

## PLANS USER GUIDE

### Introduction

*PLANS* is a computer-based drawing tool to produce scale drawings, in particular house plans. It's software I knocked up for my own use at home : it's basic & free, and consequently quick and easy to install, learn and use. *PLANS* specialises in the production of scale drawings, and is not intended to be a general-purpose drawing tool - it will not for example draw flowcharts, organograms, cool graphics, animations, etc.

A scale drawing always starts with a set of measurements. For example, to draw a scale plan of your house, you must walk round with a tape-measure annotating a rough sketch plan with the length and width of each room, the thicknesses of the walls, the position and width of the window and door openings, the widths and depths of alcoves and chimney breasts, etc. This is a chore, but it is unavoidable and is independent of whatever tools are subsequently used to produce the drawing.

Once you are armed with a set of measurements, *PLANS* takes much of the drudgery out of the subsequent stages of drawing production, including :

- o deciding on a scale that will fit the drawing to the available paper size
- o producing a set of 'on-paper' measurements by scaling the 'real-world' measurements
- o deciding where on the page to start drawing to ensure that the result is centred
- o drawing the lines to the correct length and angle
- o correcting errors
- o deriving real-world distances between points on the drawing
- o editing and extending plans

*PLANS* also offers features that cannot be replicated on paper, such as

- o the ability to zoom in and out
- o ease of safe-storage (as for any computer data)
- o portability (for a paper drawing the drawing table and instruments might be set up for days, whereas *PLANS* only occupies space on the computer - and not much at that)

*PLANS* has limitations, including :

- o Although it is well suited to drawing measured straight lines at right-angles to each other, it is weaker on drawing measured diagonals, and very weak on curves (only circular arcs are offered).
- o It has no in-built printing facility : a bitmap must be exported via the Clipboard to a bitmap editor such as Microsoft Paint to do this.
- o It cannot import or export other drawing formats such as those used by Visio, Flowcharter, etc
- o it has no library of templates or clip-art.

### Terminology

Diagrams are stored as a collection of 'Segments'. The most common type of Segment is a straight line drawn between 2 points on the diagram; other Segment types supported are Arcs and Rectangles (with potential to add others, for example improved curve algorithms, in the future). Segments may be solid or dotted.

Diagrams are drawn by manipulating 2 cursors on screen : the "O" cursor and the "X" cursor. Various facilities exist to move these cursors relative to each other and to the parts of the diagram already drawn. There are 2 methods to create new Segments using these cursors :

- (i) Locate *one of* the end-points of the proposed new Segment on the diagram (using the "X" cursor), and then enter length measurement(s) in either/both the horizontal and vertical directions, from which the software will derive the location of the other end of the Segment. This method creates a 'Measured Segment', ie one for which a real-world measurement has been taken; the measurement is stored as part of the Segment details.
- (ii) Locate *both of* the end-points of the proposed Segment on the diagram (one at "O" and the other at "X"). The software shows a draft version of the segment, as you move the O and X cursors. Once you are happy with the location of O & X and the appearance of the draft segment between, press the "Save" button to store the new Segment. Segments created in this way are referred to as "Joining Segments".

## Layers and Profiles

Each Diagram is divided into Layers. Each Segment belongs in exactly one Layer. When the diagram is displayed, you can choose which Layers to make visible and which to hide. Visible layers may be displayed bold or faint : the 'faint' option enables 'tracing' of a new layer relative to an existing one, for example first floor room layout relative to ground floor layout. The layers do not need to be to the same scale : for example, one layer might show your garden or your locality with the house as a small rectangle in one corner, and another layer might show a single room in your house in detail. If you display both layers together the room detail will be automatically shrunk to match the scale of the locality plan; whereas if you display the room detail separately it will automatically be expanded to fill the screen. By default all new Segments are placed in Layer 0. You may define further layers into which to add new Segments. Existing Segments may be moved between Layers either one at a time or in bulk (by specifying a range of segment numbers to move). The bulk move option means that initially you do not need to plan which Layers you will use, instead putting everything temporarily in Layer 0, and only later dividing the diagram up between additional Layers. It is a good strategy to use as many layers as possible, with relatively few segments in each.

Layers may be grouped together in Profiles. A Profile defines a set of layers all visible together. Selecting a Profile is a quick way of displaying all its Layers and hiding all other Layers. A Layer can be visible in many Profiles.

## Cursor movement

- o To move the "X" cursor
  - + Use a mouse click to position "X" anywhere on the diagram;
  - + Use arrow keys to move "X" one pixel at a time;
  - + Use the 'Skip' buttons to move "X" vertically or horizontally across the screen to the next colour change, ie
    - (ii) if in white space, to the next line (skipping blank space between the lines). After this type of Skip, the Recall Segment button may be used to select the horizontal or vertical segment at which the Skip stopped.
    - (i) if within a line, to the next branch point on the line, or to the end of the line (skipping intermediate pixels on the line)
  - + Use the "X to O" button to move "X" to the current position of "O".
  - + Use the "Move X half way to O" button to find the midpoint between X and O
  - + Use the 'Find Near' button to move X to the nearest stored point within a certain distance of its current position (defined as within the 'arms' of the "X").
  - + use the Measurement function (see below under New Segments) to move a measured distance relative to the current position.
  - + the "Pop X" function moves X to the position previously bookmarked by the "Push X" function.
  - + the "Undo" function moves X to its previous position.
  - + the "Extend" function extends diagonal segments OX by moving X further away from O, one pixel (or the closest diagonal equivalent) at a time.
- o To move the "O" cursor
  - + Use the "O to X" button to move "O" to the current position of "X" (so in order to position the "O" cursor you first position the "X" cursor to the desired location, then use this function to move "O" to "X").
- o The following functions move both cursors :
  - + the "Swap OX" button swaps "O" and "X".
  - + the "Find ends" buttons (horizontal or vertical) is equivalent to two Skips in opposite directions, starting from the current location of "X", with the result of the earlier Skip stored using the O cursor; this is useful in particular for reporting real-world lengths between different segments on a diagram, eg room-widths.
  - + the "Orthogonal Left" and "Orthogonal Right" functions create a new OX at right angles to the current OX, with 'new O' moved to 'old X'. and 'new X' off to the left (or right).

- o Step through
  - + Usually you will select existing components of a diagram (Segments and Points) by positioning the O and X cursors on them.
  - + As a failsafe in case it is not apparent where existing components are located (for example if a single straight line on the diagram comprises several segments), you can step through all the components currently visible. The following step-through facilities are available :
    - Points** - all visible points stored for current diagram : point X on the drawing is set to the First / Next / Previous point stored. The visible points are those which feature as 'from-point' or 'to-point' in the visible segments.
    - Segments** - all visible segments stored for current diagram : the cursors "O" and "X" are set to the end points of the First / Next / Previous segment. The visible segments are those in currently visible Layers.
    - Segments at Point** - all visible segments (if any) to or from the point X at its current position on the diagram.
    - Arcs** - all visible segments with segment type = "Arc"; see below under "Diagonals"
    - Diagonals** - all visible segments with segment type "Line" where both the x & y length-coordinates are different between the 'from' point and the 'to' point. Vertical and horizontal segments are easy to select using the Recall Segment function (see "Skip" above), but this function does not help for non-vertical/horizontal segments ie Arcs & Diagonals, whose selection is therefore facilitated by these 2 Step functions. Segments which are actually diagonal can appear to be vertical or horizontal at low resolutions.
    - Text** - all visible text - this is the only way in practice to select existing text.
- o Guidelines
  - + these are lines that appear on screen but are not stored in the diagram.
  - + they extend horizontally and vertically from the "X" cursor to each edge of the diagram (including the off-screen parts)
  - + they can be switched on or off
  - + they are visible to the Skip functions (see above), so that new segments can be aligned to existing ones.

## New segments

- o Entry of Measured Segments
  - + All diagrams start this way, ie the first segment to be added must be a Measured Segment
  - + Each Measurement comprises 2 lengths (in the x and y directions respectively), and a direction for each (ie right/left and down/up) relative to "X"
  - + The unit of Measurement is specified when a new diagram is created and applies to the diagram as a whole; in Europe millimetres are standard, and are small enough rarely to require fractions so are generally preferred, but any other units may be used (for example, inches, or yards, or ...). The software supports decimal fractions of a unit as required.
  - + On a new diagram the initial position of "X" is undefined - the software decides where to put this on the screen automatically each time the diagram is drawn.
  - + For each measurement entered
    - a new position ( $X_2$ ) of "X" relative to its current position ( $X_1$ ) is derived from the measurement
    - the new segment  $X_1X_2$  is stored
    - the 'current' position is moved from  $X_1$  to  $X_2$  ready for entry of the next measurement.
    - the whole diagram is redrawn, including the new segment  $X_1X_2$ , and including any rescaling needed (which also affects existing segments)
    - to save time the redraw may optionally be deferred while further measurements are entered.
  - + As well as allowing measured Segments (Lines, Arcs) to be entered & stored, this facility allows the X cursor to be moved around the diagram in measured 'jumps'; such Jumps are not stored as Segments.
  - + Notice that the "O" cursor is not used or moved in Measurement data-entry.
- o Entry of Joining Segments
  - + Once X and possibly also O have been repositioned on screen, click the "Joining" button to see where the Segment will appear;
  - + You can continue to move X or O while the draft segment is displayed, and it will move accordingly - this is especially useful for sizing & positioning arcs.
  - + press the "Save" button to store the new segment once its location and shape are decided.
  - + the "Line Forward" functions (= SHIFT + Skip) are like the corresponding Skip function but draw a line as they move X.

- o select “XOR” (Exclusive Or) if the new segment is to erase existing segments where these coincide. This means that the same segment types (Line, Arc, Rectangle) can be used both to create new shapes on the diagram, and to erase parts of existing ones. For example, using the ‘Rectangle’ segment type, walls can be drawn as a succession of adjacent or overlapping rectangles, whose common edges automatically ‘melt’ together leaving the walls fully joined up with each other.
- o Arcs
  - + ArcX = Arc centred on “X”, with “O” = the start point on the circumference
  - + ArcO = Arc centred on “O”, with “X” = the start point on the circumference
  - + angle specified in degrees, positive for clockwise or negative for anti-clockwise.
  - + the arc can be moved and reshaped/resized dynamically by moving the “X” cursor.
- o Rectangles
  - + can be entered as Joining Segments by specifying “O” and “X” as opposite corners.
  - + can be entered as Measured Segments by entering non-zero measurements in both the horizontal and vertical directions.
  - + stored as 4 separate line segments so as to ensure visibility to the Skip functions

### Other features

- o Zoom
  - + 4 levels of zoom are supported,
  - + Level 1 = the whole diagram is sized to fit the drawing window (usually but not necessarily full screen),
  - + Levels 2 -4 look in increasing detail at parts of the diagram.
  - + In Levels 2-4 the diagram is bigger than the screen, and scrollbars allow the screen to view different parts of the diagram. The higher levels use more computer memory; in particular Level 4 may trigger “insufficient memory” errors, especially if other programs are running.
  - + The ‘real-world’ size of a single pixel on the diagram depends on the Zoom level.
  - + New Segments may be aligned or joined to existing ones using Skip and/or Guidelines. The alignment is based on the ‘real-world’ measurements stored for each Segment, rather than on pixel coordinates implied by the current on-screen position of the segment, so remains exact when the diagram is rescaled or zoomed.
- o Text
  - + Text may be entered at any location on the diagram. The location is defined using the “X” cursor.
  - + This is useful in particular for showing the diagram scale, by drawing a stand-alone segment of a specified length and labelling the left-most end point with this length (eg “5 metres”).
  - + Text already entered for any point may subsequently be edited or deleted.
  - + Text, like segments, is associated with a Layer.
  - + Existing text may be moved to a new location : first position the “O” cursor at the new location, then use “Step Through : Text” to select the relevant text using the “X” cursor, then use the “Move Text” function to move from X to O.
- o Report the direct ‘real world’ length between O & X on the screen (even if no segment is stored for these points). This is shown in the Status Bar. Where O & X are at the end-points of a Measured Segment, the length is displayed in square brackets to distinguish it as a measured length rather than a derived length.
- o Report the real-world area of the rectangle whose corners are at O and X.
- o Extend or reduce a stored segment OX in the same linear direction by moving X a measured distance further from or nearer to O, keeping the direction OX unchanged. The extension (or reduction) is stored as a separate segment.
- o Copy to clipboard - the whole diagram (but excluding the O & X cursors) is copied (whereas the ‘print screen’ button only copies the on-screen part, and includes the cursors). Paste this into a bitmap editor such as Paint to store the diagram in a graphic format such as BMP or JPG, or to print it, or to edit it in ways not available in *PLANS* such as colour-fills.

- o Database Healthcheck / Repair
  - + This facility runs a series of checks across the whole database and reports on the results. Database errors can arise for example because of software errors, or because the version of the database has been superseded, but mainly for more common reasons, for example
    - points not used in any Segments (where Segments are deleted)
    - duplicate points (ie separate but closely adjacent in the real world, but co-located on the diagram)
  - + A Repair function allows most types of database error to be automatically repaired. The Repair function automatically secures a backup copy of the database before running. Such backups are retained separately after multiple Repairs.

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**APPENDIX - Measuring tactics** - Every measurement includes an inevitable margin of error. This is partly due to inaccuracy in the measurement process (for example, tape too slack or misread), but mostly to hidden inaccuracies in the object being measured, in particular walls not square or not straight. The measurement process needs to protect against this margin of error accumulating. When measuring / drawing eg a room, measure & draw the overall shape (usually a rectangle) first, then add the details such as windows, doors, chimney breast, each one by reference to a corner of the room. A disadvantage of this tactic is that it usually requires 2 people, to manage the 2 ends (respectively) of the measuring tape. A quicker but less accurate alternative is to build up the overall shape by drawing each detail in succession round the perimeter of the room, each one by reference to its predecessor. This approach is easier for one person since each measurement is smaller, but with this approach the last detail to be added will very likely fail, by a significant margin of error, to join up with the first detail measured - this error will then need to be resolved by adjusting all the previous measurements for that room by a small amount, a tiresome process.

In my experience measuring my (old) house I aim for the following levels of accuracy

- o within 2mm for individual measurements, ie if I repeat the measurement the result is within 2mm of the original value. This target is fairly easy to meet.
- o within 10mm for groups of measurements, ie where the same thing can be measured in several different ways then all the equivalent results are within 10mm of each other. For example, when measuring around a room, the final measurement should return to the start point within this margin of error. This target is surprisingly difficult to meet.
- o external measurements longer than about 20m I measure using pacing-out rather than using a tape. I have measured 10 paces as 7.84m. The margin of error on such measurements might be as much as 0.5m.