

Design Memorandum

Date:

Subject:

I-81 Christiansburg Roadway Lighting Plan (VDOT Project No. 0081-154-101,C-502)

Dear Mr. Hamed,

We have been asked by the Department to provide construction plans for installation of roadway lighting in Christiansburg. The project includes lighting three interchanges; I-81/Rt-11, I-81/Rt-460 Bypass & Rt-11/Rt-460 Bypass. The lighting is then extended to connect the interchanges to provide a seamless lighting system. The plan focuses on lighting the Collector-Distributor lanes (CD lanes) and the ramps & loops. The gore areas associated with the ramps/loops and CD lanes represent conflict areas and are illuminated to twice the level planned for the adjoining roadways. Effectively, the driver's eyes are allowed sufficient time to adjust to the gore area lighting by tapering the average illumination level on the roadway as vehicles approach and depart the area. In this letter we will explain the design of the illumination plan and the electrical distribution plan for this project.

The Illumination Plan

The illumination plan for the I-81 CD lanes is designed to provide an average illumination of 0.6-fc to 0.9-fc with an average-to-minimum uniformity of 3:1 or lower. These levels meet the IESNA and AASHTO criteria for "Freeway" lighting. The I-81 mainline is illuminated only in the areas north and south of the CD lane splits. The mainline adjacent to the CD lane receives only stray light and is expected to be no more than the level of moonlight, 0.02-fc. The gore areas are considered conflict areas and are generally illuminated to twice the level of the approach/departure roadways.

These light levels are accomplished with conventional (cobrahead) lighting standards. 250-watt luminaires are located along the outside of I-81, mounted at 45' over the shoulder of the CD lanes. The luminaire optics (IES Type 3, Medium, Cutoff) distributes light such that only the travel lanes closest to the pole are illuminated. That is, the forward throw of the light is cutoff from illuminating the parallel mainline roadway. The pole spacing along the CD lanes varies from 250' along the approach roads to 150' in the gore areas. The reduced pole spacing provides the desired increase illumination at the gore. This same arrangement is used along the I-81 mainline north and south of the CD lane split, however, 400-watt luminaires are used with pole spacing that vary between 300' to 250' in the gore area. Installing the light poles behind the sound wall required careful consideration of the grade behind the walls. To facilitate construction, the plans provide the contractor with the location of sound wall maintenance easements.

Rt-460 Bypass and the directional ramp system are illuminated to the same level as I-81 CD lanes. These light levels are produced by 150-watt cobrahead luminaires mounted at 40' over the shoulders. The pole spacing is generally 165' with shorter spacing along the curved sections of the ramps & loops. Twin-arm cobrahead light poles with

150-watt fixtures are placed in the median to illuminate both eastbound & westbound lanes from a single pole.

Rt-11 is illuminated to 1.0-fc, meeting the criteria for a “Major” roadway with low pedestrian conflict. Higher levels of illumination are provided for the at-grade intersections.

Under-bridge lighting is provided for the I-81 and Rt-460 Bypass overpasses. The illumination level under these bridges is typically twice the level found on the approach/departure roadways. Lighting is provided by 150-watt wall-pack luminaires secured to the bridge pier caps or bridge abutments. Illumination of the roadways under the short bridges found within the Rt-460 Bypass direction ramp system is provided by nearby conventional lighting standards.

A commuter parking lot, in the area of the Rt-460 Bypass interchange, is also incorporated in the lighting plan. The average light level in the parking lot is 1.1-fc with a maximum-to-minimum uniformity of 6:1; meeting the IESNA and AASHTO criteria for basic parking area security.

The lighting plan also considers luminance and veiling luminance visibility factors. The luminance along the CD lanes, ramps and loops is 0.6 cd/m^2 to 0.9 cd/m^2 with average-to-minimum and maximum-to-minimum uniformity levels meeting the IESNA and AASHTO criteria for Freeways. Glare produced by the roadway lighting is quantified in terms of the veiling luminance ratio. Specifying the use of a flat-glass lens or shallow drop lens reduced this ratio to below the recommended value of 0.3.

Efforts have also been made to reduce spill light onto adjacent properties and sky-glow due to up-light.

- The maximum spill light at the VDOT right-of-way line is calculated to be 0.34-fc near the I-81/Rt-460 Bypass interchange. However, the spill light level in this one area averages less than 0.15-fc; less than one-quarter the average roadway illumination. Outside this area, spill light normally does not exceed the level of moonlight.
- Up-light (resulting in sky-glow) is reduced by using only fixtures with cutoff optics to minimize direct upward light radiation from the luminaires. Also, keeping the average illumination on the road as close to the minimum recommended level has minimized the effects of reflected light from the pavement and surrounding grass.

The Electrical Plan

Six lighting control centers are included in the plan. These control centers distribute 480/277-volt, 3-phase power to the lighting system. Their locations have been coordinated with American Electric Power such that they are near existing 3-phase service.

The feeder conductor cables are generally installed in buried conduit or jacked under existing roadways. Where conduit is installed behind the sound walls, exposed metal conduit and flexible metal conduit is secured to the concrete sound wall panels and columns with a strap & back mounting bracket. The predominant conductor cable size throughout the lighting plan is #8-AWG and #4-AWG. However, the size of the conductor cable varies up to #3/0-AWG to compensate for voltage drop.

The plans provided details to connect the existing sign structure “Lumitrack” lighting systems to the roadway lighting system. Specifically, the pay item, “Sign Electrical System”, includes all material and work necessary to energize the existing sign luminaires. Power is also provided to three proposed sign structures that will be installed after this roadway lighting project is awarded to a contractor.

The roadway lighting plans also consider delivering 120/240-volt, single-phase power to four future cameras. This power is provided by a step-down control center included with the new electrical service. Details for the step-down control center, include transformer size, are included with the plan set.

Design Summary

The roadway lighting plans largely use VDOT standard items that can be provided by at least three manufactures and installed using standard construction procedures. Once energized, the lighting will greatly enhance the visibility of this roadway and interchange system. If you have any question regarding this project, please do not hesitate to contact me.

Thank you.

Signature