouts
		4150-4199	Spare
		4200-4299	Drainage, Sanitary and Storm Water
		4300-4399	Water & Irrigation Piping
		4400-4499	Air conditioning & Ventilation
		4500-4599	Fire Fighting
		4600-4699	Schedules & Equipment
		4700-4799	Schematics
		4800-4899	Spare
		4900-4999	Details Site Details
Serial Number Values:			
0000	Border Drawing		
0001	Cover Sheet, Title page		
0002-0009	Drawing List		
0010-0019	General Notes, Abbreviations, Legend etc		
0020-0039	Typical Details		
0040-0049	Existing Site Plans, Surveys and Excavation		
0050-0059	New Site Plan		
0060-0069	General Arrangement		
0070-0079	Road Plan		
0080-0089	Landscape Plan		
0090-0099	Temporary Facilities, Construction Phase		
0100	General Layout, As-Built Plans, Second No. (<u>Underlined</u>), represents the As-Built subject. this concept goes for all GL drawings.		
0100-0199	As-Built Plans, third No (<u>Underlined</u>), represents the floor. Begin numbering from the lowest floor or basement, this concept goes for all GL drawings.		
0200	General Layout, Modifications Plans		
0200-0299	Modifications Plans		
0300	General Layout, Demolition or Dismantling Plans		
0301-0399	Demolition or Dismantling Plans		
0400	General Layout, Dimensioning Plans		
0401-0499	Dimensioning Plans		
0500	General Layout, Furniture & Equipment Plans		
0501-0599	Furniture & Equipment Plans		
0600	General Layout, Ceiling or Reflected Ceiling Plans		
0601-0699	Ceiling or Reflected Ceiling Plans		
0700	General Layout, Tagging		
0701-0799	Tagging Plans		
0800	General Layout, Finishes Plans		

5000 Electrical

5000-5099	General
5100-5149	Site Electrical Layouts
5150-5199	Earthing & Lightning Systems
5200-5299	Power & Power for Mechanical
5300-5399	Lighting
5400-5449	Low Voltage
5450-5499	Fire Alarm
5500-5549	Access Control & Intercom System
5550-5599	Intrusion Prevention System
5600-5649	CCTV
5650-5699	PAVA (Public Address & Voice Alarm)
5700-5799	Schedules & Equipment
5800-5899	Schematics and Distribution Boards
5900-5999	Details Site Details
6000-6999	Safety and Security
7000-7999	Spare, other disciplines
8000-0999	Spare, other disciplines

9000 Documentation

9100-9199	Sketches
9200-9299	BOQ and Quantities
9300-9399	Reports, Briefings
9400-9499	Planning, program
9500-9599	Contracts
9600-9699	Drawing or document register
9700-9799	Transmittal
9800-9899	Project drafting standards
9900-9999	Spare

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