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GROUND IMPROVEMENT TECHNIQUES FOR RAILWAY EMBANKMENTS

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ABSTRACT

Modern railway infrastructure demands a high level of performance in terms of settlements and stability of the railway track. In areas where loose or soft cohesive deposits are found, ground improvement is often required to ensure the required level of performance.

The need of this project is to improving the bearing capacity ground and axel load on railway embankment for train run on more speed.This project is to support for design a new railway track models that would result in more reliable and economical than track designs. The railway having one of the most widen network in India which can joint all state, district and towns also so it is easy way of mode of transportation place to place. The literature survey was carried out regarding the railway network development, construction methodology for the railway track, various management techniques for embankment construction. These are the some of the ground improvement techniques that are available being used world wide for railway infrastructure project. The techniques present are Vibro Compaction, Vibro Replacement (Stone Columns), Grouted Stone Columns (GSC), Vibro Concrete Columns (VCC) and Dry Deep Soil Mixing (Cement Columns). The purpose of this project is to provide a general study and introduction of the techniques for railway embankment.

The conclusion of this project is that, to increase the speed of train and In addition to improving strength and deformation properties, stone columns density in situ soil, rapidly drain the generated excess pore water pressure, accelerate consolidation and minimise post-construction settlement. In this paper, the design methodology, installation, methodology, load testing and field instrumentation for vibro replacement with stone columns for railway embankment have been discussed.

Keywords- *Vibro Compaction, Vibro Replacement, Grouted Stone Columns, Railway Embankments, and Depth Vibrator.*

I. INTRODUCTION

Railways are one of the oldest modes of transportation system started some 150 years ago under different traffic reasons. In addition to increased axle load and train speeds, railway lines often have to cross over existing loose or soft cohesive deposits as a part of the alignment giving rise to the need for ground improvement.

In order to achieve a high level of performance of the rail system, attention should be focused on post construction settlement of the subsoil and factor of safety of the structure against slip failure. Different countries follow different sets of specifications for settlement and stability criteria for railway systems. For example in Malaysia for a railway line designed for speed of 160 km/h, typical requirement are as specified below:

- Maximum post construction settlement of 25 mm over a period of 6 months of commercial rail service.
- Maximum differential settlement of 10 mm over a track length of 10 m (1 in 1000) along the embankment centreline.
- Minimum long-term factor of safety of 1.5 against slip failure.

1.1 Need of Study

The global phenomenon of rapid industrialization and liberalization has boosted the need for various infrastructure projects; Modern Railway infrastructure demands a high level of performance in terms of settlement and stability of railway track. The presence of loose or soft soils along the alignment of railway tracks inevitably leads to problems in terms of post construction settlements, inadequate factor of safety against slip failure and problems associated. The need of this project is to improving the bearing capacity of ground and axle load on railway embankment for train run on more speed. This project is to support for design of new railway track models that would result in more reliable and economical than other track designs.

1.2 Railway Network in India

The importance of preserving an adequate condition of the rail network is widely recognized. Although, developing and maintaining a good rail network is not an easy task. It requires meticulous planning, enormous funds, challenging construction techniques, strict quality control and other related aspects. In today's economic environment of constrained budgets, as the existing rail infrastructure has aged, a more systematic approach towards determining maintenance and rehabilitationneeds is necessary. Rail networks needs to be managed now and not just maintained. The wide ranges of climate and different physical characteristics have given the continental character of India. Climatically, the country extents through some of the World's most difficult terrain from the North-Western scorching deserts of Rajasthan. The Eastern rainforests of Assam and the icy bitterness of the Northern Himalayan borders. Indian Railways (IR) owns the largest network in Asia and Fourth largest network in the world, after United States (U.S.), Russia and China. For a vast country like India, having a more than 64,015 Km. of track and 6,909 stations. The railway traverses the length and breadth of the country and carry over 20 million passengers and 2 million tons of freight daily. It is one of the World's largest commercial utility employers, with more than 1.6 million employers. As to rolling stock Indian Railwayowns over 200,000 (freight) wagons, 50,000 coaches and 8,000 locomotives.

Table-1: Present Railway Network in India

Sr. No.	Classification	Length (Km)
1	Broad Gauge	60,000
2	Meter Gauge	4,000
3	Narrow Gauge	2,000

1.3 Objective of the Study

The objective of the present study is to analyze the ground improvement techniques practices in railway construction.

- To do the review study of ground development of railway track particularly in India.
- To study literature regarding the ground improvement techniques for railway embankment.
- To study the construction methodology for the railway embankment in India.
- To study various ground improvement techniques.
- To study the various management aspects for railway track constructions.

II. PROPOSED METHODOLGY

The proposed study work is mainly focused to find out the railway development of Railway Embankment. To carry out study, survey method is used by taking a sample study at village Tuljapur, Wardha District as a case study. The literature was carried out regarding the railway network development, construction methodology for the railway track; various techniques like Vibro techniques and Dry Deep Soil Mixing are used for embankment construction, development of railways.

The construction of a selected track is a part of the Central Government Development Programme present on White Paper. Construction Methodology and strategic track development planning and management, material planning and management, legal contract management and compliance, safety management, etc. are studied.

III. LITERATURE REVIEW

Literature survey related to ground improvement techniques for railway embankment was under taken to get acquainted with the current practices. Technical articles published in the other journals have been referred to determine the further scope of work and to understand the status of each work under taken.

It started with Henri Vidal (1960) and became familiar with the pioneer work of Binquet and Lee. Ground Improvement Techniques have made considerable advances since today's commonly practiced techniques began to develop in 20th century however most of the techniques have gone through changes. This paper presents a review on research and development in the field of ground improvement.

Sondermann W. (1996), has observed that the "Soil Improvement by Vibro Replacement for Rigid Pavement Construction to the High Speed Railway System as a result of numerous research and field studies, the above technique has been established in a systematic way from analysis to construction. The past developments have been summarized in many publications.

Raju V. R. (2003), have discuss that "Ground Treatment Using Dry Deep Soil Mixing for a Railway Embankment in Malaysia", Proceedings of the 2nd Conference on Advance in Soft Soil Engineering and Technology, Putrajaya, University of Putra Malaysia. Dry Deep Soil Mixing (DSM) technology is a development of the lime-cement column method. It is a form of soil improvement involving the introduction and mechanical mixing of in-situ soft and weak soils with a cementitious compound such as lime, cement or a combination of both in different proportions.

Brill G.T. and Hussin, J.D. (1992), "The use of Compaction grouting to remediate a railroad embankment. A stone column depends on lateral support offered by the in-situ soil for its stability and load carrying capacity. In organic soils, such as peat, this lateral support may not be adequate or may diminish with time following decomposition.

Arul rajah A. and Affendi A. (2002), "Vibro Replacement Design of High-Speed Railway Embankments". Vibro replacement is a technique used to improve sandy soils with high fine contents and cohesive soils such as silts and clays. In this method, columns made up of stones are installed in the soft ground using depth vibrator.

Broms B. B. (1999), "Code of Practice for Strengthened/Reinforced Soils and Other Fills". Soil Investigation at the site indicated a 2m thick organic layer of peat followed by dense sandy layers. However, there are several developments on Vibro Techniques that are still worth mentioning.

IV. GROUND IMPROVEMENT TECHNIQUES

The nearness of delicate soils along the railroad track arrangement represents a greater risk for the post development settlement, security against slip failure and ground vibrations. With a specific end goal to beat these issues following strategies are to be executed:

4.1 Vibro Technique

This procedure can be utilised for treating delicate firm soils with depth vibrators. It includes Vibro Compaction and Vibro Replacement Strategies. Following are the various technique can be utilized for the improvement in ground soil properties:

- Vibro Compaction
- Vibro Replacement (Stone Columns)
- Grouted Stone Columns
- Vibro Concrete Columns

4.2 Dry Deep Soil Mixing (DSM) Technique

This method being an enhancement of the lime-cement column method, which was invented by Kjeld Paus roughly 3 decades ago. It includes the mechanical blending of in-situ delicate and feeble soil with a cementitious compound, for example, lime, bond or both taken in extents. This fastener blend is mixed into the dirt in dry state. The dampness in the dirt is used for restricting bringing about dirt with higher shear quality and lower compressibility.

This method can be used for foundation of embankment fill for highway and railway, slope stabilization for deep development and also for housing development. In most of the cases the quality begins to increment following a couple of hours and afterward proceeds to increment quickly amid the main week.

V. CONCLUSION

Involvement in a few nations has demonstrated that ground change is regularly required for establishing dikes for current rapid railroad foundation. Profound vibro procedures and profound soil blending strategies have discovered broad application worldwide and have ended up being adaptable in the capacity to treat an extensive variety of soils and site imperatives/conditions and productive as far as time required to finish the treatment works and for solidification.

Vibro Replacement with stone columns allows for the treatment of a wide range of soils, ranging from soft clays to lose sand by forming reinforcing elements of low compressibility and high shear strength. The type of ground improvement methods adopted in the project are dependent on various factors such as type of soil, height of embankment and thickness of soft or loose deposits.

VI. REFERENCES

1. Sondemann, W. (1996), "Soil Improvement by Vibro Replacement for Rigid Pavement Construction to the High Speed Railway System" 3rd Geotechnique-Colloquium, Darmstadt, Germany, Technical paper 10-53 E.
2. Raju V. R. "Ground Treatment using Dry Deep Soil Mixing for a railway embankment in Malaysia", Proceedings of the 2nd Conference on Advance in Soft Soil Engineering and Technology, Putrajaya, University of Putrajaya, Malaysia, 2003,589-600.
3. Brill G. T. Hussin, J. D. (1992), "The use of Compaction Grouting to Remediate a Railroad Embankment in a Karsts Environment", Proceedings of the 23rd Ohio River Valley Soils Seminar, Louisville, Kentucky, October, 1992.
4. Broms, B. B. (1999), "Design of Lime, Lime/Cement and Cement Columns", Proceedings of the International Conference on Dry Mix Methods for Deep Soil Stabilization, Stockholm, Sweden, pp. 125-153.
5. Holm, G. (1999), "Applications of Dry Mix Methods for Deep Soil Stabilization", Proceedings of the International Conference on Dry Mix Methods for Deep Soil Stabilization, Stockholm, Sweden, pp. 3-13.
6. www.fenixdigital.com.br
7. www.researchgate.net
8. www.Xa.yimg.com
9. www.kellerindia.com