CVNG 1009 ENGINEERING GRAPHICS

DRAFTING CONVENTIONS AND STANDARDS

1.0 Drawing Conventions

An engineering drawing must have only one interpretation. That is, all persons reading the drawing must arrive at the same understanding of what is to be built, or of what exists, given the description of the object as represented via the drawing. This means that every effort must be made to minimize possible misinterpretation, and an effective way of doing this is to use the same format for the different types of marks used for any drawing.

It was shown in previous sections that any civil engineering drafting project is comprised of the same set of elements – plans, elevations, sections, and details. However, each of these is comprised of lines describing the object, words that label the object, dimensions that describe the size of the object, and scales or sizes for each of these. Furthermore, there are other types of lines such as centerlines, break-lines, leader lines and construction lines that are useful but are not part of the object. Abbreviations and symbols are also useful for efficiently describing commonly used items, and materials respectively.

Since draftsmen may each choose different ways of drawing these lines, this may be a source of confusion for anyone other than the draftsman who is trying to read the drawing. For this reason, conventions have evolved for lettering, scales, line types, dimensioning, etc. As the drawings for practical projects are meant to be interpreted by many different kinds of professionals and others all working for different companies or organizations, at the national or regional level many of these conventions have become standards[1] developed by the standards organizations in the various countries. Therefore anyone working with the drawing is expected to be familiar with at least the most basic of these conventions or standards. In addition, companies usually also customize their drawings for their own look-and-feel as a means of expressing individuality, and for ease of recognition.

In this section, we present the most basic conventions used in civil engineering graphics.

2.0 Drafting Standards

Drafting standards are typically sets of documents that can be quite complex when examined as a whole. In practice a draftsman usually refers to a subset of these for a given job.

[1] The term “standard” is a technical term. It is a document that defines the minimum expectations regarding the item in question. A standard may be voluntary or compulsory and is frequently used to specify what is required by a client.

British

At present, the British standard for drafting is BS 8888 *Technical Product Documentation (TPD). Specification for Defining, Specifying and Graphically Representing Products*. It was prepared by the British Standards Institute (BSI) and evolved from BS 308 *Engineering Drawing Practice,* which has been recalled but is an excellent introduction to BS 8888, and is a bit more "user-friendly" for civil engineering drafting trainees.

International

ISO 128 is the drafting standard derived by the International Standards Organization. ISO 128 is a substantial collection of standards with the "128" as a prefix.

American

For civil engineering, there is no collective drafting standard per se. Each of the major organizations catering for the primary building materials, such as the American Concrete Institute (ACI), the American Institute for Steel Construction (AISC), etc, has developed ways of presenting graphical information that have become conventions or Best Practices across the United States. It is also noteworthy to mention that at least because the U.S.A is still in the process of adopting the Metric System, the U.S.A practice is not as integrated with the ISO standard, as is the British standard. Hence it is frequently the case that client organizations and municipalities specify the manner in which drawings must be submitted for projects.

Caribbean

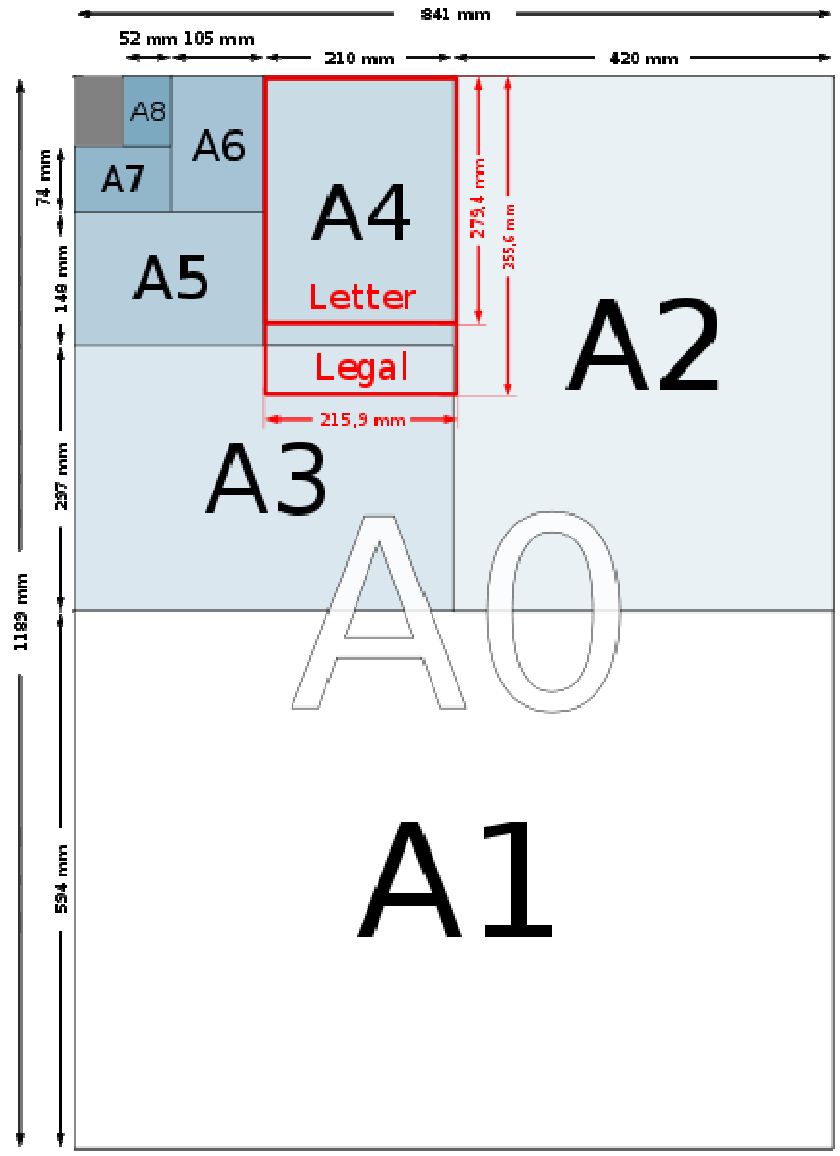
Civil engineering practice in the Caribbean has been most influenced by the British practice hence graphical communication by the British standard is most familiar. However, since it takes a while for the most recent developments to be practiced in the Caribbean, the BS 308 is much more widely known than the BS 8888. Furthermore, due to - (1) a lag in the adoption of the Metric System in the construction industry, (2) more relaxed enforcement of standards, and (3) increasing influence of U.S building codes, it is customary to have a mixture of standards or conventions employed in Caribbean drawings. This has worked well so far because the projects undertaken by regional firms are relatively small. Nevertheless, the civil engineer and construction professional are expected to know the basic set of conventions.

In this course therefore, focus is placed on the basic conventions with an emphasis on BS 308. Lastly, the impact of computer-aided drawing (CAD) has resulted in specific standards for CAD drawings and more will be said about this is subsequent sections.

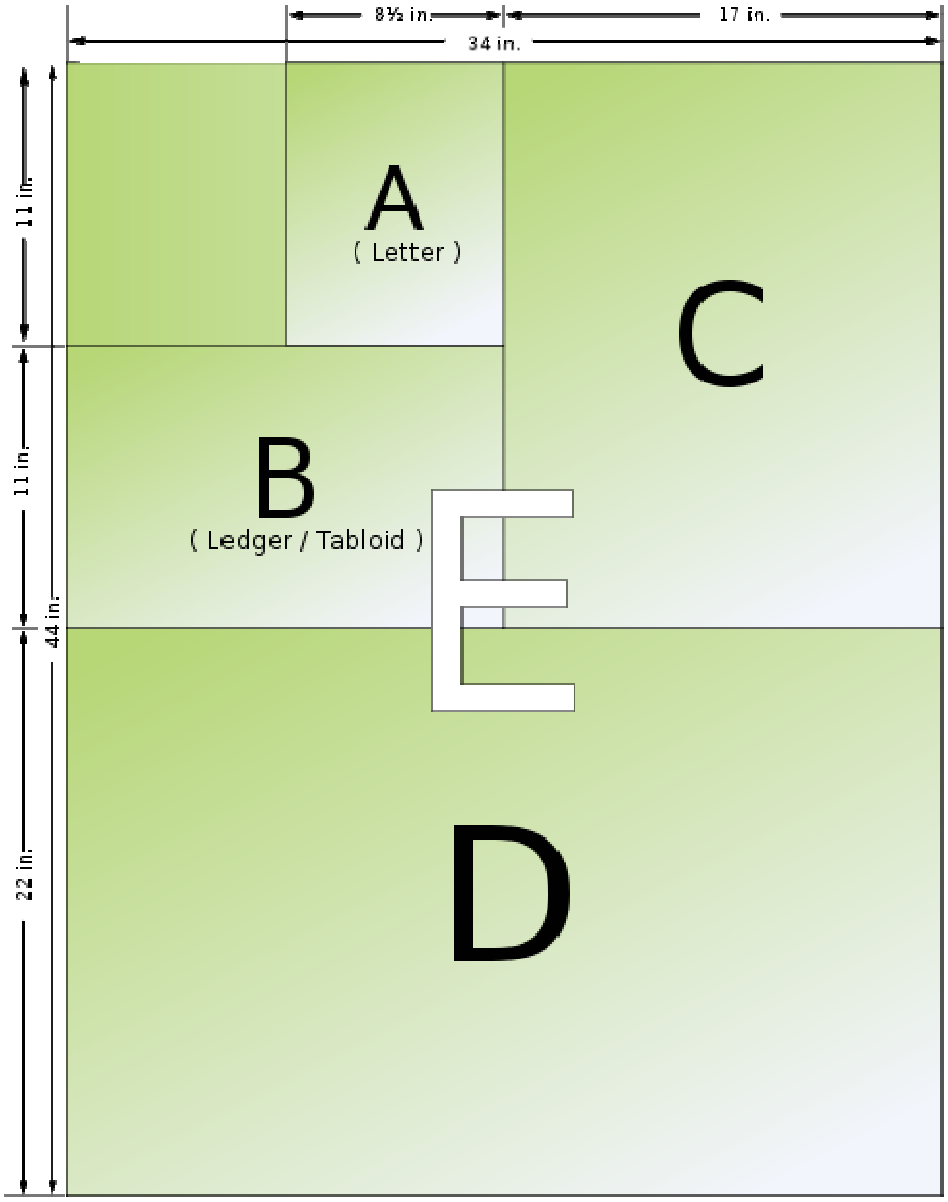
3.0 Basic Conventions

3.1 Paper Size

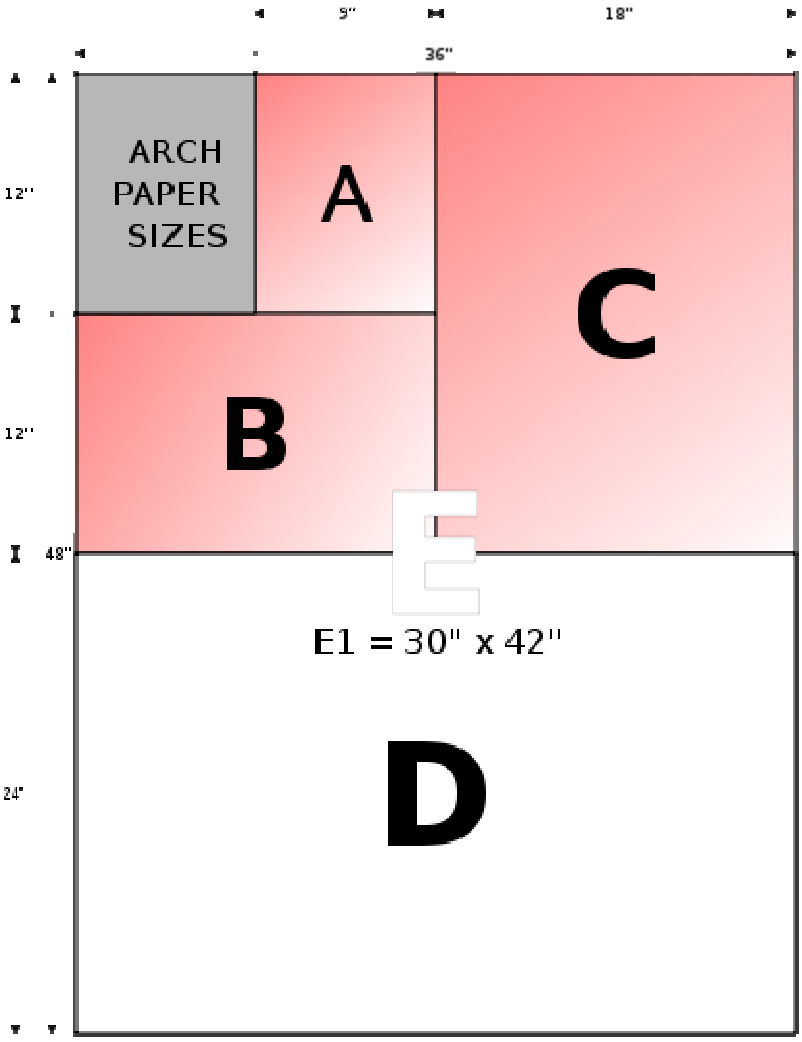
Common conventions for paper size are the ISO (ie. sizes A0, A1, etc), the American National Standards Institute, ANSI (i.e. sizes A, B, C, etc) and the American architectural (i.e. Arch A, B, etc). The significance of the paper size will become more apparent when CAD is discussed.



ISO Paper Sizes (credit User.Bromskloss)



ANSI Paper Sizes (credit User.Nakamura2828)



Arch Paper Sizes (credit Schmidt455)

Note that for the ISO paper sizes, the aspect ratio (i.e. ratio of the lengths of the sides) is always √2 or 1.414. For the ANSI paper, as it is based on the letter size paper, the aspect ratio alternates between 1.2941 and 1.5455 and back to 1.2941 as you alternate from sizes A to B to C, etc. The Arch series have aspect ratios that alternate between 3:4 and 2:3. Also, notice that for the ISO, ANSI and Arch series, the lower size can be obtained merely by folding the higher size.

ISO sheets are typically used as follows:-

SHEET	USE
A0	Arrangement drawings (plans, elevations)
A1	Details
A3	Sketches
A4	Sketches

3.2 Lettering

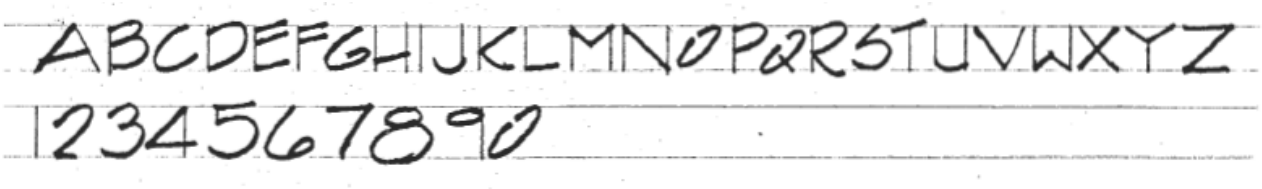
No particular style of lettering is recommended. For freehand lettering, faint guide lines should be used and not erased. The following letter sizes are recommended.

SIZE (I.E. HEIGHT)	USE
2.5mm	Notes
3.2mm	Special notes
6.3mm	Titles

Only drawing titles should be underlined, unless where special emphasis is required.

The art of printing should be adopted and is described as follows.

- Use a triangle to guide vertical strokes of letters. Place the triangle on the left side of the pencil and along the bottom edge of the T-square (for right-handers).
- Give horizontal strokes of letters a slight upward angle.
- Make vertical strokes lighter than horizontal.



EXAMPLE OF PRINTING (credit: Triton College Drafting Standards Manual 2005)

3.3 Title Block

A “Title Block” is required on each drawing. It is a rectangular portion of the sheet reserved for stating the name of the project, the name of the drawing, the name and address of the company, etc. All the sheets for a project should have their title blocks at the same location on each sheet. This gives a neat and professional look hence the impression of a well-organized and thorough presentation. There is some flexibility on the design of a title block so this is an area that companies use for individual expression.

EXAMPLE OF A TITLE BLOCK

3.4 Scales

Considering the Metric Scale, a scale is written as, for example: 1:100, 1:2, etc. These are ratios and do not represent any particular units. The former means that 1 unit of linear measurement on the scale represents 100 units on the actual object. When using the metric system it is common to use units of millimeters and meters. The draftsman must also state the units used when the scale is stated on a drawing.

A triangular scale ruler is a common draftsman's tool. Each face accommodates 2 scales so such scale rulers are called paired scales. Typical paired scales on a triangular scale ruler are:

- 1:1/1:100
- 1:2/1:20
- 1:5/1:50
- 1:20/1:200
- 1:500/1:1000
- 1:1250/1:2500

Of course, a smaller scale enables more detailed information to be drawn. Typical uses for some of the scales are as follows, though for economy, since it is preferable that as much of the paper is used as possible, there can be significant variation.

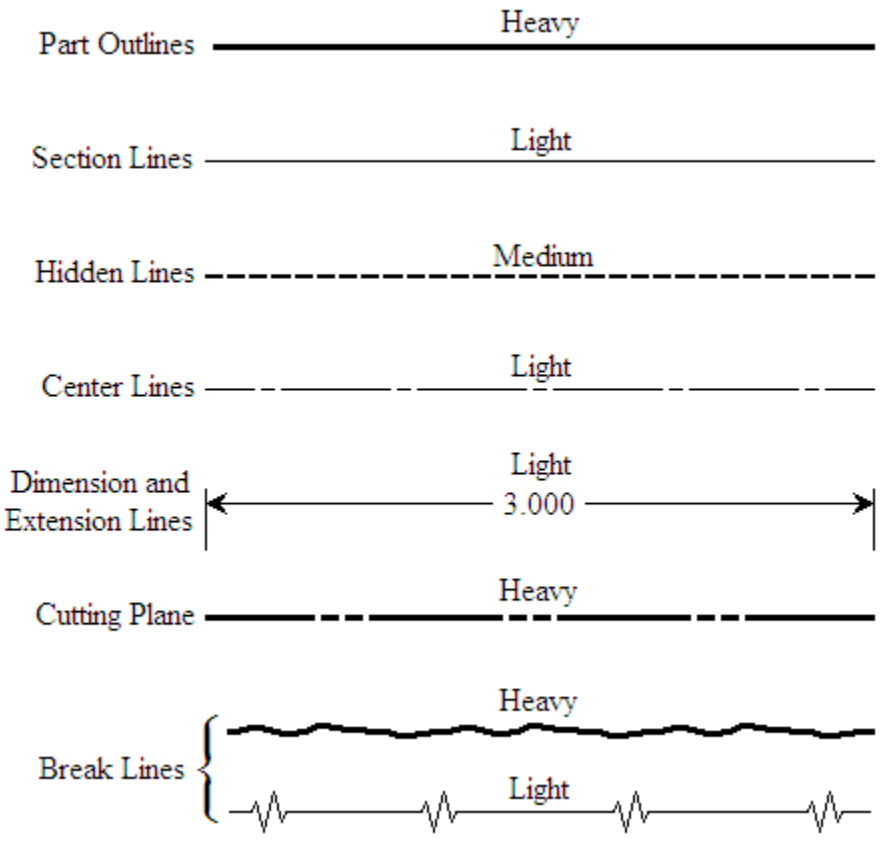
SCALE	**USE**
1:50	Floor plans
1:25	Details
1:200	Site plans
1:100	Site plans

3.5 Line types

A “line type” refers to a particular way a line is drawn using spaces between, or repeating strokes of short and long lines. Each pattern has a particular meaning. Common line types and their uses are as follows.

- *visible* – are continuous lines used to depict edges of an object directly visible from a particular angle.
- *hidden* – are short-dashed lines that may be used to represent edges that are not directly visible.
- *center* – are alternately long- and short-dashed lines that may be used to represent the axes of an object.
- *cutting plane* – are thin, medium-dashed lines, or thick alternately long- and double short-dashed that may be used to define sections for section views.
- *section* – are thin lines in a pattern (pattern determined by the material being "cut" or "sectioned") used to indicate surfaces in section views resulting from "cutting." Section lines are commonly referred to as "cross-hatching."

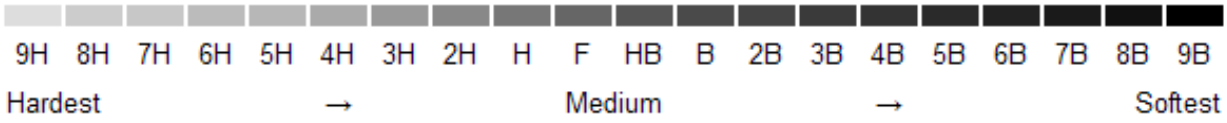
Examples of line types are:



Common Line types (credit: BAxlerod)

3.6 Line Weights

As shown in the above examples of line types, each line has a particular relative thickness or width compared with the other lines. When drawing with lead pencils, different types of pencil can be used to get lighter or darker lines. H is darker than 2H which is darker than 3H, etc. The entire range is shown below.



To get thicker lines with a lead pencil, you "chamfer" the point of the pencil. This is done by using a razor blade and shaving the point of the pencil at an angle.

When drawing with technical pens, they are available in widths measured in mm. Frequently used sizes are: 0.13, 0.18, 0.25, 0.35, 0.5, 0.7 and 1.0mm.

3.7 Dimensioning

Dimension lines are used to indicate the dimensions of an object. An example of a linear dimension line is as shown in the list of line types above. The two short vertical lines are called the "extensions" and the line with the arrows is called the dimension line. Sometimes the numerical value of the dimension is not placed as shown, but rather above the dimension line. Linear dimension lines can also be vertical.

3.8 Abbreviations

Some of the most commonly used abbreviations are as follows.

DESCRIPTION	ABBREVIATION ON DRAWING
Overall length	O'ALL
Unless otherwise stated	UOS
Diameter	DIA or Φ
Long	LG
Radius	r or RAD
Vertical	VERT
Mark	MK
Dimension	DIM
Near side, far side	N SIDE F SIDE
Opposite hand	OPP HAND
Center to center	C/C
Horizontal	HORIZ
Not to scale	NTS
Typical	TYP

Nominal	NOM
Floor level	FL
Section A-A	A-A

3.9 Other Best Practices

- Plan views must have north arrows
- Every drawing on a drawing sheet must have the name of the drawing and scale centered under the drawing
- Every set of drawings must have a Title Sheet comprised of:
    - Name and address of project
    - General Notes
    - Index of drawings
    - Material symbols
    - Legend of symbols
    - Abbreviations