



**Building Planning.**  
For a perfect people stream.



**Schindler**



# From the outline to the skyline. Your vision comes true.

In the high-rise elevator business, passenger comfort and safety always come first. The design of a building significantly influences the elevator system and its performance. Correct planning is essential to ensure the building's functionality, efficiency and longevity. With Schindler, through early engagement with our customers, this critical process is made easier all the way from the physical plot on which the building sits in the urban environment till the inside of the elevator hoistways.

Some of the key considerations during the building planning stage and topics that we aim to cover here are:

#### **Seismic / Earthquake**

#### **Building Sway**

#### **Chimney Effect**

#### **Piston Effect**

#### **Planning considerations**

Single- and double-deck elevators

#### **Planning parameters**

Single- and double-deck elevators

When we view the world's most impressive skylines, high-rise buildings appear to stand still, however this is rarely the case. Buildings often sway and move due to strong winds, temperature changes and even seismic activity. Schindler's advanced safety features aim to minimize the disturbance on the building and its occupants while ensuring safe transportation.

Intelligent building planning reduces and even eliminates the piston and chimney effects which can occur in inadequately designed hoistways and dramatically affect the elevator ride quality and passenger comfort.

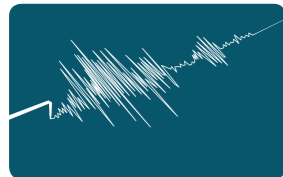
Schindler's pioneering traffic management simulation software allows the customer during the planning phase to understand our approach and to select the most efficient transportation solution, which guarantees a continuous stream of people and goods throughout the whole building.

# Intelligent all-round planning.

## For perfect traffic performances.

Major buildings in world cities rely on Schindler's proven technology for reliable performance. By combining the Schindler 7000 with our high-rise building expertise we already formulate in the planning phase the ideal solution for your needs.

### Seismic / Earthquake



An earthquake is the shaking of the surface of the earth, resulting from the sudden release of energy in the earth's lithosphere

that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities.

Earthquakes produces different types of seismic waves, which travel through rock with different velocities:

- Longitudinal P-waves (shock- or pressure waves)
- Transverse S-waves (both body waves)
- Surface waves (Rayleigh and Love waves)

In the earth's interior, the shock- or P-waves travel much faster than the S-waves. S-waves and later arriving surface waves do main damage compared to P-waves. P-wave squeezes and expands material in the same direction it is traveling. S-wave shakes the ground up and down and back and forth.

Supported by the ongoing urbanization, more and more buildings and even entire cities are being built on regions at risk from earthquakes. Therefore, not only the building itself, but also the elevator system running within building needs to cope and to be designed to withstand with this natural caused hazard.

Schindler 7000 fulfills all international codes (such as EN81-77 and A17.1 enforcing seismic risk zones or IBC/NBCC approach) specifying seismic requirement towards the elevator system. The applied seismic detection system does detect the earlier arriving P-waves and activates the seismic control feature. The control sends the cars to the next landing floor and opens the door to release passengers. Passengers and elevator installations are protected as best as possible from the effects of an earthquake.

#### The countermeasures

##### Machine room:

- Elevator components, e.g. control cabinets, hoisting motor etc., is secured in their position so that they cannot be shifted or tilted by acceleration forces
- Rope retaining guards are avoid rope crossing or other rope damage

##### Hoistway:

- Elevator components, e.g. compensation rope tension devise, buffers, etc. are secured in their position so that they cannot be shifted or tilted by acceleration forces
- Rope retaining guards are provided
- Protection against entanglement of ropes

##### Car and counterweight:

- Various construction measures
- Counterweight displacement switch

### Building sway



The high-visibility buildings of today's world cities appear to stand still. But tall buildings can move. Building sway has to be considered for structures higher than 250 m and for slim towers of more than 150 m. Depending on the shape and construction

type, most high-rises move laterally. Turbulence created in skyscraper canyons may even be strong enough to generate twist along the entire height. When they sway, observation towers mostly move in circles.

Building sway is caused by:

#### Wind loads

Wind loads, forces that act horizontally on structures causing buildings to sway, are the most typical reason for building sway. Imbalances in the pressure distribution on a building's surface may even result in twisting motion, and wind passing around a building may generate swirling whirlpools resulting in sway and twist. Tall buildings are designed for a certain amount of lateral loading and sway.

#### Ambient conditions

Temperature differences because of partial sun exposure may cause buildings to deform. Sun exposed sides of buildings get warmer than shady sides and elongation of building material may cause structures to bend.

Temperature differences between hot summers and cold winters may have an influence on the height of the building. In winter, the building may be shorter than in summer. In comparison to wind loads, structural deformation caused by ambient conditions is almost static.

The building experiences no measurable frequency and usually the deformation is smaller compared to heavy wind load deflections.

#### Earthquakes

Earthquakes may have the biggest impact on building sway. High potential seismic risk zones are governed by special building codes and elevator codes considering the risks of earthquakes.

#### Impact on elevators

Building sway has to be considered for structures higher than 250 m and for slim towers of more than 150 m.

The swinging frequency of the building may coincide with the inherent amplitude of suspension ropes, compensation ropes, governor ropes and traveling cables and result in resonance. Frequency analysis show whether further measures have to be taken.

Bending and deformation of hoistways may have an impact on the mechanical components of the elevator.

In addition to that, the following statements can be considered:

- When the building starts to sway, Schindler 7000 controls, connected to a sway detector, activates special features
- The travel speed will be reduced accordingly
- High sway will send the elevator to the evacuation floor. There, it will be emptied and placed in its parking position
- For medium and low sway, the elevator does not park at floors if the rope length or traveling cables correspond to their wavelength
- Schindler 7000 cars, counterweights and brackets are designed for all seismic applications

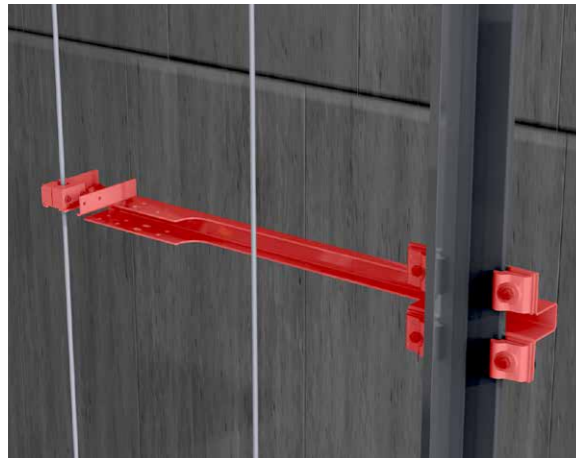
The oscillation of a high-rise building affects the performance and safety of its elevators. For this reason, Schindler pays serious attention to this potential hazard and proposes measures to reduce the impact of building sway on the elevator system, thereby increasing its safety and operational availability.

# Building sway. Countermeasures.



## 1 Traveling Cable Protection

The travelling cable is fixed at mid-height and guided in the bottom half of the hoistway.



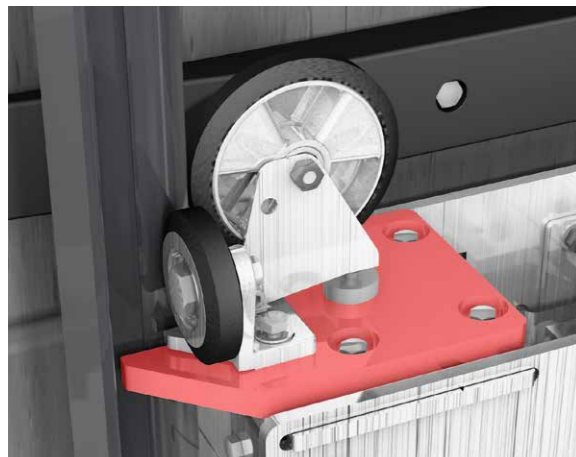
## 2 Governor Rope Guide

The passive side of the governor rope for the car and counterweight is specially guided along the hoistway.



## 3 Rope Protection with Intermediate Tie-Brakes

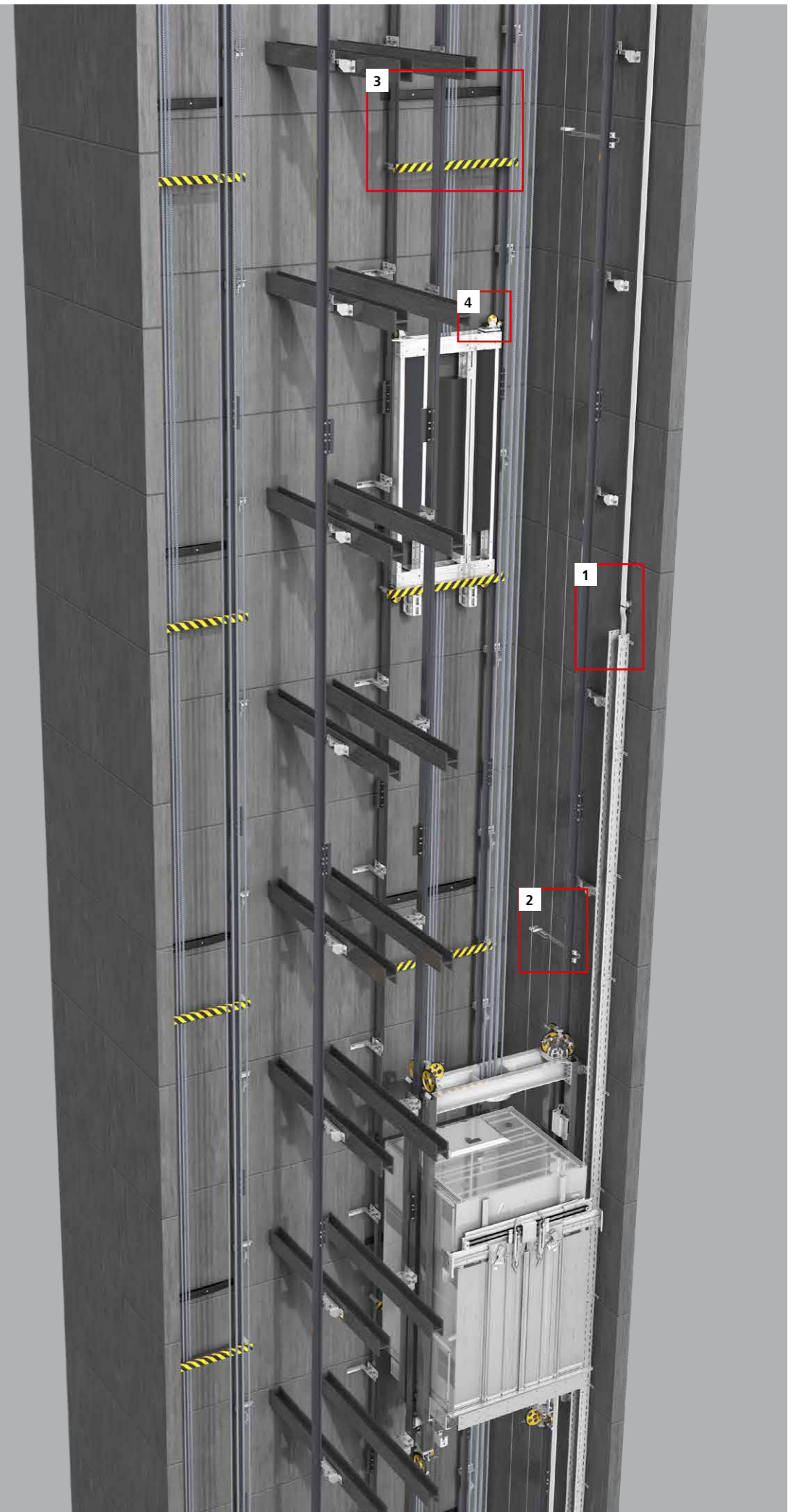
A special rope protection prevents the ropes from striking the rough surface of the hoistway rear wall. Intermediate tie brackets located between the car and the counterweight shall be provided to prevent counterweight suspension- and compensation-ropes from hitting the car.



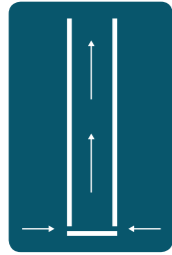
## 4 Counterweight Retainer Plates

Retainer plates prevent the counterweight from derailment if excessive force is applied to the guide.

The proposed mechanical measures by Schindler.



### Chimney effect



The chimney effect means the vertical movement of air in the hoistway caused by atmospheric conditions. It is a natural phenomenon, driven by different factors:

- Air flow from the parking garage and from the lobby entrance through the elevators

hoistway up to the top of the building. There it escapes via the air ducts and the door of the machine room.

- Air flow from the main lobby with its large entrance door
- Existence and height of vertical pathways for air transfer within buildings
- Internal and external temperature differences

#### The countermeasures

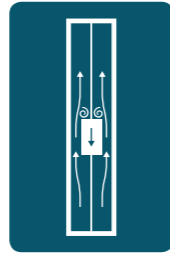
In principle, hoistways shall be separated from the rest of the building by following measures:

- Hoistways shall be completely within the core and constructed of reinforced concrete
- Loading / unloading areas shall be airtight by means of interlockable access doors
- Lobby entrance shall be equipped with revolving doors
- Upper elevator lobbies shall be separated from the rest of the floor, e.g. gates or air locks
- Machine rooms shall be separated from the rest of the building

The chimney effect can severely impair the operation of a building. To avoid such issues, our engineers provide skilled support in the building design phase.

Basically, the key to success is correct architecture and layout.

### Piston effect



An elevator car traveling in a single hoistway can be compared to a piston moving in a cylinder. When an elevator travels at high speed in a narrow hoistway, the air ahead of the car is compressed and flows around the car. The main issue is, that there

is no 'piston sealing' between car and hoistway. Either up or down ride, the pressure difference between front and rear therefore accelerates the air to the back of the car. This may result in additional noise and ear pressure.

Schindler takes account of the piston effect and proposes countermeasures to ensure the required comfort levels.

#### The countermeasures

- Sealing the elevator car doors reduces the noise, so turbulence is radically reduced
- Specially applied sealing on the door-frame eliminates the vibrations from the landing door-panels and unpleasant noise
- Air vents in hoistway walls help balance uneven pressure between parallel elevator hoistways
- When two elevators in a dual hoistway descend simultaneously – especially in parallel – the piston effect is emphasized by even more air pressure ahead of the car. Schindler's highly-developed elevator control system avoids this situation: The cars are not allowed to travel at the same time in the same direction



# Schindler 7000 planning considerations.

## Single-deck elevators.

EN81-20/50:2014 / EN81-1:1998+A3:2009

### Overall

- Hoistway width and depth dimensions are based on clear dimensions with horizontal building tolerances:
  - travel height  $\leq 180$  m:  $\pm 25$  mm
  - travel height  $> 180$  m and  $\leq 250$  m:  $\pm 45$  mm
  - travel height  $> 250$  m and  $\leq 500$  m:  $\pm 65$  mm
- Structural car height: 2200 mm - 3600 mm
- Indicated hoistway and machine room sizes are standard sizes without safety gear on counterweight
- Indicated car sizes are based on ISO. For different sizes, please contact our local sales office
- Roping: for speeds from 2.5 m/s - 4.0 m/s = 2:1, for speeds 2.5 m/s - 10.0 m/s = 1:1
- All given information is for general reference and planning. For special construction and code regulation details, please contact our local sales office
- Calculation contain energy recuperating converters only and permanent magnet technology machines where possible

### Overhead clearance and pit depth

- The overhead clearance is based on the structural car height
- For smaller overhead clearance and pit depth, please contact our local sales office

### Power supply

- Power supply wiring for lighting: single phase, neutral, earth (to be in accordance with national code requirements)
- Power supply wiring for ACVWF drive: 3-phase, neutral, earth or 3-phase, earth (to be in accordance with national code requirements)
- Main frequency 50Hz or 60Hz

### Heat dissipation in hoistway and machine room

- Our equipment is designed to withstand a temperature range of 5 to 40 degrees Celsius
- For the service personal, the machine room and hoistway temperature should be kept within the range of 5 and 35 degrees Celsius
- The humidity in the machine room should not exceed 95% and not condensing













# Schindler 7000 planning considerations.

## Double-deck elevators.

### EN81-20/50:2014 / EN81-1:1998+A3:2009

#### Overall

- Prerequisites
  - The lower deck does not serve the highest floor level
  - The upper deck does not serve the lowest floor level
- Hoistway width and depth dimensions are based on clear dimensions with horizontal building tolerances:
  - travel height  $\leq 180$  m: +/- 25 mm
  - travel height  $> 180$  m and  $\leq 250$  m: +/- 45 mm
  - travel height  $> 250$  m and  $\leq 500$  m: +/- 65 mm
- Structural car height: 2200 mm - 3600 mm
- Vertical distance between the two decks [HEDD]:
  - HEDD min.: 2943 mm
  - HEDD max.: 6000 mm
  - HEDD min.: is depending on the car configuration
- Indicated hoistway and machine room sizes are standard sizes without safety gear on counterweight
- Indicated car sizes are based on ISO. For different sizes, please contact our local sales office
- Roping: for speeds from 2.5 m/s - 4.0 m/s = 2:1, for speeds 2.5 m/s - 10.0 m/s = 1:1
- All given information is for general reference and planning. For special construction and code regulation details, please contact our local sales office
- Calculation contain energy recuperating converters only and permanent magnet technology machines where possible

#### Overhead clearance and pit depth

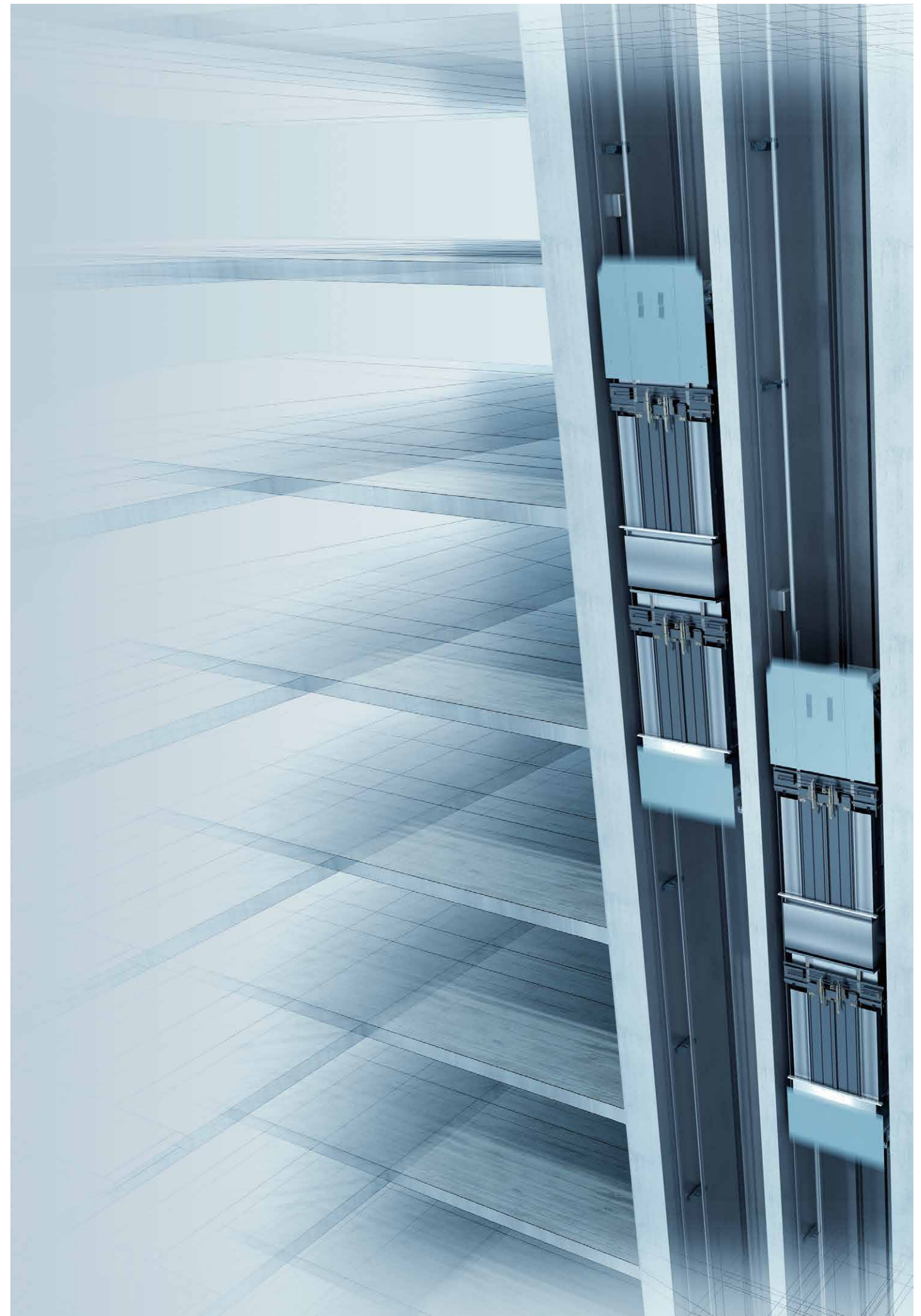
- The overhead clearance is based on a structural car height of 3000 mm
- For smaller overhead clearance and pit depth, please contact our local sales office

#### Power supply

- Power supply wiring for lighting: single phase, neutral, earth (to be in accordance with national code requirements)
- Power supply wiring for ACVWF drive: 3-phase, neutral, earth or 3-phase, earth (to be in accordance with national code requirements)
- Main frequency 50 Hz or 60 Hz

#### Heat dissipation in hoistway and machine room

- Our equipment is designed to withstand a temperature range of 5 to 40 degrees Celsius
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- The humidity in the machine room should not exceed 95% and not condensing



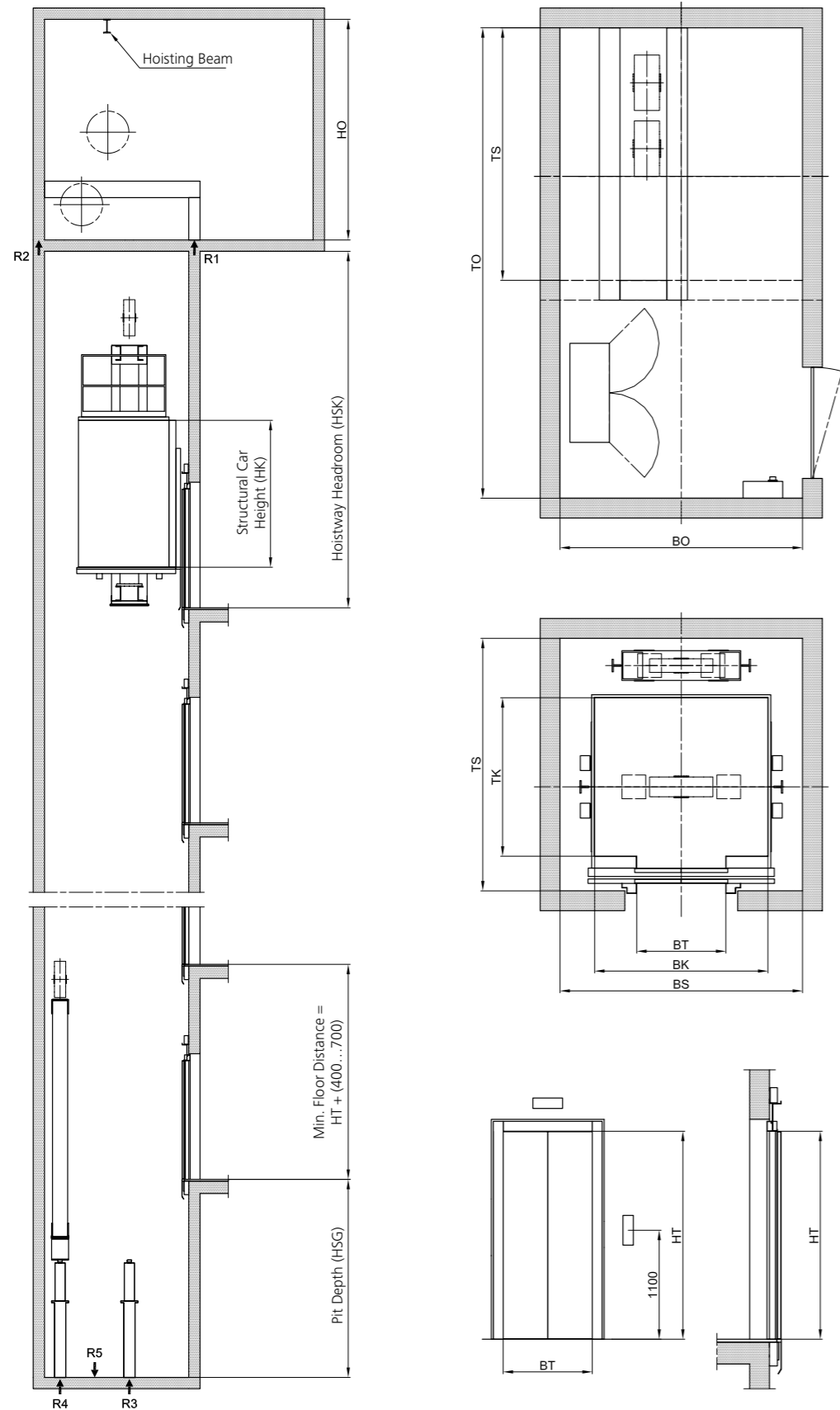




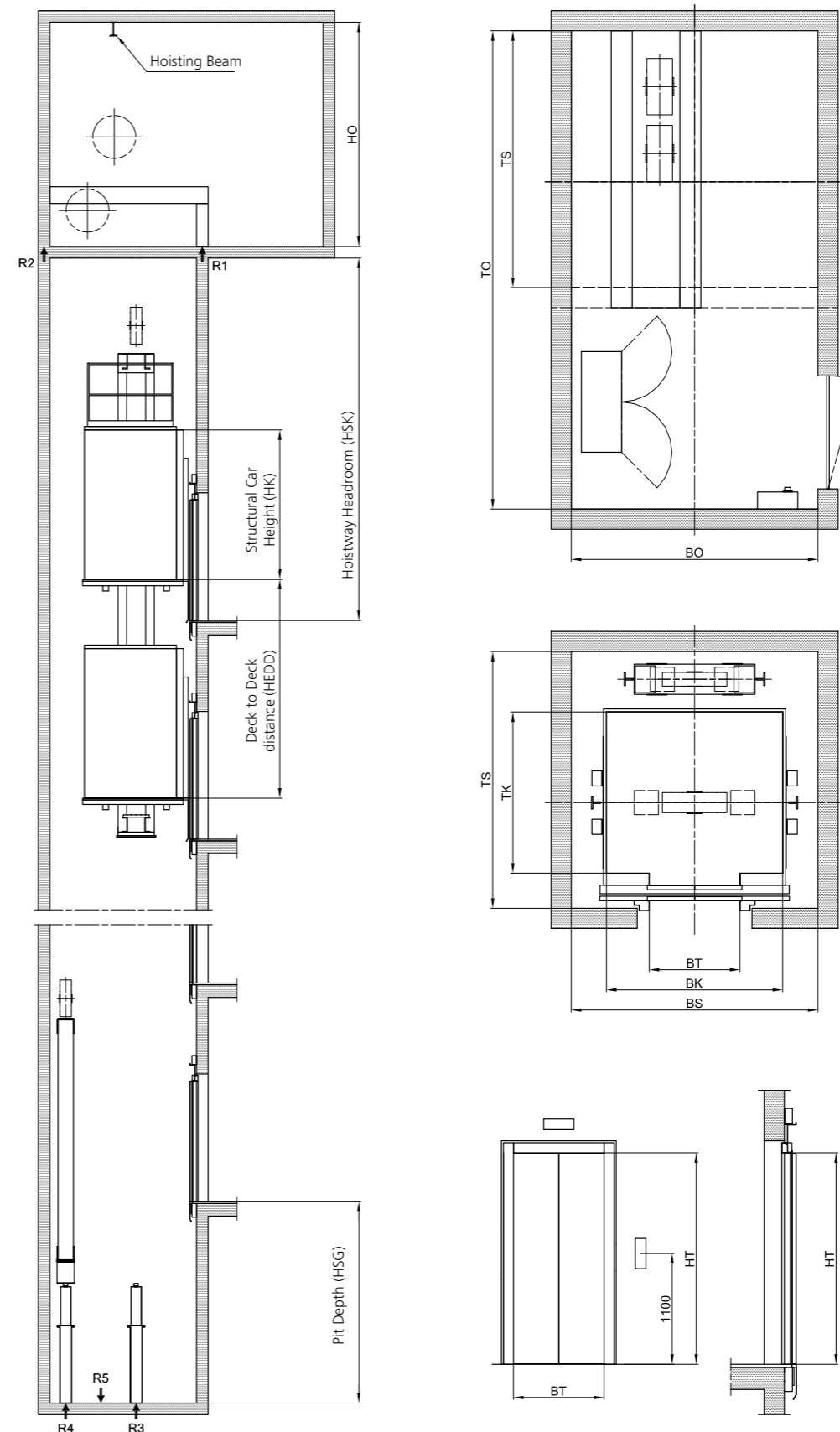
# Schindler Planning Parameters.

## Hoistway and machine room layout.

### Single-deck elevators



### Double-deck elevators



- BK** Clear car width
- BO** Width of machine room
- BS** Hoistway width
- BT** Clear width of landing door
- GQ** Rated load
- HEDD** Distance entrance to entrance on double-deck cars
- HK** Car height
- HO** Height of machine room
- HSG** Depth of hoistway pit
- HSK** Hoistway headroom (top floor to ceiling)
- HT** Clear height of landing door
- TK** Clear car depth
- TO** Depth of machine room
- TS** Depth of hoistway

**Disclaimer**  
The planning parameters are indicative only and subject to change without prior notification.

# Schindler 7000.

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