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## OVERVIEW OF NIGHT-TIME ROAD CONSTRUCTION ACTIVITIES: THE FACTORS, EFFECT AND SAFETY MEASURES

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### Abstract

*This paper gives an overview of night-time road construction activities. The objective is to give an idea on why road construction is conducted during night-time and its effects. This paper will include the criteria in determining whether to conduct road construction work at night-time or not. This paper will also look into details for implications that night-time construction will have on a project, namely in terms of safety, productivity, quality and welfare of workers. This paper will then study on how to avoid the negative impact of night-time road construction works, especially the safety impact through gathering and studying literatures.*

**Keywords:** Night-Time, Road Construction, Factors, Effect, Safety Measures

### 1. Introduction

Traffic congestion has been a serious problem in many major cities all around the world. In certain areas, cars and other vehicles pack highways to the point where these wide roads resemble more to roadways and rush hour traffic condition can last the whole working hours. As a result, any attempt to conduct maintenance or repair works during working hours and a few hours after that may almost definitely result to serious traffic problems and congestion. Furthermore, the habit of driving during day-time in holiday seasons may also result to the same problem if highway maintenance were to be carried out. As a result, some contractors or local authorities will opt for conducting works during night-time. However, not only night-time works won't necessarily mean the end of traffic congestion problems, it may also lead to other problems, especially in terms of safety of the workers and road users.

In general, night-time road construction activities may seem as the best option compared to day-time works in order to avoid traffic congestion problems especially when it comes to major roads and highways. There are many factors that can be looked into before determining whether to conduct works at night or not, but it mainly comes down to two important factors (Hinze and Carlisle, 1990), and they are:

Table 1: Factors in Determining Night-Time Construction

Factors	Explanation
Traffic pattern analysis	The characteristic of the road and the effect of lane closure towards the traffic must be determined. This can be done by either using empirical methods or analytical methods. Data can be obtained by conducting traffic counts on the said road and having a basis of knowledge of the lane capacities if work is to be conducted which can be obtained from past experience.
Cost implication analysis	Night-time construction activities have its economic implication too. The costs associated are mainly construction cost, user cost, accident cost and also maintenance cost.

## 2. Effects of Night-Time Road Construction Activities

Choosing to conduct road construction activities at night will have its implication due to its different working conditions compared to working during the day. Even if traffic congestion problems may be solved, workers may not be accustomed to the changed environment at night. This may result to unnecessary accidents and mishaps to occur which may effect the works, workers or even the road users. The following is a list of implication of conducting road construction activities at night compared to day-time operation.

Table 2: Effects of Nigh-Time Construction Activities

Implication	Explanation
Safety	<p>Like all construction site, safety is of the most important factor to be looked at. Failure to ensure safety will lead to accidents and even death to occur, even at a road works site. A night-time road construction zone should ensure the safety of works, workers or the general public.</p> <p>According to Elrahman (2008), an analysis had shown that crash rates per 100 hours of road work per mile were much higher during the day compared to the ones at night and that there is a slightly greater percentage of severe night-time crashes before night work and during night work as compare to day-time crashes. However, lower traffic demand at night can result in fewer crashes over the duration of the project.</p> <p>According to Hinze (1990), there are many variables that may contribute to accidents at night work zone such as the duration of the closure, the proportion of closed lanes, the type of work being done, the length of the closure or the variety of the traffic control devices in place.</p> <p>Elrahman (2008) and Shepard and Cottrell (1985) also mentioned that nigh time work zones tend to be more dangerous primarily because of the influence of alcohol and drugs, drowsiness, higher speeds and decreased visibility.</p> <p>Several studies have been conducted and most of them have concluded that there are no real substantial differences in terms of worker productivity between night-time and day-time construction works (Ellis et. al, 1993, Dunston et. al, 2000, Colbert, 2003 and Elrahman, 2008).</p>
Productivity	<p>However, Hinze and Carlisle (1990) did state that communication between the client's, contractor's and site personnel would become a problem during night-time since not all of them will be working at that time, thus making decision making difficult and leading to works being delayed.</p> <p>According to Abraham et. al. (2007), quality of works would be affected at night due to inadequate lighting. Besides that, Park et. al. (2001) reported that paving operations that the quality of works were 3% less at night than during the day.</p> <p>On the other hand, according to Elrahman (2008), Hacher and Taylor (2001) and Al-Kaisy and Nassar (2002) had found out that the cooler condition at associated with working at night can actually increase night-time work quality.</p>
Quality	<p>The effect of quality during night-time construction is difficult to conclude since each work has its own specification and requirement. Price (1986) states that roller marks for paving project became more apparent at night, which may be caused by the rapid cooling at night, where on the other hand will result to placement of certain types of Portland cement paving to become easier.</p> <p>There is only a small number of research conducted on the physical and mental effects of night-time works towards the workers. Carpentier and Cazamian (1977) stated that the disruption of the normal human biological sleep cycle may lead to various physiological and psychological stresses to a person, while according to Holguin-Veras et. al. (2001) mentioned that 20% of workers engaged in night shift activities report sleep-realated disorders.</p>
Workers	

### 3. Safety Measures in Avoiding Night-Time Construction Problems

Night-time construction was intended as an alternative to day-time construction in order to avoid traffic problems during the working hours (Back and Bell, 2004). However, as explained earlier, this alternative may have several impacts towards the work itself and also its surrounding, both positively and negatively. Several steps can be taken in order to minimise night-time work activities in order to maximise its positive impact towards the project, such as:

Several researches have been conducted regarding this method and all of them have their own opinion on this matter. In order to avoid negative impact towards workers, Shepard and Cottrel (1985) stated that night-time works should comprise of a volunteered workers, projects with short duration, good human relations amongst workers and also a good planning of works.

According to Liska et. al (1993), a safety management philosophy which has emphasize on zero-accident techniques should be used in order to promote safety in a construction site. Among the five high-impacts zero accident techniques identified by Liska et. al (1993) are:

- i. Pre-project/pre-task planning for safety,
- ii. Safety orientation and training,
- iii. Written safety and incentive programs,
- iv. Alcohol and substance abuse programs
- v. Accident/incident investigation

Based on his research, Toole (2002) has listed down eight root causes of construction accidents. He then identified the factors to prevent these root causes from occurring in a construction site. The following are his finding:

Table 3: Root Causes and Factors to Prevent Construction Accidents (Toole, 2002)

Root Cause	Description	Factors to Prevent Root Cause
Lack of proper training	An employee was not properly trained in recognizing and avoiding job hazards.	Have expertise in task, have expertise in training requirements, able to interview, test, or observe employee, have access to prior training records.
Deficient enforcement of safety	An employee's supervisor (or other individual with safety oversight responsibilities) knew that prescribed methods for avoiding hazards were not being followed, but neglected to enforce safety standards.	Able to monitor work on frequent basis, know safety requirements for task, able to enforce safety.
Safety equipment not provided	An employer does not provide an employee with equipment necessary to minimize hazards.	Know what safety equipment is required for task, able to provide and enforce use of equipment, know inspection and maintenance history of equipment being used
Unsafe methods or sequencing	The normal sequencing of construction tasks does not occur, resulting in a task being inherently more hazardous than is typical.	Know standard methods and sequencing for task, able to observe actual methods and sequencing, able to control methods and sequencing
Unsafe site conditions	The site is inherently more hazardous than are typical construction sites.	Know proper site conditions, able to observe actual site conditions, able to control site conditions.
Not using provided safety equipment	An employee is provided with proper safety equipment but does not use it properly or does not use it at all.	Able to observe employee constantly, able to influence behavior through evaluations, and so on
Poor attitude toward safety	An employee may have been properly trained, but does not properly avoid job hazards due to a "tough-guy" mentality, laziness, or a perception that prescribed methods would unduly slow job progress.	Interact with worker frequently, able to influence attitude through evaluations, and so forth
Isolated, sudden deviation from prescribed behavior	A normally competent and safety-conscious employee suddenly and unforeseeably performs an unsafe act due to fatigue, preoccupation, or likewise.	Cannot predict or prevent unless employee's emotional or physical condition contributed and this condition was obvious to others

According to Arditi et. al. (2005), using high visibility garments in the form on safety vests may help in ensuring the safety of workers and personnel in a night-time road construction site. The study further explained that safety garment worn in night-time activities should be highly visible, conspicuous, reflective, wearable, durable, comfortable, suitably configured and perceived to be effective (Arditi et. al. 2005).

Hancher et. al. (2007) proposed the use of "safety climate" during night-time construction in order to avoid unwanted incidents. According to Mohamed (2002), "safety climate" was born from the idea that the majority of accidents are not caused by careless workers, but by failure in control, which ultimately is the responsibility of

the manager. Among the ten factors that contributes towards a safer night-time working condition are management commitment, the two-way communication between employer and employee, safety rules and procedures, a supportive workplace environment, high degree of supervision, the involvement of worker or employee in decision making, personal appreciation of risk, appraisal of physical work environment and work hazards, work pressure and also work competence.

In addition to that, Hancher et. al. (2007) suggested a few other ideas in order to make night-time road construction zone much safer, where one of them is evaluating the use of rumble strips. Based on his study, Hancher et. al. (2007) believed that the use of rumble strip is not effective as it should have been. Besides that, the use of balsi beam, which is a form of portable work zone barriers which can be set up in a matter of minutes, is also proposed by Hancher et. al. (2007). According to Araya (2006), the purpose of having balsi beam is to protect employees working on highways from errant vehicles travelling at highway speeds.

#### 4. Conclusion

Night-time construction works can be used as an alternative to day-time construction works in order to avoid traffic and other related problems during working hours. Among the most important aspects that is looked into before deciding whether to opt for night-time construction or not are the traffic pattern analysis and also cost implication analysis. Both these factors should be thoroughly deliberated between the contractors and also local authorities in order to ensure the comfort of the road users and not interfering with their daily activities. Night-time road construction activities undoubtedly have its advantages. However, it also has its own negative impact towards a construction site and also the people around it, such as impact in terms of safety, the productivity of workers, the quality of work on site and also how the workers might react to night-time working conditions. All of these factors along with other related effect must be looked into deeply in order to avoid unwanted mishaps and tragedy from happening, as it may involve time and cost. But that doesn't necessarily mean that contractors or other bodies would have to forget altogether about having construction works performed at night. This is because, measures can be taken in order to avoid the negative impacts from occurring. These measures are more focused on the safety aspect on site as it may involve the loss of live, where it involves the safety of the workers, the general public and also the work itself.

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