

NIGHTTIME ROAD CONSTRUCTION:

CURRENT ISSUES

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EXECUTIVE SUMMARY

Due to budget constraints and aging infrastructure, the amount of new roadway construction is very limited and the amount of reconstruction and maintenance performed on the existing system has greatly increased. As the existing systems are operating at or near capacity, the delays attributed to road work to users are unacceptable. To minimize user delay, road work and maintenance are starting to be performed at off peak times, mostly at night. Working at off peak times also reduces the vehicle exposure rates for road workers. Special circumstances are introduced with working at night and agencies are setting up guidelines to implement during nighttime road work. A trade off between road users, road workers, and public surrounding the work zone must be met to ensure a timely, cost affective and good public attitude toward the project. The research illustrates the interaction between several components of nighttime road work. Adequate lighting, traffic control devices, and public involvement are the key components of nighttime road work.

INTRODUCTION

High traffic volumes on many highways make it difficult to perform work operations in or near travel lanes during much of the day because of the disruption in traffic flow and the risk this introduces for the workers and the traveling public. As a result of these concerns, all kinds of highway work are increasingly scheduled for off-peak periods, particularly at night, to alleviate the problems associated with working in traffic. An increased amount of nighttime highway work is being performed on both divided and undivided highways in urban and rural settings to minimize the congestion effects of daytime reductions in capacity and/or to accelerate the work. Nighttime highway work often reduces delay to the users but imposes more constraints to contractors. 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.

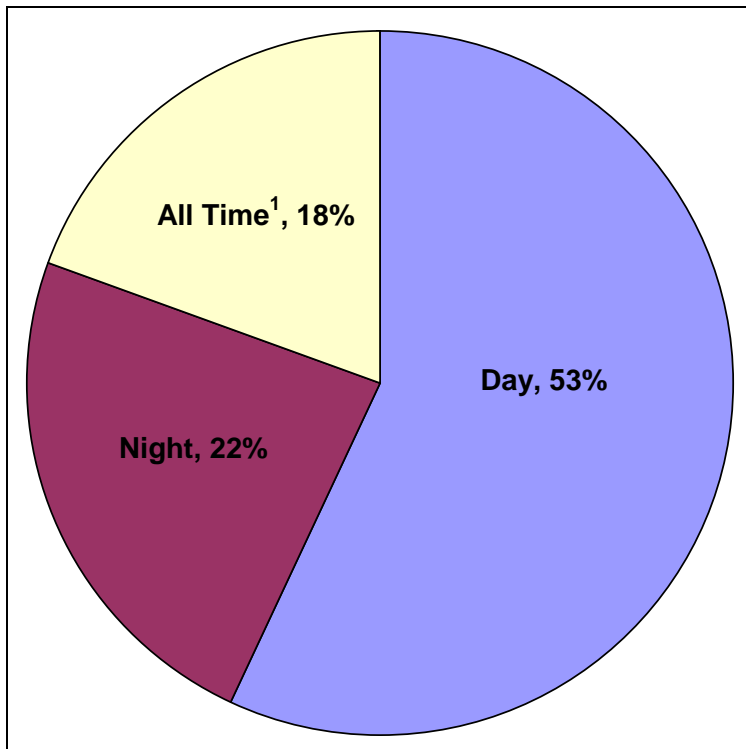
ISSUES

Background

Congestion is usually the overriding factor in considering nighttime construction. Traffic volumes are generally higher during daytime operations and lane closures can cause extreme bottlenecks, resulting in queuing, congestion, and consequent delays. During nighttime construction, however, delays and stops may be minimized because of the decrease in traffic volume at night. However it is important to analyze 24-hour traffic count data to determine volume distributions throughout the day and night to make sure that there is an adequate decrease in traffic volumes to warrant nighttime construction. Providing information to users of the systems is essential to minimizing congestion and enhances mobility. With sufficient information given to users about project location, duration, and type of work, motorists are able to adjust their routes and schedules and also better public attitudes toward delays and noise.

Research included a review of current practices for nighttime highway work and illumination and preparation of preliminary guidelines that address visibility requirements, lighting equipment, lighting

configuration and arrangement, lighting system design, system operation and maintenance, and economic considerations. A survey of transportation agencies revealed that nighttime construction and maintenance work is performed by at least 28 state departments of transportation (DOT). Of the 28 DOTs responding to the survey, the amount of work was broken down into three categories by time of day that the work was being performed. The three categories are day time only, nighttime only, and all day or at least eighteen hours of the day. Figure 1 illustrates the percentages of work being performed for each category (U.S. DOT http://ops.fhwa.dot.gov/wz/resources/facts_stats.htm). Still the majority of road work is performed during the day but nighttime work and particularly all day work are continuing to be more prevalent. The type of work being performed is also a factor when choosing to perform work at night.



(1-All Time is all day or more than 18 hours)

Figure 1. Time of Day Road Construction is Being Performed.

The construction activities most commonly performed at night are:

- resurfacing, barrier walls
- traffic separators
- milling and surface removal

- marking and stripe painting
- bridge deck construction
- concrete pavement construction
- base course construction
- ditch and channel excavation
- embankment filling and compaction
- highway signing

The maintenance activities most commonly performed at night are:

- sweeping and cleanup
- concrete pavement repair
- bridge deck rehabilitation and maintenance
- resurfacing
- milling and surface removal
- lighting system repair
- traffic signal maintenance
- marking and stripe painting
- surface treatment
- barrier walls

Safety

Safety is an important issue facing nighttime construction. At night, poor visibility, inadequate lighting, worker fatigue, and driver condition cause hazardous situations for drivers, workers and pedestrians.

The problems with visibility need to be addressed by a well-designed traffic control and lighting plan with properly designed and maintained devices and equipment. Factors affecting night accident rates include the following:

- 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
- type of traffic control devices

Further, with less traffic at night, motorists tend to drive faster through work zones and pedestrians also tend to be less cautious. The option of total road closure is often feasible in some nighttime situations resulting in a safer environment for drivers, workers, pedestrians, and other road users, especially in areas which challenge conventional traffic control strategies. Also keeping the public aware when and what type of work is being performed increases safety of nighttime work. 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.

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. Nighttime work has not been contributed to any increase in worker related fatalities. From 1992-2000 there were 910 worker fatalities in work zones nationwide (Bryden). Figure 2 shows the number of worker fatalities in highway work zones by light condition and by vehicle type. Of the 910 fatalities, only 95 fatalities occurred during twilight or dark conditions. To ensure worker safety, the worker must be visible to the road user. The worker in Figure 3 demonstrates how to be clearly visible to the road users by wearing the proper worker attire and by being in adequate lighting when in close proximity to moving traffic.

Advantages of night shifts include longer working hours and extended work shifts due to elimination of peak-hour work restrictions. However 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. Other risks

posed to workers due to reduced visibility at night may be an increase risk of falls or equipment contacting power lines, etc.

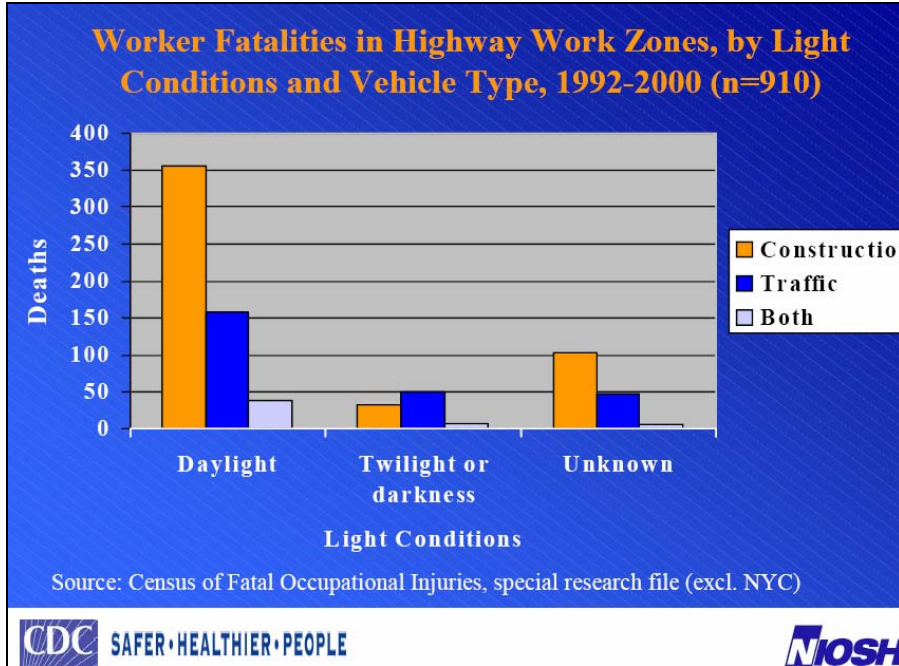


Figure 2. Worker Fatalities in Highway Work Zones

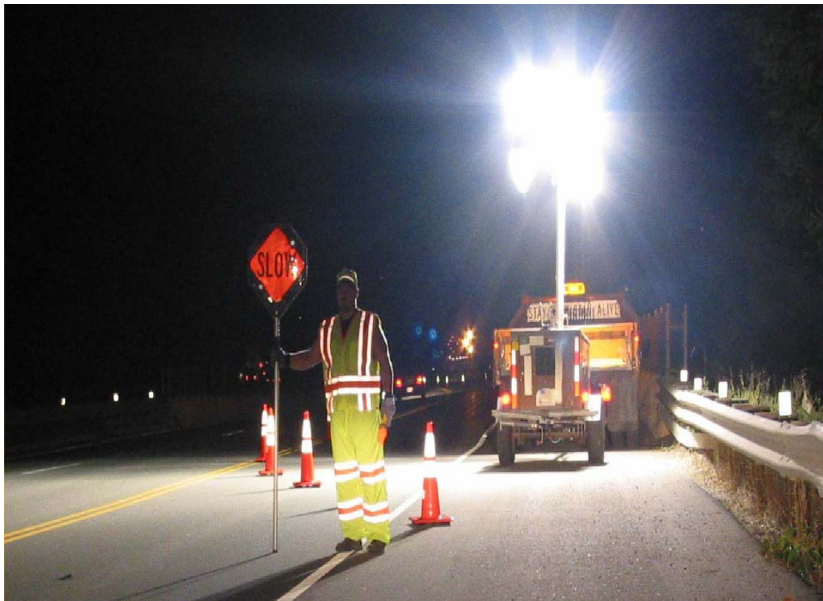


Figure 3. Proper Worker Attire and Lighting (Bryden).

PROBLEMS

Traffic Control

The most common problems with nighttime work reported by agencies are quality of work, additional cost, community resistance, and traffic control devices are frequently misused and poorly maintained. Traffic control devices are crucial for nighttime work due to reduced visibility, higher vehicle speed, and greater likelihood of driver impairment caused by fatigue or substance abuse. Special considerations must be taken in to account when designing traffic controls for nighttime work. In particular, driver expectation can easily be violated by nighttime work traffic control devices because of the placing and removal of these devices nightly. A driver traveling along a route during the day is not exposed to any traffic control devices, but at night the driver traveling along the same route will experience the presence of traffic control devices. Also, drivers are not exposed to many work zones that perform construction at night.

To limit violation of driver expectancy, traffic control devices must follow consistent guidelines. The 2000 edition of *Manual on Uniform Traffic Control Devices (MUTCD)* provides standards and guidelines for traffic control devices but has little guidance on how to implement these guidelines with the specific situations involved in nighttime work. So the National Cooperative Highway Research Program (NCHRP) conducted a study that reviewed current traffic control guidelines and made recommendations and set new guidelines based off of current guidelines. The NCHRP published *Report 476: Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction* as a current guide for nighttime work traffic control devices. The guidelines present planning for effective channelization of traffic and the effective use of signing and advanced warning systems. Figure 4 shows an example of guidelines set from *NCHRP Report 476* for proper channelization and advanced warning.

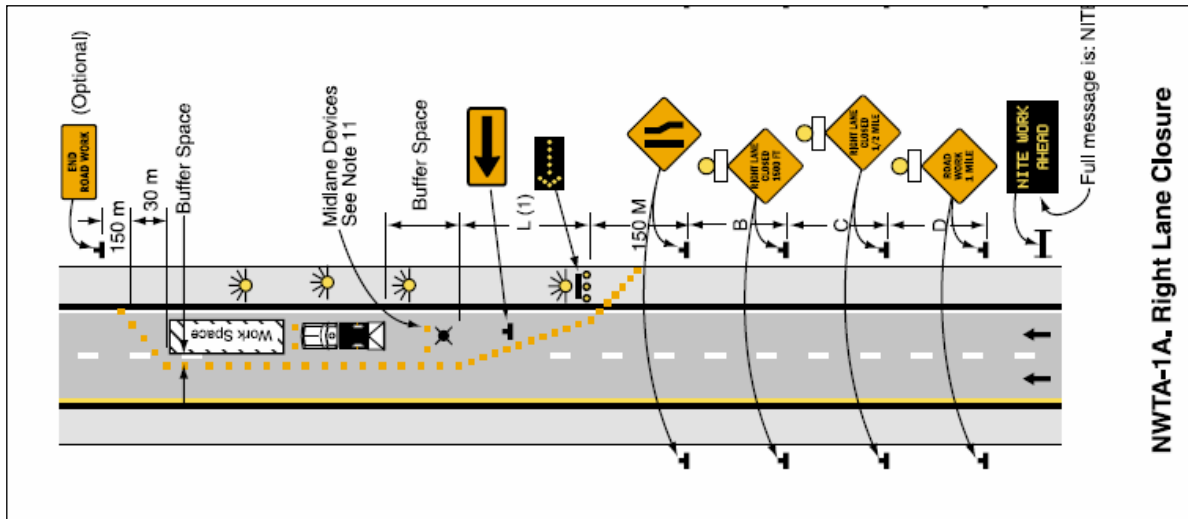


Figure 4. Guidelines for Traffic Control Devices for Nighttime Road Work (NCHRP Report 476).

Environmental Impacts

Nighttime work productivity and the quality of work 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 and quality. Nighttime temperatures have an effect on construction. Cooler temperatures contribute to less rapid drying and shrinkage cracking in concrete pavement and bridge decks placed during warm weather. Conversely, during cooler weather, nighttime temperatures may reduce productivity and quality of hot mix asphalt paving.

Environmental issues such as noise, vibrations, and lighting become more prevalent to the public at night. Construction noise that is acceptable during daytime may be unacceptable at night, particularly when the work is near residential communities. A survey of the fifty DOTs identified the source of noise that received the considerable amount of complaints from the public during nighttime construction. The percentages of complaints received by the DOTs by noise type are listed in Table 1 (U.S. DOT http://ops.fhwa.dot.gov/wz/workshops/accessible/Schexnayder_paper.htm).

Table 1. Nighttime Construction Noise Generators

Noise Generator	Percent of DOTs Identifying as Cause of Noise Disturbance
Back-up Alarm	41%
Slamming Tailgates	27%
Hoe Rams	24%
Milling/Grinding Machines	16%
Earthmoving Equipment	14%
Crushers	6%

The majority of all noise produced at a construction site is from construction equipment. To ensure minimal noise pollution, enforcement of the contractor to have properly working and up to date equipment is needed. Backup alarms are the major cause of noise complaints in the DOTs surveyed. Proper mounting of back-up warning alarms is one way to alleviate noise pollution. Also good planning will decrease the noise produced from back-up warning alarms by reducing the number of backwards movements and/or by having a worker guide the backing vehicle so that the volume of the back-up alarm may be turned down to a lower decibel. Vibration and noise from pile driving, pavement breaking, etc. may also be objectionable at night. 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.

Lighting 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. NCHRP has published *Report 498 Illumination Guidelines for Nighttime Highway Work* to establish guidelines for proper lighting of nighttime work projects. These guidelines take into consideration the effects of lighting on road users, workers, and the surrounding areas and the interaction between the three. Light pollution also becomes a major issue in the public's attitudes towards nighttime road work.

CONCLUSION

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 because of less disruption of traffic and by increased productivity resulting from more efficient construction operations. 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. 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. Night operations reduce impacts on local businesses resulting from delays, congestion, and access difficulties during the day may be lessened by night work schedules. 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 as 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 onsite decisions difficult.

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