Straight and Level Guard Rail
Using Types 10, 15, 20, 21, 25, & 26 or L10, L15, L20, L21, L25, & L26

Where:
L = distance between centres of uprights
I = length of horizontal tube
H = distance from ground to centre line of top rail
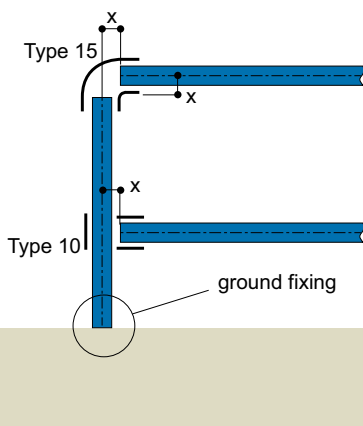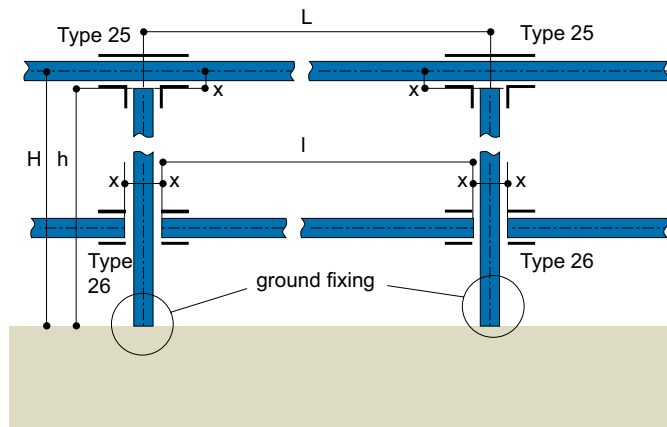h = length of upright tube

Table 1 gives details of dimension 'x' in the formula:

$$I = L - 2x$$

To calculate rail lengths and uprights use the formula:

$$h = H - x \pm (\text{ground fixing})*$$

Table 1: Dimension 'x' for fittings shown above, including Types 35, 40 and L35*

Fitting Size	x (mm)
3	−12
4	−13
5	−14
6	−17
7	−22
8	−25
9	−30

Guardrailing up Slopes 0°–11°
Using Types 86, 87, 88 and 89

Where the upright remains vertical, i.e. ramps and stairways, (i) dimension 'x' to be subtracted from the upright centre dimension measured on the slope to give rail length. (I = L – 2x); (ii) dimension 'y' to be added to the centre dimension to give the length of the upright (H = h + y + ground fixing).
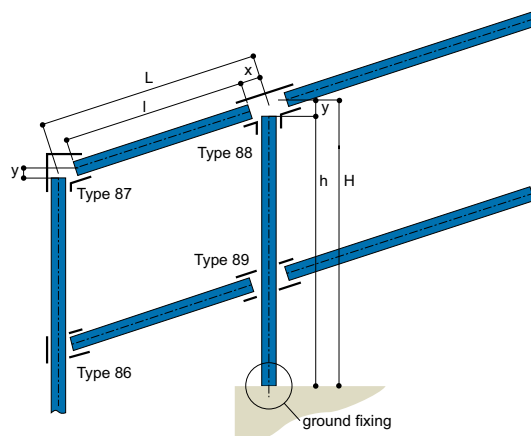

Table 2 gives details of dimensions required for calculating the rail lengths, where angles are between 0° and 11°.

Table 2: Rails

Angle of Slope	Size 8 Fittings 'x' (mm)
0° to 4°	−25
5° to 9°	−28
10° to 11°	−30

Table 3 gives details of dimensions required for calculating the upright lengths, where angles are between 0° and 11°.

Table 3: Uprights

Angle of Slope	Size 8 Fittings 'y' (mm)
0° to 4°	−25
5° to 9°	−28
10° to 11°	−30

Note: When reducing fittings are being used care must be taken to use the correct 'x' dimension. (i.e., Type 10-87, vertical tube size 8, horizontal tube size 7. To find the correct length of the horizontal tube, the length 'x' is that for the size 8 vertical tube.)

When using Types 35 and 40 the above 'x' dimension should be used.

Although guardrailing is normally constructed in size 6, 7 and 8 tube, Table 1 shows the cutting length for all **KEE KLAMP** tube sizes, and can therefore be applied to many other rectangular structures.

*When using **KEE LITE** bases, L61, L62, L69, L140, L150 and L152, "ground fixing" dimension will be zero.

Guardrail Up Slopes 11° to 30°
Using Types 55A, 56A, 327, 328, & 329 size 7 & 8

Where the upright remains vertical, i.e. stairways (i) dimension x, x1, x2, x3 to be subtracted from the upright centres; dimension (L) to give the rail length; (ii) dimension y, y1 and y2 for determining the up-right length.
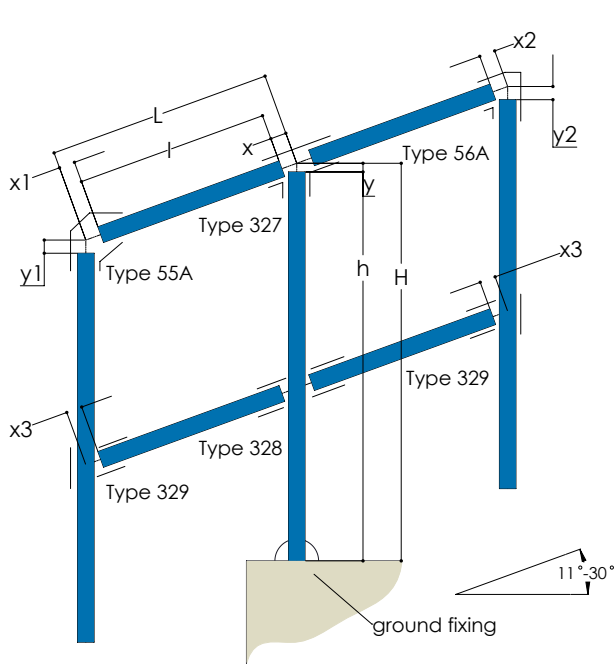
Guardrail up Slopes 30° to 45°
Using Types 29, 30, 55, 56 & 427 in sizes 7 & 8

Where the upright remains vertical, i.e. stairways (i) dimension x, x1, x3, y & z to be subtracted from the upright centres; dimension (L) to give the rail length; (ii) dimension u, v and w for determining the upright length.

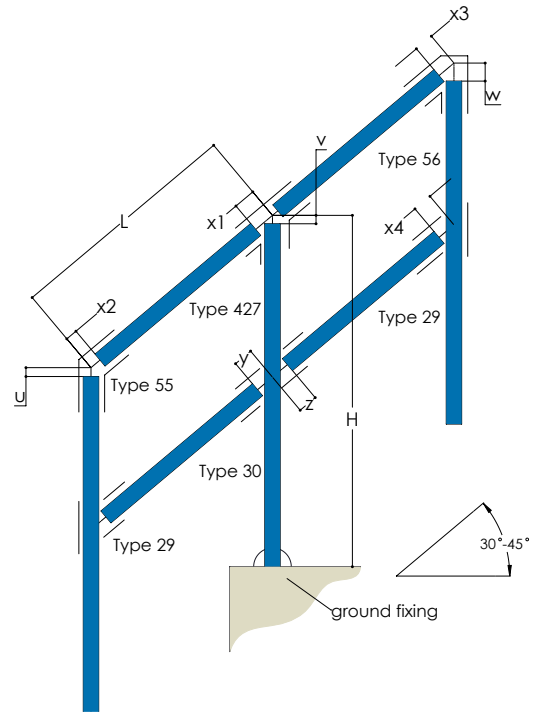Table 1 gives details of dimensions required for calculating the rail lengths, where angle are between 11° & 30°

Table 1: Rails

| Angle Of Slope | Fitting Size | | | | | | | |
| | 7 | | | | 8 | | | |
	x	x1	x2	x3	x	x1	x2	x3
11°	-26	-25	-35	-52	-29	-16	-35	-51
15°	-28	-21	-46	-53	-31	-27	-47	-52
20°	-30	-16	-48	-55	-34	-21	-49	-54
25°	-33	-15	-52	-59	-38	-22	-53	-57
30°	-37	-8	-57	-64	-42	-15	-59	-62

Table 2 Gives details of dimensions required for calculating the upright lengths.

Table 2: Uprights

| Angle Of Slope | Fitting Size | | | | | |
| | 7 | | | 8 | | |
	y	y1	y2	y	y1	y2
11°	+7	-10	-28	+6	-7	-33
15°	+7	-11	-25	+6	-8	-30
20°	+7	-13	-34	+6	-10	-38
25°	+7	-15	-43	+6	-10	-48
30°	+7	-18	-53	+6	-14	-59

Table 3 gives details of dimensions required for calculating the rail lengths, where angle are between 30° & 45°

Table 3: Rails

| Angle Of Slope | Fitting Size | | | | | | | | | | | |
| | 7 | | | | | | 8 | | | | | |
	x1	x2	x3	x4	y	z	x1	x2	x3	x4	y	z
30°	-39	-20	-55	-37	-49	-55	-45	-22	-49	-43	-60	-74
35°	-44	-16	-61	-40	-50	-54	-50	-18	-55	-47	-60	-74
40°	-47	-20	-71	-45	-51	-53	-55	-21	-66	-52	-61	-74
45°	-50	-26	-85	-51	-91	-53	-55	-26	-81	-59	-68	-66

Table 4 Gives details of dimensions required for calculating the upright lengths..

Table 4: Uprights

| Angle Of Slope | Fitting Size | | | | | |
| | 7 | | | 8 | | |
	u	v	w	u	v	w
30°	-17	+5	-48	-25	+6	-49
35°	-16	+5	-59	-21	+6	-59
40°	-8	+3	-69	-14	+6	-69
45°	+2	-1	-80	-2	-4	-81

Guardrail up slopes 30° to 45°
Using 325, 325A, 326, size 7 & 8

Type 325

Type 325A

Type 326

Type 326

X

30°-45°

ground fixing
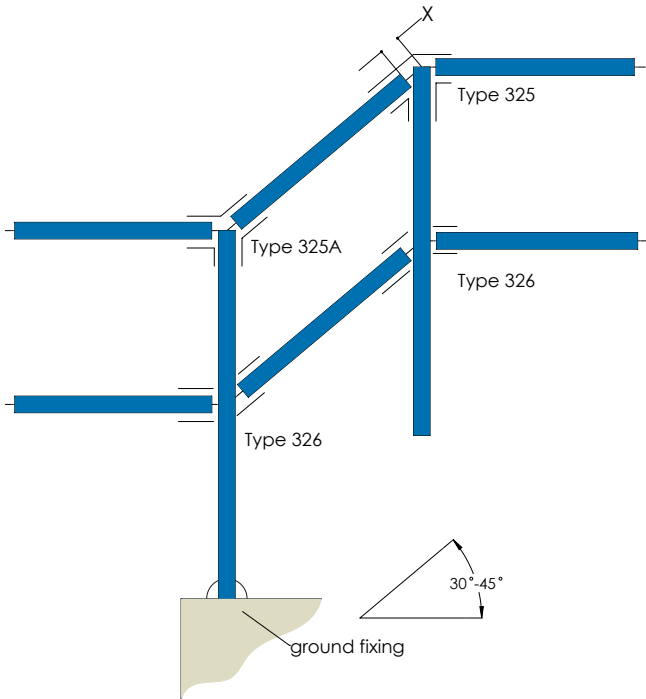
Guardrail up slopes 30° to 45°
Using 320RH, 320LH, 321RH & 321LH size 7 and 8
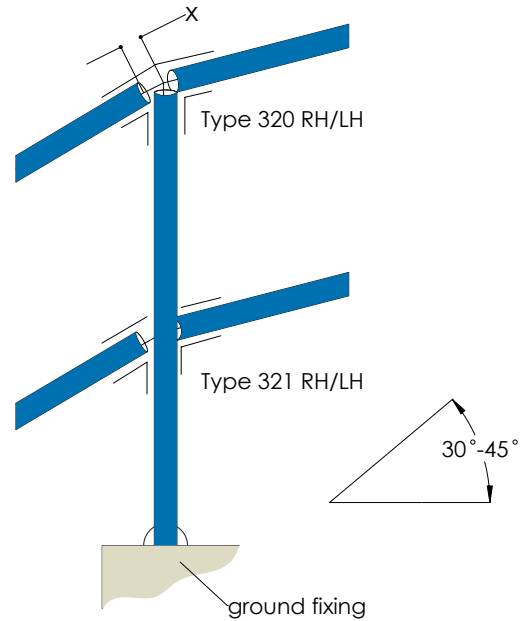

x

Type 320 RH/LH

Type 321 RH/LH

30°-45°

ground fixing

Table 5 gives details of dimensions required for calculating the rail lengths, where angle are be-tween 30° & 45°

Table 5: Rails

Angle Of Slope	Fitting Size	
	7	8
	x	x
30°	-47	-57
35°	-52	-62
40°	-59	-69
45°	-68	-79

Table 6 gives details of dimensions required for calculating the rail lengths, where angle are between 30° & 45°

Table 6: Rails

Angle Of Slope	Fitting Size	
	7	8
	x	x
30°	-55	-62
35°	-60	-68
40°	-67	-76
45°	-77	-86

New Slope Fittings

The latest addition to the **KEE KLAMP** portfolio is an extension to the current range of slope fittings designed to enhance the building of guardrail along staircases and ramps particularly when the slope is greater than 30°. The new range introduces single fittings to cater for situations where currently a combination of fittings is required. Not only does this improve the aesthetics of the finished guardrail but it also allows for a quicker and easier install. The new range of slope fittings is available in Size 7 (outer diameter 42.4mm) and Size 8 (outer diameter 48.3mm) designed for use with steel tubing to BS EN 10255.

KEE KLAMP fittings are iron castings manufactured to the requirements of BS EN 1562 & BS EN 1563. They are supplied hot dip galvanised to BS EN ISO 1461 .

A **KEE KLAMP** fitting can support an axial load of 900Kg per set screw tightened to a torque of 4Kgm (39 Nm). In common with all **KEE KLAMP** products, the threaded recesses of each fitting are covered with **THREDKOAT** protective coating to provide enhanced corrosion resistance and all grub screws are manufactured in case hardened steel coated with **KEE KOAT** for corrosion protection.

Features & Benefits

• KEE KLAMP is the best known brand of slip-on tube fittings available for over 80 years

• Manufactured to stringent quality standards to ensure consistent performance

• Extended range of slope fittings gives greater design flexibility

• Adjustability in the fittings allows greater on-site tolerances to be met

• Using single fittings rather than pairs speed up installation times

Guardrailing up Slopes 11°–30°
Using Adjustable Fittings, Types 327 and 328

Where the upright remains vertical, i.e. ramps and stairways, (i) dimension 'x' to be subtracted from the upright centres dimension measured on the slope to give rail length. (I = L –2x); (ii) dimension 'y' to be added to the centre dimension to give the length of the upright (h = H + Y + ground fixing).
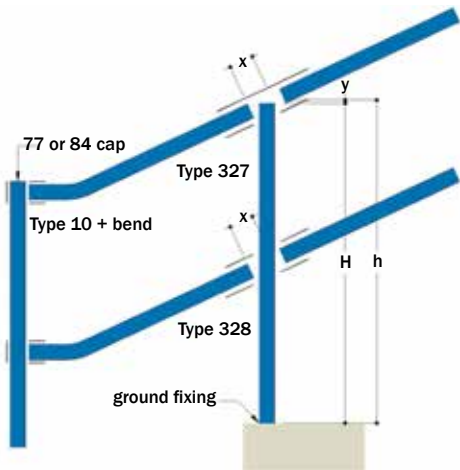

Table 4 gives details of dimensions required for calculating the rail lengths, where angles are between 11° and 30°.

Table 4: Rails

Angle of Slope	Size 7 Fittings: 'x' (mm)	Size 8 Fittings: 'x' (mm)
11°	–28	–30
15°	–32	–35
20°	–32	–38
25°	–35	–41
30°	-41	–44

Table 5 gives details of dimensions required for calculating the upright lengths, where angles are between 11° and 30°.

Table 5: Uprights

Angle of Slope	Size 7 Fittings: 'y' (mm)	Size 8 Fittings: 'y' (m)
11°	+16	+19
15°	+16	+19
20°	+13	+16
25°	+13	+16
30°	+13	+13

Guardrailing up Slopes 30°–45°
Using Adjustable Fittings, Types 29, 30, 55 & 56 or Types L29 & L30 size 6, 7 and 8

Where the upright remains vertical, i.e. stairways (i) dimension x, y, or z to be subtracted from the upright centres: dimension (L), to give the rail length; (ii) dimension u, v and w for determining the upright length.
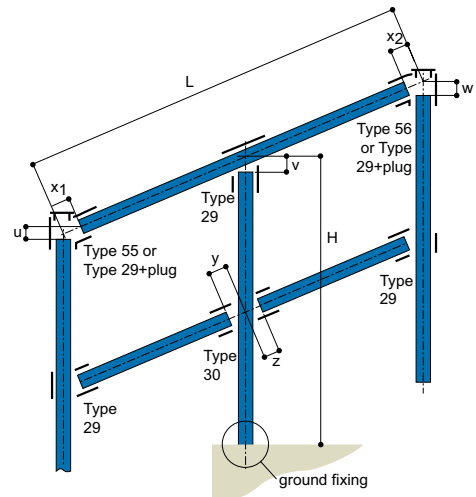

Table 6 gives details of dimensions required for calculating the rail lengths, where angles are between 30° and 45°.

Table 6: Rails

Angle of Slope	Size 6 Fitting			Size 7 Fitting			Size 8 Fitting		
	x (mm)	y (mm)	z (mm)	x (mm)	y (mm)	z (mm)	x (mm)	y (mm)	z (mm)
30°	–31	–54	–36	–40	–64	–41	–45	–77	–54
35°	–34	–51	–39	–44	–61	–44	–50	–73	–57
40°	–37	–48	–42	–48	–57	–48	–55	–64	–61
45°	–43	–45	–45	-54	–53	–52	–61	–65	–66

Table 7 gives details of dimensions required for calculating the upright lengths, where angles are between 30° and 45°.

Table 7: Uprights

Angle of Slope	Size 6 Fitting			Size 7 Fitting			Size 8 Fitting		
	u (mm)	v (mm)	w (mm)	u (mm)	v (mm)	w (mm)	u (mm)	v (mm)	w (mm)
30°	+ 36	–31	+ 24	+ 44	-40	+ 29	+46	–45	+ 33
35°	+ 42	–34	+ 18	+ 52	–44	+ 21	+ 55	–50	+24
40°	+ 49	–37	+ 11	+ 61	–48	+ 12	+65	–55	+ 14
45°	+ 58	–43	+ 2	+ 71	–54	+ 2	+ 77	–61	+ 2

Table 8 gives details of dimensions required for calculating the upright lengths.

Table 8: Uprights and rails using Types 55 and 56 – Size 8 only

Angle	u (mm)	x₁ (mm)	w (mm)	x₂ (mm)
20° to 29°	–18	–18	–50	–50
30° to 39°	–16	–16	–60	–60
40° to 49°	–14	–14	–70	–70
50° to 59°	–12	–12	-	-
60° to 69°	-10	-10	-	-
70° to 79°	–8	–8	-	-
80° to 88°	–6	–6	-	-

Shelving
Using Type 46 or L46

Shelving with carrying rails positioned on the outside of the upright.
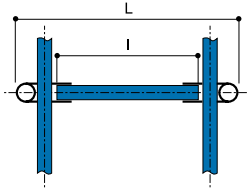

Table 9 gives the dimension 'x' to be subtracted from overall shelf width 'L' to give the length of the cross rail in the formula I = L – x. (Dimension x accounts for the use of two Type 46 or L46 fittings.)

Table 9

Fitting Size	x (mm)
4	−98
5	−134
6	−162
7	−196
8	-228
9	−276

Construction of Braces and Struts
Using Types C50, C51, C52 & C53 or LC50, LC51 & LC52

When using multiple tube sizes in one structure, Types F50-5 to F50-9 or LF50-6 to LF50-8 can all be combined with:

M50-5 to M50-9   LM50-6 to LM50-8
M51-5 to M51-9   LM51-6 to LM51-8
M52-5 to M52-8   LM52-6 to LM52-8
M53-8

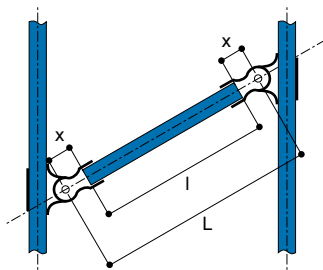to construct combination fittings (i.e. C50-75, C50-85, C51-655, C52-855 and C53-888).

Table 10 gives details of dimension 'x' to be subtracted to give the tube length required for use with two Type F50 or LF50 fittings in the formula I – L – 2x.

Table 10

Fitting Size	x (mm)
4	− 14
5	− 25
6	− 25
7	− 25
8	− 25
9	− 32

Note: Dimension 'L' is the length from pivot point to pivot point. The distance from upright to upright is dependent on the angle of the strut.

Pallet Racking
Using Type 46 or L46

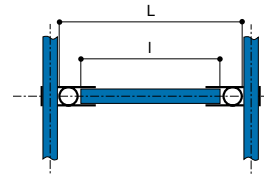Pallet racking with the carrying rails on the inside of the upright.

Table 11 gives dimension 'x' which must be subtracted from the overall width of the carrying rails, to give the length of the cross rail in the formula: I = L – x. (Dimension x accounts for the use of two Type 46 or L46 fittings.)

Table 11

| Fitting Size	x (mm)
4*	−48
5*	−59
6*	−72
7	−85
8	−102
9	−126

*Pallet racking is not recommended in less than size 7 tube.

The length of the longitudinal member can be calculated from multiples of the length of the bay between the centres of uprights, plus dimension 'z' in Table 12. Dimension z accounts for the length of tube needed to go through the topmost fitting to the fitting's termination. This also applies to constructions using fitting Type 45.

Table 12: Additional tube length to reach topmost fitting's termination

Fitting Size	z (mm)
3	+24
4	+28
5	+31
6	+38
7	+46
8	+51
9	+61

Longitudinal tubes are joined using fittings Type 14 or 18 couplings (use of Type 18 is not recommended as a load bearing joint), which must be positioned to occur at the edge of the Type 46 fitting, and must not all occur in the same bay at alternate levels.
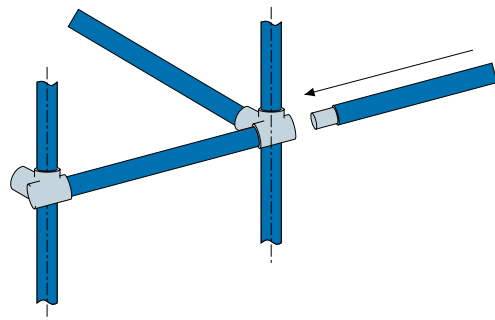
Spigots can be either tubes or rods, riveted into position, or the Type 18 fitting. When using the latter, a gap of 20mm must be allowed for the set screw fixing.
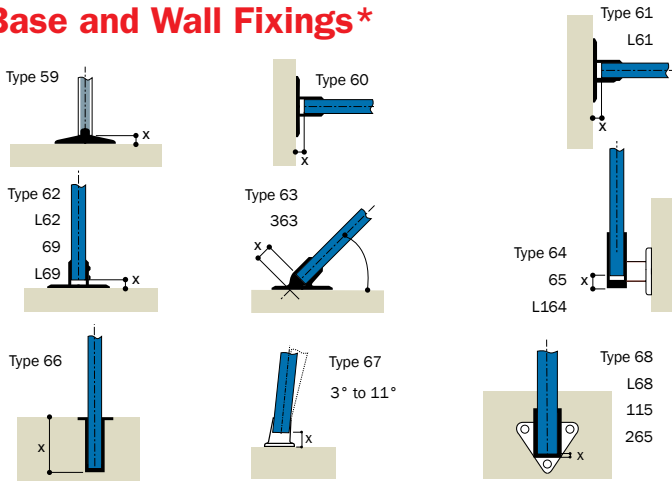
Base and Wall Fixings*

Table 13 gives details of the ground fixing dimension 'x', to be subtracted from the height 'H' to give the length of the upright 'h'.

Table 13

Flange Type	x (mm)
59	−10
60	−10
61	−6
62	−6
67	−6

Table 14 gives details of the ground fixing dimension 'x', for Type 63-6 only, to be subtracted to give the length of the upright for each angle condition.

Table 14

Angle	x (mm)
45°	−38
50°	−32
60°	−25
65°	−12

Table 15 gives details of the ground fixing dimension 'x' for Type 363, to be subtracted to give the length of the upright for each angle condition.

Table 15

Angle	x (mm)
11°	−38
15°	−32
20°	−25
25°	−20
30°	−12

Table 16 gives the dimension 'x' to be subtracted from the length of the upright for fitting Types 64, 65, 67, 68, 115, 265, L68 and L164.

Table 16

Fitting Size	x (mm)
6	−5
7	−6
8	−6

Table 17 gives the ground fixing dimension 'x', to be added to the upright member to allow for the setting into the socket Type 66.

Table 17

| Fitting Size	x (mm)
6	+115
7	+127
8	+127

*When using **KEE LITE** bases and flanges, "ground fixing" dimension (x) will be zero, except when using flanges L164, L68 and LC58.

Constructing Circles and Triangles

Slopes and radii present no problem to the **KEE KLAMP** galvanised railing systems. Fitting Types 27, 28, 29, 30, C50, C51, C52, 55, 56, 86, 87, 88 and 89 (and the 90 range pedestrian guardrail fittings) are designed to allow for raked handrail while keeping the uprights vertical. Tube can be bent and radiused to suit most situations. Also, true lengths have to be determined where braces and struts are being used.

Worked Example

Consider the following concrete single flight staircase.
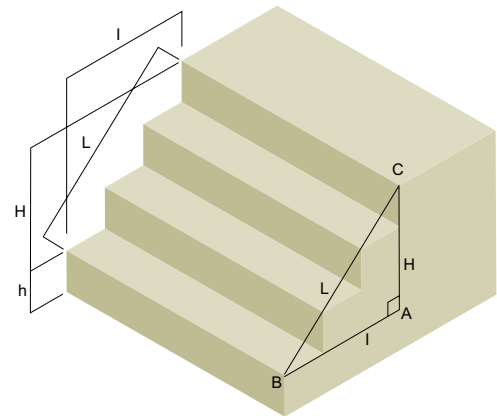
Where
H = Vertical height from 1st nosing to last nosing.
h = Vertical height from ground level to 1st nosing.
I = Horizontal dimension from 1st nosing to last nosing.
L = Hypotenuse dimension (Pitch Line) from 1st nosing to last nosing.

Known Data	Formula for Side and Angle		
H & L	$I = \sqrt{(L^2 - H^2)}$	$\sin B = \dfrac{H}{L}$	$C = 90° - B$
L & I	$H = \sqrt{(L^2 - I^2)}$	$\sin C = \dfrac{I}{L}$	$B = 90° - C$
H & I	$H = \sqrt{(H^2 - I^2)}$	$\tan B = \dfrac{I}{H}$	$C = 90° - B$

Note: The table can be used to solve angles and true lengths for braces and struts.

Step 1

From a simple site survey or information from a working drawing, obtain the following dimensions.

Note: For greater accuracy, vertical dimensions should be taken by means of a Dumpy Level or a Theodolite.

H = vertical height from the 1st nosing to the last (140cm).
L = pitch line, the diagonal dimension from the 1st nosing to the last (240cm).

Step 2

From the table to determine angle B we use;
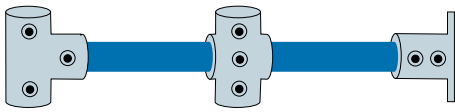
Sin B = 55 / 96, Angle B = 35°

Ramps can be dealt with in a similar way. Most ramps have a stated gradient (e.g. 1:12); for every 12 units traversed horizontally, 1 unit of vertical height is obtained.

How to Make Jigs for Railing Posts
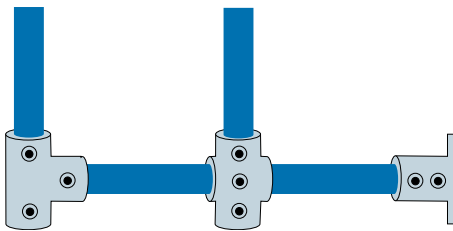## Set-up

Step 1: Start with pre-cut tube.
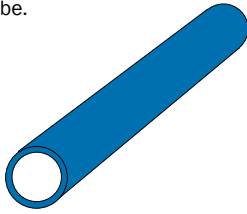
**Step 2:** Measure and locate fittings on first post only.

Step 3: Lay post horizontal, and insert two pieces of scrap tube.
This is all that's involved in setting up your jig! From this point, duplicate posts can be produced by unskilled labour, without further measuring, at the rate of 20–30 posts per hour.
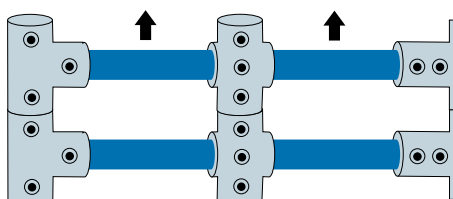
Utilising Jigs for Railing Posts
Production

Step 1: Set top and middle fittings in place, unfastened, on the two pieces of scrap pipe.
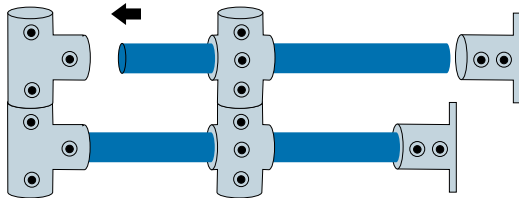
Step 2: Insert pre-cut tube into fittings, then add flange.

Step 3: Simply tighten set screws, then lift off.

Pedestrian Guardrailing
Using Types 90, 91, 92, 93 and 95

This construction is used when individual rails are required to be removable and when the site is not straight and level. Slopes of up to 7° or radii greater than six metres can be accommodated without bending the tubing.

When bending the tube around a corner, a Type 95 PGR spigot must be included to prevent sagging. Holes of 15mm diameter must be drilled through both walls of the upright, one at 25mm from the top of the upright tube.
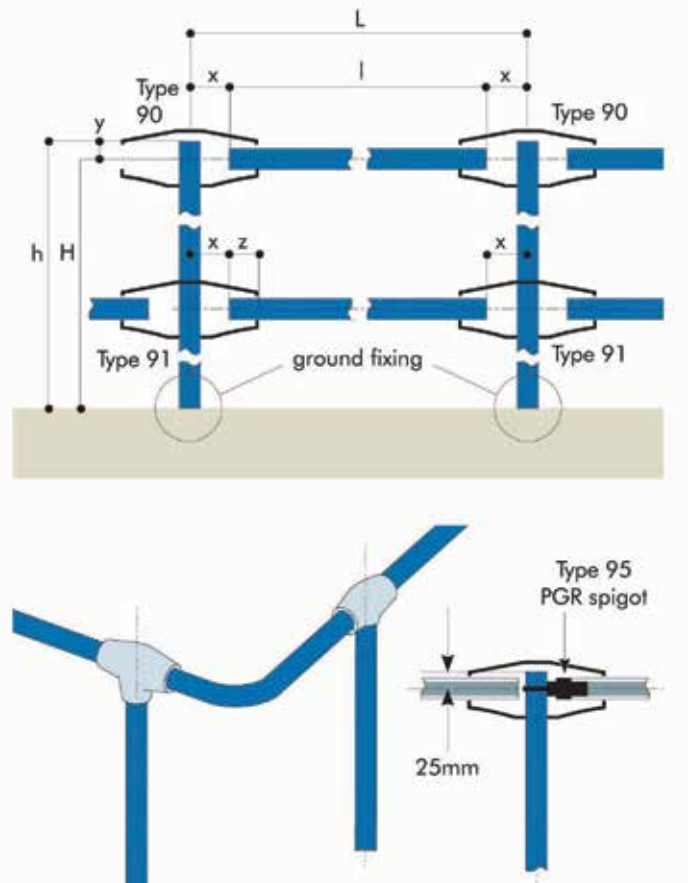
Table 18 gives details of:
(i) Dimension 'x' in the formula $I = L – 2x$ for calculating the rail lengths where:
L = distance between the centres of the uprights
I = length of the horizontal tube.
(ii) Dimension 'y' in the formula $h = H + y +$ (ground fixing) for calculating the upright length where:
H = distance from ground to the centre line of the top rail
h = length of upright tube.

Table 18

Fitting Size	x (mm)	y (mm)
8	−66	+25

A brass drive screw (No. 6 x 10mm) is located at dimension 'z', in Table 19, on one end only for each horizontal tube. This positions the horizontal tube within the **Kee Klamp** fitting to give location relative to the set screws.

Table 19

Fitting Size	z (mm)
8	37

Galvanised Racking Load Tables

Table 22 gives an indication only of the safe load, uniformly distributed, in Kg, that may be carried per shelf consisting of front and back pipes when used as continuous beams.

For uneven load distributions or single spans, the required tube size must be determined by standard bending moment calculations assuming a **KEE KLAMP** joint to give a simply supported beam.

At loads greater than 900Kg consideration must be given to set screw slip.

Table 22: Beam load tables (Kg)

Span (m)	Fitting Size				
	5	6	7	8	9
	Tube Size				
	26.9mm x 2.6	33.7mm x 3.2	42.4mm x 3.2	48.3mm x 3.2	60.3mm x 3.6
0.5	540	1060	1750	2380	4000
0.6	435	850	1407	1870	3250
0.7	375	730	1207	1595	2760
0.8	330	645	1063	1385	2420
0.9	295	579	946	1230	2160
1.0	265	525	850	1110	1950
1.1	240	478	770	1013	1775
1.2	219	438	705	930	1625
1.3	202	403	651	858	1497
1.4	187	373	604	796	1387
1.5	175	347	564	741	1290
1.6	-	325	529	693	1205
1.7	-	306	499	650	1129
1.8	-	290	472	613	1061
1.9	-	277	448	581	999
2.0	-	268	427	553	987
2.1	-	-	408	528	944
2.2	-	-	391	505	855
2.3	-	-	376	485	818
2.4	-	-	362	467	785
2.5	-	-	349	450	755
2.6	-	-	-	434	728
2.7	-	-	-	419	703
2.8	-	-	-	405	680
2.9	-	-	-	-	659
3.0	-	-	-	-	639
3.1	-	-	-	-	620
3.2	-	-	-	-	603
3.3	-	-	-	-	588
3.4	-	-	-	-	575
3.5	-	-	-	-	564

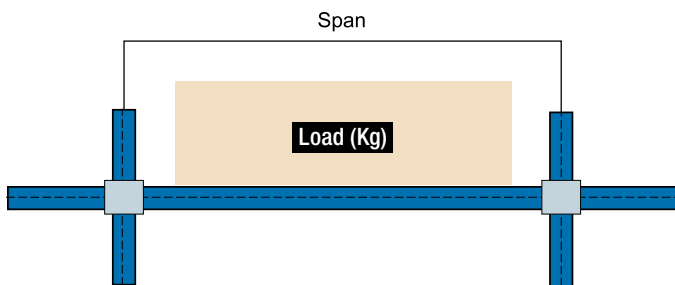Table reflects a safety factor of 1.67:1

Table 23 gives an indication only of the safe load, in Kg, that may be carried between the above restraints by single tubes to BS EN 10255 (ISO 65) when used as uprights.

Table 23: Load table (Kg) – unfixed upright

| Length (m)	Fitting Size				
	5	6	7	8	9
	Tube Size				
	26.9mm x 2.6	33.7mm x 3.2	42.4mm x 3.2	48.3mm x 3.2	60.3mm x 3.6
0.3	1720	2950	4038	4783	7044
0.4	1435	2617	3703	4446	6661
0.5	1150	2284	3368	4109	6278
0.6	910	1951	3033	3772	5895
0.7	725	1618	2690	3435	5512
0.8	590	1348	2363	3098	5129
0.9	480	1128	2028	2761	4746
1.0	-	948	1752	2424	4363
1.1	-	798	1524	2134	3980
1.2	-	-	1340	1884	3597
1.3	-	-	1188	1668	3253
1.4	-	-	1066	1484	2951
1.5	-	-	-	1328	2681
1.6	-	-	-	-	2441
1.7	-	-	-	-	2226
1.8	-	-	-	-	2032
1.9	-	-	-	-	1857
2.0	-	-	-	-	1697

Table reflects a safety factor of 2:1
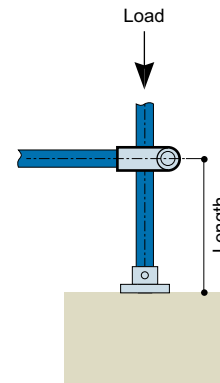
Table 24 (on page 49) gives an indication only of the safe load, in Kg, that may be carried between the above restraints by single tubes when used as uprights.

At loads greater than 900Kg* consideration must be given to set screw slip (*rating includes a safety factor of 2:1.74).
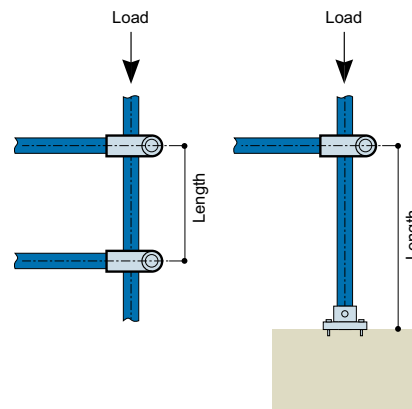
Table 24: Load tables (Kg) – fixed uprights

Length (m)	Fitting Size				
	5	6	7	8	9
	26.9mm x 2.6	33.7mm x 3.2	42.4mm x 3.2	48.3mm x 3.2	60.3mm x 3.6
0.3	1860	3086	4192	4916	7250
0.4	1600	2810	3910	4638	6930
0.5	1360	2534	3628	4360	6610
0.6	1140	2258	3346	4082	6290
0.7	940	1982	3064	3804	5970
0.8	775	1706	2782	3526	5650
0.9	640	1471	2500	3384	5330
1.0	540	1269	2235	3248	5010
1.1	-	1092	1995	2970	4690
1.2	-	937	1779	2692	4370
1.3	-	-	1587	2414	4050
1.4	-	-	1417	2169	3730
1.5	-	-	1265	1954	3410
1.6	-	-	1130	1764	3130
1.7	-	-	-	1602	2890
1.8	-	-	-	1462	2680
1.9	-	-	-	1342	2480
2.0	-	-	-	1242	2300
2.1	-	-	-	-	2120
2.2	-	-	-	-	1950
2.3	-	-	-	-	1800
2.4	-	-	-	-	1650

Table reflects a safety factor of 2:1

Aluminium Racking Load Tables

Values shown have a safety factor of 2 built into them and are based on the limit state of the material used.

The values in Table 25 are an indication of a UDL that a rack consisting of two continuous support tubes can support.

For uneven load distributions, the required tube size must be determined by standard bending moment and deflection calculations assuming the **KEE LITE** joint to give a simply supported beam.

Table 25: Beam load table (Kg)

Span (m)	Fitting Size			
	6	7	8	9
	Tube Size (mm)			
	25 N.B.	32 N.B.	40 N.B.	50 N.B.
	Grade of Material – 6082 T6 Aluminium			
0.3	1140	2468	4230	8693
0.6	285	617	1057	2173
0.9	126	274	470	965
1.1	84	183	314	646
1.2	71	154	264	543
1.5	45	98	169	347
1.7	35	76	131	270
2.1	23	50	86	177
2.3	-	42	71	147
2.4	-	38	66	135
2.7	-	-	52	107
3.0	-	-	42	86

At loads greater than 770Kg* consideration must be given to grubscrew slippage. (*A safety factor of 2 being applied in this instance.)
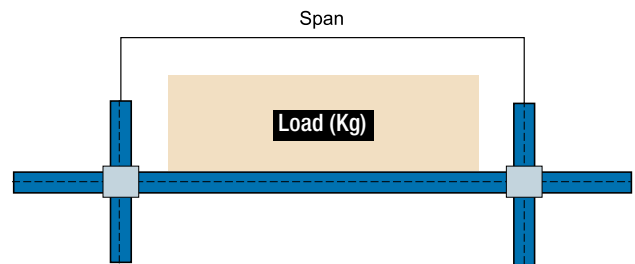
Values shown have a safety factor of 2 built into them and are based on the limit state of the material used.
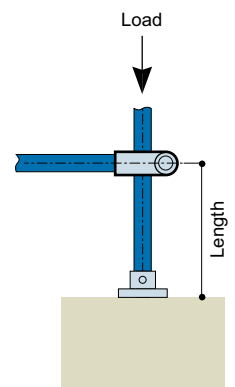
Table 26 gives an indication only of the safe load, in Kg, that may be carried between the above restraints by single tubes when used as uprights.

Table 26: Load tables (Kg) – unfixed upright bases

Height (m)	Fitting Size			
	6	7	8	9
	Tube Size (mm)			
	25 N.B.	32 N.B.	40 N.B.	50 N.B.
	Grade of Material – 6082 T6 Aluminium			
0.30	2431	4174	5249	7382
0.40	1653	3470	4593	6994
0.45	1296	2636	3675	6640
0.50	891	1977	3150	5934
0.60	502	1538	2441	5122
0.70	405	1274	1969	3850
0.75	324	725	1706	3355
0.80	267	593	1260	2755
0.90	251	505	1129	2402
1.00	210	461	997	2048
1.05	178	395	525	1942
1.10	-	351	499	1589
1.20	-	329	394	1448
1.30	-	308	381	1271
1.40	-	285	357	742
1.45	-	-	314	600
1.50	-	-	276	557
1.60	-	-	-	530
1.67	-	-	-	466
1.75	-	-	-	441
1.80	-	-	-	406
1.90	-	-	-	369
2.00	-	-	-	351

Table reflects a safety factor of 2:1

At loads greater than 770Kg consideration must be given to grubscrew slippage (a safety factor of 2 being included in this instance).

Values shown have a safety factor of 2 built into them and are based on the limit state of the material used.

Table 27 gives an indication only of the safe load, in Kg, that may be carried between the above restraints by single tubes when used as uprights.

At loads greater than 770Kg consideration must be given to grubscrew slippage (a safety factor of 2 being included in this instance).

Table 27: Load tables (Kg) – uprights restrained both ends

Height (m)	Fitting Size			
	6	7	8	9
	Tube Size (mm)			
	25 N.B.	32 N.B.	40 N.B.	50 N.B.
	Grade of Material – 6082 T6 Aluminium			
0.30	3549	5052	6063	8300
0.40	3371	4789	5906	8123
0.45	3160	4723	5722	8053
0.50	2625	4393	5512	7841
0.60	2399	4174	5249	7700
0.70	2009	3778	5118	7417
0.75	1750	3405	4803	7064
0.80	1378	2965	4147	6994
0.90	1215	2592	3622	6605
1.00	1102	2240	3360	6181
1.05	940	1933	3097	5828
1.10	843	1845	2703	5474
1.20	-	1538	2493	5122
1.30	-	1427	2231	4768
1.40	-	1318	1969	3956
1.45	-	1208	1785	3814
1.50	-	1076	1627	3461
1.60	-	988	1522	3108
1.67	-	-	1443	2755
1.75	-	-	1286	2543
1.80	-	-	1181	2402
1.90	-	-	-	2296
2.00	-	-	-	2155
2.05	-	-	-	2048
2.10	-	-	-	1801
2.20	-	-	-	1730
2.30	-	-	-	1589
2.40	-	-	-	1519

Table reflects a safety factor of 2:1
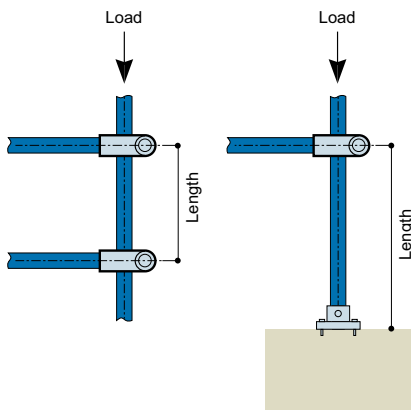
Test Report:
Vibration of Kee Klamp® Assemblies

Exhaustive tests on samples of standard size 7 **KEE KLAMP** fittings were performed by an independent research laboratory. The purpose of the test was to evaluate the use of either standard set screws or self-locking set screws.

Test Arrangement

A "Tee" section test assembly was made using three 300mm lengths of galvanised size 7 standard tube held together by a three socket tee fitting (Type 25-7). The vertical leg of the test assembly was supported in a standard railing flange (Type 62-7). The completed assembly was then rigidly attached to the vibration table.

The test assembly was initially assembled using standard set screws and tested in this configuration. The standard set screws were then replaced with the self-locking screws and the tests repeated.

Test Procedure

The test was conducted on a Ling 667Kg Electromagnetic Vibration Table. The table was programmed to perform a resonance search between 25 and 350Hz and resonant frequencies were recorded and shown in Table 28.

Table 28: Test Results

Resonance Frequencies	Q Factor	Running Time
74	1.27	Nil
106	1.27	Nil
158	1.53	6 hours
200	1.8	6 hours
221	5	6 hours
295	9	6 hours

During the resonance search, amplification factors (Q) were measured at each resonant frequency, the point of reference being the end of one horizontal tube. The table was then held at one of the resonant frequencies, set in motion with a controlled acceleration level of 4g, and ran for a period of six hours. This was repeated for three more resonant frequencies in descending order of Q factor.

Furthermore, during the twenty-four hours of vibration at the four resonant frequencies above, no signs of loosening with either type of attachment screw occurred.

Comprehensive data showing the telescopic relationship between tubes to BS EN 10255 (ISO 65) is shown in Table 29 (page 51).