

ENGINEERING REFERENCE / 2026

Betis ELEVATORS AND ESCALATORS

The Engineers' Guide

Betis Elevator Engineering Reference

Plan with Precision. Build with Confidence.

- Shaft, car and door dimensions
- Pit depth and overhead
- MR and MRL drawings
- Common installation mistakes

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13 engineering topics

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From shaft preparation to manufacturing approval.

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Using this guide

Dimensions are in millimetres unless another unit is stated. Read every table with its conditions and notes. Final construction dimensions require the approved project shop drawing.

01 Purpose and scope

This guide provides a planning reference for site engineers, consultants and contractors preparing a lift shaft before manufacturing and installation. It brings together the civil and mechanical requirements used by Betis for residential, commercial and existing-building projects in Basra and across Iraq.

Approval of final dimensions

All dimensions in this guide are indicative planning values. Manufacturing dimensions are approved only after a detailed site survey, measurement verification and approval of the Shop Drawing by the Betis Engineering Department, with project-specific load calculations, clearances and safety requirements documented.

This guide states Betis planning and preparation requirements. The approved shop drawing, lift calculations, component data and mandatory project safety requirements remain the basis for manufacturing and installation.

02 Essential technical terms

Shaft / Hoistway	The vertical structural space in which the car and counterweight travel.
Pit	The vertical distance from the finished floor at the lowest landing to the pit floor.
Overhead	The distance from the finished floor at the highest landing to the underside of the shaft roof, accounting for any lower beams or obstructions.
Counterweight	A mass that balances the car and a proportion of rated load to reduce traction demand. Half the rated load is used in some Betis designs; the balance ratio and actual counterweight mass are established by calculation.
Static load on the machine	The loads acting on the machine and shaft depend on suspension, rope routing and support reactions. Car, counterweight, ropes and rated load contribute; a single addition formula does not cover every 1:1 and 2:1 arrangement.
MR — Machine Room	A lift whose machine and controller are installed in a dedicated room separate from the shaft, in accordance with the approved shop drawing.
MRL — Machine-Room-Less	A lift whose machine is installed inside the shaft, without a separate rooftop machine room.

03 Counterweight position and car dimension formulae

Betis uses the following formulae for the initial planning of **single-entrance** lifts. Measure the internal clear shaft dimensions after allowing for finishes and checking the narrowest point over the full shaft height. **All formula values are in centimetres.**

1. Rear counterweight

Clear car width = clear shaft width − 40 cm

Planning allowance for rails, frame and clearances on both sides.

Clear car depth = clear shaft depth − 60 cm

Planning allowance for the rear counterweight and the front door assemblies and sills.

2. Side counterweight

Clear car width = clear shaft width − (65–70 cm)

Allows for the side counterweight, rails, frame and clearances.

Clear car depth = clear shaft depth − (30–35 cm)

Planning allowance for the door assembly, sills and related clearances. Betis selects the deduction within the range to suit the equipment.

When can car depth increase?

- **Open frontage:** approximately 10–12 cm may be recovered with an approved landing-door and sill position.
- **Manual / semi-automatic landing door:** mounting its frame on the outside shaft face may recover approximately 10 cm. Selecting a manual door alone does not guarantee extra depth.

The shop drawing establishes the actual gain. Do not automatically add both gains together or add a gain already included in the door position.

Lifts with more than one entrance

For two or more entrances, whether opposite or adjacent, contact Betis for a dedicated drawing defining the car dimensions, door positions, counterweight and clearances. Do not apply the single-entrance formulae directly to these arrangements.

These are initial planning formulae. Manufacturing dimensions require review of the equipment, clearances and permitted area for the rated load, followed by shop-drawing approval.

04 Open-front shaft arrangement

Some projects leave the shaft front open during civil works, then install the approved door frontage and enclosure instead of building a wall with a separate opening at each landing.

Potential space recovery

Positioning the landing door and sill at the slab edge may recover part of the front-wall thickness. Betis estimates an additional **10–12 cm of car depth** in some arrangements. The actual gain must be established in the drawing; it is not guaranteed for every shaft.

When is this arrangement considered?

1. **Narrow shafts:** to make effective use of existing-building space.
2. **Centre-opening doors:** to coordinate panel retraction and frame fixing.
3. **Steel and panoramic structures:** to coordinate fixings with the architectural frontage.
4. **Vertical alignment:** to align landing doors and reduce opening errors between floors.

Closing the frontage and completing finishes

Where an open-front shaft is approved, Betis first installs and fixes the landing doors in their approved positions. After door installation, the contractor or building owner must close the remaining openings beside and above the doors under Betis supervision, using masonry or an engineered steel framework with suitable enclosure and cladding, as detailed in the approved drawings.

Final finishes may use marble, ceramic or other decorative materials appropriate to the building and architectural design. Clear door-opening dimensions must be maintained, without obstructing door movement or access to approved maintenance points.

Open during preparation; safely enclosed before service

An open-front arrangement does not permit operation with exposed openings. Provide protective barriers during works and complete the required landing doors, enclosure and protection before the lift enters service.

05 Lift systems and structural requirements

Installation systems

1. **MR:** a geared or gearless machine, according to the design. Provide separate cooling and appropriate ventilation as specified in the thermal requirements below.
2. **MRL:** Betis uses gearless machines installed inside the shaft, with safe maintenance and rescue access.

Machine room — Betis planning requirements

Betis uses an indicative clear machine-room height of **180–200 cm**, measured from the top of the shaft enclosure at the machine position to the underside of the room roof, allowing for the lowest beam or obstruction. The illustration uses **200 cm clear height** and a technician with a representative height of 180 cm. Verify working space, clearances, safe access and equipment data before approval; a greater height may be required.

Two machine-room construction options

1. **Rooftop enclosure around the shaft head:** the enclosure walls start at the roof of the top floor and surround the projecting shaft head. Provide suitable access to the raised machine platform.
2. **Room above the shaft head:** room walls start at the top of the shaft enclosure and match its width and depth, with a room door and safe access as approved in the drawing.

Shaft construction

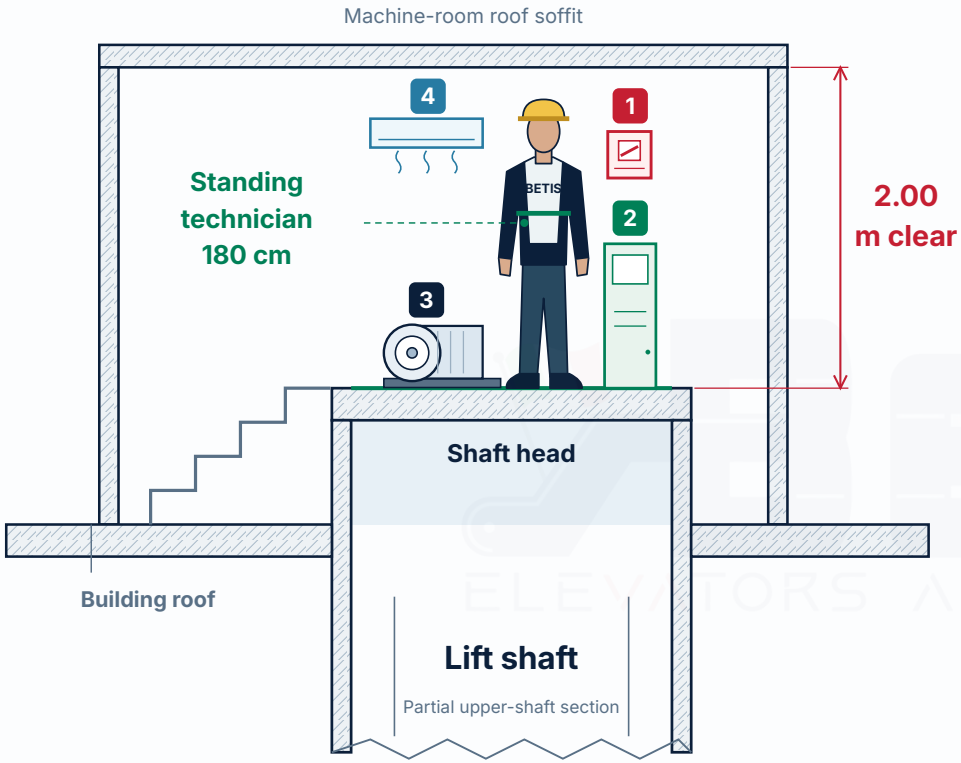
- **Reinforced concrete:** brackets may be fixed after the concrete, anchors and load capacity have been verified.
- **Masonry with concrete ties:** Betis proposes horizontal ties on the right, left and rear sides at vertical intervals of 150–160 cm. A structural engineer must check sections, reinforcement and positions against rail loads and approved bracket spacing.
- **Steel structure:** considered for existing buildings, external and panoramic lifts; designed for the lift-specific loads and reactions.

Two machine-room construction options MR

Enclosure around the shaft head | Room above it with the same footprint

Option 1 · Shaft head inside the rooftop enclosure

Enclosure walls start at the building roof

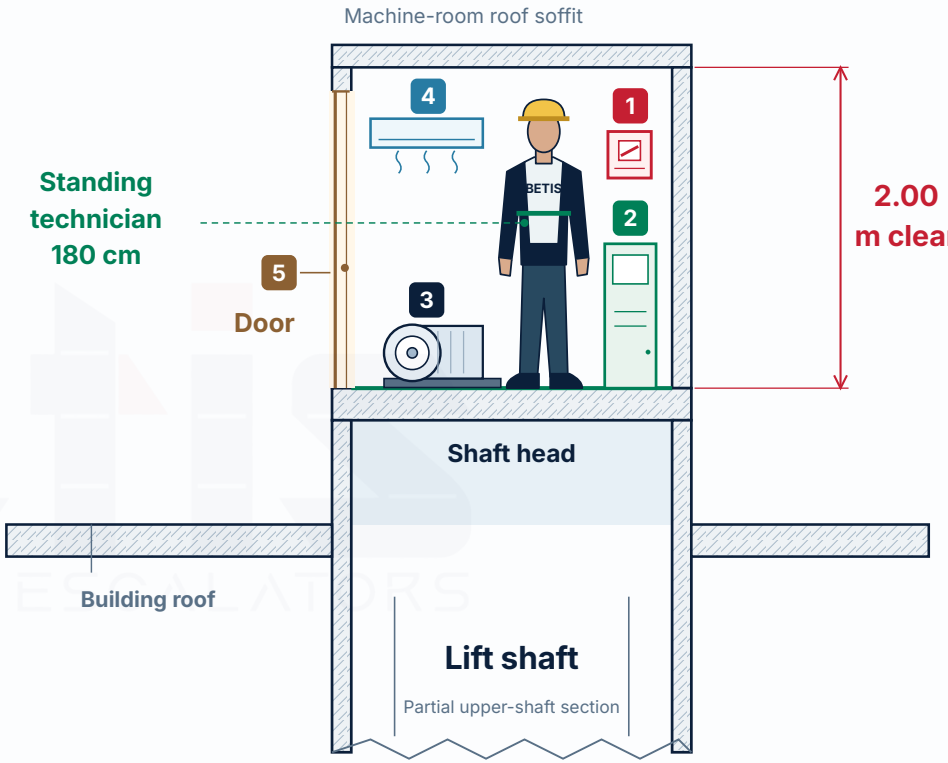


The enclosure contains the shaft head. Provide suitable access to the raised machine platform.

Clear height is measured from the shaft-head machine platform.

Option 2 · Room above the shaft head

Room walls start at the shaft-head platform



Machine-room width = shaft-head width
Machine-room depth = shaft-head depth

Clear height is measured from the shaft-head machine platform.

1 Circuit breaker 2 Controller 3 Lift motor 4 Split air conditioner 5 Machine-room door

Example: clear height 200 cm; representative technician height 180 cm | Controller-to-motor distance: maximum 5 m

Betis planning dimensions; final dimensions, clearances, safe access and equipment positions require an approved project shop drawing.

05 / A Controller, power supply and cooling

MRL controller location

Install the controller beside the lift door at the highest landing, with **no more than 5 m between controller and motor**, as required by Betis. Approve the location and cable route in the shop drawing and provide safe maintenance and rescue access. The same 5 m maximum also applies to the MR arrangement.

Power supply and circuit breaker

The contractor or building owner must bring the supply cable to the controller in the machine room, or to the top-floor controller cabinet for MRL, and provide a suitable circuit breaker. Betis specifies the cable, conductor sizes and breaker rating according to lift load, motor power, equipment data and supply-route length. Motor connections from the controller follow the approved electrical drawing.

Required supply: three phases, neutral and protective earth.

L1 + L2 + L3 + N + PE (Earth)

Protective earthing: an essential requirement

Correct protective earthing is essential for safe, reliable lift operation. Missing or incorrect earthing can impair electrical protection and operational reliability and expose people and equipment to danger. A qualified specialist must verify protective-conductor continuity and correct connections against the Betis drawing and project requirements before operation and handover.

Machine-room cooling

A machine room requires a separate split air-conditioning unit of **at least 1.5 refrigeration tons** under Betis requirements. Increase capacity where necessary for room area, equipment heat load, insulation and site conditions. For MRL, coordinate shaft and controller-cabinet ventilation and cooling to maintain required operating conditions.

Ambient temperature and operating conditions

EN 81-20:2020, clause 0.4.16, assumes an ambient temperature in the shaft and machinery spaces between **+5 °C and +40 °C**. This is an operating-condition reference range, not a single “ideal” temperature. Set cooling according to manufacturer limits, including any tighter limits for the selected equipment.

Exceeding the motor or controller temperature limits may activate thermal protection and stop the lift. 40 °C is not a universal trip setting; protection limits follow the manufacturers’ data.

Thermal reference: EN 81-20:2020, clauses 0.4.16 and 0.4.17.

06 Lift pit and groundwater

Betis determines pit depth according to rated load, speed, components and site conditions. Projects in Basra and Iraq require attention to waterproofing, under-car clearance, safety spaces and buffer capacity.

Table 01 — Pit depths and approval conditions

Pit depth	Category	Study and approval conditions
150 cm or more	Planning reference	Consider for higher loads, speeds and travel. Final depth depends on buffers, safety spaces and the approved shop drawing.
100 cm	Betis planning option	Consider within the proposed company range: up to 7 floors, 1 m/s and 1000 kg. Verify clearances, refuge spaces and buffer capacity before approval.
50–75 cm	Reduced-pit solution	A special solution for existing buildings, requiring an approved protection system and coordinated buffers and clearances. More overhead does not automatically compensate for a shallow pit.
12 cm	Dedicated home lifts	Applies to the specified Betis model and its system certification, with proposed 3000 mm overhead. It does not apply to conventional lifts generally.

Planning rule: above 7 floors, 1 m/s or 1000 kg, reassess the pit and consider 150 cm or more according to the selected system. Do not approve final depth before verifying buffers and safety spaces.

Detailed home-lift specifications

The Betis home-lift catalogue provides specifications, dimensions, car designs and reduced-pit options. Select the appropriate model with the engineering sales team.

Betis Home Lift Catalogue — PDF

07 Overhead, car height and door height

Measure overhead from the finished floor at the highest landing to the underside of the shaft roof, identifying obstructions. Check the machine, suspension, car roof, refuge spaces and clearances at the final positions of travel.

Table 02 — Overhead, car and door heights (cm)

System	Overhead	Internal car height	Door height
MR / geared	385 or more	220–230	210
MR / existing building	325–350	Up to 210	200
MRL	450	220–240	210–220
MRL / special arrangement	400	210	200

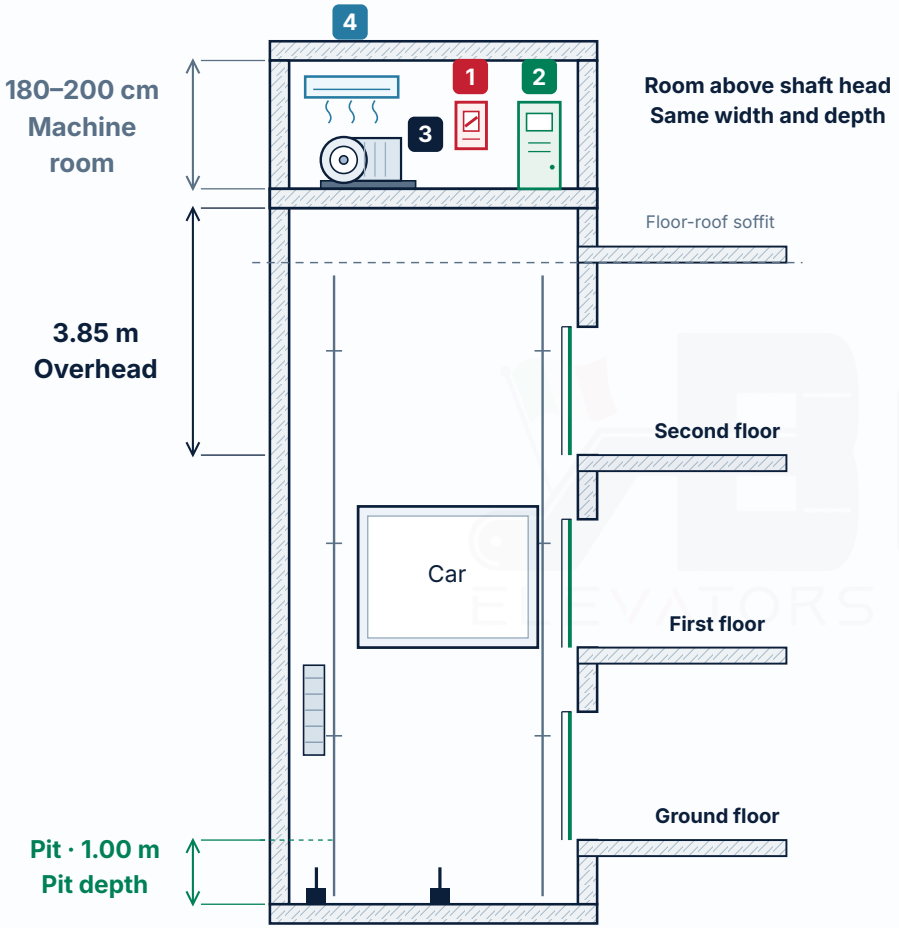
Height approval

Approve heights after coordinating the car, doors and machine in the shop drawing. Reduced-height arrangements, particularly 325 cm, require specific checks of clearances, safety spaces and protective equipment.

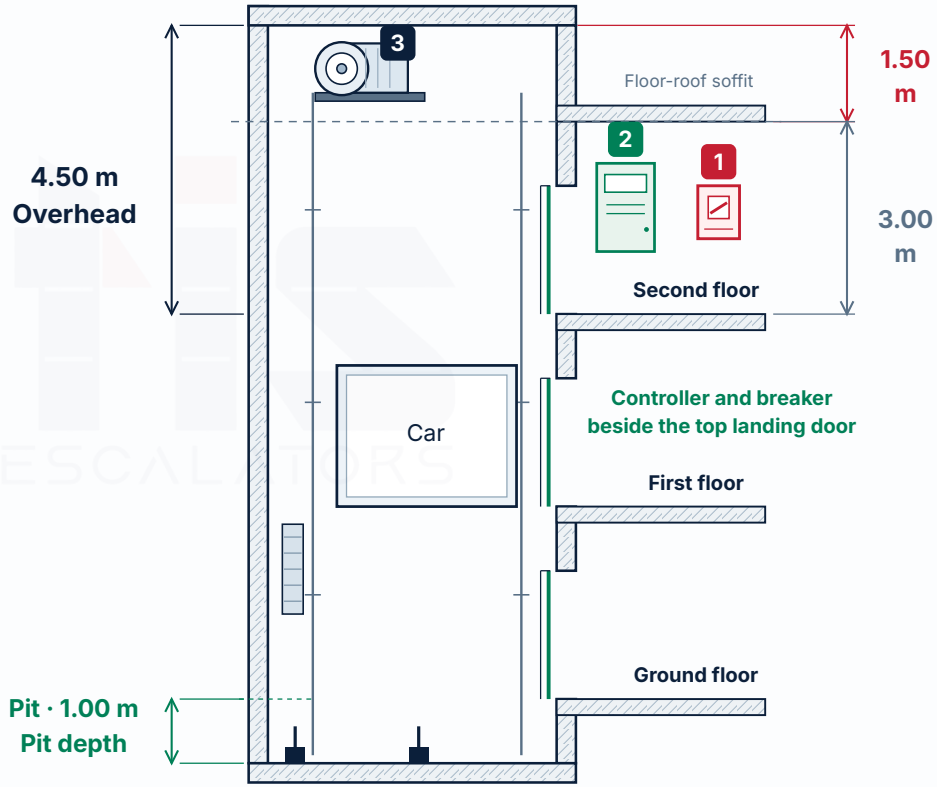
Comparison of MR / MRL

Three floors: Ground + First + Second | Betis planning dimensions

With a separate machine room MR



Machine-room-less MRL



1 Circuit breaker **2** Controller **3** Lift motor **4** Split air conditioner

Both systems: controller-to-motor distance must not exceed 5 m under Betis requirements.

Illustrative planning dimensions. Final approval requires equipment, clearance and safety review. Rope routes and wiring are not shown.

08 Doors and opening directions by shaft width

Automatic doors

Select telescopic side-opening or centre-opening doors according to clear shaft width, door frame, operator and panel retraction space. These are Betis planning options; match them to the door manufacturer’s drawings and verify shaft plumbness and required clearances.

Table 03 — Automatic door openings (mm)

Shaft width	Proposed load (kg)	Side opening	Centre opening	Door height
1300–1500	320	700; 1300 shaft width requires a specific check	Not standard in this schedule	2000
1600	480–630	800	700	2000
1800–1900	630–800	900	800	2000
2000 or more	1000	1000	900	2100
2200 or more	1250	1100	1000	2100

Rated load cannot be inferred from shaft width alone; assess car area, mass and lift arrangement. Door accessibility requirements need a separate check.

Semi-automatic / manual landing doors

- Consider for residential buildings and narrow shafts, with proposed opening widths of 700, 800, 900 or 1000 mm according to the shaft and car.
- A conventional arrangement may occupy around **12 cm** of depth, depending on the model.
- Mounting the frame on the external frontage may recover around **10 cm** in some cases, subject to sill, enclosure, clearance and protection coordination.
- A manual landing door does not eliminate any car door required by the approved system.

Installation note: consider centre-opening doors for commercial and service buildings and side-opening doors where frontage is limited. Opening and closing time depends on the model and settings, not solely on opening direction.

09 Suspension, rated loads and car areas

SUSPENSION 1:1

1:1 suspension

The car travels at rope speed. Betis uses this arrangement in some geared solutions from 320 to 800 kg.

SUSPENSION 2:1

2:1 suspension

The car travels at half rope speed. Used in Betis higher-load and gearless solutions according to system design. Suspension ratios are not universally determined by load alone.

! MANDATORY ENGINEERING REQUIREMENT

Car-area limits and lifting-system capacity

Do not increase car area or self-weight without verifying the capacity of the lifting system and all its components. Intended use for furniture or light loads does not justify exceeding approved design limits.

1. **Mass and balance:** larger car dimensions or heavier finishes require recalculation of car self-weight, counterweight and balance ratio.
2. **Mechanical verification:** check machine shaft and bearing loads, brakes, traction, ropes, rails and safety equipment. Motor power in kW alone does not establish suitability.
3. **Component safety:** exceeding rated loads can damage components, compromise traction or reduce protection, even if initial operation appears normal.
4. **Approval limits:** Betis applies the maximum car area for the selected load and system. Special solutions require a documented design and separate engineering approval. A small difference does not justify exceeding a limit.

Betis adopts the maximum areas in the dimensional schedule. Final verification includes the full available car area and any entrance recesses included in the measurement, together with car mass and lifting-system capacity.

09 / A Master dimensional schedule

A coordinated planning comparison of rated load, maximum area, car, shaft and door-opening dimensions.

Table 04 — Rated loads and dimensions

Dimensions in mm; area in m²

Load kg	Persons*	Max. area m²	Clear car		Planning shaft**		Clear door opening	
			Width	Depth	Width	Depth	Width	Height
320	4	0.90	900	1000	1400	1500	700	2000
480	6	1.30	1100	1150	1600	1650	800	2000
630	8	1.66	1100	1400	1600	1900	800	2000
800	10	2.00	1350	1400	1900	1900	800–900	2000
1000	13	2.40	1400	1600	2000	2200	900–1000	2100
1250	16	2.90	1600	1800	2200	2400	1000–1100	2100
1600	20	3.56	1400	2500	By approved shop drawing		1100	2100
2000	25	4.20	2000	2100	2700	2800	1200	2200

1600 kg car: 1400 mm width × 2500 mm depth; geometric area 3.50 m². Verify the actual available area using the approved measurement method.

Reading the dimensions

Car and shaft: clear finished width and depth.

Door: clear opening width and height.

Capacity: rated load in kilograms, read with the passenger-count rules.

Read this schedule with the approval notes and applications on the following page.

09 / B Schedule notes and applications

* Betis uses a planning weight of 75–80 kg per person. The listed loads and passenger counts fall within that range, including 630 kg for 8 persons and 1000 kg for 13 persons. Rated load in kilograms remains the binding limit and must not be exceeded even with fewer occupants.

** Shaft sizes are planning examples for different arrangements. They do not all derive from the Section 03 deductions and do not guarantee that a particular door will fit. The 1600 kg row requires the shaft to be redesigned for the 2500 mm-deep car. The 2000 kg car is geometrically at 4.20 m²; include all available area and tolerances before manufacture.

Table 05 — Suggested applications

Load (kg)	Suggested application
320	Small residential / villa
480	Medium residential
630	Residential / accessibility study
800	Residential and commercial
1000	Commercial buildings and offices
1250	Intensive use / hotels
1600	Bed / service lift, subject to requirements
2000	Goods / specific study

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Common shaft-preparation mistakes and how to avoid them

Early review of the following points helps reduce rework and installation conflicts. Read the corrective actions with the approved project drawing and requirements.

01 · Dimensions, plumbness and frontage

01 Relying on measurements from one floor

A single-floor measurement can conceal shaft misalignment or narrower sections at other levels.

Correct action: Measure every floor, check shaft plumbness and identify the narrowest finished dimensions over the full lift travel before approving the car size.

02 Building door openings without an approved drawing

Inconsistent opening sizes, levels or vertical alignment may prevent door installation and require civil alterations. Closing the frontage too early may also lose usable depth.

Correct action: Follow the Betis drawing. Where open frontage is approved, leave it open until doors are installed, then close it under Betis supervision. Depending on the project, this can recover approximately 10–12 cm of planning depth.

03 Ignoring the door-panel return space

A centre-opening or telescopic door may not fit if the shaft is too narrow for the requested opening.

Correct action: Approve the door type and clear opening only after checking frame, operator, panel-return space and clearances.

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Common shaft-preparation mistakes and how to avoid them

02 · Pit and overhead

04 Omitting complete pit waterproofing

Water and moisture, particularly in high-groundwater areas such as Basra, can damage buffers and electrical components and affect operation.

Correct action: Provide complete waterproofing and verify that the pit is dry and free from leakage before installation and operation.

05 Routing services through the lift movement zone

Drainage pipes or pumps in the movement zone obstruct equipment and required clearances.

Correct action: Keep these services outside the lift movement zone. Coordinate any permitted services outside that zone in the approved drawing.

06 Treating overhead as a substitute for pit depth

More overhead does not automatically compensate for a shallower pit; each has separate equipment, clearance and safety requirements.

Correct action: Review pit and overhead independently. Any reduced-pit solution requires suitable equipment and project-specific study and approval.

07 Ignoring beams, hooks and upper obstructions

Measuring only to the roof can overstate the actual available space.

Correct action: Record the lowest levels of relevant beams, hooks and other obstructions, then establish usable clear height against the equipment layout and clearance requirements.

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Common shaft-preparation mistakes and how to avoid them

03 · Structure and rail fixing

08 Fixing rails to unengineered masonry alone

Rail brackets fixed to masonry not designed for the loads may provide inadequate support.

Correct action: Provide concrete ties on three sides at Betis planning intervals of 150–160 cm vertically, or an engineered alternative structure. Have sections, reinforcement and anchors structurally checked.

09 Changing dimensions or levels after approval

Changes to openings, finishes or floor levels can invalidate approved measurements.

Correct action: Obtain written approval from Betis Engineering and update the affected drawings and measurements before proceeding.

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Common shaft-preparation mistakes and how to avoid them

04 · Power, cooling and car dimensions

10 Incorrect supply or missing protective earthing

A supply or protective device that does not match the selected system, or missing protective earthing, may prevent safe operation.

Correct action: For a three-phase system, provide L1 + L2 + L3 + N + PE, with cable and breaker specified by Betis. Do not change the approved supply without review. Home-lift systems may have different model-specific supply requirements.

11 Omitting machine-room cooling

Temperatures above the manufacturer’s limits can activate thermal protection and stop the lift.

Correct action: Provide a split air conditioner of at least 1.5 refrigeration tons under Betis requirements; verify capacity against room area, heat load and ventilation. Ventilation alone is not an automatic substitute for approved cooling.

12 Failing to weatherproof the machine room

An inadequately protected roof, walls, doors or openings can admit rainwater and dust, potentially damaging the machine, controller and electrical components.

Correct action: Protect the room against water and dust ingress while maintaining ventilation and providing cooling in accordance with approved Betis requirements.

13 Positioning the controller too far from the motor

Exceeding the approved distance may conflict with the specified cable-routing and connection requirements.

Correct action: For MRL, locate the controller beside the highest landing door, no more than 5 m from the motor under Betis requirements. Review cable type and route. The same distance requirement also applies to MR.

14 Increasing car size or finish weight without review

Enlarging the car or using heavy finishes such as marble changes its mass and may exceed the system’s approved area or loads.

Correct action: Recheck car and counterweight masses, machine, ropes, traction, brakes and other components before approval. Maintain the approved rated load and maximum area.

11 Pre-manufacturing site survey checklist

Manufacturing at the Betis factory must not begin until the following data are documented and the shop drawing is approved:

01 **Clear shaft measurements:** Width and depth at every floor, checking plumbness and the narrowest finished point.

02 **Pit depth:** From the final finished floor at the lowest landing to the pit floor.

03 **Overhead:** From the final finished floor at the highest landing to the roof underside, recording beams and obstructions.

04 **Floor levels:** Number of floors and stops, and vertical distance between successive floors.

05 **Structural system:** Reinforced concrete, masonry with ties, or steel structure, including rail-fixing details.

06 **Frontage and doors:** Opening sizes and locations; approval of open frontage or external frame position where needed.

07 **Machine and system:** Machine-room dimensions and cooling, or MRL arrangement, controller location and distance to the motor.

08 **Electrical supply:** Agree supply cable, circuit breaker and route with Betis; 3 Phase + Neutral + Earth with protective earthing to the approved drawing.

09 **Waterproofing:** Confirm a dry pit and prevention of harmful leakage and moisture.

10 **Documentation:** Clear photographs of the pit, shaft, frontage and roof, with a measured drawing.

12 Site execution and safety requirements

1. **Shaft preparation:** provide a clean, dry shaft free of debris and timber, with temporary power, lighting and safe access.

2. **Pit waterproofing:** install complete waterproofing and prevent drains and pumps from entering or obstructing the lift movement zone. Coordinate any permitted equipment outside this zone in the drawing.

3. **Opening protection:** Betis requires rigid protective barriers at least **120 cm** high during works. The safety supervisor must verify strength, fixing, fall-protection details and site requirements.

4. **Change control:** do not alter door openings, pit depth or floor levels after drawing approval without written approval from the Betis Engineering Department.

Drawing approval is required before manufacture

Manufacturing may start only after the site survey, documentation of final measurements and engineering approval of the shop drawing are complete. Any change affecting dimensions, levels or lift equipment requires prior written engineering approval.

13 Guide approval and project documentation

This guide provides a common planning language for Betis, engineers, consultants and contractors. Project approval is completed through the following documents:

1. **Final site survey:** clear dimensions, finished levels, pit, overhead and door-opening locations.
2. **Shop drawing:** car, counterweight, rails, doors, machine and clearance arrangements, approved by Engineering.
3. **Lifting-system calculations:** masses, loads, traction, balance, anchors, buffers and suitability of every component for the selected system.
4. **Equipment data:** door, machine and controller drawings, plus installation, maintenance and rescue requirements.
5. **Documented changes:** revise dimensions, finishes or rated load only after review and updates to the technical documents.

Special solutions

Home, bed and goods lifts; opposite entrances; and reduced pits or overhead require a model- and building-specific study. Mandatory safety requirements and competent-authority requirements remain part of each project approval.

Have a shaft drawing and need engineering advice?

Contact Betis directly

07700667028

betiselevators.com/en/guide/