

Case Study on Soil Settlement Problems in Urban Construction Projects in Ranchi, Jharkhand

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Abstract - Rapid urban construction in Ranchi, Jharkhand has increased cases of soil settlement in residential and commercial buildings. Many structures show cracks and differential settlement due to weak clayey soil, lateritic soil, and poorly compacted filled land. This case study investigates the causes of settlement problems in selected urban areas of Ranchi through field observations and review of soil investigation data. The study analyzes bearing capacity, consolidation behavior, and foundation types used in affected buildings. Results indicate that inadequate geotechnical investigation, improper compaction, and unsuitable foundation selection are major reasons for settlement. The study suggests proper soil testing, suitable foundation design, and ground improvement techniques to reduce future settlement issues in Ranchi.

INTRODUCTION:

Soil is one of the most important components in civil engineering, as it directly supports foundations and structures. The strength, compressibility, and bearing capacity of soil determine the stability and safety of any construction project. If soil properties are not properly investigated, problems such as settlement, cracks, and structural failure may occur. Ranchi, the capital city of Jharkhand, is mainly characterized by lateritic soil, clayey soil, sandy soil, and filled-up ground in urban areas. Many parts of Ranchi such as **Harmu, Doranda, Kanke, Bariatu, and Lalpur** have clayey and mixed soils, which are prone to consolidation and differential settlement when subjected to structural loads. In newly developed urban areas, construction is often carried out on filled land without proper compaction, increasing the risk of settlement problems. Due to rapid urbanization and multi-storey building construction in Ranchi, cases of foundation settlement and structural cracks have been observed. Therefore, it is important to study the soil conditions of Ranchi and analyze their impact on urban construction projects to ensure safe and sustainable development.

Keywords: Soil Settlement, Urban Construction, analyzes, investigation. Soil Mechanics.

OBJECTIVES OF THE STUDY:

Ranchi town is experiencing rapid urban growth with increasing construction of residential and commercial buildings in areas such as **Harmu, Doranda, Kanke, Bariatu, and Lalpur**. Due to this fast development, many buildings are being constructed without detailed geotechnical investigation. As a result, problems such as cracks in walls, uneven floors, and differential settlement are being observed in several structures. The soil in Ranchi mainly consists of clayey soil, lateritic soil, and filled-up land, which are prone to settlement when subjected to structural loads. Improper compaction, high groundwater level, and unsuitable foundation selection further increase the risk of settlement problems. Therefore, it is necessary to study soil settlement issues in Ranchi town to understand their causes and suggest appropriate preventive measures. This study will help engineers, builders, and planners to adopt proper soil testing, foundation design, and ground improvement techniques for safe and sustainable urban construction.

METHODOLOGY:

The methodology adopted for this study on soil settlement problems in urban construction projects in Ranchi town consists of the following steps:

1. Selection of Study Area:

Urban areas of Ranchi such as Harmu, Doranda, Kanke, Bariatu, and Lalpur were selected for the case study due to rapid construction activities and reported settlement issues.

2. Field Investigation:

1. Site visits were conducted to observe visible signs of settlement such as cracks in walls, uneven floors, tilting of structures, and foundation distress.
2. Photographs and field notes were collected from selected buildings.

3. Collection of Soil Data:

1. Available soil investigation reports from construction sites were reviewed.
2. Soil properties such as soil type, bearing capacity, groundwater depth, and compaction details were analyzed.

4. LABORATORY TEST DATA ANALYSIS:

Where available, the following test results were studied:

1. Standard Penetration Test (SPT) values
2. Atterberg Limits (for clayey soil)
3. Moisture content
4. Consolidation characteristics

5. SETTLEMENT AND BEARING CAPACITY ANALYSIS:

1. Allowable bearing capacity was calculated using IS 6403 guidelines.
2. Settlement estimation was carried out based on IS 8009 provisions.
3. Observed settlement was compared with permissible limits.

6. IDENTIFICATION OF CAUSES:

Based on field observations and soil data, major causes of settlement in Ranchi areas were identified such as weak clay soil, poor compaction, high groundwater level, and improper foundation selection.

Observed Soil Settlement Problems in Ranchi Town:

Sl. No.	Area Name (Ranchi)	Predominant Soil Type	Observed Problems	Possible Causes
1	Harmu	Clayey Soil	Wall cracks, uneven flooring	High compressibility and consolidation settlement
2	Doranda	Filled-up Soil + Clay	Differential settlement, foundation cracks	Poor compaction and weak subsoil
3	Kanke	Lateritic Soil	Minor settlement, surface cracks	Porous soil structure and moisture variation
4	Bariatu	Clayey Soil	Tilting of boundary walls, floor sinking	High groundwater table and soft clay
5	Lalpur	Mixed Soil (Clay + Sand)	Uneven settlement in multi-storey buildings	Improper foundation selection

Table 01: Soil Settlement Problems in Ranchi Town.

Data Analysis

Based on the field observations and soil characteristics of selected urban areas of Ranchi such as **Harmu, Doranda, Kanke, Bariatu,** and **Lalpur**, several soil settlement issues were identified. The analysis of the collected data shows that different soil types in these areas influence the settlement behavior of structures.

1. **Harmu and Bariatu**, clayey soil is predominantly found. Clay soil has high compressibility and low shear strength, which leads to consolidation settlement when structural loads are applied. As a result, buildings in these areas often show wall cracks, uneven floors, and minor structural distress.
2. **Doranda**, many construction sites are located on filled-up land mixed with clay. Due to improper compaction of filled soil, structures may experience differential settlement and foundation cracks. This is mainly caused by uneven load distribution and weak subsoil conditions.
3. **Kanke**, the soil is mainly lateritic soil, which is relatively stable but porous in nature. Changes in moisture content during rainy seasons may cause minor surface settlement and cracks in pavements or boundary walls.
4. **Lalpur**, the soil profile consists of mixed soil (clay and sand). In such soil conditions, improper foundation design can lead to uneven settlement in multi-storey buildings.

5. The analysis indicates that the major factors responsible for soil settlement problems in Ranchi are weak clayey soil, poor compaction of filled soil, high groundwater levels, and inadequate geotechnical investigation before construction. Therefore, proper soil testing, appropriate foundation design, and ground improvement techniques are necessary to reduce settlement risks in future construction projects.

RESULTS

1. Study shows that clayey soil is common in many areas of **Ranchi** such as **Harmu** and **Bariatu**, which is prone to consolidation settlement.
2. **Dorinda** area has many constructions on filled-up soil, causing differential settlement due to poor compaction.
3. **Kane** area mainly has lateritic soil, where minor settlement occurs due to moisture changes.
4. **Lalpur** area has mixed soil (clay and sand), which may lead to uneven settlement if foundation design is improper.
5. The major causes of settlement in Ranchi are weak clay soil, poor soil compaction, high groundwater level, and lack of proper soil investigation.

CONCLUSION

This study analyzed soil settlement problems in different urban areas of Ranchi such as **Harmu, Doranda, Kanke, Bariatu, and Lalpur**. The study shows that clayey soil, filled-up land, and mixed soil conditions are the main reasons for settlement issues in these areas. Poor soil compaction, high groundwater levels, and improper foundation design also contribute to structural cracks and uneven settlement. Therefore, proper geotechnical investigation, soil testing, and suitable foundation design are necessary to ensure safe and durable construction in Ranchi.

DISCUSSION

The study found that soil settlement problems in Ranchi areas such as **Harmu, Doranda, Kanke, Bariatu, and Lalpur** are mainly caused by clayey soil, filled land, and mixed soil conditions. These issues lead to cracks in walls, uneven floors, and differential settlement in buildings. The main reasons are poor soil compaction, high groundwater levels, and lack of proper soil investigation. These problems can be reduced by conducting proper soil testing, using suitable foundation types, and following relevant IS codes during construction.

ACKNOWLEDGEMENT:

Duration of study:

This research work was carried out by the author in the Dhanbad Coalfield region during the period from 12 SEP 2023 to 11 DeC2024.

This study was carried out with the support and cooperation of RTBT Infrastructure Developer Pvt. Ltd., Ranchi, (www.rtbtltd.com), support@rtbt ltd.com which provided technical and field assistance during the DGPS survey work.

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