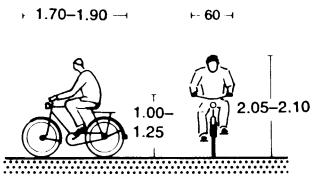
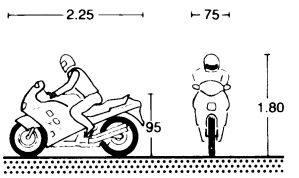
VEHICLE DIMENSIONS

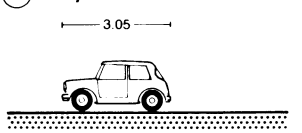
The illustrations show dimensions, turning radii and weights of typical vehicles with particular reference to space requirements and regulations for garages, parking places, entrances and passages.



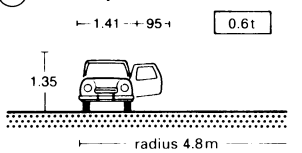
① **Bicycle**

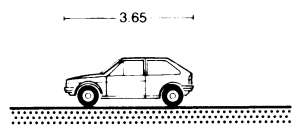


② **Motorcycle**

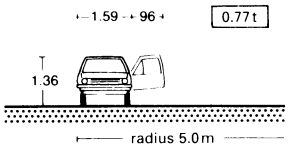


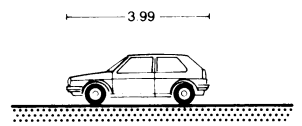
③ **Mini**



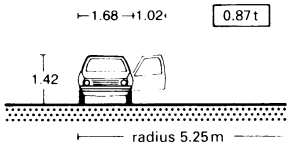


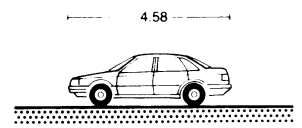
④ **VW Polo Coupé**



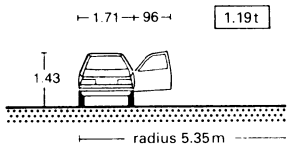


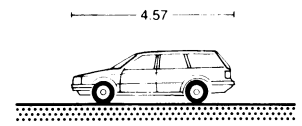
⑤ **VW Golf**



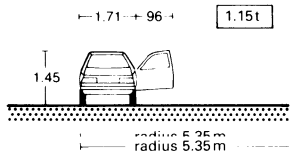


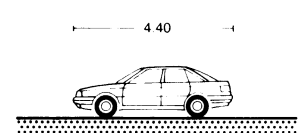
⑥ **VW Passat**



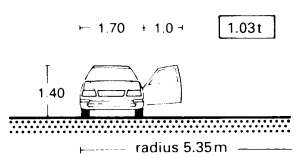


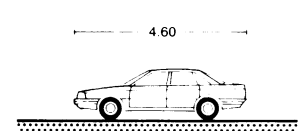
⑦ **VW Passat Variant**



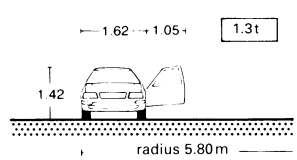


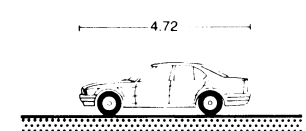
⑧ **Audi 80**



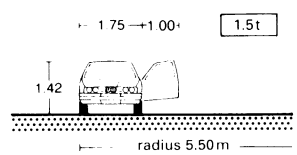


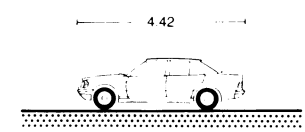
⑨ **Audi 100**



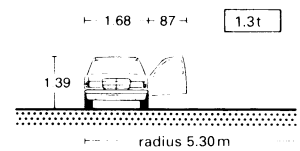


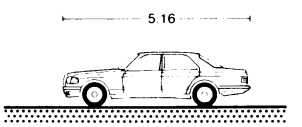
⑩ **BMW '5' series**



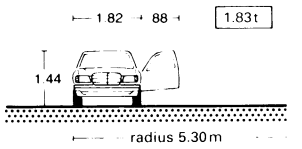


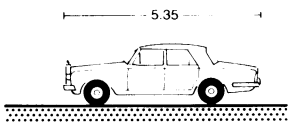
⑪ **Mercedes 190**



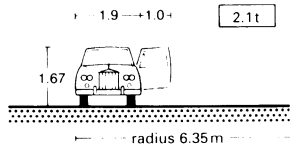


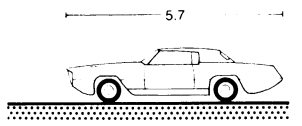
⑫ **Mercedes 560 SEL**



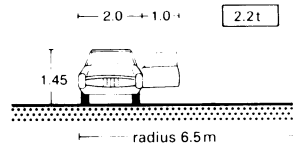


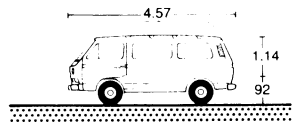
⑬ **Rolls-Royce**



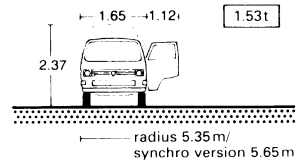


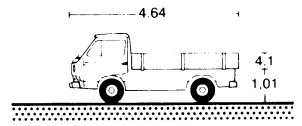
⑭ **American limousine**



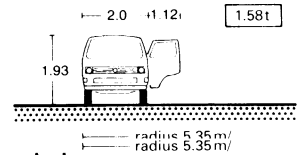


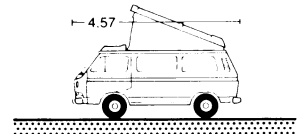
⑮ **VW (high roof) Kombi**



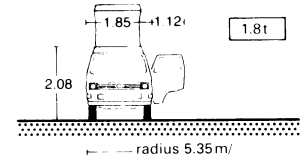


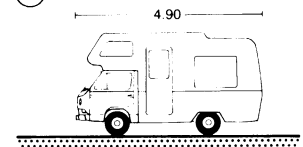
⑯ **VW stretched truck with platform body**



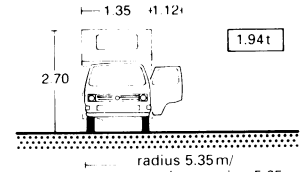


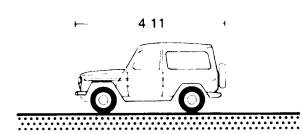
⑰ **VW Joker**



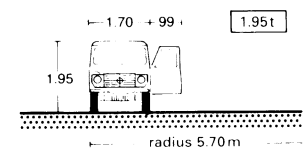


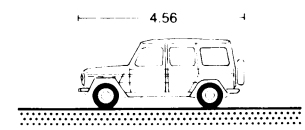
⑱ **VW Karman-Cheetan, Gipsy**



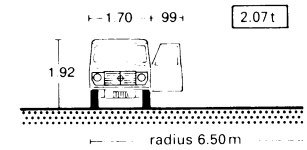


⑱ **Short wheelbase, 3-door Mercedes station wagon**





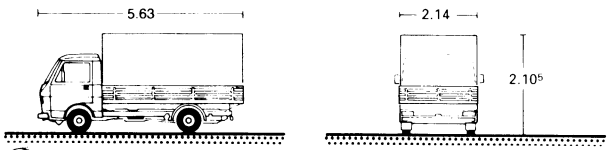
⑱ **Long wheelbase 5-door Mercedes station wagon**



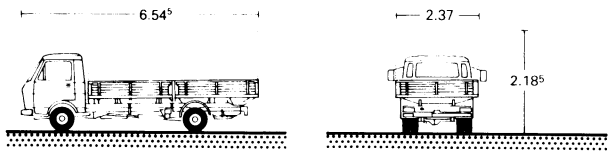
VEHICLE DIMENSIONS

Dimensions and Turning Circles of Typical Trucks and Buses

① **Pick-up van**

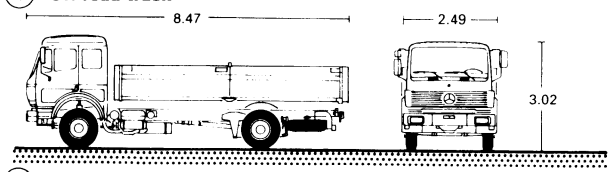


② **Fixed-bed truck**

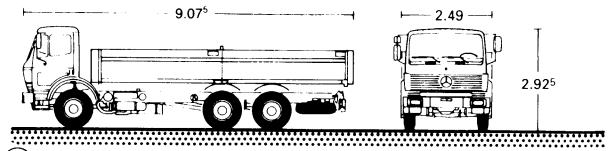


③ **Fixed-bed truck**

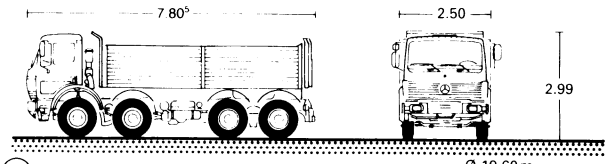
④ **Off-road truck** Ø 13.80 m



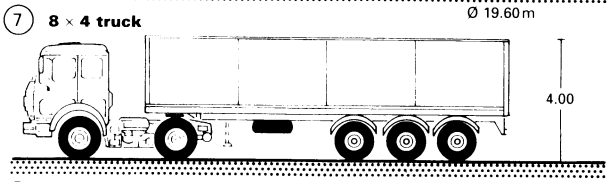
⑤ **4 × 2 truck** Ø 19.10 m



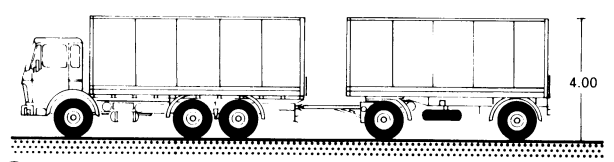
⑥ **6 × 2 (or 6 × 4) truck** Ø 18.40 m



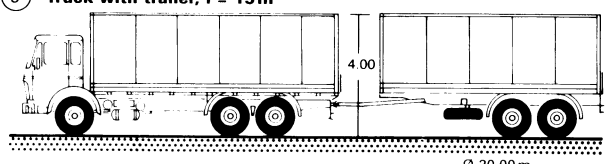
⑦ **8 × 4 truck** Ø 19.60 m



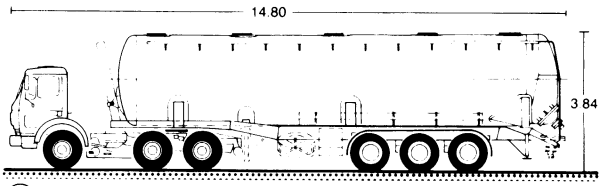
⑧ **Articulated truck, l = 15 m (UK max. o/a length = 13 m)**



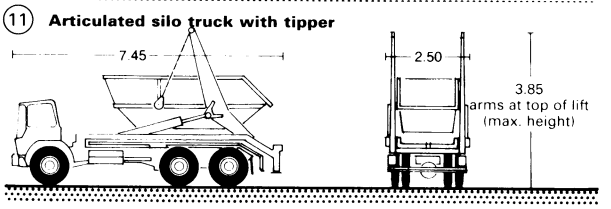
⑨ **Truck with trailer, l = 15 m**



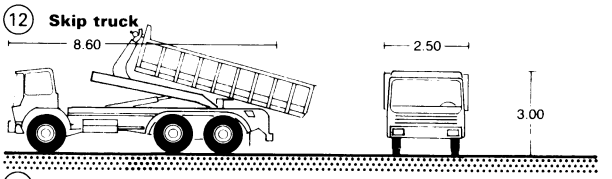
⑩ **Truck with tandem trailer, l = 18 m, w = 2.50 m** Ø 20.00 m



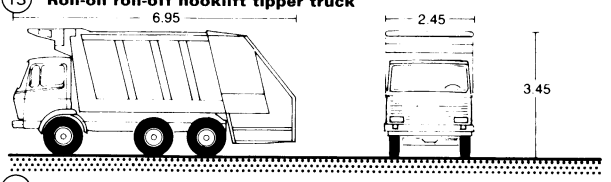
⑪ **Articulated silo truck with tipper**



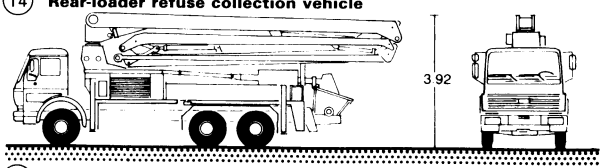
⑫ **Skip truck**



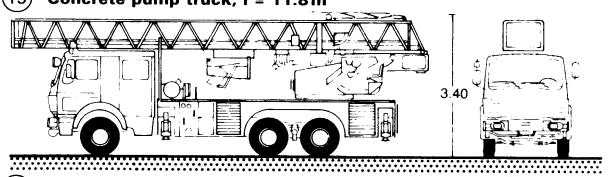
⑬ **Roll-on roll-off hooklift tipper truck**



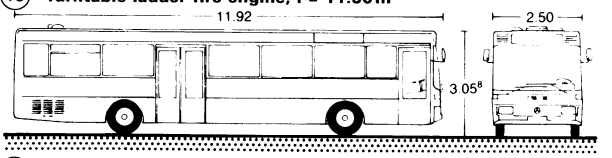
⑭ **Rear-loader refuse collection vehicle**



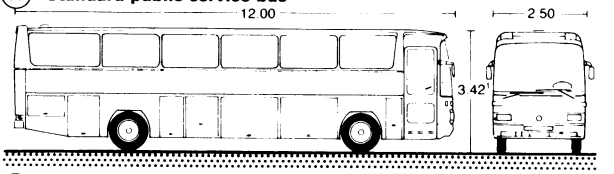
⑮ **Concrete pump truck, l = 11.8 m**



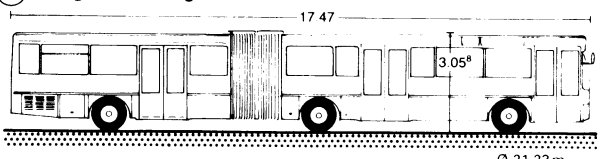
⑯ **Turntable ladder fire engine, l = 11.50 m** Ø 21.0 m



⑰ **Standard public service bus** Ø 22.1 m



⑱ **Long-distance high-deck coach** Ø 22.67 m



⑲ **Standard articulated bus, w = 2.50 m** Ø 21.23 m

LOADING BAYS

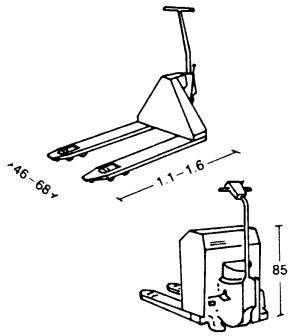
Gaps between dock ramps and vehicles have to be safely bridged to allow loading and unloading operations to be carried out easily and smoothly.

Loading bridges should safely link a dock with any type of vehicle or railway truck. The loading platform of the vehicle can be either higher or lower than the ramp → ③–④ and aluminium wedge-shaped units are ideal for raising low vehicles into line with the height of the loading dock → ⑥. These can be mounted on rollers and easily moved to various work locations. Aluminium hinged loading platforms can be set at various levels → ⑨.

Portable loading bridges can be rolled and carried, and can also be used for loading on to railway trucks → ④. Loading platforms with projecting lips are also available with automatic hydraulic action → ⑩.

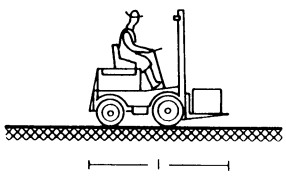
Hydraulic scissor lifts are used to adjust for differing levels between the yard and the vehicle platform → ⑧, between the vehicle and the dock ramp → ⑦ or between two dock ramps. Mobile lift platforms are also available.

Continuous height adjustment to any particular level during loading or unloading of the truck is best achieved using forklift trucks, which are available with electric, diesel, petrol and LPG engines → ②. The height of mobile drive-on ramps for loading containers, lorries and railway trucks can be automatically adjusted according to the suspension of the truck during loading and unloading.

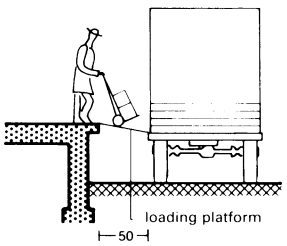


① **Pallet truck**

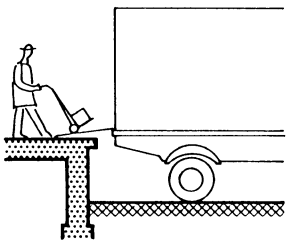
S.W.L. (t)	2.5	3.5	7	13
w (m)	1.0	1.0	1.2	1.5
l (m)	2.4	2.8	3.4	3.6



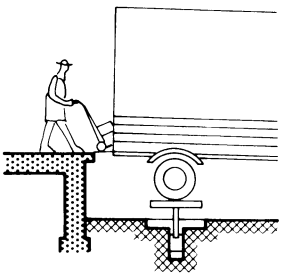
② **Forklift truck**



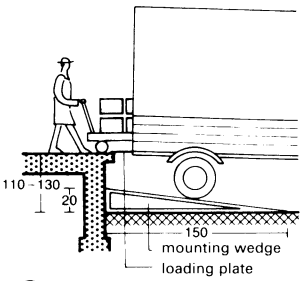
③ **Portable loading platform**



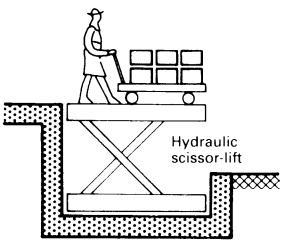
④ **Flexible loading using a steel plate**



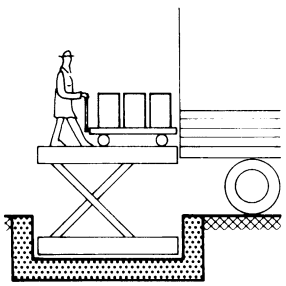
⑤ **Close to the rear axle, using a jacking system**



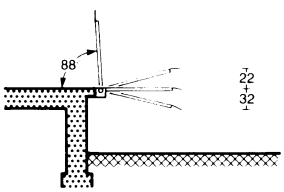
⑥ **Permanent or portable dock leveller**



⑦ **Lift platform from yard level to dock or vice-versa**

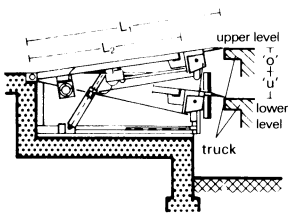


⑧ **Dock to truck**



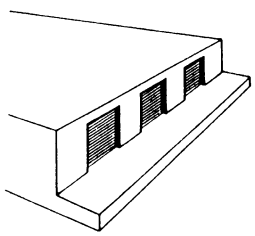
length (mm)	width (mm)	max. load (kg)
1500	1500	3000
1750	1500	3000
1750	1750	5000

⑨ **Hinged loading platform, adjustable sideways**

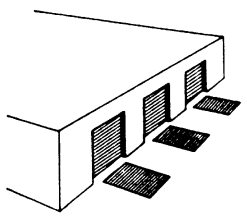


o	u	l_1	l_2	w	max load kp
290	300	2300	2000	1500	3000
360	300	2800	2500	1750	4000
430	300	3300	3000	2000	5000

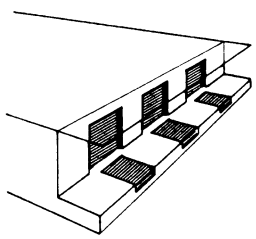
⑩ **Loading bridge**



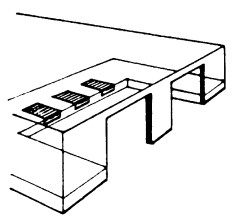
⑪ **Loading bay → ③–⑥**



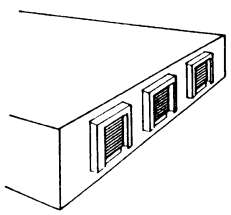
⑫ **Ground level bay, loading with lifting tables or ramps → ⑦**



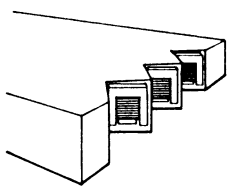
⑬ **Loading bay with canopy and hydraulic dock loading ramps → ⑩**



⑭ **Indoor loading with hydraulic dock loading ramps → ⑦**

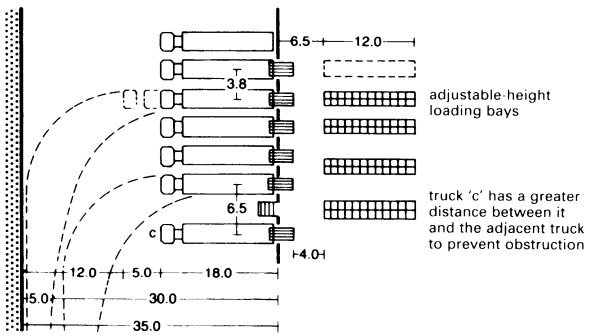


⑮ **Dock loading ramps with weather-protection systems**

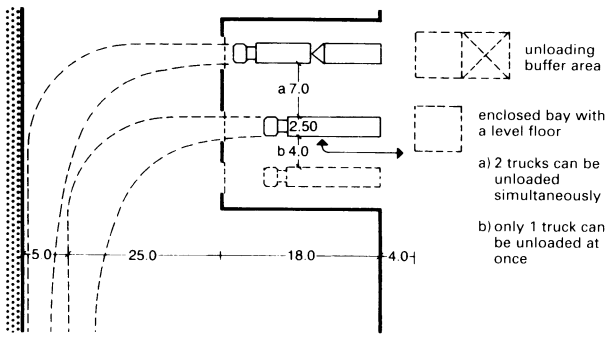


⑯ **Saw-tooth bay ramps in a restricted area**

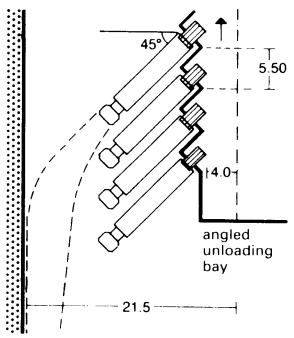
LOADING BAYS



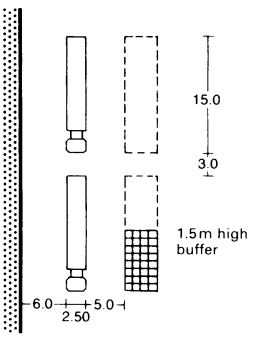
① **Close-packed loading and unloading bays; vehicles parked close together must ease forward a little before they can drive off**



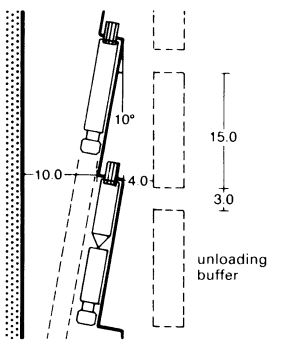
② **Loading and unloading bays take up the most space in the yard**



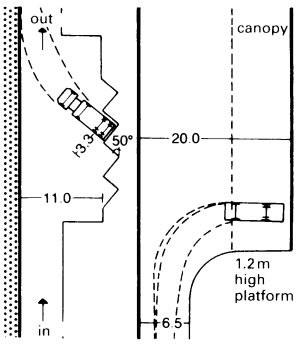
③ **Loading and unloading bays**



④ **Loading and unloading bay**



⑤ **Loading and unloading bay with raised platform and side unloading**



⑥ **Minimum space requirement for loading bays**

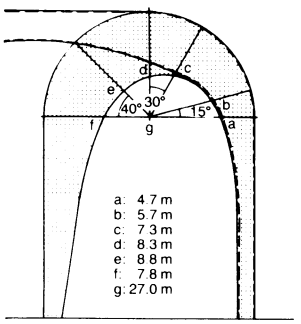
An example of the ideal depth of yard for articulated trucks with overall lengths of 18m is shown in → ①. Calculations based on experience show that under these conditions a length of 35m is required for access. Even the longest articulated truck can then be driven swiftly in and out. This is an important factor in controlling the turn-round of the vehicles on scheduled runs. If the above-mentioned conditions cannot be met, the saw-toothed bay layout, with an angle of 10°–15° offers a practical solution.

→ ③, ⑤ + ⑥.

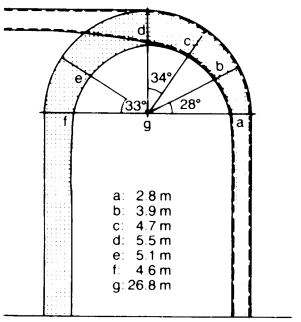
The largest turning radius for an articulated truck is about 12.00m.

The safe distance to be allowed between two adjacent trucks is a minimum of:

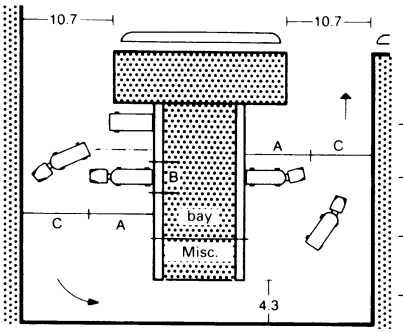
- 1.50m with the use of a loading dock;
- 3.00m with the use of loading doors.



⑧ **Normal turning circle dimensions for a 15m long articulated truck**

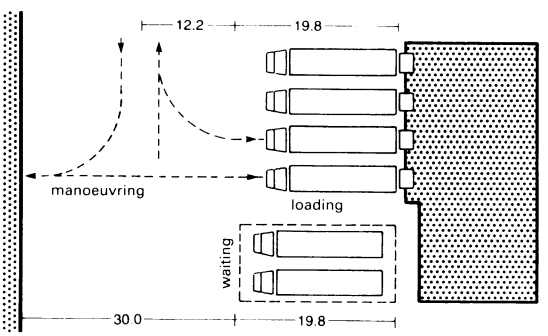


⑨ **Normal turning circle dimensions for a truck with a rigid chassis and long wheelbase**

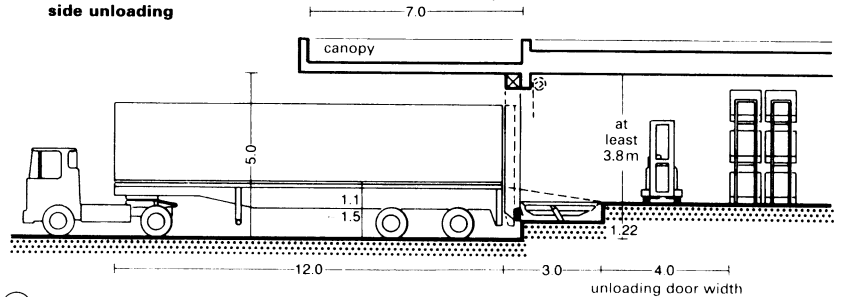


A articulated truck	B unloading position	C manoeuvring area
10.7	3.0	14.0
	3.7	13.1
	4.3	11.9
12.2	3.0	14.6
	3.7	13.4
	4.3	12.8
13.7	3.0	17.4
	3.7	14.9
	4.3	14.6

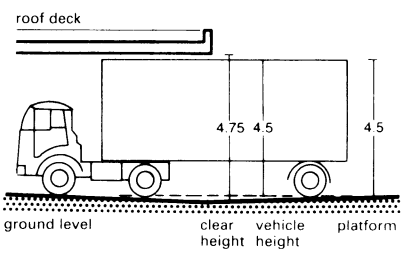
⑩ **Loading and unloading in a courtyard**



⑪ **Traffic driving clockwise on the right-hand side of the road**



⑦ **Section through a loading bay with an adjustable loading platform**



⑫ **Dimensions for sheltered loading bays**

TURNING AND PARKING

The type, size and shape of a turning place in a road depends on the road use in that particular area. It also has to be suitable for the needs of the road users and must meet town planning requirements. It is difficult to make recommendations for a correct choice of road turning place which is valid in all cases.

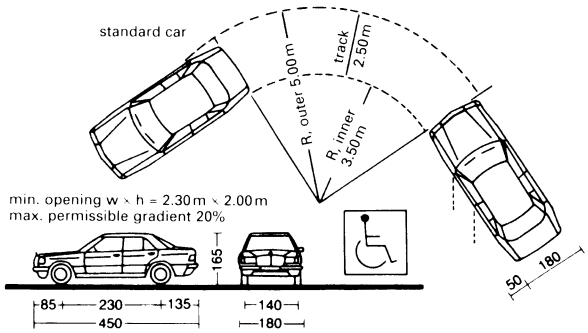
The interests of the fire and refuse collection services have to be taken into account in deciding on road turning places. Many authorities refuse to service areas with dead-end roads or lanes, where refuse collection lorries can turn only by manoeuvring backwards and forwards or must reverse quite a long distance.

Road turning places can be designed as hammerheads → ④–⑤, turning circles or loops → ⑥–⑨. The hammerhead type turning place calls for backwards and forwards manoeuvring.

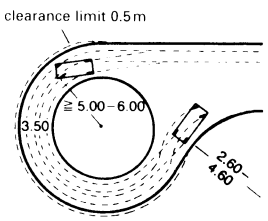
Turning circles and loops are preferable, as motor vehicles can drive straight round them without having to stop.

To facilitate steering, road turning places should be arranged asymmetrically on the left, or on the right in the case of those countries like the UK which drive on the left-hand side of the road → ⑥–⑨. Adequate clear areas should be left along the outside edges of the turning areas to safeguard fixed obstructions from the overhang of turning vehicles. In the case of turning loops, the central area to be driven around can be planted → ⑧.

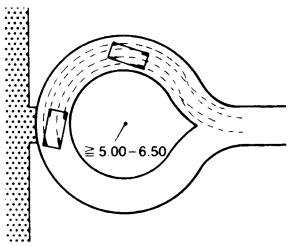
Hammerhead turning places are really only suitable for cars. They are not required for carriageways over 6 m wide, if garage forecourts or footpath crossings are available for turning purposes.



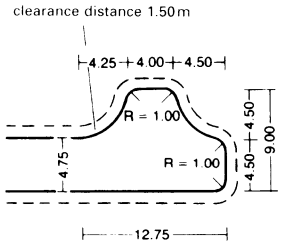
① **Standard car**



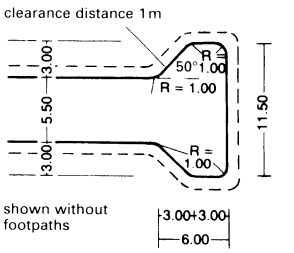
② **Car turning circle**



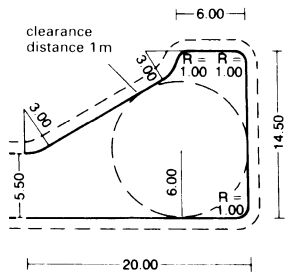
③ **Car turning circle radius for an entrance drive ≧ 5–6.50 m**



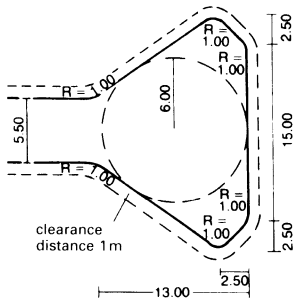
④ **Hammerhead turning place for cars**



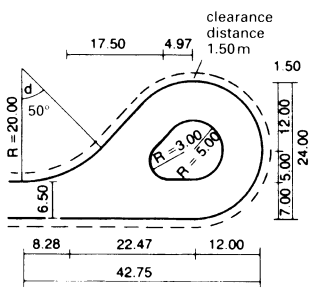
⑤ **Hammerhead turning place for vehicles up to 8 m (refuse collection vehicles, fire tenders, trucks up to 6 t)**



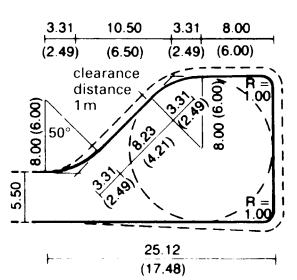
⑥ **Turning area for trucks over 10 m long and 24 t 6 × 4 refuse collection vehicles**



⑦ **As ⑥**



⑧ **Turning loop for articulated trucks and buses**



⑨ **Turning circle for 4 × 2 refuse collection vehicles and 6 m long delivery vans**

type of vehicle	length (m)	width (m)	height (m)	turning circle radius (m)
motorcycle	2.20	0.70	1.00[2]	1.00
car				
- standard	4.70	1.75	1.50	5.75
- small	3.60	1.60	1.50	5.00
- large	5.00	1.90	1.50	6.00
truck				
- standard	6.00	2.10	2.20[1]	6.10
- 7.5 t	7.00	2.50	2.40[1]	7.00
- 16 t	8.00	2.50	3.00[1]	8.00
- 22 t (+16 t trailer)	10.00	2.50	3.00[1]	9.30
refuse collection vehicle				
- standard 2-axle vehicle (4 × 2)	7.64	2.50	3.30[1]	7.80
- standard 3-axle vehicle (6 × 2 or 6 × 4)	1.45	2.50	3.30[1]	9.25
fire engine	6.80	2.50	2.80[1]	9.25
furniture van (with trailer)	9.50 (18.00)	2.50	2.80[1]	9.25
standard bus I	11.00	2.50[3]	2.95	10.25
standard bus II	11.40	2.50[3]	3.05	11.00
standard vehicle - bus	11.00	2.50[3]	2.95	11.20
standard vehicle - articulated bus	17.26	2.50[3]	4.00	10.50–11.25
standard articulated truck	18.00	2.50[4]	4.00	12.00[5]
tractor		2.50[4]	4.00	
trailer		2.50[4]	4.00	
max. values of the road regulations				
2-axle vehicle (4 × 2)	12.00	2.50[4]	4.00	12.00
vehicle with more than 2 axles	12.00	2.50[4]	4.00	12.00
tractor with semi-trailer	15.00	2.50[4]	4.00	12.00
articulated bus	18.00	2.50[4]	4.00	12.00
trucks with trailer	18.00	2.50[4]	4.00	12.00

notes:
[1] height of driver's cab; [2] total height with driver, about 2 m; [3] with wing mirrors, 2.95 m; [4] without wing mirrors; [5] turning circle radius adjusted up to max. as per regulations

⑩ **Basic vehicle data**

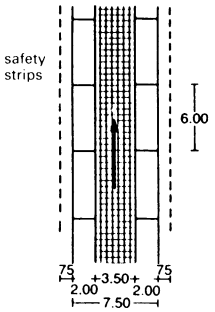
type of road	type of district	standard vehicle	R (m)	notes
accessible lightly used residential road	residential	car	6	turning circle for car
				special regulations for refuse collection vehicles (e.g. link road connection via lanes with limited traffic access)
residential road	mainly residential	cars, 2-axle (4 × 2) refuse collection vehicles	8	turning circle for small buses + most refuse collection vehicles
				room to turn by manoeuvring back and forth for all vehicles permitted under the regulations
residential road	residential area, heavily interspersed with business premises	cars, refuse collection vehicles, trucks with 3 axles (6 × 2 and 6 × 4), standard bus, articulated bus	10	adequate turning circle for most permitted trucks and buses
			11	turning circle for newer buses
			12	turning circle for articulated buses
	mainly for business premises	truck articulated truck articulated bus	12	turning circle for the largest vehicles permitted by the road regulations
1 m wide clearance on the outside of the turning areas is provided to allow for the rear overhang of vehicles				

⑪ **Recommendations for turning circle radius, R**

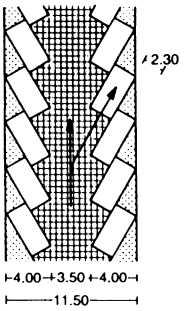
TURNING AND PARKING

Parking spaces are usually outlined by 12–20mm wide yellow or white painted lines. When parking is facing a wall, these lines are often painted at a height of up to 1 m for better visibility. Guide rails in the floor along the side have also proved popular for demarcation of parking limits, and can be about 50–60cm long, 20cm wide and 10 cm high. Where vehicles are parked in lines facing walls or at the edge of the parking deck in a multi-storey car-park, it is common practice to provide buffers, restraining bars or railings up to axle height to prevent cars from going over the edge. Where cars are parked face to face, transverse barriers about 10cm high can be used to act as frontal stops. Overhang on vehicles must be taken into account → ①. For lining up in front of a wall, a stop rail or rubber buffer will be sufficient → ①.

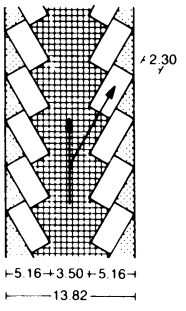
Garage parking spaces for cars should have an overall length of more than 5m and a width of 2.30m, but parking spaces for the disabled should be more than 3.50m wide.



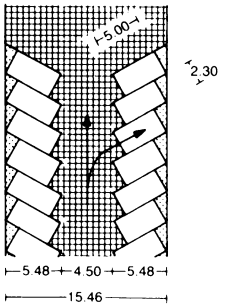
① **Parking parallel to the road**



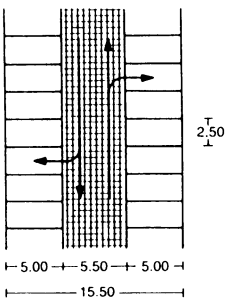
② **30° oblique spaces, easy entry and exit, but for use only with one-way traffic**



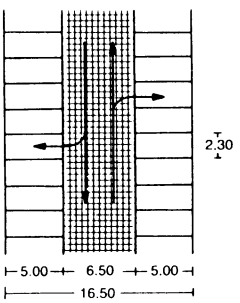
③ **45° oblique parking, one-way traffic only**



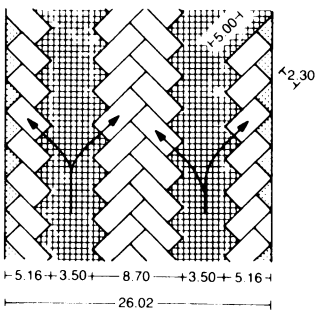
④ **60° oblique parking, one-way traffic only**



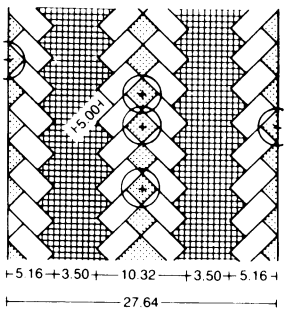
⑤ **90° entry/exit to parking spaces for two-way traffic Parking space 2.50 m wide**



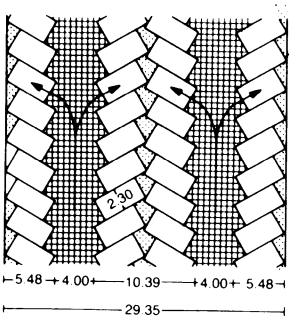
⑥ **90° entry/exit to parking spaces, for two-way traffic Parking space 2.30m wide**



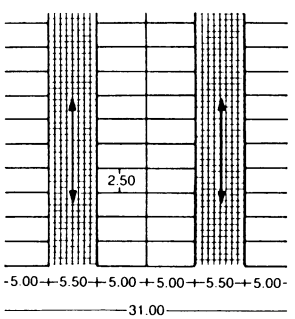
⑦ **45°-angled parking, one-way traffic only**



⑧ **Parking for one-way traffic (with spaces for plants)**

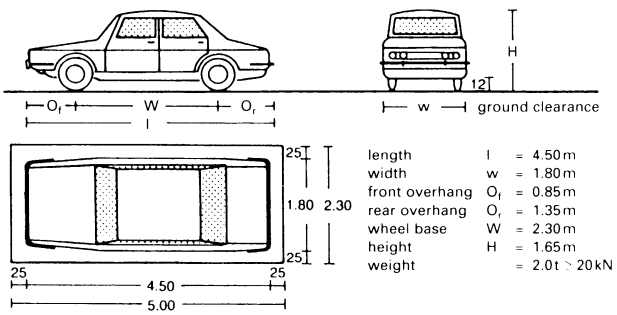


⑨ **60° angled parking, one-way traffic**

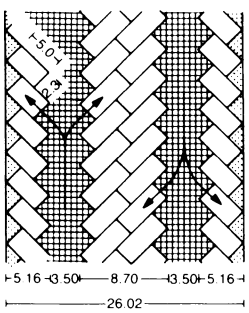


⑩ **90° parking, 5.5m wide road Parking spaces 2.5m wide**

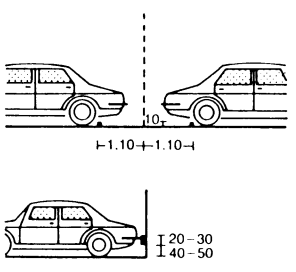
parking space arrangement	area/space (inc. open doors)	possible no. of spaces/100m² area	possible no. of spaces/100m of road (one side only)
· ① 0° - parallel to road. Entry and exit to parking bay difficult - suitable for narrow roads	2	4.4	17
· ② 30° -angle to access road. Easy entry to parking bay and exit. Uses a large area.	26.3	3.8	21
· ③ 45° -angle to access road. Good entry to parking bay and exit. Relatively small area/parking space. Normal type of layout	20.3	4.9	31
· ④ 60° -angle to access road. Relatively good entry and exit to parking bay; small area/parking space. Arrangement often used	19.2	5.2	37
· ⑤ Right-angles to road (parking spaces 2.50m wide). Sharp turn needed for entry and exit	19.4	5.1	40
· ⑥ Right-angles to road (parking spaces 2.30m wide. Small area needed/parking space. Ideal for compact parking layouts, used frequently	19.2	5.2	37



⑪ **Standard car**

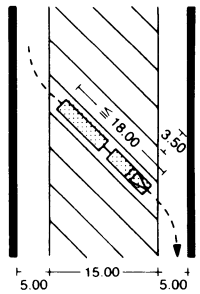


⑫ **Oblique parking layout**

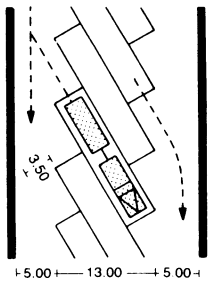


⑬ **Stop rails and buffers**

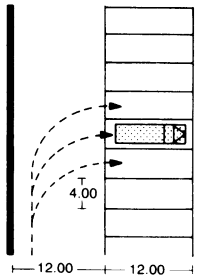
TURNING AND PARKING



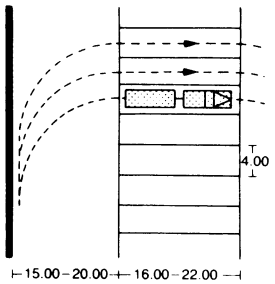
① **45° parking, truck with trailer**



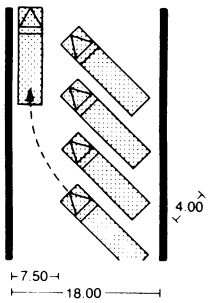
② **30° parking, truck with trailer**



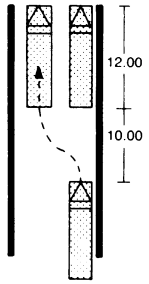
② **90° parking, a single truck**



④ **90° parking, truck with trailer**



⑤ **Parking at less than 45°**

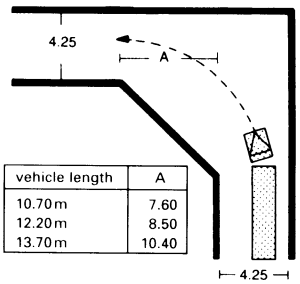


⑥ **Space loss, parking parallel to kerb**

Owing to the large variation in the size of trucks, it is not worth marking out permanent lanes or bays on the ground. The basic measurements for space and actual requirements for the manoeuvring and parking of trucks are taken from the vehicle dimensions whilst driving straight, cornering and entering into or driving out of the parking place. The line of the trailing inner rear wheels when cornering must be taken into account.

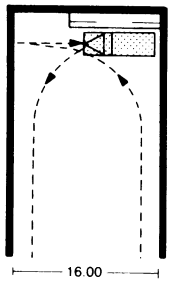
The turning circle for the largest vehicles permitted under the road traffic regulations is an outer turning circle radius of 12m.

An outer turning circle radius of 10m is nevertheless considered sufficient for the vast majority of trucks which come within the scope of the regulations (see 'Motor vehicles: turning').

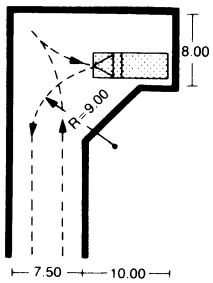


vehicle length	A
10.70m	7.60
12.20m	8.50
13.70m	10.40

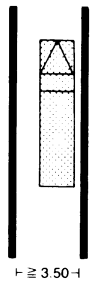
⑦ **Space needed at street corners**



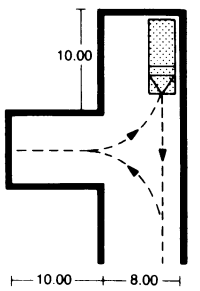
⑧ **Turning in restricted areas**



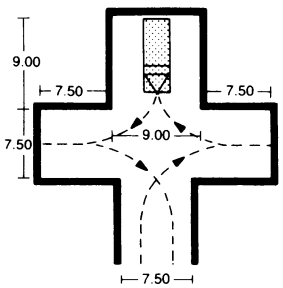
⑨ **Hammerhead turn in very tight space**



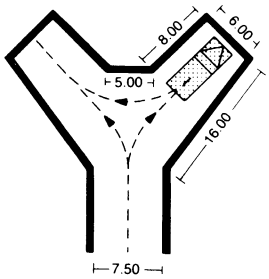
⑩ **Passage width**



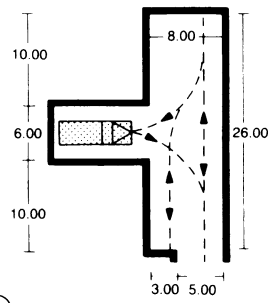
⑪ **Further turning options →** ⑫ – ⑭



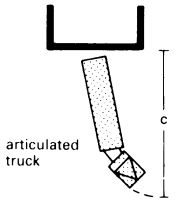
⑫



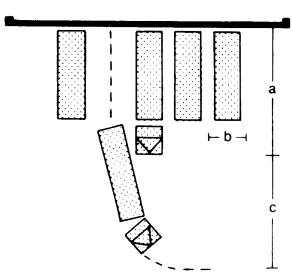
⑬



⑭



⑮ **Single parking**

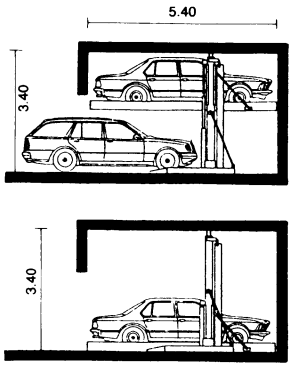


⑯ **Parking in a row**

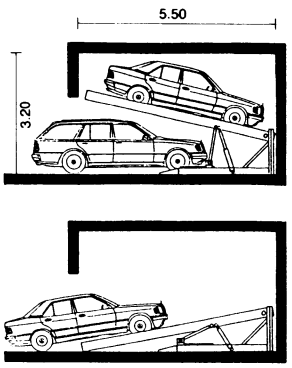
area to be kept free for entry and exit of:		
vehicle length a	bay width b	area to be kept free c
22t truck	3.00	14.00
10.00m	3.65	13.10
	4.25	11.90
fixed bed truck	3.00	14.65
12.00m	3.65	13.50
	4.25	12.80
	3.00	17.35
articulated truck	3.65	15.00
15m	4.25	14.65

⑰ **Table for ⑮ and ⑯**

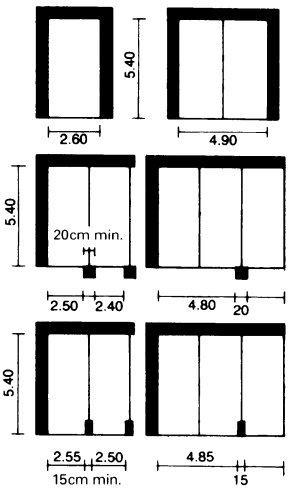
GARAGES AND CAR-PARKING



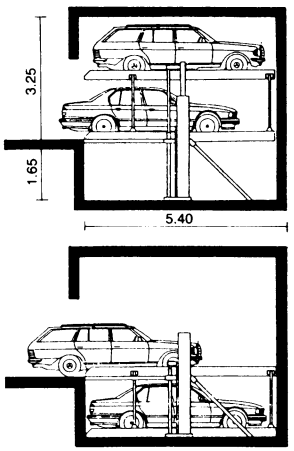
① **Parking lift without pit**



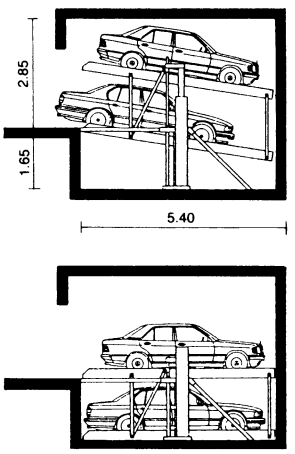
② **Suspended parking (no pit)**



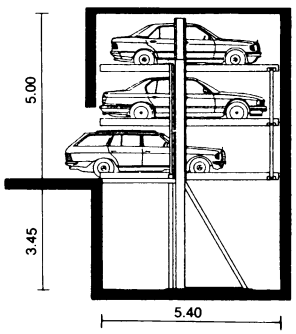
③ **Plan views**



④ **Private parking, 2 cars stacked vertically**



⑤ **An estate car can be parked underneath**

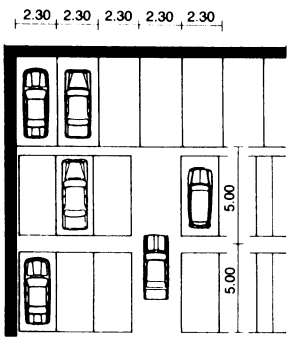


⑥ **Private parking, 3 cars stacked vertically**

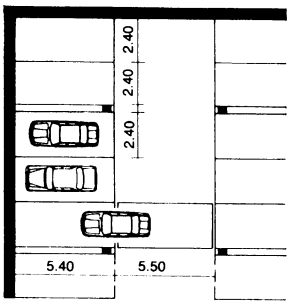
In individual garages, two cars can be parked with one above the other by means of mobile platforms → ① + ②. These are electrically operated, but in event of a power failure they can also be actuated by a hand pump. A parking lift for up to three cars → ⑥, serving a row of garages in a courtyard or multistoreyed car-park, can be operated from a control console by the doorman. The maximum loading for each parking place is 2500 kg. The gradient for both entry and exit lanes of the garage is ≤14%. The systems shown in → ⑦ – ⑩ place cars on pallets, which are then manoeuvred from a control console, thereby ensuring that the access is kept free.

A car-moving pallet → ⑧ moves the car on a platform via the central corridor of the garage to its parking place or to the lift or exit. Parking pallets used lengthways or sideways can improve parking capacity by 50–80% → ⑦ – ⑩.

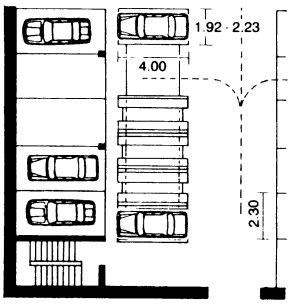
Garage lift systems → ⑬ – ⑭ make the best use of space. The drivers themselves can control these with key switches in the entrance area. These garages can be up to 20 storeys high and hydraulic lifts are used for up to 10 storeys. As the car-park is not used by pedestrians, the height of each storey can be reduced to ≥ 2.10 m. This type of garage saves space, is safe in operation, has low noise levels, is environmentally friendly and is free of exhaust gases. 40–80 cars can be handled by each lift. The average time for entry to, or exit from, the parking place is 1–2 minutes. Transverse stackers → ⑫ are used in extremely narrow areas.



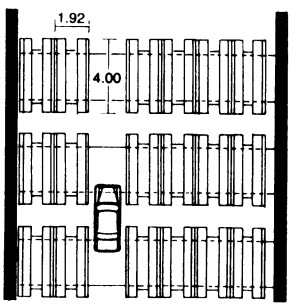
⑦ **Parking using pallets (Wöhr system)**



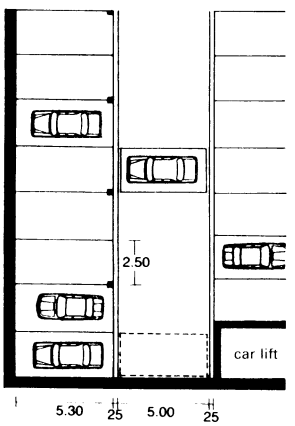
⑧ **Cars moved on pallets (Wöhr system)**



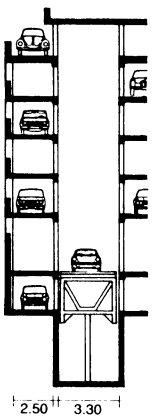
⑨ **Moving parking pallets (Klaus system)**



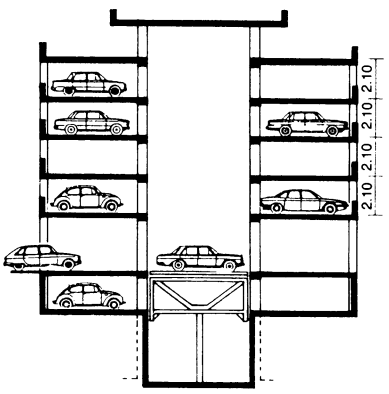
⑩ **Pallets moving along rows (Klaus system)**



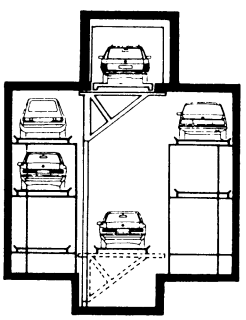
⑪ **Plan of garage lift system** → ⑫ – ⑬



⑫ **Transverse stacking**

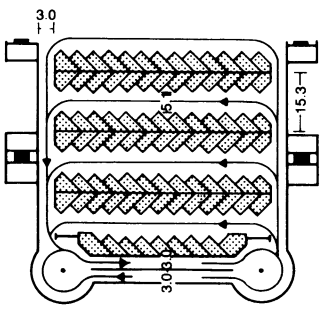


⑬ **Cross-section** → ⑪



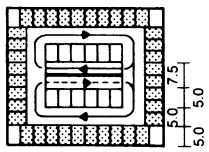
⑭ **Parksafe system**

CAR-PARKS

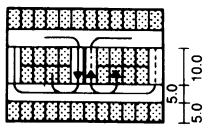


Architect: H Hertlein

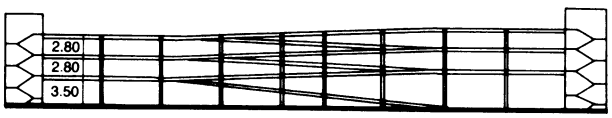
① **Large garage at Siemens**



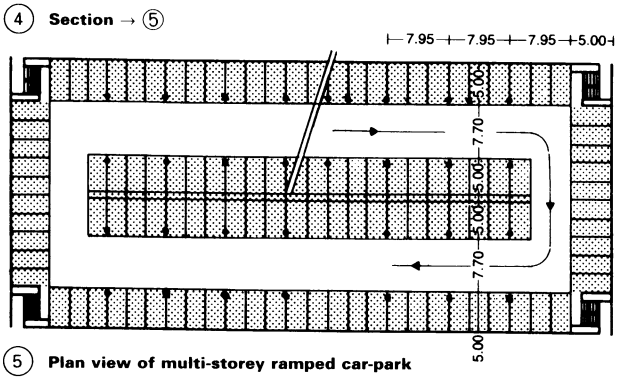
② **Longitudinal ramp**



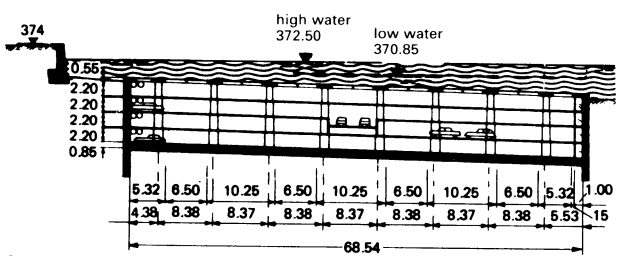
③ **Transverse ramp**



④ **Section → ⑤**



⑤ **Plan view of multi-storey ramped car-park**



⑥ **Cross-section of ⑧**

In accordance with the regulations applicable to garages:

- small garages are defined as those with ≤100 m² effective area;
- medium garages are those with 100–1000 m² effective area;
- large garages are those with ≥1000 m² effective area.

Underground garages are defined as those with the floor level on average ≥1.30 m below the surface of the ground.

Separate entrances and exits must be provided for large garages. These garages are normally located close to points of major traffic congestion such as railway stations, airports, shopping centres, theatres, cinemas, office and administration blocks and large residential buildings.

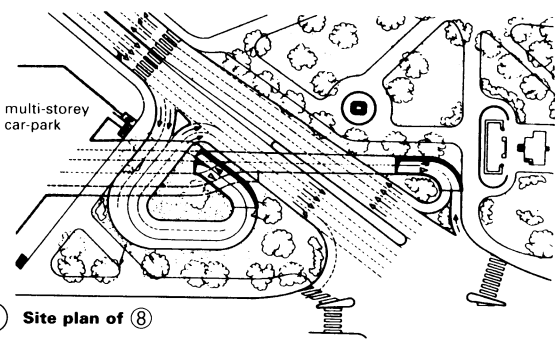
Medium and large garages must be located in easily accessible areas, have a clear headroom of 2.00 m, even below the main beams, ventilation ducts and other structural components. On the ground floor, this clear headroom is normally larger, as the space is often used for other purposes.

To accommodate small transport vehicles, this height should be 2.50 m. Floor loadings must be in accordance with local standards. Open garages have openings which cannot be closed (equal in size to one third of the total area of the outside walls) leading directly into the open air and divided in such a way that there is continuous through-ventilation, even in the presence of weather screening.

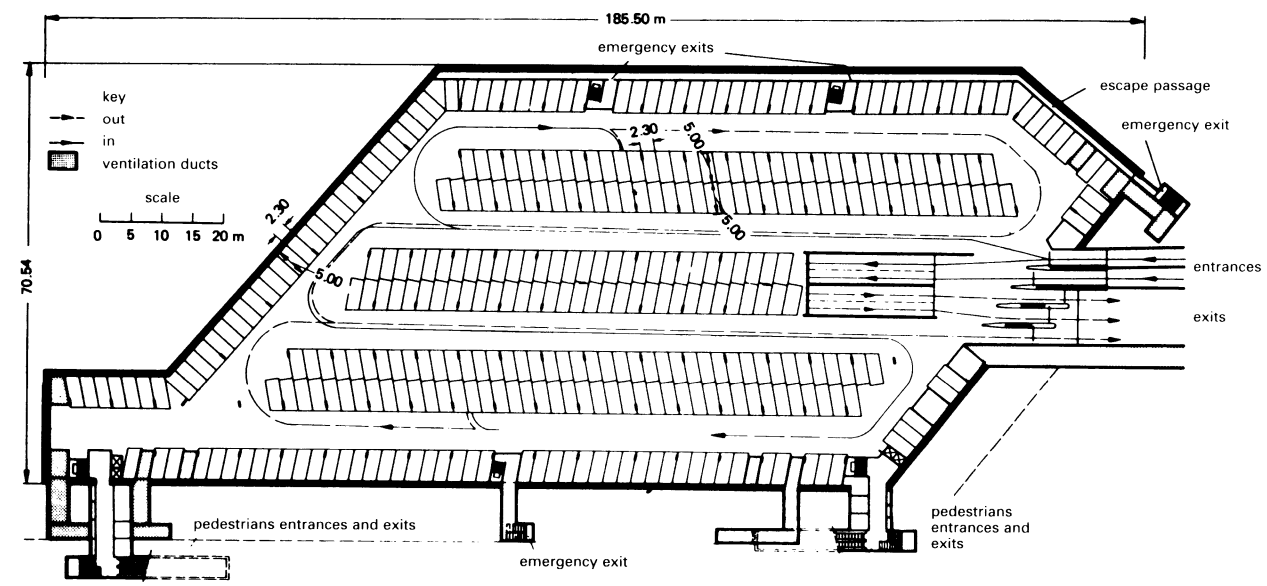
There is an ingenious example of a car-park in the centre of Geneva beneath the river Rhone. The entrance and exit points are on the approaches to the Rhone bridge → ⑦. Vehicles can easily filter in and out of the traffic flow by means of access ramps on both sides. All storeys are accessed by a right-hand drive up a central sloping ramp → ⑦ – ⑧. No staff are necessary as there are automatic parking ticket machines in use.

The criteria for the quality of multistorey car-parks are: safety in use, clear visibility, parking-space marking to enable drivers to remember the location of their vehicles, and integration into the context of town planning.

Other factors to be considered are: natural lighting and ventilation, clear views to the outside, plants and greenery and a simple system of collecting charges.



⑦ **Site plan of ⑧**



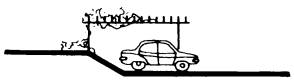
design and construction: C.Zschokke

⑧ **Under lake car-park in Geneva, Switzerland, Plan view of 1st floor. 372 parking spaces**

CAR-PARKS

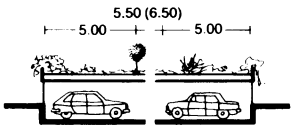
① **Banking**

② **Earth wall**

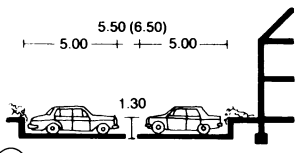


③ **Plant cover**

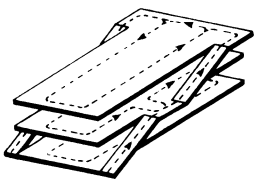
④ **Canopy (for sound-proofing)**



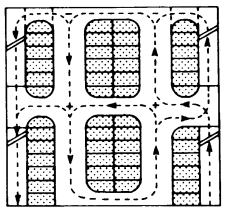
⑤ **Roofed over**



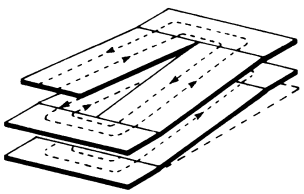
⑥ **At a lower level**



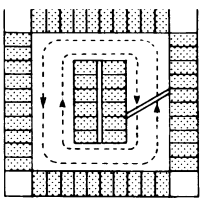
⑦ **Multi-storey structure with full ramps**



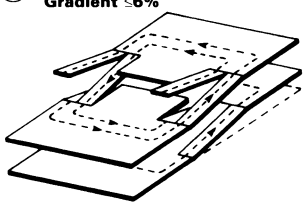
⑧ **Plan view → ⑦**



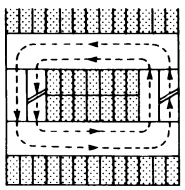
⑨ **Full ramps, no loss of space Gradient ≤6%**



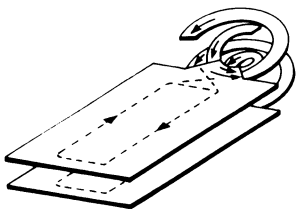
⑩ **Plan view → ⑨**



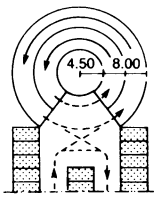
⑪ **Half-storey ramp car-park (D'Humy system)**



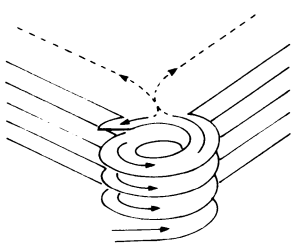
⑫ **Plan view → ⑪**



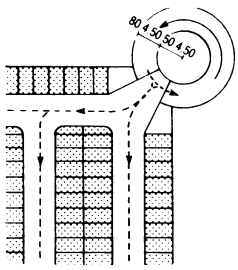
⑬ **Spiral ramp car-park**



⑭ **Plan view → ⑬. The smaller the ramp radius, the wider the lane**



⑮ **Separate circular towers for ramps at the corners**



⑯ **Plan view → ⑮**

Examples → ① - ⑥ show how parking spaces can be creatively integrated into their surroundings without restricting their use. Parking spaces can be completely or partially sunken or provided with roof planting to increase the area of open space → ③ - ⑤. Planting not only enhances the look of the area, but also provides shade and improves the environment by absorbing dust.

There are various ramp systems for gaining access to upper and lower floors of car-parks. The gradients of the ramps should not exceed 15%, or in the case of small garages 20%. A horizontal run of more than 5 m must be included between an area carrying general traffic and ramps with more than 5% gradient. For car ramps the run must be more than 3 m long, with ramps that can be up to 10% gradient. The options available for the arrangement and design of ramps can be summarised under four main headings → ⑦ - ⑭:

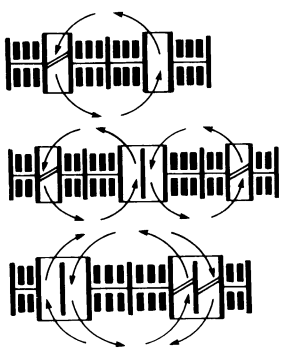
(1) straight, parallel and continuous multi-storey ramps with intermediate landings, with separate ramps for up and down traffic located at opposite ends → ⑦ - ⑧;

(2) sloping floors, with a full width ramp with no loss of space. The entire car-park structure consists of sloping levels. A space-saving system is shown → ⑨ - ⑩ with a gradient of more than 6%;

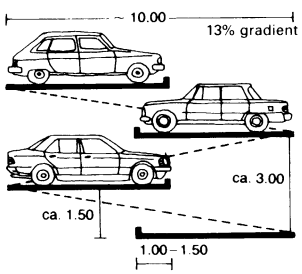
(3) offset half storeys (D'Humy ramps); parking areas are offset half storeys, height is gained by the use of short ramps ⑪ - ⑫ and → ⑰ - ⑱;

(4) spiral ramps - a relatively expensive design which lacks good visibility. The circular shape makes poor use of remaining areas → ⑬ - ⑯ and → ⑲ and ⑳. Spiral ramps must have a transverse gradient of more than 3%. The radius of the edge of the inner lane must be more than 5 m. In large garages where special pedestrian routes are not provided, the ramps that are used by both vehicles and pedestrians must have a raised pavement at least 80 cm wide. Medium-sized and large garages must have the following minimum width of lanes at entrances and exits:

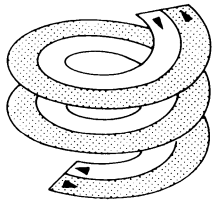
- 3 m when used by vehicles up to 2 m wide;
- 3.5 m when used by wider vehicles.



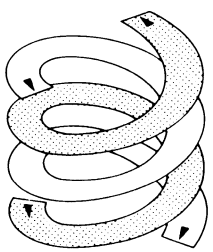
⑰ **Basic forms of D'Humy ramp Ramps have 13–15% gradient**



⑱ **Dovetailing of storeys → ⑪ - ⑫**

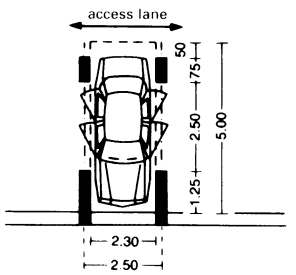


⑲ **Spiral ramp, adjacent up and down lanes**

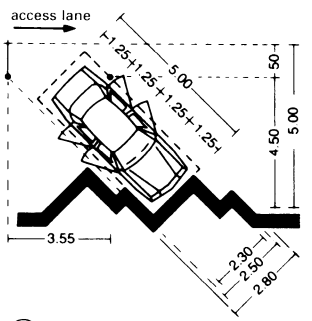


⑳ **Double spiral ramps, superimposed up and down lanes**

CAR-PARKS



① **Possible column positions, parking at 90° to access lane**

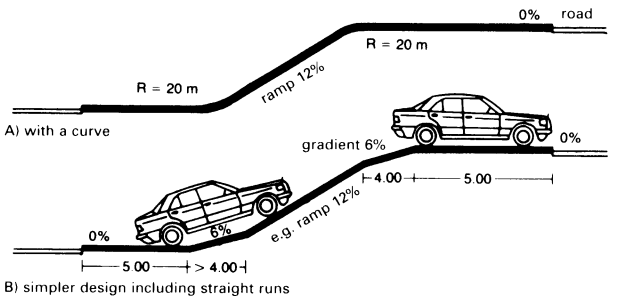


② **Parking at 45° to access lane**

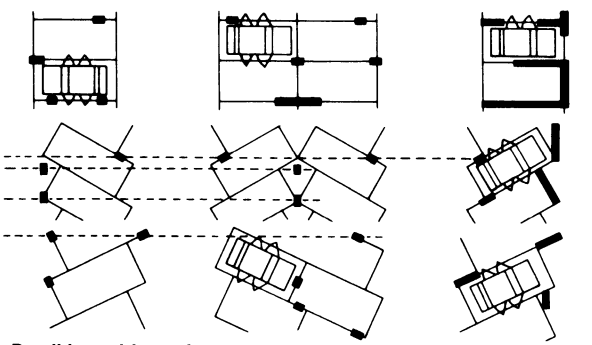
All the load bearing components of multistorey car-parks (floors, walls, support columns, bracing) must be fire-resistant. Garages open to the air must be of fire retardant design. The recommended clearance height in multistorey and basement garages is 2.20m. It is sensible to allow an extra 25cm for directional signs for drivers and pedestrians. A further 5cm is required for subsequent repair coats to the wearing surface, giving a total mean height of 2.50m, plus structures above the access lanes, which means a height per storey of 2.75–3.50m, depending upon the choice of design. A relatively narrow column grid pattern can, with careful planning and design, reduce building costs and height without any loss of function → ① + ②. Long span structures with no columns take up 7–12% less floor area than those with conventional support columns → ④.

Gradients and ramps must be appropriately shaped and designed → ③. Straight or spiral parking ramps are constructed by sloping the floor. With a spiral shape → ⑥, you can have vehicles on both sides of the ramp. In ⑧ it can be seen that the area required for a given number of cars to be parked, including the area required for manoeuvring, can be determined at the preliminary design stage. Layouts of multistoried garages and arrangements of ramps are shown → ⑦. These include two offset double rows of parked vehicles, four rows, six rows, parking in a corner, ramps in the direction of traffic, a multistorey car-park with ramps and finally one with parking on a continuous helical ramp.

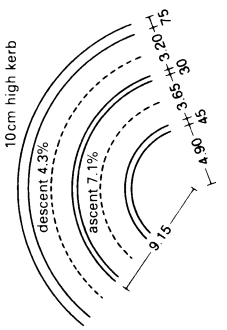
Reinforced concrete structures (with concrete mixed on site, pre-cast sections or hybrid construction) best meet the requirements for fire protection. As a rule, steel structures provide the main and subsidiary support systems and must be protected from fire with concrete, fire resistant cladding or other fire-proofing coatings. In garages, high loads should be allowed for, in addition to permitted superimposed loads of motor vehicles of 3.5kN/m², and of ramps 5kN/m². Roofs with gardens on top have to be designed for a loading of 10kN/m².



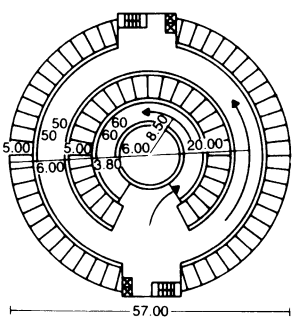
③ **Change of gradient on ramps**



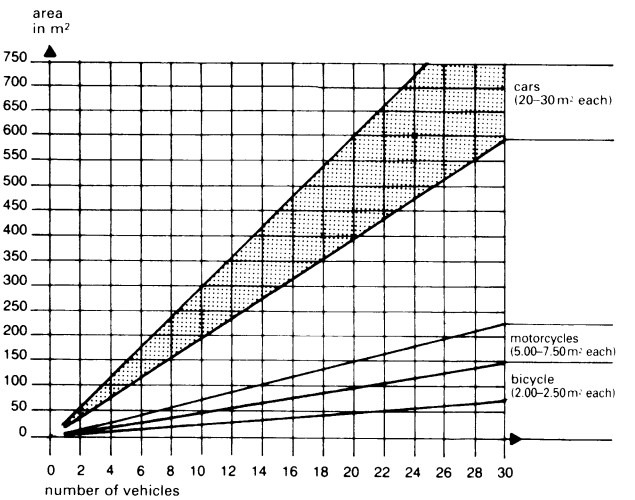
④ **Possible positions of columns**



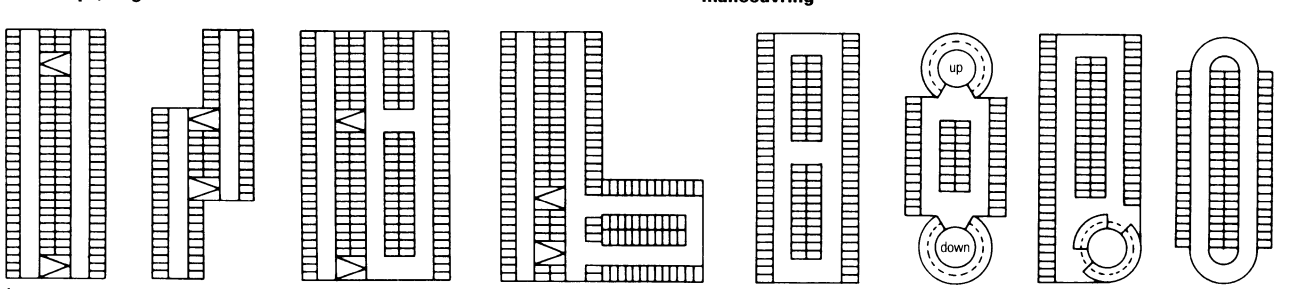
⑤ **With smaller radius of ramps, larger lane widths**



⑥ **Spiral parking ramp**

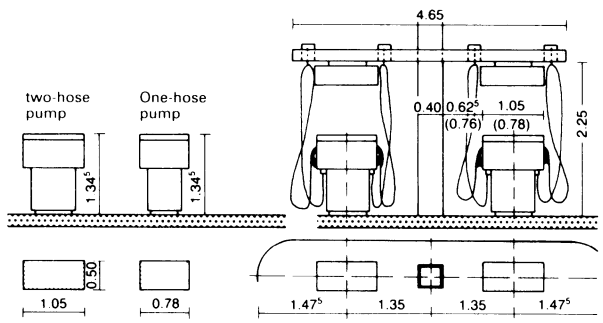


⑧ **Area required for parking spaces, including room for manoeuvring**

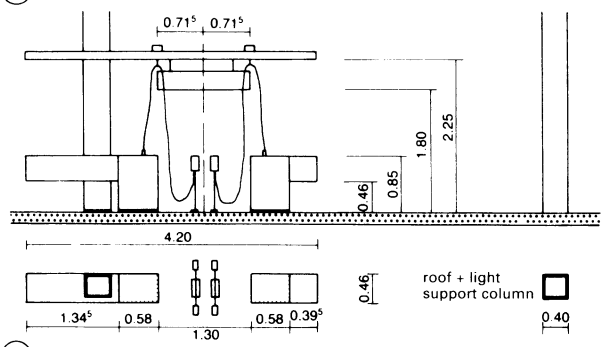


⑦ **Plan views and arrangement of ramps**

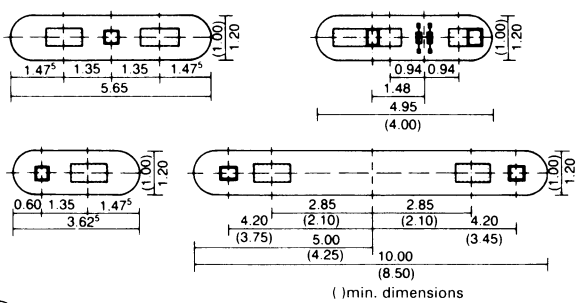
FILLING STATIONS



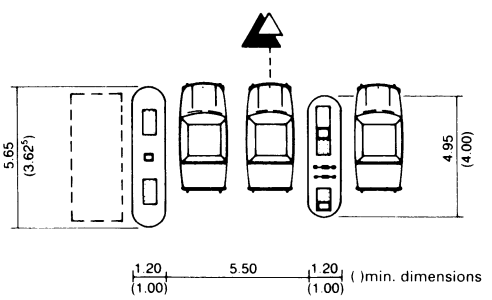
① **Pumps**



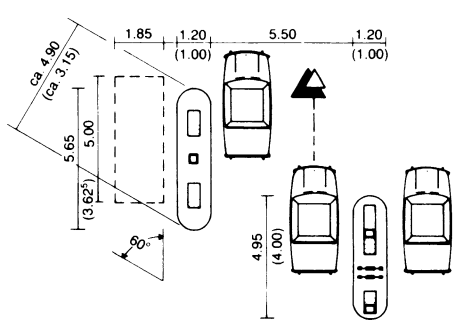
② **Single-fuel pump**



③ **Pump island dimensions**



④ **2 short islands, parallel to the roadway**



⑤ **2 short islands, <60° to the roadway**
( ) minimum dimensions

Filling stations may be combined with other commercial services. The driver can therefore obtain fuel, oil, service and maintenance, repair work, car accessories and other goods all from one location.

If there are a number of filling stations on the same stretch of road, there should be ≥100m between any two, or 250m if the road carries heavy traffic.

On the open road, outside town limits, there should be one filling station for approximately every 25km.

A plot size of about 800m² is sufficient for a basic filling station, whereas one with service facilities will require about 1000m² and a large installation usually needs up to 2000m².

In the last 10 years the range of petrol available at filling stations has increased. Most stations now offer a variety of types petrol as well as diesel. The design of filling stations should be flexible enough to accommodate future requirements.

Filling stations should be easy to turn in to, easily visible, recognisable from a distance and located as near to the road as possible. They should almost never be built in the town centre, but rather on exit roads from the town, by-passes and trunk roads and not where queues build up before a set of traffic lights. It is not good practice to site filling stations at street corners. A better answer is to site them just before a corner, so that customers can drive out of the station into a side road.

Drivers should be able to refuel their cars, check and, where necessary, top up engine oil, cooling water, tyre pressure and battery fluid. Other services should be available, such as: checking the contents of the windscreen-washer bottle; cleaning the windscreen, headlights and hands; purchasing goods; using telephones and toilets and other facilities; as well as facilities for car washing, vacuum cleaning etc.

The building line and sight line, boundary distances etc., which are shown in the development plan, must be strictly observed, as well as those terms and conditions which form an integral part of the building regulations.

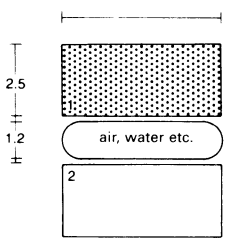
Typically, there are rules which govern the following:

- the size of short-term/long-term parking spaces (i.e. 2.50m × 5.00m = 12.50m²);
- the number of parking spaces required (this is dependent upon the number of employees working at the station, in the workshops and on the pumps); and
- the space necessary for the queue at the automatic carwash (e.g. space required has to be sufficient for 50% of the hourly throughput of the carwash).

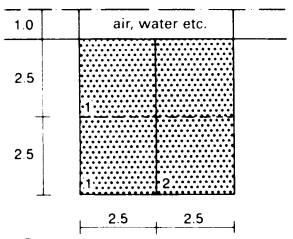
In accordance with the development plan, consideration must be given to the nominal dimensions laid down for motor vehicles, i.e.

turning circle:	car	12.50m
turning circle:	truck	26.00m
vehicle width:	car	1.85m
vehicle width:	truck	2.50m
vehicle length:	car	5.00m
vehicle length:	articulated truck	18.00m

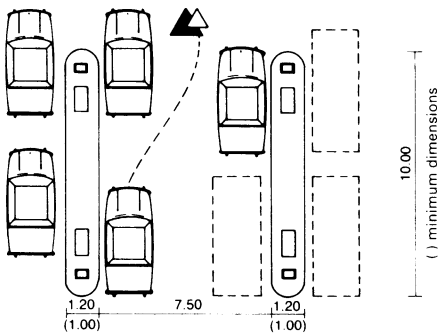
Taking these figures as a basis, the appropriate dimensions of the pump islands and widths of the approach roads can be calculated.



⑥ **Supply for air, water etc.**

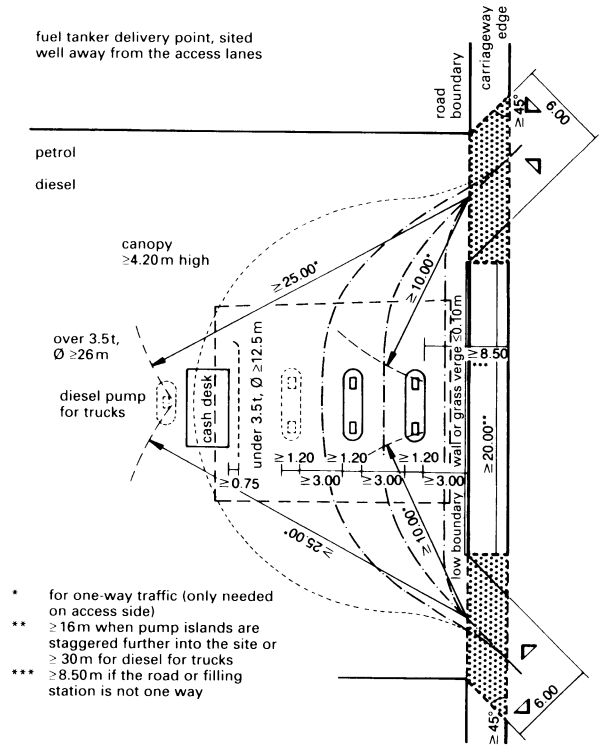


⑦ **Supply for air, water etc.**

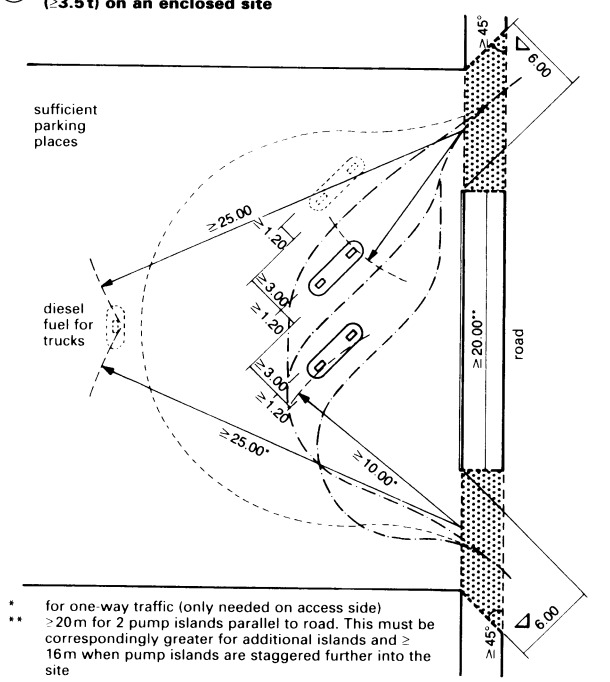


⑧ **2 long islands parallel to the roadway**
(this requires good driving skills)

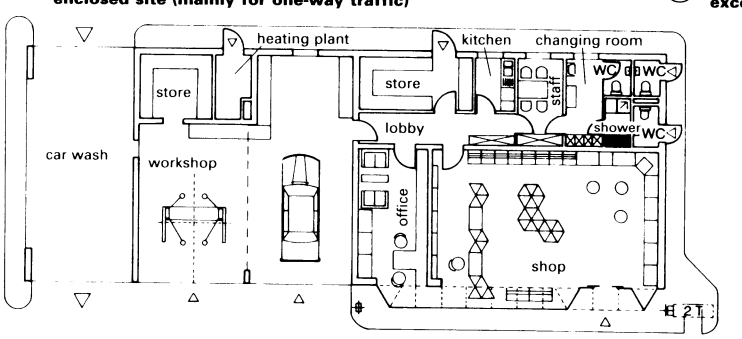
FILLING STATIONS



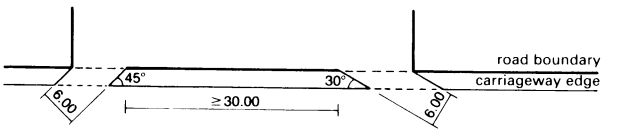
(1) **Filling station for petrol and separate diesel fuel for trucks (≥3.5t) on an enclosed site**



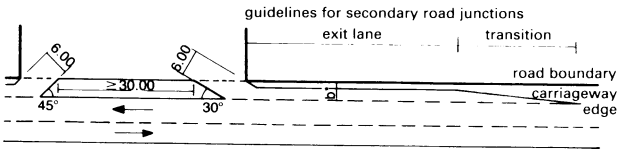
(2) **Filling station with fuel pump islands obliquely angled in an enclosed site (mainly for one-way traffic)**



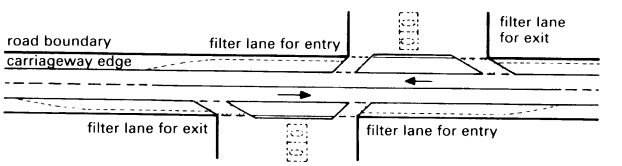
(3) **Plan of filling station with car wash and sales area**



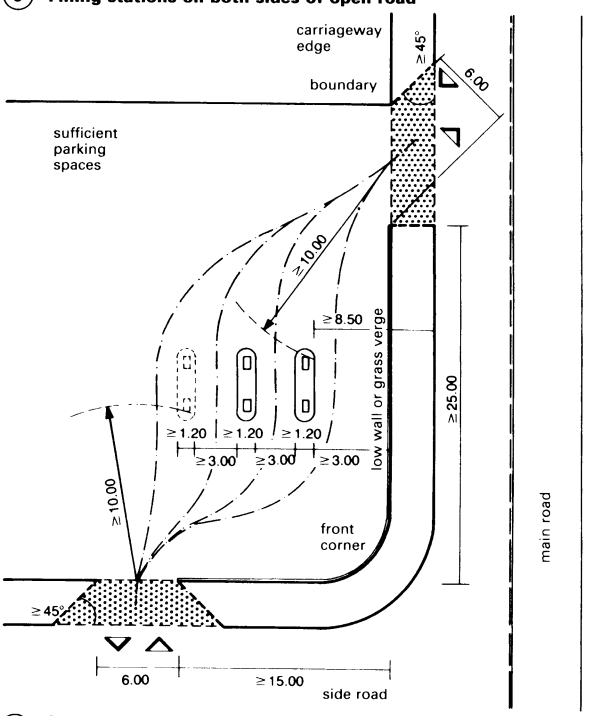
(4) **Without slip-roads in and out of traffic stream**



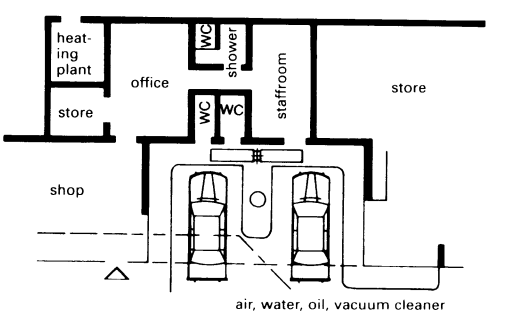
(5) **Filling station entrance and exit off an open road**



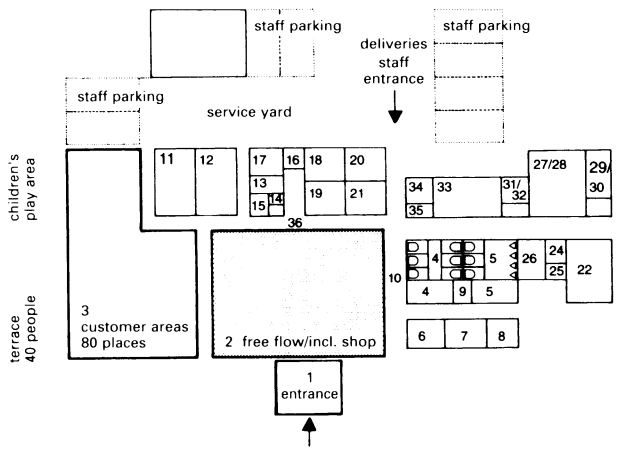
(6) **Filling stations on both sides of open road**



(7) **Corner filling station on an enclosed site. This is used only in exceptional cases, and usually not suitable for trucks**

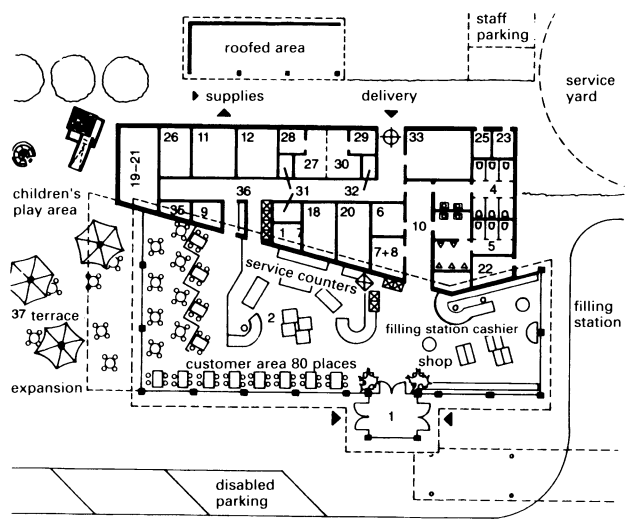


(8) **Fast-service station**

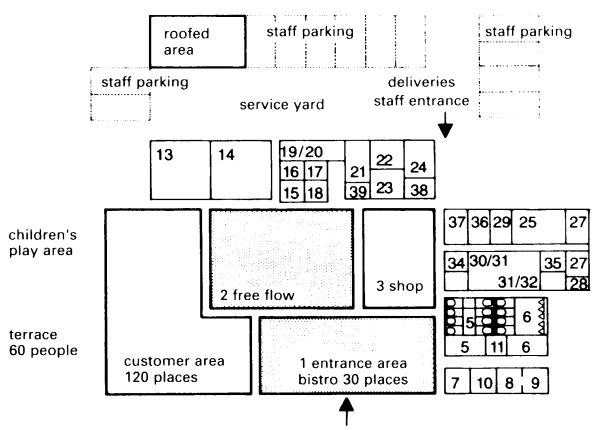


CUSTOMER AREA	approx. m²
Sales area	**270.0**
1 entrance	20.0
2 free-flow incl. shop	120.0
3 customer area 80 places	130.0
customer rooms	**70.2**
4 WC female	20.0
5 WC male	17.0
6 disabled toilets	6.0
7 shower room	5.0
8 baby changing room	4.0
9 cleaners' room 1 customer area	2.0
10 corridors of customer area, 30% of areas 4–9	16.2
SERVICE AREA	
Storage area	**68.0**
11 washing-up area	15.0
12 food preparation	15.0
13 chilled vegetable store	4.0
14 dairy and delicatessen refrigerators	1.0
15 meat cold store /or delicatessen refrigerators	2.0
16 chilling room	2.0
17 deep freeze rooms	5.0
18 drinks cold store	6.0
19/20/21 dry stores	18.0
Services	**58.0**
22 services/heating	15.0
23 ventilation plant (or in roof space or on flat roof)	30.0
24 electrics	5.0
25 switchgear and meters	8.0
Administration/staff	**134.7**
26 staff rest room	6.0
27/28 changing room male/female	22.0
29/30 staff wash room male/female	8.0
31/32 staff toilets male/female	3.0
33 office	30.0
34 files	4.0
35 cleaners' room 2 service area	1.5
36 corridors of service area, 30% of areas 11–35	60.2
Net floor area	**600.9**
37 terrace 40 seating places	80.0

(1) **Functional diagram of a service station for 80 people** → (2)

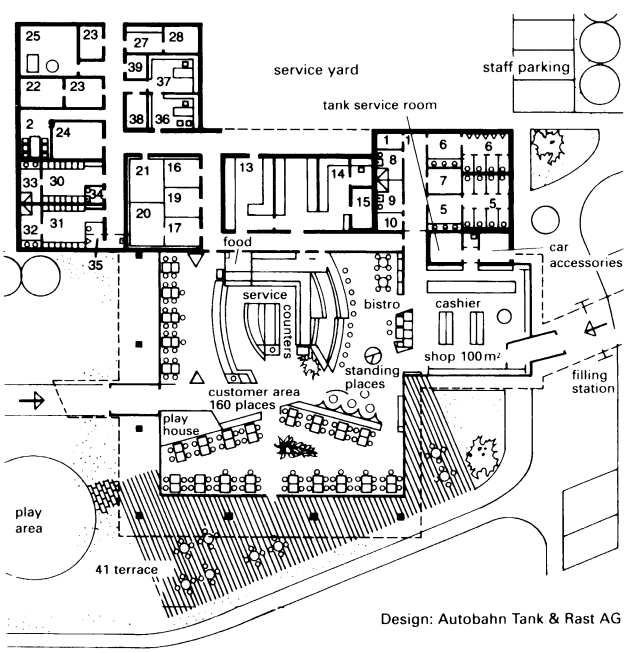


(2) **Petrol and service station for 80 people**



CUSTOMER AREA	approx. m²
Sales area	**480.0**
1 entrance area, bistro 30 seating places	120.0
2 free flow	120.0
3 shop	60.0
4 customer area 120 places	180.0
customer rooms	**99.1**
5 WC female	27.0
6 WC male	24.0
7 disabled toilets	6.0
8/9 shower room	10.0
10 baby changing room	4.0
11 cleaners' room 1 customer area	2.0
12 corridors of customer area, 22% of areas 5–11	18.1
SERVICE AREA	
Storage area	**121.0**
13 washing-up area	30.0
14 preparation	28.0
15 cold room	4.0
16/17 dairy/vegetable cold store	8.0
18 chilling room	3.0
19/20 meat cold store and deep freeze room	12.0
21 drinks cold store	10.0
22/23/24 dry stores	26.0
Services	**84.0**
25 services/heating	20.0
26 ventilation plant (or in roof space or on flat roof)	40.0
27 air conditioning	10.0
27 electrics	6.0
28 switchgear and meters	8.0
Administration/staff	**158.6**
29 staff rest room	10.0
30/31 changing room male/female	32.0
32/33 staff wash room male/female	8.0
34/35 staff toilets male/female	7.0
36/37 office	29.0
38 files	5.0
39 cleaners' room 2 service area	2.0
40 corridors of service area, 22% of areas 13–39	85.0
Net floor area	**932.7**
41 terrace 60 seating places	120.0

(3) **Functional diagram of a service station for 150 people** → (4)



Design: Autobahn Tank & Rast AG

(4) **Petrol and service station for 150 people**