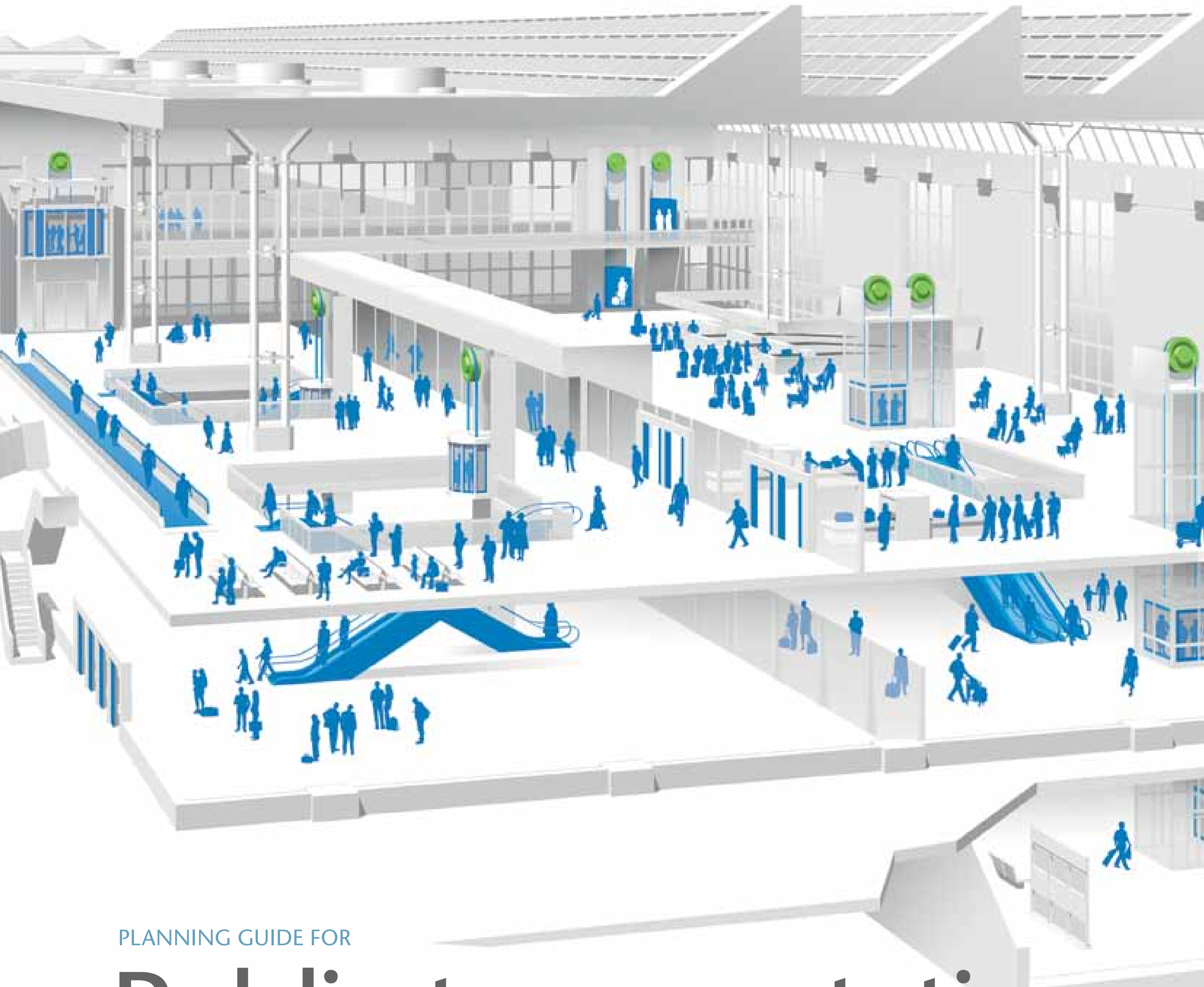
Dedicated to People Flow™



PLANNING GUIDE FOR

Public transportation elevators

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1. Introduction

1.1 About this Planning Guide

The purpose of this Planning Guide is to provide basic information on elevators for the public transportation segment (airports, railway stations, underground stations, transit centres etc.), and to help you find the best elevator solution for your particular needs.

1.2 About KONE

KONE is known worldwide for manufacturing, installing, servicing and modernising elevators, escalators and automatic doors. We have supplied elevators to thousands of public transportation buildings worldwide, from the New York metro to Beijing Capital Airport, and have over 800 service centres in 49 countries.

However, KONE provides more than elevators, escalators and automatic doors. We provide a complete solution that is greater than the sum of its parts. This means providing help in ensuring the efficient flow of people throughout the entire facility. Our vision is therefore to deliver the best People Flow™ experience. By People Flow we mean moving people smoothly, safely, comfortably and without waiting.

2. Special demands of public transportation

With new developments in technology improving the ease and accessibility of travel for everyone, it is no surprise that the volume of travelers continues to grow. This is putting greater demands on airports and transit centres, where all elements – metro station, railway station, hotel and shopping centre for example – have to be seamlessly integrated.

2.1 Airports

There are many types of traffic at an airport, as passengers arrive and depart by plane, train, metro, bus and car, and go to or through shopping areas, hotels and conference centres. KONE supplies a complete range of People Flow™ equipment for airports: passenger and service elevators, escalators and autowalks.

On top of the equipment, KONE helps manage the flow of people through an airport. Our comprehensive People Flow™ solutions ensure smooth and efficient movement of people and goods, with all of the components working seamlessly together, and supported for their entire lifecycle.

To ensure the best possible traffic in and through the airport, early planning of People Flow™ is essential. Our People Flow planning guide for transit centres (ref. ID 7172) provides valuable help in this respect.

Airport references at www.kone.com/airports

2.1.1 Benefits of KONE elevators in airports

- Eco-efficient™ life cycle and low lifetime costs
- Accessibility: KONE equipment is easy to use – for all passengers (not only disabled users)
- Easy maintenance and operation
- Reliability and safety of components
- Cutting-edge technology
- Carefully planned placement of elevators, escalators and automatic doors ensuring efficient People Flow
- Full customisation of elevator design available
- KONE has materials that comply the EN81-71 vandal code cat 1 and 2
- Quick and easy deliveries

2.2 Transit centres (railway and metro stations)

As with an airport, a transit centre must be seen as an integrated whole. KONE is the world's most experienced supplier of People Flow™ solutions for mass transit systems. We take into account not only the flow of people through a railway, underground or bus station, but also through the shopping malls, restaurants and office buildings that are often closely integrated with these transit centres, and the movement of people between these areas.

In this way our People Flow™ equipment provides safe and convenient transportation for millions of passengers every day. The equipment must operate in the toughest conditions, around the clock, year-round, and often outdoors in humidity, rain or snow.

To ensure the best possible traffic in and through the transit centre, early planning of People Flow is essential. Our People Flow planning guide for transit centres (ref. ID 7172) provides valuable help in this respect.

Transit centre references at www.kone.com/transitcentres

2.2.1 Benefits of KONE elevators in railway and metro stations

- Eco-efficient™ life cycle and low lifetime costs
- Accessibility: KONE equipment is easy to use, for all passengers (not only people with disabilities)
- Reliability of components
- Uncompromising safety
- Vandal-proof equipment complying with vandal codes
- Equipment meets required EMC standards and is safe to operate in critical environments
- Proactive maintenance solutions.

2.3 Main specifications for public transportation elevators

Airports and transit centres place special demands on elevators, depending on the daily and yearly usage range of each elevator (the duty served by the elevator). In simple terms, duty is defined as starts per year and is divided into four types:

- Low-duty = up to 200 000 starts/year
- Mid-duty = up to 400 000 starts/year
- Heavy-duty = up to 800 000 starts/year
- Extra heavy-duty = over 1 million starts/year meaning that the elevator is in constant use.

For more information on the definition of duty, see section 4.2.2.

The public transportation segment generally requires either machine-room-less elevators or elevators with the machine-room placed down on the main floor. The reason for this is to avoid electrical interference from machine-rooms located at the top of the elevator shaft.

KONE can meet both sets of requirements. We offer a wide range of machine-room-less elevators for loads up to 5000 kg. If a machine-room is required on the ground floor, our elevators for the public transportation segment are ideal for loads up to 4000 kg.

Other general demands are a low travel distance (generally less than 60 m) and a speed of normally up to 3.0 m/s. Note that KONE has a wider offering available than what is generally required by the public transportation segment.

3. Ordering a public transportation elevator

The special needs of the public transportation segment demand elevators with special characteristics, which need to be considered as early as possible in the planning phase.

If details are clarified early during the tendering or budgeting phase, the design, engineering, manufacturing and delivery can be implemented with lower costs and shorter lead times.

The following questions are crucial:

- What is the duty of the elevator – in other words its usage rate?
- What codes need to be followed and especially do vandal codes need to be followed?
- Are there any special software systems and is an OPC (an interface standard in communication between industrial automation systems) interface needed (see section 6.2)?

Within the KONE process, a number of car and signalisation templates, guides and other tools for the different phases of public transportation projects are available. Their use will help to ensure better efficiency and a good match between the solution provided and your requirements.

Because of the heavier usage, public transportation elevators need more attention and therefore maintenance than regular elevators for offices or residential buildings. Within the sector, maintenance requirements will differ: a 24/7 constant usage elevator will require more maintenance work and component replacements than a lower usage elevator.

3.1 Key cost drivers for elevators in public transportation

In the public transportation segment, cost is an extremely important issue. Below are listed the most common factors that cause increased costs. It is worth paying attention to these factors early in the planning process.

Technical dimensions

- Machine-room placed elsewhere than at the top of shaft or inside the shaft
- Other than vertical elevations
- Tight or steel shaft
- Outdoor elevators or any entrances outdoors
- Low pit or headroom
- Adjacent doors in car
- Wider or deeper car sizes than standard (dimensions stated in KONE planning guides or ISO dimensions)
- Fire-fighting elevator.

Car design

- EN81-71 vandal codes for materials and elevator design structure
- Scenic or window car
- Special local decoration
- Windows in doors
- Special curved floor
- Other than standard KONE signalisation or wide displays
- Special limited custom design including LED lights.

Software

- Special group controls
- Turnstiles
- OPC interface (can be handled with KONE E-link™ monitoring software).

Choosing any of the above may alter the price and delivery time and increase the engineering hours. The following issues may be affected:

- Selected scope
- Price
- Engineering/design of elevators
- Delivery and assembly/installation
- Maintenance
- Component replacement, spare parts
- Lifetime of elevators.

4. Choice of hoisting components

The choice of hoisting components for public transportation elevators is determined by the following inter-related factors:

- Starts per year
- Rated load
- Travel
- Speed
- Machine-room or machine-room-less elevator
- Regeneration of energy (today a default in elevators due to global eco-efficiency targets)

4.1 KONE solutions for airports and transit centres

KONE solutions for transit centres are presented in the following page.

The key data for choosing the correct duty in a transit centre can be obtained from traffic calculations which simulate the people flow throughout the area. Figure 1 displays the most important choices about the elevator-escalator ratio for transit centres. The elevator duty is defined by how much traffic is guided only through the elevators.

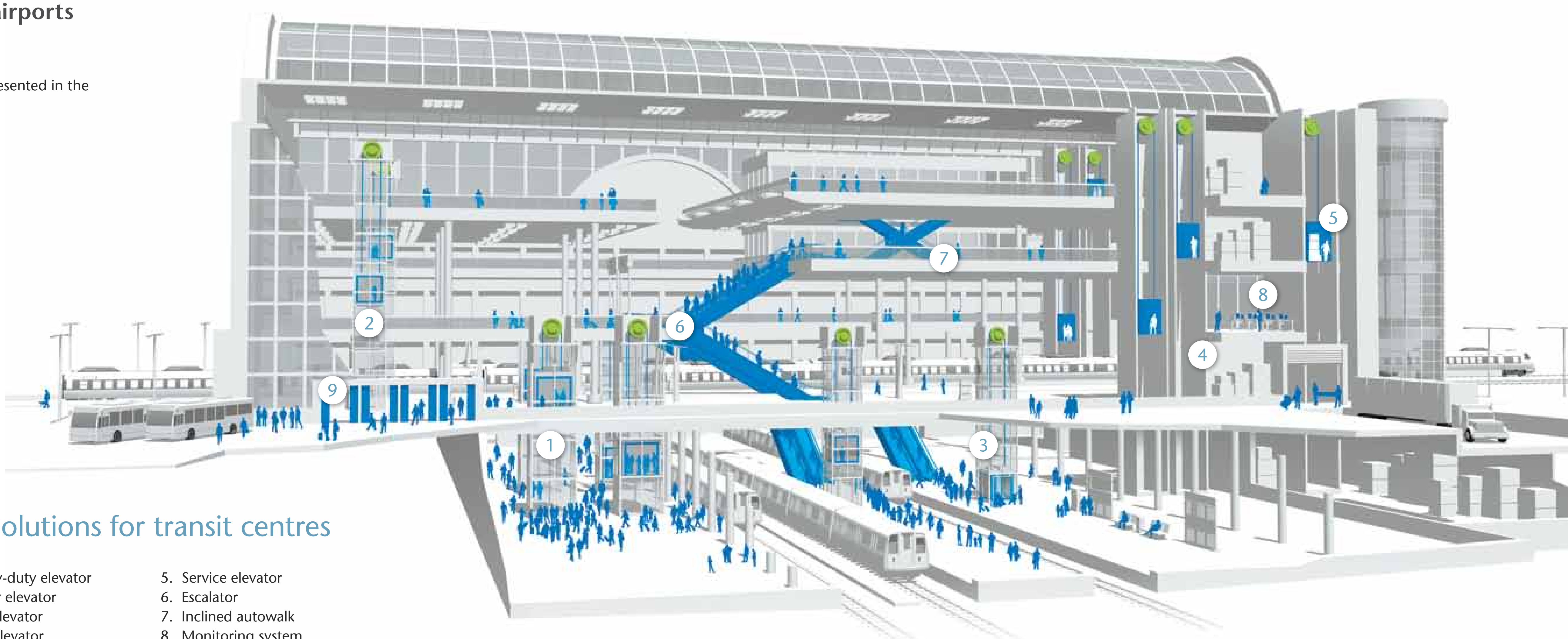
Numbers 1 and 2 in the illustration represents heavy- or extra heavy-duty elevators. The difference between them is whether the transit area is closed during any time of the day. If the transit area is open 24 hours every day, the elevator is extra heavy-duty, meaning the elevator is in constant usage apart from monthly maintenance visits. If the transit centre is closed for part of the day then a heavy-duty elevator is the correct selection.

These extra heavy-duty (over 1 million starts per year) and heavy-duty (up to 800 000 starts per year) elevators are chosen for situations where for some reason **escalators** are not available to take care of the main traffic flow.

Extra heavy-duty and heavy-duty elevators are designed to serve in cases where all or most of the traffic flow goes through the **elevators**. An example is a building where escalators can not be installed. Another example is an underground station where it is wise to bring passengers directly to the street level with a group of elevators.

Number 3 indicates a mid-duty elevator with up to 400 000 starts per year. This means that some of the traffic other than accessibility traffic (e.g. people with disabilities) is also coming through this elevator.

Numbers 4 and 5 indicate a low-duty elevator with up to 200 000 starts per year. This means only the accessibility traffic (e.g. people with disabilities) is going through the elevator. It can be located at the metro or railway platform further away from the normal people flow routes, which already reduces the usage of the elevator. Freight/goods elevators are commonly also low-duty elevators.



KONE solutions for transit centres

1. Extra-heavy-duty elevator
2. Heavy-duty elevator
3. Mid-duty elevator
4. Low-duty elevator
5. Service elevator
6. Escalator
7. Inclined autowalk
8. Monitoring system
9. Automatic building doors

Figure 1. KONE's elevator solutions for public transportation: transit centres

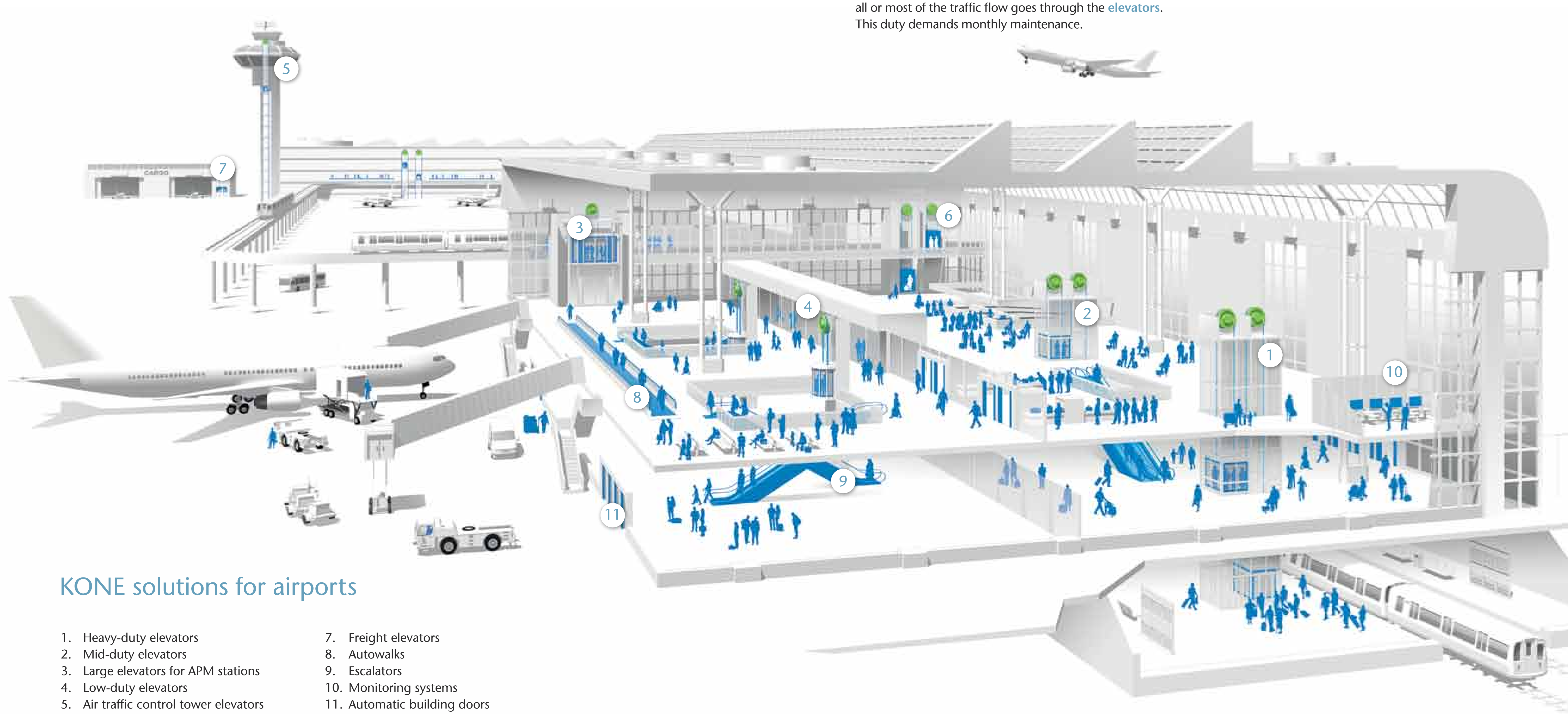
Selecting the correct duty for an elevator in an airport depends on traffic calculations performed through people flow simulation. Figure 2 illustrates the most important choices with regards to the elevator-escalator ratio for common elevators in airports. The elevator duty is defined by how much of the traffic is guided only through the elevators. The need for an extra heavy-duty elevator in an airport is rare, as people flow during night is very low or non-existent. Extra heavy-duty elevators are only needed for a constant traffic flow, 24 hours per day.

Number 1 in the illustration represent mid- or heavy-duty elevators. The difference between them is whether the people flow is directed only through elevators at the airport or also through escalators.

Numbers 2 and 3 are mid-duty elevator. They are chosen in cases where the main traffic flow goes through escalators. There may be some traffic through them in addition to accessibility traffic, bringing the usage up to 400 000 starts per year.

These heavy-duty elevators are chosen in situations where **escalators** are not required to take care of the main traffic. Heavy-duty elevators are required in cases where all or most of the traffic flow goes through the **elevators**. This duty demands monthly maintenance.

Numbers 4,5 and 6 are low-duty elevators up to 200 000 starts per year. This means only the accessibility traffic is going through the elevator. This elevator can be located at the airport in areas with multiple escalators or in rarely used areas where the usage of the elevator is reduced. Freight/goods, personnel and air control traffic tower elevators are common low-duty elevators.



KONE solutions for airports

1. Heavy-duty elevators
2. Mid-duty elevators
3. Large elevators for APM stations
4. Low-duty elevators
5. Air traffic control tower elevators
6. Service elevators
7. Freight elevators
8. Autowalks
9. Escalators
10. Monitoring systems
11. Automatic building doors

Figure 2. KONE elevator solution for public transportation: airports

4.2 Technical terms

To define what is meant by duty, the number of starts per year must first be defined.

4.2.1 Definition of starts per year

The most commonly used factor to specify an elevator in the public transportation segment is the number of starts per year. This is a controversial way of calculating elevator usage since every time the elevator moves it is recorded as a start.

However, during heavy loading the car will re-level itself possibly multiple times. This re-leveling will artificially inflate the number of starts per year. This means that in practice the start-counter in the elevator may show more starts for elevator than when counting with theoretical starts per year.

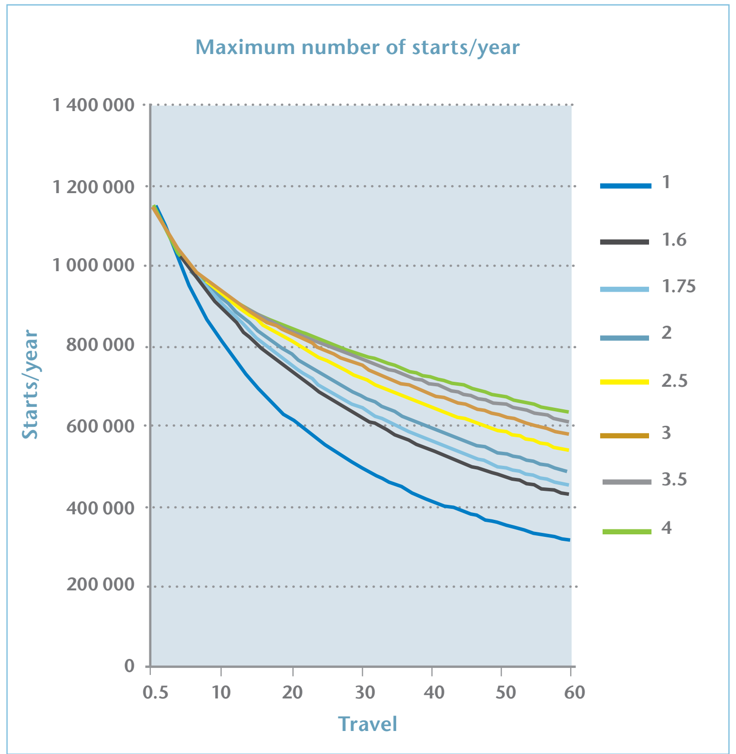
In our elevator technical qualifications we use the number of theoretical starts per year, which only indicates the elevator going either up or down and not counting in the re-leveling.

4.2.2 Definition of duty

Generally duty is defined either as:

1) the number of cycles (changes between an idle period and a period when the system is activated and running)

2) how long the component or entity is exposed to stress ("travel km per year"), which is calculated as the vertical distance an elevator runs in the shaft per year.



Graph 1. Maximum starts per year

In the public transportation segment the duty is defined by starts per year. For example, low-duty is up to 200 000 starts per year meaning that the elevator is designed for occasional usage in a calculated maximum of 200 000 starts per year. The elevator is also maintained with this same expectance of usage and lifetime in mind. When heavier usage is needed then the elevator needs to be designed, engineered and maintained according to this usage.

4.2.3. Definition of design lifetime

KONE defines lifetime for its equipment's and components. It is important that the design lifetime definition is clear to KONE and customers.

Design lifetime is the time within selected duty and **defined environmental, mechanical and climatic conditions** that the product fulfills its intended performance **within** defined reliability range. When design lifetime exceeds, product's performance starts to reduce. In all circumstances safe fail principle is followed.

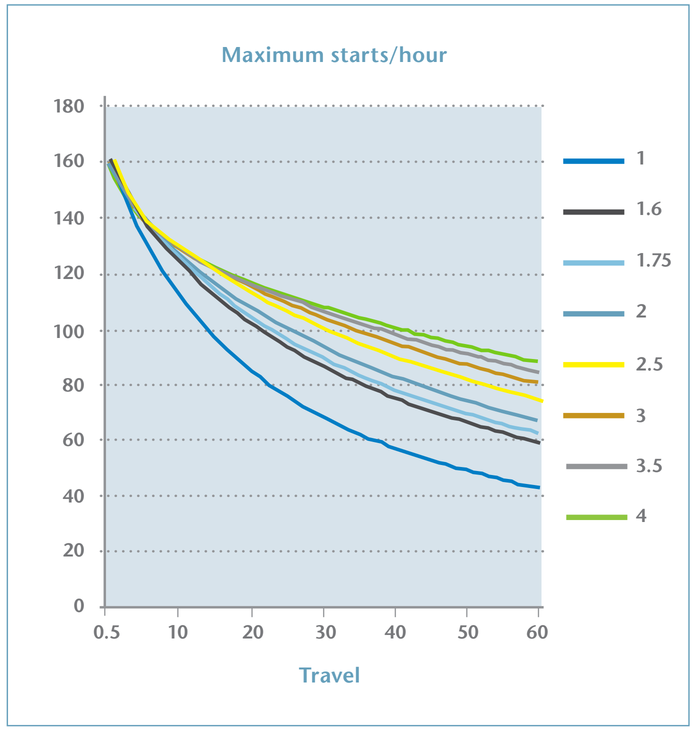
Warranty time covers defined part of the design lifetime. Design lifetime is intended to help to calculate the lifetime cost and select the best plan for the product for the specific customer. Lifetime design is also base to KONE Modular based maintenance solutions.

The graph 1 shows that the speed of the elevator and the travel distance affect the potential maximum number of starts per year.

From the graph it can be seen that with a 5-metre travel it is possible for an elevator to reach over 1 100 000 starts per year. With a 30-metre travel it is possible to reach 800 000 starts per year.

The speed of the elevator is significant in elevator selection but has little effect when the travel is small as the elevator can not reach full speed.

The calculated time for a stop per landing in this graph is 12 seconds, which covers the time people go in and out and the doors open and close. A slow passenger will influence this time and reduce the speeds amount of starts per year.

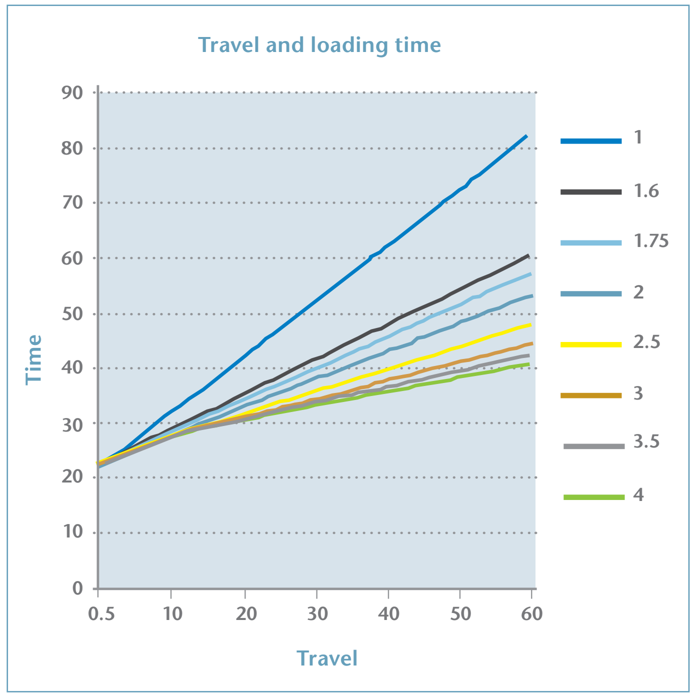


Graph 2. Maximum starts per hour

The graph 2 shows how the speed and travel distance of an elevator affect the potential maximum number of starts per hour.

With a 5-metre travel distance it is possible for an elevator to reach up to 160 starts per hour. With a 30-metre travel distance, it is possible to reach over 100 starts per hour.

Note that these values will be affected by slow passengers who do not enter the car in the calculated time. The calculated time for a stop per landing in this graph is 12 seconds, which includes the time people go in and out, and the doors open and close. A slow passenger will influence this time and reduce the speed.



Graph 3. Travel and loading time

The graph 3 shows how the travel time and loading time are formed by time in seconds and travel.

For example, if travel is 40 metres with a speed of 1.0 m/s (the blue line) the travel and loading time is about 60s.

This graph is based on a loading time at every landing of 12s, which means that when the car arrives at the floor, it takes 12s for the doors to open, the people to get in and out, and the doors close.

4.3 Description of KONE elevator duties

Low-duty

Low-duty elevators go up to 200 000 starts per year. In the public transportation sector these are generally elevators in rarely used areas, accessibility elevators, air control tower elevators and freight/goods elevators. Personnel elevators are also mainly low-duty elevators.

Mid-duty

Mid-duty elevators go up to 400 000 starts per year. This duty is selected when the main traffic is not passing through elevators, but goes through escalators, while some traffic in addition to accessibility traffic is going through the elevators.

Heavy-duty

Heavy-duty elevators go up to 800 000 starts per year. This duty is selected when the elevator handles all or most of the people flow in the area, for example from the underground platform up to the main transit floor.

Compared to a mid-duty elevator, a heavy-duty or extra heavy-duty elevator has larger more robust components. Especially in heavy- and extra heavy-duty elevators, a few components need to be chosen for heavier usage such as machinery, drive and doors. Due to the increased usage rate, the lifetime of the components is also less than in mid-duty elevators.

To understand this changes in lifetimes according to duties by components, ask your KONE representative for the public transportation segments for design lifetime and spare parts data.

Extra heavy-duty

Extra heavy-duty elevators go over one million starts per year, depending on travel, speed, door openings and people going in and out. See chapter 4.3.

An extra heavy-duty elevator is chosen when all of the traffic goes through the elevators and the transit area is open for 24 hours a day every day. In these cases the only time the elevator is not in use and running is the monthly maintenance break. Due to this constant usage there is a need to have elevators maintained frequently and spare part changes well planned in advance proactively. When the transit centre is closed during the night and the elevator is therefore not in use, an extra heavy-duty elevator is not necessary; a heavy-duty elevator is adequate.

Compared to a mid-duty elevator, an extra heavy-duty elevator has larger, more robust components. Especially in heavy- and extra heavy-duty elevators, a few components need to be chosen for heavier usage such as machinery, drive and doors.

Technically the differences between heavy- and extra heavy-duty elevators are small or non-existent. Due to the increased usage rate, the lifetime of components is also less than in mid- or heavy-duty elevators. Proactive maintenance and frequent maintenance with active component changes is highly important in extra heavy-duty elevators.

To understand this changes in lifetimes according to duties by components, ask your KONE representative for the public transportation segments for design lifetime and spare parts data.

4.4 Layouts and dimensions

Most of the layout and dimension information for public transportation elevator shafts and cars is available in the following Planning Guides:

- People Flow Planning Guide for Transit Centres (ID 7172)
- KONE MonoSpace® Planning Guide (PG-01.01.001)
- KONE MonoSpace® Special Planning Guide (PG-01.06.001)
- KONE TranSys™ Planning Guide (PG-01.12.001)
- KONE MiniSpace™ Planning Guide for Europe (PG-01.03.001-EUR)
- KONE MiniSpace™ Planning Guide for Asia-Pacific (PG-01.03.001-AP)
- KONE MiniSpace™ Planning Guide for China (PG-01.03.001-ELK)
- KONE MiniSpace™ Planning Guide for North America (PG-01.03.001-NA)
- KONE Scenic Elevators Planning Guide (PG-01.09.001).

Where the building requirements deviate from the specifications in the above guides, please contact your local KONE representative for more information. KONE Major Projects is excellent partner in challenging public transportation projects. KONE can provide solutions meeting the public transportation needs for heavy-duty elevators. They typically involve issues such as wider than normal elevator cars, more space for the elevator shafts and deeper pits. Often there is also a need to install an elevator outdoors in a self-standing elevator shaft. See section 4.4.2.

4.4.1 Layout drawings

KONE provides elevator layout drawings for the tender and supply phases of public transportation projects. For more information about the layouts, please contact your local KONE representative.

4.4.2 KONE steel shaft pack

KONE has a solution for designing self-standing elevator shafts that can be installed outdoors. Shaft walls can be made of steel or glass. KONE can deliver the steel shaft drawings to the builder and also deliver the whole construction through a 3rd party supplier based on the KONE drawings. For more information, please contact your local KONE representative.

Figure 3. Self-standing steel shaft

4.5 Maintenance of heavy- or extra heavy-duty elevators

KONE develops a unique maintenance plan for each piece of equipment. Maintenance is performed for each technical module of the equipment at the correct intervals. This ensures quality and end-user safety, and minimises equipment downtime. KONE Modular Based Maintenance meets all relevant regulations and standards.

The proactive maintenance system of KONE is based on high-tech remote monitoring. This means predicting when components will break down and replacing them before they become a problem. Routine maintenance is taken care of during off-times when it will not disturb passengers.

Proactive maintenance is particularly important for public transportation elevators in heavy- or extra heavy-duty, meaning constant use. As the number of starts per year increases, the lifetime of ropes, bearings and other wearing components decreases. KONE has made calculations of the wear of components and creates a proactive component replacement program for each elevator designed for heavy-duty use.

For more information about proactive maintenance, please contact your local KONE representative.

4.5.1 Lifetime

The lifetime designed for a product sets the foundation for quality and reliability targets. It is extremely important that the designed lifetime matches with the intended market conditions and is aligned with corresponding KONE products, solutions and processes. The designed lifetime naturally includes activities that are planned, such as regular maintenance (Modular Based Maintenance).

Setting lifetime requirements is an optimisation task with multiple variables. Duty is one of the key variables in defining lifetime. Duty is considered in this context as a combination of technical stress (forces) and how much the component is exposed to the stress.

In heavy- and extra heavy-duty elevators component lifetime in years is smaller compared to low or mid duty due to the heavy usage. The actual lifetime in kilometres is exactly the same as in mid-duty ropes for example, but because of more frequent usage of the elevator, the lifetime in years is less in heavy- or extra heavy-duty elevators. Longer elevator lifetime can of course be handled with proper maintenance and proactive component replacement in all duty classes elevators.

5 Choice of car interior component materials

Codes regulating the elevator industry pose limitations on the car design and the choice of car interior components. Details are determined by the codes to be complied with. Note that sometimes the codes may have contradictory requirements, which means that not all of the requirements can be met.

Below is a summary of the requirements of the most common codes on public transportation elevator car design. To fully understand the code requirements, study the codes or contact your local KONE representative.

5.1 Accessibility code EN81-70

The EN81-70 standard specifies the minimum requirements for the safe and independent access and use of all elevator platforms. The standard takes into account people with disabilities, including people who use wheelchairs.

Table 1. Elevator car requirements for compliance with EN81-70 (information is not platform specific)

Feature	Requirements		
Elevator type	**Type 1** elevator accommodates one wheelchair user.	**Type 2** elevator accommodates one wheelchair user and an accompanying person.	**Type 3** elevator accommodates one wheelchair user and several other users. It also allows a wheelchair to be turned around in the car.
Minimum rated load	450 kg	630 kg	1275 kg
Minimum car dimensions	• Width: 1000 mm • Depth: 1250 mm	• Width: 1100 mm • Depth: 1400 mm	• Width: 2000 mm • Depth: 1400 mm
Minimum door clear opening	800 mm	900 mm	1100 mm
Door safety device	Curtain of light		
Announcements in car	Recorded human voice announcer		

Handrail	• Location: at least on the side wall opposite to the car operating panel (COP).
	• The handrail must have the following properties:
	  • Projecting ends closed and turned towards the wall
	  • Completely made with stainless steel to avoid allergic reactions and dust collection
	  • Easy to clean.		

Mirror	• Type: partial height (or full height, if used with EN81-70 compliant handrail) • Location: rear wall or the side wall opposite to the COP		
Fixings	Stainless steel[1]		
COP	• Location with centre opening doors: on the right hand side • Location with side opening doors: on the side towards which the door closes • Placement: the distance between the buttons and the front wall is 400 mm • Double COP: not available		
Push buttons	• Buttons with accessibility function • Exit floor button: with a high green collar • Alarm button: with a high yellow collar		
Landing signalisation	• Hall lantern[2] • Visible and audible feedback signal when pushing the landing call button • The visible feedback signal (call registered light) must be a halo ring around the button. • The volume of the audible feedback signal must be 35 – 65 dB(A) and adjustable separately between the main floor and the other floors. • Audible feedback signal when pushing the landing call button even if the landing call is already registered		

1) Mirror and handrail fixings must be stainless steel to avoid allergic reactions and accumulation of dust.
2) For a single elevator, a visible and audible signaling device inside the car may be adequate, if the signaling can be noticed from the landing during the elevator arrival at landing.

5.2 Vandal code EN81-71

The EN81-71 vandal code defines how the elevator must be protected from possible vandal attacks and how it must perform after such attacks. Examples of vandalism against which the public transportation elevators have to be protected are crushing, cutting, human behavior, shearing and trapping. Typical items that may be used by vandals are keychain, walking stick, wire, cigarette lighter, pen, chewing gum
and pocket knife.

To protect the elevator against acts of vandalism, the car, car doors, landing doors and signalisation must be made with vandal-resistant components. A position indicator in the car (car operating panel) and on the main floor landing is mandatory.

EN81-71 defines two distinct categories of vandal protection: category 1 and category 2. They are described below. Note that it is also up to the customer, local regulations, country regulations or area regulations as to which category is applicable. The vandal code specifies how the elevator must be designed technically but also how the elevator car interior and doors must be protected. If the airport or underground is fully controlled by cameras and manpower, different coding applies from that of a place not controlled at all.

Note: Elevators with EN81-1 and EN81-2 standards are classified as no vandal protection and always have a reasonable degree of protection.

Car design EN81-71 Category 1

EN81-71 Category 1 vandal-resistant elevators meet the requirements of EN81-1 or EN81-2 and fulfill supplementary requirements in order to protect the elevator from moderate acts of vandalism. Category 1 is suitable for elevators used by unobserved general public, for example in shopping centres, shopping centre car parks or some areas at airports where **light supervision of people exists** by cameras or security.

For compliance with EN81-71 Category 1 vandal-resistant requirements, the following issues must be considered:

- To handle vandal attacks, the car itself is strengthened compared to a standard car.
- Material selection is restricted to ensure that no vandal can damage the materials present in the car, for example with a screwdriver, knife or torch.
- All finishes are not easily scratched and can handle frequent cleaning.
- Materials in car and landing door panels, frames and/or architraves must be non-combustible. For decorative finishes, limited flammability must be attained. The wall panels must also be thicker than in standard elevator cars.
- Car ceilings must be able to support the mass of 150 kg at any point where a person(s) can suspend themselves. The fixing of the ceiling must be arranged so that unauthorised displacement is not possible for at least 60 seconds, either by hand or use of items.
- The flooring material of the car must be chosen so that limited flammability is attained. The fixing of the floor material must prevent a tripping hazard, especially in seam joints.
- Materials used in signalisation equipment must have limited flammability. For finishing, stainless steel must be used. Both car and landing controls must fulfill the water resistance requirements according to IPX3-rating.
- Stainless steel fixings, stainless steel handrails and standard glass or stainless steel mirrors are allowed.
- There are restrictions in handrails, but KONE has standard choices for handrails (contact your KONE representative).
- The lighting must have a minimum of 100 lux at floor level in all places.
- Buffer rails, walls, car operating panel (COP), landing call station (LCS), doors, windows, mirrors, ceiling etc. must be attached in such a way that they are not removable or are removable only with special tools.
- No wood may be present in any of the structures including the strengthening structures not visible to the passenger.
- Doors must be protected and strengthened. KONE has offering for vandal code doors.

To fully understand the vandal code requirements, please study the text of the code itself.

For an example car interior template with a list of KONE standard materials, contact your local KONE representative. Both solid and window car templates are available.

Car design EN81-71 Category 2

EN81-71 Category 2 vandal-resistant elevators are designed for protection against severe acts of vandalism in uncontrolled environments. Examples are subways and airport car parks in areas with **no frequent supervision** to prevent vandalism.

For compliance with EN81-71 Category 2 vandal-resistant requirements, issues such as the following must be considered:

- To handle vandal attacks, the car itself is heavily strengthened compared to a standard car.
- Material selection is restricted to ensure that no vandal can damage the materials present in the car for example with a screwdriver, knife, torch or side cutters.
- All finishes are not easily scratched and can handle frequent cleaning.
- Walls and floor must prevent corrosion damage caused by cleaning solvents.
- Mirrors are not available by code.
- Ceiling must be a special vandal code type ceiling preventing people from suspending themselves. See KONE offering for choices or contact KONE representative for the possibility to have a unique appearance.
- Lighting must be a minimum of 100 lux at floor level.
- Signalisation as a vandal protective upgrade: see KONE's choice for Category 2 signalisations
- Buffer rails, walls, car operating panel (COP), landing call station (LCS), doors, windows, mirrors, ceiling etc. must be fixed in such a way that the fixings are not visible and none of the materials are removable. For example, the LCS must be attached to the wall from the shaft side.
- Standard **key holes** are not allowed due to the possibility of chewing gum being inserted and other vandalism.
- No wood may be present in any of the structures.
- Doors must take a heavy beating and have sufficient safety factors against vandals. Doors' maintenance access are also protected with a special opening device to protect the doors from vandalism. The KONE door offering has doors and options for them to comply with vandal code EN81-71 Category 2.

To fully understand the vandal code requirements, please study the text of the code itself.

For an example car interior template with a list of KONE standard materials and for vandal code Category 2 applicable signalisation, contact your local KONE representative. Both solid and window car templates are available.

For situations where the codes contradict one other, see section 5.4.

5.3 Fire-fighter code EN81-72

The EN81-72 compliant elevator is provided with additional fire protection. It has additional controls and signals, and the elevator car has a special structure. Therefore it can be used under the direct control of the fire service, in the event of fire.

The EN81-72 safety code only covers the requirements related to elevator installation. It does not describe the requirements for the fire-resistant building structure that is essential for building a fire protected lobby.

Table 2. Elevator installation requirements for compliance with EN81-72

Feature	Requirements
Building	• Each landing entrance used for fire fighting purposes has a fire protected lobby. • The source of the secondary power supply is located in a fire protected area. • The primary and secondary electrical power supply cables of the fire fighting elevator are fire protected and separated from each other.
Fire-fighting elevator	• The elevator serves every floor of the building. The source of the secondary power supply is located in a fire protected area. • The elevator rated load with standard car sizes is 630 kg or more. • Dual entrance cars are not allowed. • The elevator reaches the furthest floor from the fire service access level within 60 seconds.
Safety	• Landing control devices and indicator continue to function in an ambient temperature up to 65 °C. • All electrical equipment in the elevator shaft and on the car located within 1 m of any landing door is protected with an enclosure that fulfils at least the requirements of IPX3. • All electrical equipment located less than 1 m above the elevator pit floor is IP67 protected. Sockets, switches and the lowest lamp is located at least 0.5 m above the highest permissible water level in the pit. • Water level in pit must be controlled to stay below the level of fully compressed car buffers. • Also, the water level is not allowed to reach equipment that could cause an elevator malfunction.
Fire fighter rescue from the elevator car	• The roof of the elevator car has an emergency trap door with minimum measurements of 0.4 × 0.5 m for 630 kg elevators and 0.5 × 0.7 m for larger elevators. • A ladder and a safe access route to the elevator car roof is available from every landing door. • Adequate stepping points and clear identification of the trap door release point is available inside the elevator car.
Control system	• The switch of the fire fighting elevator is located in the lobby that is intended as the service access level for fire fighters. The switch is marked with a fire fighting elevator pictogram. • Phase 1 and 2 operation of the fire fighting elevator are in accordance with the norm description (SW).
Power supply	• The power supply system consists of the primary and secondary power supply. • The secondary power supply is sufficient to run the fire fighting elevator at the rated load. • Change over of electrical supplies causes a correction drive if the car is between floors.
Car and landing controls	• The car and landing controls do not register false signals caused by heat, smoke or moisture. • The car and landing controls and the landing indicator are protected to fulfil at least the requirements of IPX3. • In addition to the normal floor level markings inside the elevator car, the fire service access level is clearly marked on or adjacent to the car call button that takes the car to the fire access level. The marking for the fire access level is the fire fighting elevator pictogram.
Fire service communication system	• The fire fighting elevator has an intercom system for interactive two way speech communication between the fire fighting elevator car, fire access level and the MAP.

To fully understand the fire-fighter code requirements, please study the text of the code itself.

For situations where the codes contradict one other, see section 5.4.

5.4 Code contradictions

On rare occasions the codes contradict with each other as described below. The accessibility code does not cause problems with either of the other two codes. With accessibility code compliance, KONE needs to know which type of the EN81-70 you are aiming to fulfill, in regard to demands on the car size. For more information see section 5.1.

There are no contradictions with code combination of vandal code EN81-71 Category 1, accessibility code EN81-70 and fire-fighter code EN81-72. For KONE standard options for this combination contact your KONE representative for car and signalisation templates, available materials and additional information.

Vandal code EN81-71 Category 2 forbids:

The vandal code EN81-71 Category 2 forbids any keyholes into which a vandal could stick something or unlock the lock. Locks as such are allowed, but keyholes not.

Another problem is that for the fire-fighter code EN81-72 a trap door is needed and the fire-fighter must open the trap door from inside the car with a key, but the vandal code EN81-71 Category 2 forbids trap door locking from inside the car. The same problem is valid for the storage of a fire-fighter's ladder in the car.

Fire fighter code EN81-72 requires:

The fire-fighter code EN81-72 requires the following features forbidden by the vandal code EN81-71 Category 2:

- Key switch for COP.
- Storage of fire-fighter's ladder inside the car. The problem is how to lock the ladder as no keyholes are accepted.
- Opening of trap door from inside the car. This is hard to implement due to the vandal Category 2 keyhole restrictions.

For an example car interior template with a list of KONE standard materials for code combination EN81-70, EN81-72 and EN81-71 Category 1 (notes with EN81-71 Category 2), contact your local KONE representative.

5.5 KONE standard offering for car design items complying with codes

As not all countries need to apply a vandal code, compliance with EN81-71 may not be necessary. In such a case the car design can be selected from the whole KONE offering.

For easier car interior planning, KONE provides information about car design materials and components that have been checked for compliance with the code requirements discussed above.

Ask your local KONE representative to provide a set of example car design templates to assist in planning elevators that comply with the vandal codes. These templates cover both vandal code EN81-71 Category 1 and 2 with solid and window cars. Also example car templates are available for combination of accessibility code EN81-70, fire-fighter code EN81-72 and vandal code EN81-71 Category 1 with clarifications on the contradictions to vandal code Category 2.

5.6 Custom design offering

It is possible to choose the car interior components and materials quite freely from the KONE offering or to create custom designs, but code issues must always be studied carefully for each case.

5.7 Material and component samples

It is possible to acquire samples of materials or components to be used in the elevator. Examples of material samples are:

- Stainless steel
- Titanium nickel
- Plastic laminate
- Stone
- Wood
- Glass

Component samples are for example:

- Hand railings
- Light fitting
- Signalisation items.

5.8 Mock-up build

KONE can manufacture a mock-up of a customised car for customer approval before the final design and delivery. There are two kinds of mock-ups. There is a quality mock-up, when the car interior is checked but there is no time reserved to change the design. This check generally extends the delivery time by a few weeks. This check-up is to verify the quality of the cars and components. The second type of mock-up is when the car is built with all its final components, but the customer can change the design. This increases the delivery time estimated from 12 weeks up depending if the the design is changed, the materials are changed, whether the materials are hard to acquire etc.

For a specific case contact your KONE local representative for an estimate. Other parts and fixtures can also be mocked-up. The mock-ups are created as early as possible to ensure enough time for the engineering and manufacturing phases.

There is a standardised process for the mock-up build. The process includes the following phases:

- Mock-up design with a solution proposal (car drawings, visual renderings, samples and information about the design benefits, costs and lead times)
- Purchasing and manufacturing
- Material management
- Building mock-up car
- Customer inspection and changes (if needed).

6. Monitoring software

A complete monitoring system transmits all operating data to a central monitoring point, so that any minor irregularities can be adjusted before they lead to downtime of the equipment. Monitoring enhances the security, maintenance and availability of installed vertical transportation systems. KONE products can be connected to OPC server-based with E-Link interface.

6.1 KONE E-link™

KONE E-link™ allows easier control of the elevator system and adds value for the building owner, facility manager and tenants:

- Monitoring the location and status of the elevators in real time locally and remotely
- Large building complex or geographically (even globally) remote building monitoring and managing from a single location
- Local and remote control of equipment with scheduled commands, such as mode changes and locking
- System alarms notifying of any problems in real time, allowing you to react to them without delay
- The monitoring data can be stored and used later to generate reports, or verify the use and availability of the monitored equipment
- You can control the elevators remotely, by changing the service mode of an individual elevator
- Other systems in the building can be integrated with KONE E-link™ to increase the automation level of the building
- KONE E-link™ can be configured to interface with non-KONE control systems as well as with older generation of KONE equipment
- You can access the KONE E-link™ system using workstations that are linked to a local area network
- History playback of elevator and escalator events for security and legal purposes
- Faster reaction to malfunctions, possible vandalism and troubleshooting
- Faster rescue of entrapped passengers
- Reduced operating costs
- Intuitive user interface
- Short learning curve even for an occasional user.

KONE E-link™ has standard interfaces to enable connections to elevators and external systems. KONE E-link™ connects to KONE elevators through a CAN or a serial bus using the KONE Monitoring protocol.

6.1.1 Architecture and operating principle

The KONE E-link™ system architecture is modular. It enables both a single site and multiple site installation. The well-defined communication interfaces allow elevators from both KONE and other manufacturers to be monitored within the same system.

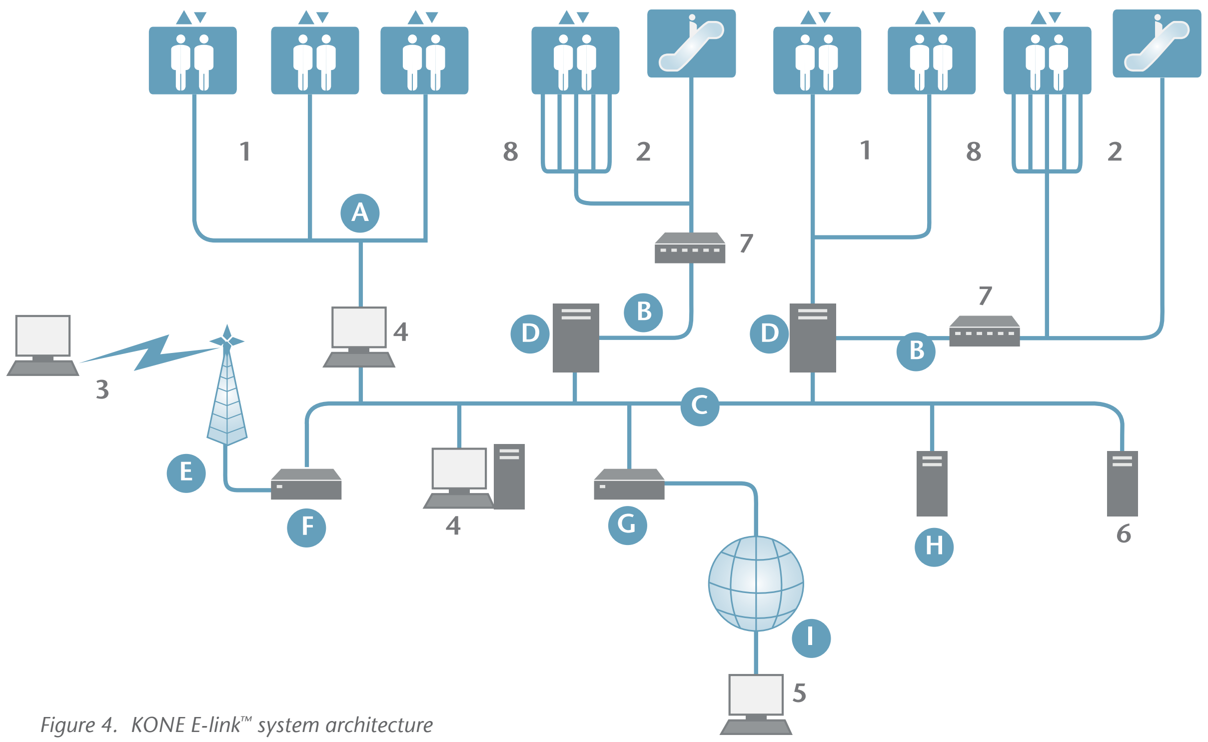


Figure 4. KONE E-link™ system architecture

A	CAN	1	KONE equipment
B	RS	2	Other manufacturer's equipment
C	LAN (ethernet)	3	Workstation with the KONE E-link™ GUI connected to the building LAN through WLAN for monitoring
D	KIC[1]	4	Any authorised workstation with the GUI in the building LAN for monitoring
E	WLAN	5	Workstation with the GUI connected to the remote access server through the Internet for monitoring
F	Firewall	6	Connection to the building management
G	Remote access server	7	Other elevator and escalator interface unit
H	Statistics server	8	Interface signals to other elevators and escalators
I	Internet		

Note: The workstations where the GUI clients are installed are not automatically provided with KONE E-link™. The workstations can be separately ordered using a specific order form.

Operating principle

The KONE interface controller (KIC[1]) receives operation data from the elevators, processes it into monitoring data and makes it available in the local area network. KONE elevators communicate with KIC using a controller area network (CAN) or a serial (RS) bus for communication. If other manufacturers' elevators are connected to the system, KIC detects certain signals from the elevators and creates monitoring data from them.

The monitoring data can be stored to a database for later use or delivered to other systems in the building through the OPC[2] interface. The other systems can also provide control commands to the elevators through the OPC interface. For example, the logistics control system can give calls to the elevators to meet the transportation needs.

The GUI client allows system users to view the monitoring data in real time through the KONE E-link™. The system can be monitored from a single location, such as the control room, from several locations, or even from remote sites. The workstations can be connected to the system either through the customer's network, or through external networks. In addition, remote monitoring over the Internet is enabled.

[1] KIC is an industrial workstation with a KONE-specific CAN-board and regular serial ports.

[2] OPC is open connectivity in industrial automation and the enterprise systems that support industry. Interoperability is assured through the creation and maintenance of open standards specifications.

6.2 OPC interface

An additional interface is provided to connect to other non-KONE manufacturers' elevators and escalators as well as to older generations of KONE control systems.

KONE E-link™ can provide the collected data to external systems through an OPC DAS 2.05A interface.

OPC stands for OLE for Process Control – "open connectivity via open standards". OPC is an interface standard in communication between industrial automation systems. OPC server software is used for connecting 3rd party systems to KONE E-link™.

The OPC interface can be used to integrate KONE E-link™ with other building management systems to increase automation in the building. The data can be sent to, for example:

- 3rd party GUI used to control other systems in the building
- Building management systems for creating a visual image of the elevators
- Passenger guidance or logistics systems to provide information about elevator position and status.

Note: Not all the corresponding features of KONE E-link™ can be obtained when used in conjunction with non-KONE equipment.

7. Elevator design tools

The online tools provided by KONE and located at www.kone.com help you browse different elevator solutions in the initial phase of the construction project and find the optimum solution quickly. This shortens the process in the later phases of the project.

7.1 Traffic planning

Determining the correct level and type of elevator service for the specific building is crucial. Insufficient handling capacity is difficult or impossible to correct later, and excessive handling capacity is expensive and wastes resources. Traffic planning tools help to determine the handling capacity, as well as define and model interaction among different transportation devices.

The KONE Quick Traffic calculation tool gives an architect or developer a quick initial estimate of the number of elevators needed in the project. Using Quick Traffic data, comparing different alternatives is very easy.

KONE Quick Traffic asks only a few basic questions and is then able to pinpoint the critical points within the building with regard to traffic flows. The tool can be used for planning People Flow™ systems with Conventional Control or Destination Control.

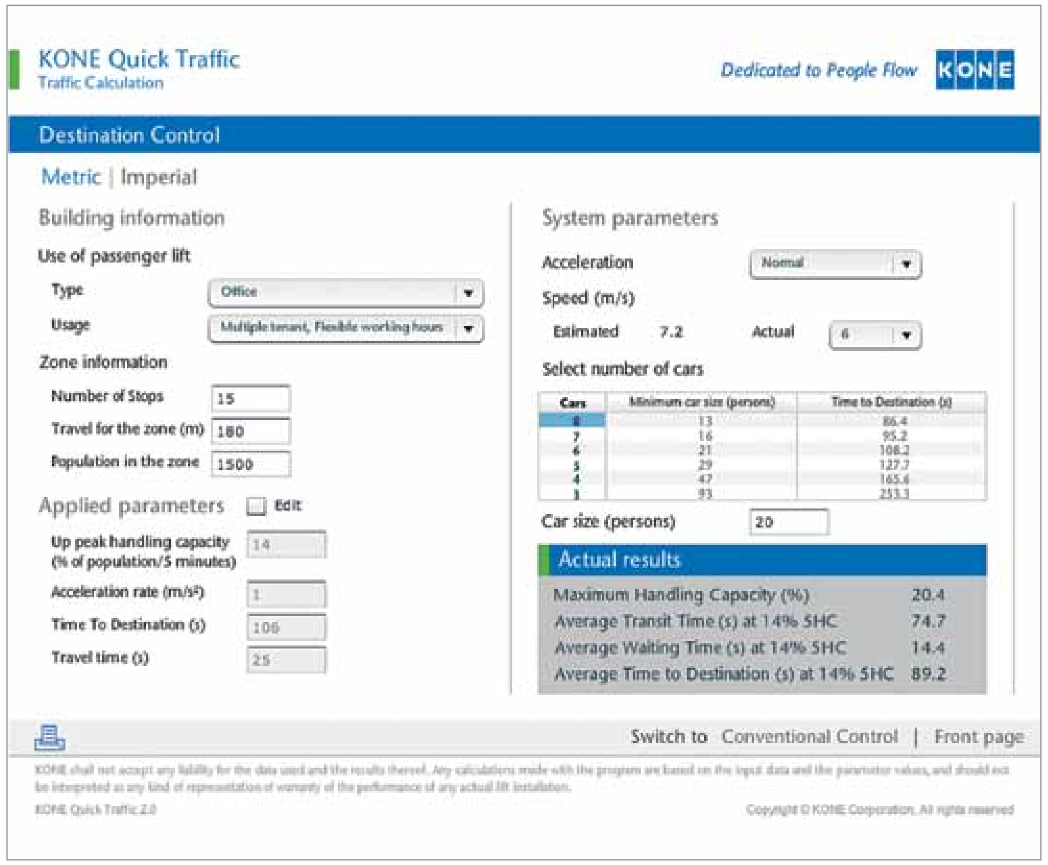


Figure 5. KONE Quick Traffic tool

7.2 Dimensioning

KONE provides design services and customised drawings for elevators and escalators. From the early stages, we can support you with detailed information and interface requirements.

With KONE dimensioning tools, it is possible to calculate and compare the space required by different elevator and escalator systems.

KONE Planulator™ is an advanced dimensioning tool. Featuring a full localisation process, the tool also considers geographical information: it is possible to choose for example between centimetres and inches, as well as among the different elevator codes.

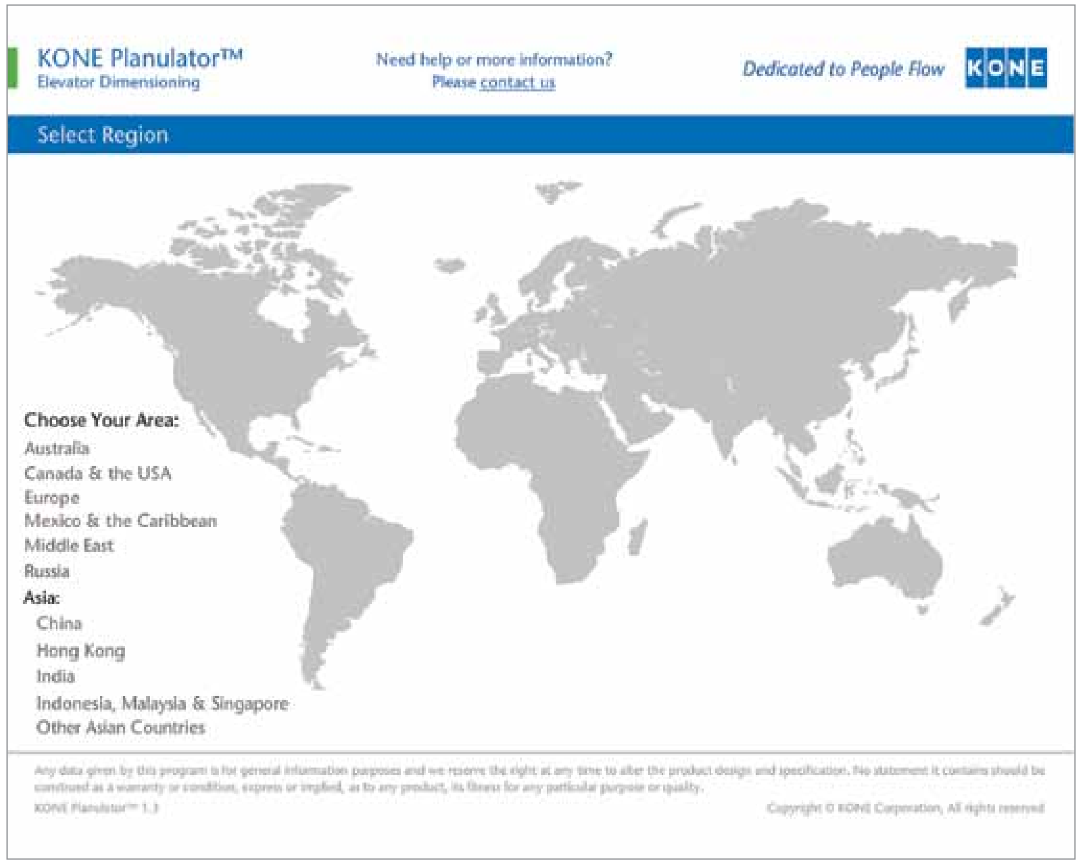


Figure 6. KONE Planulator™ tool

8. Further information

In addition to this guide, KONE can provide a lot of other useful material to support planning an efficient People Flow™ system for an airport or a transit centre. Please contact your local KONE representative to acquire of any of the following:

- Brochures (Solutions for Public Transportation, Airports and Transit centres)
- KONE Book of Solutions: Public Transportation
- General KONE information such as quality and environment issues, corporate responsibility report
- Maintenance guidelines
- People Flow and elevator platform Planning Guides (including layout and dimension information); for a list of Planning Guides, refer to section 4.4
- Layout and car interior templates designed for public transportation buildings and elevators
- Design tools such as KONE Quick Traffic calculation tool to give a quick initial estimate of the number of passenger elevators needed in the project and KONE Planulator™ dimensioning tool to quickly access and compare the space required by different elevator systems.

KONE also has a public transportation document package available. Please contact your local KONE representative to receive the document package, which contains the following information:

- Elevator technology basics
- KONE processes and design philosophy
- Reliability, Availability, Maintainability and Safety (RAMS) description
- Electrical information (Drives & Controller, EMC, IP classes)
- Certificates held by KONE
- Rescue procedures
- Lifetime and spare parts information for elevator components
- Material safety, including a list of restricted substances and a list of plastic parts in an elevator.

KONE provides innovative and eco-efficient solutions for elevators, escalators, doors, loading bays and access. We support our customers every step of the way; from design, manufacturing and installation to maintenance and modernisation. KONE is a global leader in helping our customers manage the smooth flow of people and goods throughout their buildings.

Our commitment to customers is present in all KONE solutions. This makes us a reliable partner throughout the life-cycle of the building. We challenge the conventional wisdom of the industry. We are fast, flexible, and we have a well-deserved reputation as a technology leader, with such innovations as KONE MonoSpace®, KONE MaxiSpace™, KONE InnoTrack™ and KONE UniDrive™. You can experience these innovations in architectural landmarks such as 30 St. Mary Axe and Broadgate and 201 Bishopsgate buildings, BAA Terminal 5, Emirates Stadium, Brunel University, Citigroup, Jubilee Line and St. Georges Wharf.

KONE employs approximately 35,000 dedicated experts to serve you globally and locally in 50 countries.

KONE plc

Head Office

KONE plc, Global House, Station Place,
Chertsey, Surrey KT16 9HW
sales.marketinguk@kone.com

Regional Offices

KONE plc, Unit 6, Elmwood, Chineham
Business Park, Basingstoke,
Hampshire RG24 8WG

KONE plc, Suite G7/G4, Duart House,
Finch Way, Strathclyde Business Park,
Bellshill, ML4 3PR

KONE plc, Worth Bridge Road, Keighley,
West Yorkshire BD21 4YA

KONE plc, 34 Bedford Road,
Clapham, London SW4 7HJ

KONE plc, 1000 Birchwood Boulevard,
Birchwood, Warrington,
Cheshire WA3 7QL

General Enquiries
Tel: 0845 1 999 999

www.kone.co.uk

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