



Province of
British Columbia

Ministry of
Transportation
and Highways

Construction/Maintenance
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Victoria, BC V8W 3E6

MEMORANDUM

195/30
TCIR

See Distribution

DATE: September 10, 1997
PHONE: (250) 387-7605
FILE: 195-20/T

CHIEF HIGHWAY ENGINEER
RECEIVED
SEP 11 1997
LOG _____
NOTED _____

RE: TECHNICAL CIRCULAR T-4/97 - IN-HOUSE GRADING DESIGN CONTRACT QUALITY

Attached is the text of Technical Circular T-4/97. Both the text of the circular and the appendices are located on the L.A.N. Information for locating this information is outlined below. T 4/97 replaces T 2/94 Roadway Design/Quality Management.

The text of the circular is located on the L.A.N. on the public drive: FS_Public_Files@SVRHQ_HENG03@Servers/ROOT:STANDARD. The directory is "circular". The Word6 document contains the policy and is called QA_QC6.DOC (17 pages). The appendices have the quality control and assurance worksheets and are in an Excel5 file called Quality2.xls (four tabs, 27 pages). If you print both documents arrange the pages according to the table of contents, on page one of the Word6 document.

If you have any questions on the circular or if you have difficulties accessing the L.A.N. files, please contact Richard Voyer at (250) 387-7761.

John Shaw
Manager, Operations Policy
Construction/Maintenance Branch

cc Richard Voyer, Geometric Standards and Design, Engineering Branch

/jrs

attachment

TECHNICAL CIRCULAR T-4/97

**IN-HOUSE GRADING DESIGN CONTRACT QUALITY
MANAGEMENT**

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TECHNICAL CIRCULAR T-4/97
(replaces former TC T-2/94)
IN-HOUSE GRADING DESIGN CONTRACT QUALITY
MANAGEMENT

TABLE OF CONTENTS

INTRODUCTION.....	1
PART 1 - QUALITY MANAGEMENT.....	2
Definition:.....	2
Project Director/Project Manager Responsibilities:.....	3
Engineer in charge of Work Group Responsibilities:.....	3
PART 2 - QUALITY CONTROL.....	5
Definition:.....	5
Role of Project Manager.....	5
Role of the Engineer in charge of the Design.....	5
Role of Quality Control Reviewer.....	6
PART 3 - QUALITY ASSURANCE.....	7
Definition:.....	7
Designs by District for District.....	7
Designs by Region for Region.....	8
Designs by Region for Major Projects.....	8
Designs by Region for Vancouver Island Highway Project (VIHP).....	8
PART 4 - QUALITY AUDIT.....	9
Definition:.....	9
General approach to Designs.....	9
Annual Regional Audits:.....	9
APPENDIX A QUALITY CONTROL.....	A-1
APPENDIX B QUALITY ASSURANCE REVIEW REPORTS.....	B-1
APPENDIX C ANNUAL QUALITY AUDIT REVIEW PROJECT LIST.....	C-1
APPENDIX D QUALITY AUDIT REPORTS.....	D-1

TECHNICAL CIRCULAR T-4/97
(replaces former TC T-2/94)
IN-HOUSE GRADING DESIGN CONTRACT QUALITY
MANAGEMENT

INTRODUCTION

This Technical Circular is a replacement to Technical Circular T-2/94: Roadway Design Quality Management. The first Technical circular was produced to formalize the Ministry's previously unwritten protocol for Quality Management in Design in response to the regionalization and privatization of highway design. This Technical Circular deals with designs done in-house. A separate Technical Circular will cover the Quality Management policy for constants' designs.

As for the previous document, the main purpose of this Technical Circular is two-fold: - first, it is to provide a uniform framework for the Ministry design staff to appropriately document their work and justify critical design decisions, - second, it is to improve the assurance of a quality product through an independent review. The process follows basic quality management principles and methodologies such as the use of a checklist for Quality Control and the review by an independent team.

This new document also reflects the second stage to the Ministry restructure which completed the transfer of the delivery of programs and products from headquarters to the regions. The circular reaffirms the role and responsibilities of regional staff for Quality Management of designs done in-house. The Regional staff will also do annual audits of highway projects selected from designs done in-house or contracted by Regions or by Major Projects.

The process, as described, is meant to be as comprehensive as possible. The extent to which it is used will depend on the complexity of the design. The Manager of Highway Engineering will recommend to the Project Manager what level of review is adequate and reasonable in terms of cost effectiveness for the work at hand. In any case, the basic principles of Quality Management in terms of accountability for decisions and independent review, should be adhered to.

The Quality Management process is intended to complement the Project Management Policy and Principles and all other written standards and protocol. More recently, Value Engineering reviews and Safety Audits have been performed on some Major Projects. These are independent from the process described in this circular.

PART 1 - QUALITY MANAGEMENT

Definition:

“All activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system.” ISO 9000, Quality Management - ISO Standards Compendium, fifth edition, 1994.

The Ministry of Transportation and Highways is committed to implementing and maintaining Quality Management as defined in clause 14 (b) of the Bylaws of The Association of Professional Engineers and Geoscientists of the Province of British Columbia:

- “14 (b) Members and licensees shall establish quality management processes for their practices which shall include, as a minimum;
- (1) retention of complete design and review files for these projects for a minimum period of 10 years;
 - (2) in-house checks of their designs as a standard procedure;
 - (3) concept reviews of their structural designs by members or licensees not originally involved in the designs;
 - (4) field reviews, by members or licensees, of their projects during construction.

Concept reviews under (3) above shall be in addition to any checks which designs to determine if the concepts appear complete, consistent, and in general are undertaken under (2) above. These reviews shall evaluate the compliance with the appropriate standards and practices. Samples of the individual elements shall be checked to evaluate the analysis, design and detailing procedures used by the design engineer.”

This document outlines the roles and responsibilities of Ministry staff with respect to Quality Management of design produced in-house. A separate Ministry document will outline the standard terms of reference with respect to the design consultants' roles and responsibilities for quality management of their design.

The organizational structure, and responsibilities for implementing Quality Management for highway design are set out in Table 1.

In this Technical Circular, the '**Engineer**' means the Professional engineer, member of the Association of Professional Engineers and Geoscientists, to whom the Ministry has assigned responsibility of carrying out and/or reviewing the detailed design project

Project Director/Project Manager Responsibilities:

The Project Manager/Director is responsible for quality management of the total project by having a Quality Management Plan implemented to ensure

....that all aspects of the project and its results fully meet the needs and expectations of the Project Owner, Project Team members and stakeholders. The Project Manager ensures that all project team members are aware of the project's goals, requirements, and performance standards and all project participants are involved in ensuring that these standards are complied with.¹

It is the responsibility of the Project Manager to ensure that all Business Units and Consultants providing technical input to the project have a Quality Plan to assure Quality Control and Quality Assurance of their inputs and designs.

Engineer in charge of Work Group Responsibilities:

Responsibility for providing a quality highway design rests, ultimately, with the Engineer who ensures that Quality Control and Quality Assurance procedures as detailed in this document are applied during the design process.

The following Parts of the document cover only designs done in-house. The procedures, processes, and resources for implementing Quality Control and Quality Assurance are set out in three parts:

¹ *MoTH Project Management Policy and Principles Manual*, Page 23, Project Implementation Principles, Quality Management

Quality Control

Quality Assurance

Quality Audits

Although this document deals specifically with Quality Management, including detailed processes and procedures for Quality Control & Quality Assurance for Highway Engineering input to Highway Designs (geometric details, earthworks, contract documents, budget, schedule, etc.), it is the intent of the Ministry that each MoTH Business Unit or consultant engaged in providing technical input to these designs, shall maintain a Quality Management Program that is verifiable by the Ministry. Such other disciplines of professional engineering that may provide design input would include, but not be limited to, geotechnical, electrical, structural, and traffic design.

QM Plan	Management Reporting Responsibility	Delivering Responsibility	Participants in the delivery
Project Quality Management	Project Director / Project Manager (*)	Project Director / Project Manager (*)	Management Team
Quality Management Plan, Design(**)	Engineer responsible for QA reviews	Regions:- Engineer responsible for carrying out the detailed design District:-District Tech.	MoTH Design Team
Quality Control of Design(**)	Engineer responsible for carrying out the detailed design	Regions:- Design Team Leader Districts:- District Tech.	Regions:-Independent Checkers or Team Districts:- Independent Checkers or Team
Quality Assurance of Design(**)	Engineer responsible for QA reviews	Regions:-Engineer (Q/A Reviewer) or Review Team reporting to an Engineer Districts:- Regional Q/A Reviewer or Team	Regions:- Q/A Reviewer or Team Districts:- Regional QA Reviewer or Team
Quality Audit, Designs(***)	Chief Highway Engineer	Regional Manager, Professional Services	Regional Audit Teams

Table 1
In-house Quality Management for Highway Design
(All technical activities under the responsible supervision of an Engineer)

- * - Major Projects Br. = Project Director
 - Regions = Project Manager
- ** - All designs performed for VIHP shall be subject to a Q/A Review as arranged by the VIHP Project Management Team but to no less a standard than other Majors Projects.
- *** - Annual Audits. Sample selection by HQ. Performance of Audits by the Region.
 Occasionally Audits may be required by the Project Director or Manager during the design process.

PART 2 - QUALITY CONTROL

Definition:

“operational techniques and activities that are used to fulfill requirements for quality”
ISO 9000, Quality Management - ISO Standards Compendium, fifth edition, 1994.

“The activities that have to do with making the quality of a product what it should be”
AASTHO, Quality Control/Quality Assurance - Specification and Implementation Guide,
July 1993.

Note: Quality Control in Design involves a systematic verification of the design documents -including calculations, drawings, specifications, etc.- to ensure that there are no errors or omissions and that the Ministry standards and requirements are met.

Role of Project Manager

The Project Manager is to ensure that a Quality Control Plan is included in the scope of works when negotiating a “Contract For Service” for all design work. The Project Manager is also responsible for the preparation and approval a project Design Criteria sheet (as shown in page A2 to A4 of appendix A) against which the quality Control is carried-out.

Role of the Engineer in charge of the Design

The Engineer is responsible for the supervision of all designs. The degree of delegation of responsibility to his/her team(s) depends on the experience of the members of the team(s). However, a Professional Engineer must take responsibility to sign-off the Design and Quality Reviews. The Engineer shall assign the design work produced by his/her Design Team to an independent Team to carry-out the Quality Control.

The Engineer shall ensure that a formal process is in place to ensure a step by step Quality Control will be carried out as the design work proceeds for any given project. Quality Control reviews shall be documented, signed-off and kept with the design project file. All issues raised during the Quality Control reviews shall be resolved and the corrections and recommendations emanating from the process shall be documented. Quality Control checks shall be complete for each submission of deliverables. (i.e. 50% review, 95% review, final submission).

Typically cost and schedule controls lie within the realm of Quality Control. The Engineer shall monitor the results on an ongoing basis and determine if they comply with the standards and performance expectations specified by the Ministry or otherwise typical of the industry.

The standards and work performance mentioned above relate to:

- the appropriateness and completeness of the Design Criteria,
- the appropriateness of technical design concepts and engineering formulas that are used in terms of meeting Ministry standards and guidelines and as specified in the project terms of reference,
- the work methodology, - the format and presentation of the technical information,
- the content of the work in terms of its completeness and format,
- the progress of the work,
- the accuracy and correctness of the calculations.

Role of Quality Control Reviewer

The role of the Quality Control Reviewer is to verify all calculations and formulas for appropriateness, completeness and accuracy and ensure that all of the design elements are in accordance with the Design Criteria document. The reviewer will also check all plans, drawings, tables and design documents for completeness and conformity to standards. The QC report will include recommendations to the designer to eliminate cause of unsatisfactory results.

The person doing the QC review shall be qualified for the work being checked and not have been involved in producing the original work. He or she shall use, but not be limited to, a checklist as provided in the Quality Management Plan for design. For a typical sample see the check list attached in APPENDIX A. All items verified as meeting MoTH requirements shall be initialed, and dated by the QC reviewer with appropriate comments and returned to the Designer. All items not meeting MoTH requirements shall be mentioned in the QC report, with a summary list identifying mistakes, omissions and deficiencies along with recommendations for corrective measures. The QC reviewer shall confirm that the appropriate corrective measures have taken place prior to initializing the checklist or signing off.

The QC reviewer shall enlist the support of other staff disciplines as necessary to ensure the design meets its intended scope and relevant quality standards (i.e. planning group consulted if there is doubt that design meets classification or Level of Service; traffic consulted on issues regarding storage lengths, intersection marking, need for pedestrian or bicycle facilities, traffic management; construction consulted for comments regarding staging, special provisions, etc.; geotechnical group consulted regarding pavement structure, retaining walls, clarification of Geotech report; bridge group regarding structures; properties regarding landowner concerns; etc.).

The QC reviewer shall also ensure that appropriate comments / requirements from stakeholders have been incorporated. (i.e. ALC, environment, forestry, municipalities, property negotiations, utilities, etc.)

PART 3 - QUALITY ASSURANCE

Definition:

“All the planned and systematic activities implemented within the quality system and demonstrated as needed, to provide adequate confidence that an entity will fulfill requirements for quality.”

ISO 9000, Quality Management - ISO Standards Compendium, fifth edition, 1994.

“The activities that have to do with making sure that the quality of a product is what it should be.”

AASTHO, Quality Control/Quality Assurance - Specification and Implementation Guide, 1993.

Note:

Quality Assurance in Design is a systematic, ongoing, verification of the design activities and work progress aimed at both monitoring the process to ensure a quality and cost effective product and eliminating causes of unsatisfactory performance at all stages of the design.

Designs by District for District

All designs done by Districts shall be submitted to an Engineer in the Region not directly involved in the design and who has been assigned the responsibility for the Quality Assurance review. The material, including the QC documentation, should be submitted when the design is sufficiently advanced to have been through the QC process and the designer is confident that it is free from errors. Quality Assurance reviews preferably should occur at several pre-determined stages of the design so that quality input from the review can be implemented with minimal impact on the design cost and the schedule.

The regional Engineer responsible for QA review shall assign a Q/A Reviewer or Team to review the design and perform checks on a sampling of the Design Elements (Appendix B) to assure that the design meets the appropriate standards and to ascertain that Quality Control (Q/C) has been performed during the design process. The regional Engineer or a designate, shall visit each District office (at least) on an annual basis to assure that the technical staff is up-to-date on the Ministry Quality Management Policy and processes and verify that the Q/C and Q/A processes are being used on all district designs. The regional representative will then use these visits to report to the Regional Director and the Regional Manager of Professional Services on his/her assessment of the Q/M process for designs in districts and on the needs (or not) for remedial training for District Technical staff.

Designs by Region for Region

All designs performed by a regional Highway Engineering design team shall be reviewed by a Q/A Reviewer who is an Engineer or a Team headed by an Engineer. Both of which are appointed by the regional Engineer responsible for QA reviews. The Q/A Reviewer shall review the Quality Control program and assess samples of designs for scope and quality standards, in parallel with the Quality Control process (at the same time) and prior to the tender of the construction. This Q/A review should follow a time-table that will allow full consideration of its recommendations and their cost effective and timely implementation in the final design.. In the event that the Region has insufficient resources to appoint a Q/A Reviewer, the assignment may be carried out by resources from another region or by a consultant.

Designs by Region for Major Projects

All designs performed by a regional design team for Major Projects shall be subject to a Q/A Review as in the previously above stated *Designs by Region for Region*.

Designs by Region for Vancouver Island Highway Project (VIHP)

All designs performed for VIHP shall be subject to a Q/A Review as arranged by the VIHP Project Management Team no less in standard than other Majors Projects.

PART 4 - QUALITY AUDIT

Definition:

“Systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.”

ISO 9000, Quality Management - ISO Standards Compendium, fifth edition, 1994.

Notes:

“Quality Audits are carried out by staff not having direct responsibility in the areas being audited but, preferably, working in cooperation with the relevant personnel.” (ISO 9000).

“One purpose of a quality audit is to evaluate the need for improvement or corrective action.” (ISO 9000).

General approach to Designs

A design Quality Audit is a review of the design process and the design documentation by a qualified independent party not involved in the project. The design Quality Audit is preferably performed within a period no greater than two years after completion of the design.

The Quality Audit review is more broadly based and less detailed than the Q/C checks and Q/A reviews which are mainly focused on minimizing errors and omissions and redirecting the progress of the design work towards a quality product. The main objective of the audit is to verify that Ministry policies and standards on project management, design processes and quality management have been followed.

The results and recommendations of a design Quality Audit are used to improve design standards, processes and management for future designs. These audit reviews are normally done only on randomly selected projects. However, in special circumstances, it may be decided that the Ministry would benefit from an audit review of a specific project, while the design is in progress.

Annual Regional Audits:

Annually, a selection of highway design projects, preferably from more than one region and at least one per region, will be selected for a Quality Audit. These projects shall be selected such that there is an equal number of ‘large’ and ‘small’ projects. The intent is that the selection of ‘large’ and ‘small’ projects shall alternate for any given Region in successive years where project size and complexity permit.

In January of each year, each region shall submit a list of all design projects, plus a half size set of plans, to the Senior Highway Engineer, for each project designed during the previous calendar year. The Senior Highway Engineer, or a designate, shall then pick the projects on which the Quality Assurance Audits shall be performed. The number of projects selected will depend on the total number of designs submitted and the amount of resources available to conduct the audit. The list of projects selected shall then be referred to the Regions for comment after which, the list shall be finalized. The project list from each region will include the information and be in the same format as shown on the QUALITY AUDIT REVIEW PROJECT LIST form included as APPENDIX C of this document. There shall be no strict definition of what constitutes a 'large' or 'small' project and, therefore, the term large project shall be relative to the size of projects designed in each region for the give year.

Each Regional Manager, Professional Services shall make available one appropriately qualified designer, through the Manager in charge of Highway Engineering for the region, to serve on two person Audit Teams composed of an 'author' and an 'assistant.' Up to three Audit teams shall be formed from the selected personnel. Both the author and the assistant shall be from a different region than the region in which the design to be audited was performed. Each of the audit teams shall perform Quality Audits on one or two of the selected projects, one large and one small in the case of two. If the number of designs being audited is less than three, than only one or two review teams shall be formed. Each team shall provide copies of their Quality Audit Reports to the Senior Highway Engineer, Regional Manager of Professional Services, and Manager in charge of Highway Engineering for the Region audited. The format for the Quality Audit Report may be found in APPENDIX D.

The Audit Team shall visit the design office, interview the 'Designer', and the 'Quality Assurance Reviewer' to check that there are Quality Control and Quality Assurance programs in place and that these have been applied to produce a quality design to Ministry standards with appropriate documentation on the design and project files. In addition, the Audit Team shall review the design, documentation and check a selection of design elements to provide assurance that the design meets Ministry project requirements.

Designs done for the Majors Projects Branch shall be included in the list as potential candidates for the Annual Regional Audits.

APPENDICES: See footnote²

² Appendices are located on the L.A.N.: FS_Public_Files@SVRHQ_HENG03@Servers/ROOT:STANDARD. QA_QC6.DOC contains the 10 pages of the policy document plus the first page of App. A and the whole of App. B & D. Quality2.xls contains pages 2 to 27 of App. A and App. C (one page)

APPENDIX A QUALITY CONTROL

A good quality control system will:²

- *Select what to control*
- *Set standards that provide the basis for decisions regarding possible corrective action*
- *Establish the measurement methods used*
- *Compare the actual results to the quality standards*
- *Act to bring nonconforming processes and material back to the standard based on the information collected*
- *Monitor and calibrate measuring devices*
- *Include detailed documentation for all processes*

INPUTS

*Quality Mgt. Plan:- implementation
Standard/Project Design Criteria
Stakeholder communication
Office Work
Deliverables*

TOOLS

*Checklists (ex.-Appendix A)
Inspections
Control charts
Flow charting*

NOTE:

Appendix A continues on the excel spreadsheet checklist, filequality.xls.

Note that the checklist was developed by Highway Engineering, Region 1, and is currently under review for province-wide application.

² Project Management, a Systems Approach to Planning, Scheduling and Controlling, Fifth Edition; Harold Kerzner, Ph.D.

Appendix A QUALITY CONTROL PLAN

ROADWAY DESIGN QUALITY MANAGEMENT

CAPITAL WORKS DESIGN CRITERIA

Project: _____ Date: _____

Highway No. : _____ Type of Work : _____

Location : _____

Length : _____

	Pre-Design Conditions	Design Standards	Achieved Standards
Highway Classification (from planning study)			
Design Speed			
Minimum Radius			
Minimum 'K' Factor (C: Crest, S: Sag)		C: S:	
Maximum Grade			
Maximum Superelevation			
Minimum Stopping Sight Distance (C: Crest, S: Sag)		C: S:	
Weaving Lengths			
Decision Sight Distance			
Lane Width			
Outside Shoulder Width			
Inside Shoulder Width			
Clear Zone Width			
Median Width			
R.O.W. Width (Minimum)			
Design Vehicle			
Level of Service			
Traffic Design Year			

TABLE 2

WHERE ALL DESIGN MANUAL
STANDARDS HAVE BEEN MET

RECOMMENDED BY :

WHERE DEVIATION FROM DESIGN
MANUAL STANDARDS ARE USED

RECOMMENDED BY :

REGIONAL MANAGER of PROFESSIONAL SERVICES

DATE

SENIOR HIGHWAY ENGINEER

DATE

APPROVED BY :

APPROVED BY :

REGIONAL DIRECTOR or MAJOR PROJECTS DIRECTOR

DATE

CHIEF HIGHWAY ENGINEER

DATE

NOTE:

Justification for deviation from standards and proposed mitigation must be documented and referenced by footnote number on subsequent pages attached to the main Design Criteria Sheet.

Appendix A: QUALITY CONTROL PLAN

Page ___ of ___

Date: / /

File No. :

HIGHWAY REHABILITATION PROJECT

DESIGN CRITERIA

HIGHWAY ROUTE NAME/NUMBER : _____

L.K.I. INVENTORY SEGMENT: _____ From km: _____ To km: _____

CORRIDOR UPGRADING PROJECT: Yes: No:

TOPOGRAPHY (Mountainous, Rolling, etc.): _____

DITCH TEMPLATE MATERIAL : TYPE : _____

PROJECT DESCRIPTION : _____

GEOMETRIC DESIGN ELEMENTS	EXISTING GEOMETRIC ELEMENTS			DESIGN GEOMETRIC ELEMENTS		
	PRIOR TO PROJECT LIMITS	WITHIN PROJECT LIMITS	BEYOND PROJECT LIMITS	NORMAL STANDARD VALUE	REHAB. CRITERIA VALUE	ACHIEVED CRITERIA VALUE
A	B	C	D	E	F	G
1 Functional Classification :						
2 Design Speed :						
3 Posted Speed :						
4 Minimum Horizontal Curve Radius :						
5 Minimum Stopping Sight Distance :						
6 Min. "K" Factor : Sag V.C. :						
7 Min. "K" Factor : Crest V.C. :						
8 Maximum Superelevation :						
9 Maximum Gradient (%) :						
10 Lane Width(s) :						
11 Shoulder Width :						
12 Clear Zone Width :						
13 Right of Way Width :						
14 Current Traffic Volume : SADT :						
15 Design SADT/Design Hourly Volume :						
16 Truck Volume % :						
17 Accident Rate :						
18 Level of Service :						
19 Etc. :						
20						
21						
22						
23						

RECOMMENDED BY : _____
 DESIGNER DATE

(See overleaf)

HIGHWAY REHABILITATION PROJECT

DESIGN CRITERIA (Cont'd)

HIGHWAY ROUTE NAME/NUMBER : _____
L.K.I. INVENTORY SEGMENT: _____ From Km: _____ To Km: _____

FOR PROJECTS MEETING DESIGN MANUAL STANDARDS (See note below) :

APPROVED BY : _____
MANAGER OF DESIGN DATE

FOR PROJECTS EXCEEDING REHABILITATION CRITERIA, BUT BELOW STANDARDS :

RECOMMENDED BY : _____
MANAGER OF DESIGN DATE

APPROVED BY : _____
MANAGER OF PROF. SERVICES DATE

FOR PROJECTS BELOW REHABILITATION CRITERIA :

RECOMMENDED BY : _____
MANAGER OF DESIGN DATE

RECOMMENDED BY : _____
MANAGER OF PROF. SERVICES DATE

APPROVED BY : _____
CHIEF HIGHWAY ENGINEER DATE

Note : The designer is encouraged to use optimum, cost effective values for design elements which will often exceed the minimum criteria specified in the Ministry Design Manual. This applies mostly to sight distances, curve radii, "K" values for vertical curves and spiral lengths. In the case of side slopes, ditch widths, lane and shoulder widths, right-of-way widths, median width and clear zone distances, the designer must document reasons for exceeding values specified in the Ministry Design Manual for the specific class of road. In this case, the Design Criteria sheet must be signed by the Manager of Design as well as the Regional Manager of Professional Services.

Appendix A: QUALITY CONTROL PLAN

DESIGN CRITERIA:

• REQUIREMENTS SATISFIED: _____

• REQUIREMENTS NOT SATISFIED: _____

QUALITY CONTROL STAGE		

- 1. 30% - 50% - Complete
- 2. 90% - Complete
- 3. 100% - Complete

GENERAL:

• CALCULATIONS - SEE SEPARATE SHEETS

Project Description:	
Contract No:	Reviewed by Project Manager:
1. Date/Initial	2. Date/Initial
3. Date/Initial	

• All mathematical calculations have been checked and transferred correctly to the drawings.

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• KEY PLAN				
1	• Location Map: Shows site, nearest town names, land marks, etc. and North arrow				
1	• Key Map: Alignments, Station ticks (500m), Limits of Construction with stations, gravel sources, disposal sites, relevant names, roads, rivers, lakes, etc., scale, legal boundaries where feasible, sheet layout with plan numbers				
1	• Standard title layout from manual				
1	• Appropriate Signing Authority block				
1	• Complete Symbol Legend (may be on separate sheet if too large)				
1	• Plan Index				
1	• Issue Record and date (when designed by a Consultant)				
1	• Consultant's name (if Applicable)				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• PLANS				
1	• Base Mapping up to date or has been updated by recent survey				
1	• Base Mapping to be screened 60% (no screening on Utility Drawing set)				
1	• Standard drawing format as per Design Manual				
1	• Sheets laid out in orderly sequence (intersections not broken up between sheets where possible, interchanges easily defined, etc.)				
1	• Chainage runs left to right				
1	• North arrows				
1	• Toes shown and labeled C or F				
1	• Limits of Construction shown for all alignments				
2	• Cross-referencing where required				
1	• Right-of-way layout in respect to toes				
1	• Right-of-way matches at join lines				
2	• New Right-of-way required is to be referenced from existing R/W where ever possible, rather than offsets from "L" or control lines				
2	• Legal Descriptions shown				
2	• Right-of-way areas boxed with summary shown				
2	• Required Easements (construction, slope, etc.) with areas shown				
2	• Clearing and Grubbing limits correctly defined with areas and sheet summaries				
2	• Removals and adjustments shown (culverts, manholes, valves, houses, pavement, etc.)				
2	• Urban Projects: Curb & Gutters, Sidewalks, Stairs, Storm Sewers, etc., if applicable				
2	• Fencing requirements shown				
2	• Structures identified				
1	• All required chainages, curve data, co-ordinates and azimuths shown.				
2	• L-Line referenced to monuments/iron pins, co-ordinates shown				
2	• Detours shown if applicable (may be separate drawings)				
2	• Mini Key plan showing plan location on the contract				
2	• All work items identified and boxed with leader lines to item where required.				
2	• Coherent drafting (no overlapping lines, text, etc.)				
2	• Text sizes readable when drawings half-sized				
1	• Topography highlighted (5's, 10's 15's, etc.), elevations labeled and easy to find				
1	• Design Co-ordination, Section 370 of Design Manual followed.				

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	▪ PLANS Continued.....				
1	▪ Waste areas identified				
1	▪ Is sound attenuation required?				
2	▪ Any need for crash attenuators?				
	▪				
	▪				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
• PROFILES				
1 • Standard drawing format				
1 • Existing ground line shown				
1 • Design Speed shown				
1 • Stationing of alignments (T.S., S.C., etc.) coincides with plans				
2 • Note about finished grade elevations, exc. and emb. quantities, etc.				
2 • Quantities match unadjusted figures in design folders				
2 • Correctly-placed bench marks (outside limits of work) at 400m intervals				
1 • K-values for stopping sight distance shown				
2 • Vertical curve lengths (standards)				
1 • Vertical & Horizontal alignments integrated (aesthetics)				
2 • Correct spiral lengths and superelevations				
1 • Method (stations/S.E. rates) of superelevation transition shown when there is insufficient tangent length between two curves for runoff.				
1 • Limits of construction shown				
2 • All proposed and important existing culverts shown				
2 • Existing affected utilities (storm, sanitary, gas, etc.) shown				
2 Rivers, creeks, bridge sites and structures identified, abutment • stationing and bridge end fills shown				
2 • Crossing roads, intersections, etc., identified by station, elevation and name				
1 • Unnecessary irregularities or roller coaster effect in the grades (aesthetics)				
2 • Impact on drainage (level grades, T.S./S.T. at low point on V.C. ,etc.)				
2 • Construction Notes, surcharges, anticipated settlements, etc.				
2 • Have separate Storm Sewer profiles been produced				
2 • Surcharge shown on finished grade line (if applicable)				
•				
•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• TYPICAL SECTIONS				
2	• For completeness, covering all variations required for the project (e.g. minimum median, wide median, wall one side, etc.)				
1	• Correct pavement structure				
2	• Constructability				
1	• Gravel depths measured at the correct hinge points?				
1	• Subgrade crossfall correct (from geotechnical recommendations)				
2	• Any obvious errors in the dimensions?				
2	• Has stationing been shown covering the location of design requirements?				
2	• Has Subgrade Crossfall transition treatment for curves been shown?				
2	• Surcharge details and projected settlement?				
1	• Appropriate ground lanes used.				
1	• Has clear zones been met as per Design Manual				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• GEOMETRICS AND LANING				
1	• Design Speed(s), Design Vehicle(s) and referencing notes				
1	• Compliance with Design Manual specifications and standards?				
1	• Intersection/interchange/access spacing, where applicable				
2	• Configuration improvement possibilities				
2	• Meets minimum traffic island dimensions				
2	• Wheel chair ramps employed				
2	• Island surfacing treatment (usually decorative finish in urban areas)				
1	• Maximum radii (11m) criteria for stop sign installations without islands				
1	• Correct access types and locations (no accesses on Accel/Decel lanes, etc.)				
1	• Lane balance achieved				
1	• Weave lengths check, confirmed by Traffic Branch				
2	• North arrow and mini key plan				
1	• Lateral sight distance (stopping/avoidance) checked				
2	• Curb and Gutter, Asphalt and Concrete drainage curb limits				
2	• Roadside and Median Barrier, Sta. to Sta. limits and summary of materials, Flares				
1	• Various alignments numbered (L100, L200, etc.)				
2	• Pedestrian Refuge details				
2	• Attenuator requirements detail				
2	• Proposed 4 lane design tapers to existing 2 lane highway (or should it be built full width with temporary tie-in using barriers)				
1	• Have lane drops and Intersection/Interchanges been checked for Directional Signability by Traffic Branch				
1	• Tapers shown (stations, start/stop)				
3	• Checked by Traffic Branch for Electrical				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	res or No or n/a	Original Work by:	Checked By:	Date:
	• SPOT ELEVATIONS				
2	• Note that elevations shown are finished grade				
2	• Elevations shown where required for construction purposed				
2	• Spot check for obvious errors				
2	• Shoulder or hinge point elevations shown if possible				
2	• Cross check to see how spot elevations have drainage provisions.				
2	• Have curb return profiles been done and spot elevations adjusted?				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• DRAINAGE				
2	• Work items boxed				
2	• Enclosed Drainage Systems: poor layout, obvious errors, C.B. spacings, pipe and M.H. sizes, A.S.T.M. no. and class, wall thickness, material selection (P.V.C. vs. C.S.P. vs. Concrete), drainage profiles produced?, etc.				
2	• Correct rain fall intensity for calculations				
2	• What return period was the facility designed for?				
2	• River Diversions shown				
2	• Elevations shown for proposed extra ditching				
2	Ditch block details (vertical sandbags pose hazard in clear zone - must have 10:1 slope facing oncoming traffic)				
2	• Perforated pipe layout, details & location of cleanouts				
2	• Invert elevations for all pipes shown				
2	• All affected existing items addressed (removals, adjustments, abandon, extensions, relocations, etc.)?				
2	• Reference notes to other dwgs.				
2	• Culverts, Inlet Structures, C.B.'s M.H.'s, etc., adequately described as to location, elevation, diameter, materials, wall thickness, etc.				
2	• Calculations done for enclosed system				
2	• Use of CB-M.H. minimized or eliminated				
2	• Check for conflicts with other utilities, e.g. electrical, etc.				
2	• Rip Rap details shown.				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
• UTILITIES (drawings may be combined with the above if clarity permits)				
2 • Layout and location (avoidance of the travelled roadway prism where possible)				
2 • All affected utilities contacted and dealt with?				
1/2 • All agreements in place?				
2 • All work items boxed?				
2 • Clear descriptions noted where required?				
2 • References to other dwgs. and specifications				
3 • Detail not screened				
1 • Any special crossing drawings required				
3 • Special drawings approved by appropriate agencies				
•				
•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	SOIL-STEEL AND CONCRETE STRUCTURES (over/underpasses, rivers, etc.)				
2	▪ Site plans				
2	▪ Typical sections				
2	▪ Profiles				
2	▪ Detail Drawings				
2	▪ Coherent design plans				
2	▪ Foundation excavation, structure backfill & height of cover (min.) to specs.?				
2	▪ Subdrainage addressed?				
2	▪ Alternate bids addressed?				
	▪				
	▪				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• RETAINING WALLS				
2	• Layout offsets shown				
2	• Sufficient dimension and elevations for construction				
2	• Type of wall selected suits installation location regarding aesthetics, soil conditions, cost-effectiveness and constructability?				
2	• Subdrains where required				
2	• Foundation excavation and structure backfill limits				
2	• Typical Section(s)				
2	• Plans				
2	• Profiles				
2	• Shown on working cross-sections?				
2	• Railing or Barrier required?				
2	• Wall finish				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• CONSTRUCTION DETAILS				
3	• Coherent and workable?				
3	• Errors or omissions?				
2	• Typical Sections reflect the work?				
2	• Geotechnical and Environmental issues addressed?				
2/3	• Staging and implementation				
	•				
	•				

COMMENTS:

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• GRAVEL HAUL CHART (if applicable)				
3	• When bid prices include haul, this drawing is not required				
3	• Overhaul chart shown project kms as well as haul kms				
2/3	• Pit(s) name/location/distance from project shown with vertical line • where gravels would enter the project				
3	• Types of granular material and totals				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	▪ VOLUME OVERHAUL DIAGRAM (if applicable)				
3	▪ Complies with Design Manual standards				
3	▪ Check for obvious errors				
3	▪ Marked "For Information Purposes Only" if haul is included in excavation bid prices				
	▪				
	▪				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	SIGNING AND PAVEMENT MARKINGS, ELECTRICAL, GEOTECHNICAL, BRIDGES, LANDSCAPING, ENVIRONMENTAL MITIGATION, MUNICIPALITIES AND OTHER AGENCIES				
2/3	• To be reviewed by their respective Branches/Sections				
2/3	• Signing and Pavement markings				
2/3	• Geotechnical				
2/3	• Bridges				
2/3	• Landscaping				
2/3	• Environmental				
2/3	• Municipalities				
2/3	• Other Agencies				
	•				
	•				

COMMENTS:

Notes:

Highway Engineering Quality Control and Quality Assurance only done for compliance.

Appendix A: QUALITY CONTROL PLAN

Stage DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
. ELECTRICAL, SIGNING, & TMP (Usually completed by electrical designer)				
1 . Hydro service locations confirmed with utility company (provide confirmation from utility company)				
1 . Telephone service locations confirmed with utility company (provide confirmation from utility company).				
1 . Overhead utility lines checked for conflicts with poles				
1 . Electrical design drawing checked for conflicts with underground utilities				
1 . Signal and Sign pole capacities checked using the Pole Capacity Program				
2 . Verify Illumination levels				
2 . Final civil design drawings cross check with the Electrical Design drawings				
2 . Materials List checked and finalized				
2 . Directional Sign Records finalized				
2 . Ministry Regional comments addressed				
2 . Ministry Electrical Branch comments addressed				
2 . Ministry Sign Branch comments addressed				
2 . Ministry District Electrical Maintenance Branch comments addressed				
2 . Class 'A' Construction Estimate finalized				
2 . All Dwgs checked to identify conflicts (underground and overhead)				
.				
.				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	yes or No or n/a	Original Work by:	Checked By:	Date:
	• GEOTECHNICAL				
1	• Has draft geotechnical report been produced?				
1	• Have all material horizons been identified?				
1	• Has pavement structure been confirmed?				
1	• Has depth of stripping been determined?				
1	• Have all cut and fill slope rates been set?				
1	• Has all information required for existing pavements been obtained?				
2	• Have all soil issues been addressed?				
2	• Has final report been produced?				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• ENVIRONMENTAL				
1	• Have environmental agencies been contacted? (List in comments)				
2	• Have environmental concerns been identified and included in design work?				
2	• Final approvals - Fisheries?				
2	• Clearance report submitted?				
2	• Submit approvals from agencies?				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• SUGGESTED CONSTRUCTION STAGING				
3	• Marked "For Information Purposes Only"				
2/3	• Is the staging workable with minimum traffic interruption				
	•				
	•				

COMMENTS:

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• DETOURS				
2/3	• Should show all of the information required for construction at the proposed design speed: Typical sections, surface treatment, drainage, profiles, etc.				
2/3	• Is the detour design functional, constructible and to Ministry standards?				
2/3	• Have quantities been included in project calculations.				
	•				
	•				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• SIGNING & PAVEMENT MARKINGS PLAN (USING LANING BASE)				
2	• Are all warning, regulatory and guide signs shown?				
2	• Is all sign information illustrated correctly?				
2	• Are sign bridges or cantilever signs required and bases shown?				
2	• Has roadside barrier protection been reviewed for sign bridges, etc.?				
	•				
	•				
COMMENTS:					

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• BRIDGES				
2/3	• R/W, Horizontal and Vertical alignments to be compatible with grade design				
2	• Clear distinct separation of quantity take off (from road construction)				
2/3	• Separate Q.C./Q.A. done by Bridge Branch				
2	• Barrier Connected to roadside barrier (Also shown on laning and Geometrics)				
	•				
	•				
COMMENTS:					

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	<ul style="list-style-type: none"> RIGHT-OF-WAY DRAWINGS 				
1	Is cover sheet the same as detailed design, complete with "Property Acquisition Plan"?				
1	Does cover sheet contain signature space for "Manager Property Acquisition" & "Project Director"?				
1	Has a legend sheet been included?				
1	Is plan scale the same as design drawings?				
1	Are all limits of construction shown?				
1	Is cadastral shown with plan numbers?				
1	Is right-of-way dimensioned and do dimensions agree with design plans?				
1	Is right-of-way clear of toes 5m min. on highway and 3 m min. on local roads?				
1	Do match lines meet and is correct number for adjacent sheet shown?				
1	Are drawing numbers correct with R/W added?				
1	Does right-of-way line encompass entire project?				
1	Is correct symbol utilized?				
1	Are working easements "license to construct" areas shown?				
1	Are areas shown to correct decimal place and shown boxed?				
1	Are summary sheet areas listed by legal description?				
1	Are all lots, parcels, easements, utility corridors, etc. included?				
1	Have total areas been checked?				
1	Have all the following been eliminated from plans; contours, clearing and grubbing lines and areas, proposed edge of pavement, drainage structures, pipes, catchbasins, etc. retaining walls and rip-rap?				
2	Have any alignment changes occurred during the 30 - 50% review?				
2	Has right-of-way been altered to reflect changes?				
2	Is right-of-way as submitted in Final Draft?				

COMMENTS:

Appendix A: QUALITY CONTROL PLAN

Stage	DRAWINGS	Yes or No or n/a	Original Work by:	Checked By:	Date:
	• CROSS-SECTIONS				
1	• Do section widths match what is shown on plans?				
1	• Do underground utilities show?				
1	• Does right-of-way show on cross-sections?				
3	• Are cross-section sets updated to final contract stage?				
2	• Are the cross-culverts shown?				
3	• Required number of sets of cross-sections been forwarded?				
2	• Are the walls/surcharges/construction details shown?				
	•				
	•				

COMMENTS:

- Project history, Project Initiation document, design decisions with background and approvals, utilities and agency contacts and approvals, etc.

THIRD STAGE:

SPECIAL PROVISIONS AND ESTIMATE:

Concise, accurate, cross-referenced, addressing only those items not properly covered in the Standard Specifications or the Construction Agreement.

- SECTION 1 - GENERAL
- SECTION 2 - GRADING
- SECTION 3 - ELECTRICAL
- SECTION 4 - LANDSCAPE
- SECTION 5 - PAVING
- SECTION 6 - SIGNING
- SECTION 7 - BRIDGE
- SCHEDULE OF APPROXIMATE QUANTITIES AND UNIT PRICES
- MISCELLANEOUS BY OTHERS

DESIGN FOLDERS

- Complete, covering all items in the Schedule of Quantities
- Quantities can be traced as to how they were compiled/arrived at, and agree with the associated contract documents
-
-

APPENDIX B QUALITY ASSURANCE REVIEW REPORTS

A good Quality Assurance system will³:

- *Identify objectives and standards*
- *Be multifunctional and prevention oriented*
- *Plan for collection and use of data in a cycle of continuous improvement*
- *Plan for the establishment and maintenance of performance measures*
- *Include Quality Audits*

INPUT

Quality Mgt. Plan:- implementation
Scope of project
Budget
Schedule
Contract documents
Results of Quality Control
Reports & recommendations
Stakeholder agreements / permits
Approvals & signoffs
Policies
Milestones / deliverables

TOOLS

Quality audits
Inspections/assessments
Cost/benefit analysis
*Benchmarking (compare to similar things
from other projects)*
Flow charting

Each time a Quality Assurance Review is performed on a highway design project a report of the findings shall be placed on the project file and the report shall indicate the following:

Identify Reviewer or Team

Relevant Project Information

Start and End Date of Review

Description of Material submitted for Review:

³ Project Management, a Systems Approach to Planning, Scheduling and Controlling, Fifth Edition; Harold Kerzner, Ph.D.

Appendix B (con't)

Review Results:

Effectiveness of the Designers' Q/C

Results of the design process in terms of its effectiveness to meet the projected design costs, the planned schedule and the scope

Description of the extent of the Q/A review of the Technical Design Elements

Recommendations

APPENDIX D QUALITY AUDIT REPORTS

Part 1:

Highway Design Project

Each time a Quality audit is performed on a highway design project a report of the findings shall be placed on the project file and the report shall have the following format:

Executive Summary

Introduction

- Project Description
- Project Scope
- Project Team
- Project History
- Key Map

Technical Standards and Format Review

- Traffic and Planning Reports
- Site Visit
- Design Criteria
- Contract Drawings
- Special Provisions
- Schedule of Approximate Quantities and unit Prices
- Design Folders
- Cross Sections
- Staging and Constructability

Process Review

- Correspondence Files
- Internal Contacts
- External Contacts
 - Approvals (Environmental, Municipal, etc.)
 - Reports (Traffic, Preliminary, Geotechnical, etc.)
- Utilities
- Public Information Program

APPENDIX D (con't)

Post Construction Meetings Report

If the design has been constructed, the post-constructed meetings report should be reviewed and appropriate recommendations should be made on the constructability of the design.

Conclusions and Recommendations

Appendices

Site Photographs (where necessary to clarify report contents)

Contract Drawings

Special Provisions

Schedule of Approximate Quantities and Unit Prices

Part 2:

Audit of Highway Design Elements

A Quality Assurance audit on a few selected highway design element for each project being audited shall result in a report for the project file in the following format:

Executive Summary

Introduction

Technical Review

Project Identification

Description

Key Map

History

Design Element No. 1

Design Element No. 2

..and so on for each design element reviewed.

Conclusions and recommendations

The above format is repeated for each project selected for the audit process.