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Lifts for the transportation of persons and goods —

Part 32: **Planning and selection of passenger lifts to be installed in office, hotel and residential buildings**

Ascenseurs —

Partie 32: Critères des sélection des ascenseurs à installer dans les immeubles de bureaux, hôtel et les immeubles d'habitation

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Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8100-32 consists of the following parts, under the general title Lift (Elevator[1]) installation:

– Part 1: Classes I, II, III and VI lifts

– Part 2: Class IV lifts

– Part 3: Service lifts class V

– Part 5: Control devices, signals and additional fittings

– Part 6: Planning and selection for office, hotels and residential buildings

ISO 8100-32 was prepared by Technical Committee ISO/TC 178, *Lifts, escalators and moving walks*, WG6, Subcommittee SG5.

This second edition cancels and replaces the first edition ISO 4190-6:1984.

The main changes are:

Extension to office buildings and hotels in addition to residential buildings

Equations for designs carried out by calculation supported by examples.

Processes to be adopted when carrying out simulations supported by examples.

Considerations of passenger accessibility

Selection charts updated.

Pro forma data and results sheets added.

[1] Hereinafter, the term “lift” is used in place of the term “elevator”.

Introduction

This International Standard provides guidelines for determining appropriate lift installations for office buildings, hotels and residential buildings. A lift installation describes a set of lifts by detailing the number, size, floors served, speed, and various other characteristics of the lifts. An appropriate lift installation is usually one which provides good service to potential passengers with the least cost in terms of building core space.

In earlier years the lift industry relied on probability based uppeak analysis equations which calculated interval and handling capacity values. If the interval and handling capacity values of a specific lift installation meet recommended criteria then the configuration is assumed to be acceptable. This traditional uppeak analysis worked well when lifts were relay based and is still used for evaluating simple situations or to obtain initial estimates for more complex situations.

Some lifts now include sophisticated computer program based traffic control systems. These control systems are difficult to describe via equations but can be evaluated with the use of computer simulation programs.

This standard provides two methods to determine an appropriate lift installation. The methods are:

Calculation. The calculation method uses traditional uppeak analysis equations. Selection charts in **Annex C** based on the calculation method provide a quick way of determining the lift installation for simple scenarios. The calculation method determines interval and handling capacity values that can be used to evaluate a lift installation. This method is recommended for relatively simple situations or to obtain an initial lift installation to be further analysed via simulation. The ISO Calculation Method is described in **Section 7** and a typical example using the equations is given in **Annex D**.

Simulation. The simulation method is used to clarify service levels with different traffic control systems such as destination control. This method is recommended in complex situations or when detailed information other than interval and uppeak handling capacity values are desired. The ISO Simulation Method is described in **Section 8** and a typical example is given in **Annex E**.

Both levels require building, passenger and lift data (**Section 6**); an initial data form is shown in **Annex F**.

This International Standard applies the recommendation of ISO/TR 11071-2 (1996, 2006) which says:

"While the entire subject of capacity and loading has historically been treated in safety codes as one and the same, it might be more meaningful in the future writing of safety codes to cover loading as a separate issue from capacity. One refers more appropriately to the traffic handling capacity, whereas the other refers to the maximum carrying capacity, which has a direct bearing on safety."

Accordingly, this standard distinguishes car capacity and car loading by passengers when discussing the selection of rated load and available car area (**6.5.3** and **Annex A**).

This International Standard is intended to be a reference in the early stages of a project and can be especially useful to clients or building owners, architects, general and specialized engineering consultants, building managers, lift consultants, lift contractors, building developers, principal contractors and other interested parties.

This part of ISO 8100 reflects the requirements of the global marketplace and takes into account the special needs such as accessibility of people with physical disabilities (**6.5.1**).Although this part of ISO

8100 does not give recommendations for the planning or selection of goods (US: freight[2]) lifts, these are an important aspect of lift planning.

[2] Hereinafter, the term "goods" is used in place of the term "freight".

Lifts for the transportation of persons and goods – Part 32: Planning and selection of passenger lifts to be installed in office, hotel and residential buildings

1 Scope

This part of ISO 8100 gives recommendations relating to the traffic planning and selection of new passenger lift installations in office, hotel and residential buildings. The requirements and recommendations given are applicable to both simple and complex lift installations.

This part of ISO 8100 gives guidance to select the most appropriate method of traffic planning for each case within the scope.

This part of ISO 8100 permits the number and configuration of lifts and their main characteristics to be determined at the early stages of building design, provided that the size and intended use of the building is known.

This part of ISO 8100 is applicable to lifts classified according to Table 1 of ISO 4190-1: 2010 classification of lifts.

Table 1 – ISO 4190-1: 2010 classification of lifts

Class	Purpose
Class I	Lifts designed for the transport of persons
Class II	Lifts designed mainly for the transport of persons but in which goods may be carried
Class VI	Lifts designed to suit buildings with intensive traffic, i.e. lifts with speeds of 2,5 m/s and above 加强的

This part of ISO 8100 is a revision of ISO 4190-6: 1984 and is applicable to mixed use buildings provided that the mixed use can be evaluated separately as either office, residential or hotel use.

This part of ISO 8100 gives basic requirements, recommendations and guidance as part of the planning and selection of lifts relating to:

a) the design criteria to be evaluated; 可评估的设计准则

b) the values of design criteria to be used; 设计准则的用途

c) a calculation method (**7**) to be used as part of simple planning and selection of lifts (**5.3**); 电梯简易选型配置的计算方法

d) a simulation method (**8**) to be used as part of simple and more complex planning and selection of lifts (**5.3**);
电梯复杂选型配置的模拟方法

e) output report format of lift planning and selection analysis to be provided to interested parties;
电梯选型配置输出报告格式

f) consideration of existing safety standards and cultural norms for determining the number of persons that may fit into a specific size of car[3]; 安全标准和文化规范再确定轿厢载客数上的应用

g) accommodation for luggage, bicycles, prams, etc., or other non-personal items that may be transported with passengers in the lifts; 行李、自行车、婴儿车等随行物品占用轿内空间

h) accessibility for disabled people. 残疾人可操作性

[3] The European Lift Directive 2014 refers to the car as a carrier.

This part of ISO 8100 does not address:

a) the transportation of goods only;

b) the transportation of passengers using multiple lifts sharing a single hoist way;

c) the transportation of passengers using double deck systems;

d) lift travel in excess of 200 m and/or rated speed above 7 m/s;

e) variations to the calculation method (eg: traffic conditions other than uppeak);

f) variations to the simulation method (eg: passenger batches or traffic templates with variable passenger demand);

g) design of simulator models or traffic control systems;

h) advanced passenger features (eg: walking speed).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4190-6 (1984), *Lift (Elevator) installation — Part 6: Passenger lifts to be installed in residential buildings - Planning and selection*

ISO/DIS 8100-1 (2017), *Lifts for the transport of persons and goods —Part 1: Safety requirements for passenger and goods passenger lifts*

CEN EN 81-20 (2014), *Safety rules for the construction and installation of lifts — Lifts for the transport of persons and goods Part 20: Passenger and goods passenger lifts*

CEN/TR 81-12 (2014), *Safety rules for the construction and installation of lifts — Basics and Interpretations – Part 12: Use of EN 81-20 and EN 81-50 in specific markets*

prEN 81-70 (2017), *Safety rules for the construction and installations of lifts Particular applications for passenger and good passengers lifts -Part 70: Accessibility to lifts for persons including persons with disability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4190-1: 2010, ISO 4190-5 and the following apply.

3.1
advance door opening time 预开门时间

(see **3.8** door pre-opening time)

3.2
available car area 轿内面积

area of the car, which is available for passengers or goods during operation of the lift
[SOURCE: EN 81-20:2014, definition 3.3]

3.3
conventional control system 召梯及选层集控系统

lift system with collective control that requires call buttons on each landing and floor selection buttons in the car

3.4
destination control system 目的层控制系统

lift system that provides landing controls for selecting destination floors, lobby indicators designating which lift to board, and a car indicator designating the floors at which the car will stop

NOTE 1 Also called hall call allocation
NOTE 2 Also called destination-oriented lift system (DO) [SOURCE: ISO 4190-5:2006, Definition 3.1.3

3.5
door closing time

period of time measured from the instant the car doors start to close until the doors are closed

3.6
door closing delay time 关门延迟时间

delay after passenger clearance before door closing

3.7
door opening time

period of time measured from the instant that the car doors start to open until they are open to a specified width

NOTE 1 Measurements may be completed at the instant that the doors are either 800 mm open or until the doors are fully open.
NOTE 2 The opening width used shall be reported.

3.8
door pre-opening time 提前开门功能

period of time measured from the instant that the car doors start to open until the lift is level at a landing 开门-电梯平层

NOTE Door pre-opening may compensate for lift levelling, which is the final (slow) approach of the lift to a landing.

3.9
entrance bias

proportion of traffic attributed to specific entrance floor

3.10
entrance floor(s)

floor(s) with building entrance or utility floor(s), e.g. restaurant, which attract people from populated floors

3.11
express zone

a building zone situated between an entrance floor and served floors where lift travels nonstop

3.12
flight time 单层运行时间

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.

3.13
gross internal area (GIA) 建筑内部面积

area of a building measured (at each floor level) to the internal finishes of the perimeter walls

3.14
handling capacity 客流输送能力

maximum sustainable number of passengers per specified time period that a lift group can transport for a specific traffic mix under specified loading constraints

NOTE 1 Handling capacity is usually expressed as a number of passengers per five minutes or as a percentage of population per five minutes.

NOTE 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.

NOTE 3 The average waiting time increases rapidly and passengers are constantly left behind the departing lift, when passenger demand exceeds handling capacity.

3.15
incoming traffic 基站进入流量

passengers travelling from entrance floors to the populated floors

3.16
interfloor traffic 中间楼层流量

passengers travelling between the populated floors

3.17
lift group 电梯群控

lifts having the management of calls in common

NOTE Usually a lift group serves the same set of floors, for example, low rise served, high rise served, etc.

3.18
loading limit 极限载重

ratio between P_{sim} and the rated passenger capacity

NOTE 1 Used in selection of rated load according to **Formula (5)**
NOTE 2 Loading limit is in the range 0,5 to 1,0, where a value of 0,8 or less should be selected to avoid overcrowding.

3.19
lunch traffic 午餐流量

traffic that mostly consists of incoming and outgoing passengers and also contains interfloor traffic

NOTE Lunch traffic is typical for office buildings. A typical traffic mix may be 45 % incoming, 45 % outgoing and 10 % interfloor for offices.

3.20
net internal area (NIA) 可使用净面积

usable area within a building measured (at each floor level) to the internal finishes of structural external or party walls, but excluding washrooms, mechanical equipment rooms, stairs and lift well, common entrance halls, lobbies and corridors, internal structural walls and columns.

3.21
nominal travel time 全程运行时间

time period in seconds for a lift to travel from the ground floor to the highest floor without any stops

NOTE Called "theoretical time of travel" in ISO 4190-6: 1984

3.22
occupation/design population 设计可容纳总人数

the maximum population/occupation a target building is going to be designed for

3.23
outgoing traffic 外出流量

passengers travelling from the populated floors to entrance floors

3.24
passenger demand 5分钟输送能力

rate at which people request service from a lift system normally expressed in conjunction with a traffic mix

NOTE Passenger demand is usually expressed as a number of passengers per five minutes or as a percentage of population per five minutes.

3.25
passenger transfer time 乘客进出转换时间

average time for a single passenger to enter or leave the car

NOTE The passengers usually move out faster than they move in. Transfer time is an average of both of them.

3.26
performance time 操作时间

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

NOTE 1 The performance time may also be called door-to-door time.

NOTE 2 Measurements may be completed at the instant that the doors are 800 mm open or until the doors are fully open.

3.27
rated load 额定载重

load for which the lift has been built and under which it is designed to operate
[SOURCE: ISO 4190-1, definition 2.4.2]

3.28
rated passenger capacity 额定载客数

maximum number of passengers in a lift car that must not be exceeded due to safety norms

3.29
rated speed 额定速度

speed for which the lift has been built and at which it is designed to operate
[SOURCE: ISO 4190-1, definition 2.4.1]

3.30
required handling capacity 要求的5分钟输送能力

number of passengers per specified time period that a lift group shall be able to sustainably transport according to the design criteria for a specific traffic mix under specified loading constraints

NOTE 1 Required handling capacity is usually expressed as a number of passengers per five minutes or as a percentage of population per five minutes.

NOTE 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.

3.31
reversal floor 返回楼层

number of floors above the entrance floor at which point the car reverses to return back to the entrance floor.

NOTE Used in the round trip time calculation where it is calculated with a formula to determine an average value

3.32
rise

set of floors served by a group of lifts

3.33
start delay 起动延迟

period of time from the instant the car doors are closed until the lift starts to move

3.34
time to destination

period of time from when a passenger either registers a landing call, or joins a queue, until the responding lift begins to open its doors at the destination floor

3.35
traffic mix 混合交通

traffic consisting of specified proportions of incoming, outgoing, and interfloor traffic

3.36
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.

3.37
two-way traffic

traffic mix (**3.35**) that consists of incoming and outgoing passengers without any interfloor traffic

3.38
uppeak interval 上行时间间隔

average time between successive car departures from the main entrance floor

NOTE In the calculation method (**7**), the interval is defined as the round trip time divided by the number of lifts in the group.

3.39
uppeak traffic 上行交通

traffic that consists mostly of incoming passengers

NOTE 1 Pure uppeak traffic consists of 100% of incoming passengers.

NOTE 2 In practice, pure uppeak may not be encountered, and the traffic mix may include proportions of outgoing and interfloor traffic (e.g. 85% incoming, 10% outgoing and 5% interfloor traffic).

3.40
utilization factor 空间利用率

ratio of the “utilized space” (where people are physically seated) in relation to the net internal area

3.41
waiting time

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

NOTE 1 The passenger waiting time continues if a passenger does not enter the responding lift, e.g.: it is full (a refusal)

NOTE 2 The passenger waiting time is zero, if the responding lift doors are open when the passenger arrives

NOTE 3 There may be a 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.

3.42
workplace area 人均工作区域面积

subset of an office area that represents the average amount of space allocated as working space for a single person.

4 Symbols (and abbreviated terms)

λ	passenger demand (persons/5-minutes) 要求的5分钟输送能力
a	acceleration/deceleration (m/s^2)
d_f	average interfloor distance (m) 平均楼层间距
D	terminal to terminal floor distance (m)
H	average highest reversal floor
$HC5$	handling capacity (persons/5-minutes) 5分钟输送能力
$\%HC5$	handling capacity (% of population/5-minutes)
j	jerk (m/s^3)
L	number of lifts
LL	loading limit
N	number of served (upper) floors
NIA	net internal area (m^2)
NTT	nominal travel time (s)
P_{rated}	rated passenger capacity (persons)
P_{calc}	average number of passengers in the car at departure from the main entrance floor (for calculation method)
P_{sim}	maximum number of passengers allowed in the car during simulation (input for simulation method)
%POP	percentage passenger demand (% of population/5 minutes)
RTT	round trip time (s)
S	probable number of stops
t_{ad}	preopening time (s)
t_{ba}	basic travel time (s)
t_c	door closing time (s).
t_{cd}	door closing delay time (s)
$t_f(1)$	single (1) floor flight time (s)
t_o	door opening time (s)
t_p	average one way passenger transfer time (s)
t_{pr}	prestige travel time (s)
t_s	time consumed in stopping (s)
	NOTE Sometimes called time losses per stop or stop loss time.
t_{sd}	start delay time (s)
t_v	time to travel between two standard pitch adjacent floors at rated speed (s)
U	population in the building
$UPPINT$	uppeak interval (s)
v	rated speed (m/s)

5 Use of this standard

5.1 Overview

The purpose of this standard is to determine solutions for lift installations to serve the expected passenger demands in a building. The selection should meet the design criteria to avoid poor service at all times, as this may limit the usability of the building. It is also important to avoid an over provision of equipment and the excessive use of space.

Consideration should be given to the long term use of the building and its potential changes in the future.

ISO 4190-1: 2010 gives a globally agreed range of standardized layouts, rated loads and rated speeds to meet different vertical transportation needs and also provides the type of and size of entrance, the shape of car, etc.

To achieve higher efficiency, buildings with large numbers of floors may be split into rises, for example, by dividing buildings into a low rise group and a high rise group with an express zone. Parking floors may be served by a separate lift group.

5.2 Design process

The steps of the design process, and their sequence, aim to make the overall process comprehensive, reproducible and well documented. Each step is described in one of the following sections of this standard.

The processing order of the steps is important and shall be followed as described below (**Annex G**).

a) The building data shall be collected, including the type of the building and its population (**6.3**).
NOTE The quality of any traffic design is dependent on the quality of the data obtained.

b) The method of traffic analysis shall be selected (**5.3**).

c) The design criteria shall be selected (**5.4**).

d) An initial lift configuration shall be chosen for each lift group (**5.5**).
NOTE If there are multiple lift groups, each is considered separately.

e) A traffic analysis for the chosen lift configuration shall be carried out, using the method selected above (**7** and **8**).

f) The lift configuration shall be changed, if the results from the traffic analysis do not meet the design criteria, or are significantly in excess, or if alternative design criteria are considered (see also **5.4.3** and **6.1**). If the lift configuration is changed, the process shall be repeated from step **e)**.

g) The results from selected traffic analysis for the final lift installation shall be presented in a report that documents the assumptions and design decisions, as well as the method of the traffic analysis and its outcome (**9**).

5.3 Selection of analysis method

As part of a specific design process (**5.2**), this standard uses two methods of traffic analysis.

For simpler cases a calculation method (**7**) may be sufficient. It is based on the concept known as uppeak traffic and determines uppeak handling capacity and interval.

For all cases with more complex traffic demands and all cases with destination control systems, the simulation method (**8**) shall be used. In an analysis using the simulation method, the lift parameters and the served floors of lifts can be defined individually and the group control system shall be defined. The simulation method can produce diversified results including waiting times, and the saturation point can be analysed to show where the passenger demand is too high for the lifts to handle the traffic.

A design may be considered as complex, when one or more of the following conditions apply, including:

a) the traffic control is a destination control system;

b) the number of floors served by the lift group is greater than 18 floors;

c) the lift group serves more than one entrance floor, each with given entrance bias;

d) there are more than eight lifts in the group;

e) the group contains lifts of different specification (eg: capacity, speed, door type, etc.);

f) not all lifts in the group serve all floors;

g) the lift group serves levels below the entrance floor;

h) there are "magnet" floors (e.g. restaurant, fitness centre, shopping level, etc.) other than the main entrance floor.

5.4 Selection of design criteria

The design criteria shall be specific to the analysis method selected (**5.3**).

5.4.1 Design criteria for calculation method

The calculation method (**7**) is based on pure uppeak traffic. All lifts in the group are assumed to be same. The building entrance is on the lowest floor, and passengers travel to the upper floors with equal bias per floor.

The design criteria for the calculation method shall be:

a) a required handling capacity;

b) a required interval.

The values of a) and b) shall be selected to ensure the peak passenger demand is served at the required level of service. Typical values are shown in **Table 2** for guidance. Other values may be used provided they are documented with reasons. National and cultural norms may vary the values given.

Table 2 – Typical design criteria for calculation method, depending on building type

Building type	Required uppeak handling capacity (% of population/5 min)	Required interval (s)
Office	≥ 12	≤ 30
Hotel	≥ 12	≤ 40
Residential	≥ 6	≤ 60

The values shown in Table 2 accommodate standard designs and assume that car selection has been based on both mass and area, see **6.5.3** and **Annex A**. If only mass is considered for car selection, higher values for the required uppeak handling capacity should be considered. Higher performance designs may also require higher handling capacity and lower interval values for more comfort.

A selected lift configuration fulfils the design criteria if the values from the calculation method are equal or better than the required values.

NOTE For an example, see **Annex C** (selection charts) and **Annex D** (calculation method example).

5.4.2 Design criteria for simulation method

For the simulation method (**8**) one or more traffic mixes shall be selected, according to the anticipated passenger demands. The selected traffic mixes should represent peak traffic situations where the passenger demand in the building is high.

A traffic mix can be defined by specifying the percentage of incoming, outgoing and interfloor traffic and for each component (incoming, outgoing, interfloor) the frequency of passengers per boarding floor and per destination floor.

The design criteria for the simulation method shall be, for each selected traffic mix:

a) a required handling capacity;

b) a required average waiting time.

Other design criteria may be added.

For each selected traffic mix:

a) the value of the required handling capacity shall be selected at least as high as the maximum expected passenger demand;

b) the value of the required average waiting time shall be selected at the level of the maximum acceptable average waiting time over all boarding floors.

Typical sets of traffic mix and design criteria are shown in **Table 3** for guidance

Table 3 – Typical design criteria for simulation method, depending on building type

Building type and traffic mix	Required handling capacity (% of population/5 min)	Required average waiting time (s)
Office: – Uppeak (100 % incoming) or – Mixed uppeak (85% incoming, 10% outgoing, 5% interfloor) and – Lunch traffic (40 % incoming, 40 % outgoing, 20 % interfloor) or – Lunch traffic (45 % incoming, 45 % outgoing, 10 % interfloor)	 ≥ 12 % ≥ 12 % ≥ 11 % ≥ 11 %	 ≤ 30 ≤ 35 ≤ 40 ≤ 40
Hotel: – Two-way (50 % incoming, 50 % outgoing) NOTE 1 Hotel chains may have their own design criteria.	 ≥ 12 %	 ≤ 40
Residential: – Two-way (50 % incoming, 50 % outgoing)	 ≥ 7 %	 ≤ 60

NOTE 2 For an example of use see **Annex E**

The values shown above accommodate standard designs. National and cultural norms may vary the values given. For example, for luxury residential buildings the average waiting time should be less than 40 seconds. Larger cars may be necessary to improve passenger comfort (see also **6.5.3**).

For each selected traffic mix (set of traffic mixes for office buildings) the simulation method shall be applied independently.

For office buildings, both traffic mixes (uppeak and lunch) shall be analysed. It is not sufficient to only use one traffic mix. For offices, the design criteria for uppeak and lunch traffic must be fulfilled simultaneously. Other traffic mixes may be used provided they are documented with reasons.

A selected lift configuration fulfils the design criteria if the values from the simulation method are equal to or better for each selected traffic mix than the required values.

5.4.3 Further criteria and considerations

In addition to the design criteria, which should be fulfilled, there may be other criteria. When a lift configuration fulfils the design criteria, the final selection may also consider the additional criteria. For example, consideration may be given to when one lift is out of service, preferring a lift configuration with a higher potential capacity.

If a lift configuration fulfils all the design criteria by significantly exceeding some of them, a configuration with fewer (or smaller, or slower etc.) lifts may be chosen for testing using the selected method against the design criteria. It may be selected providing it still fulfils all design criteria.

Excess capacity in one lift group shall not justify insufficient capacity in another lift group.

5.5 Initial lift configuration

An initial lift configuration is selected as a starting point for the traffic analysis.

Annex C can be used to determine a starting point with similar selection criteria and lift parameters to those used in **Annex D** and **Annex E**.

Some users may prefer to select the initial configuration:

a) using the calculation method (uppeak round trip time formulae, etc.) to estimate the number, speed and capacity of lifts.

b) based on their experience, e.g. considering similar buildings in existence.

c) using a rule of thumb

Lift parameters are selected according to **6.5**. For the lift parameters related to the car size, an initial value of either P_{calc} or P_{sim} shall be selected. This then shall be the basis for the selection of the rated load and available car area according to **6.5.3**.

6 Basic, derived and assumed data

6.1 Basic and derived data for calculation and simulation methods

There is a common set of input data for calculation and simulation methods. They include information about the building, such as number of floors, floor heights, estimation of the population and its distribution (**6.2** and **6.3**). The main lift and passenger related parameters include the number of lifts, rated load, rated speed, acceleration, jerk, start delay, door pre-opening time, door operating times, passenger transfer times, etc. (**6.5**).

The requirements for the lift quantity and quality design criteria in a building should be discussed with the client and relevant parties. It is recommended to use the criteria given in this standard (**5.4**). Local standard or local practice or client design criteria (e.g. hotel standards) should be considered. For calculation, the criteria shall include uppeak handling capacity and interval. For simulation, the criteria shall include handling capacity and average waiting time for the selected traffic mix. Additional criteria for simulation may be included, such as distribution of waiting times, percentage of long waiting times and further average values or distribution data for time to destination, transit time, intermediate stops per passenger or car loading. If client criteria or local standard are not available, then global standards may be used.

6.2 Building data

The client’s representative and the lift designer should agree on the basic building data at the earliest possible stage of a project and also indicate the lift service to be provided in the projected or target building. The basic building data required for a traffic analysis is shown in **Annex F**. It includes data such as the building type, number of served floors, entrance floors and their attraction, floor heights, utilization of floors and population.

The floor population in offices should be estimated preferably from the net internal floor area as described in **6.3** or by comparison with similar buildings and in accordance with local standards.

In a well-planned design, there should be sufficient circulation space for the passengers in the lobby and the lift calling devices should be located in positions with easy and efficient access.

6.3 Determining the population

6.3.1 General

The maximum design population to be served in the target building should be obtained from the client.

The population densities may depend on the culture, the geographical area and the type and quality level of the building.

Stair usage is occasionally considered to be taken into account and results in reduced lift usage at the lower floors. However, for lift design purposes no allowance shall be made for absenteeism and/or stair factors, since the design criteria (**5.4.1** and **5.4.2**) are based on 100 % population of the building. In all buildings consideration should be made to cater for people with impaired mobility.

6.3.2 Office buildings

Where the client is unable to provide population figures they can be estimated. A common and accurate approach is to assess the population from the Net Internal Area, NIA, considering a related workplace area and a suitable utilization factor (**Table 4**).

The utilization factor is the ratio of the "utilized space" (where people are physically seated) in relation to the net internal area. The "non-utilized space" accounts for circulation areas, cabinets, copy machines, meeting zones, etc. The utilization factor may vary on the same floor and depends on the floor usages and office type.

Table 4 gives guidance to typical workplace area and utilization factors. Other values may be used provided they are documented with reasons. National and cultural norms may vary the values given.

Table 4 – Typical workplace area and utilization factor

Office type	Workplace Area (m^2 per person)	Utilization Factor (%)
Prestige	12 – 14	80
Standard	10 – 12	80
Open plan	8 – 10	85
Trader floors	6 – 8	90

Where NIA is not available the following rule of thumb may be used as an initial estimate:

$$NIA = 65 - 85\ \%\ \text{of gross internal area} \tag{1}$$

The floor area and population shall be obtained from **Formula (2)**:

$$\text{Floor population} = NIA \times \text{utilization factor/workplace area} \tag{2}$$

It is necessary to indicate which estimations have been utilised and that a review of the initial assessment should be made once the architectural drawings are developed to a point where usually sufficient net internal area calculation can be made.

6.3.3 Hotels

Hotel chains may have their own standards for estimating the number of hotel guests. Where such a standard exists it should be used. Where such a standard does not exist the number of hotel guests may be estimated from the number of rooms.

NOTE Typical values may range from 1,0 - 2,0 persons per guest room depending on hotel type (eg: business, transit, holiday, etc.).

6.3.4 Residential buildings

Practices to define the population in residential buildings vary and, if available, local or specifically applicable methods should be used. The estimation of residential building populations may be based on the summation of the number of residents of each apartment. The number of residents per apartment can usually be estimated by correlating the number of bedrooms per apartment to the average number of residents per apartment. If there is not a local standard or other method of population estimation that applies to the situation, then a frequently used approach can be to assume two persons for the first bedroom of each residential unit and one person for each subsequent bedroom in the units. If information is known about the type of building (i.e. luxury, standard or basic) and the number of studios, 1 bedroom, 2 bedroom and 3 bedroom apartments occupying the building then **Table 5** may be used for guidance to population estimation.

Table 5 – Typical occupancy factors (persons) for residential buildings

Type	Prestige	Standard	Basic
Studio	1,0	1,5	2,0

1 Bedroom	1,5	1,8	2,0
2 Bedrooms	2,0	3,0	4,0
3 Bedrooms	3,0	4,0	6,0

6.4 Passenger data

In traffic analysis, passenger movement in and out of the lifts is modelled usually with constant delays for both calculation and simulation analysis methods. Passenger transfer times may be affected by the lift door width, car size and shape. Also the number of people entering or exiting at a floor can affect the transfer times. If the lift doors are narrow or the lift is crowded, the passenger transfer times can be longer than with wide doors or empty cars. For guidance, typical passenger transfer times for different door widths are shown in **Table 6**.

Table 6 – Typical passenger transfer times according to door width

Door width (mm)	Single passenger transfer [Loading or unloading time (s)]
800	1,2
900	1,1
1000	1,0
1100	1,0
1200	0,9

Personal parameters can be defined in detail in simulations. Social behaviour and batch arrivals can affect the distribution of destination calls. The transfer times and space demanded can differ from the values of typical office workers for a person with children, with a baby carriage, or with shopping carts. Passenger characteristics, such as age, walking speeds and times, or impaired persons vary. These advanced passenger features are out of the scope of this standard.

6.5 Lift data

6.5.1 Special considerations for accessibility of persons with disabilities

In order to address the special needs, accessibility and full manoeuvrability of people with physical and other disabilities it may be necessary to consider special measures. Where local or national authorities have made appropriate regulations they shall be observed.

These measures may impact on the traffic handling and may include:

a) larger lift cars and wider doors (see ISO 4190-1: 2010, prEN 81-70:2017)
b) non-standard car platform sizes
c) longer door operating times (particularly closing times)
d) longer walking times
e) lifts taken out of their group for independent service

6.5.2 Selection of rated speed

In order to select the rated speed the nominal travel time in relation to the travel distance may be used as an indication. **Table 7** gives typical values for nominal travel time. The selection of speed may also be influenced by design to cost, typical standardized lift speed ranges from lift suppliers, national norms and cultural considerations.

Table 7 – Typical values of nominal travel time, depending on building type

	Typical nominal travel times (s)		
Building type	**Prestige** (t_{pr})	**Standard**	**Basic** (t_{ba})
Office	20	25	30
Hotel	25	30	35
Residential	25	35	45

The rated speed (v) shall be calculated using:

$$D/t_{ba} \leq v \leq D/t_{pr} \tag{3}$$

where:

D is the terminal floor to terminal floor distance
t_{pr} is prestige travel time
t_{ba} is basic travel time

A suitable rated speed shall be selected from the range given in ISO 4190-1: 2010, 3.3. The selected speed may be lower or higher from the value calculated using **Formula (3)** depending on the performance required.

6.5.3 Selection of rated load and available car area

P_{calc} and P_{sim} describe how many passengers may be transported at the same time in a lift car. They are defined and used in the calculation and simulation methods (**7** and **8**):

- Using the calculation method (**7**), P_{calc} is the average number of passengers in the car at departure from the main entrance floor. P_{calc} is a decimal number.
- Using the simulation method (**8**), P_{sim} is the maximum number of passengers allowed in the car during simulation. P_{sim} is an integer number.

The calculation and the simulation methods are used to verify that a lift configuration fulfils the design criteria. In order that the car is capable to transport the mass required the rated load (kg) of a car shall be selected such that

for calculation method

$$\text{Rated load} \geq \frac{P_{calc} \times \text{ average mass per person}}{0{,}8} \tag{4}$$

and for simulation method

$$\text{Rated load} \geq \frac{P_{sim} \times \text{ average mass per person}}{LL} \tag{5}$$

where LL is a loading limit in the range 0,5 to 1,0 and where a value of 0,8 or less should be selected to avoid overcrowding, see **Annex A**. Choosing values of LL greater than 0,8 may result in an underlifted configuration.

NOTE The 0,8 in **Formula (4)** is included for statistical reasons. In calculation P_{calc} is an average value. In simulation, the car may load to more than the average, represented by P_{sim}.

Average mass per person depends on local norms and practices, see CEN81-12:2014, Table 1; accordingly, the value used in **Formulae (4)** and **(5)** may be adjusted.

In order to ensure that the car offers sufficient area (m^2) for the passengers, the car may be selected such that also

for calculation method

$$\text{Available car area} \geq \frac{P_{calc} \times \text{ average area per person}}{0{,}8} \tag{6}$$

and for simulation method

$$\text{Available car area } \geq P_{sim} \times \text{ average area per person} \tag{7}$$

Average area per person may depend on local norms and practices; accordingly, the value used in **Formulae (6)** and **(7)** may be adjusted, see **Annex A**.

To ensure that the rated load is sufficient to transport safely the number of passengers P_{calc} or P_{sim}, it shall be checked whether **Formulae (4)** and **(5)** are still valid after the calculations had been carried out in **Formulae (6)** and **(7)**.

To ensure that the rated load is sufficient for the available car area, it shall be checked whether the selection is consistent with ISO/DIS 8100-1:2017, Table 6 — Rated load and maximum available car area.

In order to allow more space for passengers in the car, the *LL* factor in **Formula (5)** or the value of average area per person in **Formulae (6)** and **(7)** may be changed if it is declared.

In any case, the methods and criteria for the car selection shall be reported, including deviations from standard values in the equations.

For more details and examples how to select a suitable car, see **Annex A** as a basic guideline.

6.5.4 Other lift parameters

In traffic analysis many parameters affect the lift handling capacity and lift performance. The basic lift parameters include rated load and available car area (**6.5.3**), and dynamic lift parameters that are mostly described by operating times. Lift movements can be modelled by characteristic drive curves and in advanced simulators, curves of different drive systems may be modelled.

For lift doors, the opening and closing times and dwell times shall be defined. Dwell times with and without passenger transfers or when serving a landing call or a car call, can be different and shall be defined. Where door pre-opening time is provided it shall be defined. The advanced opening time can depend on the acceleration and jerk values of the lift drive system. An example of the minimum lift data required can be seen in **Annex F**.

7 The calculation method

7.1 Uppeak equations

The calculation method is a method for designing and evaluating lift characteristics. It can be applied to simple traffic situations. In the calculation method, the collective control system and a pure uppeak traffic situation is assumed.

If the range of results produced by the calculation method meets the design criteria selected from **Table 2,** with regard to the building type, then the lift system for the building can be considered to be sized properly. The calculation report includes legal data, design criteria, building population, lift data and calculation output data (**9**).

The calculation method shall follow the following procedure.

The design shall solve the following equation:

$$HC5 \geq \lambda \tag{8}$$

where

*HC*5	is the 5-minute uppeak handling capacity (persons/5-minutes) of the lift configuration
λ	is the passenger demand (persons/5-minutes)

The uppeak handling capacity (*HC5*), in persons per 5 min, of a single lift shall be calculated using:

$$HC5 = \frac{300 \times P_{calc}}{RTT} \tag{9}$$

where

P_{calc} is the average number of passengers in the car at departure from the main entrance floor

RTT is the round trip time, in seconds (s), of a single lift during uppeak traffic

Where there is a group of L lifts the handing capacity shall be calculated using:

$$HC5 = \frac{300 \times P_{calc} \times L}{RTT} = \frac{300 \times P_{calc}}{UPPINT} \tag{10}$$

The uppeak interval (*UPPINT*) shall be calculated using:

$$UPPINT = \frac{RTT}{L} \tag{11}$$

where

L is the number of lifts

Handling capacity in percentage of the building population served in a 5-minute period *(%HC5*) shall be calculated using:

$$\%HC5 = \frac{HC5}{U} \tag{12}$$

where

U is the population in the target building

The *RTT* in seconds (s), of a single lift during uppeak traffic shall be calculated using:

$$RTT = 2Ht_v + (S+1)t_s + 2P_{calc}t_p \tag{13}$$

where

H is the average highest reversal floor

S is the average probable number of stops

t_v is the time to travel between two standard pitch adjacent floors at rated speed (s)

t_s is the time consumed in stopping (s)

t_p is the average one way passenger transfer time (s)

The time to travel between two standard pitch adjacent floors at rated speed can be calculated using:

$$t_v = \frac{d_f}{v} \tag{14}$$

where

d_f is the average interfloor distance (m)

v is the rated speed (m/s)

The time consumed in stopping shall be calculated using:

$$t_s = t_c + t_{sd} + t_f(1) - t_{ad} + t_o + t_{cd} - t_v \tag{15}$$

where

t_{ad} is the advance door opening time (s)

t_c is the door closing time (s)

t_{cd} door closing delay time (s)

$t_f(1)$ is the single (1) floor flight time (s)

t_o is the door opening time (s)

t_{sd} is the start delay time (s)

The time consumed when stopping can be expressed as:

$$t_s = T - t_v$$

where

T is the performance time (s)

The performance time T (**3.26**) shall be calculated using **Formula (16)**:

$$T = t_c + t_{sd} + t_f(1) - t_{ad} + t_o + t_{cd} \tag{16}$$

NOTE 1 Typical office building performance times for a floor height of 3,3 m are 8,0 s for an excellent system, 10,0 s for an average system and 12,0 s for a poor system.

The above times shall be confirmed by the chosen supplier.

NOTE 2 For simplicity door dwell times are not considered in this analysis.

Assuming even population distribution, a value for *S* shall be calculated using **Formula (17)**:

$$S = N\left[1 - \left(1 - \frac{1}{N}\right)^{P_{calc}}\right] \quad (17)$$

where

N is the number of landings served above entrance floor

Assuming even population distribution, a value for *H* shall be calculated using **Formula (18)**:

$$H = N - \sum_{i=1}^{N-1} \left(\frac{i}{N}\right)^{P_{calc}} \quad (18)$$

The value for t_p can only be estimated, see **Table 6** for typical values.

NOTE 3 This time may be extended for the use of persons with disabilities, see **6.5.1**.

The calculated lift group handling capacity (%HC5) should be in balance with the passenger traffic in the building and meet the given passenger demand (%POP). An example calculation is shown in **Annex D**.

7.2 Lift selection graphs

Passenger lift selection graphs for residential buildings, hotels and offices are shown in **Annex C**. The charts have been created using the uppeak equations of section **7.1.** The numbers of goods lifts as well as service lifts in hotels need to be estimated separately.

If there are more floors or a higher population in the building than defined in the chart, the lift selection charts cannot be used to find a lift configuration. Instead, the calculation method (**7.1**) or the simulation method (**8**) may be used.

8 The simulation method

8.1 Basis of the method

The simulation method is used for designing and evaluating lift characteristics. It can be applied to simple and complex traffic situations. The input and output data required by simulation are described below. A lift traffic simulation models the passengers transported by a selected lift installation, the dynamical movements of the lifts and the lift traffic control system for call allocation. The simulator programs and the traffic control algorithms are outside the scope of this standard.

The simulation method requires that building data has been collected and a lift configuration has been chosen (**5** and **6**). Depending on the building type (office, hotel, residential), each traffic situation shall be represented by a corresponding traffic mix (**3.35**), a set of related design criteria (**5.4.2**) and a range of passenger demands (**3.24**). The passenger demand should reflect typical design criteria (**Table 3**). The simulation report includes legal data, design criteria, building population, lift data and simulation output data (**9**).

The simulation method uses a series of simulations with constant passenger demand to assess each individual traffic situation for corresponding design criteria (**Table 3**). Furthermore, the handling capacity of the system can be determined.

8.2 Series of simulations

The simulation method considers the selected traffic mix for a range of passenger demands from a minimum to a maximum for a selected lift configuration. Every passenger demand is represented by a constant level of demand throughout the simulation.

The range of passenger demands should be chosen by the lift designer such that the required handling capacity is within the range of demands. This is to provide an insight into the sensitivity of the lift configuration for situations where the passenger demand is different from the required handling capacity (**Annex E**).

The simulation method should include at least three passenger demands, using the following procedure:

a) Select passenger demand x_1 equal to the required handling capacity (**5.4.2**) and two higher demands x_2 and x_3.

NOTE The increase from one passenger demand to another can be e.g. 0,5 or 1 percent points, i.e. if x_1 is 12 % then x_2 could be 13 % and x_3 could be 14 % (**Figure 1**).

b) For each selected passenger demand run a simulation, satisfying the simulation requirements (**8.3**).

c) Evaluate the results of all simulations (**8.4**).

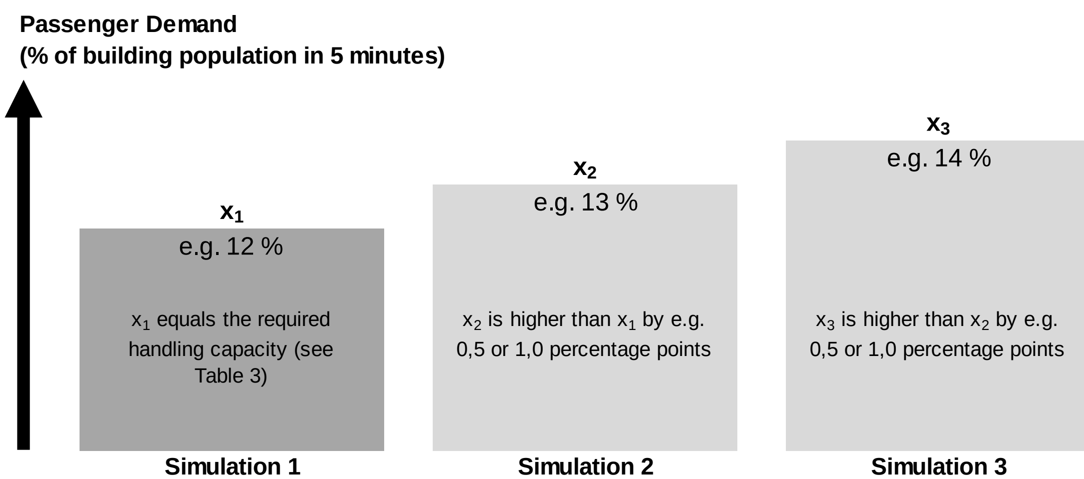

Figure 1 – Example of ISO Simulation Method: one series of simulations per traffic mix, each simulation with duration of at least 2 hours

8.3 Simulation requirements

Each simulation, which is executed for a defined traffic mix and a defined passenger demand, should fulfil the following conditions:

a) Each individual simulation starts from the same initial conditions (e.g. all cars empty, starting from main entrance floor);

b) Passengers are generated independently from each other;
Note: The passenger arrival times could follow a Poisson process or other probability distribution function where passenger arrivals are randomly distributed in time.

c) Passengers origin and destination floors are selected following the specified floor population data, entrance floors and entrance bias;

d) A lift car can be filled with passengers up to the declared value of P_{sim}, but not further.

e) The simulation duration of each passenger demand is at least 120 minutes in order to reduce the variance of the results to a level that makes multiple simulation runs unnecessary;

f) The first 15 minutes and the last 5 minutes of each simulation should be excluded from the results to avoid the influences of start and end effects.

8.4 Evaluation and review of simulation results

The evaluation of results always depends on the individual requirements of a specific building (**5.4.3**). The set of all simulation results can be used to determine if the lift configuration is properly sized for the building as follows:

a) If the results for demand x_1 (i.e. at the required handling capacity, see **8.2**) do not meet the design criteria (see **Figure 2** for an example), change the lift configuration (**5.2**) to meet the design criteria.

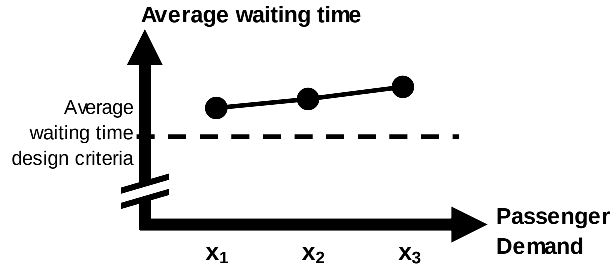

Figure 2 – Example for simulation results that do not meet design criteria

b) If the results for demand x_1 meet the design criteria, consider the results for demand x_2. For example, if the average waiting times for the demand x_2 are more than 20 % higher than required (**Figure 3**), the designer may change the lift configuration (**5.2**) to improve service level at x_2.

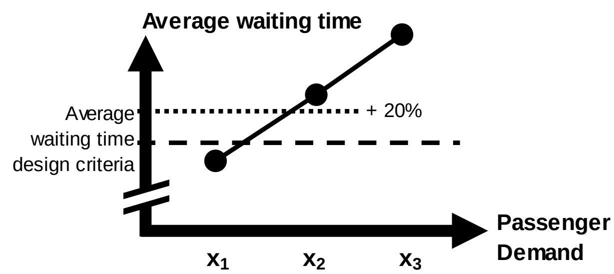

Figure 3 – Example for simulation results that do meet design, however near to performance limits

c) If all results including those for the highest demand x_3 meet the design criteria (**Figure 4**), the designer may change the lift configuration (**5.2**) to avoid an excessive design.

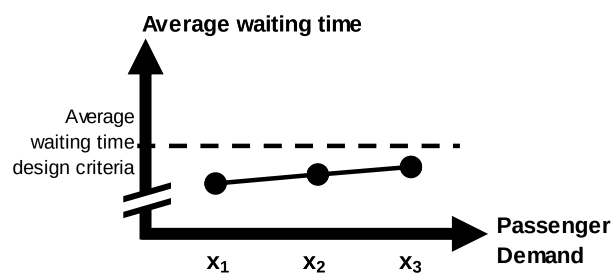

Figure 4 – Example for simulation results that excess design criteria significantly

d) If none of the three previous cases occurs (see **Figure 5** for an example), then the lift system for the building can be considered to be sized properly.

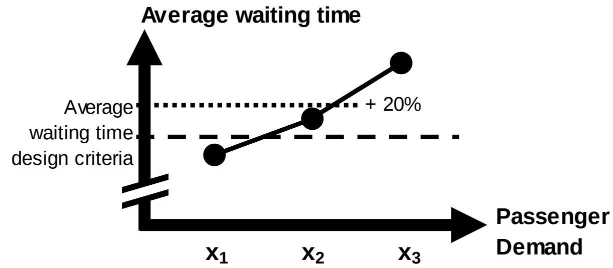

Figure 5 – Example for simulation results that indicate a properly sized lift configuration

The simulation output result shall be reported (**9**).

9 Reporting

A report of the calculation and simulation results shall be provided. The report should focus on the design criteria. The report can be extended to other criteria. Sample reports are given in **Annex D** and **Annex E**.

The relevant information of the report shall include but not be limited to:

9.1 Legal data

a) Company

b) Author of report

c) Calculator, simulator, version

d) Date and time or version of report

9.2 Building related information

a) Name and address of building/project

b) Client/consultant

c) Building type

d) Number of floors in the building

e) Floor markings/designations

f) Floor to floor heights

g) Floor utilization (entrance, office, hotel, restaurant, parking …)

h) Area per person or workplace area

i) Floor population (incl. source respectively basis of calculation)

j) Entrance bias

k) Lift group arrangements of a multiple lift installation

l) Served and non-served floors, express zone(s)

m) Population of the floors served by the lift group

For an example building data form, see **Annex F**.

9.3 Design criteria

a) Required uppeak handling capacity (to be used in calculation)

b) Required interval (to be used in calculation)

c) Traffic mix (to be used in simulation)

d) Required handling capacity for each traffic mix (to be used in simulation)

e) Required average waiting time for each traffic mix (to be used in simulation)

f) Other possible design criteria

g) Average mass per person used in **Formulae (4)** and **(5)** (**6.5.3**)

h) Value of *LL* used in **Formula (5)** (**6.5.3**)

i) Average area per person used in **Formulae (6)** and **(7)** (**6.5.3**)

9.4 Data related to lift installation

a) Lift group arrangement

b) Number of lifts in group

c) Travel height

d) Available car area

e) Rated passenger capacity

f) Rated load

g) Passenger capacity (P_{calc} for calculation, and P_{sim} for simulation)

h) Rated speed

i) Acceleration and deceleration

j) Jerk

k) Single passenger transfer time

l) Door type (e.g. 1 speed, centre/side opening)

m) Door width

n) Door opening time and how it is measured, e.g. up to fully open or up to 800mm

o) Door closing time

p) Door pre-opening time

q) Door closing delay time after passenger detection

r) Start delay

s) Time consumed in stopping

t) Performance time

9.5 Calculated lift performance output data

Output parameters are valid for conventional control system

a) Highest reversal floor

b) Probable number of stops

c) Performance time

d) Round trip time

e) Uppeak Interval

f) Uppeak handling capacity

g) Passengers transported in 5 minutes in uppeak

h) Car loading

i) Indication if calculation results meet the design criteria

For an example reporting format, see **Annex D**.

9.6 Simulated output data

Output parameters to be reported for uppeak and mixed traffic

a) Group (traffic) control system

b) Traffic mix

c) Table of simulation results including passenger demand and related average waiting time

d) Indication if simulation results meet the design criteria at required handling capacity

For an example reporting format, see **Annex E**.

10 Bibliography

[1] ISO 4190-1 (2010), *Lift (Elevator) installation — Part 1: Class I, II, III and VI lifts ISO 4190-5*

[2] ISO 4190-5 (2006*), Lift (Elevator) installation — Part 5: Control devices, signals and additional fittings*

[3] ISO/TR 11071-2 (1996), *Comparison of worldwide lift safety standards – Part 2: Hydraulic lifts (elevators)*

[4] ISO/TR 11071-2 (2006), *Comparison of worldwide lift safety standards – Part 2: Hydraulic lifts (elevators)*

Annex A
(informative)

Selection of rated load and available car area

A.1 Selection table

This annex provides guidance for simple cases to choose an appropriate car size (**6.5.3**) in terms of rated load and available car area to satisfy the required P_{calc} or P_{sim} from a specific traffic analysis (**7** or **8**) for a defined lift configuration.

The following assumptions are made for the Table A.1:

a) For given P_{calc} or P_{sim}, the selection satisfies **Formulae (4)** to **(7)** with an average mass per person of 75 kg and *LL* factor of 0,8, and also with an average area per person of 0,21 m^2;

b) for car area in **Formulae (6)** and **(7)**, the maximum available car area for the indicated rated load is considered, i.e. the raw car without decorative or protective panels. Such panels reduce the car area available for passengers, which should be taken into consideration when selecting a car size if the thickness of panels exceeds 15 mm or if inner car dimensions are specified by clients. It may then be required to choose a larger car to allow for the panels.

Furthermore, it shall be taken into consideration that the rated load shall be sufficient for the available car area (ISO/DIS 8100-1:2017, Table 6).

For typical car dimensions see ISO 4190-1: 2010.

Table A.1 – Example selection of car dimension and rated load in correlation to P_{calc} or P_{sim}

P_{calc} from ... to	P_{sim} from ... to	**Minimum rated load** (rated passenger capacity)	**Maximum available area (m^2)** measured without decorative panels
1,0 ... 4,8	1 … 4	450 kg (6 persons) see NOTE	1,30
4,9 ... 6,3	5 … 6	630 kg (8 persons) see NOTE	1,66
6,4 ... 7,6	7 … 8	800 kg (10 persons) see NOTE	2,00
7,7 ... 9,1	9 … 10	1000 kg (13 persons)	2,40
9,2 ... 11,2	11 ... 13	1275 kg (17 persons)	2,95
11,3 ... 11,8	14	1350 kg (18 persons)	3,10
11,9 ... 13,6	15 ... 16	1600 kg (21 persons)	3,56
13,7 ... 14,8	17 ... 18	1800 kg (24 persons)	3,88
14,9 ... 16,0	19 ... 20	2000 kg (26 persons)	4,20
16,1 … 19,0	21 … 23	2500 kg (33 persons)	5,00

NOTE Small cars may not suitable for persons with disabilities; see **6.5.1** for considerations for accessibility of persons with disabilities.

A.2 Selection examples

In both the following examples, the average mass per person is 75kg, and *LL* factor is 0,8.

In the second example, which also considers area, the average area per person is 0,21 m². It is assumed that the car design is based on the maximum available area, and that thickness of the finishes are below 15 mm, see **Annex A.1**.

Considering mass only

In calculation a lift car is needed to accommodate 13,1 persons (P_{calc}). Using **Formula (4):**

Rated load ≥ (13,1 x 75)/ 0,8 = 1228 kg

A lift with a rated load of 1275 kg meets the requirements.

For simulation using **Formula (5):**

P_{sim} ≤ 1275 x 0,8 / 75 = 13,60 persons

Simulation requires whole passengers, so the lift cars should not load to more than 13 persons.

LL may be lowered to 0,5 in buildings such as hotels where additional space per person may be required due to luggage.

Considering area and mass

Using **Formula (6):**

Available car area ≥ (13,1 x 0,21) / 0,8 = 3,44 m²

A 1600 kg car can have an area of up to 3,56 m². This is sufficient to satisfy both **Formulae (4)** and **(6)**.

Using **Formula (7):**

P_{sim} ≤ 3,56 / 0,21 = 16,95 persons

Simulation requires whole people, so to satisfy **Formula (7)**, the lift cars should not load to more than 16 persons. This is one person less than would be required to satisfy **Formula (5)**. To satisfy both formulae, cars should not load to more 16 persons in simulation.

The area per person may be increased to 0,30 m² in buildings such as hotels where additional space per person may be required due to luggage. If the area per person is increased, it is not necessary to lower *LL* in **Formula (5)**.

If consistency with mass only car selection is required, the area per person may need to be reduced, especially for larger lift cars e.g. from 0,21 m² per person (non-touch) to 0,17 m² (tightly packed).

Annex B
(informative)

Speed selection

Example selection:
In a 100 m high office building, for standard performance level the selected speed is 4 m/s.

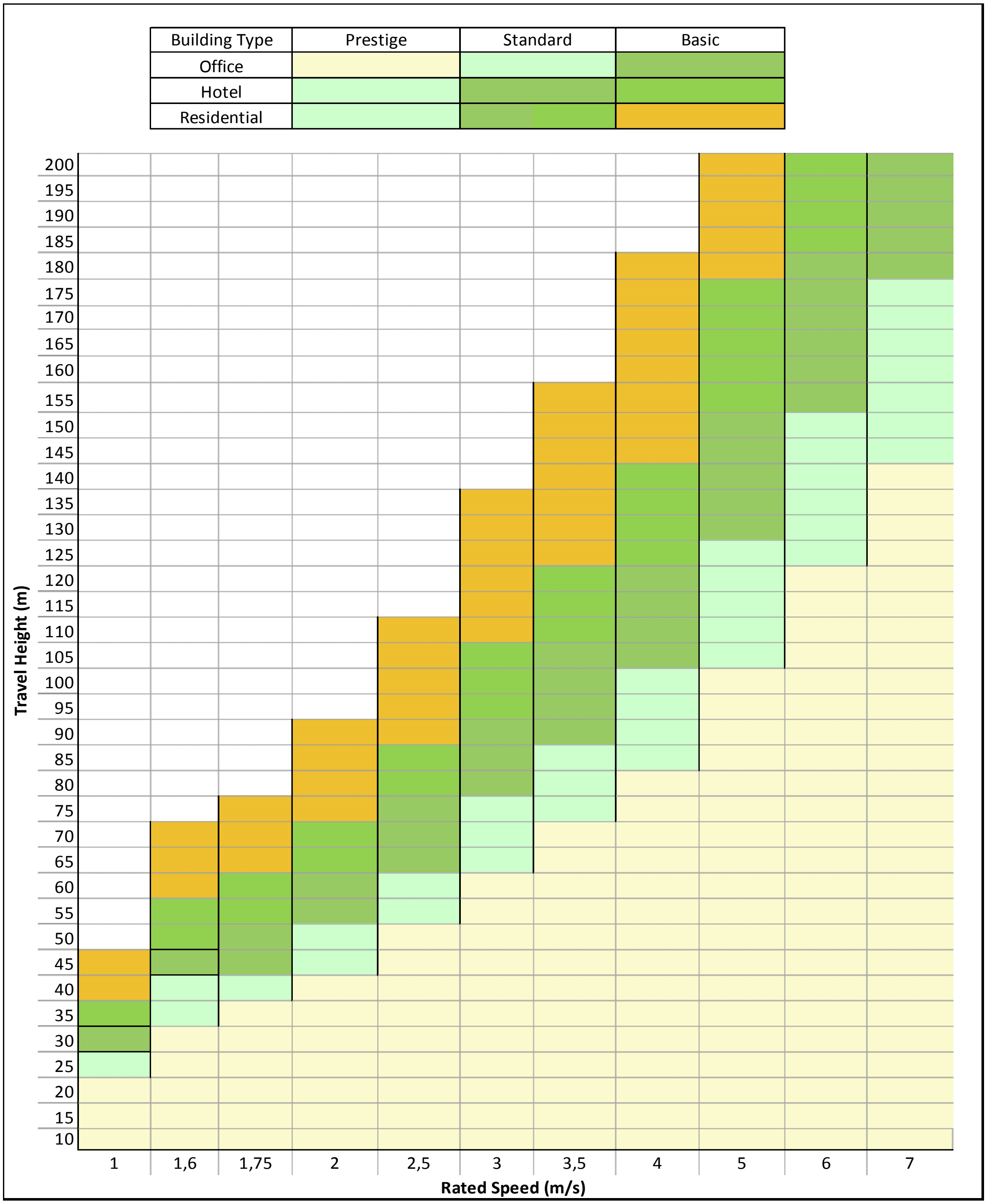

Figure B.1 – Typical selection of rated speed for different building types (6.5.2, Table 7).

Annex C
(informative)

Lift selection charts

C.1 Assumptions made in selection charts

In **Annex C**, the lift selection charts for a selection of an initial passenger lift configuration including number of lifts, their sizes and their speed are introduced. Goods and service lifts need to be defined separately. For further investigation and final verification use the calculation method (**7**) or simulation method (**8**). The lift selection charts are formed using the methods described in **Sections 6.5.3** and **7.1**. To find the minimum lift arrangement, the value of *P* shown in the legend as an integer value of P_{calc} rounded down. The rated loads should be selected for the given P_{calc} according to **6.5.3**, **Formulae (4)** and **(6)**, and the rated passenger capacity (**3.27**) according to ISO/DIS 8100-1:2017, Table 6 and EN81-20:2014, Table 6.

The following assumptions are made in the selection graphs:

a) conventional control system
b) one entrance floor
c) all cars have identical size
d) thickness of decorative panels is less or equal than 13 mm
e) even population distribution on the served floors
f) floor-to-floor height in residential buildings 3,0 m, in hotels 3,3 m, in offices 3,3 m and 4,0 m
g) the selection criteria and lift parameters used in forming the selection charts are taken from **Tables 2** and **7** (standard performance)
h) passenger transfer times are according to **Table 6**
i) assumed start delay 0,6 s and door closing delay time 2,0 s
j) door widths and stopping times used in calculations follow **Tables C.1** to **C.3**, assuming side opening (**SO**) doors for residential buildings and centre opening (**CO**) doors for hotels and offices; door times indicate the sum of opening and closing times.

If there are more floors in the building or more cars in the group than defined in the charts, building zoning is needed (**Annex D and E**)

Table C.1 - Time consumed in stopping (s) for 3,0 m floor-to-floor height in residential buildings.

SO door width (mm)	**Door times (s)**	**Time consumed in stopping (s)** **Rated speed** (rated acceleration, jerk)					
		1,0 m/s (0,6 m/s², 0,8 m/s³)	**1,6 m/s** (0,8 m/s², 1,0 m/s³)	**2,0 m/s** (0,8 m/s², 1,0 m/s³)	**2,5 m/s** (1,0 m/s², 1,0 m/s³)	**3,0 m/s** (1,0 m/s², 1,0 m/s³)	**3,5 m/s** (1,0 m/s², 1,0 m/s³)
800	5,4	10,4	10,9	11,3	11,4	11,6	11,8
900	5,6	10,6	11,1	11,5	11,6	11,8	12,0
1100	6,7	11,7	12,2	12,6	12,7	12,9	13,1

Table C.2 - Time consumed in stopping (s) for 3,3 m floor-to-floor height in hotels and offices.

CO door width (mm)	Door times (s)	Time consumed in stopping (s)			
		Rated speed (rated acceleration, jerk)			
		1,0 m/s (0,6 m/s², 0,8 m/s³)	**1,6 m/s** (0,8 m/s², 1,0 m/s³)	**2,0 m/s** (0,8 m/s², 1,0 m/s³)	**2,5 m/s** (1,0 m/s², 1,0 m/s³)
1100	4,4	9,4	9,9	10,3	10,5
1200	4,8	9,8	10,3	10,7	10,9

Table C.3 - Time consumed in stopping (s) for 4,0 m floor-to-floor height in offices.

CO door width (mm)	Door times (s)	Time consumed in stopping (s)				
		Rated speed (rated acceleration, jerk)				
		1,0 m/s (0,6 m/s², 0,8 m/s³)	**1,6 m/s** (0,8 m/s², 1,0 m/s³)	**2,0 m/s** (0,8 m/s², 1,0 m/s³)	**2,5 m/s** (1,0 m/s², 1,0 m/s³)	**3,0 m/s** (1,0 m/s², 1,0 m/s³)
1100	4,4	9,4	9,8	10,3	10,5	10,8
1200	4,8	9,8	10,2	10,7	10,9	11,2

C.2 Examples using Figures C.1-C.4 for the selection of rated load

Interpretation how to use Figures C.1 – C.4 to select rated load is shown through an example using Figure C.1. In the example, average mass per person is 75 kg, and area per person is 0,21m^2 ; other values may be selected according to cultural and/or local norms.

According to Figure C.1, a residential building with 23 floors above main entrance floor and with a population of 800 residents can be served with four lifts allowing the average number of 10 persons (P_{calc}) in cars, and rated speed (**3.29**) of 2,0 m/s.

Considering mass only

According to Figure C.1 four cars with the average number of 10 passengers and **Formula (4)**:

Rated load ≥ (10 x 75 / 0,8) = 938 kg

A lift with a rated load of 1000 kg meets the requirements.

Considering area and mass

Using 10 persons as the maximum number of passengers accommodated and **Formula (6)**:

Available car area ≥ (10 x 0,21 / 0,8) = 2,63 m²

A 1275 kg car can have an area of up to 2,95 m² and is sufficient to satisfy both **Formula (4)** and **(6)**. Alternatively, the same rated load results in by using P_{calc} value of 10 in **Table A.1**.

NOTE 1 The diagonal lines in the chart show the average population per floor

NOTE 2 The charts apply ONLY to the parameters defined above. For example, if the floor-to-floor height changes or the time consumed in stopping changes, a different set of charts would be required. See the calculation method (**7**) and **Annex D**

NOTE 3 In selection charts of **Annex C**, the minimum lift arrangement is shown. Local norms or preferences may require larger cars.

NOTE 4 When using the values of *P* in **Figures C.1** to **C.4**, car selection should be based on both mass and area, see **5.4.1** and **6.5.3** to avoid overcrowding. If only mass is considered for car selection, the graphs may give a minimal lift configuration.

C.3 Passenger lift selection for residential buildings

Table C.4 - Example selection of rated load with 75 kg average mass per person and 0,21 m² average area per person

Selection of rated load P_{calc}	**A** 6 P	**B** 8 P	**C** 10 P	**D** 13 P	**E** 14 P
Considering area and mass (**Formula (6)**, **Table A.1**)	630 kg	1000 kg	1275 kg	1600 kg	1800 kg
Considering mass only (**Formula (4),** see **C.2**, NOTE 4)	630 kg	800 kg	1000 kg	1275 kg	1350 kg

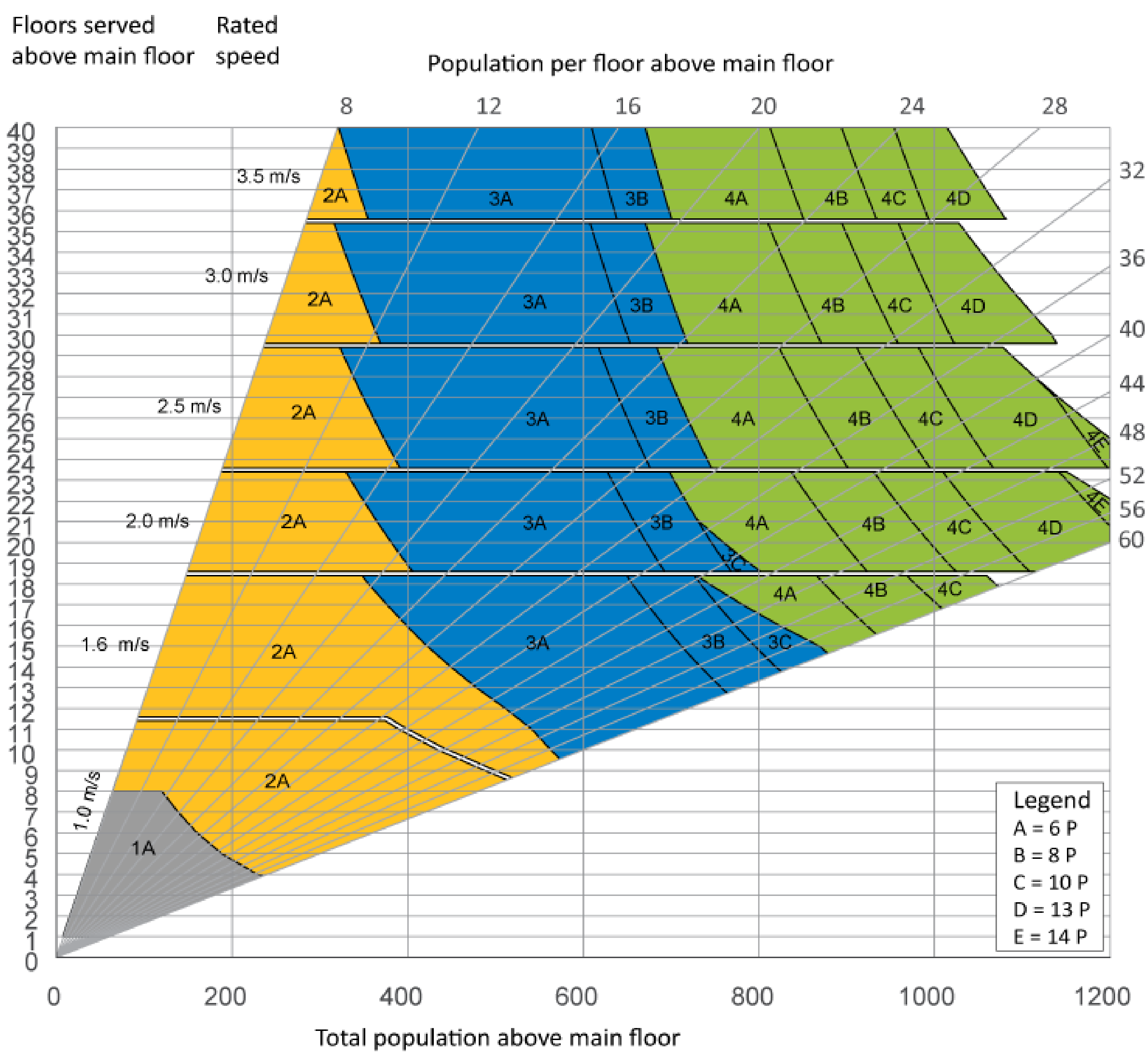

Figure C.1 – Selection chart for passenger lifts in residential buildings (floor-to-floor height 3.0m)

NOTE 1 Uppeak handling capacity ≥ 6 % of population / 5 minutes, interval ≤ 60 s and nominal travel time ≤ 35 s.

NOTE 2 It is necessary to provide at least one lift in the group with 1000 kg rated load or bigger to accommodate accessibility requirements, the movement of furniture, prams etc.

C.4 Passenger lift selection for hotels

Table C.5 - Example selection of rated load with 75 kg average mass per person and 0,21 m^2 average area per person

Selection of rated load P_{calc}	**A** 10 P	**B** 13 P	**C** 14 P	**D** 16 P
Considering area and mass (**Formula (6**), **Table A.1**)	1275 kg	1600 kg	1800 kg	2000 kg
Considering mass only (**Formula (4),** see **C.2**, NOTE 4)	1000 kg	1275 kg	1350 kg	1600 kg

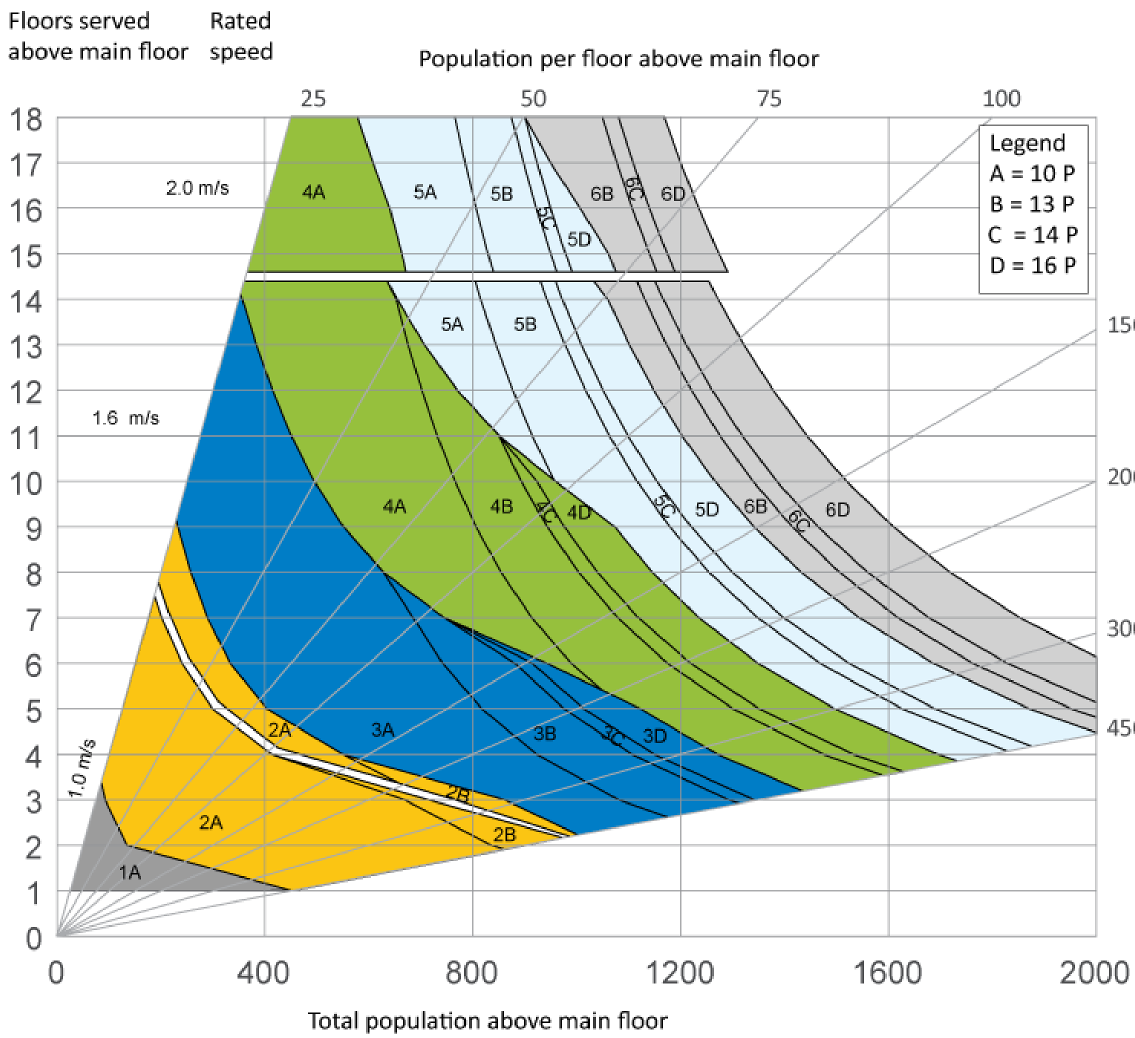

Figure C.2 – Selection chart for passenger lifts in hotels (floor-to-floor height 3.3 m).

NOTE 1 Required uppeak handling capacity ≥ 12 % of population per 5 minutes, required interval ≤ 40 s and nominal travel time ≤ 30 s.

NOTE 2 Service lifts need to be considered separately.

C.5 Passenger lift selection for offices (floor-to-floor height 3,3 m)

Table C.6 - Example selection of rated load with 75 kg average mass per person and 0,21 m² average area per person

Selection of rated load P_{calc}	**A** 10 P	**B** 13 P	**C** 14 P	**D** 16 P
Considering area and mass (**Formula (6)**, **Table A.1**)	1275 kg	1600 kg	1800 kg	2000 kg
Considering mass only (**Formula (4),** see **C.2**, NOTE 4)	1000 kg	1275 kg	1350 kg	1600 kg

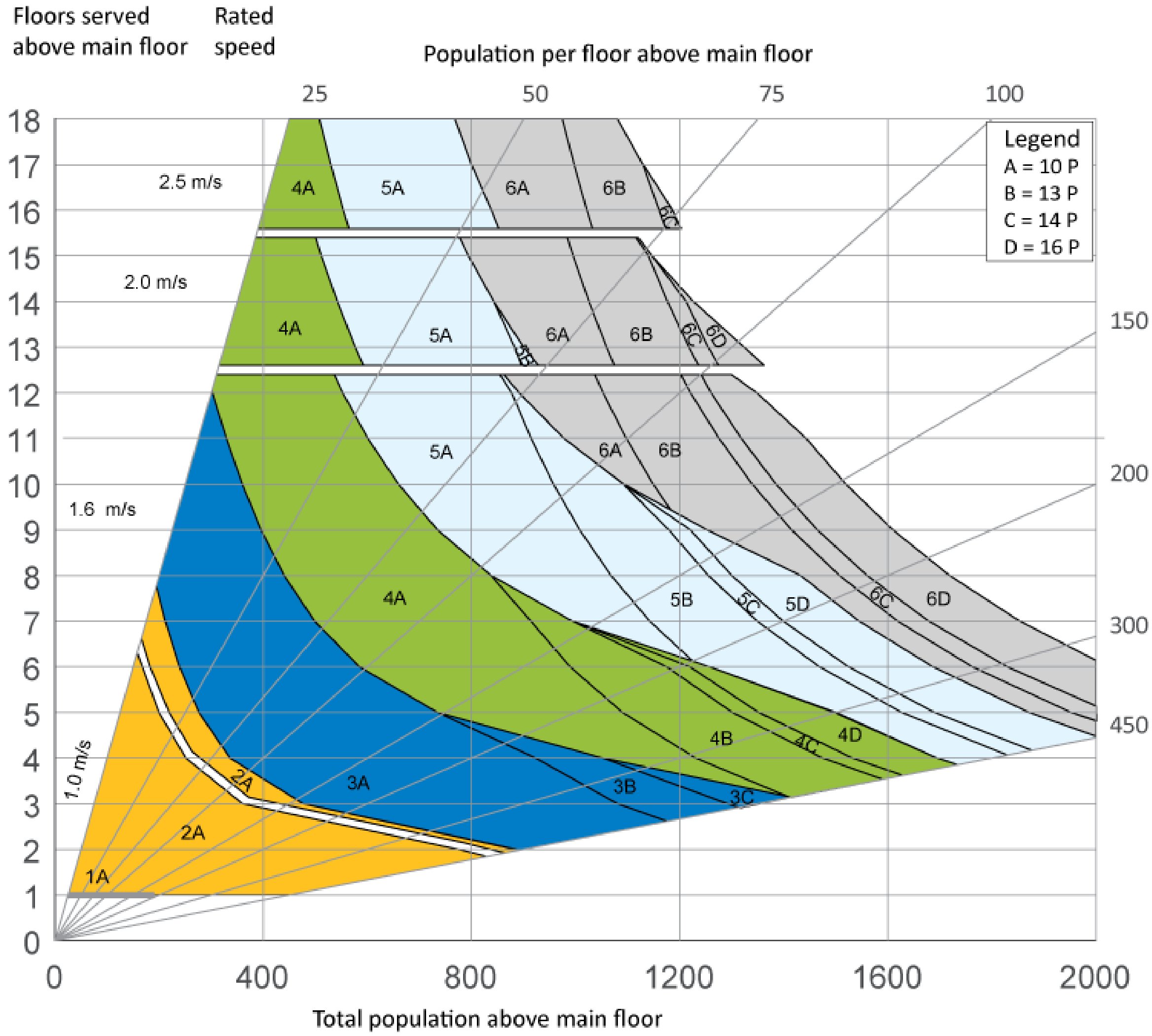

Figure C.3 – Selection chart for passenger lifts in offices (floor-to-floor height 3.3 m).

NOTE 1 Required uppeak handling capacity ≥ 12 % of population per 5 minutes, required interval ≤ 30 s and nominal travel time ≤ 25 s

C.6 Passenger lift selection for offices (floor-to-floor height 4,0 m)

Table C.7 - Example selection of rated load with 75 kg average mass per person and 0,21 m² average area per person

Selection of rated load P_{calc}	A 10 P	B 13 P	C 14 P	D 16 P
Considering area and mass (**Formula (6)**, **Table A.1**)	1275 kg	1600 kg	1800 kg	2000 kg
Considering mass only (**Formula (4)**, see **C.2**, NOTE 4)	1000 kg	1275 kg	1350 kg	1600 kg

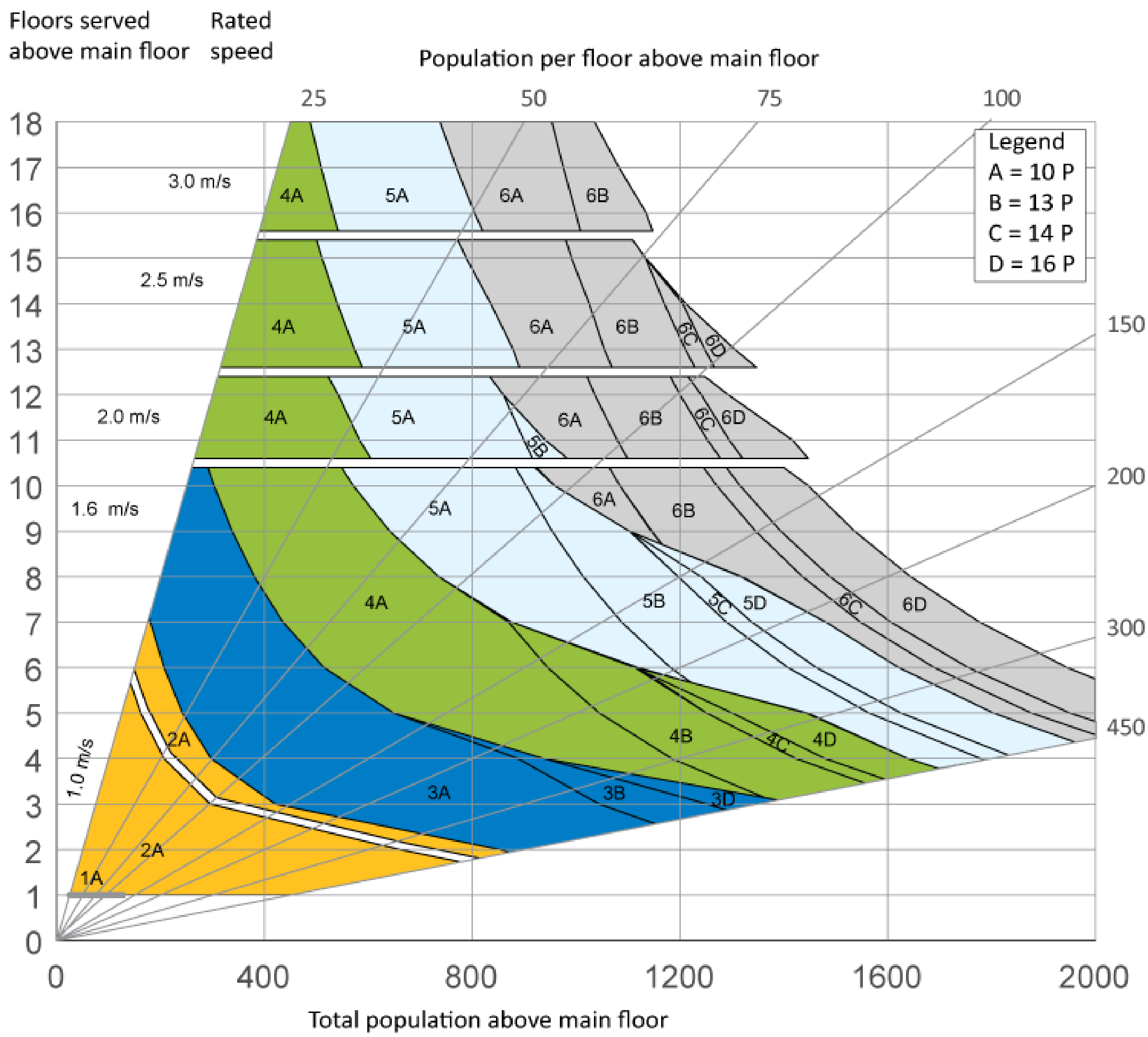

Figure C.4 – Selection chart for passenger lifts in offices (floor-to-floor height 4,0 m).

NOTE 1 Required uppeak handling capacity ≥ 12 % of population per 5 minutes, required interval ≤ 30 s and nominal travel time ≤ 25 s.

Annex D
(informative)

Example of calculation method and report

D.1 Method

Consider an example building comprising two rises: a low rise of 13 floors and a high rise of 13 served floors above the main floor. Other data are given as the example progresses and in the sample report.

To solve **Formula (8)** [*HC5* ≥ λ] the number of passengers in the car at departure from the main entrance floor (P_{calc}) should be obtained as P_{calc} determines the value for **Formula (9)**, **(10)**, **(13)**, **(15), (17)** and **(18)**.

If the *HC5* and *UPPINT* of a target system are known, they can be used to estimate P_{calc}. For offices according to **Table 2**, the required interval is 30 s and the required uppeak handling capacity is 12 % of the served population, the requirements in the following example are as follows:

D.2 Given data (see the building form in D.6)

Required interval (*UPPINT*):	≤ 30 s
Required handling capacity (%*HC5*):	≥ 12 %
Population per building rise (*U*):	1092 persons

This means that on average 131 persons will need be transported every 5-minutes (1092 x 0,12 = 131,0 persons/5-minutes rounded down) in both rises.

As the interval is 30 s there would be 10 round trips in 5-minutes (300/30).

Thus P_{calc} is 13,1 persons (131/10) which are to be transported on each round trip.

Number of floors to be served (*N*):	13	(both Low Rise and High Rise)
Travel height to highest served floor (*D*):	52 m	(Low Rise)
	104 m	(High Rise)
Average interfloor height (d_f):	4,0 m	(both Low Rise and High Rise)

D.3 Further data and assumptions

Using **Formula (15)** for time consumed in stopping (**7.1**):

$$t_s = t_c + t_{sd} + t_f(1) - t_{ad} + t_o + t_{cd} - t_v$$

Assume t_{cd} = 2,0 s, t_c = 2,4 s, t_{sd} = 0,6 s, t_{ad} = 0 s, t_o =2,0 s, and $t_f(1)$ = 5,1 s.

A standard rated speed (*v*) for a terminal floor to terminal floor travel of 52 m would be 2,5 m/s for Low Rise and 5,0 m/s for High Rise travel of 104 m (**Table 7** and **Annex B**).

NOTE 1 This is based on standard nominal travel time (**3.20**) of 25 s.

Thus for this selection the value of $t_v = d_f/v$ is for Low Rise 1,6 s and for High Rise 0,8 s.

According to **Table C.1** time consumed in stopping is 10,5 s for Low Rise and can be calculated to be 11,3 s for High Rise.

According to **Table 6** passenger transfer time (t_p) = 1,0 s.

D.4 Calculation

Using the Equations from **7.1**.

Average highest reversal floor *H* from **Formula (18)**:

$$Low\ Rise\ =\ 12{,}5\ floors$$

$$High\ Rise\ =\ 12{,}5\ +\ 13\ =\ 25{,}5\ floors$$

NOTE 3 The value for the high rise highest reversal floor is 12,6 plus the travel through the 13 non-stopping floors.

Average number of stops (*S*) from **Formula (17)**:

$$Both\ Low\ and\ High\ Rise\ =\ 8{,}4$$

Using **Formula (13)** for the round trip times.

$$Round\ trip\ time\ RTT\ in\ Low\ Rise = \ 2\ x\ 12{,}5\ x\ 1{,}6\ +\ 9{,}4\ x\ 10{,}5\ +\ 2\ x\ 13{,}1\ x\ 1{,}0$$

$$=\ 40{,}0\ +\ 98{,}7\ +\ 26{,}2\ =\ 164{,}9\ s$$

$$Round\ trip\ time\ RTT\ in\ High\ Rise = \ 2\ x\ 25{,}5\ x\ 0{,}8\ +\ 9{,}4\ x\ 11{,}3\ +\ 2\ x\ 13{,}1\ x\ 1{,}0$$

$$=\ 40{,}8\ +\ 106{,}2\ +\ 26{,}2\ =\ 173{,}2\ s$$

D.5 Selection of number of lifts

The required interval should be 30 s. As there can only be a whole number of lifts, it is necessary to divide the round trip time by a whole number to achieve an interval not exceeding 30 s.

Select six lifts, then calculate the *UPPINT* (in seconds) using **Formula (11)**, the uppeak handling capacity using **Formula (10)** and percentage population *%HC5* using **Formula (12)**:

Low Rise

$$UPPINT\ =\ 164{,}9/6\ =\ 27{,}5\ s$$

$$HC5\ =\ 300\ x\ 13{,}1/27{,}5\ =\ 142{,}9\ persons/5\ min$$

$$\%HC5 = \ (142{,}9\ x\ 100)/1092\ =\ 13{,}1\ \%/5\ min$$

High Rise

$$UPPINT\ =\ 173{,}2/6\ =\ 28{,}9\ s$$

$$HC5\ =\ 300\ x\ 13{,}1/28{,}9\ =\ 136{,}0\ persons/5\ min$$

$$\%HC5 = \ (136{,}0\ x\ 100)/1092\ =\ 12{,}5\ \%/5\ min$$

In both rises the design criteria are met. Note if the passenger demand is exactly 131 persons/5-minutes the actual Low and High Rise intervals will be smaller.

D.6 Determination of rated load and available car area

Suitable car dimensions and the related minimum rated load for P_{calc} shall be selected according to **6.5.3** and **Annex A.1**. An example corresponding to this calculation, with P_{calc} = 13,1 is given in **Annex A.2**.

Building	*Example Project, 1234 Main Street, Example City*																			
Floors									Lifts											
#	Floor Name (Mark)	Floor-to-floor height [m]	Travel Height [m]	Utilization (Entrance, Office, Hotel, Restaurant, Parking ….)	Net Internal Area [m²]	Area per person [m²]	Population [persons]	Entrance Bias [%]	Legend: **X** marks served floors, **I** non-served floors, **M** machine room 1	2	3	4	5	6	7	8	9	10	11	12
28															**M**	**M**	**M**	**M**	**M**	**M**
27	*26*	*4,0*	*104*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
26	*25*	*4,0*	*100*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
25	*24*	*4,0*	*96*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
24	*23*	*4,0*	*92*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
23	*22*	*4,0*	*88*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
22	*21*	*4,0*	*84*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
21	*20*	*4,0*	*80*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
20	*19*	*4,0*	*76*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
19	*18*	*4,0*	*72*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
18	*17*	*4,0*	*68*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
17	*16*	*4,0*	*64*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
16	*15*	*4,0*	*60*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
15	*14*	*4,0*	*56*	*Office*	*840*	*10,0*	*84*		**M**	**M**	**M**	**M**	**M**	**M**	**X**	**X**	**X**	**X**	**X**	**X**
14	*13*	*4,0*	*52*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
13	*12*	*4,0*	*48*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
12	*11*	*4,0*	*44*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
11	*10*	*4,0*	*40*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
10	*9*	*4,0*	*36*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
9	*8*	*4,0*	*32*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
8	*7*	*4,0*	*28*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
7	*6*	*4,0*	*24*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
6	*5*	*4,0*	*20*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
5	*4*	*4,0*	*16*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
4	*3*	*4,0*	*12*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
3	*2*	*4,0*	*8*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
2	*1*	*4,0*	*4*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
1	*0*	*4,0*	*0*	*Entrance*				*100 %*	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Total:		*108,0*			*21840*		*2184*		*Low Rise*						*High Rise*					

Lift group control	*Conventional*	*Conventional*
Travel	*52 m*	*104 m*
Number of served floors above main floor	*13*	*13*
Rated speed	*2,5 m/s*	*5,0 m/s*
Rated acceleration/deceleration	*1,0 m/s²*	*1,0 m/s²*
Jerk	*1,0 m/s³*	*1,0 m/s³*
Door type	*1-speed, CO*	*1-speed, CO*
Door width	*1100 mm*	*1100 mm*
Average one way passenger transfer time	*1,0 s*	*1,0 s*
Single floor flight time	*5,1 s*	*5,1 s*
Door closing delay time	*2,0 s*	*2,0 s*
Door opening time	*2,0 s*	*2,0 s*
Opening width used to measure door opening time	*800 mm*	*800 mm*
Door closing time	*2,4 s*	*2,4 s*
Door pre-opening time	*0,0 s*	*0,0 s*
Start delay	*0,6 s*	*0,6 s*
Time consumed in stopping	*10,5 s*	*11,3 s*

The following, together with above table, is a sample report page.

Example calculation result

Design criteria:	No. of pass. in car at departure from main entrance floor (Pcalc) 13.1 13.1	*13.1*	*13.1*
UPPINT ≤ 30 s			
HC5 ≥ 14%	Rated load based on mass (75 kg per person)	*1275 kg*	*1275 kg*
%HC5 ≥ 12%	Rated load based on area (0,21 m^2/pers., car area=3,56 m^2)	*1600 kg*	*1600 kg*
	Round trip time	*165,2 s*	*173,4 s*
	Uppeak interval (UPPINT)	*27,5 s*	*28,9 s*
	Passengers transported in 5 minutes	*142,9*	*136,0*
	Uppeak handling capacity (%HC5)	*13,1 %*	*12,5 %*

NOTE Calculation results may have marginal differences depending on how calculations are rounded

Annex E
(informative)

Example of simulation method and report

For this annex, the same lift system example as **Annex D** is used; see **Annex F** for input data form.

For the office building in this example project, typically two traffic mixes are considered (**Table 3**): a morning uppeak traffic and a midday traffic, with the following incoming, outgoing and interfloor distribution.

E.1 Selected traffic mixes

Uppeak traffic:	100 % incoming
Lunch traffic:	40 % incoming, 40 % outgoing, 20 % interfloor.

For each selected traffic mix, the typical design criteria for the simulation method are given in **Table 3.**

E.2 Type of Building: Office building

Selected design criteria:	Uppeak	Lunch traffic
Required handling capacity:	12 %	11 %
Required average waiting time:	30 s	40 s

E.3 Further data:

Assume a selected lift installation as shown in the building data form below.

E.4 Determination of rated load and available car area

Suitable car dimensions and the related minimum rated load for P_{sim} shall be selected according to **6.5.3** and **Annex A.1**. An example corresponding to this example, with P_{sim} =16 is given in **Annex A.2**.

Building	*Example Project, 1234 Main Street, Example City*																			
Floors									Lifts											
#	Floor Name (Mark)	Floor-to-floor height [m]	Travel Height [m]	Utilization (Entrance, Office, Hotel, Restaurant, Parking ….)	Net Internal Area [m²]	Area per person [m²]	Population [persons]	Entrance Bias [%]	Legend: **X** marks served floors, **I** non-served floors, **M** machine room											
									1	2	3	4	5	6	7	8	9	10	11	12
28															**M**	**M**	**M**	**M**	**M**	**M**
27	*26*	*4,0*	*104*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
26	*25*	*4,0*	*100*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
25	*24*	*4,0*	*96*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
24	*23*	*4,0*	*92*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
23	*22*	*4,0*	*88*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
22	*21*	*4,0*	*84*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
21	*20*	*4,0*	*80*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
20	*19*	*4,0*	*76*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
19	*18*	*4,0*	*72*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
18	*17*	*4,0*	*68*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
17	*16*	*4,0*	*64*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
16	*15*	*4,0*	*60*	*Office*	*840*	*10,0*	*84*								**X**	**X**	**X**	**X**	**X**	**X**
15	*14*	*4,0*	*56*	*Office*	*840*	*10,0*	*84*		**M**	**M**	**M**	**M**	**M**	**M**	**X**	**X**	**X**	**X**	**X**	**X**
14	*13*	*4,0*	*52*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
13	*12*	*4,0*	*48*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
12	*11*	*4,0*	*44*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
11	*10*	*4,0*	*40*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
10	*9*	*4,0*	*36*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
9	*8*	*4,0*	*32*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
8	*7*	*4,0*	*28*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
7	*6*	*4,0*	*24*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
6	*5*	*4,0*	*20*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
5	*4*	*4,0*	*16*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
4	*3*	*4,0*	*12*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
3	*2*	*4,0*	*8*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
2	*1*	*4,0*	*4*	*Office*	*840*	*10,0*	*84*		**X**	**X**	**X**	**X**	**X**	**X**	**I**	**I**	**I**	**I**	**I**	**I**
1	*0*	*4,0*	*0*	*Entrance*				*100 %*	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Total:		*108,0*			*21840*		*2184*													

	Low Rise	High Rise
Lift group control	*Conventional*	*Conventional*
Maximum passengers in car during simulation (P_{sim})	*16*	*16*
Travel	*52 m*	*104 m*
Number of served floors above main floor	*13*	*13*
Rated speed	*2,5 m/s*	*5,0 m/s*
Rated acceleration/deceleration	*1,0 m/s²*	*1,0 m/s²*
Jerk	*1,0 m/s³*	*1,0 m/s³*
Door type	*1-speed, CO*	*1-speed, CO*
Door width	*1100 mm*	*1100 mm*
Average one way passenger transfer time	*1,0 s*	*1,0 s*
Single floor flight time	*5,1 s*	*5,1 s*
Door closing delay time	*2,0 s*	*2,0 s*
Door opening time	*2,0 s*	*2,0 s*
Opening width used to measure door opening time	*1100 mm*	*1100 mm*
Door closing time	*2,4 s*	*2,4 s*
Door pre-opening time	*0,0 s*	*0,0 s*
Start delay	*0,6 s*	*0,6 s*

Time consumed in stopping	*10,5 s*	*11,3 s*

The following, together with above table, is a sample report page.

Example simulation result

		Low Rise	High Rise
Waiting times for uppeak traffic	Building rise population	*1092*	*1092*
Traffic mix	*12* % passenger demand is equivalent to	*131,0 pass/5 min*	*131,0 pass/5 min*
100 % incoming			

Design criteria:	Avg. waiting time at *12* % passenger demand	2,9	11,1
Handling Capacity ≥ 12 %	Avg. waiting time at *13* % passenger demand	9,8	34,1
Avg. waiting time ≤ 30 s	Avg. waiting time at *14* % passenger demand	*(excess demand)*	*(excess demand)*

		Low Rise	High Rise
Waiting times for lunch traffic	Building rise population	*1092*	*1092*
Traffic mix	*11* % passenger demand is equivalent to	*120,1 pass/5 min*	*120,1 pass/5 min*
40 % incoming, 40 % outgoing, 20 % interfloor			

Design criteria:	Avg. waiting time at *11* % passenger	22.1	24.7
Handling Capacity ≥ 11 %	Avg. waiting time at *12* % passenger	24,6	31.3
Avg. waiting time ≤ 40 s	Avg. waiting time at *13* % passenger	26,9	31.5

Lift installation fulfils the design criteria	[x] yes [ ] no	[x] yes [ ]
Rated load based on mass (75 kg per person and *LL* = 0,8)	1600 kg	1600 kg
Rated load based on area (0,21 m² per person with car area = 3,56 m²)	1600 kg	1600 kg
Additional comments	Properly sized lift configuration	Properly sized lift configuration

Company	Author	Report, version	Simulator & version	Date of report
xxx		1.0	Simulator xxx	October 2, 2017

NOTE 1 These results are illustrative only. Different simulators may give different results.

NOTE 2 For selection of rated load see **6.5.3**, **Formulae (5)** and **(7).**

Annex F
(informative)
Building data form

Building																				
Floors									Lifts											
#	Floor Name (Mark)	Floor-to-floor height [m]	Travel Height [m]	Utilization (Entrance, Office, Hotel, Restaurant, Parking ….)	Net Internal Area $[m^2]$	Area per person $[m^2]$	Population [persons]	Entrance Bias [%]	Legend: **X** marks served floors, **I** non-served floors, **M** machine room											
									1	2	3	4	5	6	7	8	9	10	11	12
41																				
40																				
39																				
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Annex G
(informative)

Flow chart of design process