Code of Practice on the Design and Construction of Builder's Lift

Electrical and Mechanical Services Department
1996

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PART 0 : INTRODUCTION

This Code is issued under Section 11 of the Builders' Lifts and Tower Working Platforms (Safety) Ordinance (the Ordinance). This Code, unless the Director of Electrical and Mechanical Services (the Director) provides otherwise, is applicable to any builder's lift for construction work.

Because of the varying operating conditions on sites and a builder's lift is frequently erected, altered in height of travel and dismantled, the code of safe use of a builder's lift has been drawn up based on the following requirements:

(a) it is only operated by a competent operator.
(b) it is maintained and periodically inspected, cleaned, oiled and adjusted by a registered contractor.
(c) it is checked and inspected by a competent operator daily for its function before commencement of operation.
(d) it is examined and tested by a registered examiner according to safety requirements of the Ordinance.

A builder's lift is to be used for construction work at a construction site or an existing building. It is mainly intended for the conveyance of builders and materials to different landings.

The lift cage of a builder's lift is constrained against lateral displacement by a guide or guides and moved along its supporting mast which under most circumstances is fixed to an adjoining building or a structure with wall anchorages.

PART 1 : SCOPE

This code specifies safety requirements of a builder's lift used for carrying builders and materials at a construction site. This code applies to a builder's lift defined in the Ordinance.

This code does not apply to:

- lifts as defined in Lifts and Escalators (Safety) Ordinance, Chapter 327;
- hoists for transportation of materials as defined in Construction Sites (Safety) Regulations, Chapter 59;
- suspended working platforms as defined in Factories and Industrial Undertakings (Suspended Working Platforms) Regulation, Chapter 59;
- mobile elevating working platforms not having a mast construction;
- tower working platforms as defined in the Ordinance.

The objective of this code is to enhance the reliability and safety of a builder's lift without placing undue limitations on the general design, construction and installation of the builder's lift.

PART 2 : DEFINITIONS

The following definitions are used to indicate precisely the technical terms that are used in the Code in addition to all the interpretations as stipulated in Section 2 of the Ordinance. Reference should be made to Figure 1 in Annex II for the terms provided.

Base Frame
The base frame is a structural part upon which the mast, lift cage and other components are supported.

Buffer
A resilient stop at the end of travel, and comprising a means to braking using fluids, springs, elastomers, or other similar means.

Counterweight Way
The total space within which the counterweight of a builder's lift travels.

Fence
Fixed rails used to prevent persons falling from a height.

Guides
Rigid components provided for guiding the direction of travel of the lift cage (and the counterweight when provided).

In Service Condition
An operating condition in which the laden or unladen lift cage can be either travelling or stationary in any position in the liftway.

Landing
Defined stopping level at the building or structure which includes the space required for loading and unloading of the lift cage.

Liftway
The total space within which the lift cage travels.

Mast
A structure used to support and guide the lift cage (and the counterweight when provided).

Mast Section
Individual sections which are joined together to form the mast.

Out of Service Condition
A non-operating condition in which the unladen lift cage is placed in such a position that it is least affected by wind. This is usually at the base enclosure or the lowest landing.

Overspeed Governor
A device which, when the lift cage attains a predetermined speed in either upward or downward direction, causes the lift cage to stop and, if necessary, causes the safety gear to apply.

Pitch Circle
It is the imaginary circle that rolls without slippage with a pitch circle of a mating gear.

Positive Drive
A lift cage that is driven by means of direct coupling to the driving machine, i.e. other than friction drive.

Rated Load
The maximum load that a builder's lift has been designed to carry in service.

Rated Speed
The normal speed at which a lift cage has been designed to operate.
Registered Professional Engineer
A person who has been registered under the Engineers Registration Ordinance, Chapter 409.
Safety Gear
A mechanical device for stopping and maintaining stationary on the guide(s) the lift cage (or the counterweight when provided) in the event of overspeeding of the lift cage (or the counterweight) in the downward direction.
Tooth Module
It is equal to the pitch circle diameter of a gear divided by the number of teeth.
Traction Drive
A lift cage whose lifting wire ropes are driven by friction in the grooves of the sheave of a driving machine.
Wall Anchorage
A structural member, connected between the mast and an adjacent building or other structure, uses to prevent lateral movement of the mast.

PART 3 :

TECHNICAL REQUIREMENTS

SECTION A : STRUCTURAL DESIGN

1 GENERAL DESIGN CONSIDERATIONS

The design and stability calculations shall conform to the laws and principles of applied mechanics and strength of materials. All components and structural members shall be properly designed and made of sound materials that are free from defects and shall have sufficient strength and specified quality. The construction and reliability of the equipment, in whole or part, shall be appropriate to its intended use, operating environment and design life. Materials used in the fabrication of the builder's lift shall not support combustion and emit toxic gases or fumes upon burning.

Wall anchorages between the mast and the adjacent structure or buildings are considered to be part of the structure of the builder's lift. Structural support and concrete foundation for supporting the base frame are not included in this Code. They should be designed and checked by registered professional engineers in structural or other relevant disciplines. Figure 1 in Annex II illustrates one of the general layouts of a builder's lift with mast attached to adjacent building by means of wall anchorages.

2 CONSIDERATION OF FORCE AND LOAD COMBINATIONS

2.1 General

The structure as a whole of the builder's lift shall be so designed, calculated and constructed that its strength is sufficient under all conditions, including normal operation, application of safety gear, impact of the lift cage on its buffer, installation and dismantling and adverse weather conditions.

2.2 Forces and load combinations to be considered in design

Any possible combination of the following forces and loads shall be taken into consideration when designing the structure of a builder's lift.

2.2.1 Static loads

Static load includes mast, wall anchorages and other appendages but excludes the lift cage, rated load and parts that travel with the lift cage.

2.2.2 Dynamic loads

Dynamic load includes the loads due to moving components, e.g. dead weight of the unladen lift cage, rated load, trailing cables and machinery that travel with the lift cage.

Dynamic load shall be calculated by multiplying the moving load by a dynamic factor. This factor shall be (1.1+0.264V) where V is the rated speed in m/s. Other factors may be considered if they can be determined by calculation, measurement or testing.

2.2.3 Rated load on lift cage

The rated load per unit floor area of the lift cage shall be not less than 3.3kN/m². The forces acting on the lift cage and mast due to the rated load on the floor of the lift cage shall be calculated as follows:

i. When the rate load per unit floor area of the lift cage is greater than or equal to 3.3kN/m² but less than 4.0kN/m², the rated load shall be distributed over a reduced area equivalent to 75% of the total floor area of the lift cage. The shape and the location of this reduced area shall give the most unfavourable stresses for the mast and also for the lift cage. One typical example of such loading is shown in Figure 2 in Annex II.

ii. When the rated load per unit floor area of the lift cage is greater than or equal to 4.0kN/m², the rated load shall be distributed evenly over the floor of the lift cage.

Note: Irrespective of the rated load per unit floor area of the lift cage, the lift cage shall be capable of sustaining a static loading of at least 4.0kN/m² distributed evenly over the floor of the lift cage. The load distribution is shown in Figure 3 in Annex II.

2.2.4 Wind loads

For most complete parts and structures, and individual members used in a builder's lift, the wind load shall be determined by:

$F = A \times q \times C_f$ where F is the wind load in N
q is the dynamic wind pressure in N/m^2
A is the effective frontal area in m^2
C_f is the force coefficient

The wind pressure is given by:

$q = V^2/1.6$ where V is design wind speed in m/s

The force coefficient for lift cage shall be 1.2.

To determine the force coefficient, reference shall be made to the Code of Practice on Wind Effects Hong Kong – 1983.

In calculating wind loads on the builder's lift, the following three wind conditions shall be taken into account:

(a) In service condition

The minimum value for wind pressure and the corresponding wind speed under in service condition shall be as indicated in Table 1:

Table 1:

Installation	Wind Speed (m/s)	Wind Pressure (N/m^2)
builder's lift in either free standing mode or the mast is secured with wall anchorages	20.0	250

(b) Out of service condition

The wind pressure for out of service condition shall depend on the height above the ground and the location where the builder's lift is installed.

Table 2 is extracted from the Code of Practice on Wind Effects Hong Kong - 1983 which provides the minimum design wind pressures with respect to heights.

Table 2:

Height above Ground Level	Wind Pressure in N/m^2	
	General Terrain	Built-up Area
0-10m	1,200	1,200
10-30m	2,200	1,200
30-50m	2,500	1,900
50-100m	3,000	2,400
100-150m	3,500	3,000
150-200m	3,800	3,400
200-250m	4,100	3,700
250-300m	4,300	4,000
above 300m	4,300	4,300

(c) Erection and dismantling wind pressure

The minimum design wind pressure during erection or dismantling shall be $100N/m^2$ which corresponds to a wind speed of 12.5m/s.

2.2.5 Loading and unloading forces

The lift cage and the mast structure shall be capable of sustaining forces exerted on the lift cage during loading and unloading of the lift cage. These forces include a horizontal force and a vertical force acting at the threshold member at a point which is located at one third of the width of the lift cage gate opening from either side of the uprights. The magnitudes of the horizontal and vertical forces are as follows:

i. horizontal force = half of the rated load or 500kg whichever is greater,
ii. vertical force = one-fifth of the rated load but not more than 250kg.

In addition to the above, the rest of the rated load, i.e. rated load minus the vertical force in subsection (ii), shall act vertically in the centre of the lift cage floor as well.

The directions and locations of the above forces shall give the most unfavourable stresses for the lift cage and the mast structure.

2.2.6 Forces due to application of safety gear

Forces due to application of the safety gear at tripping speed shall be taken as the total moving mass multiplied by a dynamic factor not less than 2.5. A lower factor, but not less than 1.5 can be used if it can be verified by test under all conditions of loading up to 1.5 times rated load.

2.3 Other considerations

The design of the builder's lift shall allow for a vertical misalignment of at least 0.5° introduced during erection of mast. The loading of the landing gates and landing platforms shall be taken into consideration.

2.4 Safety factors

The allowable stress of a stressed steel member shall be given by:

$\sigma_0=\sigma_y/S_y$

where σ_0 is allowable stress
σ_y is yield strength of the material
S_y is the factor of safety with respect to yield strength of steel

S_y shall not be less than 1.50 in normal loading cases and 1.25 for other loading cases.

2.5 Combination of loads and forces

The structure as a whole and each part of the builder's lift including the wall anchorages, and landing gates shall be designed by taking into account the forces calculated from the combination of loads under the following conditions:

- in service condition
- out of service condition
- erection
- dismantling
- alteration of height of travel
- application of safety gear upon over speeding
- striking of buffers
- fatigue loading of structural parts under fluctuating stresses including rack and pinions

- during test and examination
- other possible conditions that the builder's lift may encounter

2.6 Stability of builder's lift

When a builder's lift is in a free standing mode during erection, dismantling, in operation, or out of service condition, the stability of the builder's lift shall be taken into account.

2.6.1 The maximum overturning moments and the corresponding stabilizing moments shall be calculated about the most unfavourable tipping lines.

2.6.2 The calculation shall be made with the builder's lift in the most unfavourable positions with the maximum allowable inclination of the base frame as defined by the manufacturer. All loads and forces, which can act simultaneously shall be taken into account in their most unfavourable combinations. An allowance of 0.5° for inaccuracy in setting up the builder's lift shall be added to the maximum allowable inclination of the base frame.

2.6.3 The following influences shall be taken into account in the calculations:

i. Distortions due to inaccuracies in the manufacture of the components,
ii. Play in the connections of the structure,
iii. Elastic deflections due to effects of forces.

2.6.4 When calculating the stability of a builder's lift, the sum of overturning moments multiplied by the respective overturning factors shall be less than the sum of the stabilizing moments. The overturning factors shall be as in Table 3:

Table 3:

Overturning Moment Created by	Overturning Factor
static loads	1.1
dynamic loads	1.5
wind loads	1.2

2.7 Design details of steel structure

The design of steel structures shall require a general stress analysis, including buckling and cripping, and fatigue stress analysis. If metals other than steel, e.g. aluminum alloys or other materials are used for structural components, the design shall comply with recognized international standards.

2.8 Fatigue calculation

All details shall be designed to avoid stress concentrations likely to result in excessive reduction of the fatigue strength of members or connections. Care should be taken to avoid sudden change of shape of a member or part of a member, especially in regions of tensile stress or local secondary bending. For calculation

purposes, the number of stress cycles for all members of the structure shall be $5x10^5$.

2.9 Builder's lift support conditions

The ground or foundations, temporary supporting structure and fixing for builders' lifts should be of sufficient strength to withstand the maximum load imposed under in service and out of service conditions without failure, or settlements or deflection which may endanger the stability or safety of the machinery. The temporary support of the builder's lift, the assessment of maximum loads and the design of foundations, supporting structures and ancillary details should be designed by a registered professional engineer in structural or other relevant disciplines. Particular care should be taken to ensure that the imposed load is not underestimated and also a careful assessment of probable wind pressures should be made, taking into account the degree of exposure of the site and any other special factors. Manufacturers' data relating to the dead weight of the builder's lift and the dynamic forces which can occur during operation of the builder's lift should always be obtained.

Under in service conditions, the loads imposed on the supports of builders' lifts are usually due to the combined effects of:

i. the dead weight of the builder's lift
ii. the dead weight of the load
iii. dynamic forces caused by movements of the lift cage, counterweight, wire ropes, cables and the load during operation; and
iv. wind loading, resulting from operation in wind speeds up to maximum permitted for in service conditions, acting in any direction on the builder's lift and load.

When out of service, the loads on the builder's lift stand or support are imposed by the dead weight of the builder's lift combined with the wind load, acting in any direction, due to maximum wind pressures anticipated on the particular site as specified in the Code of Practice on Wind Effects Hong Kong - 1983 or even higher. Particular care should be taken to estimate loads arising during operation for which data should be obtained from the builder's lift. A safety margin should be allowed for unpredictable effects.

The overall stability and safety of a builder's lift should be carefully checked and particularly when the builder's lift must operate close to excavations or embankments, or on bridge decks, or partially completed building frames or other structural supports. The analysis of the forces imposed by a builder's lift on its support is a vitally important matter which should always be checked by a registered professional engineer in structural or other relevant disciplines. The vertical and horizontal forces imposed are not uniformly distributed, their magnitude may be much greater than the load which causes them and will vary according to the movement of the lift cage and direction and speed of the wind. On tall builders' lifts, wind forces will have a considerable influence on the strength

requirements of the supports and foundations and the greatest care is necessary in the setting-up and fixing of any holding-down devices, temporary connections or anchorages.

SECTION B : MATERIALS AND MANUFACTURING

1 MATERIALS

Material of structural parts (excluding others that are not subject to structural calculation) and mechanical parts shall be steels listed in Section B1.1 or steels having mechanical property equal or superior to them. The guides shall be made of steel and shall be rigid. Wire ropes or chains shall not be used as guides.

1.1 Structural steel shall be of grade 43, grade 50 or grade 55 of BS 7613, BS 7668, BS EN 10029, BS EN 10113 Parts 1-3, BS EN 10155 and BS EN 10210-1 or of other equivalent international standards. Other structural steel may be used provided that they comply with international standards.

1.2 Welding electrodes for joining structural steel shall be in compliance with the requirements of BS EN 499 or equivalent standards.

1.3 Bolts and nuts shall comply with international standards. High friction grip bolts shall conform to BS 4395 : Parts 1 and 2 and their use shall conform to BS 4604 : Parts 1 and 2. Plain washers shall be made of steel. High friction grip bolts of other international standards may also be used.

2 MANUFACTURING

Manufacturing of structural parts shall be by welding or bolted joints.

2.1 Welding

2.1.1 All welding on stressed parts shall be carried out in accordance with BS 5135 or other equivalent standards. The following calculations of weld strength shall apply:

(a) Butt welds shall be treated as parent metal with a thickness equal to the throat thickness (or a reduced throat thickness for certain butt welds) and the stress shall not exceed those allowed for the parent metal.

(b) When electrodes appropriate to a lower grade of steel is used for welding together parts of material of higher grade steel, the allowance stresses for lower grades of steel shall apply.

(c) When a weld is subject to a combination of stresses, the stress shall be the combined stress. The value of equivalent stresses shall not be greater than that permitted for the parent metal.

2.1.2 Welded joints shall be free from defects that will impair the service performance of the construction. Such acceptance requirements, covering both surface and subsurface defects, shall be in accordance with Tables 18 and 19 of BS 5135, bearing in mind that a higher standard of acceptance may be required for welded joints under fatigue loading. All welds shall be visually inspected in accordance

with BS 5289. Butt welds in main members shall be subject to non destructive testing methods using either radiographic or ultrasonic examination. The extent of these tests shall be set by the manufacturers taking into account the required performance of the welds and the completed structure.

2.1.3 A weld subject to visual inspection shall be acceptable if

(a) the weld is free from cracks
(b) the weld exhibits full fusion between parent metal and weld
(c) all craters are filled
(d) welds exhibit the required size and profile
(e) welds are free from excessive undercut and/or overlap

The following non destructive testing methods and standards are recommended:
Radiographic examination shall be in accordance with BS 2600 : Parts 1 and 2. Welds subject to radiographic examination shall be free from cracks and lack of fusion defects. In the case of ultrasonic testing, the calibration, sensitivity and scanning technique employed shall be in accordance with BS 3923 : Parts 1 or 2 as appropriate. Magnetic particle inspection of welds shall be carried out in accordance with BS 6072. Dye penetration test shall be in accordance with BS 6443.

2.1.4 A report on all of the non destructive tests on butt welds and fillet welds of the builder's lift including the masts, lift cage, wall anchorages, landing gates, base frame, etc., shall be provided by the manufacturer.

2.2 Bolt joint

Bolt holes shall be bored by drill and free from burrs. Precision bolts shall be turned or cold finished and fitted into reamed or drilled holes. Black bolts other than friction grip bolts shall not be used in main members in shear, for joints in stress-bearing members, or in joints subjected to fatigue. Whenever there is a risk of nuts becoming loose due to vibration or alternation of stresses, they shall be securely locked.
Preloaded bolts shall be grade 8.8 or grade 10.9. They shall be tightened by controlled means.

3 TREATMENT OF STEELWORK

All surfaces which require a protective coating applied shall have a surface preparation to a standard compatible with the protective system to be adopted.

SECTION C : LIFT CAGE

1 BASIC REQUIREMENTS

Every lift cage shall consist fundamentally of a frame and be completely enclosed by walls, floor and roof. The only permissible openings are:

(a) lift cage gate for normal access of passengers
(b) emergency trapdoor or emergency door

The assembly shall be able to withstand the forces which will be applied in normal operation, during impact on buffers and emergency application of safety gear. No movable extensions shall be allowed on the lift cage unless these have been specifically designed by the manufacturer.

1.1 Each passenger shall be considered to weigh 80kg. For determining the maximum number of passengers allowed in the lift cage, the maximum number shall not be greater than the rated load in kg divided by 80kg. The maximum number of passengers allowed in the lift cage shall include the competent operator.

1.2 The design of the builder's lift shall take into consideration that loads may be distributed either unsymmetrically or non-uniformly on the lift cage floor. The lift cage structure shall be calculated according to Section A2.

1.3 The lift cage shall be guided. The following means shall be provided during its travel to prevent derailment or jamming on the guides:

- an effective device shall be provided to retain the lift cage to the guide in the event of failure of the guide shoes, blocks or rollers.
- an effective mechanical means to prevent the lift cage from coming off the guides during operation, erection and dismantling.

1.4 The interior clear height of the lift cage shall be not less than 2,000mm.

1.5 When two lift cages are supported on the same mast, they shall be considered as two separate builders' lifts.

1.6 The rated speed of the lift cage shall be not more than 2.0m/s in the vertical direction.

2 LIFT CAGE FLOOR

2.1 The lift cage floor shall be slip resistant and be provided with means to drain off water.

2.2 The lift cage floor shall be designed to resist without permanent deflection a static

load of 150kg or 25% of rated load, whichever is greater, applied on the least favourable square of 0.01m².

2.3 The lift cage floor shall not be deflected by more than 3mm under the rated load.

3 LIFT CAGE WALLS

3.1 The lift cage shall have walls on all sides. The walls shall extend from the floor to the roof. If perforated walls are used, they shall comply with the requirements as given in Table 4.

Table 4: Size of perforation or opening related to clearance

Maximum size of perforation or Opening* in mm	Minimum clearance from adjacent moving parts in mm
≤ 10	22
> 10, ≤ 13	50
> 13, ≤ 25	100

* When the opening is in the form of a slot the length of the slot may be longer than these maxima, provided the width of the opening does not exceed the maximum stated in the table.

3.2 Each wall of the lift cage shall have sufficient strength. The strength of lift cage wall shall be designed to withstand without permanent deformation when a thrust of 30kg being evenly distributed over an area of 500mm² in round or square section is applied at right angles to the wall at any point. The wall shall also possess structural strength such that when a force of 100kg is vertically applied at any point along the top member of the wall frame, the wall shall be able to withstand it without permanent deformation.

3.3 In the case of perforated walls, no material shall be attached to the walls which may increase the dead load on the lift cage.

4 LIFT CAGE ROOF

4.1 A solid roof shall be provided for every lift cage. Opening on the roof for conveying long material shall not be allowed.

4.2 If the lift cage roof is used as a working platform for erection, dismantling, maintenance, inspection or is provided with an emergency trapdoor for egress of passengers, it shall be slip resistant and protected with fence having sufficient strength and appropriate dimensions.

The upper rail of the fence shall be at a height between 1,000mm and 1,150mm

above the lift cage roof, an intermediate rail at half the height of top rail and a toeboard not less than 200mm high shall be provided. The fence shall not be placed more than 100mm (horizontally) away from the edge of the lift cage roof.

4.3 The lift cage roof shall have sufficient strength and shall be able to sustain a concentrated load of 120kg on a square of 0.01m². The lift cage roof shall also be able to withstand a loading of at least 300kg/m² applied on an area of 1.0m² at any position without causing permanent deformation.

If the lift cage roof is provided with a storage drum for storage of surplus wire for subsequent alteration of height of travel, the strength of lift cage roof shall also be able to sustain without plastic deformation a load equal to 125% of the dead weight of the storage drum plus the weight of wire rope that can be wound on the storage drum.

4.4 In no circumstances shall the lift cage roof be used as a working platform or for conveyance or support of persons other than for the designated purposes such as inspection, servicing, erection, dismantling or maintenance of the builder's lift carried out by the authorized personnel or for emergency escape from the lift cage.

4.5 The lift cage roof shall not be used for the storage or transportation of materials other than the storage of surplus wire rope for suspension of the lift cage or counterweight. Such wire rope shall be wound on a storage drum installed on the lift cage roof. The surplus wire rope shall be used for alternation of height of travel of the builder's lift.

4.6 Where a storage drum is provided on the lift cage roof for storage of surplus wire rope, it shall be securely fixed. The loading on the lift cage due to the dead weight of the wire rope drum and the surplus wire rope wound on a storage drum shall be considered. No surplus wire rope shall be placed on the lift cage roof except wound on the storage drum.

5 LIFT CAGE GATE

5.1 The lift cage gate and its frame shall be designed and constructed with sound material in such a way that it will not become deformed in the course of time. The use of glass (even armoured) or transparent polymeric material, is only permitted for the version panel. If perforated gate panels are used, they shall meet the requirements in Table 4.

5.2 The clear height and width of the lift cage gate opening shall not be less than 2.0m and 0.6m respectively. The lift cage gate shall cover the full opening.

5.3 When solid lift cage gate is used, it shall be provided with a vision panel using transparent material of sufficient strength. This vision panel shall be at eye level and have an area of at least 250cm² and shall be shatter resistant.

5.4 The lift cage gate shall be fitted with an electrically and mechanically operated locking device. It shall not be possible to start or run the lift cage unless all lift cage gates are closed. If a lift cage has more than one lift cage gate, each lift cage gate shall have its independent electrically and mechanically operated locking device.

5.5 The strength of the lift cage gate shall be designed according to Section F4.

5.6 The horizontal distance between the lift cage threshold and the landing threshold shall not be more than 50mm during loading and unloading when the lift cage is at that particular landing.

5.7 The electrically and mechanically operated locking device of the lift cage gate shall be suitably protected against operation by unauthorized persons.

5.8 The threshold member shall be able to sustain loading and unloading forces.

These forces include a horizontal force and a vertical force acting at one third of the width of the lift cage gate opening from either side of the uprights. The magnitudes of the horizontal and vertical forces are as follows:

i. horizontal force = half of the rated load or 500kg whichever is greater,
ii. vertical force = one-fifth of the rated load but not more than 250kg.

The directions and locations of the above forces shall give the most unfavourable stresses for the threshold member.

5.9 For power operated horizontally sliding cage gates, they shall comply with Clause 4.6.2 or 4.6.3 of Code of Practice on the Design and Construction of Lifts and Escalators issued by the Electrical and Mechanical Services Department (EMSD).

5.10 For power operated vertically sliding cage gate, it shall comply with Clause 4.6.4 of Code of Practice on the Design and Construction of Lifts and Escalators issued by EMSD.

5.11 In the case of a lift cage gate with hinged joints at its lower edge, the lift cage gate shall not be used as a gangway for loading and unloading of passengers and/or materials.

5.12 If sliding lift cage gates are used, they shall comply with Section F2.2.

5.13 Any clearances around the edges of each lift cage gate or between lift cage gate sections shall conform to BS EN 294 : 1992 Table 4 except for under the gate where the clearance shall not be greater than 20mm.

6 EMERGENCY EXIT

6.1 It shall be possible in an emergency situation for the passengers and the competent operator to escape from the lift cage. This is fulfilled if the lift cage is provided with an emergency opening either as a door in the lift cage wall or as a trapdoor in the lift cage roof.

6.2 The emergency door in the lift cage wall shall have a width and a height of at least 400mm and 1,800mm respectively. It shall open towards the inside of the lift cage or be a sliding type.

6.3 The emergency trapdoor in the lift cage roof shall have a width and a length of at least 400mm and 600mm. It shall not open inwards nor project outside the edge of the lift cage when it is opened. A ladder shall be provided inside the lift cage giving access to the emergency trapdoor if an emergency trapdoor is provided.

6.4 A safety switch shall be provided to interrupt the control circuit and prevent the movement of the lift cage if the emergency door or trapdoor is not properly closed and locked. It shall not be possible to override this switch form inside the lift cage. The restoration of a builder's lift to service shall only be possible after deliberate relocking of the emergency trapdoor and emergency door.

(Note: Provision may be made to short circuit this switch specially for the purposes of inspection and erection when the lift cage control is transferred to the lift cage roof. In the interests of safety this provision should not be used to facilitate the carriage of long load.)

6.5 The emergency trapdoors and emergency doors shall be provided with a means for manual locking. They shall be opened from outside the lift cage without a key and from inside the lift cage with a removable key. The key shall be kept by the competent operator inside the lift cage at all times during operation of the builder's lift.

7 LIGHTING INSIDE LIFT CAGE

The lift cage shall be provided with electric lighting that can provide a light intensity of at least 50 lux at floor level and at the controls. A switch shall be provided inside the lift cage to switch on and off the lighting.

SECTION D : BASE FRAME, MAST AND GUIDE, WALL ANCHORAGE

1 BASE FRAME

1.1 The base frame shall be able to sustain any loading during normal operation, erection, dismantling and out of service condition. The base frame shall transfer the loading to the support or foundation effectively. Springs, elastomers, pneumatic or cushion tyres shall not be used for transferring the loading to the support or foundation.

1.2 When adjustable means are provided to transfer the load into the ground, the feet must be free to pivot in all planes to an angle of at least 15 degrees from the horizontal in order to prevent bending stresses in the structure. If the foot does not pivot, the worst resulting bending stress must be taken into account.

1.3 The plumb of the mast shall be adjusted with suitable pads, liners or other devices. The base frame shall be adjusted to the horizontal position.

1.4 Allowance shall be made so as not to exert a ground pressure exceeding the allowance stress of the foundation or support. The loading on foundation or support should be checked by registered professional engineers in structural or other relevant disciplines.

2 MAST AND GUIDE

2.1 The lift cage and the counterweight if provided shall each be guided by at least two rigid guides throughout the travel. The guides can be part of the mast. Flexible elements such as wire ropes or chains shall not be used as guides. The strength of the guides, their attachments and joints shall be sufficient to withstand the forces imposed due to the operation of the safety gear and deflections due to uneven loading of the lift cage.

2.2 The lift cage and any part of the mast shall not deflect by more than ±50mm relative to the landings, when in service.

2.3 Guides or masts shall be so designed that they are able to sustain all loads. Horizontal forces acting transverse to the guides shall be considered when calculating the lateral rigidity of the guides and their fastenings. Joints between individual mast sections and guide sections shall be effective to transfer the loads, maintain the alignment and resist loosening.

2.4 The mast sections shall be provided with a means of identification. Means shall be provided to prevent the use of inappropriate mast sections in installation.

2.5 Protective measures shall be provided to prevent excessive corrosion of the structural members of the mast sections, in particular the inner surfaces. The figure of minimum allowable thickness of the structural members of the mast shall be provided by the manufacturer.

2.6 Attachments of driving elements (e.g. rack) to the guide/mast shall ensure that the driving element is kept in correct position so that the stipulated loads can be transferred to the mast and that the fixings are ensured from loosening.

3 WALL ANCHORAGE

3.1 The wall anchorages shall be able to withstand all loads generated under normal operation, erection, dismantling, addition of mast sections and out of service condition.

3.2 The wall anchorages shall be adjustable in length to cater for variation in distance between the mast and the adjoining building or structure.

3.3 The magnitude of the load exerted by the wall anchorages on the adjoining structure or building shall be provided by the manufacturer. The strength of fixing bolts and sockets and the mounting on the building side should be checked by a registered professional engineer in structural or other relevant disciplines.

3.4 The maximum and minimum distances between two consecutive wall anchorages shall be given by the manufacturer. The length of the overhang of the mast above the highest wall anchorage shall also be provided.

3.5 If the separation between the mast and the adjoining building is very large, any extension or cantilever constructed from the adjoining building side used to connect to the wall anchorages should be designed and checked by registered professional engineer in structural or other relevant disciplines. No extensions or cantilevers shall be allowed to be directly connected to the mast except via properly designed wall anchorages.

SECTION E : BUFFER, OVERRUN, COUNTERWEIGHT, LIFTING EQUIPMENT

1 BUFFER

1.1 Buffers shall be placed at the bottom limit of travel for lift cages and counterweights if provided.

1.2 Buffers shall be designed in such a way that when the lift cage with rated load travels at a speed equal to the rated speed plus 0.2m/s, the average deceleration of the lift cage during action of the buffers shall not exceed 1g (where g is the gravitational acceleration which is equal to 9.81m/s²) with no peak exceeding 2.5g for more than 0.04sec.

1.3 If the buffers travel with the lift cage or counterweight if provided, they shall strike against a pedestal at least 0.5m high at the end of the travel.

1.4 For traction driven builders' lifts, energy accumulation type buffers with or without buffered return movement may only be used if the rated speed of the lift cage does not exceed 1.0m/s and 1.6m/s respectively. Energy dissipation type buffers may be used for any rated speed of the lift cage.

1.5 Hydraulic buffers shall be constructed so that the fluid level may be easily checked. An electric safety switch shall be provided to check whether the buffers have been returned to their extended position after operation. The lift cage cannot be driven by the normal operating means until the buffers are fully extended.

1.6 The characteristics of the buffer used shall be considered when calculating the buffer force.

2 OVERRUN

2.1 The builder's lift shall operate the final limit switch before striking the buffers.

2.2 In all cases, the minimum distance between the lowest landing and the bottom final limit switch shall be such that the latter is not operated during normal operation.

2.3 The overrun of the lift cage at the top end of mast or liftway, i.e. the vertical distance the lift cage may travel after actuation of the final limit switch and before meeting any obstruction to its normal travel or upper guide rollers reaching the end of the guides, shall be not less than:

(a) 0.15m for rack and pinion drive lift cage
(b) 0.5m for traction drive lift cage

When the lift cage travels at rated speed (V) greater than 0.85m/s, the overrun of

the above shall be increased by $0.1V^2m$ where V is in m/s.

3 COUNTERWEIGHT

If a counterweight is provided for the lift cage, the following requirements shall be complied with:

3.1 The lift cage shall not be used as a counterweight to counterbalance another lift cage.

3.2 If the counterweight incorporates filler weights, one of the following measures shall be considered to prevent their displacement:

(a) the fillers shall be retained within a rigid frame, the filler materials shall be homogeneous inside the retainer and shall be properly maintained and protected against damage and falling out; or

(b) if the rated speed of the lift cage is not greater than 1m/s, metallic fillers shall be restrained by a minimum of two tie rods.

3.3 To prevent the displacement of counterweights from their guides, the guides shall be equipped with a permanent anti-disengagement device in addition to rollers or shoes. Counterweights shall be at least guided near the top and bottom parts of the counterweight frame.

3.4 An indelible notice shall be displayed stating the total weight of the counterweights required and each individual filler shall have its own weight marked on it.

3.5 The counterweight shall be equipped with a safety gear if there is an accessible space underneath the counterweight way.

3.6 Allowance shall be made for counterweight overrun at the top end of the counterweight way.

4 LIFTING EQUIPMENT

4.1 Any lifting equipment integrated with the builder's lift shall be designed and constructed not to impose loads on the structure of the builder's lift for which it has not been designed. If the lifting equipment is power driven and designed to raise mast sections from the ground, means shall be provided to ensure that the lift cage cannot be operated simultaneously.

4.2 The lifting equipment shall only be used for installation or lifting of masts for alteration of height of travel of the builder's lift.

4.3 The lifting capacity of each lifting equipment shall not exceed 300kg. There shall be only one lifting equipment for each lift cage.

4.4 The lifting equipment shall be thoroughly tested and examined by a registered examiner before it is put into service. Further test shall be required following substantial repairs or alteration, or at intervals not more than 6 months.

4.5 For the testing and examination of the lifting equipment, the structural, electrical and mechanical parts of the lifting equipment shall be inspected and thoroughly examined. Overload tests shall be conducted with 125% of rated load of the lifting equipment. The safe working load of the lifting wire rope shall not be greater than 20% of the minimum breaking strength of the wire rope.

4.6 The lifting equipment and the lifting gear shall be clearly marked with their safe working loads in both Chinese and English and shall not be overloaded, except by a registered examiner for the purposes of the test.

4.7 The lifting equipment shall be operated by a person who has attained the age of 18 years and undergone training and is competent in the operation of the lifting equipment.

4.8 Routine maintenance of the lifting equipment shall be carried out at intervals not exceeding 7 days. Systematic maintenance, repairs and renewals shall be carried out and recorded.

4.9 No lifting appliances, other than the lifting equipment integrated with the builder's lift and used exclusively for its erection, dismantling or lifting of masts, which exert loading on the builder's lift, shall be allowed to be attached any part of the builder's lift, unless they have been designed for the purpose.

4.10 The lifting equipment, including the hook and wire rope when not in use, shall be securely stowed.

SECTION F : LIFTWAY ENCLOSURE AND LANDING GATES

1 LIFTWAY ENCLOSURE

Every builder's lift shall be provided with a base enclosure and liftway enclosure. At every loading and unloading point of passengers and/or materials, a landing gate shall be provided. These shall prevent persons or objects from being struck by any part of the moving lift cage, counterweight and their appendages, and from falling off the liftway.

1.1 Base enclosure

1.1.1 The base enclosure shall have walls on four sides with a height of at least 2.0m. If perforated walls are used, they shall conform to Table 4. The walls shall be constructed and protected to withstand and atmospheric conditions to which they are exposed.

1.1.2 When the gate of the base enclosure is used as a landing gate and also used for access of service people to the inside of the base enclosure, this gate shall be capable of being opened from the inside of the base enclosure.

If a special gate is provided for access of service people to the inside of the base enclosure for maintenance purposes, this gate shall be provided with a key operated lock. It shall be capable of being opened from inside without a key even when locked. The gate shall be provided with an electric safety switch to prevent movement of lift cage if the gate is not properly closed and locked. The strength of gate shall be designed according to Section F4. The locking device shall be designed according to Section F6.

1.1.3 When lift work is required to be carried out inside the base enclosure with the lift cage stopped at high level, there shall be a clear height of at least 1.8m. A means shall be provided to support the lift cage (a metal prop or equivalent). The means shall be capable of sustaining the stipulated load with a factor of safety of not less than 4. This means shall have an electrical interlock so that the lift cage cannot be driven when the prop is installed. The clearance shall extend under the whole floor area of the lift cage. It shall be possible to erect and dismantlle the means without any person working underneath the lift cage.

1.1.4 The base enclosure shall have a floor of sufficient strength to support service staff working inside the base enclosure. The floor shall be clean, tidy, non-slippery and provided with drains to prevent accumulation of water.

1.2 Liftway enclosure at all levels

1.2.1 If the safety separation between any point of access (other than the landing gate

opening to the liftway) and any adjacent moving part of the builder's lift is less than 1.0m, a liftway enclosure shall be provided and it shall have a minimum of 2.0m height or extend the full height from the landing floor to ceiling where this is less than 2m.

1.2.2 If the safety separation is 1.0m or more, a fixed enclosure to a minimum height of 1.5m shall be provided.

1.2.3 A liftway enclosure shall also be provided to protect those workers from being struck by any part of the moving lift cage when working on platforms resting on scaffolding erected close to the liftway at the external wall of building or other superstructures.

1.2.4 The size of perforations of liftway enclosure shall conform to Table 4. Materials for enclosure shall be wire mesh, expanded metal, or others of sufficient strength.

1.3 Strength of liftway enclosure (including base enclosure)
The liftway enclosure wall and its frame shall comply with the requirements in Section C3.2.

1.4 Landing platform
Landing platforms are often erected across the space between the building and the liftway to serve as access to the landings for the passengers. The design and construction of such landings shall comply with the following requirements:

1.4.1 It shall be of sound construction, adequate strength and free from patent defects.

1.4.2 It shall be either closely boarded, planked or plated, or shall be of a platform consisting of open metal work having interstices none of which exceeds 38cm² in area.

1.4.3 The width of the landing platform shall be greater than the width of the landing gate and in any case not less than 650mm.

1.4.4 Every board or plank forming part of the landing platform shall be of a thickness capable of affording adequate security having regard to the distance between the supports and be not less than 200mm in width and not less than 25mm in thickness or not less than 150mm in width when the board or plank exceeds 50mm in thickness.

1.4.5 Every side of landing platform from which a person is liable to fall a distance of more than 2m shall be provided with a suitable fence of adequate strength to a height between 1,000mm and 1,150mm. Intermediate guardrail at half the height of the top rail and a toeboard of not less than 200mm high shall be provided.

2 LANDING GATES

2.1 A landing gate shall be provided for every access to the lift cage. Landing gates shall be rigid and shall not open towards the liftway.

2.2 Sliding gate
If sliding gates are used, they shall be designed to avoid, during normal operation, derailment, jamming or displacement at the ends of their travel and shall comply with the following:

2.2.1 Horizontally sliding gates shall be guided at both the top and bottom parts. Vertically sliding gates shall be guided at both sides.

2.2.2 Vertically sliding gate panels shall be suspended by at least two independent wire ropes/chains. The factor of safety of wire ropes/chains shall not less than 8 with respect to the minimum breaking load of wire ropes/chains. They shall be retained in their pulleys/chainwheels.

2.2.3 The pulley/chainwheel diameter used for sliding gates shall be not less than 15 times the nominal wire rope diameter. The terminations of wire ropes shall be cast, swaged or fixed with wedge grips. Wire rope grips shall not be used.

2.3 Landing gates shall not be actuated to open and close by a mechanical device which is operated by the movement of the lift cage.

2.4 Landing gate thresholds shall be designed in accordance with Section C5.8.

2.5 A vision panel of sufficient strength shall be provided for solid landing gate. It shall be positioned such that the passengers on the landing side can ascertain whether the lift cage is at the landing level. The vision panel shall comply with Section C5.3.

2.6 Power operated horizontally and vertically sliding gate shall be designed and constructed in accordance with Section E, Part 1, Clauses 3.5.2 and 3.5.4 respectively of the Code of Practice on the Construction and Design of Lifts and Escalators issued by Electrical and Mechanical Services Department.

2.7 Landing gate shall be securely fixed and shall not be displaced accidentally.

2.8 Each landing gate shall be capable of being unlocked in the event of an emergency from the landing side with the aid of a special tool, e.g. unlocking triangle. The tool shall be kept properly and readily at site for use by competent workers in case of need.

3 DIMENSIONS AND CLEARANCES OF LANDING GATES

3.1 The clear height of the landing gate opening shall be not less than 2.0m. When the available clearance of the landing floor is not enough, the landing opening shall extend the full height available and in no case shall be less than 1.8m. If perforated panel is used, the size of perforations shall conform to Table 4.

3.2 When the width of the lift cage is smaller than the projection of the opening of landing gate, any gap so formed shall not be greater than 100mm.

3.3 When closed, the landing gates shall fill the liftway openings.

3.4 Any clearances around the edges of each landing gate or between landing gate sections shall conform to BS EN 294 Table 4 except under the gate where the clearance shall not be greater than 20mm.

4 STRENGTH OF LANDING GATES

The strength of the landing gate panel and its frame shall be designed to withstand without permanent deformation when a thrust of 30kg being evenly distributed over an area of 500mm² in round or square section is applied at right angles to the panel at any point.

The panel and its frame shall also possess structural strength such that when a force of 100kg is vertically applied at any point along the top member of the frame, the panel and its frame shall be able to withstand it without permanent deformation. The landing gate shall operate satisfactorily after such loading.

5 GATE INTERLOCK

All landing gates and lift cage gates for normal access shall be fitted with an electrically and mechanically operated locking device. The design of locking devices shall comply with Section F6. A certificate of test and examination of the type of the electrically and mechanically operated locking device shall be provided.

5.1 It shall not be possible to open any landing gate from the landing side, or to open any lift cage gate from inside the lift cage, unless the lift cage floor is 150mm above or below that particular landing floor.

5.2 It shall not be possible under normal operating conditions to start the operation of the lift cage or to keep it in motion, unless all gates (including lift cage gates and landing gates) are within 20mm of the closed position.

5.3 When there is more than one lift cage gate, only the lift cage gate at the landing side shall be able to be opened when the lift cage floor is within 150mm above or below the landing.

6 LOCKING DEVICES

6.1 All locking devices shall be fastened securely and the fastenings shall be restrained against working loose.

6.2 In the case of flap type locks, the flaps shall overlap the gate leaves over the entire width by an amount sufficient to prevent the gate from opening. It shall not be possible for the locking flap to drop into the closed position while the gate leaf or leaves are in any position other than the closed position.

6.3 The electrical contacts in the gate locking devices shall be opened positively and independent of gravity. They shall be actuated by the movement of the lock.

6.4 All gate locking devices together with any associated actuating mechanism and electrical contacts, shall be so situated or protected so as to be normally inaccessible to persons from the landing side. The devices shall also be so designed that they cannot readily be made inoperative by an unauthorized person interfering with the mechanism.

6.5 The locking devices shall be capable of resisting a force of 100kg at the level of the lock in the opening direction of the gate.

6.6 Gate locking device shall be designed to permit servicing. Electro-mechanical locks shall be encased. Parts sensitive to water, deleterious dust and other contaminants shall be contained within sealed housing. A minimum protection of IP4X of BS EN 60529 shall be fulfilled.

6.7 The locking elements shall be held in the locked position by springs or weights. Where springs are used, they shall be in compression and adequately supported. The failure of a spring shall not render a lock unsafe.

6.8 The electrical switch in gate locking devices shall be a safety switch.

6.9 The removal of any detachable cover shall not disturb any of the lock mechanism or the wiring. All detachable covers shall be retained by captive fastenings.

6.10 The lift cage shall not be able to be kept in motion unless all locking elements are engaged by not less than 7mm. The locking elements shall engage by not less than 10mm at right angles to the direction of motion of the part to be locked.

7 CALLING FOR LIFT SERVICE

Every landing shall be provided with a call button for the passenger to activate an electric bell located at a specified location (usually at the base enclosure or main access) when requesting lift service.

7.1 The call button shall be of continuous pressure type.

7.2 The sound emitted from the electric bell shall be distinguishable from the sounds emitted from the audible emergency alarm and the overload sensing device.

7.3 The call button shall have a minimum protection of IP54 of BS EN 60529.

8 LIGHTING

Every landing shall be provided with electric lighting that can provide a light intensity of at least 50 lux at floor level. A switch shall be provided to switch on and off the lighting.

9 ACCESS TO LANDING GATES

A free space of at least 2,000mm high shall be provided in front of the landing gate on the landing side for the access of passengers or materials. When the available clearance of the landing access is not enough, the clearance of the access shall extend the full height available and in no case shall be less than 1.8m. A cover shall be provided in front of the landing gate on the landing side to protect the passengers against falling objects.

SECTION G : DRIVING MACHINE

1 BASIC REQUIREMENTS

1.1 A builder's lift shall have at least one driving machine of its own. Each driving machine shall be fitted with a driving machine brake which operates immediately to arrest the lift cage when the operating circuit or safety circuit of the builder's lift is broken.

1.2 If two or more mechanically separate driving machines are used, each driving machine shall have its own independent brake.

1.3 The driving motor shall be coupled to the drive sheave or drive pinions by a positive means according to Section G1.13 that they cannot be disengaged from each other.

1.4 The lift cage shall, during normal operation, be power driven upwards and downwards at all times. Lowering under gravitational force by alternatively applying and releasing the driving machine brake or alternatively opening and closing the restrictor valve shall not be allowed during normal operation.

1.5 During normal operation, the upward speed of the empty lift cage and downward speed of lift cage with rated load shall not exceed 115% of the rated speed.

1.6 The driving machine and its associated moving parts shall be so positioned or guarded to protect persons from injury and guard against damage from falling objects. Effective guards shall be provided for gears, chainwheels, chains, moving shafts, flywheels, guide rollers, couplers and similar revolving components. These moving parts shall be designed to permit easy access for routine inspection and maintenance work. Perforated guards shall have openings conforming to Table 5. The thickness of metal guards shall not be less than 1.2mm. Any machine enclosure door or gate shall be provided with a lock.

Table 5:

Minimum distance between an opening and the point of operation (mm)	Maximum size of the Opening (mm)
40	10
65	12
90	15
140	20

Size of openings means the greatest dimension of the opening. The maximum size of the opening shall not be greater than 20mm.

1.7 For traction drive, it shall be properly protected against ingress of rain, mortar, concrete, dust and any other harmful materials into the driving machine brake, particularly the traction sheave.

1.8 Belts shall not be used for transmission.

1.9 Chains and chainwheels shall comply with BS 228 or other equivalent standards. The chainwheels shall be of cast iron or steel, have a minimum of 25 machine cut teeth and have at least 6 teeth in engagement. Means shall be provided to prevent the chain from leaving the chainwheel and riding over the teeth.

1.10 Stress concentration shall be minimized by forming adequate fillets where shafts and axles are shouldered. Pulleys or sprockets and their shafts shall be so supported and retained as to prevent them from becoming displaced.

1.11 Keys shall be effectively secured against movement.

1.12 The brake, motor, gear case and any bearings shall be mounted and assembled so that proper alignment of these parts is maintained under all conditions.

1.13 Any separate sheave, spur gear, worm wheel or brake drum shall be fixed to its shaft or other drive unit by any one of the following positive means:

(a) sunk keys;
(b) splines or serrations;
(c) secured by means of machined fitting bolts to a flange forming an integral part of the shaft or driving unit.

2 RACK AND PINION DRIVE

2.1 General

2.1.1 All rack and pinion shall be manufactured in accordance with the dimensional requirements of BS 436 : Part 2 or other equivalent standards.

2.1.2 The rack and pinion tooth module shall be not less than

(a) 4 where the forces between the counter rollers (or other means) and the rack are inter-reacted directly without any other elements of the mast in between.
(b) 6 where the forces between the counter rollers (or other means) and the rack are inter-reacted indirectly via other elements of the mast in between.

Note: A counter roller is a roller used to counter-react the separating force created by the meshing rack and pinion.

2.1.3 When there is more than one drive pinion in mesh with the rack, then either a self-adjusting means shall be provided effectively to share the loading on each drive pinion, or the drive system shall be designed to accommodate all conditions of load distribution between the pinions.

2.1.4 The overspeed governor pinion shall be at a position lower than the drive pinions.

2.1.5 Visual examination of the pinions shall be possible without the removal of the pinions or major disassembly.

2.2 Pinion

2.2.1 The drive pinion, overspeed governor pinion and other pinions engaged with the rack shall be machined from wear resistant material and provide a safety factor of not less than 6. The safety factor is equal to the ultimate tensile stress of the pinion material divided by the maximum stress exerted on the pinion. The stresses exerted in the pinion teeth shall be capable of sustaining the total suspended load which includes the weight of lift cage, rated load, weight of suspended trailing cables, surplus wire rope on the lift cage roof and the storage drum if provided.

2.2.2 Undercutting of the teeth shall be avoided.

2.2.3 The pinion shall be affixed to the output shaft by positive means. Methods involving friction and clamping shall not be used.

2.2.4 During erection and dismantling, the drive pinion shall have a safety factor of at least 4 with respect to ultimate tensile stress of the material. This safety factor shall not be lowered by taking into account the advantage of a counterweight.

2.3 Rack

2.3.1 The rack shall be made of material having properties matching those of the pinions in terms of wear and impact strength and shall possess an equivalent safety factor.

2.3.2 The rack shall be securely attached to the mast particularly at their ends. Joints in the rack shall be accurately aligned to avoid faulty meshing or damage to teeth.

2.3.3 The load imposed upon the rack by the pinion shall not cause permanent deformation of the rack.

2.4 Rack and Pinion Engagement

2.4.1 Means shall be provided to maintain the rack and all the drive pinions and any safety gear constantly in mesh under all conditions of load. Such means shall not rely solely upon the lift cage guide rollers or shoes. The correct mesh shall be when

the pitch circle diameter of the pinion is coincident with, or not more than one-third of the module out beyond the pitch line of the rack. See Figure 4(a) in Annex II.

2.4.2 Further means shall be provided to ensure that in the event of failure of the means provided in Section G2.4.1, the pitch circle diameter of the pinion shall never be more than two-thirds of the module out beyond the pitch line of the rack. See Figure 4(b) in Annex II.

2.4.3 Means shall be provided to restrict the disengagement of the drive pinion from the rack in such a way that at least 90% of the width of a rack tooth is always engaged with the drive pinion in the event of failure of a roller or shoe. The maximum disengagement is shown in Figure 4(c) in Annex II.

2.4.4 The pinion teeth and the rack teeth shall be square to each other in all planes, within a tolerance of ± 0.5°. See Figure 4(d) in Annex II.

2.5 Guarding

Substantial guarding shall be taken to prevent the entry of any material that might cause damage to the rack or pinion.

3 HYDRAULIC SYSTEM

When the lift cage is driven by hydraulic pump and motor, the hydraulic system shall comply with the following requirements:

3.1 Each hydraulic pump or pump group shall be provided with a pressure relief valve to limit the maximum pressure of the hydraulic system.

3.2 Isolation of the pressure relief valve from the hydraulic system by means of a device shall not be allowed.

3.3 The pressure relief valve shall be set at a pressure not greater than 125% of the maximum operating pressure of the hydraulic system.

3.4 The rated flow rate of the pressure relief valve shall be sufficient to pass the maximum flow delivered by the pump without building up excessive pressure in the hydraulic system.

3.5 Pressure relief valves shall have a means to prevent unauthorized adjustment after setting.

3.6 When hydrostatic transmission is used to control the speed and direction of movement of the motor, means shall be provided to stop the variable displacement pump delivering fluid when the control is in the neutral or off position.

3.7 An effective means shall be provided to cool the hydraulic oil.

3.8 Hydraulic valves shall not be used as the only means to stop and arrest the lift cage. An electro-mechanical or hydro-mechanical brake shall always be provided.

3.9 Pipes and hoses shall be protected against damage by proper fixing and cover and shall be designed to withstand a pressure equal to 4 times the full load pressure. Flexible hoses shall be protected against damage, in particular of mechanical origin. The installation of hoses shall be such as to avoid the use of sharp bends and chaffing by moving parts of the machine.

3.10 Piping shall be so supported that undue stresses are eliminated at joints, bends and fittings, and particularly at any section of the system subject to vibration.

3.11 Sufficient pressure gauges and/or gauge connectors shall be provided to allow checking for pressures of all hydraulic circuits.

3.12 The design of the hydraulic system shall enable entrapped air and hydraulic fluid to be drained off and vented via drain ports and vent ports respectively. A hydraulic tank open to the atmosphere shall be equipped with an air inlet filter. An oil filter shall be provided with the hydraulic fluid tank.

3.13 A temperature sensor shall be provided to measure the temperature of the hydraulic fluid. This sensor shall stop the machine and keep it stopped when the temperature of hydraulic fluid exceeds a preset value.

3.14 Each hydraulic tank shall be installed with a level indicator to indicate the fluid level and marked with the maximum and minimum levels. The type of oil used shall be specified by the manufacturer.

3.15 Means shall be provided to prevent the movement of the lift cage due to the external leakage of the fluid, bursting of flexible hoses or rigid pipe and internal leakage of hydraulic components or motors.

3.16 The brake shall remain in the applied position until the normal operating pressure has been reached and the movement of the lift cage is initiated.

3.17 Pilot operated hydraulic valves shall return to the neutral position in the event of failure of the pilot signal.

3.18 The braking system shall not operate pneumatically.

4 WIRE ROPE SUSPENSION FOR LIFT CAGE AND COUNTERWEIGHT

4.1 The wire ropes shall be steel wire ropes. Wire ropes shall conform to BS 302 or other equivalent standards.

4.2 Not less than two wire ropes, independent of one another, shall be provided for suspension and lifting. Means shall be provided to ensure loads are evenly distributed between the wire ropes.

4.3 The nominal diameter of the wire ropes shall not be less than 8mm. The tensile strength of the wires shall be between 1,570N/mm² and 1,960N/mm². The number of individual wires shall be not less than 144. The other characteristics of the wire rope shall correspond to those specified in BS 302 : Part 4 or other equivalent standards.

A certificate of the wire rope shall be provided by the manufacturer.

The factor of safety of suspension wire ropes shall be not less than:
- 16 for traction drive with 2 wire ropes
- 12 for traction drive with 3 wire ropes or more
- 6 for the suspension of counterweights, if it is independent of the suspension system of the lift cage

The factor of safety is the ratio between the minimum breaking load of one wire rope and the maximum static force imposed in this wire rope.

The minimum breaking load of a wire rope is the product of the square of the nominal diameter of the wire rope and the tensile strength of the wires and a coefficient appropriate to the type of wire rope construction conforming to an international standard.

4.4 When reeling is used the number to take into account is that of wire ropes and not the falls. Arrangements entailing reverse bends of wire shall be avoided.

4.5 In case of abnormal relative extension, slackening or breakage of any one of the wire ropes, an electric safety device of non-resetting type shall be provided to interrupt the safety circuit and cause the lift cage to stop.

4.6 Termination of wire rope

4.6.1 The strength of the wire rope terminations shall be not less than 80% of the minimum breaking load of that of the wire ropes.

4.6.2 Wire ropes shall be terminated by any one of the following methods:
- metal or resin filled socket
- thimble with a ferrule secured end terminal
- swaged or pressed terminal with ferrule
- a wedge and socket anchor
- an eye splice with thimble

Hand spliced and U-bolt grip fixing methods shall not be used.

4.6.3 Visual examination of wire rope terminations shall be possible without the removal of wire ropes or major disassembly of the wire systems.

4.7 Wire rope shall be suitably protected by anti-corrosive coating or lubricant to prevent corrosion and wearing. Zinc coated or corrosion resistant wire ropes are recommended for corrosive environment.

4.8 BS 6570 shall provide guidance for examination and discard criteria of wire ropes.

4.9 Wire rope storage

For the storage of surplus wire rope for subsequent alteration of height of travel on the lift cage roof, the following requirements shall be complied with:

(a) Any wire rope connectors or devices used to affix the wire rope at the terminated point shall not cause damage to that affixed section if that section would subsequently become part of the suspension system.
(b) The ratio between the pitch diameter of the storage drum and nominal diameter of the wire rope shall be not less than 15.
(c) Surplus wire rope, which is stored under tension, shall be anchored and stored on a storage drum having helical grooves. Helically grooved storage drum shall have a groove depth not less than 1/3 the nominal diameter of the wire rope and shall be pitched so that there is clearance between neighbouring turns of wire rope on the storage drum.
(d) When ungrooved drums are used, the stored wire rope shall not be under tension. Means shall be provided to relieve the tension in the stored wire rope. The wire rope shall not subject to a bend diameter of less than 15 times the wire rope diameter.
(e) The storage drum shall be flanged at both ends. When the wire rope is fully wound onto the storage drum the flanges shall project beyond the upper layer of wire rope by at least two times the wire rope diameters. This projection shall be not less than 25mm.
(f) Wire rope anchorage shall be protected by not less than 3 dead turns on the storage drum. The anchorages shall be designed to withstand the maximum working load on the wire rope making no allowance for the effect of any dead turns.
(g) Means shall be provided to prevent overloading the lift cage when excessive surplus wire rope is wound on the storage drum.

4.10 Pulleys and sheaves

4.10.1 The diameter of the pulleys and sheaves shall be not less than 30d measured at the bottom of the groove where d is the nominal diameter of the rope.

4.10.2 All grooves shall be smoothly finished and their edges rounded. The contour of the grooves shall be circular over an arc of not less than 120° and have a radius of not more than 7.5% nor less than 5% in excess of half the nominal diameter of the wire rope.

4.10.3 The groove depth shall be not less than 1.5 times the normal diameter of the wire rope. The angle of flare on the side of the groove shall be 52°.

4.10.4 Pulleys having wire ropes leading upwards shall be protected against the ingress of foreign objects. Effective precautions shall be taken to avoid wire ropes coming off their grooves.

4.10.5 The fleet angle between the wire rope and a plane normal to the axis of a pulley shall not exceed 2.5°.

5 TRACTION DRIVE

5.1 The suspension system/traction drive shall be designed in accordance with Section E, Part 1 Clause 5 of the Code of Practice on the Design and Construction of Lifts and Escalators issued by Electrical Mechanical Services Department for traction drive with the following additional requirements:

- The driving machine shall not be possible to raise the lift cage when the counterweight is resting on the buffers with the control lever or button of the builder's lift is actuated in the upward direction.
- Notes 1 and 2 of Clause 5.6 shall be satisfied with the exception that in the calculation of the ratio between T1 and T2, 150% of the rated load shall be considered.

5.2 In the case of a vee or undercut drive traction sheave the minimum diameter shall be 31d at the pitch circle diameter of the wire rope in the groove where d is the nominal diameter of the wire rope.

5.3 The wire rope groove in the traction sheave shall have one of the following forms:

(a) round grooves in which the groove is an arc having a radius not greater than 5% larger than half the nominal diameter of the wire rope and has a depth not less than 1/3 of the nominal diameter of the rope.

(b) round undercut in which the groove is the same as in (a) but undercut.

(c) vee grooves in which the straight sides subtend an included angle of 37.5 ± 2.5° .

5.4 The lead shall not deviate by more than 2.5° from a plane normal to the axis of the sheave groove.

6 DRUM DRIVE

Drum driven lift cages shall not be allowed.

SECTION H : DRIVING MACHINE BRAKE

1 The builder's lift shall be provided with a driving machine brake which operates automatically:
   (a) in case of loss of power supply
   (b) in the event of the loss of the supply to the control circuit.

2 The driving machine brake system shall have at least one electro-mechanical brake or hydro-mechanical brake, but may have additional means of braking or stopping the machine. The brake shall be of friction type.

3 Band brakes shall not be used.

4 The driving machine brake(s) of a builder's lift shall be capable of bringing the lift cage to rest under 150% of rated load and at its rated speed in the downward direction and maintaining the lift cage stationary. (Albeit the Builders' Lifts and Tower Working Platforms (Safety) Ordinance requires testing at 125% of rated load, design at 150% of rated load allows a safety margin). Under all conditions, the retardation of the lift cage shall not exceed 1g. In addition, the driving machine brakes on their own shall be capable of bringing the lift cage to rest under rated load and at the tripping speed of the overspeed governor.

5 No toggle or positive locking devices shall be used to hold off the brake.

6 In case of only one driving machine brake, at lease two brake shoes, pads, or callipers on the brake drum or disc shall be provided. All mechanical parts of the driving machine brake which brake the driving machine shall be so designed if any one of them fails, the lift cage with rated load would still be arrested.

7 The driving machine brake shall not be released in normal operation unless a continuous electric/hydraulic power is applied to the driving motor.

   In the case of an electrically/hydraulically operated brake, the electric/hydraulic supply shall be interrupted by at least two independent electrical devices/hydraulic valves, whether or not integral with those that cause the interruption of the electric/hydraulic supply feeding the motors and brakes.

8 If when the lift cage is stationary, one of the devices (i.e. electrical devices or hydraulic valves) has not interrupted the supply to the driving machine brake, further movement shall be prevented at the latest at the next change in direction of movement.

9 In the case of an electrically/hydraulically operated brake, when the motor may function as a generator/pump, it shall not be possible for the electric/hydraulic device operating the brake to be fed by the motor.

10 Compression springs shall be used to apply the brake. These shall be adequately supported and shall not be stressed in excess of 80% of torsional elastic limit of the material. Fatigue life calculation shall be considered when there is an adverse effect resulting from failure of compression spring.

11 Brake linings shall be asbestos free and of incombustible material and shall be so secured that normal wear does not weaken their fixings. The wearing surface of brake drums or discs shall be machined and shall be smooth and free from defects.

12 Braking shall become effective immediately after the power supply to the brake is cut off (the use of diode or capacitor connected directly to the terminals of the brake coil is not considered as a means of delay).

13 No earth fault, circuit malfunction or residual magnetism shall prevent the brake from being applied when the supply to the motor is interrupted.

14 The components of the driving machine on which the brake operates shall be positively coupled to the traction sheave, or drive pinion. Belts or friction clutches for coupling the motors to the components on which the brakes operates are not permitted.

15 Brakes shall be provided with means of adjustment to cater for the wear of the friction surfaces. The brake shall be self-compensating whenever practicable.

16 Every driving machine brake, if located on the lift cage roof, shall be capable of being released manually and shall require a constant force to maintain the brake open. The brake shall reapply as soon as the force is released.

17 The brake shall be designed to prevent the ingress of lubricants, water, deleterious dust or other contaminants by means of cover or enclosed housing.

SECTION I : SAFETY GEAR

1 Every lift cage shall be provided with a safety gear attached to the lift cage frame. The safety gear shall be activated by an overspeed governor.

2 The safety gear shall be tested and certificated and shall have a permanent label marked with the following data:

i. maker's name and address
ii. model
iii. serial number
iv. tripping speed
v. permitted load
vi. stopping distance
vii. year of construction

Note: The stopping distance is the distance which the lift cage with rated load will fall measured from the point of release of the stationary lift cage to the point of arrest.

3 Counterweights on traction drive shall also be fitted with a safety gear operated by an overspeed governor.

4 During erection or demolition, when workmen carry out lift work on the lift cage roof, the safety gear shall be operational at all times unless the lift cage is supported by a means, such as a prop, which shall have a factor of safety of not less than 4 against failure.

5 The design of the safety gear shall be capable of stopping and arresting the lift cage with 150% rated load at tripping speed. The safety gear with any load up to the rated load in the lift cage shall operate with the following retardation:

i. between 0.2g and 1.0g for traction driven lift cage
ii. not more than 1g for rack and pinion driven lift cage

and both systems shall have with no peak exceeding 2.5g for more than 0.04 sec.

6 Any movement of lift cage by means of normal control shall automatically be prevented by an electric safety device of the non resetting type as soon as the safety gear is applied. The motor control and brake control circuits shall be opened automatically.

7 When the safety gear has tripped, it shall not be possible to release or reset the safety gear by raising the lift cage by means of normal control. After the tripping of the safety gear, it shall require a competent worker to reset the safety gear and return the lift cage to normal operation. Clear and concise instructions for the release of the safety gear shall be provided at the point of release.

8 Testing the function of safety gear shall only be possible at a distance from the lift

cage using a remote control. No person is allowed inside the lift cage, underneath the lift cage or on the lift cage roof during the testing of safety gear.

9 Pulleys used to carry overspeed governor wire ropes shall be mounted independently of any shaft that carries the suspension wire rope pulleys.

10 Where there is relative movement between the gripping surface and the braking surface, the surfaces shall be held clear of each other during normal operation of the lift cage.

11 A safety gear designed to grip more than one guide shall operate on all guides simultaneously.

12 Safety gear shall not operate to stop an ascending lift cage. If an ascending lift cage is to be stopped on account of overspeed, then a safety gear shall be fitted to the counterweight for this purpose.

Note: An overspeed governor may however be used to cause the motor control and brake control circuits to be opened in the event of overspeed in the upwards direction.

13 Suitable provision and protection shall be made to prevent the safety gear from becoming inoperative due to the accumulation of extraneous materials or due to atmospheric conditions.

14 Where safety gear of the gripping type is fitted on the lift cage or the counterweight, no component of the safety gear shall be used for both guiding or braking.

15 Jaws, blocks or pinions of the safety gear shall not be used for guiding the lift cage under normal operating conditions.

16 In safety gear where braking action is achieved by means of coil springs, the springs shall be in the form of compression spring which shall be guided and in the non-loaded condition having a coil pitch of less than twice the nominal wire rope diameter.

17 When the safety gear operates, the load (if any) being uniformly distributed, the floor of the lift cage shall not incline more than 5% with respect to its normal position and shall recover without deformation after such test.

18 The tripping speed of the overspeed governor shall not exceed the rated speed of lift cage by more than 0.4m/s.

19 If a lift cage has more than one overspeed governor, then they shall be of the same design and shall apply simultaneously.

20 The device that sets the tripping speed of the overspeed governor shall be located, as far as possible, to prevent unauthorized alteration and shall be properly sealed.

21 Wire ropes and wire rope attachment, etc., to overspeed governors shall be with dimensions and design as laid down in Section G4. The nominal diameter of the wire rope for the overspeed governor shall be not less than 8mm. The bending diameter of the wire rope shall be at least 30 times of the nominal diameter of the wire rope for pulleys idling in normal service. Pulleys and drums that rotate only when the safety gear operates shall have a diameter of at least 20 times the nominal diameter of the wire rope.

During the assembly of the builder's lift, a wire rope to an overspeed governor shall be supported directly by the mast.

The tensile force in the overspeed governor wire rope produced by the governor when triggered shall be not less than 300N or twice that necessary to engage the safety gear whichever is greater.

22 For overspeed governors driven by a wire rope, the direction of rotation, corresponding to the operation of the safety gear, shall be marked on the overspeed governor.

23 The tripping of the overspeed governor shall not be activated by any device which operates electrically, hydraulically or pneumatically.

24 When there is an access underneath the counterweight, the counterweight shall be provided with a safety gear which shall operate in the downward direction upon overspeeding of the counterweight.

SECTION J : OVERLOAD SENSING DEVICES

Every builder's lift shall be installed with an overload sensing device to give clear visual and audible signals in the lift cage in case of overloading and overmoment. The overload sensing device shall measure the load which shall include the passengers and materials inside the lift cage and any materials on the lift cage roof.

1 Overload alarm system

A mandatory overload alarm system shall be provided for every builder's lift with the following requirements:

(a) The overload setting of the overload alarm system shall be greater than the rated load and less than 110% of the rated load of the builder's lift.

(b) When the load exceeds the overload setting, the overload alarm system shall give a continuous audible and visual (in red light) alarms. Simultaneously, the lift cage shall be prevented from movement by interrupting the control circuit. When the load is reduced to below the overload setting, the alarms shall be interrupted.

(c) Additional pre-warning alarms initiated at a setting below the overload setting will be allowed provided that the pre-warning alarms are distinguishable from the audible and visual alarms at the overload setting. However the pre-warning alarms shall not be activated at a setting below 90% of the rated load of the builder's lift and any pre-warning audible alarm if provided shall be cut off when the lift cage is moving.

2 The audible alarms shall be clearly distinguishable from other sounds emitted from pagers, wireless telephones, audible emergency alarm and bells for calling of lift service. The visual warnings shall be clearly distinguishable under all conditions.

3 All visual alarms, information displays, switches and controls shall have clear markings on or adjacent to them, with symbols or words in both Chinese and English to indicate their function and mode of operation.

4 Any faults or abnormalities of the overload sensing device shall interrupt the movement of the lift cage and activate the overload alarm system.

5 The overload sensing device shall be designed to operate in ambient temperatures between -20°C and +60°C. The design should be taken into account that under the circumstances described a temperature higher than +60°C can be reached inside the housing.

6 The overload sensing device shall be protected against rain, water spray, frost, snow, dirt, dust, condensation or other adverse conditions. The degree of protection shall be at least IP55 of BS EN 60529.

7 The overload sensing device shall not be liable to electromagnetic interference giving false alarm signals.

8 An overmoment sensing device may not be required if the moment exerted by the load is covered by stability and stress calculations together with overload sensing device.

9 The overload sensing device shall measure the load correctly even the load is distributed unevenly and unsymmetrically. The design and construction of the overload sensing device shall take into consideration the inaccuracy and variation of characteristics and parameters of the components used. Having taken into account of the unsymmetric load distribution and inaccuracy of the components used, the overload alarms shall still be activated when the load inside the lift cage is between 100% and 110% of the rated load.

10 The overload sensing device shall be able to detect the load during loading and unloading.

11 If the overload sensing device can be adjusted to suit more than one rated load, the overload sensing device shall have a light indicator or visual display to indicate the selected rated load and it shall be carried out by a competent worker only. Adjustment of the overload sensing device by unauthorized persons shall be prevented.

12 If power supply is interrupted, the data, information, selected rated load and calibration of the overload sensing devices shall not be changed.

13 No provision shall be made for unauthorized persons to cancel the overload alarms when the load has exceeded the overload setting.

14 The design and construction of the overload sensing device shall take into account the need to test the system without substantial disassembly. The performance of the overload system device shall not be affected after such test. The overload sensing device shall be capable of sustaining a load inside the lift cage not exceeding 125% of the rated load.

15 The devices shall be capable of sustaining loading from shock and vibration, loading encountered during transportation, erection, operation, dismantling and maintenance as well as influences from environment such as rain and wind.

16 Assurance of system safety integrity of the overload sensing device shall be achieved by:

(a) causing the overload sensing device to fail to a safe condition in the event of an open circuit, short circuit or earth fault on all external wiring and devices;

(b) carrying out periodic functional checks to verify that warnings and displays

are operating correctly.

Note : Manufacturers should use components which comply with BS 9000 or other standards that provide an equivalent integrity. Components should be conservatively rated to achieve a high mean time between failures.

17 The power supply for an overload sensing device shall have a nominal voltage not exceeding 50V a.c. or 120V d.c.

Note: It is recommended that power supply voltage should be as low as is reasonably practicable

18 The overload sensing device shall be designed to operate correctly for supply voltages in the range +20% to -15% of the nominal voltage. The overload sensing device shall continue to function correctly or fail to a safe condition if the supply voltage is outside this range. It shall operate correctly in the event of voltage recovery from the minimum value. Protection against voltage variations and surges and supply voltage reversal (in the case of d.c.) shall be provided.

19 The overload sensing device shall be designed to operate correctly for supply frequency variations (in the case of a.c.) as follows:
(a) ± 2% for power supplies derived from the mains;
(b) ± 5% for power supplies derived from engine driven generators.

Note: It is important that the power supply to the system to be so arranged that the overload sensing device is energized before movement of the lift cage could be initiated.

20 All signals and power supplies transmitted between units of the overload sensing shall be by means of discrete insulated conductors. The structure of the builder's lift shall not be used to transmit power, signals or the functional signal return.

21 Electrical signals which initiate continuous audible and visual alarms shall be separated from those used to drive visual displays if provided and other circuits to minimize common cause failures.

22 The operation of transducers, associated conductors and connections shall be continuously monitored for out of range condition. Should a fault occurs, the overload sensing device shall fail to a safe condition.

23 An instruction manual written clearly and precisely in English or Chinese shall be provided with every overload sensing device. This manual may be an integral part of the instruction manual for the builder's lift to which the overload sensing device is fitted; if it is then care shall be taken to ensure that the instructions relate to the overload sensing device actually fitted to the builder's lift.

The instruction manual shall contain all the information to permit the correct installation, calibration, testing, inspection, maintenance and use of the overload sensing device. It shall also contain any information about special procedures to be followed during erection, dismantling, maintenance, cleaning, repair and overload testing of the builder's lift.

SECTION K : ELECTRICAL INSTALLATIONS AND APPLIANCES

1 ELECTRICAL DESIGN AND CONSTRUCTION

1.1 General provisions

Electrical installations and appliances shall be in accordance with the Code of Practice for the Electricity (Wiring) Regulations issued by the Electrical and Mechanical Services Department. For electronic components the related possible field of temperature for use shall be considered.

1.2 Protection against electric faults

1.2.1 General provisions

Any one of the faults envisaged in Section K1.2.2(i) in the electric equipment of the builder's lift shall not , on its own, be the cause of a dangerous malfunction of the builder's lift.

1.2.2 Electrical faults

(i) The following faults are envisaged in the electrical equipment of the builder's lift:
   a. absence of voltage
   b. voltage drop
   c. insulation fault in relation to the metalwork or the earth
   d. short circuit or open circuit, changing in parameters of an electrical component such as resistor, capacitor, transistor, lamp
   e. non-attraction or incomplete attraction of the moving armature of a contactor or relay
   f. non-separation of the moving armature of a contactor or relay
   g. non-opening of a contact
   h. non-closing of a contact

(ii) The non-opening of a contact in Section 1.2.2(i)g need not be considered in the case of safety contacts conforming to Section K1.2.6.

1.2.3 Phase reversal and failure

(a) Builders' lifts connected to polyphase a.c. power supplies shall incorporate means to prevent the motor being energized in the event of a phase reversal.

(b) In the event of a phase failure the machine shall not start, and may stop immediately if the lift cage is moving. In the case of one of the phases of the supply to the directional control device failing, the machine shall stop.

If any failure of one phase occurs, it is allowable that the lift cage continues to run at the most to the next restart provided that the driving machine(s)

have sufficient driving capacity to drive the lift cage with rated load and also sufficient braking capacity to arrest the lift cage as specified in Section H4. The effect of excessive overheating of the driving motor(s) shall be considered and prevented by means of thermal protective devices in the motor windings.

1.2.4 Earthing protection

When a circuit in which there is an electric safety device in conformity with Section K1.2.5 is short-circuited to earth as in Section K1.2.2(i)c, it shall:

(a) either cause the immediate stopping of the machine, or
(b) prevent restarting of the machine after the first normal stop.

The return to service shall not be possible except by a competent worker.

1.2.5 Electric safety devices

During operation of one of the electric safety devices listed in Table 6, movement of the machine shall be prevented or it shall be caused to stop immediately as indicated in Section K1.2.8. The electric safety devices shall consist either of:

(a) one or more safety contacts satisfying Section K1.2.6, directly cutting the supply to the contactors or their relay contactors or the electrical devices referred to in Section K3 or
(b) be a safety circuit satisfying Section K1.2.7 consisting of either:
    i. One or more safety contacts satisfying Section K1.2.6 not directly cutting the supply to the contactors referred to Section K3 or their relay contactors, or
    ii. Contacts not satisfying the requirements of Section K1.2.6.

Apart from the exceptions permitted in the Code, no electric equipment shall be connected in parallel with an electric safety device.

1.2.6 Safety contacts

(a) Positive separation of contacts

The operation of a safety contact shall be by positive separation of the circuit breaking devices. This separation shall occur even if the contacts have welded together.

Positive opening is achieved when all the contact-breaking elements are brought to their open position and when for a significant part of the travel there are no resilient members (e.g. springs) between the moving contacts and the part of the actuation to which the actuating force is applied.

The design shall be such as to minimize the risk of a short-circuit resulting from component failure.

(b) Types of safety contacts

The safety contacts shall fulfill Section K1.2.2(ii) and shall be provided for a rated insulation voltage of 250V minimum.

The safety contacts shall belong to the categories as defined in BS EN 60947-5-1 or other relevant international standards:

i. AC-15 for safety contacts in a.c. circuits
ii. DC-13 for safety contacts in d.c. circuits

The clearances shall be at least 3mm, the creeping distances at 4mm and the distances for the breaking contacts at least 4mm after separation.

In case of multiple breaks, the distance after separation between the contacts shall be at least 2mm.

Abrasion of conductive material shall not lead to short circuiting of contacts.

1.2.7 Safety circuits

Safety circuit shall comply with the requirements of Section K1.2.1 relating to the appearance of a fault. In addition, they shall be designed such that:

(a) If one fault combined with a second fault can lead to a dangerous situation, the builder's lift shall be stopped at the latest at the next operating sequence in which the first faulty element should participate. All further operation of the builder's lift shall be impossible as long as this fault persists.

The possibility of the second fault occurring after the first, and before the builder's lift has been stopped by the sequence mentioned, is not considered.

(b) If a dangerous situation can only occur through the combination of several faults, the stopping and maintaining in a stopped position of the builder's lift shall be brought about at the latest before the possible appearance of the fault which, in conjunction with the already existing faults, would lead to the dangerous situation.

(c) On restoration of the power supply after it has been disconnected, maintenance of the builder's lift in the stopped position is not necessary, provided that during the next sequence stopping is reimposed in the cases covered in preceding (a) and (b).

(d) In redundancy-type circuits measures shall be taken to limit as far as possible the risk of defects occurring simultaneously in more than one circuit arising from a single cause.

1.2.8 Operation of electric safety devices

When operating to ensure safety, an electric safety contact shall prevent the setting in motion of the machine or initiate immediately its stopping. The electric supply to the brake shall likewise be broken.

The electric safety contacts shall act directly on the equipment controlling the supply to the machine in accordance with the requirements of Section K3.

If because of the power to be transmitted, relay contactors are used to control the machine, these shall be considered as equipment directly controlling the supply to the machine for starting and stopping.

1.2.9 Control of electric safety devices

The components controlling the electric safety switches shall be built so that they are able to function properly under the mechanical stresses resulting from continuous normal operation.

If the devices for controlling electrical safety devices are through the nature of their installation accessible to persons, they must be so built that these electrical safety devices cannot be rendered inoperative by simple means. A magnet or a properly designed bridge piece is not considered a simple means.

1.2.10 Safety switches

All gate switches, stopping switches, final limit switches, slack rope switches, overspeed safety device switches, etc., shall be safety switches. They shall contain safety contacts which comply with Section K1.2.6. During operation of one of the electric safety switches listed in Table 6, movement of the lift cage shall be prevented or it shall be caused to stop immediately.

1.3 Main isolating switch

1.3.1 For each builder's lift there shall be a manually operated main isolating switch or circuit breaker capable of isolating every pole of the supply network. The switch or breaker shall be capable of disconnecting the drive motor starting current. It shall have stable open and close positions.

1.3.2 The main isolating switch shall be positioned in an easily accessible position. Where this switch is housed in a cabinet, the operating handle shall be accessible outside the cabinet.

The handle shall open the contacts positively and the handle shall be capable being locked in the off position.

The "On" and "Off" positions of the switch shall be clearly marked in both Chinese and English.

1.3.3 The main isolating switch shall be at the base enclosure near the power feeding.

1.4 Cables and wiring

1.4.1 The size of all cables supplied with the builder's lift shall be such that the rating is adequate for the maximum current to be carried under all conditions of operation in service, including starting.

1.4.2 The mains cable for connecting the builder's lift to the supply network shall be such that the rating and size comply with Section K1.4.1.

1.4.3 All cables and wiring for the builder's lift shall be located and installed to provide protection from mechanical damage that may be caused during the use of the builder's lift.

1.4.4 Terminals shall be adequately shrouded and incoming power terminals shall be covered and marked "LIVE TERMINAL" in both Chinese and English.

Power and control circuits shall be grouped and, where necessary, separated by Insulating barriers; they shall also be marked according to the designation of the circuits.

1.4.5 When positioning a cable, allowance shall be made for the stresses to which the cable can be subjected as a consequence of mechanical action. When the cable is led into motors, apparatus, connection boxes, etc., this shall be done in an appropriate manner for each type of cable and in such a way that the cable is protected against the stresses occurring.

1.4.6 Trailing cables and flexible cables shall be protected against wear, breakage or tearing. The outer sheath of the cable shall be led in and securely fixed at the lead-in point so that the cores are not subjected to harmful tension or twisting in the connection space. Normal sealing glands with packing are not regarded as meeting the requirement for relief from pulling and twisting.

1.4.7 Cables shall be connected and branched in permanently mounted enclosed terminal blocks or by means of strong connectors intended for the purpose. Loose clamps or jointing of cables, e.g. flexible cables, in any other manner than by means of the devices intended for the purpose, shall not be used.

1.4.8 Special attention shall be paid to electric cables which hang from the lift cage with regard to cable strength and the effects of climates. Precautions shall be taken to ensure the free and safe movement of the trailing cable throughout the full range of travel of the lift cage.

1.4.9 The control gear cabinet shall contain such drawings or documentation as are necessary to aid maintenance and fault finding, e.g. circuit diagram and a wiring

diagram.

1.5 Contactors and relay-contactors, components of safety circuits

1.5.1 The main contactors (i.e. those necessary to stop the machine according to Section K3) shall belong to the following categories defined in BS EN 60947-4-1 or other relevant standards:

(a) AC-3 for contactor for a.c. motor
(b) DC-3 for contactor for d.c. motor

These contactor shall in addition allow 10% of starting operations to be made as inching.

1.5.2 If, because of the power they carry, relay contactors must be used to operate the main contactors, those relay contactors shall belong to the following categories as defined in BS EN 60947-5-1 or other relevant international standards:

(a) AC-15 for controlling a.c. electromagnets
(b) DC-13 for controlling d.c. electromagnets

1.5.3 Both for the main contactors referred to in Section K1.5.1 and for the relay contactors referred to in Section K1.5.2, it may be assumed in the measures taken to comply with Section K1.2.2, that

(a) if one of the break contacts (normally closed) is closed, all the make contacts are open;
(b) if one of the make contacts (normally open) is closed, all the break contacts are open.

1.5.4 Components of safety circuits

(a) When devices as per Section K1.5.2 are used as relay in a safety circuit, the assumption of Section K1.5.3 shall also apply.
(b) If relays are used which are such that the break and make contacts are never closed simultaneously for any position of the armature, the possibility of partial attraction of the armature (see Section K1.2.2i(e)) can be disregarded.
(c) Devices (if any) connected after electric safety devices shall meet the requirements of Section K1.2.6(b) as regards the creep distances and the air gaps (not the separation distances).

The requirement does not apply to the devices mentioned in Section K1.5.1, K1.5.2 and K1.5.4(a) and which themselves fulfil the requirements of BS EN 60947-5-1, BS EN 60947-4-1, or other relevant international standards.

1.6 Control circuit

Guidance on the design of control circuit is given in BS 5304 or other equivalent standards.

1.6.1 The voltage of the builder's lift control and operating circuits shall be not exceeded 130V with respect to earth and shall be connected to an alternating current network via an isolating transformer with separate primary and secondary windings and with the primary windings earth screened.

One pole of the secondary winding, or if a rectifier is connected to it one d.c. pole, shall be directly connected to earth.

1.6.2 Control circuits shall be so arranged that any fault except open circuit faults, will be faults to earth. Any faults, or the discharge or failure of any circuit component, shall not set up an unsafe condition, e.g. starting or continuing lift cage motion when any safety contact has opened or is opening.

1.6.3 All safety circuits shall be designed to prevent an intercircuit fault.

1.6.4 Control circuits shall be protected by fuses or equivalent devices, independently of the protection provided for the main circuits. In the event of an earth fault in control circuit of the builder's lift, the circuit shall be disconnected as a result of rupturing a fuse or similar protective device.

1.6.5 Switches shall not be connected between the earth and the control circuit operating coils.

1.7 Electrical control panels and cabinets

1.7.1 The control panels for the electrical equipment shall be arranged outside the danger area of moving parts.

1.7.2 To prevent unauthorized access during normal use of the lift cage, doors or covers that are provided for maintenance and inspection shall be secured by devices that required a spanner, key or special tool to remove or loosen them. Should threaded fasteners be used they shall be of the captive type.

1.8 Control equipment, relays and contacts

1.8.1 The control panel or their supporting frames shall be constructed of materials that do not support combustion.

1.8.2 The main and auxiliary resistors shall be adequately supported and ventilated.

1.8.3 Interlocking shall be provided, where necessary to ensure that the relays and contactors operate in proper sequence.

1.8.4 Contactors for reversing direction of travel shall be mechanically and electrically interlocked.

1.8.5 Every electric motor shall be protected from overcurrent.

1.9 Protection against the effects of external influences

All electrical apparatus excluding that installed in control gear cabinets shall be protected from the harmful or hazardous effect of external influences, and where appropriate to the design, positioned to provide protection against rain, mortar, concrete, dust and other dirt i.e. have a degree of protection at least equal to that which corresponds to IP54 of BS EN 60529.

1.10 Earthing

The mast structures, machine frames, controller frames, governor frames, casing of electric safety devices, and other similar exposed metallic parts, including guide rails, of the builder's lift which carry electrical equipment, shall be bonded to the main earthing terminal of the main isolating switches by supplementary bonding through protective conductors.

Table 6: Conditions for use of electric switches

closed position of landing gates	safety switch, self resetting
closed position of landing gate locking device	safety switch, self resetting
closed position of lift cage gate	safety switch, self resetting
closed position of trapdoor -under inspection control -under normal operation	 safety switch, self resetting safety switch in a safety circuit
operation of safety gear	safety switch in a safety circuit
abnormal relative extension of wire rope in driving machine	safety switch in a safety circuit
terminal limit switch, terminal slowing switch	without any conditions
buffer switch	safety switch in a safety circuit
final limit switch	safety switch in a safety circuit
slack rope switch in driving machine	safety switch in a safety circuit
slack rope switch in suspension of counterweight	safety switch in a safety circuit
emergency stopping device	safety switch, not self resetting
inspection switch	safety switch, not self resetting
stopping device	safety switch, self resetting
emergency electrical operation device	safety switch, not self resetting

2 CONTROL DEVICES

2.1 Travel limit switches

The permitted combinations of travel limit switches shall comply with Table 7 below:

Table 7:

DESCRIPTION		TRACTION DRIVE	RACK AND PINION DRIVE
terminal limit switch	top	yes	yes
	bottom	yes	yes
final limit switch	top	yes	yes
	bottom	yes	yes
terminal slowing switch	top	optional	optional
	bottom	optional	optional

2.1.1 Terminal limit switches

Terminal limit switches shall be provided to each liftway or lift cage and shall be positively operated and of self-resetting type. The switches shall be so arranged that their operation will result in the lift cage being automatically stopped from rated speed at the highest and lowest landings before contacting the final limit switch.

2.1.2 Terminal slowing switches

When the builder's lift is of the multi-speed or variable speed type, a set of slowing switches shall be fitted at the terminal landings. These switches shall be of the self-resetting type, arranged so as to decelerate the lift cage to the minimum speed prior to the lift cage reaching the terminal limit switch. This function shall be performed independent of the position of the control in the lift cage.

2.1.3 Final limit switches

(a) Top final limit switches

A top final limit switch of positively operated and non-resetting type shall be provided to interrupt the power supply to the motor and brake on all phases before contact is made with any mechanical stop, e.g. buffer. If there are no buffers the top final limit switch shall be positioned such that the lift cage will come to a stop before reaching the end of the liftway. After triggering the top final limit switch, all movements of the builder's lift shall be prevented and it shall be reset by a competent worker.

(b) Bottom final limit switches

A bottom final limit switch of positively operated and non-resetting type shall be provided to interrupt the power supply to the motor and brake on all phases such that the lift cage is not driven against the buffers. After triggering the bottom final limit switch, all movements of the builder's lift shall be prevented and it shall be reset by a competent worker.

The top and bottom final limit switches must not be actuated by same operating elements as the terminal limit switches. The switches shall be directly operated by the movement of the lift cage or its related parts.

2.2 Electrically and mechanically operated locking device

When a safety switch forms part of the electrical and the mechanical interlocking of the landing gates of liftway and the lift cage gates, the safety switch shall be mechanically coupled so that it cannot close the circuit while the gate is open. The interlock shall comply with Section F5.

2.3 Emergency exit safety switch

The switch specified in Section C6.4 shall be so positioned that any movement to open the emergency door or trapdoor during normal operation of the builder's lift would result in the control circuit of the lift cage being interrupted.

Note: Provision may be made to short circuit this switch specifically for the purposes of inspection and erection when the control is transferred to the roof of the lift cage. In the interests of safety, this provision should not be used to facilitate the carriage of long materials.

2.4 Slack rope device

Wire rope suspended builder's lift of traction drive and wire ropes for counterweight shall be incorporated with a slack rope device of non-resetting type. The switch shall be so arranged to interrupt the control circuit of the control equipment in the event of any wire rope breakage or becoming slack. After triggering the slack rope switch all movements of the lift cage shall be prevented until the device is reset by a competent worker.

2.5 Stopping devices

The stopping devices shall consist of electric safety devices in conformity with Section K1.2.5. They shall be bi-stable and such that a return to normal operation cannot result from an involuntary action. They shall stop, and maintain the builder's lift out of service, including any power operated gates:

(a) at the base enclosure
(b) in the pulley room, if any
(c) on the lift cage roof, if intended to be accessible
(d) inside the lift cage
(e) at the services/inspection control device

The stopping devices, (c), (d) and (e), shall be emergency stopping devices.

All the switches above shall be clearly identified.

3 STOPPING THE MACHINE

3.1 The stopping of the machine by means of an electric safety device in conformity with Section K1.2.5 shall be achieved by the interruption of the supply to the motor and brake, by either:

(i) the safety switch itself or

(ii) actuated by two independent contactors, the contacts of which shall be in series in the supply circuit.

Use of devices other than contactors is not covered by this standard. Other devices can be used provided that the same level of safety is ensured.

3.2 If, whilst the lift cage is stationary, one of the contactors has not opened the main contacts, further movement of the lift cage shall be prevented at the latest at the next change in the direction of motion.

4 CONTROL MODES

4.1 Normal operation

4.1.1 The control station inside the lift cage shall be provide with the minimum “Up”, “Down” and “Emergency Stop” controls. An indelible inscription indicating the “UP”, “DOWN” and “EMERGENCY STOP” of the controls in both Chinese and English shall be prominently displayed adjacent to the controls. The controls shall be placed in a position:

(a) which give the competent operator ample room for operation and a clear view of the landing levels; and

(b) that it is impossible to reach them by hand from outside a closed landing gate.

4.1.2 The builder’s lift shall be controllable from inside the lift cage in normal operation. The “Up” and “Down” controls shall be of deadman control type. That means the lift cage shall stop from moving after the “Up” or ”Down” controls return to neutral or off position upon release of the lever or switch in the actuated positions.

4.1.3 At all other control stations, there shall be a “Stop” control.

4.1.4 The controls excluding the “Emergency Stop” control shall be prevented from accidental actuation. On switching on the power, or restoration after power failure, the lift cage shall not move without the actuation of the controls.

4.1.5 A device shall be provided to prevent a lift cage from movement for at least two

seconds after the lift cage has been stopped at the landing gate.

4.1.6 During normal operation, it shall not be possible to control the lift cage from other control stations except inside the lift cage.

4.1.7 The controls of lift cage shall be so arranged that control can be effected from one location only at anyone time.

4.1.8 A switch to render the control circuit inoperative shall be fitted in the lift cage as a means of preventing unauthorized operation of the builder's lift. The switch shall be of a type that cannot be turned to the "On" position until a key has been inserted, the key being trapped when turned and not removable until returned to the "Off" position.

4.2 Inspection and erection operations

4.2.1 The lift cage shall only be operated from inside the lift cage or from the lift cage roof during erection, dismantling and maintenance. If some parts of the walls of the lift cage are removed leaving an opening more than 1.0m high to facilitate erection, dismantling and maintenance inside the lift cage, an electric safety device shall be provided to check that these parts are properly reinstalled before normal operation of the builder's lift can be returned.

4.2.2 The maximum travelling speed of the lift cage shall not exceed 40m/min during erection, dismantling and maintenance. All safety devices controlling the movement of the lift cage shall remain in operation.

4.2.3 If the running of the lift cage is obstructed by parts of the lift cage itself (e.g. lifting equipment on lift cage roof) during the course of travel, the lift cage shall be prevented from moving.

4.2.4 "Emergency Stop" switches shall not be bridged during erection, dismantling and maintenance.

4.2.5 A selector switch with 2 positions marked "Normal" and "Inspection" shall be provide for erection, dismantling, inspection and maintenance purposes. The "Inspection" mode shall comply with the following:

(a) the switch which shall be an electric safety device. It shall be bi-stable and lockable. It shall override all other control signals except from the "Inspection" control. The normal operation of the builder's lift shall only be effected by return of the switch to "Normal" mode.

(b) control shall be by the use of continuous pressure type "Up" and "Down" push-buttons. They shall be protected against inadvertent operation. The directions of movement of the lift cage shall be clearly marked on or adjacent to the buttons.

(c) an "Emergency Stop" switch shall be provide according to Section K2.5.

4.2.6 When the top final limit and terminal limit switches are not incorporated or functioning, alternative means shall be provided to prevent the lift cage coming off the top end of the guides.

4.2.7 Remote control shall be provided only to facilitate testing of the builder's lift.

SECTION L : EMERGENCY OPERATION

1 AUDIBLE EMERGENCY ALARM

In order to call for outside assistance, there shall be provide in the lift cage an audible alarm device easily recognizable and accessible to the competent operator. The device shall be a bell or similar devices installed at the lift cage. The device shall be capable of functioning for at least 60 minutes after power failure to the lift cage.

When the audible emergency alarm is not effective in alerting the rescue personnel because of the long distance away, an additional means such as an intercom, a walkie talkie or a communications system shall be provide inside the lift cage for the competent operator to communicate with the rescue personnel stationed on the construction site.

The push-button or switch for actuating the audible emergency alarm shall be clearly marked "LIFT ALARM" in both English and Chinese. In the case of more than one builder's lift, it shall be possible to identify the lift cage from which the call is being activated.

2 EMERGENCY LOWERING OPERATION

If there is a power failure or failure of controls, it shall be possible to bring the lift cage to a landing where the passengers and competent operators can safely leave the lift cage. This shall be done by manual or electrical control, and shall be from the lift cage roof or outside the liftway.

2.1 Manual emergency lowering

When the builder's lift is provide with manual emergency lowering device to move the lift cage to a landing in case of emergency. The following shall be complied with:

- the normal motor brake shall be capable of being released by hand with a constant force of no more than 400N.
- the device shall if it is located in the lift cage be protected from misuse.
- precautions shall be taken that when emergency lowering is carried out when there is more than one driving machine. As some of the brakes may be made ineffective (e.g. the brakes are released by wedging) to facilitate the emergency lowering, the remaining effective brake(s) in exercising the emergency lowering must be capable of arresting the lift cage with a capacity as described in Section H4.
- the device shall be operated by a competent worker.

2.2 Electrical emergency lowering

2.2.1 When an electrical emergency lowering system is provided, an emergency electrical operation device in conformity with Section K1.2.5 shall be provided. This device shall be only accessible to competent workers and shall prevent all movement of the lift cage except that controlled by this device. The electrical supply shall be from the normal mains or a standby generator.

2.2.2 Operation of emergency electrical operation device shall permit the control of the lift cage movement by continuous pressure type push-buttons situated near the emergency operation switch. The “Up” and “Down” push-buttons shall be clearly marked in Chinese and English and shall be prevented from unauthorized operation.

2.2.3 After operation of the emergency electrical operation device, all movement of the lift cage except that controlled by this device shall be prevented. The emergency operation switch may render inoperative by itself or through another electric safety device, the following electric safety devices of:

i. safety gears
ii. overspeed governor
iii. buffers
iv. final limit switches
v. slack rope switch in circuit when the lift cage is being raised

2.2.4 The emergency operation switch and its push buttons shall be so placed that the movement of the lift cage can easily be observed when using them.

2.2.5 The lift cage speed shall be controlled automatically and shall not exceed the tripping speed of the overspeed governor. The maximum emergency lowering speed of the lift cage shall not exceed 0.63m/s.

PART 4 : USER INFORMATION

1 INSTRUCTION MANUAL

Every builder's lift shall be provided with an instruction manual in either English or Chinese which provides technical data concerning the builder's lift. The manual shall be suitably protected and kept. The following technical description and information of the builder's lift shall be provided:

- maker's name and address
- type and model
- load carrying capacity of the lift cage, giving both the number of passengers including the competent operator, rated load (in kg) and the positions of permissible loads
- rated speed of the lift cage (in m/s)
- internal dimensions of the lift cage, (width, length and height in m)
- noise levels (in dB)
- maximum height of travel without wall anchorage (in m)
- maximum height of travel with wall anchorages (in m)
- maximum spacing between two consecutive wall anchorages (in m)
- allowable overhang of mast above the top wall anchorage (in m)
- minimum mast height required above the top landing (in m)
- in service maximum wind speed (in m/s)
- a description of the driving machine which shall include:
  - (a) power in kW
  - (b) electric power supply (voltage in V , frequency in Hz, phases)
  - (c) full load current (in A)
  - (d) starting current (in A)
  - (e) the type of brake
  - (f) a description of the driving machine
    - type and position of the control station
    - type of landing gate (e.g. rising or outward opening)
    - details of wire rope and/or counterweight wire rope when the lift cage is of wire rope suspension
      - i. number of wire ropes
      - ii. construction of wire rope
      - iii. nominal diameter (in mm)
      - iv. minimum breaking strength (in kN)
      - v. number of parts
      - vi. factor of safety of wire rope
- details of terminal and final limit switches
- full information on the operation and maintenance of safety gear, including method of assessing wear
- full information for the installation, testing, operation, alteration of height of travel, servicing and dismantling of the builder's lift, rescue procedures and emergency operation

- full information to enable foundations and wall anchorage fixings to be designed
- specification of bolts for assembling the structure
- details of operation, calibration, test and examination of overload sensing devices
- an electrical and hydraulic circuit diagrams showing the operation of the electrical and hydraulic components
- operation of audible emergency alarm and other communications system
- operation of lifting equipment and its capacity (in kg)
- details of dimensions and weights of components or assemblies of the builder's lift

2 MARKINGS

Markings must be easily legible and permanently attached to the builder's lift.

2.1 Rating plate

- maker's name and address
- year of construction
- type or model
- serial number or manufacturer's number
- rated load and maximum number of persons (in kg)
- maximum height of travel (in m)
- wire rope information
- rated speed (m/s)

2.2 Mast section identification

Each individual mast section shall be marked with identification or serial number enabling the year of construction of the mast section to be determined.

2.3 Safety gear

- maker's name and address
- model number
- year of construction
- serial number
- tripping speed (m/s)
- permitted load (in kg)
- stopping distance (in m)

2.4 Driving motor

- maker's name
- type or model
- year of construction
- operating speed (rpm)
- rated output (in kNm)
- serial number

- class of insulation
- power supply (in V , Hz and number of phases)

2.5 Hydraulic pump and motor

- maker's name
- type or model
- serial number
- year of construction
- operating speed (in rpm)
- rated output (in kNm)
- operating pressure (in bar)
- rated flow rate (in l/s)

2.6 Overload sensing device

- maker's name
- type or model
- serial number
- year of construction
- rating (in V, A)
- overload alarm setting (in kg or % of rated load)
- accuracy (in kg or % of rated load)

3 NOTICES

3.1 Notice at the lift cage

An indelible notice in both English and Chinese with letters and characters not less than 30mm in height is prominently displayed in the lift cage as shown below:

MAXIMUM NUMBER OF PERSONS INCLUDING OPERATOR :
最 高 可 裝 人 數 包 括 操 作 員 :

MAXIMUM WEIGHT :
最 高 載 重 :

WARNING :
警 告 :

THIS MACHINE SHALL BE OPERATED BY A COMPETENT OPERATOR ONLY
本 裝 置 祇 能 由 合 資 格 操 作 員 操 作

The notice shall be kept legibly at all times.

In addition, if the safe working loads of builders' lifts depend on position of load on the lift cage floor, the restrictions regarding the load position and concentration shall also be displayed with diagrams.

3.2 Notice at base enclosure

An indelible notice in both English and Chinese with letters and characters not less than 50mm in height shall be displayed at base enclosure as shown below:

ACCESS BY AUTHORIZED PERSONNEL ONLY 非 工 作 人 員 請 勿 內 進

3.3 Notice at every landing

An indelible notice in both English and Chinese with letters and characters not less than 30mm in height shall be displayed at every landing and at base enclosure as shown below:

MAXIMUM NUMBER OF PERSONS INCLUDING OPERATOR : 最 高 可 裝 人 數 包 括 操 作 員 : **MAXIMUM WEIGHT :** 最 高 載 重 :

PART 5 : TYPE EXAMINATION CERTIFICATES

The type examination certificates shall be issued by a testing institution approved and independent of the manufacturer. The following items shall be provided with type examination:

- driving machine brake
- overspeed governor
- safety gear
- rack and pinion suspension

PART 6 : COMPETENT OPERATORS

1 REQUIREMENTS OF COMPETENT OPERATORS

The competent operators for the operation of builders' lifts shall:

i. be more than 18 years of age
ii. be medically fit, with particular regard to eyesight, hearing and reflexes
iii. have been adequately trained in the operation and working principles of builders' lifts
iv. have been authorized to operate the builder's lift by the owner
v. have sufficient knowledge of the working of the builder's lift to enable him to carry out daily checks

2 REQUIREMENTS OF TRAINING

The training for competent operators shall include the following aspects:

2.1 Basic construction and working principles including:

i. the electrically and mechanically operated locking device of the gates
ii. the overload sensing device

2.2 Operational aspects including:

i. the allowable lifting capacity and permitted numbers of passengers to be carried
ii. operation of the control levers and switches installed inside the lift cage
iii. the use of audible emergency alarms and other communication systems

Note: the emergency lowering device shall be operated by competent workers and shall not be operated by competent operators

2.3 Daily checks including:

i. general visual inspection of the builder's lift for irregularities
ii. inspection of liftway for any obstruction that will endanger the operation of the lift cage
iii. inspection of the electrically and mechanically operated locking devices for lift cage gate and landing gate.

ANNEX I : REFERENCE

(a) BS4465 : Design and Construction of Electric Hoists for Both Passengers and Materials
(b) Code of Practice on the Design and Construction of Lifts and Escalators by Electrical and Mechanical Services Department
(c) Code of Practice on Wind Effects Hong Kong - 1983 by Building Development Department
(d) Code of Practice for the Electricity (Wiring) Regulations by Electrical and Mechanical Services Department
(e) Construction Sites (Safety) Regulations, Chapter 59
(f) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations, Chapter 59
(g) Lifts and Escalators (Safety) Ordinance, Chapter 327
(h) Electricity Ordinance, Chapter 406

ANNEX II :

FIGURES 1, 2, 3, 4(a), 4(b), 4(c) and 4(d)

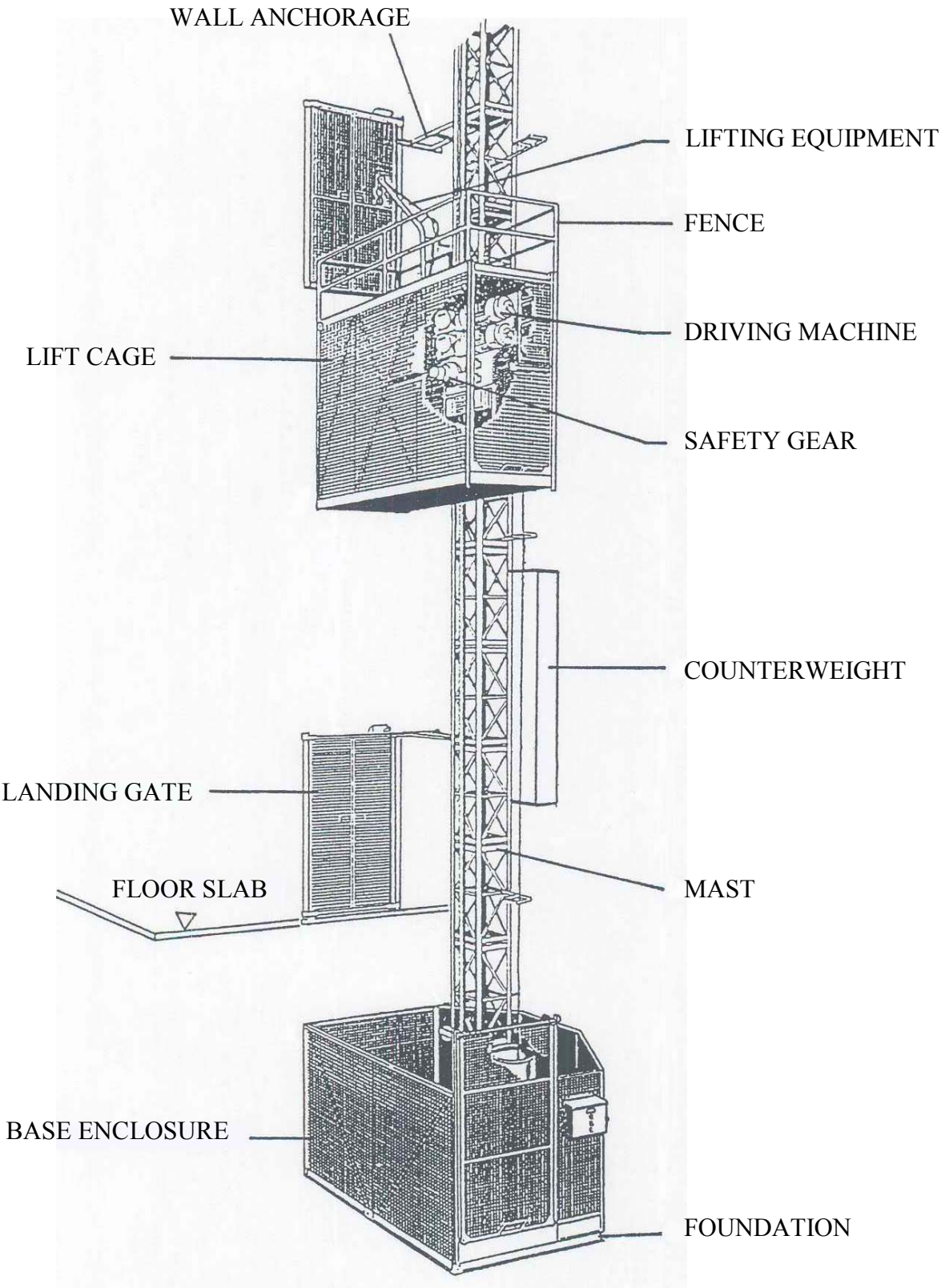

FIGURE 1 : ONE TYPICAL LAYOUT OF A BUILDER'S LIFT

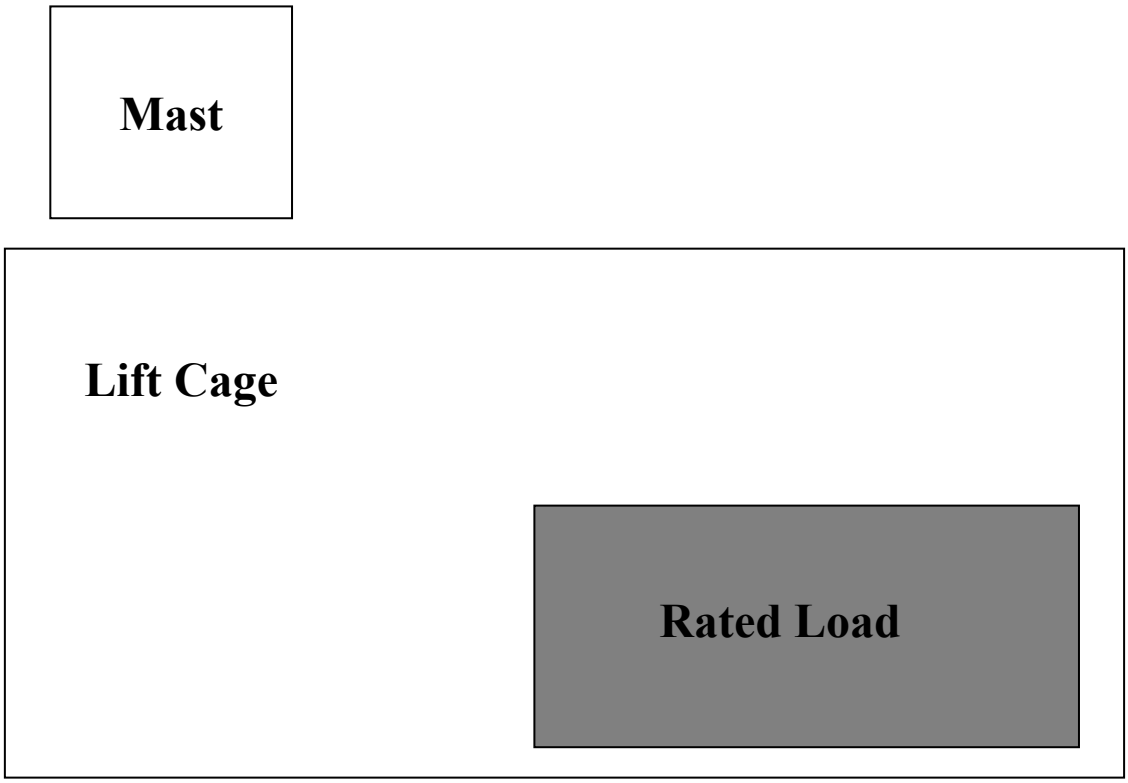

FIGURE 2 : RATED LOAD DISTRIBUTED OVER 75% OF THE LIFT CAGE FLOOR AREA

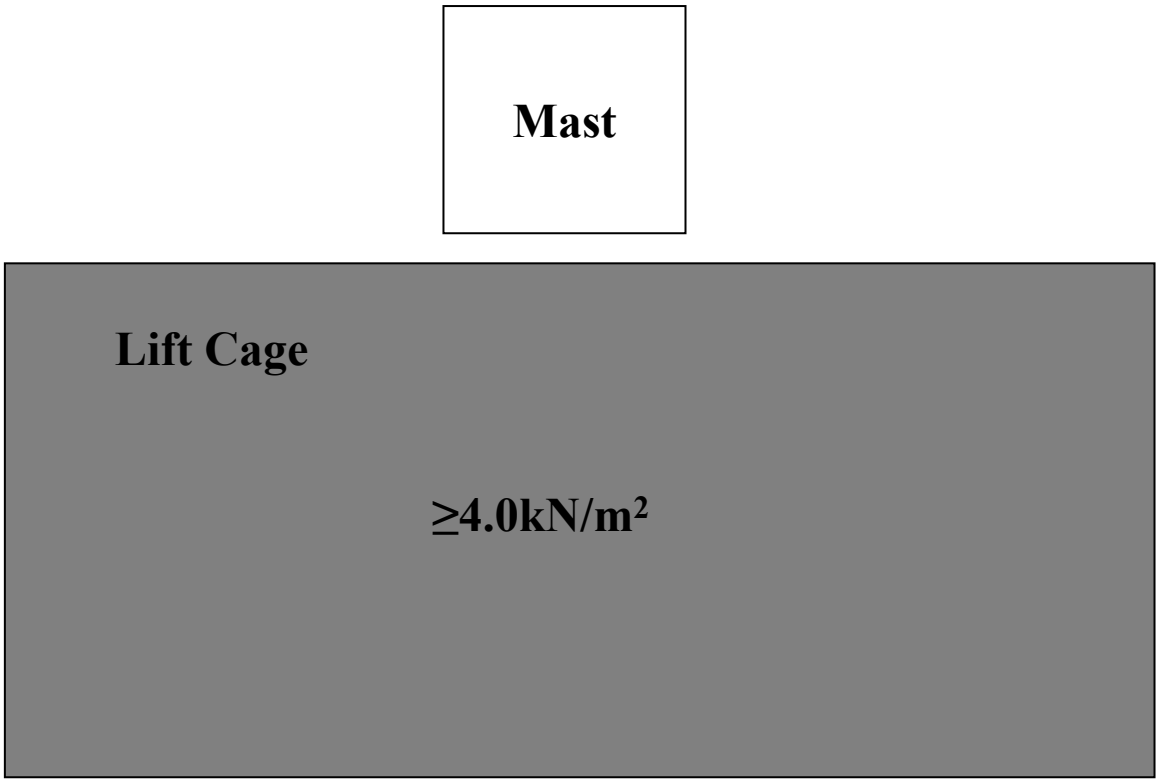

FIGURE 3 : A LOAD OF AT LEAST 4.0KN/M^2 SHALL BE PLACED OVER THE LIFT CAGE FLOOR AREA

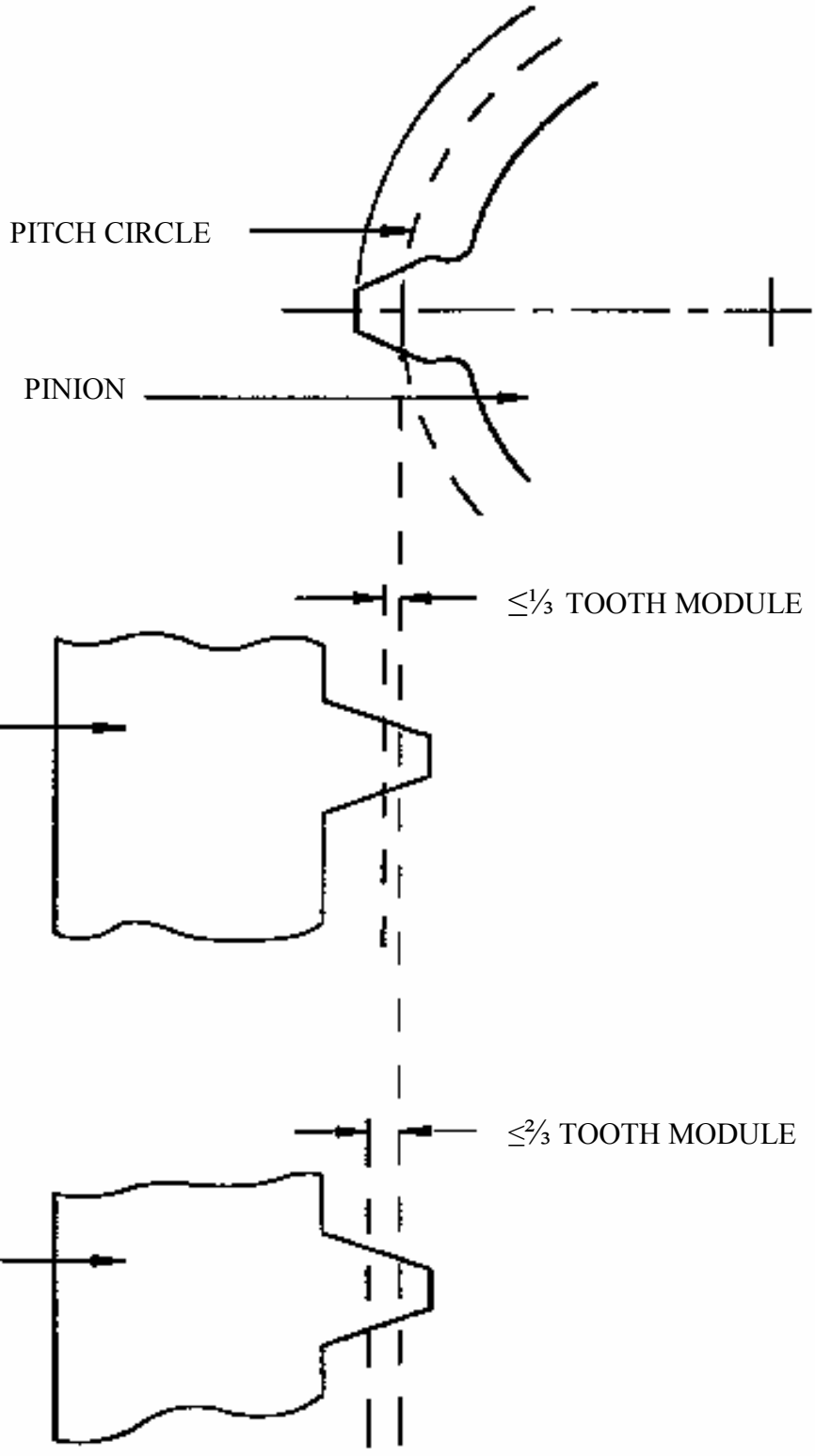

FIGURE 4(a)

FIGURE 4(b)

FIGURES 4(a) & 4(b) : SEPARATION OF PINION FROM RACK

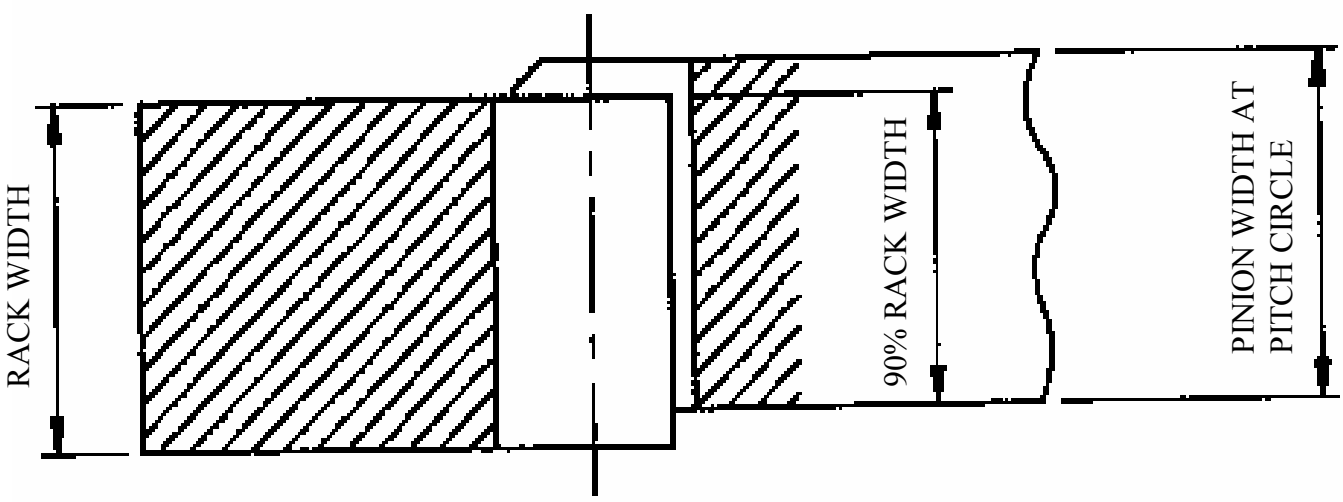

FIGURE 4(c) : RACK / PINION ENGAGEMENT

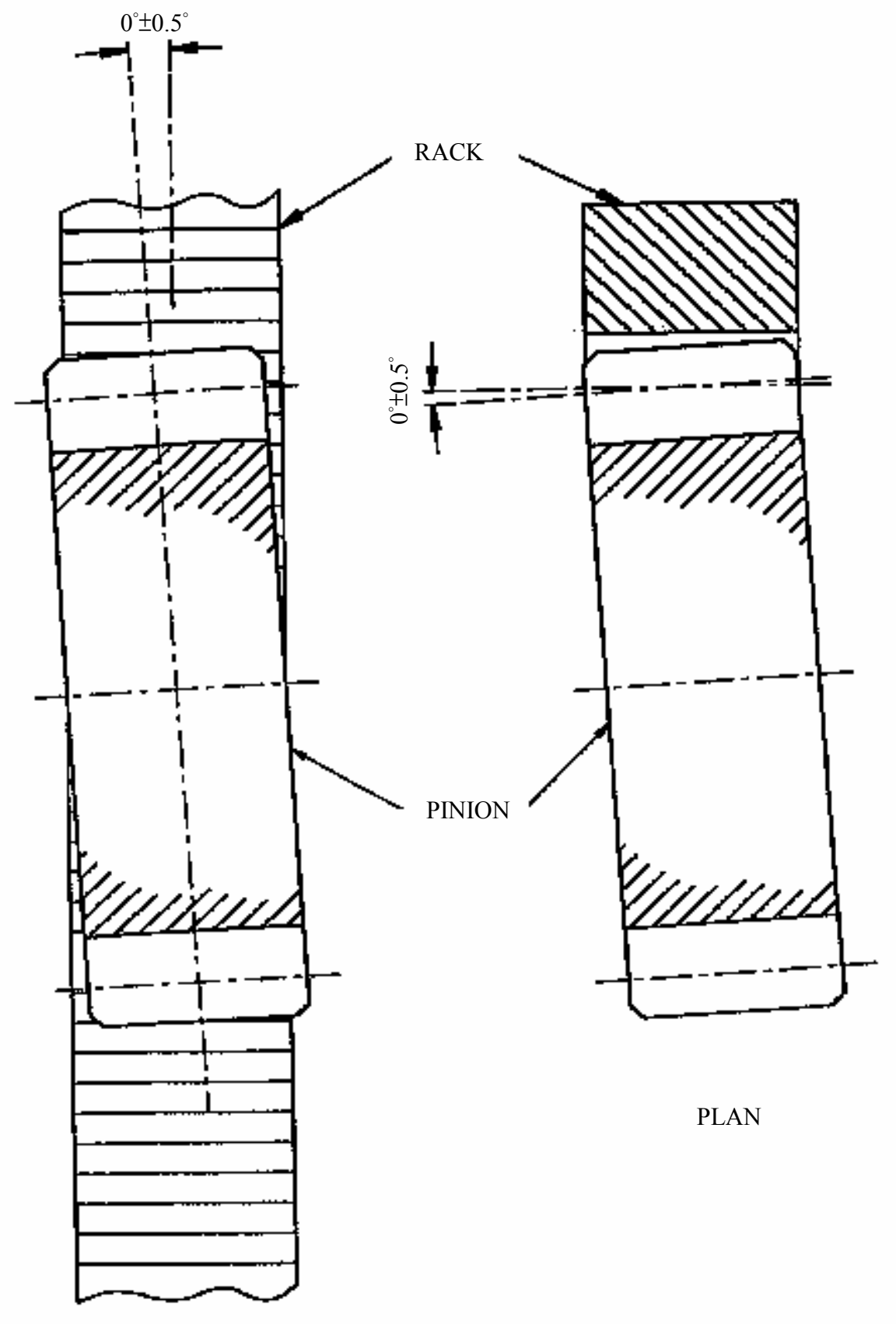

FIGURE 4(d) : RACK / PINION ENGAGEMENT