

Transportation

Road Allowances

- Primary reason is for the **roadway** itself for transportation purposes
- Sidewalks for pedestrian requirements.
- DRY Utilities: telephone lines, electrical power lines, gas mains
- WET services: water mains, sanitary sewers and storm sewers

Road Classifications

- Must know a road's purpose in order to design and build to serve its purpose with a minimum of disruption and waste.
- Traffic factors that influence the design are:
 - traffic volume
 - vehicular type (truck, bus, car)
 - trip type (commuter, local, through, shopping, sight-seeing, recreational)
 - public transportation needs
 - future traffic protection

Road Classifications

Eight Major functional classifications:

Rural

(farming, forestry)

- Freeway
- Arterial
- Collector
- Local

Urban

(industrialized areas)

- Freeway
- Arterial
- Collector
- Local



Freeway



Arterial



Collector



Local

Freeways

- Intended to accommodate heavy volumes of traffic
- at high speeds
- under free-flowing conditions
- long trip traffic
- Running speeds: 70 to 100 km/h

Traffic flow:

- Limited access roads with opposing traffic lanes separated, with grade separated interchanges, and cross-overs, and restrictions on parking, pedestrians and cycling.



Arterial Roads

- are major routes in the network
- connect industrial and commercial centres and concentrations of residential areas
- where freeway not warranted, the arterials are highest type of road
- Running Speeds: 50 to 90 km/hr

Traffic flow:

- Usually uninterrupted flow. Intersections should be controlled (signs / signals).
- Intersections should be synchronized.
- Parking and turning lanes should be provided.



Collector Roads

- collect traffic from local roads and distribute it to other local roads, arterials and sometimes freeways.
- Running Speeds: 50 to 90 km/hr

Traffic flow:

- is interrupted by stop conditions at intersections, and turning movements at access points.



Local Roads

- Where people live
- provides land access
- trips on local roads have their origin or destination within the length of the road.
- Running Speeds: 20 to 80 km/hr

Traffic flow:
Interrupted flow



Design Classifications

Physical Limitations Govern:

- Grades
- design speeds
- maximum width

Traffic Governs:

- pavement width
- shoulder width
- number of lanes

Combining physical limitations with traffic and considering financial limitations, the road or street can then be designed to a desirable, acceptable or a minimum set of standards.

Design Considerations:

- Access to the road from driveways should be as smooth as possible
- Min. Driveway grade = 5%
- Max. Driveway grade = 10%
- If sidewalks do not exist, consider future installation

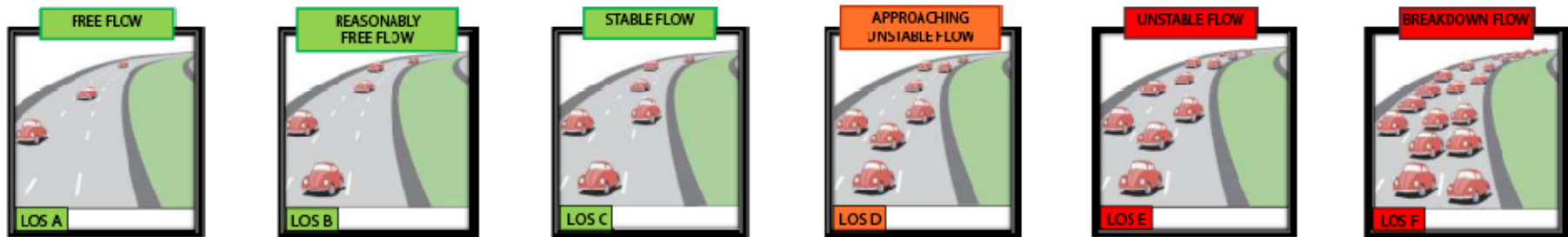


Other Design Considerations:

- Drainage Snow removal and storage in ditches
- Vertical alignment based on topography
- Must balance cut and fills
- Location of utilities
- Sight distances
- Horizontal alignment
- Construction costs
- Performance of heavy vehicles on grade
- Volumes may increase over time (pop. growth)
- Type of vehicles may change over time

Level of Service

- There are (6) Levels of service (LOS) we consider when discussing road functionality:
 - **Level A** - Free Flow (ie: hwy. 401 at 3:00am).
 - **Level B** - Stable Flow
 - **Level C** - Stable Flow (ideal)
 - **Level D** - Approaching Unstable Flow
 - **Level E** - Unstable Flow (traffic is moving slowly)
 - **Level F** - Forced Flow (traffic jam)
- Level C is desirable for establishing standards of road improvements.



Pavement Design Factors:

- Traffic
- Sub-grade soils
- Environment conditions
- Performance of similar pavement in the area
- Economics
- Designed by licensed geotechnical engineer

Pavement Classifications

There are TWO pavement classifications:

1. Flexible Pavements (asphalt concrete and granular base)
2. Rigid Pavements (concrete, both reinforced and unreinforced)

Another choice:

- Composite Rigid Pavement (asphalt surface OVER concrete surface)

Sample Structural Sections

FLEXIBLE PAVEMENTS

Conventional

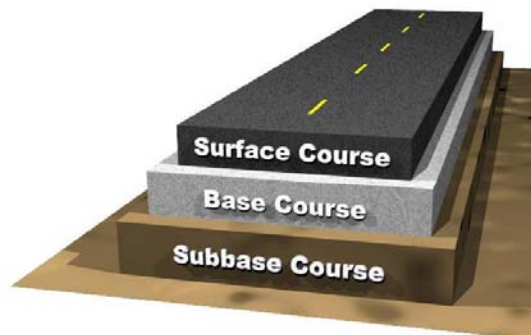
- 40 mm HL3
- 150 mm granular A
- 300 mm granular B

Deep strength

- 40 mm HL3
- 200 mm HL8
- 150 mm granular "B"

Full depth

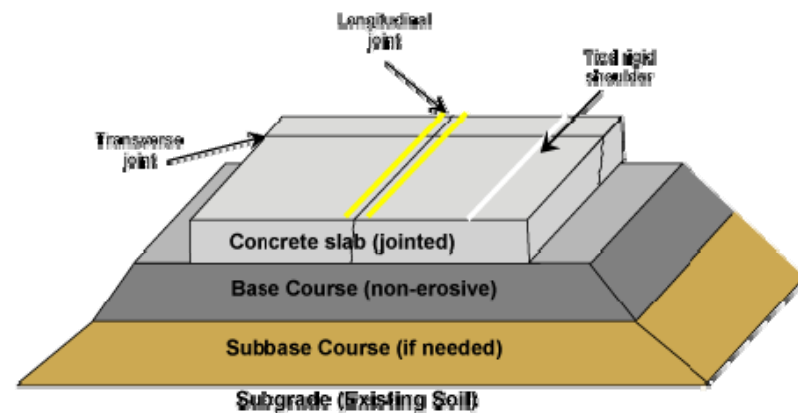
- 40 mm HL3
- 300 mm HL8
- 100 mm "A" or crushed limestone



RIGID PAVEMENTS

Example

- 150 mm exposed concrete
 - 300 mm granular B
-
- Requires expansion joints at fixed objects (bridges, manholes)



Frost Treatment

- Ontario is prone to damage to roads by the freezing and thawing of subgrades, bases, and pavements (rigid and flexible) during winter and spring.
- Frost susceptible soils
- Freezing soil temperature
- Water supply at or near the freezing front
- Note: ice is 4% larger than water
- The coarse aggregate is less prone to heaving



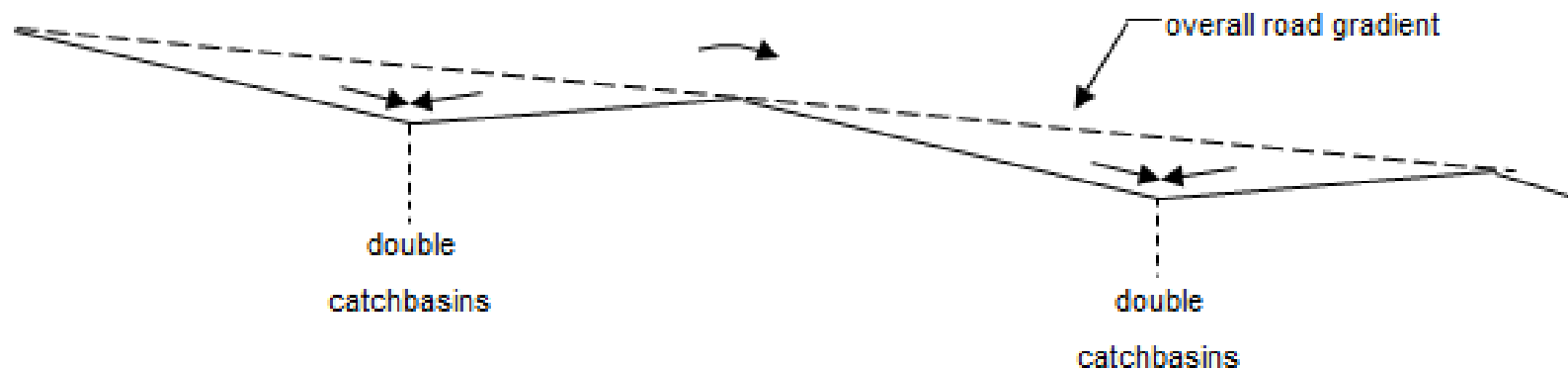
Underground Utility Protection:

- Prone to damage due to frost if buried at shallow depths
- Movement distorts or ruptures utility pipe
- Do not install directly under the roadway where frost penetration is deepest
- Construct granular soil frost tapers to minimize heaving (8:1)
- Place insulation around the utility



Road Drainage

- The road centreline gradient, rates of pavement cross slope, and the gutter gradient should provide for rapid surface drainage to avoid pavement icing due to intermittent thawing and freezing.
- Cross Slope: between 2% and 3%
- Gutter Slope: Min. 0.5%; 0.7% preferred

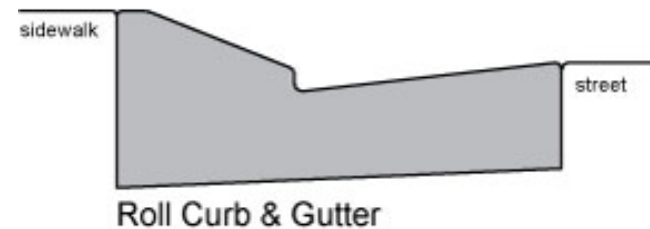
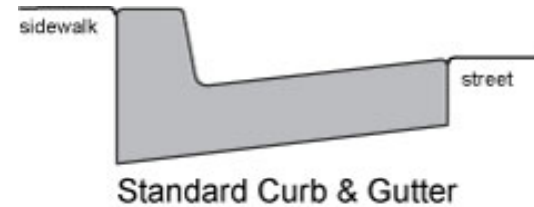


Barrier Curb and Gutter

Barrier concrete curb and gutter section is recommended for most urban street locations.

Advantages:

- Can be constructed to closer tolerance than asphalt allowing gradients down to 0.35% - 0.50% while maintaining reasonable drainage
- Gutter pan crossfall of 12:1 assists drainage
- Improved delineation to the edge of the road
- Used for median islands, driveways and parking areas



Catch Basins



Sufficient catchbasins are req'd to:

- Intercept water
- prevent flooding of the road surface

Misc. Notes:

- the gutter at the catchbasin should be depressed to facilitate the flow into the CB
- Catchbasins should be located upstream of pedestrian crossing areas, and 1.5 m clear of any driveway curb depression.
- **Double catchbasins** are required in valleys!

Roadside Ditch Drainage

- Where a storm sewer is not available, or where an "interim" type of road development is desired, ditches may be used to carry the drainage down both sides of the road.
- In a sandy soil situation, shallow swales beside the road may be sufficient and culverts may not be required at driveway crossings.
- Other soils types will require a full ditch section with sufficient depth for water storage and to allow for the installation of a suitably sized culvert at each crossing (driveways and road intersections).



Boulevard Design / Drainage

- Blvd width between SW and curb should be adequate to provide safety barrier between vehicular and pedestrian traffic
- Desirable minimum width is 3.0 m on arterial road and 2.0 on collector and local
- Absolute minimum should be 1.5 m
- Should provide adequate space for underground utilities, landscaping, and for snow storage
- In order to avoid that the drainage from the road area spill back onto private properties, the road allowance is normally graded to provide a fall from the street line to the road curb.
- The slope is generally recommended to be 2 to 6%.
- A slope in this range ensures satisfactory drainage off the boulevard area, as well as an driveway access to the road being not greater than 10%.
- Driveway slopes greater than 10% may cause a problem with vehicles backing out of the driveway hitting the pavement with their tailpipe or bumper.

Signage

- The purpose of traffic signing is to assist in the orderly movement in a safe manner.
- There are (3) Sign Classifications:
 - Regulatory (stop signs, speed limits, etc.)
 - Warning (stop ahead, right lane exits, etc.)
 - Guide (route designations, distances, etc.)



Regulatory Signs



R1-1



R1-2



R1-2a



R1-4



R1-5a



R2-1



R3-1



R3-2



R3-3



R3-4



R3-5



R3-5a



R3-6



R3-7



R3-8



R3-8a



R3-8b



R3-9a



R3-10a



R3-11b



R3-14b



R3-18



R4-1



R4-3



R4-5



R4-6



R4-7



R4-7a



R4-7b



R4-8



R4-10



R5-1



R5-1a



R6-2



R5-6



R5-10a



R5-10c



R6-1



R6-2



R6-3



R6-3a



R7-8b



R7-9



R8-4



R8-8



R9-2



R9-3



R9-3a



R9-3b



R10-3



R10-4



R10-4b



R10-6



R10-7



R10-12



R10-15



R11-2



R12-1



R12-5



R14-1



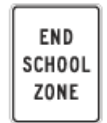
R15-1



R15-2

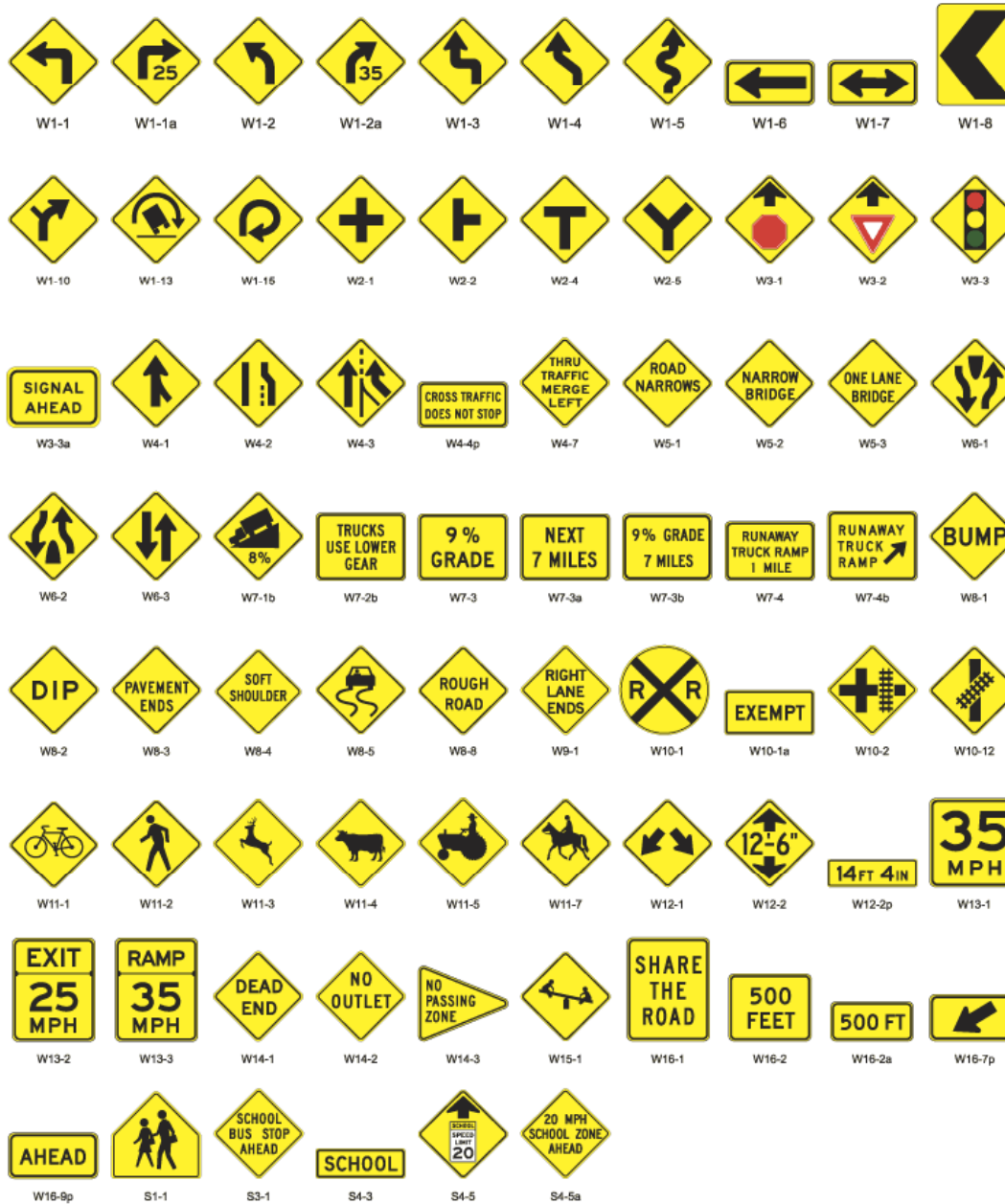


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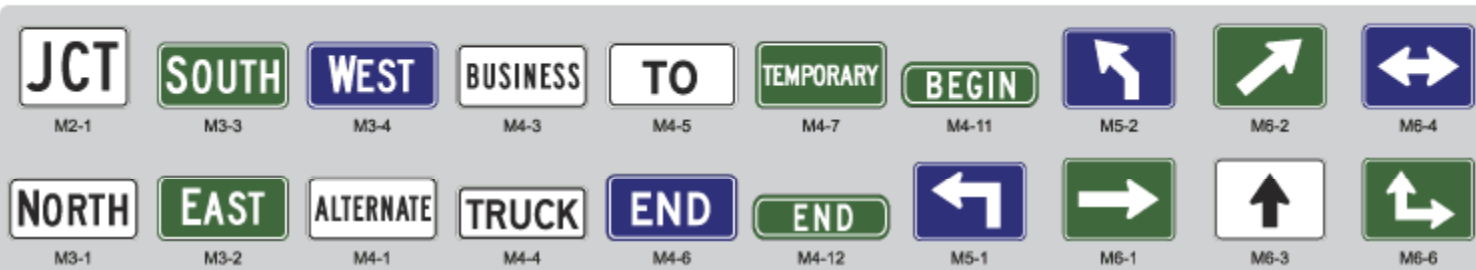


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Warning Signs



Guide Signs

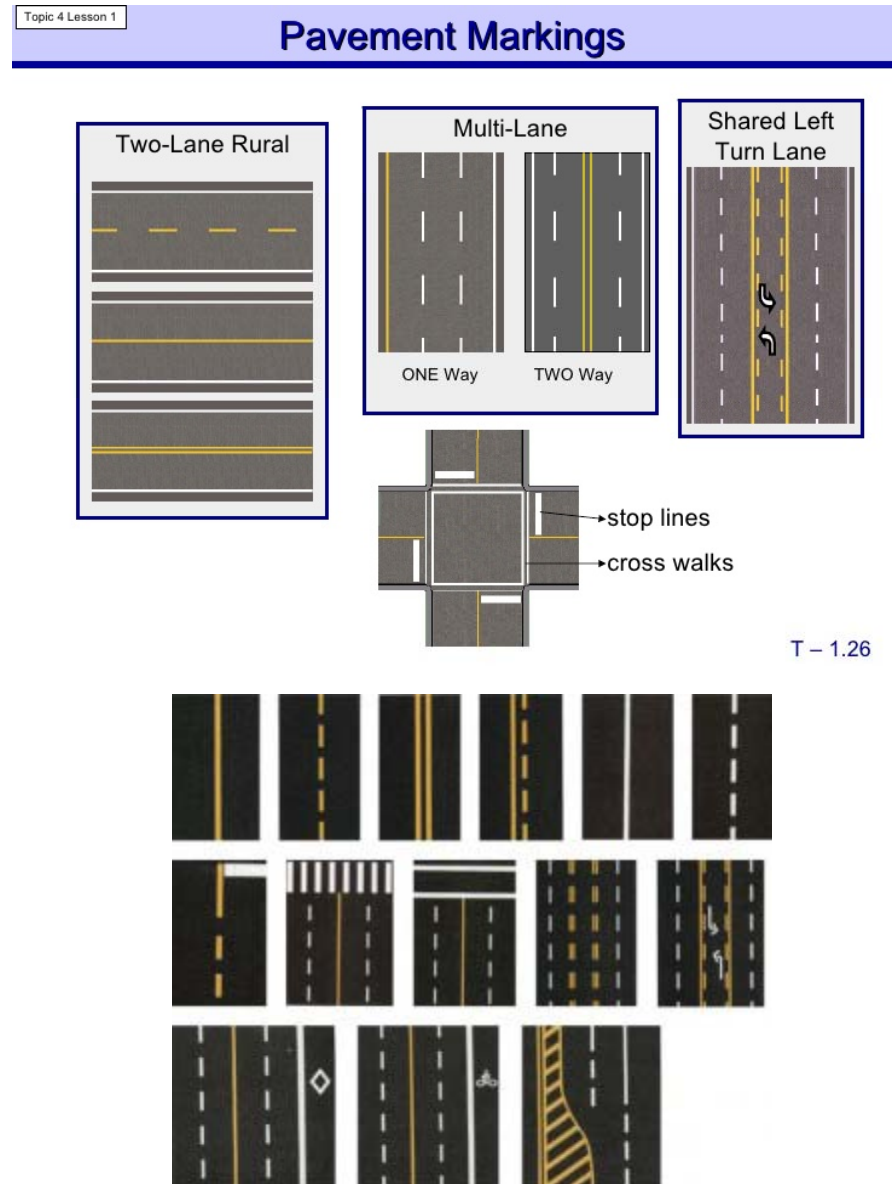


Note: These Federal M series signs may be used as white on green, white on blue, or black on white as appropriate.



Pavement Markings

- Pavement Markings are used to designate:
 - Stop lines
 - Lane lines
 - Pedestrian crosswalks
 - Convey direction
 - Warning without distracting a driver



Traffic Signals

- Used to assign the RIGHT OF WAY between conflicting streams of vehicular and pedestrian traffic with efficiency.
- Streets are public spaces. Public officials and designers should make every effort to make streets as efficient and as safe as possible.



Pedestrian Facilities

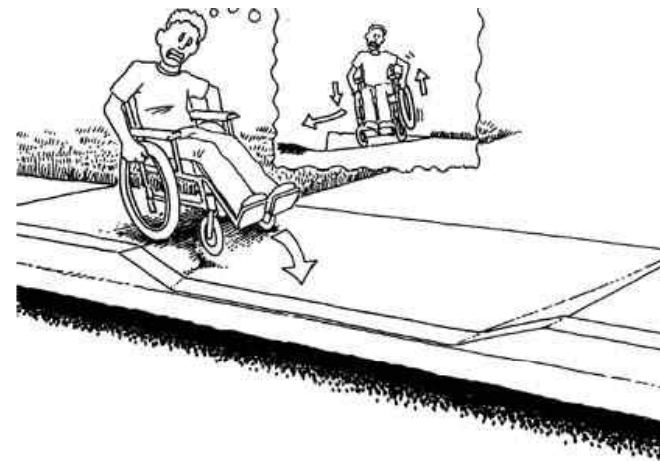
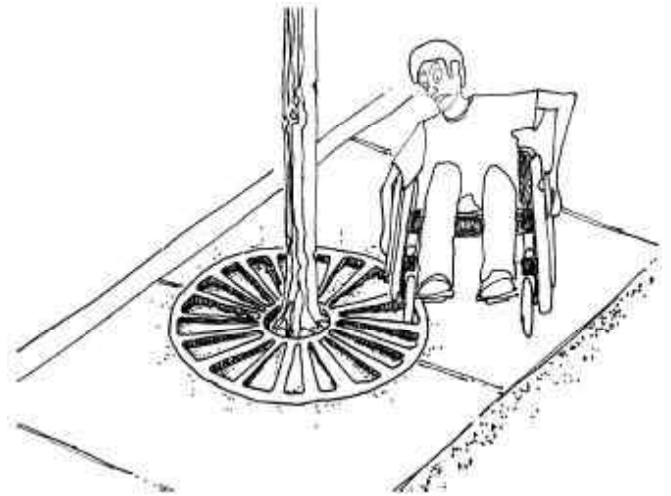
Crosswalks are designed based on:

- Pedestrian volumes crossing the street
- Vehicular volumes, speed and turning movement
- Accident frequency at intersections
- Width and shape of intersections
- School crossings
- Should be located where crossing is most convenient for pedestrian



Sidewalks

- Should be provided on both sides of Arterial Streets, Collector Streets, Local streets with through traffic and on one side of local streets
- Desirable minimum width is 1.5 m (allows for wheelchair, baby carriage etc.)
- If conditions are restricted a minimum of 1.25 may be used
- 2.0, 2.5, & 3.0 m may be used in high pedestrian areas



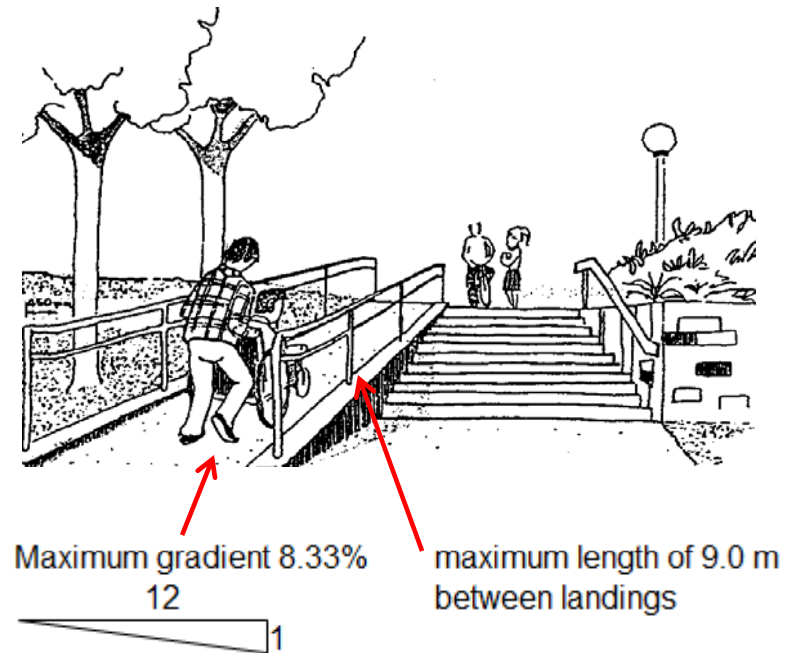
Sidewalks (cont'd)

- If sidewalk gradient is in excess of 5%, it is considered a ramp
- may need surface texture to aid in traction and add handrails
- Maximum recommended gradient is 8% or 1ft rise for 12ft of run
- Recommended cross slope of 2% for drainage purposes
- Concrete prevalent material due to long life and low maintenance
- Interlocking bricks and precast slabs can be used – more expensive
- Thickness (typical):
 - 100mm (no vehicular)
 - 150mm (residential driveways)
 - 200mm (comm/ind driveways)



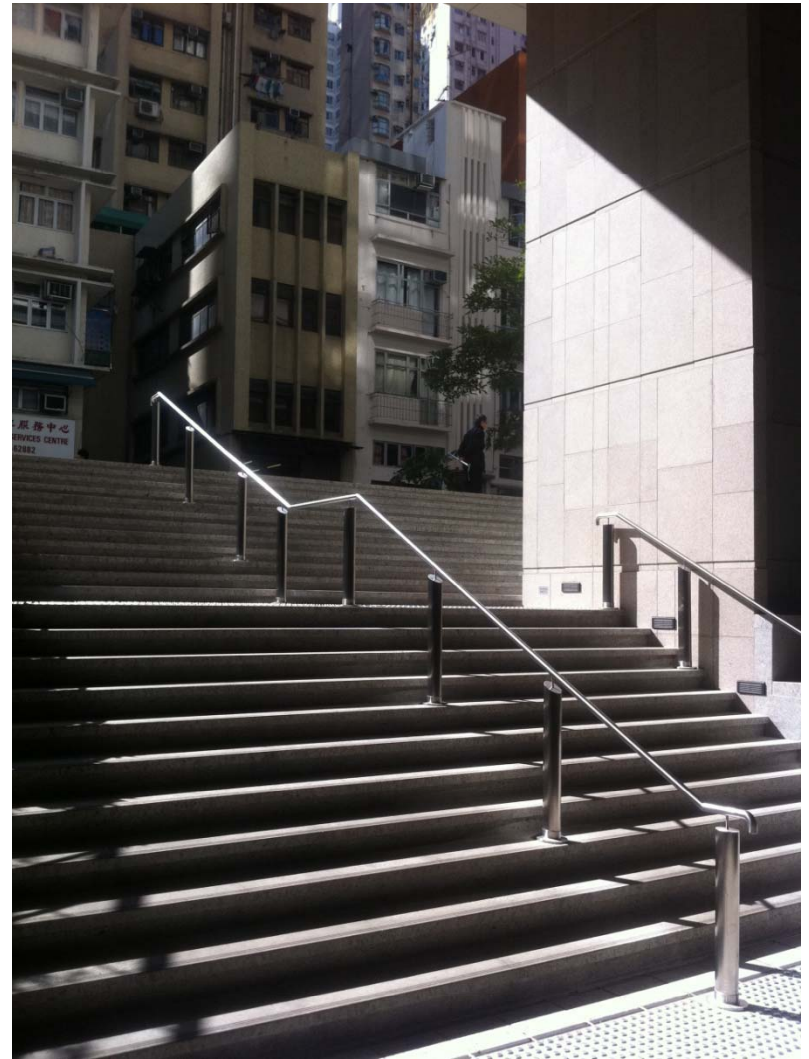
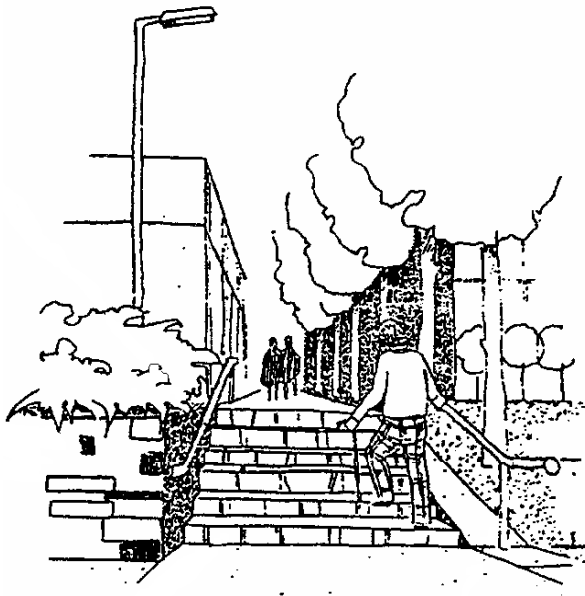
Ramps

- Ramps are required to provide “Accessible” access for disabled users.
- 8.33% max slope (12:1)
- 1.8m min. Width
- 9.0m max length (between landings)
- Provide 50mm curb
- Provide handrails

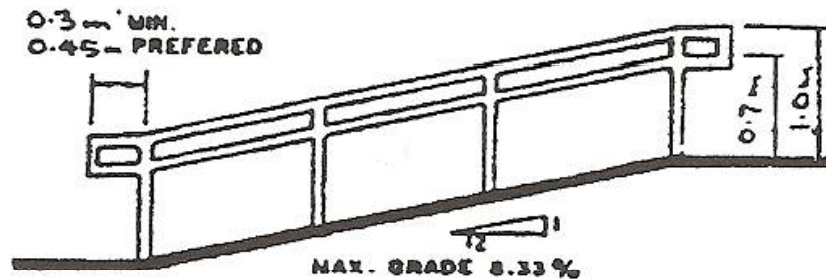


Stairs

- Surface of all treads should be non-slip
- Slope at 1% to drain surface water
- Provide chamfer or 25 mm rounding to nosing of all treads
- Colour of stairs should contrast with adjacent paving
- Stairway width should be determined by the projected amount of pedestrian traffic and the widths of approaching walkways.

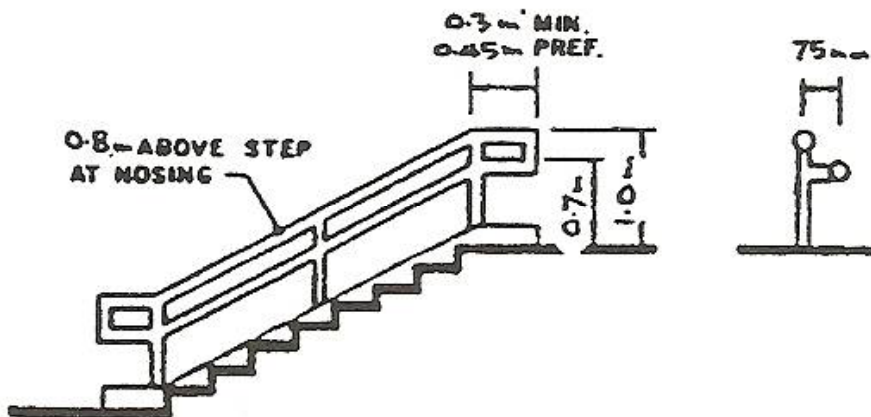


Handrails



HANDRAILS FOR RAMPS

- 1.0 m is the most comfortable height for handrails on ramps
- A second handrail (useful to people in wheelchairs and children) should be placed at 0.7 m.
- Handrails should extend a minimum of 0.3 m beyond both ends of a ramp



HANDRAILS FOR STAIRWAYS

- 1.0 m is the most comfortable height for railings at both ends of stairways. 0.8 m is the accepted height on stairways.
- A second handrail (useful to children) should be placed at 0.7 m.
- Handrails should extend a minimum of 0.3 m beyond stairways

On Street Parking

- Street parking decreases capacity, impedes traffic flow, and increases hazard.
- Eliminate parking on major streets.
- Prohibit parking during rush hour to increase efficiency.



Bus Loops / Bus Lanes

Bus Loops

- Bus drivers do not reverse buses!
- This increases passenger safety and efficiency during transfers.
- Reduce traffic congestion (buses not blocking lanes) .

Bus Loop Designs

- Design is primarily based on bus size, and manoeuvrability.
- Simplest form is the single loop with a width of 4.5 to 6.0 metres.
- Loops are expensive due to large footprint (property and construction costs).

Bus Lanes

- A lane reserved for buses only.
- Must be able to move at least the same number of people as normal traffic lane.
- Improve efficiency by improving bus speeds.
- Use overhead signs and special pavement markings to indicate Bus Lanes.



Bus Shelters

Bus Shelters – the need for a shelter is determined by:

- Number of users
- Average wait time
- Climate
- Availability of other nearby shelters
- Public relations

Bus Shelter Location

- The distance from the shelter to waiting buses
- Possible conflicts with other activities in immediate area
- Prevailing winds
- Geometrics of the bus stopping location

Functional Design

- Most important – good visibility (glass)
- Adequate lighting - inside and outside
- Must have easy entry and exit
- Avoid seats and washrooms if possible – subject to vandalism – except main transfer stations
- Must be maintained

