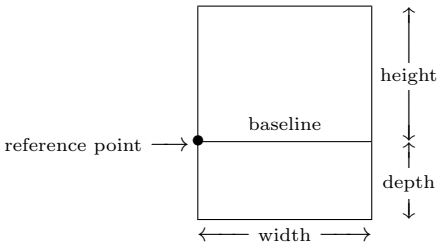
*box* **1**

`box.` A *box* is a rectangle of material to be typeset. A single character is a box by itself, and an entire page is also a box. TEX forms a page as a nest of boxes within boxes within boxes. The outermost box is the page itself, the innermost boxes are mostly single characters, and single lines are boxes that are somewhere in the middle.

TEX carries out most of its box-building activities implicitly as it constructs paragraphs and pages. You can construct boxes explicitly using a number of TEX commands, notably `\hbox` (p. '`\hbox`'), `\vbox` (p. '`\vbox`'), and `\vtop` (p. '`\vtop`'). The `\hbox` command constructs a box by appending smaller boxes horizontally from left to right; it operates on a horizontal list and yields an hbox (horizontal box). The `\vbox` and `\vtop` commands construct a box by appending smaller boxes vertically from top to bottom; they operate on a vertical list and yield a vbox (vertical box). These horizontal and vertical lists can include not just smaller boxes but several other kinds of entities as well, e.g., glue and kerns.

A box has height, depth, and width, like this:




The baseline is like one of the light guidelines on a pad of ruled paper. The boxes for letters such as 'g' extend below the baseline; the boxes for letters such as 'h' don't. The height of a box is the distance that the box extends above its baseline, while its depth is the distance that it extends below its baseline. The reference point of a box is the place where its baseline intersects its left edge.

TEX builds an hbox $H$ from a horizontal list by assuming a reference point for $H$ and then appending the items in the list to $H$ one by one from left to right. Each box in the list is placed so that its baseline coincides with the baseline of $H$, i.e., the component boxes are lined up horizontally.[1] The height of $H$ is the height of the tallest box in the list, and the depth of $H$ is the depth of the deepest box in the list. The width of $H$ is the sum of the widths of all the items in the list. If any of these items are glue and TEX needs to stretch or shrink the glue, the width of $H$ will be larger or smaller accordingly. See page 77 of *The TEXbook* for the details.

Similarly, TEX builds a vbox $V$ from a vertical list by assuming a temporary reference point for $V$ and then appending the items in the list

[1] If a box is moved up or down with `\raise` or `\lower`, TEX uses its reference point before the move when placing it.

to $V$ one by one from top to bottom. Each box in the list is placed so that its reference point is lined up vertically with the reference point of $V$.[2] As each box other than the first one is added to $V$, TEX puts interline glue just above it. (This interline glue has no analogue for hboxes.) The width of $V$ is the width of the widest box in the list, and the vertical extent (height plus depth) of $V$ is the sum of the vertical extents of all the items in the list.

The difference between `\vbox` and `\vtop` is in how they partition the vertical extent of $V$ into a height and a depth. Choosing the reference point of $V$ determines that partition.

- For `\vbox`, TEX places the reference point on a horizontal line with the reference point of the last component box or rule of $V$, except that if the last box (or rule) is followed by glue or a kern, TEX places the reference point at the very bottom of $V$.[3]
- For `\vtop`, TEX places the reference point on a horizontal line with the reference point of the first component box or rule of $V$, except that if the first box (or rule) is preceded by glue or a kern, TEX places the reference point at the very top of $V$.

Roughly speaking, then, `\vbox` puts the reference point near the bottom of the vbox and `\vtop` puts it near the top. When you want to align a row of vboxes so that their tops line up horizontally, you should usually use `\vtop` rather than `\vbox`. See pages 78 and 80–81 of *The TEXbook* for the details of how TEX builds vboxes.

You have quite a lot of freedom in constructing boxes. The typeset material in a box can extend beyond the boundaries of the box as it does for some letters (mostly italic or slanted ones). The component boxes of a larger box can overlap. A box can have negative width, depth, or height, though boxes like that are not often needed.

You can save a box in a box register and retrieve it later. Before using a box register, you should reserve it and give it a name with the `\newbox` command (p. '`\@newbox`'). See "register" (p. '`register`') for more information about box registers.

[2] If a box is moved left or right with `\moveleft` or `\moveright`, TEX uses its reference point before the move when placing it.

[3] The depth is limited by the parameter `\boxmaxdepth` (p. '`\boxmaxdepth`').