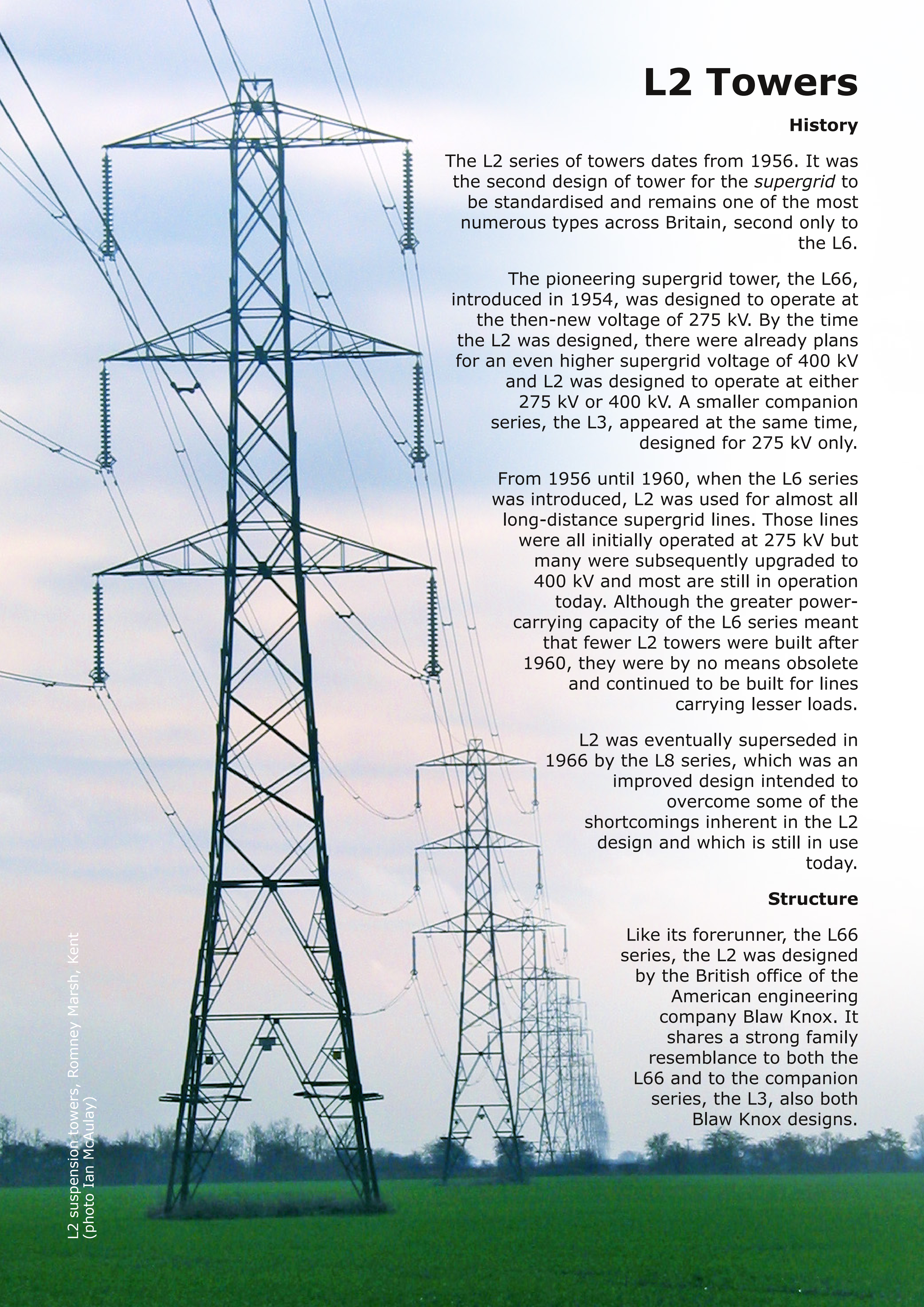
L2 Towers



L2 suspension towers, Romney Marsh, Kent (photo Ian McAulay)

History

The L2 series of towers dates from 1956. It was the second design of tower for the *supergrid* to be standardised and remains one of the most numerous types across Britain, second only to the L6.

The pioneering supergrid tower, the L66, introduced in 1954, was designed to operate at the then-new voltage of 275 kV. By the time the L2 was designed, there were already plans for an even higher supergrid voltage of 400 kV and L2 was designed to operate at either 275 kV or 400 kV. A smaller companion series, the L3, appeared at the same time, designed for 275 kV only.

From 1956 until 1960, when the L6 series was introduced, L2 was used for almost all long-distance supergrid lines. Those lines were all initially operated at 275 kV but many were subsequently upgraded to 400 kV and most are still in operation today. Although the greater power-carrying capacity of the L6 series meant that fewer L2 towers were built after 1960, they were by no means obsolete and continued to be built for lines carrying lesser loads.

L2 was eventually superseded in 1966 by the L8 series, which was an improved design intended to overcome some of the shortcomings inherent in the L2 design and which is still in use today.

Structure

Like its forerunner, the L66 series, the L2 was designed by the British office of the American engineering company Blaw Knox. It shares a strong family resemblance to both the L66 and to the companion series, the L3, also both Blaw Knox designs.

L2 D suspension towers, Edinburgh.

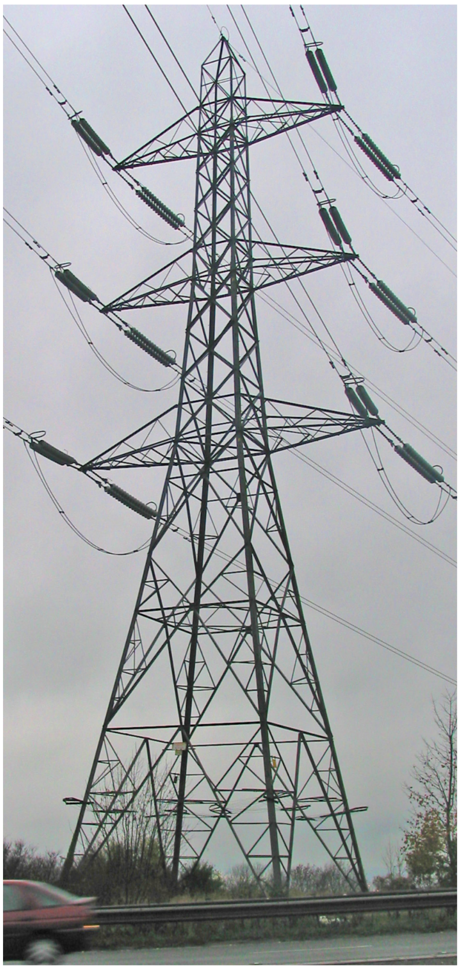
The tower on the right is a standard height L2 D; the one on the left is an L2 D E44: 44 feet (13.4 m) taller than standard. The tower on the left also carries both 400 kV (on the near side) and 275 kV (on the far side), hence the slightly different lengths of insulator strings. The tower on the right carries 275 kV on both sides.

(photo Ian McAulay)

All three of these designs have the conductors arranged almost directly one above the other, unlike earlier and later designs where the middle conductor each side is carried further out from the tower body than those at the top and bottom.

These almost equal length *crossarms* were also a feature of towers designed by Blaw Knox at roughly the same time for use in the USA and elsewhere in the world.

The biggest difference between the L66, L2 and L3 tower series is the height. The *standard height suspension tower* in the L66 series is 35.3 m (115 ft 10 in) high, whereas in the L2 series that was increased to 41.6 m (136 ft 6 in) to allow the crossarms to be further apart to accommodate the higher design voltage of 400 kV. L3, being designed for 275 kV alone, is only slightly taller than the L66 at 36.9 m (121 ft).



L2 D30 angle tower, Bluebell Hill, Kent

(photo Ian McAulay)

L2 tower types

As with all tower designs, there was a range of basic tower types in the L2 series. In addition to the suspension tower (designated D) for ordinary straight-line situations, *angle towers* were available for deviations of 10, 30, 60 and 90 degrees (D10, D30, D60 and D90).

Because of L2's extensive use throughout Britain, many different configurations of *substations* had to be accommodated at the ends of lines. Accordingly, several types of *terminal tower* (DT) and *junction tower* (DJT) were developed.

Height extensions

Because the L2 design was used so extensively, the L2 was eventually available with a wider range of different *height extensions* than was the case with most tower series. For suspension towers, these ranged from the M24 at 34.3 m (112 ft 6 in) right up to the enormous E80 at 66 m (216 ft 6 in).

L2 was designed in imperial units (feet and inches), many years before metrication, so the height extension designations indicate extensions in feet not metres. For example, a tower with an E24 extension is 24 ft (7.3 m) taller than a standard height tower and a tower designated M12 is 12 ft (3.7 m) shorter than standard.

Prior to the introduction of the L2 series, most tower designs came in a range of heights varying in steps of 10 ft (about 3 m) or in a few cases 5 ft. L2 increased this basic step size to 12 ft (3.7 m) with a range of extensions to the tower body giving overall height increases of 12 ft, 24 ft, 36 ft and so on.

For suspension towers, the L2 series provided more variation in height. There were three different leg lengths being available to allow a difference of only 4 feet (1.2 m) between successive heights in the range.

(L8, the successor design to L2 which is still used today, retained this range of height extensions, but later designs of tower reverted to 10 ft steps between height extensions or to 3 m for more modern towers designed using metric units.)

L2 D60 angle tower, Falkirk, Stirlingshire.

This tower was being repainted when the photograph was taken. The yellow paint is primer which will be covered by a grey topcoat.

(photo Ian McAulay)

Shortcomings

L2 D90 angle tower, Cockenzie, East lothian.

The D90 is a very rare tower type in any series. They are very expensive to build as well as being quite prominent visually, so they are only used where there is no room to make a line turn through a less severe angle.

(photo Ian McAulay)

The visual characteristic that most typifies the L2 series, its smaller counterpart the L3, and its forerunner the L66, is the nearly equal length of the crossarms. In practice, this also proved to be one of its weaknesses.

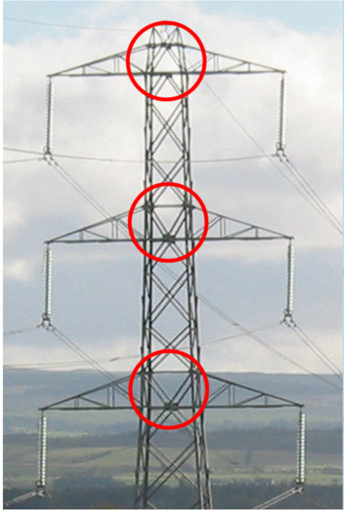
(Curiously, the crossarms are not exactly equal in width; the top pair are about 46 cm (18 in) narrower than the middle crossarms, and the bottom pair about 76 cm (2 ft 6 in) wider.)

In certain very windy conditions, *galloping* of the conductors can occur. With the conductors being stacked vertically above one another in the L2 design, gallpping can bring them very close together, so that *conductor clashing* or *flashover* can occur. More recent designs reduce the risk of this happening by having wider middle crossarms, so that the conductors are not in line vertically.

Another shortcoming of the L2 design (and many of the tower designs which preceded it) was that the *earthwire* was not as far above the top pair of conductors as it ideally could have been. This is why the *earth peak* on the L8 design which superseded it is so much more prominent than the comparatively stubby peak on the L2.

Insulators and conductors

L2 towers were used on both 275 kV and 400 kV lines and accordingly can be seen with two different lengths of insulator string. 275 kV lines are sometimes upgraded to

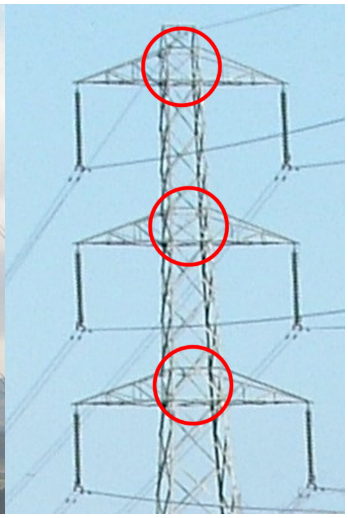


L2 tower

Where the top crossarm crosses the tower body, the bracing forms an inverted V,

Where the middle and bottom crossarms cross the tower body, the bracing forms a V.

(photo Ian McAulay)



L3 tower (applies to L66 too)

Where the top and middle crossarms cross the tower body, the bracing forms an X,

Where the bottom crossarm crosses the tower body, the bracing forms an inverted V.

(photo Flash Bristow)

L2 DT terminal tower, Chingford, North East London

This terminal tower is fitted with tower-mounted sealing-end platfoms, where the transition from overhead line to underground cable is made.

Terminal towers are available with different lengths of crossarm. On this example both the top and middle crossarms are extended to allow the conductors to drop down to the sealing ends without getting in each other's way.
(photo Flash Bristow)

400 kV by replacing the insulators; you can sometimes see lines which carry 275 kV on one side and 400 kV on the other. However, long insulator strings are not a guarantee that a line is carrying 400 kV; sometimes 275 kV lines were built with 400 kV insulators so that they could be upgraded easily at a later date.

L2 towers almost always carry *twin bundles* of conductors and were designed to take a pair of 400 mm² *aluminium-equivalent* cross-section steel-reinforced aluminium conductors (*ACSR*). (They are not strong enough to carry the heavier load of *triple* or *quad* bundles that can be carried by L6 towers.) When conductors are replaced (they have a shorter working life than the towers), they are usually replaced with the newer all-aluminium-alloy conductors (*AAAC*) which are lighter but can carry more current. The replacements are usually the same size, 400 mm², but heavier conductors up to 570 mm² can be used on lines built with a shorter than normal span length.

Identification

If a tower has similar length crossarms so that the conductors are stacked vertically one above the other on each side, then you know that you are looking at an L2, an L3 or an L66. L2 is taller than either L3 or L66, but heights can be difficult to gauge, especially when there is nothing with which to compare them.

If you are close enough to the tower to read the warning notice, that will tell you the voltage. If it says 400,000 volts, then you know it's an L2.

You can also tell L2 from L3 and L66 by looking at the bracing pattern in the steelwork. On an L2 suspension tower, where the middle crossarm crosses the tower body, the bracing is in the form of a V and where the top crossarm crosses, it's an inverted V, whereas on L3 and L66 it's in the form of an X. (This trick only works for suspension towers; you can't tell angle towers apart this way.)

If these clues aren't available, bear in mind that L2 is vastly more common than either L3 or L66, so if a tower looks like L2, then (at least statistically) it probably is L2.

'The Pink Pylon', near Rochdale, Greater Manchester.

Until recently there was a pink tower near Rochdale. It was a 400kV L2 series tower and was painted thus for the making of the film 'Among Giants'. It became something of a local landmark (known obviously as the Pink Pylon). The line it was on had been out of use for several years and the tower was demolished in November 2003.

(photo David Scott)

D10 and D30 angle towers

These are symmetrical with equal length crossarms both sides of the tower body. The D10 and D30 are visually indistinguishable, but if the line is actually straight where the tower is sited, then you can be sure it's a D10, otherwise it could be either.

D10 and D30 angles are also distinguished by their pointed earth peaks.

D60 angle towers

The D60 is noticeably asymmetric, with longer arms to the outside of the turn in the line. The ends of the longer arms are square, not pointed and the earth peak forms a sort of chisel shape, like a little house roof.

D90 angle towers

These fairly rare towers are asymmetric like the D60 and also have the same square ends on their longer arms. The short arms are little more than pointed stubs. Unlike the D60, the short arms on a D90 have no bracing at all.

DT terminal towers

The L2 terminal tower is distinguished by the way the crossarms are shaped, with the series of segments making up the upper edge of each arm appearing almost curved. (The much smaller L3 terminal tower shares this feature.)

As many substations have been reconfigured since first being built, it's not at all unusual for terminal towers not to match the lines they terminate. Don't be too surprised if a line you have identified as L2 actually has an L8 or L6 terminal tower.

L2 at a glance

Introduced:	1956
Designed by:	Blaw Knox Ltd
Voltage:	275 kV or 400 kV
Height:	41.6 m (136 ft 6 in) (standard height suspension tower)
Width:	12.1 m (40 ft) (bottom crossarm)
Normal span:	360 m (1200 ft)
Look out for:	Conductors stacked vertically above each other
Not to be confused with:	L66, L3