To: SUPERSEDED BY EB06-004 EFFECTIVE 9/7/06		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 96-027

Title: **Nighttime Construction**

Distribution:		Approved:
☐ Manufacturers (18)	☐ Surveyors (33)	
☒ Main Office (30)	☒ Consultants (34)	
☐ Local Govt. (31)	☐ Contractors/AGC (39)	P. J. Clark, Deputy Chief Engineer (Design) — 4/25/96 Date
☒ Regions/Agencies (32)	☐ _____ ( )	

Superseded Issuances

This engineering instruction supersedes EI 91-004: Night-Time Construction Policy.

Purpose

This instruction revises Department policy and guidance on selecting projects for nighttime construction. This instruction includes the following sections:

This material will eventually be incorporated into the replacement for *Highway Design Manual* Chapter 16, Maintenance of Traffic During Construction.

Effective Date

The policy and guidelines in this instruction are effective immediately. Projects currently under design which will be let prior to April 1, 1996 may continue to be progressed under the policy and guidelines contained in EI 91-004 at the Regional Director's discretion. Projects let on or after April 1, 1996 must comply with the requirements of this instruction to the extent practical, however, projects in Regions 10 and 11 must satisfy the requirements of §20 of the Transportation Law where applicable (see **Policy**, page 2).

Background

The Department first formalized its policy for evaluating whether to perform night work in 1991 with the issuance of EI 91-004. Early in 1995, the following guidelines and specifications for night work were issued:

EI 95-003	Requirements for Maintenance and Protection of Traffic During Nighttime Construction
EI 95-004	Maintenance and Protection of Traffic During Nighttime Operations - Revision to Section 619 of the Standard Specifications
EI 95-005	Lighting for Nighttime Operations - Special Specifications

Later in 1995, the Governor signed legislation[1] requiring the Department to evaluate the feasibility of nighttime construction on many projects in Regions 10 and 11. This instruction fulfills the specific requirements of the law but applies statewide to all Regions. Our projects create inconvenience of varying degrees to the highway user, the people who live and work adjacent to the construction, and those along adjacent routes used by diverted traffic. We need to be diligent in recognizing and mitigating traffic impacts associated with our construction. Each Region should have an on-going procedure to assess project and program impacts.

Policy

The Department's objectives for managing traffic during highway construction are to:

- provide a high level of safety for workers and the public
- minimize congestion and community impacts by maintaining levels of service at close to pre-construction levels
- provide the contractor adequate access to the roadway to complete the work efficiently while meeting the quality requirements of the contract.

Whenever it is not possible to achieve substantial balance among these objectives through traditional maintenance and protection of traffic schemes for daytime construction, the feasibility of nighttime construction shall be evaluated along with other traffic systems management strategies. In addition, for Regions 10 and 11, the feasibility of nighttime construction must be evaluated for "every major limited access highway, expressway and parkway capital construction project ...with a cost of more than two million dollars in region ten, and with a cost of more than five million dollars in region eleven..."[2]

---

[1]Chapter 361 of the Laws of 1995 amending the Transportation Law by adding a new §20, "Nighttime work on major capital construction projects on highways, expressways and parkways".

[2]Transportation Law, §20.

Factors Impacting Nighttime Construction

This section discusses technical, social, economic, and environmental factors affecting, or affected by, work zone construction operations. Some have qualitative attributes while others are quantitative. Reference 7 contains further discussion.

Traffic Related Factors

- Safety - This is a major factor guiding decisions for night construction. At night, poor visibility, inadequate lighting, worker fatigue, driver condition, and substance abuse can cause hazardous situations for drivers, workers and pedestrians. Further, with less traffic at night, motorists tend to drive faster through work zones and pedestrians[3] may be less cautious. The option of total road closure is often feasible in some night situations resulting in a safer environment for drivers, workers, pedestrians, and other road users, especially in areas which challenge conventional traffic control strategies. Safety is also a function of public information programs -- informed road users may expect delays and identify alternative routes or reschedule their travel accordingly.

- Congestion - This is usually the overriding factor in considering nighttime construction. Traffic volumes are generally higher during daytime operations and closing a lane can cause extreme bottlenecking, resulting in queuing, congestion, and consequent delays. During nighttime construction, however, delays and stops may be minimized because of less traffic at night. It is important to analyze 24-hour traffic count data to determine volume distributions throughout the day and night.

- Traffic Control - Traffic control is crucial for night work due to reduced visibility, higher vehicle speed, and greater likelihood of driver impairment caused by fatigue or substance abuse.

Construction Related Factors

- Productivity - Night productivity may be reduced by inadequate lighting; poor worker morale and fatigue; lack of effective communication among agency personnel, contract managers, and field staff; problems with availability and supply of materials and spare parts; and set-up/take-down times for traffic control devices and lighting equipment. On the positive side, less interference from traffic at night improves productivity. Other advantages of night shifts include longer working hours and extended work shifts due to elimination of peak-hour work restrictions.

- Quality - Factors reducing quality are similar to those affecting productivity and include poor visibility, lighting deficiencies, lack of supervision and inspection, and poor worker morale. Factors having positive impacts on quality include less disruption due to lower traffic volumes and cooler temperatures contributing to less rapid drying and shrinkage cracking in concrete pavement and bridge decks placed during warm weather. Conversely,

---

[3]Nearly half of all pedestrian crashes for ages 15 - 24 years occur at night. In addition, visual sensitivity declines significantly for older pedestrians.

during cooler weather, nighttime temperatures may reduce productivity and quality of hot mix asphalt paving.

Social Factors

- Conditions for Workers - These may impact productivity and quality of the final product. Night work usually raises concerns about worker sleep deprivation; fatigue; the effect of circadian rhythms (e.g. an altered biological clock); and social and domestic adjustment difficulties; all of which may contribute to low energy levels, poor morale, and ultimately to reduced worker performance. This also leads to concerns for worker safety. Reduced visibility at night may increase the risks of falls or equipment contacting power lines, etc.

- Conditions for Drivers - At night, fatigue and substance abuse are more common. Some agencies avoid scheduling night work on Fridays and Saturdays because of the higher potential for substance abuse. During daytime, however, anger, frustration, and fatigue caused by delays also pose hazards for drivers and workers.

- Community Concerns

  Noise - More noise near operating businesses or residences can cause problems. Many jurisdictions have established noise ordinances. Construction noise that is acceptable during daytime may be unacceptable at night, particularly when the work is near residential communities. Backup alarms, in particular, can be very annoying in residential areas. Noise is often a problem for which few means of mitigation are available. Noise attributed to construction operations could adversely affect public acceptance of night work. Vibration from pile driving, pavement breaking, etc. may also be objectionable at night.

  Lighting - Glare from lighting for nighttime operations can be annoying to nearby residents.

Economic Factors

- Construction Costs - Night shifts are theoretically more expensive due to overtime and night-premium pay, lighting expense, use of additional traffic control devices, and increased material costs. Some estimate that overall contract costs increase by 10% while the associated cost increase for traffic control is about 25%.

  These increases may be offset by decreased highway-user costs and by increased productivity resulting from more efficient construction operations. It is often possible to entirely close a roadway at night resulting in savings from reduced traffic control and greater operational efficiency. Even when traffic is maintained through the work zone, lower traffic volumes may offset other traffic control requirements, thus lowering overall costs. Early project completion may be possible with less interruption from traffic. Improved site access for equipment and materials may also be a benefit of night work resulting in decreased cost.

- User Costs - Night operations reduce user costs because of less disruption of traffic. Fewer delays for users translate into lower user/vehicle operating costs and substantial time savings. User costs are higher during daytime shifts due to longer delays which increase vehicle operating costs and travel times for drivers.

- Accident Costs - Factors affecting night accident rates include poor visibility, inadequate lighting, inadequate public announcements of night operations, lane closure duration decreasing or increasing exposure to hazardous conditions, proportion of lanes closed, type of work being done, length of the closure, and type of traffic control devices. Heavy daytime traffic in work zones may cause more accidents while less traffic at night may result in a safer work zone for drivers and workers (because there is less exposure to vehicles from less volume), even though vehicle speeds may be higher.

- Business Losses - Impacts on local business resulting from delays, congestion, and access difficulties during the day may be lessened by night work schedules.

Environmental Factors

- Air Quality - Reduced congestion, shorter delays, fewer stops, and enhanced mobility translate into reduced vehicle emissions. Since night work usually results in these benefits, it may be an environmentally friendlier alternative, particularly in areas having poor air quality.

- Fuel Consumption - This increases with delays and stops by vehicles passing through a construction zone or using long detours and may be mitigated by improved traffic flow at night.

Other Factors

- Scheduling - Problems involving scheduling for night work include the time needed to set up traffic control devices and remove them before the morning rush hour and scheduling work hours for agency inspectors, engineers-in-charge, and Regional management and support staff. Although night worker scheduling is difficult, task scheduling and materials deliveries may be easier at night.

- Public Relations - An adequate information campaign helps to minimizes congestion and enhances mobility. Dissemination of information about project location, duration, and type of work results in motorists adjusting their routes and schedules, and better public attitudes toward delays and noise.

- Lighting - This has a considerable effect on quality, productivity, and safety. Adequate lighting makes construction operations at night nearly as good as by day. Lighting levels must be adequate for efficient operations but glare must not create a hazard for motorists or workers.

- Availability of Materials, Equipment, Equipment Repair, Supervision, and Communication - Business hours of material suppliers do not commonly extend into the night, but if they do, material prices may be higher. Equipment breakdown may disrupt work, leading to loss of productivity. Equipment repair may be a problem at night, machines or parts may not be available until the next day. Lack of communication and supervision are also factors that may adversely affect night operations. Remote offices closed at night make on-site decisions difficult.

Evaluating Nighttime vs Daytime Construction

This section outlines basic guidelines for evaluating night construction against other alternative work schedules and maintenance and protection of traffic schemes including:

- Transportation systems management/transportation demand management (TSM/TDM)
- Construction phasing and scheduling
- Temporary roadways/pavement
- Temporary bridges
- Detours
- Incentive/Disincentive clauses
- A+B bidding
- Lane rental

It should be noted that nighttime work may only be necessary for those phases and operations which would be most disruptive to traffic if performed during daytime.

Identify Traffic Control Alternatives

When developing traffic control alternatives, the following information is normally compiled:

- Work activity in terms of road space needs
- Duration of the work
- Traffic conditions prevailing in the work area while work is underway
- Physical characteristics of the facility in the work area: lane width, shoulder type and width, right-of-way width, and median type and width
- Other nearby projects and activities that may impact traffic
- Availability of other routes, service roads, etc. to divert or detour traffic
- Potential traffic flow impacts on adjoining areas; i.e. detours through or adjacent to residential areas and access needs of adjacent properties
- Traffic data including 24-hour volume counts, speed data, accident history, daily and seasonal peak volumes, etc.

Based on this information, traffic control alternatives and strategies are identified which may be appropriate for the type of work activity (e.g., lane constrictions, lane closures, shared rights-of-way, median crossovers or other temporary diversions, intermittent closures, use of shoulders or medians, detours, service roads/parallel facilities, etc.).

Analyze Volume/Capacity Relationships

Next, the work zone capacities of the various traffic control alternatives are determined and compared to the traffic volumes expected to use the facility. If volume exceeds capacity, queue length, duration, and resulting delays should be calculated.

"Unacceptable congestion" is difficult to define and is not the same among urban/rural, upstate/downstate areas and, therefore, must be determined by local norms. However, when determining whether congestion is unacceptable on a specific project it is necessary to consider, as a minimum, changes in level of service during construction, queue length/duration and resulting delay, and disruption of access to businesses and to travel patterns through the community. As a general guideline, a drop in the level-of-service to level E or F from pre-construction levels of A, B, C, or D would usually be considered unacceptable. Likewise, for facilities with pre-construction levels-of-service already in the E/F range, a 50% increase in average delay per vehicle over pre-construction conditions would probably be considered unacceptable.

Identify Techniques to Reduce Delays and Congestion

If work zone capacity generated by the alternative traffic control strategies will produce unacceptable congestion, additional techniques should be considered to reduce delays and congestion. If not already included as an alternative, nighttime construction[4] should now be analyzed along with other techniques to reduce congestion such as trip diversion to other corridors, diversion within the corridor, diversion to other travel modes, trip reduction through use of high-occupancy vehicles and/or other TSM/TDM strategies

Note that a night schedule <u>may</u> offer a wider range of traffic control options than a day schedule. For example, an extra lane closure or entire roadway closure that might not be possible during daytime may be possible at night. However, even at night, unacceptable congestion may occur on some facilities and supplementary TSM/TDM schemes may be necessary.

Quantify Impacts

The comparison of alternative traffic control strategies requires quantitative and qualitative assessments of various factors.

<u>Quantitative Analysis</u>

This involves the computation of user costs (generally consisting of traffic delay costs plus vehicle operating costs) and construction costs associated with the various alternatives. Planning has developed a User Cost Analysis Microcomputer Program. The user cost analysis may be run in the Regional Planning office.

---

[4]Regions 10 and 11 need to consider nighttime construction on "every major limited access highway, expressway and parkway capital construction project...with a cost of more than two million dollars in region 10 , and with a cost of more than five million dollars in region 11..."

Qualitative Assessment

It is usually necessary to consider a number of "non-quantifiable" factors when evaluating the various traffic control alternatives. These may include safety, work quality, air quality, noise impact, energy consumption, business impacts, etc. The specific factors to include in a qualitative assessment will vary from project to project. Factors which are not significantly different between the traffic control alternatives can usually be omitted from the analysis. (However, if one or more critical factors are severe for all alternatives, additional alternatives should be developed which address these factors.) It is suggested that the factors to be considered be combined under the three primary traffic control objectives for analysis; i.e. safety, community impact, and constructability.

Safety - Evaluate hazard potential: ability of traffic control strategy to minimize hazards, level of risk of operations, visibility levels for workers and motorists.

Community Impacts - Local conditions and attitudes will determine the relative importance of noise from construction; glare from high intensity lighting; the impacts and inconvenience of traffic detours, congestion, and interference with access; and environmental impacts; etc.

Constructability - Assess the relative adequacy of the contractor's access to the work site, the relative efficiency of work operations, and relative quality of work under the various alternatives.

If factors other than those discussed earlier are considered relevant, they should be included in these objectives or additional objectives should be added.

Select Preferred Control Alternative

When both quantitative and qualitative assessments are completed, results for each alternative are compared to assist in selecting the preferred alternative. The comparative analysis is based on cost-effectiveness - the concept combining the quantitative and qualitative factors for each alternative. This method is the most suitable because of the magnitude of qualitative factors in night operations (e.g. safety, community impacts, noise, quality, condition of workers and drivers, environmental impacts, etc.). Impacts of those factors are adequately estimated in the following cost-effectiveness procedure:

1. Determine the relative importance of each objective and assign a relative weight (1 - 3) to each, with 1 being the baseline weight. A weight of 2 is assigned if the objective includes factors that are especially relevant to the project for identifiable reasons/concerns. A weight of 3 is assigned when the objective includes factors that are absolutely critical for the project.

2. Rate the alternatives for each objective on a scale of 1 to 4 as follows:

   4 - the objective can be achieved such that there is no adverse impact
   3 - small adverse impact, typical of normally accepted construction impacts
   2 - substantial negative impact, borderline acceptable for this objective
   1 - unacceptable impact, objective not achieved at an acceptable level

3. Compute an effectiveness score for each traffic control alternative by multiplying the objective weight by its rating, and then summing to obtain a single effectiveness rating for each alternative.

4. Compare the effectiveness rating for each alternative with the quantitative costs computed (i.e., user and construction costs) in an effectiveness-cost ratio. The alternative having the highest ratio is considered the best.

The table below gives an example of this technique. The table indicates the objectives with weights assigned and the ratings for each alternative. The total effectiveness rating is then measured against the alternative's total cost (user cost + construction cost). The alternative with the highest ratio of effectiveness to cost is the most cost-effective alternative (e.g. alternate C in the example).

Objective	Weight	Alternate A Cost $5.0 M		Alternate B Cost $6.0 M		Alternate C Cost $5.5 M	
		Rating	Score	Rating	Score	Rating	Score
Safety	1	2	2	3	3	3	3
Community Impact	2	3	6	2	4	4	8
Constructability	1	3	3	2	2	3	3
Effectiveness Rating			11		9		14
Effectiveness/Cost Ratio			2.20		1.50		2.55

Using the step-by-step procedures outlined here allows evaluators to conduct an objective analysis tailored to local circumstances and public attitudes. The final decision on which traffic control alternative to use is made in conjunction with the granting of design approval (see **Relationship to Project Development Process** below).

Documentation

The analysis and recommendation are documented in the project design approval document. If the analysis is particularly lengthy and complex, it might be appropriate to include the details in a technical appendix and include only a summary in the design approval document. Refer to *Design Procedure Manual* Appendix B.

Relationship to Project Development Process

Consistent with the provisions of the *Scoping Procedure Manual*, evaluation of strategies for managing traffic during construction begins during project scoping. This evaluation is further refined during preliminary design. The number of alternatives developed and the level of detail required will vary from project to project. The level of detail of the traffic management plan should be consistent with that of the design alternatives and should be of sufficient detail to support the project environmental findings and design recommendation.

The development of construction traffic management alternatives involving nighttime construction and/or other traffic systems management strategies should usually include a comprehensive community participation process.

The final decision on which traffic control alternative to use is made in conjunction with the granting of design approval in accordance with the *Design Procedure Manual*. Proposals involving nighttime construction should be coordinated with the Regional Construction Engineer and other Regional program managers impacted by the decision.

The "Notice of Design Approval" should include the approved traffic control alternative in the discussion of the approved project alternative. Refer to *Design Procedure Manual* Appendix D.

Evaluating Nighttime Proposals for Projects Under Construction

Proposals for nighttime operations advanced during the construction phase (by the Department or by the contractor) should be evaluated at a level of detail appropriate for the duration, urgency, risk, and potential sensitivity of the proposal at hand.

In principle, the contractor has flexibility (within constraints imposed by the contract, its specifications, and applicable local/State laws) to undertake nighttime construction if it is of economic or other benefit to the firm. The Regional Director has the responsibility and right to place limits on that flexibility in the public interest. Appropriate Regional group managers should normally be given the opportunity to review such proposals in non-emergency situations.

Work Hour Restrictions for Nighttime Construction

Work hour restrictions for nighttime operations are based on the specific traffic conditions in the project area. Lane or roadway closures would not begin until after the afternoon or evening peak and the road would have to be back in full service before the morning peak begins. However, for those projects in Regions 10 and 11 which come under §20 of the Transportation Law[5], consideration should be given to whether work may be performed earlier than 8 p.m. or later than 6 a.m.

When evaluating work hour restrictions, it is important to analyze 24-hour traffic count data to determine volume distributions throughout the day and night.

Questions

Questions may be referred to Steve Witham at (518) 457-7284.

---

[5]"every major limited access highway, expressway and parkway capital construction project ...with a cost of more than two million dollars in region ten, and with a cost of more than five million dollars in region eleven..."

References

1. EI 91-001 Method of Traffic Maintenance During Construction
2. EI 91-030 Plan Review by Regional Construction Group/Independent Constructability Review
3. EI 93-030 Dedicated Police Services on Department Construction Projects
4. EI 95-003 Requirements for Maintenance and Protection of Traffic During Nighttime Construction
5. EI 95-004 Maintenance and Protection of Traffic During Nighttime Construction - Revision to Section 619 of the Standard Specifications
6. EI 95-005 Lighting for Nighttime Operations - Special Specifications
7. Elrahman, O.A., and Perry, R.J., *Night-Time Construction Operations*. Special Report 116, NYSDOT Transportation Research & Development Bureau, December 1994.
8. Abrams, C.M., and Wang, J.J. *Planning and Scheduling Work Zone Traffic Control.* FHWA-IP-81-6, Federal Highway Administration, October 1981.
9. Applied Resources Inc. *Transportation Alternatives During Highway Reconstruction.* FHWA-HI-89-027, Federal Highway Administration, August 1989. Text for National Highway Institute course 13355.
10. *Highway Capacity Manual*. Special Report 209, Transportation Research Board, 1994.
11. *Design Procedure Manual*, NYSDOT Design Division, July 1994.
12. *Scoping Procedure Manual*, NYSDOT Planning Division, April 1993
13. User Cost Analysis Microcomputer Program, NYSDOT Planning Division