Technical Requirements of Cars Parking in Saudi Arabia
(English Translation of the Document sent earlier)

Objectives of the Study:
Preparation of criteria, technical bases and general requirements for car parking

1- CLASSIFICATION OF CAR PARKING

1-1 Parks besides the pavement
1-2 Lots (surface) parking
These will be constructed on the level of land surface as parking for markets or public buildings or those parking on the ground floor in some buildings.

1-3 Parking under the buildings (basement parking)
These are constructed under the level of the ground floor of the building and connected with the land surface through suitable ramps for in entry and exit.

1-4 Multiple floor parking
This is composed of a number of floors, and is used in public places which are visited by people many times like commercial areas.

1-5 Handicapped Parking

2- DESIGN OF PARKING

2-1 Planning Criteria for Cars Parking
The number of car parking for each activity is identified according to the planning criteria confirmed by the concerned municipality and actual need.

2-2 Design Prerequisites for Parking beside the Pavements / Sidewalks
The parking besides the streets pavements can be divided into two types as follows:
- The parallel parking and incline parking

These are prerequisites for each type as follows:-

2-2-1 Design Prerequisites for Parallel Parking
- Parallel parking is considered one of the most used designs in parking beside the pavement, and the prerequisites are shown in Figures 1 and 2.
- The distance from the intersection of roads and the first car should not be less then 6 meters in secondary roads, and not less than 15 m on the main streets.
- The distance identified for cars parking is 6.5 m.
- The minimum width of the lane is one direction in which it is allowable for parallel parking beside pavements is 5.5 m in each direction (including 2.5 m for parking and 3.0 m for vehicle traffic).
2-2-2 Design Prerequisites for Angular Parking

Angular parking is considered in general of the parking which is not preferable beside pavements, and generally they are used in lots of lands which are allotted for cars parking. If
they are used in streets, the streets should be wide and handles low volume of traffic. The prerequisites here are shown in Figure 3.

- The lowest limit for the inclined parking from the intersections of the road is 9 meters in the beginning of the road and 12 meters at the end of the road.
- The distance allotted for car parking is 5.5 meters.

![Figure-3](image)

2-3 Parking Lots Design Prerequisites

2-3-1 Entrance and Exits

- Entrance and exits should be away from the streets intersections, so that they can not affect the traffic.
- Entrance and exits should be placed on the right side in the centre of the building in the streets as shown in Figure 4.
- Entrance and exits should not contradict with normal traffic in the streets.
- In case the streets are one direction, it is suggested that entrance and exits should be on the left of the streets, because turning to the left is easier than to turn to right.
- The width of the entrance or out should not be less than 3.5 meters.
- In case, if the entrance and exits are both through one opening, the width of the opening should not be less than 7.5 meters, and there should be a barrier for traffic not less than 0.5 m.
2-3-2 Parking Design Criteria

a) Dimensions
A space for one car should be allotted (normal passenger car) so that the car can move easily when it enters the parking or get out it.
- The following dimension identify the minimum limit for the suitable dimensions for parking for any type of passengers cars as it is shown in the Figure 5.
  - Length  =  5.50 m.
  - Width   =  2.60 m.
- In case of parallel parking, the length should be 6.5 m and width 2.5 m.
- The parking should be with tilted angle ($n$) from the pavement: and there are the distances which help the designer to deduct the distances and areas engaged by the cars after identifying the required angle of inclination, as it is explained in the Figure 6 and Table 1.

![Figure-4](image-url)
Figure-5

Figure-6
Table-1: Parking Dimensions for Different Angles

<table>
<thead>
<tr>
<th>Parking Angle</th>
<th>30°</th>
<th>45°</th>
<th>60°</th>
<th>75°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>أ</td>
<td>2.25</td>
<td>1.84</td>
<td>1.30</td>
<td>0.67</td>
<td>0</td>
</tr>
<tr>
<td>ب</td>
<td>2.75</td>
<td>3.89</td>
<td>4.76</td>
<td>5.31</td>
<td>5.50</td>
</tr>
<tr>
<td>ج</td>
<td>5.20</td>
<td>3.68</td>
<td>3.00</td>
<td>2.69</td>
<td>2.60</td>
</tr>
<tr>
<td>د</td>
<td>3.90</td>
<td>1.84</td>
<td>0.75</td>
<td>0.18</td>
<td>0</td>
</tr>
<tr>
<td>ه</td>
<td>1.30</td>
<td>1.84</td>
<td>2.25</td>
<td>2.51</td>
<td>2.60</td>
</tr>
<tr>
<td>烏</td>
<td>4.76</td>
<td>3.89</td>
<td>2.75</td>
<td>1.42</td>
<td>0</td>
</tr>
<tr>
<td>突</td>
<td>4.76</td>
<td>3.89</td>
<td>2.75</td>
<td>1.42</td>
<td>0</td>
</tr>
<tr>
<td>ح</td>
<td>6.35</td>
<td>7.78</td>
<td>11.00</td>
<td>21.25</td>
<td>-</td>
</tr>
<tr>
<td>戟</td>
<td>2.75</td>
<td>3.89</td>
<td>4.76</td>
<td>5.31</td>
<td>5.50</td>
</tr>
<tr>
<td>巴</td>
<td>9.96</td>
<td>7.57</td>
<td>5.75</td>
<td>4.11</td>
<td>2.60</td>
</tr>
<tr>
<td>捷</td>
<td>6.06</td>
<td>5.73</td>
<td>5.00</td>
<td>3.93</td>
<td>2.60</td>
</tr>
<tr>
<td>咸</td>
<td>1.59</td>
<td>3.89</td>
<td>8.25</td>
<td>19.83</td>
<td>-</td>
</tr>
<tr>
<td>汝</td>
<td>5.00</td>
<td>5.73</td>
<td>6.06</td>
<td>5.98</td>
<td>5.50</td>
</tr>
<tr>
<td>晋</td>
<td>4.50</td>
<td>2.60</td>
<td>1.50</td>
<td>0.70</td>
<td>-</td>
</tr>
<tr>
<td>败</td>
<td>3.18</td>
<td>5.50</td>
<td>9.53</td>
<td>20.53</td>
<td>-</td>
</tr>
</tbody>
</table>

b) Lanes
The suitable distance for cars traffic in the parking and entering the identified lots for parking and leaving these places without any accidents or traffic problems, the following measures should be considered:

- The relation of the angle of inclination of the parking with the width of the lanes as shown in the Table 2.
- The width of the other lanes in the parking in one direction should not be less than 4.5 m.

Table-2: Relationship between Parking Angles and Aisle Width

<table>
<thead>
<tr>
<th>Parking Angle</th>
<th>One-Way Aisle Width (m)</th>
<th>Two-Way Aisle Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (Parallel)</td>
<td>5.5</td>
<td>6.71</td>
</tr>
<tr>
<td>30°</td>
<td>4.57</td>
<td>6.71</td>
</tr>
<tr>
<td>45°</td>
<td>4.57</td>
<td>6.71</td>
</tr>
<tr>
<td>60°</td>
<td>5.50</td>
<td>7.92</td>
</tr>
<tr>
<td>75°</td>
<td>6.71</td>
<td>7.92</td>
</tr>
<tr>
<td>90°</td>
<td>7.33</td>
<td>7.92</td>
</tr>
</tbody>
</table>
c) Angle of deviation
The angle of deviation of cars parking ranges between (0° – 90°), and the angle of deviation which are commonly used are: (0 – 30, 45, 65, 70, 90), angle (0) refers to the parking parallel to the pavement

d) Curves
Its measures include suitable turning of cars and their safety switch inside the parking when in and out it is as follows:

1 – Curve with one direction traffic
It should be noticed that its distance should be as explained in the Table 3 and Figure 7.

Table-3: Dimensions for 1 way Ramp

<table>
<thead>
<tr>
<th>Min RampWidth</th>
<th>Min Inner Radius</th>
<th>Outer Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.50 m</td>
<td>2.60 m</td>
<td>6.10 m</td>
</tr>
</tbody>
</table>

Figure 7

2- Curve with two directions:
Its dimensions should be as shown in Table 4 and Figure 8, and in this type, separation is must between traffic in the curve in which the separation should not exceed 1.0 m.

Table-4: Dimensions for 2 way Ramp

<table>
<thead>
<tr>
<th>Min RampWidth</th>
<th>Min Inner Radius</th>
<th>Outer Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.00 m</td>
<td>2.60 m</td>
<td>9.60 m</td>
</tr>
</tbody>
</table>
2-3-3 Cars traffic inside parking

The duration of cars traffic must be short and safe, and all available parking areas can be noticed.
2-4 Prerequisites of parking design under the building (Basement Parking)

a) The width entrance or exit should not be less than 3.5 m.
b) In case, if both entrance and exit are through one opening, the width of the opening should not be less than 7.5 meters, and there should be a barrier for traffic not less than 0.5 m.
c) The location of the cars parking entrance or exit should be chosen to ensure traffic safety in the streets around the parking, it should be located as far as possible away from the intersection and highways. See Figure 11.
d) To ensure clear vision when moving out of the parking, refer Figure 12.
e) The net height which allows the traffic of cars whether in the basement or the ground floor or any of the multiple floors in the parking, should not be less than 2.50 m.
f) The height of the opening for entrance and exit of the parking should not be less than 2.5 m.

2-5 Prerequisites of parking design for Multiple Floors

2-5-1 Location of Parking

The location should be away from the intersection, and if preferable to be between the buildings to prevent congestion on the streets.

2-5-2 Parking Entrances and Exits

a) Entrance

The design of the entrance depends on if the parking will be self-service or with the help of an employee, and when the parking is self-service the vehicles will move smoothly.
These types of parking provide an average flow ranges between 300-500 cars per hour. When the parking operates with the help of an employee, there should space for storing cars, and this (reserve space) depends on the overage percentage of the arrival of the customer and the average service of the parking worker. Figure 13 shows the required reserve area for the average arrival of cars. For example at the peak hour, if one car arrives every 50 seconds and takes 45 seconds for the worker to settle it in the parking, then the percentage of arrival and average of storage in this case will be as follows:

$$\frac{3600}{50} = 72$$ and
3600/45 = 80 cars / hour.

Hence the percentage of parking storage will be 80/72 = 1.11 time from percentage of arrival, and form the Figure 13 the reserve area requires 14 car capacities.

b) Exits
At parking exits, there should be a worker in a cabinet who uses the card and collect the fare, and on this basis, the average exit of cars will be identified as less than 250 cars / hour. To increase this average, various ways to collect the fare were developed, which leads to increase the average exit of cars from 300 to 500 car / hour.

2-5-3 Design of Ramps for Floors

a) Ramps:
These are the grade surface which enables the cars to move form one level to another and it guarantees accurate and safe up and down movements of cars to provide suitable grades. Table 5 explains types of various ramps in parking.

![Figure-13]
Table 5: Types and Dimensions of Ramps

<table>
<thead>
<tr>
<th>Ramp Type</th>
<th>Min RampWidth (1 direction)</th>
<th>Min RampWidth (2 separate directions)</th>
<th>Inner Radius</th>
<th>Outer Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight</td>
<td>3.66 m</td>
<td>7.32 m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Curved</td>
<td>4.90 m</td>
<td>9.80 m</td>
<td>1 Direction 5.5 m</td>
<td>1 Direction 10.40 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Directions 5.5 m*</td>
<td>2 Directions 15.3 m*</td>
</tr>
<tr>
<td>Clock Wise Spiral</td>
<td>6.10 m</td>
<td>12.20 m</td>
<td>5.18 m</td>
<td>1 Direction 11.28 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Directions 17.38 m</td>
</tr>
<tr>
<td>Counter Clock Wise Spiral</td>
<td>4.57 &amp; not less than 3.96 m for Upgrade.</td>
<td>9.14 m</td>
<td>5.18 m</td>
<td>1 Direction 9.57 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Directions 14.32 m</td>
</tr>
</tbody>
</table>

1- Straight Ramps
This is used for entrance and exits in parking to make easy in and out and clear vision.

- This grade should not exceed 15%.
- In case of increase in grade than 15%, there must be two stages of transfer in the start and end of the grade, and the grade of each should not exceed 15% and the length of each should not exceed 5 m, with transfer stage in the middle connected them, and its grade should not exceed 18% as explained in Figure 14.
- When using ramps to join the parking floors only, the grade should be between (10 – 13%).
- In case of using ramps for car parking, the grade should be between 5 and 8%. See Figure 14.

![Figure 14](image-url)
2- Spiral Ramps

The grade of the spiral ramps in one direction up or down should not exceed (12%), as explained in Figure 15.

- Half the diameter of the internal spiral ramp should not be less then (5.18 meters) as explained in Figure 15.
- The width of the spiral ramp should not be less then (6.1 meter) when the traffic is in direction of clockwise.

Spiral Ramps with Two Directions

- the width of the spiral ramp in the direction clockwise = 6.1 m
- The width of the spiral ramp in the direction anti clockwise = 4.57 m and not less then 3.97 m for upward movement.

Spiral Ramps with One Direction:

- The width of the curve in the direction clockwise = 6.1 m.
- The width of the curve in the direction anticlockwise = 4.57 m.
b) Design of floors:-
It’s preferred that the floors should be horizontal, the net height not less than 2.5 m, and the height of the ground floor 3.75 m to allow for high vehicles. The area to be engaged by the car should be from 27.5 – 37.2 square meters.

2-5-4 Internal Signs

As cars parking are considered extension to the road by stem, there is a need for guiding signs, and these should be consistent with the standard signs in streets. These signs should be designed after completing the parking. The study recommended is driving inside the parking with a car after it is completed. The location of these signs to be specified according to the lines, the location of stopped cars, vision hindering like anti rays and pillars. See Figure 15.
2-5-5 Lifts

a) All lifts should be prepared to serve the handicapped and the public who use the parking so that all parking floors should be connected together including the basement.

b) The lifts should be provided with warning bell, and a telephone to address the parking services office in case of the lift is out of order.

c) The number of parking lifts should be identified according to Table 6.

<table>
<thead>
<tr>
<th>Number of Parking Spaces</th>
<th>Number of Elevators (5 Persons Each)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 200</td>
<td>1</td>
</tr>
<tr>
<td>Up to 500</td>
<td>2</td>
</tr>
<tr>
<td>Up to 1000</td>
<td>3</td>
</tr>
</tbody>
</table>

2-5-6 Emergency Stairs

Emergency stairs should be provided for the floors of the parking (multiple floors), and these should be separated with doors against fire, and these emergency stairs should be at the edges of the building in open space. The final exit of the stairs in the ground floor must be connected to the street or to an open area leading to a street or road, and provided with a fence one meter high. The distance between any point in the parking and the emergency stairs should not exceed 30 meters.

2-5-7 Emergency Doors

- Emergency exits must be constructed in all floors leading to emergency stairs.
- The emergency doors should open from inside to outside.
- The emergency doors should be provided with hydraulic lift to enable the door to close automatically after opening.
- It should be restricted to fire.
- There should be guiding signs identifying the direction to the emergency exit.

2-6 Handicapped Parking

a) A percentage of 5% of the area of the parking should be allotted for handicapped, and the number of parking must not be less then two.

b) The parking allotted for the handicapped must be done according to the following measures:
   - The length of the parking should not be less then 5.5 m.
   - The width of the parking should be 3.6 m.
   - Places of handicapped parking must be located in places easy to move in, and closer to the main entrance of the building and within the shortest distance leading to the handicapped car and his destination.
   - It should be closer to the lifts.
The distinguished sign for the handicapped parking must be put in the place allotted for the parking of the handicapped only as shown in Figure 16.

The movements closer to the parking allotted to the handicapped must be provided with slopes to make easy the movement of the handicapped from and to his car as explained in Figure 17.

Figure-16
2-7 **Extension and drainage**

a) to ensure sewage of any water, the grade of the parking surface must be as follows:
   - 1% to 2% for asphalt layer.
   - 1% for layers of concrete (OPC).

b) It is not allowed for sewage of collected water in one of the parking floor to the next floor. Iron painted sorters should be used to prevent, and these sorters should be at the end of the graded sewage at each floor, and divided into lengths not to exceed 1.5 meter and width not less than 20 cm.

c) The water sewage should end to a reservoir on the ground of the basement, and to be provided with enough number of pumping machines to drain water out of the parking to the public sewage system.

d) Adequate number of public water closets one for men and another for women should be provided and it preferable to be closer to the control room of the multiple floor parking.
3- CONSTRUCTION PREREQUISITES

This Includes:-

3-1 The ground floor of parking

a) Figure 18-a shows vertical section of the parking ground on land surface or basement parking, and the parking ground consist of the following materials:

- Blocks layers, it thickness 15 cm.
- Clean sand fill layers, each layer 30 cm, sprayed and compacted.
- Cleaning layer of concrete, its thickness 5 cm.
- Moist basement separation layer not less then 8 mm.
- Protection concrete layers, its thickness 5 cm.
- Concrete 2 m x 2 m and thickness 10 – 15 cm.

Figure-18a
3-2 Side Walls

The side walls in the multiple floors or ground floor, should separate units (panels) of cement concrete, with height not less than 120 cm from the ground of the parking and its length not more than 5 m with barriers 3 cm between each unit and the others as shown in Figure 19.
3-3 Types of concrete Detainers in parking ground:

This is to be carried out in parking ground in front of the cars front tires, and its center should be far from the wall or the pavement of the parking (76 cm) and to be done according to what is explained in the Figure 20.
قفصين من حديد تسليح محورين عموديين
لثبت المخصصة بالأرض (البعد 142 و 141)

قفصين من حديد تسليح محورين عموديين
لثبت المخصصة بالأرض (البعد 142 و 141)

مصفة مثبتة بالأرض بمادة الايروسية اللاصقة

شكل رقم (20) طرق تثبيت المخصصة بالأرضية بأرضية المواقف

Figure-20
4– MECHANICAL REQUIREMENTS

4-1 Prerequisites of Ventilation in parking

Ventilation in cars parking is carried out by one to the following two methods:

a) Natural ventilation which takes place without using mechanical devices and it depends on the current of air which passes through the parking.

b) Artificial ventilation which takes place by using electrical mechanical devices in closed parking.

4-2 Parking with Natural Ventilation

These are open parking which are constructed on land surface, or multiple floors parking which allows the outside current of air passes through adjacent walls in the parking, and hence air is automatically circulated without the need for any ventilation.

4-3 Parking with Mechanical Ventilation

These are closed parking which are constructed in basements or that which has no openings to allow natural ventilation other then the openings specified for cars to get in or out.

a) If the area of the land of cars parking in the basement is around 2500 square meters or more, an absorbing fan should be installed to move the air (heavy duty), on the opening designed for this purpose.

b) Opening (windows) should be designed and its location in the parking to be specified in a way that the air can be absorbed through it from any place in parking.

c) The capacity of the absorbing devices should be tested in a way that the air any where in the parking can absorbed in a period that did not exceed 120 seconds.

d) This type of parking needs a device to change the inside air by fresh air from outside, and this can take place through the walls, and absorption will continue up the building or the open space for outside air.

e) A pass for duct can be used from inside the parking up the building (above the roof).

4-4 Mechanical Instructions and Guides

a) Air absorbing device should be installed on the opening, and one device for each opening in the parking.

b) These devices must be well fixed so that no troubling noise can come out during operation.

c) These devices of absorbing and renewing air in the parking must he of that type which can afford the local climatic conditions like the sun, high degrees temperature, rains, dust and rust.

d) The devices of absorbing air should be of a well know type and through an agent in the Kingdom representing the manufacturing company, and should guarantee to provide spare parts for at least five years period.
e) The devices must be effective to work at 220 / 127 volts, 60 Hertz or according to what is available in the region.

5– ELECTRICAL REQUIREMENTS

5-1 General Requirements

a) The design and execution must be according to local system or international.
b) There must be continuous available service, and economical and less cost of maintenance.
c) The electrical devices must be of closed type for protection against dust.
d) Bright light: The lights should be designed according to the following measures as explained in Table 7.

<table>
<thead>
<tr>
<th>Serial</th>
<th>Location</th>
<th>Min Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal Parking</td>
<td>200 Lux</td>
</tr>
<tr>
<td>2</td>
<td>Spiral Ramps</td>
<td>100 Lux</td>
</tr>
<tr>
<td>3</td>
<td>Exit / Access Locations</td>
<td>500 Lux</td>
</tr>
<tr>
<td>4</td>
<td>Engine and Electric Rooms</td>
<td>320 Lux</td>
</tr>
<tr>
<td>5</td>
<td>Generator Rooms</td>
<td>300 Lux</td>
</tr>
<tr>
<td>6</td>
<td>Security and Ticket Rooms</td>
<td>400 Lux</td>
</tr>
</tbody>
</table>

Table-7: Minimum Lighting Requirements

e) Lights should be available in the areas or cars parking by devices against rust like moisture, heat and dust, and it was made of one piece of aluminum or plastic with glass.
f) Passage should be lighted with suitable light units fixed on the roof or the walls directly, or other devices fixed inside the walls.
g) Lighted guide marks:-
   • To be fixed in various places according to usage. The source of light is florescent pipes fixed on the roof or walls.
   • To be supplied with electric current from energy device for emergency.

h) Reserve electric generator should be provided to operate two thirds of the light units specified for emergency in the parking, passage, grades, light signs, stairs, lifts, and electrical stairs.
i) To control light from one room with push button and each floor with separate distribution board.
j) Warning devices against fire must be provided
k) In addition to the above mentioned prerequisites the following should be considered:
   • The in and out of parking must be provided with control rooms and automatic barriers to control in & out traffic and operate by electric current according to the local electricity company.
   • In case current is out of order, manual barriers should be made.
• Lighted signs should be fixed above the main entrance & exit to show the direction of traffic, and to operate from the control and observation room.

5-2 **Pipes, Withdraw boxes & Contact**

a) The pipes must be of plastic material (PVC), heavy steel.
b) The pipes should be extended inside the concrete roofs and walls, with electric connections in the separation expansions in the building.
c) The pipes should be connected together by using special joints or joining suitable material, according to the manufacturing company.
d) Pipes extension should be straight, no more then two bending are allowed in one like between the withdraw box and the next.
e) Its should be noticed when constructing the pipes of electric extensions, the distance separating them from the others should be less than as mentioned in the Table 8.

<table>
<thead>
<tr>
<th>Separation Distance</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 cm</td>
<td>Hot for Parallel Water and Steam Lines</td>
</tr>
<tr>
<td>15 cm</td>
<td>Hot for Intersecting Water and Steam Lines</td>
</tr>
<tr>
<td>7.5 cm</td>
<td>Water for Parallel or Intersecting Cold Lines</td>
</tr>
</tbody>
</table>

f) The radius of the pipes should be suitable to the number of the extended connections; the average occupation of wires in the pipes should not exceed 4%.
g) The withdraw boxes and contact and exits must be of galvanized steel or plastic (PVC) strong and heavy, and suitable for construction with the pipes and electric expansions network.
h) The boxes used in moist places or outside the building should be provided with gasket to prevent leaking of water or moist to it.
i) The pipes in the boxes should be connected by special ties.

5-3 **Connection and Cables**

a) The connections and cables should be of red copper and isolated with plastic material (PVC) to afford a degree of heat not less than 85 degree and electric current not less then 450 – 750 volts.
b) The connection and cables should be used with continued length, and not to use connection unless in boxes of connection, and using suitable connections, the plastic tapes must not be used.
c) A system using colored separation connections for electrical extension as given in table 9.
Table-9

<table>
<thead>
<tr>
<th>Type</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>Blue</td>
</tr>
<tr>
<td>Ground</td>
<td>Green with Yellow or Green</td>
</tr>
<tr>
<td>Phase</td>
<td>Any Color Except the Ground and Neutral</td>
</tr>
</tbody>
</table>

5-4 Extension of Ground Cables

a) Inside the Building:
The cables must be of a concrete type, to be extended under the floor directly or not concrete with separate connection, and to be extended inside plastic pipes or special channels.

b) Grade Degrees: As shown in table 10.

Table-10

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Curve Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Un-reinforced Double Câble Radius</td>
<td>8 – 10</td>
</tr>
<tr>
<td>Reinforced Double Câble Radius</td>
<td>10 – 12</td>
</tr>
</tbody>
</table>

5-5 Electric Distribution Board

a) Minor Boards
   - To be made of metal boards with thickness not less then 1 mm and painted gray- the separation level should be less then (500F)
   - To be supplied with front door and the protection degree (421 P) and distribution bars with suitable capacity, in addition to natural bar.
   - The lords to be fixed in the wall in a way that its lower edge with a height not less than 150 cm from the surface of the floor.

b) Main Distribution Boards
   - To be made of metal boards with thickness not less then 150 mm in the shape of a cabinet, painted, the separation level not less then (500 F)
   - Four metal distribution bars should be constructed, one of them to be specified for balancing line, which to be separated from the board, in addition to a floor bar connected to the board.
   - The board should be provided with the following measuring devices:
     a) One device to measure voltage (voltmeter) with test key to measure the voltage and 3 devices to measure the current (ampere meter) with transformers for the suitable current and 3 test lamps.
     b) Enough vacuum to be left under the board with height not less then 30 cm form the base to connect the main cables with its ends in this vacuum.
c) It should be noticed that the cable must not be connected directly to the devices or joining more than on cable at one end.
d) The board should be fixed on concrete line or cement base with height of 20 cm from the ground surface.

5-6 Earthing Network

a) All units of light, electrical devices and metal pieces which did not carry electrical current in the electrical device and iron bars for foundation of building.
b) In case of using concrete cables between the minor and main boards, the concrete cable can be used in connection.
c) The floor resistance should not exceed 25 Om

6- SAFETY PRECAUTIONS

6-1 Entrance and Exits
d) Each entrance and exit must be provided with light signs to show in writing the entrance and the exit.
e) Each entrance must be provided with a board indicating the allowed height for entering, and this board to be fixed in a way to move when touched by the roof of the vehicle when its height is more than the allowed.
f) Moveable barriers to be fixed at the entrance and exit in private parking, and also the public parking and also those parking controlled by investors.
g) To make sure of the systematic land and pavement gradient leading to the entrance and exit of the parking, so that to ensure that the pavement level is not high or low in front of the entrance or exit in a way to disturb the pedestrian or the handicapped movement, and the pavement must be lined with clear paint to ensure safety crossing of pedestrian, as explained in Figure 12 above.

6-2 Ramps

Hinders of slipping in the land slopes of entrance and exit must be used to prevent slipping of cars when ascending and to lower its speed when descending as shown in Figure 21.

6-3 Pavements

Concrete cement hinders must be made on the floor of the parking to help in stopping the car in the place specified for it, and to avoid hindering the movements of the pedestrian when the car stops as explained in Figure 22.

6-4 Extinguishing Devices

a) Each floor must be provided with the necessary extinguish devices and follow the safety instructions required by Civil Defense in this regard.
b) Multiple floor parking must be provided with a suitable extinguish system which works automatically when needed.

6-5 Protection of Walls and Pillars

a) Concrete cement hinders must be put in front of front tires of the cars in the floor of the parking for each car with distance not less than 76 cm from the wall of the parking to the middle of the hindering block as explained in Figure 23-a.

b) Metal angles or any other material against shocks and rust and with suitable dimensions on the angles of the pillars in the parking to ensure its safety and protection from shocks as explained in Figure 23-b.
مخطط أفقي للمنحدر

قطع رأس B - باستخدام شرائح معبدة في سطح المنحدر، شكل رقم (21) عمل تقوية في أرضية المنحدر لمنع انزلاق الإطارات.

Figure-21
شكل رقم (22) عمل مصدات خرسانية لوقوف السيارة في مكاها المحدد.

1- عمل مصدات خرسانية بأرضية المواقف لحماية الحائط.

Figure-22

زاوية حماية العاود بارتفاع 1000 متر عن أرضية المواقف

ب- قطاع يوضح حماية الأعمدة ضد الصدمات.

شكل رقم (23) يوضح كيفية حماية الجدران والأعمدة في المواقف.

Figure-23
7- OPERATION AND MAINTENANCE

7-1 Operation

a) The mobile barriers must operate at the entrances and exits of car parking electrically or by the workers in the private parking or public parking controlled by investors.
b) The guiding signs which identify the speed in the parking. The directions, turning points, slopes, emergency exits, the heights, water closets and the lifts must be shown clearly, and the lighted guiding markers must operate electrically or through the control room. The emergency signs should operate automatically.
c) There should be an observer for the operation of the parking, who is responsible to make sure that the parking is not used for any purpose other than one it was constructed for.
d) The number in the cars boards must be registered particularly those which remain parked for more than 24 hours, and the traffic police must be informed unless there is an already understanding. This action should be carried out in private parking and also public parking controlled by investors.

7-2 Maintenance

a) The construction of the parking building must be checked in durations and the necessary maintenance to be done.
b) Duration test for the extinguishing devices in the parking must be carried out and all the pipes of the extinguishers too.
c) All pipes of water sewage must be maintained according to an interval, and also the water pumping devices and reservoir too.
d) All guiding marks and light lamps must be maintained and changing the out of order ones, and also maintenance for the lighted signs.
e) Cleaning the parking from dust and waste in a constant way.
f) Maintenance of mechanical devices related to ventilation and circulation of air.
g) Lifts should be maintained according to a specified interval.
h) Painting the land lines in parking floors.

7-3 Parking Service Office

a) A parking service office should be provided in the public parking, and it must be in a location to supervise the in and out of the traffic.
b) The responsibility of the office to observe the cars in the parking, and the in and out movement, and in addition to this, to observe the maintenance of the parking and to make available all the necessary requirements to operate the parking in the best way.