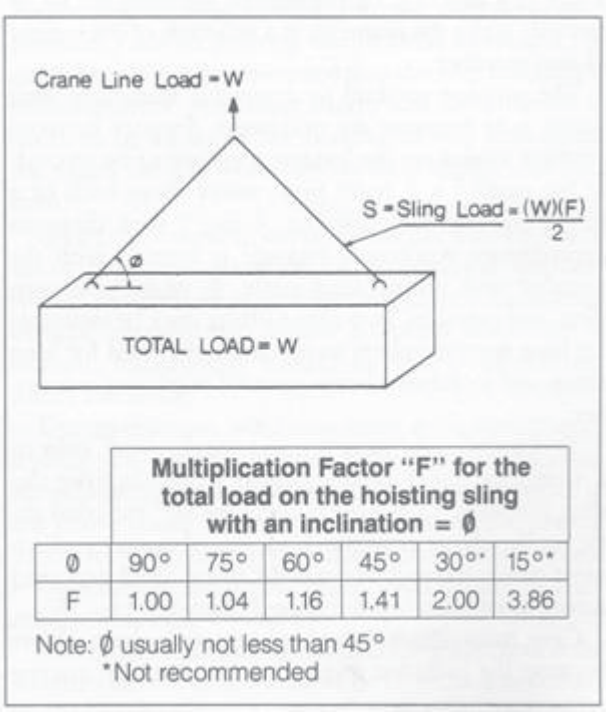
Rope angles	Published Date: 30/03/2009

When units are lifted, it is usually with wire ropes, attached at one end to a cast-in lifter, and to a shackle or hook at the other. Normally there are two or four such ropes, and it is very rare for these ropes to be vertical when in use. An exception to this is where a spreader beam or lifting frame is used.

When assessing the size of lifter to be cast in, the angle that the ropes may achieve is an important factor to be taken into account. If a rope is indeed vertical, then it follows that the vertical component of the load simply 'passes through' the rope and no adjustment is needed. Similarly if the rope is near horizontal, then its efficiency in taking vertical loads is severely reduced. It therefore takes a far greater load in the rope to achieve the same vertical result. In theory, a perfectly horizontal rope taking a vertical load would have an infinitely high tension in it! In between these two extremes, a factor is applied to take account of the angle. This multiplying factor is

F = 1 / (sine of the angle the rope makes to the horizontal)



	Multiplication Factor "F" for the total load on the hoisting sling with an inclination = ø					
ø	90°	75°	60°	45°	30°*	15°*
F	1.00	1.04	1.16	1.41	2.00	3.86

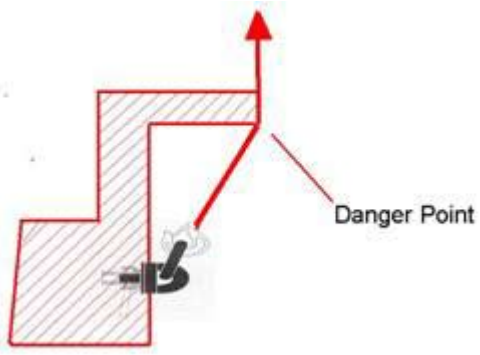
Note: ø usually not less than 45°
*Not recommended

Details traditionally refer to the angle being between the rope and horizontal. Some references and manufacturer's literature refers to the angle between rope and vertical. In this case the formula uses the cosine of the angle, but the result is the same.
The diagram shows the factor for several rope angles. Angles less than 45o are not normally used. Although not recommended, the factors for shallow angles show how the load can rapidly increase.

The above 'rules' apply only to the choice of lifting insert. For specifying rope capacity, more specialist guidance is given in BS6210 (Safe use of Wire Rope Slings).

The 'W/2' part of the equation is for 2 ropes and symmetrical loading. For 4 ropes the total load is divided by 4, provided that the rigging is such that each rope takes ¼ of the load.

If this is not achieved, or if the loading is not symmetrical then an engineering check is required. In addition, a further factor is added to take account of the dynamic effects (snatch) of the crane. This is typically 1.3.



Apart from the increased rope load, it is important to check that the angle of a rope during handling is such that it does not clash with the concrete. Although not common, such cases can occur and run the risk of a) damaging the concrete at the corner, b) causing bending in the concrete section, c) damaging the rope and risking failure.