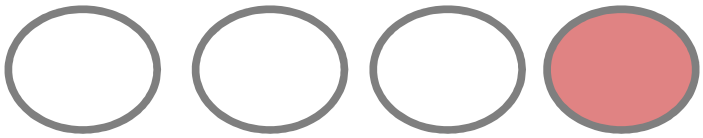
Outline: Chapter 4

- 4.1 Design of Cross-sectional Elements
- 4.2 Horizontal Alignments
- 4.3 Vertical Alignments
- 4.4 Special and Parking Facilities



4.4 Special Facilities and Parking Facilities

Special Facilities For Heavy Vehicles On Steep Grades

- Statistics indicate a continual increase in the annual number of vehicle-kilometers of large trucks on highways.
  - as the grade of a highway section increases, the impact of the presence of trucks become more pronounced
- It becomes necessary to consider the provision of special facilities on highways with steep grades where high volumes of heavy vehicles exist.
  - Climbing lanes, for the upgrades
  - Emergency escape ramps, for the downgrades

3

Climbing lanes

- **A climbing lane is an extra lane in the upgrade direction for use by heavy vehicles whose speeds are significantly reduced by the grade.**
- **Objective:** A climbing lane eliminates the need for drivers of light vehicles to reduce their speed when encountering heavy slow-moving vehicles.
- They become important because of:
  - The increasing rate of crashes associated with the reduction in heavy vehicles speed on steep sections of two-lane highways
  - The significant reduction of the capacity of these sections when heavy vehicles are present

4

Climbing lanes

- The need for a climbing lane is evident when a grade is longer than its critical length,
  - **Critical length is the length that will cause a speed reduction of the heavy vehicle by at least 15 km/hr (10 mi/h)**
- The amount by which a truck's speed is reduced when climbing a steep grade depends on the **length of the grade**.

5

Climbing lanes

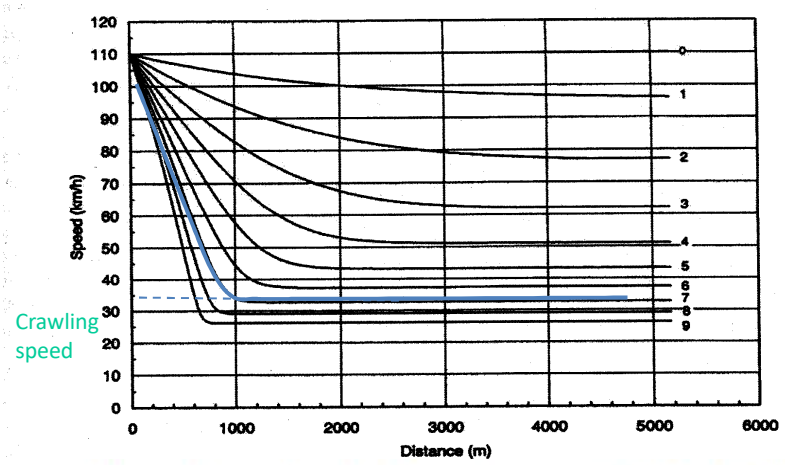


Figure 3-24. Speed-Distance Curves for a Typical Heavy Truck of 120 kg/kW [200 lb/hp] for Deceleration on Upgrades

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Climbing lanes

- The length of the climbing lane depends on the physical characteristics of the grade, but
  - Climbing lane should be long enough to facilitate the heavy vehicle's rejoining the main traffic stream without causing a hazardous condition.
- A climbing lane is provided only if (in addition to the critical length requirement):
  - Upgrade traffic flow rate is greater than 200 veh/h
  - Upgrade truck flow is higher than 20 veh/h.
- When warranted, climbing lanes are only used on two-lane highways, and are not typically used on multilane highways.

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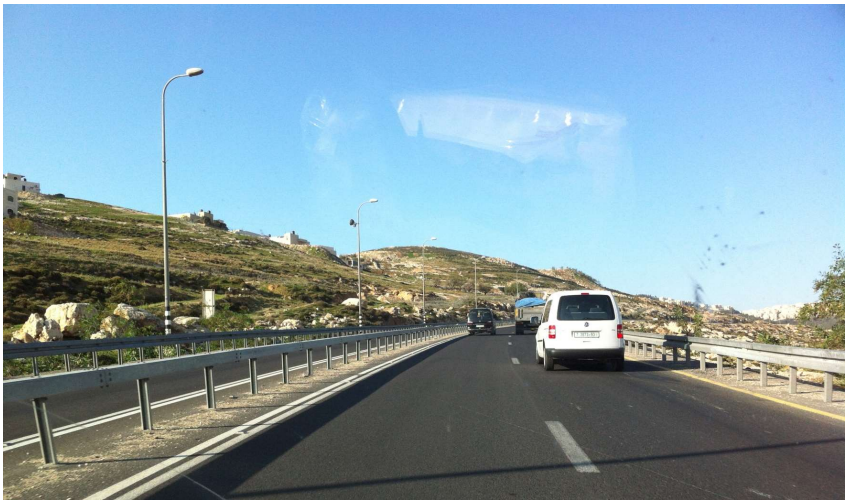
Climbing lanes



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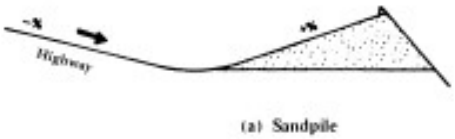
Emergency Escape Ramps

- An emergency escape ramp is provided on the downgrade of a highway for use by a truck **that has lost control and cannot slow down**.
- When a vehicle enters the escape ramp, its speed is gradually reduced, and eventually it stops.
- Common designs are:

1. The sandpile



(a) Sandpile

  - It provides increased rolling resistance
  - It is placed with an upgrade to assist stopping by gravity.
  - Not greater than 120 m (400 ft) in length.

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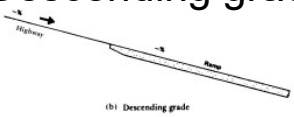
Emergency Escape Ramps

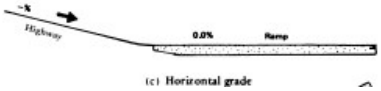
- Common designs are:

2. Descending grade



(b) Descending grade

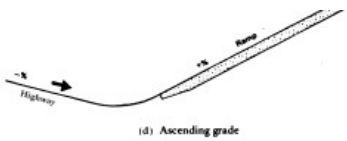
3. Horizontal grade



(c) Horizontal grade

  - **Does not employ gravity in stopping the vehicle**
  - **It utilizes the increased rolling resistance of the ramp surface.**

4. Ascending grade



(d) Ascending grade

  - **Combines the effect of gravity and the increased rolling resistance.**
  - **This ramp design is the shortest of all types.**

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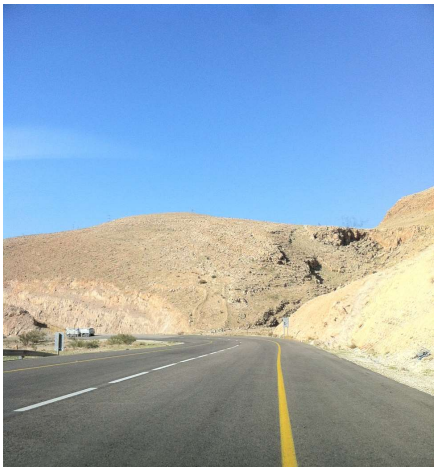
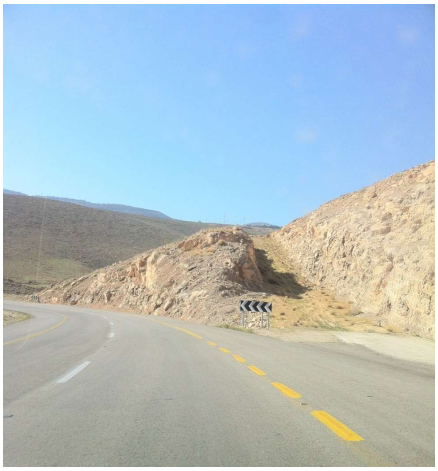
Emergency Escape Ramps





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Emergency Escape Ramps

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Parking Facilities

- The geometric design of parking facilities involves the dimensioning and arranging of parking bays to provide safe and easy access without restricting the flow of traffic on the adjacent traveling lanes.

1. **Design of On-Street Parking Facilities**
2. **Design of Off-Street Parking Facilities—Surface Car Lots (Parks)**
3. **Design of Off-Street Parking Facilities—Garages**

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Parking Facilities

1. **Design of On-Street Parking Facilities**
   - On-street parking facilities may be designed with parking ***lanes*** or ***bays,*** that are ***parallel*** or ***inclined*** to the curb.
   - The number of parking spaces that can be fitted along a given length of curb increases as the angle of inclination increases
   - Parking spaces that are inclined at angles to the curb interfere with the movement of traffic,
     - Crash rates tend to be higher
   - Dimension of the design vehicle has to be considered.

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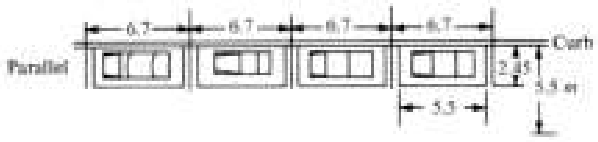
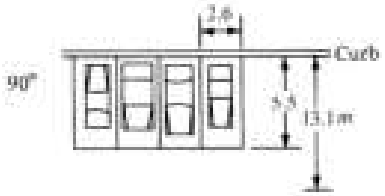
Parking Facilities

1. Design of On-Street Parking Facilities





N = number of spaces
L = curb length

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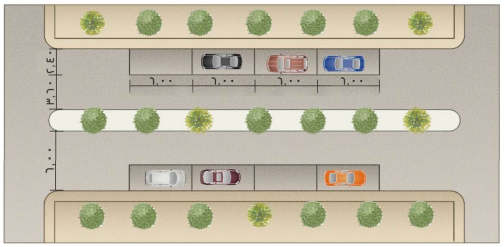
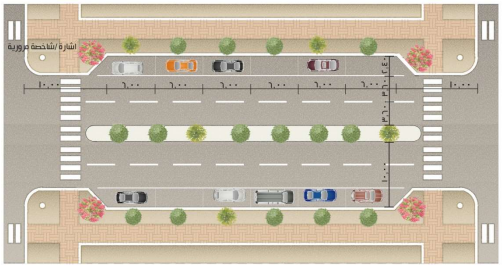
Parking Facilities

1. Design of On-Street Parking Facilities





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إعداد: المجموعة العالمية، لصالح وزارة الحكم المحلي، ٢٠١٣

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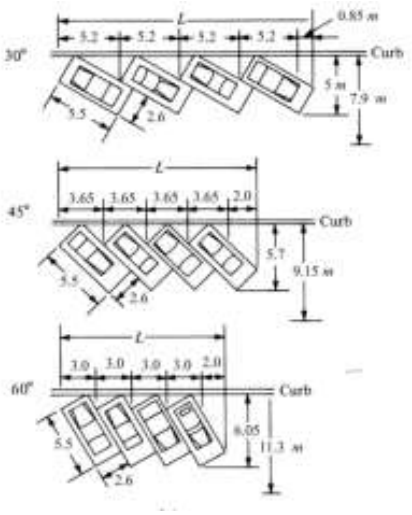
Parking Facilities

1. **Design of On-Street Parking Facilities**



$N = \frac{L - 0.85}{5.2}$

$N = \frac{L - 2.0}{3.65}$

$N = \frac{L - 2.0}{3.0}$

A parking space is called **parking stall**

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Parking Facilities

2. **Design of Off-Street Parking Facilities—Surface Car Lots (Parks)**
   - The primary aim in designing off-street parking facilities is to **obtain as many spaces as possible within the area provided**.
   - **Important consideration:** the layout should be such that parking a vehicle involves only one distinct maneuver, without the necessity to reverse.

- **Parking spaces are efficiently used when the parking bays are inclined at 90 degrees to the direction of traffic flow.**

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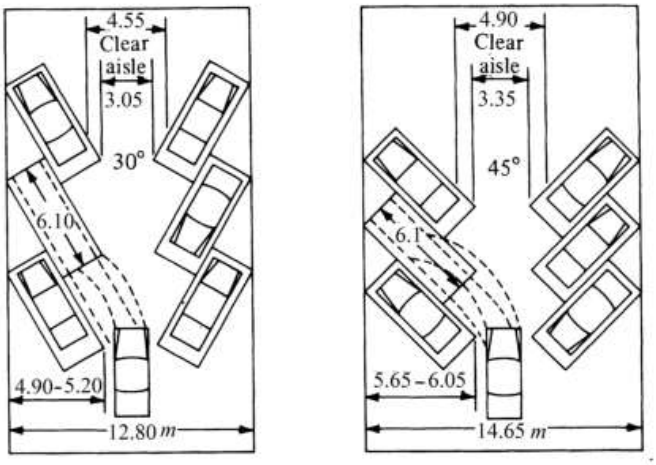
Parking Facilities

2. Design of Off-Street Parking Facilities—Surface Car Parks



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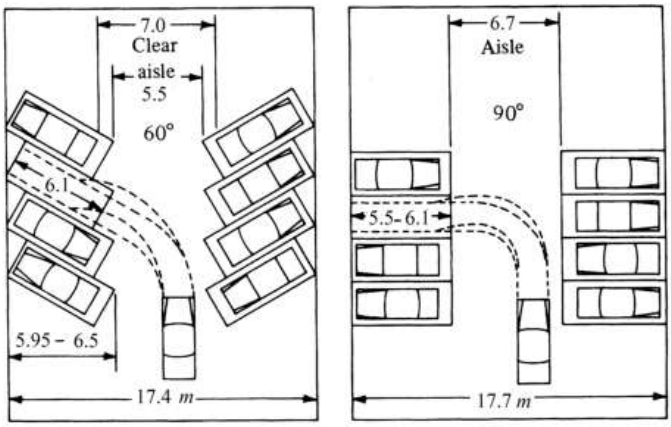
Parking Facilities

2. Design of Off-Street Parking Facilities—Surface Car Parks

Highest Capacity



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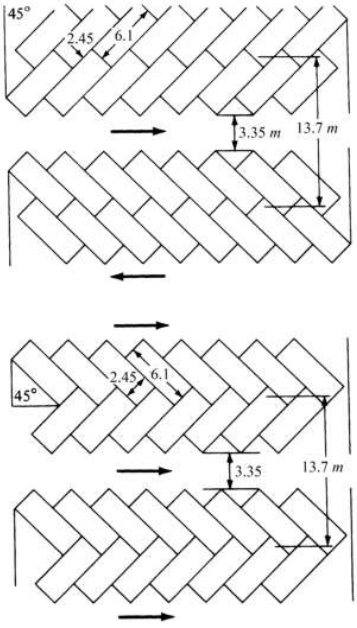
Parking Facilities

2. **Design of Off-Street Parking Facilities—Surface Car Parks**
   - The use of the **herringbone** layout facilities traffic circulation because it provides for one-way flow of traffic on each aisle.

Best Trade-off between Circulation and capacity



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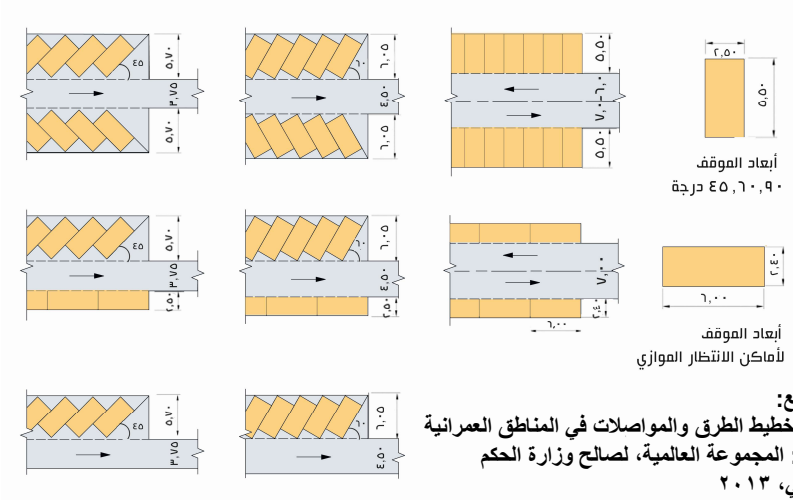
Parking Facilities

2. **Design of Off-Street Parking Facilities—Surface Car Parks**



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Parking Facilities

3. Design of Off-Street Parking Facilities—Garages

- Parking garages consist of several platforms, supported by columns,
  - which are placed in such a way as to facilitate an efficient arrangement of parking bays and aisles.
- Access ramps connect each level with the one above.
  - The gradient usually is not greater than 1:10 on straight ramps and 1:12 on the centerline of curved ramps.
  - The radius measured to the end of the outer curve should not be less than 20 m (70 ft).
  - maximum superelevation should be 0.15.
  - Lane width should not be less than 4.8 m (16 ft) for curved ramps and 2.7 m (9 ft) for straight ramps.

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Parking Facilities

3. Design of Off-Street Parking Facilities—Garages

- Ramps can be one-way or two-way, with one-way ramps preferred.
  - In two-way ramps, the lanes must be clearly marked and where possible physically divided at curves and turning points to avoid head-on collisions.
- Platforms may be connected by elevators into which cars are driven or placed mechanically. Elevators then lift the car to the appropriate level for parking.

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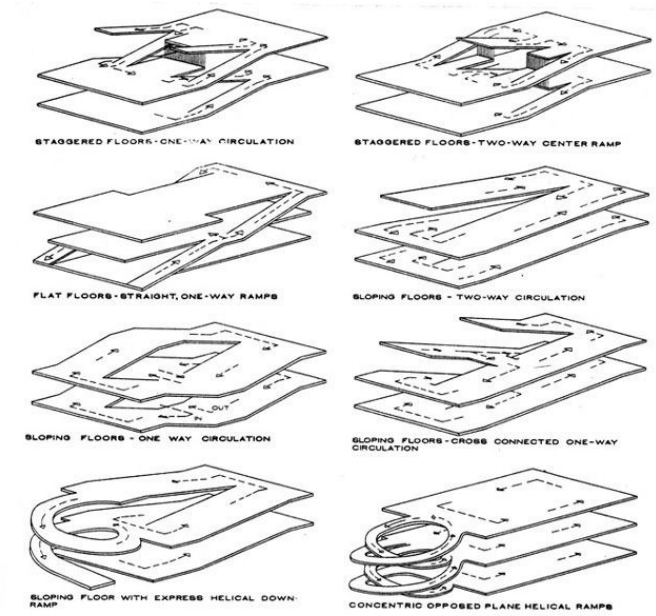
Parking Facilities



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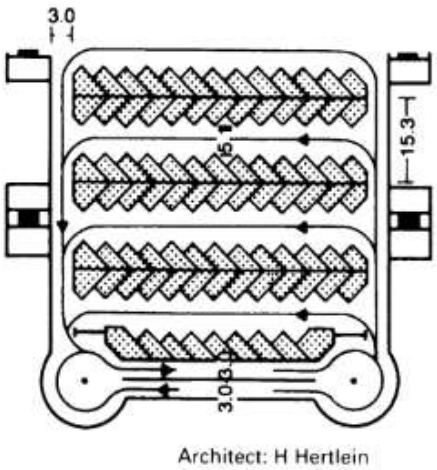
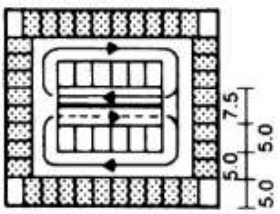
Parking Facilities

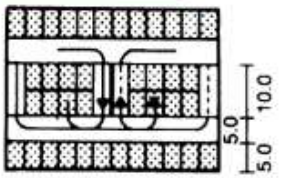


Architect: H Hertlein

1 **Large garage at Siemens**



2 **Longitudinal ramp**



3 **Transverse ramp**

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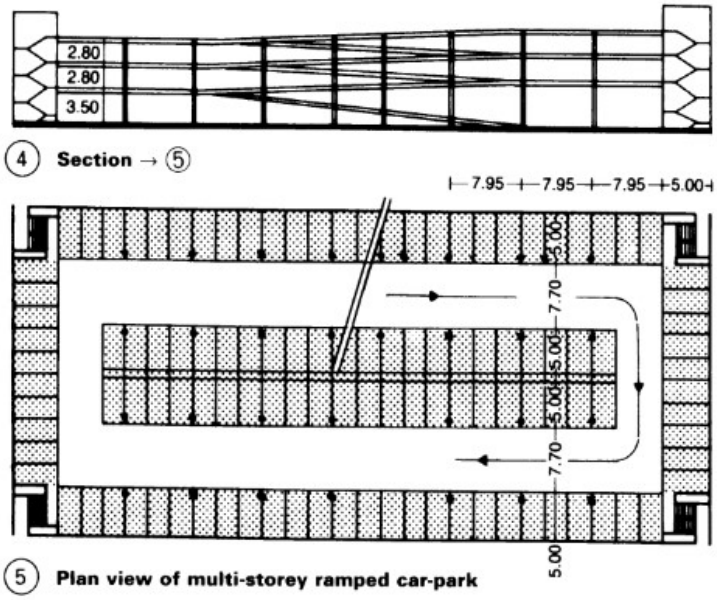
Parking Facilities



④ Section → ⑤

⑤ Plan view of multi-storey ramped car-park

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Parking Facilities

3. Design of Off-Street Parking Facilities—Garages

Traditional Parking Garage

Automatic Parking Garage

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Parking Facilities

Interior of a Parking Garage

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