TG16:21

Anchoring to the Ground

NASC
National Access & Scaffolding Confederation

Many free-standing scaffolding structures, such as access towers, major signboards, fences and enclosures, need to be anchored to the ground, primarily to resist wind forces.

All structures requiring restraint via anchoring to the ground must be subject to a bespoke design produced by a competent scaffold designer.

The scaffold design must consider the possibility of disturbing underground services. In areas where this possibility exists, the client or site owner should be requested to provide an up to date plan of the area showing the location and depth of any underground services. Alternatively, a service identification survey should be conducted to provide the necessary information. Suitable precautions must then be implemented to eliminate or mitigate any identified hazards, prior to the installation of any type of ground anchor. Further details can be found in HSE document HSG47 'Avoiding danger from underground services'.

Anchor capacities are dependent on ground conditions and reference should be made to the designer for the type, number and location of anchors. Where proprietary ground anchors are used the recommendations of the manufacturer or an accredited installer should be followed and a certificate of safe or ultimate loading obtained. In all cases a suitable assessment, which should include a sufficient number of pull-out tests should be carried out on site to verify the design statistically.

Capacities of individual anchors quoted within this guidance are 'typical' indicative values only and will vary with the type and condition of the soil and environmental conditions. If there is any doubt, regarding the suitability of the ground to support a particular type of anchor, a competent geotechnical engineer should be consulted.

Based on available information and past experience, it is recommended that a factor of safety of not less than 1.5 is applied to all characteristic loads. This should be confirmed with the client prior to the completion of the design.

Connections between anchors and the scaffold may be made with 'guy wires' (as generally shown in the diagrams below) or where practicable, with scaffold tubes and fittings. All connections must be designed to support the calculated loadings.

If guys are chosen, a suitable gauge/grade of wire rope must be selected (typically 10mm or 12mm diameter) which should be connected to the scaffold structure and the ground anchor by a single round turn and a minimum of three bulldog grips at each end. The recommended factor of safety for guy ropes and connections is 3.0.

Normally guys should be tensioned so that the slack is just removed. This is usually achieved with the aid of a small winch or turnbuckle. When guys are designed to be pre-stressed, a means of measuring the force applied (such as by the use of a tension meter or dynamometer) will need to be incorporated. No tensioning device should be pulled too tightly, as this can result in very considerable tension being placed on the ground anchorage and compression on the structure before live and wind loads have been applied. All guys should be tensioned progressively to avoid any uneven overloading of the structure, which could lead to overturning.

Scaffold tubes may be used to form rakers or buttresses (e.g. fencing or signboards) to maintain stability in all directions. Connections should be designed to support the calculated loadings and fitted with supplementary couplers (as recommended in TG14) if required. Any joints in rakers must be suitably lapped or sleeved and spliced as required to support the required tensile and/or compressive loadings.

Tube Anchors

Figure 1 shows possible solutions for employing scaffold tube anchors, with indicative values of anchor strength (or holding capacity) which can normally be achieved in 'good' ground.

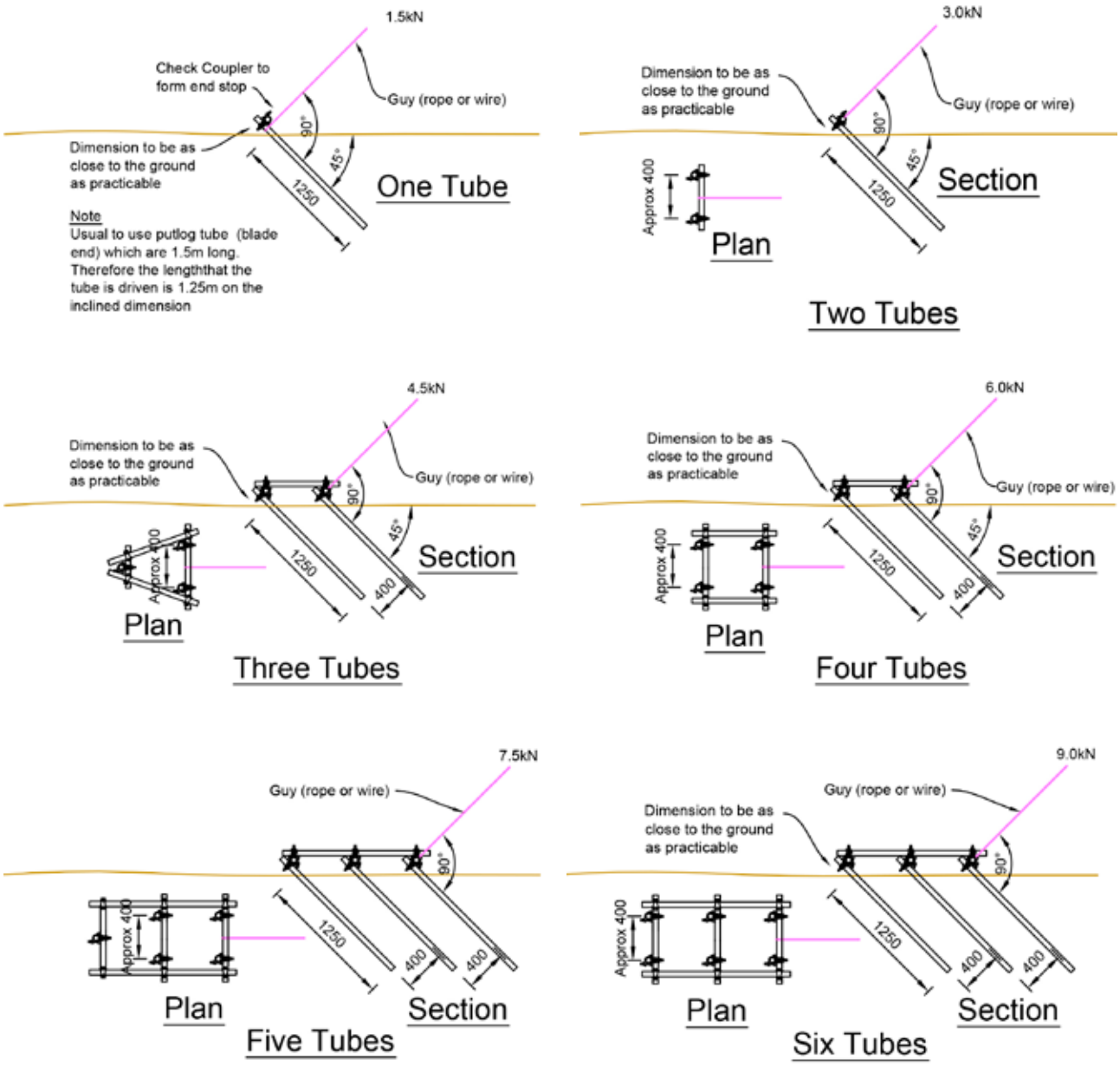

Figure 1 Tube Anchors

Driven tube anchors can be used with as many tubes as required as shown in Figure 1. Tubes are typically about 1.5 m long and penetrate 1.25 m into the ground. The tubes should be set at right angles to the guy and fixed together with tube and right angle couplers. Guys should be attached to the front tube, which should be fixed as near the ground as possible. Guys should be prevented from slipping by means of a scaffold fittings.

Driven tube anchors should not be used on a down slope towards the structure. They can be used in clay, sandy or gravelly ground and driven into position with a sledge hammer or post driver.

Cross Tubes Attached to a Foot Lift

Temporary stability of large structures during construction and permanent stability of small structures may be achieved by using cross tube anchors attached directly to the bottom of the structure as shown in Figure 2. The forces involved should be calculated and the necessary number of anchors inserted. The necessary number of supplementary and check couplers should be added to the base frame and any tension loads in the standards should be catered for by sleeving and splicing each joint with a short butt tube and a suitable number of swivel couplers at each side.

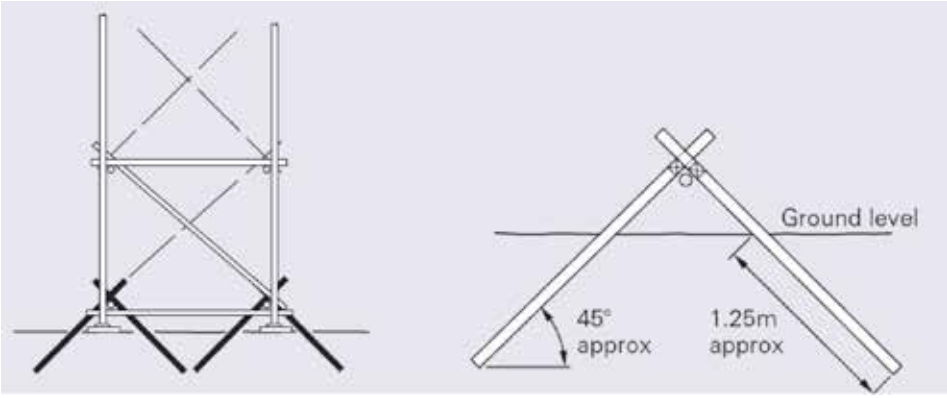

Figure 2 Cross Tubes

Helical Anchors

Details of typical types of helical anchors are given in Figures 3, 4 and 5 together with an indication of their holding capacities for different size anchors in various types of soil. Please note that these values are indicative only and in all cases, must be properly assessed and manufacturers' guidance followed.

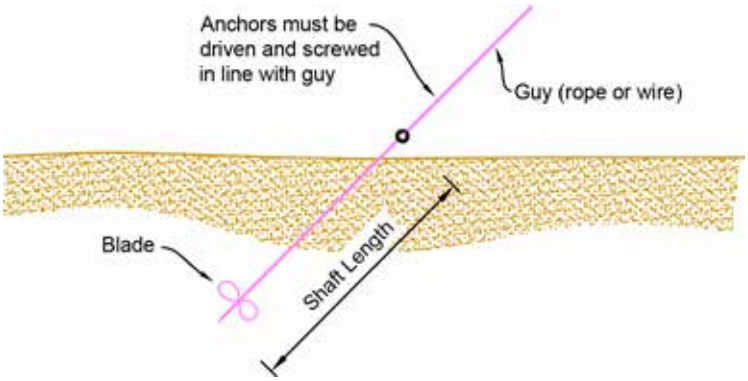

Figure 3 Helical Anchor (Single helix type)

Indicative holding capacities

Ground ↓ / Size →	Blade – 101mm Shaft – 12mm Length – 457mm	Blade – 153mm Shaft – 18mm Length – 762mm	Blade – 203mm Shaft – 25mm Length – 1219mm	Blade – 254mm Shaft – 28mm Length – 1594mm	Blade – 304mm Shaft – 29mm Length – 1676mm
Chalky Damp	8.0kN	30.0kN	47.0kN	73.0kN	84.0kN
Crumbly	6.0kN	23.0kN	34.0kN	45.0kN	53.0kN
Firm Moist	4.0kN	11.0kN	23.0kN	36.0kN	42.0kN
Plastic Wet	2.5kN	8.0kN	12.0kN	19.0kN	25.0kN

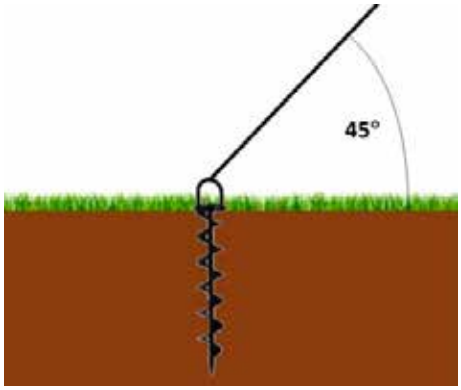

Figure 4 Helical Anchor (Spiral type)

Indicative holding capacities (in soft moist ground)

Length	500mm	650mm	900mm
Capacity	5.4kN	9.4kN	12.0kN

Figure 5 Helical Anchor (Ground bolt type)

Indicative holding capacities in kN
(Load range for various soils)

Anchor Diameter	**Length**	**Typical Load Range***
75mm	1100mm	13.2–26.5kN
75mm	1320mm	17.2–36.3kN
75mm	1760mm	22.6–49.1kN
75mm	2200mm	29.4–63.8kN
75mm	2640mm	37.3–80.4kN

Mechanical Anchors

Mechanical anchors (sometimes known as 'percussion driven earth anchors') can be driven into the ground using conventional portable equipment. (See Figures 6 and 7).

Figure 6 Typical Percussion Driven Earth Anchor

Anchors are installed by using a drive rod to hammer them into the ground to the correct depth. This task can be performed using a sledge hammer, post driver or power tools. The drive rod is then removed and pressure is applied to the cable manually or with a mechanical jack or 'load locker'. This causes the blade of the anchor to rotate within the ground into its 'load-locked position'. This produces a cone effect within the soil to resist uplift.

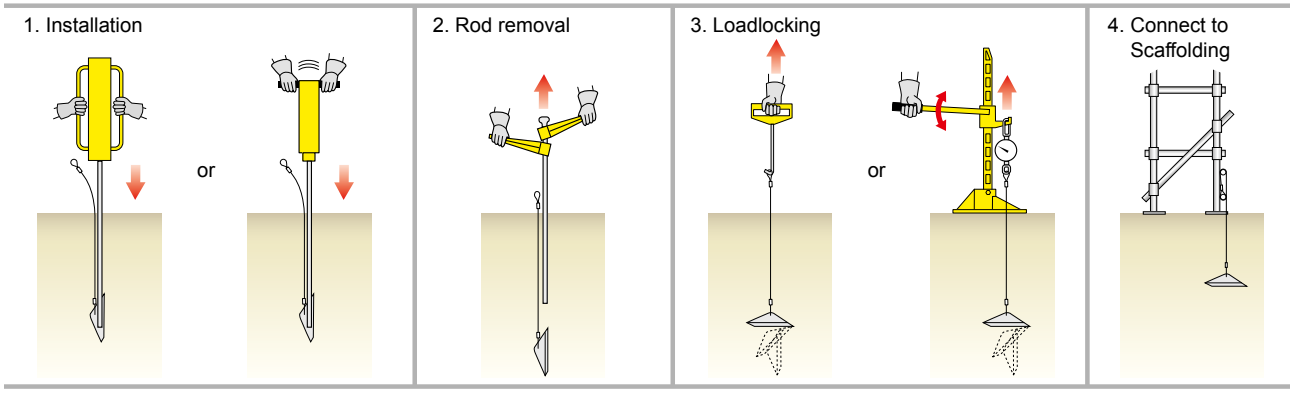

Figure 7 Method of Installation

Anchors may be inserted vertically into the ground and connected directly to the foot lift of a scaffold as shown in Figure 8 below, or installed at a suitable angle for the inline pull of a guy wire.

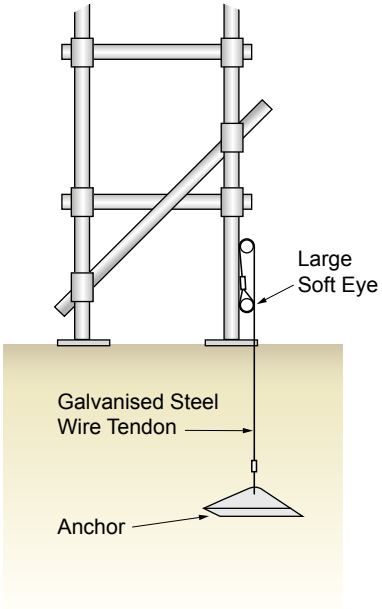

Figure 8 Method of Connection to Scaffold

Note: Various types of mechanical anchors are available on the market and indicative holding capacities can vary from 0-300kN, depending on the blade design and size, depth of installation and the soil conditions. True capacities should be determined by the use of a 'load locker' or an equivalent device incorporating a load cell. Manufacturers' guidance on installation and holding capacities should always be followed.

Anchors in Concrete

Where ground conditions are considered unsuitable or cannot be determined, tubes may be cast in concrete blocks or slabs, to provide suitable restraint. The concrete should be of a suitable size to provide the required resistance and set into the ground or otherwise prevented from sliding.

Prior to anchoring in concrete, contractors should seek advice from a competent engineer.

When embedding tubes in concrete, the interface bond strength between tube and concrete will vary with the grade of concrete, the condition of the tube, the length of attachment etc. This can, however, be enhanced by fixing a loadbearing coupler, a small butt tube, or by 'ragging/flaring' the tube end, prior to casting, to provide additional resistance.

Blinding concrete is unlikely to be strong enough to provide a suitable anchorage.

The anchor strength will be dependent on the size and shape of the concrete block and the method of fixing to both the embedded tube and the scaffold structure.

If scaffolds are based on an existing concrete floor or slab, they may be restrained with conventional scaffold anchors (e.g. expanding sockets, self-tapping screws, resin anchors etc.) by the same methods described in TG20 Operational Guide, Sections 7.15 to 7.19. However, the suitability of the slab must first be determined and permission sought from the client, before doing so.

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