भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
BUREAU OF INDIAN STANDARDS
(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

मानक भवन, 9, बहादुर शाह ज़फर मार्ग, नई दिल्ली – 110002
Manak Bhawan, 9, Bahadur Shah Zafar Marg, New Delhi – 110002
Mob.: 7071963270, Phones: 011-23608594, Extn: 8594
Website: www.bis.org.in , www.bis.gov.in

व्यापक परिचालन मसौदा

हमारा संदर्भ: सीईडी 46 /टी-18 **18 मार्च 2025**

तकनीकी समिति: भारत की राष्ट्रीय भवन निर्माण विषय समिति, सीईडी 46

प्राप्तकर्ता :

1. सिविल अभियांत्रिकी विभाग परिषद, सीईडीसी के सभी सदस्य
2. राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46 के सभी सदस्य
3. सीईडी 46 की उपसीमितियों और अन्य कार्यदल के सभी सदस्य
4. रुचि रखने वाले अन्य निकाय।

महोदय/महोदया,

निम्नलिखित मानक का मसौदा संलग्न हैं:

प्रलेख संख्या	शीर्षक
सीईडी 46 (26651) WC	**भारत की राष्ट्रीय भवन निर्माण संहिता भाग 8 भवन सेवाएँ अनुभाग 5 लिफ्ट, स्वचालित सीढियाँ, चलपथ तथा पार्किंग सिस्टम की स्थापना 5ए लिफ्ट** [SP7(भाग 8 अनुभाग 5, 5ए) का चौथा पुनरीक्षण] (आई सी एस नंबर: 01.120: 91.040.01)

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजे कि यह मसौदा प्रकाशित हो तो इस पर अमल करने में आपको व्यवसाय अथवा कारोबार में क्या कठिनाइयां आ सकती हैं।

सम्मतियाँ भेजने की अंतिम तिथि: 17 अप्रैल 2025

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को ई-मेल द्वारा ced46@bis.gov.in पर या उपरलिखित पते पर, संलग्न फोर्मेट में भेजें। सम्मतियाँ बीआईएस ई-गवर्नेंस पोर्टल, www.manakonline.in के माध्यम से ऑनलाइन भी भेजी जा सकती हैं।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा संबंधी त्रुटि हुई तो उपरोक्त प्रलेख को यथावत अंतिम रूप दे दिया जाएगा। यदि सम्मति तकनीकी प्रकृति की हुई तो विषय समिति के अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा।

यह प्रलेख भारतीय मानक ब्यूरो की वैबसाइट www.bis.gov.in पर भी उपलब्ध हैं।
धन्यवाद।

भवदीय

ह/-
(द्वैपायन भद्र)
वैज्ञानिक 'ई' एवं प्रमुख (सिविल अभियांत्रिकी विभाग)

सलंग्न: उपरिलिखि

भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
BUREAU OF INDIAN STANDARDS
(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

मानक भवन, 9, बहादुर शाह ज़फर मार्ग, नई दिल्ली – 110002
Manak Bhawan, 9, Bahadur Shah Zafar Marg, New Delhi – 110002
Mob.: 7071963270, Phones: 011-23608594, Extn: 8594
Website: www.bis.org.in , www.bis.gov.in

WIDE CIRCULATION DRAFT

Our Reference: CED 46/T-18 **18 March 2025**

National Building Code of India Sectional Committee, CED 46

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of the National Building Code Sectional Committee, CED 46
3. All Members of Subcommittees, Panels and Working Groups under CED 46
4. All other interests

Dear Sir/Madam,

Please find enclosed the following draft:

Doc No.	Title
CED 46 (26651) WC	**National Building Code of India Part 8 Building Services Section 5 Installation of Lifts Escalators Moving Walks and Parking Systems 5A Lifts** [Fourth Revision of SP 7 (Part 8 Section 5, 5A)] (ICS No. 01.120: 91.040.01)

Kindly examine the attached draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments: 17 April 2025

Comments if any, may please be made in the enclosed format and emailed at ced46@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, www.manakonline.in.

In case no comments are received or comments received are of editorial nature, kindly permit us to presume your approval for the above document as finalized. However, in case comments, technical in nature are received, then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website www.bis.gov.in.

Thanking you,

Yours faithfully,

Sd/-
(Dwaipayan Bhadra)
Scientist 'E' / Director and Head
(Civil Engineering Department)

Encl: As above

FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause. **Comments through e-mail to ced46@bis.gov.in shall be appreciated**.

Doc. No.: CED 46 (26651) WC **BIS Letter Ref**: CED 46/T-18

Title: National Building Code of India Part 8 Building Services Section 5 Installation of Lifts Escalators Moving Walks and Parking Systems 5A Lifts [Fourth Revision of SP 7 (Part 8 Section 5, 5A)] (ICS No.01.120:91.040.01)

Last date of comments: **17 April 2025**

Name of the Commentator/ Organization: _____

Clause/ Para/ Table/ Figure No. commented	Comments/Modified Wordings	Justification of Proposed Change

NOTE- Kindly insert more rows as necessary for each clause/table, etc

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

(Not to be reproduced without the permission of BIS or used as a Standard)

Draft Indian Standard

National Building Code of India

Part 8 Building Services

Section 5 Installation of Lifts Escalators Moving Walks and Parking Systems
5A Lifts

[Fourth Revision of SP 7 (Part 8 Section 5, 5A)]

(ICS No. 01.120: 91.040.01)

National Building Code Sectional Committee, CED 46	**Last Date for Comments: 17 April 2025**

CONTENTS

National Building Code Sectional Committee, CED 46

FOREWORD

This Code (Part 8/Subsection 5A) deals with the installation requirements for planning, design, installation, operation, maintenance and inspection of lifts (passenger lifts, goods lifts, hospital lifts, service lifts and dumb waiter) so as to ensure safe movement of people with satisfactory performance.

This Section was first published in 1970 and was subsequently revised in 1983 , 2005 and 2016. This Section covers the requirements for installation and maintenance of lifts and escalators in buildings. This Section shall be read with Part 4 'Fire and Life Safety' of the Code from fire safety requirements point of view. The major changes in the first revision of 1983 were addition of outline dimensions of different types of lifts and requirements of escalators in buildings. Emphasis was laid on coordination between the engineer/architect and the lift manufacturer to arrive at the number and position of lifts for attaining optimum efficiency in serving the building with safety.

The significant changes incorporated in the 2005 revision included addition of new clauses/recommendations on building management system; addition of new clauses on fireman’s lift, infrared light curtain safety, and braille button for blind people and the updation of provisions as per the revised standards on lifts on which this section was based.

In the 2016 revision, the erstwhile Section 5 on Lifts and Escalators was divided into two subsections namely:

5A Installation of Lifts
5B Installation of Escalators and Moving Walks

The significant changes incorporated in the last 2016 revision included the introduction of high-speed lifts and lifts for tall buildings, the use of lifts for fire-fighting and emergency evacuation, machine room less (MRL) lifts, the introduction to destination control system, seismic resistance aspects in lifts, performance measurements for lifts and introduction of new clause on operation and maintenance of lifts.

As a result of experience gained since the implementation of the 2016 version of the Code and feedback received as well as revisions of Indian Standards on which this Section was based, a need was felt to revise this Section.

This revision has, therefore, been prepared to take care of these. The significant changes incorporated in this revision (Subsection 5A) include the following:

a) Definitions of various terms relating to energy dissipation and accumulation types, compensation means, hydraulic and electric systems, and safety mechanisms have been included to enhance clarity in performance measurement, seismic considerations, and maintenance aspects of lifts.

b) Introduction of double-deck lift systems, with two cabins arranged one above the other, optimizing shaft use and improving efficiency in high-traffic areas.

c) New provisions for two independent lift cabins in a single shaft solution address up-peak and inter-floor traffic demands.

d) Provisions of destination control systems (DCS) for call assignments, improving passenger flow and operational efficiency have been included.

e) Provisions for fireman's lifts, including specific requirements for fire-rated doors [in **7.2.1.1**(d)] and speed criteria (in **11.8**) to ensure quick and safe evacuation.

f) Introduction of passenger evacuation strategies (in **11.8.1** and **11.8.2**) for both independent and joined cabin systems, enhancing safety during emergencies.

g) Inclusion of hidden car operating panel for Fireman Control or special operations, improving safety and operational flexibility (in **11.7.1** and **11.7.2**).

h) Updated guidelines for compensation rope systems, with specific measures for high-speed lifts to maintain required traction, in **11.7.2**.

j) Expanded requirements for machine room levels based on lift speed and shaft dimensions.

k) Detailed provisions for the use of guide rails, counterweights, and landing doors shared between cabins, optimizing shaft space and reducing installation complexity.

m) Clarification of minimum safety distance requirements between cabins, ensuring compliance with contract speed regulations.

The information contained in this Section is largely based on the following Indian Standards:

IS No.	*Title*
14665 (Part 1) : 2000	Electric Traction Lifts Guidelines for outline dimensions of passenger, goods, service and hospital lifts
(Part 2/ Sections 1 and 2) : 2000	Code of practice for installation, operation and maintenance, Section 1 Passenger and goods lifts, Section 2 Service lifts
(Part 3/ Sections 1 and 2) : 2000	Safety rules, Section 1 Passenger and goods lifts, Section 2 Service lifts
(Part 4/ Sections 1 to 9) : 2001	Components, Section 1 Lift buffers, Section 2 Lift guide rails and guide shoes, Section 3 Lift car frame, car, counterweight and suspension, Section 4 Lift safety gears and governors, Section 5 Lift retiring cam, Section 6 Lift doors and locking devices and contacts, Section 7 Lift machines and brakes, Section 8 Lift wire ropes, Section 9 Controller and operating devices
(Part 5 : 1999)	Inspection manual
IS 14671 : 1999	Code of Practice for installation and maintenance of hydraulic lifts
IS 15330 : 2020	Code of Practice for installation and maintenance of lifts for persons with disabilities (*first revision*)
IS 15785 : 2007	Code of Practice for installation and maintenance of lift without conventional machine rooms

Assistance has also been derived from the following publications in preparation of this Subsection:

EN 81-20 : 2020	Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 20: Passenger and goods passenger lifts

EN 81-77 : 2022	Safety rules for the construction and installations of lifts. Particular applications for passenger and goods passenger lifts. Lifts subject to seismic conditions
EN 81-50 : 2020	Safety rules for the construction and installation of lifts – Examinations and tests – Part 50: Design rules, calculations, examinations and tests of lift components
ISO 18738-1 : 2012	Measurement of ride quality – Part 1: Lifts (elevators)
ISO 7465 : 2007	Passenger lifts and service lifts – Guide rails for lift cars and counterweights – T-type
ISO/TS 18870 : 2014	Lifts (elevators) – Requirements for lifts used to assist in building evacuation
ISO 3008-2 : 2017	Fire-resistance tests – Part 2: Lift landing door assemblies
ISO 3864-1 : 2011	Graphical symbols – Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings
ISO 4190-1 : 2010	Lift (Elevator) installation — Part 1: Class I, II, III and VI lifts
ISO 4190-5 : 2006	Lift (Elevator) installation – Part 5: Control devices, signals and additional fittings
CIBSE Guide D : 2015	Transportation Systems in Buildings 2015, The Chartered Institution of Building Services Engineers, London, U.K.
CTBUH 2020	Emergency Evacuation: Elevator Systems Guidelines, Council on Tall Buildings and Urban Habitat, Illinois, USA

All standards, whether given herein above or cross-referred to in the main text of this Subsection, are subject to revision. The parties to agreement based on this Subsection are encouraged to investigate the possibility of applying the most recent editions of the standards.

For the purpose of deciding whether a particular requirement of this Subsection is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Subsection.

Code Users are requested to share their inputs/comments on the draft particularly based on the changes listed above in the foreword; and specially on those text highlighted in blue and yellow in this draft.

Important Explanatory Note for Users of the Code

In any Part/Section of this Code, where reference is made to **'good practice'** in relation to design, constructional procedures or other related information, and where reference is made to "**accepted standard**" in relation to material specification, testing, or other related information, the Indian Standards listed at the end of the Part/Section shall be used as a guide to the interpretation.

At the time of publication, the editions indicated in the standards were valid. All standards are subject to revision and parties to agreements based on any Part/ Section are encouraged to investigate the possibility of applying the most recent editions of the standards.

In the list of standards given at the end of a Part/Section, the number appearing within parentheses in the first column indicates the number of the reference of the standard in the Part/Section. For example:

a) Good practices [8-5A(1)] refers to the Indian Standard(s) give at serial number (1) of the list of standards give n at the end of this Part/Subsection, that is, IS 14671 : 1999 'Code of practice for installation and maintenance of hydraulic lifts'.

DRAFT FOR COMMENTS ONLY

(Not to be reproduced without the permission of BIS or used as a Standard)

Draft Indian Standard

National Building Code of India

Part 8 Building Services

Section 5 Installation of Lifts Escalators Moving Walks and Parking Systems 5A Lifts

[Fourth Revision of SP 7 (Part 8 Section 5, 5A)]

(ICS No. 01.120: 91.040.01)

National Building Code Sectional Committee, CED 46	**Last Date for Comments: 17 April 2025**

1 SCOPE

1.1 This Code (Part 8/Subsection 5A) covers the requirements for planning, design, installation, operation, maintenance and inspection of lifts (passenger lifts, home lifts, goods lifts, hospital lifts, automobile lifts, rack and pinion lifts, service lifts, and dumbwaiters) so as to ensure safe movement of people and goods with satisfactory performance.

1.2 This Subsection gives information that should be exchanged among the architect/engineer, the consulting engineer and the lift manufacturer from the stage of planning to installation including maintenance.

NOTE – The provisions given in this Subsection are primarily for electric traction lifts; however, most of these provisions are also applicable to hydraulic lifts {*see* good practice [8-5A(1)]}.

2 TERMINOLOGY

2.0 For the purpose of this subsection, the following definitions shall apply.

2.1 General Terms Relating to Lifts

2.1.1 *Automatic Rescue Device (ARD)* — Device that operates automatically in case of failure or loss of power supply to move the lift car to a nearest landing.

2.1.2 *Apron* — Smooth vertical part extending downwards from the sill of the landing or car entrance.

2.1.3 *Available Car Area* — Area of the car, which is available for passengers or goods during operation of the lift.

2.1.4 *Accessibility* — Accessibility in the context of this standard is the quality of a building or structure or a lift which enables all people irrespective of their age, gender, or abilities to access it and use its features equally and independently.

2.1.5 *Automobile Lift* — A lift designed primarily for the transport of vehicles which may however, carry a lift attendant and / or occupants of the vehicle.

2.1.6 *Bottom Car Run-by* — The distance between the car buffer striker plate and the striking surface of the car buffer when the car is in level with the bottom terminal landing.

2.1.7 *Balancing Weight* — Mass which saves energy by balancing all or part of the mass of the car.

2.1.8 *Bottom Counterweight Run-by* — The distance between the counter weight buffer striker plate and the striking surface of the counterweight buffer when the car is in level with the top terminal landing.

2.1.9 *Buffer* — A device designed to stop a descending car or counter weight beyond its normal limit of travel by storing or by absorbing and dissipating the kinetic energy of the car or counterweight.

The buffer shall be one of the following types:

a) Energy dissipation type
b) Energy accumulation type
    1) Linear type
    2) Non-Linear type

2.1.9.1 *Energy Dissipation Type* — These are usually hydraulic buffer that dissipate the energy of the impact in the form of heat during the travel of the buffer. The hydraulic buffer falls in this category.

These types of buffers may be used whatever may be the rated speed of the lift. For example, oil buffer.

2.1.9.1.1 *Oil Buffer Stroke* — The oil displacing movement of the buffer plunger or piston, excluding the travel of the buffer plunger accelerating device.

2.1.9.2 *Energy Accumulation Type* — These can take the form of simple mechanical springs or polymer buffers which store the absorbed energy of the impact in the form of strain energy.

Energy accumulation type buffers, with linear and non-linear characteristics, shall only be used if the rated speed of the lift does not exceed 1 m/s.

2.1.9.2.1 *Spring Buffer Load Rating* — The load required to compress the spring by an amount equal to its stroke.

2.1.9.2.2 *Spring Buffer Stroke* — The distance, the contact end of the spring can move under a compressive load until the spring is compressed solid.

2.1.10 *Call Indicator* — A visual and audible device in the car to indicate to the attendant the lift landings from which calls have been made.

2.1.11 *Car Bodywork* — The enclosing bodywork of the lift car which comprises the sides and roof and is built upon the car platform.

2.1.12 *Car Door Electric Contact* — An electric device, the function of which is to prevent operation of the driving machine by the normal operating device of the lift unless the car door is in the closed position.

2.1.13 *Car Frame* — The supporting frame or sling to which the platform of the lift car, its safety gear, guide shoes and suspension ropes are attached.

2.1.14 *Car Platform* — The part of the lift car which forms the floor and directly supports the load.

2.1.15 *Control* — The system governing starting, stopping, direction of motion, acceleration, speed and retardation of moving member.

2.1.15.1 *Variable Voltage Motor Control (Generator Field Control)* — A system of control which is accomplished by the use of an individual generator for each lift wherein the voltage applied to the driving machine motor is adjusted by varying the strength and direction of the generator field.

2.1.15.2 *Electronic Control* — A system of control which is accomplished by the use of electronic devices for driving the lift motor at variable speed.

2.1.15.3 *Alternating Current Variable Voltage (ACVV) Control* — A system of speed control which is accomplished by varying the driving and braking torque by way of voltage variation of the power supply to the driving machine induction motor.

2.1.15.4 *Alternating Current Variable Voltage Variable Frequency (ACVVVF) Control* — A system of speed control that is accomplished by varying the voltage and frequency of the power supply to the driving machine induction motor.

2.1.15.5 *Solid-State d.c. Variable Voltage Control* — A solid-state system of speed control which is accomplished by varying the voltage and direction of the power supply to the armature of driving machine d.c. motor.

2.1.16 *Counterweight* — A weight or series of weights to counterbalance the weight of the lift car and part of the rated load.

2.1.17 *Compensation Means* — Includes all ropes/Coated Synthetic Belts/ Elastomeric coated ropes/Chain to counterbalance suspension means.

2.1.18 *Deflector Sheave* — An idler pulley used to change the direction of a rope lead.

2.1.19 *Door (Lift Landing Door and Lift Car Door)* – The door located at each floor entrance of the lift shaft, providing access to the lift car. It remains closed when the lift is not present at that level for safety, which opens and closes in synchronization with the landing door, ensuring passengers' safe entry and exit.

2.1.19.1 *Door, Centre Opening Sliding* — A door which slides horizontally and consists of two or more panels which open from the centre and are usually so interconnected that they move simultaneously.

2.1.19.2 *Door, Mid-Bar Collapsible* — A collapsible door with vertical bars mounted between the normal vertical members.

2.1.19.3 *Door, Multi-Panel* — A door arrangement whereby more than one panel is used such that the panels are connected together and can slide over one another by which means the clear opening can be maximized for a given shaft width. Multipanels are used in centre opening and two speed sliding doors.

2.1.19.4 *Door, Single Slide* — A single panel door which slides horizontally.

2.1.19.5 *Door, Two Speed Sliding* — A door which slides horizontally and consists of two panels, one of which moves at twice the speed of the other.

2.1.19.6 *Door, Vertical Bi-Parting* — A door which slides vertically and consists of two panels or sets of panels that move away from each other to open and are so interconnected that they move simultaneously.

2.1.19.7 *Door, Vertical Lifting* — A single panel door, which slides in the same plane vertically up to open.

2.1.19.8 *Door, Swing* — A swinging type single panel door which is opened manually and closed by means of a door closer when released.

2.1.20 *Door Closer* — A device which automatically closes a manually opened door.

2.1.21 *Door Operator* — A power-operated device for opening and closing doors.

2.1.22 *Dumb Waiter* — A lift with a car which moves in guides in a vertical direction; has a net floor area not exceeding 1 m^2, total inside height of 1.2 m, whether or not provided with fixed or removable shelves; has a capacity not exceeding 250 kg and is exclusively used for carrying materials and shall not carry any person.

2.1.23 *Direct Acting Lift* — Hydraulic lift where the ram or cylinder is directly attached to the car or its sling.

2.1.24 *Down Direction Valve* — Electrically controlled valve in a hydraulic circuit for controlling the descent of the car.

2.1.25 *Drive Control System* — System controlling and monitoring the running of the lift machine.

2.1.26 *Electrical and Mechanical Interlock* — A device provided to prevent simultaneous operation of both up and down relays or power contactors.

2.1.27 *Electro-Mechanical Lock* — A device which combines in one-unit, electrical contact and a mechanical lock jointly used for the landing and/or car doors.

2.1.28 *Electrical Anti-Creep System* — Combination of precautions for hydraulic lifts against the danger of creeping.

2.1.29 *Electric Safety Chain* — The total of the electric safety devices connected in such a way as to stop the lift when one of them is activated.

2.1.30 *Evacuation Lift* — A lift designed to be used for the evacuation of persons, in automatic mode, or under the direction of building management, or by trained evacuation person(s).

2.1.31 *Evacuation Exit Lobby (EEL)* — Destination floor(s) for evacuating persons in the building using lift(s), determined by the fire evacuation plan and which has a safe area(s).

2.1.32 *Existing Lift* — Lift which is in service at the disposal of its owner.

2.1.33 *Floor Levelling Switch* — A switch for bringing the car to level at slow speed in case of double speed or variable speed machines.

2.1.34 *Floor Stopping Switch* — A switch or combination of switches arranged to bring the car to rest automatically at or near any pre-selected landing.

2.1.35 *Full Load Pressure* — Static pressure exerted on the piping, jack, valve block, etc., with the car and rated load being at rest at the highest landing level.

2.1.36 *Geared Machine* — A machine in which the power is transmitted to the sheave through worm and worm wheel or spur reduction gearing.

2.1.37 *Gearless Machine* — A lift machine in which the motive power is transmitted to the driving sheave from the motor without intermediate reduction gearing and has the brake drum mounted directly on the motor shaft.

2.1.38 *Goods Lift* — Lift mainly intended for the transport of goods and on which only the operator and the persons necessary for loading/unloading of the goods are permitted to ride.

2.1.39 *Guide Rails* — Rigid components which provide guiding for the car, the counterweight or the balancing weight.

2.1.40 *Guide Rails Fixing* — The complete assembly comprising the guide rails bracket and its fastenings.

2.1.41 *Guide Shoe* — An attachment to the car frame or counterweight for the purpose of guiding the lift car or counter weight frame.

2.1.42 *Headroom/Overhead* – The vertical distance from the level of the top lift landing to the bottom of the machine room slab/Ceiling.

2.1.43 *Hoisting Beam* — A beam, mounted immediately below the machine room ceiling/machinery space ceiling, to which lifting tackle can be fixed for raising or lowering parts of the lift machine.

2.1.44 *Hospital Lift* — A lift normally installed in a hospital, dispensary or clinic and designed to accommodate one bed or stretcher along its depth, with sufficient space around to carry a minimum of three attendants in addition to the lift operator.

2.1.45 *Hydraulic Lift* — Lift in which the lifting power is derived from an electrically driven pump transmitting hydraulic fluid to a jack, acting directly or indirectly on the car (multiple motors, pumps and/or jacks may be used).

2.1.46 *Indirect Acting Lift* — Hydraulic lift where the ram or cylinder is connected to the car or the car sling by suspension means (Ropes or Coated Steel Belts (CSBs)).

2.1.47 *Jack* — Combination of a cylinder and a ram forming a hydraulic actuating unit.

2.1.48 *Home Lift* — A lift specifically designed for a private home taking into consideration the following:

a) Compact design in view of the limitations of space in a private residence and light duty;
b) Usage of the lift restricted primarily to the residents of the private home;
c) Special facilities to meet the needs of elderly and persons with disabilities, including wheelchair users;
d) Quiet, smooth, jerk-free movement of the lift; and
e) Controls to have ease of operation.

2.1.49 *Landing Call Push* – A push button fitted at a lift landing, either for calling the lift car, or for actuating the call indicator.

2.1.50 *Landing Door* – The hinged or sliding portion of a lift well enclosure, controlling access to a lift car at a lift landing.

2.1.51 *Levelling* — Operation which achieves the accuracy of stopping at landings.

2.1.52 *Levelling Accuracy* — Vertical distance between car sill and landing sill during loading or unloading of the car.

2.1.53 *Levelling Devices*

2.1.53.1 *Levelling Device, Lift Car* — Any mechanism which either automatically or under the control of the operator, moves the car within the levelling zone towards the landing only, and automatically stops it at the landing.

2.1.53.2 *Levelling Device, Two-Way Automatic Maintaining* — A device which corrects the car level on both under run and over-run and maintains the level during loading and unloading.

2.1.53.3 *Levelling Device, Two-Way Automatic Non-Maintaining* — A device which corrects the car level on both under run and over run but will not maintain the level during loading and unloading.

2.1.54 *Levelling Zone* — The limited distance above or below a lift landing within which the levelling device may cause movement of the car towards the landing.

2.1.55 *Lift* — Lift means a hoisting mechanism equipped with a lift car which moves in a substantially vertical direction, is worked by power and is designed to carry passengers or goods / Vehicle or both

2.1.56 *Lift Car* — The load carrying unit with its floor or platform, enclosing bodywork, and car door.

2.1.57 *Lift Landing* — That portion of a building or structure used for discharge of passengers or goods or both into or from a lift car.

2.1.58 *Lift Machine* — Unit which drives and stops the lift, including any motor, gear, brake, sheave and drum (traction or positive drive lift) or comprising the pump, pump motor and control valves (hydraulic drive lift).

2.1.59 *Lift Pit* — The part of the well situated below the lowest landing served by the car.

2.1.60 *Lift Well* — Space in which the car, the counterweight or the balancing weight travel. This space is usually bounded by the bottom of the pit, the walls and the ceiling of the well.

2.1.61 *Lift Well Enclosure* — Any structure which separates the lift well from its surroundings.

2.1.62 *Laminated Glass* — Assembly of two or more glass layers, each of which is bonded together with one or more plastic or liquid interlayers.

2.1.63 *Load Bearing Member* — Steel wire rope or steel wire strand inside of an elastomeric coated belt.

2.1.64 *Machine Room* — Fully enclosed machinery space with ceiling, walls, floor and access door(s) in which machinery as a whole or in parts is placed.

2.1.65 *Machine Room Less Lift* — This special lift does not need a separate machine room

2.1.66 *Machinery* — Equipment such as: control cabinet(s) and drive system, lift machine, main switch(es), and means for emergency operations.

2.1.67 *Machinery Space* — Volume(s) inside or outside of the well where the machinery as a whole or in parts is placed, including the working areas associated with the machinery.

NOTE — A machinery cabinet with its associated working area(s) is considered as a machinery space.

2.1.68 *Maintenance* — All the necessary operations to ensure the safe and intended functioning of the installation and its components after the completion of the installation and throughout its life cycle.

NOTE — Maintenance shall include:

a) Lubrication, cleaning, etc.;
b) Checks;
c) Rescue operations;
d) Operations of setting and adjustment;
e) Repair or changing of components which can occur due to wear or tear and do not affect the characteristics of the installation.

2.1.69 *Minimum Breaking Load (MBL)* — Specified value in kN below which the measured breaking load is not allowed to fall in a breaking load test.

2.1.70 *Mast* — Structure that supports and guides the cage

2.1.71 *Mast Section* — Indivisible piece of mast, between two adjacent mast joints

2.1.72 *Mast Tie* — Connection system between the mast and any building structure, providing lateral support for the mast.

2.1.73 *Non-Return Valve* — Valve which allows flow in one direction only.

2.1.74 *Operation* — The method of actuating the control of lift machine.

2.1.74.1 *Automatic operation* — A method of operation in which by a momentary activation of a call button the lift car is set in motion and caused to stop automatically at any required lift landing.

2.1.74.2 *Non-Selective collective automatic operation* — Automatic operation by means of one button in the car for each landing level served and one button at each landing, wherein all stops registered by the momentary actuation of landing or car buttons are made irrespective of the number of buttons actuated or of the sequence in which the buttons are actuated. With this type of operation, the car stops at all landings for which buttons have been actuated making the stops in the order in which the landings are reached after the buttons have been actuated but irrespective of its direction of travel.

2.1.74.3 *Selective collective automatic operation* — Automatic operation by means of one button in the car for each landing level served and by up and down buttons at the landings, wherein all stops registered by the momentary actuation of the car made as defined under non-selective collective automatic operation, but wherein the stops registered by the momentary actuation of the landing buttons are made in the order in which the landings are reached in each direction of travel after the buttons have been actuated. With this type of operation, all 'up' landing calls are answered when the car is travelling in the up direction and all 'down' landing calls are answered when the car is travelling in the down direction, except in the case of the uppermost or lowermost calls which are answered as soon as they are reached irrespective of the direction of travel of the car.

2.1.74.4 *Single automatic operation* — Automatic operation by means of one button in the car for each landing level served and one button at each landing so arranged that if any car or landing button has been actuated, the actuation of any other car or landing operation button will have no effect on the movement of the car until the response to the first button has been completed.

2.1.74.5 *Group automatic operation* — Automatic operation of two or more non-attendant lifts equipped with power-operated car and landing doors. The operation of the cars is coordinated by a supervisory operation system including automatic dispatching means whereby selected cars at designated dispatching points automatically close their doors and proceed on their trips in a regulated manner.

Typically, it includes one button in each car for each floor served and up and down buttons at each landing (single buttons at terminal landings). The stops set up by the momentary actuation of the car buttons are made automatically in succession as a car reaches the corresponding landings irrespective of its direction of travel or the sequence in which the buttons are actuated. The stops set up by the momentary actuation of the landing buttons may be accomplished by any lift in the group, and are made automatically by the first available car that approaches the landing in the corresponding direction.

2.1.74.6 *Signal operation* — Same as collective operation, except that the closing of the door is initiated by the attendant.

2.1.74.7 *Continuous pressure operation* — Operation by means of buttons or switches in the car and at the landings any of which may be used to control the movement of the car as long as the button or switch is manually pressed in the actuating position.

2.1.75 *Operating Device* — A car switch, push button or other device employed to actuate the control.

2.1.76 *Overhead Beams* — The members, usually of steel, which immediately support the lift equipment at the top of the lift well.

2.1.77 *Over Speed Governor* — Device which, when the lift attains a predetermined speed, causes the lift to stop, and if necessary, causes the safety gear to be applied.

2.1.78 *One-Way Restrictor* — Valve which allows free flow in one direction and restricted flow in the other direction.

2.1.79 *Passenger Lift* — A lift designed for the transport of passengers.

2.1.80 *Passenger* — Any person transported by a lift in the car.

2.1.81 *Position and/or Direction Indicator* — A device which indicates on the lift landing or in the lift car or both, the position of the car in the lift well or the direction in which the lift car is travelling or both.

2.1.82 *Pawl Device* — Mechanical device for stopping involuntary descent of the car, and maintaining it stationary on fixed supports.

2.1.83 *Positive Drive Lift* — Lift which is directly driven (not reliant on friction) by drum and ropes.

NOTE — In this Code, the term “positive drive lift” includes drum drive.

2.1.84 *Preliminary Operation* — Energizing of the machine and the brake/hydraulic valve as preparation to a normal run when the car is in the door zone and doors are not closed and locked.

2.1.85 *Pressure Relief Valve* — Valve that limits the pressure to a pre-determined value by exhausting fluid.

2.1.86 *Programmable Electronic System in Safety Related Applications for Lifts(PESSRAL)* — System for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices, used in safety-related applications

2.1.87 *Pulley Room* — Room not containing the machine, in which pulleys are located, and in which the overspeed governor should also be housed.

2.1.88 *Pulley Space* — Space(s) inside or outside of the well where pulleys are placed.

2.1.89 *Rated Load (Lift)* — In a normal operation the maximum load for which the lift car is designed and installed to carry safely at its rated speed.

2.1.90 *Rated Speed (Lift)* — In a normal operation the mean of the maximum speed attained by the lift car in the upward and downward direction with rated load in the lift car at the time of normal operation.

2.1.91 *Refuge Space* — An area of refuge is a place on the lift car roof or in the pit within the lift well designed to hold the technician/ service person in safety when the car is at its highest or lowest position of the lift well.

2.1.91.1 *Bottom refuge space* — When the lift car is at its lowest position, at least one clear area where a refuge space can be accommodated shall be provided on the pit floor with a posture of upright, crouching or laying, selected the posture from Table 1.

2.1.91.2 *Top refuge space* — When the lift car is at its highest position, at least one clear area where a refuge space can be accommodated shall be provided on the car roof with a posture of Upright or Crouching, selected the posture from Table 1.

Table 1 Dimensions of Refuge Spaces
(*Clauses* 2.1.92.1 *and* 2.1.92.2)

Sl No.	Type	Posture	Pictogram	Horizontal Dimensions of the Refuge Space m x m	Height of the Refuge Space m
(1)	(2)	(3)	(4)	(5)	(6)
i)	1	Upright		0.40 x 0.50	2.00
ii)	2	Crouching		0.50 x 0.70	1.00
iii)	3	Laying		0.70 x 1.00	0.50

2.1.92 *Retiring Cam / Coupler* — A device which prevents the landing doors from being unlocked by the lift car unless it stops at a landing.

2.1.93 *Roping Multiple* — A system of roping where, in order to obtain a multiplying factor from the machine to the car, multiple falls of rope are run around sheave on the car or counterweight or both. It includes roping arrangement of 2 to 1, 3 to 1, etc.

2.1.94 *Re-levelling* — Operation, after the lift has stopped, to permit the stopping position to be corrected during loading or unloading.

2.1.95 *Rescue Operations* — Specific actions required to safely release persons entrapped in the car and well by competent persons.

2.1.96 *Residual Breaking Load (RBL)* — Measured value of suspension member after normal use at the end of expected life span which is detected when discard criteria have been reached.

2.1.97 *Restrictor* — Valve in which the inlet and outlet are connected through a restricted passage way.

2.1.98 *Rupture Valve* — Valve designed to close automatically when the pressure drops across the valve, caused by the increased flow in a pre-determined flow direction, exceeds a pre-set amount.

2.1.99 Rack and pinion lift — Lift which uses a toothed rack and pinion as the load suspension system.

2.1.100 *Safety Gear* — A mechanical device attached to the lift car or counterweight or both, designed to stop and to hold the car or counterweight to the guides in the event of free fall, or, if governor operated, of over-speed in the descending and / or ascending direction. Any anticipated impact force shall be added in the general drawing or layout drawing.

2.1.100.1 *Instantaneous Safety Gear* — Safety gear in which the full gripping action on the guide rails is almost immediate.

2.1.100.2 *Progressive Safety Gear* — Safety gear in which retardation is effected by a braking action on the guide rails and for which special provisions are made so as to limit the forces on the car, counterweight or balancing weight to a permissible value.

2.1.101 *Service Lift* — A passenger cum goods lift meant to carry goods along with people.

> NOTE — Typically in an office building this may be required to carry food or stationeries, in a residential building to carry luggage or accommodate a stretcher and in a hotel to be used for food trolleys or baggage. There is a need in such lifts, to take care of the dimensions of the car and the door clear opening in line with the type of goods that may have to be carried based on mutual discussion between the supplier and the customer. Also, such lifts shall have buffer railings in the car at suitable height to prevent damage to the car panels when the goods are transported. Typically, such lifts, if provided with an automatic door, may use some means to detect trolleys and stretcher movement in advance to protect the doors against damage. The car floor load calculations and car area of such a lift is as in the case of a passenger lift except that these are not meant to carry heavy concentrated loads.

2.1.102 *Sheave* — A rope wheel, the rim of which is grooved to receive the suspension ropes but to which the ropes are not rigidly attached and by means of which power is transmitted from the lift machine to the suspension ropes.

2.1.103 *Slack Rope Switch* — Switch provided to open the control circuit in case of slackening of rope(s).

2.1.104 *Suspension Ropes* — The ropes by which the car and counter weight are suspended.

2.1.105 *Safety Component* — Component provided to fulfil a safety function when in use.

2.1.106 *Safety Integrity Level (SIL)* — Discreet level (one out of a possible three) for specifying the safety-integrity requirements of the safety functions allocated to the programmable electronic safety-related system, where safety-integrity level 3 has the highest level of safety integrity and safety-integrity level 1 has the lowest.

2.1.107 *Safety Circuit* — Circuit containing contacts and/or electronic components which is regarded to fulfil demands of an electric safety device.

2.1.108 *Safety Rope* — Auxiliary rope attached to the car, the counterweight or balancing weight for the purpose of tripping a safety gear in case of suspension failure.

2.1.109 *Shut-off Valve* — Manually operated two-way valve which may permit or prevent flow in either direction.

2.1.110 *Single Acting Jack* — Jack in which displacement in one direction is by fluid action and in the other by influence of gravity.

2.1.111 *Special Tool* — Tool unique to the equipment required in order to keep the equipment in a safe operating condition or for rescue operations.

2.1.112 *Stopping Accuracy* — Vertical distance between car sill and landing sill at the moment when a car is stopped by the control system at its destination floor and the doors reach their fully open position.

2.1.113 *Suspension Means* — Includes all ropes/elastomeric coated belts suspending car/counterweight/balancing weight and is engaged to car/counterweight/balancing weight side termination.

2.1.114 *Suspension Member* — Is one rope/elastomeric coated belt in the system to suspend car/counterweight and is engaged to car/counterweight side terminations.

2.1.115 *Terminal Slow-Down Switch* — A switch when actuated shall compulsorily cut off the high speed and switch on the circuitry to run the lift in levelling speed before reaching on terminal landings.

2.1.116 *Terminal Stopping Switch Normal* — Switch for cutting off all the energizing current in case of car travelling beyond the top or bottom terminal landing or a switch that cuts off the energizing current so as to bring the car to a stop at the top or bottom terminal landing level in the respective direction of travel.

2.1.117 *Terminal Stopping Device Final* — A device which automatically causes the power to be removed from an electric lift driving machine motor and brake, independent of the functioning of the normal terminal stopping device, the operating device or any emergency terminal stopping device, after the car has passed a terminal landing.

2.1.118 *Top Counterweight Clearance* — The shortest vertical distance between any part of the counterweight structure and the nearest part of the overhead structure or any other obstruction when the car floor is level with the bottom terminal landing.

2.1.119 *Travel* — The vertical distance between the bottommost and topmost lift landings served by the lift.

2.1.120 *Traction Lift* — Lift whose suspension means are driven by friction on the driving sheave of the machine.

2.1.121 *Travelling Cable* — Flexible electric cable containing multiple cores between the car and a fixed point.

2.1.122 *Unintended Car Movement* — Non-commanded movement of the car with doors open within the door zone away from the landing, excluding movements resulting from loading/unloading operation.

2.1.123 *Unlocking Zone* — Zone, extending above and below the landing level, in which the car floor has to be, to enable the corresponding landing door to be unlocked.

2.1.124 *User* — Person making use of the services of a lift installation which includes passengers, persons waiting at the landings and authorized persons.

2.2 Terms Relating to Performance Requirements for Lifts

2.2.1 *A95* — Values of acceleration or vibration within defined boundaries or limits, in which 95 percent of found values are equal to or less than.

NOTE – This value is used statistically to estimate typical levels.

2.2.2 *Acceleration* — Rate of change of z-axis velocity, attributed to lift motion control.

NOTE – It is expressed in metre per second squared (m/s^2).

2.2.3 *Axis of Measurement* — Orthogonal reference axes for the measurements, where for lifts of conventional configuration,

a) X-axis – Axis perpendicular to the plane of the car front door (that is, back to front),
b) Y-axis – Axis perpendicular to X and Z (that is, side to side), and
c) Z-axis – Axis perpendicular to the car floor (that is, vertical).

2.2.4 *Equivalent Sound Pressure Level* (L_{Aeq}) — Average sound pressure level, using frequency weighting A and time weighing 'fast', determined within defined boundaries.

2.2.5 *Jerk* — Rate of change of z-axis acceleration, attributed to lift motion control. It is expressed in meter per second cube (m/s^3).

NOTE – The passenger perception of vertical ride quality during jerk is represented by the assessment of vertical vibration during non-constant acceleration.

2.2.6 *Lift Ride Quality* — Sound levels in the car, and vibration of the car floor, relevant to passenger perception, associated with lift motion.

2.2.7 *Peak to Peak Vibration Levels* — Sum of the magnitudes of two peaks of opposite sign separated by a single zero crossing.

2.2.8 *Sound* — A-weighted sound pressure level measured in decibels (dB).

2.2.9 *Sound Pressure Level* ($L_{p,A}$) – Sound pressure level using frequency weighting A as defined in Part 8/Sec 4 of the Code:

$$L_{p,A} = 10 \log (p_A^2/p_0^2) \quad dB(A)$$

NOTES
1 1 The reference sound pressure level (p_0) is 20 µPa (2×10^{-5} Pa).
2 The measured sound pressure, p_A, is in Pascals (Pa), using frequency weighting A.

2.2.10 *V95* — Value of velocity, within defined boundaries or limits, in which 95 percent of found values are equal to or less than.

NOTE — This value is used statistically to estimate typical levels.

2.2.11 *Velocity* — Rate of change of z-axis displacement, attributed to lift motion control.

NOTE — Velocity is reported as speed and direction of travel. It is given in meters per second (m/s)

2.2.12 *Vibration* — Variation with time of the magnitude of acceleration, when the magnitude is alternately greater and smaller than the average acceleration of the lift when no lift motion acceleration is present.

NOTES
1 1 It is expressed in metre per second squared (m/s^2).
2 The deprecated unit Gal (Galileo) is sometimes used: 1 Gal = 0.01 m/s^2

2.3 Terms Relating to Planning and Design of Lifts

2.3.1 *Door Closing Time* (t_c) — Time period measured from the instant that car doors start to close until the doors are closed.

NOTE – The door closing time is expressed in second (s).

2.3.2 *Door Opening Time* (t_o) — Time period measured from the instant that car doors start to open until they are open to a specified width

NOTES
1 1 Measurement may be completed at the instant that the doors are either 800mm open or until the doors are fully open.
2 2 The opening width used shall be reported.
3 3 The door opening time is expressed in second (s).

2.3.3 *Performance time / Door-to-Door Time* (t_{pref}) — period of time between the instant the car doors start to close and the instant that the car doors are open to a specified width at the next adjacent floor.

NOTES
1 1 The performance time is expressed in seconds (s).
2 Measurements may be completed at the instant that the doors are 800mm open or until the doors are fully open.

2.3.4 *Handling Capacity* (C_h) — Maximum sustainable number of passengers per specified time period that a single lift or a group can transport for a specific traffic mix under specified loading constraints.

NOTE
1 1 Handling capacity is usually expressed as a number of passengers per five minutes (C_h) or as a percentage of population per five minutes (percent C_h).
2 Typical loading constraints are limiting the number of passengers in the cars and are determined by comfort and / or safety considerations that may reflect cultural and / or national norms.
3 The average waiting time increases rapidly and passengers are constantly left behind the departing lift, when passenger demand exceeds handling capacity.

2.3.5 *Interval* (INT) — Time period between successive car arrivals at the main terminal floor with cars loaded to any value.

2.3.6 *Nominal Travel Time / Theoretical Time of Travel* (t_{nt}) — Time period in seconds for a lift to travel from the lowest floor to the highest floor without any stops at rated speed

NOTE — The nominal travel time is expressed in second (s)

2.3.7 *Passenger Arrival Rate* — Percentage of a building's population arriving within a 5 min period.

2.3.8 *Passenger Transfer Time* (t_p) — Average time for a single passenger to enter or leave the lift car.

NOTES
1 The passenger usually moves out faster than they move in. Transfer time is an average of both of them.

2 The passenger transfer time is expressed in second (s).

2.3.9 *Passenger Waiting Time* (WT) — Period of time from when a passenger either registers a call on a landing, or joins a queue, until the responding lift that will accommodate the passenger begins to open its doors at the boarding floor.

NOTES
1 The passenger waiting time continues if a passenger does not entre the responding lift, that is, it is full (a refusal).
2 The passenger waiting time is zero, if the responding lift doors are open or opening when the passenger arrives.
3 There may be difference between waiting times measured at a site and waiting times produced by a simulation due to the difficulty of accurately measuring waiting times at an actual site.

2.3.10 *Round Trip Time* (t_{rt}) — Average period of time for a single lift car trip during up-peak traffic conditions, measured from the time the car doors open at the main terminal until the car doors reopen at the main terminal after serving the registered car calls.

NOTE — The round-trip time is expressed in second (s).

2.3.11 *Single Floor Flight Time* (t_{f1}) — Period of time measured from the instant that the car doors are locked until the lift is level at the next adjacent floor.

2.3.12 *Single Floor Transit Time* (t_v) — Period of time required to transit two adjacent floors at rated speed.

2.3.13 *Sky Lobby* — A sky lobby is the main floor for local groups in the upper part of a very tall building.

2.3.14 *Door Closing Delay Time* (t_{cd}) — Delay after passenger clearance before start of door closing

NOTE — The door closing delay time is expressed in second (s).

2.3.15 *Express Zone* – Building zone situated between an entrance floor and served floors where lift travel nonstop

2.3.16 *Door Pre-Opening Time / Advance Door Opening Time* (t_{pre}) — Time period measured from the instant that car doors start to open until the lift is level at the landing

NOTES
1 1 Door pre-opening may compensate for lift levelling, which is the final (slow) approach of the lift to a landing.
2 The pre-opening time is expressed in second (s).

2.3.17 *Incoming Traffic* — Component of traffic where passengers travel from entrance floors to the populated floors.

2.3.18 *Inter-Floor Traffic* — Component of traffic where passengers travel between the populated floors

2.3.19 *Outgoing Traffic* — Component of traffic where passengers travel from the populated floors to entrance floors

2.3.20 *Population* (*U*) — Maximum population a target building is going to be designed.

2.3.21 *Start Delay Time* (t_{sd}) — Perion of time from the instant the car doors are close until the lift starts to move

NOTE — The start delay time is expressed in second (s).

2.3.22 *Flight Time* (t_f) — period of time from the instant the lift starts to move until the lift is level at the next stop floor.

NOTE — Flight time is usually calculated by assuming ideal lift kinematics based on the rated speed, rated acceleration and jerk.

2.3.23 *Entrance Floor* — floor with building entrance or utility floor, that is, restaurant, which attract people from populated floors

2.3.24 *Entrance Bias* — proportion of traffic attributed to a specific entrance floor.

2.3.25 *Transit Time* — period of time from when a responding lift begins to open its doors at the boarding floor until the doors begin to open again at the destination floor

NOTE — The transit time commences when a passenger arrives, if the responding lift doors are open or opening.

2.4 Terms Relating to Seismic Operation of Lifts

2.4.1 *Design Acceleration* (a_d) — The horizontal acceleration to be used for calculation of forces (moments acting on lift systems and arising from seismic events).

NOTE — The value of (a_d) shall be obtained by the lift manufacturer from the building engineer/structural engineer.

2.4.2 *Normal Operation* — Operation mode in which the lift performs when not in seismic mode or in seismic stand-by mode.

2.4.3 *Retaining Device* — Mechanical device securely fixed to a structural member of the lift car, counterweight frame designed to retain the lift car and counterweight within its guide rails during seismic activity.

2.4.4 *Seismic Mode* — Special mode in which the lift operates after detection of seismic trigger level.

2.4.5 *Seismic Stand-By Mode* — Special mode in which the lift operates after detection of primary earthquake wave without the activation of the seismic detection system.

2.4.6 *Seismic Trigger Level* — Seismic acceleration which is used to activate a seismic detection system.

2.4.7 *Snag Point* — The point of interference between flexible elements (for example, ropes, chains, travelling cable, etc) and fixed elements (for example, by guide rail brackets, guide rail clip bolts, fishplates, vanes, and similar devices).

2.5 Terms Related to Maintenance of Lifts

2.5.1 *Competent Maintenance Person* — Designated person, suitably trained, qualified by knowledge and practical experience, provided with necessary instructions and supported within their maintenance organization to enable the required maintenance operations to be safely carried out.

2.5.2 *Installation* — Completely installed passenger lift or good passenger lift or accessible goods only lift or service lift.

2.5.3 *Installer* — Natural or legal person who takes responsibility for the design, manufacture, installation and placing on the market of lifts.

2.5.4 *Maintenance Organization* — Company or part of company where competent maintenance person(s) carry out maintenance operation on behalf of the owner of the installation.

2.5.5 *Manufacturer* — Natural and legal person who takes responsibility for the design, manufacture and placing on the market either of safety components for lifts or complete lift.

2.5.6 *Owner of the Installation* — Natural or legal person who has the power of disposal of the installation and takes responsibility for its operation and use.

2.5.7 *Inspector* — Inspector means an inspector of lifts or any other officer appointed and approved by State/Union Government to maintain Lift Act/Rules or any other Act/Rules connected with safety of lifts and framed by State/Union Government

2.5.8 *Authorized Person* — Person with the permission of the natural or legal person who has the responsibility for the operation and use of the lift, to access restricted areas (machinery spaces, pulley rooms and lift well) for maintenance, inspection or rescue operations.

2.5.9 *License* — A permission granted by competent authority to engage in a business or occupation or in an activity otherwise unlawful.

3 GENERAL

3.1 Conformity with Lifts Act and Rules

3.1.1 The installation shall generally be carried out in conformity with *Lifts Act* and *Rules* wherever they are in force.

3.1.2 It is the responsibility of the owner of the premises where the lift will be installed, to obtain necessary permission from the Authority before and after the installation of lifts and for subsequent operation of lifts.

3.1.3 A license for public use is a safety provision, issued by state authorities under *Lifts Act* and *Rules* wherever they are in force, and shall be obtained as per the laid down statutory requirement.

3.2 Conformity with *The Electricity Act,* 2003 and Rules/Regulations Thereunder

All electrical work in connection with installation of lifts shall be carried out in accordance with the provisions of the *Electricity Act*, 2003 as amended up-to-date along with the rules and regulations framed thereunder and shall also comply with the other provisions of Part 8 ‘Building Services, Section 2 Electrical and Allied Installations’ of the Code.

3.3 Conformity with Indian Standards

All materials, fittings, appliances, etc, used in electrical installation shall conform to Indian Standard specifications wherever these exist. In case of materials for which Indian Standard specifications do not exist, the materials shall be approved by the competent authority. For detailed specification for lifts, reference shall be made to accepted standards [8-5A(2)].

3.4 Conformity to Accessibility Requirements

All lifts installed for public use shall meet the accessibility requirements in accordance with **13** of Part 3 ‘Development Control Rules and General Building Requirements’ of the Code.

3.5 Conformity with Fire Regulations

The installation shall be carried out in conformity with Part 4 'Fire and Life Safety' of the Code and the state fire acts/local fire regulations wherever they are in force.

3.6 Considerations for Selection of Lifts

The considerations for selection of lifts shall be based on the following criteria:

a) *The Intended Use of Lift* – The number of lifts and their capacities (that is, load and speed) required for a given building shall be suitably decided to meet the

intended requirement. The passenger lifts shall meet the requirements of handling capacity and waiting time for passenger, depending on the lift's expected usage and building type.

b) *System Performance* – System performance criteria shall be based on building type (residential, commercial, hotel, hospital, etc).
c) *Accessibility Requirements – see* **3.4**.
d) *Environmental Conditions* – Lifts directly exposed to atmospheric conditions, that is, weather (for example, those meant for external applications), or any other adverse condition shall be appropriately designed and protected for that particular condition.
e) *Type of main drive for lift* – Whether electric traction, geared or gearless or hydraulic depending on speed, stops/travel height and capacity requirement.
f) *Civil Engineering Requirements* – Machinery location that is, machinery to be located in machine room or machinery to be kept inside lift well thereby eliminating conventional machine room.
g) *Seismic Considerations* – Whether the lift is to be protected against seismic forces or whether the lift is to be rescued to a landing on detection of earthquake or both.

3.7 Maintenance

The considerations relating to maintenance shall be as follows:

a) The lift installation shall receive regular cleaning, lubrication, adjustment and adequate servicing by authorized competent persons at such intervals as per type of equipment and frequency of service demand. It is desirable and normal for the lift supplier to be entrusted with the servicing during the guarantee period of new lift.
b) In order that the lift installation is maintained at all times in a safe condition, a proper maintenance schedule shall be drawn up in consultation with the lift manufacturer and rigidly followed. The provision of a log book to record all items relating to general servicing and inspection is recommended for all lifts.
c) Any accident arising out of operation or maintenance of the lifts shall be duly reported to the authority in accordance with the rules laid down.
d) Lifts are required by statutory regulations to be examined at regular intervals as specified by lift acts, by a competent person.
e) The company entrusted with maintenance contract shall have valid licence to maintain the lifts. The persons assigned for maintenance work shall be appropriately qualified and experienced as required by *Lift Acts* and *Rules*.

3.8 Energy Efficiency and Sustainability

Design options like space restrictions, reliability and safety, riding comfort have been the major market and technological driver. The following should be encouraged for reducing power consumption and promoting sustainability in buildings.

a) Energy efficient a.c. variable voltage variable frequency (VVVF) motor drive or equivalent. Lifts with 1-speed and 2-speed motor control are not recommended

for passenger lifts because of high power consumption, poor passenger comfort and tripping hazard.

b) When the lift has answered the last call and stopped at a landing and no further landing call is registered, the car and landing doors shall close. If there is no further landing call after pre-determined period but not less than 90 s, the light and fan inside the car shall both be automatically switched off. Car lights and fan shall switch on automatically before the lift doors start to open or the lift is set in motion.

c) Under normal operating status, at least one lift car of a lift bank shall operate under a standby or sleep mode during off-peak period when the traffic demand on the vertical transportation system is low. During low demand periods, even completely shutting down one or more lifts within a group can be a good energy saving option, without compromising quality of service.

d) Where a number of lifts are installed together, their controls are interconnected to optimize their operation. By efficiently delivering passengers with the least no. of trips, starts and stops, the energy consumed is significantly reduced.

e) Energy saving LED lamps for car lighting in place of conventional lamps.

f) Gearless type machines to reduce transmission losses.

g) Improvement in total power factor of the motor drive of a lift at the isolator connecting lift to the building's electrical supply circuit.

h) Regenerative drives to recycle energy rather than wasting it as heat. The regenerated energy may be used for charging batteries, staircase lighting, lobby lighting, etc.

j) Use of high efficiency motors such as Permanent Magnet Synchronous Motors, or Induction motors having minimum efficiency class equivalent to IE2 as per accepted standard [8-5A(3)].

Adoption of materials and practices that are environmentally friendly and sustainable shall be promoted.

4 PLANNING AND DESIGN GUIDELINES

This clause provides guidelines and minimum requirements for traffic analysis and is not a substitute for detailed understanding of the complex theory and the required practical experience.

4.1 The planning guidelines, design considerations, and precautions to be exercised during design of passenger and goods lifts operated by electric traction are provided hereunder. Manufacturer may be consulted for other types of lifts such as hydraulic, home, automobile lifts, etc.

Design of lifts necessarily calls for coordination among various parties concerned, namely the client, the architect/engineer, the consulting engineers and the lift manufacturer. These guidelines give the information from the stage of planning till the design that should be exchanged between parties. It is essential that all the parties involved in the planning should have a clear understanding of the basis and the theory of planning. All parties involved need to recognize that it is highly impractical to correct

badly planned lifts in a building as no changes shall be carried out to the building core, if the number of hoist-ways is inadequate or of wrong size or wrongly positioned.

These provisions specify requirements for the architects/engineers, builders/ developers and tenderers while finalizing specification of lifts. Two basic considerations, namely, the quantity of service required and the quality of service desired, determine the number and type of lifts to be provided in a particular building. The quantity of service factor, that is, how many people might use the lift system over a defined period of time is represented by the handling capacity. The quality of service factor, that is, how well the lift system deals with its passengers is represented by passenger waiting time and lobby queuing. These factors are interrelated and depend, among other things, on the type of building and its use and on the type of occupier. Both these factors require proper study into the character of the building, extent and duration of peak periods, frequency of service required, type and method of control, type of landing doors, etc.

Figure 1 shows the flow chart to arrive at a reasonable vertical transportation solution for a building.

The adequacy of the lift group in a building is a major contributing factor to the success or failure of a building. Users of lifts would be intolerant of long queues and long waiting times. The planning and selection of the vertical transportation equipment is a specialized activity. Although the basic calculations are relatively simple, the theory on which they are based is complex. The difficulty in planning a lift installation is not only in calculating its probable performance but also in estimating the passenger demand and usage patterns. The architect/engineer doing the planning work should establish the lift system at a very early stage in consultation with the lift manufacturer/consulting engineer and not after the rest of the building has been designed.

This Subsection defines the calculation approach for conventional two button dispatching and does not define calculation methods for destination control systems or hybrid systems. It also does not define an approach to simulation methods as consensus on how to apply simulation has not been established.

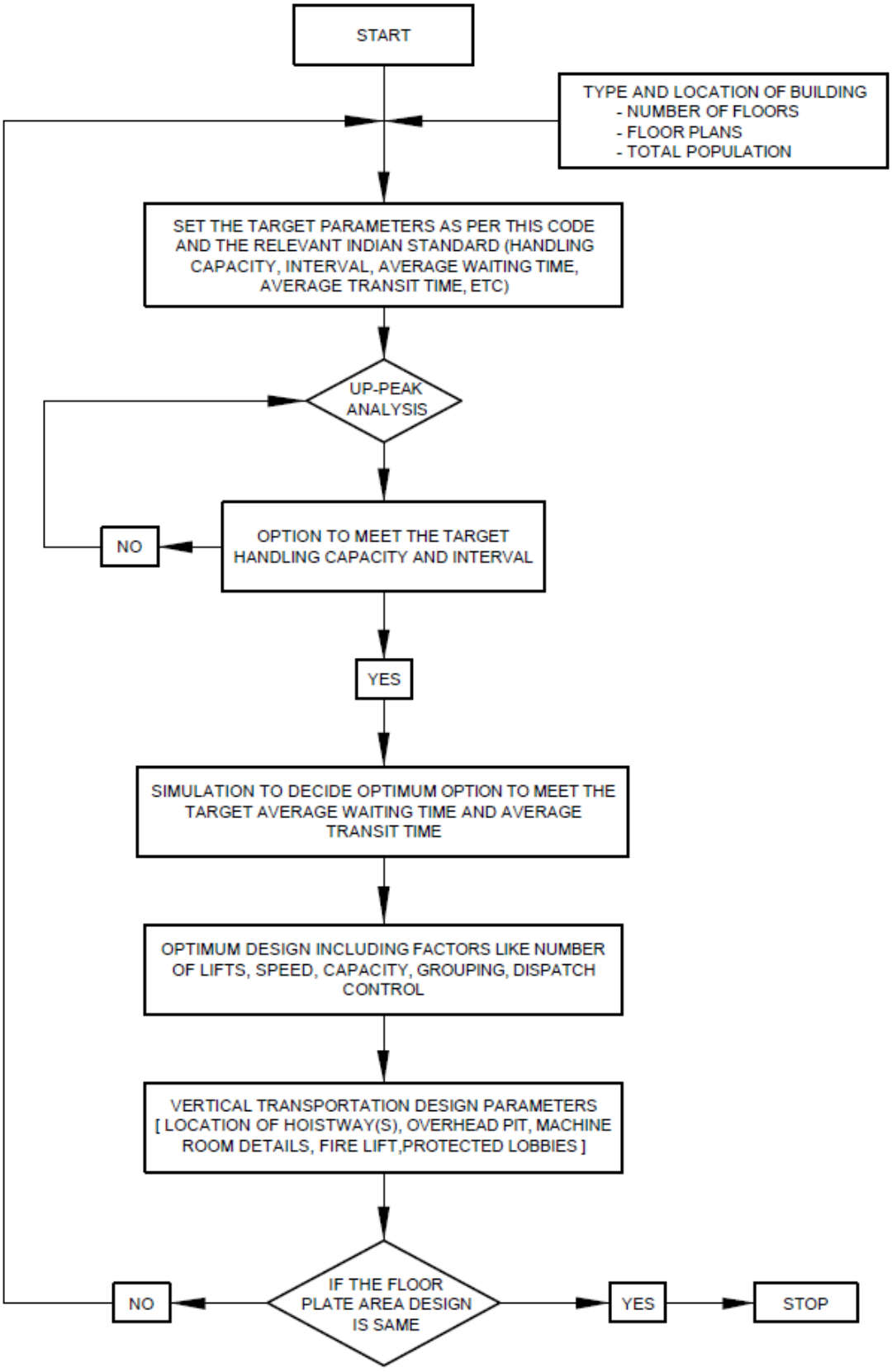


FIG. 1 TYPICAL FLOWCHART ON PRELIMINARY DESIGN OF LIFTS

4.2 Preliminary Lift Planning

4.2.1 Two models can be used for lift traffic analysis and design:

a) The first model uses a calculation method based on mathematical formulae. This classical model uses the pure up-peak condition as this provides a well-defined, simple traffic pattern amenable to mathematical analysis. These calculations can be carried out manually, using a spreadsheet or by using computer based programme.

b) The second model is based on discrete digital simulation of the movement of lifts in a building and the passenger dynamics. This simulation model allows very complex situations to be analyzed and is generally capable of better evaluations. However, simulation approaches and algorithms vary with software ranging from crude to very sophisticated. With the varied approaches and lack of consensus on simulation approaches and how to apply simulation this standard does not define standards for simulation.

Generally, if a lift system (using a conventional landing call system) is sized correctly for the up-peak traffic pattern, all other traffic patterns should be adequately served. The notable exceptions to this, are:

1) Hotels where check-in/check-out clashes with meal times;
2) Hospitals;
3) Buildings that open at specified times (For example, stock exchanges, movie theatres, stadiums);
4) Buildings with 24x7 operation and shift changes (For example, BPO/ITES buildings);
5) Buildings with amenities located at higher floors (For example, roof top restaurants, cafeterias, health clubs);
6) Residential buildings (sometimes two-way traffic is considered);
7) Buildings with multiple entry levels;
8) Parking towers;
9) Schools where students change floors or buildings at the beginning and end of classes; and
10) Mixed-use buildings.

Methods of calculating the traffic handling capabilities of lifts were first devised for office buildings. In due course, detailed modifications were devised to suit other applications without altering the basic principles. The application to office buildings is the most frequently used, and is outlined in **4.2.2** to **4.2.10** as a general approach to lifting.

Subsequently, traffic conditions other than up peak are examined as also building types other than office. It is recommended that calculations based on the classical model should be carried out in order to obtain an understanding of the various factors. A simulation may then be performed in order to cover special situations or to obtain information not provided by the calculation method.

4.2.2 *Population*

4.2.2.1 The first point to be ascertained from the owner/developer or proposed occupier is the total building population. If a definite population figure is not available, then an estimation should be made using floor areas, more specifically, the net usable area (NUA). The NUA excludes circulation areas (stairs, corridors, foyers, etc), structural intrusions (columns, ducts, etc) and facilities (pantry, kitchens, toilets, conference rooms, training rooms, server rooms, storage areas, etc).

4.2.2.2 The number of people occupying the net usable area can vary according to the usage pattern or building type. Because of the criticality of establishing the population, it is recommended that the architect/engineer should prepare a typical test fit to establish an estimate of the population. The test fit estimates can be validated from population counts from buildings with similar usage patterns and types.

4.2.2.3 *Absenteeism*

While the absenteeism is subjected to input from the developer / tenants, studies have shown that in many office buildings it is unlikely that all the total population is present on any one day. Where this is known to be the case the building population to be used in a design can be reduced by 10 percent to 20 percent on account of persons working from home, holiday, sickness, travelling, vacant posts etc. It would be unpractical to consider absenteeism beyond 20 percent of total population. The designer shall note that the absenteeism shall be applied only for office buildings, absenteeism factor shall not be considered for residential buildings, hotels or hospitals. People arriving in morning adopts a bell curve pattern, designer shall note that assuming additional absenteeism towards people arriving before peak period / after peak period, this regime shall adversely impact the peak demand traffic in lunch and for building operating round the clock in shifts.

The designers need to understand the clear circulation and movement pattern of the occupants (and goods) of a building and design to facilitate the circulation and movement. Table 2 gives typical values for the density of population.

Table 2 Occupancy Area Per Person in Office Buildings
(*Clause* 4.2.2)

Sl No.	Building Type	Open Plan/ Hall Seating	Cellular Plan/ Cabins
(1)	(2)	(3)	(4)
i)	Premium	10 m^2	12 m^2
ii)	Regular	8 m^2	10 m^2
iii)	Low end	5 m^2	8 m^2

For certain specialized building functions such as BPO, areas ranging from 6 m^2 to 10 m^2 per person may be considered.

4.2.3 *Quantity of Service*

It is measured in terms of the total number of passengers handled during the peak 5 min period of the day. This is calculated by determining the number of trips made by the lifts over the peak 5 min period and then multiplying it by the average number of passengers carried in each trip. The target handling capacity as a percentage of the building population is usually the estimated value of passenger arrival rate for the 5 min up-peak period. The minimum recommended quantity of service is given in Table 3.

This would vary depending on various factors like starting time (fixed or flexi-time), nearness to fast access routes like mass rapid transport systems, express ways, major roads, etc.

Table 3 Recommended Quantity of Service in Office Buildings
(*Clause* 4.2.3)

Sl No.	Type of Occupancy	Quantity of Service
		Percent
(1)	(2)	(3)
i)	Multi tenancy	10 to 15
ii)	Single tenancy	15 to 25

4.2.4 *Quality of Service*

It is very difficult to get real indications of passenger waiting time and lobby queuing from the classic calculation models. Therefore, interval is considered as the measure. During pure up-peak traffic, the interval or the average time between successive arrivals of the lift cars at the main lobby is generally considered as an indicator of passenger waiting time. Table 4 gives the quality of service based on interval.

If interval is used as an indicator of quality of service, it should be noted that passenger average waiting time depends on the car occupancy, the handling capacity *vis-a-vis* the passenger arrival rates, the control systems, etc. The average waiting time approximates 75 percent to 85 percent of the interval for average car occupancy of 80 percent of the actual lift capacity provided the handling capacity is equal to or better than the peak arrival rate. Beyond 80 percent car loading passenger average waiting time increases exponentially and cannot be approximated from interval. Table 5 gives the recommended quality of service measured as average waiting time.

Table 4 Recommended Quality of Service in Office Buildings (Based on Interval)
(*Clause* 4.2.4)

Sl No.	Quality of Service	Interval s
(1)	(2)	(3)
i)	Excellent	Less than 25
ii)	Very good	25 to less than 30
iii)	Good	30 to less than 35
iv)	Fair	35 to less than 40
v)	Poor	40 to less than 45
vi)	Unsatisfactory	45 and above

Table 5 Recommended Quality of Service in Office Buildings (Based on Average Waiting Time)
(*Clause* 4.2.4)

Sl No.	Class of Building	Average Waiting Time s
(1)	(2)	(3)
i)	Premium	< 25
ii)	Regular	25 to 35

4.2.5 *Traffic Analysis Equations*

The classical method to size a lift installation requires the determination of the time, in second, that it takes for a single lift to make a round trip around the building during the up-peak traffic condition. This is called the round trip time and is given by:

$$RTT = 2Ht_{\mathrm{v}} + (S+1)(T - t_{\mathrm{v}}) + 2Pt_{\mathrm{p}}$$

where

N = number of floors above main terminal floors,

H = average highest reversal floor = $N - \sum_{i=1}^{N-1} (i/N)^{\mathrm{P}}$,

S = average no of stops $S = N\left[1 - \left(1 - \frac{1}{N}\right)^{\mathrm{P}}\right]$,

P = average passengers carried (= 0.8 x maximum actual car capacity),

t_{v} = single floor transit time = average inter floor distance/rated speed,

T = door operating time (t_{c}+t_{o}) + single floor flight time $t_{\mathrm{f}}(1)$, and

t_{p} = passenger transfer time.

The derivation of the round trip time equation assumes the following:

a) Traffic pattern corresponds to a pure up-peak.
b) Passengers arrive according to a rectangular probability distribution.
c) Lifts, on an average, fill to 80 percent of the actual car capacity by numbers irrespective of the weight of each passenger or the space that maybe occupied
d) All floors are equally populated.
e) Rated speed is achieved in a single floor jump.
f) Inter-floor heights are equal.
g) Door dwell time does not exceed the calculated passenger transfer time.

Interval, *INT* = *RTT* / *L*, where *L* is the number of lifts in a single group.

Five minute handling capacity, $HC = \frac{300 \text{ x } P \text{ x } L \text{ x } \ 100 / \text{Population}}{RTT}$

or

$$\frac{300 \text{ x } P \text{ x } 100 / \text{Population}}{INT}$$

The down peak round trip time is estimated as:

$$RTT_{\text{downpeak}} = Nt_{\text{v}} + (0.5S + 1)(T - t_{\text{v}}) + 2Pt_{\text{p}}$$

The mid-day round trip time is estimated as:

$$RTT_{\text{mid-day}} = 2Ht_{\text{v}} + 2S(T - t_{\text{v}}) + 4Pt_{\text{p}}$$

An estimation of interfloor performance can be obtained using:

$$AWT_{\text{interfloor}} = INT_{\text{uppeak}} + \left(0.22 + 1.78 \frac{A_{\text{interfloor}}}{HC_{\text{uppeak}}} \right)$$

where $A_{\text{interfloor}}$ is the number of passengers arriving during the interfloor period.

4.2.6 *Configuration of Lifts: Number*

Determination of number of lifts depends on the required quality and quantity of service. It should be noted here that grouping of lifts and location should be given adequate attention.

If a bank of two lifts or more is required to meet the anticipated traffic requirements, they have to be oriented to facilitate grouping. Individual lifts will not achieve the required quantity and quality of service.

4.2.7 *Configuration of Lifts: Capacity*

Determination of car capacity depends on the required quality and quantity of service. A larger car, while improving the handling capacity might adversely impact the quality of service.

4.2.8 *Configuration of Lifts: Speed*

In addition to the speeds derived from the calculations for handling capacity and interval, the nominal travel time is used for selecting suitable rated speeds. The higher the building, the faster lifts are needed. The recommended values for nominal travel time in case of an office, commercial or hotel building are given in Table 6.

Table 6 Recommended Nominal Travel Time for Office, Commercial or Hotel Buildings
(*Clause* 4.2.8)

Sl No.	Level	Nominal Travel Time s
(1)	(2)	(3)
i)	Excellent	15 to 25
ii)	Good	> 25 to 35
iii)	Satisfactory	> 35 to 45

4.2.9 *Configuration of Lifts: Layout*

The shape and size of a passenger lift car bears a distinct relation to its efficiency in traffic handling. A study of the most suitable proportions for passenger lifts reveals that the width of the lift well entrance is the basic element in the determination of the best proportions. In other words, the width of the car is determined by the width of the entrance and the depth of the car is regulated by the loading per square metre permissible under this standard.

Centre opening doors are the most practicable and the most efficient entrance units for passenger lifts. Given the same door speed, the centre opening is much faster than the side opening type. For passenger lifts, wider cars are preferred as the ingress and egress efficiency is higher. For service/freight/ stretcher lifts deeper cars are preferred, so as to easily carry the stretcher/goods.

While sizing the hoist-ways, the possible construction inaccuracies have to be considered. Further where high speeds lifts are being considered the hoist-ways need to be designed to address the impact of the wind tunnel effect.

4.3 Planning for Specific Building Features

4.3.1 *Special Building Facilities*

Facilities like cafeteria, food courts, restaurants, gymnasia, etc, in the building impact the circulation patterns in a building and should be considered for lift traffic design. It is advisable to have cafeteria on lower floor, however when cafeteria / food court is located in mid-way or top of the building, the probable number of trip per person is on higher side and cannot be simulated to practical situation.

4.3.2 *Basement Service*

Buildings are sometimes designed with car parks or other facilities at basement levels below the terminal floor. Such floors, if they are served by the main lifts have an adverse impact on the up-peak, down-peak and mid-day traffic patterns. During up-peak conditions, this may cause lifts to arrive at the main terminal already partly full causing confusion. In such a situation people have a tendency to push both up and down buttons resulting into deterioration of the lift service.

If basement floors are served by only a part of a lift group, passengers experience difficulty in selecting the correct lifts out of a group that will serve the basement. It is therefore better to provide basement service to the main lobby by a separate group of 'shuttle' lifts so as to avoid compromising the traffic handling capability of the main lift group.

4.3.3 *Multiple Entry Levels*

Some buildings have main entry points at more than one level. The effect of more than one main terminal is disruptive and adversely impacts effective circulation and movement. If there are more than one entrance levels, means should be provided to bring all the routes to a single terminal floor. If this is not possible, then the lift system planning should take into account the extra times incurred stopping and loading at multiple entry floors. Another difficulty is in deciding whether the building population will use each entrance equally. In the absence of any guidance, the solution is to assume an entrance bias with an additional 10 percent and size the lifts to meet the additional required handling capacity.

The loss of lift efficiency because of multiple entry levels could be as high as 15 percent per additional entry level. Both basement service and multiple entry level buildings with lifts serving all floors also can impact the security of the building.

4.3.4 *Non-Smoking Buildings*

When buildings are defined as non-smoking buildings, designers need to factor in the additional load put on the lifts on account of the additional trips that smokers make to go outside the building. It is appropriate to provide pressurized smoking zones at the floor level rather than require smokers to make additional trips.

4.3.5 *Reserved Lifts*

When lifts have to be reserved for VIP personal movement, designers should not consider these lifts as part of the lift group.

4.3.6 *Zoning (Vertical)/Sky Lobbies in Very Tall Buildings*

As the number of floors served increases, the values of H and S also increase, adversely impacting the round trip time and performance of the lift system. This has led to the concept of zoning in tall buildings. In stacked zoning, a tall building is effectively divided into horizontal layers or stacks. RTT, quality and quantity of service can be arrived at separately for each zone. The desired level of service can be attained by adjusting two parameters in this case – the number of lifts and the number of floors in the zone. The round trip time for each zone is given by:

$$RTT = 2Ht_v + (S+1)(T-t_v) + 2Pt_p + 2[t_{express} - t_f(1)]$$

where $t_{express}$ is the flight time from the main terminal to the express zone terminal/ sky lobby.

The round trip time for shuttle lifts serving only 2 floors – main terminal and sky lobby is given by:

$$RTT = 2T + 2Pt_p$$

4.4 Planning For Specific Building Types

4.4.1 *Residential Buildings*

The peak traffic condition occurs during the morning down-peak when many adults and children are leaving for work and school at the same time. Population assumptions would also need to consider the service staff, drivers of cars, etc. For high rise buildings the delivery of newspapers and milk and disposal of garbage also requires to be considered.

In the luxury housing segment, where the number of ratio of service staff to residents is fairly high, separate service lifts may be required for door deliveries and service staff. Typical average daily population for a residential building is given in Table 7.

Table 7 Typical Average Population for Residential Buildings
(*Clause* 4.4.1)

Sl No.	Type of Apartment	Number of Bedrooms Per Apartment				
		1	2	3	3 With Servant Quarters	4 With or Without Servant Quarters
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	*High end apartments:*					
	a) Residents	2 to 3	3 to 4	5	5	5 to 6
	b) Resident service staff	0	0	0	1	1
	c) Floating service staff	1	2 to 3	3 to 4	3 to 4	4 to 5
ii)	*Mid end apartments:*					
	a) Residents	3	4	5	5	5 to 6
	b) Resident service staff	0	0	0	1	1
	c) Floating service staff	1	1	2 to 3	2 to 3	3 to 4
iii)	*Low end apartments:*					
	a) Residents	4 to 5	5 to 6	NA	NA	NA
	b) Floating service staff	0.5	0.5	NA	NA	NA

NOTE – Unless separate lifts are provided for service staff, due consideration for service staff shall be given while calculating the required number of lifts.

The passenger handling capacity shall be as given in Table 8. The target handling capacity for residential building is lowered as compared to office building with a understanding that the traffic for residential building would be comparatively less. It shall be noted that the absenteeism factor does not apply to residential buildings. The intervals shall be as per values in Table 9. Table 10 gives the recommended quality of service measured as average waiting time for residential buildings and Table 11 gives the nominal travel times.

Sizing of lifts should consider the requirement to shift the stretchers, heavy material, etc and it is recommended that at least one lift in each building should be a deep car which can accommodate a regular ambulance stretcher.

Table 8 Recommended Handling Capacity for Residential Buildings
(*Clause* 4.4.1)

Sl No.	Class of Building	Handling Capacity Percent
(1)	(2)	(3)
i)	High end building	> 8
ii)	Mid end building	6 to 8
iii)	Low end building	5 to 7

Table 9 Recommended Quality of Service for Residential Buildings (Based on Time Interval)
(*Clause* 4.4.1)

Sl No.	Class of Building	Interval s
(1)	(2)	(3)
i)	High end building	≤ 60
ii)	Mid end building	61 to 80
iii)	Low end building	81 to 100

Table 10 Recommended Quality of Service in Residential Buildings (Based on Average Waiting Time)
(*Clause* 4.4.1)

Sl No.	Class of Building	Average Waiting Time s
(1)	(2)	(3)
i)	High end building	≤ 30
ii)	Mid end building	31 to 45
iii)	Low end building	46 to 60

Table 11 Recommended Nominal Travel Time for Residential Buildings
(*Clause* 4.4.1)

Sl No.	Level	Nominal Travel Time s
(1)	(2)	(3)
i)	High end building	25 to 35
ii)	Mid end building	36 to 45
iii)	Low end building	46 to 60

NOTE – In case of super tall buildings considering limit of lift speed 10 m/s, the travel time may be longer than specified above.

4.4.2 *Service Apartments & Hostel*

Average population as 2 to 3 person per flat/room can be considered. The quantity and quality of service can be considered as per high end residential building.

4.4.3 *Hospitals*

Factors to be considered include number of staff and shift patterns, number of visitors and visiting hours, location of operation theatres, facilities, delivery of housekeeping supplies, waste disposal, evacuation procedures and segregation of sterile areas. When carrying out traffic analysis for hospitals, designers should consider establishing average car loading by volume rather than by weight. Arrival rates may approximate 10 percent to 15 percent and interval may be 30 s to 50 s.

The number of lifts for hospitals with in-patients shall be adequate to ensure that at least 50 percent patients on beds can be evacuated in reasonable time.

The sizing of the lift car and doors should be such that a standard hospital stretcher and attendant can be easily accommodated. Where the hospital bed is likely to be moved the lift car should be able to accommodate the standard hospital bed including the auxiliary support equipment like oxygen cylinders, etc.

In addition to passenger lifts, service lifts would be required for the movement of housekeeping staff, catering, etc. Dedicated service lift is may be considered for movement of medical waste, garbage, etc.

In large hospitals, it is recommended that the lifts for the patients/hospital beds (or stretchers) should be separated from the lifts for staff/visitors.

NOTE – For hospital buildings, designers should also consider that in an emergency a number of patients would require to be evacuated on stretchers.

4.4.4 *Hotels*

4.4.4.1 The most demanding time is during the check-in and check-out period and two-way traffic occurs during this period with guests going to and from rooms and restaurants and in and out of the hotel. Calculations should be made assuming an equal number of up and down stops during this period. Average room occupancy may range from 1.5 to 2 persons and arrival rates from 10 to 15 percent.

a) Handling capacity > 12 percent.
b) Interval should < 40 s.
c) Average waiting time : 30 to 40 s (Peak check-in / checkout time)

4.4.4.2 Security considerations need to be taken into account whilst establishing the circulation and lift requirements. Escalators should be employed for heavy short range movements such as from the lobby to banquet/ function level. Adequate number of service lifts need to be provided for service movement of housekeeping and room

service staff as well as movement of material. Way finding signage shall be helpful to locate lift lobby for guest.

4.4.5 *Retail – Malls with Multiplexes*

Pedestrian movement in retail establishments like malls is generally centered on escalators, and lifts do not play a major part. However, provision should be made for movement of shopping trolleys, wheel chairs, perambulators and persons with limited mobility from one level to another. A commonly applied solution is the installation of inclined moving walks. Where lifts are provided, assumptions of lift car sizing should take into account space occupied by trolleys and shopping bags. Where multiplexes are located on the upper floors, the last movie of the day gets over after the mall is closed at which time the escalators might not be available. In such cases the lift provision has to be adequate to handle the egress of the total multiplex population with recommended average waiting time shall be below 40 seconds catering to a demand population of a minimum of 8 percent for 1/3rd of total screens or exiting at different intervals. The staircase factor can be considered for a simulation model.

4.4.6 *Airports/Railway Stations*

While moving walks and escalators greatly improve the building circulation, the use of lifts has to be considered for persons with limited mobility and for movement of baggage trolleys from one level to another. The RTT equation of **4.2.5** may be used, but care may need to be taken in the assumptions of lift car occupancy levels taking into account space occupied by trolleys.

4.4.7 *Multi-Level Car Parking*

Multi-level car parks may be standalone public car parks or attached to office, retail or residential complexes. These car parks may be fully automated where drivers would leave the cars inside or on a trolley at the entry floor and the car is parked and retrieved automatically. The other alternative would be for the use of car lifts and/or ramps.

When the movement of the cars is dependent on car lifts, detailed study has to be carried out to establish the required number of car lifts ensuring that average car retrieval/parking time does not exceed 2 min. The sizing of the car lifts has to be adequate to fit the largest vehicle that is intended to be transported as well as adequate space to enable opening of the doors to enable evacuation of passengers in the eventuality of an entrapment. Designers will also need to take into account the probability of queues developing and provide for holding lanes. For luxury / high end residential buildings the car parking provision may exceed the total resident count of building. Where there are no separate shuttle lifts for parking floors, designer need to consider the movement of drivers in passenger lifts. When parking count exceeds the count of residents, the entrance bias shall be calculated with assumption of certain percentage of total parking from each entry level.

4.4.8 *Multi-Level Car Parking Passenger Traffic*

When car lifts or ramps are the means for parking the cars, then means would need to be provided for the movement of passengers from and to the parking floors. If the main building lifts also serve the parking floors, it is to be noted that, performance will be adversely impacted due to multiple entry floors. Additional entry floors will also affect the security of the building. It is therefore recommended that separate lifts should be considered to move passengers. If separate parking lifts are provided, the basic RTT equation of **4.2.5** may be used. Average vehicle occupancy may be considered as 1.5 per car for office car parks, 4 for airports and retail and 2 elsewhere.

4.4.9 *Schools and Other Educational Institutions*

In schools and other educational institutions, the traffic flow would consist of peak demand for short duration that would exist just before the start or after finishing of a class or lecture. It is unlikely that an economical solution can be implemented for such high peak requirements. Therefore, the design of the building has to be such that heavy stair usage is facilitated. Mostly for college building demand time would be before and after each lecture / tutorial or seminar, lifts shall be designed to cater the demand population of 12 percent to 15 percent with an interval of 30 to 50 seconds. Staircase factor can be considered for a simulation model.

4.4.10 *Data Centre*

Building population for data centre is usually low, however data centre has requirement freight lifts. The design of freight lift shall be based on the input from architect / owner on the class of loading, dimension details & weight of equipment to be taken from freight lifts.

4.4.11 *Buildings with 24 x 7 Operations*

In buildings operating 24 x 7 (round the clock), the peak traffic conditions would not be a typical up peak but will occur during shift changes. The handling capacity should take into account the incoming as well as outgoing traffic. Calculations shall be made assuming both up and down stops during this period. Particular attention should be paid while designating the drop off points, these should be assigned to a level so as to not increase the burden on the system. Designers need to consider that the lifts in such buildings would have a significantly higher number of starts/stops per hour than a conventional building.

4.4.12 *Observatory*

The height at which the observatory is located and the number of people expected at the observatory level shall decide the speed and the number of lifts. The circulation logic is crucial in locating the observatory lifts. Also, if the observatory is connected with lounge/café/souvenir shops and others separate service lifts may need to be provided.

4.5 Other Considerations

Designers need to be aware that the door opening and closing times, acceleration and deceleration times, etc, would vary between suppliers and equipment types and can impact the overall lift performance. The dispatch algorithms and controller responses would also vary between the suppliers and the equipment types and can impact the actual operational results.

Lifts will breakdown as well require to be shut-down for regular maintenance and repairs. Lift availability might be hampered during renovation of the building as a lift might be taken up for movement of material and debris. Designers should take into consideration the impact of such non-availability of lifts. The provision of well-located and easily accessible stairs can considerably lessen the demands on the lifts and therefore architect/engineer should consider this aspect in the layout.

4.5.1 *Lift Speed*

For passenger lifts in a building, the general recommendations as given in Table 12 may be followed.

Table 12 Lift Speed
(*Clause* 4.5.1)

Sl No. (1)	**No. of Floors** (2)	**Speed** m/s (3)
i)	Up to 6	0.6 to 1.0
ii)	7 to 15	1.0 to 1.5
iii)	16 to 20	1.5 to 1.75
iv)	21 to 30	1.75 to 2.5
v)	31 to 45	3.0 to 4.0
vi)	46 to 60	4.0 to 6.0
vii)	Above 60	6.0 and above

NOTES

1 Above table is considering buildings with average floor height of 3.0 m.
2 For office buildings average floor height is 4.2 m (*see* Table 6 and Table 11).
3 Finalizing the lift speed for any building depends on detailed traffic analysis because number of floors, area per floor, area per person and class of building are crucial factors, which serve as inputs for such traffic analysis.
4 Finalizing the speed for hotel depends on the number of keys per floor and similarly for an observatory depends on the number of expected footfall.
5 For any building, the speed of the lifts will have to be validated against the total population and travel height of the building.

4.5.2 *Quiet Operation of Lifts*

Every precaution should be taken with passenger lifts to ensure quiet operation of the lift doors and machinery. The insulating of the lift machine and any motor generator from the floor by rubber cushions or by a precast concrete slab with rubber cushions, prevents transmission of most of the noise. In this connection, see also good practice [8-5A(4)] and Part 8 'Building Services, Section 4 Acoustics, Sound Insulation and Noise Control' of the Code for some useful recommendations.

5 LIFT ARRANGEMENTS AND PLANNING DIMENSIONS

The appropriate aspect of lift installation shall be discussed during the preliminary planning of the building with all concerned parties, namely, client, architect, consulting engineer and/or lift manufacturer. This enables the lift manufacturer to furnish the architect and/or consulting engineer with the proposed layout or *vice-versa*.

5.1 Exchange of Information

5.1.1 The guidelines laid down together with Fig. 2 will enable the preliminary scheme for the installation to be established. Figure 2 shows only some of the typical arrangements and variations are possible with respect to number of lifts and the layout of lifts especially when destination control system (DCS) is used instead of conventional group control system

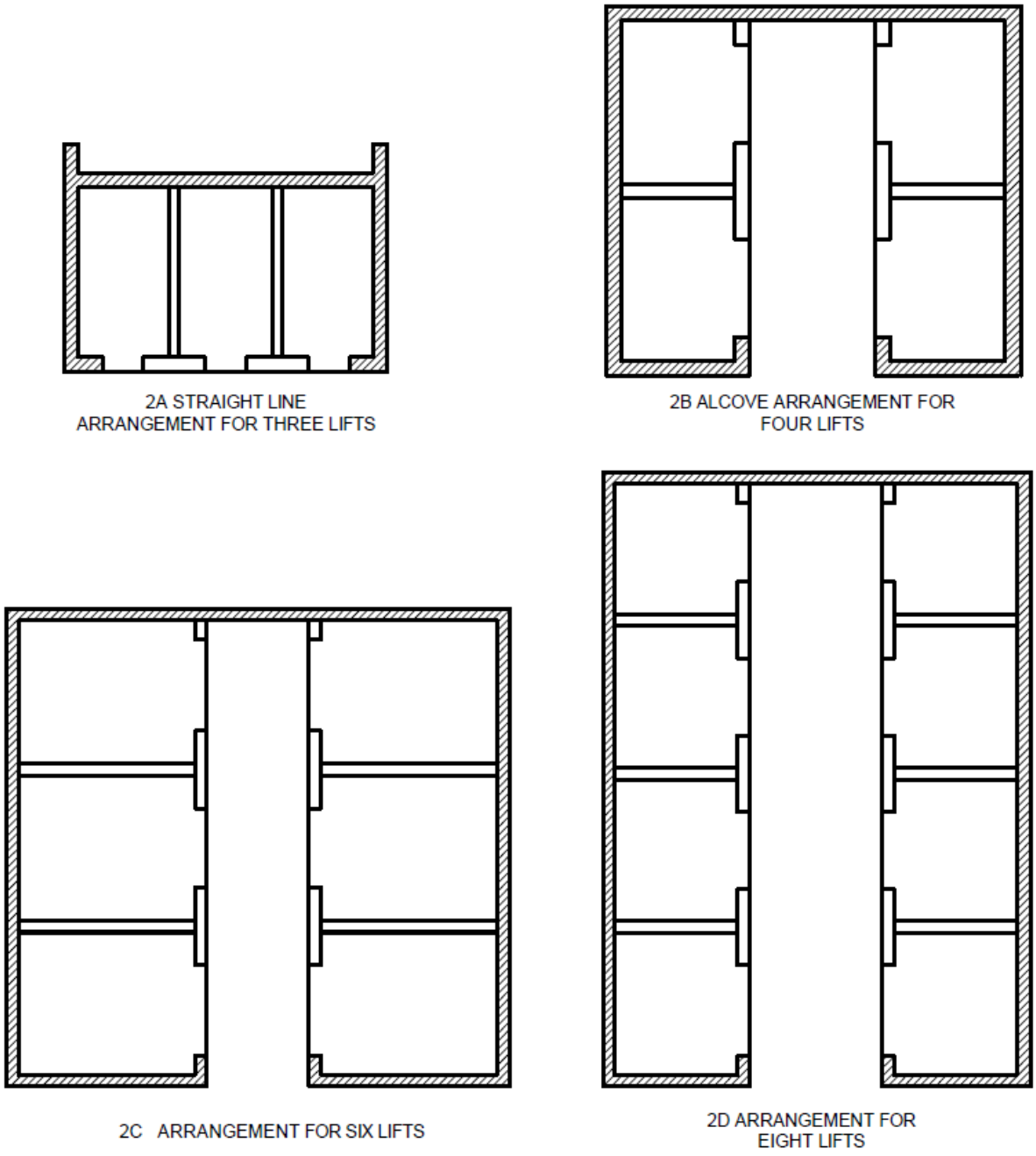


FIG. 2 TYPICAL ARRANGEMENT OF LIFTS

Although the recommended outline for the various classes of lifts enable the general planning details to be determined by the architect/engineer, these should be finally settled at the earliest possible stage by detailed investigation with the purchaser's representative reaching agreement with the lift manufacturer (where necessary) before an order is finally placed. This will enable a check to be made and information to be exchanged on vital matters such as:

a) Number, capacity, speed and disposition of the lifts necessary to give adequate lift service in the proposed building;

b) Provision of adequate access to the machine room;
c) Loads which the lift will impose on the building structure, and the holes to be left in the machine room floor and cut-outs for wall boxes for push-buttons and signals;
d) Necessity for and type of insulation to minimize the transmission of vibration and noise to other parts of the building;
e) Special requirements of local authorities and other requirements set out in the 'planning permit';
f) Need for the builder to maintain accuracy of building as to dimensions and in-plumb;
g) Periods of time required for preparation and approval of relevant drawings for manufacturing and the installation of the lift equipment;
h) Requirements for fixing guide brackets to the building structure;
j) Time at which electric power will be required before completion to allow for testing;
k) Requirements for electrical supply feeders, etc;
m) Requirements for scaffolding in the lift well and protection of the lift well prior to and during installation of equipment; and
n) Delivery and storage of equipment.

5.1.2 *Information to be provided by Architect or Engineer*

As a result of preliminary discussions, the drawings of the building should give the following particulars and finished sizes:

a) Number, type and size of lifts and position of lift well;
b) Particulars of lift well enclosure;
c) Size, position, number and type of landing doors;
d) Number of floors served by the lift;
e) Height between floor levels;
f) Number of entrances;
g) Total headroom;
h) Provision of access to machine room;
j) Provision of ventilation and, if possible, natural lighting of machine room;
k) Height of machine room;
m) Depth of lift pit;
n) Position of lift machine, above or below lift well;
p) Size and position of any trimmer joists or stanchions adjacent to the lift well at each floor;
q) Size and position or supporting steel work at roof levels;
r) Size and position of any footings or grillage foundations, if these are adjacent to the lift pit; and
s) In the case of passenger lifts whether the lift cage is required to carry household luggage, such as refrigerator, steel almirah, etc.

5.2 The lift lobby should be designed appropriately since this has bearing on the traffic handling especially when more number of lifts are involved. In a dual line arrangement (lifts opposite to each other) the lobby should be between 1.5 times and 2.5 times the

depth of one car. Typically, the greater the number of lifts, the bigger the multiplier to be used. As an example, a quadruplex may use 1.5 to 2, where as an octoplex will need 2 to 2.5. For in-line (single line) arrangements, the lobby can be typically half of the above recommendations.

It is preferable that the lift lobby is not used as a thoroughfare. If unavoidable the lift corridor shall take into account space for people who are moving.

5.3 The architect/engineer should advise the lift manufacturer, if the Authority has any special requirements regarding lifts in buildings in the administrative area concerned.

5.4 The architect/engineer should inform the lift manufacturer of the dates when the erection of the lift may be commenced and is to be completed so that sufficient time is allowed for the manufacture and erection of the lift.

5.5 When submitting application for a building permit to the local Authority, the building plans shall include the details of lifts (number of lifts duly numbered, location, type, type of doors, passenger capacity and speed).

5.6 Positioning of Lifts

A thorough investigation should be made for assessing the most suitable position for lift(s) while planning the building. It should take into account future expansions, if any. Though each building has to be considered individually for purposes of location of lifts, factors influencing the locations of passenger and goods lifts are given in **5.6.2** to **5.6.4.**

5.6.1 *Arrangement of Lifts*

The lifts should be easily accessible from all entrances to the building. For maximum efficiency, they should be grouped near the centre of the building. It is preferable not to have all the lifts out in straight line and, if possible, not more than four lifts should be arranged in this manner. If more than 4 lifts have to be grouped together in a straight line, then destination control systems would require to adopted. Further, the corridor should be wide enough to allow sufficient space for waiting passengers as well as for through passengers.

In some cases when there are more than three lifts, the alcove arrangement is recommended. With this arrangement, the lift alcove leads off the main corridor so that there is no interference by traffic to other groups or to other parts of the ground floor. This arrangement permits the narrowest possible corridors and saves space on the upper floors. Walking distance to the individual lift is reduced and passenger standing in the centre of the group can readily see all the lift doors and landing indicators. The ideal arrangement of the lifts depends upon the particular layout of the respective building and should be determined in every individual case. Some typical recommended arrangements are given in Fig. 2.

5.6.2 *Passenger Lifts*

5.6.2.1 *Low and medium class flats*

Where a lift is arranged to serve two, three or four flats per floor, the lift may be placed adjoining a staircase, with the lift entrances serving direct on to the landings. Where the lift is to serve a considerable number of flats having access to balconies or corridors, it may be conveniently placed in a well-ventilated tower adjoining the building.

5.6.2.2 *Office buildings, hotels and high-class flats*

In general, the arrangement as recommended in **5.6.1** should be followed. However, in case this is not possible, it is desirable to have at least a battery of two lifts at two or more convenient points of a building. If this is not possible, it is advisable to have at least two lifts side by side at the main entrance and one lift each at different sections of the building for inter-communication. When two lifts are installed side by side, the machine room shall be suitably planned with sufficient space for housing the machine equipment. The positioning of lifts side by side gives the following advantages:

a) All machines and switch gear may be housed in one machine room,
b) Lifts can be inter-connected more conveniently from an installation point of view, and
c) Greater convenience in service owing to the landing openings and each floor being adjacent.

5.6.2.3 *Shops and departmental stores*

Lifts in shops and stores should be situated so as to secure convenient and easy access at each floor.

5.6.2.4 For buildings with more than 12 floors, where passenger and service lifts are provided in one lobby, it is recommended to have group control for all the lifts.

5.6.3 *Goods Lifts*

The location of lifts in factories, warehouses and similar buildings should be planned to suit the progressive movement of goods throughout the buildings, having regard to the nature of position of the loading platforms, railway sidings, etc. The placing of a lift in a fume or dust laden atmosphere or where it may be exposed to extreme temperatures, should be avoided, wherever possible. Where it is impossible to avoid installing a lift in an adverse atmosphere, the electrical equipment should be of suitable design and construction to meet the conditions involved.

Normally goods lifts have lower speeds than passenger lifts for the same travel because traffic conditions are less demanding, and more time is required for loading and unloading. As loads for goods lifts increase in size and weight, so the operation

of loading and unloading becomes more difficult. Therefore, it is usual to require greater accuracy of levelling as the capacity of the goods lift increases.

A large capacity goods lift operating at high speed is often a very uneconomical solution. The inherent high cost is enhanced due to the very small demand for such equipment, much of which is custom made. The high capital cost of the lift, building work and electrical supply equipment usually shows a much smaller return as an investment than more normal sizes of lifts.

5.6.4 *Hospital Bed Lifts*

Hospital bed lifts should be situated conveniently near the ward and operating theatre entrances. There shall be sufficient space near the landing door for easy movement of stretcher/bed. It is convenient to place the passenger lifts in a hospital, near the staircases.

5.7 General Arrangement Drawings (GAD)

The general arrangement drawings should be prepared by the lift manufacturer. The lift manufacturer requires sufficient information for the preparation of working drawings and is usually obtained from architect's drawings supplemented by any information obtained from the site and by collaboration with the other contractors.

General arrangement drawings showing the layout of lifts duly numbered, details of builders work, for example, holes in walls for guide fixing, holes in machine room floor for ropes and conduits, recesses for landing sills, supports for lift machine and loads imposed on the building should be submitted by the lift manufacturer to the architect/engineer for written approval.

5.8 Additional Requirements for Passenger, Goods and Service Lifts

5.8.1 *Bottom Car Clearance*

When the car rests on its fully compressed buffer there shall be a vertical clearance of not less than 600 mm between the pit floor and the buffer striker plate or the lowest structural or mechanical part equipment or device installed. The clearance shall be available beneath the whole area of the platform except for,

a) guide shoes or rollers, safety jaw blocks, platform aprons, guards of other equipment located within 300 mm measured horizontally from the sides of the car platform; and
b) compensating sheaves.

Provided that in all the cases, including small cars, a minimum clearance of 600 mm is available over a horizontal area of 800 mm x 500 mm.

Provided also that in all the cases, when the car rests on its fully compressed buffers, there shall be a vertical clearance of not less than 50 mm between any part of the car and any obstruction of device mounted in the pit.

5.8.2 *Top Car Clearance*

The vertical clearance between the car cross-head and the nearest overhead obstruction within 500 mm measured horizontally to the nearest part of the crosshead when the car platform is level with the top landing, shall be not less than the sum of the following:

a) Bottom counterweight run-by.
b) Stroke of the counterweight buffer used.
c) One-half of the gravity stopping distance based on,

1) 115 percent of the rated speed where oil buffers are used and no provision is made to prevent the jump of the car at counterweight buffer engagement; and
2) Governor tripping speed where spring buffers are used.

NOTE — The gravity stopping distance based on the gravity retardation from any initial velocity may be calculated according to the following formula

$$S = 51\ V^2$$

where
S = free fall, in mm (gravity stopping distance), and
V = initial velocity, in m/s.

d) 600 mm.

Where there is a projection below the ceiling of the well and the projection is more than 500 mm, measured horizontally from the centre line of the cross-head but over the roof of the car, a minimum vertical clearance not less than that calculated above shall also be available between the roof of the car and the projection.

Provided that the vertical clearance between any equipment mounted on top of the car and the nearest overhead obstruction shall be not less than the sum of the three items (a), (b) and (c) as calculated above plus 150 mm.

5.8.3 *Bottom Run-by for Cars and Counterweights*

The bottom run-by of cars and counterweights shall be not less than the following:

a) 150 mm, where oil buffers are used.
b) Where spring-buffers are used;

1) 150 mm for controls as in **2.1.11.4** to **2.1.11.8**, and
2) Not less than the following for controls as in **2.1.11.1** to **2.1.11.3**:

Rated Speed m/s	*Run-by* mm
Up to 0.125	75
0.125 to 0.25	150
0.25 to 0.50	225
0.50 to 1	300

5.8.4 *Maximum Bottom Run-by*

In no case shall the maximum bottom run-by exceed the following:

a) 600 mm for cars; and
b) 900 mm for counterweights.

5.8.5 *Top Counterweight Clearances*

The top counterweight clearance shall be not less than the sum of the following four items:

a) Bottom car run-by.
b) Stroke of the car buffer used.
c) 150 mm.
d) One-half the gravity stopping distance based on,

    1) 115 percent of the rated speed where oil buffers are used and no provision is made to prevent jump of the counterweight at car buffer engagement; and
    2) Governor tripping speed where spring buffers are used.

5.9 Additional Requirements for Dumb Waiters

5.9.1 *Top Car Clearance*

The top car clearance shall be sufficient to avoid any protruding part fixed on the top of the car coming in direct contact with the ceiling or diverting sheave.

The clearance shall be calculated taking into account the following and shall not be less than the sum of the following four items:

a) Bottom counterweight run-by.
b) Stroke of the counterweight buffer used.
c) Dimensions of the portion of the diverting sheave hanging underneath the ceiling in the lift well.
d) 150 mm for compensating for gravity stopping distance and future repairs to the rope connections at counterweight and at the car or at the suspension points.

5.9.2 *Bottom Car Clearance*

The bottom car clearance shall be maintained in such a way that the counterweight shall not come in contact with the ceiling or any part hanging underneath the ceiling, when the car completely rests on fully compressed buffers, provided the buffers are spring type mounted on solid concrete or steel bed.

In case of wooden buffers the bottom car clearance shall be maintained in such a way that the total downward travel of the car from the service level of the immediate floor near the pit, shall not be more than the top counterweight clearance, when the wooden buffers are completely crushed.

5.9.3 *Top Counterweight Clearance*

The top clearance for the counterweight can be calculated taking into account the following and shall not be less than the sum of the following three items:

a) Car run-by.
b) Compression of the buffer spring or height of the wooden block used as buffer.
c) 150 mm to compensate for gravity stopping distance for counterweight and any future repairs to rope connections at the counterweight at the car ends or at the suspension points.

5.9.4 *Run-by for Cars and Counterweights*

a) *Minimum bottom run-by* – The bottom run-by for cars and counterweights shall not be less than 150 mm.
b) *Maximum bottom run-by* – In no case shall the maximum bottom run-by exceed 300 mm.

5.10 Planning for Dimensions

5.10.1 *General*

The dimensions of lift well have been chosen to accommodate the doors inside the well which is the normal practice. In special cases, the door may be accommodated in a recess in the front wall, for which prior consultation shall be made with the lift manufacturer.

5.10.2 *Plan Dimensions*

All plan dimensions of lift well given hereunder, are the minimum clear plumb sizes. The architect/engineer, in conjunction with the builder, shall ensure that adequate tolerances are included in the building design so that the specified minimum clear plumb dimensions are obtained in the finished work.

NOTE – The words 'clear plumb dimensions' should be noted particularly in case of high rise buildings.

Rough opening in concrete or brick walls to accommodate landing doors depend on design of architrave. It is advisable to provide sufficient allowances in rough opening width to allow for alignment errors of opening at various landings. When more than one lift is located in a common well, a minimum allowance of 150 mm for separator beams shall be made in the widths shown in Tables 1 to 4.

Where the governor operated counterweight safety is required under conditions stipulated in good practice [8-5A(5)], the tabular values should be revised in consultation with the lift manufacturer.

For outline dimensions of lifts having more than one car entrance, lift manufacturers shall be consulted.

5.10.3 *Outline Dimensions*

5.10.3.1 The outline dimensions of lift shaft, machine-room, pit depth, overhead and raw door opening size for lifts to which this Subsection applies are specified in Tables 13 to 24 as indicated below:

a) Machine room lifts:

1) Recommended dimensions of passenger lifts and service lifts	Table 13
2) Recommended dimensions of hospital bed/stretcher lifts	Table 14
3) Recommended dimensions of goods lifts with machine room	Table 15
4) Recommended dimensions of machine room height, overhead, pit depth for passenger, goods, stretcher/hospital lifts with machine room	Table 16
5) Recommended dimensions of automobile lifts with machine room - Through type car	Table 17
6) Recommended dimensions of dumbwaiter lifts	Table 18

b) Machine room-less lifts:

1) Recommended dimensions of passenger lifts MRL	Table 19
2) Recommended dimensions of stretcher/hospital lifts MRL	Table 20
3) Pit depth for passenger/stretcher/hospital lifts MRL	Table 21
4) Overhead height for passenger and stretcher/hospital lifts MRL	Table 22
5) Recommended dimensions of goods lifts MRL	Table 23

6)	Recommended dimensions of automobile lifts MRL	Table 24

5.10.3.2 *Minimum floor to floor height*

Minimum floor to floor height for landings on same side for horizontally sliding door is *f* +750 mm, where '*f*' is clear entrance height, in mm.

Table 13 Recommended Dimensions of Passenger Lifts and Service Lifts
(*Clause* 5.10.3.1)
All dimensions in millimetres.

Fig.

Sl No.	No. of Passengers	Rated Load	Car Size		COPD Door	Passenger and Service Lifts with Machine Room: Shaft Sizes													
						Rated speed < 1 m/s		1.0 m/s ≤ Rated Speed ≤ 2.5 m/s		3.0 m/s ≤ Rated Speed ≤ 3.5 m/s		4.0 m/s ≤ Rated Speed ≤ 5.0 m/s		Rated Speed = 6.0 m/s		7.0 m/s ≤ Rated Speed ≤ 8.0 m/s		9.0 m/s ≤ Rated Speed ≤ 10.0 m/s	
						Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size	
			Width	Depth	Width	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth
		kg																	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
i)	4	272	1 100	700	800	1 900	1 300	1 900	1 300										
ii)	6	408	1 100	1 000	800	1 900	1 700	1 900	1 700										
iii)	8	544	1 300	1 100	800	1 900	1 900	1 900	1 900										
iv)	10	680	1 300	1 350	800	1 900	2 150	1 900	2 150										
v)	13	884	2 000	1 100	900	2 600	1 900	2 600	1 900										
vi)	14	952	1 600	1 400	900	2 200	2 100	2 200	2 100	2 200	2 150	2 250	2 150	2 250	2 250	2 300	2 300	2 300	2 450
vii)	16	1 088	1 600	1 600	1 000	2 300	2 300	2 300	2 300	2 300	2 350	2 300	2 350	2 300	2 450	2 300	2 500	2 300	2 650
viii)	18	1 224	2 000	1 400	1 100			2 600	2 100	2 600	2 150	2 600	2 150	2 600	2 250	2 700	2 300	2 700	2 450
ix)	20	1 360	2 000	1 500	1 100			2 600	2 100	2 600	2 250	2 600	2 250	2 600	2 350	2 700	2 400	2 700	2 550
x)	22	1 496	2 100	1 600	1 100			2 700	2 300	2 700	2 350	2 700	2 350	2 700	2 450	2 800	2 500	2 800	2 550
xi)	26	1 768	2 350	1 600	1 200			3 000	2 300	3 000	2 350	3 000	2 350	3 000	2 450	3 050	2 550	3 050	2 550
xii)	29	1 972	2 350	1 700	1 200					3 000	2 500	3 000	2 500	3 000	2 550	3 050	2 600	3 050	2 700

NOTES

1 All dimensions given above for lifts having centre opening power operated doors (COPD) with counterweight at rear, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed between the manufacturer and the purchaser are permitted. However, variation in,

a) car inside dimensions shall be within the minimum and maximum area limits specified in accordance with accepted standards [8-5A(6)].
b) entrance width on higher side is permitted.
c) entrance width on lower side is permitted up to 100 mm subject to minimum of 700 mm.

2 The minimum size of the lift car and all other requirements relating to accessibility, in all public buildings shall be in accordance with **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code.

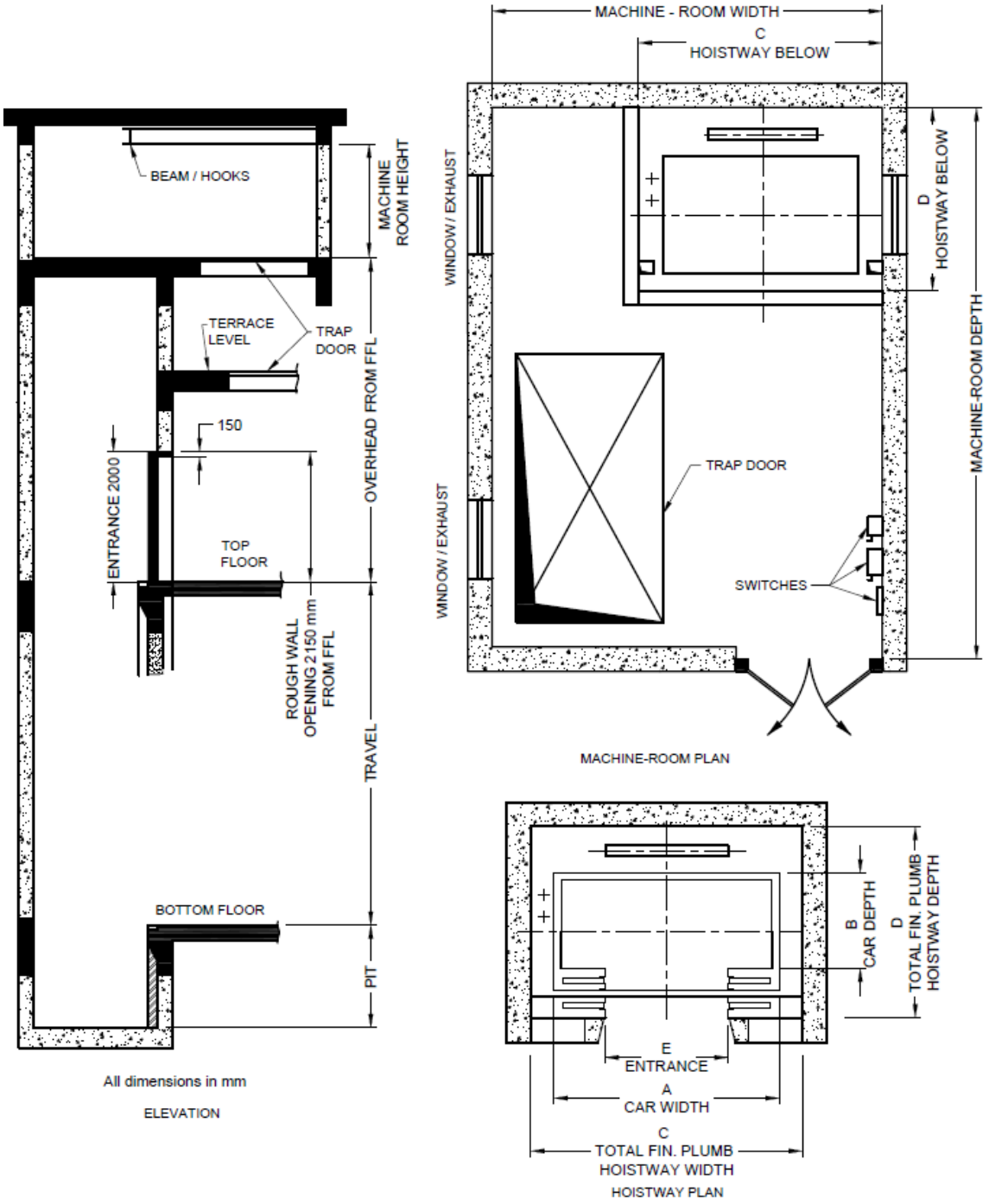


FIG. 3 UNDER TABLE 12 FOR PASSENGER LIFTS AND SERVICE LIFTS

Table 14 Recommended Dimensions of Stretcher/Hospital Lifts

All dimensions in millimetres.

(*Clause* 5.10.3.1)

Fig.

Sl No.	**No. of Passengers**	**Rated Load**	**Rounded off Rated Load**	**Car Size**		**2P TSPD Door**	**Hospital Bed / Stretcher Lifts with Machine Room: Shaft Sizes**													
							Rated Speed ≤ 1 m/s		0.6 m/s ≤ Rated Speed ≤ 2.5 m/s		3.0 m/s ≤ Rated Speed ≤ 3.5 m/s		4.0 m/s ≤ Rated Speed ≤ 5.0 m/s		Rated Speed = 6.0 m/s		7.0 m/s ≤ Rated Speed ≤ 8.0 m/s		9.0 m/s ≤ Rated Speed ≤ 10.0 m/s	
							Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size	
		kg	kg	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
i)	15	1 020		1 000	2 400	800	1 800	3 000	1 800	3 000										
ii)	20	1 360		1 300	2 400	1 200			2 300	3 000	2 350	3 000	2 350	3 000	2 350	3 000	2 500	3 000	2 500	3 000
iii)	26	1 768	1 800	1 400	2 550	1 200			2 500	3 050	2 500	3 050	2 500	3 050	2 500	3 050	2 600	3 150	2 650	3 150
iv)	29	1 972	2 000	1 500	2 700	1 400			2 650	3 200	2 600	3 200	2 600	3 200	2 600	3 200	2 700	3 200	2 700	3 200
v)	36	2 448	2 500	1 800	2 700	1 400			2 800	3 150	2 900	3 200	2 900	3 200	2 900	3 200	3 000	3 200	3 000	3 200

NOTES

1 All dimensions given above for lifts having two panel telescopic doors (2P TSPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, variation in:

a) car inside dimensions shall be within the maximum area limits specified in accordance with accepted standards [8-5A(6)].
b) entrance width on higher side is permitted.
c) entrance width on lower side is permitted up to 100 mm subject to minimum of 700 mm.

2 Car depth of 2 100 mm may be considered in residential/commercial buildings, where use of only ambulance stretcher is envisaged. The hoist-way depth maybe reduced accordingly.

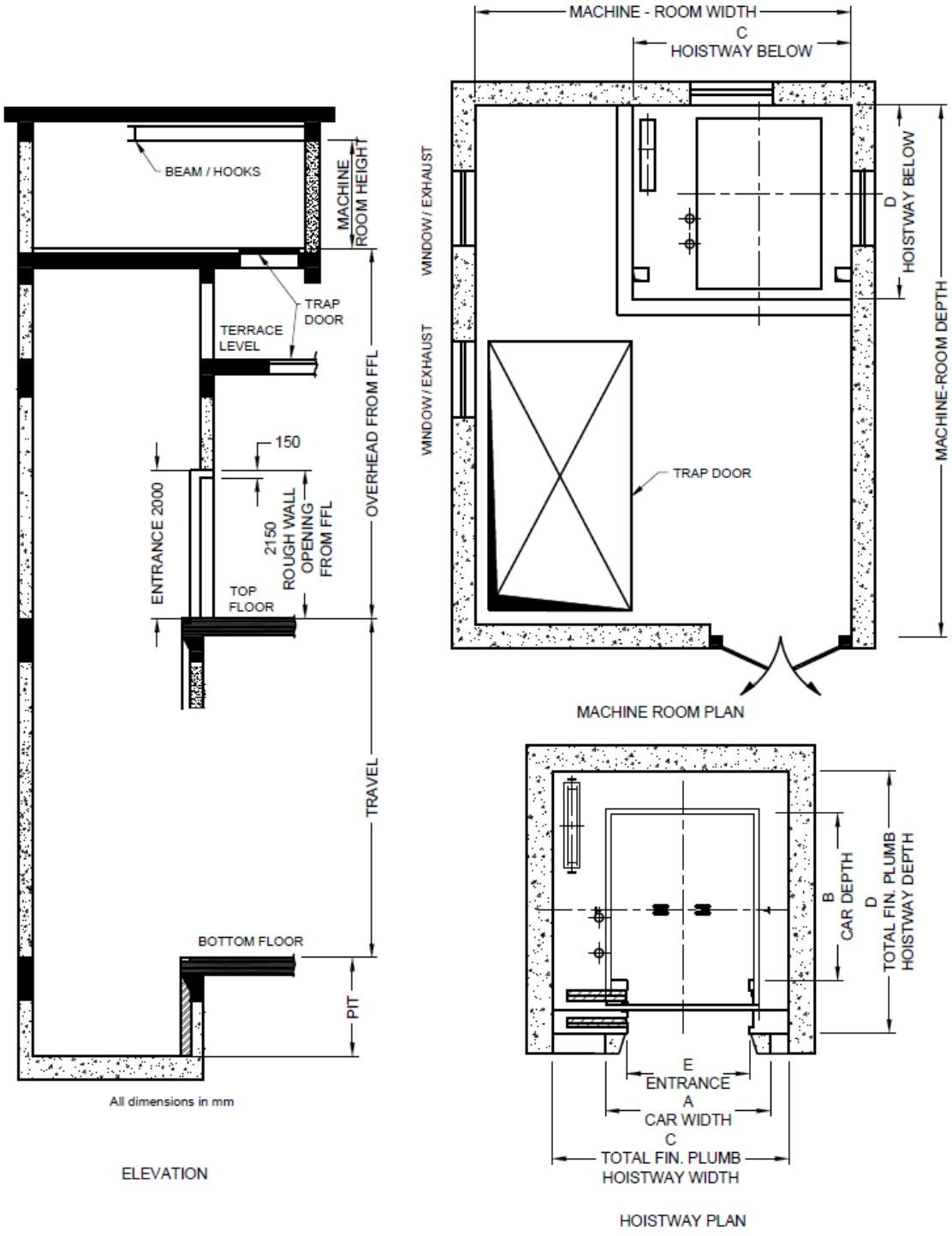


FIG. 4 UNDER TABLE 13 FOR STRETCHER/HOSPITAL LIFTS

Table 15 Recommended Dimensions of Goods Lifts with Machine Room

All dimensions are in millimetres.

(*Clause* 5.10.3.1)

Fig.

Sl No.	**Rated Load**	**Car Size**		**COPD Door**	**0.6 m/s ≤ Rated Speed ≤ 2.5 m/s**		**3.0 m/s ≤ Rated Speed ≤ 3.5 m/s**		**4.0 m/s ≤ Rated Speed ≤ 5.0 m/s**		**Rated Speed = 6.0 m/s**		**7.0 m/s ≤ Rated Speed ≤ 8.0 m/s**		**9.0 m/s ≤ Rated Speed ≤ 10.0 m/s**	
					Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size		Shaft Size	
	kg	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)	1 000	1 400	1 800	2P-tel-1200	2 300	2 350										
ii)	1 500	1 700	2 000	4P-1500	2 750	2 550										
iii)	2 000	1 700	2 500	4P-1500	2 800	3 050	2 800	3 050	2 900	3 050	3 000	3 050	3 000	3 050	3 000	3 050
iv)	2 500	2 000	2 500	4P-1700	3 000	3 050	3 000	3 050	3 100	3 050	3 200	3 050	3 200	3 050	3 200	3 050
v)	3 000	2 000	3 000	4P-1700	3 000	3 550	3 000	3 550	3 100	3 550	3 200	3 550	3 200	3 550	3 200	3 550
vi)	4 000	2 500	3 000	6P-2100	3 700	3 650	3 700	3 650								
vii)	5 000	2 500	3 600	6P-2100	3 850	4 250	3 850	4 250								

NOTE – All dimensions given above for lifts having centre opening power operated doors (COPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, the minimum rated load for the goods lift shall be based on a load of not less than 3.45 kN/m^2 of the net inside car area.

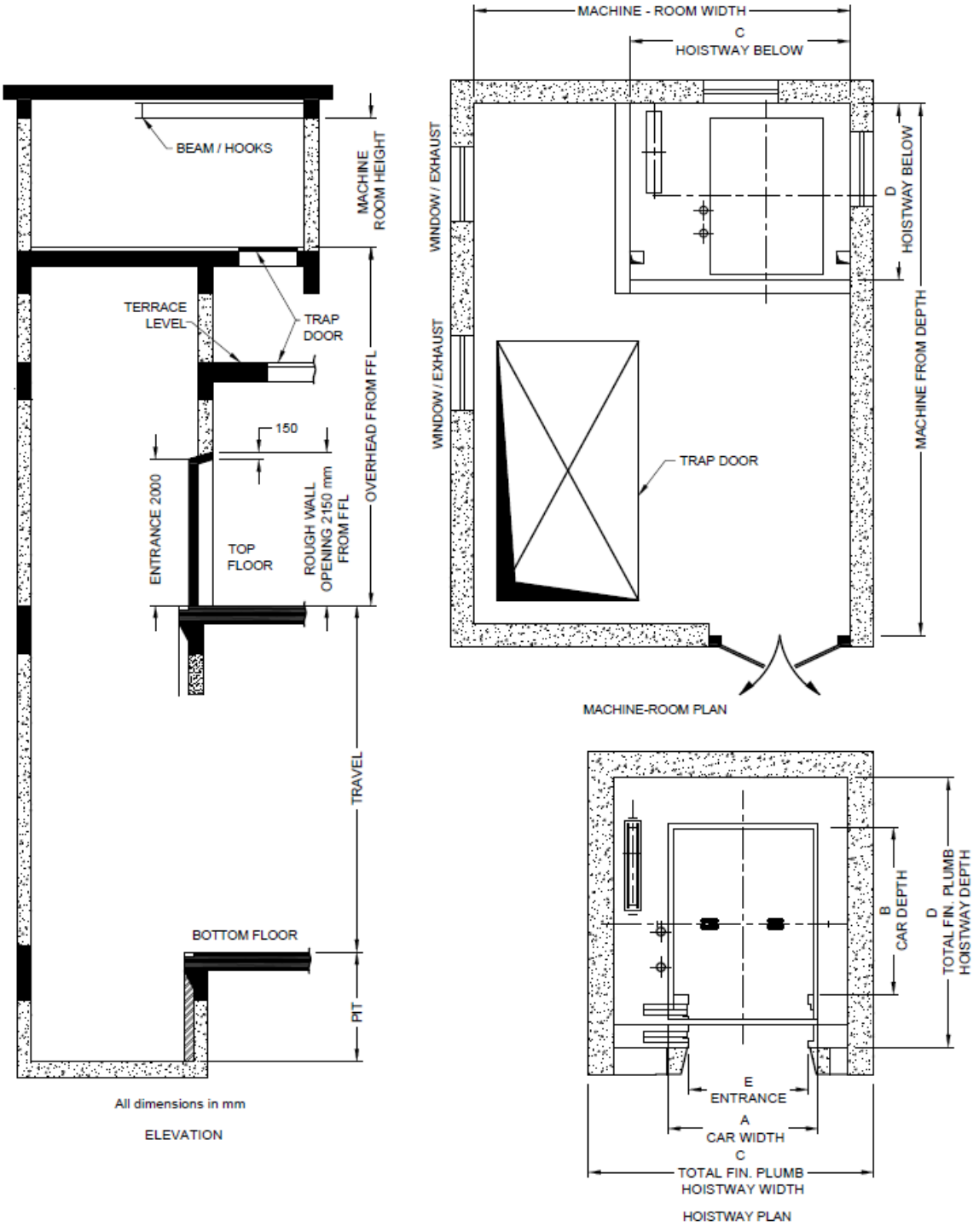


FIG. 5 UNDER TABLE 14 FOR GOODS LIFTS

Table 16 Recommended Dimensions of Machine Room Height, Overhead, Pit Depth for Passenger, Goods, Stretcher/Hospital Lifts with Machine Room

All dimensions are in millimetres.

(*Clause* 5.10.3.1)

For speed up to 3.5 m/s

Sl No.	No. of passengers	Rated Load	Dimensions of Pit Depth, Overhead Height (HR) and Machine Room Height (MR)																				
			0.7 m/s			1.0 m/s			1.6 m/s			2 m/s			2.5 m/s			3 m/s			3.5 m/s		
			Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR
		kg																					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
i)	4	272	1 350	CH + 1 900	2 500	1 500	CH + 1 950	2 500	1 600	CH + 2 400	2 500	2 200	CH + 2 800	2 500									
ii)	6	408	1 350	CH + 1 900	2 500	1 500	CH + 1 950	2 500	1 600	CH + 2 400	2 500	2 200	CH + 2 800	2 500									
iii)	8	544	1 350	CH + 1 900	2 500	1 500	CH + 1 950	2 500	1 600	CH + 2 400	2 500	2 200	CH + 2 800	2 500									
iv)	10	680	1 350	CH + 1 900	2 500	1 500	CH + 1 950	2 500	1 600	CH + 2 400	2 500	2 200	CH + 2 800	2 500									
v)	13	884	1 350	CH + 1 900	2 500	1 500	CH + 1 950	2 500	1 600	CH + 2 400	2 500	2 200	CH + 2 800	2 500									
vi)	14	952				1 500	CH + 1 950	2 500	1 800	CH + 2 400	2 500	2 200	CH + 2 800	2 500	2 500	CH + 3 000	2 500	3 000	CH + 3 000	3 000	4 500	CH + 3 450	3 000
vii)	16	1 088 / 1 000				1 500	CH + 1 950	2 500	1 800	CH + 2 400	2 500	2 200	CH + 2 800	2 500	2 500	CH + 3 000	2 500	3 000	CH + 3 000	3 000	4 500	CH + 3 450	3 000
viii)	18	1 224				1 500	CH + 1 950	2 500	1 800	CH + 2 400	2 500	2 200	CH + 2 800	2 500	2 500	CH + 3 000	2 500	3 000	CH + 3 000	3 000	4 500	CH + 3 450	3 000

Dimensions of Pit Depth, Overhead Height (HR) and Machine Room Height (MR)																							
Sl No.	**No. of passengers**	**Rated Load**	**0.7 m/s**			**1.0 m/s**			**1.6 m/s**			**2 m/s**			**2.5 m/s**			**3 m/s**			**3.5 m/s**		
			Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR
		kg																					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
ix)	20	1 360				1 500	CH + 1 950	2 500	1 800	CH + 2 400	2 500	2 200	CH + 2 800	2 500	2 500	CH + 3 000	3 000	3 000	CH + 3 000	3 000	4 500	CH + 3 450	3 000
x)	22	1 496 / 1 500				1 500	CH + 1 950	2 500	1 800	CH + 2 400	3 000	2 200	CH + 2 800	3 000	2 500	CH + 3 000	3 000	3 000	CH + 3 000	3 000	4 500	CH + 3 450	3 000
xi)	26	1 768				1 500	CH + 1 950	3 000	1 800	CH + 2 400	3 000	2 200	CH + 2 800	3 000	2 500	CH + 3 000	3 000	3 000	CH + 3 450	3 000	4 500	CH + 3 450	3 000
xii)	29	1 972 / 2 000				1 600	CH + 1 950	3 000	1 800	CH + 2 400	3 000	2 200	CH + 2 800	3 000	2 500	CH + 3 000	3 000	3 000	CH + 3 450	3 000	4 600	CH + 3 450	3 000
xiii)		2 500				1 800	CH + 1 950	4 000	1 800	CH + 2 400	4 000	2 200	CH + 2 800	4 000	2 500	CH + 3 000	4 000	3 000	CH + 3 450	4 000	4 600	CH + 3 450	4 000
xiv)		3 000				1 800	CH + 1 950	4 000	1 800	CH + 2 400	4 000	2 200	CH + 2 800	4 000	2 500	CH + 3 000	4 000	3 200	CH + 3 450	4 300	4 600	CH + 3 600	4 300
xv)		4 000				1 800	CH + 2 200	4 300	1 800	CH + 2 400	4 300	2 200	CH + 2 800	4 300	2 500	CH + 3 000	4 300	3 200	CH + 3 450	4 300	4 600	CH + 3 600	4 300
xvi)		5 000				1 800	CH + 2 200	4 500	1 800	CH + 2 400	4 500	2 200	CH + 2 800	4 500	2 500	CH + 3 000	5 000	3 200	CH + 3 450	5 000	4 600	CH + 3 600	5 000

Table 16 – *Concluded*

For speed from 4 m/s to 10 m/s

Passenger, Goods, Stretcher/Hospital Lifts With Machine Room: Dimensions of Pit Depth, Overhead Height (HR) and Machine Room Height (MR)

Sl No.	No. of passengers	Rated Load kg	4 m/s			5 m/s			6 m/s			7 m/s			8 m/s			9 m/s			10 m/s		
			Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR	Pit Depth	HR	MR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
i)	14	952	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 000	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
ii)	16	1 088 /1 000	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 000	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
iii)	18	1 224	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 000	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
iv)	20	1 360	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 000	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
v)	22	1 496 / 1 500	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 000	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
vi)	26	1 768	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 300	5 500	CH + 3 800	4 300	5 900	CH + 5 000	4 300	6 500	CH + 5 800	4 300	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
vii)	29	1 972 / 2 000	4 600	CH + 3 450	4 000	4 700	CH + 3 450	4 300	5 500	CH + 3 800	4 300	5 900	CH + 5 000	5 000	6 500	CH + 5 800	5 000	7 100	CH + 6 500	5 000	7 500	CH + 6 900	5 000
viii)		2 500	4 600	CH + 3 450	4 300	4 700	CH + 3 450	5 000	5 500	CH + 3 800	5 000	5 900	CH + 5 500	5 000	6 500	CH + 6 300	5 000	7 100	CH + 7 000	5 000	7 500	CH + 7 500	5 000
ix)		3 000	4 600	CH + 3 600	4 300	4 700	CH + 3 600	5 000	5 500	CH + 4 000	5 000	5 900	CH + 5 500	5 000	6 500	CH + 6 300	5 000	7 100	CH + 7 000	5 000	7 500	CH + 7 500	5 000

CH - Car clear inside height measured from car finished floor level to false ceiling.

NOTES

1 Recommended dimensions for pit depth, overhead and machine-room for different lift speeds are given in the table above. These dimensions may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the pit depth and overhead shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].

2 In case of goods lifts minimum pit depth required is 1 600 mm.

3 In case of lift speeds 3.5 m/s and 4 m/s with rear counterweight the pit depth requirement could be less by about 500 mm to 1 000 mm.

Table 17 Recommended Dimensions of Automobile Lifts with Machine Room - Through Type Car (Rated Speed = 0.6 m/s or 1.0 m/s)

All dimensions in millimetres.

(*Clause* 5.10.3.1)

Fig.

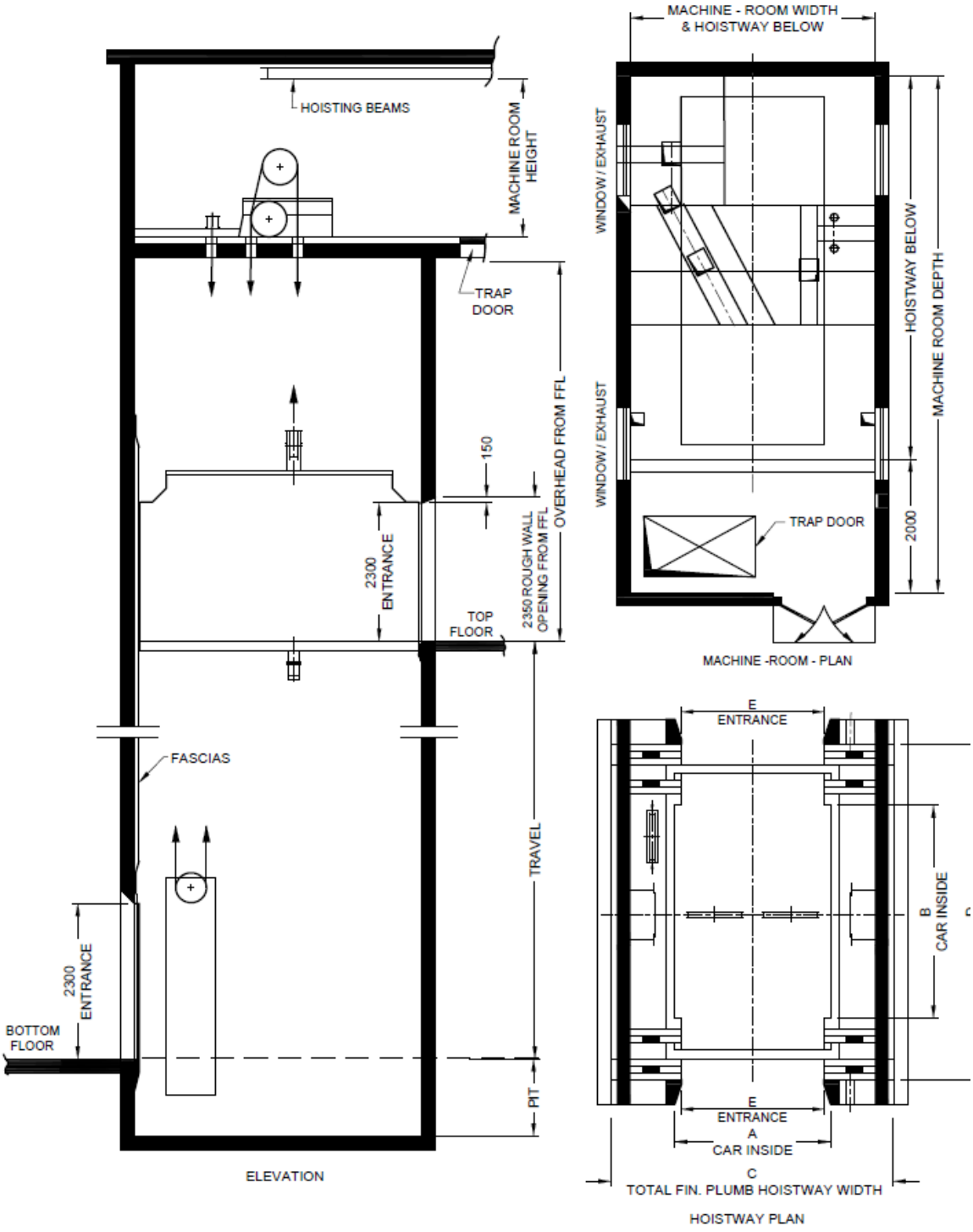
Sl No.	Rated Load	Car Size		COPD Door	Shaft Size		Car Height	Overhead Height	Pit Depth	Machine Room Height
		Width	Depth	Width	Width	Depth	CH	HR	PH	MR
	kg									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	2 500	2 500	5 300	4P-2 400	4 000	6 100	2 400	5 200	1 800	4 000
ii)	3 000	2 700	5 400	4P-2 400	4 000	6 200				
iii)	4 000	3 000	5 800	6P-3 000	4 300	6 700			2 000	4 500
iv)	5 000	3 000	6 000	6P-3 000	4 300	6 900				

NOTES

1 All dimensions given above for lifts having centre opening power operated doors (COPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, the minimum rated load for the automobile lift shall be based on a load of not less than 1.45kN/m^2 of the net inside car area.

2 Dimensions of machine room height, pit depth and overhead may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the pit depth and overhead shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].

3 The lift car width should be selected such that in case of emergency while the automobile is in the car-lift the driver should be able to open the automobile door and come out of the automobile.



All dimensions are in millimetres

FIG. 6 UNDER TABLE 16 FOR RECOMMENDED DIMENSIONS OF AUTOMOBILE LIFTS

Table 18 Recommended Dimensions of Dumbwaiter Lifts
All dimensions in millimetres.
(*Clause* 5.10.3.1)

Sl No.	Load	Car Inside			Lift Well		Entrance
	kg	*A*	*B*	*H*	*C*	*D*	*E*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	100	700	700	800	1 200	900	700
ii)	150	800	800	900	1 300	1 000	800
iii)	200	900	900	1 000	1 400	1 100	900
iv)	250	1 000	1 000	1 200	1 500	1 200	1 000

NOTE – Entrance width '*E*' is based on assumption of provision of vertical biparting doors (no car door is normally provided).

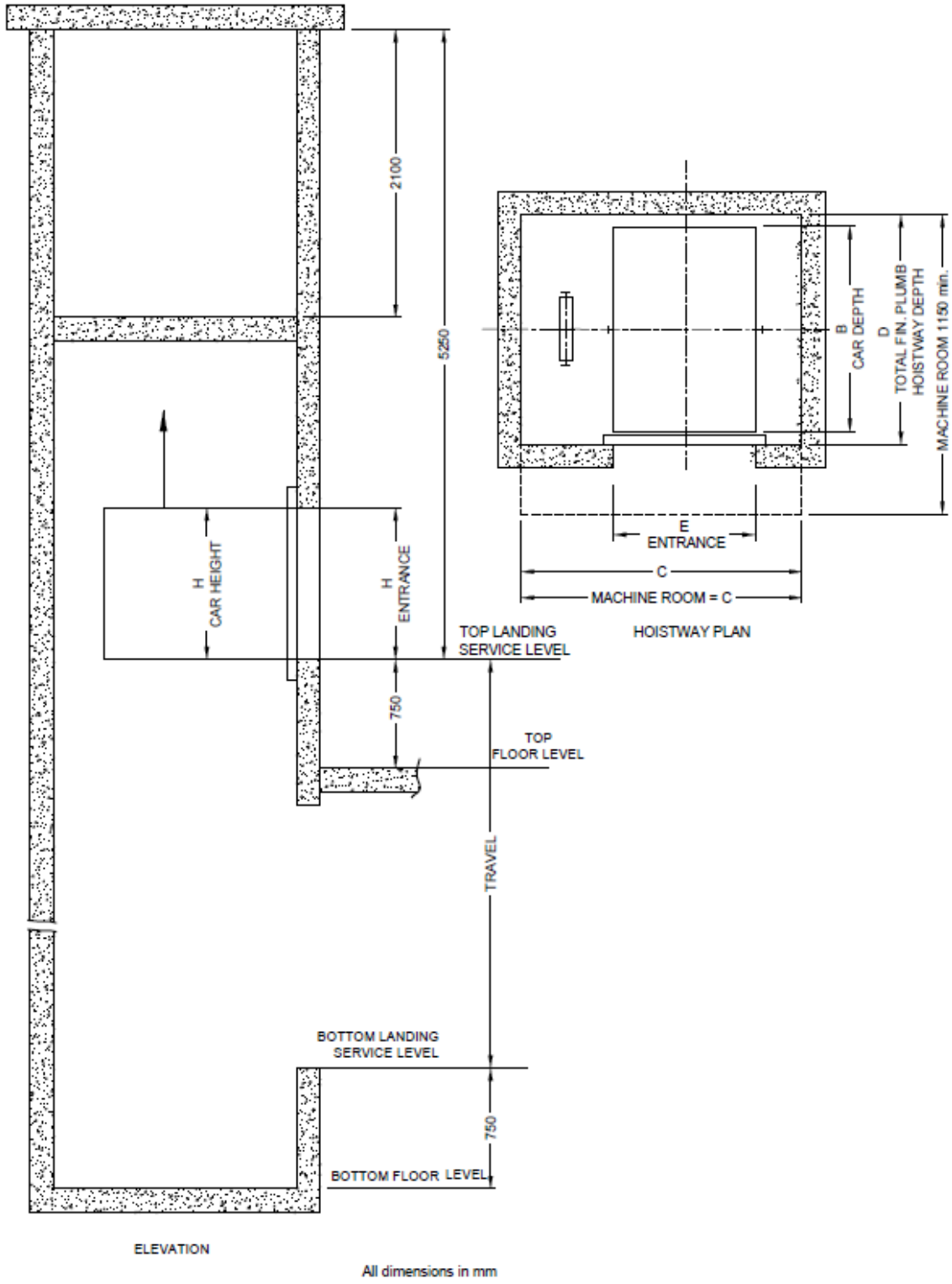


FIG. 7 UNDER TABLE 17 FOR DUMBWAITER LIFTS

Table 19 Recommended Dimensions of Passenger Lifts MRL COPD
All dimensions in millimetres.
(*Clause* 5.10.3.1)

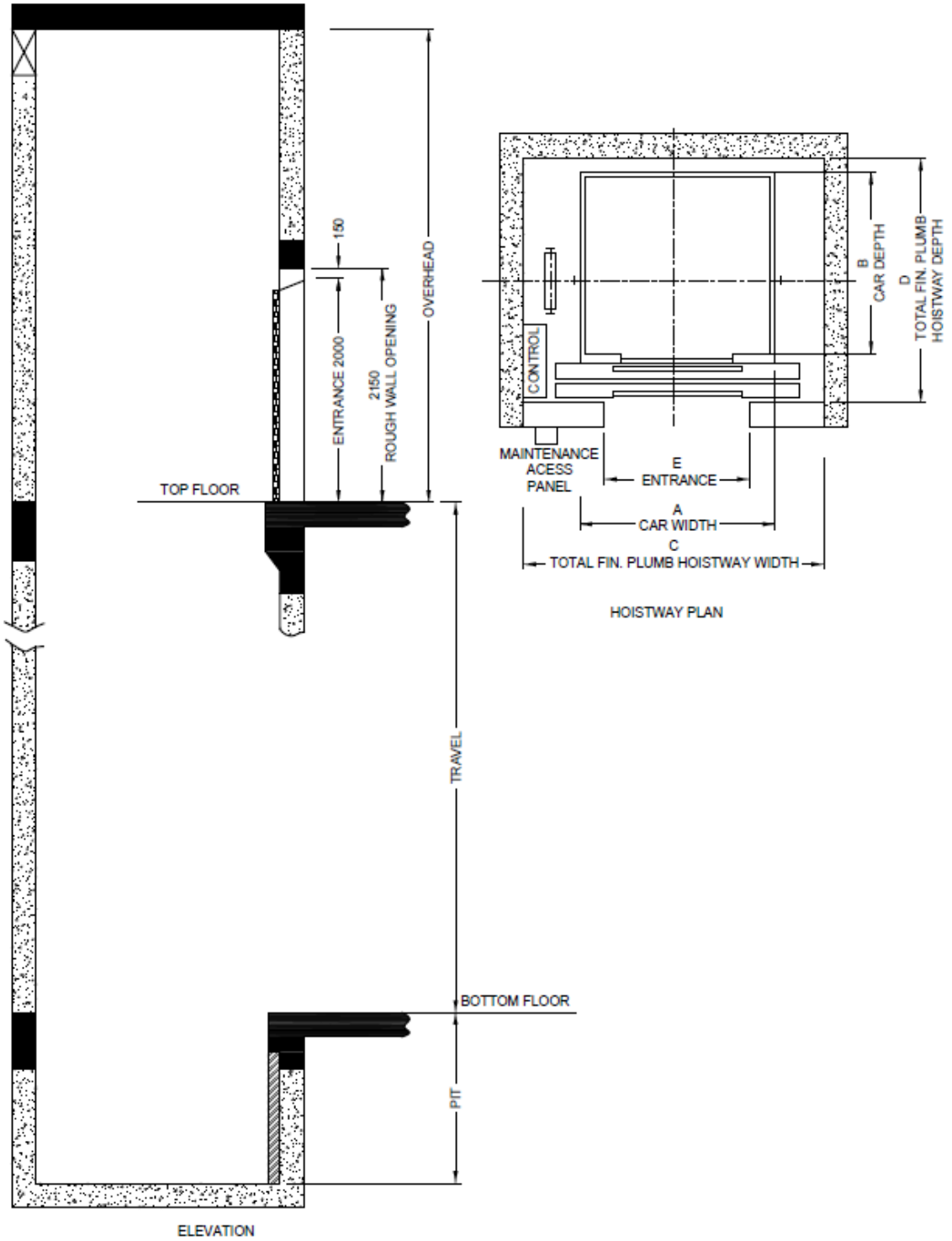
Sl No.	No. of passengers	Rated Load	Car Size		2 P COPD Door	1.0 m/s ≤ Rated Speed ≤ 2.0 m/s		Rated Speed = 2.5 m/s		Rated Speed = 3.0 m/s	
						Shaft Size		Shaft Size		Shaft Size	
		kg	~~Width~~	~~Depth~~	Width	~~Width~~	~~Depth~~	~~Width~~	~~Depth~~	~~Width~~	~~Depth~~
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	4	272	900	850	700	1 600	1 550				
ii)	6	408	1 000	1 100	800	2 000	1 700				
iii)	8	544	1 300	1 100	800	2 150	1 800				
iv)	10	680	1 350	1 300	800	2 150	1 900				
v)	13	884	1 600	1 400	1 000	2 550	1 950	2 550	2 050	2 550	2 250
vi)	15	1 020	1 600	1 550	1 000	2 550	2 050	2 550	2 150	2 550	2 250
vii)	16	1 088	1 600	1 600	1 000	2 550	2 100	2 550	2 200	2 550	2 300
viii)	20	1 360	1 800	1 700	1 100	2 700	2 300	2 700	2 350	2 700	2 350
ix)	22	1 496	1 800	1 900	1 100	2 700	2 400	2 750	2 450	2 750	2 450
x)	26	1 768	1 900	2 000	1 100	2 800	2 450	2 850	2 450	2 850	2 500
xi)	29	1 972	2 350	1 700	1 200	3 100	2 200	3 100	2 200		

NOTES

1 All dimensions given above for lifts having centre opening power operated doors (COPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, variation in,

a) car inside dimensions shall be within the maximum area limits specified in accordance with accepted standards [8-5A(6)].
b) entrance width on higher side is permitted.
c) entrance width on lower side is permitted up to 100 mm subject to minimum of 700 mm.

2 The minimum size of the lift car and all other requirements relating to accessibility, in all public buildings shall be in accordance with **13** of Part 3 ‘Development Control Rules and General Building Requirements’ of the Code.



All dimensions in mm

FIG. 8 UNDER TABLE 18 FOR MRL LIFTS COPD

Table 20 Recommended Dimensions of Stretcher/Hospital lifts MRL (2P Telescopic Door/4P COPD, Speed 1.0 m/s to 2.0 m/s)

All dimensions in millimetres.

(*Clause* 5.10.3.1)

Sl No.	Rated Load		Car Size		Door Size	Shaft Size	
	Persons	kg	width	depth		width	depth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	15	1 020	1 100	2 400	900	2 150	2 950
ii)	20	1 360	1 300	2 400	1 200	2 350	2 950
iii)	23	1 600	1 400	2 400	1 300	2 450	2 950
iv)	29	2 000	1 500	2 700	1 300	2 450	3 250

NOTES

1 All dimensions given above for lifts having 2 panel telescopic or 4 panel centre opening power operated doors (4P COPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, variation in,

i) car inside dimensions shall be within the maximum area limits specified in accordance with accepted standards [8-5A(6)].
ii) entrance width on higher side is permitted.
iii) entrance width on lower side is permitted up to 100 mm subject to minimum of 700 mm.

2 Car depth of 2 100 mm may be considered in residential/commercial buildings where use of only ambulance stretcher is envisaged. The hoist-way depth maybe reduced accordingly.

Table 21 Pit Depth for Passenger/Stretcher/Hospital Lifts MRL
All dimensions in millimetres.
(*Clause* 5.10.3.1)

Sl No.	No. of Passengers	Pit Depth for Speed					
		1 m/s	1.6 m/s	1.8 m/s	2 m/s	2.5 m/s	3 m/s
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	4	1 600	1 800	2 000	2 200		
ii)	6	1 600	1 800	2 000	2 200		
iii)	8	1 600	1 800	2 000	2 200		
iv)	10	1 600	1 800	2 000	2 200		
v)	13	1 600	1 800	2 000	2 200	2 500	3 100
vi)	15	1 600	1 800	2 000	2 200	2 500	3 100
vii)	16	1 600	1 800	2 000	2 200	2 500	3 100
viii)	20	1 800	1 800	2 000	2 200	2 500	3 100
ix)	22	1 800	1 800	2 000	2 200	2 500	3 100
x)	26	1 800	1 800	2 000	2 200	2 500	3 100
xi)	29	1 800	1 800	2 000	2 200	2 500	

NOTE – Recommended dimensions for pit depth for different lift speeds are given in the table. These dimensions may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the pit depth shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].

Table 22 Overhead Height for Passenger and Stretcher/Hospital Lifts MRL
All dimensions in millimetres.
(*Clause* 5.10.3.1)

Sl No.	No. of Passengers	For Speed			
		1 m/s	1.6 m/s ≤ Rated Speed ≤ 2 m/s	2.5 m/s	3 m/s
(1)	(2)	(3)	(4)	(5)	(6)
i)	4	CH + 1 900	CH + 2 400		
ii)	6	CH + 1 900	CH + 2 400		
iii)	8	CH + 1 900	CH + 2 400		
iv)	10	CH + 1 900	CH + 2 400		
v)	13	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
vi)	15	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
vii)	16	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
viii)	20	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
ix)	22	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
x)	26	CH + 1 900	CH + 2 400	CH + 2 600	CH + 2 800
xi)	29	CH + 1 900	CH + 2 400	CH + 2 600	

NOTE – Recommended dimensions for overhead for different lift speeds are given in the table. These dimensions may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the overhead shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].

Table 23 Recommended Dimensions of Goods Lifts MRL (Speed 1.0 m/s)
All dimensions in millimetres.
(*Clause* 5.10.3.1)

Sl No.	Rated Load	Car Size		Door Size	Telescopic Door Shaft Size		4P COPD Shaft Size		2P COPD Shaft Size		Overhead Height	Pit Depth
	kg	Width	Depth	Width	Width	Depth	Width	Depth	Width	Depth	HR	PH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	500	1 300	1 100	800					1 950	1 800	CH + 1 900	1 600
ii)	1 000	1 600	1 550	1 000					2 250	2 050	CH + 1 900	1 600
iii)	1 600	1 400	2 400	1 300	2 550	3 000	2 500	3 000			CH + 1 900	1 800
iv)	2 000	1 500	2 700	1 300	2 550	3 300	2 550	3 300			CH + 1 900	1 800
v)	2 500	1 800	2 650	1 700			3 150	3 250			CH + 2 100	1 800
vi)	3 000	2 000	2 700	1 800			3 350	3 300			CH + 2 100	1 800
vii)	4 000	2 100	3 400	1 800			3 400	4 000			CH + 2 100	2 100
viii)	5 000	2 500	3 500	2 200			3 800	4 100			CH + 2 400	2 200

NOTES

1 CH is the clear car height from car finished floor level to car roof (goods lifts will normally not have any false ceiling).
2 Normal range for CH is 2 100 mm to 2 400 mm.
3 Door height is less than or equal to the car height CH.
4 In case counterweight safety is applicable check for dimensions with lift manufacturer.
5 All dimensions given above for lifts having telescopic or centre opening power operated doors (COPD) with counterweight at side, are recommended dimensions primarily for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, the minimum rated load for the goods lift shall be based on a load of not less than 3.45 kN/m^2 of the net inside car area.
6 Recommended dimensions for overhead and pit depth for different lift speeds are given in the table. These dimensions may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the overhead and pit depth shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].

Table 24 Recommended Dimensions of Automobile Lifts MRL COPD (Speed 0.5 m/s to 1.0 m/s)

All dimensions in millimetres.
(*Clause* 5.10.3.1)

Sl No.	Rated Load kg	Car Size		6P COPD Door Size: Opposite Entrances	Shaft Size		Overhead Height	Pit Depth
		Width	Depth	Width	Width	Depth	HR	PH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	3 000	2 500	5 500	2 200	3 800	6 450	4 850	2 500
ii)	4 000	3 000	6 000	2 700	4 300	6 950	4 850	2 500

NOTES

1 Car height normal range is 2 100 mm to 2 700 mm.
2 Overhead height shown is required for all values of car height CH shown above.
3 In case counterweight safety is applicable check for dimensions with lift manufacturer.
4 All dimensions given above for machine room less lifts with 6 panel centre opening power doors (6P COPD) used for automobiles are recommended dimensions for architects and building planners. Any variations mutually agreed to between the manufacturer and the purchaser are permitted. However, the minimum rated load for the automobile lift shall be based on a load of not less than 1.45kN/m^2 of the net inside car area.
5 Dimensions of pit depth and overhead may differ in practice as per individual manufacturer's design depending upon load, speed and drive. However, the pit depth and overhead shall be such as to conform to the requirements of bottom clearance and top clearance in accordance with the accepted standards [8-5A(7)].
6 The lift car width should be selected such that in case of emergency while the automobile is in the lift car the driver should be able to open the automobile door and come out of the automobile.

6 CIVIL AND ELECTRICAL REQUIREMENTS FOR LIFTS

6.1 Civil Requirements

Lift well enclosures, lift pits, machine rooms and machine supports besides conforming to the essential requirements given below should form part of the building construction and comply with the lift manufacturer's drawings.

6.1.1 *Requirements of Lift Well Enclosure*

The requirements of lift well enclosures are as given hereunder:

a) *Totally enclosed well* – Lift wells shall be totally enclosed by imperforate walls, floor, and ceiling, constructed for protection against all weather and of dust free surface material or should be painted to minimize dust circulation on to moving apparatus and from being pumped by the car movement into machine room or on to landings and shall be rendered minimum 120 mins fire-resistant.

The lift well may have openings for landing doors, inspection and emergency doors, vent openings for escape of gases and smoke in case of fire, ventilation openings, openings in the machine room floor for connecting lift components such as ropes, cables, etc.

b) *Partially enclosed well* – In case of partially enclosed lift wells used for applications, for example, observation lifts in connection with galleries or atriums, tower buildings, etc, the well does not need to be totally enclosed, provided the height of the enclosure at places normally accessible to persons is sufficient to prevent such persons:

1) being endangered by moving parts of the lift; and
2) interfering with the safe operation of the lift by reaching lift equipment within the well either directly or with handheld objects.

The height of the enclosure shall be minimum 3.5 m at the landing door side. The height of enclosure at other sides shall be 2.5 m minimum when the horizontal distance between the moving parts of the lift and enclosure is 0.5 m minimum. The height of enclosure at other sides may be reduced to 1.1 m progressively if the horizontal distance between the moving parts of the lift and enclosure increases to 2 m. The enclosure shall be located within 150 mm of the edge of the floor. The enclosure shall be imperforate and made of non-combustible material.

c) *General requirements related to the lift well* – The well shall be exclusively used for lifts. It shall not contain ducts, cables, or devices, etc. other than

those for the lift. Permanently installed adequate lighting shall be provided comprising sufficient number of lamps fixed throughout the lift well such that the illumination level 1 m above the car roof within its vertical projection at any position of the car in the well and 1 m above pit floor everywhere a person can stand, work and/or move between the working areas shall be at least 50 lux and at least 20 lux at remaining locations, even when all the doors are closed.

NOTE – Additional lamps may be fixed on the car top as a part of the well lighting system to achieve this.

Well lighting switches (or equivalent) shall be located both in the pit and in machine room or in controller (in case of machine room less application) so that the complete well lighting can be operated from either location that is, it shall be an arrangement of 2-way switch in machine room / controller (in case of MRL) and pit for controlling well lighting. Well lighting switch shall be in the machine room close to the main switch and pit lighting switch in lift well close to and easily accessible from lowest landing door. Each point of well lighting shall consist of bulkhead with bulb, 3-pin socket and switches to control supply.

Should a lift entrance open out into an area exposed to the weather, the entrance should be protected by a suitable canopy and the ground level sloped up to the lift entrance to prevent rain or drainage water entering the lift well through the clearances around the landing doors. Any push buttons exposed should be of weatherproof type.

The natural or artificial lighting of the landings in the vicinity of landing doors shall be at least 50 lux at floor level, such that a user can see ahead when they are opening the landing door to enter the lift, even if the car light has failed. The approach of the landing door on each floor shall be kept lit during the whole time the lift is available for use at night, and during the day time, if so required, due to insufficient natural light.

When the distance between consecutive landing door sills exceeds 11 000 mm, intermediate emergency landing(s) with lift landing door(s) shall be provided such that the distance between any two consecutive landings is not more than 11 000 mm. Rescue to these landings is permissible in case of automatic rescue device operation.

No counterweight shall be allowed to travel in any lift well, or part of any lift well other than that to which it belongs.

In the case of a lift well which is common to more than one lift and where the lift car or the counterweight of one lift is working in juxtaposition to the

lift car or counterweight of another lift, such lift cars or counterweights shall be guarded carefully and adequately in order to protect persons working in the lift well or on the lift cars from accidental contact with such cars or counterweights in any part of their travel.

d) *Construction of the lift well* – The side walls of the lift well may be made of reinforced cement concrete at least 150 mm thick; or brick or similar fire resisting materials provided tie beams are made available for lift guide rail fixings at such heights as specified by the lift manufacturer, to provide satisfactory anchoring arrangement for fixing guide rails and other equipment to the lift well.

The inner surface of the lift well and its enclosure facing any lift-car entrance shall, so far as practicable, be kept smooth and flush devoid of projections or recesses. Where any projections or tops of the recesses cannot be rendered flush, they shall be levelled on the underside to an angle not less than 60° from the horizontal, by means of metal plates, cement rendering or other fire resisting material.

Where a lift car levelling device is operative with the lift car door open, such interior surfaces shall always form a smooth and flush surface below each landing level for a depth to at least the depth of the car-levelling zone plus the distance through which the lift car may travel of its own momentum when the power is cut-off.

The horizontal distance between the sill of the car and sill of the landing doors shall not exceed 35 mm. The distance between the lift well enclosure on the sides facing any lift-car entrance and the sill edge of the car shall not be more than 35 mm in the landing zone below the landing gate. If such distance is more than 35 mm in the lift well enclosure, the same shall be finished with suitable and smooth plaster work or fascia plates so as to make the surface thereof devoid of all projections and recesses. In case the enclosure wall on the sides facing the lift-car entrance is more than 130 mm from the sill edge of the lift-car platform, the lift-car door of such lift shall be provided with means to prevent it from being opened except when the lift-car is at the landing served by such car entrance.

Sufficient space shall be provided between the guides for the car and the side walls of the lift well enclosure to allow safe and easy access to the parts of the safety gears for their maintenance and repairs.

All landing openings shall be protected by gates or doors which shall extend to the full height and full width of the landing openings. These openings shall not be less than 2 000 mm in clear height and 700 mm clear

in width (refer **5.10.3.1** Table 12 to 23) when the gates or doors are fully opened. There shall not be any common wall between lift well and water tank.

e) *Strength of the walls of the well* – The structure of the well shall be able to support at least the loads which may be applied by the machine, by the guide rails at the moment of safety gear operation, by eccentric load in the car, by the action of buffers, by the application of anti-rebound devices, by loading and unloading the car, etc.

The walls of the well shall withstand a force of 1 000 N, being evenly distributed over an area of 900 cm^2 in round or square section and applied at right angles to the wall at any point on either face,

1) without permanent deformation greater than 1 mm; and
2) without elastic deformation greater than 15 mm.

Glass panels, plane or formed shall be made of laminated glass. Such panels and their fixings shall withstand horizontal static force of 1 000 N applied on an area of 900 cm^2 at any point, from either side, without permanent deformation.

f) *Partition walls between lifts in a common lift well* – In case of common lift well for multiple lifts, the partition wall(s) of the common lift well may be either be RCC or brick or steel or glass which may be provided with openings for escape of air displaced due to movement of lift in the adjacent well. For high speed lifts the partition between the lifts maybe of suitable wire grill / expanded metal of following specifications:

1) It shall be made of at least 2.2 mm thick steel wire or expanded metal.
2) A ball of 25 mm diameter shall not pass through the wire grill.
3) It shall be so fixed as not to deflect more than 15 mm when subjected to a force of 450 N applied horizontally at any point from either side.

6.1.2 *Requirements of the Pit*

Pit shall be soundly constructed and maintained in a dry (waterproofed) and clean condition. Where necessary, provision shall be made for permanent drainage. The floor of the pit shall be able to support beneath each guide rail, force due to mass of guide rails plus the reaction due to safety gear operation. The floor of the pit shall be able to support beneath the car buffer supports, force in Newton, equal to 4 times the static load being imposed by the mass of fully loaded car:

4.g (P + Q)

where,

P = mass of empty car and components supported by the car that is, part of travelling cable, compensating rope/chain, if any, etc, in kg;
Q = rated load, in kg; and
g = acceleration due to gravity.

The floor of the pit shall be able to support beneath the counterweight buffer support, force in Newton, equal to 4 times the static load being imposed by the mass of the counterweight:

4.g (P + $q.Q$)

where,

P = mass of empty car and components supported by the car, that is, part of travelling cable, compensating rope/chain, if any, etc, in kg;
Q = rated load, in kg;
g = acceleration due to gravity; and
q = live load balancing factor (normally, q = 0.5).

The floor of the pit shall be able to support upward thrust of the tied down rope compensation device, if provided. If accessible spaces do exist below the well, the base of the pit shall be designed for an imposed load of at least 5 000 N/m^2 and the counterweight shall be equipped with safety gear. In addition, it is recommended to provide double slab for the lift pit.

NOTES

1 Lift wells should preferably not be situated above a space accessible to persons.
2 Enclosing projected area of the lift well under the pit in accessible spaces will not nullify above provisions.

There shall not be any common wall/slab between lift pit and any water reservoir.

The pit shall be accessible by an access door. A permanent ladder inside the well may be provided close to the last landing *in-lieu* of access door, if the pit depth does not exceed 2.5 m.

NOTE– In case of structural limitations for providing pit access door at pit floor level, alternative arrangement to access pit may be provided which shall allow access to pit with complete safety.

A physical means of protection shall be provided to prevent accidental contact with the counterweight.

The pit shall be equipped with a stop switch which is easily accessible from the lowest landing and the pit floor. If more than one switch is required, they shall be wired in series.

6.1.3 *Requirements Associated with Machine Room and Pulley Room*

It must be noted that generally lifts have machine rooms immediately over the lift well, and this should be arranged, whenever possible without restricting the overhead distance required for normal safety precautions. In case where machine room provision on top is a limitation, either machine room less lift or basement drive or side drive lift can be considered. The spaces and tolerances shall be in accordance with the following:

a) *Requirements associated with machine room and pulley room (where lift machinery is placed in the machine room)*

1) The lift machine, controller and all other apparatus and equipment of a lift installation, except such apparatus and equipment having functional location in the lift well or other positions, shall be placed in the machine room which shall be adequately lit and rendered fire-resistant and weather-proof.

If parts of different lifts are present in one machine room and/or pulley room each lift shall be identified with a number, letter or colour consistently used for all parts (machine, controller, over speed governor, switches, etc). If the machine room contains several lifts, it is necessary to have one switch per car to control the supply to the circuit for lighting and socket outlets of the car. This switch shall be located close to the corresponding main power switch.

2) Machine room should be considered as plant space, and conditions provided to permit reliable operation of electrical switchgear and rotating machinery and be conducive to good maintenance. The machine room shall be either air conditioned or adequately ventilated so as to maintain the ambient temperature therein between +5 °C and +40 °C. The machine room shall be such that the motors and equipment as well as electric cables, etc. are protected as far as possible from dust and humidity. Machine room should also be protected from all weather and if ventilation louvers are provided, they should be designed and located to prevent entry of rainwater in the machine room. Preferably, metal or wooden louvers should be provided.

The well, machinery spaces and pulley rooms shall not be used to provide ventilation of rooms other than those belonging to the lift.

3) Rescue instructions with required tools and tackles, if any, shall be made available in the machine room.

4) Machine room floor shall be provided with a trap door, if necessary. The size of the trap door shall be as per manufacturer's recommendation. Since the purpose of the trap door is to lift or lower the machinery, controller, etc. between machine room and the top landing, it may be necessary to provide trap door of same size in the terrace slab which coincides with trap door in machine room, depending on the design of the building.

The trap door when closed shall be able to support 2 000 N on an area of 0.20 m x 0.20 m at any position. The trap door shall not open downwards. Hinges, if any, shall be of a type which cannot be unhooked. Trap doors shall be locked. When the trap door is in the open position, precautions shall be taken to prevent the fall of persons (for example, a guardrail) and prevent the trapdoor from closing such as to cause a crushing hazard (for example, by counterbalance).

5) Lighting shall be provided to give at least 200 lux around the controller and machine. At least one plug socket point with button shall be provided in the machine room for every lift. The switch for the machine room light shall be fixed near the entrance of the machine room. The machine room walls, ceiling and floor should be finished in dust-resisting materials, tiles, etc, or painted as a minimum to stop dust circulation, which otherwise could damage rotating machinery and cause failure of switchgear.

6) The machine room shall be so designed as to allow free and easy access to all parts of the equipment and the width of the clear space around the machine from any two sides shall in no case be less than 600 mm. Provision shall be made to allow the removal and replacement of various units. The entrance of the machine room shall be minimum 1 000 mm wide and 2 000 mm high to allow removal and replacement of machinery therein. The floor of the machine room shall be designed and constructed to carry safely at any point the heaviest part of the equipment and withstand the loads and forces to which they are intended to be subjected to. If the floor does not extend to the enclosing wall, the open sides shall be adequately guarded by suitable means for example, rails, guards.

7) The height of the machine room shall be sufficient to allow any portion of the equipment to be accessible and removable for repairs and replacement. Distance between the machine lifting point and the machine room hook shall be at least 1 000 mm and there shall be a clear vertical distance of at least 300 mm above the rotating parts of the machine. Machine room height shall not be less than 2 100 mm clear from the floor of the access area and working area in any case. This clear height for movement is taken to the underside of the lowest striking point and measured from the floor of the access area.

8) The machine room shall be locked and shall be accessible to those who are concerned with the operation and maintenance of the machinery or equipment. Machine room doors shall not open towards the inside of machine room. They shall be provided with a key-operated lock, capable of being reclosed and relocked without a key and be openable from inside the machine room without a key, even when locked. Approach way to machine room from top landing level shall be direct, easy and safe to walk by way of stairs. If stairs are not possible, sufficiently wide and deep permanent structural steps may be used. These structural steps shall be provided with adequate hand holds and shall not be too steep. Minimum width of the steps shall be 1 000 mm.

9) A danger notice board shall be displayed permanently on the outside of the machine room door, trap door and near the machinery. Refer clause **8.1**(e) for the warning signs.

10) There shall not be any common wall/slab between machine room and any water reservoir.

11) The machine room shall not be used as a storeroom or for any purpose other than housing the machinery/components connected with the lift installation. The machine room shall not act as a passage to any other room or utility.

The lift well, machine and pulley rooms may, however contain,

i) Equipment for air conditioning or heating of these spaces, excluding steam heating and high pressure water heating. However, any control and adjustment devices of the heating apparatus shall be located outside the lift well, machine room and pulley room.
ii) Fire detectors and/or suppression system, with a high operating temperature (for example, above 80 ^{o}C), appropriate for the electrical equipment and suitably protected against accidental impact.

When sprinkler systems are used, activation of the sprinkler shall only be possible, when the lift is stationary at a landing and the electrical supply of the lift and lighting circuits are automatically switched off by the fire or smoke detection system.

NOTE – Such smoke, fire detection and sprinkler systems are the responsibility of the building management.

12) Machine room floor shall be designed to carry an imposed (live) load of not less than 10 kN/m^2 over the whole area and any load which may be imposed thereon by the equipment used in the machine room or by any reaction from any such equipment both during periods of normal operation, maintenance and repair.

13) One or more beams or hooks with the indication of the safe working load, as appropriate, shall be provided in the machinery spaces. Position of the beams or hooks shall be according to the layout provided by lift manufacturer. Hoisting beams or hooks shall be tested for safe working load (SWL) before indicating the lifting capacity on it.

14) The total load on overhead beams used for supporting machinery shall be assumed as equal to all equipment resting on the beams plus twice the maximum load suspended from the beams.

15) The factor of safety for all overhead beams and supports based on ultimate strength of the material and load in accordance with (14) shall not be less than the following:

i) For steel : 5
ii) For reinforced concrete : 7

The deflection of the overhead beams under the maximum static load calculated in accordance with above shall not exceed 1/1 500 of the span.

16) The place in which the overhead pulleys, over speed governors and similar machinery are fixed shall be easily accessible for maintenance and repair purposes. It shall be lit adequately, and safe working procedure shall be established for maintenance and repair works.

17) It is recommended that emergency exit is provided in case of large machine rooms having four or more lifts.

18) Where the machine room occupies a prominent position on roof of a building, provision should be made for lightning protection in accordance Part 8 'Building Services, Section 2 Electrical and Allied Installations' of the Code and applicable standards.

b) *Requirements associated with machine spaces (where machinery is placed in the well)*

1) Access to the interior of the machinery and pulley spaces shall be capable of being properly lit by a permanent electric light fixture(s) with intensity of at least 200 lux at floor level, easy to use, and completely safe in all circumstances without necessitating entry into private premises.

2) Machinery spaces inside the well shall be designed and constructed to withstand the loads and forces they are subjected to.

3) In the case of partially enclosed wells located at the exterior of the building, the machinery shall be suitably protected against environmental influences.

4) Provision should be given to access the machine for maintenance purpose either from car top or otherwise

5) The clear height for movement shall not be less than 2 000 mm.

6) The machinery spaces shall be suitably ventilated. The electric equipment of the machinery shall be protected as far as it is reasonably practicable from dust, harmful fumes and humidity.

7) The working area and machinery spaces shall be provided with permanently installed electric lighting on the basis of at least 200 lux at floor level.

8) One or more beams or hooks with the indication of the safe working load, as appropriate, shall be provided in the machinery spaces. Position of the beams or hooks shall be according to the layout provided by lift manufacturer. Hoisting beams or hooks shall be tested for safe working load (SWL) before indicating the lifting capacity on it.

9) The total load on overhead beams used for supporting machinery shall be assumed as equal to all equipment resting on the beams plus twice the maximum load suspended from the beams.

10) The factor of safety for all overhead beams and supports based on ultimate strength of the material and load in accordance with (9) shall be not less than the following:

i) For steel : 5
ii) For reinforced concrete : 7

The deflection of the overhead beams under the maximum static load calculated in accordance with above shall not exceed 1/1 500 of the span.

c) *Requirements associated with machine spaces (where machinery is placed outside of the well)*

1) Machinery spaces outside of the well shall be constructed to withstand the loads and forces to which they are subjected.

2) The total load on beams used for supporting machinery shall be assumed as equal to all equipment resting on the beams plus twice the maximum load suspended from the beams.

3) The factor of safety for all beams and supports based on ultimate strength of the material and load in accordance with (2) above shall be not less than the following:

i) For steel : 5
ii) For reinforced concrete : 7

The deflection of the overhead beams under the maximum static load calculated in accordance with above shall not exceed 1/1 500 of the span.

4) Access to the interior of the machinery and pulley spaces shall be,

i) Capable of being properly lit by a permanent electric light fixture(s) with intensity of at least 200 lux at floor level; and
ii) Easy to use and completely safe in all circumstances without necessitating entry into private premises.

The clear height for movement shall not be less than 2 000 mm.

5) The machinery shall be located inside a cabinet consisting of imperforate walls, floor, roof and lockable door(s).

6) The machinery cabinet shall be suitably ventilated. It shall be such that the machinery is protected as far as it is reasonably practicable from dust, harmful fumes and humidity.

7) The inside of the machinery cabinet shall be provided with permanently installed electric lighting on the basis of at least 200 lux at floor level. The switch placed inside shall be close to the door(s), at an appropriate height, to control lighting of the cabinet.

d) *Dimensional tolerances*

1) *Lift well dimensions* – Plan dimensions of lift wells given by the lift manufacturer represent the minimum clear plumb sizes. The purchaser's representative, in conjunction with the builder, should ensure that adequate tolerances are included in the building design so that the specified minimum plumb dimensions are obtained in the finished work. Dimensions in excess of these minimum plumb dimensions for lift well and openings (but not less) can be accommodated by the lift manufacturer up to certain maximum values beyond which changes in design may be necessary involving additional expense or work by the builder. The purchaser's representative should take these factors into account when specifying the lift well structural dimensions on the basis of the constructional tolerance appropriate to the building technique.

2) *Landing door openings* – It is very important that finished landing openings should be accurate to design size and plumb one above the other for the full travel of the lift. In constructing the structural openings in concrete walls to lift wells it is not possible to achieve a degree of accuracy vertically which will allow doors and frames to be inserted in the opening without some form of masking or packing to overcome inaccuracies. Provisions should therefore be made in design by increasing the nominal height from design finished floor level and width of openings to each jamb and head. In addition, the alignment of the outer face of the front wall of the lift well is of importance when architrave of fixed dimensions are called for, and in this case the alignment of the outer face from floor to floor should not vary to a greater extent than can be accommodate by the subsequent front wall finish, the architrave being set accurately plumb.

3) *Structural limits for lift wells at any level* – If the net plumb well (dimensions *A* and *B* in Fig. 9) and the nominal structural entrance openings (dimensions *C* and *D* in Fig. 9) are defined by plumb lines, the actual wall should not encroach on these dimensions.

Dimension *K* (inside face of wall of Fig. 9) should fall within the following limits:

i)	For wells up to 30 m	:	0 - 25 mm
ii)	For wells up to 60 m	:	0 - 35 mm
iii)	For wells up to 100 m	:	0 - 50 mm
iv)	For wells taller than 100 m	:	0 - 50 mm for any 100 m portion of the well.

When architraves are to be supplied by the lift manufacturer dimension *L* (side of structural opening of Fig. 9) should fall within the limits of 0 and 25 mm and dimension *M* (outer face of the front wall of Fig. 9) should not vary to a greater extent than can be accommodated by the subsequent front wall finish, the architrave being set accurately plumb. When the entrance linings are supplied by the builder, corresponding provision should be made for the finished openings to be accurately plumb one above the other for the full travel of the lift end to design size.

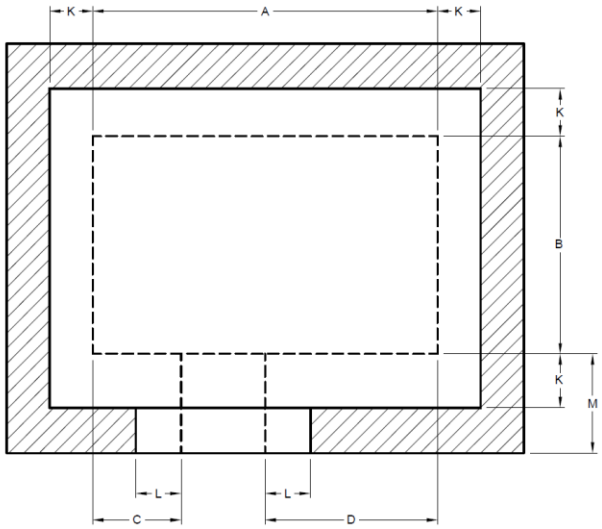


FIG. 9 LIFT WELL TOLERANCE

6.2 Electrical Installation Requirements

The lift manufacturer should specify, on a schedule, particulars of full load current, starting current, maximum permissible voltage drop, size of switches and other details to suit requirements. The main power cable and lighting cable shall be separate and routed through respective lift shaft for every lift. Every electric supply line other than the earthed or earthed neutral conductor of any system or the

earthed external conductor of a concentric cable shall be protected by a suitable switchgear by its owner. It is important that the switchgear at the intake and in the machine room which are provided by the electrical contractor of owner are of correct size. No form of 'NO VOLT' trip relay should be included anywhere in the power supply of the lift.

6.2.1 *Main Switchgear*

For each lift, a main switchgear capable of breaking the supply to the lift on all the live conductors shall be provided. This switchgear shall be capable of interrupting the highest current involved in normal conditions of use of the lift.

This switchgear shall not cut the circuits feeding the following:

a) Car lighting and ventilation
b) Socket outlet on the car roof;
c) Lighting of machinery spaces;
d) Socket outlet in the machinery and pulley spaces and in the pit;
e) Lighting of the lift well including pit;
f) Alarm device; and
g) Automatic rescue device.

The switchgear shall be located,

1) In the machine room, where it exists;
2) Where no machine room exists, in the distribution box (db) on top floor near the controller or meter room; or
3) At the emergency and test panel, when control panel is mounted in the well.

The following points shall be taken into consideration while fixing location of distribution box:

i) It shall be installed in common areas where there is no hindrance to reaching and operating, especially during emergency conditions;
ii) Suggested height above floor level shall be such that it is beyond the reach of children. But the replacement/ reset of protective devices shall be in an accessible position without the aid of any tackle, for example, at an average height between 1.8 m and 2.1 m.

If the emergency panel is separate from test panel, the switchgear shall be at emergency panel. If the main switch is not easily accessible from the controller cabinet, then the cabinet shall be provided with an isolating switch.

The main switchgear shall have stable open and closed positions and shall be capable of being locked-off in the open position with the use of a padlock or equivalent, to ensure no inadvertent operation takes place.

For a single lift, this switchgear should be fixed adjacent to the machine room entrance in the machine room or in distribution box (DB) near Controller (in case of MRL). In a machine room common to more than one lift, each main switch should be conveniently situated with respect to the lift it controls. Main switch for each lift shall be conspicuously marked.

The supply to the car light should be from a separate circuit and controlled by a switchgear in the machine room or in distribution box (DB) near Controller (in case of MRL). For multiple lifts with a common machine room a separate supply and switch gear should be provided for each car. The car lighting and well lighting supply should be independent of the power supply mains. Switch gear for car light and well light of each lift shall be separate and conspicuously marked.

Any capacitors to correct the power factor shall be connected before the main switch of the power circuit.

6.2.2 *Supply Cables Wiring and Apparatus*

The main power supply cables providing the electricity supply to a lift installation shall be flame retardant, low smoke, low halogen with cross-linked polyethylene (FRLSH XLPE) insulated armoured cables. The cables shall be terminated in the main switchgear panels / distribution box using cable glands such that the armour of the cables is positively connected to the metal body of switchgear panels / distribution box. For each lift, one 415 V $^{+6\ \text{percent}}_{-10\ \text{percent}}$, 3-phase, 4-wire, 50 Hz and one single phase 230 V $^{+6\ \text{percent}}_{-10\ \text{percent}}$, 3-wire, 50 Hz supply shall be independently provided. Other than this, power circuit at 230 V $^{+6\ \text{percent}}_{-10\ \text{percent}}$ for power and lighting sockets in the lift machine room and the lift shaft shall be provided. This is to facilitate maintenance and other related works with lighting and socket outlets while the lift is switched off.

The cables for lift shall be run in respective lift wells. Cables which are not part of lift installation shall not run in the lift well.

Fixed electrical wiring for circuit voltage up to 250 V located in lift wells shall be one of the following:

a) PVC wires encased in rigid conduit (or trunking) made either of metal or plastic.
b) PVC insulated PVC sheathed cables.

c) PVC wires in flexible metallic or plastic conduits not exceeding 1 500 mm in length for limit switches, interlocks, push buttons and similar devices.

Control cables on lift cars shall run in rigid / flexible metallic / plastic conduit or trunking. Short runs of flexible conduits may be used, where they are securely fastened in place and not exposed to oil and grease. Short runs of flexible cord may be used as flexible connections between fixed wirings on the car and the switch on car door provided that the chord is securely fastened in position and so located as not to be subjected to mechanical damage.

Wiring in machine room shall be run in rigid metallic trunking. The trunking in machine room floor shall be flush with the finished floor to avoid trip hazard. The following additional requirements may also be taken care of:

1) Dedicated power supply feeder shall be given for all lifts, which shall be separate from other building services. This feeder shall be distinctly identified and shall have controlled access such that it cannot be switched off by unauthorized person.

2) The lift sub-circuit from the meter room should be separate from other building services. Each lift should be capable of being isolated from the mains supply. This means of isolation shall be with lock-out and tag-out facility. The electric supply cables shall run in a route safe from fire, subsequently within the respective lift shafts to the machine room.

3) For banks of interconnected lifts, a separate sub-circuit is required for the common supervisory system, in order that any car may be shut down without isolating the supervisory control of the remainder lifts.

4) When the alarm system is connected to a transformer or trickle charger, the supply should be taken from the machine room lighting.

5) All electrical supply lines and apparatus in connection with the lift installation shall be so constructed and shall be so installed, protected, worked and maintained that there may be no danger to persons therefrom.

6) All metal casings or metallic coverings containing or protecting any electric supply lines of apparatus shall be efficiently earthed.

7) No bare conductor shall be used in any lift car as it may cause danger to persons.

8) All cables and other wiring in connection with the lift installation shall be of suitable grade for the voltage at which these are intended to be worked and if metallic covering is used it shall be efficiently earthed.

9) Suitable caution notice shall be affixed near every equipment or apparatus in which voltage used exceeds 250 V.

10) A single trailing cable for lighting control and signal circuit shall be permitted, if all the conductors of this trailing cable are insulated for maximum voltage running through any one conductor of this cable.

11) *Emergency signal or intercom* – The lift car shall be provided either with an emergency signal that is operative from the lift car and audible outside the lift well or with intercom.

12) When an alarm bell is to be provided, each car is fitted with an alarm push button which is wired to a terminal box in the lift well at the ground floor by the lift manufacturer. This alarm bell, to be supplied by the lift manufacturer (with indicator for more than one lift) should be fixed in an agreed position and wired to the lift well. The supply may be from a battery (or transformer) fixed in the machine room or, when available, from the building fire alarm supply.

An intercom system, or similar device, powered by the emergency supply shall be installed if the travel exceeds 30 m or if direct acoustic communication between the car and the place from which the emergency operation is carried out is not possible. When an intercom is to be provided in the lift car the lift manufacturer should fit it in the car and provide wiring from the car to a terminal box adjacent to the lift well. Alternatively, a hands-free unit may be provided. The type of intercom should be stated in the enquiry.

(ENTIRE 6.2.3 is re-worded – to match the provisions in ***National Electrical Code of India 2023****)*

6.2.3 *Earthing*

Earthing provides safety of human beings, livestock and apparatus against earth faults. Any system is characterized by the type of distribution system, which include types of systems of live conductors and types of system earthing.

The subject of earthing covers the problems associated with connection of exposed conductive part of installations to the main earthing terminal of that installation and to achieve automatic disconnection of supply before the fault

voltage creates a shock hazard. The terms earth and earthing have been used interchangeably, to denote a low impedance return path of the fault current. The earth is mainly used for fixing the voltage of system neutrals and is not used as a part of return circuit.

6.2.3.1 *System earthing*

Earthing of system is designed, primarily, to preserve the security of the system by ensuring that the potential on each conductor is restricted to value consistent with the level of applied insulation. It is equally important that earthing should ensure efficient and fast operation of protective gear, in the case of earth faults. Commonly used system earthing are TN, TT and IT.

6.2.3.2 *TN system*

A system having one or more points of the source of energy directly earthed, the exposed conductive-parts (and extraneous conductive parts) of the installation are connected by means of protective conductors to the earthed point(s) of the source, that is, there is a metallic path for earth fault currents to flow from the installation to the earthed point(s) of the source. TN systems are further sub-divided into TN-S, TN-C-S and TN-C systems.

a) TN-S system – A system with separate neutral and protective conductor throughout the system (*see* Fig. 10).

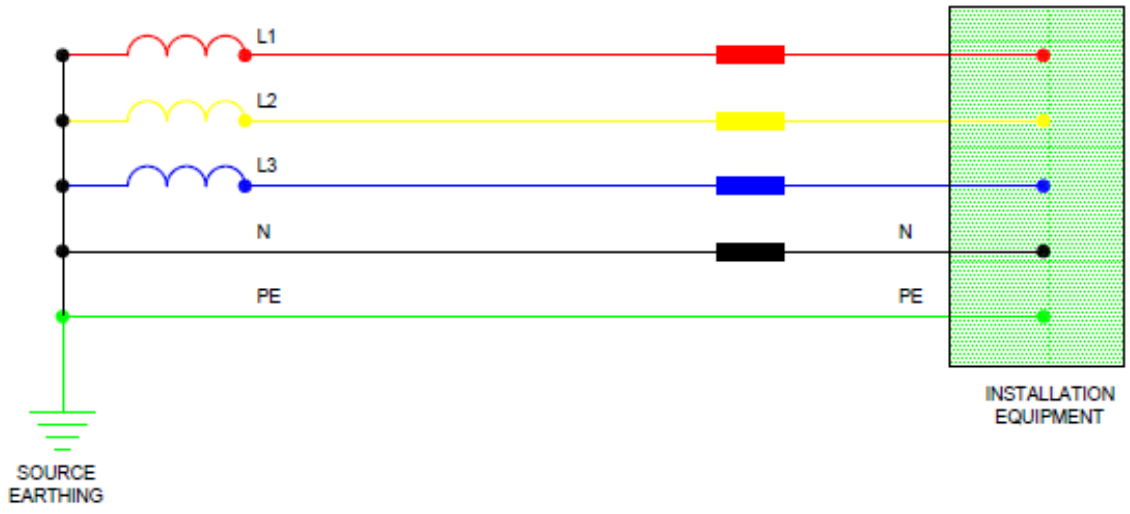


FIG. 10 TN-S SYSTEM WITH SEPARATE NEUTRAL AND EARTH CONDUCTOR FROM THE SOURCE

b) TN-C-S system – A system in which neutral and protective conductors are combined in a single conductor in part of the system. The PEN conductor referred to as a combined neutral and earth (CNE or PEN) conductor, is earthed at the source and at multiple points. Multiple earthing of the PEN conductor ensures that if the conductor becomes open circuit due to any reason, exposed-conductor parts remain connected to earth. Under such conditions, the supply voltage between the installation line and neutral conductor is substantially reduced (*see* Fig. 11).

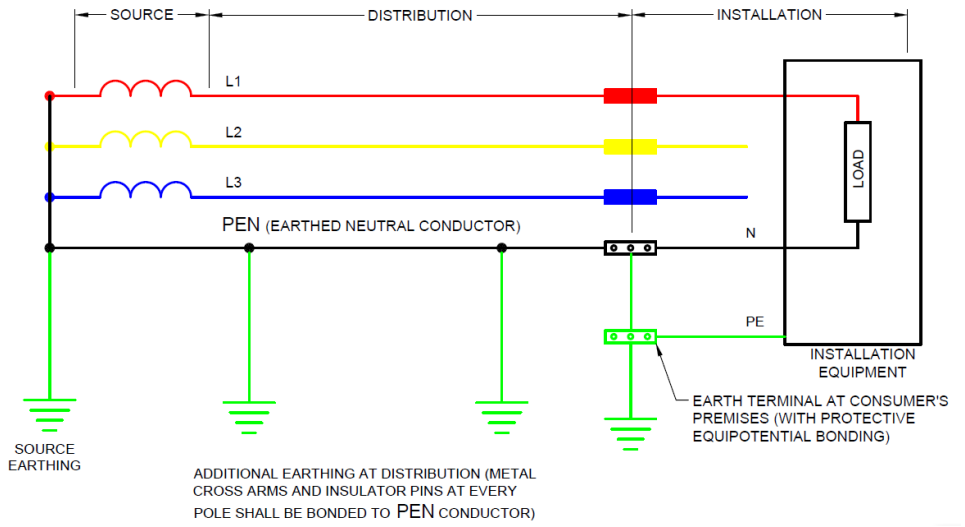


FIG. 11 TN-C-S SYSTEM WITH PROTECTIVE MULTIPLE EARTHING (PME) USED IN PUBLIC DISTRIBUTION

c) TN-C system – A system in which neutral and protective conductors are combined in a single conductor throughout the system. TN-C is not permitted inside consumer premises (*see* Fig. 12).

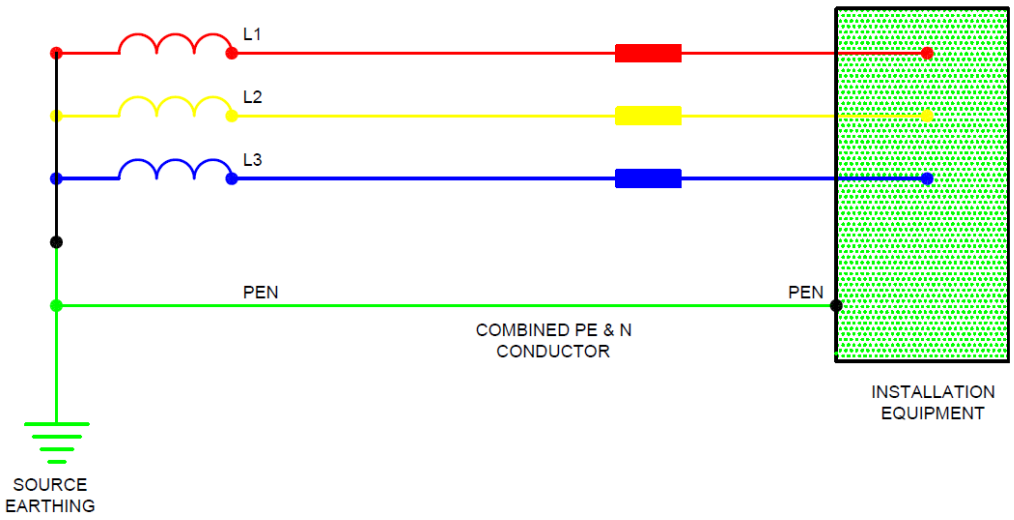


FIG. 12 TN-C SYSTEM (NEUTRAL AND PROTECTIVE FUNCTION COMBINED IN A SINGLE CONDUCTOR THROUGHOUT SYSTEM)

6.2.3.3 *TT system*

In this system one or more points of the source of energy are directly earthed and the exposed and extraneous conductive parts of the installation are connected to a local earth electrode, electrically independent of the source earth. Every consumer installation shall be protected with an RCD for earth fault protection at the origin of installation (*see* Fig. 13).

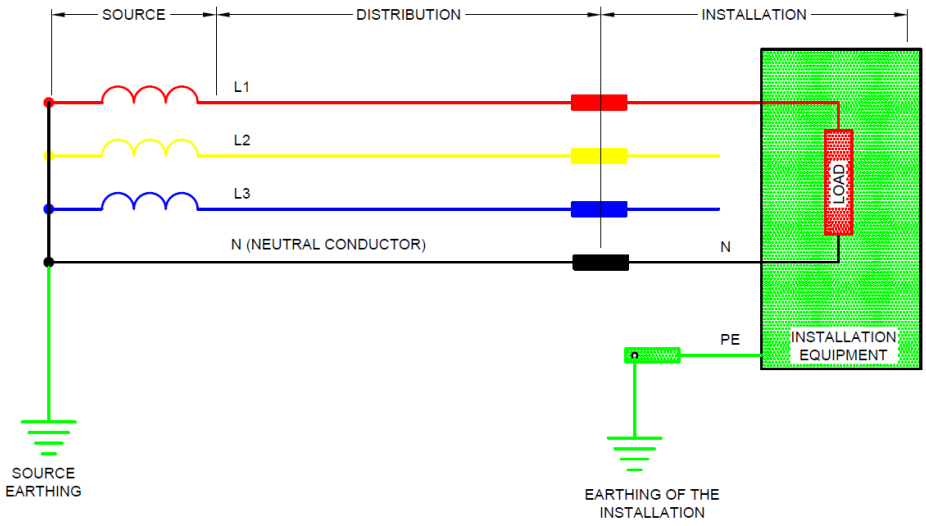


FIG. 13 TT SYSTEM

6.2.3.4 *IT system*

The live parts have no direct connection / isolated from earth or one point is connected to earth through an impedance. The exposed-conductive-parts of the electrical installation are earthed independently or collectively. The IT systems are generally used for special applications such as operation theater in hospitals. It is not intended for use in lifts (*see* Fig. 14).

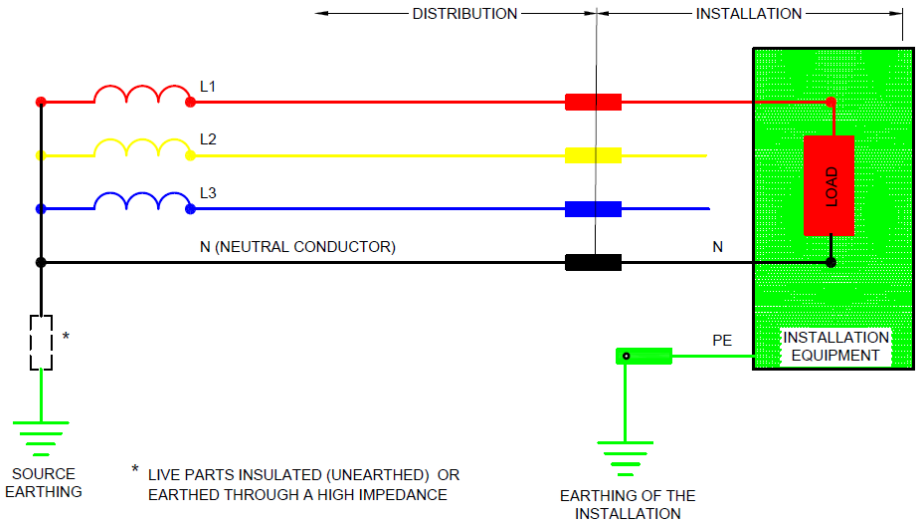


FIG. 14 IT system

6.2.3.5 *Basic purpose of earth fault protection*

The occurrence of an earth fault in an installation creates two possible hazards:

a) Firstly, voltages appear between exposed conductive parts and extraneous conductive parts, and if these parts are simultaneously accessible, these voltages constitute a shock hazard, this condition is known as indirect contact.

b) Secondly, the fault current that flows in the phase and protective conductors of the circuit feeding the faulty equipment may be of such a magnitude as to cause an excessive temperature rise in those conductors, thereby creating a fire hazard.

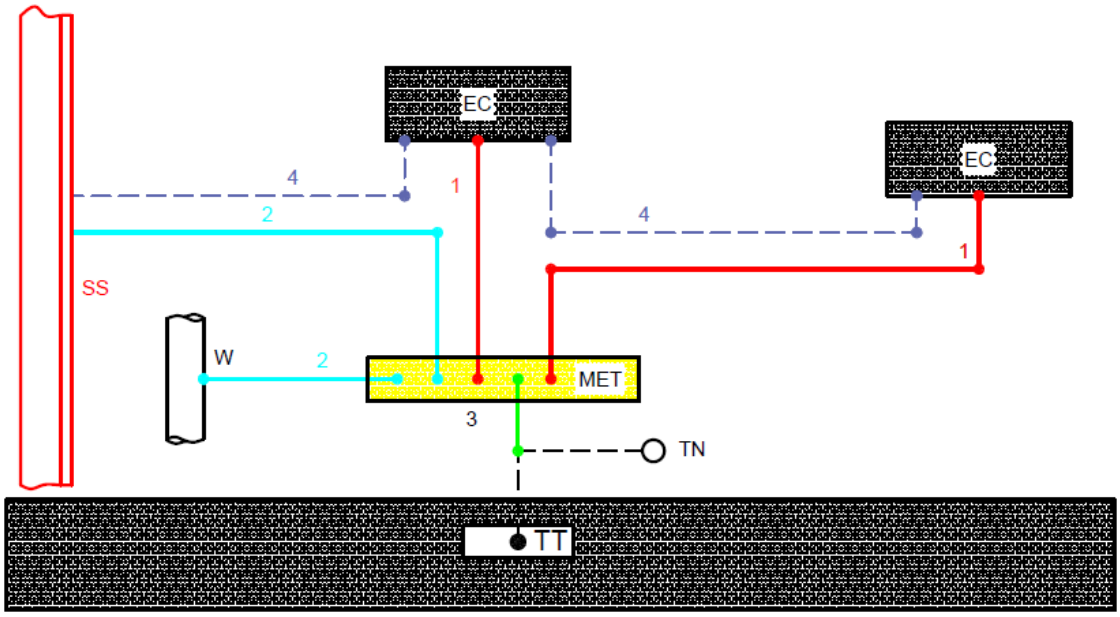
The protective measure known as protective equipotential bonding and automatic disconnection of the supply is intended to provide a high degree of protection against both hazards. The choice of protective device for disconnection is influenced by the type of system of which the installation is a part, because either:

a) The earth fault loop impedance shall be low enough to allow adequate earth fault current flow to cause an overcurrent protective device (for example, a fuse or circuit breaker) in the faulty circuit to operate in a sufficiently short time; or

b) Where it is not possible to achieve a low enough earth fault loop impedance, disconnection may be initiated by fitting a residual current device (RCD).

6.2.3.6 *Protective equipotential bonding*

Protective equipotential bonding is through connecting extraneous conductive parts in a building to the main earthing terminal of the installation by protective bonding conductors. Where such conductive parts originate outside the building, they shall be bonded near their entry point within the building.



KEY
EC - EXPOSED CONDUCTIVE PART (PART BOARD BODY)
MET - MAIN EARTHING TERMINAL
SS - STRUCTURAL STEEL (EXTRANEOUS CONDUCTIVE PART)
W - METALLIC WATER PIPE (EXTRANEOUS CONDUCTIVE PART)
TT - EARTH ELECTRODE IN A TT OR IT SYSTEM
TN - OTHER MEANS OF EARTHING IN A TN SYSTEM, FOR EXAMPLE, CONNECTION TO EARTHED POINT OF THE POINT OF THE POWER SYSTEM

1 - CIRCUIT PROTECTIVE CONDUCTOR
2 - MAIN PROTECTIVE BONDING CONDUCTOR
3 - EARTHING CONDUCTOR
4 - SUPPLEMENTARY PROTECTIVE BONDING CONDUCTORS (ADDITIONAL BONDING, IF REQUIRED)
1,2,3,4 - PROTECTIVE CONDUCTORS

FIG. 15 ILLUSTRATION OF EARTHING AND PROTECTIVE CONDUCTORS

In each building the earthing conductor, the main earthing terminal and the following conductive parts shall be connected to the protective equipotential bonding:

a) Metallic pipes supplying services into the building, for example, gas, water;

b) Structural extraneous conductive parts, if accessible in normal use, metallic central heating and air-conditioning systems; and

c) Metallic reinforcements of constructional reinforced concrete, if reasonably practicable.

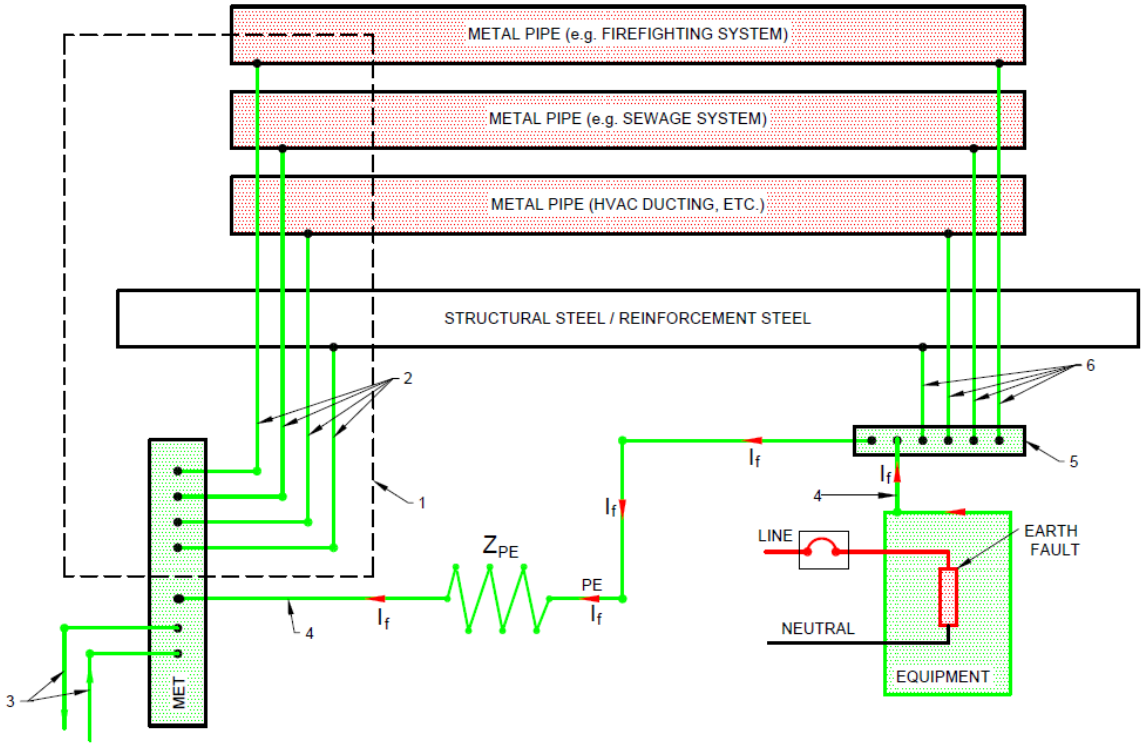


FIG. 16 ILLUSTRATION OF MAIN AND ADDITIONAL PROTECTIVE EQUIPOTENTIAL BONDING

The connection of various conductors in an earthing arrangement shall be proper. The connection shall be by exothermic welding, pressure connectors, clamps or other suitable mechanical connectors. Mechanical connectors shall be installed in accordance with the manufacturer's instructions. Where a clamp is used, it shall not damage the electrode or the earthing conductor.

Two separate copper protective earthing conductors shall be provided from Main Earthing Terminal to Lift Controller. Refer to Table 25 for cross sectional area of protective conductor.

Table 25 Cross Sectional Area of Protective Conductor
(*Clause* 6.2.3.6)

Sl No.	**Cross-sectional Area of Line Conductor, *S*** mm^2 Cu	**Minimum Cross-sectional Area of the Corresponding Protective Conductor** mm^2 Cu
(1)	(2)	(3)
i)	$S \leq 16$	S
ii)	$16 < S \leq 35$	16
iii)	$S > 35$	0.5*S*

Earthing system above 230 V should be designed as a Protective Multiple Earthing (PME) system with separate protective conductor (TN-S). Protective multiple earthing system shall be implemented to reduce the earth fault loop impedance and to ensure reliable disconnection of supply during an earth fault by the Over Current Protective Device (OCPD), for example MCB/MCCB. In PME system, neutral of the supply transformer and the non-current carrying metal parts in the system are interconnected by the common earth grid, in addition to the separate protective conductor.

Hence, it is recommended to have TN-S system with PME, where the neutral of the source and exposed conductive parts in the installation are solidly connected to the MET and an earthing grid. In this interconnected system, earth fault current is returned to the neutral, through the interconnected system consisting of the PE conductor and earth grid. Protective Earth (PE) conductor shall run in parallel and proximity to line conductors.

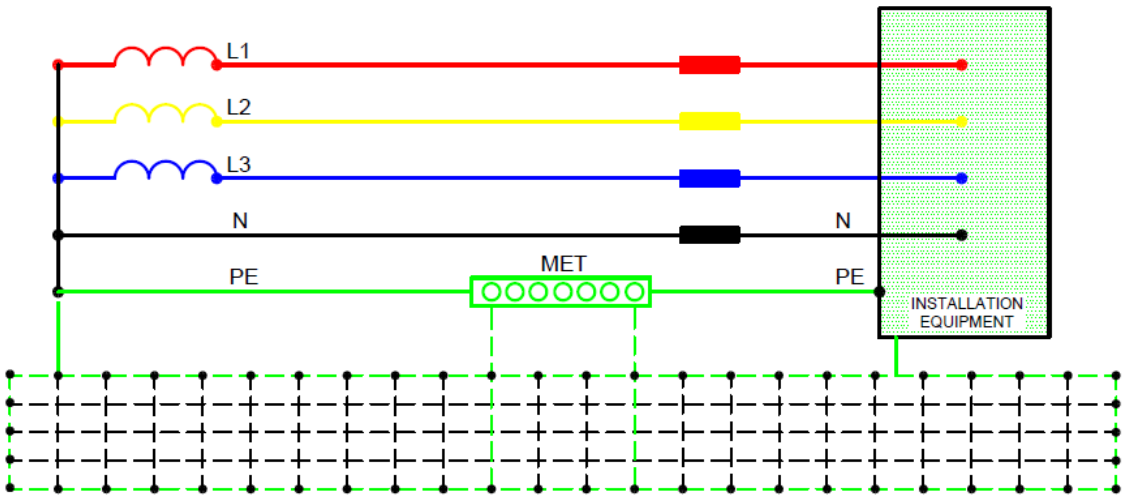


FIG. 17 SYSTEM WITH SEPERATE EARTH CONDUCTOR (TN-S) WITH PROTECTIVE MULTIPLE EARTHING (PME), RECOMMENDED FOR INDUSTRIAL AND COMMERCIAL USE

The continuity resistance of the earth return path through the earth grid shall be less than one ohm.

6.2.3.7 *Automatic disconnection of power supply in case of a fault*

Automatic disconnection of supply is a protective measure in which:

a) Basic protection is provided by basic insulation of live parts or by barriers or enclosures; and

b) Fault protection is provided by protective equipotential bonding and automatic disconnection in case of a fault in accordance with **4.2.11.3** to **4.2.11.6** of [8-5A(15)].

A protective device shall automatically interrupt the supply to the line conductor of a circuit or equipment in the event of a fault of negligible impedance between the line conductor and an exposed-conductive-part or a protective conductor in the circuit or equipment within the disconnection time specified in **4.3.11.2.2, 4.3.11.2.3 and 4.3.11.2.4** of [8-5A(15)].

If automatic disconnection cannot be achieved in the time required, supplementary protective equipotential bonding shall be provided as specified in **4.2.15.2** of [8-5A(15)].

In general, every circuit is provided with a means of overcurrent protection. If the earth fault loop impedance is low enough to cause these devices to operate within the specified times (that is, sufficient current can flow to earth under fault conditions), such devices may be relied upon to give the requisite automatic disconnection of supply. If the earth fault loop impedance does not permit the overcurrent protective devices to give automatic disconnection of the supply under earth fault conditions, the first option is to reduce that impedance. It may be permissible for this to be achieved by the use of protective multiple earthing or by additional earth electrodes.

An alternate approach is to be adopted for the complete safety of the operating personnel and equipment from the hazards that may result from earth faults. This is to use residual current devices with appropriate settings to clear the faults within the permissible time, based on the probable contact potential. This method is equally applicable where earth loop impedances cannot be improved.

6.2.3.8 *Residual Current Device (RCD)*

RCD's can be used for fault protection and additional protection. RCD is used for automatic disconnection of supply during earth fault, in case of failure of this protection by OCPD/MCB. The good practice given in [8-5A(15)] recommends that in locations where fault protection is achieved by 500 mA RCD, earth fault loop impedance test is not required.

RCD of $I_{\Delta n}$ ≤30 mA shall be used as an additional protection against electric shock in locations where the chance of shock is high.

In addition to giving protection against earth fault or shock protection, RCD’s may also give fire risk protection, the degree of protection being related to the sensitivity of the device and magnitude of leakage current. The good practice given in [8-5A(15)] recommends use of 300 mA RCD for protection against fire in building due to leakage current.

Residual current device (RCD), when provided, right type and sensitivity shall be selected.

The RCD shall,

a) have maximum rating of $I_{\Delta n}$ 500 mA as tripping current are suitable for frequency converters with a 3-phase supply against Earth faults.
b) be sensitive for sinusoidal currents up to 1 000 Hz, and insensitive for currents more than 1 000 Hz.

NOTE – National Electrical Code of India 2023 recommends Type B RCD for applications which may create smooth DC residual current, for example, three-phase variable frequency drive.

6.2.3.9 Reinforced protective earthing conductors for currents exceeding 10 mA in the protective earthing conductor

For lifts with ACVF of higher KVA ratings if the current in the protective earthing conductor exceeds 10 mA the following applies:

a) where the ACVF has only one protective earthing terminal, the protective earthing conductor shall have a cross-sectional area of at least 10 mm2 Cu or 16 mm2 Al, through its total run;

NOTE — Refer [8-5A(15)] Clause 5.4.3.4.

b) where the ACVF has a separate terminal for a second protective earthing conductor, a second protective earthing conductor of at least the same cross-sectional area as required for fault protection shall be run from a point where the protective earthing conductor has a cross-sectional area not less than 10 mm^2 Cu or 16 mm^2 Al.

6.2.3.10 *Additional protection*

Additional protection by means of a residual current device (RCD) with a rated residual operating current not exceeding 30 mA shall be provided for:

a) socket outlets;
b) control circuits for landing controls and indicators and the safety chain with voltage higher than 50 V AC;
c) circuits on the lift car with voltage higher than 50 V AC.

This requirement is to protect persons from direct shock risk. It is different to automatic disconnection of supply offered by residual current device (RCD) > 30 mA as they are intended to protect persons from indirect shock risk to persons in contact with earthed part. Due to the inherent leakages from electronic devices such as power supplies and VFD's an RCD of 30 mA as a fault protective measure could create unwanted tripping due to excessive PE conductor current. Refer **5.3.2.2.1.3** of [8-5A(15)]. Therefore 3-phase power supply for the lift should never be protected with a 30 mA residual current device (RCD). The 30 mA RCD trips easily when the lift starts to drive and prevents the lift to run. If the construction-time power supply is for some reason protected with a 30 mA residual current device (RCD), suitably sized isolation transformer needs to be provided by the electrical contractor.

6.2.3.11 *Earth fault loop impedance*

The impedance of the earth fault current loop (phase to earth loop) starts and ends at the point of earth fault. See Table 26 for the recommended values. The earth fault loop comprises the following, starting at the point of fault:

a) The circuit protective conductor;
b) The consumer's earthing terminal and earthing conductor, and for Terre-Neutre (TN) systems, the metallic return path;
c) For terra-terra (TT) and isolated-terra (IT) systems, the earth return path;
d) The path through the earth neutral point of the transformer;
e) The transformer winding; and
f) The line conductor from the transformer to the point of fault.

Table 26 Recommended Maximum Earth Fault Loop Impedance Values (Z_s) for MCBs
(*Clause* 6.2.3.11)

Sl No.	**MCB rating** Amp	**Z_s** Ω		
		Type B MCB	Type C MCB	Type D MCB
(1)	(2)	(3)	(4)	(5)
i)	6	5.11	2.56	1.28
ii)	10	3.07	1.53	0.77
iii)	16	1.92	0.96	0.48
iv)	20	1.53	0.77	0.38
v)	25	1.23	0.61	0.31
vi)	32	0.96	0.48	0.24
vii)	40	0.77	0.38	0.19
viii)	50	0.61	0.31	0.15
ix)	63	0.49	0.24	0.12
x)	80	0.38	0.19	0.10
xi)	100	0.31	0.15	0.08
xii)	125	0.25	0.12	0.06

6.2.3.12 *Verification of effectiveness of automatic disconnection*

The effectiveness of the measures for protection against indirect contact by automatic disconnection of supply shall be verified according to **6.3.2.6** and **6.2.3.7** of [8-5A(15)]

Ensuring effectiveness of automatic disconnection of earth fault is essential in every lift. For this, earth fault loop impedance must be measured and compared

with the characteristics of OCPD/MCB or test the disconnection time of RCD which is installed as an earth fault protective measure. This test shall be carried out before the lift is released for public usage.

NOTE

1 In TN systems, fault protection (protection against indirect contact) shall be offered by;
– overcurrent protective device (MCB / MCCB);
– residual current protective devices (RCDs).

2 In TT systems, RCDs shall be used for fault protection.

3 Where an RCD is used for fault protection:
a) The circuit shall also be protected by an overcurrent protective device that is, Standalone RCD shall not be used.
b) The disconnection time shall be according to Table 27.
c) Fault protection is provided in this case also if the fault impedance is not negligible.

Table 27 Minimum Disconnection Time
(*Clause* 6.2.3.12)

Sl No.	**Voltage** V	**Disconnection Time** s			
		TN System		TT System	
		a.c.	d.c.	a.c.	d.c.
(1)	(2)	(3)	(4)	(5)	(6)
i)	50 $< U_o \leq$ 120	0.8	Note 1	0.3	Note 1
ii)	120 $< U_o \leq$ 230	0.4	5	0.2	0.4
iii)	230 $< U_o \leq$ 400	0.2	0.4	0.07	0.2
iv)	$U_o >$ 400	0.1	0.1	0.04	0.1

The terminal for the earthing of the frame of the motor, the winding machine, the frame of the control panel, and similar electric appliances which normally carry the main current shall be at least equivalent to a 10 mm diameter bolt, stud or screw.

The terminal for the earthing of the metallic cases and covers of door interlocks, door contacts, call and control buttons, stop buttons, car switches, limit switches, junction boxes and similar electrical fittings which normally carry only the control current shall be at least equivalent to 5 mm brass screw (such terminal being one specially provided for this purpose), and the earth conductor size shall be at least equivalent to 0.5 mm^2 copper.

The earth conductor shall be secured to earthing terminal in accordance with the recommendations made in good practice [8-5A(8)] and also in conformity with the latest provisions of *Electricity Act*, 2003 and the Rules framed thereunder from time to time.

The exposed metal parts of electrical apparatus installed on a lift car shall be sufficiently bonded and earthed.

Where screwed conduit screws into electric fittings carrying control current making the case and cover electrically continuous with the conduit, the earthing of the conduit may be considered to earth the fitting. Where flexible conduit is used for leading into a fitting, the fitting and such length of flexible conduit shall be effectively earthed.

7 FIREMEN PROTECTION REQUIREMENTS FOR LIFTS AND EVACUATION LIFTS

7.1 Fire Protection Requirements of Lifts in High Rise Buildings

7.1.1 *Buildings of Height 15 m and Above*

Following requirements over and above those specified in **6** and **8** are applicable to all lifts provided in buildings having height more than 15 m.

a) All materials of constructions in load bearing elements, stairways and corridors and facades shall be non-combustible.

b) The interior finishing materials shall be very low flame spread.

c) Walls of the lift well enclosure for a lift or group of lifts shall have a fire rating of 2 h. The lift well shall have a vent at the top of area not less than 0.2 m^2 per lift.

d) *Landing doors* – Lift landing doors shall be imperforate. Collapsible doors shall not be permitted. Lift landing doors shall have a minimum fire resistance rating of 1 h for integrity as per [8-5A(19)].

e) *Lift car door* – Lift car doors shall be imperforate. Collapsible car doors shall not be permitted.

f) Telephone or other communication facilities shall be provided in the lift car and the lift main lobby. Communication system for lifts shall also be connected to the fire control room of the building if provided. For lifts for use by persons with disabilities, the facilities shall be provided in accordance with **13** of Part 3 ‘Development Control Rules and General Building Requirements’ of the Code.

g) Photo luminescent safety signs shall be posted and maintained on every floor at or near the lift indicating that in case of fire, occupants shall use the stairs unless instructed otherwise. The sign shall have the plan of the

respective floor showing location of the stairways. The plan shall indicate the direction to and the level of refuge floors. All signs posted and maintained on every floor of buildings open to and used by the public shall comply with the requirements of accessible signage given in **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code.

h) All lifts (fireman's lifts/non fireman's lifts) shall be provided with Phase I operation as per **7.1.1**(j) (grounding operation).

i) The grounding operation may be initiated by individual switches for lifts or a common switch for a group of lifts or by a signal from smoke detector / fire alarm system of the building if available.

j) *Fireman's lift* – The fireman's lift is provided in a building for the purpose of aiding firemen in evacuating trapped persons in the building and to take the equipment for fighting fire to upper levels with minimum delay. Some lifts out of all the lifts shall be identified as fireman's lifts.

The number of required fireman's lifts and their locations in a building will vary depending on the size, design, complexity of the building. Some considerations are as follows:

1) There shall be at least one fireman's lift per building.
2) If there are multiple wings in the building, there shall be at least one fireman's lift per wing.
3) If there are multiple banks of lifts in the building there shall be at least one fireman's lift per bank of lifts.
4) If the building height is up to 600 m and it is zoned height-wise and it does not have fireman's lift serving every floor of the building, then there shall be at least one fireman's lift per zone which shall serve the main level/fire access level and shall serve all the landings in the respective zone.
5) If the building height is more than 600 m and it does not have any single lift serving all the floors, that is, it has all lifts serving only respective zones, the fireman's lift shall be provided in each zone separately, serving all landings in respective zone, with a transfer landing for transferring from one zone to another.

Considering all above the fireman's lift(s) shall be identified on the building plan by the concerned firefighting authority. This shall be respected.

To be effective in firemen operation the fireman's lift(s) shall be identified on the building plan and duly displayed in Fire Command Center.

i) The fireman's lift may be used by the occupants in normal times.

ii) The fireman's lift shall be provided with a fireman's switch. The switch shall be a two position (ON/OFF) switch fixed at the evacuation floor (normally main entrance floor) to activate fireman's mode. The switch shall be housed in a box with glass cover along with suitable label and fixed adjacent to the lift at the entrance level. When the switch is turned on, all landing operating panels shall become inoperative and the lift shall operate only from car operating panel or priority control device. When the switch is off, the lift will return to normal working.

iii) The fireman's lift shall be provided with an audio and visual signal in the car.

iv) The fireman's lift shall have a floor area of minimum 1.43 m^2. It shall have loading capacity of not less than 544 kg (8 persons lift).

v) The fireman's lift shall be provided with power operated (automatic) doors of minimum 0.8 m width.

vi) The speed of the fireman's lift shall be 1.0 m/s or more such that it can reach the top floor from main floor/ fireman access level within 1 min. In case the building is zoned, the fireman's lift shall operate from the lowest served landing to the topmost served landing in 1 min.

NOTE – Notwithstanding the above, the speed of lifts shall be established based on **4**.

vii) Reliable back up source of power supply shall be provided for all firemen lifts through automatically operated change-over switch. In case of failure of normal electric supply, it shall automatically changeover over to alternate supply. The route of wiring shall be safe from fire.

viii) The normal power feeders and back up power feeders shall be provided with 2 h fire resistance rated enclosures until they reach the machine room/controller.

ix) Suitable arrangements such as providing slope in the floor of lift lobby shall be made at all the landings to prevent water used during firefighting from entering the lift shafts.

x) The fireman's lift well and machinery spaces shall not contain sprinklers.

xi) The words 'FIREMAN LIFT' shall be conspicuously displayed in fluorescent paint/colour on the lift landings at each floor level.

xii) *Operational requirements of fireman's lift* – The lift shall be provided with the following operational controls, phase I and phase II.

a) Phase I: Return to evacuation floor – Shall start when the fireman's switch at the evacuation floor is turned to the 'ON' position or the signal from smoke detector/fire alarm system (if provided by the Building Management System) is on. All lifts controlled by this switch / signal shall cancel all existing car calls and separate from landing calls and no landing or car calls shall be registered. The audio and visual signal shall be turned on. All heat and smoke-sensitive door reopening devices shall be rendered inoperative.

If the lift is travelling towards the evacuation floor, it shall continue driving to that floor.

If the lift is travelling away from the evacuation floor, it shall reverse its direction at the nearest possible floor without opening its doors and return non-stop to the evacuation floor.

If the lift is standing at a floor other than the evacuation floor, it shall close the doors and start travelling non-stop to the evacuation floor.

When at the evacuation floor the lift shall park with doors open.

The continuous audio signal is turned off after this return drive. The visual signal shall remain activated until the lift is restored to normal operation.

NOTE – If the building is designed for alternative evacuation floor, in case of fire at main floor the lifts shall park at the alternative evacuation floor with doors open.

b) Phase II: Operation of the lift shall be as defined below – The phase II is started after phase I, if the fireman's switch is 'ON'.

If the lifts are grounded by the signal from smoke detector/fire alarm system, for phase II to begin it shall be necessary to turn the fireman's switch 'ON'.

The lift does not respond to landing calls but registers car calls. All heat and smoke sensitive door reopening devices are rendered inoperative.

When the car call button is pressed the doors start closing. If the button is released before the doors are fully closed, they re-open. The car call is registered only when the doors are fully closed.

After registering a car call the lift starts driving to the call. If more than one car call is registered, only the nearest call is answered and the remaining calls will be cancelled at the first stop.

At the floor the doors are opened by pushing the door open button. If the button is released before the doors are fully open, they re-close.

The lift returns to normal service when it stands at the evacuation floor with doors open and the switch is turned 'OFF' thereafter.

The operation of fireman's lift shall be by means of a full set of push buttons in the car. Other operating systems shall be rendered inoperative.

7.1.2 *Buildings of height 60 m and above*

The following requirements over and above those specified in **7.1.1** are applicable to the lifts and lift enclosures provided in buildings having height more than 60 m.

a) *Fireman's lifts* — Following additional requirements apply to all fireman's lifts in the building.

1) The fireman's lift shall have loading capacity of not less than 1 000 kg and floor area not less than 2.35 m^2.

2) Electrical equipment within the fireman's lift well and on the car, located within 1.0 m of any wall containing a landing door, shall be protected from dripping and splashing water or provided with enclosures classified to at least IPX3 according to good practice [8-5A(9)].

3) The electrical switchgear placed less than 1 m above lift pit floor shall be protected to IP 67 as per to good practice [8-5A(9)]. The socket outlet and lowest lamp shall also be located at least 0.5 m above the highest permissible water level in the pit.

4) Suitable means shall be provided in the lift pit to ensure that water will not rise above the level of the fully compressed car buffer.

5) Means shall be provided to prevent the water level in the pit from reaching equipment which could create a malfunction of the fireman's lift.

6) Alternative source of power supply shall be provided for all fireman's lifts through automatically operated changeover switch. In case of failure of normal electric supply, it shall automatically change over to alternative supply. The route of wiring shall be safe from fire.

b) There shall be Fire Command Centre (FCC) and/or Building Management System (BMS) room in the building. CCTV cameras shall be fixed in the lift lobbies and the display screen(s) shall be placed in the FCC or BMS room.

7.2 Evacuation Lifts

Buildings, particularly super high rise (height more than 200 m) buildings, may be designed for a systematic evacuation of persons in case of emergencies that are relevant to a specific building. There are many reasons why a building may need to be evacuated, for example, a fire, explosion, chemical or biological attack, flooding, storm damage, earthquake etc. Not all of these are relevant to every building hence those which are not relevant can be disregarded. Designers of buildings shall determine if a particular hazard is sufficiently great as to require addressing. This clause deals primarily with fire situation although similar logic can be used in case of other situations as well.

It defines intended use of the lift(s) by persons in order to assist the evacuation, either partial or complete, of a building in case of a fire emergency in the "golden period" that is, after detection of the fire and before arrival of the fire brigade at the affected building; so long as use of the lift(s) is safe, thereby preventing possible human casualties, especially in case of complex high-rise buildings.

The lifts may be planned only supplementary to, not as a replacement of, exits. In fact, using lifts instead of stairs may well increase evacuation times in many building designs, especially low and medium rise buildings. However, lifts may be allowed to play a positive role in assisting and improving efficiency of the building evacuation strategy especially for persons with disabilities. The building designers should decide, if they want to use lifts for evacuation purpose. It may be noted that in general a fireman's lift may be suitable as an evacuation lift. Three evacuation operation methods are possible for lifts to be used for evacuation of persons. One or a combination thereof may be selected based on the building type and fire evacuation strategy planned for that building.

a) Automatic evacuation operation
b) Remote assisted evacuation operation
c) Manually assisted evacuation operation

To ensure that the lift(s) is available in the event of an evacuation, following principles shall be considered:

a) The evacuation strategy and process has been defined consistent with the operation of the evacuation lift(s) as described here.
b) Building requirements mentioned in this document are followed.
c) Until the evacuation of persons is complete, the evacuation strategy and process ensure that the evacuation lift(s) is dedicated to their evacuation.

The number and size of lifts required, or the size of door opening shall be determined on a case-by-case basis by the building designer for calculating the number of lifts required, and the fire evacuation plan for the building, in collaboration with lift specialists and fire officials.

In case of an emergency, the usual way for the occupants of a building to escape to an exit floor by taking to the building stairs shall continue to be available.

7.2.1 *Pre-requisites to Using Lifts for Evacuation in Case of Fire*

7.2.1.1 Building interface and requirements for implementing an evacuation lift(s)

Evacuation Operation has been designed with the assumption that the following building provisions are in place.

1) The building shall be constructed and shall not sustained structural damage, for example, from fire, explosion, flood, lightning strike, earthquake, storm, etc.

2) The automatic sprinkler system required ~~by the building code~~ is installed except that sprinklers in lift machine rooms and in hoist ways are prohibited.

3) The building shall be provided with a means to protect the lift(s) from the effects of fire and smoke at every landing, a safe area directly outside the lift door, and fire-resistant structure, etc.

4) The lift lobby at each floor shall be enclosed and separated from the remainder of the floor by a smoke barrier. The lift lobby door shall be 2 h fire rated & shall close automatically upon initiation of building fire alarm. The lift lobby shall be large enough to accommodate at least 25 percent of the floor population at 0.28 m^2 per person.

5) The lift lobbies & staircase shall be pressurized, if required, see Part 4 of the Code ~~as per the National Building Code of India~~.

6) The lift lobbies shall be provided with CCTV cameras with the monitor located in FCC / BMS room.

7) Fire / smoke / temperature detection shall be provided in the building in a thoughtful manner in all areas of the building including lift shaft, machine room, lift lobbies, etc.

8) Activation of any of those detectors which signifies unsafe operating environment for the evacuation lift(s) shall initiate phase I operation of the fireman's / non fireman's lift; and suspend the evacuation operation.

9) The fire alarm system may have a provision to automatically send public announcement messages to the residents of the floor with active alarm & to the residents of two upper & two lower contiguous floors.

10) Power supplies shall be secure and reliable, the provision of a secondary supply is essential. The cable providing power to the lift(s) shall be fire protected to the same fire protection level as given to the lift well structure.

12) The secondary power supply shall be sufficient to run the evacuation lift at the rated load and rated speed for a minimum period equal to the planned evacuation time consistent with the evacuation strategy.

13) The car lighting shall be also supplied by secondary power supply.

15) The normal power feeders & back up power feeders shall be provided with 2 hr. fire resistance rated enclosures until they reach the machine room/controller.

16) The source of the secondary supply, the level of independence between the primary and secondary supplies.

17) The source of the secondary power supply and automatic switch gear shall be located in a fire protected area.

18) The building shall be designed to minimize the risk of flooding into the lift or lift well. To this end; sprinkler discharge, burst pipes, fire hose, etc. should not be located to discharge towards the lift, and any water close to the lift should be directed away from it by sloping floors etc.

19) Water sensor shall be provided in the pit to shut down the lift in case the operation becomes unsafe due to accumulation of water in the pit.

20) Interior exit stairwell doors if locked, shall automatically unlock permitting exit and reentry upon setting of alarm.

21) The lift shall be maintained, and the evacuation operation shall be tested at suitable regular intervals.

22) The building shall have a fire safety and evacuation plan specifically including procedures for evacuation using stairs and lifts, the role of wardens, a routine training and drills for occupants.

23) Training shall include the message that lifts shall not be used for evacuation in buildings not having lifts provided with special Occupant Evacuation Operation.

24) The machine room and lift lobbies shall be maintained with minimal fire load.

25) Responsibility for safe evacuation shall rest with and shall be in the control of a trained person(s) located at the building premises.

26) Those with a disability shall be evacuated with the help of specially trained persons or with their personal assistant.

7.2.1.2 Detecting fire, smoke, and temperature

Methods of fire detection are well established. If the lifts are to operate a safe evacuation service, good monitoring of the fire in relation to lift equipment is essential.

To ensure the safety of users and lift equipment; the lift machine room, lift well (including lift pit and overhead areas) and landing areas shall be provided with means to detect and monitor for the presence of smoke and heat. Temperature in any safe area provided for persons to wait (lobby, refuge, etc) and the lift well, machine room, etc, should be continuously monitored to determine if it is safe and remains safe for persons and equipment. When an unsafe temperature or presence of smoke is detected the information should be sent to the BMS or FCC. The BMS or FCC should determine what is to be done next and send appropriate signals to the lift, for example remove lift from service at floor x with doors parked open or closed as required. The equipment used for this sensing and monitoring of heat and smoke should be specified by those responsible for the design of the building fire and smoke detection system and not the lift manufacturer.

7.2.1.3 Location of an event in relation to lifts

In detecting an event like fire it will be important to know its location in relation to any lift intended for evacuation use. Experts in fire detection systems and lift experts should be consulted to determine the best solution for the design in

question. The more the level of sophistication of detection system employed, the more precise will be the level of information available to make decisions and more meaningful these decisions will be. The building designer shall determine the degree of sophistication required taking into account the importance of the building, type of occupancy, etc.

7.2.1.4 *Emergency power provisions*

Secondary (emergency) power shall be provided that has sufficient capacity to run all the evacuation lifts at full speed for the required evacuation time. The route of the wiring shall be safe from fire.

7.2.2 *Operational Decisions for Evacuation*

7.2.2.1 *Types of evacuation*

The evacuation strategy developed should lead to an obvious evacuation type. Lifts will not be able to evacuate all floors at once, so to some degree a systematic evacuation will be governed by the capacity of lifts and the number of persons to be evacuated. Lift engineers can calculate the number of persons that can be moved for a given set of circumstances but the first thing to determine is the number of persons to be evacuated within the required evacuation time. Fire engineers and other experts shall determine these figures. It shall also be determined what proportion of wheel chair and others with impaired mobility may be there and if there is likely to be a floor or building area with a particular concentration of them.

In many instances some sort of phased evacuation will be desirable while at other times a full evacuation may be essential. Phased evacuation involves the evacuation of certain areas first, usually those floors areas at greatest risk followed by other key areas. Also, there could be horizontal evacuation, partly or fully, for example, in case of hospitals.

The entire 7.2.2 (until 7.2.2.2.4.1) is reworded. Comments are solicited.

7.2.2.2 *Evacuation Process*

There are 3 types of lift operation methods to hasten the building evacuation process.

a) *Automatic evacuation operation* – The evacuation operation is completely automatic,

b) *Remote assisted evacuation operation* – The evacuation operation is controlled remotely by the “remote evacuation assistant”,

c) *Manually assisted evacuation operation* – The evacuation operation is controlled by an assistant in the car “manual evacuation assistant”.

The type of Evacuation Operation(s) to be deployed in a building shall depend on the specific building fire evacuation strategy. The evacuation service shall be operational between the floors as decided by the building designer. The logic of operation shall be mutually agreed between the building designer, the lift designer, and the fire expert.

7.2.2.2.1 Evacuation Process (Phase 1)

7.2.2.2.1.1 Initiation of evacuation service

Evacuation service shall be initiated by a two-position switch. The two-position switch for the evacuation operation having START– STOP functions shall be provided at the emergency exit lobby (EEL) for the manually assisted evacuation operation**,** &/or a switch at the remote-control panel located in FCC/BMS room for the remote assisted evacuation**,** & / or another switch at the remote control panel for the automatic evacuation operation**.**

This switch shall enable either starting (START) or stopping (STOP) the evacuation process. When this switch is turned to START position, the lift system shall be ready to evacuate all floors served by that group of lifts.

7.2.2.2.1.2 On activation of the evacuation service, the lift shall behave as described below:

a) All registered car and landing calls shall be cancelled and no new calls shall be registered;

b) In the car the door re-open button, the door close button, and the door protective device shall remain operative.

c) The lift, occupied or unoccupied, shall proceed to the EEL as follows; except in case of Automatic evacuation operation wherein the lift if unoccupied, shall proceed to the affected floor directly as per the pre-determined priority logic for serving the affected floors; and park there with doors closed till a landing call from the affected floor is initiated.

    1) A car stationary at a landing in no call condition, shall close the doors if open, and travel nonstop to the active EEL.

2) Visual indication in car operating panel shall display “Evacuation Service”.

3) A car travelling away from the active EEL shall make a normal stop at the nearest landing without opening the doors, make an audible message such as “Evacuation Service” and return to the active EEL.

4) A car travelling towards the active EEL shall continue its travel nonstop to EEL.

5) If the lift has already started stopping at a level, it shall continue to make a normal stop and without opening the doors, with message displayed “Evacuation Service”, proceed to the active EEL.

6) On reaching at the active EEL, the evacuation lift car shall open its door and shall provide an audio-visual indication “Exit Lift”. The audible signal shall have a sound level of between 35 dBA and 55 dBA adjustable to suit the site conditions with a typical recommended level of 50 dBA.

7) If the door is not closed at the active EEL after 20 s, the protective device shall be made inactive, the doors shall attempt to close and an audible signal shall sound in the car until the doors are closed.

8) To start the evacuation service:

   i) in case of Automatic evacuation operation, any landing call at the affected floor(s) shall initiate the travel of the lift to that floor as per priority logic decided,

   ii) in case of Remote assisted evacuation operation, the person-in-charge at the remote-control panel shall initiate the travel of the lift to the affected floor,

   iii) In case of Manually - assisted evacuation operation, pressing the car call button at car operating panel (COP) shall initiate the travel of the lift to the affected floor.

7.2.2.2.2 Evacuation service (Phase 2)

After the evacuation service (Phase 1) is completed and any type of evacuation operation signal is active, the lift shall operate in Phase 2 as follows:

7.2.2.2.2.1 Automatic evacuation operation

a) when automatic evacuation signal is active and when no higher priority signal is active, the lift shall operate in automatic evacuation operation and shall serve registered landing calls.

b) The priority of answering the landing calls shall be based on the distance from the active EEL, with the furthest landing call getting highest priority.

c) On arrival at a landing other than the active EEL, the car shall open the doors and give a voice announcement as “Evacuation Service. Enter the car”.

d) Once the doors are closed, the car shall proceed towards the active EEL. If the car is empty, it may respond the next landing call without visiting the active EEL.

e) The car if not full, may serve other landing calls on the way to the active EEL. If the car makes stops on the way to the active EEL, it shall provide audio-visual indication “Do Not Exit”. The audible signal shall have a sound level of between 35 dBA and 55 dBA adjustable to suit the site conditions with a typical recommended level of 50 dBA.

f) Actuation of the landing call booking device shall not prevent a loaded car from closing its doors and leaving the floor.

g) On arriving at the active EEL, the evacuation lift car shall open its door and shall provide an audio-visual indication “Exit Lift”. The audible signal shall have a sound level of between 35 dBA and 55 dBA adjustable to suit the site conditions with a typical recommended level of 50 dBA.

7.2.2.2.2.2 Deactivation of automatic evacuation operation

Automatic evacuation operation shall cease when -

a) the automatic evacuation signal is deactivated; or
b) the remote assisted evacuation signal is activated; or
c) the manually assisted evacuation signal is activated; or
d) the suspend service signal is activated; or
e) The lift receives phase1 signal of the fireman's control.

In these cases, the car shall return to the active EEL.

7.2.2.2.3 Remote assisted evacuation service

Remote assisted evacuation is the evacuation under the control of an authorized person (“remote evacuation assistant”), who controls the lift from remote evacuation control panel located in BMS/FCC room in the same building.

NOTE – Remote assisted evacuation operation shall be subjected to cybersecurity. Cybersecurity of industrial control systems are specified in the IEC 62443 series of standards and in the cybersecurity standard ISO 8102-20.

In the remote assisted evacuation operation, control from outside the lift car that is,, from a remote location, is permitted provided there are communication means between the remote-control location and the lift car. The use of remote assisted evacuation and the communication means shall be selected based on building evacuation strategy.

Activation of the remote assisted evacuation operation shall override the automatic evacuation signal, if any.

7.2.2.2.3.1 Remote assisted evacuation operation

After the completion of Phase1 of evacuation service, if the remote assisted evacuation signal is active and no higher priority signal is active, the lift shall operate as per details below.

a) Information sharing between the lift and the remote evacuation control panel shall be opened by the lift control.

b) After communication sync is established, the remote evacuation control panel is activated to operate in remote control mode.

c) The alarm button and door open button in the car operating panel shall remain operative; and other controls of the lift shall be operable solely from the remote evacuation control panel.

d) The remote evacuation control panel shall have displays indicating the registered landing calls, car position and direction of travel, and car door status.

e) A call registered through remote evacuation control panel shall cause the lift doors to close and the car to travel to the required landing.

f) If the door closing is prevented by a door protective device, a separate door close command from remote evacuation control panel shall bypass the protective device and the doors shall attempt to close.

g) At any time, it shall be possible to register a new call from the remote evacuation control panel. The previous call shall be cancelled. The car shall travel in the shortest time to the newly registered landing.

h) On arrival at a landing, the lift shall open the doors and shall provide an audio-visual indication “Evacuation Service. Enter the car”. The audible signal shall have a sound level of between 35 dBA and 55 dBA adjustable to suit the site conditions with a typical recommended level of 50 dBA.

j) On arriving at the active EEL, the evacuation lift car shall open its door and shall provide an audio-visual indication “Exit Lift”. The audible signal shall have a sound level of between 35 dBA and 55 dBA adjustable to suit the site conditions with a typical recommended level of 50 dBA.

7.2.2.2.3.2 Deactivation of remote assisted evacuation

Remote assisted evacuation operation shall cease when:

a) The remote assisted evacuation signal is deactivated; or
b) The remote evacuation control panel becomes inactive; or
c) The connection between the remote evacuation control panel and the lift is interrupted for more than 30 s; or
d) The audible or video communication system is interrupted for more than 30 s; or
e) The manually assisted evacuation signal is activated; or
f) The suspend service signal is activated; or
g) The lift receives phase 1 signal of the fireman's control.

In these cases, the car shall return to the active EEL.

7.2.2.2.4 Manually assisted evacuation operation

Manually assisted evacuation operation shall override the automatic evacuation operation or remote assisted evacuation operation.

Manually assisted evacuation is the evacuation under the control of an authorized trained person(s), who controls the lift from car operating panel and assists occupants to evacuate the building.

After the completion of Phase1 of evacuation service, if the manually assisted evacuation operation signal is active, the lift shall operate as per details below. `

a) Registered landing calls shall be indicated in the car operating panel by blinking car call acceptance light of the given landings.

b) Where multiple lifts in a group are in evacuation operation, all registered landing calls shall be indicated in each lift. If one of the lifts serves the landing call, the landing call shall be cancelled from the other lift(s) as well.

c) The active EEL location shall be indicated in the car;

d) All heat and smoke sensitive door protection devices shall be made inactive.

e) Constant pressure on any car call button or on the door close button shall cause the car door to close. Closing shall start only after 1 to 2 s delay. If the button is released before the car door is fully closed, the doors shall automatically reopen.

f) Car call shall be registered when the car door is fully closed, and the car shall start to travel to the destination landing.

g) If car doors are closed by the door-close button and car call is not registered within 15 s, the car shall travel to the active EEL and open its doors.

h) At any time, it shall be possible to register a new call from within the car. The previous car call shall be cancelled and the car shall travel to the newly registered landing.

j) On arrival at any destination, the car shall automatically open its selected door and remain at the landing until the car door is closed by the attendant and a new car call is registered or until timeout expires.

7.2.2.2.4.1 Deactivation of manually assisted evacuation operation

Manually- assisted evacuation operation shall stop when the car is at the EEL; and when the manually-assisted evacuation operation signal is no longer active or when the suspend service signal is active or when the lift receives phase 1 signal of the fireman's control.

↑ ---------- ↑

7.2.2.3 *Decide, if evacuation is required (building management)*

This is a decision to be made by other experts and those responsible for building management. In large buildings evacuation may take some time and it shall not be assumed that continued use of a particular lift or lifts is guaranteed. Serious thought shall be given to how information will be displayed to those managing the building especially where the BMS system is capable of providing a large amount of information. It should be possible to see at a glance if lifts are operating correctly

and what services they are running. There shall always be provision made to allow the building management or authorities to override any automatic evacuation signal that is generated by a smart BMS. Irrespective of the systems employed the evacuation decision cannot be made by a lift system and therefore other experts in this field shall determine what risks will constitute the need for evacuation and the type of evacuation (partial or full).

7.2.2.4 *Decide, if lifts are to be used for the evacuation*

If for some reason a significant number of lifts are not available for use then it may be prudent to remove all lifts from automatic evacuation service rather than have too few. If too few lifts are in service, delays will result that could be dangerous or cause panic. In such circumstances it is probably desirable to run a limited service for the evacuation of those who have difficulty negotiating stairs. Any such service needs to be managed by lift attendants who will drive the lift, manage possible crowding and assist those who need it. The decision to operate some form of service when not all lifts are available shall be taken by those managing the building evacuation.

7.2.2.5 *Building evacuation information*

When evacuation is required, updated information shall be provided through the building systems informing persons concerned including those in waiting areas which lifts to use during the particular emergency. This information shall be in both audible and visual format. Any safe areas/waiting areas should also have an emergency communication system.

7.2.3 *Specifications of Automatic Evacuation Lift*

7.2.3.1 *Determining the number and size of lifts*

To calculate the number and size of lifts required for an adequate evacuation service, the handling capacity of a given lift or group of lifts shall be determined considering possibility that a lift or lifts may not be available for some reason such as planned maintenance, repairs. This analysis can be done by the lift designer. Also due consideration shall be given to the requirement of accommodating a wheel chair in the lift car.

7.2.3.2 *Protection of lift equipment*

Lift shafts and machine rooms or machinery spaces located outside the shaft should be fully enclosed. The temperature in the enclosures should be monitored and maintained to acceptable levels for the equipment, as determined by the lift supplier in consultation with the building management. Protection from water may be considered, if required as per overall evacuation strategy.

7.2.3.3 *Removal or suspension of lifts from evacuation service*

Where a lift receives a command from a BMS or manual signal to stop or suspend service to a floor or area of the building, any stop shall be a controlled stop at a safe area. A controlled stop means allowing the lift to slow down and stop at a floor in the normal manner. Where a lift or lifts are instructed to suspend service the lift(s) shall inform the FCC and any BMS once it is no longer available for service.

7.2.3.4 *Remote lift car surveillance*

At times of emergency, it is vital to be able to see that lifts do not contain trapped passengers who may be incapacitated. A means to display the entire floor area of the car shall be provided with information to the occupants that the lift car is under surveillance. At least one viewing terminal shall be located in the FCC and clearly marked 'LIFT CAR SURVEILLANCE' with the lift designation identified.

7.2.3.5 *Communication system requirements*

As a minimum a 3-way communication system shall be available for passenger use to permit direct communications between the lift car and safe area and FCC. Operation of the communication device in the lift car shall be simply by means of a single button, operation of which shall connect the system to the FCC. Further operation of the device in the lift car shall be hands free.

7.2.3.6 *Initiation of evacuation service*

Evacuation service can be initiated by a device such as a button or lever, key, etc, located near the lift shaft at the evacuation landing, or from a signal sent by a BMS or hazard detection system. Where a button or other manual activated device is used it shall be protected against unauthorized use. Its purpose shall be clearly marked with a symbol and/or the words 'LIFT EVACUATION SERVICE'.

The evacuation service shall be operational between the floors as decided by the building designer. The logic of operation shall be mutually agreed to between the building designer and the lift designer. However, any lift will be automatically removed or suspended from evacuation service if, where provided, it is turned to firemen operation.

7.2.3.7 *Cancellation of evacuation service*

On cancellation of a signal from the device that initiated the service and receipt of a signal from an evacuation service cancellation switch, all lifts which are not at the main landing shall complete any allocated task and return to the main landing.

On arrival at the main landing the doors shall open and then the lift evacuation for that particular lift shall be cancelled. Any lift already at the main landing shall on opening its doors cancel its evacuation service.

7.2.4 *Information to be provided to the building owner / operator*

Detailed instructions shall be provided to the building owner / operator by the building designer in the form of a manual. The manual shall explain the evacuation strategies to be used, how any detection system operates, how they shall be maintained and how the lift will operate on evacuation service. It should also provide advice on periodic checks the owner / operator can make to ensure the system is working correctly and explain the importance of a suitable testing and maintenance system being in place. Training being very important aspect of this new concept, the manual shall include such details of training as who should be covered by training, how the training should be carried out, what should be the frequency, etc.

8 MINIMUM TECHNICAL AND SAFETY REQUIREMENTS

8.1 General Requirements

The following general requirements shall be adhered to:

a) Passenger and goods lifts shall comply with the safety requirements and/or protective measures of the following clauses. In addition the passenger and goods lifts shall be designed according to good practices [8-5A(2)].

b) All labels, notices, markings and operating instructions shall be permanently affixed, indelible, legible and readily understandable (if necessary aided by signs or symbols). *See also* **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code. They shall be of durable material, placed in a visible position, and written in the accepted language(s).

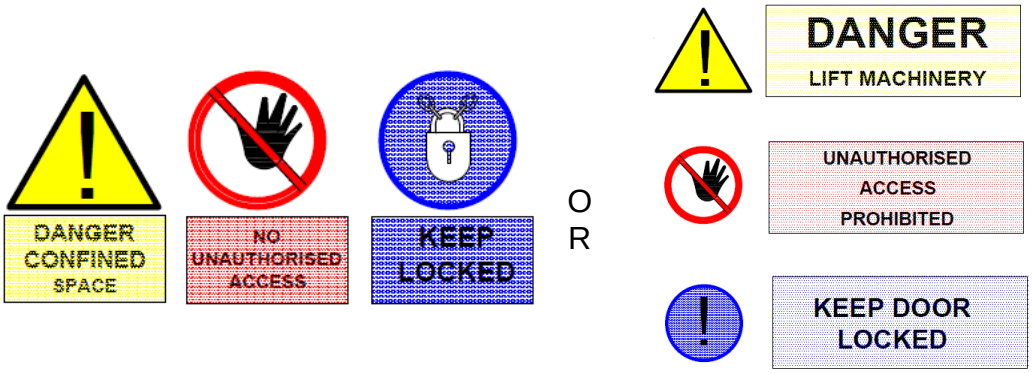
c) The minimum factor of safety for any part of the lift shall not be less than five. Higher factor of safety for various parts shall be applicable in accordance with accepted standards [8-5A(5)] and [8-5A(6)].

d) All passenger, goods, stretcher, automobile, dumbwaiter lifts shall have conformity with *Lifts Acts and Rules* in force, *Indian Electricity Act,* 2003 and *Rules*, all relevant and applicable Indian Standards, applicable fire regulations, fire prevention act and rules in force.

e) *Notices* – The following notices shall be placed at respective places:

1) A notice (*see* Fig. 18) bearing the following (typical) minimum inscription shall be fixed to the outside of doors or trap-doors (excluding landing doors and doors of emergency and test panels) giving access to machine and pulley rooms.

"Lift machinery - Danger
Access forbidden to unauthorized persons
Keep door locked"



AND

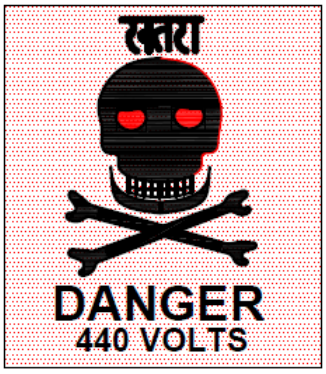


FIG. 18 TYPICAL INSCRIPTIONS ON DOORS

2) In the case of trap-doors, a permanently visible notice (*see* Fig. 19) shall indicate necessary warning to those using the trap-door.

" DANGER OF FALLING - RECLOSE THE TRAP - DOOR "

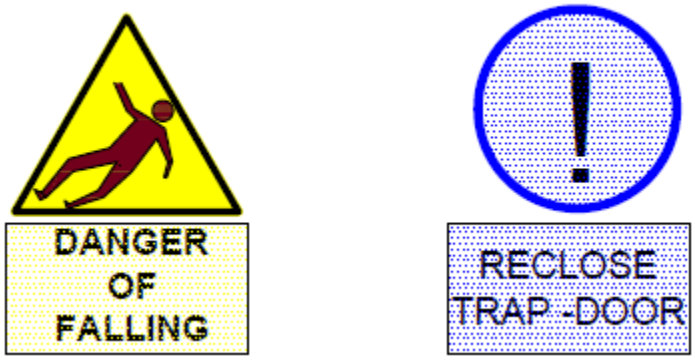


FIG. 19 TYPICAL NOTICE ON TRAP DOORS

3) Outside of the well, near the access doors and emergency doors, if any, there shall be a notice stating as shown in Fig. 20.

" LIFT WELL - DANGER
ACCESS FORBIDDEN TO UNAUTHORIZED PERSONS "

FIG. 20 TYPICAL NOTICE ON ACCESS DOORS AND EMERGENCY DOORS

4) A notice board with following instructions as applicable, and/or other applicable instructions shall be placed in conspicuous position in the lift car:

i) Maximum capacity of lift _____ kg/_____ persons.
ii) Close the car and landing door/gate properly, on entering, or while leaving the lift car.
iii) Do not open the lift-car gate when the lift-car is moving. The gate should only be opened after the lift-car has stopped opposite a landing gate.
iv) In case of danger, press the alarm button, but do not try to open the car door. Wait inside, until the lift car is brought

opposite a landing, and do not attempt to leave the lift car until the landing door is opened fully.

v) Children under 12 years of age shall not use the lift, unless accompanied by an adult.

5) The Table 28 is a typical list of Do's and Don'ts that should be displayed in the lift car, and in case of lifts open to public use, in an accessible format complying requirements of accessible information board/signage, given in **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code:

Table 28 List of Do's and Don'ts
[*Clause* 8.1 (e)]

Do's	*Don'ts*
a) Press call button lightly	a) Do not overload the lift
b) Know your destination. Push lift call for direction you want to go	b) Do not press call button again and again
c) Stand aside for exiting passenger	c) Do not force-open the doors, it is dangerous
d) Pay attention to floor indicator	d) Do not stand in between the doors
e) Push and hold the door open button, if door needs to be held open	e) Do not fiddle with the equipment
f) Wait for the next car, if the lift is full	f) Do not step in until lift has stopped at landing and doors are fully open
g) Take the stairs, if there is a fire	g) Do not crowd in the middle of car
h) In case of emergency call customer service cell for rescue operation	h) Do not lean against car panels
	j) Do not panic in case of power failure
	k) Do not attempt to jump out, if the lift has stopped out of floor level

NOTE — No other notices should be fixed in the lift car

8.2 Power and Control Systems

8.2.1 *Features Associated with Power Systems*

The features associated with power systems are listed below.

8.2.1.1 *Industrial switchgear*

Switchgear for controlling lift power systems is characterized by its high duty cycle and its high rupturing capacity. Switchgear shall be robust enough and shall be so designed as to withstand the high duty cycle and high rupturing capacity introduced during the operation of the lifts.

8.2.1.2 *Levelling accuracy*

The levelling tolerances in accordance with good practice [8-5A(7)] are those which can be reasonably expected between no load and full load in either direction. With the VVVF drives good leveling accuracy can be expected.

8.2.1.3 *Corrective levelling*

This should only be used, when it is impossible otherwise to achieve the required levelling tolerances or on long travel lifts to maintain the required levelling tolerances during loading and unloading.

8.2.1.4 *Levelling with Variable Voltage*

A variable voltage system is one using continuous regulation which minimizes speed differences due to load variation. Therefore, the actual levelling speed is of less importance than the general refinement of its regulation control. In fact no levelling speed as such may be identifiable.

8.2.1.5 *Overload tests*

A lift is designed to operate and transport the contract load, at the required duty cycle, and should not by intention or habitually be used to carry overloads. During test as a safeguard to cover variable supply and temperature conditions a lift is checked for the car to complete one round trip with contract load plus 10 percent at nominal supply voltage and nominal ambient temperature. There is also a static test with contract load plus 25 percent to check that the brake will sustain the car. It is unnecessary to specify and additional overload test or capacity and in fact it is detrimental to the normal running efficiency and safety of the lift to do so.

8.2.1.6 *Occasional extra load*

It is not good practice to request that a lift should be designed to carry an occasional extra load. It is tantamount to specifying an excessive overload test which is detrimental to the normal running efficiency and safety of the lift.

8.2.2 *Description of Operation Systems*

The following description relates to the associated operating systems.

8.2.2.1 *Methods of control systems*

The methods of control systems are as follows [*see* **8.2.2.2** (a)]:

a) Attendant and dual control, and
b) Automatic push button operation.

8.2.2.2 *Types of control systems*

The features of control systems shall be as described below:

a) *Automatic push button operation* — Automatic control is a method of operation by which a momentary pressure on a push button sets the car in motion and causes it to stop automatically at any required lift landing. This is the simplest control system and it is sometimes referred to as push button control. A car answers a landing or car call, whichever is actuated first by momentary pressure provided the lift is not in use. Momentary pressure of a car push button will send the car to the designated floor. The car always responds to a car push button in preference to a landing push button. With this type of control, a red landing signal light or direction arrow indicates that the car is in use that is the lift is travelling. This type of control is recommended for single passenger lifts serving up to 4 floors and goods lifts.

   For special purposes, the following two systems may be considered:

   1) Dispatch from landings as an additional feature for a goods lift with manually operated doors. The call is registered by pressing the car push button and when the doors are closed the car will travel to the designated floor.

   2) Automatic with attendant control as an additional feature on goods lifts with a key operated switch in the car to transfer the control from normal automatic to attendant operation. There is also a visual call indicator with buzzer in the car to indicate to the attendant the landing floors at which push buttons have been pressed when the car is under attendant control.

b) *Collective control* — Collective control is a generic term for those methods of automatic operation by which calls made by pressing push buttons in the car and at lift landings are registered and answered by the car stopping in floor sequence at each lift landing for which calls have been registered irrespective of the order in which the calls have been made, and until all calls have had attention. Collective control of any form is usually not

suitable for goods lifts except where loading is not expected to fill the car and additional loads can be taken at other stops.

c) *Single push button collective control* — Single push button collective control has a single push button at each landing. It is not recommended, as the direction in which it is desired to travel cannot be registered by the intending passenger.

d) *Down collective control* — Down collective is a control system where landing calls are registered from a single push button, irrespective of the car being in motion or the landing door being open and calls are stored until answered. Any number of car calls can be registered and the car will stop in sequence in the down direction at each of the designated floors. The car will travel in the up direction to the highest call registered stopping only in response to car calls. It will then travel downwards answering calls in floor sequence. If only one call has been registered the car travels to the floor of call.

This system is suitable where there is traffic between the ground and upper floors only and no inter floor traffic. Two or three car banks have interconnected control. With this type of control the following signals are included:

1) A landing signal light indicates that the call has been registered and will be answered.
2) Illuminated car position indicator above car entrance.

e) *Directional collective control for one car* — Directional collective control for one car is a control system having ‘UP’ and ‘DOWN’ push buttons at intermediate landings whereby the call is registered for the intended direction of travel. Calls from the car or landing push buttons are registered and stored until answered. The car will answer calls in floor sequence in one direction of travel. Calls for the opposite direction of travel are answered when the direction of travel is reversed.

This system is suitable for single lifts serving 4 or more floors with inter floor traffic, such as small office blocks, hotels and blocks of flats. With this type of control the following signals are included:

1) A landing signal light for each landing push button indicates that the call has been registered and will be answered.
2) Illuminated car position indicator above the entrance in the car.
3) Arrow shaped signal lights in the back of the car or on the landing to indicate to the entering person in which direction the car is going to depart.

f) *Directional collective control for two or three cars* — Directional collective control for two or three cars is a system covering a control in which the two or three cars in a bank are interconnected. One push button unit with 'UP' and 'DOWN' push buttons or floor buttons (in case of car control from floor) are required at each landing and the call system is common to all lifts. If for architectural balance, in the case of a three car bank, extra push button units are required, these should be specified. Each landing call is automatically allocated to the best placed car. The control is designed so that cars are effectively spaced and thus give even service. When a car reaches the highest floor to which there is a call its direction of travel is automatically reversed when it next starts. One or more cars will return to the parking floor. Automatically bypassing of landing calls when a car is fully loaded is an essential feature for three-car banks. It is also necessary for two-car banks in offices. Other cars will continue to provide service to all floors. When three-car banks serve 7 or 8 floors and over, some form of automatic supervisory control [*see* **8.2.2.2**(g)] is generally necessary in the interest of efficiency. With this type of control the following signals are included:

1) A landing signal light for each landing push button to indicate that the call has been registered and will be answered.
2) Illuminated car position indicator above the entrance in the car.
3) Arrow shaped signal lights in conjunction with an audible single stroke gong or an indication on the landing call push button station above each landing entrance to indicate to the waiting person(s) which car is going to stop and in which direction it will continue its course.

g) *Group supervisory control* — A bank or group of intensive traffic passengers lifts requires a supervisory system to coordinate the operation of individual lifts which are all on collective control and are interconnected. The very nature of intensive service calls for a sophisticated automatic supervisory control system so as to match the speed capacity of these lifts. The supervisory system regulates the dispatching of individual cars and provides service to all floors as different traffic conditions arise minimizing such unproductive factors as idle cars, uneven service and excessive waiting time. The system will respond automatically to traffic conditions such as 'UP' and 'DOWN' peaks, balanced or light traffic and provides for other specialized features. If desired, a master station can be provided in the lift lobby which gives by indicators, visual information regarding the pattern under which the system is operating. Where the system is based on a definite programme, control means are provided for altering the type of traffic programme. There are other facilities, such as the removal of any lift from service.

h) *Destination control system* — In case of a bank of lifts Destination Control System (DCS) may be provided. The passengers enter their destination floors on the Destination Operating Panels (DOPs) provided on the lift landings. The lift controller allocates a lift to every call registered which is displayed on the DOP. The passenger is expected to board the assigned lift and travel to his destination floor. He need not register his destination floor in the lift car operating panel (COP) again. In fact COP in the lift car may not be provided with floor buttons in case of DCS control system. The principle behind the DCS is to group passenger with same destinations together thus reducing the number of stops of the lift reducing round trip time thus boosting traffic.

j) *Number of DCS terminals* – Number of terminals at every floor shall be established based on the 5 minute peak traffic, however it shall not be less than 2 on every floor.

It is recommended that the DCS input terminals barring one for people having special needs is not located in the position of the conventional hall buttons. It is recommended that the DCS input terminals are positioned outside the lift lobby or at the entrance to the lift lobby or integrated with the turnstiles.

The advantages of DCS system over conventional collective control are:

1) Enhanced passenger handling capacity,
2) Less transit time, few intermediate stops, and
3) Passengers do not have to struggle through crowd to book the calls.

In addition to the DOPs the lift landings are provided with lift identifier. Indicators shall be provided on the car jambs indicating the car stops.

Hybrid Destination Control (HDCS) combines features of the DCS and conventional control system. The main floor is provided with DOPs, Lift Identifiers and the lift car is provided with the conventional COP as well. Thus, while availing benefit of traffic boosting HDCS provides convenience of call booking from inside the lift car as well.

8.2.2.3 *Features of operation systems*

The features associated with the operating systems are as follows:

a) *Car preference* – Sometimes it is necessary to give a special personal service or a house service. When this service is required and for whatever purpose, it should be specified as ‘car preference’; is activated by a key

operated switch in the car. The operation is then from the car only and the doors remain open until a car call is registered for a floor destination. All landing calls are bypassed and car position indicators on the landing for this lift are not illuminated. The removal of the key when the special operation is completed, restores the control to normal service.

b) *Landing call automatic bypass* – For collective operation, automatic bypassing of landing calls can be provided. This device will bypass landing calls when a car is fully loaded but the calls are not cancelled.

c) *Basement service* – For lifts with collective control when service is required below the main parking floor, which is usually the ground floor, to a basement and/or a sub-basement, the lift manufacturer should be informed of the type of service required, as special technical considerations are then usually necessary.

d) *Hospital service* – Lifts for carrying beds and stretchers require a car preference switch so that an attendant can have complete control of the car when required. This requirement should be specified as 'car preference' and it will function as described in **8.2.2.1**. Otherwise such lifts can have the same control systems as for normal passenger lifts, the choice depending on the number of floors served, the service required and the number of lifts.

e) *Manually operated doors* (*without closers*) – A 'door open' alarm should be provided to draw attention to a car or landing door which has been left open.

f) *Automatically power closed doors* – For passenger operation when the car arrives at a landing the doors will automatically open and then close after lapse of a time interval. This time interval can be overruled by the pressure of a push button in the car to give instant door closing. An 'open door' push button is provided in the car to reverse closing motion of the doors or hold them open.

g) *Controlled power closed doors* – When there are conditions that particularly affect the safety of passengers or damage to vehicles or trucks, the closing of the doors should only be made by the continuous pressure of push buttons in the car or on landings. A 'door open' alarm should be provided to draw attention to a car or landing door which has been left open. This means of operation is required for some forms of goods lifts.

j) *Safe operation of doors* – The safety of passengers passing through lift entrances is fully covered by the provision of good practice [8-5A(6)]. No modification of these provisions should be specified.

k) *Directorial service* – There are many forms of giving special service for individuals, but they should always be avoided. They range from key operated switches at preferred landings to the complete segregation of one out of a bank of lifts. It is obvious that any preferential treatment of this nature can seriously jeopardize the efficiency of the service as a whole. When a bank of say three lifts is installed to meet the anticipated traffic requirements and then, when the building is occupies, one lift is detached permanently for directors' service, the traffic handling can be reduced by a half rather than a third. When preferential service is imperative, then the car preference feature should be available [*see* **8.2.2.3**(a)].

m) *Indication of car arrival* – As all lift cars are illuminated when available (in service). It is recommended that this illumination be used to signal the arrival of a car at a landing in preference to special signals such as 'LIFT HERE' signs since signal lamps can fail when the lift is still operating satisfactorily.
The following is the practice adopted for vision panels in doors:

1) For lifts with manually operated car and landing doors, vision panels are provided in all doors;
2) For lifts with power operated car doors and manually operated landing doors, vision panels are provided in the landing doors only;
3) For lifts with automatically opened car and landing doors, vision panels shall not be provided and are not required.

n) *Service switches* – When switches are provided to take cars out of service, that is because the remaining cars in the group can cater for the required passenger traffic, it is essential that such switches should not stop the fireman's control from being operative in the event of the lift being designated as a fireman's lift. Service switches should not be confused with maintenance switches which are only used when it is dangerous to attempt to operate the lift because maintenance work is actually in progress. A control station fitted on top of the car is regarded as a maintenance switch.

p) *Fire switch* – When required by the fire authority a fire switch has to be provided, the function of which is to enable the fire authority to take over the complete control of one or more lifts in an installation.

q) *Push buttons and signals* – It is most important that the purpose of every push button and signal should be clearly understood by all passengers.

r) In public places where visually impaired are expected to use the lifts it is recommended to provide Braille/tactile buttons.

8.3 Capacity and Loading

The minimum rated load of a passenger lift car corresponding to the net inside car area shall bear the relationship given in Fig. 21, the net inside car area being evaluated as shown in Fig. 22. The net inside car areas for various passenger capacities with corresponding minimum rated loads have been given in Table 29.

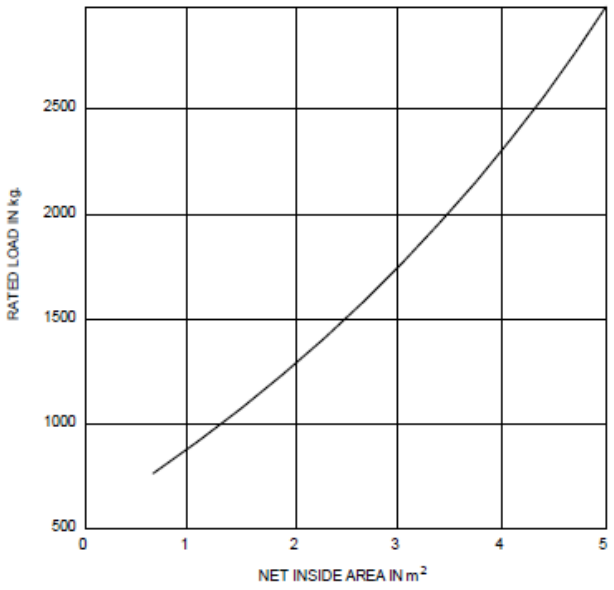


FIG. 21 MINIMUM RATED LOADS FOR PASSENGER LIFT CAR

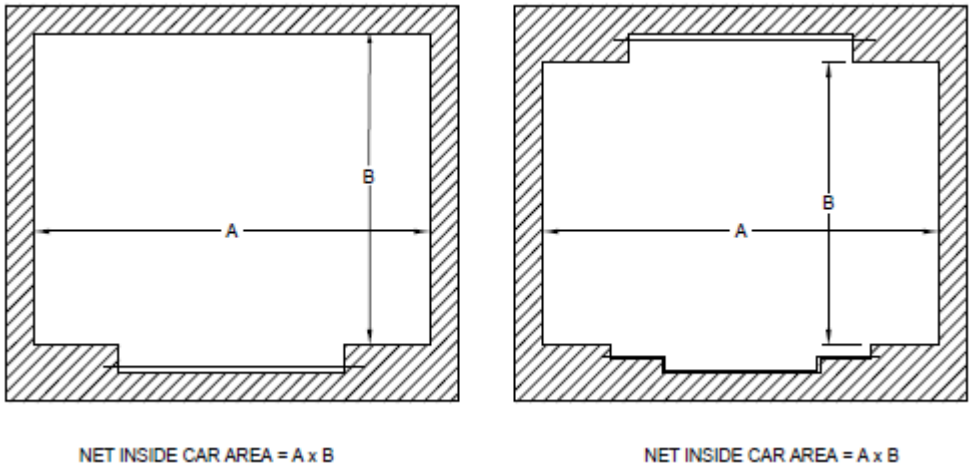


FIG. 22 NET INSIDE CAR AREA FOR PASSENGER LIFTS

NOTES

1 The graph shown in Fig. 21 is based on the following formula:

$$W = 35.05\ A^2 + 325.66\ A$$

where

W = rated load, in kg; and
A = net inside areas, in m^2.

2 For rated loads exceeding those covered by the graph, value may be evaluated from the formula given above.

3 To avoid the possibility of serious overloading of bed lifts, they shall be treated as passenger lifts.

4 The minimum rated load for goods lifts shall be based on a load of not less than 3.45 kN/m^2 of the net inside car area.

5 The minimum rated load for automobile lifts shall be based on a load of not less than 1.45 kN/m^2 of the net inside car area.

6 When the load in a goods lift consists of pallets or similar single piece loads loaded by means of a power truck, it is necessary during loading and unloading to take into account the total load on the car platform the capacity of the brake, and the resistance to slipping of the ropes on the sheave of a traction machine. Similarly, guide rails, guide fixing, car frame and platform shall be designed to withstand the horizontal thrust imposed by power trucks, motor vehicles and the like.

7 For motor vehicle and other special purpose lifts for transportation of light weight and heavy volume loads, the lift car inside dimensions mutually agreed to between the manufacturer and the purchaser will be permitted with the provision of a device to prevent the lift from starting from a landing in case of overloading.

8 A load plate giving the rated load of the lift shall be filled in each lift car in a conspicuous position. For passenger lifts, the rated load shall be given in number of person and kg. For goods lifts, the rated load shall be given in kg or other convenient units and in persons. For the purpose of this clause, a person shall be regarded as weighing 68 kg.

Table 29 Minimum and Maximum Net Car Areas for Various Rated Loads – Passenger lifts

(*Clause* 8.3)

Sl No.	**No. of Passengers**	**Rated Load W** Kg	**Minimum Available Net Inside Area** m^2	**Maximum Available Net Inside Area A** m^2
(1)	(2)	(3)	(4)	(5)
i)	4	272	0.68	0.77
ii)	5	340	0.85	0.95
iii)	6	408	1.00	1.12
iv)	7	476	1.16	1.28
v)	8	544	1.31 (1)	1.45
vi)	9	612	1.46	1.60
vii)	10	680	1.61	1.76
viii)	11	748	1.77	1.91

Sl No.	No. of Passengers	Rated Load W Kg	Minimum Available Net Inside Area m^2	Maximum Available Net Inside Area A m^2
(1)	(2)	(3)	(4)	(5)
ix)	12	816	1.92	2.05
x)	13	884	2.06	2.20
xi)	14	952	2.23	2.34
xii)	15	1 020	2.35	2.47
xiii)	16	1 088	2.48	2.61
xiv)	17	1 156	2.62	2.74
xv)	18	1 224	2.75	2.87
xvi)	19	1 292	2.88	3.00
xvii)	20	1 360	3.01	3.13
xviii)	21	1 428	3.14	3.25
xix)	22	1 496	3.26	3.37
xx)	23	1 564	3.38	3.49
xxi)	24	1 632	3.50	3.61
xxii)	25	1 700	3.62	3.73
xxiii)	26	1 768	3.74	3.84
xxiv)	27	1 836	3.85	3.95
xxv)	28	1 904	3.96	4.07
xxvi)	29	1 972	4.08	4.18
xxvii)	30	2 040	4.17	4.29
xxviii)	31	2 108	4.25	4.39
xxix)	32	2 176	4.34	4.50
xxx)	33	2 244	4.44	4.61
xxxi)	34	2 312	4.53	4.71
xxxii)	35	2 380	4.62	4.81
xxxiii)	36	2 448	4.72	4.92

NOTES:

1 1 The maximum available car area is calculated as per formula: W = 35.05A2 + 325.66A, where W = the rated load, in kg A = the maximum area, in m^2.

2 Beyond 36 passengers add 0.109 m2 in maximum available area for each extra passenger.

3 Beyond 36 passengers add 0.104 m2 in minimum available area for each extra passenger.

4 Hospital lifts shall be treated as passenger lifts & shall be designed according to above table.

5 Minimum net car inside area for fireman lift is 1.43 m^2.

For planning the quantity of lifts (passenger/service/hospital bed/ stretcher lifts) and deciding their main specification in any project, reference shall be made to **4**. For **"Enhanced personal space"** in the lift car without impacting the rated load and the car area as specified in Table 6 of good practice [8-5A(16)]; while planning for the lifts, passenger occupancy may be considered less than the 80 percent specified in **4**, thereby providing larger area per person in the lift car. The suggested no. of passengers may be displayed in the lobby and in the car

alongside the statutory rating plate required as per **5.4.2.3.2** of good practice [8-5A(16)], by the user. The given table 30 shall be used for the purpose.

Table 30 Maximum Net Car Areas for Various Rated Loads – Goods lifts
(*Clause* 8.3)

Sl No.	Rated Load	Maximum Available Net Inside Area A
	kg	m^2
(1)	(2)	(3)
i)	250	0.71
ii)	500	1.34
iii)	750	1.91
iv)	1 000	2.43
v)	1 250	2.92
vi)	1 500	3.38
vii)	1 750	3.81
viii)	2 000	4.22
ix)	2 250	4.62
x)	2 500	5.00

NOTES:

1 The maximum available area in above table is calculated as per formula:

W = 35.05A2 + 325.66A,

where,

W = the rated load, in kg

A = the maximum available area, in m^2.

2 Beyond 2 500 kg, add 0.16 m^2 for each extra 100 kg.

3 Refer to Notes under Fig. 22.

8.4 Other Technical and Safety Requirements

8.4.1 All lifts shall be provided with one or more car door(s) and landing doors, Passenger lifts shall be provided with power operated doors which are imperforate, vision panels shall not be provided and are not required.

8.4.2 Power operated car doors on automatically operated lifts shall be so designed that their closing and opening is not likely to injure a person. The power operated car door shall be provided with a sensitive device which shall automatically initiate reopening of the door in the event of a passenger being struck or is about to be struck by the door, while crossing the entrance during closing movement. The effect of the device may be neutralized,

a) During the last 58 mm of travel of door panel in case of side opening doors;
b) When panels are within 58 mm of each other in case of center opening doors; and
c) During emergency fire operation.

The force needed to prevent the door from closing shall not exceed 150 N and this measurement shall not be made in the first third of the travel of the door. In order to achieve this, it is desirable that all power operated doors have a full length (covering at least 1 600 mm of car door height from bottom) infrared or equivalent light curtain safety to retract the door in the event of coming across any obstacle during closing of the door.

8.4.3 Single speed and two speed drives which are poor in levelling accuracy and energy consumption shall not be used for new lifts in view of availability of latest technology energy efficient variable voltage variable frequency (VVVF) drive systems with improved levelling accuracy.

When an lift moves up or down in negative load conditions that is,, empty car/less than 50 percent load in UP direction or more than 50 percent load/full load in DOWN direction and during lift system deceleration, the lift motor generates energy which is lost in the form of heat in set of resistors in traditional non-generative drives. The additional heating could also result in additional cooling costs to the building owner depending on the size, duty and number of lifts in a building.

The regenerative drive converts the energy generated by the motor and feeds it back to the building internal electrical grid thereby eliminating the need of using braking resistors. This energy can be utilized to feed other loads or users connected to the same network. The amount of energy savings due to regeneration depends on various system parameters and configurations such as car load, speed, length of run, traffic pattern and system efficiency. The efficiency of the regenerative drive in both motoring and generating modes should not be less than 0.8. Regenerative drives lower overall building operating costs, delivering significant annual savings to building owners and tenants year-after-year during the life of the lift. These drives help to reduce peak power demand and energy consumption. As a result, both the fixed costs based on peak power demand (kVA)and variable costs based on energy consumption (kWh) decrease. Depending on different parameters (traffic, load, speed, etc), energy saving can be up to 40 percent. It reduces the cost of the air conditioning system and eliminates excess heat in the building that would have been otherwise wasted.

If a stand-alone generator or Uninterrupted Power Supply (UPS) is used to feed power supply to the lift system, the energy fed back to the stand-alone generator or UPS during negative load conditions or deceleration cannot be consumed. It is therefore imperative to connect sufficient load to the generator (other than lift load),

which can consume the regenerated energy. If UPS is used, it shall be capable of handling the recuperated energy. If such measures are not implemented, it will lead to frequent breakdowns of the lift or failure of regenerative drive. Building owners should consult lift manufacturers to understand the amount of regenerated energy and implement suitable measures.

8.4.4 For passenger lifts with car call button control in car, an additional car operating panel with call buttons shall be provided for ease of access to call buttons when the car is wider than 1 600 mm and/or the rated capacity of the lift is 16 passengers and more. This additional car operating panel shall be suitably located in the lift car.

8.4.5 Battery operated Automatic Rescue Device (ARD) shall be provided on all lifts as per **5.12.3.3** of good practice [8-5A(16)] to take lifts to the nearest possible landing in case of power failure, which includes power failure of one or more phases. In case of lifts equipped with backup generator with AMF (Automatic Mains Failure) panel, the provision of ARD is optional. For all lifts with ARD, an audio and visual indicator shall be provided inside the lift car to alert the persons trapped inside that they are being rescued. Capacity of batteries shall be such that minimum ten rescue operations can be performed without recharging. Emergency light and at least one fan inside the lift car shall be operational till the end of Rescue Operation. Levelling accuracy of + 40 mm or better shall be achieved in the ARD Operation. The ARD should operate only when all safety circuits are operational. The safety circuits shall be checked and verified continuously during the rescue operation.

8.4.6 Minimum one stretcher lift shall be provided in each building having height more than 24m so as to take care of medical as well as other emergencies. This lift shall have minimum car entrance width of 800 mm and car depth of 2 100 mm.

8.4.7 Every passenger lift shall be provided with an overload device as per **5.12.1.2** of good practice [8-5A(16)].

8.5 Painting at Works and on Site

Lift equipment will normally receive a protective coat of paint at works before dispatch to site. Further painting of lift equipment may be necessary and is normally in the form of a finishing coat and can take place on site. Alternatively, the further painting of the equipment may be carried out at works as a finishing coat with normal touching up after site erection as may be necessary. Any additional painting, due to site conditions during erection and/or final operating conditions in the premises, is subject to negotiation between the lift manufacturer and the purchaser. Decorative finishes are a subject for separate negotiation.

8.6 Emergency Manual Rescue

The emergency manual rescue operation with brake release should only be carried out in an emergency and by authorized persons who have received necessary instructions, because it is dangerous for any other persons to attempt to do so.

Before attempting to move the car, it is imperative that any person in the car be warned of the intention to move the car and that they shall not attempt to leave the car until they are advised that it is safe to do so. Any failure to carry out this precaution may render the person concerned guilty of negligence should an accident occur.

Before attempting to hand wind the lift machine, it is vital that the supply is switched off at the main switch. It is usually necessary to have two persons in the machine room: one to operate the brake release and the other to carry out the hand winding. The exceptions are small lift machines where the hand winding can be easily controlled by one man and larger machines which need two men to operate the hand winding alone with an additional man to control the brake release. In case of gearless machines especially, the brake shall be released and applied at very short intervals (of the order of 0.5 s to 1 s) so as to avoid the lift car attaining dangerously high speed due to the lift car and create unbalance in the absence of the gear box with large reduction ratio.

If the car is stuck in the lift well and cannot be moved when an attempt is made to move it in a downward direction, then no attempt at hand winding should be made because the car safety gear may have set. Any further procedure should be carried out under the instruction of a qualified lift mechanic. Provided the car is free to be moved in the downward direction, then it should be hand wound to the nearest floor. There is a preference to move the car in down direction. However, this may not always be practical owing to the distance involved and the time taken to complete the movement. In addition, the amount of out of balance load on the counterweight side, due to the size of car and the small number of persons inside it, may make it necessary to wind the car upwards. In the case of high speed lifts the direction of hand winding will usually be governed by the effort required to move the car because of the absence of a large gear reduction ratio. It is essential that all detail operations be carried out according to the manufacturer’s instructions for the lift concerned and these should be clearly stated and permanently displayed in the form of a notice in the machine room.

8.7 Flood Sensors

Two water level sensors to be installed in the pit to provide two input signals to the control system. one input is for warning, another one input is for shutdown. When the first switch is activated, an alarm message will be generated, so that maintenance personnel can understand the situation of water ingress in the pit and eliminate the danger in advance, When the second switch is activated, due to the water level position affecting the operation of the lift (such as the submerged tension device switch), the lift needs to be stopped at the nearest level and an alarm needs to be triggered in the lift car.

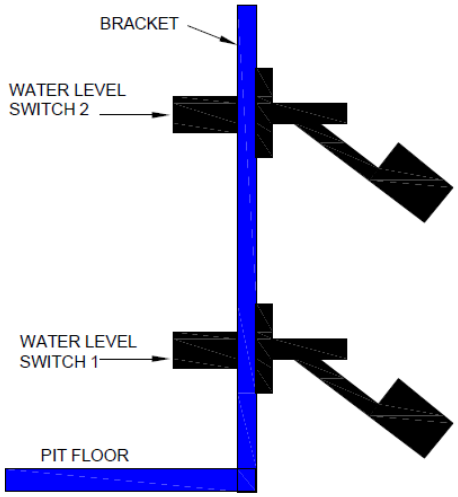


FIG. 23 FLOOD SENSORS

The water level switch 1 is recommended to be installed 30 mm to 50 mm above the pit floor to detect the lowest possible water condition. The water level switch 2 is recommended to be installed at 250 mm to 275 mm above the pit, however, the height at which the switch should be installed can be adjusted to ensure that the switch lies below the buffer and safety switches which monitor the safe travel of lift.

9 SPECIAL TECHNICAL REQUIREMENTS

The objective of this clause is to define some special type of lifts that are used currently in buildings such as lifts without conventional machine rooms (MRL lifts), lifts used in private apartments (home lifts), hydraulic type of lifts and lifts required for differently abled persons, etc.

9.1 Lifts without Conventional Machine Rooms (MRL Lifts)

9.1.1 MRL lifts are a special type of lifts where hoisting machine is placed inside the lift shaft and control system may be inside and/or adjacent or at close proximity to top landing door, eliminating the need for conventional machine room.

9.1.2 The MRL lifts shall be in conformance with good practice [8-5A(10)] apart from other relevant provisions of this Section.

9.1.3 MRL lifts may be provided with emergency door on the top portion of the hoist-way which is equipped with electromechanical lock wired in series with lift safety chain and of size 700 mm x 700 mm minimum, so as to access the machinery space in case of emergency or safety device being activated on or above the top landing.

9.2 Lifts Used in Private Apartments/Houses/Villas (Home Lifts)

9.2.1 The home lift is designed especially for private home having up to 5 stops (maximum rise 12 m), where the usage of the lift is restricted primarily to the residents of the private home. Unlike conventional lifts which allow virtually unlimited access to members of the general public, in case of home lifts non-residents shall have limited access.

9.2.2 The rated capacity of the home lift shall be minimum 208 kg (3 persons) and maximum 272 kg (4 persons) and lift car speed shall not exceed 0.2 m/s.

9.2.3 The home lifts shall conform to good practice [8-5A (11)] apart from other relevant provisions of this Section.

9.2.4 Electric MRL type home lifts, shall in addition conform to the technical requirements specified in good practice [8-5A(10)].

9.2.5 Hydraulic type home lifts shall in addition conform to the technical requirements specified in good practice [8-5A (1)].

9.3 Hydraulic Lifts

9.3.1 The hydraulic lift is a special type of lift where the lift car is directly or indirectly driven by action of one or more hydraulic jacks.

9.3.2 The hydraulic lifts shall conform to good practice [8-5A (1)] apart from other relevant provisions of this Section.

9.3.3 These lifts should preferably be hole-less type of lifts.

9.4 Lifts Accessible for Persons with Disabilities

9.4.1 All lifts open to public shall adhere to the accessibility provisions in terms of size of the car, door width, control panel, flooring, finishes, handrails, communication systems and information, given in **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code.

9.4.2 Lifts for differently abled persons shall conform to good practice [8-5A(12)] apart from other provisions of this Section.

9.5 Seismic Resistance in Lifts

When seismic protection of the passengers and equipment is a consideration, the safety requirements and protective measures given in good practice [8-5A(17)] may be adopted, the specified requirements being applicable when the units are subject to seismic conditions where the specified design acceleration (a_d) ≥1 m/s^2:

> NOTE – The design acceleration is a function of ground acceleration, soil behaviour, importance factor, etc. Thus, the value of (a_d) applicable to the building and to be considered for lift design/installation shall be provided by the building architect or structural designer to the lift manufacturer.

9.6 Automobile lifts

Where required, lifts suitable for moving passenger vehicles such as light motor vehicles (LMV), small utility vehicles (SUV), etc. may be provided. The minimum requirements to be considered while providing such lifts are as given in **9.6.1** to **9.6.8**.

9.6.1 The minimum and maximum car area requirements for passenger lifts as defined in **6.1** of [8-5A (6)] may not be applicable for automobile lifts. For this class of loading, the rated load shall be based on not less than 1.45 kN/m^2 of inside net platform area.

9.6.2 Strengthening stiffeners may be added to car panels to have sufficient strength to avoid permanent or temporary deflection of car panels beyond limits in case the vehicle touches the lift car panels while moving in or out. Under no circumstance, it should result into unsafe condition.

9.6.3 The hall button for calling the lift may be provided in the approach way at such a location that the button is accessible to the vehicle driver in the driving position without having to get off the vehicle. Optional light ray detection system or card reader system may be provided for automatic detection of vehicles and calling the lift to the floor.

9.6.4 Minimum entrance width of such lifts may be 2 400 mm and entrance height of 2 300 mm. The minimum car inside dimensions may be 2 500 mm wide and 5 300 mm deep and typically with entrance doors on both sides of the lift. This will enable the car to be driven inside and can be taken out in the same direction, without any need to reverse the same. Minimum load carrying capacity shall not be less than 2 500 kg.

9.6.5 Barricades may be provided outside the lift entrance door(s), so as to limit the size of the vehicle and preventing oversized vehicles from entering the lifts and possibly damaging the equipment.

9.6.6 There shall be sufficient place on both sides of the vehicle, once the vehicle is inside the lift. The lift car width should be selected such that in case of emergency while the automobile is in the lift car the driver should be able to open the automobile door and come out of the automobile.

9.6.7 The car operating panel, where the car call can be given, may be provided at such a location that is accessible by the vehicle driver in the driving position without having to get off the vehicle. The time duration for which the door remains open upon arrival at landing floor or upon stopping at landing floor shall be sufficient enough so as to enable smooth movement of the vehicles in and out of the lift car. Lift car entrance door(s), shall be equipped with light curtain device in accordance with **19.1.4** of good practice [8-5A(5)].

9.6.8 Overload warning device shall be installed in accordance with **6.2** of good practice [8-5A(6)].

9.7 Air Conditioning System for Lift Cabin (Car)

Where the lift car is equipped with air conditioning system, following additional requirements are recommended:

a) The whole equipment, its container, condenser, etc, should be typically made of corrosion resistant material, with average designed life span of 10 years.

b) The air conditioning system should work on single phase electric power supply of maximum 230 V a.c. and should be well within the current carrying capacity of trailing cable cores provided for the air conditioning system. The power supply for the air conditioning system shall be provided from RCCB of suitable rating. This RCCB shall be located in the lift machine room with proper identification and lock out tag out facility.

c) The air conditioning system should be provided with suitable air filters which should ensure clean air inside lift car. The filters should be easily accessible and serviceable from top of the lift car in a safe and easy manner.

d) The lift air conditioning should typically include functions such as:

1) Cooling, with adjustable temperature setting provided on the unit itself or through remote control unit, which may be maintained in the lift car.
2) Heating, with adjustable temperature setting provided on the unit itself or through remote control unit may be maintained in the lift car.
3) Ventilation, with adjustable air flow having less than 52 dBA noise level in the car.
4) De-humidification, with effective condensation water management system.

e) The lift air conditioning should be equipped with effective condensation monitoring and condensed water recycling system so as to avoid water spillover or leakage on top of the lift car and other lift components.

1) Condensation water monitoring and dealing with it is a very important feature any lift air conditioner shall have. Condensation water leakage or spillover on the lift car top may cause damage to the lift and may lead to electrocution or even fire.

2) When the condensation water level in the reservoir reaches high level and remains at that or above that level for three minutes, the compressor should stop working and the air conditioner should go into ventilation mode. In the ventilation mode the air conditioner fan still works, water pump still runs, the water is pumped to the condenser for condensation water to be vaporized. When the water goes below 80 percent, the compressor may restart and the air conditioner may go into cooling mode.

3) When the condensation water level reaches 100 percent, and remains at that level for 1 min, to avoid the water spill over and damage to lift components, the air conditioner should power off by itself. All components of air conditioner should stop working. This air
4) conditioning unit shut down should not be automatically resettable and should require manual intervention. Also, it should be possible for this condensation water to be drained out by opening the drain plug provided. This facility of draining off excess condensation water shall be safely accessible either from lift car or lift pit.

f) It shall be possible to manually switch ‘ON’ and ‘OFF’ the lift air conditioning unit either by key switch provided in the lift car or by remote control.

9.8 Lift Interface with Building Management System (BMS)

Where required, a means to interface, monitor and control be provided by lift manufacturer, which should become the part of building management system. The following information and controls, but not limited to those, may be provided either through potential free contacts or building automation (BA) interface device suitable for providing necessary lift information over other accepted communication protocols. With potential free contacts only lift monitoring is possible. It shall not be possible to control the lift.

a) *Monitoring signals*

1) Floor position of the lift for each lift.
2) Direction of travel for each lift.
3) Load condition of each lift specially indicating overload status.
4) Lift door status of each lift, whether open or closed.
5) Lift modes such as attendant, automatic, independent operation, emergency fire service, seismic mode, emergency medical service and inspection mode for each lift.

b) *Control signals*

1) Bring the lift down to lobby floor in case of emergency or VIP movement.
2) Park and shutdown lifts based on building and traffic requirements, so as to save power.
3) Force the lift into emergency fire service, seismic mode or emergency medical service, etc through command from BA system based on respective sensor’s such as smoke detectors, seismic sensor, etc, input to BMS.

c) *Reports* – Software tools may be developed to report out performance of each lift such as average response time, number starts per hour, average lift uptime, round trip time, etc. Flexibility to provide additional reports based on building requirements.

The above mentioned requirement for potential free contacts, other standard protocols, etc. may be optional, if the full-fledged lift management system software is provided by lift manufacturer for monitoring and control of lifts in the building. This software may be custom built providing above mentioned requirements. The wiring between lift machine room to Building Management Systems shall be planned and carried out by the builder along with other wiring in the building.

9.9 Closed Circuit Camera Inside Lifts for Monitoring (CCTV)

Where required, closed circuit camera is provided either by lift manufacturer or by third party supplier, inside the lift car for security purposes. Suitable warning mentioning 'You are under CCTV surveillance' shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with.

The cable used for connecting in car camera to monitoring system, provided by supplier, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Trailing cables are specialized cables used in lift applications. Wireless CCTV may also be considered alternatively.

If the camera signal is disconnected, either because of fault or intentionally, the lift monitoring system should get an alert indicating the same. Responsibility of monitoring, recording, organizing and maintaining CCTV shall be duly decided in advance.

9.10 Emergency Medical Service (EMS) for Hospitals

Optional emergency medical car operation may be provided especially for hospitals and operation theatre lifts and the lift behaviour in this mode is as described below. Activation of the emergency medical hall switch activates the in-car buzzer and illuminates a lamp in the car and hall. This forces the car to cancel car calls, reassigns hall calls, and return non-stop to the defined medical landing. Upon arrival, the door opens and the buzzer is deactivated.

The door remains open until the switch is turned off or the doors have been open for at least 60 s. If the medical switch is toggled, this operation remains in effect for additional 60 s. The second phase of EMS operation can only be activated when the doors are open at the medical landing. Once the car is on emergency medical operation fire service operation cannot be initiated, even though the fire service lamp and buzzer are activated.

If the car is performing fire service operations, emergency medical operations cannot be initiated, even though the medical lamp and buzzer are activated. The car automatically enters the emergency medical car operation after the doors are open at the medical return landing. If the emergency medical car switch is not activated within 60 s, the medical operation is cancelled.

To move the car, the emergency medical car switch needs to be activated. Prior to activation, the door cannot be closed and car calls cannot be registered. An active car switch allows car calls to be registered, which automatically closes the door and moves the car to the target landing. At the target landing the door opens

and remains open until another car call is registered. The door close button has no effect on this operation.

If the car medical switch is deactivated away from the medical return landing with the doors open, the car remains at the landing not allowing car calls to be registered or the door to be closed. The car shall be returned to the medical landing and the emergency medical car switch deactivated to remove the car from emergency medical car operation.

9.11 Destination Control System (DCS)

The destination control system (DCS) uses passenger destination information to improve traffic flow and travel time in busy mid- and high-rise buildings. Instead of using standard hall call buttons, passenger enters specific floor number he wants to travel to – before entering the lift. The system groups passengers traveling to nearby floors to the same car.

9.11.1 Conventional Destination Control System requires keypads or touch screens at all floors to book the calls. This conventional DCS may be additionally provided the car operating panel (COP) in the lift car to improve passenger comfort. Alternatively, the COP in the lift car may be hidden. Traditional hall lanterns are no longer needed.

9.11.2 Hybrid Destination Control System requires keypads or touch screens only at the main floor allowing up-peak boosting of traffic. Traditional hall button stations and hall lanterns need to be provided at all other floors. A full COP is required in the lift. With both conventional and hybrid DCS provided with touch screens and/or keypads, hot button(s) may be provided to facilitate call booking to common floors as fast as possible.

9.11.3 *Identification of Lifts*

To avoid confusion between identification of lifts and floor nomenclature, particularly when braille is considered, it is recommended that the lift identification should be alphabetic and floor nomenclature to be numeric.

9.11.4 *DCS Car Loading for Simulation*

While 80 percent is considered as the average loading for traffic analysis with conventional controls, the car loading for simulation with DCS shall not exceed 80 percent

9.11.5 It is advisable that DCS input keypads at main floor to be placed at the entrance of lift lobby and not at conventional location (between two lifts) to avoid multiple calls by same person. When DCS keypads are integrated with turnstiles,

additional DCS keypad to be provided in the lobby to re-register the call in case a person fails to enter lift.

9.11.6 Conventional control system allows maximum of 8 lifts in group operation, having not more than 4 lifts in row, however DCS provides an advantage of increasing number of lifts in group operation, which can be extended to 10 lifts in a group to 16 lifts in a group. The designer must note that arrangement for lifts shall be limited to 5 lifts in row.

9.12 Special Environments

Standard equipment is suitable for use inside normal residential, commercial and industrial buildings but when unusual environments are likely to be encountered, the advice of the lift manufacturer should be sought at the earliest possible stage to enable the most economic satisfactory solution to be found. Special mechanical protection and or electrical enclosures may be necessary as well as compliance with statutory or other regulations and with the purchaser's particular requirements, which should be fully considered at the time of enquiry.

Examples of situations which necessitate special consideration are:

a) Exposure to weather, for example, car parks.
b) Low temperatures, for example, cold stores.
c) High temperatures, for example, boiler plant.
d) Hosing-down, for example, for hygiene or decontamination.
e) Corrosive atmosphere, for example, chemical works.
f) Dusty atmospheres, for example, gas plants.
g) Explosive and inflammable atmosphere, for example, gas plants, and petroleum and polyester industries.
h) Nuclear/heavy water plants.

10 PERFORMANCE REQUIREMENTS FOR LIFTS

10.1 It is necessary to have uniformity in the definition, measurement, processing and expression of vibration and noise signals that comprise lift ride quality. The aim of such uniformity is to benefit users by reducing variability in the results of lift ride quality measurements caused by differences in the methods of acquiring and quantifying the signals. Experience indicates that evaluation of vibration in terms of peak-to-peak levels is of particular relevance to passenger comfort. It is considered necessary to provide a dual form of expression, quantifying both the maximum peak-to-peak and A95 peak-to-peak vibration levels.

10.2 Measurement of Lift Ride Quality

Ride quality of all lifts shall be measured in accordance with accepted standards. The selection and calibration of measuring and test equipment shall also be in accordance with accepted standards.

Measurements shall be made during normal building conditions, after the lift has been running under normal daily operation for at least one hour. Vibration measurements shall be made at the geometric center of the car.

11 SPECIAL TECHNICAL REQUIREMENTS FOR SUPER TALL BUILDINGS

The provisions given hereunder describes the different physical phenomena that occur in super high rise buildings (> 200 m high) and have an effect on vertical transportation solutions.

Although there are no major differences with regard to suspension and guidance systems between high-rise and low-rise lifts, there are other aspects to be considered such as system technology and passenger comfort levels. Control system artificial intelligence levels, safety requirements, load-bearing component ratings, rope weight, energy consumption, and thus cost increase exponentially with the height of the building.

11.1 Air Pressure Effect

In high rise buildings, air pressure is different on ground level and on top of the building. Practically, pressure change on the ear becomes uncomfortable for some persons when lift is landing faster than 10 m/s. The thresholds are lower for small children, elderly persons and passengers having flu. Therefore, practically, lifts are offered as a standard solution up to 10 m/s maximum.

11.2 Piston Effect

If high speed lifts especially those having rated speed greater than or equal to 4 m/s, are housed in single shaft, the displaced air due to movement of the lift car tries to escape through the gaps between the lift car walls and the shaft walls in turbulent flow. This phenomenon known as piston effect causes the quality of ride in the lift car to deteriorate. Noise level in the lift car may increase along with vibrations which will be felt by the passengers. The air being displaced past the car generates whining and whistling noises inside the car. Buffeting when passing doors may be audible and passenger may feel uncomfortable. Both lift car doors and landing doors may whistle at high speeds.

Therefore, high speed lifts should preferably be housed in common shaft with ventilation holes in the common wall(s), if any. These holes allow the air displaced due to the movement of the lift car to escape in the adjoining hoist-way. Thus, the velocity of the escaping air which depends on the ratio of the lift car area to lift shaft area reduces which mitigates the piston effect ensuring good ride comfort for the passengers. The size of the vent and the pitch at which the vents need to be provided depend on lift car size in relation to lift shaft size, as well as the speed of the lift and the ride comfort expected.

In addition, high speed lifts especially those having rated speed more than 6 m/s may be provided cars with aerodynamically designed exteriors. This special construction of the car however increases the requirements of the overhead and pit for which lift manufacturer should be consulted. To reduce hammering sounds caused by the passage of the lift past the landing doors, shaft in front of the lift car door may be clad with facia plates of full shaft width between the landing door sill of the upper floor and door header of the lower floor door to create an even, flush surface. Lift cars also need to be specially constructed to absorb noise and thus reduce transmission of noise in the car.

It is advisable not to have common wall between the lift shafts. There should be shaft divider beams provided at every floor level and in between floors, if required, for the support of the guide rail brackets. Metallic wire mesh shall be provided for separation of shafts.

11.3 Stack Effect

Stack effect is defined as the vertical, natural air movement throughout a high rise building caused by the difference in temperatures between the inside air and the outside air. Positive stack effect is characterized by a strong draft from the ground floor to the roof. Positive stack effect is more significant in cold climates because of the greater difference in temperature between the inside and the outside of the building. The colder the weather and the taller the building, the greater will be the stack effect. Negative stack effect can also occur in the reverse direction in hot climates but is not as significant because the difference in temperature is not as great.

The magnitude of stack effect is a function of,

a) Building height;
b) Air tightness of exterior walls;
c) Air leakage between floors; and
d) Difference in temperature between inside air and outside air.

The stack effect has following effects:

1) *Differential pressure on the lift landing doors* – The stack effect generates differential pressure on the landing doors. In case of buildings with airtight separation of each storey the differential pressure on a particular landing door from inside and outside of the lift shaft is small however the pressure on the door of the first landing and that on the last landing varies a lot.

   In case of buildings with no air partitions the converse is true. The differential pressure on a particular landing is significant and is the maximum at the top most and bottom most landings which are farthest from the neutral pressure level. At the neutral pressure level, which occurs somewhere in the mid of the building height, the differential pressure on the landing door from inside and outside of the lift shaft is nil. The differential pressure on the landing door may cause difficulty in the operation of the door.

2) *Smoke movement* – The stack effect influences the smoke movement. In case of positive stack effect, the air moves out from core of the building towards the exterior of the building above the neutral pressure level and it moves in from the exterior of the building to the core of the building below the neutral pressure level. In case of negative stack effect, reverse phenomenon occurs. This air movement naturally affects the smoke movement in case of fire and must be considered.

   Since stairwells, lift shafts and lifts tend to contribute to the stack effect it is essential that all lift lobbies are well sealed, and lifts parked with door closed to minimize stack effect. Especially in case of fire the stack effect needs to be controlled to prevent the spread of smoke in the building. On the other hand, the stack effect may be beneficially used to quickly drive smoke out of the building in case of fire.

11.4 Building Sway

The wind induced sway of the building may cause the lift suspension and/or compensation ropes and lift car travelling cables to sway. Buildings have natural frequencies of oscillations. Similarly lift ropes also have natural frequencies of oscillations which depend on the position of the car in the hoist-way amongst other parameters. When natural frequencies of the ropes and the building match, a large amount of energy is transferred to the ropes and they start swaying violently. This results into reduced ride comfort for the passengers in the lift and increases possibility of ropes getting stuck to snag points in the shaft and damaging shaft equipment. In general, the rope and travelling cable resonance phenomenon should be taken into account in the lift design for over 200 m tall buildings and slender buildings over 150 m tall, for example, TV towers. It is a fact that the resonance cannot be completely avoided in high rise buildings, hence the need for

the solutions to cope with the phenomenon. If resonance is not taken into account in the lift design, it could increase the lift out-of-service time and decrease lift ride comfort.

The main purpose of the sway management is to improve lift safety and service time by reducing rope sway by optimizing tension of compensation ropes, providing shaft protection equipment to prevent ropes from entangling and damaging the lift equipment. A sway detector may be used to control the lift operations. The output signals from the sway detector are used to reduce the speed of the lifts or park them at a safe floor.

In order that the sway analysis is done, the building designer should be in touch with the lift designer since early design stage of the building and share information on the building natural frequencies, maximum amplitude of building displacement with probability of occurrence, etc. The lift designer would then be in a position to calculate the rope/cable sway and decide on the preventive measures to be taken in the lift design.

11.5 Ride Comfort

A robust car guidance system with meticulously aligned guide rails is essential for reducing vibrations to an acceptable comfort level. Guide rails shall be rated for heavy-duty usage. Irregularity in the guidance system causes an unpleasant and uncomfortable transverse vibration within the car at high speeds. High-quality roller guidance system is required for smooth ride. In addition, the lift guidance system shall be able to withstand the effects of the building settling and the response of the building's structure to thermal and climatic changes.

11.6 Jump Lifts

In super high rise buildings, there may be a need to start lift erection before the machine room is finished in order to compress total time required to complete the building. The self-climbing lift technique may be used to build the lift as the building construction progresses. Jump lift uses a temporary machine room that is moved upward as construction progresses. Typically, when the building construction reaches 7th floor, the jump lift may start operating and start serving lower floors. Exterior hoists can be removed sooner, enabling the façade to be enclosed. This means that lower floors are ready for finishing much earlier and the entire building can be completed sooner. Since all transportation takes place in a dry, windproof shaft, construction can continue safely and unhindered, even in bad weather. The change-over to final lift is very quickly done.

---NEW CLAUSES—

↓

11.7 How to Handle High-Density Population in Buildings

Due to continued exponential growth in urbanization, thickly populated buildings are becoming common in all metro and Tier-I cities. It has become quite essential to improve the efficiency of vertical transportation systems within the available shafts in the buildings, significantly beyond the conventional single deck system. (*see* Fig 24)

The following two different types of systems are possible solutions:

a) 2 cabins running independently in one single shaft; or
b) 2 cabins mounted one above the other.

These systems are compliant with the latest Indian good practices as per [8-5A(16)] and [8-5A(18)].

11.7.1 The benefits of these systems are as follows:

a) Optimal use of shaft with 2 lift cabins arranged one above the other.
b) Connection of two main landing levels with the highest efficiency.
c) Handling of high traffic volume and short travel times between two main landing levels.
d) Simultaneous filling of both lift cars.

In combination with other lift systems, double deck is generally used as a shuttle lift. It is particularly suitable for passenger transport from main entrance levels to defined terminal landings, for example outdoor viewing platforms or transfer landings, so-called sky lobbies.

Two independent cars in a single shaft solution, is used where both up-peak and inter-floor traffic are heavy.

The advantages come into their own when each of the landings in the access area or terminal landings are interconnected via escalators to split up the flows of passengers. In this case, both lift cars can be loaded and unloaded simultaneously.

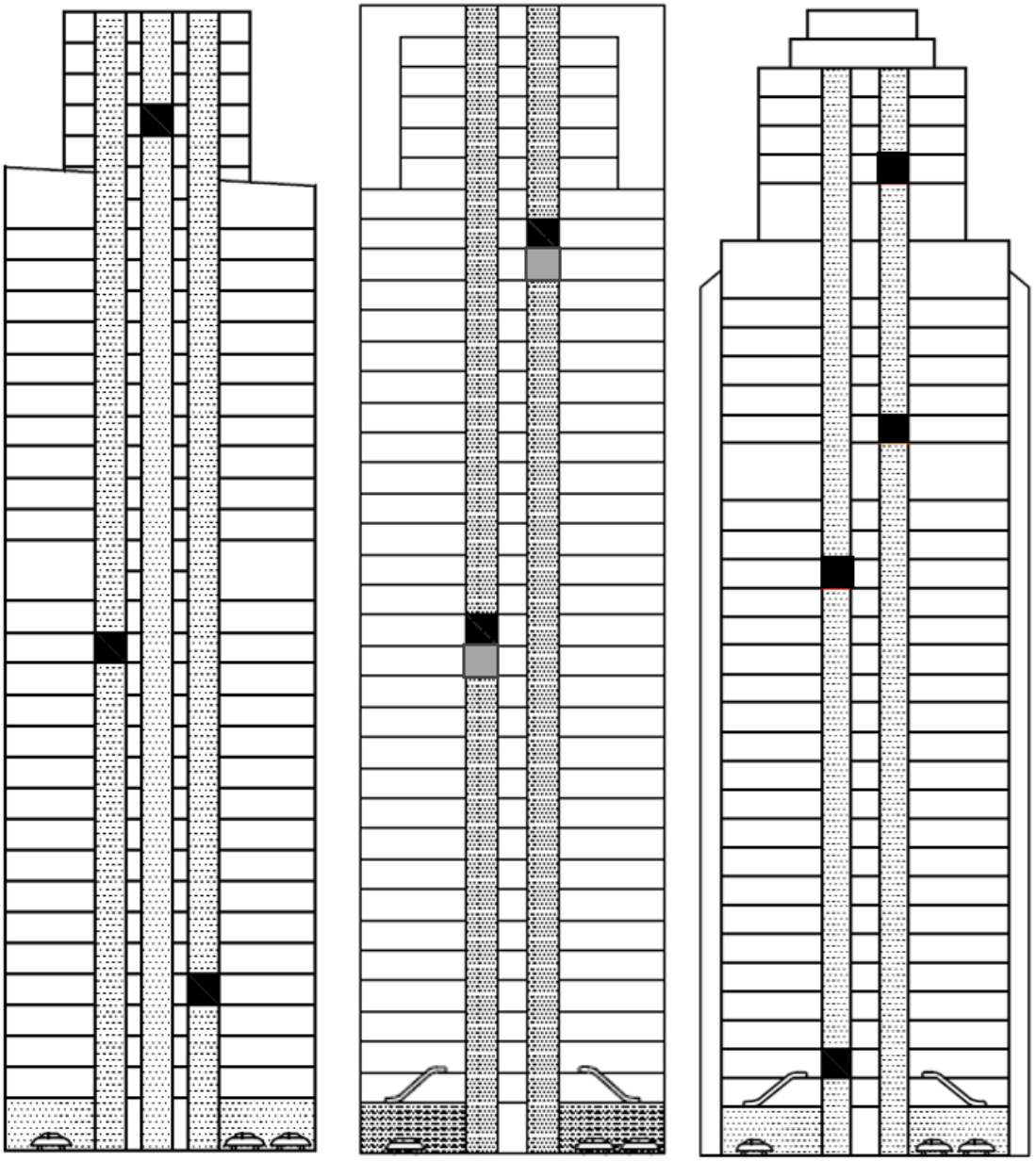


FIG. 24 DIFFERENT TYPES OF VERTICAL TRANSPORTATION SYSTEMS

11.7.1.1 The benefits for new installations include:

a) Significantly more handling capacity with fewer lift shafts compared to conventional lifts.
b) 2 independent cars and 2 cars one above the other in one shaft reduce the building core by approximately 50 percent.

c) Reduction in construction cost in both labour and material for the developer and contractor.
d) Increase in the rentable floor space and the rental income for the owner.

11.7.1.2 The benefits for modernization projects include:

a) Increased handling capacity with two lift cabins in one shaft.
b) Reduction in waiting time by around 30percent to 40 percent over the conventional single deck system.
c) Replace single-deck lifts that can no longer handle the building capacity and passenger comfort demands.

Whether used in new buildings or as part of a modernization project, these 2 car systems in one shaft can transport up to 40 percent to 50 percent more passengers.

11.7.2 Overview of the system with 2 sperate cabins moving independently inside the shaft:

The lift group must be planned as a multiple car system. The cars must operate independently and use the same shaft. The lift cars are arranged one above the other and run independently.

Both cars use the same guide rails. The cars can move towards each other and are also able to move away from each other.

Each of the 2 lifts has its own drive system and counterweight. Each counterweight runs on its own guide rails. Both lifts have their own safety equipment where required. Both cars use the same landing doors.

The suspension of the cars is dependent on the lift speed and travel height. It can be 1:1 or 2:1. The suspension of each car can be different or same.

Measures for rope compensation can be designed with compensation chains or belts to reach the required traction. For speeds above 2.5 m/s tensioned compensation rope systems should be used.

The call assignments will be undertaken by Destination Control System. The destination call will be set onto an input station (terminal) in the lobby in front of the lifts or in close proximity. Therefore, pushbuttons for call assignment in the car are not required for passenger use. Hidden COP is provided for Fireman Control

or special operation. The cars can serve floors with adequate distance directly above each other.

The minimum required safety distance depends on contract speed of the lifts. An independent working safety controller guarantees the prevention of a collision in any operating condition.

Depending on the type of suspension and shaft dimensions, the drives are distributed in one, two or three machine room levels.

This system is designed for safety integrity level (SIL) 3 as defined in PESSRAL.

> NOTE – Programmable Electronic Systems in Safety Related Applications for Lifts (PESSRAL) was included in the EN standards and also in the Indian Standard Specifications.

11.7.2 Overview of the system with 2 cabins joined & mounted one upon the other

The lift group has to be planned as a single car system with 2 entrances (upper & Lower). The cars are joined to operate simultaneously and use the same shaft.

Both cars use the same guide rails, counter-weight rails, landing doors, machine, drive, controller system, rope system and safety equipment.

The suspension of the cars is dependent on the lift speed and travel height. It can be 1:1 or 2:1. The suspension of each car is same.

Measures for rope compensation can be designed with compensation chains or belts to reach the required traction. For speeds above 2,5 m/s tensioned compensation rope systems should be used.

The call assignments will be undertaken by destination control system (DCS). The destination call will be set onto an input station (terminal) in the lobby in front of the lifts or in close proximity. Therefore, pushbuttons for call assignment in the car are not required for passenger use. Hidden COP is provided for Fireman Control or special operation.

Depending on the speed, the drives are distributed in one or two machine room levels.

11.8 Fireman's Lift

Minimum one number of single deck lift (15 Pass, 1 000 Kg capacity) serving all floors of the building is to be provided meeting all the requirements as per concerned fire authority such as 2 h fire rated landing doors, minimum speed

criteria of travel time less than 60 seconds for travel from the main lobby to the topmost landing.

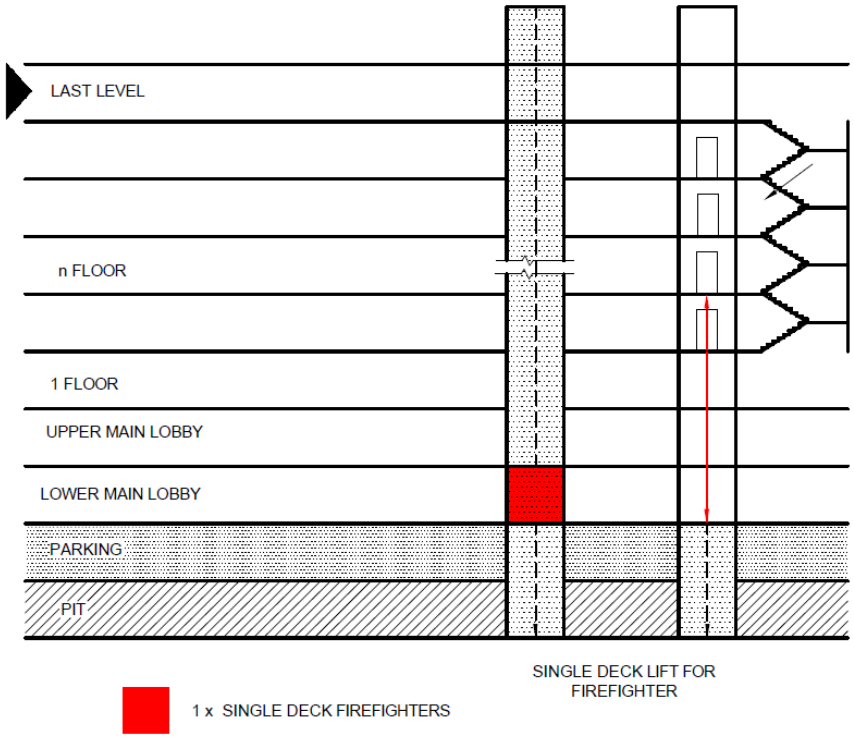
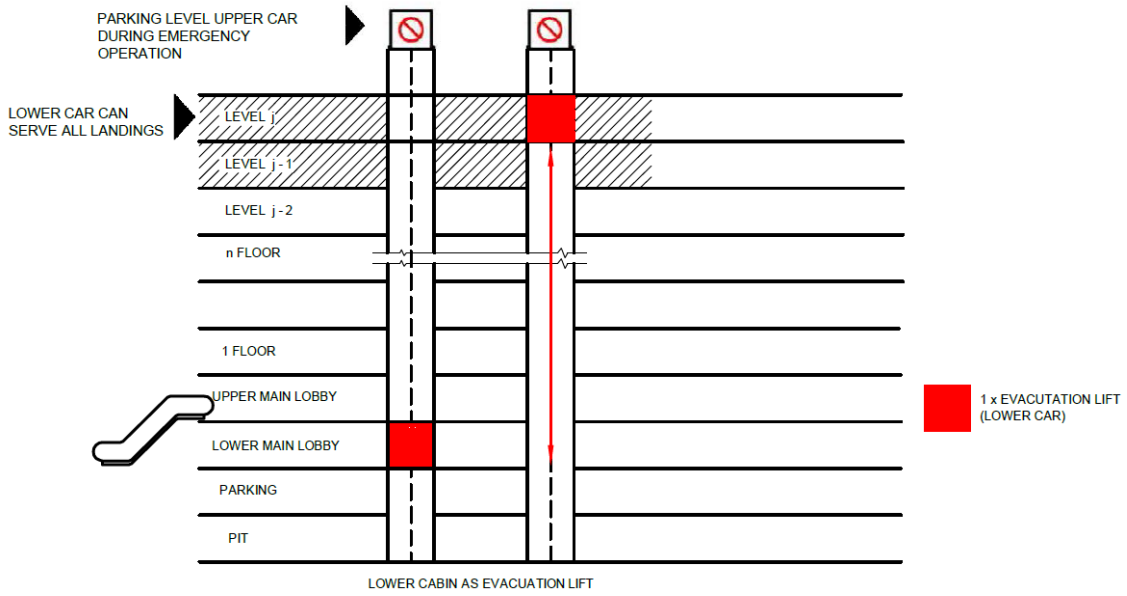


FIG. 25 FIREMAN'S STRATEGY

11.8.1 *Passenger Evacuation Strategy For 2 Cabins Running Independently Inside A Single Shaft*

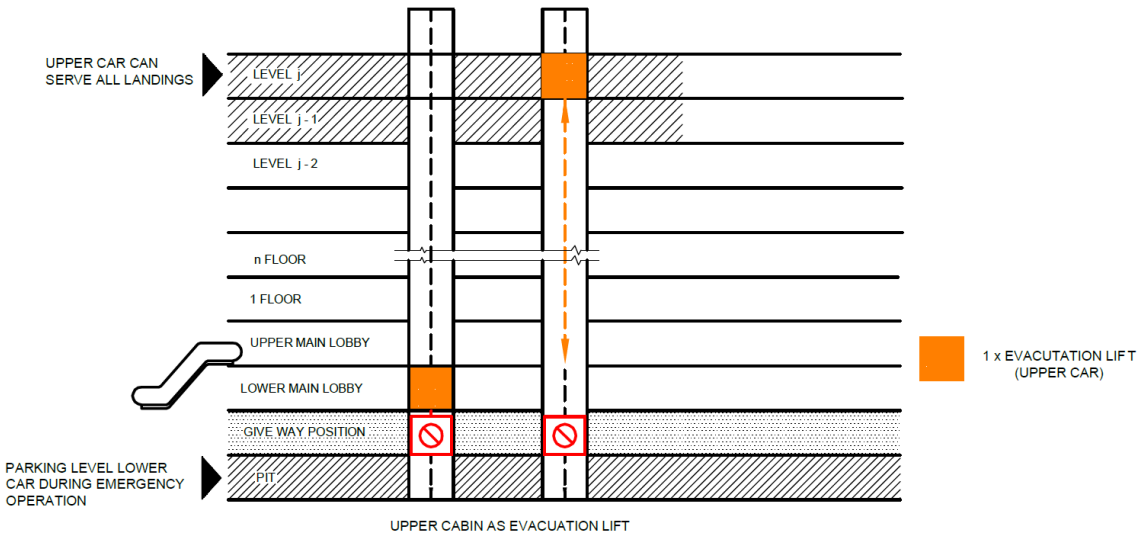
a) Case (I)



NOTE – OEM to be consulted for suitable depth of the pit.

FIG. 25B GIVE WAY IN ELEVATOR OVERHEAD ROOM FOR UPPER CAR AND OPERATION ONLY WITH LOWER CAR

b) Case (II)



NOTE – OEM to be consulted for suitable depth of the pit.

FIG. 25C GIVE WAY IN ELEVATOR PIT FOR LOWER CAR AND OPERATION ONLY WITH UPPER CAR

c) Case (III)

Without any giveaway, either in pit/overhead, but with 2 firefighter access levels, one on the ground floor (lower main landing), and one on the first floor (upper main landing) so that either of the cabins can be utilized as an Evacuation Lift.

11.8.2 *Passenger Evacuation Strategy for 2 Cabins Mounted One Above the Other and Running Together Inside a Single Shaft*

It can be achieved with 2 firefighter access levels, one on the ground floor (lower main landing), and one on the first floor (upper main landing) so that either of the cabins can be utilized as an Evacuation Lift.

↑

---NEW CLAUSES —

12 LIFT ENQUIRY OR INVITATION TO TENDER

12.1 General

A period of two to four weeks is normally sufficient for return of tenders. This should be extended, if large numbers of lifts or special requirements are involved.

The enquiry documents should be kept to the essential minimum and should be strictly confined to material relevant to the lifts works and to the particular project concerned.

When enquiring for and ordering lifts, the particulars given below should be furnished:

1) Type of lift (passenger, goods, service or dumb waiter);
2) Number of lifts required;
3) Capacity/Load of lift (s): number of persons (in kg);
4) Rated speed (m/s);
5) Travel (in m) and building height;
6) Floors served (no. of regular openings, emergency openings, blocked openings);
7) Method of control (simplex or group control);
8) Position of machine room (if machine room-less, machine below, hydraulic);
9) Machine room height;

10) Clear overhead/Clear top clearance;
11) Pit depth;
12) Sizes of hoist-way (width x depth), in mm;
13) Position of counterweight;
14) Car size (width x depth), in mm;
15) Construction, design and finish of car bodywork;
16) *Car entrances*:
    i) Number of entrances,
    ii) Size (width x height), in mm
    iii) Type of door (center opening, telescopic, 4 panel, vertical bi-parting), and
    iv) Whether through opening.
17) Car light;
18) Call indicator;
19) Position indicator in car;
20) *Lift landing entrances*:
    i) Number of entrances,
    ii) Size (width x height), in mm
    iii) Type of door or gates or shutters (for goods lifts) (centre opening, telescopic, 4 panel, vertical bi-parting), and
    iv) Whether through opening.
21) *Electric supply*:
    i) Power in volts a.c.,
    ii) Phase, and
    iii) Cycles (wire system).
22) Whether neutral wire available for control circuit;
23) Temporary guarding of hoist-way and car cabin;
24) Lighting volts a.c./d.c.;
25) Are premises subject to *Lifts Act and Rules;*
26) Disable friendly requirements [such as voice announcement of floor levels, accessible control panel (good contrast with the background wall, Braille, raised letter and font), railing on three sides, two way accessible communication system];
27) Earthquake protection requirements; and
28) Additional items

12.2 Additional Items

The enquiry should state any additional items required beyond those specified in good practice, such as interface requirements, dismantling of existing lifts, fireman’s control, seismic design consideration, sway/deflection requirements, gravity distortion, etc.

12.3 Finishes

Finishes should be specified at the enquiry stage or provisional sums should be included for them. Finishes to be considered may include interior car finish, false ceiling design, false ceiling lighting, flooring material and weight, blower, ventilation details, car wall cladding details (weight to be considered), multimedia display details (like screen type, size, location, etc), door cladding details, transom details (flushed with the wall, material type, etc) *see also* **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code.

12.4 Inclusions and Exclusions

A number of peripheral items are associated with lifts installation, of which some should always be provided by the builder and some are best included by the manufacturer. The requirements vary to some extent with the type of installation.

It is important that the limits of responsibility are clearly understood, and the enquiry documents should be specific in this respect.

The lifts manufacturer should include such items mentioned in **12.1**.

The lifts manufacturer should exclude the supply and fixing of the items or as per the contract conditions as follows:

a) Builder's work such as forming lift well, pit and machine room, and building wall inserts.
b) Machine room floor including any reinforcement necessary for load bearing.
c) Hoisting hook/lifting beam fixing, where necessary.
d) Any necessary tanking, lining or reinforcement of the pit.
e) Diving beams for multiple wells and inter well pit screen (or as per the contract).
f) Trap door.
g) Intermediate beams for bracket fixing.
h) Door cladding (or as per the contract).
j) Cutting away and making good.
k) Working lights/permanent electricity supplies.
m) Site painting of steel work other than lift material (if any).

For more detailed discussion of the requirements for site preparation and work by other trades, reference should be made to good practice [8-5A(7)] and to other relevant clauses of this Section.

Facilities for the use of the main contractor's crane should be provided to assist in installing heavy equipment in addition to other unloading facilities on site in the course of erection.

The main contractor should be instructed to include these facilities in his own quantities.

Where the lift manufacturer agrees to use mobile platforms in place of lift well scaffolding, the general contractor should provide 400/440 V 3-phase and 200/220 V single-phase supply in the lift shaft to operate such equipment, the supply to terminate at the position in the lift well required by the lift manufacturer.

These mobile platforms are limited in use for erection personnel and the transportation of light equipment only, but use of crane will also be necessary to assist in the installation of the heavy machinery and also in the initial installation of the mobile platform equipment.

12.5 Site Programme

The enquiry should indicate as accurately as possible the contract programme as it affects the manufacturer, in particular the target date for completion, construction schedule, site preparedness, the availability of crane for hoisting, coordination details (with other contractors like BMS interfacing, CCTV interfacing, etc).

13 ACCEPTANCE OF TENDER AND SUBSEQUENT PROCEDURE

13.1 General

The procedure indicated below particularly relates to the most usual case, where the lift manufacturer is the sub-contractor.

13.2 Order

The building owner places an order with the selected contractor for supply and installation of lifts. If alternative schemes have been offered, the order should clearly indicate which has been accepted.

13.3 Programme

The contractor shall submit a detailed programme after acceptance of the order showing his intended method, stages of the works, together with the period of time that has been estimated for each and every stage of progress.

13.3.1 The programme shall cover each lift separately, including dates, such as:

a) Date of order of equipment and materials;
b) Date of commencement and completion of every stage of the works in line with the building construction programme;

c) Date of expected completion of builder's work requirements;
d) Date of delivery of equipment and materials to site; and
e) Date of requirement of temporary and permanent electricity supply, and date of completion, commissioning and testing.

13.3.2 The period between order and delivery of material falls into two stages: first the finalizing of details and secondly the actual production of the equipment which depends on the first stage. Within the first stage, other dates may need to be considered, such as:

a) All relevant building information available.
b) Submission of lift manufacturer's drawings.
c) Approval of drawings.
d) Final selection of finishes.

13.4 Drawings to be Submitted after Placing of Order

The lift manufacturer shall prepare layout drawings based on the civil/structure drawings, order requirements and submit to building owner within mutually agreed time frame. The same shall be briefed to building owner.

The drawings shall indicate clearly the position and sizes of all holes and cuttings, the loads on beams and structures, and all other requirements in relation to 'Lift Installation' namely:

a) Lift machine room and associated equipment, including sub-floor where appropriate.
b) All structural openings, such as landing entrances (including structural dimensions), ventilation openings, etc.
c) All bases, plinths, channels, holes, grouting-in of fixings, etc.
d) Lifting beams or other facilities for supporting lifting tackle in the machine room and lift well, permanent means of access to the lift pit.
e) Hoisting facilities and access required for delivery of equipment to the machine room, etc.
f) Details of structural steelwork for lift machinery in the lift machine room.
g) Details of shaft dividing steelwork for supporting guard brackets etc, and inter-well screens/wall for multiple wells.
h) Method of fixing guide rails.

13.5 Approval of Drawings

The building owner should go through the drawings submitted by lift manufacturer and ensure that it is prepared in line with civil/structural drawing and order requirements provided.

If any addition/alteration is noted in the drawing, the same shall be updated in the drawing by the lift manufacturer and resubmitted to the building owner for approval. The drawing shall be approved by building owner, once it has been clearly understood.

13.6 Selection of Finishes

Where the contract provides for the purchaser's choice of decorative finishes, colours, etc, the decisions should be communicated by the purchaser's representative as early as possible, preferably not later than the time of approval of drawings.

13.7 Electricity Power Supply for Lifts

Operation of the machine requires electrical power supply from a comparatively early stage of installation for the most efficient working, and shall be provided accordingly. Whilst temporary supply may be sufficient for erection purposes, the quality of power should be ensured by provider. Final testing and setting up should only be carried out with the permanent power supply. For this reason, the timely provision of the permanent supplies is important.

14 COORDINATION OF SITE WORK

14.1 Preparatory Work on Site

In accordance with the general arrangement drawing for the lift, the representative of the lift company would brief the building owner or his nominated representative about the preparatory work that is required to be carried out before commencement of the lift installation.

The building owner will ensure that the preparatory work is done in accordance to the general arrangement of lift and also the state Lift Rules are followed for the construction of the lift shaft as well as machine room. Once the preparatory work is completed, the building owner or his nominated representative, will ask the lift company to cross check and see that everything is in order. The lift installation will start after receiving all necessary statutory approvals applicable as per the state laws.

The representative of lift manufacturer shall check the lift shaft and bring the shortfalls, if any, to the notice of the building owner till the preparatory work is completed in compliance with the requirement of lift supplier. The following works shall be completed by the building owner before commencement of lift erection.

14.1.1 *Machine Spaces / Head Room*

a) Adequate ventilation for machine room with rain protected windows or louvers with exhaust fans or air-conditioning system so that the ambient temperature of the machine spaces is maintained between +5^{o}C and + 40^{o}C. (taking into account the heat dissipated by the equipment, ambient temperature, humidity, direct sunlight, air quality and air tightness of buildings due to energy saving requirements).

b) Suitable access door preferably with louvers to machine spaces with RCC steps or MS Staircase with hand railing (Not applicable for MRL)

c) Machine spaces access door shall be of M.S, in two panels, hinged type construction, opening outward and clear entrance not less than 1000 mm wide x 2000 mm high with proper locking arrangement. Caution notices of 440V and restricted entry shall be marked on the entrance. (Not applicable for MRL) A trap door with steel enclosure shall be provided for each machine spaces as per GAD. (Not applicable for MRL)

d) Hoisting beams/ load hooks of required lifting capacity in machine room for machine room lift, one directly above the lift shaft and other directly on top of the trap door as specified in the lift general arrangement drawing. The same shall be provided in the slab in the overhead area for machine room less lifts, as specified by the lift manufacturer in their general arrangement drawing. The safe working load (SWL) shall be specified after certification and tagged on the hook/ beam in the machine room/ head room.

e) Machine room slab shall be cast after the slab marking for rope pocket holes is done by manufacturers team. Reinforced concrete machine room slab of 230mm thickness designed to sustain more than1000 kg/sq.m uniformly distributed load all over its surface in addition to specific load shown in GAD. (Not applicable for MRL)

f) Machine spaces walls, floor and ceiling to be treated and painted to minimize accumulation of dust. (Not applicable for MRL)

g) RCC pedestal for fixing the machine bed frame. (Not applicable for MRL)

h) Fire extinguisher shall be provided by building contractor to prevent fire accidents.

14.1.2 *Hoistway*

a) Hoistway dimensions mentioned in the GAD shall have minimum clear plumb dimensions in mm and hence actual wall shall not encroach on these dimensions**.**

b) Hoistway shall be without any projections and recess from headroom to the pit floor.

c) If any projections or recesses are there, then those shall be flushed and leveled on underside to an angle not less than 60° from the horizontal by means of metal plates or cement.

d) Anything not related to lift equipment like Service pipes, ventilation ducts, plumbing and mechanical systems, electrical conduits shall not be allowed to run in lift well and machine room.

e) Front wall at the ground floor and top floor shall not be constructed until all lift equipment is set in position.

f) The thickness of lift walls shall be minimum 230 mm in brick or 150 mm in RCC. The walls shall be constructed in consultation with structural engineers or consultant to verify suitability based on lift load/reactions.

g) In case of brick walls, it would be recommended to have concrete solid block at locations where guide rail brackets are to be installed and in the overhead area in case of MRL Lifts. Similarly in case of structural shaft suitable ISMC / ISMB shall be provided by the builder to fix guide rail brackets at all bracket fixing levels. The lift manufacturer shall provide a drawing indicating the locations of brackets in the lift shaft.

h) Similarly for fixing the landing entrances, the builder shall provide RCC lintels/ RCC beams for fixing landing door header and sill. In case of structural shaft suitable metallic channels shall be provided in the entrance area at lintel and floor level.

j) The shaft in masonry shall be fully plastered and given two coats of white wash or paint

k) All the structural shafts shall be completely covered and finished in accordance to the local codes before the start of installation.

m) Suitable cut-outs near the entrance area as indicated in the lift general arrangement drawing shall be provided for fixing human interface system

like landing operating panel, floor indicator, hall gong and lantern, emergency alarm, fireman switch and other devices like 'THIS CAR NEXT', group indicators, etc.

n) Scaffolding (bamboo/steel) shall be erected as required by the lift manufacturer with necessary safety measures.

o) Adequate barricading shall be provided on all the lift entrance openings to avoid mishap.

p) Smoke window with louvers shall be provided below overhead slab in the hoistway as per GAD.

q) Adequate measures shall be taken to prevent water from seeping into the hoistway at all times.

14.1.3 *Pit*

a) Lift well pit floor and side wall of the lift shaft may be plastered and water proofed. Pit shall be free from any water leakage/seepage and debris. Building owner shall ensure the construction of the pit depth in accordance with the speed of the lift as specified by the manufacturer in the general arrangement drawing.

b) Pit floor shall be strong enough to bear the load reactions as per GAD.

c) Pedestals shall be provided for fixing car and counterweight buffers to bear the reactions as mentioned in GAD.

14.1.4 *Lighting & Power for Installation*

a) Lift shaft shall be provided with permanently installed electric lighting giving at least 50 lux, 1.0 m above the pit floor and above the pit platform (when provided) everywhere, a person may stand, work &/or move between the working areas and at least 20 lux in all other areas, excluding shadows created by car or components, even when doors are closed.

b) The lighting to be protected against mechanical damage.

c) The lighting outside each landing to be provided with 50 lux illumination.

d) Adequate Power supply (Single phase/3 phase) as required by the lift manufacturer, shall be provided for running winch machine, lift machine for scaffold-less installation.

e) Double earthing shall be provided in the machine room / control panel as required by the manufacturer.

14.2 Delivery of Material

The delivery of the material shall be made based on mutual agreement of the lift manufacturer and the building contractor. It is strongly recommended that the material should be delivered at site only when a a suitable dry, lockable and weather-proof storage area is provided by the building contractor; the building shall be ready for installation as per GAD.

The scope of unloading and stacking materials shall be as per mutually agreed terms between the lift manufacturer and the building contractor. While unloading and shifting of materials due care shall be taken by both the parties to ensure safe unloading and shifting of materials.

Suitable equipment like hydra, fork lift, crane and trolleys shall be used for unloading and shifting of lift materials. Building contractor shall ensure safe passage for vehicles carrying materials, up to the storage area.

14.3 Storage

In order to enable efficient material distribution, it is important that the material shall be unloaded from the delivery truck within a distance of 50 m of the storage/unit location and have proper access from unloading area to storage area. The building contractor shall provide the storage area near the installation site, that is within 20 m distance from the installation site. The minimum storage space per lift shall be 35 m2 per lift & shall be increased adequately in consultation with the lift company, for bigger capacity high speed lifts and tall buildings.

The storage room should be dry, well lit, weather protected and should have locking arrangement and provision of a 16 A power point is recommended. The storage area provided by the building owner should have PCC flooring. The storage room shall be kept ready before arrival of material at site and shall remain in possession of installation engineer till the erection of lift is completed and handed over to the owner.

The material shall be stacked in sequential manner, in accordance with the planned activities. The storage area should be provided at a suitable location near the vicinity of the lift shaft preferably above the ground floor level and should remain in possession of the lift supplier till the installation and commissioning work is completed. It is strongly recommended that the location of the store is not changed to avoid material damages.

14.4 Site Meetings

For the successful progress of the work, full cooperation among all agencies is essential. In large sites, regular meetings of such agencies are beneficial for coordination of work efficiently. Programme for the constructional work in that part of the building containing the lift should be made in consultation among all parties concerned.

14.5 Service of Other Trades

The lift erector will require the services of architect, civil, and electrical contractors, and other agencies as the work proceeds, and it is essential that the lift erector should give due notice to the building contractor of the demands to be made on other trades, so that he may plan accordingly. Mutually agreed, periodic meeting to review work progress with agencies concerned would ensure better coordination and efficiency.

14.6 Scaffolding, Fencing, Wherever Provided

Scaffolds and stationary work platforms shall be erected in accordance with adequate safety under the supervision of a competent person. When used, wooden or synthetic planks shall be scaffold-grade or approved by a qualified person for scaffold and stationary work platform use, and the same shall be capable of withstanding 4 times the working load.

The assembly and disassembly of scaffolds and stationary work platforms shall be done using a safety harness, Rope grabber and lifeline as required. All temporary lighting shall be so installed so as not to make any contact with the metal frames of the scaffold. Also, the metallic scaffolding shall be double earthed. Prior to start of any lift installation work, all lift landing shall be barricaded adequately, preferably to full height, with display of warning notices informing presence of persons at work. When scaffold less method of installation is used, certified man-riding rope hoist machine shall be used with double fall protection system.

14.7 System Building Sites

If the building programme allows insufficient time for lift erection in conventional fashion after the well is completely built special procedures are needed. This applies particularly to industrial and multi-storeyed buildings. The building contractor should provide a suitable portable cover to the completed portion of the lift well in order to protect the lift erectors working below against the weather and falling objects.

When the top of the well has been reached it is normal to cap it immediately with a precast load bearing floor slab on to which is lowered the pre-assembled

machine room equipment. It then remains for the building contractor to complete and weatherproof the machine room as swiftly as possible. On all such projects the close cooperation between the building contractor and the lift manufacturer is essential.

14.8 Connecting to Power Supply

The lift manufacturer should give prior intimation to the building contractor of the date the power supply to the lift is required, so that suitable arrangements for connection should be made.

15 INSPECTION AND ACCEPTANCE PROCEDURE FOR LIFTS

15.1 Reference

This suggested procedure for inspection of lifts is based on good practice [8-5A(2)], [8-5A(10)] and [8-5A(13)] for the traction lift.

15.2 Purpose

To ensure safe operation of new lifts on their completion and before being placed in service, they need to be subjected to acceptance inspection and tests in the field to determine that installation shall conform to the requirements of applicable standards. An inspection and test shall also be carried out on an existing installation after a major alteration.

15.3 General Requirements

These requirements shall be as follows:

a) *Personal safety*

i) Use of relevant personal protective equipment is mandatory by the inspector and his support staff at the time of inspection.
ii) Should stop work and arrange for correction, if unsafe conditions are noticed at the installation.

b) *Safety precautions during inspection*

i) Inspectors should have a proper working knowledge of the lifts.
ii) They should always ensure that the car is in his control while working on car roof and pit
iii) They should at all times be alert for moving objects, and when on top of lift car for moving counter weight, hoist-way projection such as beams,

adjacent moving cars, cams and other equipment attached thereto or mounted in the hoist-way.

iv) The overhead clearance should always be noted as number of fatal accidents occurs due to cars running into limited overhead spaces while inspections are made from top of the lift cars.

v) Inspector should never enter in lift pits containing water.

vi) When working in the lift pit the inspector should always note the position of car.

vii) Keeps clear distance from descending counterweight in the hoist-way of the lift being inspected and those in adjoining hoist-way.

15.4 Description of Installation

The following provides a template of typical description of installation:

Site Name with details	Vendor
Length of travel (mm)	Job No:
Number of floors served Total: *	Purchaser's identification number
Front: *	Power supply
Rear: *	Permanent
Car door: Glass / SS Landing door: Glass / SS	Temporary
Rated Load	Voltage *
Rated Speed m/s *	Phase *
Lift type : Passenger / Goods Machine Room / Machine Room Less/ Hydraulic	Frequency *
Location of Machine Room (For MR / Hydraulic Lifts) Give a tick mark in the appropriate box	Wire (3 or 4) *
Above well	MCCB rating *
Below well	RCD Rating *
At side	Are the above entries acceptable
Roping ratio: _____	Yes No

15.5 Visual and Functional Checks

A typical checklist of visual and functional checks involved in the installation of lifts is given in Annex A.

16 MAINTENANCE OF LIFTS

16.1 Following sections specify the elements necessary for the preparation of the instructions for the maintenance operations of lifts. The requirements are applicable for all new installed passenger lifts, goods – passenger lifts, special goods lifts such as vehicle lifts, service lifts.

NOTES
1 Existing installed lifts are not covered.
2 Instructions for installation and dismantling of lifts are not covered.

16.2 Maintenance of the lift essentially covers all necessary operations to ensure safe and intended functioning of the installation and its components after completion of the installation and throughout its life cycle. Maintenance includes:

a) Lubrication, cleaning, etc.;

NOTE – The following cleaning operations cannot be considered as maintenance:
a) Cleaning of the external parts of the well, and
b) Cleaning of the inside of the car.

b) Checks;
c) Passenger rescue operations;
d) The operations of setting and adjustment; and
e) Repair or changing of components which may occur due to wear and tear and do not affect the characteristics of the installation.

The following are not considered as maintenance operations:

1) Changing of major component such as the machine, even if the characteristics of the new component are the same as the original;
2) Replacement of installation;
3) Modernization of the installation including changing of any characteristics of the installation (such as load, speed, etc); and
4) Rescue operation carried out by fire brigade.

16.3 Elaboration of Maintenance Instructions

16.3.1 *General*

The installation shall be maintained in good working order in accordance with the manufacturer's instructions. To this effect, regular maintenance of the installation shall be carried out to ensure, in particular, the safety of the installation. The safety of an installation shall take into account the ability to be maintained without causing injury or damage to health.

Regular maintenance of the installation shall be carried out to ensure the reliability of the installation. The access and the associated environment shall be maintained in good working order in accordance with the installer's instructions.

The instructions for maintenance of an installation shall be provided by the installer after completion of the installation as a result of a risk assessment. The instructions for maintenance of the safety components of lifts shall be provided by the manufacturer to the installer. The instructions for maintenance which shall be based on a detailed risk assessment of an installation shall be provided by the manufacturer.

In order that the aim of the maintenance instructions can be achieved, they shall be formulated so that they can be clearly and easily understood by competent maintenance person.

The competent maintenance person within the maintenance organization shall be continuously updated.

> NOTE – The owner of the installation should be informed that the qualification of the maintenance organization is in conformity with the regulation applicable in the state in which the installation operates.

The manufacturer shall provide maintenance instructions intended for the owner of the installation including the information intended for the maintenance organization.

16.3.2 *Elements to be Taken into Account for Maintenance Instructions*

When preparing the content of the maintenance instructions the following elements shall be taken into account:

a) The specifications and the intended use of the installation (type of installation, performance, type of goods to be transported, type of users, etc).
b) The environment in which the installation and its components are installed (weather conditions, vandalism, etc).
c) Any restriction of use.
d) The result of risk assessment for every working area and for every task undertaken.
e) The specific maintenance instructions provided by the manufacturer of safety components.
f) In case of components other than safety components, where maintenance is necessary, the maintenance instructions provided by the manufacturer of these components.

16.3.3 *Information to be Included in the Maintenance Instructions*

16.3.3.1 *General*

The maintenance instructions shall contain information relating to the tasks of the owner and respectively the maintenance organization.

16.3.3.2 *Information to the owner of the installation*

The information relating to the tasks of the owner of the installation shall include that given in **16.3.3.2.1** to **16.3.3.2.16**.

16.3.3.2.1 The need for the owner to keep the installation in a safe operating condition. To fulfil this owner shall use a maintenance organization complying with the requirements of this Section.

> NOTE – It is recommended to inform the owner of the installation about the need to use a maintenance organization with adequate and proper insurance cover provided by an insurance company.

16.3.3.2.2 The need for the owner to take care of any state/local regulations and other requirements, where relevant, and their implications on maintenance.

16.3.3.2.3 The need for planned maintenance to be carried out by a maintenance organization, at the latest when the installation is put into service or if the installation is to remain unused for a long period of time, before being put into service first time thereafter.

16.3.3.2.4 The importance for the owner of the installation to have the same maintenance organization in the case of several installations having common well/spaces and/or machine room.

16.3.3.2.5 The need for the owner of a passenger/goods-passenger lift to keep the two-way means of communication efficient and linked to a 24 h rescue service for the whole of the time that the installation can be used.

16.3.3.2.6 The need for the owner to remove the passenger/goods-passenger lift from service when the two-way means of communication is out of order.

16.3.3.2.7 The need for the owner to put the installation out of service in case of dangerous situations.

16.3.3.2.8 The need for the owner of the installation to inform the maintenance organization,

a) immediately about any perceived abnormal operation of the installation or abnormal change in its direct environment;
b) immediately after putting the installation out of service in the case of a dangerous situation;
c) after any rescue intervention by their authorized and instructed person(s);
d) before any modification related to the installation and/or its environment or use;
e) before any authorized third party inspection or works other than maintenance works are carried out on the installation;
f) before taking the installation out of service for a prolonged period of time; and
g) before putting the installation back into service after a prolonged period of non-operating time.

NOTE – The owner of the installation should obtain from the company carrying out the relevant modification the maintenance instructions for the maintenance organization.

16.3.3.2.9 The need for the owner of the installation to take into consideration the consequences of the risk assessment carried out by the maintenance organization.

16.3.3.2.10 The need for the owner of the installation to make sure that the risk assessment for maintenance is carried out,

a) If the maintenance organization is replaced;
b) If the use of the building and/or the installation changes;
c) After a major modification of the installation or of the building; and
d) If it is the case, after an accident involving the installation.

16.3.3.2.11 The need for the building owner to ensure, through a risk assessment, that,

a) Their premises are safe and free from risk to health as far as is practicable. This includes access to the premises and installation equipment, and articles or substances used according to the regulation for the use of work equipment at the workplace;
b) The persons using the premises are informed about any remaining risks; and
c) Any action to be done as a consequence of his risk assessment is carried out.

Regarding the access ways to areas reserved to maintenance persons, the need for the owner of the installation to inform the maintenance organization, in particular about,

1) The access ways to be used and fire evacuating procedures from the building;

2) The place where the keys of the reserved areas can be found;
3) If necessary, the persons who shall accompany the maintenance persons to the installation; and
4) If necessary, personal protective equipment to be used in the access ways, and, possibly, where this equipment can be found.

The information shall be made available also on site to the maintenance organization.

16.3.3.2.12 The need for the owner of the installation to ensure that the name and the telephone number of the maintenance organization are always available to the user of the installation, permanently affixed and clearly visible.

16.3.3.2.13 The need for the owner of the installation to ensure that the keys of machine and pulley room doors (trap doors) and of inspection and emergency doors (trap doors) are permanently available in the building and are used only by persons authorized to gain access.

16.3.3.2.14 The need for the owner of the installation to provide, in all circumstances, safe access to the building and to the installation for the maintenance organization involved in the rescue of persons.

16.3.3.2.15 The need for the owner of the installation to keep the access to working areas and working rooms safe and free for the maintenance persons and to inform the maintenance organization about any hazard or change in the workplace and/or the access ways (lighting, obstructions, ground conditions, etc).

16.3.3.2.16 In addition to those examinations and tests which the owner of the installation entrusts to the maintenance organization, the need for the owner to carry out periodically, in their own interests, the following:

A full ascent and descent travel to assess any changes in the quality of the ride or damage to the equipment. Typical items to be checked to ensure that they are in place, undamaged and functioning correctly are,

a) landing doors and bottom door tracks;
b) stopping accuracy;
c) indicators that are not located in a reserved area;
d) landing push controls;
e) car push controls;
f) door open controls;
g) two-way means of communication in the car which provides permanent contact with a rescue service;
h) normal car lighting;
j) door reversal device; and

k) safety signs/pictograms.

For goods only and service lifts the checks to be carried out are the same, when relevant.

16.3.3.3 *Information for the maintenance organization*

The information relating to the tasks of the maintenance organization shall include the following:

a) The need to carry out the work of maintenance in conformity with the maintenance instructions and based on systematic maintenance checks. After these checks, the maintenance organization shall decide in conformity with the maintenance instructions what is required to be done.

   A list of typical examples of maintenance checks to maintain the installation is shown in Annex B.

   NOTE - Due to the fact that the components can be different in design and operation, it is therefore not possible to give specific guidelines.

b) The need to update the original maintenance instructions if the installation changes its intended use and/or the environmental conditions existing on the completion of the installation.

   NOTE – The maintenance organization should be provided by the owner of the installation with the relevant maintenance instructions where modifications are carried out on the installation.

c) The need for the maintenance organization to ensure that a risk assessment for any working area and for any maintenance operation has been carried out taking into account the installer's/manufacturer’s maintenance instructions and all information supplied by the owner of the installation.

d) The need for the maintenance organization to inform the owner of the installation about any work to be carried out as a consequence of a risk assessment especially for the access and/or the environment related to the building/installation.

e) The need to carry out a maintenance plan so that preventive maintenance is suitable for the installation and maintenance time is as short as reasonably practicable, without reducing the safety of persons, in order to minimize the non-operational time of the installation.

f) The need to adapt the plan for maintenance so as to take account of any predictable failures, for example, those due to misuse, mishandling, deterioration, etc.

g) The need to carry out maintenance operations by competent maintenance persons and provided with the necessary tools and equipment.

h) The need to maintain the competency of maintenance persons.

j) In determining the frequency of maintenance interventions, the following non-exhaustive list should be considered:

1) Number of trips per year, operating time and any non-operating periods of time;
2) Age and condition of the installation;
3) Location and type of building in which the installation is installed, as well as the needs of the users and/or the kind of goods transported;
4) Local environment where the installation is situated, as well as external environmental elements, for example, weather conditions (rain, heat, cold, etc) or vandalism.

k) The need to provide a 24 h, all year round call-out service for rescue of persons.

m) The need to keep records of the result of each intervention due to a failure of the installation. These records shall include the type of failures in order to detect any repetition. They shall be available to the owner of the installation on request.

n) The need to put out of service the installation, if the maintenance organization is aware of a dangerous situation, detected during the maintenance, which cannot be eliminated immediately, and to inform the owner of the installation of the need to keep it out of service until repaired.

p) The need to be organized to provide the necessary spare parts for any repair.

q) The possible need for attendance of a competent maintenance person(s), given reasonable notice, for any inspection carried out by an authorized third party or for building maintenance works to be carried out in the areas reserved for the maintenance organization.

r) The need to inform in due time the owner of the installation about necessary progressive upgrading of the installation.

s) The need to organize rescue operations, even with sub-contractor(s), and to make provision for circumstances such as fire, panic, etc.

16.4 Risk Assessment

16.4.1 *General*

Before an installation is placed on the market, it is necessary that the installer/manufacturer carry out a risk assessment. Every risk shall be limited as much as reasonably possible by means of safety measures and suitable instructions. The instructions can never replace a safety measure which can be provided to reduce the risk.

It is necessary to determine the different intervention procedures of the maintenance operations and to determine the appropriate safety measures for each of these procedures.

The use of diagnostic systems (for example, remote monitoring system) may support fault finding, improve the maintainability of the installation and reduce the exposure of maintenance persons to hazards.

Safety in maintenance operations of the installation is ensured by adopting safety measures and providing instructions. Safety measures on the installation and in the building shall be provided by the installer and by the owner of the installation, respectively.

For any working area, it is necessary to identify the list of the specific hazards related to health and safety and to carry out a risk assessment for any maintenance operation, including access to the working area.

For this purpose, the following should be taken into account:

a) Presence of one or more maintenance persons in a working area;
b) Foreseeable actions of persons other than maintenance persons (for example, person switching on or off power circuits and dependent circuits or lighting circuits or trying to use the installation during maintenance operations, etc); and
c) Possible states of the installation (normal or abnormal due to a foreseeable failure of its component parts, external disturbances, disturbance of its power supply, etc).

Annex C gives a list of examples of elements to be taken into account in any risk assessment for maintenance operations. However, several methods are available for the systematic assessment of risk.

16.4.2 *Information for the Maintenance Organization*

For safe maintenance and to provide relevant instructions, it is necessary, first of all, to identify the maintenance operations. In particular, maintenance operations are,

a) those operations considered necessary for a correct and safe functioning of the installation and its components after the completion of the installation;
b) those operations considered necessary during the 'life' of some components, determining, as far as possible, the time or condition after which the functioning or the integrity of the component is no longer ensured even if correctly maintained.

In carrying out specific maintenance operations, if it is necessary to neutralize some safety functions (for example, an electric safety device), the hazard identification shall be taken into account for such a situation.

It is necessary to inform and warn the maintenance persons about,

1) Residual risks, that is, those for which risk reduction by design and safeguarding techniques are not - or not totally - effective; and
2) Risks that arise from the necessary removal of certain guards to carry out specific maintenance operations.

The maintenance instructions and warnings shall prescribe the procedures and operating modes intended to overcome these risks and, if it is necessary, to specify personal protective equipment, instruments, tools and provisions to be used.

16.5 Information to the Owner for Lift Rescue Operations

The information to the owner shall be inclusive of that given in **16.5.1** to **16.5.5**.

16.5.1 The need for person(s) authorized by the owner of the installation to rescue trapped passengers to be trained by the maintenance organization.

16.5.2 The need to ensure that the training is appropriate to the specific installation and updated.

16.5.3 The need to ensure his authorized person(s) rescue people only through landing doors.

16.5.4 The need to ensure that the maintenance organization is called when the owner's authorized person(s) are not able to move the car through the use of the manual and/or electric emergency devices.

16.5.5 The need to inform their authorized person(s) about any conditions for which only the maintenance organization shall carry out a rescue operation.

16.6 Markings, Signs, Pictograms and Written Warnings

If the risk assessment of the maintenance organization indicates that additional specific warnings are required for the purpose of maintenance, these shall be affixed directly on the installation/component or, when this is not possible, in the close vicinity.

Markings, signs, pictograms and written warnings shall be readily understandable and unambiguous. Readily understandable signs and pictograms shall be used in preference to written warnings.

Signs or written warnings carrying only ‘DANGER’ shall not be used.

Information affixed directly on the installation/component shall be permanent and legible.

Any markings, signs, pictograms and written warnings affixed on the installation shall be renewed if they become illegible.

16.7 Format of the Maintenance Instruction Handbook

The maintenance instruction handbook for any installation shall contain at the front at least the following:

a) Type of installation, with its serial number, to which the instructions apply;
b) Title of the handbook;
c) Date of issue;
d) Name and address of the installer/manufacturer; and
e) Name of the publisher, when different from the installer/manufacturer.

In the handbook,

1) all units used shall be SI units;
2) all pages shall be numbered; and
3) all references to other documents shall be in full.

Warnings shall state the hazard, the related risks and the appropriate safety measure.

Type and size of print shall ensure the best possible legibility. Safety warnings and/or precautions shall be emphasized through the use of colours or symbols and/or large print. Signs shall comply with the accepted standard [8-5A(14)].

Documents giving instructions for maintenance shall be produced in durable form (that is, they shall be able to survive frequent handling) or triplicate copies shall be provided.

16.8 Documents to be Kept at the Site of Installation of Lifts

The following documents shall be maintained at the job site near the controller such that they are easily available:

a) Wiring diagram,
b) Lift license copy,
c) Log card, and
d) General arrangement drawing.

ANNEX A
(*Clause* 15.5)

TYPICAL CHECKLIST OF VISUAL AND FUNCTIONAL CHECKS INVOLVED IN THE INSTALLATION OF LIFTS

A-1 MACHINE ROOM

Sl No.	Requirement	Result	Remarks
i)	There shall be easy access from the top landing to the machine room	Accessible / Not accessible	
ii)	Steps along with handrail for the access to machine room to be provided	Provided / Not provided	
iii)	Machine room access door of M.S, in two panels, hinged type construction, opening outward and clear entrance not less than 1000 mm wide x 2000 mm high.	Provided / Not provided	
iv)	Caution notice of 440V and restricted entry marked on the entrance	Displayed / Not displayed	
v)	Locking arrangement provided and machine room shall be kept locked	Provided / Not provided	
vi)	The machine room used for the purpose of lift machinery only	Yes / No	
vii)	Machine room walls, floor and ceiling treated and painted to minimize accumulation of dust	Yes / No	
viii)	Machine room shall be maintained clean, without any seepage of water from roof, walls or any other opening.	Yes / No	
ix)	The height of the machine room shall not be less than 2100 mm at working areas	Yes / No	
x)	Machinery spaces and pulley rooms provided with permanently installed electric lighting with an intensity of at least 200 lux at floor level everywhere a person needs to work and 50 lux at floor level to move between working areas.	Provided / Not provided	
xi)	Adequate ventilation for machine room with rain protected windows or louvers with exhaust fans or air-conditioning system so that the ambient temperature of the machine room is maintained between +5^{o}C and + 40^{o}C	Yes / No	

Sl No.	Requirement	Result	Remarks
xii)	Are the rope openings below the machine closed adequately as required	Yes / No	
xiii)	The hoisting beams or hooks are certified as per the safe working load required and marked.	Provided / Not provided	
xiv)	Trap door with metal cover to be provided to lift the machine to / or from the machine room and to be located vertically below the hook provided in the machine room ceiling	Provided / Not provided	
xv)	Rescue chart pasted in the machine room with proper identification	Yes / No	

A-2 POWER SUPPLY

Sl No.	Requirement		Result	Remarks
i)	Incoming power supply to be 415 V ± 10 percent or as specified in the contract agreement		R-Y : _____ Y-B : _____ R-B : _____ Ok / Not Ok	
ii)	Neutral – Earth voltage	Idle condition within (0- 3) V	Value: _____ Ok / Not OK	
iii)	Neutral – Earth voltage	Running condition within (0- 3) V	Value: _____ Ok / Not OK	
iv)	Separate supply with MCB	Three phase supply	Provided / Not provided	
		Single phase supply (For car lighting and hoistway lighting)	Provided / Not provided	
v)	Check whether the power cables are connected with lugs for termination		Connected / Not connected	
vi)	The correct capacity main switch (with Lock out tag out provision) with protective device, provided as per the requirement, separately for lift power, light for machine room and Hoistway. Three pin sockets with switch provided.		Provided / Not provided	
vii)	Double Grounding conductor of correct size is provided on the main switch. Earthing of lift motor, control panel, overspeed governor switch etc. provided.		Provided / Not provided	

Sl No.	Requirement	Result	Remarks
viii)	Hoistway lighting provided at least 50 lux,1.m above the pit floor and above the pit platform (when provided), everywhere, a person can stand, work &/or move between the working areas and at least 20 lux in all other areas, excluding shadows created by car or components, even when doors are closed.	Provided / Not provided	
ix)	Residual current protective device (RCD) with rated residual operating current not exceeding 30mA (not applicable to main drive) provided	Provided / Not provided	

A-3 MACHINE AND BRAKE ASSEMBLY (FOR TRACTION LIFTS)

Sl No.	Requirement	Result	Remarks
Make:	*Sl No.:*	*Rating:*_____	
i)	The motor is smooth in operation without overheating	Satisfactory / Unsatisfactory.	
ii)	The Gear box (if provided) is smooth and without any oil leakage except little oozing.	Satisfactory / Unsatisfactory.	
iii)	The condition of machine grooves is such that the ropes /CSB do not slip when the traction sheave stops normally.	Satisfactory / Unsatisfactory.	
iv)	Is the machine fixation as per the installation manual	Yes / No	
v)	Are the electrical connections of the machine routed and well tightened	Yes / No	
vi)	Are the machine isolation pads installed correctly (if applicable)	Yes / No	
vii)	Ropes / elastomeric coated steel belts are fixed by suspension means in the machine room are fixed as required and locked with nuts and split pins.	Yes / No	
viii)	Clear vertical distance of at least 300 mm is available above rotating equipment	Yes / No	
ix)	The lift provided with braking system which operates automatically in the event of loss of a) the main power supply b) the supply to the control circuits.	Provided / Not provided	
x)	The Machine, Governor etc. identified with the correct contract number	Yes / No	

Sl No.	Requirement	Result	Remarks
xi)	The manual brake release device is available and easily accessible	Yes / No	
xii)	Guards provided for moving parts such as machine sheave etc to protect against pinching hazard.	Provided / Not provided	

A-4 CONTROLLER

Sl No.	Requirement	Result	Remarks
Type:	*Sl No.:*	*Wiring drawing No:*	
i)	The controller fixed as per the GAD (General Arrangement Drawing)	Yes / No	
ii)	The controller identified with the correct contract number	Yes / No	
iii)	The controller should have an easy access to open and close with lock	Yes / No	
iv)	The required warning stickers pasted	Provided / Not provided	
v)	All extra cables neatly arranged.	Yes / No	
vi)	Are the battery terminals covered	Yes / No	
vii)	The field and controller wiring properly routed	Yes / No	
viii)	The control Panel wiring is neatly grouped and the insulation of wires is not more than one Mega Ohm with 500-volt megger.	Yes / No	
ix)	Log book maintained in up-to-date condition	Maintained / Not Maintained.	

A-5 OVER SPEED GOVERNOR

Sl No.	Requirement	Result	Remarks
Make:	*Model:* *Sl No:*	*Tripping speed:*	
i)	Is the correct over speed governor provided and installed as per layout	Yes / No	

Sl No.	Requirement	Result	Remarks
ii)	The sticker/painted indication represents the down direction of rotation which will facilitate the safety gear actuation	Yes / No	
iii)	Check whether the OSG is calibrated and sealed	Yes / No	
iv)	The governor is aligned and the rope passes through the holes without any obstruction	Yes / No	
v)	The governor rope runs free does not contact any with any object in the hoist way	Yes / No	
vi)	The governor tripping mechanism is free and clean	Yes / No	
vii)	The electrical switch is provided and operates in both the directions	Yes / No	
viii)	All fixation bolts are provided and adequately tightened	Yes / No	

A-6 GENERAL INSPECTION ON CAR ROOF

Sl No.	Requirement	Result	Remarks
Instructions before entering to the car top: a) Allow the lift to move in down direction from the top terminal landing with no load. b) Stop the lift from the controller by changing to maintenance mode, such that easy access to enter the car top from the top terminal landing. c) Switch on the shaft lighting. d) Use the door open key to open the top terminal landing door. e) Switch on the car top stop switch from the landing to enable the 'STOP' mode. f) Switch on the light on car top. g) Switch to maintenance mode from the car top before entering the car top. h) Put Stop switch to Run position and press UP/DN & Common button to move the car UP or down in maintenance speed.			
i)	Car top guard rail on car roof to be provided of 0.70 m where the distance between car and hoistway wall is > 0.30 m and <=0,50 m; is 1.10m where the distance exceeds 0.50 m and not required if the distance is < 0.30m.	Provided / Not provided	
ii)	The car roof has been provided with toe board of 100 mm.& non slip working area.	Provided / Not provided	
iii)	Car roof has sufficient strength to resist a minimum force of 2 000 N at any position on an area of 0.30 m × 0.30 m without permanent deformation.	Yes / No	

Sl No.	Requirement	Result	Remarks
iv)	Lighting with proper protection is provided on the car roof of at least of 50 lux intensity,1.0 m above the car roof.	Provided / Not provided	
v)	Emergency light on car top with minimum intensity of 20 lux for 1 hr operation & Alarm initiation device provided.	Provided / Not provided	
vi)	Wires and trunking are properly routed and does not hinder with any maintenance related equipment	Yes / No	
vii)	The car fan/ blower is properly fixed with isolation	Yes / No	
viii)	Three pin plug sockets with switch is available and is in working condition	Yes / No	
ix)	The emergency stop switch is positioned not more than 0.75 m from the landing	Yes / No	
x)	Check whether the top car clearance meets the requirement. Value required:_____	Value measured:_____ Ok / Not Ok	
xi)	Overhead dimension in W×H×D Value required:_____	Value measured:_____ Ok / Not Ok	
xii)	If overhead height is less, then the indication to be provided with ZEBRA PAINTING in the overhead	Provided / Not provided	
xiii)	Floor levelling switches are fixed as per requirement	Yes / No	
xiv)	Rope/CSB hitches on car roof are fixed as required and locked with nuts and split pins	Yes / No	
xv)	Car sheave if available is adequately guarded from accidental contact	Yes / No	
xvi)	The junction box is fixed securely and all wires are adequately protected	Yes / No	
xvii)	The car shoe liners / rollers are fixed as per requirement and adjusted properly	Yes / No	
xviii)	Oil tank are provided and fixed with proper oil levels	Yes / No	
xix)	Engagement of the car door coupler with the landing door at every landing	Ok / Not Ok	
xx)	Engagement of shaft limit switches	Ok / Not Ok	
xxi)	The governor rope and linkage is correctly connected to the car	Yes / No	

Sl No.	Requirement	Result	Remarks
xxii)	The guide rail clips are fixed as per requirements and in the correct directions	Yes / No	
xxiii)	The safety gear assembly and connecting rod should be free from external disturbances	Yes / No	
xxiv)	The safety switches have been verified for correct operation during travel	Yes / No	
xxv)	The safety gear linkages is checked for operation and actuation and actuation of switches	Yes / No	
xxvi)	Clearance between the car door coupler and the landing sill to be as per the manufacturer design at every landing	Ok / Not Ok	
xxvii)	Clearance between the landing rollers with the car sill to be as per the manufacturer design at every landing	Ok / Not Ok	

A-7 PIT INSPECTION

Sl No.	Requirement	Result	Remarks
Instructions before entering to the pit: a) Allow a person in the car top and ask him to move the lift to the top most landing. b) Open the bottom terminal landing door with door open key. c) Switch on the pit stop switch from outside the pit. d) Enter in to the pit using ladder or from access door.			
i)	It should be clean and dry	Yes / No	
ii)	Pit access door to be provided, if pit depth exceeds 2500 mm. Either an access door or a ladder inside the well to be provided, where pit depth does not exceed 2500 mm	Pit Depth= mm. Pit Access Door / Ladder Provided / Not Provided	
iii)	Oil trays are available at the bottom of each guide rail	Provided / Not Provided	
iv)	Pit stop switches to be provided, accessible from the lowest landing. When pit depth >= 1.6 m, two pit switches, one accessible from lowest landing and other from pit floor to be provided.	Provided / Not Provided	
v)	Pit stop switches to be verified with the electrical circuit such that lift should not	Ok / Not OK	

Sl No.	Requirement	Result	Remarks
	move further after the activation of pit stop switches		
vi)	Inspection control station is permanently installed in the pit If more than one inspection control station is switched to 'Inspection', it shall not be possible to move the car from any of them, unless the same push buttons on the Inspection control are operated simultaneously.	Provided / Not Provided Ok / Not Ok	
vii)	Counterweight screen should be provided and fixed, except where rope compensation sheave is provided,	Provided / Not Provided	
viii)	Buffers provided for bottom limit of travel of car and counterweight are correctly fixed and not in bent condition. PU buffers not to be in degenerated condition	Ok / Not Ok	
ix)	The governor tension pulley is fixed at the correct height from the pit floor as per the manufacturer recommendation	Ok / Not Ok	
x)	The electrical switch for the tension pulley is verified, if provided	Ok / Not Ok	
xi)	Check whether the bottom car clearance meets the requirement Value required:_____	Value measured:_____ Ok / Not Ok	
xii)	Pit lighting to be provided of at least 50 lux,1.m above the pit floor and above the pit platform (when provided), everywhere, a person can stand or work.	Ok / Not ok	
xiii)	Refuge space to be provided in the pit and signage readable from entrance, indicating allowed number of persons and type of posture to be provided.	Provided / Not Provided	
xiv)	Is the travelling cable below car secured and correctly fixed and the excess cable is not secured below car	Ok / Not Ok	
xv)	The travelling cable is adjusted and clear of the pit floor with the car at the lowest position	Ok / Not Ok	
xvi)	The bottom guide shoes or rollers are fixed as per requirement and adjusted for smooth travel	Ok / Not Ok	

Sl No.	Requirement	Result	Remarks
xvii)	The car safety gear is properly adjusted as per the installation manual	Ok / Not Ok	
xviii)	The compensation chain fixing arrangement is fixed as per requirement	Ok / Not Ok	

A-8 EARTHING

Sl No.	Requirement	Result	Remarks
i)	Separate earth bar to be provided in the machine room	Provided / Not Provided	
ii)	Earthing to be done for all controllers and the machine	Yes / No	
iii)	Earthing to be done for the shaft equipment and car top components	Yes / No	
iv)	Earthing from controller to car top components to be linked through the travelling cable	Yes / No	
v)	Routing of the earth from the controller to the main earth bar	Ok / Not Ok	
vi)	Connection of the lift earth bar to main earth bar	Ok / Not Ok	

A-9 INSPECTION FROM THE LIFT CAR

Sl No.	Requirement	Result	Remarks
Instructions: a) No one should be present in the pit as well as on the car top. b) Make sure the lift is normal mode. c) Enter the lift car from any of the landing.			
i)	Car inside width Value required:_____	Value at site:_____ Ok / Not Ok	
ii)	Car inside depth Value required:_____	Value at site:_____ Ok / Not Ok	
iii)	Height below false ceiling Value required:_____	Value at site:_____	

Sl No.	Requirement	Result	Remarks
		Ok / Not Ok	
iv)	Door opening width Value required:_____	Value at site:_____ Ok / Not Ok	
v)	Door opening height Value required:_____	Value at site:_____ Ok / Not Ok	
vi)	Car capacity to be displayed inside the lift car	Yes / No	
vii)	Safety warning plate to be displayed (*see* Note)	Yes / No	
viii)	Functioning of car display.	Functioning / Not functioning	
ix)	The stopping accuracy of the car shall be ± 10 mm. If during loading and unloading levelling accuracy of ± 20 mm is exceeded, shall be corrected to ±10 mm.	Ok / Not Ok	
x)	DO button and DC button functional check: *For power operated door:* 1) Press the DO button at level - Door should open 2) Press the DO button during running - Door should not open 3) While closing press the DO button at level - Door should open 4) DC button at level when the door is in open condition - Door should close	Functioning / Not functioning	
xi)	*For manual operated door:* 1) Lift should not move if any of the door car/landing in open condition 2) If door is opened during run, lift should stop and should not move further	Functioning / Not functioning	
xii)	Car alarm functions even though there is no power supply to the lift	Functioning / Not functioning	
xiii)	Functioning of intercom (*see* Note)	Functioning / Not functioning	

Sl No.	Requirement	Result	Remarks
xiv)	Functioning of car call buttons and landing call buttons (*see* Note)	Ok / Not ok	
xv)	Provision of fan/ blower and its operations	Provided / Not Provided	
xvi)	Provision and working of permanently installed cabin lights that are continuously illuminated except when the car is parked with doors closed. Illumination shall be 100 lux.	Provided / Not Provided	
xvii)	Emergency light provided shall come on Automatically upon failure of the normal car lighting supply. Shall be capable of illumination intensity of at least 20 Lux for 1 hour.	Provided / Not Provided	
xviii)	Provided with ventilation apertures on the upper and lower parts of the car with imperforate car doors.	Provided / Not Provided	
xix)	Doors are verified for smooth opening and closing at each level	Ok / Not Ok	
xx)	Riding comfort – No appreciable jerk shall be noticed at the time of travelling, stopping / starting in the car.	Ok / Not OK	
xxi)	Car Door Protective device shall automatically initiate re-opening of the power operated car door(s) in the event of person crossing the entrance during the closing movement	Ok / Not OK	
xxii)	Lift should not move for any safety failure	Ok / Not Ok	
xxiii)	Provision of grab bars inside the lift car (*see* Note)	Provided / Not Provided	
xxiv)	Provision of buffer rail (applicable only for service lifts) at the rear panel of the lift car	Provided / Not Provided	

NOTE – Lifts open to public use shall also be inspected for requirements as per **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code, including those relating to lift closing time, finishes of interior surfaces, etc.

A-10 INSPECTION FROM THE FLOOR LANDINGS

Sl No.	Requirement	Result	Remarks
i)	Provision and functioning of landing door de-locking at every landing	Functioning / Not functioning	
ii)	Condition of landing door at every floor	Ok / Not Ok	

iii)	Functioning of landing display at every floor	Functioning / Not functioning	
iv)	Functioning of landing call button	Functioning / Not functioning	
v)	Functioning of duplex / group operation at every landing (if applicable)	Functioning / Not functioning	

A-11 RESCUE OPERATIONS

Sl No.	Requirement	Result	Remarks
i)	Is the automatic rescue device (ARD) installed and operating as per the instructions	Yes / No	
ii)	An audio-visual indicator is provided inside the lift car to alert the passenger(s) trapped inside the car that the lift is on emergency power or there is a mains power failure & they are being rescued	Yes / No	
iii)	Is the stopping accuracy of $\pm$ 40 mm achieved during the automatic rescue operation	Yes / No	
iv)	ARD operate in case of failure of any one phase, or any two phases, or all the three phases. It also operates during phase reversals (in non-VF type lifts where phase failure relays are installed).	Yes / No	
v)	Emergency Light is at least operational till the end of the ARD operation.)	Yes / No	

A-12 FIRE OPERATION

Sl No.	Requirement	Result	Remarks
i)	*Phase I* a) When the fireman switch is activated, all the landing calls to be inoperative and the car shall report to the evacuation floor and the lift doors to be in opened condition b) If the lift is moving away from the evacuation floor, then it shall reverse its direction at the nearest floor landing without opening its door, and return back to the evacuation floor	Functioning / Not functioning	

Sl No.	Requirement	Result	Remarks
	and remains there itself with the doors open		
ii)	*Phase II* (if applicable) a) It will be started once after the completion of Phase I along with the fireman switch in ON position b) In Phase II, lift should not respond to landing call and when the car call button is pressed, the door should start closing. If the button is released before the full close of doors, then the doors should open automatically c) After the full close of door, the lift should move on to the floor of registered car call d) The doors should only open if the open button is pressed after reaching the level. If the open button is released before the full open, then the doors should reclose automatically	Functioning / Not functioning	

A-13 INSPECTION FOR HYDRAULIC LIFTS

Sl No.	Requirement	Result	Remarks
Instructions before inspecting Hydraulic Lift a) Do not open or tighten the parts of a pressurized system. b) Make sure that the energy source has been locked and tagged before starting the worl. c) Ensure that there is no pressure d) The car must be at the lowest position e) The piston must be at the bottom f) The shut -off valve must be closed g) Press the emergency lowering valve to release all system pressure			
i)	Check that the oil level in the tank covers the motor- pump system (min 20 mm over the motor) when the cylinder is in upper end position and the oil level is 70/80 mm under the tank edge, when the cylinder is in lower extra travel position.	Found Ok / Not Ok	

Sl No.	Requirement	Result	Remarks
ii)	Check visually the connection pipe sealing, the joints of the flexible hoses and rigid pipes	Found Ok / Not Ok	
iii)	Check the Rapture valve intervention by loading the car with rated load uniformly distributed and over-speeding the descending car.	Found Ok / Not Ok	
iv)	Is the oil temperature, same as room temperature after the Rapture valve intervention.	Ok/ Not Ok	
v)	Check protection against accidental operation of emergency lowering valve..	Ok/ Not Ok	
vi)	When the main shut off valve is closed, activating the hand pump, the pressure on the manometer has to increase up to the adjusting valve.	Ok/ Not Ok	
vii)	Check the provision of Motor Thermistor	Provided/ Not Provided	
viii)	Any abnormal noise during normal drive, both in UP and DN direction travel..	Ok/ Not Ok	
ix)	Check the working of electrical anti-creep system	Ok/ Not Ok	
x)	Emergency Lowering with battery backup provided and working.	Provided/ Not Provided	
xi)	At least one electrically retractable pawl is provided, designed in its extended position to stop the downward moving car against fixed supports.	Provided/ Not Provided	
xii)	Check visually, the integrity of the hydraulic system after applying 200 percent full load pressure applied between the non-return valve and the jack for 5 minutes (observe for any leakage / drop in pressure).	Ok/ Not Ok	

A-14 SAFETY DEVICES

Sl No.	Requirement	Result	Remarks
Instructions: a) The lift is in ideal condition and the following safety devices get activated, then it should not move further. b) If the lift is in running condition and the following safety devices get activated, then the lift shall stop and should not move further.			

Sl No.	Requirement	Result	Remarks
i)	OSG – Over speed governor	Functioning / Not functioning	
ii)	Car door contact	Functioning / Not functioning	
iii)	Landing door contact	Functioning / Not functioning	
iv)	Car top stop switches	Functioning / Not functioning	
v)	Pit stop switches	Functioning / Not functioning	
vi)	Functioning of screen sensors and door safety edge: 1) Door should reopen, if we cut the screen. 2) Door should reopen, if it hit any object.	Functioning / Not functioning	
vii)	Check whether the car and counterweight buffers installed as per the requirement	Yes / No	
viii)	Functioning of limit switches so as lift should not travel beyond the limit	Functioning / Not functioning	
ix)	Brake on its own shall be capable of stopping the machine when the car is travelling downward at rated speed and with the rated load plus 25 percent	Ok / Not Ok	
x)	Ascending Car Overspeed Protection provided to detect overspeed of the ascending car and cause the car to stop or at least reduce its speed.	Functioning / Not Functioning	
xi)	Provision to prevent or stop Unintended car movement away from landing with landing door not in the locked position and the car door not in the closed position. Stopping distance shall not exceed 1.20 m from the landing where the unintended car movement has been detected	Functioning / Not functioning	
xii)	*Safety gear test*: 1) Lift car safety gear to be tested in down direction with 100 percent rated load in the lift car (during maintenance it shall be tested only in inspection speed), with test tripping arrangement.	Stopping distance:_____ Ok / Not Ok	

Sl No.	Requirement	Result	Remarks
	2) 3) If provided, Counterweight safety gear to be tested in up direction of lift car with no load w with test tripping arrangement. 4) ith Lift stopping distance depends upon the tripping speed of the governor and shall be within the range as per the Indian Standard.		

A-15 STOPPING ACCURACY AND RUNNING CLEARANCE TEST

Instructions:

a) The Stopping accuracy shall be within ±10 mm of the finished floor level.
b) The running clearance between the lift car threshold and landing door sill should be 35 mm.

No. of floors: _____

Floors (Landing)	Stopping Accuracy		Running Clearance		
	UP	DN	LH	Centre	RH
1st					
2nd					
3rd					
4th					
5th					
6th					
…					
…					
RESULT Ok / Not Ok					

A-16 LOAD TEST

Sl No.	Load in Percent	Direction of Travel	Voltage	Current
			V	A
Instructions: a) With balanced load, the current value in both the up and down directions to be same. b) Check the current only after the lift reaches its rated speed.				
i)	No load	UP		
		DN		
ii)	Balance load	UP		
		DN		
iii)	Full load	UP		
		DN		

The following ANNEXES B AND C THAT WERE IN NBC 2016 ARE PROPOSED FOR DELETION BY THE PANEL

~~ANNEX B~~
[~~*Clause* 16.3.3.3 (a)~~]

~~TYPICAL EXAMPLES OF CHECKS TO BE TAKEN INTO ACCOUNT IN MAINTENANCE INSTRUCTIONS~~

~~B-1 ELECTRIC LIFTS~~

~~Item~~	**~~Checks~~**
~~General~~	~~Check all components are clean and kept free from dust and corrosion~~
~~Pit area~~	~~Check for excess oil/grease at bottom of guides.~~ ~~Check the pit area is clean, dry and free from debris~~
~~Anti-rebound device and switch (where fitted)~~	~~Check for free movement and operation~~ ~~Check for equal tension of ropes~~ ~~Check switch where fitted~~ ~~Check lubrication~~
~~Buffers~~	~~Check oil level~~ ~~Check lubrication~~ ~~Check switch where fitted~~ ~~Check fixings~~
~~Drive motor/generator~~	~~Check bearings for wear~~ ~~Check lubrication~~ ~~Check condition of commutator~~
~~Gear box~~	~~Check gear for wear~~ ~~Check lubrication~~
~~Traction sheave~~	~~Check condition and grooves for wear~~
~~Brake~~	~~Check braking system~~ ~~Check parts for wear~~ ~~Check stopping accuracy~~
~~Controller~~	~~Check cabinet is clean, dry and free from dust~~
~~Overspeed governor and tension pulley~~	~~Check moving parts for free movement and wear~~ ~~Check operation~~ ~~Check switch~~
~~Main rope diverter pulley(s)~~	~~Check condition and grooves for wear~~

	~~Check bearings for abnormal noise and/or vibrations~~ ~~Check guarding~~ ~~Check lubrication~~
~~Car/counterweight guides~~	~~Check for film of oil where required on all guide surfaces~~ ~~Check fixings~~
~~Car/counterweight guide shoes~~	~~Check guide shoes/rollers for wear~~ ~~Check fixings~~ ~~Check lubrication, where necessary~~
~~Electric wiring~~	~~Check insulation~~
~~Lift car~~	~~Check emergency lighting, car buttons, key switches~~ ~~Check fixings of panels and ceiling~~
~~Safety gear(s)/ascending car over speed protection means~~	~~Check moving parts for free movement and wear~~ ~~Check lubrication~~ ~~Check fixings~~ ~~Check operation~~ ~~Check switch~~
~~Suspension ropes/chains~~	~~Check for wear, elongation and tension~~ ~~Check lubrication only where intended~~
~~Rope/chains terminations~~	~~Check for deterioration and wear~~ ~~Check fixings~~
~~Landing entrances~~	~~Check operation of landing locks~~ ~~Check doors for free running~~ ~~Check door guiding~~ ~~Check door gaps~~ ~~Check wire rope, chain or belt when used for integrity~~ ~~Check emergency unlocking device~~ ~~Check lubrication~~
~~Car door~~	~~Check door closed contact or lock~~ ~~Check doors for free running~~ ~~Check door guiding~~ ~~Check door gaps~~ ~~Check wire rope or chain when used for integrity~~ ~~Check passenger door protective device~~ ~~Check lubrication~~
~~Floor level~~	~~Check stopping accuracy at landing~~
~~Final limit switches~~	~~Check operation~~
~~Motor run time limiter~~	~~Check operation~~
~~Electric safety devices~~	~~Check operation~~ ~~Check electric safety chain~~ ~~Check correct fuses are fitted~~
~~Emergency alarm device~~	~~Check operation~~

Landing controls and indicators	Check operation
Well lighting	Check operation

B-2 HYDRAULIC LIFTS

Item	Checks
General	Check all components are clean and kept free from dust and corrosion
Pit area	Check for excess oil/grease at bottom of guides Check the pit area is clean, dry and free from debris
Buffers	Check oil level Check lubrication Check switch where fitted Check fixings
Tank unit	Check hydraulic fluid level Check tank and valve unit for leakage
Jack	Check for oil leakage
Telescopic jack	Check for synchronization
Controller	Check cabinet is clean, dry and free from dust
Overspeed governor and tension pulley	Check moving parts for free movement and wear Check operation Check switch
Main rope pulley(s)	Check condition and grooves for wear Check bearings for abnormal noise and/or vibrations Check guarding Check lubrication
Car/balancing weight/jack guides	Check for film of oil where required on all guide surfaces Check fixings
Car/balancing weight/jack guide shoes	Check guide shoes/rollers for wear Check fixings Check lubrication where necessary
Electric wiring	Check insulation
Lift car	Check emergency lighting, car buttons, key switches Check fixings of panels and ceiling
Safety gear/pawl clamping devices	Check moving parts for free movement and wear Check lubrication Check fixings Check operation Check switch
Suspension ropes/chains	Check for wear, elongation and tension

	~~Check lubrication only where intended~~
~~Ropes/chains terminations~~	~~Check for deterioration and wear~~ ~~Check fixings~~
~~Landing entrances~~	~~Check operation of landing locks~~ ~~Check doors for free running~~ ~~Check door guiding~~ ~~Check door gaps~~ ~~Check wire rope, chain or belt when used, for integrity~~ ~~Check emergency unlocking device~~ ~~Check lubrication~~
~~Car door~~	~~Check door closed contact or lock~~ ~~Check doors for free running~~ ~~Check door guiding~~ ~~Check door gaps~~ ~~Check wire rope or chain when used for integrity~~ ~~Check passenger door protective device~~ ~~Check lubrication~~
~~Floor level~~	~~Check stopping accuracy at landing~~
~~Final limit switch~~	~~Check operation~~
~~Motor run time limiter~~	~~Check operation~~
~~Electric safety devices~~	~~Check operation~~ ~~Check electric safety chain~~ ~~Check correct fuses are fitted~~
~~Emergency alarm device~~	~~Check operation~~
~~Landing controls and indicators~~	~~Check operation~~
~~Well lighting~~	~~Check operation~~
~~Anti-creep device~~	~~Check operation~~
~~Rupture valve/one way restrictor~~	~~Check operation~~
~~Pressure relief valve~~	~~Check operation~~
~~Manual lowering valve~~	~~Check operation~~
~~Hand pump~~	~~Check operation~~
~~Hose/pipe work~~	~~Check for damage and leakage~~

ANNEX C
(*Clause* 16.4.1)

EXAMPLES OF ELEMENTS TO BE TAKEN IN TO ACCOUNT IN ANY RISK ASSESSMENT FOR MAINTENANCE OPERATIONS

Elements	Car	Machinery Spaces	Pulley Spaces	Area Outside the Lift	Pit	Car Roof
Unsuitable access (ladders not secure, no hand rails, unsuitable trap door, obstacle on car roof, etc)	NR	R	R	R	R	R
Unauthorized entry	NR	R	R	R	R	R
Inadequate lighting (including access)	R	R	R	R	R	R
Uneven floor surface (holes, projections)	R	R	R	R	R	R
Slippery floor surface	R	R	R	R	R	R
Strength of floor	R	R	R	R	R	R
Unsuitable dimensions (passages, maintenance spaces)	R	R	R	R	R	R
Identification of car position	R	R	NR	NR	NR	NR
Indirect contact with electricity	R	R	R	R	R	R
Switches	NR	R	R	R	R	R
Contact with moving parts (ropes, pulleys)	NR	R	R	R	R	R
Unexpected movements		R	R	R	R	R
Crushing by moving parts (car, counterweight)	NR	R	R	R	R	R
Voids between car and well	NR	R	R	NR	NR	R
More than one lift in same area	NR	R	R	R	R	R
Overhead beams and sheaves	NR	R	R	R	R	R
Refuge volume(s)	NR	R	R	NR	R	R
Manual handling	NR	R	R	R	R	R
More than one maintenance person working	NR	R	R	R	R	R
Absence of means of communication	R	R	R	R	R	R
Ventilation and temperature for persons	R	R	R	R	R	R
Dangerous substances	R	R	R	R	R	R
Falling objects	R	R	R	R	R	R
Entrapment	R	R	R	R	R	R
Means/controls for rescue operations	R	R	R	R	R	R
Fire	R	R	R	R	R	R

'R' = Relevant and 'NR' = Not relevant

LIST OF STANDARDS

The following list records those standards which are acceptable as 'good practice' and 'accepted standards' in the fulfillment of the requirements of the code. The latest version of a standard shall be adopted at the time of enforcement of the code. The standards listed may be used by the Authority as a guide in conformance with the requirements of the referred clauses in the code.

	IS No.	*Title*
(1)	14671 : 1999	Code of practice for installation and maintenance of hydraulic lifts
(2)	14665 (Part 1) : 2000	Electric traction lifts Guidelines for outline dimensions of passenger, goods, service and hospital lifts
	(Part 3/ Sec 1 and 2) : 2000	Safety rules, Section 1 Passenger and goods lifts, Section 2 Service lifts
	(Part 4/ Sec 1 to 9) : 2001	Components, Section 1 Lift buffers, Section 2 Lift guide rails and guide shoes, Section 3 Lift Carframe, car, counterweight and suspension, Section 4 Lift safety gears and governors, Section 5 Lift retiring cam, Section 6 Lift doors and locking devices and contacts, Section 7 Lift machines and brakes, Section 8 Lift wire ropes, Section 9 Controller and operating devices
(3)	12615 : 2018	Energy efficient induction motors - Three phase squirrel cage (*first revision*)
(4)	1950 : 1962	Code of practice for sound insulation of non-industrial buildings
(5)	14665 (Part 4/ Sec 1 to 9) : 2001	Electric traction lifts: Part 4 Components, Section 1 Lift buffers, Section 2 Lift guide rails and guide shoes, Section 3 Lift carframe, car, counterweight and suspension, Section 4 Lift safety gears and governors, Section 5 Lift retiring cam, Section 6 Lift doors and locking devices and contacts, Section 7 Lift machines and brakes, Section 8 Lift wire ropes, Section 9 Controller and operating devices

	IS No.	*Title*
(6)	14665 (Part 3/ Sec 1 and 2) : 2000	Electric traction lifts: Part 3 Safety rules, Section 1 Passenger and goods lifts, Section 2 Service lifts
(7)	14665 (Part 2/ Sec 1 and 2) : 2000	Electric traction lifts: Part 2 Code of practice for installation, operation and maintenance, Section 1 Passenger and goods lifts, Section 2 Service lifts
(8)	3043 : 2018	Code of practice for earthing (*second revision*)
(9)	IS/IEC 60529 : 2001	Degrees of protection provided by enclosures (IP CODE)
(10)	15785 : 2009	Code of practice for installation and maintenance of lifts without conventional machine room
(11)	15259 : 2002	Code of practice for installation and maintenance of home lifts
(12)	15330 : 2020	Code of practice for installation and maintenance of lifts for persons with disabilities (*first revision*)
(13)	14665 (Part 5) : 1999	Electric traction lifts: Part 5 Inspection manual
(14)	9457 : 2005	Code of practice for safety colours and safety signs (*first revision*)
(15)	732 : 2019	Code of practice for Electrical Wiring Installations (*fourth revision*)
(16)	17900 (Part 1) : 2022	Lifts for the transport of persons and goods Part 1: Safety Rules
(17)	IS 17900 Part 7 Section 7	
(18)	17106 (Part 1) : 2019 ISO 22201-1 : 2017	Lifts (Elevators), escalators and moving walks - Programmable electronic systems in safety - Related applications: Part 1 lifts (Elevators) (Pessral)

	IS No.	*Title*
(19)	17518 (Part 2) : 2021 ISO 3008-2 : 2017	Fire-resistance tests – Part 2 Lift landing door assemblies

****