ENGINEERING DESIGN

MANUAL

CHAPTER 5
TRANSPORTATION SYSTEM

ENGINEERING SERVICES
DIVISION

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Contents

5.1 TRANSPORTATION SYSTEM

5.1.1 Classification

5.1.1.1 The Public Transportation and Highway Improvement Act

The Public Transportation and Highway Improvement Act classifies all roads and highways into thirteen (13) separate groups as follows:

1. King's Highways (including "Intersecting Highways", "Crossing Highways", and Connecting Link Extensions")
2. Controlled Access Highways
3 Secondary Highways
4. Tertiary Roads
5. Resource Roads
6. Industrial Roads
7. Country Roads
8. Suburban Roads
9. Township Roads
10. City, Town and Village Roads
11. District, Metropolitan and Regional Municipal

5.1.1.2 Functional Classification System

The Functional Classification System classifies all roads and highways into four (4) separate groups as follows:

1. Freeway
2. Arterial
3. Collector
4. Local

5.1.1.3 Comparison between The Public Transportation and Highway Improvement Act and the Functional Classification System

The Public Transportation and Highway Improvement Act and Functional Classification System are compared in Table 5.1.

5.1.2 Access and Mobility

Access and mobility are two major considerations in the function classification of road systems. Figure 5.1 describes graphically this relationship.

Local facilities are normally short distance roads which emphasize the land access function. Arterials and freeways are normally long distance roads providing a high level of mobility for through movement with the freeways striving for optimum mobility. Collectors offer a balanced service for both functions.

5.1.3 Definition of Road Type

1. Major Urban Roads

   a) Primary Arterial
      - Connecting City with other major centres outside the City and/or inter-connecting settlements.
      - Long distance person or goods movement/travel through the City or between major activity areas within the City or area communities.

   b) Secondary Arterial
      - Connecting two or more settlements or major activity centres within the City or;
      - Connecting between two primary arterial roads or;
      - Connecting a settlement or activity centre with a primary arterial road.
      - Trip origin and/or destination along it, an intersecting tertiary arterial intersecting collector or a local street intersecting with the collector.

   c) Tertiary Arterial
      - Connecting small settlements or;
      - Connecting settlement to primary or secondary arterial leading to a recreational area.
      - Trip origin, and/or destination along an intersecting collector or along a local street intersecting with the collector.

   d) Collector
      - Connecting neighbourhoods or;
      - Connecting a neighborhood with an arterial road.
      - Trip origin and/or destination along it or an intersecting local street.

   e) Local
      - Connecting properties within a neighborhood.
      - Trip origin and/or destination along its right-of-way.

2. Industrial Roads

   Standard Industrial − two traffic lanes or alternate two traffic lanes and one parking lane, geometry and construction to accommodate heavy industrial or commercial truck traffic, occasional driveway access.

5.1.4 Road Design Criteria

Geometric design standards are shown in Table 5.2.

5.1.4.1 Integration of Design Features

The designer should observe the following guidelines when combining various components such as horizontal and vertical alignment:

a) The use of minimum radius should be avoided wherever possible, since this represents the limiting condition;

b) A sharp curve should not be introduced at the end of a long tangent;

c) Sudden changes from long radius to short radius (i.e. compound curves) should be avoided;

d) At the end of a long tangent section, a transition of gradually decreasing radius should be introduced to allow the driver to adjust his/her speed to the new condition. The additional length provides the opportunity for reducing speed safely;

e) Sharp curves should not be introduced on high fills. In the absence of physical objects above the roadway, a driver may have difficulty in estimating the extent of the radius and fail to adjust to the conditions;

f) Spirals should be used wherever possible rather than compounding circular curves.

g) Abrupt reversal in alignment should be avoided. When reverse curves are too close it is difficult to super-elevate them adequately, resulting in hazardous and erratic operation. A reversal in alignment can be suitably designed by introducing back to back spirals of sufficient length between two circular curves.

h) Where it is necessary to change the widths of medians and shoulders, curvilinear tapers rather than tangents should be used to ensure smooth gradual tapers so as to appear to be a natural transition to the driver.

5.1.5 Layout Details

5.1.5.1 Street Layout

a) Cross Sections − See GSSS 225.010

5.1.5.1 Street Layout − Cont'd

b) Cul-de-Sacs
   - bulb radius at back of curb - 14 m
   - bulb radius at property line - 17.5 m
   - bulb out returns - 20 m

c) Intersections
   - streets should be aligned at 90°
   - corner radius at back of curb - 9 m
   - corner radius at property line - 6 m

5.1.5.2 Driveways

a) Maximum Grades − See GSSD 303.020

b) All access driveways shall be located a minimum of 1.0 metre from utility poles, hydro transformers, catch basins, hydrants, watermain valves, telephone maintenance holes and Bell and Cable T.V. junction boxes.

c) Minimum 150 mm compacted depth Granular "A" and 50 mm compacted depth HL3.

5.1.5.3 Curbs and Gutters

Where barrier curbs are specified, curb depressions shall be provided at driveways and sidewalk ramp locations.

Layout and construction of curbs and gutters shall be in accordance with OPSS 353, OPSD 600.010, OPSD 604.010, OPSD 605.030, OPSD 608.010, OPSD 605.040 and GSSD 610.010, GSSD 600.010, GSSD 600.030.

5.1.5.4 Bus Bays

Layout and construction of bus bays shall be in accordance with OPSD 501.01.

5.1.5.5 Sidewalks

The City shall have various criteria for sidewalk needs and locations. The designer should consult on a site specific basis. See A697A.

5.1.5.6 Guide Rails and Barricades

Guide rails and barricades shall be installed in accordance with Geometric Design Standards.

5.1.5 Layout Details **- Cont'd**

5.1.5.7 Underground Electric Distribution and Street Lighting

Underground electrical distribution lines, lights and light poles, lot service lines and other necessary appurtenances to service all lots, blocks and road allowances shall be provided for the subdivision, including provision for future signalization of major intersections.

The need for future signalization, shall be provided by the General Manager of Infrastructure Services.

5.1.5.8 Sodding

All areas of the road allowance not covered with asphalt or concrete shall be prepared with a minimum of 100 mm of compacted topsoil and sodded in accordance with OPSD 571.

5.1.6 Structural Requirements

These are the minimum requirements:

Base

- Fill section (Earth or Rock)
  150 mm compacted depth Granular "A"
  600 mm compacted depth Granular "B"

- Cut section in earth
  150 mm compacted depth Granular "A"
  600 mm compacted depth Granular "B"

- Cut section in rock
  150 mm compacted depth Granular "A"
  300 mm compacted depth Granular "B"
  300 mm rock shatter

- Cut section in partial rock & partial earth
  150 mm compacted Granular "A"
  600 mm compacted Granular "B"
  300 rock shatter in rock section

Asphalt-Arterial

- 40 mm compacted depth HL-3 surface
  100 mm compacted depth HL-8 heavy duty binder

Asphalt-Collector

- 40 mm compacted depth HL-3 surface
  100 mm compacted depth HL-8 heavy duty binder

Asphalt-Local

- 40 mm compacted HL-3 surface
  50 mm compacted HL-8 binder

5.1.6 Structural Requirements – Cont'd

For typical treatments for rock cut to earth cut transitions refer to OPSD 205.050.

The standard City of Greater Sudbury road cross sections are as indicated on drawings GSSD 225.010 and GSSD 225.040.

5.1.7 Road Pavement Design Report

A road pavement design report prepared by a competent Geotechnical Investigative firm shall be required for certain soil conditions. The report should include an investigative report and recommendations based on soil tests conducted on the underlying strata and a pavement design in accordance with the Canadian Good Roads Association publication, "A Guide to the Structural Design of Flexible and Rigid Pavements in Canada."

A pavement design report shall be prepared where construction of subbase, base or asphalt layers will take place at or below freezing temperatures or during wet periods in the Spring or Fall.

Pavement designs must be capable of supporting the loads imposed by heavy truck traffic with only the base lift of asphalt in place (i.e. before the top lift is applied).

The design report must consider the effect of existing and future services located under the road bed.

5.1.8 Access

5.1.8.1 Number of Accesses

a) A pair of properly designed one-way accesses may be considered as a single access.

b) An automobile gas service station will normally be permitted two accesses.

5.1.8.2 Access to Primary Arterials

Access to Primary Arterials shall be limited to public roads at specific points determined by the City to provide an optimum collector road system and proper traffic progression along the arterial. These points should be approximately 400 m apart.

Parcels of land with 200 metres or more of street line on a primary arterial shall be permitted one access to the primary arterial.

Existing parcels of land with less than 200 metres of street line on a Primary Arterial but with street lines only on primary arterial shall be permitted one access to the primary arterial.

5.1.8 Access – *Cont'd*

5.1.8.3 Access to Secondary Arterials

Parcels with greater than 100 metres of street line on a secondary arterial shall be permitted one access to the secondary arterial for every full 100 metres of frontage.

Existing parcels of land with less than 100 metres of street lines, but with street lines only on secondary arterials or abutting only primary and secondary arterials, shall be permitted one access to the secondary arterial.

5.1.8.4 Access to Tertiary Arterials

Parcels of land with 50 metres or more of street line on a tertiary arterial shall be permitted one access to the Tertiary Arterial for every full 50 metres of street line.

Existing parcels of land with less than 50 metres of street line but with street lines only on arterial roads shall be permitted one access to the Tertiary Arterial.

5.1.8.5 Location of Accesses

5.1.8.5.1 Primary Arterials

Location of all access to primary arterials shall be determined by the General Manager of Infrastructure Services, based on considerations of safety, protection of vehicular capacity of the primary arterial and sound engineering practice.

5.1.8.5.2 Secondary & Tertiary Arterials

Access to second and tertiary arterials shall be located as requested by the applicant, except that where in the opinion of the General Manager of Infrastructure Services the access would unduly reduce safety or capacity of the arterial, the General Manager of Infrastructure Services will indicate an alternate location.

5.1.8.5.3 Locational Criteria

Locational criteria shall include the following:

a) Where the speed limit is 80 km/h or more:

   i) The minimum sight distance shall be as specified in Table 5.3.

   ii) Access shall not be within a daylighting triangle.

5.1.8 Access

5.1.8.5.3 Locational Criteria − Cont'd

iii) Access shall not be on a turning roadway at a channelized intersection.

iv) Access shall not be on a grade of more than 4 percent.

b) Where the speed limit is less than 80 km/h:

i) The minimum sight distance shall be as specified in Table 5.3.

ii) Access shall not be within a daylighting triangle.

iii) Access shall not be on a turning roadway at a channelized intersection.

5.1.8.6 Width of Access

Access width for Light Industrial and apartments shall be 7.2 m.

Access width for Heavy Industrial and Commercial shall be 9.1 m.

5.1.9 Limits of Construction

Limits of construction for urban and rural sections shall be as indicated in Figures 5.2 and 5.3 respectively.

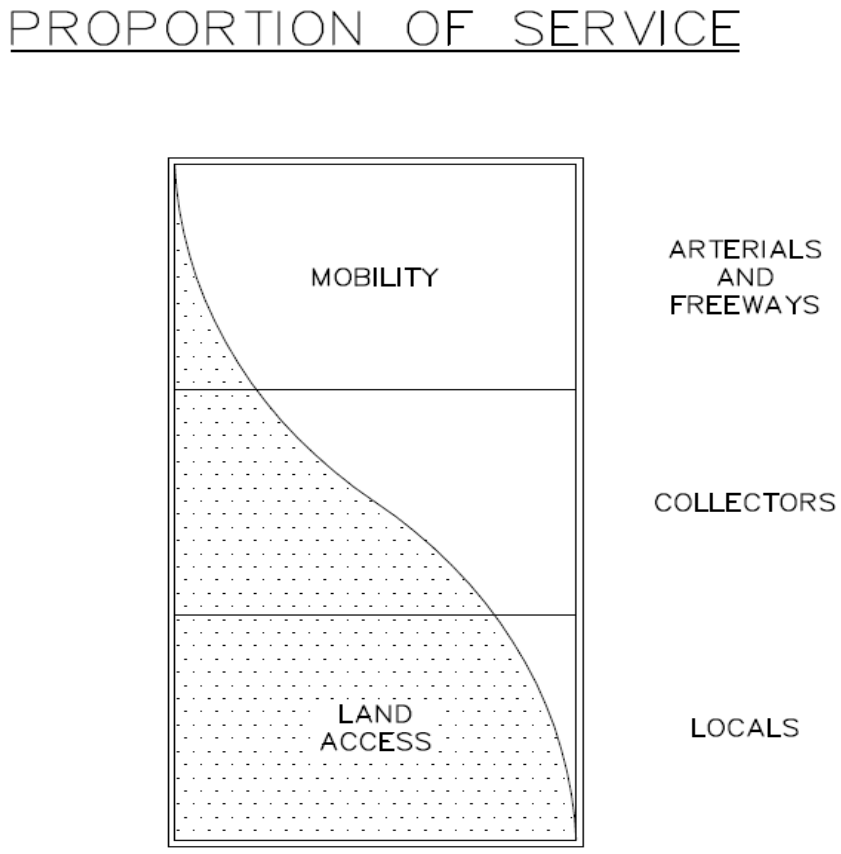

Figure 5.1 Proportion of Service

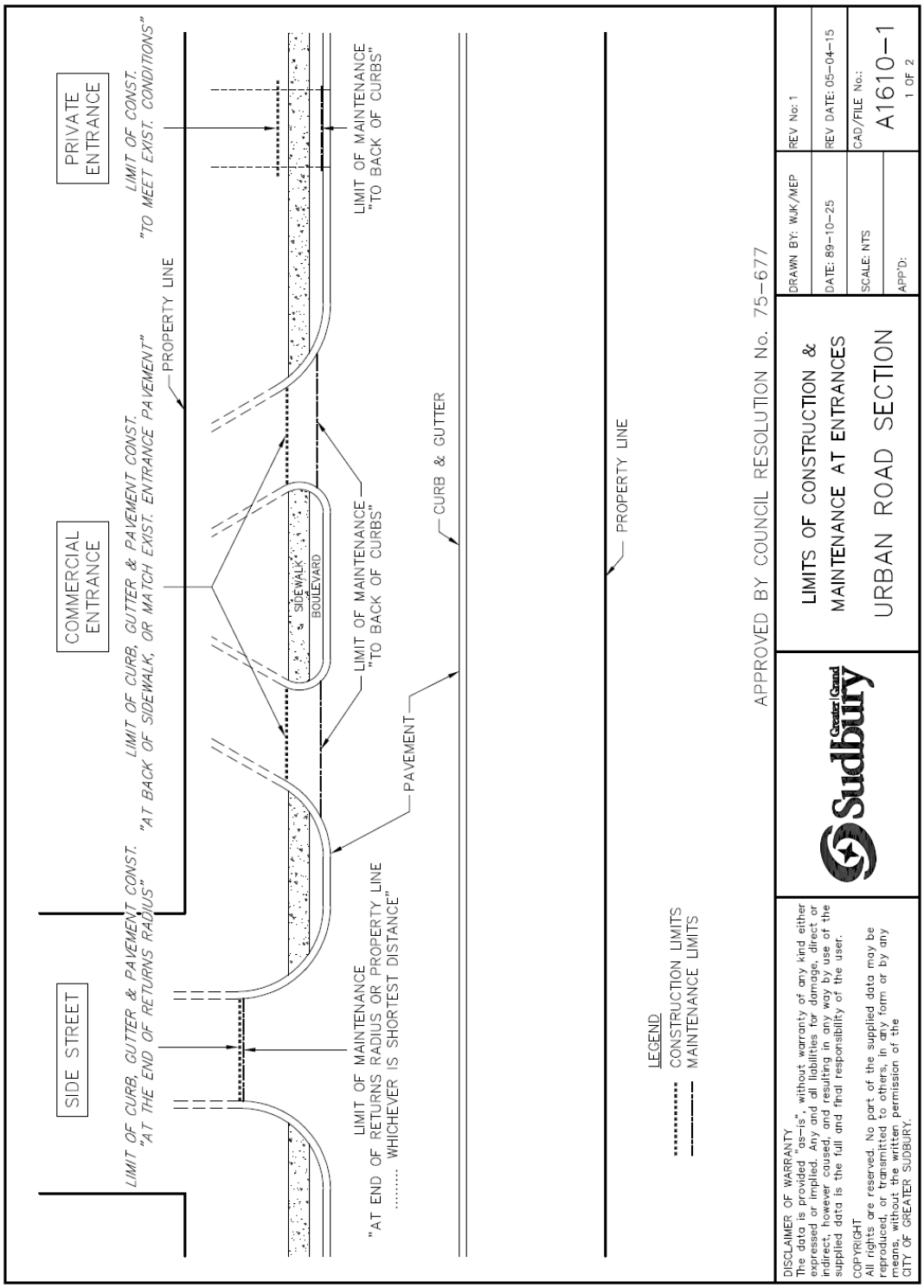

FIGURE 5.2

Figure 5.2 Limits of Construction & Maintenance at Entrances Urban Road Section

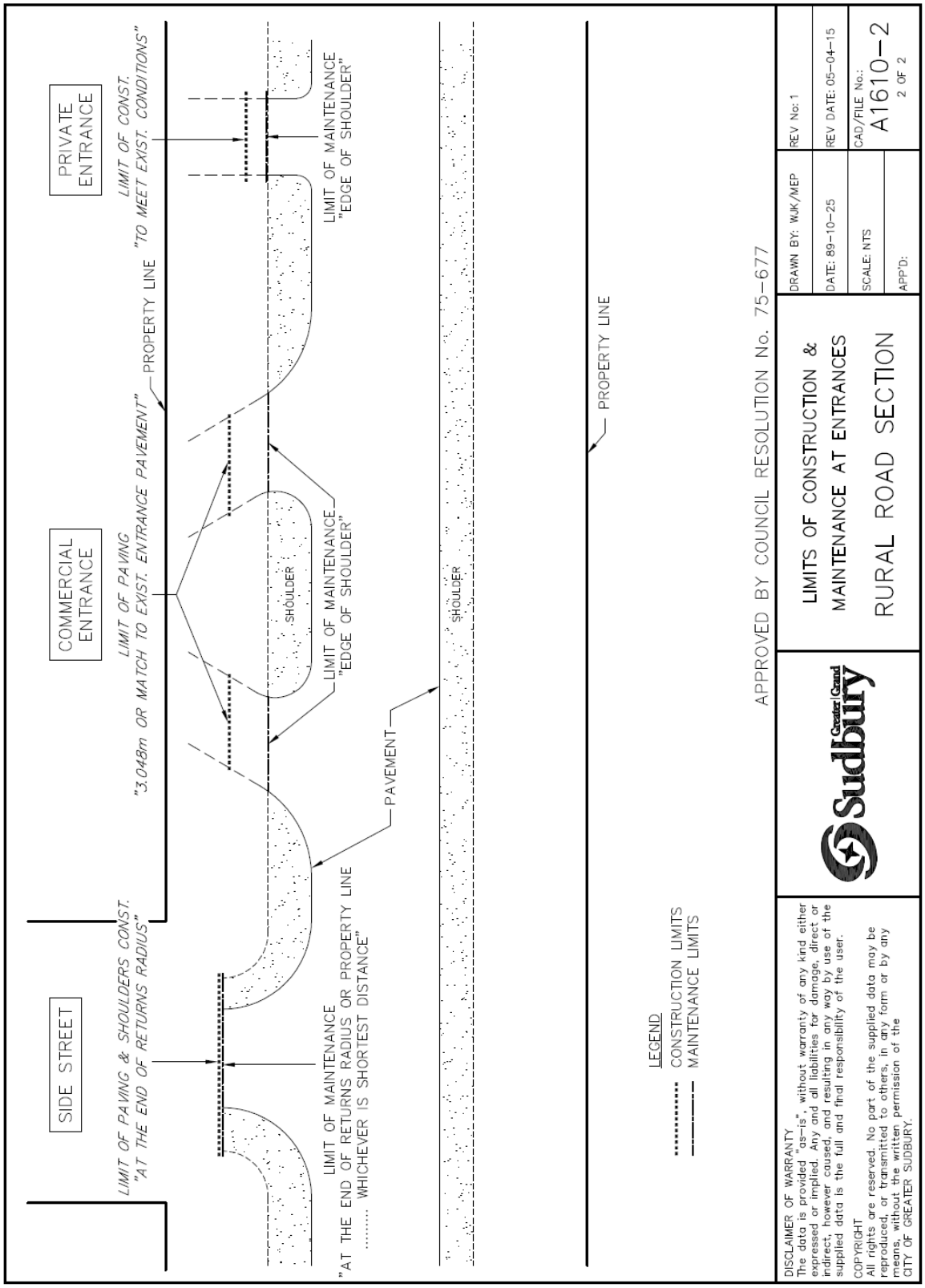

FIGURE 5.3

Figure 5.3 Limits of Construction & Maintenance at Entrances Rural Road Section

FUNCTIONAL CLASSIFICATION SYSTEM	PUBLIC TRANSPORTATION AND HIGHWAY IMPROVEMENT ACT
Freeway	Controlled Access Highway
Arterial	Controlled Access Highway King's Highways Secondary Highway
Collector	King's Highways Secondary Highway
Local	Secondary Highway Tertiary Road Resource Road Development Road Roads in Territory without Municipal Organization Remaining roads in this classification are part of the Municipal Road System

TABLE 5.1 Functional Classification System/Public Transportation & Highway Improvement Act

ROAD DESIGN, GEOMETRIC FEATURES						
	Standard Residential Roads		**Industrial Roads**	**Major Urban Roads**		
	Local Residential	**Feeder & Minor Collector Residential**	**Standard Industrial**	**Collector & Tertiary, Secondary & Primary Arterials**		
Design Speed (km/h)	60	60	60	60	70	90
Min. Super-elevated Horizontal Curve Radius (m)						
e = -0.02	N.C.	N.C.	210	210	300	750
e = 0.00	N.C.	N.C.	190	190	280	475
e = 0.02	N.C.	N.C.	170	170	230	420
e = 0.03	N.C.	N.C.	160	160	220	400
e = 0.04	N.C.	N.C.	150	150	200	380
e = 0.06	N.C.	N.C.	--	130	190	340
Min. Stopping Sight Distance	130	130	130	130	180	260
K. Crest min. (m)	15	15	15	15	25	50
K-Sag min. (m) (with streetlights)	8	18	18	18	25	40
Grade (%) - min.	1.0	1.0	1.0	1.0	1.0	1.0
- max.	*8.0	8.0	6.0	6.0	6.0	6.0

TABLE 5.2 Road Design, Geometric Features

NOTE: A maximum super-elevation of 0.02 is recommended for urban local streets and a maximum of 0.06 for all other urban roads by the Transportation Association of Canada (TAC).

e = Pavement super-elevation (tangent of the angle)

k = The length of a section of curve measured horizontally over which there is a 1% change of gradient.

N.C. = Normal Crown

* Maximum 10% in rock cut section (50 m to 100 m maximum tangent length), straight alignment only (Approach grade 2% for 20 m)

MINIMUM SIGHT DISTANCE*	
SPEED LIMIT KM/HR	**SIGHT DISTANCE IN METRES**
50	120
60	140
70	160
80	180
90	200
100	230
110	250
120	270

TABLE 5.3 Minimum Sight Distance

* Safe sight distance for a passenger vehicle, turning left into 2-lane highway across a passenger vehicle approaching from left. Taken from Ministry of Transportation - Geometric Design Standards for Ontario highways (sight distance requirements for stopping, crossing, and turning movements).