2018

Quality Control and Quality Assurance Program

by the VTrans Structures Section

VTrans Structures Section
Montpelier, Vermont
VTrans Structures Management

Second Edition

Quality Control and Quality Assurance Program

SECOND EDITION

by

VTrans, Structures Section

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Montpelier, Vermont

Quality Control and Quality Assurance Program, Second Edition
 Published by the State of Vermont, Agency of Transportation (VTrans)

VTrans Structures Section
National Life Building
1 National Life Drive
Montpelier, VT 05633

The use of this guideline constitutes the acceptance of the following statement:

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MISSION, VISION AND GOALS

MISSION

Provide for the safe and efficient movement of people and goods.

VISION

A safe, reliable and multimodal transportation system that promotes Vermont's quality of life and economic wellbeing.

GOALS

1. Provide a safe and resilient transportation system that supports the Vermont economy.
2. Preserve, maintain and operate the transportation system in a cost effective and environmentally responsible manner.
3. Provide Vermonters energy efficient, travel options.
4. Cultivate and continually pursue innovation, excellence and quality customer service.
5. Develop a workforce to meet the strategic needs of the Agency.

INTRODUCTION

The *VTrans Quality Control and Quality Assurance Program*, the Program" or "QC/QA Program", establishes the organizational procedures and practices for ensuring that requirements and expectations are fully met. This QC/QA Program provides checks and balances within the Structures Section to assure quality in documents, design calculations, plans, and specifications. This QC/QA Program applies to in-house design, consultant design as well as design–build projects. The primary focus of this manual is to set procedures for the design development team, however, sections are dedicated to discuss the quality control processes implemented by the Scoping Group within the Structures Section.

In-house designers, consultant designers and reviewers must recognize that quality is the result of several processes. It requires many individuals performing many appropriate activities at the right time during the plan development process. Quality does not solely consist of a review after a product is completed. It is an approach and a realization that Quality is something that occurs throughout the design and plan preparation process. Quality requires performing all activities in conformance with valid requirements, no matter how large or small their overall contribution to the design process. Good CADD techniques, attention to detail and ensuring the plans are correct and useful to the contractor are also essential to quality.

Consultants are agents for VTrans with the primary responsibility for preparation of contract plans. Consultants must ensure quality and adhere to established design policies, procedures, standards and guidelines in the preparation and review of all design products for compliance with good engineering practice.

Structures Section Management shall monitor and measure the Quality Control efforts used by Project Managers and their Consultants.

Structures shall identify and coordinate training needs of in-house staff engaged in the project management, design, review, and plan production for projects.

SECTION 1: BACKGROUND

The findings of the investigation of the 2007 collapse of the I-35W Bridge highlighted the importance of all Department of Transportation agencies to review and implement more rigorous Quality Assurance and Quality Control programs within their Departments. The National Transportation Safety Board (NTSB) began an investigation on the cause of the collapse and discovered that failed gusset plates lead to the bridge collapse. The NTSB also cited "insufficient bridge design firm quality control procedures for designing bridges, and insufficient Federal and State procedures for reviewing and approving bridge design plans and calculations" as one safety issue among others.

In response to their findings, NTSB made several recommendations. Two similar recommendations were directed to FHWA and AASHTO recommending that they:

> [D]evelop and implement a bridge design quality assurance/quality control program, to be used by the States and other bridge owners, that includes procedures to detect and correct bridge design errors before the design plans are made final; and, at a minimum, provides a means for verifying that the appropriate design calculations have been performed, that the calculations are accurate, and that the specifications for the load-carrying members are adequate with regard to the expected service loads of the structure.

They worked together and developed "Guidance on Quality Control and Quality Assurance (QC/QA) in Bridge Design" as a framework to identify and correct errors in design, plans, calculations and specifications.

The VTrans Structures Section recognizes the importance of QC/QA procedures in our work in achieving the Agency's goal to provide Vermonters with a safe, efficient and resilient transportation system. The Structures Section believes that a commitment to quality, resiliency, and public engagement is intrinsic in achieving this goal. The Structures Section has developed this QC/QA Program to recognize our commitment to quality and procedures the Structures Section shall follow to ensure it.

SECTION 2: OBJECTIVE

The main objective of the *Structures Quality Control and Quality Assurance Program* is to provide a mechanism by which all projects are subject to deliberate and systematic reviews to reduce the risk of introducing errors and omissions into the final design. The Program ensures that Quality work is performed and deliverables are produced at the end of the design process. Quality final designs should be able to clearly demonstrate project objectives, while recognizing environmental, sustainability and constructability milestones. The intent of the reviews at multiple levels is to create a set of Quality project plans, which should be substantially free of errors.

A secondary objective of the QC/QA Program is to provide a well-documented "trail" of the design process. A properly documented Design Book should be a byproduct of the Quality Control and Quality Assurance process. A knowledgeable person unknowing of the design should be able to read through the Design Book, observe QC/QA procedures and understand the results of narratives during design. VTrans should be able to substantiate its position from properly documented project files if any legal, social or procedural issues arise regarding the project.

Another secondary objective of the QC/QA Program is to provide information feedback from reviews that will increase expertise and awareness in the Structures Section. Designers' improved expertise and increased knowledge from feedback should result in product improvement at early stages even before a project review is started. The QC/QA Program thus serves as a parallel training program between Reviewers, Checkers and Designers.

This Program will be reviewed and updated periodically to ensure compliance with changes to plans preparation requirements, processes and organizational structure within the Agency and the Structures Group.

SECTION 3: DEFINITIONS AND NOTATION

CHECKER: An individual responsible for performing a full technical review of the structural design calculations, drawings, specifications and contract documents.

DESIGNER: An individual directly responsible for the development of design calculations, drawings, specifications and contract documents and review of shop drawings related to a specific structural design with a level of technical skills and experience commensurate with the complexity of the subject structure or structures being designed.

ENGINEER OF RECORD (EOR): An individual responsible for all structural aspects of the design including its systems and components. This individual is appointed by the owner of the structure, and generally is a licensed professional engineer.

ONLINE SHARED REVIEW (OLSR): A project review process in which reviewers from multiple areas of expertise interactively evaluate project plans, specifications and estimates for completeness, clarity, consistency, correctness, and constructability. This type of review takes place at multiple plan milestones and is utilized for both Quality Control and Quality Assurance efforts. The OLSR also allows for efficient and effective shared review archives to be maintained and referenced.

LEAD DESIGNER: An individual who is tasked as lead in the development of design calculations, and drawings. He/She may task other Designers to design or review a portion of the project. The Lead Designer shall ensure that all components come together properly to meet the project goals.

MANAGEMENT EXPERTISE AND TECHNICAL ARCHIVE (META): A framework - a formal structure - consisting of people and technology that seeks to capture knowledge and experience and disseminate it in a useful way.

DESIGN BOOK: Collection of all relevant information for the complete planning and design of the structures for a given project. This should include, but is not limited to, site conditions, requirements from other State agencies and project stakeholders, location assumptions, design assumptions, final design calculations, and evidence of the required QC/QA procures used during project development and design.

QUALITY ASSURANCE (QA): Procedures of reviewing the work to ensure the quality control measures are in place and effective in preventing mistakes, and consistency in the development of design plans and specifications.

QUALITY CONTROL (QC): Procedures of checking the accuracy of the calculations and consistency of the drawings, detecting and correcting design omissions and errors before the design plans are finalized.

QUALITY: Quality is a product and process that conforms to requirements; meets stakeholder needs; and strives for excellence in so doing.

REVIEWER: An individual responsible for performing QA procedures for assuring that QA procedures have been performed.

SECTION 4: ORGANIZATION

The organization of personnel is important for the integrity and effectiveness of the QC/QA Program. The following will lay out individual's roles in the QC/QA Program. Each person is key to the effectiveness of the QC/QA Program and establishing Quality in the Structures Section and our work.

4.1 FEDERAL HIGHWAY ADMINISTRATION (FHWA)

The general role of FHWA Division Office is to review each QC/QA Program and to ensure the QC/QA program is thorough, effective, documented, and followed. Further, it is the role of the Office of Bridge Technology to assure uniformity within Division Offices regarding implementation of this guidance. FHWA Division Offices may perform periodic reviews of the program. VTrans will provide project documents to the FHWA Division Office for review in accordance with the Federal-aid Stewardship Agreement upon request. The need of periodic reviews depends on the complexity of the highway structures.

4.2 PROGRAM MANAGER

The Structures Section Program Manager is responsible for creating, implementing, and updating this QC/QA Program Plan for the Structures Section. The Program Manager is responsible for monitoring the effectiveness with QA performance measures.

4.3 STRUCTURES DESIGN ENGINEER

The Structures Design Engineer is responsible for filling the role of quality assurance manager. The Structures Design Engineer is a manager with significant experience in the area of highway structure design, whose has the primary responsibility is to develop VTrans design policies, procedures, standards and guidelines. This manager also coordinates the in-house project plan review process. In addition, this individual will periodically perform unannounced QA reviews as required by the Program Manager to ensure the plan is being adhered to.

4.4 PROJECT MANAGER (PM)

The Project Manager has primary responsibility of Reviewer for QC during the design and plan preparation of an assigned project.

For projects that are to be designed in-house the PM is responsible for determining the necessary technical knowledge and experience of the Designer/Checker for that specific design. Designers and Checkers shall be assigned to structural projects (or portions of a project design) by matching experience to project complexity. The PM also has the QA responsibility to verify that all QC activities have been performed by the assigned design team.

For consultant designed projects, the EOR has the primary responsibility for QC and is responsible for determining the necessary technical knowledge and experience of the Designer/Checker for that specific design. The PM has the QA responsibility to verify that all QC activities have been performed by the assigned design team.

The PM is responsible for technical review and approval of project documents; and maintains frequent contact and communication with other Divisions/Sections within VTrans, local governments, other state agencies and the general public. The PM directs technical staff and assigns Quality Control functions.

The PM allocates resources to various elements of work for the project within the constraints of the project schedule, project budget and the quality of the project. The PM must identify potential problem areas and resolve them in a timely manner to meet the needs of the project.

The constraints of Cost, Time and Quality are always interrelated and exist in a state of equilibrium. If one factor is changed then at least one other must be altered as well. One underlying assumption of this Quality Control Program is that the Quality should be a fixed point around which the others revolve. Each project should be managed to produce a high-quality product.

However, the Program Manager understands that the schedule and/or budget for a particular project may infrequently require a reduced QC/QA process be implemented, rather than the procedures outlined in this Program. It is the responsibility of the Project Manager to oversee and administrate the QC/QA tasks. Implementing a reduced QC/QA program should not be taken lightly, as the potential for risk and oversight may greatly increase. If the PM elects to deviate from the Program, they shall document and notify the Structures Design Engineer and the Structures Program Manager of this decision, the measures being taken to ensure quality, and the how this decision affects the potential for risk. The PM shall not reduce QC at any point in a project.

4.5 LEAD DESIGNER

The Lead Designer has the task of overseeing the QC procedures for a project. He/She may be the Designer for a project or component. However, their work still must meet the QA and QC procedures of the Program. Under the discretion of the Project Manager, the Lead Designer may also assign other Designers and Checkers to select tasks of a project.

The Lead Designer is primarily responsible for collecting and initial oversight of all components for the design of a project. He/She may perform a preliminary QA review and is responsible for determining if, and when, components and the whole of a structure is finalized. The Lead Designer is responsible for preparing the Design Book for final review.

4.6 DESIGN ENGINEERS AND TECHNICAL STAFF

Design Engineers and Technical Staff primarily act as Designers for projects. These individuals are tasked with a majority of the development documents, design calculations and plans. Individuals may select an experienced Checkers from coworkers to review their work. The Checker shall be approved by the Lead Designer and/or Project Manager prior to checking the work. The Lead Designer and/or Project Manager has precedence in this decision and may select a different individual for various reasons to be the Checker.

SECTION 5: QUALITY CONTROL REVIEW PROCEDURE

The first part of this section of the Program contain procedures used by the Scoping group within the Structures Section. These groups initiate project scale, boundaries and requires. The remainder of the Chapter discusses the procedures used by the design team for project development. Quality Control procedures shall be completed in-house for all documents, reports, calculations, drawings, and special provisions prior to their release to external sources. Structures Engineering Instructions (SEI's) and the Structures Manual will be used to document the design policies, procedures, standards and guidelines. All Quality Control reviews emphasize the use of computers and programs to reduce paper documents and large project binders. Documents, calculations, and plans should all be developed using computer programs whenever possible. This effort helps to create a more sustainable office, reducing the abundance of paper waste. It will also result in better management and organization of Design Book for final design.

5.1 SCOPING

The quality of a scoping report is measured by the selection of the bridge rehabilitation or replacement alternative that meets the needs of the asset, fits the context of the corridor, is cost effective and supported by internal and external stakeholders. Quality Control processes within the Project Initiation and Innovation Team (PIIT) are intended to increase flexibility, collaboration and stakeholder support during the project initiation phase in order to select the preferred alternative. The biggest factor in the quality outcome of a scoping report is based heavily on the success of project collaboration both internally and externally.

At the beginning of the scoping phase, each of the internal stakeholders are involved in identifying the resources and potential issues in their area of expertise. The "Collaboration Phase" is initiated following the completion of the draft scoping report which provides an explanation of alternatives that were explored and culminates with a recommended alternative.

After Structures Projects are initiated in the AMP, they are transferred to the Project Initiation and Innovation Team (PIIT). The PIIT gathers existing project information, such as bridge condition, natural and cultural resources, existing utilities and right-of-way, and availability of detour routes as well as local and regional concerns related to the project. This information is analyzed during the "Alternatives Analysis" phase to vet various rehabilitation and replacement options along with associated cost and schedule implications. After this information is thoroughly examined, scoping engineers identify a recommended alternative documenting all of their decisions in a project specific scoping report.

The PIIT combines information gathering, alternatives development, and public engagement into a seamless process for definition of the project scope. While the Accelerated Bridge Program has a focus on delivering projects in a timely manner, there are no performance measures placed on the duration a project is in the PIIT. That is, there is no time limitation to the scoping process. Projects are scoped appropriately to fully define the project so that when they enter the design phase risks are known. In addition, it's essential to remove as many impediments to project delivery as possible during Project Definition Phase and garner support from internal and external stakeholders and customers.

DEDICATED SCOPING TEAM

The Structures PIIT is the focal point for scoping and defining structures projects. The PIIT is a dedicated team of engineers and technicians whose purpose is to fully scope and define each project that is assigned to the Structures Section. The use of a dedicated team has led to many efficiencies during this important aspect of a project's life. The project is defined by an objective, independent team without bias toward the design effort. This model has been innovative for Structures and has resulted in a team that is highly specialized in developing the most appropriate scope for a project and then communicating that scope to internal stakeholders and interested external parties. Over time, this team has developed institutional knowledge which can be applied from one project to another. That is, if an issue arises with a project, the PIIT discusses the issue and identifies how the issue can be avoided for future projects.

QUESTIONNAIRES

The traditional VTrans development process includes a local concerns meeting which is intended to gain local insight into the project so that development team can fully understand what is important from a local and regional perspective. Because local concerns meetings are often not well attended a "Local Concerns Questionnaire" is utilized to increase the success of early public input.

The "Local Concerns Questionnaire" topics include important town events, emergency services, local schools, local businesses, pedestrian and bicycle use, design considerations and land use and zoning. The Local Concerns Questionnaire is sent via email to the Town Manager and/or Selectboard Chair and the affiliated RPC once the project has been transferred into the PIIT from the AMP. Local and regional considerations are examined alongside other project documentation during the "Alternatives Analysis" phase.

In addition, an "Operations and Maintenance Questionnaire" is used to obtain information regarding ongoing maintenance at the site, bridge geometry, preferred bridge railing type, other ongoing projects in the area and public concerns from the Operations Division.

These questionnaires create consistency and promote efficiency in the collection of vital information from affected communities and maintenance districts. The information is invaluable to helping craft the recommended alternative and helps establish community partnerships early on in the project development process.

DEVELOP ALTERNATIVES

When all resource information is received, the PIIT develops a Scoping Report that attempts to balance all the constraints of the project. This Report considers all the information provided, develops alternatives that have been considered, and includes a matrix where all the viable alternatives can be evaluated considering cost, project development duration, construction duration, and community impact.

Collaboration with other sections occurs as necessary throughout the development of the Report and experts from Traffic & Safety, Bicycle/Pedestrian program and Hydraulics are often consulted in these areas.

COLLABORATION PHASE

The primary function of the "Collaboration Phase" is to exchange information with project stakeholders prior to finalizing the scoping report and seeking endorsement from management. The Collaboration Phase begins by sending out the draft Scoping Report for an OLSR to all internal stakeholders involved with the project "from cradle to grave", including Operations and Maintenance, Planning, Design, Resource Coordination and Construction. Following the OLSR, an internal collaboration meeting will be held to discuss existing conditions, project constraints, associated requirements, and vet the preferred alternative. The Collaboration Phase provides an avenue for internal stakeholders to review and provide valuable feedback on the proposed project and recommended alternative. The ultimate goal is to garner support for the project while removing unforeseen barriers to project delivery.

Along with the scoping report, the PIIT also produces a draft Transportation Management Plan (TMP), a risk register, and completes the alternative delivery selection matrix. This information combined with traffic data, existing utility data, existing ROW data, resource reports, preliminary hydraulics, preliminary geotechnical assessment, and the questionnaires are combined into a single package for distribution and review. The "Collaboration Phase" includes an OLSR of the draft scoping report followed by meeting to discuss the proposed scope and comments from the OLSR with all pertinent stakeholders including the following:

- Utilities
- Environmental
- TSMO
- ROW

- Construction (Regional construction engineer and construction structures engineer)
- Maintenance (Districts)
- Planners (including RPCs)
- Design Project Manager
- Structures Design Engineer

Following the "Collaboration Phase", the scoping report is revised based on the comments received.

MANAGEMENT APPROVAL OF SCOPE

In an effort to build consistency in decision making and increase credibility for the definition of projects, the Structures Section has incorporated "Management Approval of Scope" (MAOS) into the scoping process. MAOS includes convening a meeting with Structures leadership including, but not limited to, the following:

- Structures Program Manager
- ABP Senior PM
- PIIT PM
- Conventional and Complex Unit Senior PM
- Alternative Delivery Senior PM
- Hydraulics Engineer
- Bridge Maintenance Senior PM
- Structures Design Engineer
- Design Project Manager

Prior to the meeting, the final scoping documents are distributed for review to provide an understanding of how the project was defined. During the MOAS meeting, the scoping engineer provides a brief overview and then opens up the meeting to comments, questions and general discussion. At the MAOS meeting any questions will be discussed and if further information or project definition is needed it can be requested at this time. When all concerns have been unanimously addressed and there is consensus that the correct scope has been defined for the project, the scope is approved by the Structures Program Management by signing off on the MOAS form. The intent is that the MAOS brings credibility to the scope and receives endorsement from senior leadership within the Structures Section. It isn't just the project manager advancing the project, it is the entire Structures Section saying that the scope of the project has been fully vetted and the project is moving forward on the correct path. On high profile, risky or multimillion dollar projects, MOAS is expanded to include upper level management within the Highway Division.

APPROACH TO PUBLIC ENGAGEMENT

Early and meaningful public engagement is essential to building community partnerships and continuing public support for the project. The PIIT reviews all pertinent information related to the scope of the project to help determine the level of public outreach that is appropriate for each individual project and uses several tools to actively engage public stakeholders during the project definition phase. As described above, "Local Concerns Questionnaires" are distributed to the affected town and RPC at the beginning of the data collection and resource ID. Once projects have received endorsement from internal stakeholders and VTrans leadership, the public participation phase begins.

For higher profile or risk projects, focused stakeholder meetings are held with key constituents including the RPC, town managers and planners, selectboard chairs and emergency services to provide an overview of the bridge or culvert rehabilitation or replacement project and discuss any immediate concerns in an intimate, collaborative atmosphere. This allows for open and free flowing dialog providing a mechanism to create community partnerships and brainstorm solutions to minimize project impacts to the surrounding region and mitigate risk.

In addition, public meetings called "Regional Concerns Meeting" for state and interstate projects or the

"Preferred Alternatives Presentation" for town highway projects are held for all projects scoped by the PIIT. Meeting participants are polled on several questions throughout the presentation using an audience response system to engage the public and ensure everyone has a voice. including familiarly and use of the bridge or culvert, best timing and duration for proposed short term closures, greatest concerns, important design aspects and endorsement of the scope. Rather than the public stakeholders feeling like a project is being imposed, meeting participants play an active role in refining the scope of the project. This has been highly effective at garnering early public support. For higher profile projects, a specialized Public Information Officer (PIO) may be brought onto the project team to assist with outreach and dissemination of information.

Communications with the public and commitments that are made during this time stay with the project throughout its development life and beyond construction. Developing the appropriate outreach strategy is important, as well as engaging the public appropriately through public presentations and audience responses systems. Setting the expectations for public engagement through the PIIT has brought consistency to the information that is delivered to the public and has allowed VTrans to build a reputation of delivering an accurate message with credible expectations that can be trusted through the life of the project.

FUZZY HANDOFF

The PIIT process culminates with a fuzzy handoff to the design team that will be advancing the project forward through design and into construction. VTrans characterizes the handoff as "fuzzy" because the process is a multi-step a transition. It starts with the Design Project Manager becoming familiar with the project, participating in the "Collaboration Phase", attending the MAOS, and being included in public engagement. The fuzzy handoff allows for the PIIT to continue to advance the development of the project scope, while slowly transitioning project responsibility to the Design Project Manager. It allows the Design Project Manager to contribute to the final scoping report, the draft TMP, the risk register, the public outreach plan, and the Artemis Schedule. Over the course of the fuzzy handoff there is a sharing of knowledge that occurs which allows the Design Project Manager to pick up the project and hit the ground running without having to go back and relearn everything that occurred to this point. In addition, members of the PIIT and Design Project Manager work together to develop a credible schedule and spending profile based on risks identified during the Project Definition Phase.

5.2 DOCUMENTS AND REPORTS

All documents and reports, including Scoping Reports, that are intended for external sources and clients shall be reviewed and undergo the QC/QA procedures and must be reviewed by the Project Manager prior to its release. Once a document leaves the Agency it contains the Agency's interpretation and/or official viewpoint on the given subject. Because of this all documents should be reviewed through the QC/QA procedures. All persons who contribute to the views within the document shall review its contents. Once the report writing has progressed to an appropriate stage of development, the assembled draft is assembled is sent to the Checker. The Checker will be given a specific and reasonable deadline for commenting and correcting the document. They should be reviewing the content as well reviewing the document for syntax and grammatical errors.

VTrans widely uses the Microsoft Office 365 suite of document development programs. Reports and text documents should utilize the functions built into Microsoft products whenever possible. Once a report or document has been prepared the file should be saved in the M: drive located on the AOT servers. This will allow other internal collaborators to access the document. The original author will notify the Reviewer when the document is ready for review. The reviewer will use the Review tab and Track Changes functions to make changes, corrections, and comments to the document. Once the Reviewer is finished they will notify the author to review their edits and take appropriate actions to modify the document.

This process will continue between the original author and the reviewer until all corrections have been addressed and no changes are required. If additional reviewers are requested, one reviewer should make comments/edits to the document at a time. Once the document has been reviewed and is finalized, drafts should be rejected and only the finalized file should remain in the Project File. If external reviewers are required, the report/document should be saved to a SharePoint site or OneDrive. Once the document is placed in one of the cloud locations, external reviewers can access the document by invite only. These documents should not be made public on the cloud service.

Documents may also be saved as a PDF and changes can be can be marked on the draft PDF. The Reviewer shall add a comment at the top of the document stating their name or initials and the date of the review. This comment is to be stylized (text, color, border, fill) to demonstrate the reviewers style for comments throughout the document. The Reviewer/Checker will complete the review in a similar manner as described above; reviewing for content, syntax and grammar. Upon completion of the review, the checker will sign and date or place a dynamic stamp if utilizing OLSR the cover page of the draft and returns the draft to its author.

The author then confirms or revises the corrections and comments, adds his/her own corrections/comments, and consults with the appropriate person(s) to resolve any conflicts. The author then makes the corrections to the text. The marked-up draft is placed in the project files after the document is finalized.

5.3 DESIGN CALCULATIONS

Calculations shall be prepared using electronic programs whenever reasonably possible. Programs including MathCAD and Excel, are available to develop design calculations. Manual hand calculations, when used, will be prepared in pencil. A calculation may also include other forms, charts, graphs, data sheets, computer printout, etc. to support any given calculation.

Design Calculations should always be prepared such that a person that may not be knowledgeable about the project can follow and reference the methodology and assumptions made in any calculation. Each page is to begin with the Designer's name, date, and page number with total number of pages. The first page of each calculation will also include the following:

- Project Name
- Project Identification Number (e.g. 13j308)
- Calculation Title

Assumptions, upon which calculations are based, shall be stated in the calculations. Assumptions with limited application should immediately precede the calculations to which they apply. This is to include but not limited to preliminary geometry, material properties, and material behavior. If geometry from drawings is used in calculations, dated drawings that were referenced shall be attached to the calculation and noted within the computation. All references are to be complete to the right of the equation or assumption used in the calculation. Whenever necessary, the Designer shall include commentary to calculations so that their thought process and conclusions are understood. See Appendices A through C for examples of calculations prepared with the VTrans preferred formatting.

When using spreadsheets (MS Excel) for calculations, formulas are not apparent when spreadsheets are printed. The Designer shall prepare example calculations or formulas so that the Checkers follow methodology for each calculation.

Calculations are to be prepared by a Designer, verified and corrected by a Checker. The Designer is the only person who should edit the oringinal calcuations and the Checker shall not make direct changes to the Designer's prepared calculations. Corrections to checked calculations are to be accepted by the Designer. No Designer will check his or her own work. The Checker shall be experienced in the discipline being checked and have the level of knowledge and qualifications to perform the calculation that is being checked. Cursory supervisory reviews do not satisfy the intent of this section.

The Designer determines the point at which design work has progressed sufficiently that checking can begin on a completed portion of work. The Designer provides a PDF file or a copy of the original manual calculation to the Checker. The Designer reviews the data and the scope of the work with the assigned Checker. The Designer provides the Checker with design criteria, copies of pertinent information, related drawings, and related calculations, if needed.

A design check includes verification of the introductory material on the calculation sheet, as well as the calculation itself. The Checker verifies that all information is appropriate, correct, complete, consistent, legible, and reproducible. To do this, the Checker needs to follow a logical method to make sure that he/she has not missed verifying any data. The standard policy is to check the major items of importance first.

The Checker will mark items to indicate either his/her agreement or disagreement. The following is a color code that may be used for making calculations:

Yellow: Highlight regions for agreement with result or content
Blue: Questions or comments between Designer/Checker
RED: Use for corrections

When satisfied, the Checker will place his/her name or initials and date on each calculation sheet and return the calculations to the Designer for back checking.

5.4 PLANS, DRAWINGS, AND DETAILS

Drawings are prepared under the direction of the Lead Designer. They are developed progressively by an interactive process using sources of information, including survey data, reports, record data, preliminary sketches, samples, official maps, etc. Plans, drawing and details shall be prepared in conformance with the design requirements, criteria, and standards. They should also be prepared in to meet the requirements of the *VTrans CADD Standards and Procedure Manual,* and its supplements, and the *VTrans CADD Drafting Standards Manual*. Before a drawing is considered final, it will be independently checked for:

- Conformance with the design criteria, project requirements including graphic standards (CADD Standards).
- Completeness and clarity.
- Coordination with other aspects of the project, i.e., structural, civil, traffic, right-of-way, etc., and with other associated project documents.
- Compatibility standards and good plans preparation practice.
- Coordination with project elements being developed or planned development on adjacent projects.

All primary structural components of design drawings should be checked in detail. In cases where the Designer is not the drawing Checker, the Designer must at least review the drawings to ensure that drawings are in conformance with the designed components. The Checker will review all drawings to determine if it meets the objectives of the task and are clear, complete, accurate, and suitable for the intended use. All items must be marked by the Checker to indicate either his/her agreement or disagreement. Following is a color code that may be used for plan and drawing review, particularly between a single Designer and Checker.

Yellow: Checker agrees with drawing
Blue: Comments or Questions between Reviewer, Drafter and/or Checker. These comments may or may not result in a direct change to the drawing.
RED: Area requiring correction. These markings should be used to portray direct additions/modifications to drawings.
Orange: Used to mark areas in drawings to be deleted.
Green: Used to confirm correction when back checking, after corrections have been incorporated to drawings.

The Designer then inspects the checked plans, confirms or revises the Checker's corrections /comments, adds his/her own corrections/comments. The Designer will consolidate and coordinates comments. Then consult with the Checker and others, as appropriate, to resolve any conflicts.

Once the corrections are compiled from the Designer and Checker, the corrections are incorporated to the original drawings. The CADD operator will prepare a revised set. The Designer then back checks that the revisions to the original set were incorporated into the revised drawings.

Designers are encouraged to repeat this review process multiple times and/or with multiple Checkers to reduce error within the prepared drawings.

5.5 SHOP DRAWINGS AND CONTRACTOR SUBMITTALS

Shop drawings and submittals shall be reviewed by the Project Manager in a timely and efficient manner from when they are submitted to VTrans. Many submittals have predetermined deadlines for review, as stated in the project's contract documents. The Project Manager may elect to designate a Reviewer that shall be experienced in the content of the submittal being reviewed and have the level of knowledge and qualifications to perform the review. Cursory supervisory reviews do not satisfy the intent of this review. After the Reviewer has completed his/her review, they shall return the reviewed document to the PM to review and return to its source.

When reviewing, comments and corrections shall only have one appearance throughout the submittal and should be distinguishable, by appearance, from other reviewer's commentary if multiple reviewers exist within one submittal.

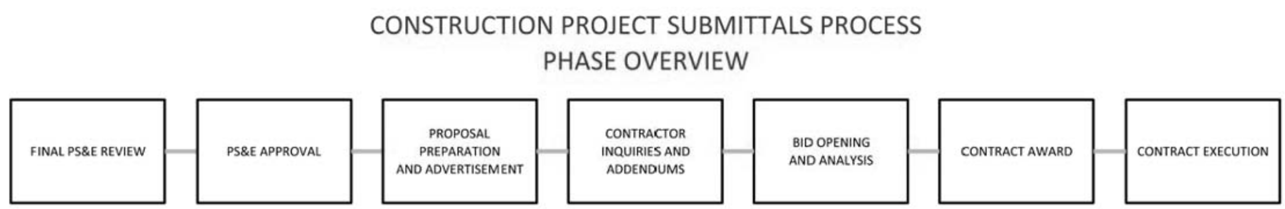
Each page of shop drawings should be stamped with a *Shop Drawing & Submittal Stamp*. The stamp should contain the Reviewer's name or initials, the Project Manager's name or initials and the date of the review. A cover letter shall be attached to front page of the document.

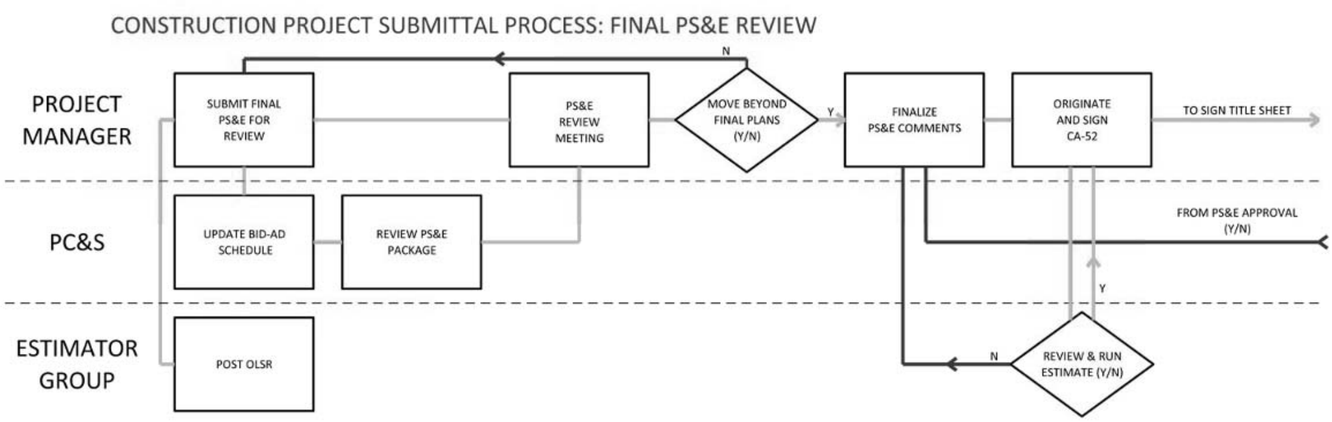
5.6 SPECIAL PROVISIONS

Special Provisions for VTrans projects are typically created by the Lead Designer and Project Manager. When a draft Special Provisions are supplied for review, the Designer shall check them to verify that they are in conformance with the design requirements for the project. Special Provisions should be reviewed in a similar manner to Documents and Reports. The Lead Designer and Project Manager shall ensure that the specifications and assumptions in the Special Provisions match those used in the design calculations. Once they have been reviewed within the Structures Section they are submitted as part of the PS&E submittal. They are subject to the QC process through the OLSR format. Once the Designer has completed their review, they should consult to the Project Manager and submit comments to Contract Administration.

5.7 FINAL PS&E SUBMITTAL

The final Plans Specifications and Estimate (PS&E) submittal consists of the project development team submitting contract documents (plans, specifications, and estimate) to other teams to begin the contracting process. The submittal is the hand-off of PS&E documents and supporting documents from Project Development to Construction, and is a sub-process that marks the start of the Construction Project Submittal process, sometimes known as "End of Process".





The Final PS&E Submittal Review Process is a multi-step, and sometimes iterative, process that includes an external (Agency-wide) OLSR review. The external OLSR should only be initiated after an internal OLSR has been conducted and the resulting comments have been sufficiently addressed. See Section 7 for more information about the OLSR process. Parallel to the external OLSR, the Project Manager or Lead Designer should prepare PS&E supporting documentation. The process of handing off PS&E documents and supporting documentation is discussed on the following META:

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/ConMatMETA/Pages/Submitting%20PS%26E%20and%20Supporting%20Documentation.aspx

Upon completion of the OLSR, the design team shall review and address/respond to comments. A PS&E meeting will be held to review comments with stakeholders at the end of the meeting the PS&E Submittal will be approved for submission, or it will enter another review until it is considered acceptable.

5.8 DISPUTE RESOLUTION

During the review and checking process, if the Checker does not agree with the results of the design task being checked, the Checker will first discuss the matter with the Designer. If the difference cannot be resolved between the Checker and the Designer, the dispute continue follow up the "chain of command" for the project. The Lead Designer/Project Manager, whoever takes next to assist in the resolution of the dispute. As needed, the Structures Design Engineer and other management personnel may also be consulted to arbitrate questions of design policy and standards. The result of the dispute shall be documented with its source for record.

5.9 CONSULTANT ASSIGNED PROJECTS

The EOR shall have the primary responsibility for all QC activities for consultant designed projects. All design consultants associated with a VTrans Structures project will have a documented QC/QA program for its design including QC procedures that shall meet or exceed the Program used for in-house projects. Consultant Quality Control Plans are required for all projects and will be submitted to the PM in advance of any design work and shall include, but not be limited to, the following areas:

- Organization personnel that are involved in QC/QA activities
- Quality Control Review of Plans, Reports, Calculations & Correspondence
- Proposed Method of Documentation of Comments, Coordination, Response and QC Records
- QC/QA of Sub-Consultants and Vendors
- Proposed method for monitoring and measuring efficiency of production.
- Quality Assurance Certification

Strong emphasis will be placed on coordination with all of the sub-consultants throughout the project. Particular attention will be placed on critical path activities and on the sub-consultant's needs for information required for participating in these and other activities in a timely manner. Regular meetings and teleconferences will take place in order to facilitate this coordination. All sub-consultants shall be required to conform to the Consultant Quality Control Plan and provide their supplement where they are performing a specialized service.

SECTION 6: QUALITY ASSURANCE REVIEW PROCEDURE

The quality assurance review occurs after quality control procedures have already occurred. The primary purpose of the QA procures are ensure the QC measures have occurred and the resulting product is accurate. The product resulting from QC should only have to be reviewed for consistency with the project plans and specifications. Although, errors and discrepancies may be found and resolved at this stage, it is not intent of this review to be discovering errors in general concepts and basic calculation methodology or computation.

6.1 SCOPING

The intent of the Project Initiation and Innovation Team (PIIT) is that every project will go through a consistent scoping process and will emerge on the other end with a set of documents to guide the project through design and construction. Having the documents thoroughly examined and well thought out is critical for all structures projects but is fundamental/vital for project management on the ABP projects. Prior to leaving the PIIT, every project file contains, but is not limited, the following documents

- Management Approval of Scope
- Scoping Report
- Credible Artemis Schedule
- Credible Spending Profile
- Risk Register
- Draft Transportation Management Plan (TMP)
- Draft Public Involvement Plan
- Alternative Delivery Selection Matrix

BATCHING PROJECTS

Batching projects means that a group of projects is advanced through an aspect of scoping at the same time and therefore realizes efficiency in scale and repetition as well as providing the information early in the process. Receiving information at the appropriate time allows for a full discussion about potential impacts or risks to the development of a project. Understanding constraints associated with utility relocations or wetland impacts can have a significant effect on the scope of a project as well as the schedule and estimate. The VTrans PIIT has developed a process for batching projects during select aspects or phases of scoping. Projects are generally batched for the following activities:

- Survey
- Traffic Data
- Existing Right-of-Way
- Existing Utilities
- Natural and Cultural Resource Identification
- Geotechnical Assessment
- Preliminary Hydraulics

Before the scoping unit, requests for preliminary information were inconsistent and prioritization between projects was difficult. Each project manager had their own way of making requests and each wanted their project prioritized over everyone else's. Efficiency and accountability in obtaining preliminary information suffered because of this. The PIIT process allows projects to begin with a wealth of information, early in the process, so that scoping engineers have all appropriate information when starting their work on the project.

6.2 PM REVIEW

At the conclusion of the QC process and when all of the Checker comments have been resolved, the plans shall be forwarded to the PM for QA Review. The PM will perform the first step in the QA review and will verify that all of the necessary QC checks were completed. The PM will review the plans for conformance with VTrans standards and all of the owner requirements for each project. At the end of the review, the PM will communicate any QC process concerns and/or review comments to the Designer to be addressed.

6.3 STRUCTURES INTERNAL REVIEW

Plans or reports will be submitted by the Project Manager for QA review to the Structures Design Engineer. The internal shared review is conducted using similar reviewing tools as the On-Line Share Review process. The Structures Design Engineer will coordinate the review in the Section by assigning the project to a primary reviewer (typically a third-party PM) and make copies available to other Project Managers and to Bridge Management for review and comment. At the conclusion of the review period, the Structures Design Engineer will schedule a plan review meeting with the Project Manager, primary reviewer, Bridge Management and other interested Project Managers to discuss the review results. Three to four weeks should normally be allowed for the review. Lesser time frames will be allowed if required to meet a project schedule.

At the conclusion of the review, the Project Manager will consider and address the review comments and make appropriate revisions to the project. The Structures Design Engineer will be notified by the Project Manager when and why a significant review comment is not being addressed.

Internal plan reviews will occur at the following project milestones:

a) Scoping Report/ Alignment Study or Conceptual Plans
b) Preliminary Plans
c) Final Plans (Special Provision and Estimate review)

The review requirements above do not preclude a project from skipping any milestone as allowed in the Project Development Process. A project manager may request review of a project at additional project milestones if desired.

6.4 EXTERNAL REVIEW

Plans or reports will be submitted by the Project Manager for review to identified parties. The distribution list for the plan review shall that used in the standard distribution memos that are used in the Structures Section. It shall be the responsibility of the Structures management to ensure that the lists are maintained.

External plan reviews will occur at the following project milestones:

a) Scoping Report/ Alignment Study or Conceptual Plans
b) Preliminary Plans
c) Final Plans (PS&E Submittal)

The review requirements above do not preclude a project from skipping any milestone as allowed in the Project Development Process. A project manager may request review of a project at additional project milestones if desired.

At the conclusion of the review, the Project Manager will address all review comments in a similar manner as with internally-generated reviews. The Structures Design Engineer will be notified by the Project Manager when a review comment is not being addressed.

In some instances, review comments will be made that are not addressed to the satisfaction of the Reviewer. Every effort should be made by the PM to communicate with the Reviewer as to why the comment was not addressed. In those cases where there is no resolution the decision of the PM will prevail. As noted above, the PM has primary management responsibility for QA during the development of a project and as such they have the authority to determine how comments are addressed.

The decision of the PM may be appealed through the Program Manager of the commenting Section to the Program Manager of Structures.

Communication between the PM and external reviewers for comments and responses will primarily be through the use of OLSR. In the event that comments are received through meetings with reviewers, there shall be minutes prepared that summarize the comments received. All significant comments shall be responded to, by the PM. The response shall be in made in the OLSR review or in memo form if appropriate. The PM will be responsible for submittal of comment/responses to the reviewing entity.

Where it is necessary and prudent to discuss the comments with the Reviewer(s) prior to making a response, the PM shall arrange for the meeting.

Consultant designed projects shall follow the same QA process as noted above. However, where appropriate the PM may designate the Consultant to prepare responses to review comments.

6.5 PROJECT SPECIFIC PEER REVIEW

For major projects involving unusual, complex, and innovative features, a peer review may be desirable to raise the level of confidence in the quality of the design, plans and specifications. A peer review is generally a high-level QA review by a special panel of professionals specifically appointed by the Program Manager to meet the demands for quality and accuracy, recognizing the complexity of the design. Peer review is an effective way to improve quality and to reduce the risk of errors and omissions.

SECTION 7: QC/QA PROCESS TRACKING

Monitoring quality control and quality assurance processes during the in-house design process is imperative. Such monitoring will provide the PM and the Structures Section Management that these QC processes are in-practice and are effective in implementation. Doing so will allow the Structures Section Management to gage if changes to the Program are needed.

The *QC/QA Process Tracking* form shall be completed for intermediate steps during the design process. It should not be used once at the end of the design process, or for each calculation performed. Rather, significate milestones in the design process should be identified to track QC during that phase. One document, may document preliminary and final design. Below are examples of some of the possible these milestones.

- Alignment
- Drainage
- Substructure – Abutment Geometry
- Substructure – Pile Loads
- Substructure – Approach Slabs
- Superstructure – CIP RC Interior Deck
- Superstructure – CIP RC Overhang Deck
- Superstructure – Steel Girder Design

The *QC/QA Process Tracking* form is intended to be a living document until the end of the design and should be signed off by the project manager once a milestone is finalized and acceptable for the Electronic Design Book. An example of a *QC/QA Process Tracking* form for a project task can be found in Appendix D. In this appendix there is also a Plan Set Tracking Spreadsheet that is intended to be used to track the progress of Plan Sheets.

SECTION 8: ONLINE SHARED REVIEW PROCESS (OLSR)

The OLSR Process is an important part of the Structures Section QA procedure. This process can be used for internal and external QA reviews. OLSR is an essential activity in the Construction Project Submittal Process. Provided is a general overview of the two types of OLSR's used in the design process. More information can be found on the following META page, or by searching Online Shared Review on the META site.

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/HSDMETA/Pages/Online%20Shared%20Review.aspx

8.1 OLSR FOR INTERNAL REVIEWS

OLSR provides an opportunity to involve other Design Engineers and Technical Staff from the Structures Section as part of the QA procedure for a project. This is a great opportunity to introduce others to a new design component or concept. This is the time to involve those with an expertise in an area related to the project or others that may have been consulted in a cursory capacity during the design to review the project.

Internal OLSR's can be setup by any Designer, but should be conducted under the direction of the Lead Designer or PM. A guide for setting up an in-house OLSR can be found on Structures META. It is recommended to setup the OLSR to be sent to the organizer first and then forward the generated email to others with an OLSR Information Sheet. After the review period, the Lead Designer should carefully review all comments made as indicated below:

- All comments shall be reviewed by the Lead Designer, and Project Manager if deemed necessary.
- Typos and CADD QC issues shall be addressed but do not require a response back to the Reviewer.
- The Lead Designer should respond to all other Reviewer comments. The method of response may be as simple as a check mark to indicate that the document will be revised to address the Reviewer's comment. If the comment is not going to be incorporated into a revision in the document, then the Lead Designer shall give a brief explanation to the Reviewer.
- Comments of such complexity that a back and forth discussion may be required between the Reviewer and the Lead Designer shall be done via conversation or email. Refer to the section on dispute resolution if necessary.

8.2 OLSR FOR EXTERNAL REVIEW

External, or Agency-wide, OLSR's are typically reserved for the End of Process PS&E Review. This Review should include the following documents:

- Request for Project Review (RFPR) Form
- Final Plans
- Special Provisions
- Engineer's Estimate
- CPM Schedule
- Risk Register
- Traffic Management Plan

The OLSR documents should be completely filled and sent to the OLSR Coordinator to distribute to the identified persons/stakeholders on the RFPR Form. The Project Manager and/or Lead Designer should carefully review all comments made at the end of the OLSR and provide responses to the reviewers as indicated below:

1) All comments shall be reviewed by the Project Manager and/or Lead Designer.
2) Typos and CADD QC issues shall be addressed, if necessary, but do not require a response back to the reviewer.
3) All other comments require some form of response back to the reviewer by the Project Manager and/or Lead Designer. The method of response may be as simple as a check mark to indicate that the Document will be revised to address the reviewer's comment. If the comment is not going to trigger a revision in the document, then the Project Manager and/or Lead Designer shall give a brief explanation of why the comment does not require a revision.
4) Comments of such complexity that a back and forth discussion may be required between the Reviewer and the Project Manager and/or Lead Designer shall be done via some other collaboration (phone call, email, meeting) so as not to bog down and clutter the Shared Review with numerous comments on the same topic.
5) In-house personnel may comment during the OLSR period.
6) Consultants should provide their responses after the OLSR period has ended utilizing the FDF Process.

SECTION 9: DESIGN SOFTWARE VERIFICATION/STANDARDIZATION

The use of computer software for the design of bridges and other transportation structures is fully integrated in the process in the Structures Section. It is critical that the output and results that are obtained from the software that is used in the design are accurate and repeatable. It is equally important to that the Structures Section adopts standard computer programs for use. Verified and standardized software applications are an important component in producing Quality designs.

Software verification is a process that provides objective evidence that the design outputs of particular software meet all of the required outputs, provide consistent output, correct and accurate output and that the results are well documented.

Commercial "off the shelf" software before it is provided for general use will be verified by experienced engineers. The verification shall be done by testing and comparing output with known designs or output from previously verified software.

A list of verified computer programs and application will be maintained by the Structures Design Engineer

SECTION 10: STRUCTURES META

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/StructuresMETA/Pages/Structures%20META%20Home.aspx

The Structures META most-often refers to the Common Source Archive (CRA). META is not intended to standardize, but to act as a framework for collaborative work. This is a tool intended be a resource for all technicians and designers. The CRA is a result of collaboration development within the framework. It consists of several pages of content the overviews process, design resources, guides and standards. Page content is generated by the META Steering Committee and other users.

The Structures CRA (Common Resource Archive) is a Wiki library that we use to keep, organize, and share knowledge in an easily accessible and modifiable format. Our jobs are both dynamic and complex. Our field changes. The Structures CRA is a knowledge base that is designed to be flexible enough to accommodate the needs of the dynamic and complex environment that we operate in.

All state employees may access this content from within the State network. Information about searching for content and contributing to the CRA is located on the following META page:

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/StructuresMETA/Pages/How%20to%20Use%20this%20Library.aspx

SECTION 11: STRUCTURES ELECTRONIC DESIGN BOOK

The objective of the Structures Electronic Design Book Guidance is to provide a consistent mode of capturing important project design information. The design book will capture the appropriate information at the appropriate time – assuring proper documentation is generated for every project.

During the project's development, the Lead Designer or Engineer of Record shall maintain a detailed, organized, and properly named design book. All documents must go through the QC process previously prescribed in this Program. The design book will be delivered to the Project Manager for a final Quality Assurance review prior to the submission of Contract Plans.

Every structure that the Structures section designs is a "custom" job, requiring considerations specific to each site. Thus, design documentation must be generated for each structure – even in cases when multiple structures are lumped into one project. As each project develops toward advertisement, changes may occur from one project phase to the next. The Designer will be responsible to track and report on modifications made during each design phase. The Designer must incorporate any modifications into previous design phase PDFs as applicable to avoid document redundancy. Refer to META Structures for formatting the Design Book folder in the Project Folder.

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/StructuresMETA/Pages/Structures%20Electronic%20Design%20Book.aspx

SECTION 12: PROGRAM QUALITY ASSURANCE

Program QA is a process to ensure compliance with the QC/QA plan. It will include periodic reviews of projects and review of established processes used to deliver projects. The Structures Design Engineer will work to ensure that an appropriate level of review (and cooperativeness in the review process) have occurred for:

1. Design
2. Constructability
3. Bid Ability
4. Value Engineering

This will also incorporate a general review of personnel to ensure an acceptable level of expertise is maintained for quality design products. Also communication is a vital element in all processes and the QA will also review documentation concerning the level and quality of communications accomplished during various processes.

At least annually, the Structures Design Engineer shall meet with customers of the Structures Section (Operations, Construction and Contract Administration) to discuss issues and quality of plans and shall use the information to improve processes and Quality. The Structures Design Engineer may perform QA reviews in an unannounced fashion. He/she may perform the review or delegate this duty. For consultant projects, he/she may direct the PM to perform the QA review.

Annually, the Structures Design Engineer report to the Structures Program Manager about the effectiveness of the QC/QA processes used in the past year's projects. The Structures Design Engineer may recommend any changes necessary to improve quality.

SECTION 13: REFERNECES

VTrans Structures Design Manual (SD5-2014.2.19), *VTrans Structures Section LRFD Implementation Committee*, Fifth Edition.

Structures Engineering Instructions (SEI 07-001), VTrans Highway Division.

Integral Abutment Bridge Design Guidelines (SD0002), *VTrans Structures Section Integral Abutment Committee*, Second Edition.

VTrans Field Welding Manual, *VTrans Structures Section*, 1 June 2017.

VTrans Structures Plan Generation Manual (SP6-2013.10.18), *VTrans Structures Section*, Sixth Edition.

VTrans CADD Standards and Procedure Manual, *VTrans Structures Section*, 5 August 2014.

VTrans CADD Drafting Standards Manual, *VTrans Structures Section*, 20 October 2010.

SECTION 14: APPROVALS

The VTans *2018 Quality Control and Quality Assurance Program* and the appendices have been reviewed by the Structures Section Management. The Program and the document is approved by:

____

Kristin Higgins
Structures Program Manager
Vermont Agency of Transportation

____

Kenneth A. Robie
Project Delivery Bureau Director
Vermont Agency of Transportation

____

Tod Kimball
Bridge/Structures Engineer
FHWA Vermont Division

APPENDIX A: DESIGN NARRATIVES AND SUMMARIES

Each component of the design should be introduced with a narrative or design summary. This is the place where assumptions should be stated with explanations for those assumptions, if necessary. The summary should state the general geometric assumptions and material properties used for a particular set of calculations. The Designer shall use an active voice in writing this document. It will state the steps and assumptions that they have made during the design and include the results of the final design.

The following is a design summary, formatted to match the Mathcad sheets following the narrative. Summaries/Narratives do not need to follow this format, however they should be written in a manner that is clear, concise, thoughtful, and accurate.

VERMONT
AGENCY OF TRANSPORTATION

PROJECT:	Cavendish BO 1442(38)	**DESIGNER:**	D. Ribbans	**DATE:**	12/05/2017
JOB ID:	13j302	**CHECKER:**	S. Coley	**DATE:**	12/17/2017

Cast-In-Place Concrete Deck

Design Narrative and Summary

General Project Description:

The Cavendish BO 1442(38) bridge project is located on Vermont Route 103, north of the intersection of Pratt Hill Road, in Cavendish, VT. A new Integral Abutment Bridge will replace an existing closed bridge in this location. The new single span bridge begins at project STA 21+60.48 and ends at STA 22+57.51, to spanning approximately 97 ft. over the Black River. There is a curve that begins at STA 21+89.01, located on the bridge. A 5'-6" sidewalk is adjacent to north rail of the bridge. The bridge and will be a minimum of 31'-9" from fascia to fascia.

The superstructure consists of four (4) plate girders, typically spaced at 8'-9" on center, one girder located 2'-9" from the north fascia. Due to the curvature at the beginning of the bridge the width will increase to a maximum of 34'-0 7/8" maximum apparent as a "flare-out" of the southern portion of the deck overhang. This increased overhang is located at the southeast corner of the bridge. The remainder of this document, discusses the design assumptions and results for the reinforced concrete deck and overhang for the Cavendish BO 1442(38) bridge.

Deck Design:

The deck design consists of two main components; the interior deck bays and the overhangs at the north and south elevations of the bridge. All design procedures were performed in accordance to the latest AASHTO Specifications. High Performance Class A (HPC A) concrete and Epoxy Coated Reinforcing Steel was used for all concrete components for the bridge deck, overhangs and rails. The design compressive strength of HPC A concrete is 4000 psi and the design yield strength of the rebar is 60 ksi.

Interior Deck Bays

The interior bays were designed using Mathcad calculation files available on the VTrans Structures M: Drive. The files consist of an input, calculation and results sheets. The reinforcing was designed for all applicable loads required in AASHTO. The dimensions of the deck were obtained from preliminary deck drawings dated December 7, 2017. These drawings are available in the Deck Design Folder.

The interior bays were designed with the following assumptions:

- The bridge width is equal to 31'-9" because the curvature only affects the overhang in one location
- There are 4 girders supporting the deck spaced at 8'-9". The girders have top flanges that are 20" wide and 1.5" thick
- The thickness of the deck is designed as 8.5" thick with 0.5" of sacrificial concrete
- 3" of future pavement in addition to sacrificial concrete
- Reinforcing steel has a 2.5" top clear cover and 1.5" bottom clear cover
- One 5'-6" sidewalk located to adjacent to the right fascia
- A 20'-0" travel lane is 3'-3" from the left fascia
- The railing has a dead load of 412 pounds per linear foot of railing (in the longitudinal direction of the bridge)

Overhang

The overhang has two design components; the railing parapet, and the deck overhang. The same railing system used in the Barre Town project (s06j002) was used with a Test Level 2 rating (TL-2). The reinforcing steel for concrete elements in this rail system are designed in accordance to AASHTO A13. Steel rails and components are assumed to be the same as the Barre Town project. The reinforcing steel has been designed for the 2'-4" tall parapet wall. The parapet wall has a total thickness of 1'-0" and has architectural inlays that are 1" thick on both sides. Due to the inlays, the parapet wall has a design thickness of 10". The parapet wall was designed using yield line theory specified in AASHTO A13.3.1. Pilasters located between parapet locations are designed with the same reinforcing as the parapet wall. Temperature and shrinkage requirements were checked as specified in AASHTO. No additional reinforcing was required for temperature and shrinkage.

The deck overhang is designed using Design Case 1 and Design Case 3, described in AASHTO A13.4.1, as Design Case 2 rarely governs the design of overhangs. In part, the wall is designed for the total resistance of the parapet wall to transverse loading and the loads that occupy the overhang. The critical location for the overhang is at the flare-out at the southeast corner of the bridge.

Rebar Development and Splices

The length of the overhang at this location is 4'-10". The following splice and development cases were identified as critical rebar development locations:

1. Lap Splice of two (2) No. 4 bars located in the rail. The cover was taken as 2.5" and excess reinforcing was not considered.
2. Lap Splice of a No. 6 bar and a No. 4 bars located near the top face of the deck. The cover was taken as 2.5" and excess reinforcing was not considered. The splice length was taken as the greater of the two required lengths of the individual bars.
3. Lap Splice of a No. 5 bar and a No. 4 bars located near the bottom face of the deck. The cover was taken as 1.5" and excess reinforcing was not considered. The splice length was taken as the greater of the two required lengths of the individual bars.
4. Lap Splice of two (2) No. 5 longitudinal bars located in the deck. Lap splice is the same as the lap splice of the No. 5 with 1.5" cover.
5. The development length of the No. 6 standard hook located near the top face of the deck. The cover was taken as 2.5" and excess reinforcing was considered. This bar is developed for the tensile load resulting from the impact load case.

Designer: D.Ribbans 12/05/2017 Cavendish BO 1442(38) Page: 3 of 4
Checker: S. Coley 12/17/2017

Results:

A summary of the general design parameters are as follows:

Bridge Deck

Concrete:

The concrete shall conform to the Performance Class, Deck (PDC) specifications. The thickness of the nominal thickness of the deck is 9 in. For design purposes, the structural thickness is assumed to be 8.5 in due to a sacrificial 0.5 in on the top deck surface. Concrete clear cover on the top face of the deck is 2.5 in. from the structural surface. At the bottom face of the deck the clear cover is 1.5 in. All other locations shall maintain 3in. cover.

Reinforcing:

	Transverse Top	Transverse Bottom	Longitudinal Top	Longitudinal Bottom
Bar Size	#6	#5	#5	#5
Spacing	6 in	6 in	12 in	12 in
Cover	2.5 in	1.5 in	3.25 in	2.1 in
Splice	N/A	3'-3"	3'-3"	3'-3"
Hook	180 deg @ OH	---	---	---

Overhang and Parapet/Rail

Concrete:

The concrete rail shall conform to the Performance Class, Deck (PDC) specifications. The thickness of the nominal thickness of the deck is 12 in. For design purposes, the structural thickness is assumed to be 10 in due to architectural depressions on both the near and far faces of the rail. Concrete clear cover is 2.5 in. from the structural surfaces on the near and far faces. At the bottom face of the deck the clear cover is 1.5 in. Otherwise the clear cover shall be 3in.

Reinforcing:

	Additional Transverse in Deck	Parapet Transverse Bars, E.F.	Parapet Longitudinal Bars, E.F
Bar Size	---	#4	#4
Spacing	---	12 in (typ)	12 in (typ)
Cover	---	2.5 in	2.5 in

Rebar Development and Splices

Case	1	2	3	4	5
Type	Lap Splice	Lap Splice	Lap Splice	Lap Splice	180 STD Hook
Length	2'-0"	3'-1"	3'-3"	3'-3"	0'-6"

References:

2017 AASHTO LRFD Bridge Design Specifications
2008 VTrans Integral Abutment Design Guideline
2010 VTrans Structures Design Manual
2011 VTrans Standard Specifications for Construction
2018 VTrans Standard Specifications for Construction – concrete specification
VTrans BRF 6100(7) "Barre Town" PID:s06j002

APPENDIX B: FORMATTING CALCULATIONS PRODUCED IN MATHCAD

PTC Mathcad is engineering math software that allows you to perform, analyze, and share your most vital calculations. [PTC]

From: Wikipedia

The Mathcad interface allows users to combine a variety of different elements (mathematics, descriptive text, and supporting imagery) into the form of a worksheet, which is naturally readable. Because the mathematics are core to the program, the math is inherently live, dynamically recalculating as upstream values are altered. This allows for simple manipulation of input variables, assumptions, and expressions, which in turn update in real-time. The examples below serve to outline the scope of Mathcad's capabilities, rather than to give specific details on the individual product functionality.

- Utilize numerous numeric functions, across examples such as statistics, data analysis, image processing, and signal processing
- Automatically manage units throughout the worksheet, preventing improper operations and performing automatic unit-reduction
- Solve systems of equations, such as ODEs and PDEs through the use of several methods
- Find roots of polynomials and functions
- Calculate and manipulate expressions symbolically, including within systems of equations
- Create parametric 2D and 3D plot types, as well as discrete data plots
- Leverage standard, readable mathematical expressions within embedded program constructs
- Perform vector and matrix operations, including eigenvalues and eigenvectors
- Perform curve fitting and regression analysis on experimental datasets
- Utilize statistical and Design of Experiments functions and plot types, and evaluate probability distributions
- Import from, and export to, other applications and file types, such as Microsoft Excel and MathML.[More information about MathCAD is available on Structures META

All Design Calculations should be performed and presents in a uniform and consistent manner. **Structures META** contains more information and tools for using MathCAD. On this page, there is a template that can be used for starting design calculations in MathCAD. This information can be found at:

https://vermontgov.sharepoint.com/sites/VTRANS/e/META/StructuresMETA/Pages/Mathcad.aspx

The following pages are an example of the template used for an alignment calculation.

Note: that the following computation of this calculation should not be used or referenced. The provided calculations are to illustrate formatting only.

PROJECT:	Springfield BF 0134(49)	**DESIGNER:**	A. Aaaaaa	**DATE:**	mm/dd/yyyy
JOB NO:	s16b068	**CHECKER:**	B. Bbbbbb	**DATE:**	mm/dd/yyyy

GEOMETRIC DESIGN: Alignment Calculations

Minimum Radius / Rate of Vertical Curvature

References:

1. AASHTO Geometric Design of Highways and Streets, 6th Edition. 2011 [Referenced as Green Book]
2. Federal Highway Administration, The Highway Functional Classification: Concepts, Criteria and Procedures, 2013 Edition [Refemeced as "FHWA Functional Classificaiton"]
3. VTrans Vermont State Standards, October 22,1997 [Refemeced as "VSS"]
4. "Scoping Report for Springfield BF 0134(49)" [Referenced as "Prj. Scoping Report"]
5. Project drawings [s16b068nu1.dgn, s16b068pro.dgn]

Assumptions/Notes:

1. User Note: This sheet currently does not determine required SSD, K.c and K.s values for Principal Arterial - Freeway or Principal Arterial - Interstate functional classifications.
2. This worksheet is an example design originally developed for a previous project, January 2018.

Color Key

Basic Input:

FHWA Functional Classificaiton:

$\mathrm{Functional}_{\mathrm{Classification}} :=$ Major Collector - Urban — Prj. Scoping Report

Is this project new construction at a new location?

This toggles between the high and low values given in the VSS for Stopping Sight Distances, K Value for Crest Vertical Curve, and K Value for Sag Vertical Curve, where applicable.

$\mathrm{ConstructionLocation}_{\mathrm{NEW}} :=$ No

Is there a side road that intersects on the outside of the main road curve?

$\mathrm{Is}_{\mathrm{SideRoad}} :=$ Yes

$\mathrm{Design}_{\mathrm{Speed}} :=$ 25 Design Speed, (mph) — Prj. Scoping Report

$V_d := \mathrm{Design}_{\mathrm{Speed}} \cdot \mathrm{mph} = 25 \cdot \mathrm{mph}$ — Prj. Scoping Report

Designer: A.Aaaaa mm/dd/yyyy
Checker: B.Bbbbb mm/dd/yyyy

Springfield BF 0134(49)

Design Geometric Requirements:

$e_{max} = 6\%$ Max Rate of Roadway Superelevation, (%) VSS Section 3.13, 4.13 or 5.13

$$f := \text{vlookup}\left(\frac{V_d}{mph}, \text{table}_{Side\_Friction}, 1\right)_{0,0}$$

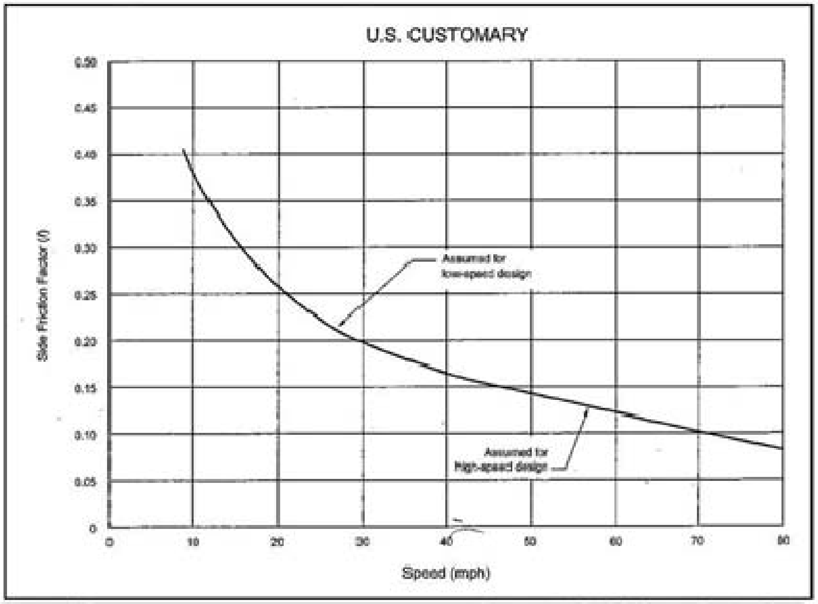


Figure 3-7 Source: AASHTO Green Book, 2011

$f = 0.23$ Max Side Friction Factor, (unitless) Green Book Figure 3-7

$$R_{min} := \frac{\left(\frac{V_d}{mph}\right)^2}{15 \cdot (e_{max} + f)} ft$$

$R_{min} = 144\ ft$ Minimum Horizontal Radius, (ft) Green Book Eq. (3-8)

Horizontal Curves:

Horizontal Curve - Curve(I)

$R_{proj} := 314 ft$ s13j334nu1.dgn

$Design_{CHK\_R.proj} :=$	"OK" if $R_{proj} \geq R_{min}$ "N.G." if $R_{proj} < R_{min}$	= "OK"

Horizontal Curve - Curve(I)

Designer: A. Aaaaa mm/dd/yyyy
Checker: B. Bbbbb mm/dd/yyyy

Springfield BF 0134(49)

Page: 3 of 3

Superelevation:

$e := B_{row_{num},0} \cdot \% = 5 \cdot \%$ — Green Book Table 3-9 or 3-10b

$e_{proj} := 6.2\%$ — Prj. Scoping Report

Vertical Curves:

$K_{cp} = 20\ \text{ft}$ — Proposed Minimum Rate of Vertical Curvature at Crest, (ft) — VSS Table 3.1, 4.1 or 5.1

$K_{sp} = 30\ \text{ft}$ — Proposed Minimum Rate of Vertical Curvature at Sag, (ft) — VSS Table 3.1, 4.1 or 5.1

Crest Vertical Curves:

Crest Vertical Curves - DNE

Sag Vertical Curves:

Sag Vertical Curves

$L_s := 350\text{ft}$ — Length of Curve at Sag, (ft) — s13j334pro.dgn

$G1 := -2.2007\%$ — s13j334pro.dgn

$G2 := -1.7505\%$ — s13j334pro.dgn

$A_s := (G2 - G1) \cdot 100$

$A_s = 0.45$ — Algebraic Difference in Intersecting Grades at Sag

$$K_s := \frac{L_s}{A_s} = 777.43\ \text{ft}$$

$$\text{Design}_{CHK\_Ks} := \begin{array}{|l} \text{"OK"} \ \text{ if } K_s \geq K_{sp} \\ \text{"N.G."} \ \text{ if } K_s < K_{sp} \end{array} = \text{"OK"}$$

Green Book page 3-153

Sag Vertical Curves

APPENDIX C: FORMATTING CALCULATIONS PRODUCED BY HAND

Calculations produced by hand should be prepared on engineering calculation paper or graphing paper whenever possible. The format and layout of hand-calculations should be similar to the format and layout of the calculations prepared in MathCAD. Referenced figures, graphs and text may be copied and attached immediately following the calculation page that they are used or referenced. The Designer will include these pages within the calculations and write their name and date at the top of each page.

All paper calculations shall be scanned into the Project Folder and the original shall be retained until the completion of the final design. The final, checked calculations will be scanned and saved in the Electronic Design Book.

Following is an example of a hand calculation. Note, the example is meant to demonstrate general setup, and formatting for information, and clarity. It has not been checked for correctness and is not intended for design use.

Sometown BO 1234(00) | DESIGNER: D. RIBBANS | 2/2/18 | 1/6

15x789 | CHECKER:

GIRDER DESIGN
SECTION PROPERTIES

DETERMINE: NON-COMPOSITE SECTION PROPERTIES OF A WEATHERED STEEL PLATE GIRDER FOR NON-COMPOSITE LOADING DURING CONSTRUCTION USING FULL SECTION, (AND) FOR COMPOSITE SECTION FOR FINAL DESIGN USING REDUCED SECTION.

$F_{y\text{-}t} = 50\ \text{KSI}$ YEILD STRENGTH OF TOP FLANGE

$F_{y\text{-}w} = 50\ \text{KSI}$ YEILD STRENGTH OF WEB

$F_{y\text{-}b} = 50\ \text{KSI}$ YEILD STRENGTH OF BOTTOM FLANGE

$b_{ft} = 18\ in$ WIDTH OF TOP FLANGE PLATE

$t_{ft} = 1\ in$ THICKNESS OF TOP FLANGE PLATE

$D_w = 40\ in$ HEIGHT OF WEB PLATE

$t_w = 5/8\ in$ THICKNESS OF TOP FLANGE PLATE

$b_{fb} = 18\ in$ WIDTH OF BOTTOM FLANGE PLATE

$t_{fb} = 1\ 3/8\ in$ THICKNESS OF BOTTOM FLANGE PLATE

① PROPERTIES FOR CONSTRUCTION & CASTING OF DECK.

DURING THIS STAGE, THE SECTION WILL BE NON-COMPOSITE AND THE STEEL PLATE WILL NOT HAVE A REDUCED SECTION.

$d_{girder} = t_{ft} + D_w + t_{fb} = 42\ 3/8\ in$

AREA OF TOP FLANGE:

$A_{ft} = b_{ft} t_{ft} = 18\ in^2$

AREA OF BOTTOM FLANGE

$A_{fb} = b_{fb} t_{fb} = 24.75\ in^2$

AREA OF WEB

$A_w = D_w t_w = 25.0\ in^2$

TOTAL AREA OF GIRDER

$A_{girder} = 67.75\ in^2$

D. RIBBANS 2/2/18

DISTACE TO CENTROID OF TOP FLANGE:

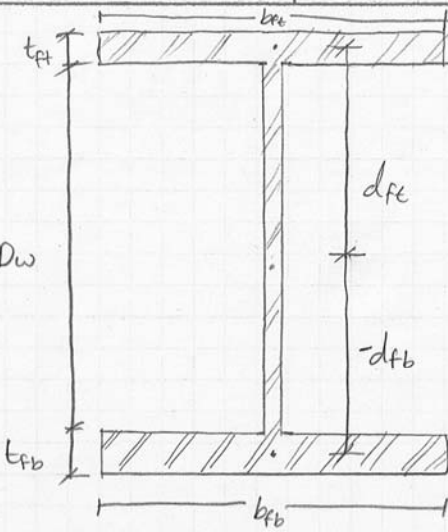
$d_{ft} = D_w/2 + t_{ft}/2$

$d_{ft} = 20.5\ in$

DISTANCE TO CENTROID OF BOTTOM FLANGE

$d_{fb} = D_w/2 + t_{fb}/2$

$= -20.688\ in$



LOCATION OF NEUTRAL AXIS OF NON-COMPOSITE SECTION, LOCATED FROM THE CENTROID OF THE WEB.

$$d_{s.nc} = \frac{A_{ft}d_{ft} + A_{fb}d_{fb}}{A_{girder}} = \frac{(18in^2)(20.5in) + (24.75in^2)(-20.688in)}{67.75in^2}$$

$$= \frac{369.00\,in^3 + 512.02\,in}{67.75\,in^2} = -2.11\ in$$

* negative distance indicates that the N.A. of the section is below the centroid of the web plate

DEPTH OF STEEL IN COMPRESSION:

$d_{top\text{-}steel\ NC} = D_w/2 + t_{ft} - d_{s.nc} = 23.11\ in$

DEPTH OF STEEL IN TENSION:

$d_{bot\text{-}STEEL.NC} = D_w/2 + t_{fb} + d_{s.nc} = 19.26\ in$

MOMENT OF INERTIA OF TOP FLANGE:

$I_{ft} = \frac{1}{12}\, b_{ft}\, t_{ft}^3 + b_{ft}\, t_{ft}\,(d_{ft} - d_{s.nc})^2$

$\frac{1}{12}(18in)(1in)^3 + 18in(1in)(22.61\ in)^2 = 9204.08\ in^4$

D. Ribbans 2/2/18 | 3/6

MOMENT OF INERTIA OF BOTTOM FLANGE

$$I_{fb} = \frac{1}{12} b_{fb} t_{fb}^3 + b_{fb} t_{fb} (d_{fb} - d_{s.nc})^2$$
$$= \frac{1}{2} (18in)(1.375in)^3 + (18in)(1.375in)(18.58in)^2 = 8544.85\ in^4$$

MOMENT OF INERTIA OF WEB

$$I_w = \frac{1}{12} t_w (D_w)^3 + t_w D_w (d_{.o.nc})^2 =$$
$$= \frac{1}{12} (0.625in)(40in)^3 + (0.625in)(40in)(2.11in)^2 = 3444.7\ in^4$$

NON-COMPOSITE MOMENT OF INERTIA

$$I_{NC} = I_{ft} + I_{fb} + I_W = 21193.7\ in^4$$

SECTION MODULUS FOR EXTREME FIBER AT TOP FLANGE

$$S_{TOP.NC} = \frac{I_{NC}}{d.top.steel.NC} = 917.04\ in^3$$

$$S_{BOT.NC} = \frac{I_{NC}}{d.bot.steel.NC} = 1100.17\ in^3$$

② PROPERTIES FOR FINAL DESIGN CONDITION:

DURING THIS STAGE THE STEEL WILL BE COMPOSITE WITH THE CONCRETE DECK AND THE STEEL SECTION WILL BE REDUCED.

FOR WEATHERED STEEL, THE THICKNESS OF THE STEEL SHALL BE REDUCED BY 1/16". THIS WILL REDUCE THE DEPTH OF THE GIRDER AND ULTIMATELY BE CONSERVAIVE IN DESIGN CAPACTIY.

VTRANS STRUCTURES DESIGN MANUAL

THE PROCEDURES FOR DETERMINING THE NON-COMPOSITE SECTION PROPERTIES ARE THE SAME AS SECTION ① WITH THE FOLLOWING PLATE DIMENSIONS FOR WEATHERED STEEL, VALUES SUMMARIZED BELOW:

$b_{ft} = 18\ in$ $\quad D_w = 40in$

$t_{ft} = 1in - 1/16in = 15/16\ in$ $\quad t_w = 5/8in - 1/16in = 9/16in$

$b_{fb} = 18in$

$t_{fb} = 1\ 3/8in - 1/16in = 1\ 5/16\ in$

D. Ribbans 2/2/18

4/6

$d_{girder\_w} = 42.25\,in$

$A_{ft\_w} = 16.88\,in^2$

$A_{fb\_w} = 23.63\,in^2$

$A_{w\_w} = 22.5\,in^2$

$A_{girder\_w} = 63\,in^2$

$d_{ft\_w} = 20.47\,in$

$d_{fb\_w} = -20.66\,in$

$d_{B\_NC\_w} = -2.26\,in$

$d_{top.steel\_NC\_w} = 23.2\,in$

$d_{bot.steel\,NC\_w} = 19.05\,in$

$I_{ft\_w} = 8721.4\,in^4$

$I_{fb\_w} = 7995.66\,in^4$

$I_{w\_w} = 3115.27\,in^4$

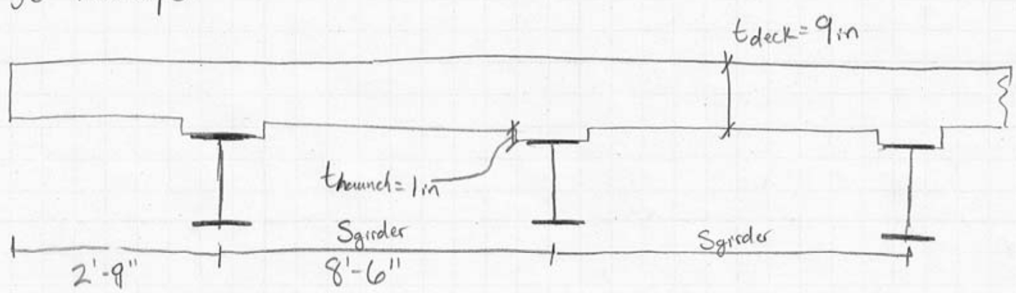
$I_{NC\_w} = 19832.3\,in^4$

$S_{top.NC\_w} = 854.81\,in^3$

$S_{bot.NC\_w} = 1041.12\,in^3$

COMPOSITE SECTION PROPERTIES

$f'_c = 4000\,psi$



D. Ribbens 2/2/18 | 5/6

Effective WIDTH OF CONCRETE

$b_{eff.int} = 8'-6''$

$b_{eff.ext} = \left(\frac{8'-6''}{2}\right) + (2'-9'') = 7'-0''$

DEPTH OF COMPOSITE MEMBER

$d_{comp} = t_{deck} + t_{haunch} + d_{girder\_w} = 52.25 in$

$n = \frac{E_s}{E_n}$

$E_n = 57620\sqrt{f'_c} = 3644$ KSI

$n = \frac{29000}{3644} \approx 9$

LONG-TERM COMPOSITE ($3n = 27$) FOR INTERIOR GIRDER

TRANSFORMED AREA OF DECK

$A_{deck.int} = \frac{b_{eff.int}(t_{deck})}{3n} = 34 in^2$

TOTAL EQ AREA OF STEEL

$A_{3n} = A_{girder\_w} + A_{deck.int} = 97 in^2$

Distance to centroid of equivalent DECK to center of web

$d_{3ndeck} = D_w/2 + t_f + t_{haunch} + t_{deck}/2$

$=$

$= 26.44 in$

DISTANCE TO NA FROM CENTER OF WEB

$d_{3n.int} = \frac{(20.47 in)(16.88 in^2) + (-20.66 in)(23.63 in^2) + (26.44 in)(34 in^2)}{97 in^2}$

$= 7.8 in$

D.Ribbans 2/2/18

6/6

DISTANCE TO EXTREME FIBER OF TOP FLANGE

$d_{top.3n.int} = Dw/2 + t_{ft.w} - d_{3n.int} = 13.14 in$

DISTANCE TO EXTREME FIBER OF BOTTOM FLANGE

$d_{bot.3n.int} = Dw/2 + t_{ft.w} + d_{3n.int} = 29.11 in$

$$I_{3n.int} = A_{deck.int}\left(Dw/2 + t_{ft.w} + t_{haunch} + t_{deck}/2 - d_{3n.int}\right)^2$$
$$+ I_{NCw}$$
$$+ A_{girder}\left(d_{3n.int} + - d_{NS.nc}\right)^2$$
$$+ \frac{b_{eff.int}}{3n}\frac{(t_{deck})^3}{12}$$
$$= 38252.07 \ in^4$$

$$S_{topsteel.3n.int} = \frac{I_{3n.int}}{d_{top.3n.int}} = 2910.94 \ in^3$$

$$S_{bot\ steel.3n.int} = \frac{I_{3n.int}}{d_{bot.3n.int}} = 1314.09 \ in^3$$

APPENDIX D: QC/QA PROCESS TRACKING

VERMONT
AGENCY OF TRANSPORTATION

Page: 1 of 2

QC/QA Process Tracking

CIP RC Deck Design

DATE: 1/31/2018

Project Information:

PROJECT NAME:	SomeTown BO 1234(89)
JOB ID:	00x000
PROJECT MANAGER:	Rob Young
LEAD DESIGNER:	Jared Grigas
DESIGN COMPONENT:	Cast in Place Reinforced Concrete Interior Deck

Design Acceptance:

Quality Control

STATUS	DESIGNER	CHECKER	LEAD DESIGNER
[X] SUBMITTED	DAR	SC	JG
[X] REVIEWED, EXCEPTIONS NOTED	DAR	JG	JG
[ ] REVIEWED, NO EXCEPTIONS			
[ ] APPROVED DESIGN			

Quality Assurance

The procedures used for the development of the design component meets the required Quality Control processes outlined in the VTrans Structures Section QA/QC Manual and the final design appears to be in conformance with the VTrans Standards and project requirements.

	PROJECT MANAGER	DATE
[ ] APPROVED FOR FINAL DESIGN		

QC/QA Process Tracking Page: 2 of 2

Revision Tracking:

No.	Designer	Checker(s)	Date	Comments:
1	D. Ribbans	S. Coley	12/13/2017	Initial Design Submission. Designer had incorrect input geometry and some calculation methodology. Revision Required.
2	D. Ribbans	J. Grigas	01/18/2018	Designer to add additional deck weight from overhang, girder spacing updated for skew and update for new concrete spec. Revision Required
3	D. Ribbans		1/31/2018	

SomeTown - BF 0123(89) , 12b596
Project Task List

Last updated	Conceptual Plans Due	Preliminary Plans Due	Final Plans Due (In-House)	Contract Plans Due
11/15/2017	10/31/2017	4/12/2018	6/5/2019	9/16/2019

KEY

COMPLETED
IN PROGRESS
Back Check Needed
NOT STARTED
Not Applicable
Performed by Others
List Needs Work

Completed
Pending
Not Done

SECTION OF THE PLAN GENERATION MANUAL	Sheet Name	KEY DETAILS / INFORMATION	Conceptual		Preliminary		Final		Contract	
			Draft Details	Details Checker	Draft Details	Details Checker	Draft Details	Details Checker	Draft Details	Details Checker
A.1	Title Sheet		M. Longstreet	G. Laroche	M. Longstreet	G. Laroche	M. Longstreet	G. Laroche	M. Longstreet	G. Laroche
A.2	Preliminary Information Sheet	Sheet Builder	M. Longstreet	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche
A.3	Typical Section Sheet	Create Option Typical	M. Longstreet	G. Laroche	M. Longstreet	G. Laroche	M. Longstreet	G. Laroche	M. Longstreet	G. Laroche
A.4	Earthwork Typical Section Sheet		NA	NA			0	0	0	0
A.5	Project Notes		NA	NA	NA	NA			0	0
A.6	Quantities Sheets		NA	NA	NA	NA			0	0
A.7	Legend Sheet		M. Longstreet		S. Coley	0	S. Coley	0	S. Coley	0
A.8	Tie Sheet	Survey Tie Sheet	NA	NA	S. Coley		S. Coley	0	S. Coley	0
A.9	Layout Sheet		M. Longstreet	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche
A.10	Profile Sheet	Add Banking Diagram and Material transition Diagrams to theis section	M. Longstreet	G. Laroche	S. COley	G. Laroche	S. COley	G. Laroche	S. COley	G. Laroche
A.11	Traffic Control Sheets		NA	NA	S. Coley		S. Coley	0	S. Coley	0
A.12	Drainage Layout		NA	NA	S. Coley				0	0
A.13	Drainage Details		NA	NA	S.Coley		S.Coley	0	S.Coley	0
A.14	Utility Layout		NA	NA			0	0	0	0
A.15	Traffic Sign and Line Layout		NA	NA	S.Coley				0	0
A.16	Boring Information Sheets		NA	NA	S. Coley		S. Coley	0	S. Coley	0
A.17	Plan & Elevation		NA	NA	S. Coley		S. Coley	0	S. Coley	0
A.18	Structural Detail Set	Create a group of sub lists based on bridge type to replace A.19	NA	NA	NA	NA			0	0
A.19	Superstructure Details		NA	NA	NA	NA			0	0
A.20	Substructure Details	Detail order; Abutments, Wingwalls, Piers	NA	NA	NA	NA			0	0
A.20.2			NA	NA	NA	NA			0	0
A.21	Other Sheets or Details		NA	NA	NA	NA			0	0
A22	Reinforcing Steel Schedule		NA	NA	NA	NA			0	0
A.23	Roadway Cross Sections		M. Longstreet	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche
A.24	Material Transition Details	Show with the Profile and the Banking diagram (above)	NA	NA	S. COley		S. COley	0	S. COley	0
A.25	Drive & Culvert Cross Section Sheet(s)		M. Longstreet	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche
A.26	Channel Cross Section Sheet(s)		M. Longstreet	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche	S. Coley	G. Laroche
A.27	Erosion Control Sheets		M. Longstreet	G. Laroche	N/A	N/A	N/A	N/A	N/A	N/A
---	ROW Sheet(s)		NA	NA			0	0	0	0