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Safety Aspects in Road Construction Projects, Study of Safety Measures used by Workers at Site

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Abstract - Road construction industry has wide expansion growth in the world particularly in past few years. The India's road network is, in need of extensive construction, reconstruction and maintenance of constructed roads. High traffic rush on roads runs to be safe with minimum time take to reach at their destinations as well as the road construction workers are to be safe during working and playing of traffic. The scope of safety in road construction is to be standardize and develop before starting, during construction and after completion of road project.
This road safety study is to identify the critical safety practices in major accident areas with the safety of construction workers.
The provision of minimum safety standards is mentioned in IRC: SP: 55-2014 "GUIDLINE ON TRAFFIC MANAGEMENT IN WORK ZONS. This is for making the road route smooth with advance information so road users can understand the road features easily by seeing the advance sign boards, cautionary board, road marking and blinkers etc.
Many suggestions have been made by researchers for improvement of safety measures during execution of projects and after completion to road users.

Key Words: IRC, SP, FY

1.INTRODUCTION *(Size 11, Times New roman)*

Safety of Road construction activities are to be ensured as per contract agreement and method with risk analysis to be explained to avoid the accident potential of newly constructed as well as of existing roads. It is an effective and very productive and efficient method used to improve the road infrastructure during construction and after for road user as well workers those are involved directly or indirectly. It is the best method to prove that providing safety measure is the good practice to minimize the incidents, accidents and may save the life of many peoples on the globe.
It is very necessary to consider the safety aspects from the very beginning i.e. preconstruction plan, construction phase and after construction for road users. During the preparation of DPR a proper safety measures consideration to be adopted, because this is the very important time for safety adoption for project highways as well as road users. Analysis of adopting safety measures by the workers shall be discussed in the report during construction. The safety aspects have been considered in camp yard, workshop and construction sites.
A study has been made on NHAI project which is in state of UP from Hapur Bypass to Moradabad section of NH 24 Hence the study of road safety ensures that many risk contributing factors to be reviewed, so that the controlling factors to be taken in the account of at an advance stage of highway during and after construction with new technologies in manufacturing of automobiles in a cost-effective way.

2. Study of Safety Measures at Site

The related data have been collected from different websites via online and project site from Hapur to Moradabad section of NH – 24 project "Six laning of Hapur bypass to Moradabad section from Km. 50.00 to Km 150. In the state of Uttar Pradesh on DBFOT". The data analysis has been done as below mentioned. Study of different literatures like, road safety audit, accidents reports, implementation of safety measures during construction and after construction. Audit of road after construction to identify the black spots, road signs installation and any deficiency during road design.
The methodology is prepared in order to reflect the different aspects of construction sites and to reflect overall project objectives. It has following steps.

1. Visit of road construction site at NH 24 (New NH-09) to obtained the relevant data.
2. About 22 questions were prepared to gain the actual knowledge as its importance. The questions were asked to managers, site engineers and workers during site visit and in the site office.
3. Study of various manuals government policies tender document etc.

In the last step, a detailed report has been prepared with showing the statistics of safety process.
In details it can be seen in following steps: -

A) Identification subject Content: First I recognize the actual requirement for the project worked. It seems that there is some additional work need to be done with the existing provisions. Identify what is the requirement & what is the actual work to be done for the particular location of project.
B) Review of Existing Literature: I go through several existing literature /research paper has already been done in this area. This is very helpful to me, a lot of with adding great knowledge. Also avoiding the repetitions of any already existing work. Literature review also strengthen to interacted with subject and improve the methodology being adapted the various project from the last two or three decades.
C) Study of Road Safety Manual and IS CODE SP 55 - 2014 etc.: After studying the Road Safety Manual and SP 55 – 2014 at site I have identify that the safety measures have been done as per norms or not. All from their I received valuable data for project.

D) Selection of Project Site: Case study of new Highway project of NHAI from Hapur Bypass to Moradabad section of existing NH – 24 New NH-09. The length of project is about 80.00 Km and excluding 20.00 Km wildlife area. I selected some locations randomly to identify the norms and how the safety TBT conducted at site.

i) Work of Earthwork Embankment/Sub Grade construction in green field

ii) Widening of existing 4 lanes highway to 6 lanes i.e. work in traffic running zones.

iii) Work of RE walls approaches of bridges in green field and on existing road.

iv) Safely work monitoring of heavy machineries i.e. graders, road rollers and big bitumen pavers.

E) Various activities related to safety assessment & rescue calculation (Accident) : From the collected literature and face to face discussions, manuals, site visited and questioner find followings.

1. The approximate of no. of minor accidents at the site during work: – 2-3 per site per year
2. The measure accident: – 1 during work
3. Data collection and visit at project: – 2 years
4. Septic control related with work value: – Regularly is being done in all workers accommodations.

It has found that these contracts have less no. of accidents comparative to lower value of same nature.

5. What is risk for construction of Highway project- Highway projects have high risk during construction because during construction the safety team have to provide safe access to the road users as well as in house traffic movement with high skill traffic management plan.

F) Study of manuals & tender documents:

a. There are various provisions guidelines for safety in construction but these are not completely followed in actual execution/ maintenance.

b. Several professional are totally un aware from policies

c. Workers are mainly unaware from safety norm and methods and taking it casually.

d. Thumb rule are being in practice without scientific approach e.g. size of warning boards at few locations.

e. The focuses are timely/ speedy work execution work with economy is main criteria.

G) Identification of conflicts: – During monitoring and discussion with workers/Engineers those who are involved directly at site it is found the different conflicts at site within the stockholders. Contractors want more profit while client want maximum quality with economy. Due to these safety measures may compromise. There is no separate provision for payment getting from client. To avoid such conflicts a middle approach should be introduce which can help to implement safety measures with high standards.

I. Accident's Causes on Site

Accidents happened at site due to unsafe act by any worker from engineer rank to first line worker. unsafe act created by road users or combination of both. Unsafe act is an act of work activity (doing something without following the safety norms). Unsafe activities are due to overconfidence, negligence or not to follow the instructions due to ego point of view, not to use PPE (personal protective equipment's). Unsafe activities are one in which the physical layout of the workplace or work location, and the status of tools, equipment and/or material are in violation of contemporary safety standards. These conditions are due to lack of proper knowledge, using of substandard safety measures/equipment's and unsafe methods of safety, unsafe methods or sequencing, unsafe site conditions.

B. Excavation for Road Work

A common practice is that during excavation the excavated soil has to be placed adjacent to the excavated pit without any safety protection. By doing this the worker may fall into the excavated area or earth may collapse on the workers working underneath in the construction pit. Soil may collapse if the heap is just with the excavated pits aren't in proper place. The excavated earth should be kept at minimum 1.00 m to 1.500 m away from the pit in safe manner to avoid from slide or collapse.

C. Working with Heavy Equipment's

In Highway sector the maximum accidents happened with heavy graders, dumpers/tippers, road rollers, backhoe loaders, tandem rollers, PTR rollers and heavy pavers during in operation of different activities i.e. earthwork excavation and dumping, grading of soil, GSB, WMM etc., paving of WMM, DBM and BC with heavy pavers, compacting rollers and unloading of tippers during operation. All machineries must be equipped with back alarm sound and light system. The safety man must be available to watch and alert the workers during work.

D. Electrical Accidents

It is very important to check the site condition and identify the overhead and underground electric line in the field in advance where have to commence the road work in any stage. In most of the cases it found that existing electric lines may come in the contact of heavy machineries while in excavation, dumping or movement of machinery. Some electrical lines are for low voltage and some have high voltage. If any contact with live line which can become serious accident or even the death of worker with catching fire by machinery.

E. Working Near Buildings

It is risky to do the road work near to the residential/commercial buildings. An alert should be given to the building owners and discussion to be conducted with safety engineer, site manager, site engineers and with the stockholder. Tool Box Talk must be given to workers those who are directly involved in the road activity.

F. Provision of Guidelines for safe practices at Sites

There are many provisions in the tender/contract documents and these provisions to be followed by all concerns to avoid accidents at site.

a. Site Management

Safety providing is the key responsibility of company's higher management at site. The vision and provision for resources for effective health and safety must be clear. The higher management must set an example so the sub ordinates and workers must get influence to follow the safety rules.

b. Risk Hazard Identification and Assessment

This part is very necessary and must be evaluate by qualified safety officer/engineer before commencing any activity in the shape of method statement or any risk evaluation parameter.

c. Participation of All Workers

The success rate of safety depends on good active involvement management and of workers. Such type of participation will lead to successful education to all who are involved at site. By conducting safety programs, the site concerns will able to identify the risk in any job easily. Continuous monitoring and

conducting safety programs, this will give a good control on hazard prevention.

d. Safety Training and Education of Workers

This is the very important part of safety which provide good lessons to employers and workers who are involved in the project. After getting the training they can apply the safety measure at site in easy manner, which may avoid any big consequences at site. The safety training should be involved in all programs as an awareness. Such type of training and education will increase the knowledge of all concerns which will give a good impact on project. In other word we can say that the job may done in once to get good product.

e. Project Safety organization

Although safety is the responsibility of all not only for safety team. However, the project safety organization should be prepared with involvement of all departments i.e. Highway, Structures, Quality, Planning and Safety. By making such organizations the risk of incidents may be minimized. The responsibilities shall be distributed and all concerns will aware.

f. Guidelines not followed at Site Project

This is the big issue that after getting the contract, the implementation of safety measures at site is taking casually. Some of companies compromise with safety measures, which give a big impact on project, if any accident happened at site. Now a days the Government authorities are asking for safety measures but there should be some financial provision should be considered by seeing the cost impact on the project. This implementation of safety measures in the industry is less seen due the following reasons: -

1.1 Safety Implementation Cost

The medium or small companies not able to bear the cost of safety measures, to hire the safety expert for implementation and monitoring with less amount. The reason may be getting the tender on less quoted price in competition which become big consequences with the client and the company. By getting the low rate tender, the companies trying to manage the site expanses by escaping the safety measures. Safety is less in priority in budget allocation for projects. This may be the main reason no to provide good safety measures. However, the 0.01% cost have been considered in the total project cost as the project value is very high.

1.2 Negligence of Worker and Site Engineer

The site engineer thinks that providing of safety measure is the responsibility of safety team and worker may not be able to understand the importance of safety. The provision of safety measure is mainly to save the life of workers, money and time. Sometime engineer/workers may take the safety in casual or overconfidence which may lead to very serious accident.

Conclusion of Collected Data & Questionnaire: -

The below table data have been collected from site which shows the average number of workers engaged at different sites as the length of project is about 80.00 Km and there are different types of activities are in progress.

Table -1: Data of Employees and Workers taken FY 2020-2021

F/Year 2020-2021	Average No. of Employees / Day	Average No. of Workers / Day (Company)	Average No. of Workers / Day (Sub-con)	Total Man Days
April	223	383	50	656
May	268	389	60	717
June	298	405	144	847
July	321	412	86	819
August	335	415	63	813
September	338	409	88	835
October	380	495	581	1456
November	380	483	563	1426
December	385	510	580	1475
January	375	500	560	1435
February	380	495	573	1448
March	400	510	534	1444
TOTAL	4083	5406	3882	13371
AVERAGE	340	451	324	1114

Fig- 1: From the above data

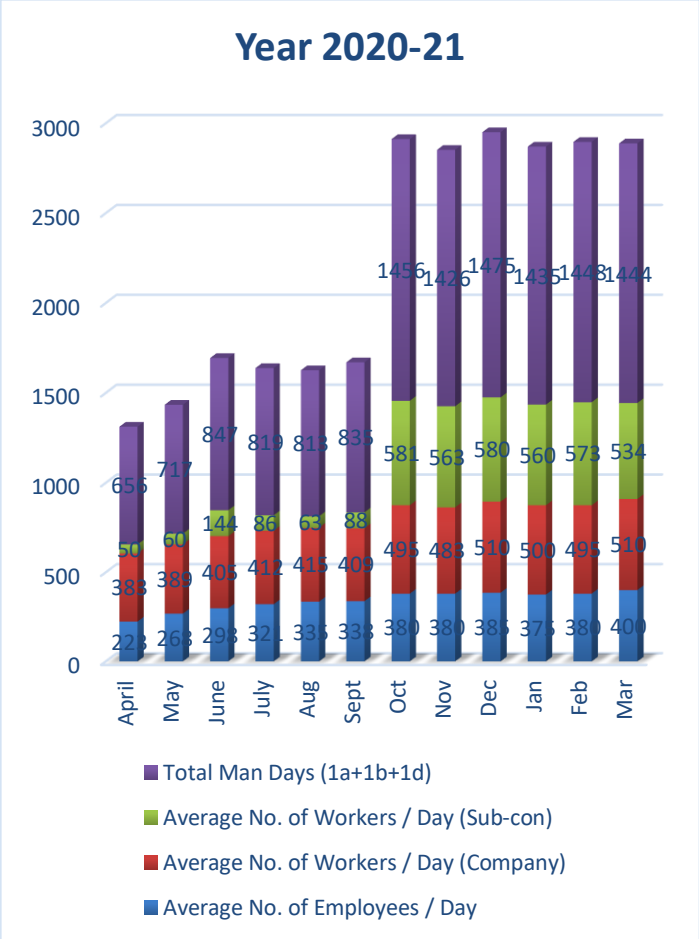


Table -2: Data of Employees and Workers taken FY 2021-2022

Year 2021-2022	Average No. of Employees / Day	Average No. of Workers / Day (Company)	Average No. of Workers / Day (Sub-con)	Total Man Days
April	390	474	584	1448
May	280	480	520	1280
June	216	195	584	995
July	220	167	401	788
August	408	190	576	1174
September	293	260	426	979
October	290	157	304	751
November	326	188	289	803
December	323	184	293	800
January	404	182	276	862
February	375	180	252	807
March	385	175	596	1156
TOTAL	3910	2832	5101	11843
AVERAGE	326	236	425	987

Fig- 2: From the above data

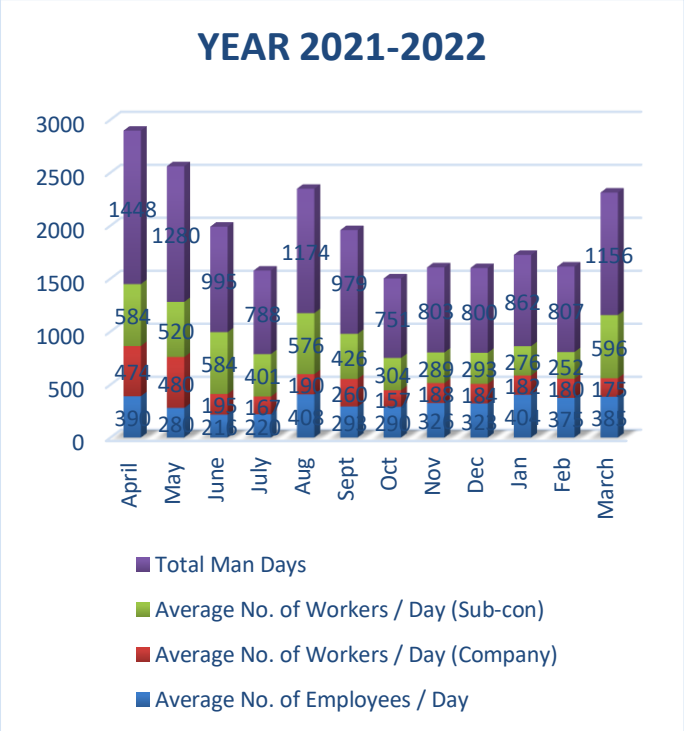


Fig -1: Figure

Table -3: Data of Employees and Workers Training attended FY 2020-2021

Year 2020-2021	Total Man Days	No. of training programme conducted	No. of employees trained	No.of Tool Box Talk conducted	No. of employees attended	No. of employees/ Workmen inducted
April	656	2	20	14	156	640
May	717	2	15	17	201	698
June	847	2	20	23	235	812
July	819	4	35	18	65	819
August	813	3	28	21	85	813
Sept	835	4	44	26	70	825
Oct	1456	4	25	23	180	1398
Nov	1426	6	27	18	210	1410
Dec	1475	8	20	22	150	1422
January	1435	7	25	28	145	1420
February	1448	6	22	20	210	1405
March	1444	5	10	15	200	1412
TOTAL	13371	53	291	245	1907	13074
AVERAGE	1114	4	24	20	158.92	1090

Fig- 3: From the above data

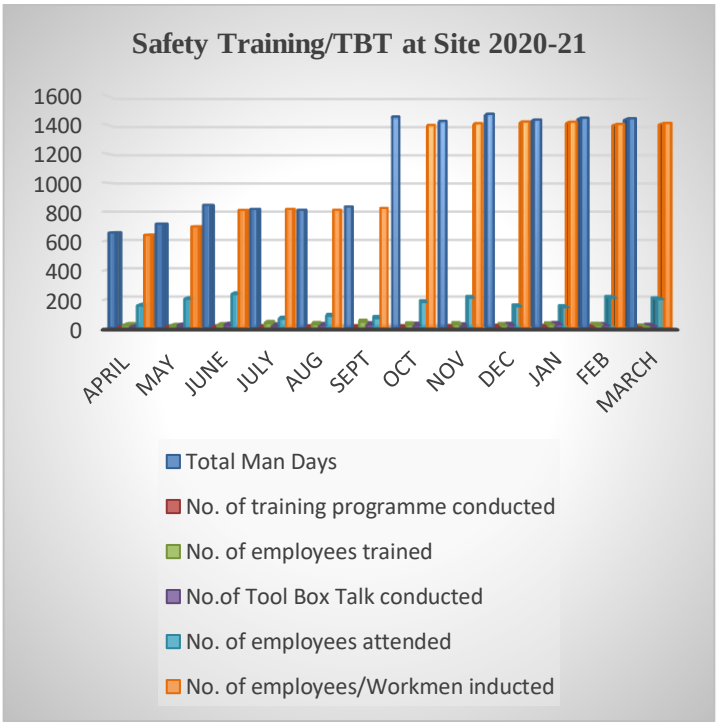
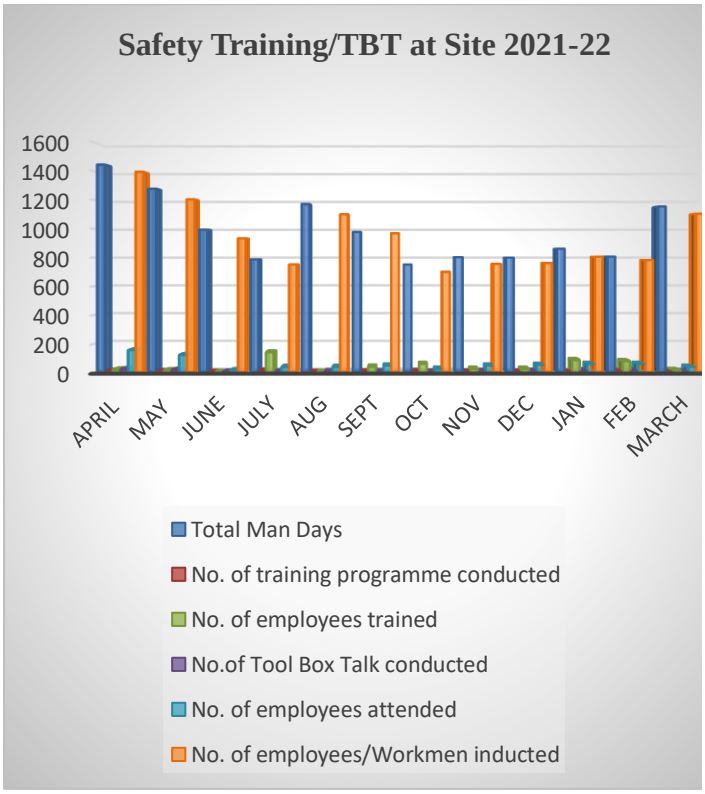


Table -4: Data of Employees and Workers Training attended FY 2021-2022

Year 2021-2022	Total Man Days	No. of training programme conducted	No. of employees trained	No.of Tool Box Talk conducted	No. of employees attended	No. of employees/Workmen inducted
April	1448	8	18	20	154	1398
May	1280	5	12	15	120	1206
June	995	0	0	2	13	935
July	788	10	139	4	36	752
August	1174	0	0	5	36	1103
Sept	979	3	38	5	46	970
Oct	751	6	58	2	23	700
Nov	803	2	23	7	46	756
Dec	800	2	23	8	51	762
January	862	2	85	11	58	806
February	807	6	77	11	58	783
March	1156	3	14	5	37	1106
TOTAL	11843	47	487	95	678	11277
AVERAGE	987	4	41	8	56.5	940

Fig- 4: From the above data



By conducting the tool box talks and trainings the below are the results as Safe Man Hours Achieved during FY 2020-21 & 2021-22.

Fig- 5: Total Safe Man Hours Achieved 2020-2021

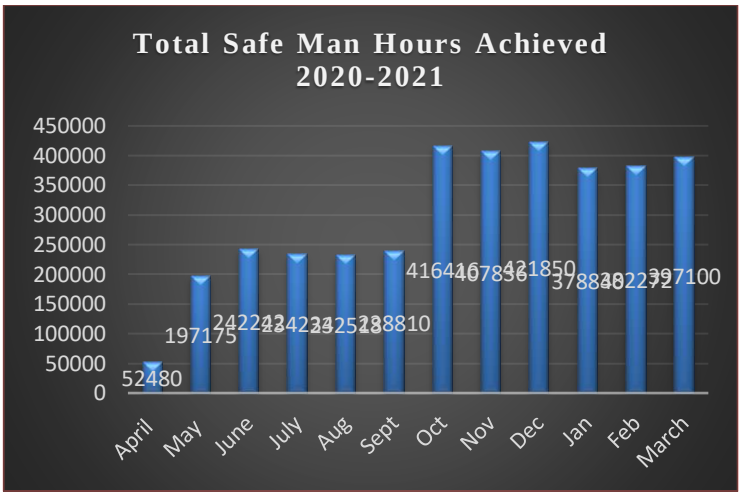


Fig- 6: Total Safe Man Hours Achieved 2021-2022

3. CONCLUSIONS

It is observed that safety aspects are very important feature for Road construction and in operation. Now a days the traffic on the all type of roads is being increasing fastly. By seeing the increment in traffic, the road construction also being in construction. The construction of different types of roads are constructing in short time span by seeing the requirement for our country development. The plant, machineries and workers are also in work, in more quantum. Without safety measures it is very difficult to control the movement and classifications of works without safety aspects.

Safety is the key element which is making a good bond between construction and road users. A good safety management system can save a lot of time and money for any project. During construction it is very necessary to provide the safe access to construction people as well as for road users. Mainly in India we are developing our existing road infrastructure by widening the additional lanes of roads.

A proper road following rules and safety aspects training continuously is required for locals and road users because there are maximum casualties have been reported in India from all over the world.

The main finding on this particular road stretch that the local road users are using the opposite direction of road which may cause the serious accident.

Safety is the prime responsibility of everyone those who are involved in road construction and use after construction. By preparing this report it is expected to find out the shortcomings and recommendations for safety aspects to be followed.

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