Using CAD to Model Buildings

Part 1 - Guidelines for Using CAD to Model Buildings
Part 2 - Guidelines for Naming of Layers
Part 3 - Guidelines for Structuring Computer Files

Royal Australian Institute of Architects - Victorian Chapter
Computer Based Technology Committee

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Other Documents

Schedule of Comments

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Part 1. – Guidelines for Using CAD to Model Buildings

Introduction

The use of computers to design and document the construction of buildings is now common amongst Architects.
The introduction of computers has not only created opportunities to increase the efficiency with which drawings can be created, but also extended the ways the design and construction of buildings can be documented.
Unfortunately this opportunity has lead to a situation where not only Architects, but also their clients and allied consultants, all use differing methods.
The different Parts contained in the Using CAD to Model Buildings document attempt to standardise some methods commonly used with Computer Aided Drafting (CAD) software.
It is intended that further guidelines be created covering other methods that are currently used, and methods that will become more common in the future.
The guidelines contained in the various Parts are structured with sufficient flexibility to be useful for projects from the very simple to the very complex, from 3D visualisations to full working documentation, and to use with the simplest to the most complex software.

The Using CAD to Model Buildings is directed at Architects, and in particular Architects who are familiar with the use of computers and AEC (Architectural/Engineering/Construction industry) software in particular. It is not intended as a primer for using computers to create Architectural documents, or on how to use particular proprietary AEC software.

This part contains a description of how a computer model of a building should be organised, and some discussion on dealing with completed computer files.

Industry Standards

There is an Australian standard for naming of layers - Australian Standard AS 13576 – 1999 "*Organization and naming layers for CAD*" (a direct copy of International Standard ISO13567-2.), which supersedes the previous Australian standard - AS 3883 - 1991 (a direct copy of British Standard BS1192 – Part 5.)
Both standards proscribe Layer Naming structures only. These standards have been reviewed and considered too cumbersome for the majority of architectural work.
There are also a number of published guidelines more relevant to architectural work. The American Institute of Architects "CAD Layer Guidelines" was considered the most appropriate and these guidelines build on that document.
Work has also been done on establishing standards for computer modelling in the construction industry. STEP (ISO 10303 Standards for The Exchange of Product model data) is well developed in the area of manufacturing (particularly car assembly). The IAI (International Alliance for Interoperability) is attempting to establish standards for describing complete objects in building models (such as doors, windows, walls etc), building on standards created by STEP.
It is envisaged that the method computer software use will move gradually from dealing with drawing objects (lines, text etc) to complex building objects (doors, walls etc.). These guidelines should be considered a bridge between these two approaches.

The purpose in creating these guidelines is to offer guidance to Architects in constructing their in-house management system, and to create a benchmark that can be referred to when dealing with other building consultants and clients.

Aims of CAD Modelling

Modelling versus CAD

Computer Aided Drafting (CAD) has been accessible to architects since the early 1980s. Its purpose, as the name suggests, was to use the computer as a tool in the production of drafted paper documents. The systems were designed to mimic existing simple repetitive processes, therefore speeding up the production of paper drawings.

Advances in other fields have pointed to a more useful and efficient use of computer power.
Using computers to model the real world is now common in industrial and mechanical design, scientific research, social research and with virtual reality, the pursuit of fantasy. Software designed for industrial designers and structural engineers create real world model objects that contain information about density, centre of gravity, hardness etc. that can be used by algorithms that mimic real world conditions such as stress loading and behaviour in a cutting mill. Animation software can contain information that describes how an object behaves when it moves.
This is possible because simple objects (such as lines) can be combined into a hierarchy of complex objects (such as doors, walls containing doors, rooms containing walls, etc.). By attaching information to the object in addition to a simple graphic representation it can also be intelligent.

It makes eminent sense to use computer power to model buildings, to create a digital model of the complete building, in effect a CAD Information Model (CIM).
Information in addition to a graphic representation could include performance specifications, costs, sequence of construction, clash avoidance algorithms (e.g. duct work clashing with structure) etc.
Although much work is currently being undertaken to achieve these aims they are not yet practical to implement in most Architectural offices, mainly through lack of appropriate software.
However the concept of creating a CAD Information Model (CIM) as opposed to a CAD file is still valid.
The CIM approach can be achieved using currently available software by considering plans, sections, details etc. as slices through the actual building. Where a slice is taken materials are represented and exactly located. Also the digital information can be set up in such a way that a particular part of a building is drawn once but occurs many times, mimicking a single model of the building.

> *Computer data should be structured to create a CAD Information Model (CIM) rather than Computer Aided Drafted (CAD) drawings.*

Sharing Digital Data

The most obvious reason to standardise a CIM structure is to facilitate the sharing of information. This is not only required within an office, but also with others outside the office who may or may not be using the same software.
There is a danger in creating a structure that is too rigid, as although quickly understood, these types of standards soon become restrictive and ultimately limiting.
The structure should be comprehensive enough to communicate most information that may be required, but divisible so information not required can be left out without compromising the standard structure.

> *A CIM is based on a standard structure that proscribes a limited set of commonly used information fields, and embeds all information within these fields.*

Software Flexibility

Currently the computer software industry is highly proprietary, and is likely to be so in the foreseeable future. Each software production house has developed their own standards. Despite what software vendors might claim transferring information between different software products is problematic.
There is invariably a loss of information content.
The choice of software also has a bearing on the level of sophistication you can make your CIM.
CAD packages designed for drafting are obviously more limiting than packages capable of creating and manipulating complex objects (so called Object Orientated software).
In practice AEC software packages fall between these extremes.

A CIM is not be dependant on particular proprietary software, and is structured to allow information to be transferred to other proprietary software without loss of information.

Co-ordinating Documentation

Ideally any particular part of a building should be drawn once only. This is desirable not just to reduce staff time but more importantly to assist co-ordination.
CAD software makes copying information very easy but once copied there is no active check on whether this information is still valid.
A part of a building may appear in 1:500 Site Plan, 1:100 Floor Plan, 1:100 Reflected Ceiling Plan, 1:50 Layout Plan and 1:5 Detail, if it is changed these changes should be automatically reflected in all these drawings. Although the type of information required in 1:500 Site Plan is different to 1:5 Detail changes to one may effect the other. For example, if a wall is relocated this should be obvious in the 1:5 Detail so the detail can be checked to see if it also requires revising.

A CIM must be structured to minimise, if not eliminate, the duplication of information.

Distributing Information

The production of documents for the construction of a building is basically an exercise in transcribing, collating and transferring information.
Part of the productivity revolution due to computerisation has been the ability to transfer information virtually instantly irrespective of distances and numbers of copies involved.
For this to happen the documents must not only be in a form that can be digitally transferred, but also in a form that is tailored for the receiver of the documents.
Members of a building team need documents that they can incorporate into their work, tenderers and suppliers need documents that can not be altered and do not contain superfluous information.
Ideally documents transferred for inclusion in others work should contain only content that they will use, typically the building model without any annotation.

A CIM must be arranged so that annotation can be separated from the building model.

CIM files are unsuitable for the communication of information. This is because they are too information rich. They may contain the ghosts of prior schemes (e.g. in the form of invisible ('frozen') objects), they may contain alternatives that never proceeded or are still under development. They may contain preliminary information that is unchecked (e.g. door schedule information contained in attributes). Also, without information on how the CIM is structured it is impossible to exactly recreate a printed drawing. Documents transferred for information, (traditionally on paper) should be in a form that is unalterable, but capable of being printed on any printer, redlined and measured from.

The communication of issued information must always be via a rendered (i.e. digital file) or printed document (paper).

Organising Computer Models

Embedding Information in Computer Objects

Because digital objects in a computer file represent real world objects there is no theoretical limit to the amount of information they can contain. A drawn line on paper can have a thickness, a colour, a linetype, but not much else. A computer representation of a line can have all of these plus other information, such as what material the line represents, what element (wall, roof, floor), which drawings it appears in (plan, elevation or section) etc.

The reasons additional information is useful include:

- It adds control over what is visible at print time – so giving control over the issued results.
- Aids co-ordination by allowing more information to be combined in one place.
- Aids communication between design team members by providing information about what something represents beyond its visual appearance.

In an attempt to standardise this information these guidelines describe a set number of information categories, or fields, an object in a CIM must be capable of containing.

There are three methods by which information can be embedded, in order of preference:

1. By directly using the software's in-built ability to associate information with an object.
2. By separating information into different files, then linking them back together into one file.
3. By including information within the layer name an object resides on.

The first method depends on the proprietary software being used, the second is discussed in **Part 3 – *Guidelines for Structuring Computer Files***, the third is discussed in **Part 2 – *Guidelines for Naming of Layers***.

Information that can be embedded using the first method should use that method.
Depending on the structure of linked files being used for a project, the second should be used for information suited to this method.
Any information not included in the first two methods should be included in the layer name of an object.

Information Fields of CIM Objects

The following fields are a standard list of information a CIM object should be *capable* of containing, whether by direct embedding, file linking or inclusion in a layer name. No particular fields are mandatory, but any information that is to be associated with an object must be structured so it can be put within one of these fields.

Discipline

A description of the discipline that created the object (Architect, Electrical engineer, etc.)
Usually included in linked file name, otherwise included in layer name.

Stage

A code representing the stage in terms of information accuracy of an object. (Schematic, Design Development, for construction etc.)
Usually included in linked file name, otherwise included in layer name.

Location

A description of the location, or time, within the building the object appears. (floor level, package, zone, stage etc.)
Usually included in linked file name, otherwise included in layer name.

Element

A description of the building element the object represents (walls, floors, etc.), or annotation element (text, dimensions etc.)
Usually included in layer name if can't be directly embedded by software.

Material or element Modifier

A description of the building material the object describes (brick, timber, etc), type of element (text, dimension etc.), or further description (modifier) of the object's element (above, below etc).
Usually included in layer name if can't be directly embedded by software.

Status

A code representing the information accuracy, or status, of an object. (Schematic, under review etc.)
Included in layer name when status of an object differs from rest of file.

Owner

A code representing the person who owns the object.
Usually included in layer name if can't be directly embedded by software.

Representational Information

Information on where and how an object will be represented.
This is divided into:

Drawing Type

A description of the type of drawing the object appears in. (plan, elevation etc.)
Usually included in linked file name, otherwise included in layer name.

Drawing Scale

A description of the scale of the drawing the object appears in. (1:100 etc.)
Usually included in linked file name, otherwise included in layer name.

Graphical Information

Information on how an object will appear when printed.
This is divided into:

Colour

A description of the colour that an object is normally printed in. This is whether the drawing is printed to paper or electronic file format.
Colours should comply with AutoCAD 256 colour numbers.
Normally directly embedded by software, otherwise in layer name.

Line Weight

A description of the pen width that an object is normally printed with. (0.25, 0.35 etc.)
This is whether the drawing is printed to paper or electronic file format.
Pen widths should be described in ISO 9175 Part 1 standard widths.
Normally directly embedded by software, otherwise in layer name.

Linetype

A description of the line type that an object is normally printed in (dashed, dotted etc).
This is whether the drawing is printed to paper or electronic file format.
Line type should comply with ISO 128-21:1997 descriptions.
Normally directly embedded by software, otherwise in layer name.

Separating Information

A computer model of a building needs to be divided into separate parts so a number of people can work on the model simultaneously. However, in doing so it must be organised so that the **Aims of CAD Modelling** described in these guidelines can still be achieved.
Different software packages have their own method of dividing a model up. Some allow many users to access a single file, others divide it into separate linked files.
As software that allows many users to access a single file generally use their own proprietary control methods, these guidelines only cover how to structure separate linked files.

Part 3 – *Guidelines for Structuring Computer Files* includes a description of a standard file naming format, and guidelines for structuring linked files.

Data Exchange

The Problem

It is sometimes desirable to issue other members of a design team live AEC files. For example so engineering consultants can use the Architectural drawings as backgrounds.
When the receiver has the same AEC software as the sender the problem to overcome is different in-house drafting standards. When the software is different the problems multiply as each deals with information in different ways.
Although common 'data exchange' formats have been developed in the past (e.g. IGES) few have managed to keep up with developments in proprietary AEC software.

Exchanging Files

As Architects are usually the head consultant they are in a good position to define the standards required of sub-consultants. These standards should be included in any sub-consultant agreement, along with clarifications and definitions of what the information in a computer files constitutes.

Computer files sent to third parties should have file names that correspond to a known structure. This is also true of files received from a third party. This structure should be agreed before the first file transfer takes place.
The structure described in **Part 3 – *Guidelines for Structuring Computer Files*** is recommended.
The files should only contain information required by the recipient for the purposes they requested the file for. For example, notes, dimensions, cross references are rarely required by sub-consultants.
Title blocks should not be included in any file sent out of the office.

Ensure layer names and other attributes conform to an agreed format. This may be as simple as ensuring each consultant identifies objects created by them with a discipline field in the layer name, to full compliance to the layer name format described in **Part 2 – *Guidelines for Naming of Layers***.

When developing agreed standards with sub-consultants be mindful that onerous requirements are not only costly to conform to (in time and money), but are less likely to be adequately complied with by their staff (or your own).

It is critical that trial runs of data exchange occur before a project is in full swing. These things never happen smoothly no matter how careful the preparation.

Converting Files

When exchanging files creating using different AEC software additional procedures should be established.

A single format that files are converted to should be agreed. (e.g. AutoDesk DXF, Microstation Version 5, etc).
Minimum information fields that are retained in the translation should be agreed. An example could be pen thickness, linetype and layer element. The layer name format described in Part 2 – *Guidelines for Naming of Layers* can be used as a method to translate this information.
The way linked files will be translated must be agreed. The combining of all linked files into one file should be avoided. This can resultant in files so large they are unmanageable, and files that contain large amounts of information not required by the recipient. Linked files should be structured so that individual files that do not rely on links contain information suitable for third parties. The linked file structure described in **Part 3 – *Guidelines for Structuring Computer Files*** describes a way to do this.

AutoDesk DXF

The most common data exchange format at date of publication is AutoDesk's DXF format. This can be in either binary or text format, listing all of objects, as well as other information. AutoDesk only support it for AutoDesk products (e.g. AutoCAD). Consequently each version of AutoCAD generates different DXF files. The format has only become common through the market penetration of AutoCAD, other software vendors picking it up so their products can communicate with AutoCAD.
The text format it is quite robust and can be edited with a text editor if all else fails. DXF files tend to be very large but compress very well.
Because it is a proprietary standard it is not recommended as an archive format, if it is used the text (ASCII) format should be used.

Digital Drawings

Introduction

There are obvious advantages in being able to send digital drawings via disks, tapes or CD, email, ftp sites, web sites etc. Until there are common methods and uniform standards for extracting information and tracking ownership of objects in AEC computer files, distributing information by sending live computer files is problematic.
The safest way to distribute information is to plot drawings to a digital file format, effectively creating a digital version of a paper drawing.

General Requirements

Digital equivalents of paper drawings need to be uneditable, yet capable of being marked up digitally in a way that does not interfere with the original information.
They must be capable of being printed on a range of different printers, including being reduced to fit small format printers.
Ideally it should be possible to measure from them, although the level of accuracy need only equal to a paper drawing at the same scale.

HPGL2

HPGL2 (Hewlett Packard Graphics Language) is a file format that sends pen up and pen down information to a plotter that supports HPGL2. It is widely supported and there are many software packages that can display HPGL2 files on the screen and convert them to other formats. Some allow red-lining of HPGL2 files.
The format is relatively simple so quite robust, and compresses very well.
Most AEC software can create HPGL2 files directly.
As the format is designed for plotters not all printers are capable of printing HPGL files. Software that will allow HPGL files to be sent to any printer are available.

PDF

Adobe PDF (Page Description Language) was developed by Adobe to be a standard way to combine text, raster graphics and vector graphics.
It is a more intelligent format than HPGL2 so can be manipulated more. PDF is a compressed format so there is little value in further compression.
At time of publication a PDF reader (Acrobat Reader) is available free from Adobe (www.adobe.com). Many other file viewers support PDFs, and Abode sell programs that allow manipulation of PDF files. Add-ins are available to add functionality such taking measurements of distances and areas, red-lining, cropping etc.
Some AEC software can create PDF files directly, otherwise Adobe products such as PDFwriter and Distiller must be used.
Adobe Acrobat reader supports printing to any system printer. Printing directly to plotters is not supported (although you can print to a plotter if it is set up as a system printer).

Archiving Computer Files

Computer files must be archived onto a media that will not degrade with time, is in a storage format that will be supported into the foreseeable future, and is in a software format that will remain available.

All forms of magnetic storage (floppy disks, removable hard disks, tapes) are susceptible to degradation over time. The earths magnetic field alone will degrade these formats, as will constantly accessing the data. Formats that physically embed data, such laser systems, do not degrade with time or use.

At time of publishing there are no standard tape or removable hard disk formats in common usage. Each proprietary system uses it's own 'standard'. The CD-ROM standard has not only been in use for many years but is also being supported by later versions such as DVD. The CD-ROM format is also used for music and is unlikely to be superseded in this use by DVD.

Software format is problematic. New versions of AEC software are released regularly, and invariably introduce a new file format. Backward compatibility is usually included, but may be restricted how far back it goes. Converting files to a data exchange format is probably not worth the effort as they too change over time.
The only way to safe guard against this problem is to archive a working copy of the software used to create the files, and if necessary a copy of the operating system the software worked on. Be sure to include all information necessary to install the software, such as serial number, CD key etc.

Do not use backup or compression software when archiving files. This adds a layer of complexity when retrieving archived files. Do not backup or compress files across a number of storage containers. If one fails all the data is likely to be lost.

Develop a system of structuring and recording archive contents. This should not be so onerous that it is unlikely to be accurately and consistently complied with. Many software products exist to assist this task but be aware of using proprietary systems that may not be around in the future.

Recommendations

Archive files onto ordinary CD-ROM discs in an uncompressed format.
Retained copies of software used to create the archived files on CD-ROM discs.
Structure the data on CD-ROMS in a manner that makes the contents obvious, include text files on the CD for additional descriptions or instructions. Label CDs clearly so the contents are obvious.
Make two copies of archive CDs, keep one off site.

Part 1 Appendix A – Principles of CAD Information Models

1. Treat information in computer files as a model of the actual building rather than representation of the printed output.
2. Information must be drawn accurately.
3. A computer object that represent a real object in the building must be identifiable as representing that real object.
   Computer objects that create graphical annotation must identify the type of annotation.
4. Objects are described using the standard information fields:
   a) Discipline
   b) Stage
   c) Location
   d) Element
   e) Material
   f) Status & Owner
   g) Representation information
   h) Graphic information

   These fields may be:
   a) Embedded within the object by software
   b) Included in the Layer name the object resides on.
   c) Included in the file name of the file the object is in.
5. Only information fields that are relevant need be used on any object.
   All objects within a file or drawing set do not need to have exactly the same fields associated with them.
6. Annotation objects must always be separatable from building model objects.

Part 1 Appendix B – Glossary

AEC		Architectural, Engineering, Construction. Used to describe the industry.
Annotation		parts of a drawing that describe the building model. Typically notes, dimensions, cross references, amendments.
Associative		When a computer object is associated with other objects, and relies on that relationship for it's functionality. Typically dimensions associated with the objects they dimension.
CIM		CAD Information Model
CAD		Computer Aided Drafting
Entities		A single identifiable object within a computer files (e.g. a line, text). Sometimes called *Objects*.
External Links		The linking of one file into another so it is visible and accessible to varying degrees. Sometimes called *External References*.
External References		The linking of one file into another so it is visible and accessible to varying degrees. Sometimes called *External Links*.
Layer		An attribute attached to an object in a computer file that allows for an arbitrary value. Objects with the same layer value can be manipulated together.
Object		A single identifiable (i.e. selectable) object within a computer files (e.g. a line, text, a block). In some software complex collections of objects can be identified as a single object (e.g. door, window, wall). Sometimes objects are called *Entities*, although entities usually refer to primitive objects like lines, circles etc..
Object Orientated		Software that combines digital information into groupings called objects, and can manipulate these objects.

Part 1 Appendix C – Other Standards

AS 13567-1999 "*Technical product documentation – Organization and naming of layers for CAD*" (identical to ISO 13567-1 & ISO 13567-2)

AS 3883 – 1991 (SUPERSEDED) "*Computer graphics – Computer Aided Design (CAD) – Guide for structuring of computer graphic information*" (identical to BS 1192 Part 5)

BS 1192: *Construction drawing practice* – Part 5: *Guide for structuring of computer graphic information*

ISO 8601 "*Data Elements and Interchange formats – information interchange – Representation of Dates and Time*"

ISO 9175 Part 1 "*Tubular tips for hand-held technical pens using India ink on tracing paper -- Part 1: Definitions, dimensions, designation and marking*"

ISO 128-21 "*Technical Drawings – General principles of presentation – Part 21:Preparation of lines by CAD systems*"

ISO 3098-5 "*Technical Product documentation – Lettering – Part 5:CAD lettering of the Latin alphabet, numerals and marks*"

ISO 13567-1 "*Technical product documentation – Organization and naming of layers for CAD* – Part 1: *Overview and principles*"

ISO 13567-2 "*Technical product documentation – Organization and naming of layers for CAD* – Part 2: *Concepts, format and codes used in construction documentation*"

ISO 13567-3 "*Technical product documentation – Organization and naming of layers for CAD* – Part 3: *Application of ISO 13567-1 and ISO 13567-2*"

"*CAD Layer Guidelines – Computer-Aided Design Management Techniques for Architecture, Engineering and Facility Management*" Editor Michael Schley. The American Institute of Architects Press Washington D.C.

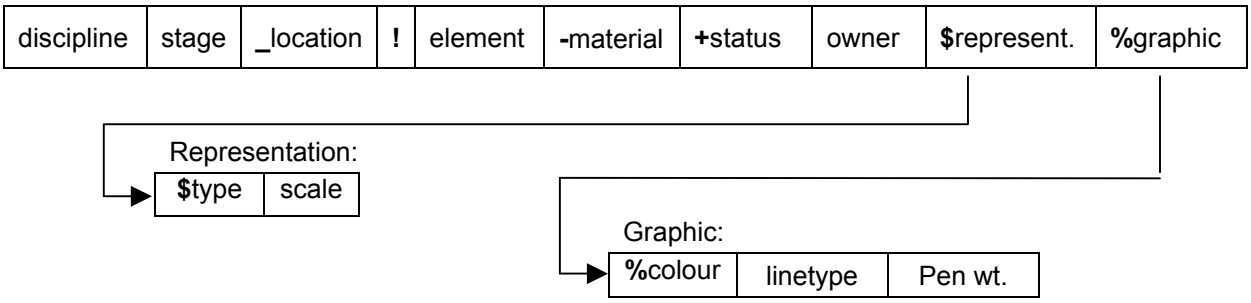
Part 2. – Guidelines for Naming of Layers

Introduction

This part of Using CAD to Model Buildings describes how the information that forms a CIM (CAD Information Model) can be included within layer names. Refer to **Part 1 – Guidelines for Using CAD to Model Buildings** for an explanation of the CAD Information Model concept.

Layer Name Format

The full layer name format contains all of the information fields, so if required the layer name can be used for all information fields. Refer to Part 1 *Guidelines for Using CAD to Model Buildings* – **Organising Computer Models** for a description of information fields.
The Layer Name Format identifies particular fields by divider characters, type of character (number or letter), and to a lesser extent position. This structure means fields can be identified even if other fields are missing. It reduces the need to include dummy information or restrict fields to predefined lengths. Fields have been defined as being in either upper or lower case. This is suggested for readability only, using all upper or all lowercase is acceptable.
The full layer name structure:



where:

FIELD	DESCRIPTION	CHARACTERS	RULES
discipline	Building Team discipline	1 letter, lower-case	
stage	Information accuracy	1 number	
_location	Location, level, stage or option	Letters or numbers lower-case (4 recommended)	Must begin with underscore (_)
!element	Building element	Letters, upper-case (4 recommended)	Exclamation (!) required if discipline &/or location used.
-material	Building material or Modifier or Annotation type	Letters or numbers, lower-case (4 recommended)	Must begin with dash (-)
+status	Information accuracy	1 number	Must begin with plus (+) Required if owner used.
owner	Owner	2 letters, lower-case	
$represent.			Must begin with dollar ($)
type	Type of drawing	1 letter, lower-case	Required if Scale used
scale	Scale of object	numbers	
%graphic			Must begin with percent (%)
colour	Plotted colour	3 numbers	Required if Linetype & Pen used
linetype	Plotted Line type	2 letters, lower-case	Required if Pen used
pen	Plotted Pen width	1 number	

e.g.	A6_planL1L9**!**WALL**-**plbd**+**2am**$**p100**%**007dh4	Architectural, for construction, Plan levels 1 to 9, wall, plasterboard, schematic, owned by AM, appears plan only, 1:100, black, half sized dashed line, 0.25 pen.

Use of dividers means fields can be omitted:

e.g.	WALL**%**003ls7	wall, green, continuous linetype, 0.70 pen
	WALL**-**plbd	wall, plasterboard
	WALL**$**p	wall, appears in plan only

Where divider characters (! + $ %) are not supported replace them with the underscore (_) character.

Refer to **Part 2 Appendix B - Standard Layer Name Fields** for a full list of recommended layer field names.

Handling Optional Layer Name Fields

The number of actual information fields in a layer name used depends on a number of factors, including the size and complexity of a project, the stage the project is at, and the extent that externally linked files will be used. Refer to the Guidelines for Use section on how to apply this structure to different sized projects.
The number of fields may also change as the project progresses, from pen weight and simple elements during sketch design to possibly all fields by the end of documentation.

However, it is important all those working on a project are aware what fields are normally included and which are optional. This is true for external consultants (and clients), as well as staff within the office.

This guideline defines a number of “Grades”. These prescribe which fields are normal for that Grade, and which are optional.
The Layer Name structure for a project can be defined by declaring (for example in Client/Architect agreements, Consultant agreements) which Layer Grade a project shall be using.

The range of Grades are described in **Appendix A** of this document.

Layer Name Fields - Guidelines for Use

Software Limitations

Each AEC software package has it’s own limitations on layer names. Some software will not be capable of containing all of the layer name fields. Where possible the fields that are capable of inclusion should follow the Layer name format and use the Standard Layer Name fields. (see **appendix B**). Where divider characters (! + $ %) are not supported replace them with the underscore (_) character.

Data Exchange Requirements

Data exchange between AEC software packages that don’t support identical methods of directly embedding information leads to loss of data each time an exchange takes place. For example, if one has a separate attribute for pen weight, the other does not, the pen weight of objects is likely to be lost when the translation occurs.
If it is envisaged data exchange will occur reasonably frequently consideration should be given to including all information in the layer name, even if not actually required by the originating software. This ensures no data is lost during translation.

Drawing Requirements

There is no benefit in including more information than required for a particular purpose.
The layer name structure allows only information required, or known to be included:

e.g.	WALL	a wall
e.g.	-plbd	plasterboard material
e.g.	GRID%001	grid, colour 1
e.g.	WALL$c	wall, appears only on reflected ceiling plan

When additional information is know it can be added:

e.g.	WALL	becomes	WALL-plbd
e.g.	GRID%001	becomes	GRID-A%001

This means layers used in sketch design files can simply be renamed for documentation.

Project Size

The size of a project will dictate how the files will be structured, and in turn the number of layer name fields required.
One of the requirements of larger projects is for many people to be able to work on the project at the same time. Large projects need to be split over many files to facilitate this, typically using linked files to share information. These linked files typically remove the need for the *location, type* and *scale* layer name fields as different levels, different types of drawings, and drawings of different scales are split into separate files.
Small projects with less people working on them may only need one file, with all drawings (plans, reflected ceilings, elevations, details etc.) generated from that one file. In this case all layer name fields may be used to distinguish objects that appear on the different drawings being produced.
Projects may fall between these two extremes, or indeed move from having few to many people working on them.
By using layer fields a project that started as a single file can be split into a number of files by isolating the objects on the relevant layer fields and writing them out to a separate file.

Master Lists

Although **Appendix B** lists suggested standard layer field names it is not intended to be, nor could ever be, all encompassing. It is recommended an Office Master List be created.
Individual projects often generate new layer field names, these should be added to the Office Master List as they arise.
As a single list that covers all possibilities for all projects would be unmanageably long to actually use on a single project it is recommended each project have a Project Master List (created by cutting down the Office Master List), that, once created, can only be added to via an approval process.

Recommended Uses for Fields

The purpose of defining information fields is to structure information rather than restrict what information can be embedded. The following discussions offer advice only.

Discipline

This field is only necessary in layer names if CIM (CAD Information Model) files are going to contain objects from a number of different disciplines. There is no point identifying objects as originating from the Architect if there are no objects in the file that originated from other consultants. The best way to identify objects from other disciplines is via linking their files into your files.

Stage

A broad description of the stage the object is a part of. Use stage to describe the general accuracy of a group of objects, use *Status* for individual objects whose accuracy differs from that group.

Location

This field can be used to hold information related to the construction of the objects represented. For example the floor level, construction stage, construction package, sub-contract. One particular use is to separate different floors of a multi-storey building that would otherwise be on top of each other. Often the best way to identify this type of information is by separating it into linked files.

Element

This field identifies the major element an object represents. This may be building element (wall, roof etc) or annotation element (text, dimensions etc.) The range of elements should be kept to a restricted number so known groups of objects can be manipulated together using wildcards.

Material or element Modifier

Use for additional information to compliment what the Element describes. The range of these field names need not be as restricted as the range of element names. Users should be encouraged to exactly describe what they are representing, although there needs to be consensus on the field names used for the same material or modifier.
Identifying what material an object represents can impart information to other members of the design team that would otherwise require referring to notes, schedules, legends etc. This can lead to significant time saving and reduction of errors. It means drawings can progress quickly without the need for continually adding notes, hatching or dimensions. These can all be added later as the information is all there in the drawing file. (Notes, hatching and dimensions are only required to make information visible on a printed drawing. Eventually when only CIM files are issued for construction these will become redundant).

Status

One of the problems with CIM files is it is not possible to identify the accuracy of information. A wall will have an exact position in a CIM file (up to 16 decimal places!), even if it has been drawn in what was intended to be a tentative location. If, (as is common) sketch design CIM files are used to create documentation drawings there is no way to identify which parts have been drawn or altered as the result of detailed design and which are left-overs from sketch design. Status can also be useful to represent the completeness or otherwise of a CIM file. As construction information is confirmed, approved, or constructed the status can be changed to reflect this. This means the same drawing can be used for package or staged issues.

Owner

Some software can use layers to identify who has permission to work on what objects within a file. This field can be used to identify which individual 'owns' which layers. It can also be used to identify who has added or altered objects in a file, for example in as-built drawings, or red-lining or commenting in drawings.

Representational Information

Information on where and how an object will be represented.

> ***Drawing Type***
>
> This field is useful to separate information that occurs in the same location but in different planes, as in floor plans, reflected ceiling plans, slab set-out plans etc., or separate trades or contracts, such as furniture, electrical layout etc. Use the layer name field for small projects, use linked files for larger projects.
>
> ***Drawing Scale***
>
> Used where objects are only relevant to a particular scale. For example when a 1:5 detail is drawn over the top of a 1:50 wall section, or text for a 1:500 site plan is placed within a 1:100 floor plan.

Graphical Information

Information on how an object will printed.

Colour

Used when colour can't be directly embedded, or when this information will be lost when transferring to another CAD system.

Linetype

Used when line type can't be directly embedded, or when this information will be lost when transferring to another CAD system.

Line Weight

Used when line weight can't be directly embedded, or when this information will be lost when transferring to another CAD system.

Wildcard Filtering

If your software supports wildcard matching use it to filter layers.

e.g.	*WALL*	all walls
	ANNO	all annotation
	-cmt or *+1	all comments
	+0	all layers not plotted
	$c	all layers that appear only on reflected ceiling

Refer also **Part 2 Appendix C – Wildcard Table**.

Annotation

Drawing annotation are all those objects that are not part of the actual building model. Generally these are text notes, cross references, dimensions, grid references, level references etc. Annotation objects are scale dependant. That is, their size in a file differs depending on what scale the drawing will be printed out.
It is useful to be able to isolate all annotation. This may be desirable if a drawing is linked as a reference only or when supplying backgrounds to consultants.
This can be achieved by identifying all annotation with the same element – e.g. ANNO, then manipulating them through wildcard filtering.

Amendments

Use a layer name describing the date the amendment is drawn. Date in ISO 8601 format

e.g.	AMDT-2000506	6th May 2000
or.	AMDT-010506	6th May 2001

Leading zeros are required for correct sorting. The Century can be dropped, although problems may occur with dates before the year 2000 and after the 2100.

Grids

Use the Modifier field of the layer name to describe the actual grid reference.

e.g. GRID-1 or GRID-a or GRID-1a

This means grids are identifiable without needing to find the written grid reference bubble (which may actually be in another file).
Grid references should use the GRID element so all grid entities can be grouped together.

e.g. GRID-ref

Comments & Red-lining

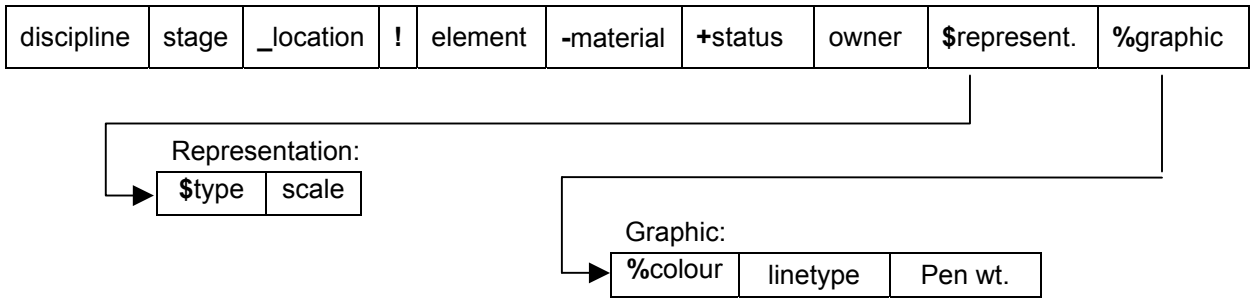
It is useful to allocate layers for comments and red-lining. Comment notes, bubbles, dimensions, construction lines etc. can be used to remind oneself, other design team members, and consultants about current issues relating to objects in the CIM file. Printing of comments and red-lining can be controlled at print time, so they don't appear on issued drawings.
Although an annotation modifier (e.g. –cmt) identifies comments, use the appropriate status, (+1) to identify comments that must never appear on issued drawings.

e.g.	ANNO-cmt	for comments
	ANNO-cmt+1	for comments not printed on final (issued) drawings.
	ANNO-cmt+3am	schematic comments by AM
e.g.	ANNO-redl	for red-lining
or	ANNO-redl+1	for comments not printed on final (issued) drawings.

Comments can be turned into proper notes by simply changing the layer they reside on.

Part 2 Appendix A –Layer Name Format & Compliance Grades

Layer Name Format



where:

FIELD	DESCRIPTION	CHARACTERS	RULES
discipline	Building Team discipline	1 letter, lower-case	
stage	Information accuracy	1 number	
_location	Location, level, stage or option	Letters or numbers lower-case (4 recommended)	Must begin with underscore (_)
!element	Building element	Letters, upper-case (4 recommended)	Exclamation (!) required if discipline &/or location used.
-material	Building material or Modifier or Annotation type	Letters or numbers, lower-case (4 recommended)	Must begin with dash (-)
+status	Information accuracy	1 number	Must begin with plus (+) Required if owner used.
owner	Owner	2 letters, lower-case	
$represent.			Must begin with dollar ($)
type	Type of drawing	1 letter, lower-case	Required if Scale used
scale	Scale of object	numbers	
%graphic			Must begin with percent (%)
colour	Plotted colour	3 numbers	Required if Linetype & Pen used
linetype	Plotted Line type	2 letters, lower-case	Required if Pen used
pen	Plotted Pen width	1 number	

e.g. A6**_**planL1L9**!**WALL**-**plbd**+**2am**$**p100**%**007dh4 — Architectural, for construction, Plan levels 1 to 9, wall, plasterboard, schematic, owned by AM, appears plan only, 1:100, black, half sized dashed line, 0.25 pen.

Where divider characters (! + $ %) are not supported replace them with the underscore (_) character.

Layer Name Compliance Grades

These grades provide a way to describe the fields that an in-house standard uses. Layer grades can be referred to in contracts with other parties (client/Architects, consultant agreements, etc.).

Regular fields are always used within a layer namer, optional fields are used in addition to the regular fields when extra information is required for objects on that layer.

Layer Grades

	Regular Fields							Optional Fields
0								all fields
1				Element				all other fields
2				Element	Material			all other fields
3				Element	Material	Status	Owner	all other fields
4	Discipline	Stage		Element	Material	Status		all other fields
5	Discipline	Stage		Element				all other fields
6	Discipline	Stage		Element	Material			all other fields
7	Discipline	Stage	Location	Element	Material			all other fields
8	Discipline	Stage	Location	Element	Material	Status		all other fields
9	Discipline	Stage	Location	Element	Material	Status	Owner	

Layer Sub Grades

	Regular Fields					Optional Fields
	Representation		Graphic			
.0						all fields
.1			colour			all other fields
.2			colour	linetype		all other fields
.3			colour	linetype	pen weight	all other fields
.4	type					all other fields
.5	type	scale				all other fields
.6	type	scale	colour			all other fields
.7	type	scale	colour	linetype		all other fields
.8	type	scale	colour	linetype	pen weight	all other fields

Grade 9.8 represents all information fields.

A layer complying with	Layer Grade 2.0	WALL-pbrd
	Layer Grade 3.0	WALL-pbrd+2am
	Layer Grade 0.1	%007
	Layer Grade 2.1	WALL-pbrd%007
	Layer Grade 5.5	a2!WALL$p100

Part 2 Appendix B – Standard Layer Name Fields

discipline **building consultant, 1 letter**

Discipline	Description	Notes
a	Architect	
b	Building surveyor	
c	Civil	
d	Drainage, Sewerage	
e	Electrical	
f	Fire services	
g	Geographical / Land Surveyor	
i	Interior	
k	Client	
l	Landscape	
m	Mechanical	
n	Acoustic	N for Noise
q	Quantity surveyor	
s	Structural	
t	Planning	
v	Lifts	V for Vertical Transport
w	Contractor & shop drawers	
x	Sub-contractors & shop drawers	
y	Specialist Designers	
z	Other	

stage **document stage, 1 number**

Stage	Description	Notes
0	Invisible (not plotted)	
1	Comments & redlining	not normally issued outside of office
2	Schematic only	
3	Developed design	
4	Preliminary for construction	pre-tender
5	Awaiting Approval for construction	tender
6	Approved for construction	after tender
7	As built	
8	Existing	
9	***Dummy*** – has no meaning	Use if Discipline field included

Location, **letters &/or numbers**

Location	Description	Notes
_Level01	Level 1 only	
_Lev0180	Levels 1 to 80	
_Floor	Floor plan	
_Ceil	Reflected ceiling	
_Option1	Option 1	
etc.		

element Building element, 4 letters

Element	Description		Colours	Notes
BLDG	Building outline		purples	
CEIL	Ceiling		yellows	
COLN	Columns		greens	
DOOR	Doors		browns	
EQPM	Equipment		reds	
FLOR	Floor		browns	
FURN	Loose furniture		purples	
GLAZ	Glazing		yellows	Windows to ceilings
HRAL	Handrails & balustrades		reds	
JNRY	Built in joinery		browns	
LIFT	Lift cars		reds	
PARO	Partitions (to underside ceilings) e.g. Office partitions		yellows	WALLs go through ceilings.
PART	Partitions - (do not go to ceiling) e.g. Toilet partitions		yellows	
RAMP	Ramps		reds	
ROOF	Roof		blues	
SANT	Sanitary fixtures		blues	
SITE	Site information		browns	
SLAB	Floor slabs		greens	
STRS	Stairs		reds	
STWR	Stormwater (DPs etc.)		blues	
WALL	Walls (not internal partitions)		greens	
WIND	Windows		blues	Windows within walls (not to ceiling

element Services & Consultants element, 4 letters

Element	Description			Notes
CARS	Cars & trucks		yellows	
CARPK	Car parks		purples	
ELEC	Electrical items		reds	
EXHB	Exhibition items		reds	
FIRE	Fire services items		reds	
LITE	Lights		reds	
LSCP	Landscape information		greens	
MECH	Mechanical items		reds	
ROAD	Roads		blues	

element Drawing element, 4 letters

Element	Description			Notes
ANNO	Annotation, (text, dimensions, references etc)		purples	
AREA	Area boundaries, hatching etc		grays	
GRID	Grid lines, grid references & dimensions		reds	
REVI	Revisions		greens	
SHEET	Drawing sheets		grays	Blocks inserted on this layer
VPORT	Viewports in paper space		grays	

Building material, 4 letters &/or numbers

Material	Description	Notes
-alum	Aluminium	
-blok	Masonry block	
-brik	Clay brick	
-carp	Carpet	
-conc	Concrete	
-deck	Timber decks	
-fcbd	Fibrecement board (villaboard)	
-flsh	Flashings	
-glas	Glass	
-insl	Insulation	
-pave	External paving	
-pgbd	Plasterglass board	
-plbd	Plasterboard	
-plyw	Plywood	
-scrd	Floor screeds	
-seal	Sealant or seals	
-stel	Steel	
-tile	Tiles – ceiling or ceramic	
-timb	Timber	

Object, 4 letters &/or numbers

Object	Description	Notes
-box	Floor boxes	
-cars	Cars, line marking	
-dp	Downpipe	
-duct	A/C ducts	
-fixg	Fixings	
-fw	Floor waste	
-grnd	ground	
-gutt	Gutters	
-hose	Hose reel	
-hydr	hydrant	
-matt	Floor matt	
-pene	Penetration	
-plnt	plant	
-reg	Register	
-retg	Retaining (wall)	
-road	Roads	
-skyl	Skylight	
-soff	Soffit	
-sprk	sprinkler	
-sump	Sumps & pits	
-tree	Trees	

Modifier, 4 or 5 letters &/or numbers

Modifier	Description	Notes
-above	Above	
-behnd	behind	
-below	Below	
-beynd	beyond	
-edge	edges	
-head	Door & window heads	Used in Reflected Ceiling plans
-setd	setdowns	

Annotation, 3 letters &/or numbers

Annotation	Description	Notes
-brk	Break line between drawing sheets	Drawn in Model files
-cmt	Comment	Not plotted final drgs
-dim	Dimensions	
-hat	Hatching	
-lev	Level reference	
-ref	Reference, Cross reference, grid etc.	
-rma	Room area	in attribute blocks only
-rmb	Room brief number	in attribute blocks only
-rmn	Room name reference	
-rmt	Room name text	in attribute blocks only
-tag	Text with reference block	Used within blocks only
-tit	Title text	Used in paperspace
-txt	Text	

status, information status, 1 number

Status	Description	Notes
+0	Invisible (not plotted)	
+1	Comments & redlining	not plotted on final (issued) drgs.
+2	Schematic only	
+3	Developed design	
+4	Preliminary for construction	pre-tender
+5	Awaiting Approval for construction	tender
+6	Approved for construction	after tender
+7	As built	
+8	Existing	
+9	***Dummy*** – has no meaning	Use if Owner field included

owner owner, 2 letters

Status	Description	Notes
am		
ah		
etc…		

Representation – **Drawing Type** **1 letter**

Type	Description	Notes
a	Mechanical	*(a)ir conditioning*
b	Building Sections	
c	Reflected Ceiling plan	
d	Demolition	
e	Elevation	
f	Furniture layout	*Fit-out*
g	Legend	*Le(g)end drgs & key drgs*
h		
i	Lighting	*L(i)ghting*
j	Joinery	*Joinery & fittings*
k	Sprinkler	*Sprin(k)ler & fire*
l	Layout (setout) plan	*Slab set-out*
m	Masterplan	
n		
o	Location plan	*(o)verall plan*
p	Floor Plan	
q		
r	Roof plan	
s	Site plan	
t	Detail	*De(t)ail*
u		
v		
w	Wall Sections	
x	Existing conditions	*E(x)isting conditions*
y	Electrical	*Electricit(y)*
z	Reference	*Cro(z) reference* ${}^{A}Z_{A}$

Representation – **Scale** **plotted scale, numbers**

Scale	Description	Notes
1	1:1	
2	1:2	
5	1:5	
10	1:10	
100	1:100	
1000	1:1000	
10000	1:10,000	
etc.		

Graphic – **colour** **plotted colour, 3 numbers**

Colour.	Description	Notes
000	***Dummy*** – has no meaning	use if line-type and/or pen. wt. included
001	red	
002	yellow	
003	green	
004	cyan	
005	blue	
006	magenta	
007	black (or white)	
008	gray	
↓		
255	Light gray	

Graphic – **line type** **plotted line width, 2 letters, first letter linetype, 2nd scale of linetype**

Linetype	Description	Notes
l	continuous Line	
d	dashed	
h	hidden	
p	phantom	
b	border	
t	dot	
c	centre	
v	divide	
a	dash-dot	
Linetype Scale	**Description**	**Notes**
s	standard	
d	Double size	
f	four times size	
e	Eight times	
h	Half size	
q	quarter size	
t	Oct (eighth) size	
ls	***Dummy*** – continuous line standard scale	Use if pen wt. included

Graphic – **pen wt** **plotted line width, 1 number**

Pen Wt.	Description	Notes
0 (zero)	Not plotted	
1	Thinnest width	0.10 mm
2	↑	0.13 mm
3		0.18 mm
4		0.25 mm
5		0.35 mm
6		0.5 mm
7		0.7 mm
8	↓	1.0 mm
9	Thickest width	2.0 mm

Part 2 Appendix C – Wildcard Table

Wildcard Table Legend

A		an alphabetical character (A to Z)
N		a number (0 to 9)
*	(asterisk)	Matches any character sequence, including an empty one, and it can be used anywhere in the search pattern: at the beginning, middle, or end
#	(pound)	Matches any single number
@	(at)	Matches any single alphabetic character
?	(question mark)	Matches any single character

Wildcard Table - to list all layers with a particular field:-

FIELD	WILDCARD	NOTES
discipline	A***!**** or A*	use **!** (exclamation) if some layers DON'T have Discipline field.
stage	@N***!**** or @N*	use **!** (exclamation) if some layers DON'T have Stage field.
location	*_AAAA*	can include numbers
element	***!***AAAA* or AAAA*	***!*** (exclamation) optional if Discipline, Stage & Location not used.
material	*-AAAA*	can include numbers
status	*+N*	
owner	*+#AA*	
type	*$A*	
scale	*$@NN*	
colour	*%NNN*	
line type	*%###AA*	
pen	*%###@@N	

e.g.	***WALL***	all walls
	ANNO	all annotation
	+0	all layers not plotted
	$c	all layers that appear only on reflected ceiling

Part 3. – Guidelines for Structuring Computer Files

Introduction

This part of Using CAD to Model Buildings describes how the information that forms a CIM (CAD Information Model) can be included within the file name of linked files. Refer to **Part 1 – Guidelines for Using CAD to Model Buildings** for an explanation of the CAD Information Model concept.

Linked Files

All business strength software makes use of the ability to link files together, so the information from a number of files can appear together.
This means one file can appear as part of another, or many other, files. For example a single file containing the building's grid might be linked to every floor plan and reflected ceiling plan of a multi-storeyed building.
To keep control of linked files it is important to standardise the naming of files. This is not only critical to manage the files themselves, but the file name is often added to layer names to manage layers of linked files.

This document includes guidelines for the naming of files.

Model Files, Reference Files & Sheet Files

If digital drawings (whether two dimensional or three dimensional) are considered models representing the real building it is necessary to separate annotation from the model.
For example, a section is drawn at full scale in the computer model, yet this section (or parts of it) may appear in a 1:500 site section, 1:100 building section, 1:20 wall section and 1:5 detail section. The annotation for each of these separate drawings is different.
It is also useful (except for very small projects) to have a computer file that represents an issued document. This makes identifying which computer file created which drawing easier to manage. These "drawing sheet" files are called Sheet files.
Sometimes it is useful to have an additional file type – the *Reference* file, which contains common information appearing in a number of other files, such as grids, cross references, structural elements etc.
This create an hierarchy consisting of *Model* files, which may have *Reference* files linked to them, both are linked to *Sheet* files.
Model files contain the building model only, Reference files may contain annotation or model information, Sheet files contain annotation and a single title sheet.
For example a floor plan (*Model)* is linked to a file containing grids (*Reference)*, both are linked to a file that contains annotation and a title block with an outline of an A1 sheet, sized to print out at 1:100 (*Sheet)*. The same floor plan may also be linked to a sheet file with annotation and an A3 title block & sheet outline sized to print out at 1:50. Various objects can be made invisible within each file to exclude information not relevant.
Model and *reference* files are referred to as *Working files* as they do not directly create an issued drawing.

This document includes guidelines for the Structuring of linked files.

File Structure of Computer Models

The degree to how files are split and combined using external links depends in part on the size and complexity of a project, and how the work will be allocated between people working on it.
The following file types would be used for a large project, it may be more appropriate to combine some for smaller projects, or at the beginning of a project.

Model Files

Model files contain information about the building only. They may contain external links to other Model files. For example Reflected Ceiling Plans may contain a link to a floor plan. They are linked into Sheet files.

Reference Files

Reference files contain information that is common to a number of Model files, e.g. grid lines. Some reference files are scale dependant, e.g. building section cross references. Reference files are linked into Model files

Sheet files

Files that create the finished drawing. Each of these drawings represent a finished issuable drawing. They contain the title block and annotation at particular scales. Annotation is all those objects that describe the building and are scale dependant. It includes notes, dimensions, cross references, door references etc.
They contain links to Model files and Reference files.

Guidelines for Naming of Files

General

It is not recommended that project numbers are embedded with a file name. Files may be sent out to be used by people outside of the office and project numbers have no relevance to these people.
It is recommended folder (or directory) names be used to manage files within Project numbers.
If it is necessary to include project numbers prefix them to the beginning of the discipline field (e.g. 0061a4_B1L01.drg).
Files names (excluding revision) should ideally be kept to a maximum of 12 characters. Although most computer operating systems can now handle longer file names, when a file name is added to a layer name in a linked file the resulting layer name can exceed the software's limit.

Revisions

Issued drawing revisions (called *amendments* in this document) are different from computer file revisions.
Computer files are given a revision letter when there is a reason information being changed may need to be resurrected.
Issued drawing amendments refer to the sequence of drawings that have been issued (as done with paper drawings).
There is no point in trying to synchronise the two revision systems, as they serve different purposes they are unrelated to each other.

File Name Format for Working files

The file name is divided into fields of information similar to those described in **Part 2 – Naming of Layers**. As discussed in Part 2 fields only need to appear in *either* the File name or layer name. Fields have been defined as being in either upper or lower case. This is suggested for readability only, using all upper or all lowercase is acceptable.

The full file name format is:.

discipline	stage	_ location	$ type	scale	(revision)

Where:

FIELD	DESCRIPTION	CHARACTERS	RULES
discipline	Building Team discipline	1 letter, lowercase	
stage	Stage, status or package	1 number	
_location	Description: location, level, direction, option etc	Letters or numbers upper or lowercase (4 to 7 recommended)	Must begin with underscore (_).
revision	Superseded revision	1 letter, lowercase	Must begin with and end with brackets [()] Current file does not have a revision letter.

For example:

a4_planB1L09(a).drg describes an Architectural file, pre-tender Construction stage; plan of building 1, level 9, superseded revision A.

a4_planB1L09.drg would be the current revision of this particular drawing.

Guidelines for Model File Names

Files that contain only information about the building.
The *Scale* field is dropped as Model files may appear in a number of sheet files at different scales.
For example:

a4_B1L09.drg describes an Architectural file, pre-tender Construction stage; plan of building 1, level 9, superseded revision A.

Guidelines for Reference File Names

Files that contain information appearing in a number of other files.
Include scale information in the location field if information they contain is scale dependant.
For example:

a4_SecRef100.drg describes an Architectural file of the pre-tender Construction stage; section references at 1:100.

File Name Format for Sheet File Names

Files that are plotted out to produce the document set.

sheetnumber	[amendment]

Where:

FIELD	DESCRIPTION	CHARACTERS	RULES
sheetnumber	the drawing sheet number of the drawing the file prints out.	letters or numbers (max. 12 recommended)	Exactly match drawing number on drawing title block.
amendment	the issued drawing amendment number	1 uppercase letter or 2 numbers encloed in square brackets.	Exactly match revision number on drawing title block.

The issued drawing amendment is added to the file name so the most recent amendment can be identified from the file name without having to open or print the drawing and look at the title block.
This is useful when electronic drawing issues are done, and is a check that a human has at least altered the file (and hopefully checked it) before it has been issued.
If it is not practicable to rename sheet files (e.g. when using some types of batch plotting software), ensure any electronic drawing files (i.e. PDF, HPGL), issued have been manually renamed reflecting the current amendment.
There is no point archiving superseded Sheet files as they are linked to Model files that are always the latest drawings.
If sheet files are archived linked files must be bound to the file. This must be done when the drawing is issued rather than just before the next issue as linked files will have changed between the two issues.
A mixture of numbers and letters may be used to distinguish the status of the amendment. For example numbers may be used for issues before tender or construction, letters after.

For example:

MU-S-A101[F].drg	Produces the drawing with number MU-S-A101, amendment F.
MU-S-A10101[01].drg	Produces the drawing with number MU-S-A101, amendment 01.

External Linked Files - Guidelines for Use

Software Limitations

Each AEC software package has it's own method of dealing with externally linked files.
Some allow many users to access a single data file, having no need for externally linked files, and are beyond the scope of these guidelines.

Complexity and Project Size

There is no benefit in creating an externally linked file structure that is more complex than required.
Because only one person at a time can make changes to a particular file the driving force in designing an externally linked file structure is the number of people that will be working on the project.
On a small project all drawings could emanate from a single file, whereas a large project may need to be divided into a number of sectors to maximise the number of files (and therefore number of people who can simultaneously work on the project).
Through a mixture of the externally linked file structure and layer name format the optimum level of complexity can be achieved.
Projects can also start with a minimal structure, and be expanded at a later date.

By using layer name fields a project that started as a single file can be split into a number of files by isolating the objects on the relevant layer fields and writing them out to a separate file.

File Paths

If possible do not explicitly path linked files. If this is done links will only work in an identical folder structure.
Problems can occur when files are sent to others with a different folder structure, or if folders are renamed.

Circular references

A circular reference occurs when a file (floor plan) is linked to another file (ceiling plan) that is linked back to the first file (floor plan).
If the software you use can't handle circular references (i.e. causes it to crash), you will need to carefully design your file linking structure to avoid this problem.
Some software has in-built methods and commands to deal with circular references. These should be taken into account when designing your file linking structure.

Annotation

Generally all annotation occurs in Sheet files.
There may be exceptions for annotation that is useful for those working on Model files. These would be placed in the Model files at the scale most commonly used to plot these drawing out.
These could include Room Names, Level references.
It may also be sensible to put associative dimensions and notes that rely on being actively connected to other objects within Model files. If this is done appropriate use of layer names must be maintained so these types of entities are separatable from model objects.
If Sheet files become unwieldily large annotation can be separated into a separate linked file, creating in effect a Annotation *Reference* file. This is linked into the Sheet file. Even if this is done some annotation may still be more appropriate in Sheet files, for example grid references, grid dimensions, cross references. Generally items that normally appear at the edges of a drawing sheet.

Amendments

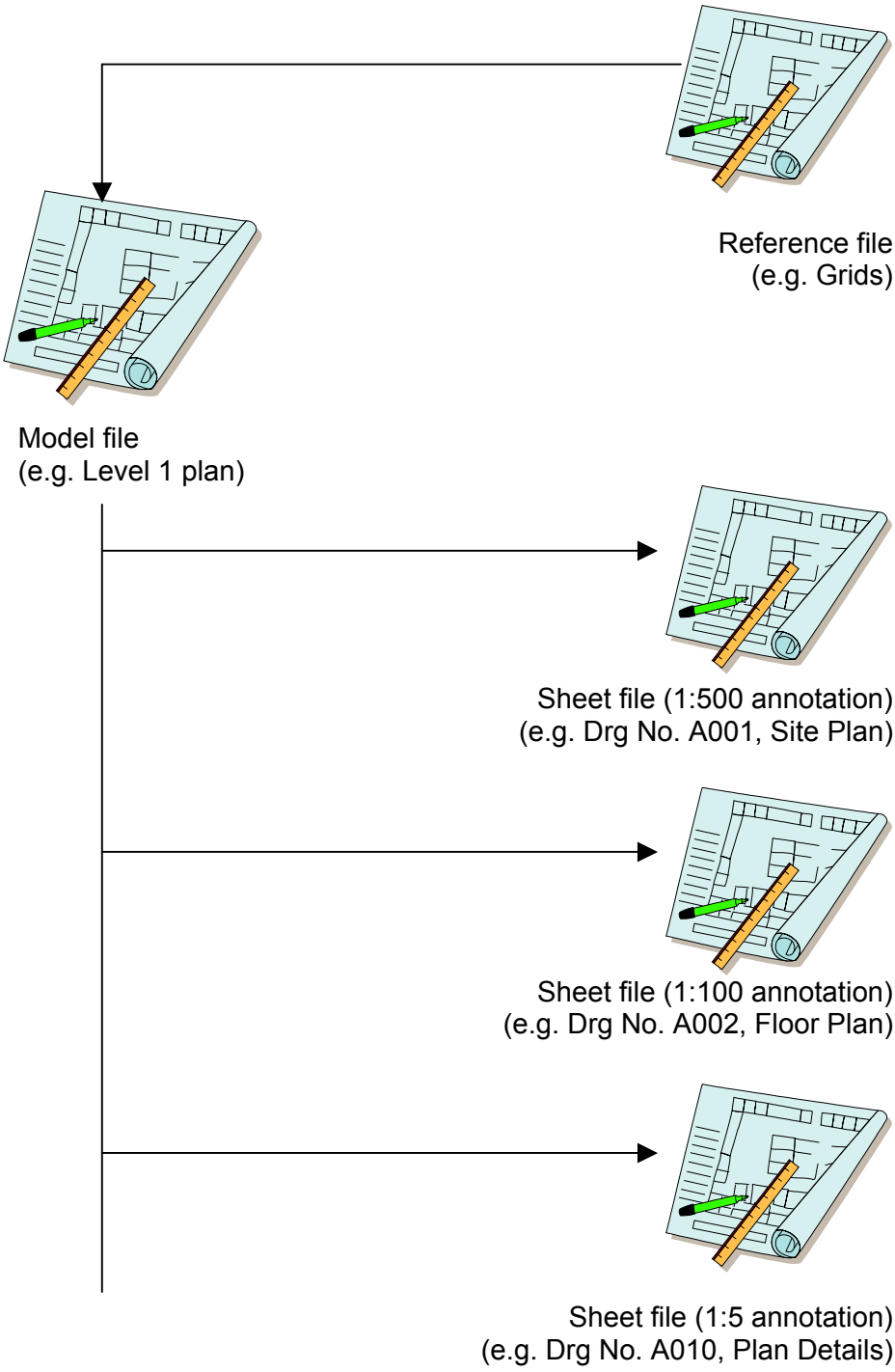
As model files may appear in a number of different drawings there needs to be a system of identifying changes without reference to the drawing issue amendment number.
Amendment bubbles are done in model files, (or Sheet files if it is a annotation change), as the changes occur. They are put on a layer that describes the date the change was made (see **Part 2- Guidelines for Naming of Layers: Layer Field Names – Guidelines for Use**).
Before a sheet file is printed only those amendment layers with a date in their layer name that is after the last time the drawing was issued are made visible. Therefore only changes made since the last issue will be identified.
A tag pointing to each visible bubble describing the amendment number or letter can be added in the Sheet file if it is so desired.

Recording Links

It is desirable to record the various links and dependencies between drawings.
If the software package does not generate reports of links it may be necessary to manually record them. This could be done diagrammatically or in a tabular form.
At a minimum it should be possible to identify which computer files were used to generate which printed drawing. Ideally the names and paths of files used in a particular drawing should be printed somewhere in the title block so reference to a separate document is unnecessary.

Externally Linked File Structure Diagram

Reference files are linked to *Model* files, Model files into *Sheet* files.



Part 3 Appendix A –File Name Format

File Name Format for Working Computer files

discipline	stage	_ location	$ type	scale	(revision)

Where:

FIELD	DESCRIPTION	CHARACTERS	RULES
discipline	Building Team discipline	1 letter, lowercase	
stage	Stage, status, or package	1 number	
_location	Description: location, level, direction, option etc	Letters or numbers upper or lowercase (4 to 7 recommended)	Must begin with underscore (_).
revision	Superseded revision	1 letter, lowercase	Must begin with and end with brackets [()] Current file does not have a revision letter.

For example:

a4_planB1L09(a).drg describes an Architectural file, pre-tender Construction stage; plan of building 1, level 9, superseded revision A.

a4_planB1L09.drg would be the current revision of this particular drawing.

File Name Format for Sheet File Names

sheetnumber	[amendment]

Where:

FIELD	DESCRIPTION	CHARACTERS	RULES
sheetnumber	the drawing sheet number of the drawing the file prints out.	letters or numbers (max. 12 recommended)	Exactly match drawing number on drawing title block.
amendment	the issued drawing amendment number	1 uppercase letter or 2 numbers encloed in square brackets.	Exactly match revision number on drawing title block.

For example:

MU-S-A101[F].drg produces the drawing with number MU-S-A101, amendment F.

Part 3 Appendix B – Standard File Name Fields

discipline **building consultant, 1 letter**

Discipline	Description	Notes
a	Architect	
b	Building surveyor	
c	Civil	
d	Drainage, Sewerage	
e	Electrical	
f	Fire services	
g	Geographical / Land Surveyor	
i	Interior	
k	Client	
l	Landscape	
m	Mechanical	
n	Acoustic	N for Noise
q	Quantity surveyor	
s	Structural	
t	Planning	
v	Lifts	V for Vertical Transport
w	Contractor & shop drawers	
x	Sub-contractors & shop drawers	
y	Specialist Designers	
z	Other	

stage **Documentation stage, or information status, 1 number**

Stage	Description	Notes
0	Invisible (not plotted)	
1	Comments & redlining	not normally issued outside of office
2	Schematic only	
3	Developed design	
4	Preliminary for construction	pre-tender
5	Awaiting Approval for construction	tender
6	Approved for construction	after tender
7	As built	
8	Existing	
9	***Dummy*** – has no meaning	Use if Discipline field included

location **description of contents**

location	Description (examples)	Notes
_floorTYP	Typical floor plan	
–ceilL01	Level 1 reflected ceiling	
–roofP01	roof Podium level 01	
–furnB01	furniture layout Basement 01	
–elevEAST	east elevation	
–sectNS	North South section	
etc.		

Comments