Note to reviewers:

This document is a **draft version** of the MTO Design Supplement to the TAC GDG and is being circulated for consultation on proposed technical and editorial revisions to the 2023 edition.

As the document is still under review, final formatting, editing, and quality assurance checks have not yet been completed. Additional revisions are anticipated as a result of the consultation process. Consequently, reviewers may encounter inconsistencies in figure and table numbering, page layout, spacing, cross-references, pagination, and other formatting elements.

While every effort has been made to ensure the draft is coherent and readable, reviewers are requested to focus their comments on the proposed technical content and editorial changes. A comprehensive formatting, editorial, and quality review will be undertaken prior to publication of the final document. Comments related solely to formatting, pagination, numbering, or document layout are generally not required at this stage, unless they affect the interpretation of the technical content.

Thank you for your feedback and participation in this consultation.

MTO DESIGN SUPPLEMENT

FOR

TAC GEOMETRIC DESIGN GUIDE (GDG) FOR CANADIAN ROADS - 2017

DRAFT JULY 2026

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STANDARDS and CONTRACTS BRANCH
HIGHWAY DESIGN OFFICE

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Record of Revisions

This version of the Design Supplement dated July 2026 includes Edition #4 and supersedes the previous edition. Changes from the previous edition are summarized below.

All Appendices

- Updates and standardization of formatting, spelling and grammar and MTO organizational structure.
- Revisions to wording to provide greater clarity as appropriate.

Appendix 1

- Section 1.1.7 removed reference to Southern and Northern Highways Programs and the need to justify exceptions.
- Section 1.2.3 added references to FHWA Proven Safety Countermeasures and introduction to context classification
- Section 1.2.3 updated guidance for design speed on freeways with posted speed of 110 km/h
- Section 1.3.3 added guidance on construction of berms within the right of way to manage excess soils

Appendix 2

- Section 2.6.3.1 removed guidance on 130 km/h design speed on new and existing freeways.
- Section 2.6.3.2 added guidance on municipal functional classification and design speed combinations that do not correspond to standard MTO values.
- Section 2.6.3.4 added clarification on separation of opposing rural freeway traffic

Appendix 3

- Table 3.2.6 added minimum radii for normal and reverse crown cross sections
- Section 3.2.4.5 added clarification that subgrade cross slope is to be 3% on curves with superelevation less than 3%.
- Section 3.2.5.4 added clarification that painted lane widths are to be equal when applying curve widening
- Section 3.5.4 added requirement to refer to Drainage Design Standards for cross slope and superelevation on roadway platforms with 4 or more lanes draining in a single direction.

Appendix 4

- Section 4.3.2.2 added considerations for right-turn lane warrants
- Section 4.3.2.4 added guidance for provision of buffers adjacent to parking spaces with EV chargers

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- Section 4.3.2.4 removed reference to recent market trends towards smaller vehicles
- Section 4.7.2 added guidance on the use of curb and gutter beyond bridge approaches as a means of erosion control
- Section 4.7.2 added guidance on the use of mountable curbs at channels to facilitate truck trailer off-tracking
- Exhibit – 4W added note that accommodation of out-of-service vehicles and snow removal operations should be considered when reducing side clearance on long-span bridges
- Section 4.10.1.3 added consideration of sidewalks wider than AODA minimum in areas with higher pedestrian traffic
- Section 4.10.1.3 added guidance on standard sidewalk thickness and granular depth

Appendix 6

- Section 6.4.6.1 expanded guidance on the use of TWSIs

Appendix 8

- No substantive changes

Appendix 9

- Section 9.9 added guidance discouraging construction of intersections on roads with design speeds of 120 or greater and provision of sight distances well in excess of minimums where such situations cannot be avoided
- Section 9.15.9.1 added requirement that all median and channel islands are to be bound by curb and gutter
- Exhibit – 9O added note that mountable curbs with aprons may be provided where constraints preclude standard pavement widths
- Section 9.17.4 added recommendation that an opposing left turn lane be constructed when a left turn lane is warranted in one direction at a 4-way intersection stop-controlled on sideroad approaches

Appendix 9A

- Added guidance on consideration of left turn lanes where percentage of left turning traffic is less than 5% of through traffic
- Clarified how to interpolate between warrant graphs where left turning traffic percentages are not an even multiple of 5 percent

Appendix 10

- Section 10.1.1 added clarification that guidance for “freeways” applies to all high-speed divided highways regardless of functional classification.
- Exhibit 10E added notes that minimum ramp radii shall correspond to TAC GDG Section 3.2.2.6 and spiral parameters shall be according to GDG Table 10.6.4

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- Table 10.6.2, Design Length for Deceleration is replaced by GDSOH guidance on deceleration lane design.
- Table 10.6.5 Design Length for Acceleration is replaced by GDSOH guidance on acceleration lane design.
- Section 10.7.4 added guidance that open ditches are preferable for drainage at interchange ramps.

Appendix 11

- No substantive changes

Appendix 12

- No substantive changes

Appendix 13

- Section 13.3.1 added clarification that the Traffic Staging Plan is a subset of the Traffic Control Plan
- Section 13.4 removed reference to OTM Book 7 for planning and mitigation techniques
- Removed Exhibit 13G, Taper Lengths for Work Zones and Exhibit 13, Taper Length Criteria for Work Zones. Revised guidance to refer to OTM Book 7 to determine lane closure taper lengths. Revised subsequent references to taper lengths accordingly
- Section 13.8.3 added note that constricted lane widths shall be according to OTM Book 7
- Section 13.8.5 removed reference to American MUTCD and corresponding Exhibit 13O
- Section 13.8.6 added guidance that traffic control and staging to be designed according to OTM Book 7 on interchange ramps
- Exhibit 13W Clear Zone Distances for Work Zones added guidance that temporary traffic signal poles should be a minimum of 7m from the travelled roadway
- Section 13.9.3 removed subsections 13.9.3.1, 13.9.3.2 and 13.9.3.3 and updated guidance to refer to OTM Book 7 for use of traffic protection for mobile, short and long duration work

Appendix A

- Added definition for Freeway
- Updated definition for Multi-Lane Roads
- Corrected definitions for Secondary Highway and Stopping Sight Distance
- Other changes consistent with the Roadside Design Manual updates

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Appendix B

- Reverted stopping sight distance values for freeways and divided highways to reflect 2.5 seconds of perception-reaction time.

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MTO Design Supplement
Preface

Background

In 2017, the Transportation Association of Canada (TAC) released the Geometric Design Guide ~~(GDG)~~ for Canadian Roads (GDG), replacing the previous 1999 ~~iteration~~version, which contains updated design guidance ~~information~~, standards including the addition of human factors and an emphasi~~ze~~s on ~~the~~ safety in design.

The TAC GDG ~~for Canadian Roads~~ originally ~~released~~ issued in June 2017 consists of ten chapters, with future chapters planned. ~~Later in spring of 2020 C~~chapter 11 was added in the spring of 2020. While ~~TAC~~ the TAC GDG was developed with MTO participation, it is difficult to develop guidance and standards that are equally applicable across Canada due to differing limiting factors and design demands across the nation. As a result, jurisdiction-specific supplements may be required. With this in mind, there exist certain aspects of the TAC GDG which may not be suitable for roads and highways under MTO jurisdiction or where additional guidance is required.

To address these areas of the TAC GDG, MTO reviewed the guide and compared it against pre-existing manuals, guidelines, and policies (e.g., Geometric Design Standards for Ontario Highways (GDSOH), Capacity Analysis Manual, Highway Corridor Management Manual, Illumination Policy, Ontario Traffic Manuals, Roadside Design Manual and various Design Policy Memos, etc.) to determine if there was conflicting, missing or repetitive guidance ~~between TAC GDG and MTO~~. If any conflicting or missing information was found, ~~proper~~ appropriate guidance, standards or policies were provided, and are compiled in this document, being the MTO Design Supplement (DS) for the TAC GDG for Canadian Roads.

~~Each Chapter of the TAC GDG has been reviewed and supplemental design guidance on each chapter is provided in this document, being the MTO DS.~~ The MTO DS is intended to be read in conjunction with the TAC GDG to aid designers in completing the design of provincial highways or roads crossing or constructed within the rights-of-way~~s~~ of provincial highways. Anywhere that conflicting information between the TAC GDG and MTO DS exists, the MTO DS takes precedence.

Organization of the Design Supplement

The MTO DS consists of 16 Appendices. Appendices 1 to 8, 10, and 11 correspond to chapters 1 to 8, 10, and 11 of the TAC GDG respectively. ~~While~~ Appendices 9 and 9A correspond to chapter 9 of the TAC GDG. Appendix 12 ~~is developed by the ministry for~~ provid~~ing~~es guidance on ~~"~~Managed Lanes and~~"~~ ~~which is not currently available from TAC.~~

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~~Also,~~ Appendix 13 ~~is added for a chapter~~provides guidance on ~~"~~Work Zones~~"~~. The TAC GDG does not currently provide guidance for either of these subjects. ~~This chapter~~Appendix 13 ~~is developed by the ministry~~ providesing guidance to designers for the planning and geometric design of ~~the~~ work zones. This ~~chapter~~ appendix is not intended to be a substitute for ~~the~~ Ontario Traffic Manual (OTM) Book – 7 for Temporary Conditions but rather a supplement to it and should be applied in conjunction with OTM Book 7. Appendix A ~~is for the~~contains a comprehensive Glossary while Appendix B ~~is~~ provides the MTO Geometric Design Standards Summary Tables for Design Criteria (DC).

How to use the Design Supplement

By default, guidance in the TAC GDG is ~~the Guide~~ to be used for geometric design of provincial highways unless otherwise ~~stated in~~modified by the MTO DS.

Two chapters of the TAC GDG, *Chapter 5 – Bicycle Integrated Design and Chapter 7 – Roadside Design* are ~~Not~~ not ~~Applicable~~ applicable for design guidance of provincial highways. These Chapters are replaced with the ministry's Bikeway Design Manual (~~originally issued in~~ March 2014) and the ~~latest edition of~~ Roadside Design Manual (originally issued in December 2017 ~~and~~ with subsequent editions ~~of~~ issued in 2020 and 2023). The user shall ensure they are referring to the ~~latest~~ current version of each manual and this supplement.

Some individual Sections, Figures, and Tables in all chapters of the TAC GDG are either fully or partially ~~Not~~ not ~~Applicable~~ applicable, as indicated in the Design Supplement and should not be used for design guidance.

Some individual Sections, Figures, and Tables in all chapters of the TAC GDG are ~~Not~~ not ~~Applicable~~ applicable and are replaced with substitute guidance, as indicated in the Design Supplement. The substitute guidance should be used.

Some individual Sections, Figures, and Tables in all chapters of the TAC GDG are ~~Applicable~~ applicable with additional guidance. This additional guidance should be read and applied in conjunction with relevant Sections, Figures, and Tables.

Some individual Sections, Figures, and Tables in all chapters of the TAC GDG are Applicable with slight modification. The modified guidance should be read and applied in conjunction with relevant Sections, Figures, and Tables.

While TAC originally published ten new chapters in June 2017 all with the same ~~release~~ date of issue, they were published as individual chapters and are intended to being updated independently~~separately~~. In addition, Chapter 11 was ~~added~~ issued in 2020. The MTO DS Appendices 1 through 10 are developed to apply to the release date version of

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June 2017 while chapter 11 for March 2020 of the TAC GDG.

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MTO Design Supplement

For
TAC Geometric Design Guide (GDG) for Canadian Roads

Appendix 1 for Chapter 1

Design Philosophy

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~~October 2023~~July 2026

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MTO Design Supplement
Appendix 1 for Chapter 1
Design Philosophy

The following design supplements are applicable to *Chapter 1 – Design Philosophy* of the *TAC Geometric Design Guide for Canadian Roads - June 2017:*

Section 1.1.2 – The Use of Standards and Guidelines

- This section is **~~Applicable~~ applicable** with the following **additional g~~G~~uidance**:

  Policy
  In various places designers will see reference to "policy". Policy is specific direction given for ministry projects. Policy may be related to the specific application of a standard or guideline or relate to a design approach. Policy may be specifically outlined in this supplement or may be issued in the form of a *Directive* or a *Provincial Engineering Memorandum*. It is the designer's responsibility to be familiar with current ~~policy~~ policies and ~~its~~ their application.

  Any policy in Provincial Engineering ~~Memorandums~~ Memoranda issued after the current date of ~~the last update of~~ this document supersedes what is contained in this document and shall be followed.

Section 1.1.7 - Rehabilitation Design

- This section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

  Policy
  The following policy provides direction on the scope of work that is to be included in rehabilitation projects to assist the regions with the delivery of their Major and Minor Capital Programs and ensure a consistent provincial approach. Work performed under the Minor Capital and Day Labour program shall also follow the direction of this policy.

This direction also applies to Contracts and Maintenance resources that may be required to consider additional work beyond the original design of the project.

Project Focus

- ~~All commitments of the Northern and Southern Ontario Highways Programs (N/SOHP) must be delivered as scheduled. Additional work beyond the commitments of the N/SOHP, including warranted improvements to these projects, shall only be considered on an exception basis.~~
- Existing highways and bridges will maintain their present configuration.
- Projects shall focus expenditures on bridges and pavements.
- A cost-effective pavement structure suitable for the expected volumes and loading and corresponding drainage system shall be maintained.
- Structural integrity of the pavement should not be compromised – shoulder construction, subgrade improvements, frost heave repairs, and a sound drainage system are required to ensure pavement integrity.

Standard Application

- Many highways function well with their current geometrics and non-standard elements.- The intent is to improve the structural integrity of the highway by maintaining the existing shoulder and lane platform.
- Other Major Capital improvements, including cost-shared improvements with developers and municipalities shall only be considered by exception and upon agreement by the Engineering Functional Team (EFT) to ensure provincial consistency.
- All improvements that have been deferred shall be recorded and retained for future programming.

Section 1.1.4 – The Concept of Safety

- This section is **applicable** with the following **additional guidance**:

The ministry recognizes the Safe System Approach in the planning, design, operation, maintenance, and rehabilitation of provincial transportation infrastructure.

The Safe System Approach recognizes that:

- Deaths and serious injuries for road traffic collision are not acceptable.
- Human error is inevitable.
- People are vulnerable to crash forces.
- Responsibility for safety is shared among designers, operators, regulators, enforcement agencies, vehicle manufacturers, and road users.
- Transportation systems should be designed to anticipate and accommodate human error.

The objective of the Safe System Approach is to provide a transportation system that maintains mobility and accessibility while reducing the risk of death and serious injury for all road users.

Designers should consider Safe Systems principles throughout project planning, design, rehabilitation, operation, and maintenance activities.

Application of the Safe System Approach includes consideration of:

- Speed management and the relationship between operating speed and injury severity.
- Design consistency and drivers' expectation.
- Reduction of conflict points and conflict severity.
- Provision of forgiving roadsides and recovery opportunities.
- Accommodation of vulnerable road users, including pedestrians, cyclists, transit users, older adults, and persons with disabilities.
- Substantive safety performance in addition to compliance with design standards.
- Risk-based decision-making and performance-based design.
- System resilience and network reliability.

Designers should recognize that compliance with design standards does not necessarily guarantee the best safety outcome. Sound engineering judgment should be applied to achieve the safety, operational, environmental, and social objectives of a project while supporting Safe Systems principles.

The Safe System Approach complements, but does not replace, established design standards, guidelines, and policies. Standards provide consistency and minimum requirements for design. Safe System principles assist designers in evaluating project-specific conditions and identifying opportunities to improve safety performance beyond minimum requirements where appropriate.

Future revisions of the Design Supplement and other ministry guidance will substantially revise guidance to designers to comprehensively align each aspect with the Safe Systems Approach. The Transportation Association of Canada's *Vision Zero and the Safe System Approach: A Primer for Canada* may be referred to for further information at www.tac-atc.ca/en/whats-happening/news/vision-zero-and-the-safe-system-approach-a-primer-for-canada/. The US Federal Highway Administration's site is an additional reference highways.dot.gov/safety/zero-deaths.

Section 1.1.8 - Value Engineering

- This section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Policy

Mandatory Studies

Value Engineering studies are required on the following project types, unless exempted:

- ○ Route Planning Studies
- ○ Preliminary Design Studies for expansion projects over $20 million
- ○ Preliminary Design or Detail Design projects of individual structures over $10 million, when they meet one or more criteria in the Recommended Projects for Consideration for a VE Study

Where an individual work project meets the mandatory requirements for a VE study, it can only be exempted on the approval of the responsible Manager, Engineering.

Recommended Projects for Consideration for a VE Study

Value Engineering Studies should also be considered for projects with technical challenges, complicated functional requirements, or complex external issues.- These projects provide the greatest opportunities for improved value. Examples of candidate projects for consideration are:

- ○ New interchanges
- ○ High complexity reconstruction
- ○ Complex (multi-span) bridge rehabilitation
- ○ Projects involving multiple construction contracts~~.~~

- Projects involving complex or conflicting stakeholder issues, where a workshop could support communication and decision making~~.~~
- Projects with significant environmental, utility, geotechnical or foundations requirements
- Projects over $10 million that involve significant infrastructure modifications such as:
  - Complex intersections
  - Significant storm drainage works~~.~~
- Design-Build Major projects over $20 million
- Projects with unique safety challenges
- Multi-modal and multi-use projects
- Major policies, standards, procedures, and business processes

Annual VE Program

Each ~~Region~~ Project Delivery area must prepare and submit an annual program for VE projects during the third fiscal quarter. The responsible Manager must approve and sign the program. The program will list projects where a VE study is to be scheduled over the subsequent two-year period. The ~~Program~~ program is to be submitted to ~~the~~ Highway Design Office.

Exemption of Mandatory Studies

On an annual basis, mandatory studies must be documented on the VE Projects Annual Program to indicate those projects that will have a VE study completed, and those projects exempted from a VE study.

VE Study Finalization

For each study, a VE study implementation meeting shall be held. The responsible Manager will make the final decision on the disposition of all VE study recommendations. The VE study recommendation decisions and study finalization form shall be forwarded to the Highway Design Office.

Application of Value Engineering Concepts and Tools in Day-to-Day Project Management

In addition to VE studies on projects, there are a variety of creative and analytical procedures used in VE workshops that can also be used within projects, meetings, and other day-to-day activities to support project analysis and decision-making. Information

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and assistance on these methods are available on the MTO Technical Publications website, and through Regional Value Engineering Coordinators.

Timing of VE Studies

Guidance for the timing of VE studies is available through the Highway Design Office.

VE Study Duration and Independence

Guidance for the duration of VE Studies and the importance of team independence is available through the Highway Design Office.

Section 1.2.3 Design Decisions

- This section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Designers should note that "standards" do not necessarily mean "best" nor are standards intended to be a substitute for engineering judgment and context-specific considerations to ensure that designs address the needs of all road users and the overall operation and safety of the facility.

Nominal Versus Substantive Safety

Nominal safety refers to ensuring that the design features meet minimum design standards, however this does not ~~examine~~ consider the actual or expected safety performance of a highway facility. Substantive safety refers to the expected and/or estimated long-term average safety performance of the highway. This takes into consideration the following quantitative measures:

- Collision Types~~,~~
- Collision Frequency
- Collision Severity

This is done to aid designers in making appropriate design decisions addressing operational and safety issues pertaining to a specific section of the highway facility.

When making design decisions, it is important to consider both nominal and substantive safety performance of the facility.

Design Exceptions

A design exception is a documented decision related to one or more design elements of a highway facility ~~to a degree~~ that do~~es~~ not meet minimum prescribed standard values or ranges. The purpose of design exceptions is to permit deviations from ~~normal~~ design standards based upon project-~~-~~specific conditions and constraints ~~making~~ where application of ~~typical~~minimum standards is not practical and/or appropriate. A design exception may be considered for a variety of reasons including but not limited to:

- Environmental Impacts
- Construction or Right-of-Way Costs
- Social Impacts

~~Please r~~Refer to Section 1.5.3 Design Exception Process of the *TAC ~~Geometric Design Guide for Canadian Road~~GDG – Chapter 1* as well as the additional guidance provided in Section 1.5.3 Design Exception Process of th~~is~~e *~~TAC Geometric Design Guide for Canadian Road –~~ MTO Design Supplement,* for more information on ~~how to handle~~ design ~~exemptions~~ exceptions and the approval process.

Performance-Based Design

Performance can be an important factor in establishing the purpose and needs of a given project.~~ ~~ The performance-based design approach can help focus a designer on addressing the needs of a project and limiting the project scope to focus on documented performance improvement needs.

The data that may be available for performance-based design includes:

- Past performance data (typically from collision reports)~~; and,~~
- Forecasts of future performance~~.~~

Performance-based design can be taken for granted as on the surface it can be perceived as part of the regular design process.~~ ~~ However, the designer, particularly on re~~-~~construction projects, should specifically consider performance in major design decisions. Performance is also a factor in the Design Exception Process (see Section 1.5.3).

The assessment of performance is not an exact science, and available tools often require engineering judgment applied.

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Some jurisdictions or designers may also refer to this as “Practical Design”.

For more information on performance-based design, ~~please~~ refer to Section 1.2 of the *American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 2018*, commonly referred to as *“The Green Book” (AASHTO – Green Book)*.

Proven Safety Counter Measures

The Federal Highway Administration publishes a comprehensive list of 28 Proven Safety Countermeasures with supporting evidence substantiating their efficacy. These countermeasures are broken into five major categories: Speed Management, Pedestrian/Cyclist, Roadway Departure, Intersections and Crosscutting. The countermeasures are shown at the following link: highways.dot.gov/safety/proven-safety-countermeasures. Designers are encouraged to consider countermeasures as appropriate, in consultation with regional Traffic sections and as supported by provincial legislation, regulations and standard practices. Example countermeasures for Speed Management are described below.

Appropriate Speed Limits for All Road Users - FHWA-SA-21-034

Speed management is critical to improving road safety, particularly where vehicles interact with pedestrians and cyclists. Lower speeds significantly reduce the likelihood and severity of injuries—especially for vulnerable users.

Speed limits should be set using engineering studies that consider factors such as land use, roadway function, traffic volumes, and user activity. In urban areas, lower speeds (30–50 km/h) should be considered where pedestrian and cyclist activity is present. Evidence shows that reducing speed limits and implementing comprehensive strategies can lead to meaningful reductions in crashes, injuries, and fatalities.

Speed Safety Cameras- FHWA-SA-21-070

Speed safety cameras (SSCs) are an effective tool within the Safe System Approach to enforce safe speeds and reduce crash risk. They use automated technology to detect and document speeding violations, complementing traditional enforcement, engineering, and education efforts.

SSCs can be deployed as fixed, point-to-point, or mobile units, and are typically implemented based on data-driven analysis of high-risk locations such as school zones, urban corridors, and work zones.

They improve safety by reducing speeding and influencing driver behaviour more broadly, including spillover effects beyond camera locations. Successful programs require public trust, legal authorization, equity considerations, and ongoing evaluation. Evidence shows significant safety benefits, including reductions in crashes, injuries, and speeding rates, demonstrating SSCs as a reliable and scalable speed management strategy.

Variable Speed Limits - FHWA-SA-21-054

Speed should be a core design parameter integrated into roadway planning, ensuring that target operating speeds align with context and Safe System principles. Posted speed limits must be based on engineering analysis and reflect roadway function, land use, and safety needs, with lower speeds (30–50 km/h) in urban and mixed-use areas.

Road design should consider factors such as land use, active transportation, collision history, and geometry, and should promote self-enforcing speeds through context-sensitive features. Transitional areas should include gradual speed reductions supported by visual and physical cues.

Speed limits should be reinforced with measures like traffic calming and enforcement. Overall, lower speeds improve safety, and effective speed management must be embedded in both design and operations.

Context Classification for Geometric Design

Functional classification (freeways, arterials, collectors, and local roads) is a useful starting point for design, but it does not fully address how a roadway fits into its community or serves all users, such as pedestrians and bicyclists.

Designers should not rely only on the formal classification. Instead, roadway design should reflect the actual role the road plays in the transportation system, based on project-specific conditions. Geometric design should also consider the surrounding context and the needs of multimodal transportation.

Traditionally, Canadian jurisdictions have only considered two major classifications, Rural and Urban. The *AASHTO's A Policy on Geometric Design of Highways and Streets 7th Edition, ~~(~~2018,~~)~~* introduced a broader set of contexts for geometric design. The 8th Edition will further enhance this guidance. The introduction of context classifications is not intended to replace the traditional functional classification system but to encourage designers to consider how the highway relates to its natural and built environment when making design decisions.

Five contexts are used, two for rural areas and three for urban areas:

Rural Areas:

- Rural context
- Rural town context

Urban Areas:

- Suburban context
- Urban context
- Urban core context

The primary factors that define the context classes include Suburban context:

- Development density (existence of structures and structure types)
- Land uses (primarily residential, commercial industrial and or agricultural) ~~and~~
- Building setbacks (distance of structures to adjacent roadways)~~.~~

Note: The primary factors are easy to identify by observing other factors including topography, soil type, land value, population density and building square footage are also related to context classification; however data on these other factors are more quantitative and more difficult to acquire, so the context classification does not rely on them.

Roads in any context classification may fall within any functional classes except freeways and if ever are designed for a rural town context**.**

Context Classes~~s~~
for roads and Streets in Rural Areas

Roads in rural areas should be designed for either the rural or rural town context. Each of these contexts is discussed below:

Rural Context~~:~~

The rural context applies to roads in rural areas that are not within a developed community. These include areas with the lowest development density; few houses or structures; widely dispersed or no residential, commercial, and industrial land uses; and usually large buildings setbacks. The rural context may include undeveloped land, farms, outdoor recreation areas or low densities of other types of development. Most roads in rural areas fit the rural context and should be designed in a manner similar to past design criteria for rural facilities.

Rural Town Context~~:~~

The rural town context applies to roads in rural areas located within developed communities. Rural towns generally have low development densities with diverse land uses, on street parking, and sidewalks in some locations, and small building setbacks. Rural towns may include residential neighbourhoods, schools, industrial facilities and commercial main street business districts, each of which present differing design challenges and differing levels of pedestrian and bicycle activity. The rural town context recognizes that rural highways change character where they enter a small town, or other rural community, and that design should meet the needs of not only through travelers, but also the residents of the community.

Context Classes for Roads and Streets in Urban Areas

Roads and streets in urban areas may be designed for the suburban, urban, and urban core contexts. These contexts differ in development density, land use, and building setbacks.

Suburban Context

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The suburban context applies to roads and streets, typically within the outlying portions of urban areas, with low to medium development density, mixed land uses (with single-family residences, some multi-family residential structures and non-residential development including mixed town centers, commercial corridors, big box commercial stores, light industrial development). Building setbacks are varied with mostly off street parking. The suburban context generally has lower development densities and drivers have higher speed expectations than the urban and urban core contexts. Pedestrian and cyclist activity are higher than in rural context, may not be as high as found in urban and urban core areas.

Urban Context

The urban context has high density development, mixed land uses, and prominent destinations. On-street parking and sidewalks are generally more common than in the suburban context, and building setbacks are mixed. Urban location often includes multi-story and low to medium rise structures for residential, commercial and educational uses. Many structures accommodate mixed uses: commercial, residential and parking. The urban context includes light industrial, and sometimes heavy industrial, land use. The urban context also includes prominent destinations with specialized structures for entertainment, including athletic and social events, as well as conference centers. In small and medium sized communities, the central business district may be more an urban context than an urban core context.

Urban Core Context

The urban core context includes areas of the highest density, with mixed land uses within and among predominantly high-rise structures, and with small building setbacks.

The urban core context is found predominantly in the central business districts and adjoining portions of major metropolitan areas. On street parking is often limited and time restricted than in the urban context. Substantial parking is in multi-level structures attached to or integrated with other structures. The area is accessible to automobiles, commercial delivery vehicles and public transit. Sidewalks are present nearly continuously, with pedestrian plazas and multi-level pedestrian bridges connecting commercial and parking structures in some locations. Transit corridors including bus and rail transit, are typically common and major transit terminals may be present. Some government services are available, while other commercial uses predominate, including financial and legal services. Structures may have multiple uses and setbacks are not as generous as in the surrounding urban area. Residences are often apartments or condominiums.

The urban core represents the densest and most active part of a city, typically located in the downtown or central business district**.**

- It consists mainly of high-rise buildings with mixed uses, such as offices, shops, and residential units, often within the same structure.
- Buildings are closely spaced, with minimal setbacks, creating a compact and built-up environment.
- On-street parking is limited, with most parking provided in large multi-level or integrated structures.
- The area is highly accessible, supporting cars, delivery vehicles, and extensive public transit, including bus and rail systems and major transit hubs.
- Pedestrian infrastructure is strong, with continuous sidewalks, plazas, and sometimes bridges connecting buildings and parking structures.
- Commercial activities dominate, especially financial and professional services, along with some government services.
- Housing is present but typically in the form of apartments or condominiums.

For more information on context for geometric design please refer to Section 1.5 of the *American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 2018, "The Green Book" (AASHTO – Green Book)*.

Desirable Versus Acceptable Design

Consideration of desirable versus acceptable design speeds typically depends on the economics of achieving the additional margin of safety and capacity normally associated with a desirable design. When economics and other constraints are not present, a "desirable" design is always preferable to an "acceptable" design. There are circumstances, however, where conditions warrant the use of an acceptable design speed.

For operational and safety considerations, the design speed should desirably be 20 km/h greater than the posted speed. Acceptable relations are to have the design speed 10 km/h greater than the posted speed or in some cases equal to the posted speed, as described in the following paragraphs.

Every effort should be made to use desirable design speeds when designing freeways, arterials and collectors, which are important links in the highway system. These roads typically carry significant traffic volumes with moderate to high operating speeds. Considering the expected service life and function of these highways, desirable standards are the preferred alternative. However, achieving desirable standard is not always practical or realistic when faced with terrain, urban development, and economic factors. Sound engineering judgment is required.

Existing freeway sections designed and constructed with a design speed of 120 km/h, as documented in the corresponding Design Criteria, are candidates for posted speed increase to 110 km/h. This effectively reduces the difference between design and posted speeds to 10 km/h. An operational review should be carried out to identify locations where enhanced advisory signage, minor capital works, illumination, roadside safety devices, or warning devices may be required.

A posted speed equal to the design speed is acceptable and normal practice on secondary, tertiary, and some 7,000-series highways due to low traffic volumes, rugged terrain and economic considerations. Although these highways fulfil a provincial mandate in terms of public service, the low traffic volumes justify the use of posted speeds equal to design speeds.

When considering design speed or other design parameters, the highway designer must always be mindful of the overall objective – to create a safe, efficient, and economical transportation system. Several concepts for improved design have been developed which directly support this goal. These include design consistency and uniformity as well as context- sensitive design and performance-based design.

Design consistency has been defined as the condition which exists when the geometric features of the roadway are consistent with the operational characteristics as determined by what drivers expect of the roadway ahead and what they are willing to accept in terms of operational quality.

The concept of operational uniformity is similar in nature to that of consistency. It refers to a consistent arrangement of geometric features, exits and entrances that reinforces a driver's confidence or expectation.

Consistency and uniformity of design standards place a driver in an environment which is fundamentally safer because it is more likely to compensate for the driving errors that are inevitably made.

~~For operational and safety considerations, the design speed should desirably be 20 km/h greater than the posted speed. be An acceptable relation is one where the design speed equals the posted speed.~~

~~The decision for Consideration of desirable versus acceptable typically, usually depends on the economics of achieving the additional margin of safety and capacity normally associated with the a desirable design. Of course, When economics and other constraints are not present, a "desirable" design is always preferred overpreferable to an "acceptable" design if economics are not a consideration. There are circumstances, however, where conditions warrant the use of the an acceptable design speed. Acceptable design speeds may be appropriate where the highway is a minor link in the system, particularly secondary, tertiary and some 7,000-series highways. For these types of roads, operating speeds are in the low to medium range, and traffic volumes are expected to remain at low levels for the foreseeable future. Although the highway fulfils a provincial mandate in terms of public service, the low speeds and traffic volumes justify consideration of the "acceptable" design standard. A similar analogy can be drawn for the values chosen for other geometric design parameters.~~

~~Every effort should be made to use the desirable standard on freeways, arterials and major collectors which are generally important links in the highway system. These roads normally typically carry significant traffic volumes at with medium moderate to high operating speeds. Considering the expected service life and function expected of these highways, desirable standards are the preferred alternative. However, achieving the desirable standard is not always practical or realistic when faced with terrain, urban development, and economic factors. Sound engineering judgment is required.~~

~~When considering design speed or other design parameters, Whether design speed or another design parameter is under debate, the highway designer must never lose~~

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~~sight~~always be mindful ~~of the overall objective – to create a safe, efficient, and economical transportation system. Several concepts for improved design have been developed which directly support this goal. These include design consistency and uniformity as well as context- sensitive design and performance-based design.~~

~~Design consistency has been defined as the condition which exists when the geometric features of the roadway are consistent with the operational characteristics as determined by what the driver expects of the roadway ahead and what they are willing to accept in terms of operational quality.~~

~~The concept of operational uniformity is similar in nature to that of consistency. It refers to a consistent arrangement of geometric features, exits and entrances that reinforce the driver's confidence or expectancy~~expectation.

~~Consistency and uniformity of design standards place the driver in an environment which is fundamentally safer because it is more likely to compensate for the driving errors that are inevitably made.~~

Guidelines for Geometric Design of Municipal Roadways within Provincial Highway Right-of-Ways

Policy

For planning and geometric design of municipal roadways crossing provincial highways within (and immediately adjacent to) provincial highway rights-of-way~~s~~:

- For new municipal crossing roads and bridges, and widening of existing municipal roads and bridges, design should be in accordance with the TAC Geometric Design Guide for Canadian Roads and the MTO Design Supplement.
- In constrained areas consideration may be given to using alternative design standards or ~~aspects~~ values at the lower end of specified ~~our~~ design domains.
- For rehabilitation of existing municipal crossing roads and bridges, consideration may be given to using the local municipal road design guidelines issued by the municipality's engineering department or the TAC Geometric Design Guide for Canadian Roads.
- For new municipal crossing roads and bridges, and widening of existing municipal roads and bridges, consideration may also be given to using the local

municipal road design guidelines issued by the municipality's engineering department or the TAC Geometric Design Guide for Canadian Roads. This would be appropriate in the situation where certain geometric features, such as lane width, are consistent ~~at~~ with the ~~other~~ applicable standard for a reasonable distance on either side of the provincial ~~project~~highway.

- Where the municipality proposes to use their design guidelines or the TAC Geometric Design Guide for Canadian Roads for design of the municipal roadway within the provincial highway right-of-way, a formal request in writing shall be submitted to MTO along with indemnification.
- Where MTO proposes to use parameters from within the design domain in the TAC Geometric Design Guide indemnification is not required.

Guidance for Choice of Municipal Design Parameters

In applying engineering judgment to choose the design parameters for rehabilitation of existing municipal crossing roads and bridges, the following considerations should be applied in this order:

1. Use design parameters in accordance with the *TAC Geometric Design Guide for Canadian Roads* and the *MTO Design Supplement*.
2. If width is a~~n~~ ~~issue~~limitation, ~~look at~~consider reallocation of road space as follows:
    a. Consider narrowing features such as centre islands and shoulders as much as possible.
    b. Consider narrowing sidewalks to the minimum ~~allowed~~ permitted under the~~by~~ Accessibility for Ontarians with Disabilities Act (AODA) ~~standards~~and associated regulations.
    c. Considering narrowing lanes to meet widths in the *TAC Geometric Design Guide for Canadian Roads.*
    d. Consider eliminating shoulders and gutter pan offsets.
3. For all features consider using the local municipal road design guidelines issued by the municipality's engineering department.
4. Consider design parameters from standards or guidelines published by another North American jurisdiction with similar climate and operating characteristics.

Section 1.3.2.4 - The Cost of Collisions

- This section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

  The collision costs used for calculations on ~~Ontario~~ provincial highway projects shall be as per the latest Traffic Office Document for "Collision Costs in Engineering Analyses Updated", found on the MTO Technical Publications website under MTO Technical Documents. ~~*Traffic Office Memo for "Collision Costs in Engineering Analyses Updated" August 3, 2012*, and shown in **Exhibit -1A**~~.

  ~~Currently, Provincial Traffic Office is updating the collision cost in consultation with the ministry's Transportation Safety Division. The designer should contact the Provincial Traffic Office for the latest figures for collision cost analyses.~~

~~Exhibit - 1A~~

~~Collision Cost for Engineering Analyses~~

~~Collision Severity~~	~~Updated Values (2011$)~~
~~Fatal (K)~~	~~$1,582,000~~
~~Disability / Major Injury (A)~~	~~$142,000~~
~~Evident / Minor Injury (B)~~	~~$53,000~~
~~Possible Minimal Injury (C)~~	~~$36,000~~
~~Injury (A/B/C)~~	~~$59,000~~
~~Property Damage Only (O)~~	~~$8,000~~

Section 1.3.3 – Environmental Impacts and Aesthetics

This section is **a~~A~~pplicable** with the following **additional g~~G~~uidance**:

-

Climate Change

Climate change is altering temperature, precipitation, and weather patterns across Ontario and is increasing the frequency and severity of many extreme weather events. Historically, transportation infrastructure was designed using the assumption that past climate conditions were representative of future conditions. While this approach was appropriate for many years, changing climate patterns mean that historical climate data alone may no longer adequately represent future conditions throughout the service life of a transportation asset.

Climate change considerations should be integrated into the evaluation, selection, and development of transportation solutions to help ensure that provincial highway infrastructure remains safe, reliable, and resilient throughout its intended service life.

Resilience refers to the ability of transportation infrastructure to maintain or restore acceptable levels of service following a disruptive event. The level of resilience required should reflect the importance of the asset, the consequences of failure, and the expected service life of the infrastructure.

Designers should consider climate change using a risk-based approach that accounts for:

- Likelihood of climate-related hazards
- Consequences of asset or network failure
- Asset criticality and network importance
- Infrastructure service life
- Operational and maintenance requirements
- Opportunity for adaptation over time
- Lifecycle costs, performance, and reliability

The significance of climate change considerations will generally increase for infrastructure with longer design lives, greater strategic importance, limited redundancy, or higher consequences of failure.

Climate Hazards in Ontario

Climate conditions vary significantly across Ontario, ranging from humid continental conditions in southern Ontario to subarctic conditions in northern and far northern regions. Climate change is expected to affect transportation infrastructure throughout the province, with northern and remote areas facing additional challenges associated with permafrost degradation, changing seasonal conditions, and reduced winter road reliability.

Climate-related hazards that may affect transportation infrastructure include:

- Extreme rainfall and intense precipitation events
- Flooding, flash flooding, and rain-on-snow events
- Snow, ice, freezing rain, and freeze-thaw cycles

- Extreme heat, extreme cold, and temperature variability
- High winds, severe thunderstorms, and tornadoes
- Drought conditions
- Tropical storms and hurricane remnants
- Wildfires and wildfire smoke
- Landslides, erosion, and slope instability
- Permafrost degradation in parts of northern Ontario

The frequency, intensity, and duration of many of these hazards are expected to change over time. Designers should consider both current and projected future climate conditions when evaluating transportation infrastructure alternatives.

Climate Change Impacts on Highway Infrastructure

Climate-related hazards can affect both individual transportation assets and the overall performance of the transportation network. Potential impacts include:

- Damage to pavements, bridges, culverts, retaining walls, and roadside infrastructure
- Flooding, erosion, embankment instability, and slope failures
- Reduced asset service life and accelerated deterioration
- Disruptions to the movement of people, goods, and emergency services
- Increased safety risks to road users
- Increased maintenance, rehabilitation, and replacement requirements
- Delays to construction and maintenance activities
- Reduced network reliability during and following extreme weather events

These impacts can result in significant economic, operational, environmental, and safety consequences. Consideration of climate-related risks is therefore an important component of engineering judgment when evaluating, selecting, and developing transportation infrastructure solutions.

Climate Change Adaptation

Climate change adaptation involves considering climate-related risks during the planning, design, construction, operation, and maintenance of transportation infrastructure to improve long-term performance and resilience.

Examples of adaptation measures include:

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- Designing infrastructure to withstand future temperature and weather extremes
- Improving network resilience and system redundancy where appropriate
- Incorporating climate risk assessments into planning, design, and asset management processes
- Modifying operational and maintenance practices to improve performance under changing climate conditions

Adaptation measures help improve long-term infrastructure performance, reliability, and resilience while reducing vulnerability to future climate-related risks.

Climate Change Mitigation

Climate change mitigation focuses on reducing greenhouse gas emissions and minimizing the transportation sector's contribution to climate change.

Examples of mitigation measures include:

- Using recycled, low-carbon, alternative, or longer-life construction materials where appropriate
- Improving construction, operational, and maintenance efficiencies to reduce energy consumption and emissions
- Extending asset service life through durable and sustainable design solutions
- Preserving and enhancing natural features within highway corridors that contribute to environmental sustainability and carbon sequestration

Mitigation can reduce greenhouse gas emissions, support environmental sustainability, and help limit the severity of future climate-related impacts.

Consideration of adaptation and mitigation measures can support the long-term performance and resilience of the provincial highway network.

~~It has become more important in recent years to consider climate change impacts in design standards. In a previous approach to highway design, designers relied on climate factors being consistent for a given area, and while this approach worked for many years, changes in climatic patterns have resulted in extreme weather events occurring more frequently and at increased severities. Due to climate change, historical climate is no longer a reliable predictor of future risk. Highway designers should be aware of these predicted changes and take the factors and risks into consideration when making decisions.~~

~~**Types of Extreme Weather in Ontario**~~

~~Ontario is a large province; the weather can vary greatly depending on the season and location. Summers in southern Ontario can be extremely warm and humid with high temperatures. The~~

~~northern part of the province has longer and colder winters than southern Ontario. Climate change is expected to have a fundamental impact on the transportation system in northern Ontario through severe weather and unsuitable conditions for winter roads. Climate change is expected to have a disproportionate impact on the far north and its many remote communities.~~

~~Ontario experiences a wide variety of weather hazards across the province including:~~

- ~~Eextreme rainfall, freezing rain, hail.~~
- ~~Ttropical storms and hurricanes~~
- ~~Ffloods and flash floods~~
- ~~Mmudslides~~
- ~~Ppermafrost degradation~~
- ~~Mmelting snow / ice jams causing flooding~~
- ~~Eextreme heat / extreme cold including temperature fluctuations.~~
- ~~Ddroughts~~
- ~~Fforest fires~~
- ~~Ddamaging winds and tornadoes~~

~~Extreme Weather Impacts on Highway Infrastructure~~

~~Highway designers should be aware that weather patterns are shifting, and events are becoming more extreme. These factors and risks should be taken into consideration when making design decisions. It is important to consider the resultant impacts on the road network and its users. Extreme weather and prolonged impacts from climate change can:~~

- ~~Ddamage infrastructure, shortening the life expectancy of highways, bridges, and other roadside features.~~
- ~~Ddisrupt the continuity of the road network and make routes impassable.~~
- ~~Ccause delays in the movement of people, services, and goods~~
- ~~Iincrease collision risk and driver frustration from hazardous conditions – poor visibility and slippery conditions, etc..~~
- ~~Iincrease the frequency of maintenance and rehabilitation resulting in increased costs.~~
- ~~Ooverwhelm the capacity of drainage infrastructure.~~
- ~~Wweaken or wash out soil and culverts that support roads, tunnels, and bridges.~~
- ~~Llimit and delay construction activities~~

~~Challenges for Climate Change Consideration in Provincial Highway Management~~

~~The development of climate change solutions requires the consideration of several economic,~~

~~environmental, and social factors to ensure that ideas can proceed effectively. This involves bringing attention to several challenges including:~~

- ~~Eeconomic viability of measures~~
- ~~Iindustry capacity to respond to new requirements.~~
- ~~Ddevelopment of new specifications and contract requirements~~
- ~~Sstakeholder consultation~~
- ~~Bbuilding public awareness~~
- ~~Rretraining staff~~
- ~~Qquantification and tracking of greenhouse gases.~~

~~To combat climate change, it is important to take an approach that includes both mitigative and adaptive approaches.~~

~~Climate Change - Adaptation~~

~~Adaptation means managing the impacts of the changing climate. This includes:~~

- ~~Ensuring transportation infrastructure is resilient and able to adapt to the effects of climate change including extreme weather events.~~
- ~~Avoiding or withstanding climate impacts~~
- ~~Designing, constructing, and operating facilities for future weather trends (beyond historical)~~

~~Adaptation is important:~~

- ~~To ensure the continual movement of people and goods safely, efficiently, and sustainably to support a globally competitive economy and a high quality of life.~~
- ~~To minimize health & safety risks~~
- ~~To extend the longevity of infrastructure and offset future rehabilitation~~
- ~~To minimize financial impacts~~

~~An example of adaptation could be designing an interchange to have the primary road go over the secondary road in an area prone to flooding.~~

~~Climate Change – Mitigation~~

~~Mitigation is important in the fight to slow down the impacts of the greenhouse effect. For the purposes of highway infrastructure management, mitigation can include (but is not limited to) using recycled, alternative, or extended life-cycle materials, and renewable resources. Additionally, mitigation practices can include congestion reduction measures which can be achieved through better geometric layouts and more efficient construction staging. Carbon~~

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~~sinks such as trees and other landscaping measures in the highway right of way can also lead to the absorption of greenhouse gases and can improve aesthetics.~~

~~Mitigation is important:~~

- ~~To minimize the work and money needed for future adaptation efforts~~
- ~~To reduce the incidence of extreme weather events that threatens transportation infrastructure in the future~~
- ~~To minimize the disruption of climate change on the ecosystem.~~

Berms within the Right-of-Way

A berm is a raised earth feature, typically constructed of compacted soil, that functions as a protective barrier or raised embankment. Berms may be used for a range of applications, including but not limited to noise attenuation, landscaping, flood mitigation, stormwater management, agricultural control, containment, and protective or security purposes. The design, geometry, and performance requirements of a berm shall be based on its intended function. Berms are a useful method of keeping excess soils within the limits of a single project.

Berms within the highway right-of-way shall be designed to maintain roadside safety and preserve visibility for motorists. Wherever practicable, berms shall be located outside the clear zone, which is intended to provide a relatively flat, unobstructed recovery area for errant vehicles before encountering fixed objects or critical slopes. Berm heights shall not obstruct required sightlines or stopping sight distances, particularly within intersection visibility triangles. Berm side slopes shall be gradual to promote slope stability and minimize erosion. Where standard clear zone widths cannot be achieved due to operational, geometric, right-of-way, or constructability constraints, designers shall evaluate the associated safety risks and determine whether mitigation measures are required. Such mitigation may include positive protection, such as roadside barriers or other appropriate safety treatments.

Berms shall also be designed so as not to obstruct existing drainage paths, including roadside ditches or surface runoff systems. Berms shall also be placed such that snow drifting is not exacerbated.

Section 1.4.2 - Applying the Design Domain Concept

- This Section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Policy

For guidance in interpreting the design domain values during the design of ~~Ontario~~ provincial highways, the designer shall follow the guidance provided in the *MTO Design Supplement* to the *Geometric Design Guide for Canadian Roads*.

Section 1.5.3 Design Exception Process:

- **Step 5: Document, Review and Decide (Approve or Reject)~~.~~**
- **Table 1.5.2~~.~~**
- **Figure 1.5.2**~~, and~~
- **Step 6: Monitor and Evaluate In-Service Performance**

The above noted Steps, Table, and Figure are **~~Not~~ not ~~Applicable~~ applicable** and **replaced** with the following:

Policy

Certain elements on highway and bridge rehabilitation and reconstruction projects are required to have a formal exception approval. Specific direction is given for some highway elements.

Highways are built to the standards that exist~~s~~ at the time of their design and construction.~~ ~~There is not an expectation or requirement to bring all highway elements up to the current standard when repair or rehabilitation work is completed on the highway.

The policy in Section 1.1.7 (Rehabilitation Design) and this Exception Operating Policy apply to all capital rehabilitation and reconstruction projects~~,~~ including, but not limited to, those with ~~environmental~~ Environmental ~~assessment~~ Assessment approvals, included in a published N/SOHP, works funded by others, and projects with other commitments.

Any highway element to be changed from its ~~present~~ current configuration is to be done so in accordance with policy. Exception approvals shall be completed as soon as possible in the design process~~,~~, ~~and~~ preferably~~,~~ before the start of detail design on the highway element. All exception decisions, with supporting documentation~~documents~~, shall be retained in the project file.- The project's Design Criteria is to have all exception approvals stated under Remark 1.

The Annual Prioritized Provincial Improvement List (APPIL) scoring, and analysis is prepared by the Provincial Traffic Office.

1. All capital projects are required to comply with this Exception Operating Policy.
2. Any deviation from **Exhibit -1E** requires exception approval.
3. Any highway element not in the following tables requires exception approval to be changed from ~~the~~ its existing configuration.
4. Preliminary ~~designs~~ Designs and E~~e~~nvironmental A~~a~~ssessments that could lead to improvements covered by this policy are required to have exception approval, prior to public commitments made and the documents being finalized.
5. Exception decisions, with supporting documents, shall be retained in the project file.
6. The project Design Criteria is to have all exception approvals stated under Remark 1.
7. Exception Approval Process for **Exhibit -1B** Highway Elements:

-PART A: Group Approval Process

The Provincial Traffic Office prepares APPIL analysis and scoring for **Exhibit -1B** highway elements.

a. Traffic Office presents the APPIL analysis and scoring for **Exhibit -1B** highway elements to the Engineering Functional Team (EFT).
b. EFT develops a provincial prioritised list based on APPIL scoring.
c. EFT approves highway elements for construction based on available –funding.

d. An individual approval is not required for provincial prioritised list approved **Exhibit_-1B** elements.
e. EFT decisions for **Exhibit_-1B** highway elements are to be documented in the EFT minutes and communicated to Asset Management Branch, Standards and Contracts Branch, and ~~Regional~~ Project Delivery Offices.

PART B: Individual Approval Process

a. An individual approval is required for **Exhibit_-1B** highway elements not on the provincial prioritised list of approved highway elements.
b. Exception Submission and Approval Form is to be completed and is to include APPIL analysis and scoring.
c. EFT exception decisions are to be documented in the EFT minutes and shall include the reason when an exception is not approved.
d. Exception decisions are to be documented on the Exception Submission and Approval form and the signed form is retained in the project file in the region.

~~8.~~1. Exception Approval Process for **Exhibit_-1C** Highway Elements:

a. Exception Submission and Approval Form completed for all approvals.
b. Project GWP program value $10 million or less.
   - The responsible Manager may approve **Exhibit_-1C** highway elements up to $500,000 cumulative construction cost for the entire project.
c. Project GWP program value greater than $10 million.
   - The responsible Manager may approve **Exhibit_-1C** highway elements up to $1,000,000 cumulative construction cost for the entire project.
d. EFT approval is required for all exceptions greater than the cost limits above.
   - The responsible Manager approves the first $500,000/$1,000,000 in project exceptions and EFT approves all other project exceptions.
   - EFT does not re-visit the Manager decisions for approvals.
e. The responsible Manager may not delegate their approval authority for **Exhibit_-1C** highway elements.

f. The responsible Manager or the MTO project manager is to present the exception information to EFT, as decided in the program area.
g. EFT exception decisions are to be documented in the EFT minutes and shall include the reason when an exception is not approved.
h. Exception decisions are to be documented on the Exception Submission and Approval form and the form is retained in the project file in the region.

~~9.~~2. Exception Approval Process for **Exhibit -1D** Highway Elements:

a. Exception Submission and Approval Form completed for all Regional approvals.
b. The responsible Manager is responsible to approve **Exhibit -1D** highway elements.
c. The responsible Manager may not delegate their approval authority for **Exhibit -1D** highway elements.
d. Exception decisions are to be documented on the Exception Submission and Approval Form and the form is retained in the project file.

Exhibit -1B

Highway Elements for APPIL Analysis and Engineering Functional Team Approval

Highway Element
Horizontal curve alignment change
New left-turn lane
New right-turn lane
Convert from single left-turn lane to double left-turn lane
Left-turn lane/right-turn lane extension
Speed change lane extension
New passing lane
New truck-climbing lane
New roundabout
New illumination
New overhead beacon
New traffic signal

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Median – installing a median barrier (concrete, steel or cable), or install median (remove left turn movements)

Exhibit -1C

Highway Elements for Engineering Functional Team Approval

Highway Element
New signature bridges on existing highways
Existing bridge widenings: greater than 1.0 m on any side, or beam, or abutment changes are required
New non-highway use underpasses/overpasses/culverts (includes, but is not limited to snowmobile, recreational, bicycle, pedestrian, agricultural, wildlife)
New noise barriers, including extensions to existing noise barriers
New permanent changeable message signs – when not on ITS approved and funded list
New/expanded ITS/ATMS plant – when not on ITS approved and funded list
Curve widening, when the platform width changes
Lane width increases, when the platform width changes
Shoulder width increases (applies to granular and paved shoulders), when the platform width changes
Horizontal spiral alignment changes, when the platform width changes
Vertical alignment changes, when the change is more than a minor grade change dictated by the structural or pavement design
Rock removal for clear zone
New bicycle and pedestrian facilities/trails/alternative transportation facilities
New fully paved shoulders for bicycles

Exhibit -1D

Highway Elements for Responsible Manager Approval

Highway Element
Horizontal spiral alignment changes, when the platform width does not change
Vertical alignment changes, when the change is only a minor grade change dictated by the structural or pavement design
Extensions to turning-lane tapers
Extensions to passing lanes, truck-climbing lanes, and associated tapers
Lane width increases, when the platform width does not change
Shoulder width increases (applies to granular and paved shoulders), when the platform width does not change
Short term pavement markings – painted (minimize use)
Short term pavement markings – continuous edge line (minimize use)
Temporary pavement markings – painted (minimize use)
Clearing for sight lines at intersections
Clearing for icing areas, sight lines
Commercial entrances changes

Residential entrances changes
New ramp closure gates
Highway fence – new or replacement
Chain link fence – new or replacement
Trees and shrubs
Sod
New snow plow turnarounds with passing lane/truck-climbing lane
Snow plow turnaround with passing lane/truck climbing lane – paving a granular turnaround or paving a new turnaround
Median crossover – new
Median crossover – paving existing or paving a new crossover
Upgrading traffic signals
Upgrading existing illumination, including changes to electrical poles and bases
Upgrading to ATMS plant
Upgrading to noise barriers
Replace existing permanent changeable message signs
New loop detectors – traffic counting stations
Temporary work, detours, temporary bridges
Bridge widenings done with barrier wall replacements: - -up to 1.0 m widening on each side if no beams or abutment changes
Bridge aesthetics
New fully paved shoulder, when the platform width does not change, and they are not due to bicycles
New partially paved right-lane shoulders
Turning-lane tapers
Rock removal for hazard
Removal of invasive plants and species from the right-of-way

Exhibit -1E

Other Highway Elements Operating Policy

Highway Element	Operating Policy
Cross-fall correction, superelevation correction	All non-selective resurfacing projects: Follow TAC Geometric Design Guide for Canadian Roads and MTO Design Supplement. Selective resurfacing projects: Follow TAC Geometric Design Guide for Canadian Roads and MTO Design Supplement if possible.- Note deviations in Design Criteria and reasons for not complying with MTO Supplement.
Culverts, centreline	Replace, line or repair if estimated remaining culvert lifespan is less than the expected next resurfacing date.
Culverts, entrance	Greater than 500 mm: replace, line or repair if estimated culvert lifespan is less than the expected next resurfacing date. 500 mm or less: replace, line or repair if drainage is compromised.

Highway Element	Operating Policy
Culvert, extensions	As required to maintain the drainage system and for other approved work.
Curb and gutter	Maintain existing configuration unless changes due to other work or if estimated curb and gutter lifespan is less than the expected next resurfacing date.
Curve widening	Apply standard widening when existing platform allows. Exception required when the platform width changes.
Ditching and dich clean out	As required to maintain the drainage system.
Durable pavement markings – lines, stop blocks, symbols	As per CDED.
Erosion control	As per standard treatment processes.
Frost heaves	As per standard treatment processes.
Granular sealing	As per design policies.
Guide rail – all types and situations	In compliance with ministry policy documents issued for province wide use.
Paved shoulder – highways with a functional classification of freeway and four or more lanes	In compliance with ministry policy documents issued for province wide use.
Pavement	As per standard pavement design processes
Rumble strips centreline and shoulder – all highways	As per standards, if shoulder pavement exists. If pavement is not present, see partially/fully paved shoulder policy.
Sign replacement	Replace if condition requires replacement within two years of construction completion.
Storm sewers	Changes are required to maintain drainage. Replace line or repair if estimated remaining storm sewer lifespan is less than the expected next resurfacing date.
Traffic counting stations – replace existing	Replace only if required for future traffic counts.
Traffic loop detectors – replace existing	Replace only if required for future traffic counts.

Exception Submission and Approval Form

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One (1) page maximum per highway element, plus attachments.

Region: GWP No: Highway No.: Type of Project:

Location: Length:

Exception Number: (start at 1 for each GWP) Highway Element:

Highway Element Cost: Cost of Exception Approvals to Date:

Technical Considerations: (include APPIL score if **Exhibit 1-B** element)

Other Considerations:

EFT Approval Date: or

Regional Approval by:
(printed name, signature and date):

Reason Not Approved:

Attachments: At responsible Manager request (such as location map, photos and drawings).

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MTO Design Supplement

For
TAC Geometric Design Guide (GDG) for
Canadian Roads

Appendix 2 for Chapter 2

Design Controls, Classification and Consistency

~~October~~ ~~TBD~~July 202~~3~~6

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MTO Design Supplement

Appendix 2 for Chapter 2

Design Controls, Classification and Consistency

The following design supplements are applicable to *Chapter 2 – Design Controls, Classification and Consistency* of the *TAC Geometric Design Guide for Canadian Roads June 2017*:

Section 2.3.6.1 – General Application Heuristics

- This s~~S~~ection is **~~Applicable~~ applicable** except the second bullet point which should be as follows:
  - The overall range in design speeds is 40 km/h to 130 km/h.

- The following **additional ~~Guidance~~ guidance** is also ~~Applicable~~applicable:

  Criteria for Selection of Design Speed

  Many factors influence and constrain the selection of the appropriate design speed for ~~a~~ given highway facilities, which include:
  - T~~t~~raffic conditions, such as volumes, composition, expected greenhouse gas emissions and trip length~~.~~
  - C~~c~~haracter of terrain
  - S~~s~~ocio-economic-political characteristics of the area, i.e., population density and land development and travel habits of the local residents
  - ~~e~~Environmental quality and aesthetics
  - ~~f~~Future projected weather hazards for a given area because of climate change~~.~~
  - ~~e~~Economics

  Application of these criteria ~~applied~~ applies only to the selection of a specific design speed within the logical range of values pertinent to the functional classification type selected. The ranges for each classification are illustrated in **Exhibit -2I** and **Exhibit -2J**.

  Traffic volumes are instrumental in the selection of the appropriate functional classification from the eight basic types, as well as in the selection of road cross-sectional features and intersection or ~~/~~interchange design which affect the capacity and

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level of service.

The effects of terrain types, socio-economic characteristics, environment, and economics are not immediately obvious.

~~The typical~~ Typical drivers can recognize or sense a logical operating speed for a given highway based on knowledge of the system, appraisal of the ruggedness of the terrain, and the extent, density, and size of development. Based on this judgement, ~~the~~ drivers will adjust their speed to be consistent with the conditions expected to be encountered. ~~The~~ Drivers initially~~driver's~~ ~~initial~~ respond~~se~~ by~~is to~~ reacting to the anticipated situation rather than to the actual situation. In most instances, the two are similar enough that no problems are created. When the initial response is incorrect, operation and safety may be ~~severely~~ adversely affected.

Design speed should be chosen to be consistent with the speed ~~a~~ drivers are~~is~~ likely to expect. Where a ~~difficult~~ constrained condition is obvious, drivers are more inclined to accept lower operati~~onal~~ng speed ~~operation~~ ~~the~~an where there is no apparent technical reason for it.

An emerging factor to consider is inclement weather and worsening storm events, ~~because of~~due to climate change. In these types of events, ~~the~~ driver~~'~~s' visibility, perception-reaction time, and stopping sight distances (SSD) may be hindered.

~~All other things being equal, I~~It ~~follows~~is logical that a highway in level or rolling terrain justifies a higher design speed than one in mountainous terrain, and a highway located in a rural environment calls for a higher design speed than one situated in an urban area.

A highway carrying a large volume of traffic may justify a higher design speed than a less ~~important~~ heavily used facility in similar topography, particularly where the savings in vehicle operation and other operating costs are sufficient to offset the increased costs of right-of-way and construction. A low design speed, however, should not automatically be assumed for a lower volume or secondary highway where the topography is such that drivers are likely to travel at high speeds. Drivers do not adjust their speed~~s~~ ~~to~~based on the ~~importance~~ functional classification of a~~the~~ highway but ~~to~~

rather its physical ~~limitations~~ attributes and ~~the~~ traffic characteristics~~thereon~~.

When an appropriate highway functional classification ~~division~~ is selected from **Exhibit-2G**. The design speed can be chosen from the range of values provided in **Exhibit -2I** and **Exhibit -2J**.

When designing a substantial length of highway, it is desirable, although it may not be feasible, to ~~assume~~ select a constant design speed. Changes in terrain and other physical controls may dictate a change in design speed on certain sections. Each section, however, should be of relatively long length, compatible with the general terrain or development through which the highway passes. The justification for introducing a reduced design speed should be obvious to ~~the~~ drivers. Moreover, the introduction of a lower or higher design speed should not occur~~be affected~~ ~~done~~ abruptly but over sufficient distance to permit drivers to change speed gradually before reaching the section of highway with the different design speed.

Differences in design speed from one segment to another should not be ~~more~~ greater than 20 km/h. Notwithstanding this, ~~Even so,~~ drivers may not perceive the slower condition ahead, ~~for which they should be warned well in advance~~and adequate advance warning signage should be provided. A transition section allowing for speed reductions, ~~as~~ for example from 90~~100~~ to 7~~9~~0 to 5~~8~~0 km/h should be provided. Thus, the changing condition should comprise extra-long (anticipatory) sight distances, speed-zone signs, curve speed signs, and so on.

Design speed should be greater than or equal to the legal posted speed. Generally, the desirable practice of selecting the design speed for new construction and reconstruction is 20 km/h greater than the proposed posted legal maximum speed, unless circumstances warrant a reduction.

Freeway sections with a design speed of 120 km/h as documented in the most recent Design Criteria may be posted at 110 km/h, effectively reducing the difference between design and posted speed to 10 km/h.

Alternatively, where a Design Criteria does not exist, a review of geometric parameters in conjunction with 85th percentile operating speed and collision history, may be used to inform the suitability to increase the posted speed to 110 km/h.

Sections with a posted speed less than 100 km/h should retain their current design and posted speeds.

A review shall be conducted prior to increasing posted speeds to identify locations where enhanced advisory signage, minor capital works, illumination, roadside safety devices, or warning devices are required.

A design speed equal to the maximum posted speed is accepted where warranted by such factors as low traffic volumes, rugged terrain and economic considerations. This practice ~~would be more~~may be appropriate for minor collector and local roads. A design speed equal to the legal posted speed is the normal practice for Secondary and Tertiary highways.

Where a highway section warrants only resurfacing to remove pavement structure deficiencies, the general practice is to limit construction costs by removing only critical deficiencies as identified by ~~the accident~~ collision and maintenance records. The existing alignment is generally retained. In these situations, the proposed and the existing design speeds should be the same.

Horizontal and vertical alignment geometry should be consistent with the selected design speed. In practice, because of numerous constraints often encountered, minimum acceptable values for alignment standards are recognized and used. Minimum acceptable standards are based on the allowable reduction in the design speed of isolated curves from the overall design speed of the highway.

The reduction should preferably be no greater than 10 km/h and never greater than 20 km/h.

Where higher than average ~~accident~~ collision rates can be attributed to geometric design deficiencies, corrective measures should be considered. Isolated deficiencies should be improved if signing alone proves to be ineffective and costs are acceptable.

Where a low volume secondary or tertiary highway has a generally ~~substandard~~ non-standard alignment and advisory and warning signs have proven ineffective, consider:

- Where no improvements are warranted - reduce~~ing~~ the legal posted speed to be consistent with the overall highway design speed~~; or~~

- Where improvements are warranted – select~~ing~~ a design speed and corresponding legal posted speed commensurate with the topography and with a realistic balance between improvement costs and user benefits~~.~~

The implications of employing ~~substandard~~ non-standard curvature are more fully explained in *Chapter 3 – Alignment and Lane Configuration* and *MTO Design Supplement* for *Chapter 3.* See also *Chapter 1 Section 1.2.3 – Design Decisions.*

Design speeds have been established in 10 km/h increments, ~~usually~~ typically ranging from 40 km/h for local roads, to a maximum of 130 km/h for ~~design of~~ rural freeways. Maximum and minimum design speeds have been established for each ~~major~~ functional classification ~~of highways~~. The resulting functional classification system is presented in **Exhibit -2G**.

~~Additional Guidance for~~ 130 km/h ~~Design Speed – 130 km/h~~

~~It is desirable that newly constructed freeways have posted speeds of 110 km/h and therefore will be designed with a design speed of 130 km/h in the Design Criteria. This can be achieved because new highways can typically be constructed with features that meet or exceed the highest design speed standards without constraints typically encountered on existing highways. New freeways may be constructed in existing urban areas where acquisition on land to accommodate rights of way for high design speeds is impractical for financial, social, or environmental reasons. In these cases, it may be required to use reduced design and posted speeds, however this scenario is expected to be a rare occurrence for new construction. Design aspects of freeways currently being designed should be reviewed and upgraded to 130 km/h where this would not cause extensive changes and delays to delivery. If significant property, drainage, environment, or other impacts would result from a design speed increase to 130 km/h, such an increase may be deferred.~~

~~Existing highway segments with posted speeds of 110 km/h that are rehabilitated or reconstructed should be done with a design speed of 130 km/h in the Design Criteria. Certain existing elements such as horizontal and vertical geometry, interchange geometry, stopping sight distance and clear zone may not meet the design requirement during design and any decisions to defer such improvements~~ must be ~~documented and justified.~~

~~**Policy**~~

~~On newly constructed divided freeways, including extensions to existing freeways, where design has not commenced prior to issuance of this Design Supplement, the default design speed shall be 130 km/h.~~

~~On highway segments that have had (or are planned to have) the posted speed raised from 100 km/h to 110 km/h, which undergo major capital rehabilitation or reconstruction, the desirable design speed of such projects shall be 130 km/h. Locations with elements identified as not meeting 130 km/h design speed and where upgrades are being deferred shall be documented in the Design Criteria with appropriate justification. Existing roadside safety installations including guide rail, steel beam energy attenuating terminals and crash cushions for which the ministry does not have current standards shall be replaced with systems for which current standards are available. Guidance is provided in the next section.~~

~~Current design projects for new or rehabilitated freeways located within sections proposed to be posted at 110 km/h speed, should have the Design Criteria revised to reflect 130 km/h design speed standards. Alternatively, if design has advanced too far, 120 km/h design speeds can be maintained in the Design Criteria, with enhancements to 130 km/h design speed (if any) noted where easily obtainable/achievable. This should apply to all impacted projects that have not yet undergone reached the 30% detail design completion meeting (for design-bid-build delivery) or where tendering process has not been completed (for design-build and alternative delivery models) as of the date of this Design Supplement, unless otherwise exempted by the Manager, Engineering Program Delivery to revisit design on projects that have advanced further and bring it in line with a 130 km/h design speed.~~

~~For design-build projects, which have been awarded as of the date of the ministry memorandum: *SCB-HDO-2022-02 dated June 27, 2022*, reasonable efforts should be made to negotiate obtainable enhancements to the design speed if the project has not progressed to a point where the Manager, Engineering Program Delivery deems negotiations impractical. For all other alternative delivery models, where the tendering process has been completed as of the date on this Design Supplement, the proponent should be made aware of this policy change and any changes will be optional for those projects. The assessment for changes to the design speed of alternative delivery projects, should be based on factors such as funding and schedule impacts as assessed at the local-level and approved by the responsible director for each project.~~

~~Design parameters for 130 km/h design speed from the *TAC Geometric Design Guide for*~~

~~*Canadian Roads, MTO Design Supplement* and the *MTO Roadside Design Manual* shall be used.~~

~~**Guidance**~~

~~Design elements including stopping sight distance, horizontal and vertical curvatures, grades, ramp gores, lane widths, shoulder widths and rounding and median widths should be reviewed as part of the detail design projects. Existing elements that do not meet 130 km/h design speed should be identified in the Design Criteria. In many cases, there will be no operational or safety issues identified with such locations and as such, improvements may not be justified. Decisions not to make improvements shall be noted in the Design Criteria. These should be monitored on an ongoing basis between capital contracts and localized improvements considered if safety or operational issues are identified. The following are additional design parameters for 130 km/h design speed:~~

- ~~The desirable horizontal curve radius shall be 2,300 m.~~
- ~~The cross slope shall be 2% on tangent sections. Acceptable design tolerances for resurfacing shall be 1.7% to 2.5%. Section 3.5.3.1 of the *TAC GDG - Design Domain: Quantitative Aid* shall also be applied.~~
- ~~All left and right shoulders should be paved in accordance with the ministry policy.~~
- ~~Narrow medians 10 m to 15 m in width should be protected with appropriate barrier according to the ministry *Roadside Design Manual.*~~
    - ~~Designer should ensure that Ssigns should meet the retro-reflectivity requirements as perin the *Ontario Traffic Manuals* and *Ontario Provincial Standard Specifications.* Maintenance staff should be contacted to obtain this information. Designers should also consider implementing Eenhanced signing and pavement markings should be considered whenever possible and based on recommendations of the regional Pre-Contract Traffic Officesection.~~

Section 2.4.2 – Vehicle Classifications

- This ~~Section~~ section is ~~**Applicable**~~ **applicable** including the following three additional vehicles operating in Canada:
    - WB-15: Tractor-semitrailer combination; this design vehicle is not representative of most large tractor-semitrailers. An ~~round~~ axle spacing dimension of 15.2 m.
    - WB-17.5: Tractor-semitrailer combination; an~~the~~ axle spacing of 17.5 m.
    - WB-20.5: Tractor-semitrailer combination; an~~the~~ axle spacing of 20.5 m.

In locations where specific vehicle types are expected to operate regularly, such as maintenance facilities, turnarounds or staging areas, designers should consider swept-path characteristics of such vehicles in addition to the standard design vehicles. Examples may include tow-plow combinations, maintenance vehicles, and other specialized equipment.

For accommodation of Long Combination Vehicles, refer to the ministry's *Long Combination Vehicles (LCVs) Best Practices for Design, September 2021* which can be found on the ministry's Technical Publications website.

Section 2.4.3.1 – Length, Width, and Turning Radius

- This ~~Section~~ section is **~~Applicable~~ applicable** including the following three Exhibits (**Exhibit -2A, Exhibit- 2B** and **Exhibit -2C**)

Exhibit -2A

WB-15 Tractor-Semitrailer Dimensions

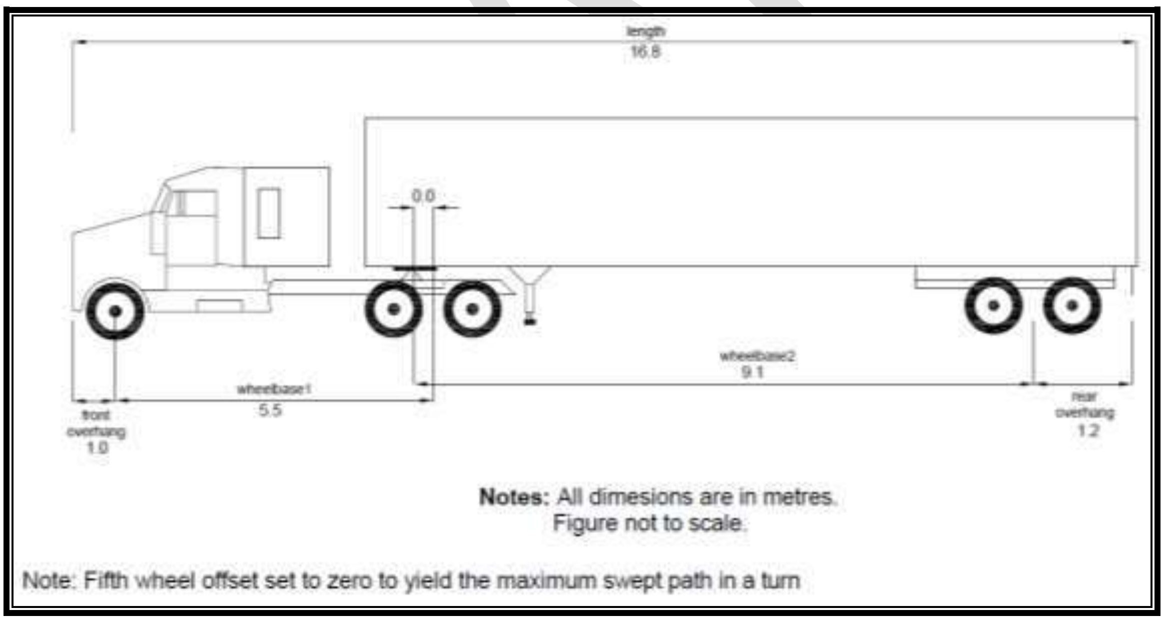


Exhibit -2B

WB-17.5 Tractor-Semitrailer Dimensions

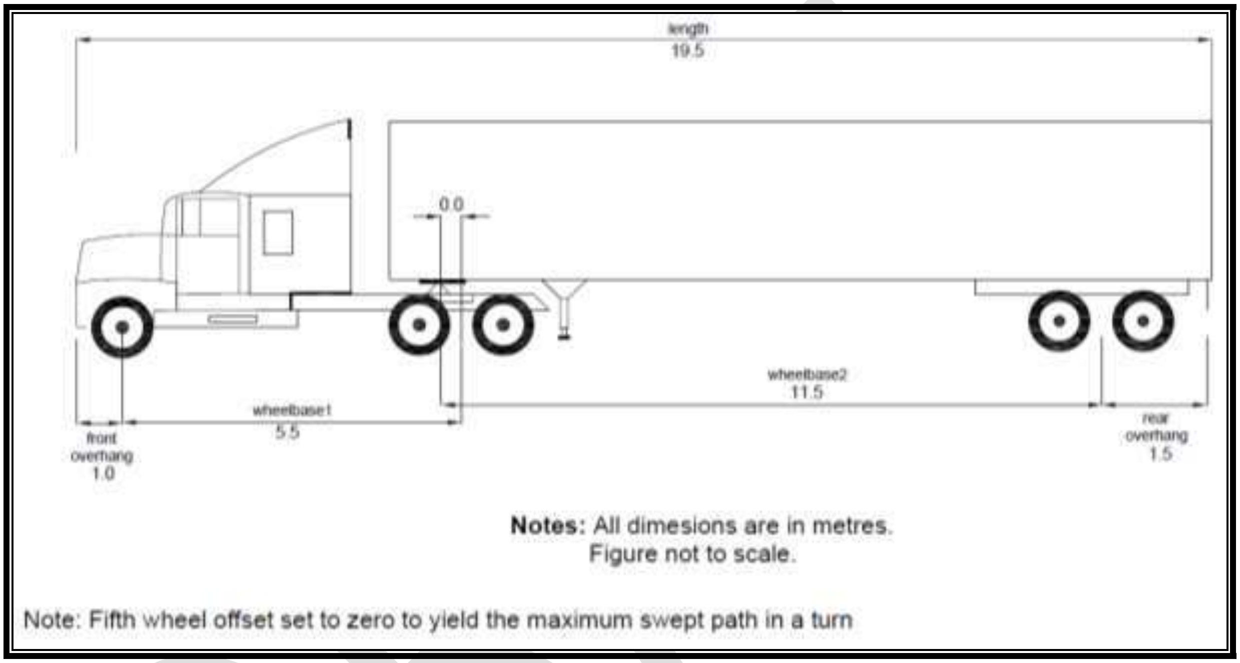
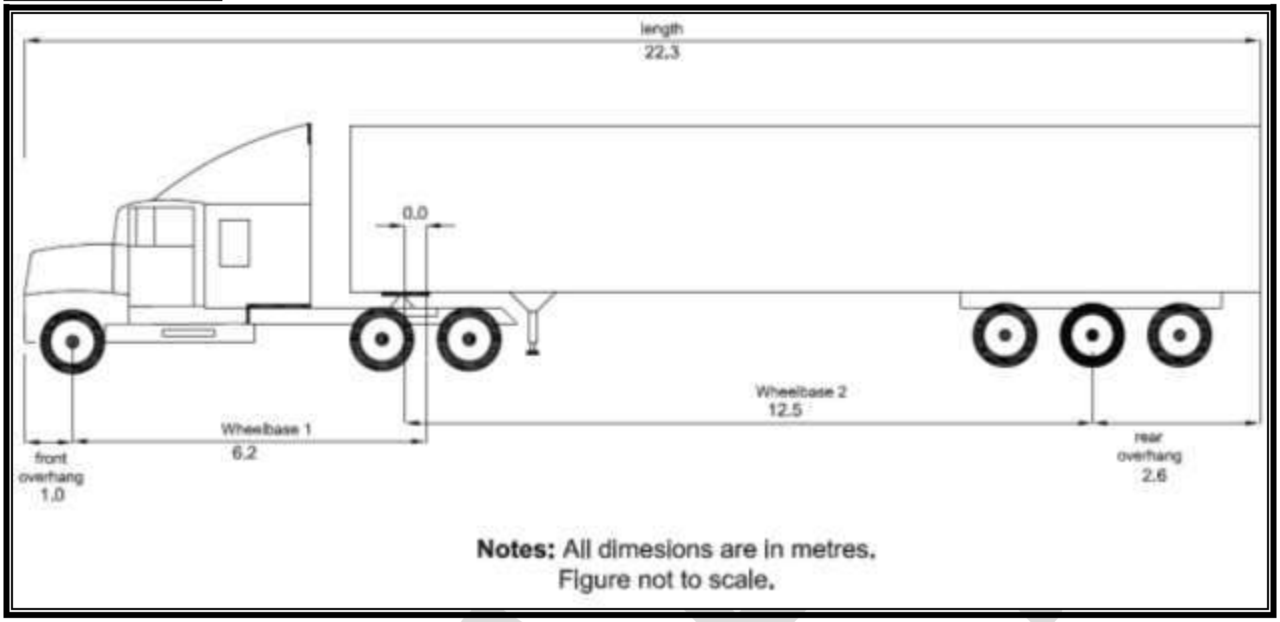


Exhibit -2C

WB-20.5 Tractor-Semitrailer Dimensions



Notes: All dimesions are in metres.
Figure not to scale.

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Section 2.4.5 – Selecting a Design Vehicle

- This s~~S~~ection is ~~**Applicable**~~ **applicable** including the following **additional g~~G~~uidance**:

  The dimensions of design vehicles include maximum values of dimensional trends in motor vehicle manufacture and the design vehicle sizes are greater than those for nearly all vehicles belonging to the corresponding vehicle type category that are expected to be in use several years in the future.

  The Heavy Single-Unit (HSU) design vehicle characteristics are suitable for all single unit trucks and smaller buses. A separate bus design vehicle is required because of the trend toward buses with longer wheelbases. The geometric design requirements for trucks and buses are much more ~~severe~~ generous than they are for passenger vehicles. Trucks and buses are wider, have longer wheelbases and require more space for their turning maneuvers ~~than~~ compared to passenger vehicles.

  In the design of any highway facility, the largest design vehicle likely to use that facility is selected. A design vehicle with special characteristics that must be considered in dimensioning the travelled roadway is used to determine the critical features such as radii for the inner edge of pavement at intersections and on turning roadways.

- -For further additional Guidance on selection of design vehicle, refer to Section 9.13.2 – *Corner Radius Considerations and Design* of Appendix 9 – *Intersections* of this Design Supplement.

Section 2.5.2.1 – Object Height

- This s~~S~~ection is **a~~A~~pplicable** with **~~modification~~ modified guidance** in the last paragraph that object height for determining passing sight distance should be 1.08 m.

Table 2.5.1 – Object Height Design Domain

- This Table is **a~~A~~pplicable** with **~~modification~~ modified guidance** in the last row that object height for determining passing sight distance should be 1.08 m which is equivalent to the driver~~'s~~ eye height criterion.

Table 2.5.2 – Stopping Sight Distance on Level Roadways for Automobiles

- This Table is **~~Applicable~~ applicable** for Rural King's Highways and Secondary Highways.
- For Freeways and high-speed ~~Divided~~ divided ~~Highways~~highways, ~~designer must~~ use **Exhibit 2-E** which is based on 3.0 s ~~sec~~ perception reaction time.

Section 2.5.4 – Passing Sight Distance

- This s~~S~~ection is **~~Applicable~~ applicable** with **~~modification~~ modified guidance** in the second last paragraph that object height for determining passing sight distance should be 1.08 m which is equivalent to driver's eye height.
- The following are additional assumptions in driver~~'s~~ behaviour when applying research model (*1, 2*):
    - Passing and opposing vehicle speeds are the same and ~~it is~~equal to the design speed of highway~~,~~
    - The speed differential between passing and passed vehicles is 19 km/h~~,~~
    - The passing and passed vehicles are passenger vehicles ~~and~~ with a length of~~is~~ 5.8 m~~,~~
    - The perception-reaction time of the passing vehicle to abort a passing maneuver is 1 s~~ec~~ and deceleration rate is 3.4 m/s^2

- The space headway between the passing and passed vehicles is 1 s~~ec.~~

Table 2.5.4 – Minimum Passing Sight Distance – 2004 AASHTO Methodology

Table 2.5.5 – Minimum Passing Sight Distance – 2006 MUTCDC (marking) Methodology

- These Tables are **n~~N~~ot a~~A~~pplicable** and are~~is~~ **replaced** with **Exhibit -2D** which is taken from *AASHTO's A Policy on Geometric Design of Highways and Streets, 7th Edition, ~~(~~2018~~)~~.*

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Exhibit -2D

~~PASSING SIGHT DISTANCE FOR DESIGN OF TWO-LANE HIGHWAYS~~Passing Sight Distance for Design of Two-Lane Highways

Design speed (km/h)	Assumed Speeds (km/h)		Passing Sight Distance (m)
	Passed Vehicle	**Passing Vehicle**	**Rounded for Design**
40	21	40	140
50	31	50	160
60	41	60	180
70	51	70	210
80	61	80	245
90	71	90	280
100	81	100	320
110	91	110	355
120	101	120	395
130	111	130	440

Passing Sight Distance for Design

Minimum passing sight distances for use in design are based on the minimum sight distances provided in MUTCD or OTM Book 11 as warrants for no-passing zones on two-lane highways. Design practice ~~should be~~is most effective when it anticipates the traffic controls (i.e., passing, and no-passing zone markings) that will be placed on the highways. The potential for conflicts in passing operations on two-lane highways is ultimately determined by the judgments of drivers in initiating and completing passing maneuvers in response to driver~~'~~s' views of the road ahead as provided by available passing sight distance, passing and no-passing zone markings. Research (*3, 4*) has shown that the MUTCD or OTM passing sight distance criteria result in two-lane highways that experience very few crashes related to passing maneuvers. The passing sight distance values provided in **Exhibit -2D** are consistent with field observations of passing maneuvers (*4*).

Passing sight distance for use in design should be based on a single passenger vehicle passing a single passenger vehicle. While there may be occasions to consider multiple passings, where two or more vehicles pass or are passed; it is not practical to assume such conditions in developing minimum design criteria. Observations have shown that longer sight distances are needed when passing or passed vehicles are commercial motor vehicles. Longer sight distances occur in design, and such locations can accommodate an occasional multiple passing manoeuv~~e~~res or a passing maneuver involving a commercial motor vehicle.

Additional Guidance on Passing Sight Distance

Effect of Grade on Passing Sight Distance

Grades may affect the sight distance needed for passing. If the passing and passed vehicles are on a downgrade, then the opposing vehicle is on an upgrade, or vice versa, and the effects of the grade on acceleration capabilities of the vehicle may offset each other. Passing drivers generally exercise good judg~~e~~ment as to whether to initiate and complete passing maneuvers. Where frequent slow-moving vehicles are present on a two-lane highway upgrade, a climbing lane may be installed to provide opportunities to pass the slow-moving vehicles without limitations due to sight distance and opposing traffic.

Frequency and Length of Passing Sections

The frequency and length of passing sections for highways depends on topography, design speed, and cost. It is not practical to directly indicate the frequency with which passing sections should be provided on two-lane highways due to the physical constraints and cost limitations. Designs with infrequent passing sections may not provide enough passing opportunities for efficient traffic operations. Providing frequent passing sections may ~~have e~~affect ~~on~~the level of service of the highway. Traffic analysis procedure provided in MTO's *Capacity Analysis Manual* or in *Highway Capacity Manual* is based on two measures of effectiveness – percent time following and average travel speed. Both criteria are affected by the lack of passing opportunities. There is a similar effect on the average travel speed. As the percentage of no-passing zones increases, there is an increased reduction in the average travel speed for the same demand flow rate.

Table 2.5.6 – Decision Sight Distance

- This Table is **~~Not~~ not ~~Applicable~~ applicable** and is **replaced** with **Exhibit -2E** which is taken from *AASHTO's A Policy on Geometric Design of Highways and Streets, 7th Edition, ~~(~~2018~~)~~.*

Exhibit -2E

~~DECISION SIGHT DISTANCE~~Decision Sight Distance

Design Speed (km/h)	Decision Sight Distance (m)				
	Avoidance Maneuver				
	A	B	C	D	E
50	70	155	145	170	195
60	95	195	170	205	235
70	115	235	200	235	275
80	140	280	230	270	315
90	170	325	270	315	360
100	200	370	315	355	400
110	235	420	330	380	430
120	265	470	360	415	470

130	305	525	390	450	510

NOTES:

Avoidance Maneuver A: Stop on rural road --- t = 3.0 sec

Avoidance Maneuver B: Stop on urban road --- t = 9.1 sec

Avoidance Maneuver C: Speed/path/direction change on rural road --- t varies between 10.2 and 11.2 sec

Avoidance Maneuver D: Speed/path/direction change on suburban road--- t varies between 12.1 and 12.9 sec

Avoidance Maneuver E: Speed/path/direction change on urban road --- t varies between 14.0 and 14.5 sec

Section 2.6.2 – Design Classification System

- This ~~Section~~ section is **~~Applicable~~ applicable except the last sentence** which is **replaced** with the following:

  The design classification system has **eight** primary ~~divisions~~classifications.

Table 2.6.1 – Urban and Rural Design Classification in Canada

- This Table is **~~Not~~ not ~~Applicable~~ applicable** and is **replaced** with **Exhibit -2F**.

Exhibit -2F

~~HIGHWAY CLASSIFICATION – MAJOR DIVISIONS~~Highway Classification – Major Divisions

RURAL	URBAN
Freeway	Freeway
Arterial	Arterial
Collector	Collector
Local	Local

Table 2.6.2 – Design Classification

- This Table is **~~Not~~ not ~~Applicable~~ applicable** and is **replaced** with **Exhibit -2G**.

Section 2.6.3.2 – Service Function

- This ~~Section~~ section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

  Rural Freeways

  Rural arterial roads are intended to ~~move~~ carry large volumes of traffic at high speeds under free-flow conditions. Rural freeways connect the larger cities, industrial concentrations, and recreational areas. They also serve as the major highway routes through intensely developed areas and serve ~~larger~~ major international and interprovincial travel movements. The need for unrestricted traffic movement on these facilities justifies the elimination of direct property access. Ultimate development will require grade separation at all crossing roads.

  Rural Arterial Roads

  Rural arterial roads are intended to ~~move~~ carry large traffic volumes at high speeds. The major distinction between this classification and the freeway classification is in the full control of access. Roads that have full control of access should normally be in the freeway classification. Rural arterial roads, together with freeways, serve as the major routes in a network connecting the major economic regions and centres of large cities, industrial concentrations, agricultural areas and recreational facilities. In areas where freeways are not warranted by the traffic service required, rural arterials are the highest type of road. Because arterials carry large traffic volumes moving at high speed, direct access to abutting lands may be restricted or even eliminated. This applies particularly in areas of intensive development and in undeveloped areas where the lack of other road service would encourage strip development.

Exhibit -2G

~~THE FUNCTIONAL HIGHWAY CLASSIFICATION SYSTEM~~The Functional Highway Classification System

Design Speed Km/h	Freeway	Arterial	Collector	Local
RURAL				
130	RFD 130			
120	RFD 120			
110	RFD 110	RAD 110		

		RAU 110		
100	RFD 100	RAD 100 RAU 100	RCU 100	
90		RAD 90 RAD 90	RCU 90	
80		RAD 80 RAU 80	RCU 80	RLU 80
70			RCU 70	RLU 70
60			RCU 60	RLU 60
50				RLU 50
URBAN				
120	UFD 120			
110	UFD 110	UAD 110 UAU 110		
100	UFD 100	UAD 100 UAU 100		
90	UFD 90	UAD 90 UAU 90	UCU 90	
80		UAD 80 UAU 80	UCU 80	
70			UCU 70	
60			UCU 60	ULU 60
50			UCU 50	ULU 50
40				ULU 40

Legend of Abbreviations

FIRST LETTER: R – Rural -THIRD LETTER:_ D - Divided
U – Urban -U - Undivided
SECOND LETTER: F – Freeway _______-NUMBER: _ _Design Speed
A – Arterial
C – Collector
L – Local

Example: RFD 120 means Rural, Freeway, and Divided with Design Speed of 120 km/h

Rural Collector Roads

Rural collector roads collect traffic from local roads and feed traffic~~it~~ to arterials or distribute it from arterials to locals. They generally form an integrated network throughout all developed areas of the province and provide direct traffic service for development such as tourist areas, mining areas and the small towns and villages.- Rural collector roads have a land service function in that they directly serve the adjacent properties.

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Rural Local Roads

The main function of rural local roads is to provide land access. The only traffic service function of a local road is to allow vehicles to reach the frontage of properties from the main highways. Development roads that serve natural resource areas may be considered as local roads until volumes and function justify reclassification.

Urban Freeways

Urban freeways are intended to accommodate heavy volumes of traffic moving at high speeds under free-flowing conditions. Urban freeways connect major points of traffic generation and may serve as urban extensions of principal rural highways. They are intended to serv~~ic~~e traffic between large residential areas, industrial or commercial concentrations and the central business district. To provide optimum mobility for through traffic, service to adjacent lands is completely eliminated. No parking, unloading of goods or pedestrian traffic is permitted.

Urban Arterial Roads

Urban arterial streets are intended to carry large volumes of all types of traffic moving at ~~medium~~ moderate to high speeds. These streets serve the major traffic flows between the principal areas of traffic generation and also connect to arterials and collectors. In urban areas without freeways, arterial streets provide the ~~best quality~~highest level of traffic service.

Urban arterial streets should limit the amount of direct private access to adjacent development. Desirably, this access should be confined to local and collector road connections, but utilizing such treatments as reverse road frontages, side road access and so on.

Urban Collector Roads

Urban collector streets provide both traffic service and land service. The traffic service function of this type of street~~s~~ is to carry traffic between local and arterial streets. Full access to adjacent properties is generally allowed on collectors.

Urban Local Roads

The main function of local streets is to provide land access. Direct access is allowed to all abutting properties. Local streets are not intended to ~~move~~ carry large volumes of traffic. ~~The~~ L~~l~~ocal streets primarily carry~~ies~~ traffic with an origin or destination along its length. It is not intended to carry through traffic other than to immediately adjoining streets. Local streets may be residential or commercial. Residential developments may carry appreciably higher traffic volumes and may, therefore, be multi-lane but they are seldom divided.

Occasionally, designers may encounter municipal roads crossing MTO facilities whose municipally-designated functional classification and design speed combinations which do not match a combination listed in **Exhibit 2G**. Design of elements on such roads should be primarily based on design speed, with engineering judgment applied as necessary with respect to the impact of functional classification on design. Design decisions should be documented in the Design Criteria.

Section 2.6.3.3 – Traffic Volume

- This ~~Section~~ section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

  The design hour volume (DHV) and the annual average daily traffic (AADT) in the design year are only two factors to be considered in the classification. The volume range for each class is wide and overlaps that of other classifications. For more ~~details~~ information about DHV and AADT, refer to *Provincial Engineering Memorandum HSBM DCSO 2016-05 dated March 31, 2016,* for *Capacity Analysis Manual.*

  Rural Freeways
  A freeway might be required when traffic volumes are 10,000 AADT and greater. While a relatively high volume is generally a prerequisite for a freeway, the need for ~~high speed~~high-speed movement under free flow conditions must also be present.

  Rural Arterial Roads
  The ~~annual average daily traffic (~~AADT~~)~~ volumes on rural arterials vary from 1,000 to 20,000 vehicles. This wide range occurs because arterials in ~~the~~ sparsely populated regions have relatively low traffic volumes while providing an important inter-regional traffic service. ~~Average daily traffic~~AADT volumes of 20,000 vehicles occur on arterial highways in very densely populated areas.

Rural Collector Roads

~~Average daily traffic~~AADT volumes on rural collector roads may vary from 200 to 10,000 vehicles depending on the population density.

Rural Local Roads

Traffic volumes on rural local roads are generally low but could be several hundred vehicles per day, depending on the density of development along the sides of the road.

Urban Freeways

Freeways may be required when traffic volumes reach 75,000 AADT.

Urban Arterial Roads

Urban arterial streets normally experience ~~average daily traffic~~AADT volumes of 5,000 to 50,000. Urban arterials may be divided or undivided, depending on the amount of traffic to be served.

Urban Collector Roads

The ~~average daily traffic~~AADT in the design year normally ranges between 1,000 and 20,000 vehicles. Collector streets can have more than two traffic lanes and may be divided.

Section 2.6.3.4 – Flow Characteristics

- This ~~Section~~ section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Rural Freeways

On rural freeways, traffic flow should be uninterrupted and unrestricted. Opposing traffic lanes must be physically separated by a wide grass median or a TL-5 barrier. Access should be controlled with grade separations or interchanges provided at all road~~s~~, rail or pedestrian crossings. Parking should be prohibited by regulations on all controlled access highways.

Rural Arterial Roads

Rural arterial roads carry large traffic volumes at high speeds and should be designed for uninterrupted flow of traffic except at controlled intersections with crossing roads. However, intersections on ~~high speed~~high-speed roads controlled by traffic signals or stop signs can be hazardous and should be avoided if possible. In some cases, grade separated interchanges are warranted by traffic volumes. Bicycle and pedestrian traffic are sometimes prohibited by regulation on controlled access arterial roads.

Rural Collector Roads

Traffic flow on rural collector roads is often interrupted by stop conditions or signalized intersections with arterials or other collector roads. Traffic flow is also ~~impeded~~ interrupted by vehicles leaving and entering the highway directly from adjacent properties. Bicycle and pedestrian traffic are not restricted.

Rural Local Roads

Traffic flow on rural local roads is normally interrupted by stop conditions at all intersecting roads and is affected by traffic moving to and from adjacent properties. Pedestrian traffic is not restricted.

Urban Freeways

To move high volumes at high speeds, it is necessary to have uninterrupted flow conditions on urban freeways. These conditions can only be provided by grade-separated crossings and interchanges. Parking and pedestrian access is prohibited. Urban freeways are generally constructed on new alignments, because of difficulty of providing the desired service and operating conditions on existing streets.

Urban Arterial Roads

The traffic flow is, desirably, uninterrupted except at signalized intersections and crosswalks. Where signals are closely spaced, they should be interconnected and synchronized to minimize the interference to through movements. Parking and unloading should be prohibited where they might affect through movement of traffic, particularly at rush hours. Pedestrians should be permitted to cross only at intersections or designated ~~cross walks~~crosswalks. Public transit loading stations should be designed to minimize interference with through traffic movements. Turning lanes may be

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provided at intersections.

Urban Collector Roads

The traffic flow on urban collector streets, in and near the central business district, is interrupted frequently by signalized intersections. In residential areas, simpler forms of traffic control are generally used. There are few parking restrictions except during peak hours when traffic movement may be the most important consideration. There are generally no special pedestrian crossing restrictions, but special cross walks might be provided where traffic volumes are high. To improve traffic flow, particularly at peak hours, it is sometimes desirable to provide collector streets with bus bays or turning lanes similar to those provided on arterial streets.

Urban Local Roads

Local streets have stop, yield or signalized controls where they intersect ~~more important~~ streets with higher volumes and/or functional classifications. Parking may be prohibited or restricted to one side on narrow streets. Pedestrian traffic is unrestricted.

Section 2.6.3.5 – Operating Speed

- This ~~Section~~ section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Rural Freeways

The average operating speed under most conditions is between 90 and 120 km/h on rural freeways.

Rural Arterial Roads

The average operating speed is between 70 and 100 km/h. The higher values are found on those sections of rural arterial roads having some control of access.

Rural Collector Roads

~~The~~ A~~a~~verage operating speeds on rural collector roads vary~~ies~~ between 60 and 90 km/h.

Rural Local Roads

Depending on the condition of the surface, the average operating speed on rural local roads varies from 50 to 80 km/h.

Urban Freeways

The normal operating speed under free-flow conditions varies between 80 and 110 km/h.

Urban Arterial Roads

Operating speed under free-flow conditions normally ranges from 60 – 90 km/h with the higher values prevailing in suburban areas.

Urban Collector Roads

The normal operating speed under free-flow conditions varies between 40 and 70 km/h, with the higher value prevailing in urban fringe areas.

Urban Local Roads

Operating speed under free – flow conditions is generally 40 – 60 km/h.

Section 2.6.3.6 – Vehicle Type

- This Section is **~~A~~applicable** with the following **additional g~~G~~uidance**:

Rural Freeways

Rural freeways carry all types of vehicular traffic, commercial motor vehicles normally ~~amount to~~account for between 20 and 30% of the total volume. Rural freeways are constructed to connect large cities or heavily developed areas. The total length of these roads is normally less than 5% of the total length of rural roads.

Rural Arterial Roads

Rural arterial roads link the major regions of a province and serve all types of vehicles. Up to 20% of traffic is commercial motor vehicles. Rural arterial roads normally make up from 5~~%~~ to 10% of the total rural road length depending upon the extent of rural freeway development in the area.

Rural Collector Roads

Although rural collectors carry all types of vehicles, commercial traffic consists mainly of

single unit trucks. In agricultural areas these are normally farm trucks carrying produce such as milk, feed, and livestock. These commercial motor vehicles amount to as much as 30% of the volume of traffic using these roads. Few heavy transport trucks use ~~the~~ this class of road except when the road serves mining and resource land uses.
Rural collector roads make up from 10 to 20% of the total length of rural roads.

Rural Local Roads

In agricultural areas, hauling is done by light and medium single unit vehicles with occasional heavy commercial motor vehicles. In mining and forestry areas, heavy units will predominate. The number of commercial motor vehicles depends upon the adjacent land use and ranges up to 50% of the total vehicular volume. Local roads normally make up approximately 75% of the total length of rural roads.

Urban Freeways

Urban freeways are expected to carry all types of vehicles including a relatively high percentage of commercial motor vehicles, comprising~~amounting~~ up to 20% of the total volume. Only express bus services with no stops are~~if~~ permitted on urban freeways. The total length of u~~n~~rban freeways is normally less than 10% of the total length of urban roads.

Urban Arterial Roads

All types of vehicular traffic use urban arterial streets. Commercial motor vehicles of all sizes may comprise as much as 20% of the total traffic volume. Both express and local buses are generally routed on arterial streets. The combined length of urban collectors and urban arterials may be as much as 30% of the total length of urban streets.

Urban Collector Roads

In commercial and industrial areas, all types of vehicles use urban collector streets, including commercial motor vehicles moving to and from arterials. In residential areas, collectors will carry a low percentage of commercial motor vehicles composed mainly of service vehicles. The combined total length of arterial and collector streets may amount to 30% of the total length of urban streets.

Urban Local Roads

The type of vehicles using local streets will vary. Residential streets carry predominantly passenger vehicles and the occasional transport. Industrial streets carry a high percentage of commercial motor vehicles. Bus operations rarely occur on residential streets.

The length of local streets amounts to about 70% of the total length of urban streets.

Section 2.6.3.7 – Connections

- This ~~Section~~ section is **~~Applicable~~ applicable** with the following **additional ~~Guidance~~guidance**:

Rural Freeways

Rural freeways should interchange traffic only with other freeways, arterials, and collectors. The interconnection of freeways with local roads is not a desirable practice.

Staged Construction

All rural freeways should normally be planned and designed as multi-lane, divided, controlled access facilities even though they may be developed by staged construction. In the plans for each stage of development, provision should be made to adapt each stage to the next or ultimate stage. The transition should be made with minimum waste of the exiting plant and minimum interference to traffic.

Rural Arterial Roads

Rural arterial~~s~~ roads connect with all other classifications of rural roads.

Rural Collector Roads

Rural collector roads connect with all other classifications of roads~~ except freeways~~.

Rural Local Roads

Rural local roads connect with collector and arterial roads. In Northern Ontario, local roads on the secondary highway network may connect with freeways.

Urban Freeways

Urban freeways are directly connected to intersecting or adjacent freeways and to most intersecting or adjacent arterial streets. Some direct connections to collector streets may be provided in the central business district.

Staged Construction

All urban freeways should normally be planned and designed as multi-lane, divided, controlled access facilities even though they may be developed by staged construction. In the plans for each stage of development, provision should be made to adapt each stage to the next or ultimate stage. The transition should be made with ~~minimum waste of the existing plant~~minimal wasted or “throwaway” construction and minimum interference to traffic.

Urban Arterial Roads

Urban arterial streets connect with freeways, arterials, and collectors.

Urban Collector Roads

Urban collector streets ~~are~~ may connect~~ed~~ to freeways and are rarely found except in the central business district.

Urban Local Roads

Local streets connect to other local streets and collector streets. It might be necessary to have industrial or commercial local streets connect directly to arterials.

Table 2.6.3 – Connections by Classification

- This Table is **n~~N~~ot a~~A~~pplicable** and is **replaced** with **Exhibit -2H**.

Exhibit -2H

Desirable Highway Classification Connections

Classification	Connects to (Classification)
Freeway	Freeway Arterial

Arterial	Freeway Arterial Collector
Collector	Arterial Collector Local
Local	Collector Local

Figure 2.6.2 – Relationship of Urban Road Classifications

- This Figure is ~~**Not**~~ **not** ~~**Applicable**~~**applicable**.

Table 2.6.4 – Characteristics of Rural Roads

- This Table is ~~**Not**~~ **not** ~~**Applicable**~~ **applicable** and is **replaced** with **Exhibit -2I**.

Table 2.6.5 – Characteristics of Urban Roads

- This Table is ~~**Not**~~ **not** ~~**Applicable**~~ **applicable** and is **replaced** with **Exhibit -2J**.

Exhibit -2I

~~**CHARACTERISTICS OF RURAL ROAD CLASSIFICATIONS**~~**Characteristics of Rural Road Classifications**

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FUNTIONAL CLASSIFICATION	RURAL FREEWAYS	RURAL ARTERIALS	RURAL COLLECTORS	RURAL LOCALS
Traffic Services	Optimum mobility	Traffic movement Primary Consideration	Traffic movement & land access equal importance	Traffic movement Secondary Consideration
Land Service	No access	Land access Secondary Consideration	Traffic movement and land access equal importance	Land access Primary Consideration
Range of Traffic Volume AADT	More than 10,000	1,000 – 20,000	200 – 10,000	Not applicable
Traffic Flow	Free flow	Uninterrupted flow Except at signals	Interrupted flow	Interrupted flow
Design Speed	100 – 130 km/h	80 – 110 km/h	60 – 100 km/h	60-80 km/h
Average Operating Speed Off-peak Conditions	90 – 120 km/h	70 – 100 km/h	60 – 90 km/h	50-80 km/h
Vehicle Type	All types Commercial motor vehicles Average 20-30%	All types Up to 20% commercial motor vehicles	All types Up to 30% commercial motor vehicles Mostly single unit type	Predominantly Passenger cars And light to medium, and occasional heavy commercial motor vehicles
Percentage of Total Length	Up to 5	5 - 10	10 – 20	75 approx.
Connects to	Freeways Arterials Collectors	All classifications	All classifications	Arterials Collectors L~~l~~ocals

Exhibit 2-J

~~CHARACTERISTICS OF URBAN ROAD CLASSIFICATIONS~~Characteristics of Urban Road Classifications

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REFERENCES

FUNCTIONAL CLASSIFICATION	URBAN FREEWAYS	URBAN ARTERIALS	URBAN COLLECTORS	URBAN LOCALS
Traffic Services	Optimum mobility	Traffic movement Primary Consideration	Traffic movement & land access equal importance	Traffic movement Secondary Consideration
Land Service	No access	Land access Secondary Consideration	Traffic movement and land access Equal importance	Land access Primary Consideration
Range of Traffic Volume AADT	More than 75,000	5,000 -– 50,000	1,000 -20,000	Not applicable
Traffic Flow	Free flow	Uninterrupted flow except at signals and cross walks	Interrupted flow	Interrupted flow
Design Speed	80 – 120 km/h	80 – 110 km/h	60 – 90 km/h	60 – 80 km/h
Average Operating Speed Off-peak Conditions	80 – 110 km/h	60 – 90 km/h	40 – 70 km/h	40 – 60 km/h
Vehicle Types	All types up to 20% commercial motor vehicles	All types Up to 20% commercial motor vehicles	All types	Passenger And Service vehicles
Percentage of Total Length	Up to 10	Up to 30	Up to 30	70 approx.
Connects to	Freeways Arterials	Freeways Arterials Collectors	Arterials Collectors Locals	Collectors Locals

1. Glennon, J. C. New and Improved Model of Passing Sight Distance on Two-Lane Highways. In *Transportation Research Record 1195.* Transportation Research Board, National Research Council, Washington, DC, 1998.

2. Hassan, Y., S. M. Easa, and A. O. Abd El Halim. Passing Sight Distance on Two-Lane Highways: Review and Revision. *Transportation Research Part A,* Vol. 30, No. 6, 1996.

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3. FHWA. *Grade Severity Rating System Users Manual,* FHWA-IP-88-015. Federal Highway Administration, U.S Department of Transportation, Washington, DC, August 1989.

4. Harwood, D. W., D. K. Gilmore, K. R. Richard, J. M. Dunn, and C. Sun. *National Cooperative Highway Research Program Report 605: Passing Sight Distance Criteria.* NCHRP, Transportation Research Board, National Research Council, Washington DC, 2007.

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