



BS 5974 : 1982

UDC 69.057.66.033.6

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Code of practice for Temporarily installed suspended scaffolds and access equipment

(Formerly CP 97 : Part 2)

Code de bonne pratique pour les échafaudages suspendus et équipement d'accès provisoires

Richtlinie für provisorisch errichtete Schwebegerüste und Zugangseinrichtungen

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This code of practice represents a standard of good practice and takes the form of recommendations. Compliance with it does not confer immunity from relevant legal obligations.

Foreword

This code relates to suspended scaffolds and working platforms other than those which are permanent installations on a completed building. It supersedes CP 97 : Part 2, which will be withdrawn on publication of this code. Since some of the construction work detailed herein uses scaffolding materials, reference may need to be made to BS 1139 and BS 5973.

Certain equipment is used both for temporary works and as a permanent installation. A roof trolley with a small suspended platform may be dismantled and re-used for temporary work or left permanently on a roof. Similarly, a permanently installed roof rig and/or trolley track may

have attached to it a separately supplied platform, by a contractor, for use as a temporary installation. In these cases such equipment should satisfy the appropriate requirements of this code and BS 6037.

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British Standard Code of practice for

Temporarily installed suspended scaffolds and access equipment

Section one. General

1. Scope

This code of practice makes recommendations for the construction and use of temporarily installed suspended scaffolds and access equipment, comprising a working platform or platforms, work cage, cradle or safety chair, which are to be dismantled after the completion of the work for which they were erected. The equipment referred to is suspended by ropes from the outriggers of a roof rig or similar equipment and capable of being raised and lowered by means of lifting appliances which may be manually or power operated. In certain cases horizontal traversing is also provided.

Recommendations for slung scaffolds, being working platforms suspended on tubes or wires but not permitting raising or lowering, are contained in BS 5973.

For permanently installed suspended access equipment reference should be made to BS 6037.

2. References

The titles of the standards publications referred to in this code are listed on the inside back cover.

3. Definitions

For the purposes of this code the definitions given in BS 5973 apply (except for terms also listed here); together with the following (see figure 1):

3.1 bay. That section of a platform between any two adjacent suspension points.

3.2 building. A completed building, a building during construction, an engineering construction or any works or face which the suspended scaffold services.

3.3 cantilever length of outriggers. The length of the outrigger which extends unsupported.

NOTE. It is frequently not the same as the 'projection length' and should not be used in the calculation of the moments for stability.

3.4 climbing device. A lifting appliance manually or power operated through which the suspension rope passes controlled either by friction grips or by turns of the rope round drums within the appliance. The lower end of the rope is not anchored to the climbing device.

3.5 counterweight. A weight or series of weights to counterbalance the overturning forces on the roof rig and provide the required factor of safety.

NOTE. This usually comprises the self-weight of the inboard portion of the roof rig plus added kentledge.

3.6 cradle. That portion of the assembly designed to carry the work people and their equipment. (Also known as *working platform* (3.31)).

3.7 fulcrum point. The point of pivoting nearest to the outside edge of the roof rig about which the balancing moments of the roof rig are calculated.

3.8 lashing. A rope intended for joining two or more objects, such as scaffolding, at the points of intersection.

3.9 lever arms. The distances between the fulcrum point and the centre of gravity of any weights, including the self-weight of the roof rig.

NOTE. These lengths may be shorter than the whole length of the inboard or the outboard portion of the roof rig.

3.10 lifting appliance. A crab, winch, pulley block or gin wheel or other device used for raising and lowering as specified in the appropriate Statutory Regulations.

3.11 lifting gear. Chains, ropes, slings, rings, hooks, shackles, girder clamps, swivels, eye bolts, girder runners and trolleys and similar gear as specified in the appropriate Statutory Regulations.

3.12 maximum total suspended load. The maximum force which can be imposed on the roof rig including the safe working load on the platform, the self-weight of the platform and the suspension and safety ropes together with any portion of the means of suspension and the rope tensions, plus any extra force resulting from the operation of the equipment and environmental loads.

3.13 safe working load. The maximum allowable working load on the equipment during use.

3.14 outrigger. The cantilevered portion of the roof rig or roof trolley from which the cradle is suspended.

3.15 projection length. The distance between the fulcrum point and the suspension point.

NOTE 1. This length is greater than the distance from the vertical part of the suspension rope to the face of the building.

NOTE 2. The projection length is the length which is to be used in the calculation of moments for stability.

3.16 traversing. Moving laterally across the face of the building either manually or mechanically and operated from either the working platform or the roof.

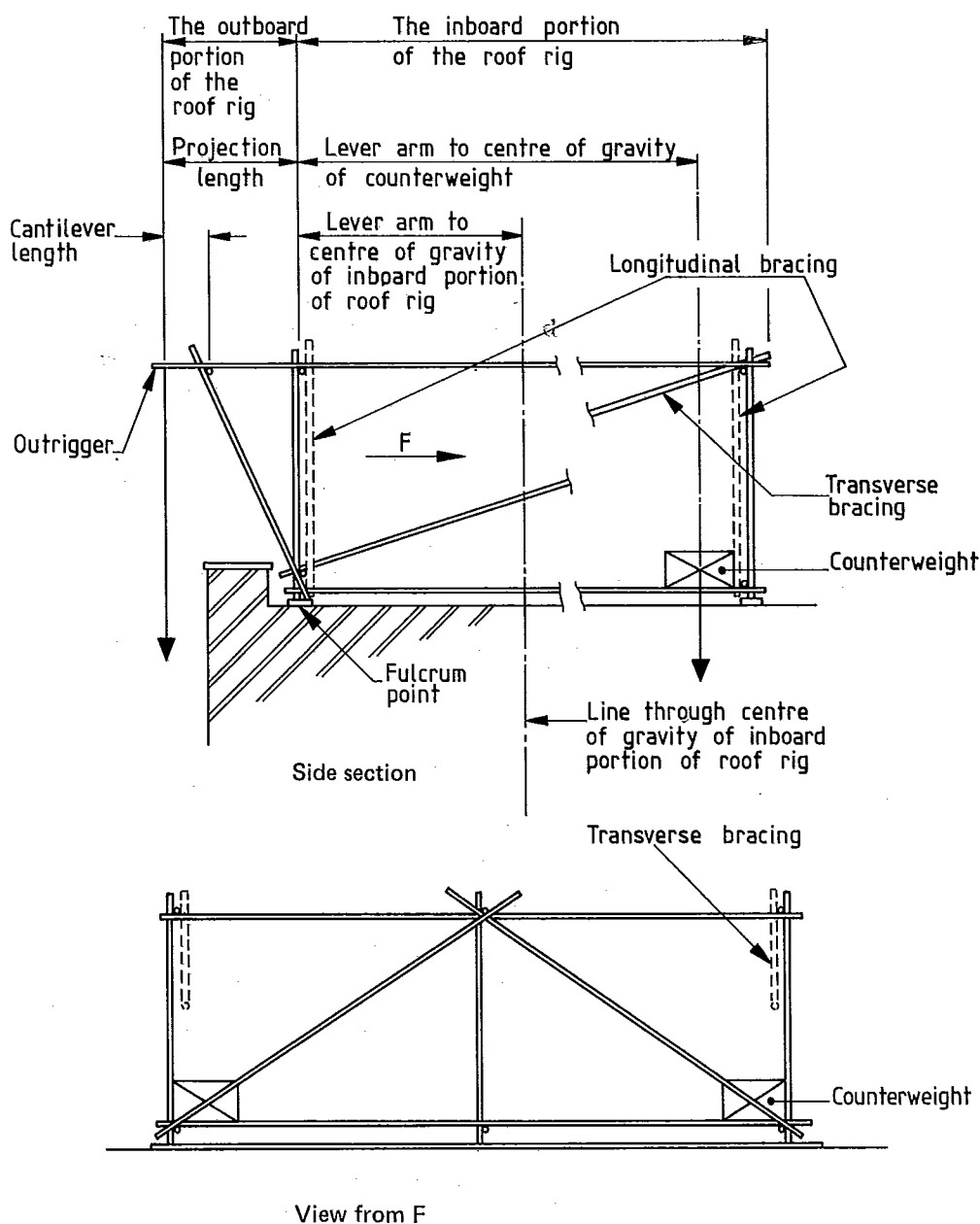


Figure 1. Examples of roof rig definitions (for calculations, see figure 3)

3.17 roof rig. That portion of the equipment (excluding the trolley track) mounted on the roof or at roof level to support and position the suspended platform.

3.18 inboard portion of the roof rig. That portion of the roof rig which is inside the fulcrum point, i.e. on the roof side of the fulcrum point.

3.19 outboard portion of the roof rig. That portion of the roof rig which is on the outside of the fulcrum point, i.e. not on the roof side of the fulcrum point.

3.20 roof trolley. The mobile portion of the roof rig which is capable of horizontal movement, being mounted on wheels or castors and supporting a fixed platform.

3.21 Ropes

3.21.1 minimum breaking load of ropes. The minimum value which shall be reached in a tensile test to destruction.

3.21.2 by-pass rope. Short ropes fixed in parallel with

another part of the suspension gear (for instance from a platform to a safety device), to come into operation in the event of a failure of that part.

3.21.3 safety or secondary rope. Rope(s) not normally carrying the weight of the working platform and the imposed load thereon but rigged in conjunction with a safety device to come into operation in the event of a failure of the suspension rope(s).

3.21.4 suspension rope. The ropes carrying the weight of the working platform and the imposed load thereon.

3.21.5 traversing rope. Ropes rigged for the purpose of traversing the platform and not carrying the weight of it.

3.22 factor of safety against overturning. The coefficient by which the maximum overturning moment of the working platform is multiplied to ensure safety against overturning, being the ratio of the sum of the righting moments to the maximum overturning moment.

3.23 safety gear. A device or devices acting on a separate safety rope, which will arrest and sustain a cradle in the event of the failure of a suspension rope.

3.24 single and double wire rope suspensions. A single wire rope suspension system is one which has one suspension rope at each end of an independent platform or cradle or at each end and hinge of a continuous platform.

A double wire rope suspension system is one which has two ropes at these locations.

3.25 stop end or quadrant. The attachment at or near the end of a rail or track or at an intermediate point to prevent further traversing of the platform.

3.26 suspended safety chair. A bosun's chair, or similar appliance suitable for one man to use.

3.27 suspension gear. The assembly of lifting appliances and gear which joins the working platform to the roof rig.

3.28 trolley track. The rail or rails normally installed at roof level which support and guide the roof trolley or cradle jockeys in the working position.

3.29 user. Any person, firm or organization using the suspended scaffold or access equipment.

3.30 winch. A lifting appliance manually or power operated to raise and lower the working platform by means of a suspension rope reeled on to a drum.

3.30.1 platform mounted or cradle mounted winch.

A winch which is mounted on the platform or cradle with the free end of the rope attached to the roof rig.

3.30.2 roof mounted winch. A winch which is mounted on the roof or roof trolley with the free end of the rope attached to the working platform.

3.31 working platform. See *cradle* (3.6).

3.31.1 fixed working platform. A working platform which does not traverse horizontally except by movement of a roof rig but which is capable of being raised and lowered.

3.31.2 hinged continuous working platform. A working platform of several sections hinged together enabling operatives to walk from one section to another.

3.31.3 individual working platform. A separate platform used by itself (see figure 2 type 2).

3.31.4 one man working platform. A short length of individual platform or a work cage.

3.31.5 travelling or traversing working platform.

A working platform capable of being moved horizontally.

3.32 work cage. A working platform which is suspended from a single wire rope, for use by up to 2 persons.

4. Description

4.1 Systems of attachment to structure. Suspended scaffolds and access equipment can be subdivided into

two classes according to the means of attachment to the building:

(a) those which rely on counterweights for their stability;

(b) those which are structurally attached to the roof or top part of the building or structure.

Either type may be fixed or traversing. The two methods of attachment may occasionally be combined.

4.2 Suspension system. A further subdivision of the types is between those having roof mounted winches and those having platform mounted winches or climbing devices. Two types of lifting appliances are in common use:

(a) winches, which reel the wire rope on to a drum;

(b) devices which 'climb' up the wire rope leaving the tail end of the rope hanging or reeled below the machine.

4.3 Types of platform. Four main types of platform are considered in this code and shown in figure 2. (See also section four.)

Type 1. Hinged continuous platforms. The working area may be a single deck or several decks beneath each other. There may be either one or two ropes at each end and at each hinge.

Type 2. Individual platforms. These may have a single deck or several below one another. Each end may be suspended by either one or two wire ropes.

Type 3. 'Painter's' cradles. These may be suspended on a fibre rope at each end passing through blocks if the length of the cradle is less than 3.2 m or on one wire rope at each end if the length is greater.

Type 4. Suspended safety chairs (bosun's chairs). These may be suspended by a single fibre rope passing through blocks or on a wire rope when a mechanical lifting appliance is used.

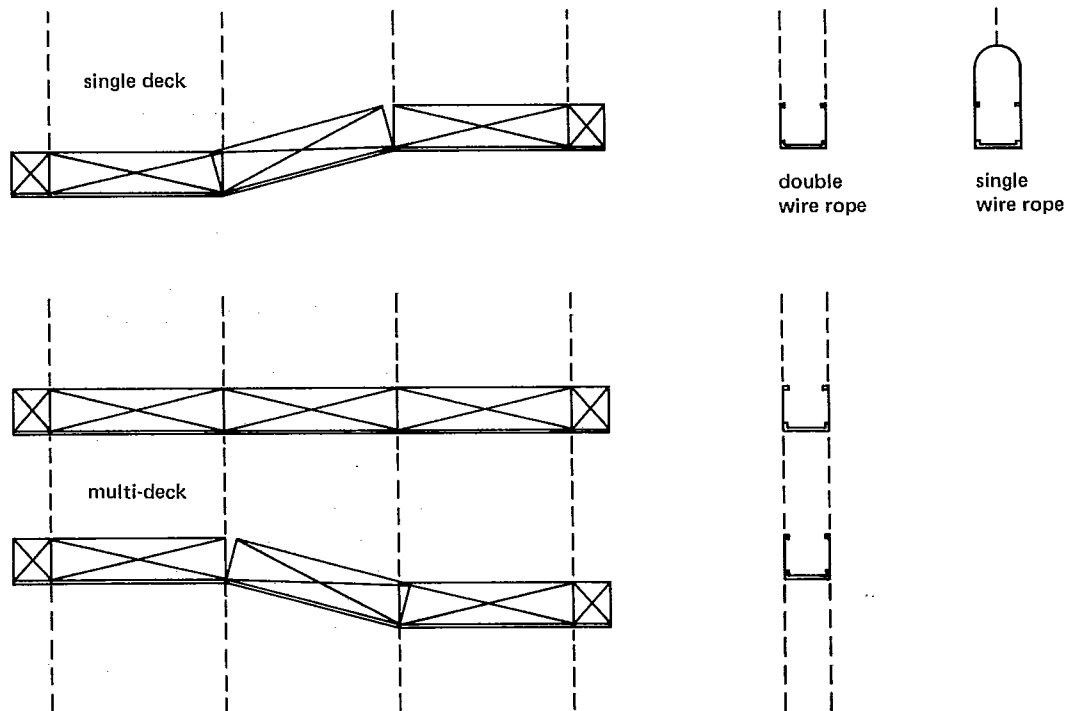
All four types may be manually or power operated. When power operated, types 1, 2 and 3 may have the lifting appliance mounted on either the roof or the platform. Type 4 is not customarily used with a roof mounted winch. Types 2 and 3 may be designed to be traversed horizontally.

Types 1 and 2 may be mounted below the soffits of bridges or from special structures on the parapets of the bridge.

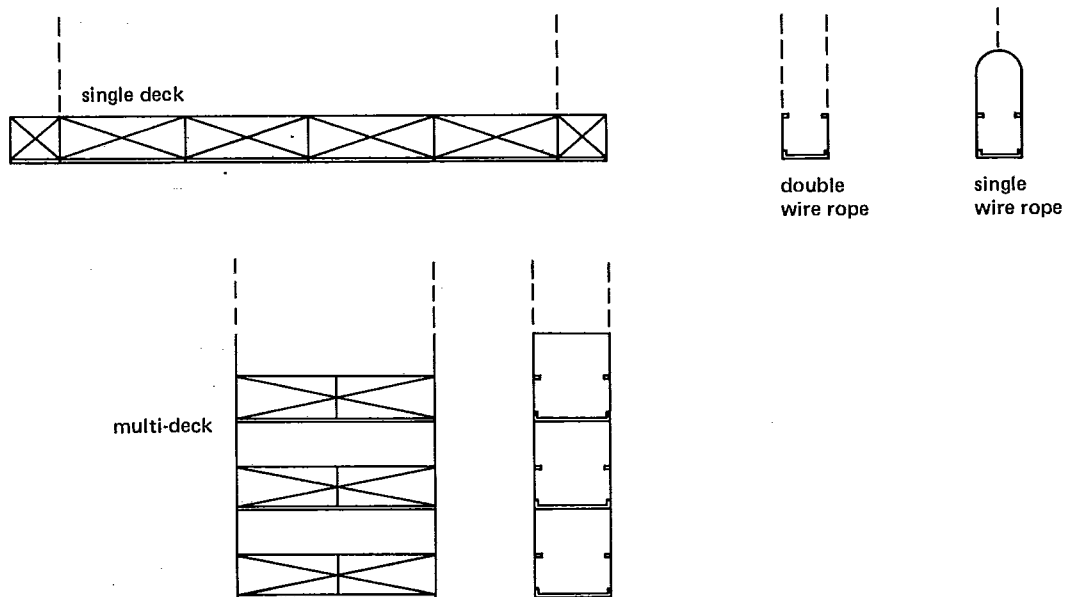
All four types are installations to which the Health and Safety at Work etc., Act 1974 and the Construction Regulations may apply.

NOTE. For suspended scaffold structures intended for use in shipyards, reference should be made to the Shipbuilding and Ship-Repairing Regulations, 1960 and other appropriate regulations.

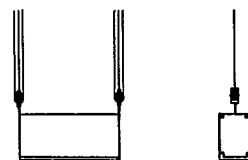
Special safety precautions are required for scaffolds suspended from wire ropes used in the construction of metal structures where electric arc welding and cutting is employed.



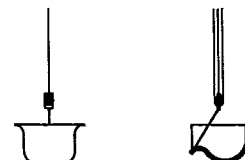
Type 1. Hinged continuous platforms



Type 2. Individual platforms



Type 3. Painter's cradles on fibre or wire ropes



Type 4. Bosun's chairs on fibre ropes

Figure 2. Types of suspended scaffolds

5. Statutory requirements

Attention is directed to Acts, Byelaws, Regulations and any other statutory requirements relating to matters dealt with in this code. The equipment should comply with these regulations and requirements. Its performance, use, inspection, testing and maintenance should also be in accordance with the appropriate regulations. Amongst others, the following statutory requirements, current at the date of publication of this code, relate to suspended scaffolds and access equipment:

- (a) Health and Safety at Work etc., Act 1974;
- (b) Factories Act 1961;
- (c) The Electricity (Factories Act) Special Regulations 1908 and 1944;
- (d) SI 94 Construction (Working Places) Regulations 1966;
- (e) SI 1580 Construction (General Provisions) Regulations 1961;
- (f) SI 1581 Construction (Lifting Operations) Regulations 1961.

6. Identification and registration of components and marking of safe working loads

For the purpose of this code every lifting appliance, and each piece of lifting gear, should have plainly marked on it an identification number and its safe working load.

The components referred to in this section should be registered and the tests and inspections carried out thereon recorded as required by the relevant regulations (see clause 5).

Counterweights should preferably be marked with their mass, in kg.

The platform when ready for use should also be marked with the following:

- (a) the safe working load in kilograms;
- (b) the maximum number of persons (excluding materials) allowed to be on the platform or on any given length of it.

7. Materials and components

7.1 General. All materials and components used in the construction and assembly of suspended access equipment should satisfy the requirements of the relevant British Standards and codes of practice where they exist. Where these do not exist the materials should be of sound construction and adequate for the purpose for which they are intended.

The materials and components and their method of assembly should comply with the relevant statutory regulations. A list of British Standards which give details of materials and components which will satisfy the recommendations of this code is given in appendix A.

All parts of the equipment should be capable of being re-used and re-erected in a safe manner.

7.2 Scaffold tubes and fittings

7.2.1 Steel. Steel scaffold tubes and scaffold fittings should have been manufactured in compliance with BS 1139.

The tubes and fittings should be free from flaws or splits or other defects and the ends of the tubes should be cut cleanly and square with the axis of the tube.

Effective protection against rust staining of the building (such as the use of plastics caps), when this is of consequence, may be applied to the tube.

7.2.2 Aluminium. Aluminium scaffold tube may be used in roof rigs and platforms provided due account is taken in the calculations of its lesser strength, weight and greater deflection under load than steel tube. Aluminium tube should not be mixed with steel tube in the same roof rig owing to the difference in its weight, strength and deflection under load.

Aluminium tube and other aluminium sections may be used in the working platform.

Aluminium scaffold tubes and scaffold fittings should have been manufactured in compliance with BS 1139.

The tubes and fittings should be free from flaws or splits or other defects and the ends of the tubes should be cut cleanly and square with the axis of the tube.

Only fittings suitable for aluminium tube should be used thereon.

7.3 Timber poles. Timber poles used in roof rigs and outriggers should be of Norway spruce or Douglas fir or other timber with equivalent performance characteristics and should be carefully selected for the purpose. They should be sound and free from defects and any signs of deterioration, and should be free of bark and unpainted.

Lengths of up to 7.6 m are commonly used and these should be not less than 65 mm diameter at the 'top' or thin end, and approximately 115 mm diameter at the 'butt', 'bottom' or thick end.

7.4 Lashings. Lashings should have no significant defects and be of steel wire rope of not less than 6 mm diameter. They may be formed with a thimble eye at one end with the other suitably terminated to prevent unlaying.

7.5 Steel wire ropes. Wire suspension and safety ropes of 8 mm diameter and above, where used with winches, should comply with BS 302. Wire suspension and safety ropes of less than 8 mm diameter, where used with winches, should comply with BS 3530 and with the testing and interpretation requirements of BS 302.

Wire ropes used for climbing devices other than winches should preferably comply with BS 302 or BS 3530, but, where a special size or form of construction is required by the manufacturer of the device, such a rope should be of good quality and should be replaced, when damaged, only by ropes of the same type.

Wire ropes should be free from significant defects arising from previous use or other cause.

Wire suspension ropes should have an identification and the safe working load marked thereon and be subject to inspection and registration in accordance with the appropriate regulations.

7.6 Fibre ropes

7.6.1 Natural fibre ropes. Natural fibre ropes should comply with BS 2052, grade 1 special quality manila or equivalent. Traversing ropes may be of sisal.

Natural fibre suspension ropes or safety ropes should not be less than 18 mm diameter. They should be free from serious defects arising from previous use or other cause.

Natural fibre ropes should not be used where they will be subject to attack by aggressive chemicals. Instead man-made fibre ropes constructed of materials resistant to the chemicals being used should be utilized. Advice should be obtained from the cordage supplier.

Hot gases from blow lamps and similar heat sources may cause fibre embrittlement in natural fibre cordage exposed to them, and this should be borne in mind when selecting ropes.

7.6.2 Man-made fibre ropes. Appropriate man-made fibre ropes are recommended for use where aggressive chemicals are in use. Advice should be obtained from the cordage supplier. Such ropes should comply with appropriate British Standards and should be of the same size as natural fibre ropes recommended in 7.6.1 and of a similar texture to provide adequate grip when either wet or dry (only a limited number of man-made fibre ropes possess this characteristic and they are related to BS 4928 : Parts 1 and 2).

Man-made fibre ropes have a lower fire performance than natural fibre ropes (but see 7.6.1) and special care should be exercised where such ropes are being used by operators working with blow lamps or burners or other heat sources, including lighting.

7.6.3 Jointing. Fibre ropes for suspension should be in one continuous length and free from joints.

7.6.4 Marking and inspection. Fibre ropes should have an identification and the safe working load marked thereon and be subject to inspection and registration in accordance with the appropriate regulations.

7.7 Traversing track. Traversing track should be constructed of material complying with BS 4360 or BS 1474.

7.8 Other materials. Other materials should comply with the appropriate British Standards. Where there is no British Standard special attention should be given to the quality and strength and durability of the materials.

7.9 Lifting gear, appliances and devices. Lifting gear, appliances and devices should be of good construction and in working order and properly maintained and be subjected to inspection, testing and registration in accordance with the appropriate regulations.

7.10 Counterweights. Counterweights may be of any suitable material capable of being fixed to the inboard end of the roof rig in a manner which does not permit displacement. 25 kg weights with handles or rings for attachment are recommended.

Materials which may be subject to deterioration or easily damaged, such as sand bags, should not be used.

7.11 Proprietary components and equipment. Proprietary equipment should be of good and sound construction and suitable for repeated use for the purpose and period for which it is intended. Its characteristics should be adequately described in data sheets.

7.12 Factors of safety

NOTE. See 8.8 for factors of safety against overturning of a roof rig.

7.12.1 General. All components of both the roof rig and the suspended platform should be designed with the factors of safety normally applied to those individual components.

7.12.2 Steel. Steel work should be designed with a factor of safety in accordance with the requirements of BS 449.

7.12.3 Aluminium. Aluminium components should be designed with the factor of safety in accordance with the recommendations of CP 118.

7.12.4 Timber. Timber should be used in accordance with the recommendations of CP 112 : Part 2 according to the grade of materials used in the structure, except that timber poles, used as outriggers, should be used in accordance with B.2 of this code.

7.12.5 Scaffold couplers. Scaffold couplers should be used at a factor of safety of not less than 2 or otherwise in accordance with the recommendations of B.7.

7.12.6 Ropes. Each suspension and safety rope should have a factor of safety of not less than 8, based on the maximum rope tension when related to the minimum breaking load of the rope, or such other higher factor as specified by the manufacturer of the winch or climbing device.

Where a rope does not have to pass through a lifting or climbing device, a winch, or over a pulley, and does not form part of the means of suspension of the working platform, it may be used at a factor of safety of 3. Examples of such ropes are:

Guys to rigid fixing points for stability

Cross wire ties in frames

Traversing ropes

Tying in wires

Tie back wires carrying any part or component of the vertical maximum suspended load on the outriggers should have a factor of safety of not less than 6.

7.12.7 Lifting devices and winches. The factor of safety against collapse of lifting devices and winches should be not less than 6 or whatever greater value is specified by the manufacturer, based on the statically loaded condition.

7.13 Weights and strengths of materials and components. Appendix B provides some data on the strength and weights of materials and components.

8. Design loads

8.1 Structural design of the equipment. The structural design of the platform, the suspension points and the members of the suspension systems should be based on the rope tensions and load outputs of the suspension systems, taking into account the load output of any pulley system used in the suspension system (see 14.9.1).

The roof rig should be designed so that the permissible stresses appropriate to the material(s) of construction are not exceeded when the maximum total suspended load (see 8.5) is applied to the suspension point. In addition, the design should ensure that the minimum yield stress of the materials used is not exceeded when the maximum rope tension is developed as a result of the operation of slipping clutches, load limiting devices, stalling torques, etc.

8.2 Grouping of the loads at one end of a platform or bay. In the case of an individual platform with the suspension points at the ends the design of all parts of the installation should take account of the possible grouping of the persons using the platform at one end of the

platform either adjacent to a point of suspension or centred outside this point when cantilevered end extensions are fitted.

Consideration should be given to ensuring the balance of the platform when one cantilevered end is loaded by applying an adequate factor of safety against overturning of the platform, based on the safe working load.

In the case of a hinged continuous platform the load applied to the suspension system at the hinge between two bays should be calculated from the safe working loads of both adjacent bays added together on the assumption that they have accumulated beneath the suspension system supporting the hinge between the bays.

8.3 Safe working load of the platform. The safe working load on an individual platform is the maximum load which may be placed on the platform having regard to its strength and to the value and distribution of the load and to the counterweighting of the roof rig. It should be marked on the platform in kilograms and the maximum number of persons should also be marked.

The safe working load on a hinged continuous platform having a series of suspension points is the maximum load which may be placed in any one bay having regard to its strength and to the value and distribution of the load and to the counterweighting of the roof rig. It should be marked on the platform in kilogram and the maximum number of persons should also be marked with the words added 'per bay'.

8.4 Rope tension. The rope tension on which the choice of the suspension rope is made should be based on the summation of the following:

- (a) that portion of the self-weight of the platform and any lifting appliances attached to it acting on the suspension rope, plus the self-weight of that portion of the suspension rope hanging below its upper point of contact with the roof rig including that portion of it reeled on to a winch on the platform or hanging beneath it through a climbing device and any stabilizing weight attached thereto;
- (b) the maximum load resulting in the suspension rope from the approved number of operatives and associated imposed loads grouped together or adjacent to it or in a cantilevered portion of the deck;
- (c) an allowance for impact resulting from the operation of the winch or climbing device of such impacts as are recommended by the manufacturers but with a minimum factor as indicated below:

Type of suspension	Impact factor expressed as a percentage of the sum of (a) and (b)
Manually operated on fibre ropes	10
Manually operated winches or lifting devices on wire ropes	10
Power operated winches or climbing devices on wire ropes	25

The above criteria should also be used when choosing a safety rope, with the exception that the following allowance (d) should replace that in (c) above in those cases where the value of (d) is higher than that of (c):

- (d) an allowance for the impact load imposed by the operation of any safety device.

Where the suspension rope is reeved through pulleys calculation of the rope tension should take into account the cumulative friction losses arising from the rope reeving system and the number of parts of rope in the purchase, and the location of the lifting machinery which may be on the platform, or on the roof, or on the ground. (See also 14.9.1.)

8.5 Maximum total suspended load. Whatever the arrangement of the suspension rope or its pulley system or its travelling track assembly the maximum total suspended load is the maximum load at the top of the system which can apply an overturning moment or a direct pull on a roof rig.

The maximum total suspended load should be calculated from the rope tension calculated as in 8.4, and modified where necessary to take account of pulley systems incorporated in the system as recommended in 14.9.1 with the further additions listed below:

- (a) the weight of the travelling track and trolleys and its suspension gear;
- (b) the additional loads which may result from the difference in spacing of the outriggers from the spacing of the suspension ropes which may occur in travelling systems;
- (c) the increased loads derived from two suspension ropes from two platforms travelling together under one outrigger (this situation may be avoided by fitting intermediate stop ends on the trolley track and mounting two outriggers above them each with its own counterweights as structural attachments)

The suspension gear above the trolley track need not be designed to take into account the redistribution of loads due to the continuity of the travelling track beams.

8.6 Maximum overturning moment. The maximum overturning moment, see figure 3, should be calculated from the summation of the moment about the fulcrum point of the maximum total suspended load at its projection length and the moment about the fulcrum point of the self-weight of the outboard portion of the roof rig acting at its centre of gravity.

8.7 Righting moment

8.7.1 Counterweighted roof rigs. The righting moment, see figure 3, for roof rigs depending for their stability on weight only should be calculated from the summation of the moment about the fulcrum point of the self-weight of the inboard portion of the roof rig acting at its centre of gravity and the moments of any counterweights acting at their lever arms.

8.7.2 Structurally attached roof rigs. The righting moment of roof rigs depending for their stability on bolted or other structural fixings of the inboard section of the roof rig to the building should be calculated from the summation of the moment of the self-weight of the inboard portion of the roof rig acting at its centre of gravity and the moments of the safe working loads of the structural fixings acting at their lever arms.

8.8 Stability

8.8.1 Stability against overturning. The following sub clauses describe the means of ensuring stability. Appendix C shows worked examples of stability calculations. The factor of safety against overturning is the ratio of the sum of the righting moments to the maximum overturning moment.

8.8.1.1 Use of counterweights. Where counterweights are used to provide stability or when any mass of the structure is relied upon to contribute to the stability, the counterweights or mass should be firmly attached to the roof rig in such a manner that they cannot become accidentally dislodged. Where it is proposed to provide some part of the restraining force by the use of roof fixing the appropriate recommendations in 8.8.1.2 should be followed.

Where spreaders or pads are inserted to distribute a load on to a roof or parapet, the material of the pad should be such that a proper distribution of the load is achieved and that the pad is protected from deterioration due to exposure.

(a) *Manually operated systems.* When counterweights and/or the self-weight of the inboard portion of the roof trolley are relied upon as the sole means of achieving stability, the factor of safety against overturning should be three except in the case of a bosun's chair when it should be four.

(b) *Power operated systems.* When the stability of a power operated system is achieved solely by means of counterweights and/or the self-weight of the inboard portion of the roof rig, the factor of safety against overturning should be not less than the greatest of the following values:

- (1) 3 or 4 based on the maximum overturning moment (see (a));
- (2) 1.25 based on the maximum overturning moment resulting from the rope tension which can be exerted by the winch or climbing device operating through an overload clutch or other mechanical load-limiting device;
- (3) 1.33 based on the maximum overturning moment resulting from the rope tension which can be exerted by the winch or climbing device operating through an electrical or thermal overload limiting device, or which can be exerted by the winch or climbing device when it stalls due to excessive load if it is not fitted with an overload clutch or other load-limiting device.

8.8.1.2 Roof fixings. When roof fixings are relied upon as the sole means of achieving stability they should be capable of providing a factor of safety of two against uplift. Where a roof is insufficiently strong to provide this factor of safety, the holding down ability of the roof should be assessed, and counterweights added to provide an overall factor of safety against overturning of three.

Roof fixings should be designed according to the stresses appropriate to the material. No component in the system should be loaded to more than the manufacturer's recommendations.

8.8.2 Lateral stability. In addition to having adequate stability against overturning the roof rig, outriggers and traversing track should have sufficient lateral strength or be adequately braced against lateral sway parallel to the face of the building.

The forces producing lateral sway are wind forces, surge and braking and the applied force on traversing lines. Wind forces should be estimated for the position of the maximum exposure of the equipment and guidance should be obtained from CP 3 : Chapter V : Part 2.

In the case of a wire rope fixed roof rig the restraining wire ropes should be so angled in plan, or supplemented by additional angled wire ropes or other means, that lateral stability in both directions is achieved.

9. Strength of the building

Agreement should be reached between the supplier and the user on the maximum imposed load (including uplift) for the system. The proposed loading to be imposed on the building should be approved by the building owner or his architect or structural engineer before such loads are applied.

Section two. Types of roof rig

10. Timber pole and lashing roof rigs

10.1 Lashings. Figure 4 shows a square lashing to two poles. Both free ends of the lashing should be pulled under the turns in such a way that the load causes the loose end to be gripped.

When the angle between the two poles is not a right angle, the diagonal lashing turns should be arranged so that a change of the angle between the poles in either direction is resisted, figure 5 shows this.

The angular stiffening of any lashing should not be relied upon to maintain frames square. This should be achieved by bracing poles lashed in across diagonally opposite corners of frames.

Only wire lashing should be used but fibre rope may be used to tie off the free ends of wire ropes attached to structural members or poles with round turns and hitches.

10.2 Outriggers. The outrigger poles should be set on the roof with the butt end projecting over the edge and with the thin end inboard. Suspension points should be not less than 150 mm from the butt end.

10.3 Ledgers. Pole outriggers should not be laid as separate members but should be joined together by longitudinal or ledger poles at either end as shown in the simple flat roof rigs illustrated in figures 6 and 7.

10.4 Attaching the counterweights. Single counterweights should be firmly lashed at the end of the tailing end of the outrigger up against it so that the weight is effective before any movement of the outrigger has taken place. Double or multiple counterweights should be firmly lashed to the back ledger immediately adjacent to each side of the outrigger.

Weights with rings or handles which can be used to secure the lashing to the weights should preferably be used.

10.5 Attaching the suspension rope. The suspension ropes should wherever practicable be attached directly to the outriggers rather than to the front ledger, but the latter method may be unavoidable, such as in those cases where the trolley track has to be supported at closer centres than those provided by the spacing of the outriggers (see 10.8).

Fibre suspension ropes should be tied on to the outrigger using a complete round turn and two half hitches and this

should be over lashed with cord or seized to the standing part to prevent movement. The same procedure should be followed when wire suspension ropes that are not fitted with eyes are used. Alternatively a complete half turn with two bulldog grips fastening the free end should be used.

If eyes are fitted to the top end of wire suspension ropes they should be attached to the end of the outrigger by wire lashings with at least three turns. The lashing should not be left as a loose loop on the outrigger which might slip off the end, but should be moused and finished off with a half hitch and clove hitch on opposite sides of the main loop.

10.6 Parapet roofs. Figures 8 and 9 show pole and lashing outriggers for a parapet roof. In figure 8 the fulcrum point should be taken at the inside edge of the parapet. In figure 9 it should be at the location of the ledger behind the parapet.

10.7 Built-up pole and lashing rigs. Figure 10 shows a built-up rig used where it is desired to raise the platform to a higher level than the roof or parapet top.

10.8 Trolley track. Figure 11 shows a travelling cradle assembly in which the track attachment is lashed to the outrigger. The traversing lines may alternatively be rigged vertically passing over pulleys on the trolleys and tied off at the stop ends.

In cases where a trolley track has to be supported at centres closer than the spacing of the roof rig outriggers, the outside ledger may be moved out to and on top of the end of the outriggers, or a supplementary pole ledger fixed there. The track attachments are then lashed to this front ledger instead of to the outriggers. The weight of the outside ledger should then be taken into account in calculating the outboard weight of the roof rig. The ledger should be stiff enough to take its proper share of the load from the intermediate lashings to the outriggers.

10.9 Double level and stepped roofs. Figure 12 shows a rig for a building with a double level roof and figure 13 shows a modification of this for the case where the front raking strut cannot be placed on the parapet at the front edge of the building. In this case the projection length is very much greater and the counterweights should be calculated accordingly. The lateral stability of the front frame of this rig should be supplemented as in the case detailed in figure 12.

10.10 Ridge roofs. Figures 14 to 17 show typical methods of providing ridge fixing for a variety of roofs. In the examples illustrated in figures 14 and 15 use is made of an existing parapet to provide location for the roof rig. In many cases there is no parapet or similar feature and a saddle rig should then be constructed (see figures 16 and 17), in which positive location of the roof rig is provided by saddle poles on the opposite side of the ridge to the outrigger.

Saddle poles should be lashed to the back ledger and should be at least 4 m long. The back ledger should be placed in the angle beneath the outrigger and above the saddle pole so that this angle cannot become less and allow the saddle pole to hinge and slip over the ridge. In cases of low pitch roofs it may be necessary to lash across the top ends of the outrigger pole and the saddle pole to maintain the angle.

Figure 17 shows a saddle fixing on a mansard roof utilizing a front frame. The lateral stability of this rig should be

supplemented by diagonal bracing in the front frame which may be constructed as shown in figure 10, or may be wired with cross wires between the front struts or may be anchored by wires from the end struts crossed over the adjacent roof on to suitable points on the ridge.

Suitable and secure packing should be used under the poles.

Counterweights should be placed behind the ridge and lashed to both the back ledger and the saddle pole.

The front ledger should be under the outrigger pole if the suspension is from the end of the outrigger pole, but above it if the suspension is from the ledger itself.

10.11 Mixing poles with steel tubes. The roof rigs detailed above may also be constructed from scaffold tubes and couplers (see clause 11). It is generally undesirable to mix timber poles and scaffold tubes in a roof rig, but in certain circumstances it may be necessary to lash poles to tubular scaffolding in which case the lashings should only be at a braced node point of the tubular work, and the lashing should be such that it passes both sides of the scaffold fittings at the node so that it cannot slip along the steel tube.

10.12 Steel wire rope fixings. The form of construction of many roofs does not permit either poles or scaffold tubes to be fixed in the necessary places to support a platform. In these cases wire rope fixings may be used. Figure 18 shows such an arrangement.

The main steel wire rope ties should preferably be at right angles to the front frame. Where this is not possible and they have to be at an angle in plan there should be another wire rope at the opposite angle to rectify the lateral forces. Wire rope ties should have a minimum diameter of 8 mm.

The front frame should be continuously diagonally braced with poles, as in figure 10 or figure 18.

10.13 Special problems. It is not possible to give an example of every problem offered by roofs. Where difficulties occur or where any doubt exists in the matter, reference should be made to an experienced person and the design should satisfy the normal requirements of structural engineering. The spacing of the struts and outriggers in these pole rigs should be determined with reference to the loads to be carried.

In certain cases it is advantageous and sometimes necessary to place the outrigger poles at an angle overlapping at the tailing end and utilizing a single larger counterweight at this point. When this is done the projection and tailing lengths are altered and the portion of the counterweights necessary to allow for the movement of the men on the platform operates on both outriggers. The balancing moments should be recalculated to maintain the factors of safety required by 7.12.

11. Scaffold tube and fittings roof rigs

11.1 Difference between pole and steel tube rigs. Certain differences should be catered for. Tubes should never be connected together with rope or lashing but should instead be connected together with scaffold couplers. Normal scaffold couplers should be used in accordance with their safe working loads (see table 7). Critical tension joints in tubes should be lapped with the appropriate number of couplings in accordance with B.7.