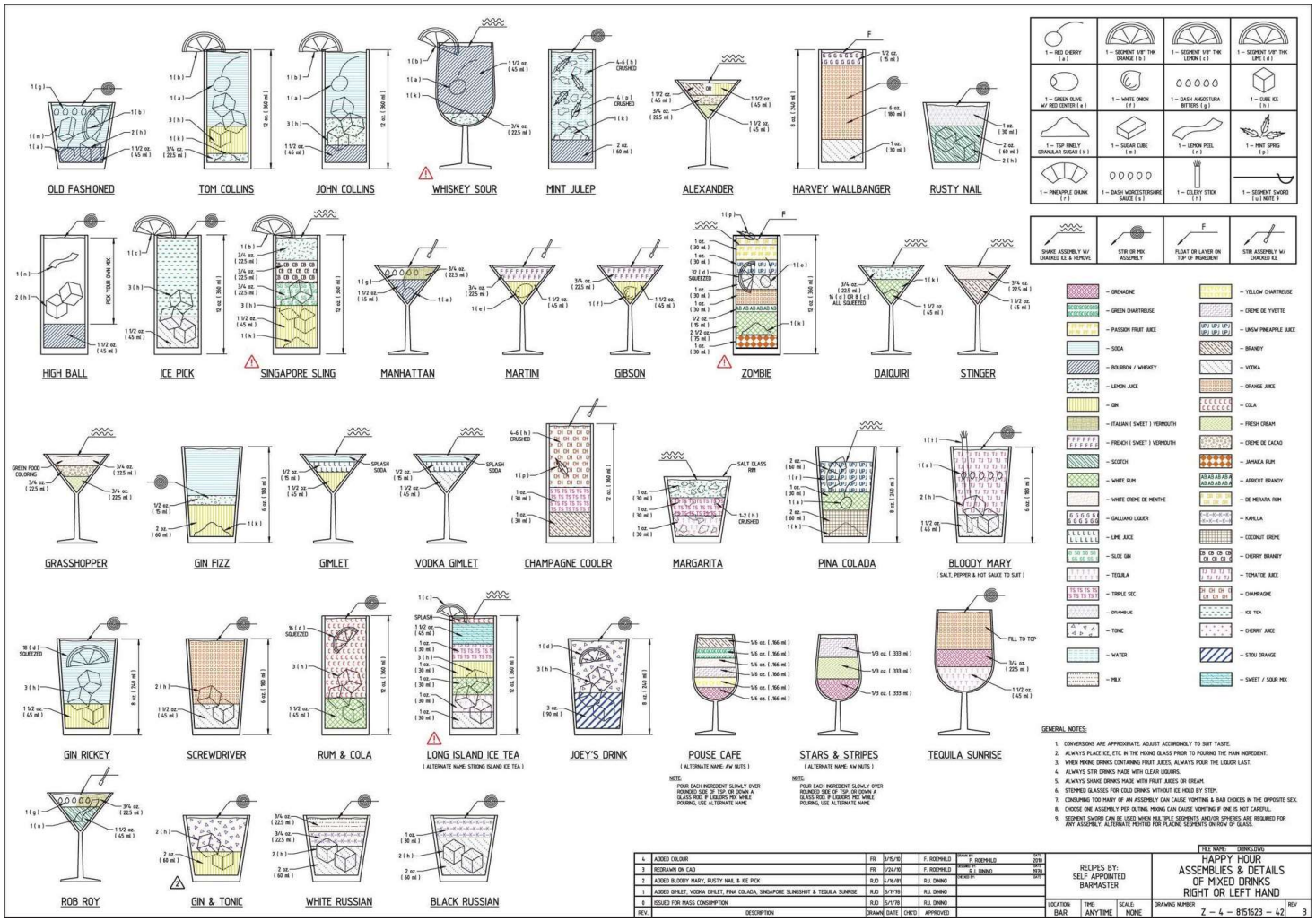
ACBA 4019

DIGITAL TECHNOLOGIES CAD: LEVEL 4

# Working with Digital Technologies CAD

Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

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Gavin M Traylor RIBA

Session 1:

- House Rules
- Introductions
- What is it all about?
- What am I expected to do?
- How will it be assessed?
- Module Introduction

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**ACBA 4019 Digital Tech CAD 2025-26_...**

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Main Channels
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Week 01
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**General** Posts Files

Gavin Traylor Wednesday 13:05

## Welcome to the Class

Some useful links:

Mewngofnodi / Login

For remote access to the Uni PCs.

Autodesk Student Access to Education Downloads

Download specialist CAD software for free onto your own laptop.

Reply

About Me:

Gavin Traylor (Gavin is fine)

- **Subject Experience with Digital Technologies & BIM**
- Chartered Architect with over 20 years of experience, working within the public and private sector.
- Since April 2019, a Lecturer in Architecture & Construction
- Prior to working at uwtsd was Operational Manager for the multidiscipline 'in house' design and construction management for Cardiff Council. 45 staff consisted of, Architects, Architectural Technologists / Technicians, Structural engineers, Mechanical & Electrical Engineers, Construction Project Managers, Quantity Surveyors, Principal Designer (CDM), Clerk of Works and Business Support Team.
- Studied at the Welsh School of Architecture at undergraduate level (RIBA Part 1) and Birmingham School of Architecture at postgraduate level (RIBA Part 2 and Part 3)
- Former Chair of CLAW Design Group and client board member SEWSCAP Procurement Framework.
- Former Chair of Design Circle & RSAW Council Member
- Past President Royal Society of Architects in Wales.

…….but much more importantly…..

What experience do you have in producing Technical Construction Drawings?

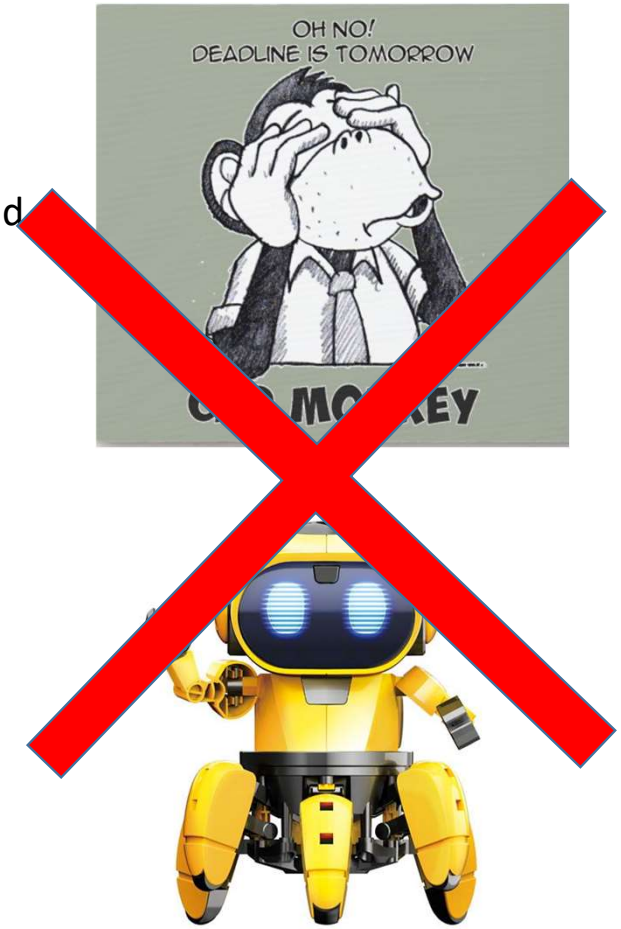
- [ ] None at all.
- [ ] I draw construction drawings by hand.
- [ ] I can produced 2D CAD drawings for construction projects.
- [ ] I can produced 3D models using modelling software.
- [ ] I am a pro and should be running this class.

What is it all about?

Aim:
To provide learners with the skills needed to produce two dimensional drawings using industry-standard computer-aided design (CAD) software and to provide learners with an understanding of standards and collaborative practice in the construction industry.

Learning Outcomes

- interpret data and produce 2D drawings using industry-standard CAD software applications;
- understand Building Information Modelling (BIM) naming conventions.




NO CAD MONKEYS NO BIM ROBOTS

What am I expected to do?

Predominately practical activities supplemented with lecture guidance over semester 1

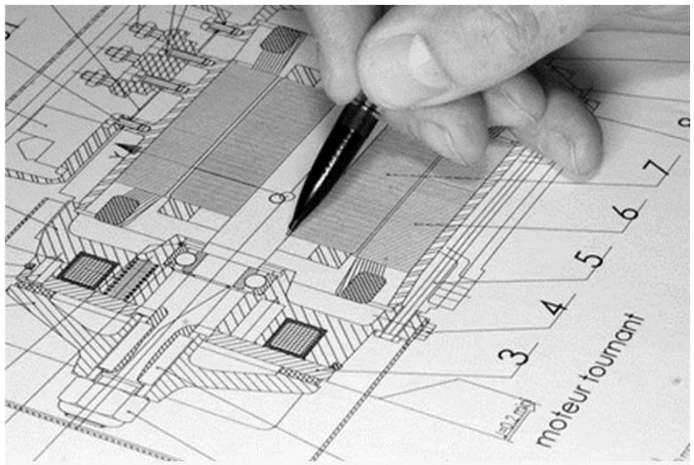
General Overview (Me)

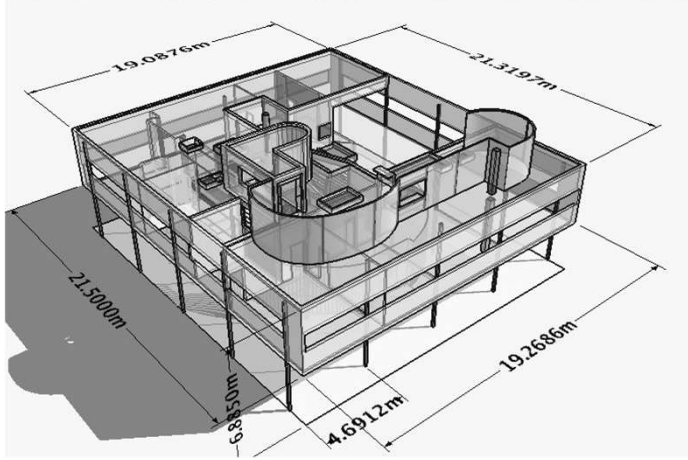
- Communication through draughting techniques
- Introduction to BIM process of naming/ filing conventions to International Recognised standards.
- 2D draughting
- Mix of taught lectures and workshops where feedback can be given.

General Overview (You)

- You need to know how to use the Library and Online resources
- You need to attend all timetabled activities
- You need to manage your time and meet deadlines
- Ask Gavin if you have any problems regarding the module

- Learning new skills requires practice



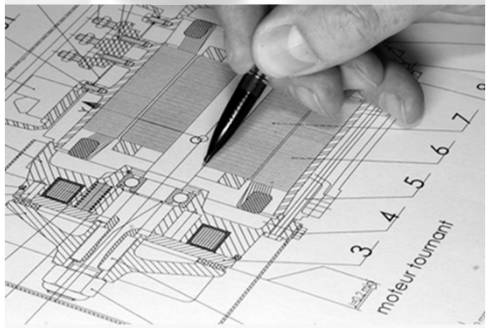



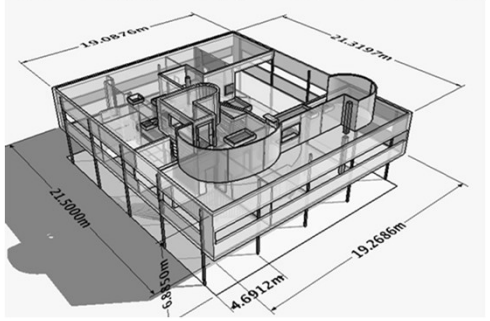
How will it be assessed?

Module Credit 10

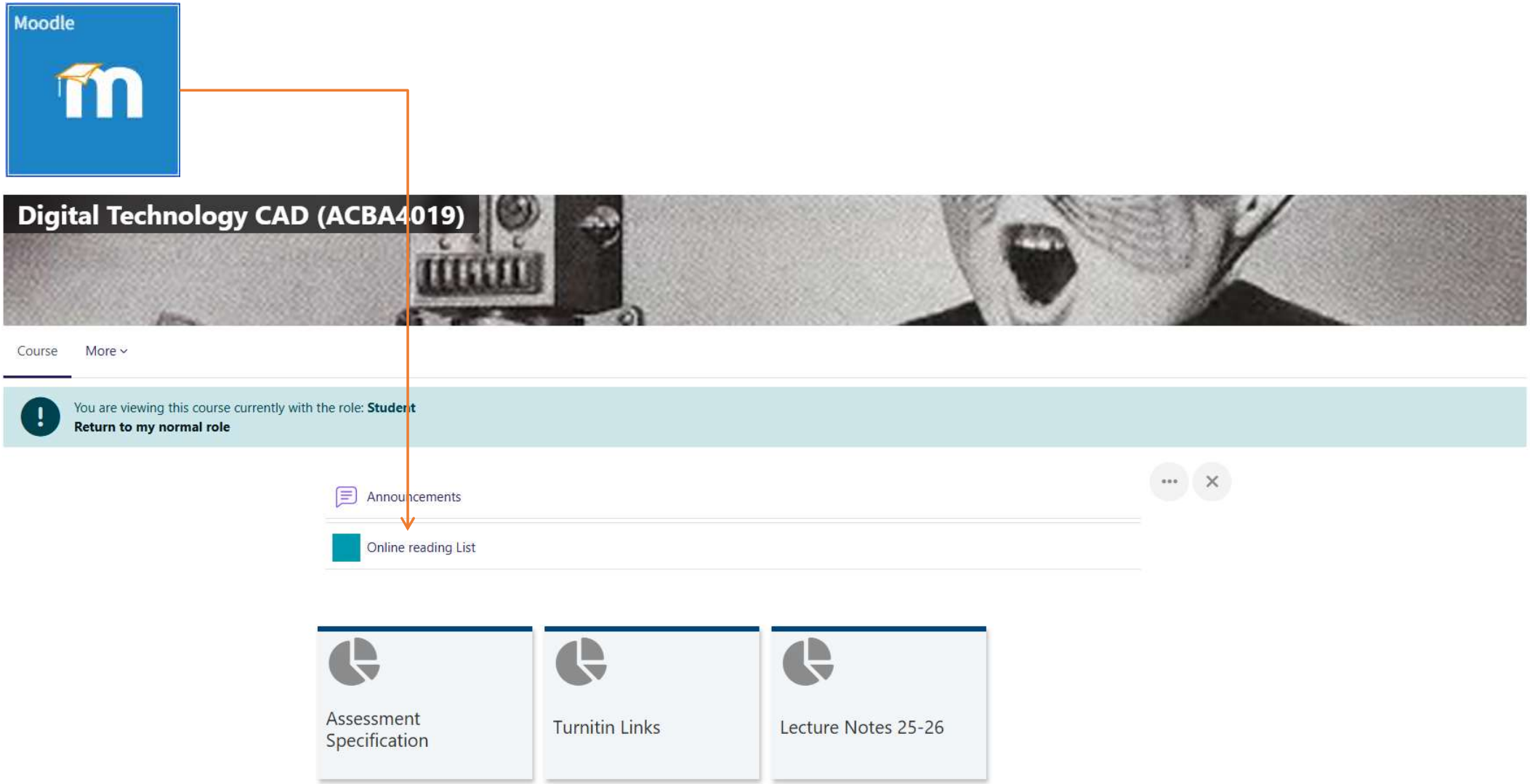
24% Scheduled Learning and <u>76% Independent Learning</u>

| Assessment Component 1 | | |
|---|---|---|
| **Mode of Assessment** | **Word Limit** | **Weighting** |
| Portfolio | 2 elements (2,000 words equivalent with drawings) | 100% |



# Moodle - Reading List



Digital Technologies CAD (ACBA4019) Draft ACBA4019 (202... List info

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Essential reading (7)

Material which is an essential part of the course and students are expected to draw on as a core part of their learning. Must be available from the library and should be available online.

**Architectural graphics**

Book | Ching, Francis D. K.., Sixth edition., Hoboken :, John Wiley & Sons, 2015., Total pages 1 volume :

Essential

Available at Swansea Campus Y Fforwm Library Main Collection: 720.284 CHI

**Architectural graphics**

E-book | Ching, Francis D. K.., Great Britain :, Elsevier Science, 1975., Total pages 1 online resource

Essential

View online

**Autocad for dummies**

Book | Grabowski, Ralph,, Ralph Grabowski author, Nineteenth edition., Hoboken, NJ :, John Wiley and Sons, [2...

Essential

View online Available at Swansea Campus Y Fforwm Library Main Collection: 620.00420285 GRA

**AutoCAD 2014 for dummies [electronic resource]**

E-book | Fane, Bill., Byrnes, David,, Hoboken, NJ :, John Wiley & Sons, c2013., Total pages 1 online resource (93...

Note: Basic AutoCAD has not changed a great deal over the years. Although some features may change in later versions, the content in the free E book is very relevant to this module.

Essential

Supplementary Reading List.

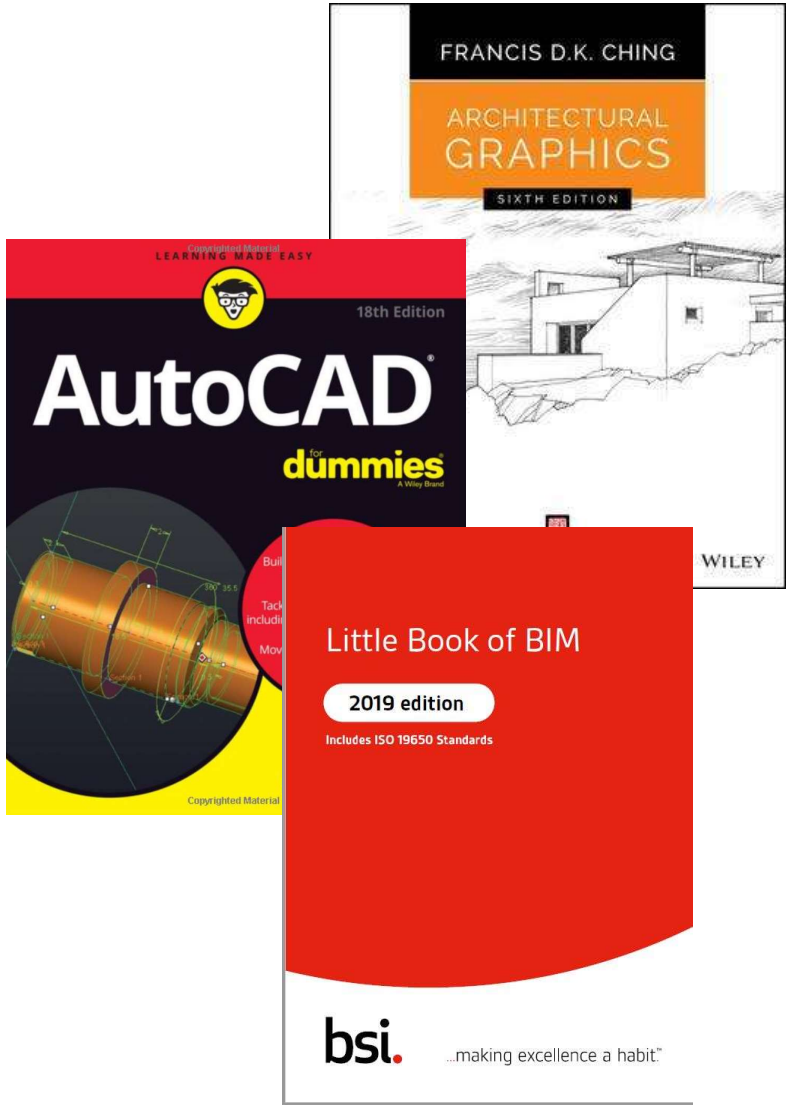
Drawing:
Francis Ching (2015) *Architectural Graphics*
Chudley, Greeno, Merritt (2016) *Building Construction Handbook*
Reid, E (2016) *Understanding Buildings*

2D CAD:
Guide to AutoCAD (moodle)
AutoCAD for Dummies
https://academy.autodesk.com/

3D Modelling:
Guide to Revit (moodle)
https://academy.autodesk.com/
Revit Tutorials - Youtube.

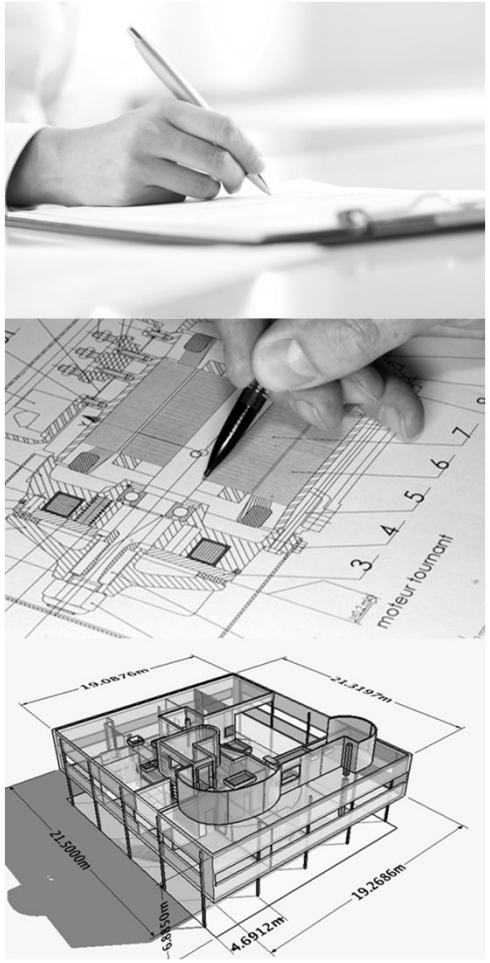
BIM:
Key BIM Standards, ISO and PAS – refer to 'Little Book of BIM' guide.
BSi (2019) *The Little Book of BIM (later versions also appropriate)*
BSi (2019) *Introduction to the New International Standard ISO 19650*

https://bimblog.house/ Dan Rossiter (BSi)



Week 1:

Introduction to technical drawing techniques used within the Construction Industry and an overview of 2D Computer Aid Draughting with AutoCAD.

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Cave Paintings Argentina
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Cave Paintings France
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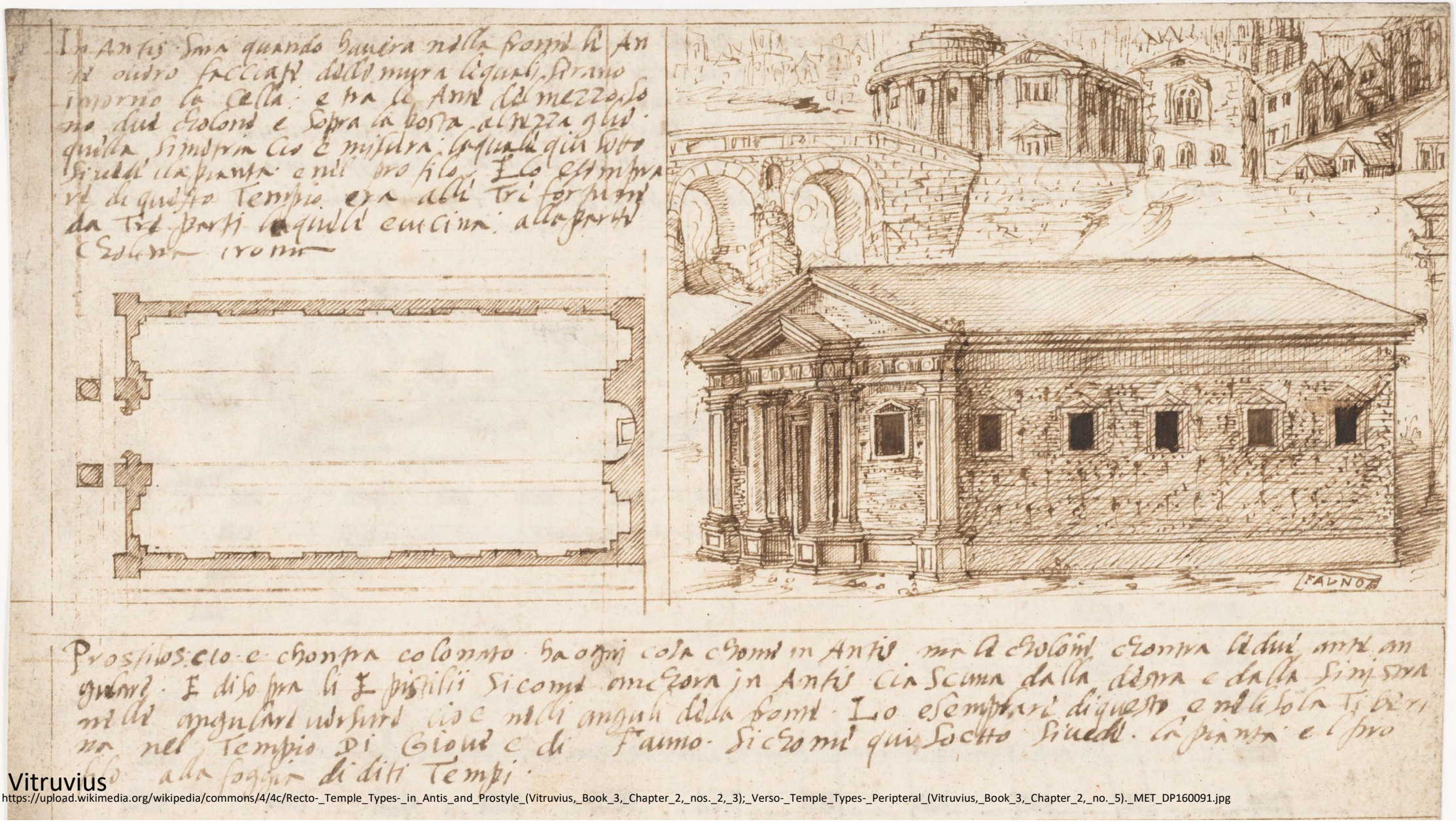


Vitruvius

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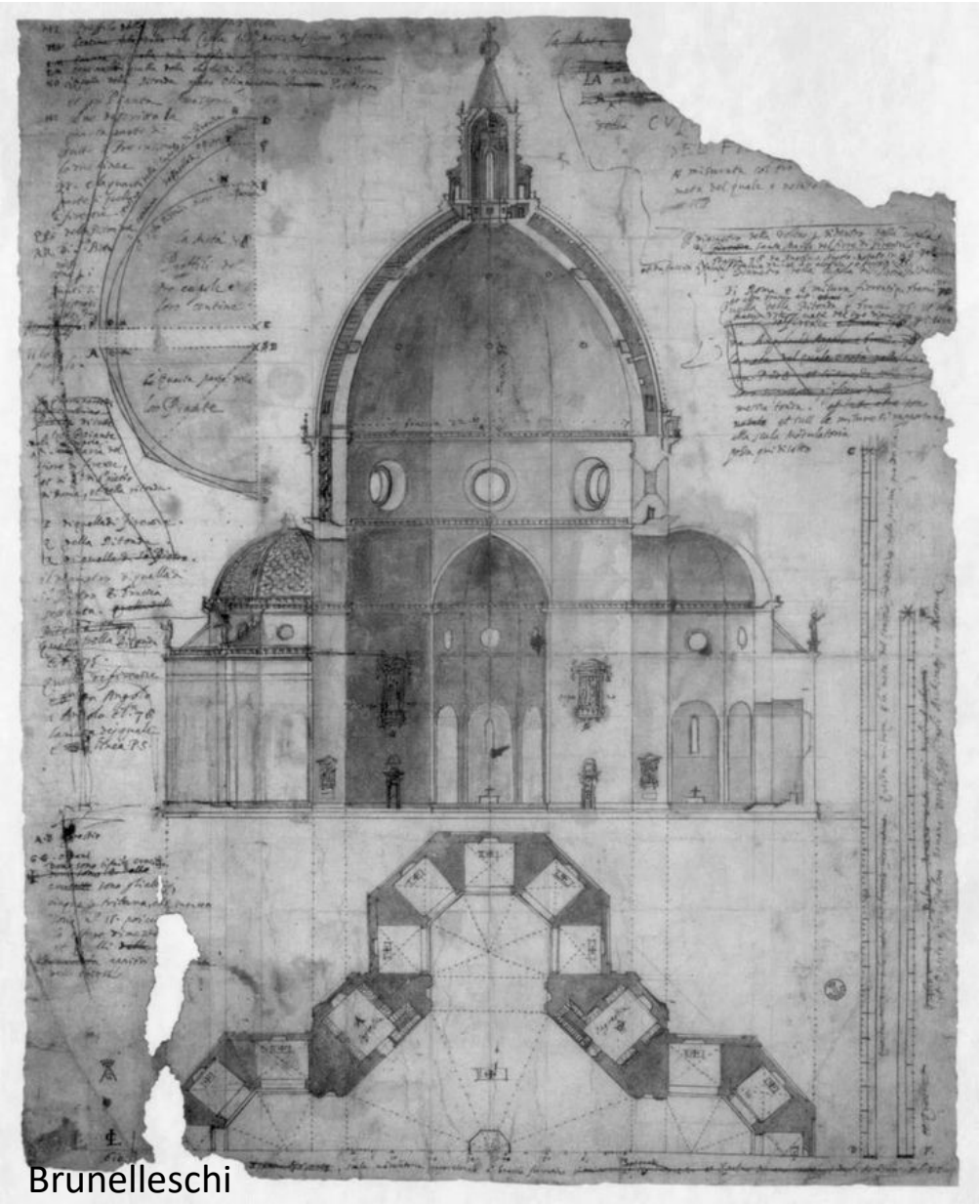


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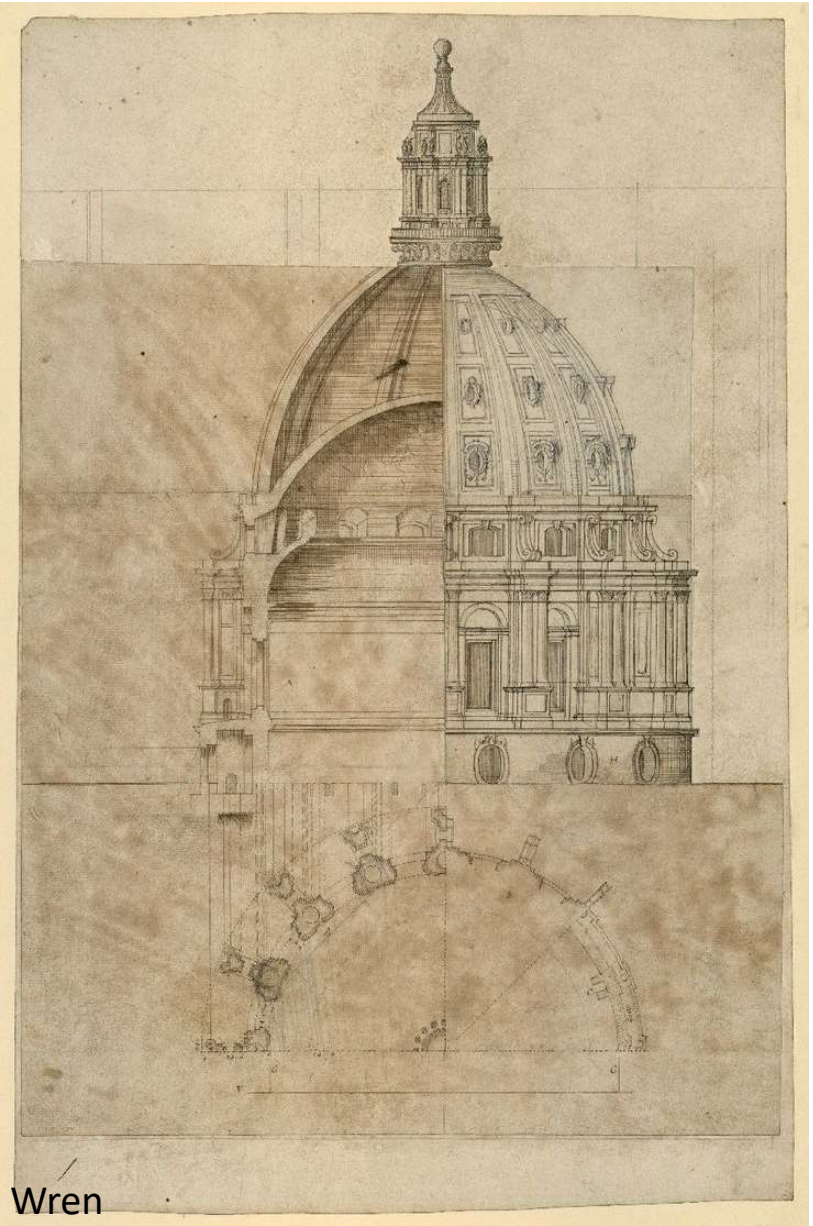


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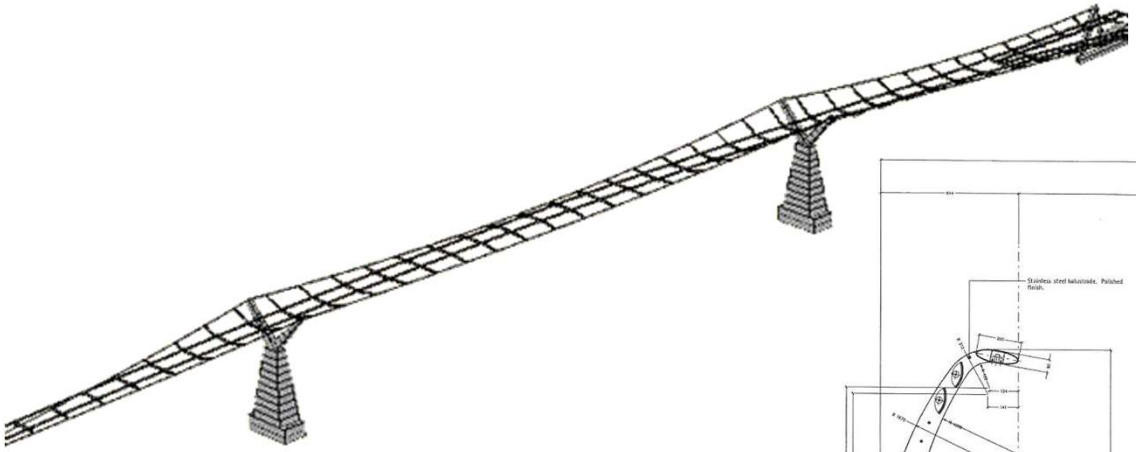

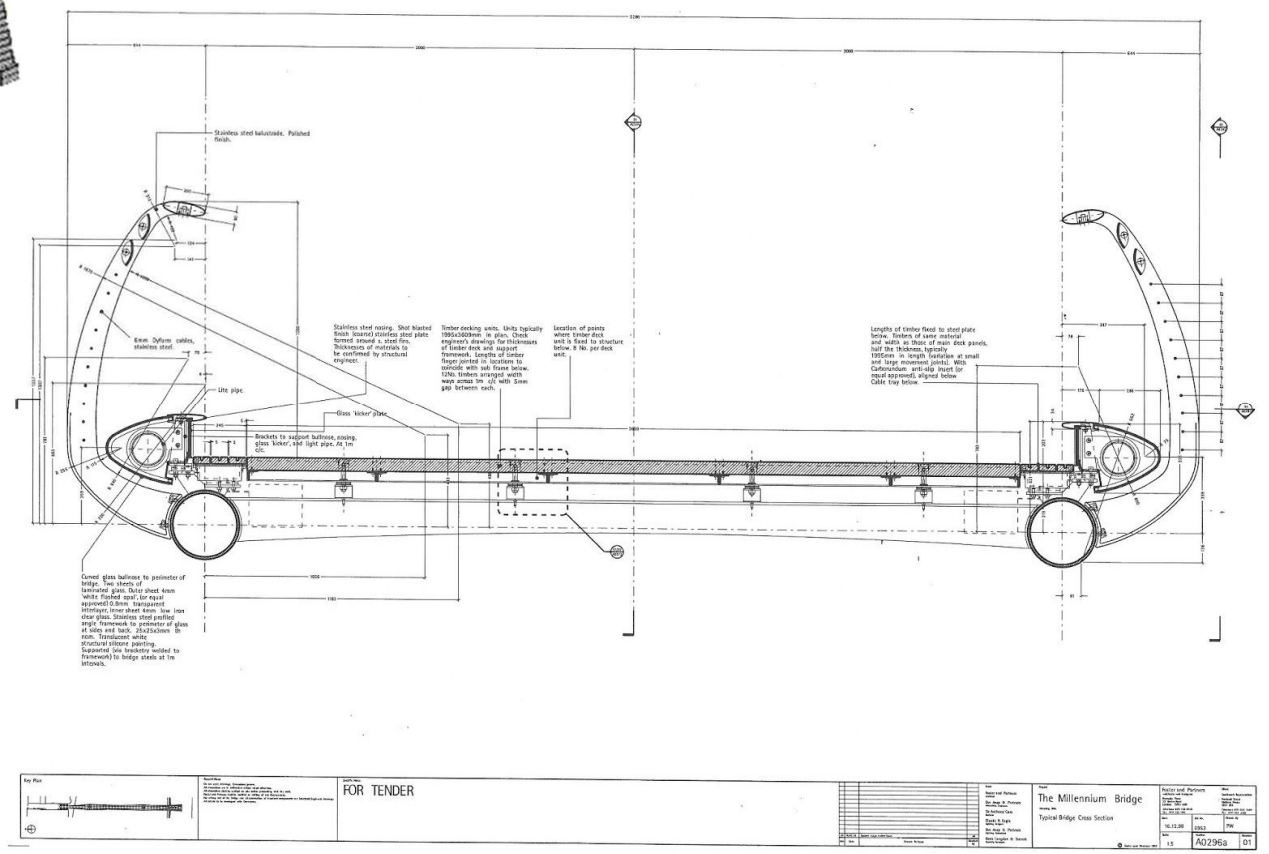


# Arup & Foster

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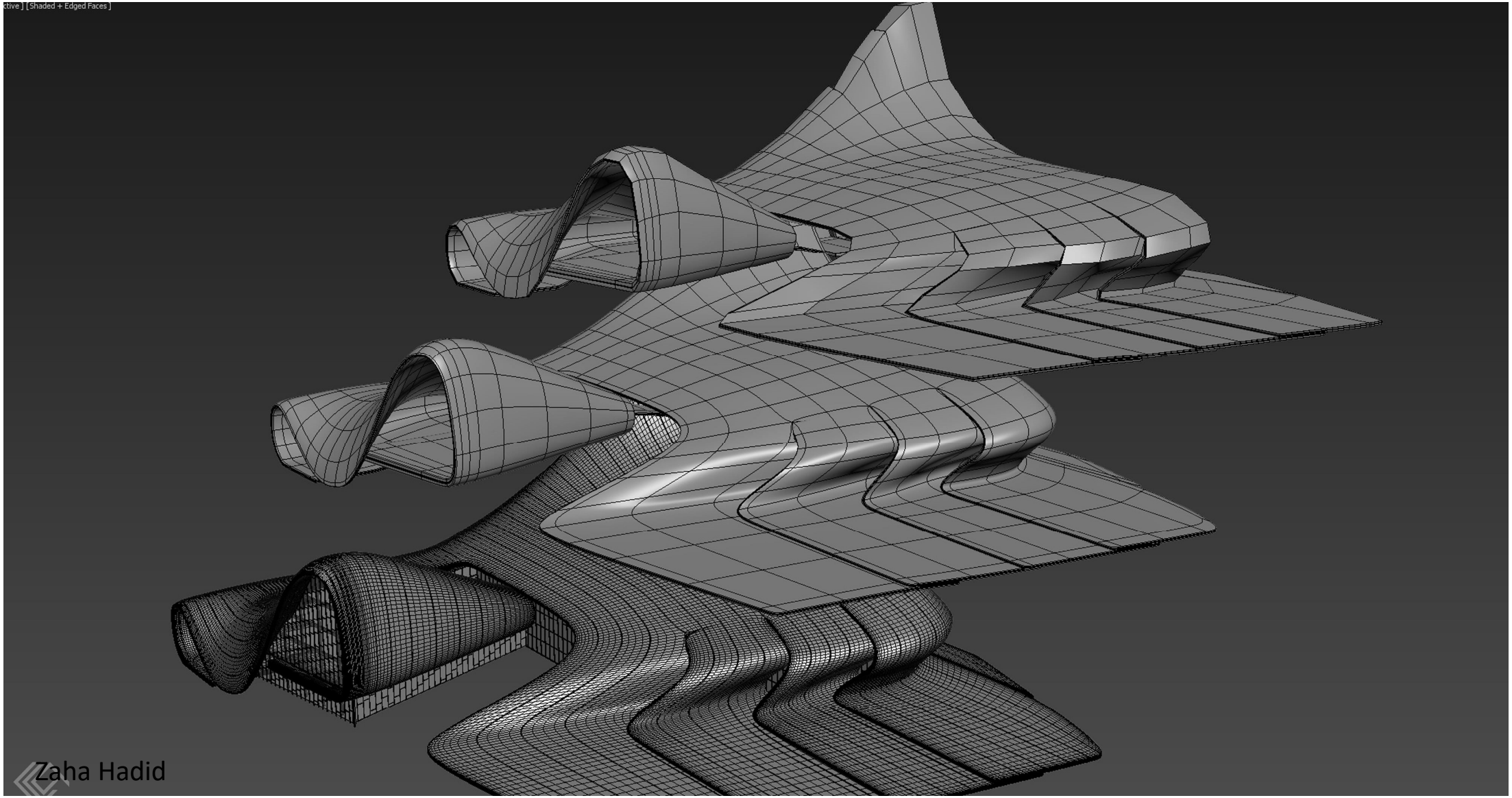


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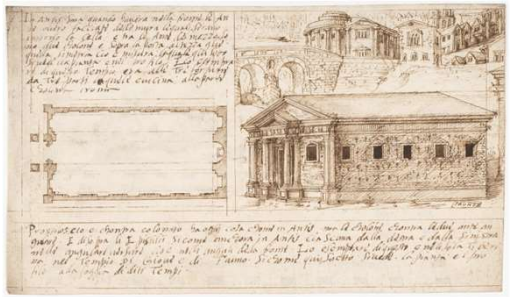
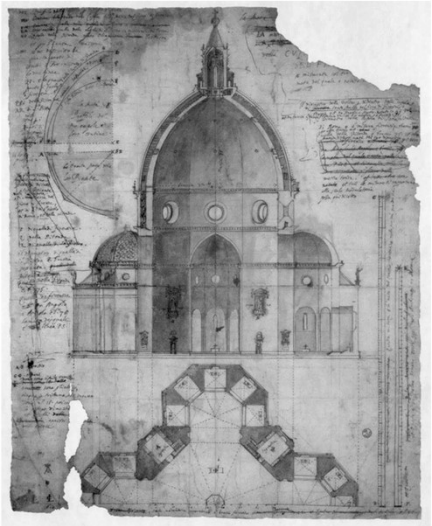
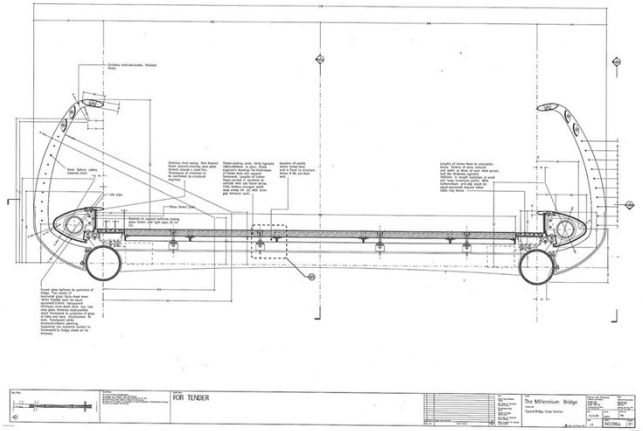
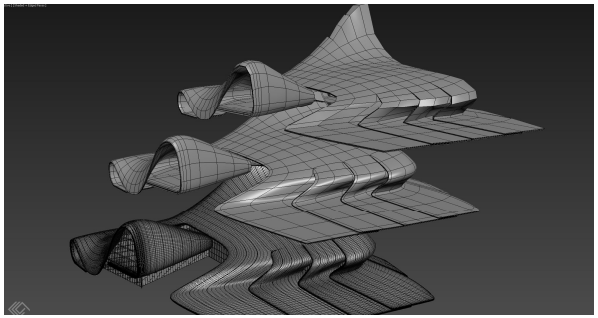
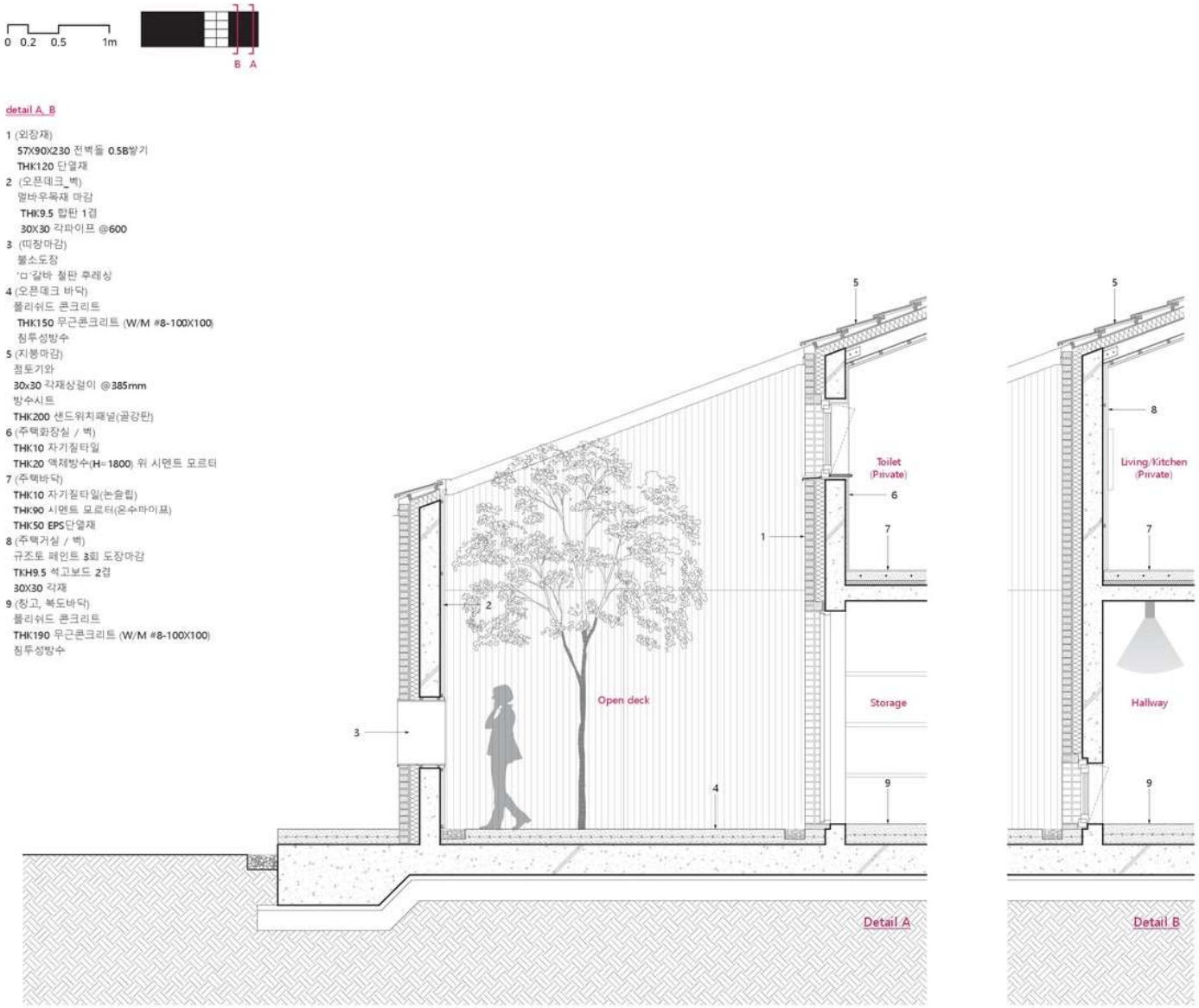
# A picture is worth a thousand words









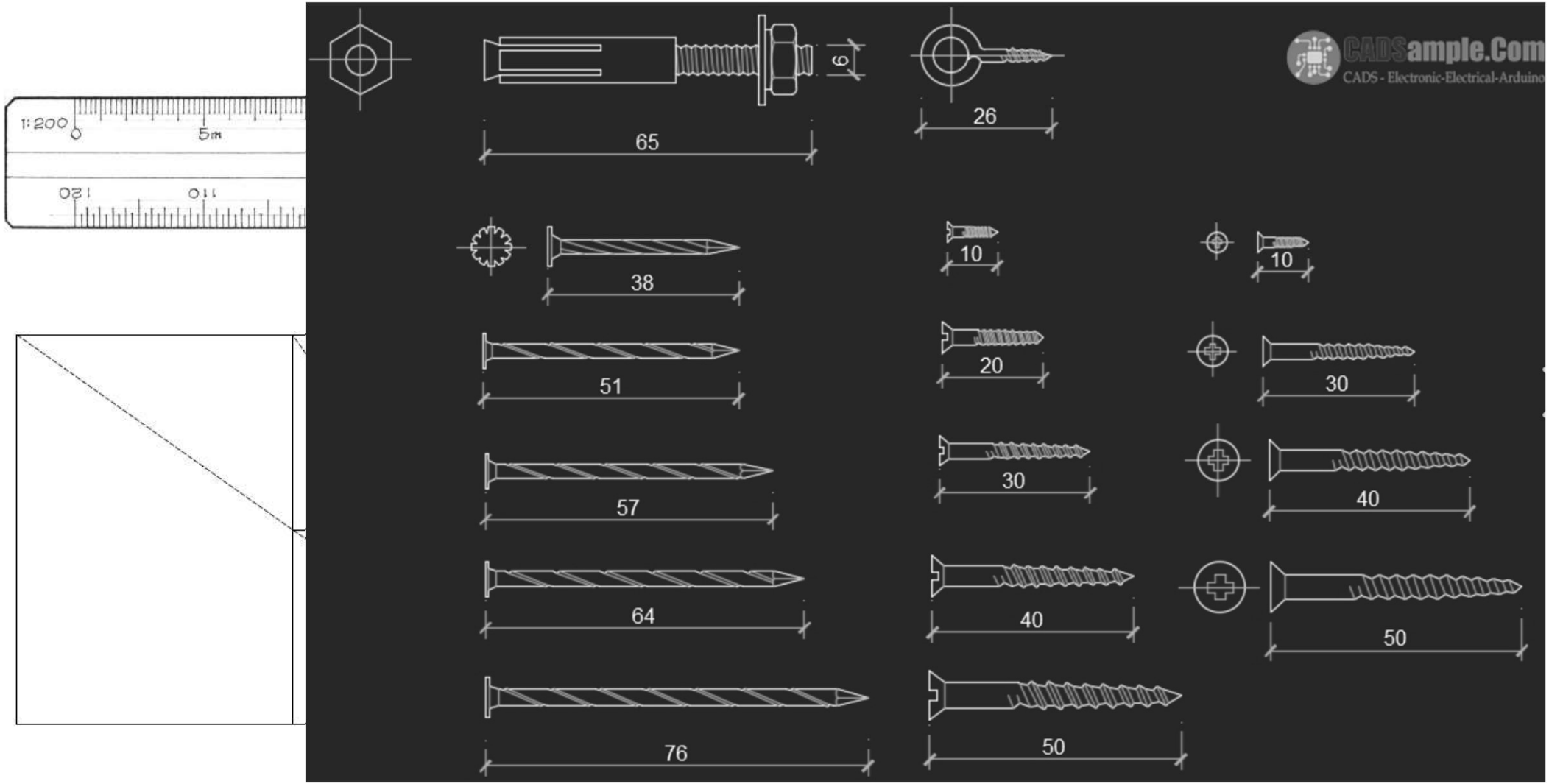

Drawings prepared in the Construction Industry

Must:

- Convey a message
- Read with understanding
- Demonstrate Knowledge
- Convey Ideas
- Explain a Narrative / Story

Industry conventions assist in the legibility of drawn information.

# Appropriate Scale Drawings

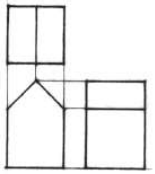


## Conventions

When we study how each projection system represents the same subject, we can see how different pictorial effects result. We categorize these pictorial systems into multiview drawings, paraline drawings, and perspective drawings.

**Projection Systems**

Orthographic Projection

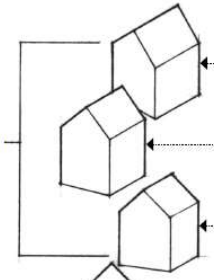


**Pictorial Systems**

**Multiview Drawings**

- Multiview drawings consist of plans, sections, and elevations.
- The principal face in each view is oriented parallel to the picture plane.

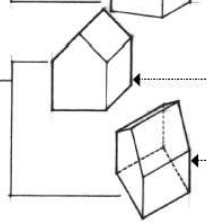
*Axonometric Projection*



**Paraline Drawings**

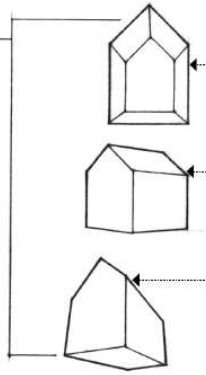
- Isometrics: The three major axes make equal angles with the picture plane.
- Dimetrics: Two of the three major axes make equal angles with the picture plane.
- Trimetrics: All three major axes make different angles with the picture plane.

Oblique Projection



- Elevation obliques: A principal vertical face is oriented parallel to the picture plane.
- Plan obliques: A principal horizontal face is oriented parallel to the picture plane.

Perspective Projection



**Perspective Drawings**

- 1-point perspectives: One horizontal axis is perpendicular to the picture plane while the other horizontal axis and the vertical axis are parallel with the picture plane.
- 2-point perspectives: Both horizontal axes are oblique to the picture plane and the vertical axis remains parallel with the picture plane.
- 3-point perspectives: Both horizontal axes as well as the vertical axis are oblique to the picture plane.

These pictorial views are available in most 3D CAD and modeling programs. The terminology, however, may differ from what is presented here.

Orthographic Projection

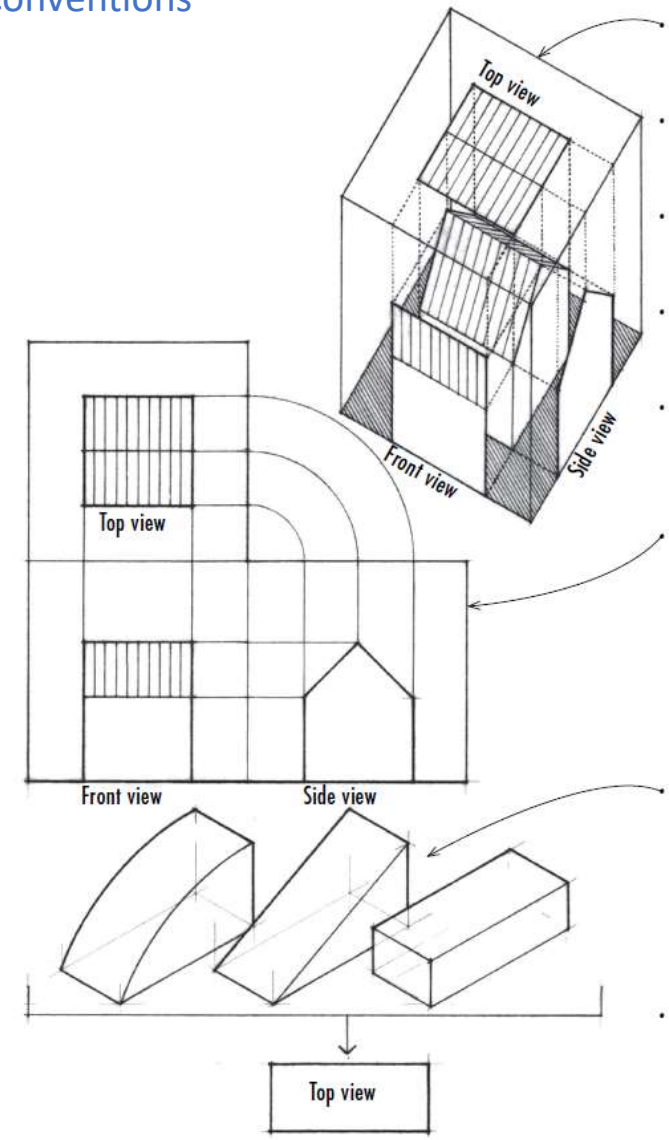
Drawings the can be prepared through orthographic projection to produce WHAT?

PLANS

SECTIONS

ELEVATIONS

## Conventions



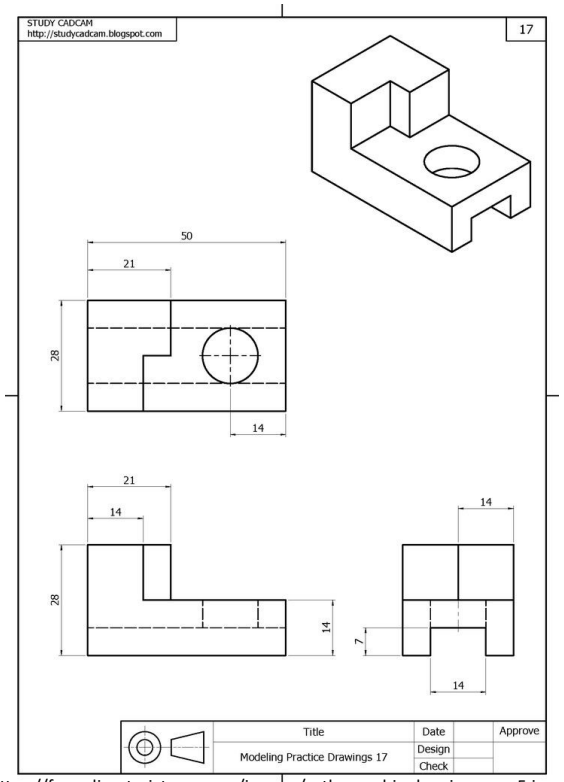

- If we enclose an object within a transparent picture-plane box, we can name the images projected orthographically onto the principal picture planes.
- Top views are orthographic projections cast onto the horizontal picture plane. In architectural drawing, top views are called plans.
- Front and side views are orthographic projections cast onto the vertical picture planes. In architectural drawing, front and side views are called elevations.
- See Chapter 4 for floor plans and sections, which are orthographic projections of cuts made through a building.

- To make it easier to read and interpret how a series of orthographic projections describe a three-dimensional whole, we arrange the views in an orderly and logical fashion.
- The most common layout results when we unfold the transparent picture-plane box into a single plane represented by the drawing surface. The top or plan view revolves upward to a position directly above and vertically aligned with the front or elevation view, while the side view revolves to align horizontally with the front view. The result is a coherent set of related orthographic views.

- Although these three objects have different forms, their top views appear to be identical. Only by looking at related orthographic projections are we able to understand the three-dimensional form of each object. We should therefore study and represent three-dimensional forms and constructions through a series of related orthographic projections.
- The mind must be able to read and assemble a set of multiview drawings to fully understand the nature of the three-dimensional subject.

## Orthographic Projection

CAD Packages can assist us to create multiple view of the same object through projection

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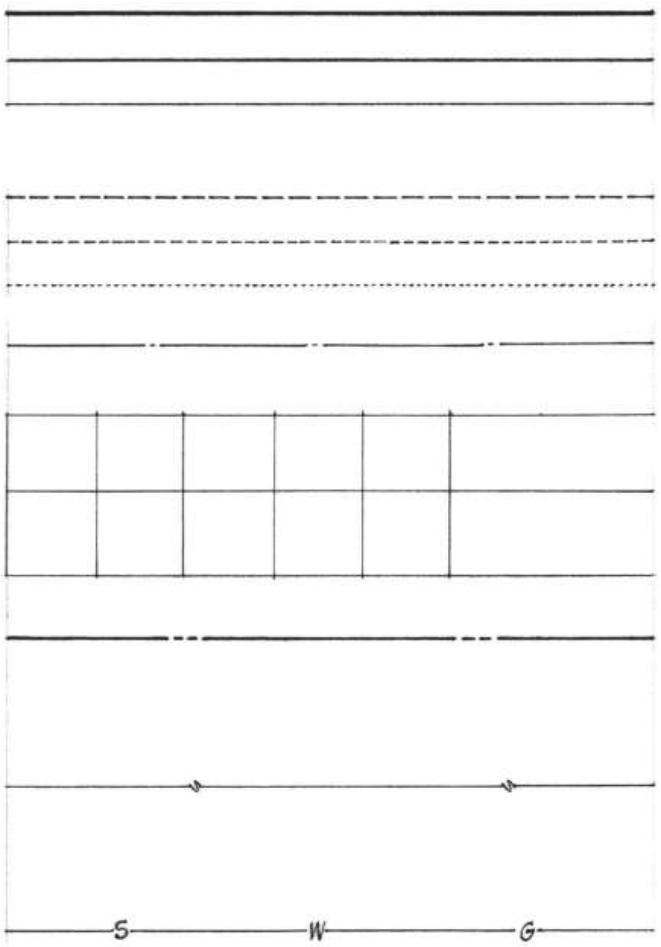
## Conventions - Lines




- Solid lines delineate the form of objects, such as the edge of a plane or the intersection of two planes. The relative weight of a solid line varies according to its role in conveying depth.
- Dashed lines, consisting of short, closely spaced strokes, indicate elements hidden or removed from our view.
- Centerlines, consisting of thin, relatively long segments separated by single dashes or dots, represent the axis of a symmetrical object or composition.
- Grid lines are a rectangular or radial system of light solid lines or centerlines for locating and regulating the elements of a plan.
- Property lines, consisting of relatively long segments separated by two dashes or dots, indicate the legally defined and recorded boundaries of a parcel of land.
- Break lines, consisting of relatively long segments joined by short zigzag strokes, are used to cut off a portion of a drawing.
- Utility lines consist of relatively long segments separated by a letter indicating the type of utility.

Line type conventions assist in the legibility of drawn information. The quality, thickness, scale and type of line can help communicate the importance of the line.

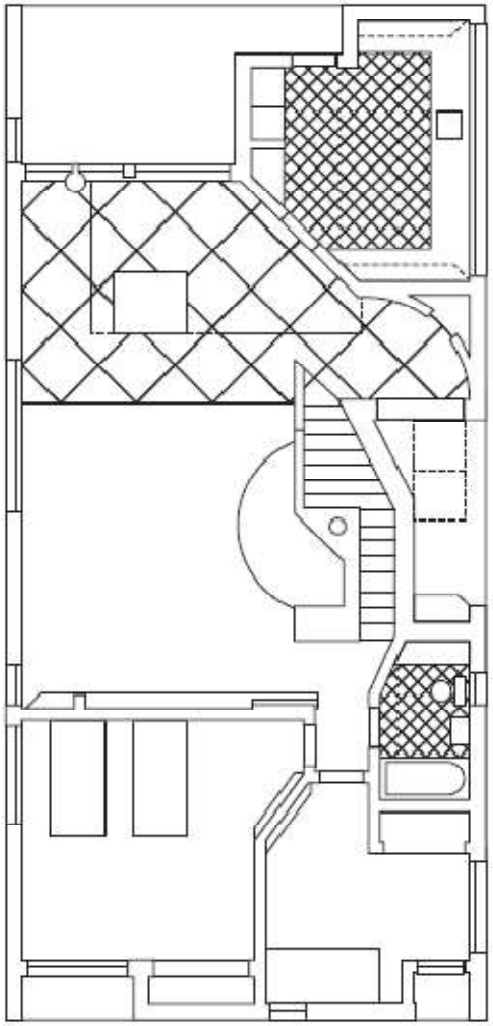
E.G

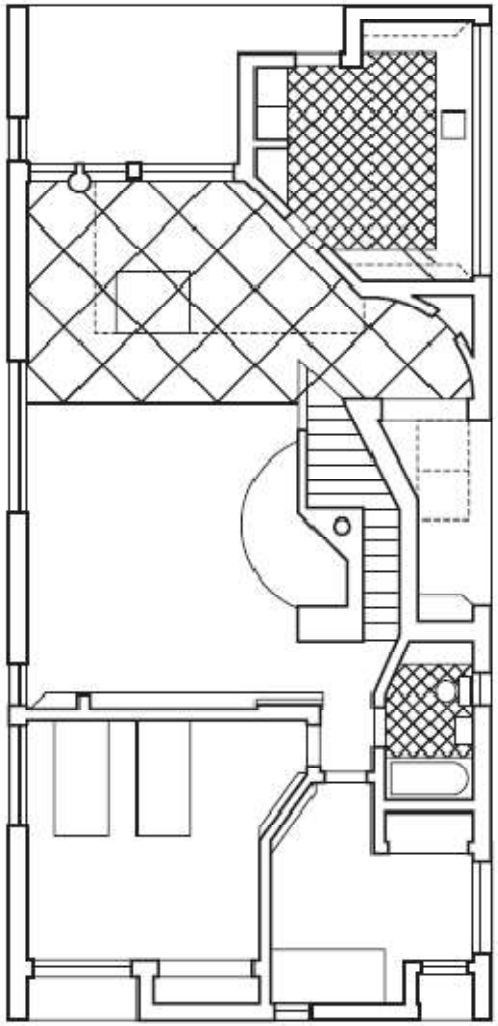
Thick Solid line depicting a section cut.

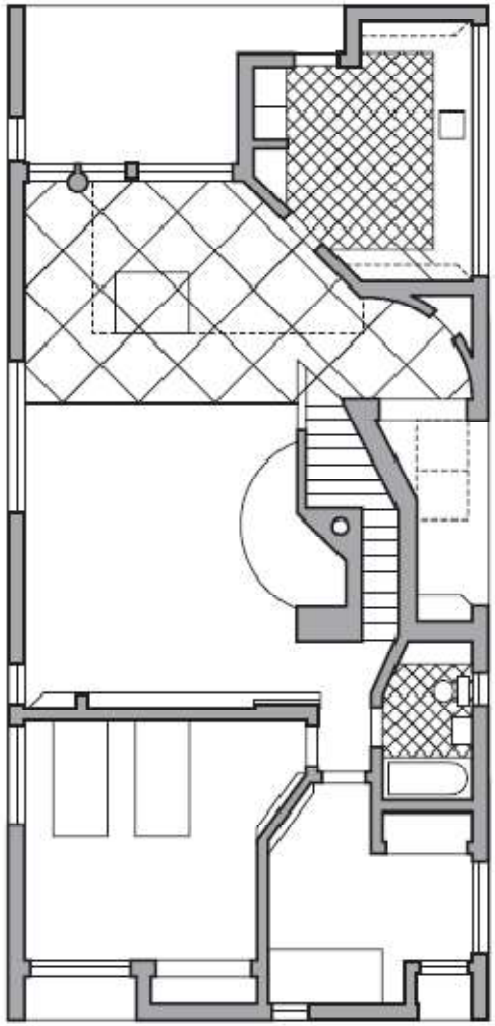
Dashed lines depicting something hidden from view.

Centrelines through steelwork allowing accuracy between column positions.

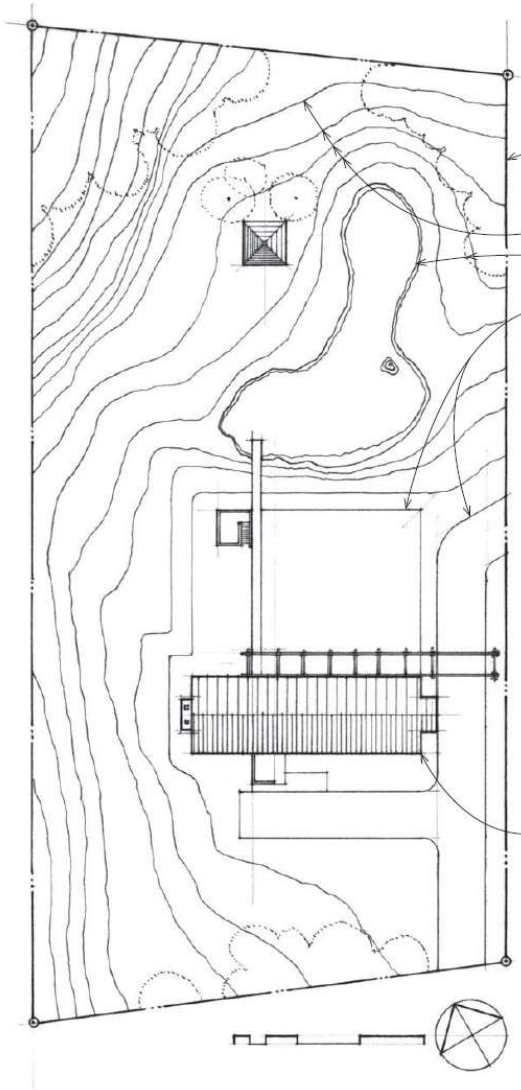
## Conventions - Lines







# Conventions - Plans



A site plan describes the location and orientation of a building or building complex on a plot of land and in relation to its context. Whether this environment is urban or rural, the site plan should describe the following:

- Legally recorded boundaries of the site, indicated by a broken line consisting of relatively long segments separated by two short dashes or dots
- Physical topography of the terrain with contour lines
- Natural site features, such as trees, landscaping, and watercourses
- Existing or proposed site constructions, such as walks, courts, and roadways
- Architectural structures in the immediate setting that impact the proposed building

In addition, a site plan may include:

- Legal constraints, such as zoning setbacks and rights-of-way
- Existing or proposed site utilities
- Pedestrian and vehicular entry points and paths
- Significant environmental forces and features

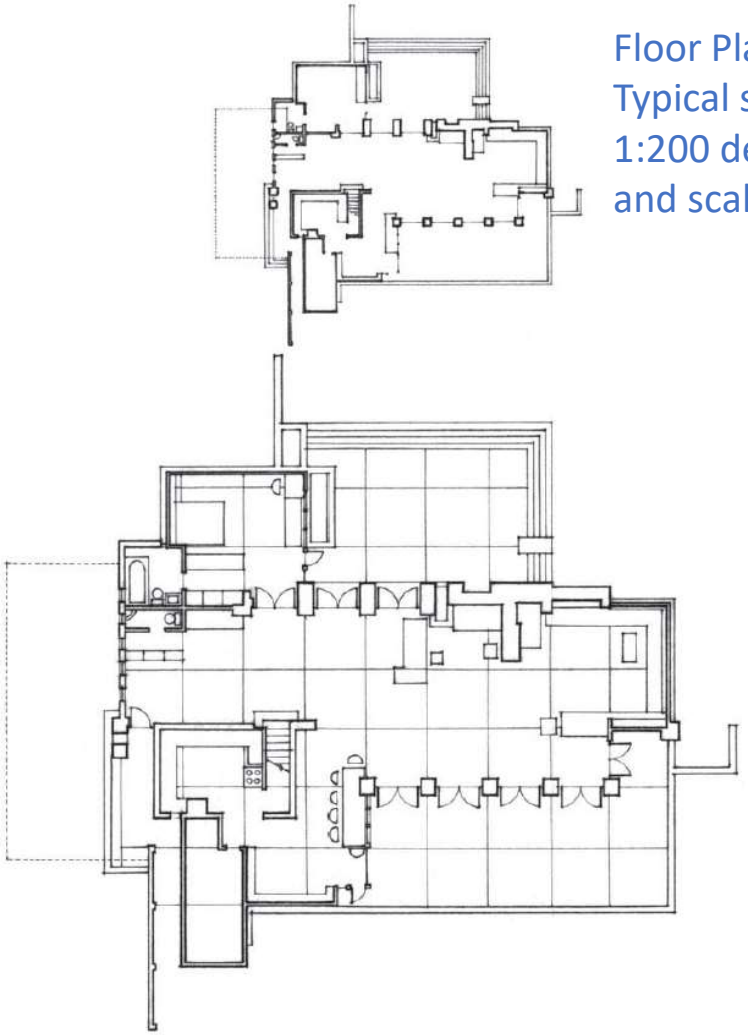
**Roof Plans**

A roof plan is a top view describing the form, massing, and material of a roof or the layout of such rooftop features as skylights, decks, and mechanical housings.

- Roof plans are typically included in the site plan for a proposed building or building complex.

## Site Plans
## Typical scale 1:1250 / 1:500

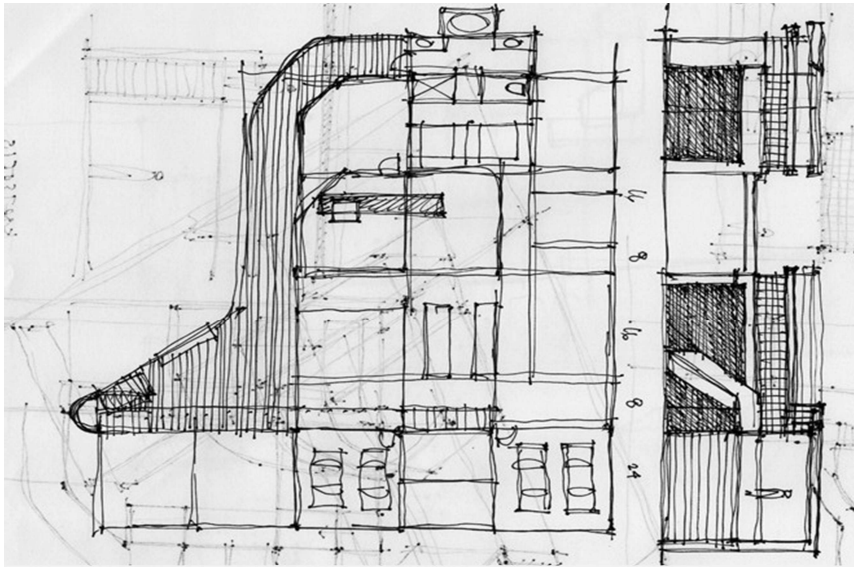
- Graphic scale designates the scale of the site plan and a north arrow indicates the orientation of the site.

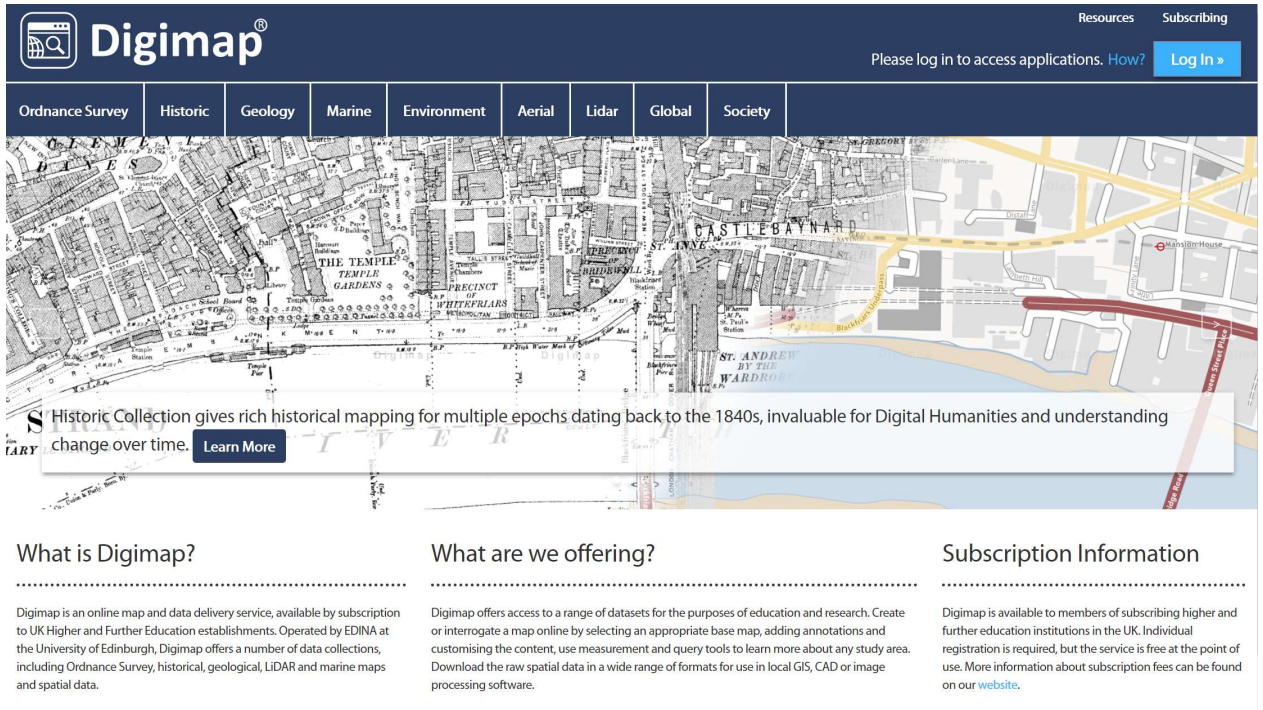


## Floor Plans
## Typical scales 1:100 / 1:200 depending on size and scale of the building.

## Conventions – Plans

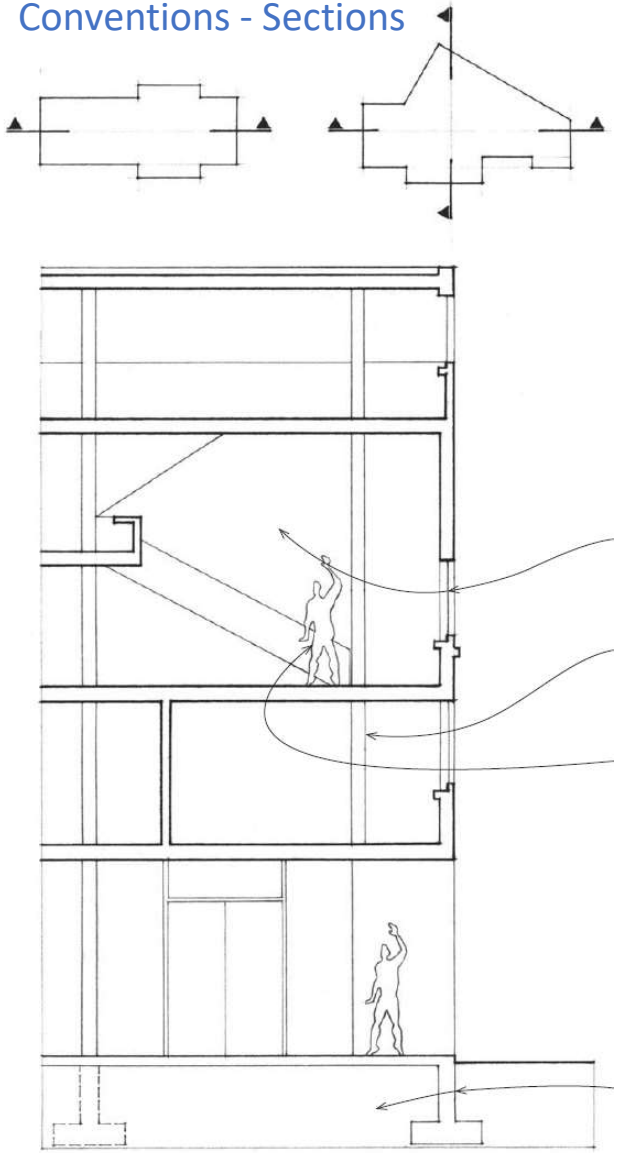
Plans may be produced by a Surveyor from measuring and / or in combination with Ordinance Survey Information.

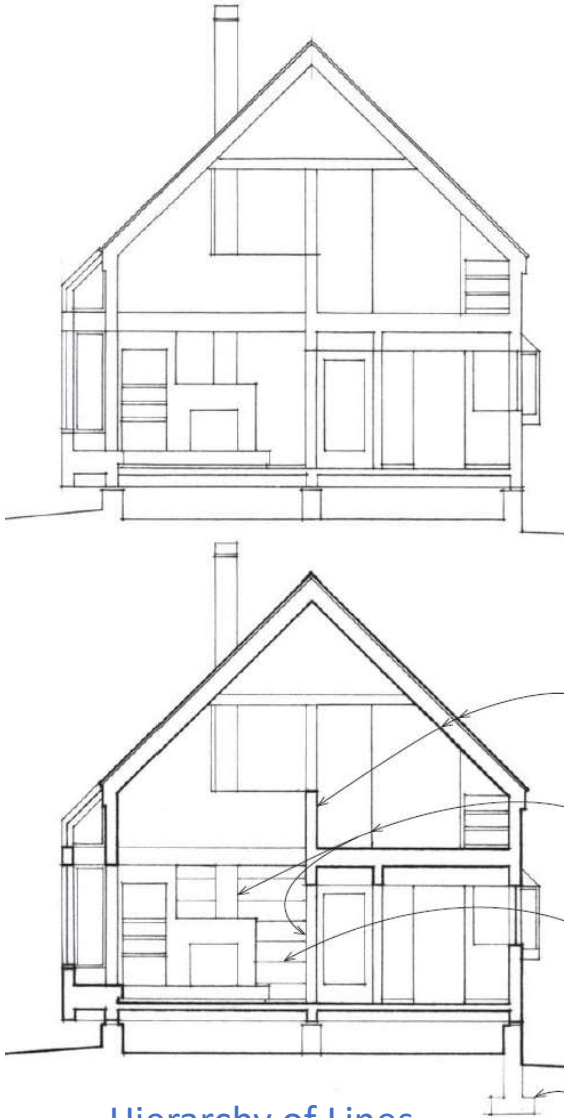





https://digimap.edina.ac.uk/

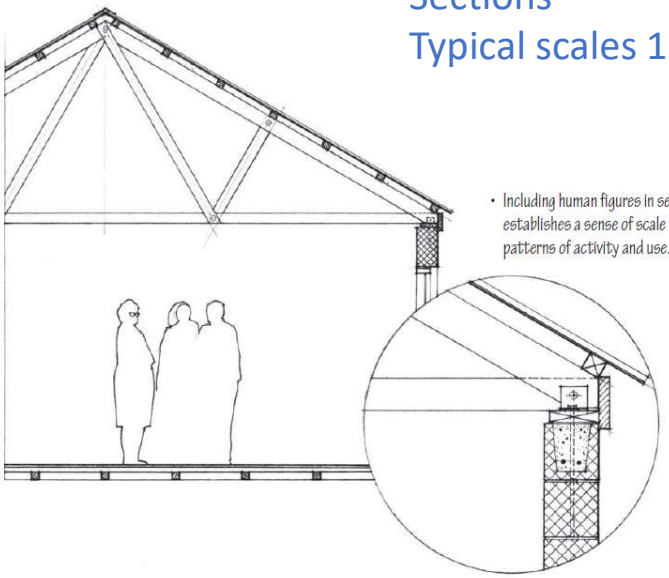
## Conventions - Sections



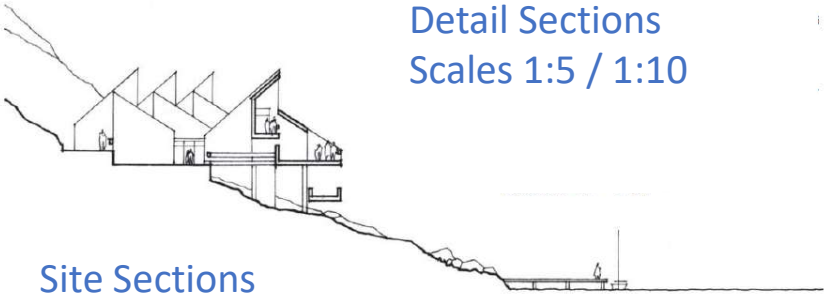


Hierarchy of Lines

## Sections
## Typical scales 1:20 / 1:50

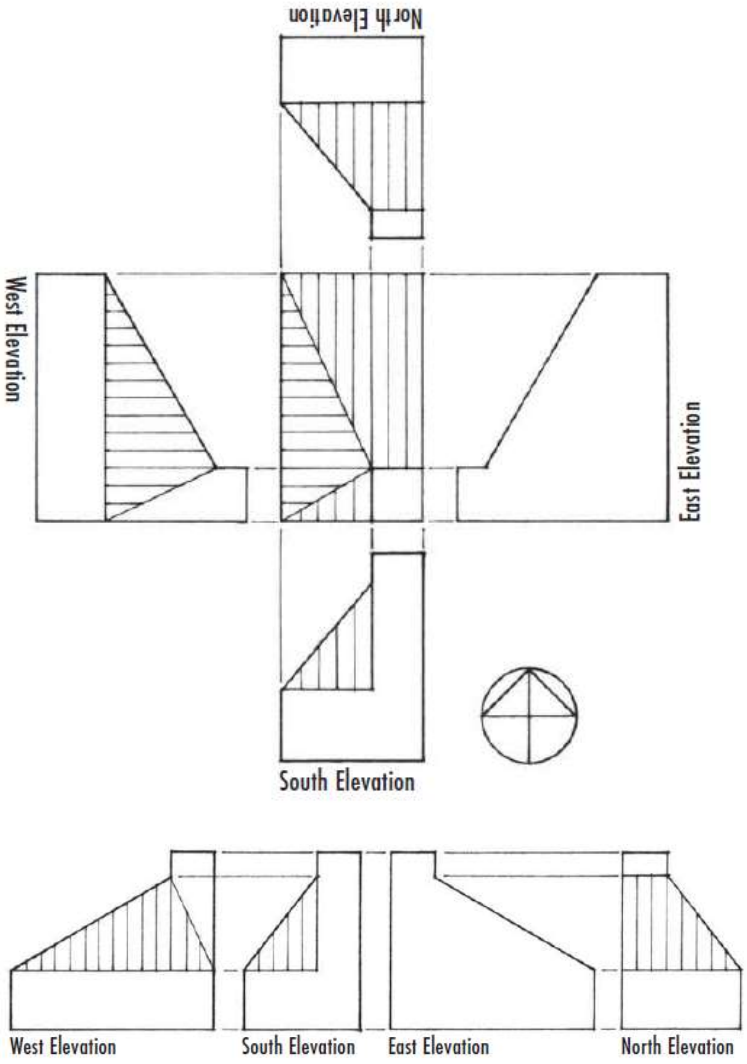



## Detail Sections
## Scales 1:5 / 1:10

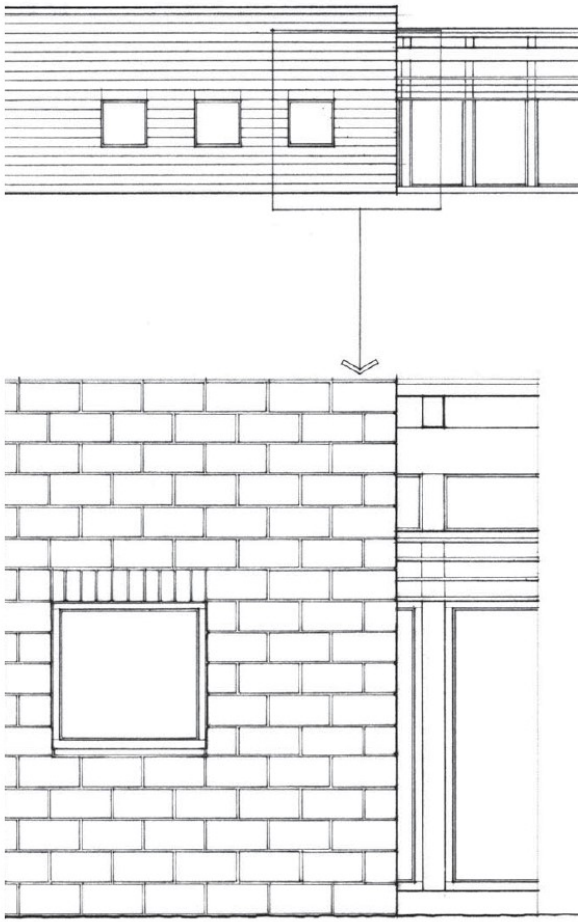


## Site Sections
## Scale 1:200 / 1:500

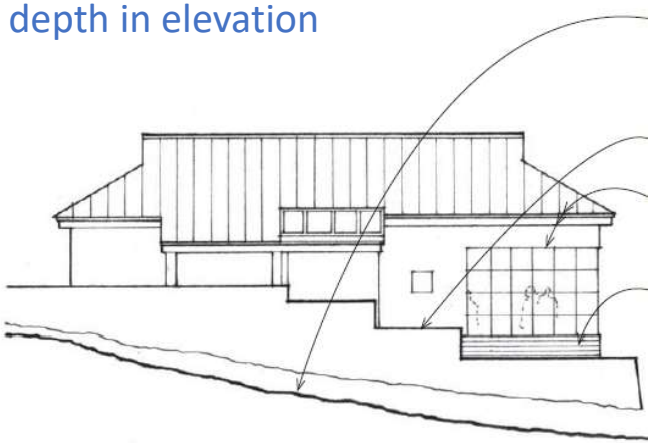
## Conventions - Elevations



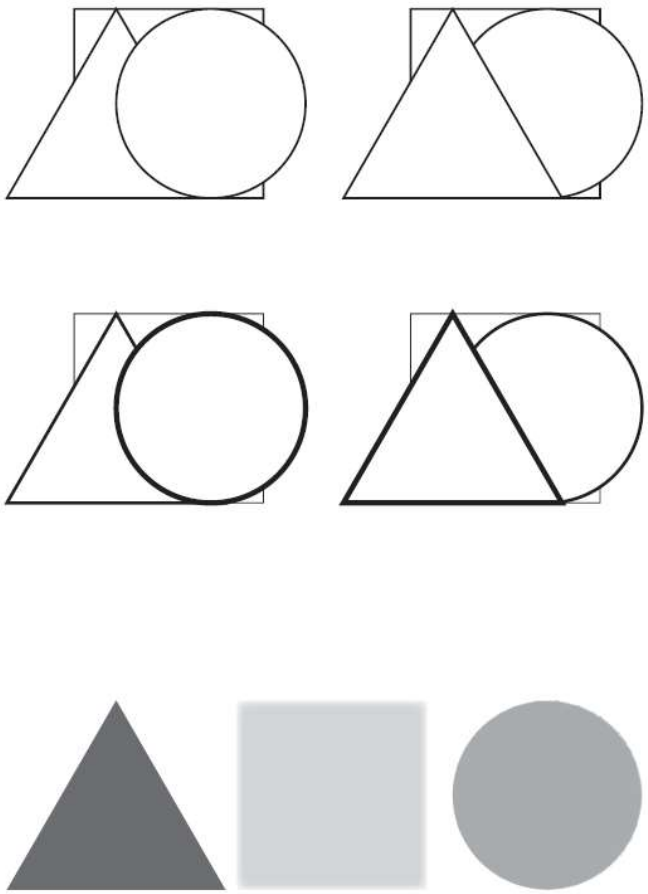

Elevations are normally drawn in a scale relative to the floor plans. 1:100 Further detail can be emphasised at a larger scale. (1:50)



Hierarchy of Lines, showing depth in elevation



# Conventions - Depth



## Spatial Depth Cues

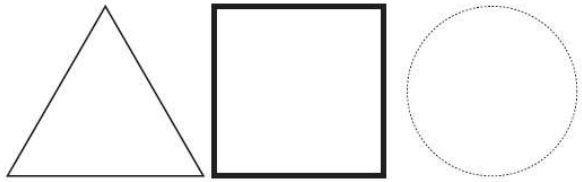
The examples on the previous two pages illustrate the use of varying line weights and detail to convey a sense of spatial depth in the drawing of building elevations. This series of drawings illustrates in a more discrete and abstract way how visual cues can enhance the sense of depth in any orthographic projection.

- Continuity of Outline: We tend to perceive a shape as being in front of another when it has continuity of outline and disrupts the profile of the other shape. Since this visual phenomenon relies on nearer objects overlaying or projecting in front of objects farther away, we often refer to this depth cue simply as overlap.

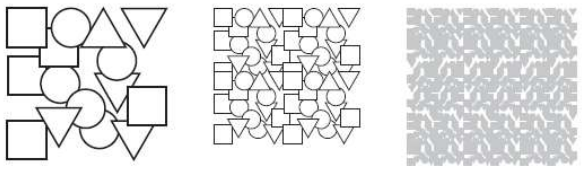
- By itself, overlap tends to create relatively shallow intervals of space. However, we can achieve a greater sense of intervening space and depth if we combine overlap with other depth cues, such as by varying the line weights of a pure-line drawing. Darker and thicker profile or contour lines tend to advance and appear to be in front of lighter and thinner outlines.

- Atmospheric Perspective: A progressive muting of hues, tonal values, and contrast occurs with increasing distance from the observer. Objects seen up close in the foreground of our visual field typically possess more saturated colors and sharply defined contrasts in value. As they move farther away, their colors become lighter in value and more subdued, and their tonal contrasts more diffuse. In the background, we see mainly shapes of grayed tones and muted hues.

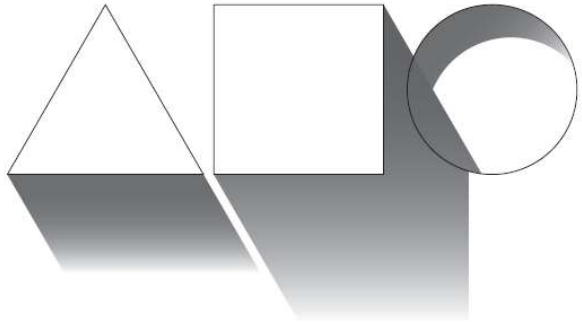
- Perspective of Blur: This depth cue reflects the fact that we normally associate clarity of vision with nearness and blurring of outlines with farness. The graphic equivalent of perspective blur is a diminishing or diffusion of the edges and contours of more distant objects. We can use either a lightly drawn line or a broken or dotted line to delineate these edges of shapes and contours of forms that exist beyond the focus of a drawing.



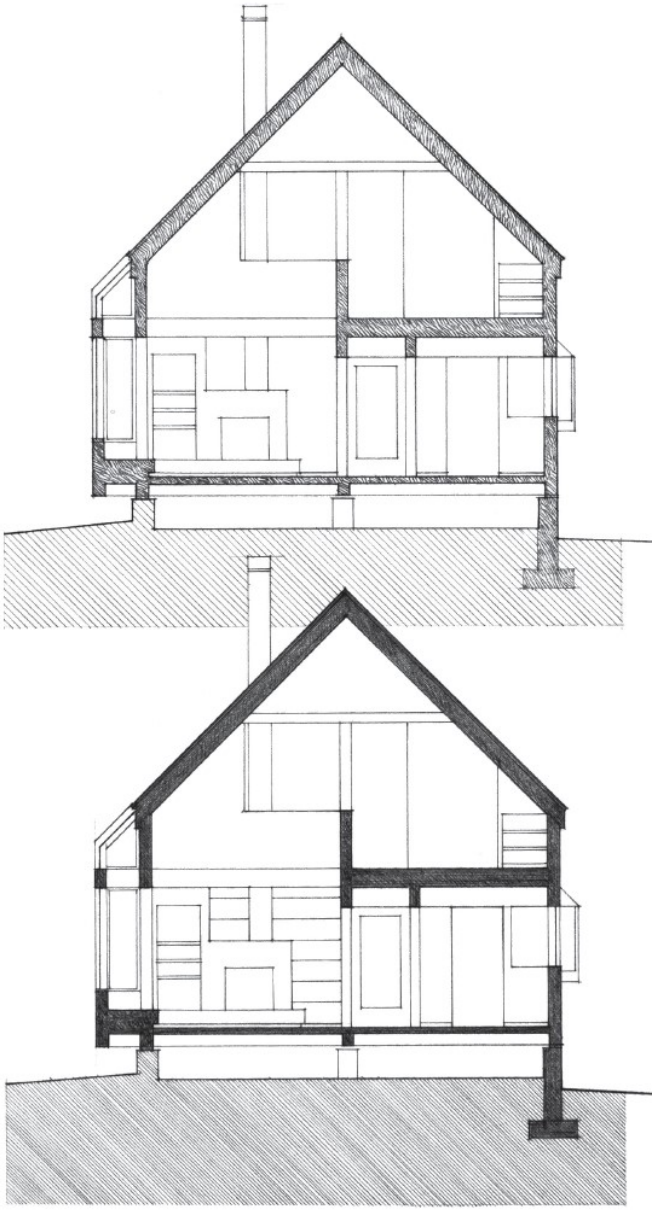
- Texture Perspective: The density of the texture of a surface gradually increases as it recedes into the distance. The graphic technique for depicting the visual phenomenon of texture perspective involves gradually diminishing the size and spacing of the graphic elements used to portray a surface texture or pattern, whether they be dots, lines, or tonal shapes. Proceed from identifying units in the foreground to delineating a textured pattern in the middleground and finally to rendering a tonal value in the background.



- Light and Shade: Any abrupt shift in brightness stimulates the perception of a spatial edge or profile separated from a background surface by some intervening space. This depth cue implies the existence of overlapping shapes and the use of contrasting tonal values in a drawing. See Chapter 7 for more information on the use of tonal values in architectural graphics.



## Conventions - Depth



CAD Packages can assist in demonstrating spatial depth through hatching.

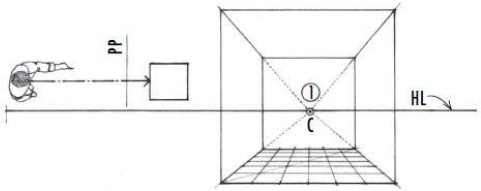
# Other Drawing Types

## TYPES OF PERSPECTIVE

In any rectilinear object, such as a cube, each of the three principal sets of parallel lines has its own vanishing point. Based on these three major sets of lines, there are three types of linear perspective: one-, two-, and three-point perspectives. What distinguishes each type is simply the observer's angle of view relative to the subject. The subject does not change, only our view of it, but the change of view affects how the sets of parallel lines appear to converge in linear perspective.

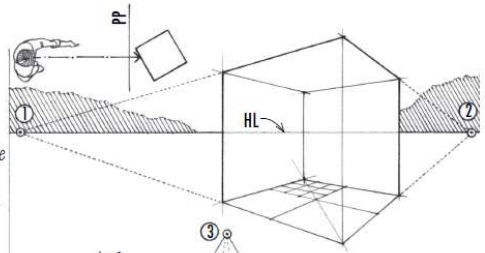
### One-Point Perspective

If we view a cube with our central axis of vision (CAV) perpendicular to one of its faces, all of the cube's vertical lines are parallel with the picture plane (PP) and remain vertical. The horizontal lines that are parallel with PP and perpendicular to CAV also remain horizontal. The lines that are parallel with CAV, however, will appear to converge at the center of vision (C). This is the one point referred to in one-point perspective.



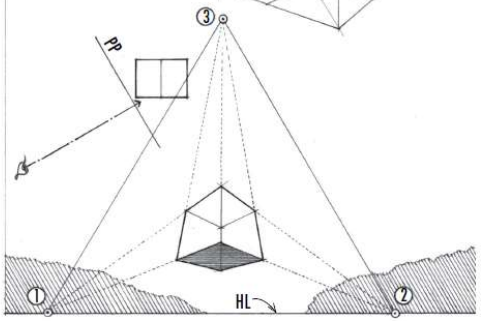

### Two-Point Perspective

If we shift our point of view so that we view the same cube obliquely, but keep our central axis of vision (CAV) horizontal, then the cube's vertical lines will remain vertical. The two sets of horizontal lines, however, are now oblique to the picture plane (PP) and will appear to converge, one set to the left and the other to the right. These are the two points referred to in two-point perspective.

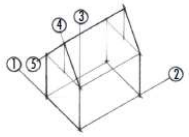



### Three-Point Perspective

If we lift one corner of the cube off the ground plane (GP), or if we tilt our central axis of vision (CAV) to look down or up at the cube, then all three sets of parallel lines will be oblique to the picture plane (PP) and will appear to converge at three different vanishing points. These are the three points referred to in three-point perspective.



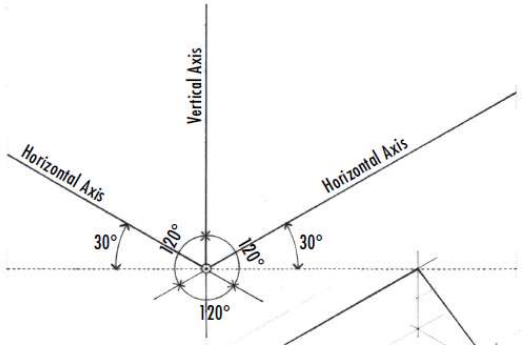

Note that each type of perspective does not imply that there are only one, two, or three vanishing points in a perspective. The actual number of vanishing points will depend on our point of view and how many sets of parallel lines there are in the subject being viewed. For example, if we look at a simple gable-roofed form, we can see that there are potentially five vanishing points, since we have one set of vertical lines, two sets of horizontal lines, and two sets of inclined lines.

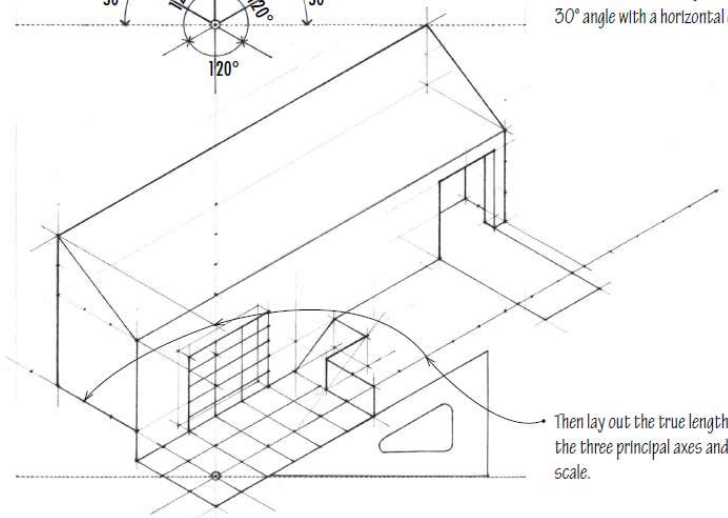



## ISOMETRIC DRAWINGS

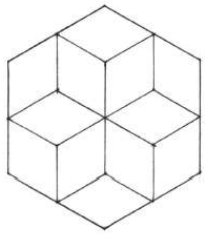
Isometric drawings establish a lower angle of view than plan obliques and give equal emphasis to the three principal sets of planes. They preserve the relative proportions of a subject or scene and are not subject to the distortion inherent in oblique views.

- To construct an isometric drawing, first establish the direction of the three principal axes. Because they are 120° apart on the picture plane, if we draw one axis vertically, the other two axes make a 30° angle with a horizontal on the drawing surface.



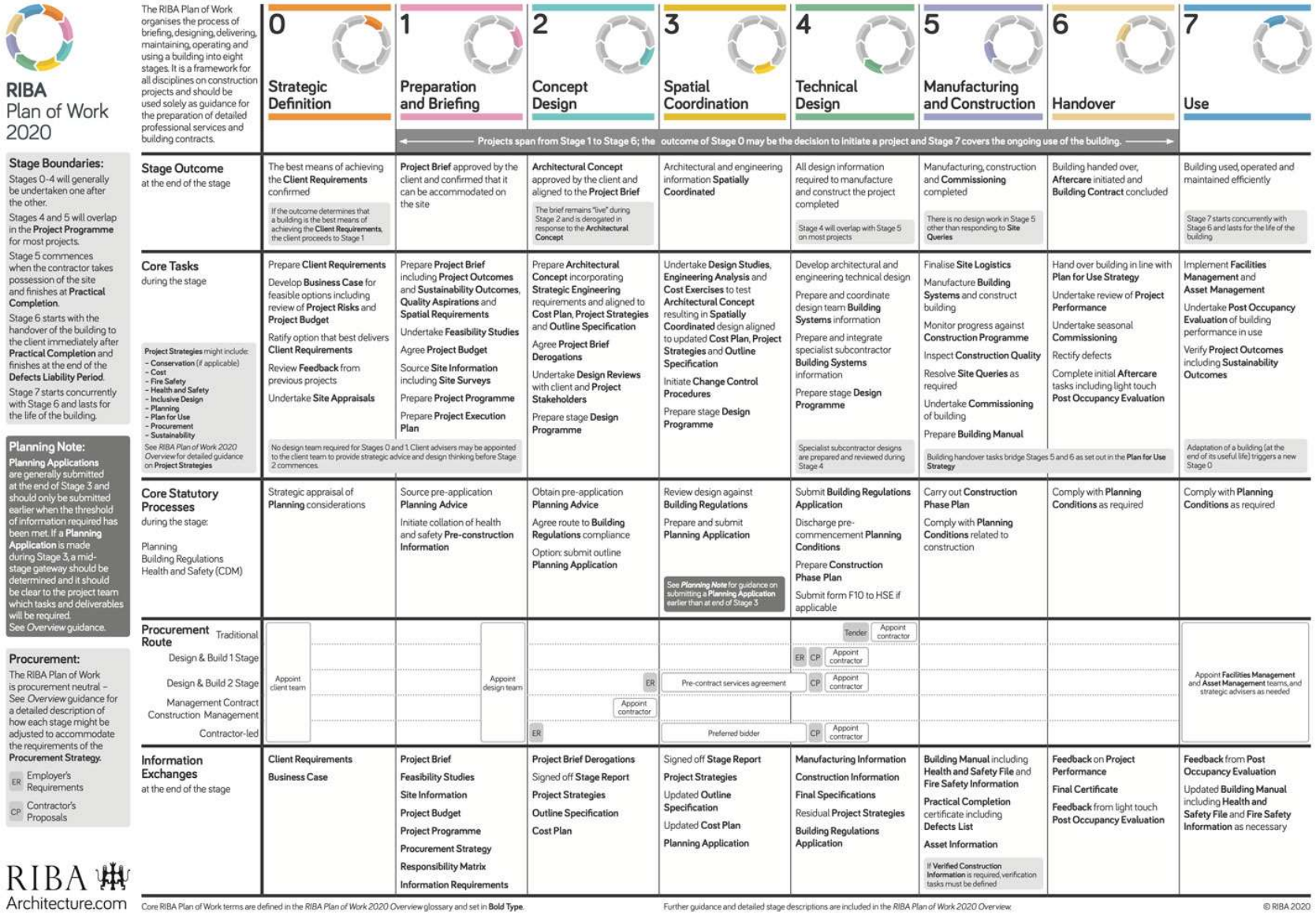



- Then lay out the true lengths of all lines parallel to the three principal axes and draw them to the same scale.



- Isometric drawings of forms based on the square can create an optical illusion and be subject to multiple interpretations. This ambiguity results from the alignment of lines in the foreground with those in the background. In such cases, a plan oblique might be a better choice.

CAD packages can assist in preparing views through snap grids and dynamic 3D modelling.




Drawings prepared in the Construction Industry

Must:

- Convey a message
- Read with understanding
- Demonstrate Knowledge
- Convey Ideas
- Explain a Narrative / Story

Industry conventions assist in the legibility of drawn information.

Type and complexity of the drawings is dependant on the stage of the project.

Typical CAD packages that are used in the Industry.

AUTODESK AUTOCAD

VECTORWORKS®
A NEMETSCHEK COMPANY

GRAPHISOFT®
ARCHICAD

Rhinoceros®

AUTODESK CIVIL3D

SketchUp

AUTODESK®
REVIT®

# Working with AutoCAD

AUTODESK
AUTOCAD

# Download Education Version of AutoCAD

AUTODESK
AUTOCAD

https://www.autodesk.com/education/edu-software/overview?_ga=2.119678017.834319708.1600961686-1615692111.1593105833&sorting=featured&page=1

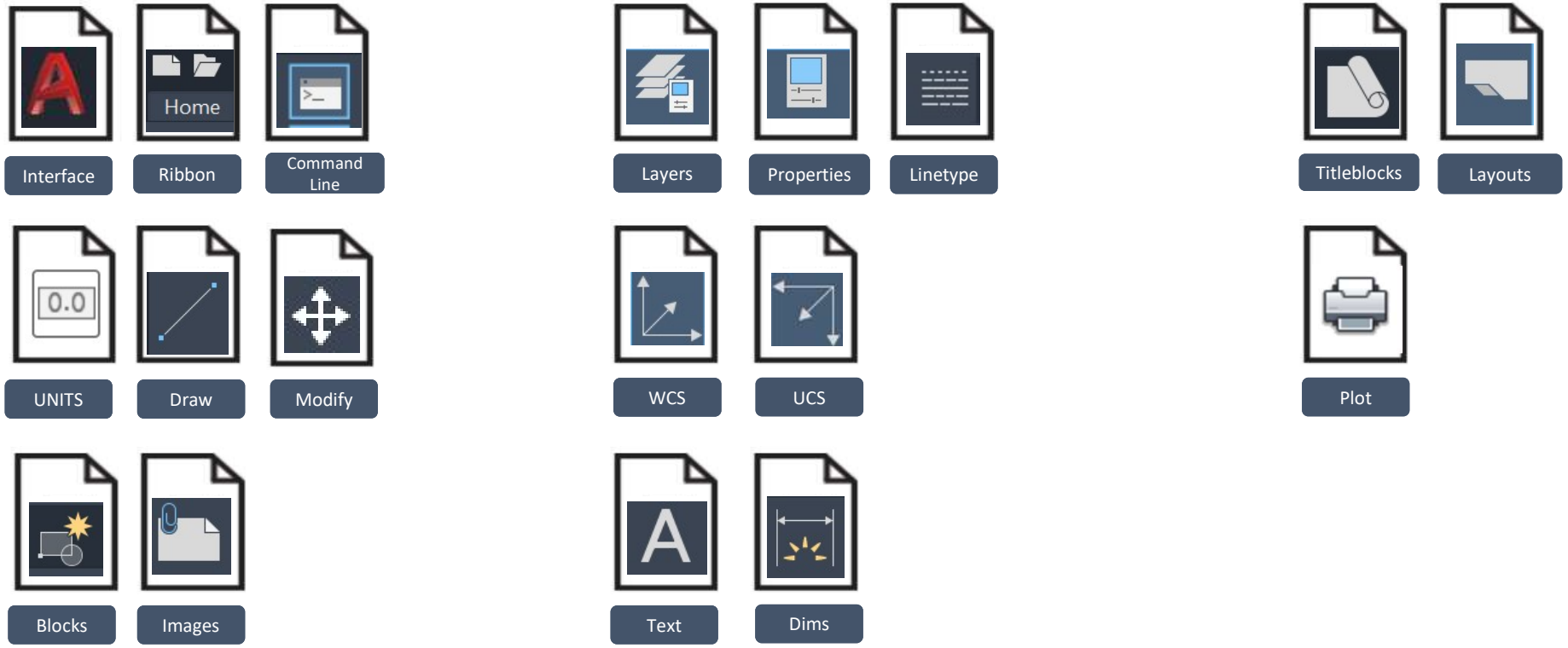
MFA setup guides & the RemotePC Dashboard are the following:

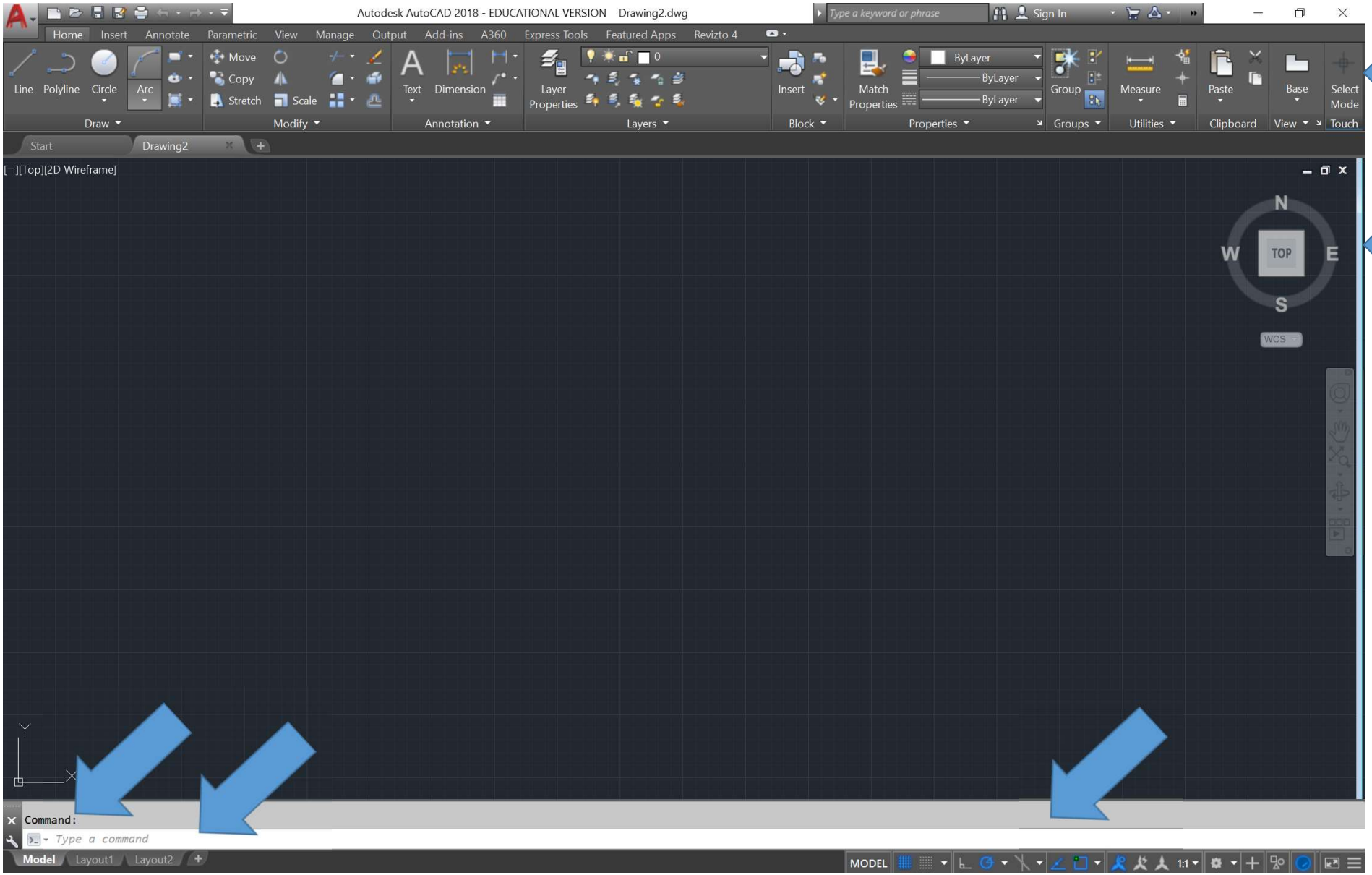
RemotePC Dashboard - https://remotepc.uwtsd.ac.uk/
MFA Setup Guides - https://www.uwtsd.ac.uk/mfa/
Connection Guides - https://www.uwtsd.ac.uk/virtuallearning/

A booking system is in the process of being developed which will allow dedicated slots to be booked in advance.
At present a default of 180mins is allowed per student, so make sure you save your work regularly as you may need to log back in.

AUTODESK
AUTOCAD

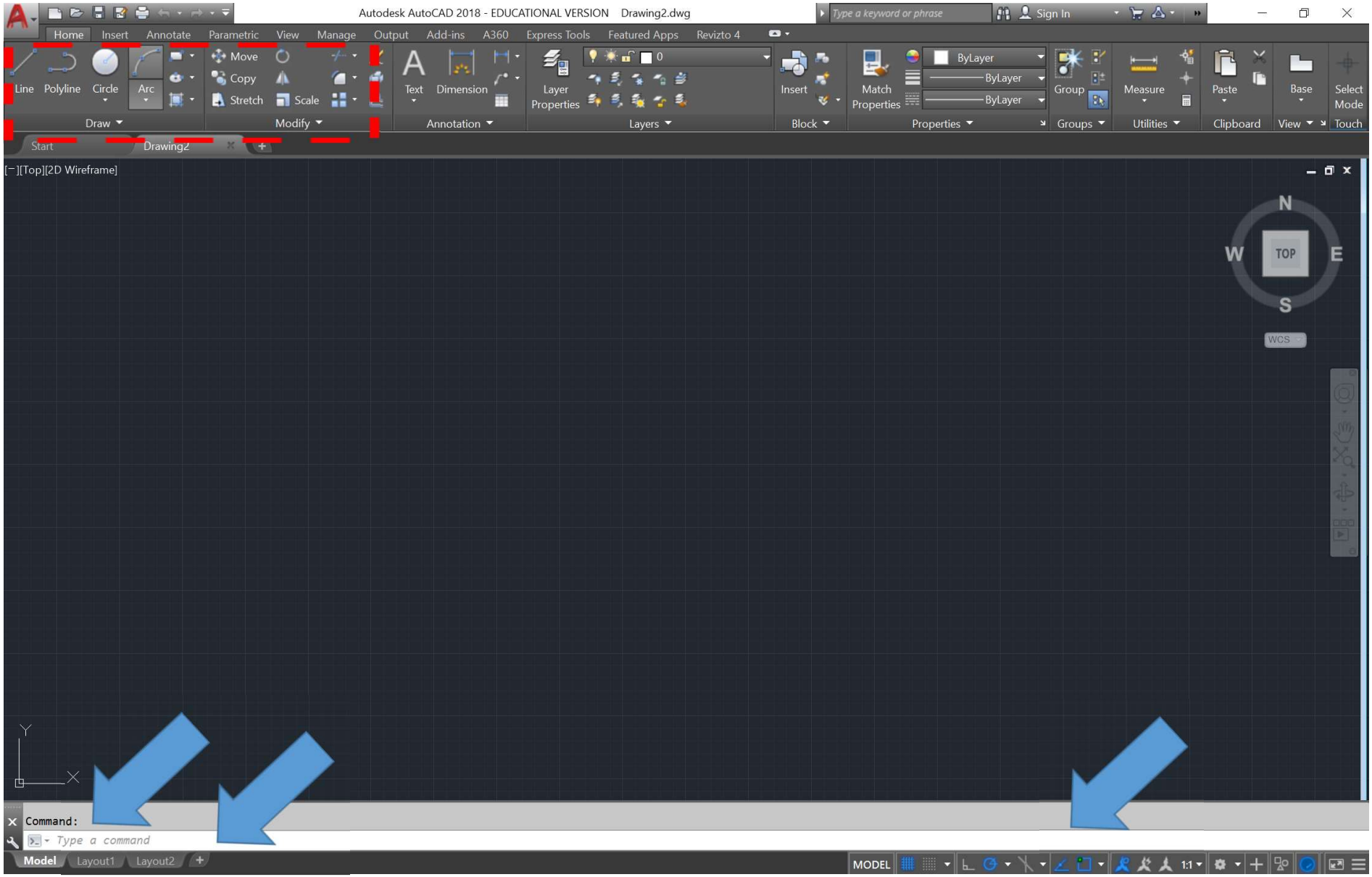
# the basics






UNITS

BASIC COMMANDS




UNITS

BASIC COMMANDS

DRAW Menu

MODIFY Menu

Q QSAVE / Saves the current drawing.

A ARC / Creates an arc.

Z ZOOM / Increases or decreases the magnification of the view in the current viewport.

W WBLOCK / Writes objects or a block to a new drawing file.

S STRETCH / Stretches objects crossed by a selection window or polygon.

X EXPLODE / Breaks a compound object into its component objects.

E ERASE / Removes objects from a drawing.

D DIMSTYLE / Creates and modifies dimension styles.

C CIRCLE / Creates a circle.

R REDRAW / Refreshes the display in the current viewport.

F FILLET / Rounds and fillets the edges of objects.

V VIEW / Saves and restores named views, camera views, layout views, and preset views.

T MTEXT / Creates a multiline text object.

G GROUP / Creates and manages saved sets of objects called groups.

B BLOCK / Creates a block definition from selected objects.

N NEW / Create a new drawing

H HATCH / Fills an enclosed area or selected objects with a hatch pattern, solid fill, or gradient fill.

J JOIN / Joins similar objects to form a single, unbroken object.

M MOVE / Moves objects a specified distance in a specified direction.

I INSERT / Inserts a block or drawing into the current drawing.

O OFFSET / Creates concentric circles, parallel lines, and parallel curves.

L LINE / Creates straight line segments.

P PAN / Adds a parameter with grips to a dynamic block definition.

https://www.autodesk.com/shortcuts/autocad

PL Polyline
CO Copy
REC Rectangle
MO/PR Modify Properties Pallet
LA Layer Pallet

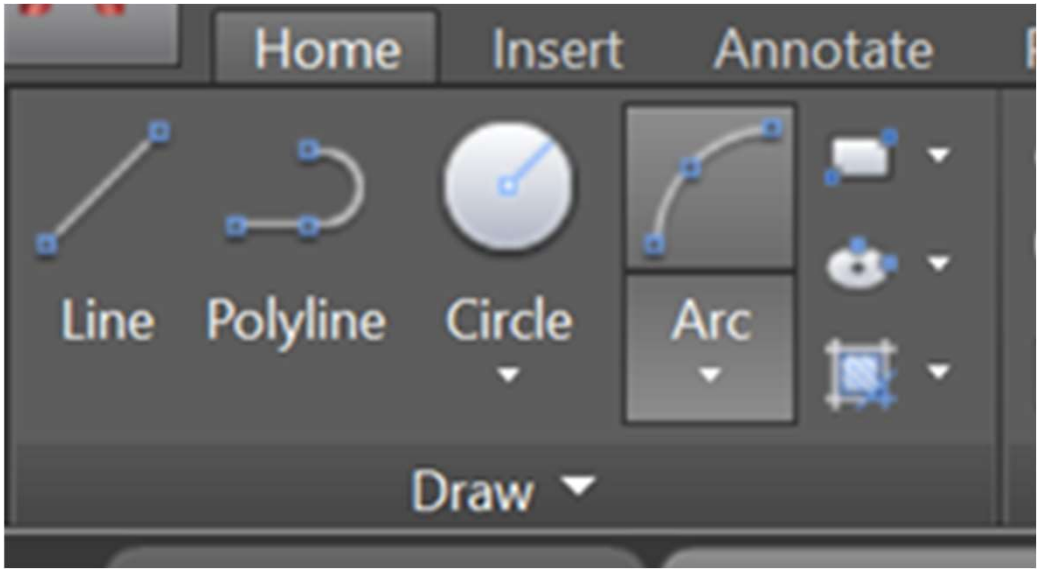
# Warm Up

Explore the DRAW menu on the Ribbon:

Draw Line and shapes using the icons on the ribbon.

Look at the Command line.

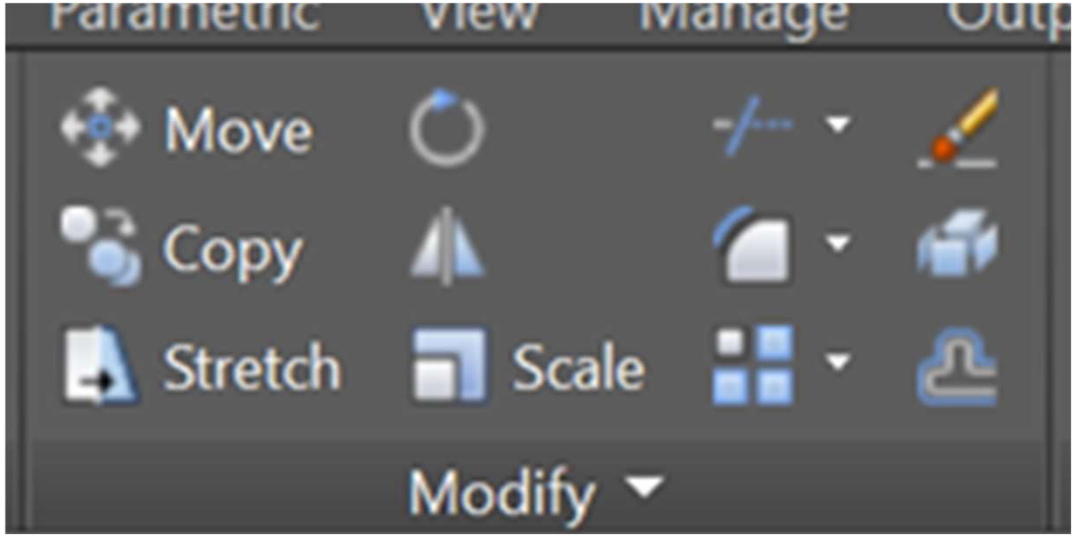
Are there any prompts?



# Warm Up

Explore the Modify menu on the Ribbon:

See what happens if you try and ‘Modify’ something that you have drawn.

Look at the Command line.

Are there any prompts?