

# A Comparative study of sleep efficiency among construction labour through application method and Fit-bit method

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## ABSTRACT

The sleep disturbances of laborers at work lead to acute anxiety and stress stemming from the construction workplace. The sleep deprivation study was conducted on construction laborers in Bengaluru, Karnataka. The paper represents sleep immunity and sleep scores, which track productivity at the construction site. The outcome shows the interconnection between sleep patterns and labour productivity, relating to the concentration level and performance at work. There was a comparative study performed on the calculation of the sleep cycle between the application method and the fit-bit method. The decision-making structure has been interpreted as being sleep-related work, which is related to laborers and may result from an effective decision to withhold the work done by laborers. The productivity of labour in the construction industry has been decreased by up to 12% due to a lack of insufficient sleep. The sleep cycle summarizes the practical implementation of the productivity of labour in the construction industry, which has been decreasing gradually due to a lack of sleep.

**Keywords: Sleep immunity, Labour's performance, Acute anxiety, Sleep score**

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## 1.INTRODUCTION

The construction sector in India exercises a prioritized role in development, as it generates investment opportunities [1]. The industry is split and occupied by high-ranking companies that are a part of many construction sectors. Construction labour productivity is influenced by factors such as technology, labour organization, management, overtime and turnover, real wage trends, and sleep deprivation [2-4]. The improper sleep of laborers will cause accidents while they are working on-site and reduce the productivity of workers at the construction site [5,6]. The body condition of the mind, which typically recollects for many hours every night, states that the nervous system is inactive; thus, there will be closed eyes, the muscles relax, and practically consciousness is suspended [7-10]. The symptoms of sleep deprivation are droopy eyelids and general discomfort.

Sleep is considered periodically as the state of body and mind and can be characterized by altering consciousness, which is inhibited by sensory activity, which reduces the activity of muscles and inhibition of nearly all muscles that are voluntary active during rapid eye movement sleep and can be reduced by surrounding interaction [11]. The suggested sleep time for aged people is 7 to 8 hours a night. Few human beings need 6 hours or 9 hours of sleep in a day. Adults over the age of 75 require 7-8 hours of sleep per day [12]. During pregnancy, women require several hours of rest. A human being usually sleeps for eight hours during the night at the age of 50 and more than five and a half hours a night between the ages of 45 and 50. A 75-year-old in good health requires approximately six and a half hours of sleep per night [13–15]. The restoration of body powers is performed during natural periodic sleep [16]. Natural periodic sleep time is associated with psychological and subjective nature, with overall life satisfaction [17]. If the quality of sleep is not of sufficient quality, it will impact walking activities and could even affect long-term health [16]. The sleeping hours of individuals are 6 hours or less, contributing 70% to the higher mortality rate than those who sleep 7 or 8 hours during the night [17]. There are five stages of sleep in a human being: awake sleep, deep sleep, light sleep, and REM sleep [18]. Rem sleep is divided into two types: rapid eye movement sleep and nonrapid eye movement sleep [19]. The pattern of sleep that has been recorded provides the sleep score after the calculation of different stages of sleep [20].

Sleep deprivation has an effect on shift workers that will gradually decrease the productivity growth in their daily work. Shift work reduces both the quality and the quantity of sleep. Sleep individuals are less ambitious and less productive [21]. Researchers have found that the amount of sleep required for adults per day will be approximately 7 hours for completely reviving results, but most get less than 7 h, resulting in a sleep deficit. As a result, sleep deprivation occurs. Outcomes are affected by sleep deprivation in several ways [22–24]. The negative effect of sleep deprivation has a greater influence on the brain and cognitive processes [25]. During the years of college, many pupils were speciated about the capital value of human and knowledge capital, which provides jobs, and when pupils flourished in managing techniques that survived their studies [26]. The two management skills are required for cognition and leadership, which have significantly increased knowledge about written works in documents [27-29]. The different stages of sleep will help

in memory formation. The formation of memory was prompted and consolidated by the gentle REM (rapid eye movement) sleep cycle. The negative effects were profound on sleep performance, which is small for sleep restriction.

The research was conducted by a functioning body and evaluated individual factors and situational factors that rely on sleep deprivation. Sleep deprivation is partially dependent on the tasks performed by individuals [30,31]. The deficits are largely prioritized on measures of activeness and responsiveness, with a few consistent deficits in more macrolevel tasks, and few of them are related to smartness, major functions that help in problem-solving. Researchers have mainly focused on the sleep immunity of students and their concentration level. Hence, there was an attempt made in this paper to compare the Fit-bit watch method and the application method used in the construction industry to determine the labor productivity of the construction project.

## 2.METHODOLOGY

Laborers and engineers wore a Fit-bit watch for 30 days all day long to capture their sleep activity. The estimated worker's performance decrements due to their measured sleep [32]. To evaluate the sleep time, the laborers kept sleep logs to record their sleep daily. For further comparison results, the validation of measurements was performed from the same survey in a separate manner [33]. During September and October of 2021, the study was conducted at the Pramuk meridian [34,35]. The collected data were then analysed.

### 2.1 Labour Productivity

The construction sector is a suitable sector for labour to work effectively in construction projects as the work is intensive. Construction labour is the prime source of importance in the construction sector throughout the world [36]. The measurement of labour productivity is done on an hourly basis, which enriches the country's economy [37,38]. The growth in labour productivity is influenced by factors such as saving and investment in capital value, advanced technology, and human value. Compared with the growth of 4.5 percent in the previous year, as shown in Figure 1, the labour productivity of India improved gradually by 5.4 percent in May 2020. The data reached an all-time high of 9.6% in May 2010. Labour Productivity Growth is to be considered for the construction industry [39].



Figure 1- Labour Productivity of India

### 2.2 Data collection

The data collection of labour and engineers included their daily progress reports (DPR) and the readings of sleep. The FIT-BIT method was used for the collection of sleep readings. It is a watch that tracks the sleep of a human being. The Fit-bit watch is a smart device that has the capability of calculating sleep duration and has been designed to compute the health functioning, heart rate, and pattern of sleep [40]. There are many Fit-bit watches on the market. The Fit-bit watch used for the project is the FIT-BIT VERSA LITE EDITION, which costs 14,900 and gives an accurate result of different stages of sleep with the sleep score.



Figure 2- Fit-Bit Watch

### 2.3 Stages of sleep

The different stages of sleep in a human being:

- Awake sleep
- Light sleep
- Deep sleep
- Rem sleep

### 2.4 Application Method

To track important health and activity metrics, such as quality of sleep, patterns of sleep, and the number of steps walked, an application method has been designed that is a portable mobile application. The application is called SleepBot for Android devices and Pillow for iOS devices. These two applications have been effectively used for research. This application method shows the 5 different stages of sleep in Figure 3 and determines the sleep pattern.

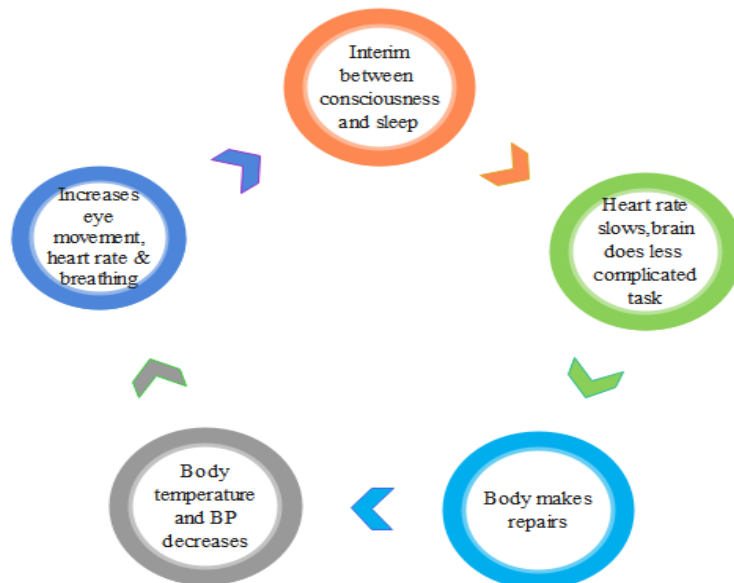


Figure 3- Different stages of sleep

### 2.5 Sleep study parameters

The study parameters that are considered for the study of sleep are the reality of sleep (need for monitoring of awaking), temperature, alcohol consumption, food intake, and absence of physical activity. These are the parameters that depend on the sleep cycle of labor every day. Sleep study parameters such as temperature result in hot, cold, or medium fluctuations in temperature. Food intake depends on the consumption of food that suits our body condition.

### 2.6 Sleep data

The total number of sleep hours was calculated to be 100. The longest sleep hours each day was 8+ h, which was 7.2, whereas 7-8 h was 43.5, which was predominantly more among the data collection. 6-7 h was 26.4, considerably the average sleep hours of labor per day in India. 5-6 h was 13.6, which was the bare minimum sleep required for labor in their lives, and less than 5 h was 9.3, which was the poorest sleep that was given to laborers after their work to boost

their daily cycle life for the next day. The optimum sleep required for laborers to have good productivity in their work is 8+ hours daily after work, which should be considered. The figure 3 shown below explains the sleep hour calculation for 100 laborers.

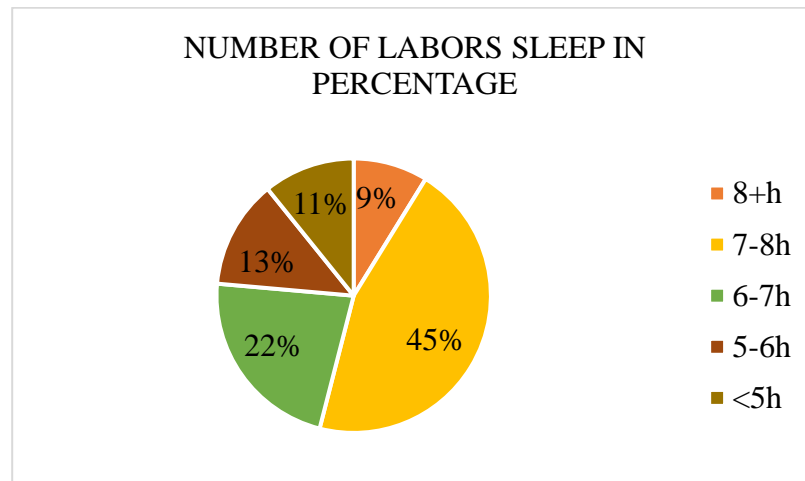


Figure 4- Sleep Hours of 100 Labors

**2.6 Site Details**

Pramuk Meridian is a luxurious apartment that is enclosed amid greenery in Bengaluru, improving the modern way of life. Bengaluru provides you with the opportunity to live life to the fullest with the best weather. Pramuk Meridian in Jayanagar gives you the best infrastructure and well-established amenities such as a fruit garden, a library, a shopping mall, a flower orchid and many more. The data were collected from the Pramuk Meridian project. The data were acquired from site engineers, project managers, labour (male and female) and supervisors. The daily progress report and the sleep cycle readings were noted for analysis.

**3.DISCUSSION**

This analysis gives the scope to determine the sleep cycle of laborers and their interrelationships with labour productivity in the project. The study is said to be noteworthy from these results [41]. The quantification illustrated that laborers were not getting enough sleep, which was recommended shown in figure 4. If the recommended sleep score were to be 100, then the productivity of work would not be 100% due to various effective factors, such as psychological and environmental conditions [42]. This analysis is used on 2,500 laborers at the Pramuk Meridian site. It is considered to have higher labour risk at all stages of construction, and average productivity is decreased annually due to a lack of efficient sleep [43]. It is captivating to note that the Pramuk Meridian site performs well. The following was found during the study: Only 7.2% of the labour is measured and has a balanced relationship with the suggested guidelines of eight hours of sleep per night for the average adult population [44]. The laborers are exhausted due to lack of sleep, which results in the narrowing of up to 8%. The analysis contributes to the body of knowledge by showing that sleep deprivation is intuitive in nature and that technical, intellectual, and civic factors interact to shape intuitive sleep decisions.

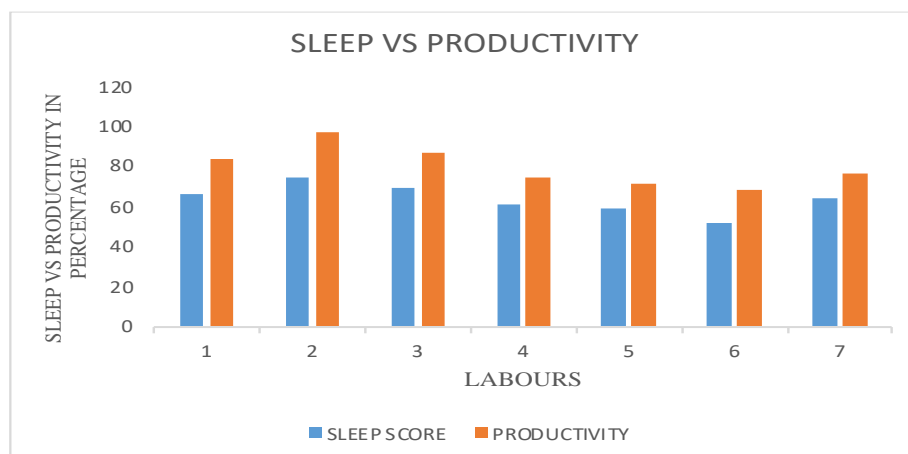


Figure 4-Sleep Vs Productivity

**3.1 Polysomnography**

The tiredness of labour was recorded by the Fitbit watch in the form of sleep. The polysomnography revealed that laborers' productivity would suffer as a result of their hypersomnia. There was awareness created among the laborers about sleep requirements and that a small amount of sleep should be given to laborers in construction. The workers wore Fitbit watches for the 4-week period, which illustrated the amount of sleep they got during their work shown in figure 5 and 6. The worker's daily progress report shown below represents the productivity of workers at the construction site. This suggests that laborers do not have an idea about how long and efficiently they sleep at a particular point, and the conditions that depend on labour sleep during the night should be noted.

Table 1-Female Daily progress report

Date	Name and ID	Age	Gender	Activity	Nature of work	Quality of work	Number of days assigned
1-Sep-21 to 7-Sep-21	Labour S1	24	Female	Plastering	Plastering	high	5
8-Sep-21 to 14-Sep-21	Labour S2	35	Female	Curing	Curing	medium	7
15-Sep-21 to 21-Sep-21	Labour S3	28	Female	Plastering	Plastering	high	5
22-Sep-21 to 28-Sep-21	Labour S4	24	Female	Roof Slab	Bar bending Electric wiring	High High	4 2
29-Sep-21 to 31-Sep-21	Labour S5	31	Female	Brick work	Brick work	high	6

Table 2-Male Daily Progress Report

Date	Name and ID	Age	Gender	Activity	Nature of work	Quality of work	Number of days assigned
1-Sep-21 to 7-Sep-21	Labour S6	26	Male	Course masonry	Mixing C: FA:CA proportions Placing block from right corner Placing block from left corner Curing	High Medium Medium Medium	8 8 8 8
8-Sep-21 to 14-Sep-21	Labour S7	32	Male	Plastering	Shuttering	High	7
15-Sep-21 to 21-Sep-21	Labour S8	28	Male	Roof Slab	Plastering Electric wiring	High High	4 4
22-Sep-21 to 28-Sep-21	Labour S9	31	Male	Roof Slab	Plastering Placing Bars Shuttering	High High High	3 3 3
29-Sep-21 to 31-Sep-21	Labour S10	37	Male	Plastering	Plastering	High	5

**3.2 Sleep cycle**

The laborers wore the Fitbit watches for an indicated period of time. From the Fit-bit watch, the extraction of sleep cycles of the labour on a weekly average basis in a year [45]. The average results may vary from labour to labour according to their well-being, and partial sleep habits were not reported before the analysis by Fitbit Watch and were known after that they were lacking in sleep. This reported the percentage decrease in productivity levels at a construction

site. The application method for sleep cycle and sleep quality of labour is shown in figure7 and 8. Laborers' sleep scores were compared using a fit-bit and an application method. The fit-bit method provides exact results when compared practically. Sleep differs greatly based on gender, so the immunity to sleep is drastically deprived.

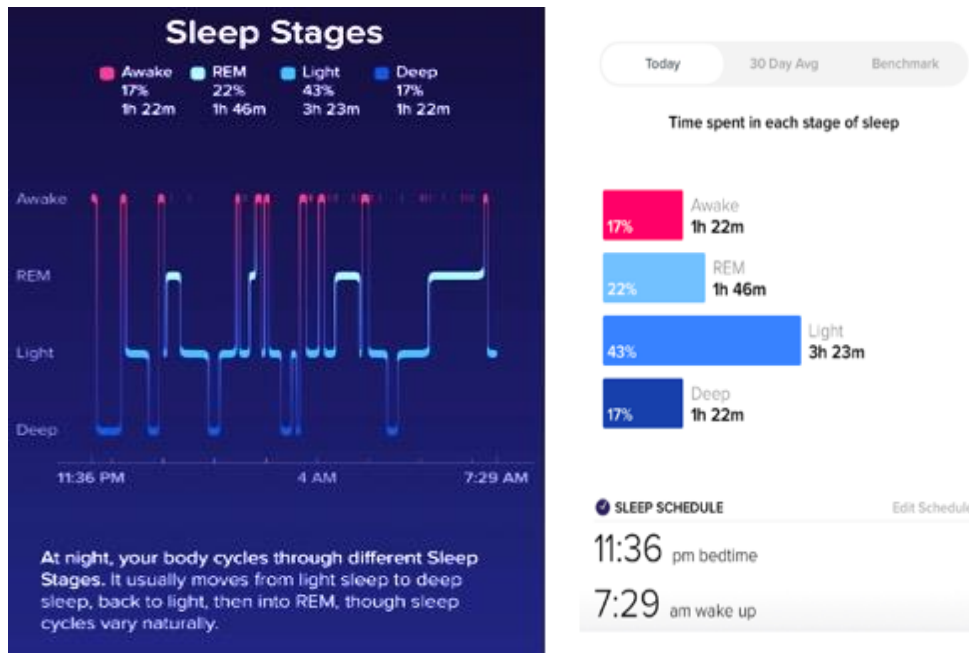


Figure 5- Fitbit watch results. Figure 6- Sleep Cycle Results

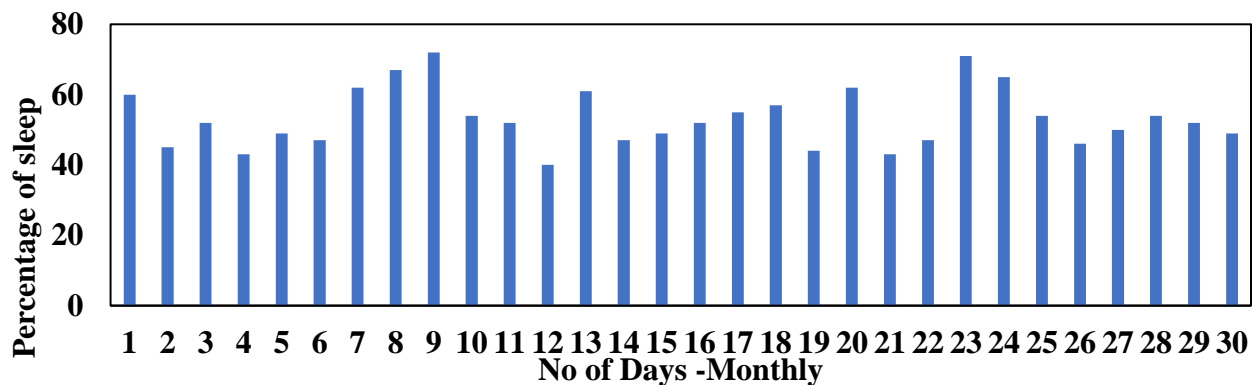


Figure 7-Sleep quality of labour

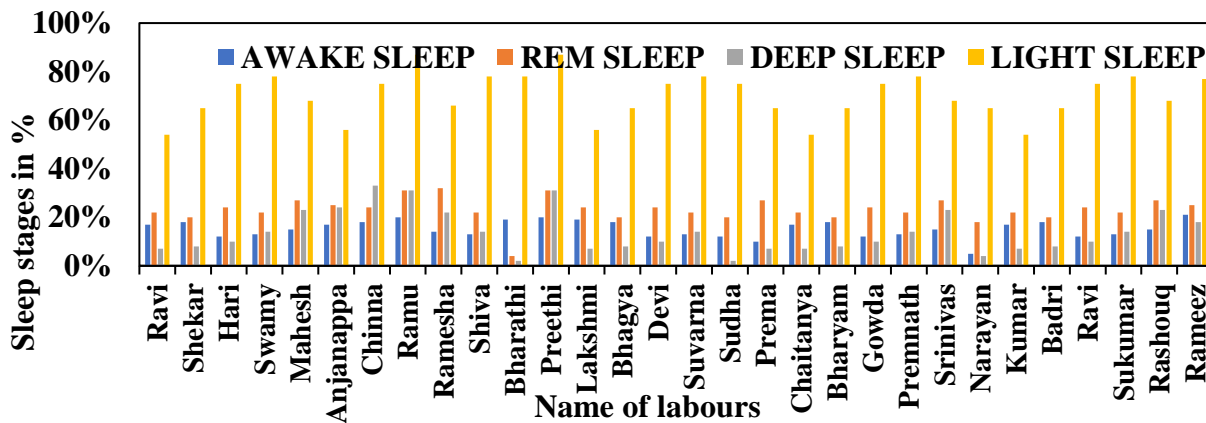


Figure 8-Sleep cycle of laborers

#### 4. CONCLUSION

This study has provided many valuable insights about tiredness and its operational influence in several other sectors, as the sleep environment and habits of laborers were the main reasons for poor productivity in the construction project. There was an operational attempt made to check whether tiredness might be the major factor for lack of sleep. The main issue of tiredness in labour is to know the human and socioeconomic impact of inadequate sleep. Laborers who are sleeping less than 6 hours will find their productivity at work lower. Laborers who are sleeping between 6 and 7 hours have an average rate of productivity, and computing both sleep ranges, laborers who sleep more than 8 hours can achieve maximum productivity. The study indicated that the average risk of work in construction was 10.9% and site workers was 12.9%, which was even higher. Thus, when jointed together, the work environment on the site will cause tiredness in laborers. It is very important to screen out laborers who are not fit to work for their shift due to tiredness and lack of food intake.

The most predominant factor in laborers' lack of sleep is excess working hours. The laborers' work judgments have been shaped by psychological and social factors, as they suggest a multidisciplinary approach to sleep management in the construction project environment. Laborers should be aware of the consequences of inadequate sleep and take the necessary steps to improve their sleep time. At the construction site, the laborers who are working in different sectors, such as equipment handling, night shift labour, and dayshift labour, are prescribed to undergo training, monitoring, and controlling. Site engineers and project managers, who are few in number in the construction project, should inform the labour about sleep and its effects.

The eradication of tiredness should be done by taking necessary preventive measures, and shifts should not start early and end late. Proper food allocation on a timely basis, as well as medical check-ups to labour,, makes them aware of the effects of sleep deprivation. There will be a marginal decrease in the productivity of work done by laborers, either directly or indirectly. Due to the intake of alcohol and an improper sleep cycle, labour's participation in construction will scale down the productivity of the work.

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