DEVELOPMENT OF DIFFERENT ROADS IN BUSIEST AREA OF KHULNA CITY: CONSTRUCTION PROCESS AND PROGRESS

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ABSTRACT

Road development is an important aspect of infrastructure, playing a key role in the socio-economic growth, mobility, and quality of life of a nation, hence it cannot be evaded. A number of road construction works are underway to improve Khulna City's economic prosperity, road networking systems, improve public transport, and quality of life. However, the process of road construction in the different busy areas of Khulna City faces various challenges which are related to the construction process, socio-economic factors, and environmental considerations. In this paper, the process of road construction, difficulties that arise while constructing roads and potential solutions in the context of practical experience will be discussed. All these difficulties and the road construction process have been identified through site monitoring and site investigation. The main objectives of this paper are to highlight the construction process of roads for junior engineers and undergraduate students who are interested in this field to develop their careers. According to the study, road development often involves many stages, including planning and programming, project conception, construction, and maintenance. The key findings from this paper are to describe several excavation techniques for developing the sub-grade, sub-base, and base course of the road construction. Different types of concrete mixing techniques for RCC roads and asphalt mixing techniques for bituminous road construction are discussed. The weather effects on road construction, socioeconomic factors, and the overall construction process are summarised. Additionally, there is typically strong public support for road construction projects since the public knows the significance of good roads for economic growth and quality of life. By overcoming the difficulties noted in this paper, or by coordinating them in the event of certain particular difficulties, this study will be helpful in the future implementation of road construction systems in other cities, including Khulna.

Keywords: *urban road, construction, construction process, construction challenges, construction progress, rigid pavement, flexible pavement*

1. INTRODUCTION

The communication system is one of most valuable elements for a country's development. The only form of mode of transport that can offer everyone the best possible experience is the road. Regarding route, direction, time, and speed of travel, this option offers the most freedom (Jain et al., 2013). The growth of the country becomes easier if the transportation infrastructure from every major city to any other area of the country is seamless. The road is the primary mode of communication. Roads, in particular, serve as the primary means of transporting most people and products inside a country. This change benefits the entire country's social and economic development. However, it is nearly difficult to reach every area of the country via all of these methods, making road construction essential to communication, financial development, and infrastructure development. Road development is essential for a country's communication system. As a result, the government must invest a significant amount of money in road development, which may not appear lucrative at first, but the consequences of road construction may be seen gradually. However, not only should road construction be done, but road planning should be done carefully taking into account every situation in the country, and the construction process and materials should be carefully determined, or the road's condition will deteriorate promptly after construction (Tipovi, 2015).

Road building has a tremendous influence on any nation's economic growth; thus, it cannot be disregarded. Nonetheless, it is known that road-building endeavours have an impact on the structures in the construction zone. Road construction has a predicting and didactic effect on human activity and behaviours. Road building has a predictive impact because it improves the circulation of traffic, increases accessibility for people, and streamlines the transfer of commodities and services. However, the normative impact also includes the approval of beneficial growth in the region and the modification of the infrastructure. Still, road building has little effect on beneath-ground water or the movement of rivers (Deborah Ihuoma et al., 2021).

There are many types of roads depending on material, rigidity, location & and function. Based on location and function roads may be classified as national highways, state highways, district roads, and rural or village roads. Depending on materials it may be earthen roads, gravel roads, WBM roads, bituminous roads, and concrete roads. Based on rigidity it may be classified as flexible pavement and rigid pavement (Classification or Types of Roads and Their Details, 2017).

The third-biggest city in Bangladesh, Khulna is located at 22°49′0″N and 89°33′0″E in the southwest (Saju et. al. 2022). Khulna is an urban centre that is expanding quickly and is confronting several issues connected to climate change and urbanization. Khulna city has three different modes of transportation namely road, rail and water (Khan 2022). Khulna city has a variety of roadways. Khulna's roadways are busy at all hours of the day since it is the busiest city. There are National Highways, State Highways, District Roads, and Rural or Village Roads in Khulna. In terms of construction, these roads in Khulna are classified into two categories: rigid pavement and flexible pavement. These roads in Khulna are being built by Khulna City Corporation, Khulna Roads and Highway Department, Khulna Local Government Department, and Khulna Development Authority. The majority of these projects are supported by the Bangladesh government, as well as the World Bank, ADB, and other non-governmental organizations.

When it comes to flexible pavement, the natural subgrade is first upgraded by filling it with sand; this process transfers the incoming load to the natural subgrade. Initially, the current road soils are excavated. Improved subgrades are utilized with base courses and subbases. After a day, bituminous surface placement is carried out using prime coat on the base course layer if its compaction meets the necessary standards. These works are primarily intended to distribute the stress from the wheel load layer by layer over the entire area. The top bitumen surface gives the wheels of the vehicle a firm grip and keeps them from sliding or skedding (Jain et al., 2013).

When it comes to rigid pavement, sub base or base course is applied on top of an existing natural subgrade that has been enhanced. An experimental examination was carried out in the quest of substituting standard GSB courses by stabilizing locally available soil and harmonizing it for road constructions by treating silty sand with colloidal nano silica in three distinct concentration grades of NS-20, NS-30, and NS-40. Each percentage was then treated with 2%, 4%, and 6% cement, respectively. The effect of nano silica on modified proctor compaction, CBR, and UCS tests was investigated through experiments (Kulkarni & Mandal, 2022). Ultimately, the subbase layer's top surface construction is completed as an RCC or CC slab to allow for the layer-by-layer distribution of the incoming wheel load. Although the initial cost of rigid pavement is slightly greater, its lifespan is significantly longer and more cost-effective than that of flexible pavement (Deshmukh et al., 2017). Flexible pavements with this stress distribution feature often have numerous layers. As a result, the notion of a layered system is used in the design of flexible pavement (Mathew et al., 2006). The most common cause of rutting on flexible pavements is high traffic volume and unfavourable weather conditions (Betooniühing & Tinni, 2013). The top slab of rigid pavement transmits the load across a vast area to the subgrade because of its great strength and rigidity (Ioannides & Salsilli-Murua, n.d.). Rigid pavement may also be built on a substandard subgrade since its top surface can support a higher compressive load. (Gill et al., n.d.) Road construction presents several difficulties and endorsements, including land acquisition, disruption of livelihood, restrictions on community involvement, construction delays, and significant environmental effects like noise, vibration, and air pollution. New road construction is easier than old road re-construction in terms of waste generation. In any re-construction process a large amount of demolition wastes generates compared to construction wastes (Hassan et. al. 2015). As a result, road construction must be done carefully (ROADEX Network, 2016; Schnebele et al., 2015).

This paper will outline each phase of road construction, which will be useful for young engineers working on road construction sites in the future. This paper can be used as proof for future road building in any city. Furthermore, in the construction of roads, the numerous problems that must be overcome will be highlighted and detailed in this article.

2. METHODOLOGY

The methodology used for this publication is a review of earlier studies, most of which are cited for reference in the introduction. After that, earlier studies are examined, and some findings from those investigations are included in this publication. The section that follows discusses several types of roads. The many classifications of roads built in Khulna are also discussed.

Part of this paper's approach was routinely monitoring and observing at least fifty road-building locations at each stage. Every stage of the construction process, including site clearing, layout, earth excavation, subgrade preparation, subbase preparation, base course preparation, rod binding, road casting preparation, and bituminous road work was checked and documented during the inspection of those sites.

Regular site monitoring allowed observers to notice and record challenges such as land acquisition, interruption of living, low community participation, and construction delays throughout the execution phases. Senior engineers and consultants then assisted in the analysis of the solutions to those issues.

3. OBSERVATION AND DISCUSSTION

Rural or village roads in Khulna are often constructed with rigid pavement, whereas the remainder of the city's roadways are constructed with flexible pavement. Except for the National Highway, most of the roads in Khulna are not used by highly laden vehicles. Roads with flexible pavements degrade quickly owing to structural flaws or a lack of sufficient maintenance, resulting in potholes. All of the routes eventually became inaccessible. Another cause of this issue is that on certain roads, the flexible pavement is done manually, and the compaction is not done properly, resulting in road damage in a short period of time. One potential solution to address these issues is to install

rigid pavement with an appropriate mixing ratio on any routes that are not used by heavy-duty vehicles. As a result, even while the initial cost is somewhat more, there is a far lower chance of road damage and a much longer lifespan. When constructing new roads, Khulna City Corporation and other authorities are increasingly prioritizing rigid pavement. However, in this instance, issues with rigid pavements develop within a few days of construction because of improper construction work. To address these issues, constant site monitoring throughout the construction of roads and repeated testing of the mixing ratio are necessary.

3.1 Types of Road Construction in Bangladesh

According to LGED (Web Copy, n.d.) types of various roads in Bangladesh are
National Highway: Highways that link the capital of the nation to the several division headquarters, seaports, land ports, and Asian highways.
Regional Highway: Highways linking District HQ/s, important river or land ports, or between them that are not linked by National Highways.
Zila Road: Roads linking District HQ/s with Upazila HQ/s or one Upazila HQ to another Upazila HQ via a single primary connection with National/Regional Highway, using the shortest distance/route.
Upazila Road: Roads linking Upazila HQ/s to Growth Centre/s via a single primary connection or connecting Growth Centre to Higher Road System by the shortest distance / route.
Union Road: Roads linking Union Headquarters to Upazila Headquarters, Growth Centres, Local Markets, or each other.
Village Road: a) Roads linking villages to Union Headquarters, local marketplaces, fields, and ghats, or between villages. b) Roads within a village.

3.2 Types of Roads in Khulna City

As Khulna is a divisional city it has all type of roads like National Highway, Regional Highway, Zilla, Upazila, Union and village road. Based on materials types of roads in Khulna:
Earthen Roads: It refers to the kinds of roads built from typically available dirt. The structure is composed of two layers of flattened soil, much like the asphalt of an earthen road. After all of the earth has been laid down, it is compacted using a hammer or roller to remove any unnecessary spaces. The cheapest kind of roads is made of earth. They are sometimes referred to as temporary roadways.
Brick Flat Soling Road: To level the concrete bed, brick flat soling, or BFS, is used. Brick flat soling is the process of arranging bricks atop of the sand or earthen surface. Ground level and foundation areas are typically covered with brick flat soling. It also used as a road when the budget is low for constructing a concrete road.
Rigid Pavement: (a) Cement Concrete (CC) Road: Cement concrete roads, are a crucial component of our transportation network. Their strength, resilience, and low maintenance requirements are well-known. In order to provide a firm, durable surface, CC roads are built with a mixture of cement, water, and aggregates that are compacted and cured with water mainly from ground and surface water sources (Roy et.al. 2019; Bari et. al. 2022). This road is constructed especially in the rural side of Khulna city where cars are not usually used only for people to move.
(b) Reinforced Cement Concrete (RCC) Road: RCC roads are commonly defined as roadways composed of concrete, cement, and reinforcement. Another name for it is rigid pavement. It can support heavy loads and is quite robust. Because of its endurance, this road building is currently taking place throughout as much of Khulna as possible.
Flexible Pavement: Flexible pavement also known as Bituminous or Carpeting Road. Roads with pavement are commonplace worldwide. The world's busiest roadways are these ones. These sorts of roads are affordable and appropriate for the driving environment. The thickness of the carpeting surface is determined by the volume of traffic on the road as well as the road's substructure. Volumetric parameters of a bituminous concrete mix at binder concentration compared to stability, flow, air spaces, bulk density, bitumen-filled voids, and voids in mineral aggregate (using a 20:80 ratio of brick-stone aggregate mix) (Sarkar et al., 2016). Flexible pavements deteriorate prematurely, and academics are divided on the significance of the underlying reasons, resulting in

incorrectly chosen modelling parameters and increasing ambiguity in forecasting eventual behaviour and performance (Milling et al., 2023). Bituminous road construction is done on several major roads including Khulna City, National and Regional roads in Khulna.

3.3 Process Applied in Road Construction at Khulna

3.3.1 Site Acquisition and Layout

Site Acquisition: The chosen location for constructing a road is frequently inhabited. In order to ensure that there are no issues once the work begins, the area set aside for the road is first cleansed of all encroachment and cleared of debris. Usually, Ward Councillors and State Officers from the Government Department are present while this task is done. Figure 1(a) shows that the land acquisition work before the starting of main construction road work.

Layout of the site: The contractor brings and stores construction supplies including sand, brick, and cement at the site after determining the region that has been set aside for road construction. The contractor receives preliminary instructions to begin construction, known as layout, after the official and on-site engineer inspect the materials. Figure 1(b) illustrates the checking of materials stocked in the site before starting the work.

Figure 1(a): Land acquisition for road construction

Figure 1(b): Stocked material check in the site

3.3.2 Foundation Preparation of Road Bed

Earth excavation**:** The first stage in beginning road development after layout is to excavate the chosen area for the road because the existing soil is typically not capable of sustaining the load. To replace the existing soil, excavators are used to excavate the soil according to the design of the road area. The excavated earth is later relocated. It is often excavated to a depth of 400mm to 600mm. After excavation, the layer that remains is referred to as the natural subgrade. Figure 2(a) illustrates the earth excavation work for road construction.

Improved subgrade and compaction process: After all the soil has been removed, the removed area is filled up with sand around 300 mm to 400 mm in depth. This layer of sand is referred as an improved subgrade which is done on natural subgrade. Sand of 0.5 FM is often utilized for this layer. Sand is one of the materials used to fill because it can equally disperse the incoming load throughout the whole area of the road. When it comes to sand filling, adequate compaction is maintained by doing compaction 150 mm layer by layer. Since water accounts for 90% of the compaction of sand, water is typically employed in conjunction with rollers. After the full layer of sand has been done, the DCP test is used to determine the CBR value, which indicates whether or not the compaction was done correctly. For the sand layer, the usual CBR value is 8%. In other words, the sand layer has to be recompacted if the CBR velocity is less than 8%. Figure 2(b) illustrates the sand filling work on road construction site.

Subbase preparation: Improved subgrade, i.e. sand filling is completed, and the layer becomes the subbase layer. Sub-base is typically made with a 1:1 mixture of sand and brick or stone chips. It is often produced in thicknesses ranging from 100 mm to 300 mm at times. In this situation, it should be noted that the size of the brick chips should not exceed 38 mm, otherwise, the compaction requirement will not be met. For compaction, a required amount of roller should be given and it should ensure the mixing ratio of subbase is 1:1 of sand and gravel otherwise compaction may not meet the required. After this layer's job is done, the CBR value is tested using the DCP test to check if it meets the compaction criteria. The subbase course has a minimum CBR value of 30%. Compaction should be repeated if the CBR Value is less than 30%. Otherwise, load transfers would be ineffective, and road settling will occur, which is one of the causes of road surface deterioration. In both situations of road building, rigid pavement and flexible pavement serve as the sub-base. Figure 3(a) illustrates that the subbase preparation work at road construction site.

Figure 2(a): Earth excavation work on site

Figure 2(b): Improved subgrade or sand filling work

Base course preparation: The base course layer is completed after the subbase course layer is completed. Brick chips or stone chips make up 80% to 90% of the base course. Base course is often utilized on flexible pavement; however, it is also employed on rigid pavement with high wheel loads in rare circumstances. In the case of flexible pavement, the base course is normally located under the surface course, and in the case of rigid pavement, it is located beneath the RCC road surface. The base course's minimum CBR value is 80%. The base course surface should be compacted again if the CBR value is less than 80%. Depending on the road design, base course layer thickness is given around 100 mm to 300 mm in thickness. If the thickness of this layer is greater, 100 mm to 150 mm layers are rolled though a heavy weight roller at layer by layer for proper compaction, with the maximum size of brick or stone chips remaining at 38 mm. Figure 3(b) illustrates that the Base course preparation work at road construction site.

Figure 3(a): Subbase work at road construction site

Figure 3(b): Base course work at road construction site

Brick edging work: In the event that the road is unsupported, brick edging is placed on both sides to prevent materials from moving outside when casting or carpeting is being done. This is done before creating rigid or flexible pavement.
Brick soling work: Cement Concrete (CC) casting is frequently carried out on less-travelled highways. Underneath this, sometimes brick soling is used as a foundation in place of base course or sub base course.

3.3.3 Preparation and Types of Rigid Pavement

CC casting preparation: CC casting typically has a thickness of 75–100 mm and a mixing ratio of (1:1:1.5:3) or (1:1:2:40 This indicates that 1 is one bag of cement, or 1.25 cubic feet of cement; 1.5 or 2 is fine aggregate, or 1.875 or 2.5 cubic feet of sand; and 3 or 4 is coarse aggregate, or 3.75 or 4.0 cubic feet of brick or stone chips. Road is completely cleaned before casting begins, and polythene sheets are then put over it in order to prevent the road bed from absorbing water from the mixed material. If it is not done it has a big chance of concrete segregation. A PVC pipe is placed in the middle of the road and cut on both sides based on thickness; these PVC pipes serve to maintain the thickness over time. With the aid of a mixing machine, the water cement ratio is maintained and the mixing process is carried out in accordance with the mixing ratio.
RCC casting preparation: RCC castings typically have thicknesses between 125 and 300 mm. The road bed is properly cleaned and covered with a polythene sheet before casting is carried out. Rod placement is carried out then according to the design. A small 2 in by 2 in CC blocks are provided to preserve a clear cover beneath the rod in the centre of the road and on both sides when the rod installation is complete. With a compressive strength of 20 mpa, the mixture ratio for RCC road casting is typically (1:1.5:3). Depending on the configuration of the road, a main bar made of 12 mm or 16 mm rod is often utilized. And the binding bar is made of 10 mm or 12 mm rod. The rod's internal spacing ranges from 100 mm to maximum of 300 mm from centre to centre. Figure 3(a) shows that the construction phase of rigid pavement. Figure 4(a) illustrates the ongoing casting road construction.
Final finishing and maintenance: After the casting is completed, the top surface of the road is grouted using a cement sand and water mixture if the finishing on the CC or RCC surface is not satisfactory. Regular water curing should be carried out for at least 28 days following the casting of the road. Additionally, it's important to make sure that no cars are driving during this period to avoid the road's eventual strength being compromised. Figure 4(b) illustrates the curing process of completed road

Figure 4(a): RCC road casting

Figure 4(b): Curing of completed road

Preparation of Flexible pavement: When the base course is ready in accordance with the design, at this point the carpeting construction gets underway. Prime coat is applied to the base course one day before to the commencement of carpeting installation to ensure that the road bed is dust-free and waterproof and that existing brick or stone chips are well bonded. This strengthens the base course's adhesion to the bituminous layer. On the next day following prime coating, carpeting

installation begins. The components of the asphalt surface layer include gravel, pick gravel, coarse sand, and bitumen. The ratio specified in the asphalt design is followed while mixing. Afterwards, a paver machine is used to install it on the base course bed that has been prepared. The complexion is then guaranteed by rolling as necessary. If new carpeting work is installed over an old carpeting bed, make sure the old bed is well cleaned before applying a tack coat. Tack coat provide a good bonding with existing bituminous road. Before asphalt is placed on the road bed, its temperature must be monitored. The asphalt material should be between 130 and 150 degrees celsius before it is placed on the road bed. Additionally, the minimum rolling temperature is 85 degrees celsius. This means that compaction should be done with a roller between 85 and 100 degrees celsius, or before the asphalt material's temperature drops below 85 degrees. Figure 5(a) shows that the construction phase of flexible pavement by paver machine and Figure 5(b) shows that the temperature check of bituminous materials on site.

Figure 5(a): Bituminous carpeting work by paver machine

Figure 5(b): Temperature check of bituminous materials

4. CHALLENGES AND ENDORSEMENT IN DRAIN CONSTRUCTION IN KHULNA CITY

4.1 Land Acquisition

It can be challenging to acquire land for road construction for a variety of reasons, especially in densely populated urban areas. The limited amount of land available in urban areas is a typical characteristic. It can be difficult to locate enough land for new road construction or expansion the old road, especially in areas with a high population density. It can be challenging and time-consuming to locate and negotiate with many parties and property owners. Project schedule delays could result from the settlement of property title disputes and the obtaining of consent. Navigating the legal and regulatory frameworks governing land acquisition, use, and property rights can be challenging. Numerous jurisdictions and municipal regulations may make the process more challenging, requiring strict adherence to avoid legal issues. Businesses and locals may be against purchasing land because they fear being uprooted, having their livelihoods disturbed, and maybe having their property values significantly damaged. Determining what constitutes a fair compensation for property owners can be contentious. Disagreements on the rates of compensation may lead to conflicts and delays in the land purchase procedure. Project delays are caused by issues with acquiring property, electric poles near the construction site, the local population's opposition to construction, etc.

4.2 Disruption of Livelihoods

Indeed, constructing new road or expansion the old road in a city can cause disruptions to people's livelihoods, particularly in heavily populated urban areas. Businesses near the construction route may need to relocate or temporarily close as a result of the road construction. Both employees and business owners may suffer financial losses as a result of this. Construction-related operations can

impede firms' access to markets and customers, so affecting their sales and revenue. Diversions, lowered accessibility, and road closures may result from construction activity. This may cause delays and inefficiencies in the flow of customers, workers, walkers, and commodities. Construction sites produce a lot of dust, noise, and other pollutants that can harm the surrounding community's economy and quality of life for neighbouring businesses and inhabitants. If the construction of road requires the use of public spaces such as sidewalks or parking areas, this can reduce available space for vendors, street vendors, and outdoor businesses. Construction is typically difficult at dead ends of roads because of the narrow width of the road. Pedestrian foot traffic may be diverted during construction, which could have an impact on establishments that depend on foot traffic to attract clients. Construction may result in the relocation of informal labourers, such as rubbish collectors, street vendors, and others who work in public areas, which will affect their daily income. Construction projects may pose a risk to the workers' and inhabitants' health and safety in the area. This may cause worries and a decline in comfort in the vicinity. Therefore, the disruption of local businesses and livelihoods due to building operations may lead to citizen discontent and reduce community support for the project.

4.3 Limited Community Engagement

Inadequate community participation in the road construction within cities can have a number of negative effects, including as misunderstandings and subpar project outcomes. If community members are not appropriately involved, they might not be aware of the purpose of the construction project or any potential consequences. This could lead to misconceptions and misunderstandings. Communities not involved in the planning process may object to construction operations due to mistrust, fear, or perceived negative repercussions. This could lead to disagreements, delays, and even legal challenges. By incorporating the community, project planners can gain a deeper understanding of the unique demands of the area. Communities usually have enlightening local knowledge that can promote innovative problem-solving or better project concepts. Low involvement may result in missed opportunities for advancement.

Inadequate community participation during the planning phase can lead to misunderstandings, resistance, and delays. Effective community involvement is required to ensure that the interests and concerns of stakeholders and local residents are taken into account. A positive outlook and assistance from the community have a beneficial effect on the construction process.

4.4 Construction Delay

Road construction projects frequently face construction delays, which can be brought on by a number of different things. Adverse weather conditions such as heavy rains, excessive heat may cause construction delays. During many road constructions, unforeseen site conditions can cause construction delays such as unstable soil, underground utilities, archaeological finds, etc. Construction delays are also caused by design changes, material shortages or late arrivals, lack of skilled manpower, machinery failure or breakdowns, capital shortages, traffic management and public interference, and finally contractor performance. On road construction projects, construction delays can have a variety of major repercussions that affect many stakeholders and parts of the project. Construction deals increase labour costs, equipment rental costs that increase project costs. Urban area road construction involves temporary road closures, alternative arrangements or lane restrictions. This increases traffic congestion causing losses of time to the traders and local people. Additionally, it caused financial losses for companies along the impacted roads. Construction delay decreases work productivity and lengthens project life cycle. It also leads failure to maintain proper quality of the work. Layout date, work order completion date, and actual completion date of different roads in Khulna City are shown in Table 1. From this table, it can be seen that each road takes more time from months to a year to complete fully. If it is calculated as days per kilometre, the time required is more than one month to five months per kilometre to complete a road in Khulna City. The reasons discussed above are some of the reasons for this construction. The majority of the roads are occupied, the cost of construction supplies has increased, there are seasonal issues like road construction being suspended during the monsoon season, contractors not showing up for work on time, and numerous other factors all contribute to the lengthening of the construction time of

these roads. A comparison of the time delay of different roads in Khulna City are shown in Figure 6 through a bar chart.

Table 1: Full details with time delays of different roads of Khulna City

Road Name	Road Length (m)	Road Width (m)	Layout Date	Workorder Completion Date	Actual Completion Date	Delay (Day)	Delay (Day/km)
Jalil Sharani Road, Khulna	2459	15.60	12/05/2021	15/03/2022	28/02/2023	343	139
Khalishpur 12 no Road, Khulna	1600	4	12/05/2021	31/12/2021	07/03/2022	67	42
BD Seafood Road, Khulna	660	5	06/04/2023	30/06/2023	29/08/2023	61	92
KD Gosh Road, Khulna	1770	9.50	29/03/2023	30/06/2023	22/10/2023	115	65
Circuit House Road, Khulna	650	7.82	22/03/2023	30/06/2023	25/10/2023	118	182
Khalishpur 16 no Road, Khulna	1238	5	25/04/2023	30/06/2023	12/12/2023	166	134

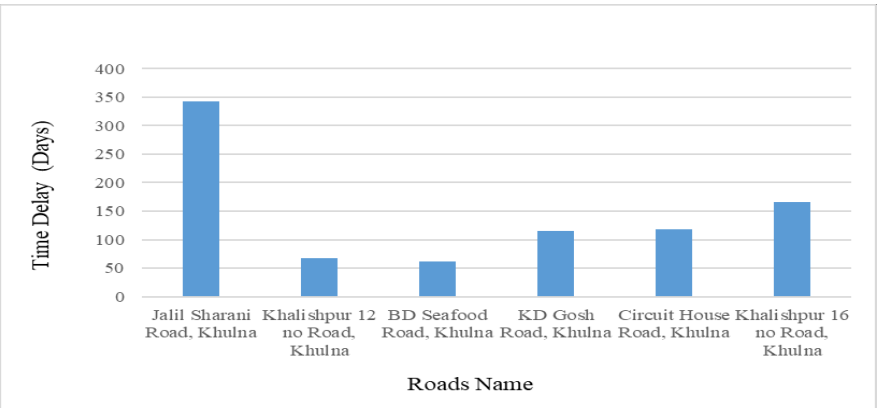

Figure 6: Time delays of different roads of Khulna City

5. ENGINEERING SIGNIFICANCE

Adopting a sustainable strategy for building urban roads in underdeveloped countries presents a number of simple hurdles that can be overcome, ranging from institutional issues to educational programs. A number of administrative measures must be put in place to enable full institutional integration among the various city administrative entities in order to support the adoption of compensating devices for urban road construction. Arranging should be given to the creation and execution of appropriate urban road master plans as well as the enforcement of laws and mandates requiring the installation and upkeep of compensatory devices. Planning for the long term should come first. Regarding education, it is imperative to facilitate the spread of knowledge at different levels: technical data to designers, allowing for the clarification of appropriate projects; broad data to legislators and decision-makers, assisting in the education of the public about the environment and the significance of the sustainable method; experimental studies are already being conducted in this manner to demonstrate the advantages of the sustainable approach in particular situations. Current students and junior engineers who are interested in entering the construction sector as recently graduated engineers may find the knowledge in this paper to be very helpful. Future

scholars studying Khulna's road construction techniques will find this research useful. It will provide information about Khulna's pollution, everyday living disturbances, and community involvement as a result of ongoing construction. Future research, after reading this report, can suggest any modifications or enhancements to the construction process.

6. CONCLUSIONS

The removal of traffic congestion in a city is required for urban modernization. A city's road networks necessitate well-planned road development. In the current setting, rigid and flexible pavements are being built in Khulna and other cities to relieve traffic congestion and provide smooth public mobility. This study will assist future engineers with constructing such roads following appropriate guidelines for road construction management. Road development in Khulna has a number of problems, including socioeconomic and environmental concerns. Addressing these issues necessitates a comprehensive strategy that includes careful planning, stakeholder participation, and consideration of environmental implications. The paper briefly discusses solutions to the issues encountered during the construction of roads, which will be valuable for junior engineers or students working in the field. The city of Khulna may strengthen its road construction system and contribute to a more resilient and sustainable urban future by following the ideas provided in this paper. The following are the key findings:

Using knowledge from routine construction site monitoring, a solid conceptual understanding of the step-by-step road construction process in Khulna city is obtained.

Delays in project execution may arise from settling land ownership conflicts and gaining approval.

The continuous construction process has the potential to damage the surrounding environment, but this may be avoided by adopting the appropriate precautions.

The construction procedure may cause disruptions to regular everyday routines. It is possible to improve community involvement in order to prevent misunderstandings or mistrust among the local population while building is underway.

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