

TRAFFIC SIGNAL GENERAL NOTES

1. OVERHEAD SIGNAL SUPPORTS SHALL CONFORM TO AASHTO'S "SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS", DATED 2013 AND ITS LATEST REVISIONS.

2. THE DESIGN CALCULATIONS SHALL TAKE INTO ACCOUNT THE FOLLOWING CRITERIA:
- STRUCTURE CRITERIA
 - DESIGN LIFE AND RECURRENCE INTERVAL: 50 YEARS
 - WIND LOAD: 90 M.P.H.
 - FATIGUE CRITERIA
 - FATIGUE CATEGORY: 2 FOR STRUCTURES ON ROADWAYS WITH A SPEED LIMIT GREATER THAN 35 MPH, 3 FOR STRUCTURES ON ROADWAYS WITH A SPEED LIMIT LESS THAN OR EQUAL TO 35 MPH.
 - VORTEX SHEDDING: NOT REQUIRED
 - NATURAL WIND GUSTS: INCLUDE
 - TRUCK INDUCED WIND GUSTS: INCLUDE FOR ROADWAYS WHERE SPEED LIMIT IS 40 M.P.H. OR GREATER
 - GALLOPING: NOT REQUIRED
 - FOUNDATION CRITERIA
 - CONCRETE: CONCRETE, CLASS B, VTrans' "STANDARD SPECIFICATIONS FOR CONSTRUCTION", DATED 2011, SECTION 541.
 - REINFORCING STEEL: REINFORCING STEEL, LEVEL I VTrans' "STANDARD SPECIFICATIONS FOR CONSTRUCTION", DATED 2011, SECTION 507.
 - GEOTECHNICAL SOIL RESISTANCES TO BE DETERMINED BY CONTRACTOR. GEOTECHNICAL DATA REPORT SUMMARIZING SUBSURFACE INVESTIGATION INCLUDED IN CONTRACT DOCUMENTS

3. ANCHOR BOLTS

- A) GALVANIZED ANCHOR BOLTS WITH TWO HEXAGON NUTS AND TWO WASHERS PER BOLT SHALL BE FURNISHED WITH EACH POLE. ANCHOR BOLT PLATES, WHEN USED, SHALL ALSO BE GALVANIZED. SEE SECTION 714.09. AFTER INSTALLATION, A MINIMUM OF TWO THREADS ON THE BOLT SHOULD BE EXPOSED ABOVE THE NUT.
- B) A MINIMUM OF 6 ANCHOR BOLTS SHALL BE PROVIDED AT EACH SINGLE UPRIGHT POST FOUNDATIONS.
- C) PROCEDURE FOR TIGHTENING DOUBLE-NUT ANCHOR BOLT CONNECTIONS:
 1. VERIFY THAT THE NUTS CAN BE TURNED ONTO THE BOLTS PAST THE ELEVATION CORRESPONDING TO THE BOTTOM OF EACH IN-PLACE LEVELING NUT AND BE BACKED OFF BY THE EFFORT OF ONE PERSON ON A 12-IN. LONG WRENCH OR EQUIVALENT (I.E., WITHOUT EMPLOYING A PIPE EXTENSION ON THE WRENCH HANDLE).
 2. CLEAN AND LUBRICATE THE EXPOSED THREADS OF ALL ANCHOR BOLTS. CLEAN AND LUBRICATE THE THREADS AND BEARING SURFACES OF ALL LEVELING NUTS. RE-LUBRICATE THE EXPOSED THREADS OF THE ANCHOR BOLTS AND THE THREADS OF THE LEVELING NUTS IF MORE THAN 24 HOURS HAS ELAPSED SINCE EARLIER LUBRICATION, OR IF THE ANCHOR BOLTS AND LEVELING NUTS HAVE BECOME WET SINCE THEY WERE FIRST LUBRICATED.
 3. TURN THE LEVELING NUTS ONTO THE ANCHOR BOLTS AND ALIGN THE NUTS TO THE SAME ELEVATION.
 4. PLACE STRUCTURAL WASHERS ON TOP OF THE LEVELING NUTS (ONE WASHER CORRESPONDING TO EACH ANCHOR BOLT).
 5. INSTALL THE BASE PLATE ATOP THE LEVELING NUTS, PLACE STRUCTURAL WASHERS ON TOP OF THE BASE PLATE (ONE WASHER CORRESPONDING TO EACH ANCHOR BOLT), AND TURN THE TOP NUTS ONTO THE ANCHOR BOLTS.
 6. TIGHTEN TOP NUTS TO A SNUG-TIGHT CONDITION IN A STAR PATTERN. SNUG-TIGHT IS DEFINED AS THE MAXIMUM NUT ROTATION RESULTING FROM THE FULL EFFORT OF ONE PERSON ON A 12-IN. LONG WRENCH OR EQUIVALENT. A STAR TIGHTENING PATTERN IS ONE IN WHICH THE NUTS ON OPPOSITE OR NEAR-OPPOSITE SIDES OF THE BOLT CIRCLE ARE SUCCESSIVELY TIGHTENED IN A PATTERN RESEMBLING A STAR. (FOR EXAMPLE, FOR AN 8-BOLT CIRCLE WITH BOLTS SEQUENTIALLY NUMBERED 1 TO 8, TIGHTEN NUTS IN THE FOLLOWING BOLT ORDER: 1, 5, 7, 3, 8, 4, 6, 2.)
 7. TIGHTEN LEVELING NUTS TO A SNUG-TIGHT CONDITION IN A STAR PATTERN.
 8. BEFORE FINAL TIGHTENING OF THE TOP NUTS, MARK THE REFERENCE POSITION OF EACH TOP NUT IN A SNUG-TIGHT CONDITION WITH A SUITABLE MARKING ON ONE FLAT WITH A CORRESPONDING REFERENCE MARK ON THE BASE PLATE AT EACH BOLT. THEN INCREMENTALLY TURN THE TOP NUTS USING A STAR PATTERN UNTIL ACHIEVING THE REQUIRED NUT ROTATION SPECIFIED BELOW. TURN THE NUTS IN AT LEAST TWO FULL TIGHTENING CYCLES (PASSES). AFTER TIGHTENING, VERIFY THE NUT ROTATION.
 9. TOP NUTS FOR ASTM F1554 GRADE 55 ANCHOR BOLTS SHALL BE TIGHTENED TO 1/3 TURN BEYOND SNUG TIGHT CONDITION FOR BOLTS LESS THAN OR EQUAL TO 1 1/2" DIAMETER AND 1/6 TURN BEYOND SNUG TIGHT CONDITION FOR BOLTS GREATER THAN 1 1/2" DIAMETER. THE TOLERANCE FOR NUT ROTATION IS PLUS 20 DEGREES. USE A BEVELED WASHER IF THE NUT IS NOT IN FIRM CONTACT WITH THE BASE PLATE OR THE OUTER FACE OF THE BASE PLATE IS SLOPED MORE THAN 1:40.

4. FLANGE BOLTS

ALL FLANGE BOLTS, HEX NUTS, AND WASHERS SHALL CONFORM TO SUBSECTION 714.05. THE FLANGE BOLTS SHALL BE CAPABLE OF RESISTING 133% OF THE FULL DESIGN STRESS OF THE TUBE AT ITS YIELD STRENGTH STRESS. FLANGE BOLTS SHALL TENSIONED IN ACCORDANCE WITH SUBSECTION 506.19. DIRECT TENSION INDICATORS ARE REQUIRED.

5. U-BOLTS

U-BOLTS AND ASSOCIATED HARDWARE SHALL CONFORM TO SUBSECTION 714.04.

6. STEEL FOR SIGNAL STRUCTURES

- A) ALL MATERIAL GREATER THAN 1/2" THICK SHALL MEET THE CHARPY V-NOTCH IMPACT REQUIREMENTS FOR THE SPECIFIED MATERIAL. TESTING AND SAMPLING SHALL BE IN ACCORDANCE WITH AASHTO T 243.
- B) PIPE AND TUBES SHALL MEET THE REQUIREMENTS OF ONE OF THE FOLLOWING SPECIFICATIONS:
 - CANTILEVER MAST ARM STRUCTURE:
 - ASTM A595, GRADE A WELDED, ROUND, TAPERED STEEL TUBE
 - ASTM A1011, GRADE 50 WELDED, ROUND, TAPERED STEEL TUBE
 - NON-CANTILEVERED OVERHEAD SIGN AND SIGNAL STRUCTURES:
 - ASTM 1500, GRADE B WELDED AND SEAMLESS STEEL PIPE (ROUNDS ONLY)
 - API 5L GRADE X42 AMERICAN PETROLIUM INSTITUTE SPECIFICATION 5L

7. GALVANIZING

ALL STEEL COMPONENTS, EXCEPT CONCRETE REINFORCING, ARE TO BE HOT DIPPED GALVANIZED AFTER FABRICATION. THE ASSEMBLIES SHALL BE DESIGNED AND FABRICATED TO PERMIT GALVANIZING ON ALL INTERIOR AND EXTERIOR SURFACES AND SHALL BE FREE OF POCKETS AND OTHER STRUCTURAL OBSTRUCTIONS THAT WILL NOT PERMIT PROPER DEPOSITION OF ZINC COATING. GALVANIZING SHALL BE IN ACCORDANCE WITH SECTION 752.02.

8. WELDING

- A) ALL WELDING SHALL BE PERFORMED PER SECTION 506.10
- B) ALL WELDS SHALL BE AT LEAST AS STRONG AS THE MATERIAL(S) BEING WELDED

9. FOUNDATIONS

- A) FOOTINGS SHALL BE DESIGNED IN ACCORDANCE WITH VTrans' MATERIALS & RESEARCH ENGINEERING INSTRUCTIONS, GEOTECHNICAL DESIGN PROCEDURES FOR MAST ARM AND OVERHEAD SIGN SUPPORT FOUNDATIONS (MREI 10-01), DATED MARCH 9, 2010, A COPY OF WHICH CAN BE FOUND ON THE AGENCY'S WEBSITE: WWW.VTRANS.VERMONT.GOV.
- B) FOUNDATIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE FOLLOWING NOTES:
 1. A MINIMUM EMBEDMENT DEPTH OF FIVE FEET SHALL BE USED FOR ALL SPREAD FOOTING FOUNDATIONS; MEASURED FROM THE GROUND SURFACE ELEVATION TO THE BOTTOM OF THE FOOTING ELEVATION.
 2. FOR DRILLED SHAFT FOUNDATIONS, CONCRETE SHALL BE POURED AGAINST UNDISTURBED SOIL UNLESS A PERMANENT CASING IS DESIGNED FOR AND APPROPRIATE SUPPORTING CALCULATIONS ARE PROVIDED. THE TOP TWO FEET OF SOIL SHALL BE NEGLECTED FOR DESIGN PURPOSES. A DISPOSABLE CIRCULAR CONCRETE FORM, IF USED, SHALL NOT BE PLACED DEEPER THAN TWO FEET, IN ORDER NOT TO REDUCE THE FRICTION BETWEEN THE SOIL AND THE CONCRETE. AS AN ALTERNATIVE TO THE DRILLED HOLES, FOOTINGS MAY BE POURED IN EXCAVATED HOLES USING THE PROPER FORMS, WHICH MUST BE REMOVED. THE EXCAVATED HOLES SHALL BE AT LEAST TWO FEET CLEAR OF THE FOUNDATION SIDES AND ONE FOOT DEEPER THAN THE FOUNDATION. CARE SHALL BE TAKEN TO AVOID EXCAVATING AROUND THE TOP OF THE FOUNDATION. THE BACKFILL MATERIAL SHALL BE COMPACTED AS DESCRIBED IN SECTION 204.08. DESIGN LIMITS AS FOR AUGURED FOOTINGS APPLIES.
 3. ANY BACKFILL PLACED ADJACENT TO THE FOOTING SHALL BE GRANULAR MATERIAL MEETING THE REQUIREMENTS FOR GRANULAR BACKFILL FOR STRUCTURES, SECTION 704.08. IT SHALL BE COMPACTED AS DESCRIBED IN SECTION 204.08.
 4. CONCRETE FOR THE FOUNDATION SHALL CONFORM TO THE REQUIREMENTS OF CONCRETE, SECTION 541 STRUCTURAL CONCRETE. IF DRILLED SHAFT FOUNDATIONS ARE REQUIRED, THE CONCRETE SPECIFICATIONS MAY NEED TO BE ADJUSTED FOR CONSTRUCTABILITY ISSUES. HOWEVER, IF REQUIRED, THE CONTRACTOR SHALL SUBMIT ANY CHANGES TO THE CONCRETE SPECIFICATION FOR REVIEW BY THE VTrans PROJECT MANAGER.
 5. STEEL PILES IF USED, SHALL MEET THE REQUIREMENTS OF SECTION 505.
 6. WHEN THE DESIGN DEPTH OF A FOUNDATION CANNOT BE OBTAINED DUE TO UNFORSEEN FIELD CONDITIONS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER FOR THE MANUFACTURER TO OBTAIN A REVISED FOUNDATION DESIGN. SUCH A REVISION SHALL BE SUBMITTED TO THE VTrans PROJECT MANAGER AND MAY REQUIRE UP TO A FOUR WEEK REVIEW PERIOD BY VTrans.
- C) SIGNALS/SIGNS SHALL BE INSTALLED AND LEVELED AND POLES SHALL BE PLUMB PRIOR TO PLACING GROUT UNDER POLE BASE. GROUT MATERIAL SHALL BE NON-SHRINKING MORTAR CONFORMING TO SECTION 707.03, MORTAR TYPE IV.

10. EACH OVERHEAD TRAFFIC SIGNAL/SIGN SUPPORT SHALL BE GROUNDED. THE GROUND SHALL CONSIST OF THE FOLLOWING:

- A) AN INTERNAL GROUND LUG OPPOSITE THE HAND HOLE
- B) A #6 (MIN.) SOFT DRAWN COPPER GROUNDING ELECTRODE CONDUCTOR
- C) A 5/8" X 8" (MIN.) COPPER CLAD GROUNDING ELECTRODE THE RESISTANCE TO GROUND SHALL BE 25 OHMS OR LESS. ADDITIONAL GROUNDING ELECTRODES MAY BE REQUIRED (MINIMUM SPACING SHALL BE 6'). WHEN A POWER SERVICE, METER AND DISCONNECT ARE ATTACHED TO A POLE, THERE SHALL BE A CONTINUOUS GROUND WIRE FROM THE METER AND DISCONNECT WITH MAY RUN INTERNAL TO THE UPRIGHT, THROUGH THE 1/2" FLEXIBLE TUBING IN THE CONCRETE BASE TO THE REQUIRED GROUNDING ELECTRODE(S). THE GROUND WIRE FROM THE POLE GROUNDING LUG, CONTROLLER CABINET AND/OR LUMINAIRE MAY ATTACH TO THIS CONTINUOUS GROUNDING ELECTRODE CONDUCTOR FROM THE SERVICE METER AND DISCONNECT. THE CONTRACTOR SHALL PERFORM A RESISTANCE TO GROUND TEST ON THE CONTINUOUS GROUNDING ELECTRODE CONDUCTOR FROM THE SERVICE METER AND DISCONNECT AND PROVIDE A WRITTEN STATEMENT TO THE AREA ELECTRICAL INSPECTOR THAT THE GROUNDING ELECTRODE CONDUCTOR IS CONTINUOUS FROM THE SERVICE METER AND DISCONNECT AND THE RESISTANCE TO GROUND IS 25 OHMS OR LESS.

11. HORIZONTAL MEMBERS SHALL BE CAMBERED AND THE VERTICAL POLES BACK RAKED, WHERE APPLICABLE, TO THE ANTICIPATED DEAD LOAD DEFLECTION PLUS THE CAMBER, IF ANY, SPECIFIED ON THE PLANS.

12. AN EQUIVALENT ALTERNATE DESIGN MAY BE SUBSTITUTED FOR THE DETAILS AND MATERIALS SHOWN.

13. THE DETAILS OF DESIGN FOR THE STRUCTURE AND FOUNDATION ARE TO BE SUPPLIED BY THE CONTRACTOR AND/OR BY THE MANUFACTURER. THE STRUCTURE SHALL BE DESIGNED TO RESIST THE MAXIMUM LOADING AS OUTLINED IN THE AASHTO STANDARD SPECIFICATIONS, SEE NOTE 2. ALL DESIGN CALCULATIONS FOR THE STRUCTURE AND THE FOUNDATION SHALL BE CHECKED AND STAMPED BY A LICENSED PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF VERMONT PRIOR TO SUBMITTAL OF THE FABRICATION DRAWINGS TO VTRANS.

14. THE CONTRACTOR SHALL SUBMIT ONE DIGITAL VERSION OF THE DESIGN CALCULATIONS TO VTRANS PROJECT MANAGER SHOWING THE FOLLOWING INFORMATION FOR EACH OF THE VERTICAL AND HORIZONTAL COMPONENTS OF THE STRUCTURE AND FOUNDATION:

- A) THE DESIGN AXIAL AND SHEAR FORCES AND BENDING AND TORSIONAL MOMENTS ACTING AT THE TOP OF THE FOUNDATION.
- B) THE DESIGN AXIAL, BENDING AND SHEAR STRESSES AND THE COMBINED STRESS RATIO.
- C) VIBRATION AND FATIGUE CALCULATIONS AS SET FORTH IN SECTION 11 OF THE AASHTO PUBLICATION REFERENCED IN NOTE 2.
- D) THE ALLOWABLE AXIAL, BENDING, AND SHEAR STRESSES.
- E) ITEMS A, B, AND D SHALL BE SHOWN FOR EACH OF THE GROUP LOADINGS (I, II, III) AND FOR THE BASIC WIND LOAD APPLIED TO THE TWO CASES OUTLINED IN THE AASHTO STANDARD SPECIFICATIONS (SEE NOTE 2), SECTION 1.2.5(D)(4).
- F) FAILURE TO SUPPLY THE PROPER DESIGN INFORMATION SHALL BE CAUSE FOR REJECTION OF THE STRUCTURE.
- G) A MINIMUM OF TWO WEEKS SHALL BE REQUIRED FOR REVIEW BY VTRANS.
- H) EVERY MEMBER AND CONNECTION IN A CANTILEVERED OVERHEAD TRAFFIC SIGNAL SUPPORT SHALL BE DESIGNED TO PROVIDE ADDITIONAL RESIDUAL CAPACITY FOR FUTURE MODIFICATION EQUIVALENT TO A 5-SECTION TRAFFIC SIGNAL HEAD WITH A 5-INCH LOUVERED BACKPLATE LOCATED ON THE OUTERMOST EXTENT OF THE MAST ARM. OVERHEAD SIGN STRUCTURES AND NON-CANTILEVERED TRAFFIC SIGNAL STRUCTURES SHALL BE DESIGNED TO A MAXIMUM DESIGN RATIO OF 85% FOR EVERY MEMBER AND CONNECTION.

15. FABRICATION DRAWINGS IN A DIGITAL FORMAT SHALL BE SUBMITTED TO VTrans PROJECT MANAGER FOR APPROVAL PRIOR TO FABRICATION. THE FABRICATION DRAWINGS SHALL INCLUDE THE FOLLOWING INFORMATION:

- A) DETAILED DRAWING OF EACH COMPONENT OF THE STRUCTURE.
- B) MATERIAL SPECIFICATION FOR EACH COMPONENT OF THE STRUCTURE, EITHER BY COMPLETE SPECIFICATION OR REFERENCE TO APPLICABLE ASTM STANDARDS.
- C) NOTATION OF PROJECT NAME, PROJECT NUMBER, ROUTE NUMBER, AND STRUCTURE STATIONING TO BE INCLUDED ON EACH SHEET.
- D) DETAILS FOR LOCATION OF SIGNS/SIGNALS AND ATTACHMENT HARDWARE FOR THE SUPPORT STRUCTURE.
- E) ALL ELEVATIONS AND DIMENSIONS NECESSARY TO PROVIDE A COMPLETE SET OF RECORD PLANS.
- F) DEAD LOAD DEFLECTION AND CAMBER INFORMATION.
- G) WELDING DETAILS AND PROCEDURES ARE REQUIRED FOR ALL WELDS. PROCEDURES SHALL BE SUBMITTED FOR APPROVAL WITH REFERENCE TO EACH WELD IDENTIFIED ON THE FABRICATION DRAWINGS. SEE SECTION 506.10.
- H) BOLT TENSIONING REQUIREMENTS

16. THE TRAFFIC SIGNALS SHALL BE MOUNTED TO THE ARM OR POLE USING A FIXED MOUNT SYSTEM, UNLESS OTHERWISE NOTED ON THE CROSS SECTION SHEET. FOR SIGNALS MOUNTED ON A MAST ARM, THE MAST ARM AND MOUNTING POINT SHALL BE IN THE MIDDLE OF THE SIGNAL HEAD.

17. BASE PLATES SHALL BE STAMPED WITH POLE INFORMATION INCLUDING: POLE DIAMETER, HEIGHT, YIELD STRENGTH, AND GAUGE; ARM INFORMATION SHALL INCLUDE: HORIZONTAL MEMBER DIAMETER, LENGTH, YIELD STRENGTH, AND GAUGE. THE INFORMATION SHALL BE STAMPED ON A METAL TAG RIVETED TO THE POLE NEAR THE HAND HOLE.

18. SEE STANDARD E-171A FOR ADDITIONAL NOTES.

REVISION	DATE	DESCRIPTION	BY
△	5/10/17	NOTES REVISED	KAR

PROJECT NAME:	WILLISTON-ESSEX		
PROJECT NUMBER:	STPG SGNL(46)		
FILE NAME:	t15i017fm.dgn	PLOT DATE:	5/10/2017
PROJECT LEADER:	M. LACROIX	DRAWN BY:	K. RECORD
DESIGNED BY:	K. RECORD	CHECKED BY:	M. LACROIX
TRAFFIC SIGNAL GENERAL NOTES SHEET	SHEET 50	OF	66