

Gokhale Memorial Girls' College

To whom it may concern

Date: 17/04/2023

Subject: Completion of Group Projects by GEOA students of Semester VI in 2021-22

The undersigned certifies that the students mentioned in the table have completed their Group Projects for the University of Calcutta B.A./B.Sc. Semester-VI Examination, 2022 in CC-14 course of Geography Honours. These students are mentioned in the modified template of Metric 1.3.2 (DVV) completed as GEOA (SEM VI- Gr. A to Gr. D) with pdf link of the four projects stated alongside the groups of students.

SL.NO.	REGISTRATION NO.	COLLEGE ROLL NO.	NAME	SUBJECT
Group-A				
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4	013-1214-0156-19	19/BSCH/0170	Atreyee Sur	GEOA
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7	013-1212-0185-19	19/BSCH/0154	Sukanya Mallick	GEOA
8	013-1214-0151-19	19/BSCH/0157	Eshika Sen	GEOA
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10	013-1212-0226-19	19/BSCH/0190	Soniya Das	GEOA
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4	013-1211-0196-19	19/BSCH/0158	Adrija Dawn	GEOA
5	013-1211-0216-19	19/BSCH/0186	Pinanki Das	GEOA
6	013-1211-0221-19	19/BSCH/0145	Renita Nath	GEOA
7	013-1211-0188-19	19/BSCH/0209	Yashaswi Raman	GEOA
8	013-1211-0201-19	19/BSCH/0111	Debasmita Acharyya	GEOA
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B.Sc. Semester VI Practical Examination, 2021-2022

Project Report

Subject: Geography Honours (GEOA)

Paper : CC 14

Registration No. : 013-1211-0148-19

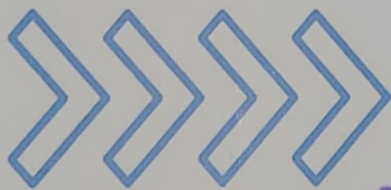
Roll No. : 193013-11-0023

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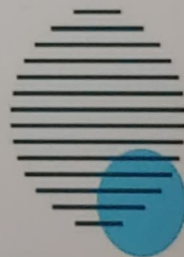
Examined
President
12.07.2022

Session: 2021-2022

STRUCTURAL COLLAPSE CASE-STUDIES OF MAJHERHAT BRIDGE (4TH SEPT, 2018), VIVEKANANDA ROAD FLYOVER (31ST MAR, 2016)



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Kolkata - 20



ACKNOWLEDGEMENT

I express my deep gratitude and appreciation to those who agreed to participate in this project, for their time expended and courage in sharing their insights with a fledging student. It is to them that I am most indebted, and I can only hope that the product of our collaboration benefits each one, as much as I am benefited from the process.

I have been immeasurably enriched by working under the supervision of Smt. Kamalini Dasgupta, the group mentor; for directing me in every situation possible, with her vast knowledge, which has enabled me to complete the project. I also convey my gratitude to Dr. Iqbal Sultan, Dr. Krishnakali Roy and Dr. Mahua Dutta, our respected professors for their constant support. I would also like to acknowledge our principal maam, Dr. Atashi Karpha for her kind cooperation.

Last, but not the least, I acknowledge my parents and my friends for their encouragement and all possible help in undertaking such a project work.

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- Casualty and Relief overview of Vivekananda Flyover

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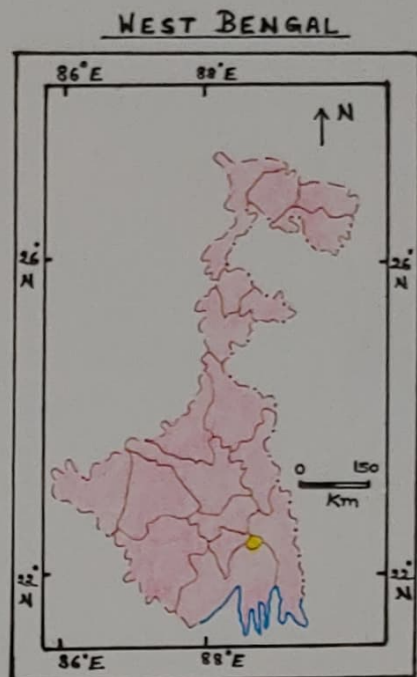
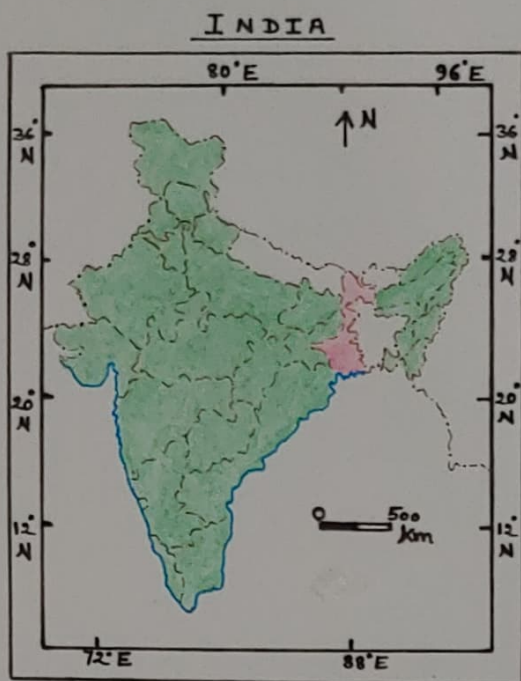
- Vivekananda Road Flyover collapse (31st March, 2016)
- Majherhat Bridge collapse (September 4, 2018)

INTRODUCTION

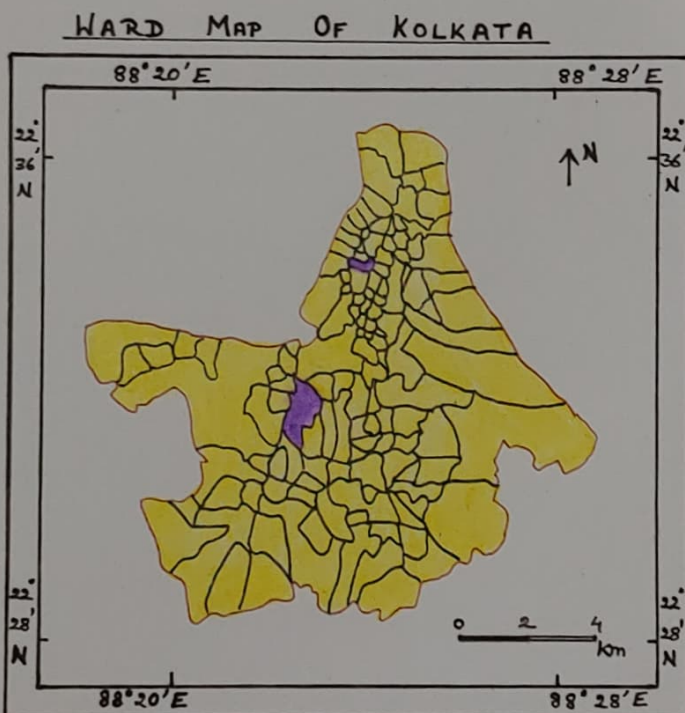
Definition— A structural collapse refers to the failure of a structure or component to maintain its structural integrity. Structures that may collapse include buildings, bridges or flyovers, and trenches. Structural collapse can be caused by quasi natural factors that is both natural factors (earthquake, weather-related events) and man induced factors (defective engineering or safety measures, poor maintenance, explosion and fire effects). So basically, a structural failure is initiated when a material is stressed beyond its strength limit causing fracture or excessive deformations. The hazards associated with a structural collapse include falling from the collapsed structure, being hit by falling materials and being crushed by debris.

Selection of Study Area— Kolkata is the capital city of West Bengal state within the Indian Union, lying at a coordinate of 22.5726°N and 88.3639°E . It covers an area of approximately 185 sq. km and is one of the densely populated cities in the country. To overcome the traffic congestion on the major roads in the business districts, the Government has undertaken construction of several flyovers which has eased the traffic flow in central localities. But the collapse of flyovers in 2016 and 2018 in Ward no. 26 and 74 of Kolkata, respectively; has put several question marks on the engineering practices adopted in the construction of flyovers, use of substandard materials and lack of supervision. Thus, this project report is an attempt to draw light over the actual scenario of the two great flyover collapse and find a solution to avoid this kind of hazards in near future.

LOCATION MAP



SOURCE: Abir Shankar Pal & Suornita Choudhury,
"School Geography" (November, 2014)



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Study area

SOURCE: HHH. Km.gov.in

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POSSIBLE CAUSES OF THE COLLAPSE:

Structural failure can occur from many types of problems, most of which are unique to different industries and structural types. However, most can be traced to one of five main causes:

- The first is that the structure is not strong and tough enough to support the load, due to either its size, shape, or choice of material.
- The second type of failure is from fatigue or corrosion, caused by instability in the structure's geometry, design or material properties. These failures usually begin when cracks form at stress points, such as squared corners or bolt holes too close to the material edge.
- The third type of failure is caused by manufacturing errors, including improper selection of materials, incorrect sizing, improper heat treating, failing to adhere to the design, or shoddy workmanship.
- The fourth type of failure is from the use of defective materials.
- The fifth cause of failure is from the lack of consideration of unexpected problems. This type of failure can be caused by events such as vandalism, sabotage or natural disasters.

From our study, an example can be cited where according to a RITES official, the possible cause of the collapse of the Majherhat bridge was due to excessive thickness. As he said -

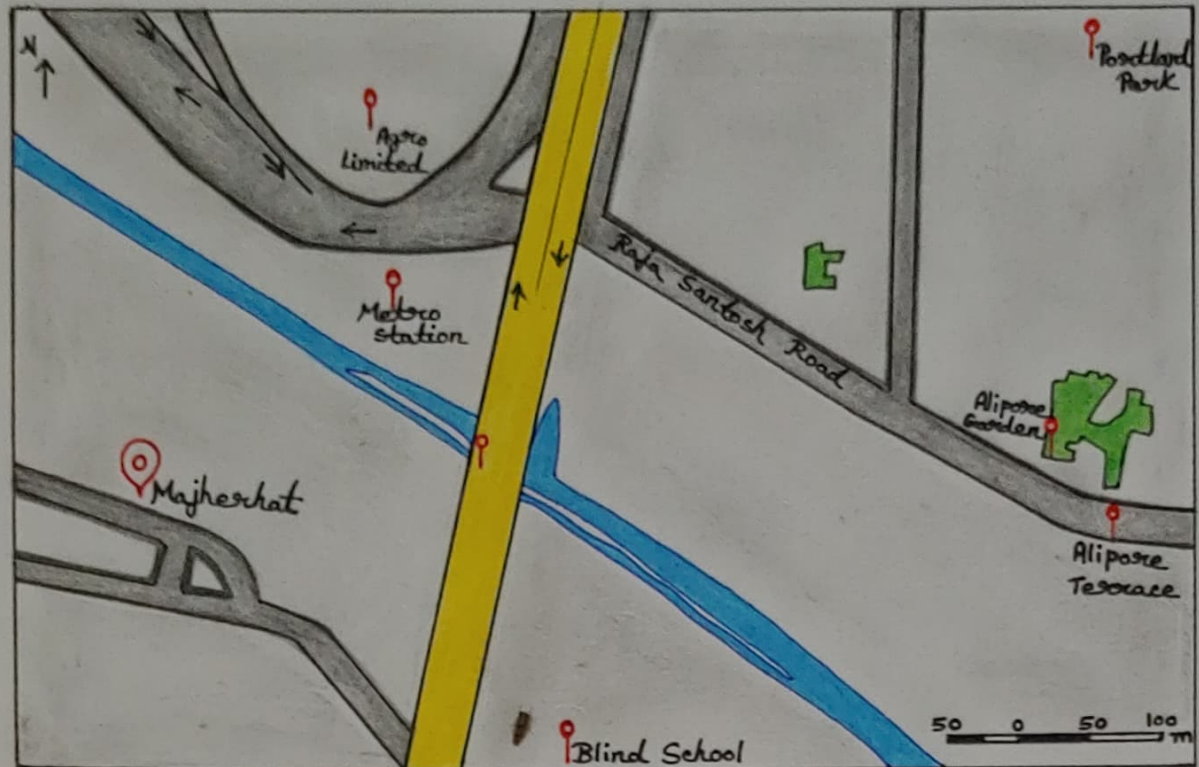
"Instead of removing old layers, fresh coating / patch work was done, which increased its thickness. This increases the weight of the bridge." In case of the Majherhat bridge, the surface was found to be 12 inches thick at the time of

fall which is not supposed to be more than two to three inches thick. However, according to others, the possible cause of the collapse was pollution and poor maintenance, besides hastily done repair works.

On the other hand, in case of Vivekananda Road Flyover other set of different cause were issued. Anandaprasad Gupta, former head of the department of civil engineering at IIT KGP stated that his investigating committee found defects in multiple aspects of the flyover construction including design, construction, raw materials and supervision. Bishanji Acharya, an experienced construction professional, claimed that the main cause was the failure of a pier cap which brought down two spans supported over it. Some flaws either in joints of pier cap or unwanted eccentric loading may have been responsible.

So, it can be understood that there can be multiple reasons behind the collapse of any structure.

LOCATION OF MATHERHAT BRIDGE

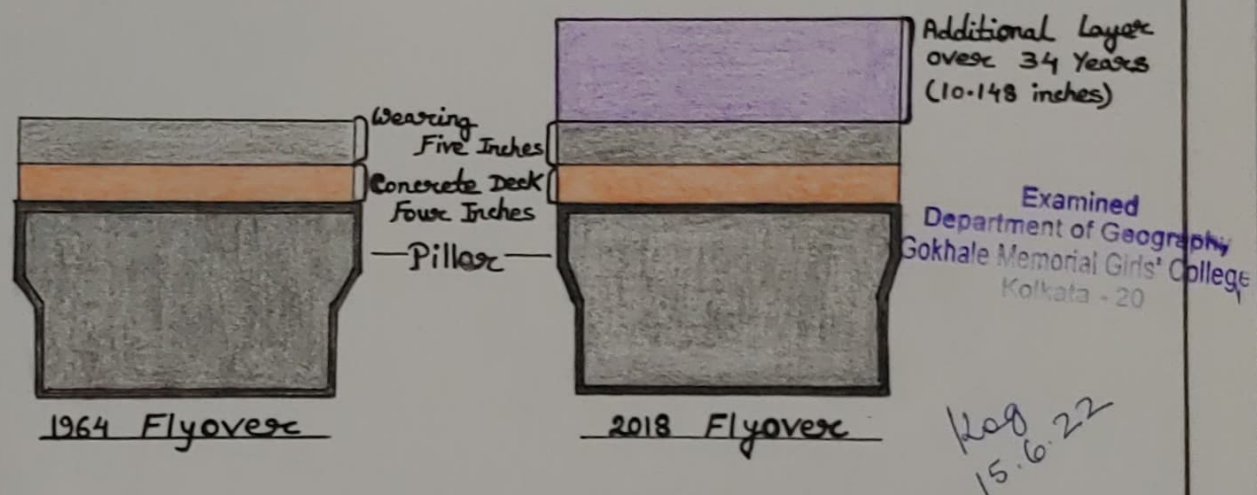


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Local Road	Flyover	Main Location
Others	Canal	Local Location
	Gardens	

Source: www.googlemaps.com, (08/04/22, 8:30 am)

SCHEMATIC DIAGRAM OF MATHERHAT BRIDGE OVERLOAD



Source: Report by Devendra Naraine Singh, Institute head, Professor of Civil Engineering Department, IIT Bombay

LOCATION OF VIVEKANANDA ROAD FLYOVER

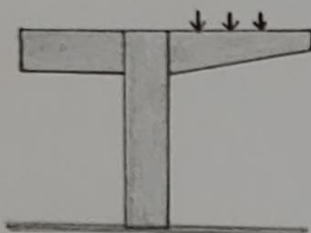


Source : www.googlemaps.com.
(08/04/22, 8:30 pm)

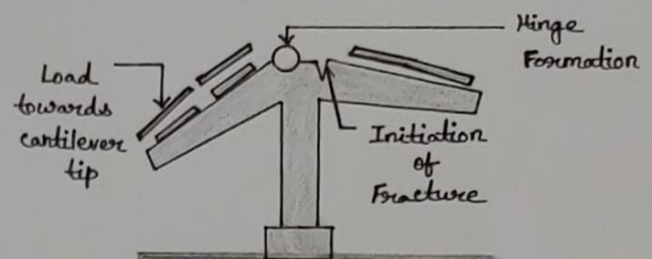
INDEX

- | | | |
|--|--|---|
| Park | Main Road | Others |
| Street | Flyover | |

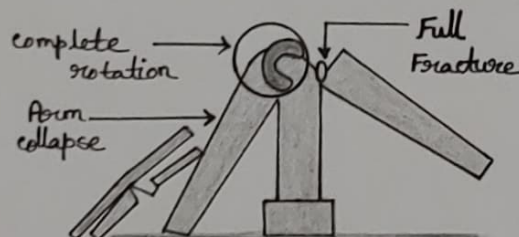
SCHEMATIC ILLUSTRATION OF VIVEKANANDA ROAD FLYOVER CANTILEVER ARM COLLAPSE



Before Collapse



Deflection causes yielding of top flange of loaded cantilever arm



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Collapse of left arm and instantaneous fracture of right cantilever arm

Source : [Turipex Online Journal Material Science](http://www.turipex.com) (April 24, 2017)

EFFECTS and CASUALTIES :

Majherhat bridge (September 4, 2018) - After the collapse of the bridge, Eastern Railways suspended train services via Majherhat railway station on the Kolkata Circular Railway and Sealdah-Budge Budge lines. Widespread road traffic and disruption ensued as the bridge was a major route for vehicles moving between north and south Kolkata. A pie diagram has been drawn to present the numbers of affected people from this collision. Almost 83% people were minor injured, 10% people were dead and almost 7% people were severely injured. The loss of properties has been represented by using Bar Diagram. From that, we've observed that most of the vehicles were four wheelers and two wheelers. Also, there was one bus at the time of collision.

Vivekananda Road Flyover (31st March 2016) - A set of cartograms has been prepared to show the effects of the collapse. The categories of effected people have been shown by a pie diagram. All total there were 297 affected people, out of which 27 people accounted for fatal; that is 9.09%. There were 80 people with non fatal injuries (i.e. 26.9%). 90 people (30.30%) were rescued and rest were unaccounted.

The types of trapped vehicles has been shown by a bar graph. It is seen that two buses, two motor cycles, two hand pulled rickshaws, eight taxis, six auto rickshaws, three private cars, one truck and one van were trapped under the collapsed structure.



Pic.- Vivekananda Road Flyover



Pic.- Majherhat Bridge

SOURCE: zee news.india.com

SOURCE: Indianexpress.com

RELIEF and REHABILITATION:

Majherhat Bridge (September 4, 2018) - The rescue effort was started by the Kolkata Police, an Indian Army unit from the Fort William and fire special disaster management teams of the NDRF after the mishap. Injured people were sent to nearby SSKM, CMRI and Vidyasagar hospitals for treatment.

Two horizontal bar diagrams has been drawn to show the mitigation of this hazard, from which we can observe that government has compensated injured by giving Rs. 50000; while dead peoples family received Rs. 5 lakhs as compensation.

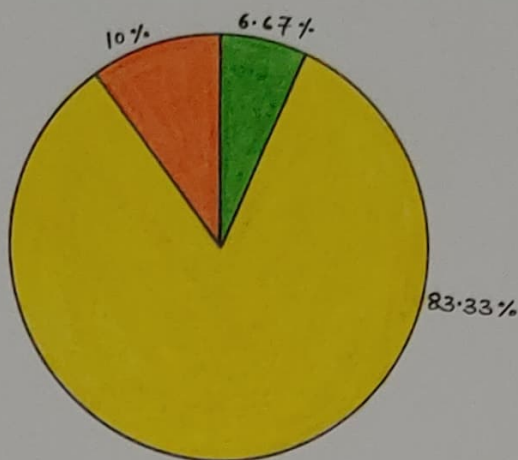
Vivekananda Road Flyover (31st March, 2016) - A set of cartograms has been prepared to show the rescue operations after the collapse. The categories of rescue operating teams have been depicted with the help of a horizontal bar graph. The highest number

of teams of army personnel's (10 teams) were spotted at the area followed by each five teams of National Disaster Response Force and City Police. There were also two teams of National Disaster Relief Fund and one team of State Disaster Management, Fire Brigade, Medical team and Engineers.

The State Government extended their helping hands to the affected people due to the collapse and compensated the families who lost their family members. The category of people who received different amounts of relief funds has been shown with the help of a line graph. The government gave Rs. 5 lakhs to the family of the deceased, Rs. 3 lakhs to the seriously injured victims and Rs. one lakh to the less injured victims.

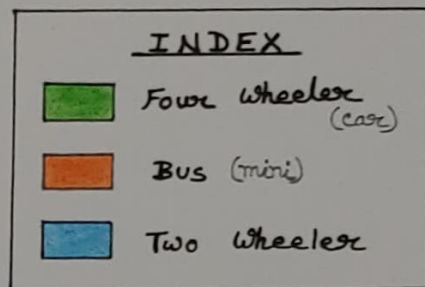
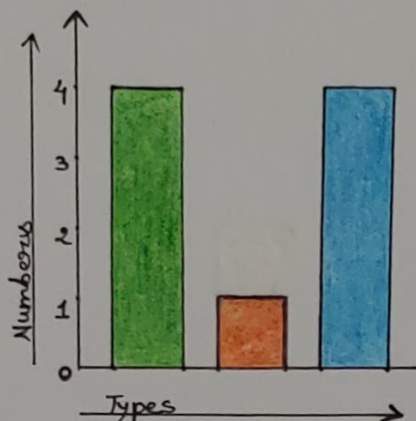
CASUALTY OVERVIEW OF MATHERHAT BRIDGE COLLISION

PERSONS AFFECTED



Source: WWW.WIKIPEDIA.COM (17/04/22, 11:20 am.)

LOSS OF PROPERTIES (VEHICLES)



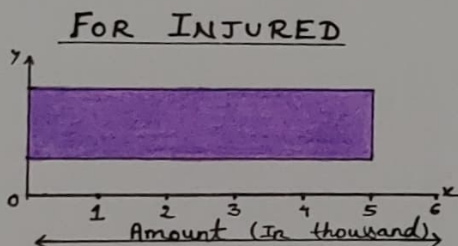
Vertical Scale: 1 cm $\equiv$ 1 Property

Source: m.economictimes.com (17/04/22, 11:00 am.)

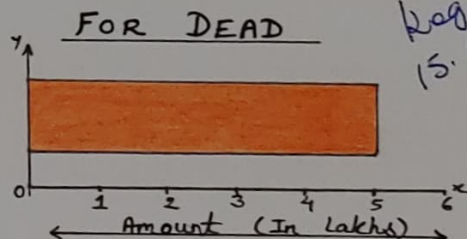
HAZARD MANAGEMENT

RELIEF

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Horizontal Scale: 1 cm $\equiv$ 1 thousand

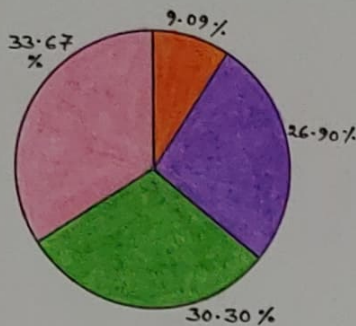


Horizontal Scale: 1 cm $\equiv$ 1 Lakh

Source: WWW.ndtv.com (17/04/22, 12 Pm.)

OVERVIEW OF VIVEKANANDA ROAD FLYOVER COLLAPSE

PERSONS AFFECTED

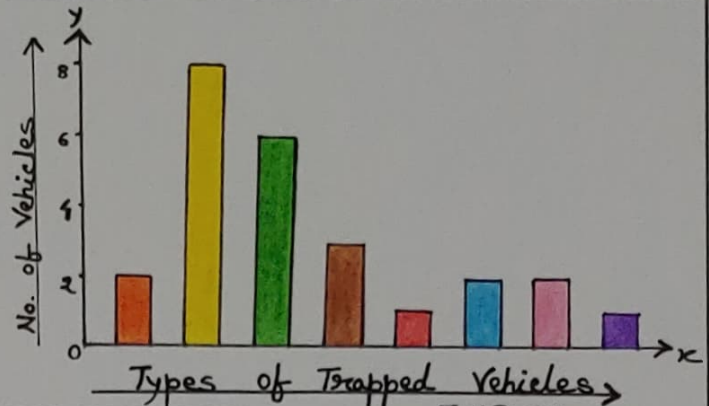


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- Fatal
- Non-Fatal
- Rescued
- Unaccounted

SOURCE: WWW.WIKIPEDIA.COM (20/03/22, 8:41 pm)

TYPES OF TRAPPED VEHICLES



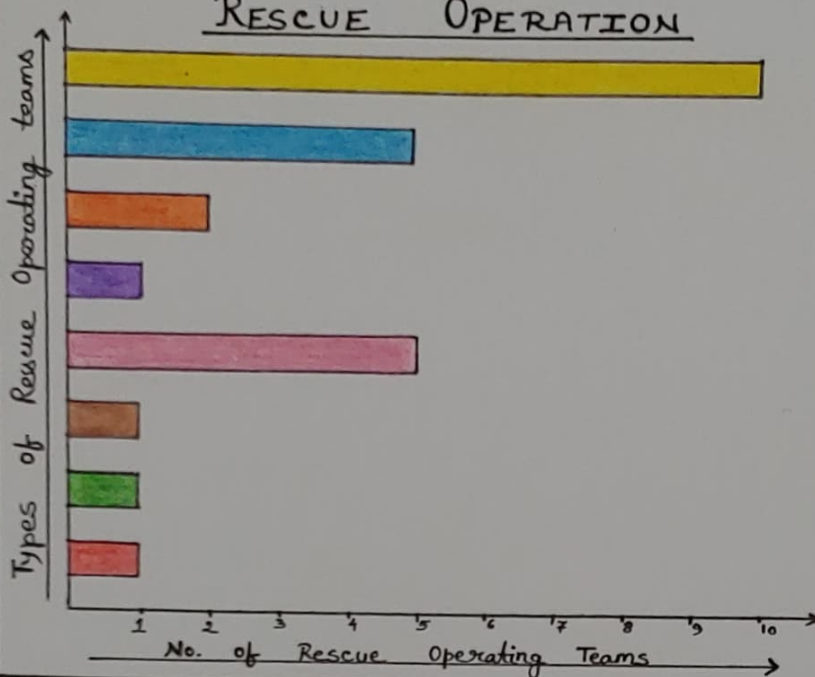
Vertical Scale: 1cm $\equiv$ 2 vehicles

INDEX

- Bus
- Auto
- Truck
- Van
- Taxi
- Private car
- Motor cycle
- Rickshaw

SOURCE: m.timesofindia.com (20/03/22, 8:30 pm)

RESCUE OPERATION



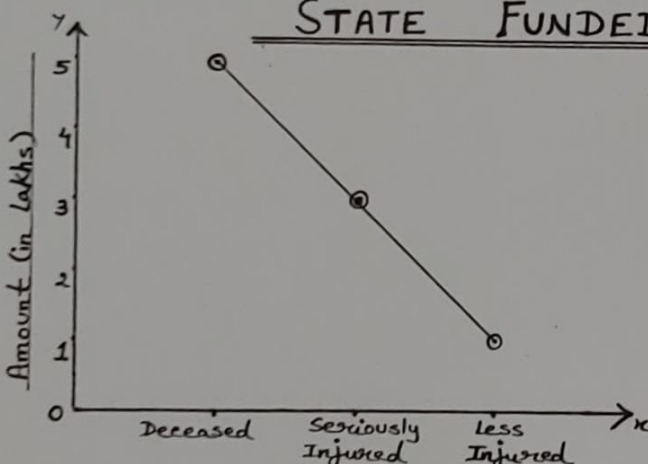
INDEX

- Army Personnels
- National Disaster Response Force
- National Disaster Relief Fund
- State Disaster Management
- City Police
- Fire Brigade
- Medical Team
- Engineers

Horizontal Scale: 1cm = 1 Rescue Team operating

SOURCE: <https://thewire.in> (21/03/22, 1:30 pm)

STATE FUNDED RELIEF



Vertical Scale: 1cm $\equiv$ One lakh rupees

SOURCE: <https://www.business-standard.com> (21/03/20, 1:30 pm)

PREPAREDNESS PLAN :

To further prevent the collapses of bridges and flyovers in Kolkata, several initiatives are taken into consideration which requires both Government intervention and community participation. A proper preparedness plan minimizes the negative consequences of extreme events and try to reduce the impact of the hazard.

The major problem with the bridges of Kolkata is the years of neglect and lack of proper and regular maintenance and checkup. So, all the bridges should be examined at least once in a year. The engineers must be fully skilled and a strict supervision should be taken place regarding the design of the flyovers and raw materials used for constructing them.

Necessary precautions should take place to reduce the pressure on the bridges and so on, the Government should impose a restriction on the heavy vehicles (long 10 to 20 wheeler vehicles) and a load test of the flyovers should be conducted every six months.

The natural calamities like earthquake may be responsible for collapse of bridges or flyovers; that's why ideal hazards resistant designs should be considered to be undertaken and also a proper prediction and warning should be given. Lack of housing in Kolkata has caused many slums and squatter settlements to be built under the bridges and thus making the people living in them, the most vulnerable during a bridge collapse. The Government should take necessary

steps to reduce the problem of shortage of housing. Some of the shops below the bridge degrade the stability or condition of the flyovers by drilling holes into the flyovers or its piers and thus, making them susceptible to an accident without any warning. Inspectors and the engineers must examine and take mandatory steps to improve their condition.

Following a catastrophic failure of structure; an evacuation should be alarmed, population and live loads should be removed urgently, utilities like gas and electricity has to be disconnected and fire service should be informed as early as possible.

CONCLUSION:

Kolkata is the capital city of West Bengal state which covers an area of approximately 185 sq. km and current population around five million. To overcome the traffic congestion on the major roads in the business districts, the Government has undertaken construction of several flyovers which has eased the traffic flow in certain localities. But several misfortunes and questions arose regarding the frequency of the bridge collapses in the city.

Mainly, two case studies have been taken - the Vivekananda Road Flyover, which collapsed in 2016 and the Majherhat Bridge, which collapsed in the year 2018; to analyze and point out the probable causes and effects caused by them.

After scrutinizing the actual reason behind the collapse of the Majherhat Bridge, it was revealed that the bridge dates back to mid 1960s making it 50 years old. So, the experts have blamed the lack of proper maintenance of ageing constructions in the city. The bridge collapse resulted in the death of three people and injuries to atleast 25 others. Eventually, the State Government took initiative and a new bridge was built in the place of the old one and was renamed as 'Jai Hind' Bridge.

Unlike the aged Majherhat Bridge, the Vivekananda flyover was still unused and still an under-construction project when it came crumbling down in March 2016. The blame, here, fell directly on the shoulders of bad construction. The demolition of the flyover finally commenced in 2021, five years after the accident. In 2018, the State Government revealed that 20 flyovers across the city were in 'weak condition'. Here, 10 bridges or flyovers from Kolkata are taken into consideration to show the severity effect on them:

Ranking	Effect	Severity Effect	Flyovers / Bridges
10	Hazardous without warning	Very High severity without warning	Vivekananda Flyover
9	Hazardous with warning	Very High severity with warning	EM Bypass Flyover
8	Very High	Destructive failure without safety	Sealdah Flyover
7	High	System inoperable equipment damage	Bijon Setu

Ranking	Effect	Severity Effect	Flyovers / Bridges
6	Moderate	System inoperable with minor damage	Samprite Flyover
5	Low	System inoperable without damage	Nagerbazar Flyover
4	Very Low	Degradation of performance	Gariahat Flyover
3	Minor	System operable with some degradation in performance	VIP Road Flyover
2	Very Minor	System operable with minor minimal interference	AJC Bose Road Flyover
1	None	No effect	Maa Flyover

Source : Juniper Online Journal Material Science
(April 24, 2017).

From the given table we can conclude, that the major flyovers in Kolkata are still in a dilapidated condition due to neglect and misuse of them. But, now the state Government is thoroughly inspecting the root causes behind the collapse of flyovers. KMDA, PHD and Irrigation Departments are doing regular inspection and monitoring work to take note of the condition of the elevated structures across the city. According to sources from the state secretariat, all departments and agencies concerned will have to take necessary steps in an urgent basis if any potential damage or fault is detected in any of the flyovers. Actions will be taken against the concerned engineers if any damage/fault is not rectified soon.

REFERENCES

- Juniper Online Journal Material Science (April 24, 2017)
- <https://www.telegraphindia.com/west-bengal/flyovers-sick-young-and-old-alike-in-calcutta/cid/1744082>
- <https://timesofindia.indiatimes.com/city/kolkata/Chief-secretary-reviews-condition-of-flyovers-in-kolkata/articleshow/68854176.cms>
- <https://www.thehindubusinessline.com/news/mamata-20-flyovers-in-the-city-in-weak-condition/article24885235.ece>
- www.ndtv.com (Access time: 17/04/22, 12 pm)
- <https://www.business-standard.com> (Access time: 21/03/22, 1:30 pm)
- Google Map (Access time: 08/04/22, 8:30 pm and 12/04/22, 7:45 pm)

Examiners
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ANNEXURE

Majherhat Collision (04/09/2018) :-

1.

Affected People	Number of People
Fatal	3
Non-fatal	2
Minor injured	25

Source : www.wikipedia.com (17/04/22, 11:20 AM.)

2.

Property Type	Number of Property
Minibus	1
Cars	4
Two wheelers	4
Shops	0

Source : www.m.economictimes.com (17/04/22, 11:00 AM.)

3.

Relief	Amount (in ₹)
Dead's family	5,00,000/-
Injured	50,000/-

Source : www.ndtv.com (17/04/22, 12:00 Noon)

Vivekananda Road Flyover collapse (31/03/2016)

1. Affected	Number of People
Fatal	27
Non-Fatal	80
Rescued	90
Un-Accounted	100

Source : www.wikipedia.com
(30/03/22, 8:41 pm)

2. Property Type	Number of Property
Bus	2
Taxi	8
Auto	6
Private car	3
Truck	1
Motor cycle	2
Rickshaw	2
Van	1

Source : m.timesofindia.com
(30/03/22, 8:30 pm)

3. Rescue Operating Teams	Number of Team
Army Personnels	10
NDRF (Response)	5
NDRF (Relief)	2
SDM	1
City Police	5
Fire Brigade	1
Medical team	1
Engineers	1

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Examinee
Prekshita Das
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Source : <https://thewire.in>
(21/03/22, 1:30 pm)

4. Relief Receiver	Relief Amount (In ₹)
Deceased	5 Lakhs
Seriously Injured	3 Lakhs
Minor Injured	1 Lakh

Source : <https://www.businessstandard.com>
(21/03/22, 1:30 pm)

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