

A Case Study of Tariq Road Underpass, Karachi: Environmental Analysis

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Abstract: The construction projects are rising in Pakistan to overcome the flow of traffic on the main road of big cities. Karachi is the metropolitan city of Pakistan facing uncontrolled growth and urbanization, which leads to an increase in the demand for urban transport facilities. The study focuses on the assessment of the environmental impacts of the Tariq Road underpass construction site. The data was collected with the help of community consultation using analytical methods. It includes public chat, site visits, interviews, questioners, and the samples collection of environmental components. The results show that the most common hazards were related to excavation, working practice variation, and personal protective equipment (PPEs). Faulty and unmaintained machinery with the lack of proper barrier producing noise and air pollution.

Keywords: Environmental impact, Karachi, Pakistan, urbanization.

Introduction

Infrastructure development is considered one of the important approaches for a country's progress because it improves the economic and social welfare of people (Koutroumpis, 2009; Rehman, et al., 2019). Though land transport is the cheapest, bridges are an essential component of the road network and termed lifeline structures, since they improve the quality of life by linking one area to another and making an easy excess (El-Maissi et al., 2021; Haq et al., 2021). The paved road and bridges help to reduce pollution and associated risks (Tang et al., 2020).

The experience from many construction projects of different countries proves that large-scale or mega projects may have negative environmental, social, health and safety effects with associated risk problems (Pinto et al., 2020; Wang et al., 2020). The risk assessment must be carried out to control the negative impacts of road projects that can be measured as probabilities and possibilities. Risks in a project directly or indirectly affect the budget productivity, performance, quality, and cost overturn (Ihtesham et al., 2021; Bamusiime, 2020). Construction projects are rising in Pakistan to overcome the flow of traffic on the main road in big cities (Kanwal et al., 2020). Consideration of financial, general, and technical perspectives during infrastructure construction is important, but on the other hand, shutting the eyes regarding safety of the environment is a matter of concern mostly in developing countries (Huber, 2019). Being a megacity, Karachi needs some special activities for the construction of new infrastructure and to restore natural beauty. To solve the problem of traffic in the city, the Sindh government took an initiative to construct a network of underpasses, flyovers, and bridges. For instance, the underpass project at Shaheed a Milat Road on the junction of Tariq Road and Hill Park makes an easy transportation system and reduces

traffic congestion. Present study aims to identify and highlight the basic problems related to environmental evaluation and propose basic solutions to overcome the impacts of construction activities.

Location of the study area

Karachi is the largest city of Pakistan and the capital of province Sindh, located on the coast of the Arabian sea, northwest of the Indus River delta (Fig. 1). The city is highly dense and the population is around 16 million (Chandir et al., 2020). Karachi had a moderate climate due to marine effects, but presently due to climate change and urban sprawl, the temperature of the city is rising drastically up 41 °C. Tariq road is the most significant road of Karachi located in Jamshed Town, stretches from Sindhi Muslim Cooperative Housing Society to meet Bahadurabad and connects different areas. Tariq Road is among Karachi's busiest roads with an improper traffic management system and the unavailability of parking areas resulting from parked vehicles on the road site which eventually becomes inconvenient to the pedestrians. The traffic from University road, Bahadurabad, and Jail roads, meeting at main Tariq road causes rise in the flow. Tariq road is home to almost countless stalls, shops, and mega shopping malls hosting branded and non-branded retail outlets. The road is also home to well-known eateries, educational institutions, and healthcare centers.

Materials and Methods

The data collection is one of the important parts of the study. To make a clear study, it is important to involve the consultation of the community, especially those determined to be affected by the project through interview sessions and the physical collection of the data related to environmental variables. The consultation visit was paid to institutions, businesses, and individuals that were determined to be directly affected by the proposed project. The meeting involves

the questionnaire and free discussion. The questionnaire was designed to elicit responses related to the likely impact of the project, particularly during and after construction. Also, to measure public concern about the project and find ways to ameliorate or mitigate the concern.

During the construction, heavy machinery produces high intensity of noise. The majority of the construction activity requires on-site machinery, ranging from trucks, drilling, and heavy plants. The project site was located in a highly-populated area with many institutions, manufacturing companies, and hospitals.

Table 1 Hazards identification and assessment in the study area.

Observation	Hazards and Consequences	Preventive Measures
Meson and laborers working inside and outside the excavation area were without PPEs	In case of a slip, trip, and fall risk it may cause serious injuries to the laborers.	Provide proper safety information and safety kit to every worker to avoid such risks.
No fire safety and first aid kit were present on site.	In case of any emergency, the risk will be high for injury and fire.	The fire extinguisher should provide a working area.
Exposure of vibration produced from drilling to drill operator	It may cause an operator to develop Hand-arm operation syndrome (HAVs).	Provide a working brake. Provide gloves to grip the machine.
There is a lack of washing area, resting facility, lack of clean and safe drinking water.	Results dehydration of staff and no resting area create workers to tire early.	Provide facility of washing and resting room. Provide dispenser for code water
Staff and labor did not know about the silica dust and cement.	The exposure may result in adverse health effects.	Awareness should provide according to silica and cement exposure.
Working hours are high for laborers and is up to 10-12 hour/day.	Result reduction of body efficiency.	Reduce work timings. Work break for every worker.
A sign of hazards was absent at the construction site.	Identification of hazard become difficult for workers and visitors.	Provide sign for every hazard
During observation, some good practices were observed		
Proper lighting was observed during the night.	–	Maintenances continue monitor
Toolbox talk was observed before the start of work.	–	TBT must be maintained, and entries made manually.
Workers were provided a walky-talky to communicate.	–	It is a good practice to communicate from long distance

The environmental variables are air, water, and noise level for which the data were collected. For data collection of air, an instrument named Ecotec AIR station with 12 hours monitoring to determine the values was placed at the project site. Noise Meter was used for the noise measurements which carried out for a week during 9:00 am to 9:00 pm. To test the water quality, groundwater samples were collected from 4 representative sites. These samples were taken in washed one-liter plastic bottles which were rinsed with distilled and groundwater, respectively, before sampling. Physical analysis was carried out at the site of sampling while the samples were transported to the laboratory. Standard methods were used for both physical and chemical analysis (Federation and Association, 2005).

Results and Discussion

Infrastructure and road projects are generally linked to the economic and social well-being of the nation and state (Yusupov, 2020). With all the positive features of road constructions, it may have detrimental impacts on nearby communities and the environment. These impacts can be classified into the ones taking place during construction and after the completion of the project. The impacts can be controlled, avoided, or minimized through appropriate project design, careful implementation of operations, and effective collaboration with local communities.

Construction workers were also immediately exposed to a variety of hazards (Table 1). Fire and ambulance services were experiencing difficulties, which jeopardized their ability to respond effectively and timely. Air pollution caused ailments such as inflamed eyes and difficulties in breathing. Traffic congestion created a significant social disruption, making it impossible for students and people to get to their schools and jobs on time.

Air quality tests were conducted at the location to identify and assess the risk of air contaminants (Table 2; Fig. 2). The movement of heavy machinery and traffic jam during construction activities increased air pollution in the area, which includes material handling, excavation, and erosion of the unpaved area stockpile. It contributes to air pollution by emitting exhaust from machinery and drilling dust. Debris from the demolition caused dust as well. Carbon dioxide and water are the primary byproducts of motor fuel combustion, but inefficiencies and high temperatures inherent in engine operation encourage the creation of a wide range of additional pollutants with variable effects.

Site runoff is predicted to have the greatest influence on water quality especially groundwater around the construction site as it may contain suppression spray, oil, grease from construction machinery, vehicles, and leakage. Machinery working can give rise to turbidity and increase downstream sedimentation, but in this

case, there is no surface water body around the area. The quality of the groundwater sample is presented in Table 3. Samples 1 and 2 show a very high concentration of most of the parameters. The reasons for poor water quality are the surface runoff and surface infiltration from exhaust emissions, pavement and tire wear, petroleum product drippage, and metal corrosion.

Table 2. Descriptive statistics of air pollutants in study area.

Variable	Min	Max	Mean ± StD
NO	0.71	5.78	4.059 ± 1.859
NO ₂	3.24	11.65	9.077 ± 2.793
NO _x	4.1	23.6	17.18 ± 6.93
PM _{2.5}	65.4	176.6	123.2 ± 39.0
PM ₁₀	135.1	370.9	293.7 ± 69.9
SPM	212.5	637.1	462.4 ± 138.3

Here NO = nitric oxide; NO₂ = nitrogen dioxide; NO_x = Nitrogen oxide; PM = particulate matter; SPM = suspended particulate matter.

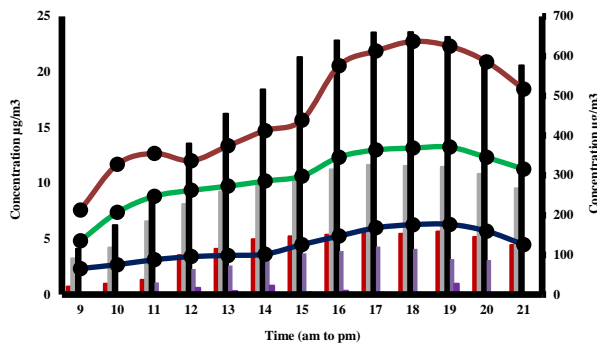


Fig. 2 Concentration of air pollutants at the project site.

NO_x ■ NO ■ NO₂ ■ SO₂ ■ CO ■ PM 2.5 ■ PM 10 ■ SPM ■

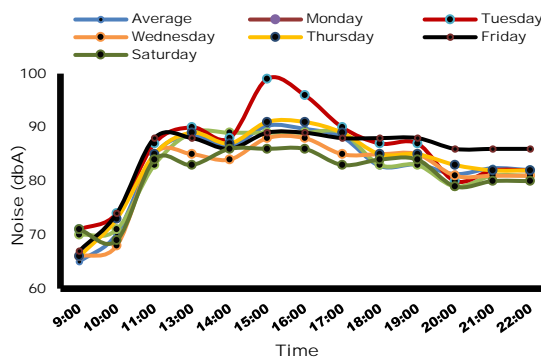


Fig. 3 Variation in noise level during the monitoring time.

The noise monitoring was carried out continuously during a week to find the exposure of surrounding shareholders (Fig. 3). Undesirable noise is a common source of discomfort, health issues, and psychological problems, especially in urban areas (Bolaji et al., 2018). Noise can cause voice interference, ear pain, sleep disturbances, changes in focus ability, decreased

productivity, and learning issues in youngsters. The construction activities involve the use of the plant for pilling, excavation, substructure, and superstructure construction.

Conclusion

There is a need for innovative ideas to control growing traffic jams on the busy roads of Karachi. Flyovers and underpasses are used to regulate traffic flow all over the world. The construction of the Tariq Road Underpass plays an important role in the smooth flow of traffic in the area. During the construction, it is identified that there were lots of improvement required in terms of health, safety, and environmental aspects. The most identified hazards were related to excavation, working practice variation, and personal protective equipment (PPEs). Because of a lack of equipment maintenance, the operation created excessive noise, exceeding the safe exposure level. To reduce health risks, workers must be provided with PPEs such as facemask, gloves, goggles, safety shoes, and helmets.

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