Crane information

Cranes are designed to lift freely-suspended loads in a vertical plane. They are commonly used to carry out lifting operations on construction projects.

Contractors are under a duty to ensure that cranes are operated safely. A lack of consideration at the design stage can make this duty difficult to discharge, and put pressure on contractors to use cranes at or beyond their operating limits.

By providing information about a site, designers can help contractors select the correct crane and associated equipment, and plan the lifting operation.

This Information Sheet provides designers with some basic background information on cranes. It also summarises the issues you should consider at the design stage, when designing a structure whose components will be delivered by cranes.

The information here will help you fulfil your responsibilities. You should apply it to your designs and, with the help of expert advice, modify them to create safe conditions for lifting operations.

Cranes and the pre-construction information

Pre-construction information should cover the use of cranes.

It should contain enough information to ensure that lifting operations are initiated and proceed in a logical and safe manner. This involves making sure that everyone involved in the specification, installation or use of cranes is aware of the fundamental criteria that need to be fulfilled, and planning issues that need to be considered.

Consideration should be given to the ways in which the manufacturer and hirer intend their cranes to be used. Regard should also be had for any limitations that might affect safety, taking into account the anticipated site conditions.

Types of crane

Cranes come in many forms, as classified in detail in ISO 4306. The majority of cranes used in the UK construction industry tend to fall into four classes:

- **Lorry loaders. These are suitable for delivery purposes and routine lifting operations associated with the vehicle on which they are fitted**
- **Truck-mounted/mobile cranes. These are suitable for short-duration operations, where mobility around the site is important**
- **Crawler cranes. These are suitable for longer-duration operations and 'pick and carry' duties, and for use on certain types of terrain unsuited to the use of a wheel-mounted crane**
- **Tower cranes. These are suitable for semi-permanent installation, when covering large areas. They take up relatively little room at ground level**

Each of these classes contains a variety of crane types, with different lifting capacities. A description of each type of crane, and details of how to use it safely, are given in BS 7121.

Selection of cranes

The choice of crane may well be influenced by economic factors. Nevertheless, it must be capable of lifting all loads that it will be expected to handle, within its capacity and stability limits.

Manufacturers' duty charts give details of safe working loads for specific tasks. These provide designers with useful information about the size of crane required – and, consequently, the space and loading requirements on site.

Factors affecting crane safety

The characteristics of the load to be lifted

In order to carry out a lifting operation safely, it is necessary to know the weight and dimensions of a load, and the position of its centre of gravity. As such, the following information should be provided as a minimum:

- **The maximum weight to be lifted**
- **Any non-routine handling instructions that are required for a safe lift**
- **The position of the centre of gravity of asymmetric loads, or loads of non-uniform mass (preferably marked)**

Special lifting accessories may have to be designed to lift asymmetric loads, or loads of a non-uniform mass. If lifting accessories do need to be used, these will add to the overall weight to be lifted.

Bear in mind that lifting is made safer when designated lifting points are provided, or marked on the load itself.

The crane position

You should consider where the load is to be lifted from, the route it will take during the lift, and the position in which it will land. Potential obstructions, either temporary or permanent, should be taken into account – buildings, trees and overhead power lines providing three such examples.

If the crane is to be positioned on or next to an existing structure, be aware that it may overload that structure. You may need to carry out a design calculation check to establish whether temporary strengthening or propping is needed.

The radius over which a crane has to operate will also affect the loads it can carry, and the height at which these can be lifted. Table 1 illustrates this point, by reference to a particular type of crane.

Table 1: Lifting radius and lifting capacity

Radius (m)	Capacity (t)	Maximum height (m)
3	30	50
10	7.3	47
20	2.2	44
30	0.5	35

Clearances
It is important to maintain a safe distance between the crane and:

- **The structure under construction**
- **Adjacent buildings**
- **Roads**
- **Pedestrian access**

Mobile cranes require enough space around them to enable the correct deployment of their outriggers. They should also be able to slew and manoeuvre a load with adequate clearance (of at least 600mm) from any obstructions.

Other important considerations include:

- **Overhead electricity cables: cranes should never be positioned in the exclusion zone around overhead electricity cables. Lifting operations close to electricity cables or pylons may have to be scheduled to take place during power-off periods**
- **Railway tracks, overhead catenaries and public highways: if a crane is to be positioned adjacent to a railway, canal or public highway, an independent design check may be required. This can be used to prove that the scheme has been planned and engineered to avoid damage to existing structures or property, or to the public**
- **Airfields: a crane operating within six kilometres of an airfield can be a hazard to air traffic – particularly if its height exceeds 10 metres, or the top of the crane is higher than the surrounding structures or trees. In such cases, the airfield manager must be notified of the operation**

Erection and dismantling constraints
Cranes have to be erected, extended and dismantled. Remember that, normally, space will need to be provided for these operations.

Ground conditions and foundations
In order to operate safely, cranes need adequate foundations or support. So, the ground conditions on a site are important.

Crane operators need to know about:

- **The character of the ground, including water conditions**
- **The engineering properties of the strata relevant to the support of the crane or design of the foundations**
- **The location of any underground hazards – for example services, open- or back-filled excavations, drainage pipes, tunnels, trenches and basements**

By considering these factors at the design stage, you may be able to remove them or make them easier to control.

Site weather conditions
Prevailing weather conditions and the exposure of a site can affect lifting operations.

Wind, in particular, can affect the behaviour of a load when it is lifted. Structural items that offer a large effective area, such as shutters for concrete, can be difficult to control even in moderate winds.

Manufacturers will specify maximum wind speeds for erection, lifting, out-of-service and dismantling operations. In very exposed areas (such as cliff tops) or areas subject to wind turbulence (such as those that are built up), these speeds may have to be reduced.

Tower crane foundations

The design of tower crane foundations requires close consultation between a number of parties such as the crane manufacturer, temporary works designer, permanent works designer and structural engineer.

It will sometimes be necessary to tie a crane tower to another structure, to enable it to achieve sufficient height to complete a construction project. Most tower sections can only be connected to a tie at certain points. You will need to consult the crane manufacturer to discern the tower's maximum allowable shear forces.

Access routes

Cranes need access routes, and sufficient space to enable loads to be delivered. You may need to allow special access for the high-capacity trailers often used for deliveries such as counter-weights and jib sections.

When working in city centres, advance planning will be required to move the crane on and off the site. This will often need to be carried out in conjunction with police and local authorities, and may involve overnight working.

Useful resources

ISO 4306-1: 1990 Cranes Vocabulary Part 1: General
ISO 4306-2: 1994 Lifting Appliances Vocabulary Part 2: Mobile Cranes
BS 7121: Part 1: 1989 Code of Practice for the Safe use of Cranes – General Requirements
BS 7121: Part 3: 2000 Code of Practice for the Safe use of Cranes – Mobile Cranes
BS 7121: Part 4: 1997 Code of Practice for the Safe use of Cranes – Lorry Loaders
BS 7121: Part 5: 1997 Code of Practice for the Safe use of Cranes – Tower Cranes
BS EN 150 17892-12: 2018
CIRIA publication C703: Crane Stability on Site

See elsewhere on SID:

ADM008 Management of the works: the construction phase plan