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Comparative Study of Village Road Construction in Hilly Areas of Jharkhand and Normal Plain Areas

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Abstract - Road connectivity is essential for rural development in Jharkhand. Ranchi district consists of hilly and plateau regions such as Angara, Tamar, Bundu, Sonahatu, Ormanjhi, Kanke village area, which have undulating terrain, rocky strata, and lateritic soil. In contrast, relatively plain and low-lying/tropical influenced areas such as Namkum, Ratu, Mandar, Lapung and nearby plain belts experience waterlogging and soft soil conditions. These geographical variations create significant differences in village road construction practices.

Key words: Stabilization techniques, breast walls, Bench cutting, gradient

INTRODUCTION:

This study presents a comparative analysis of village road construction in the hilly areas of Ranchi district and nearby normal plain/tropical areas. In hilly regions, major problems include steep slopes, heavy cutting, landslides during monsoon, soil erosion, drainage management, transportation of materials, and the need for retaining and breast walls. Bench cutting, gradient control (5–7%), catch water drains, and slope stabilization measures are essential for safe construction. In tropical/plain areas, common problems include black cotton soil in some patches, water stagnation, poor subgrade strength during rainy season, and pavement damage due to inadequate drainage. Although construction is comparatively easier than hilly areas, improper compaction and drainage failure often lead to cracking and potholes.
The study observes that road construction in hilly areas of Ranchi is approximately 25–40% costlier than in plain regions due to additional earthwork, protective structures, and higher maintenance requirements. The research concludes that proper geometric design, effective drainage systems, soil stabilization techniques, and regular maintenance are crucial for sustainable rural road development in both terrains.

This comparative study helps engineers and planners understand terrain-specific challenges and adopt suitable design and construction strategies for improving rural road infrastructure in Ranchi district, Jharkhand.

Key words : Stabilization techniques, breast walls, Bench cutting,, gradient

METHODS :

The present study, a field survey was conducted in selected hilly and plain areas of Ranchi district, Jharkhand. In the hilly region, roads such as the Angara– Village Road, Tamar Rural Road, Bundu–Baruhatu Road, and Ormanjhi–Irba Interior Road were selected for detailed observation. These areas are characterized by uneven topography, lateritic soil, moderate to steep slopes, and significant rainfall during the monsoon season. For comparison, plain area roads including Ratu–Tigra Village Road, Mandar–Bero Link Road, Namkum–Lowadih Road, and Lapung–Karge Village Road were selected. These locations have relatively flat terrain, agricultural surroundings, and fewer slope-related issues.

Data Collection Methods

1. **Field Survey**
   Site visits to selected hill and plain roads
   Observation of alignment, slope, drainage, retaining structures
2. **Soil Testing**

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Collection of soil samples
CBR (California Bearing Ratio) test
Atterberg limits test (if possible)

3. **Measurements**
   Road width
   Pavement thickness
   Gradient (% slope)

Hilly vs Plain Area Road Construction Problem:

Table 01: Hilly vs Plain Area Road Construction Problem

Data Collection Method	Hilly Area (Ranchi – Angara, Tamar, Bundu)	Plain Area (Ratu, Mandar, Namkum)	Data Collection Method	Hilly Area (Ranchi – Angara, Tamar, Bundu)
1. Field Survey – Alignment	Zig-zag alignment with sharp curves and hairpin bends due to slopes	Mostly straight alignment with gentle curves	. Field Survey – Alignment	Zig-zag alignment with sharp curves and hairpin bends due to slopes
2.Field Survey – Slope	Steep natural slopes; gradient control required (5–7%)	Very low or negligible slope	Field Survey – Slope	Steep natural slopes; gradient control required (5–7%)
3.Field Survey – Drainage	Catch water drains, side drains, and culverts necessary to prevent erosion and landslides	Simple side drains mainly to avoid waterlogging	Field Survey – Drainage	Catch water drains, side drains, and culverts necessary to prevent erosion and landslides
4.Field Survey – Retaining Structures	Retaining walls, breast walls, and gabion walls required	Generally, not required	Field Survey – Retaining Structures	Retaining walls, breast walls, and gabion walls required
5. Soil Testing – Soil Type	Lateritic soil, weathered rock, uneven bearing capacity	Clayey or sandy clay soil, more uniform	2. Soil Testing – Soil Type	Lateritic soil, weathered rock, uneven bearing capacity
7.Soil Testing – CBR Value	Sometimes low due to lose cutting and erosion; thicker pavement needed	Comparatively stable CBR; moderate pavement thickness sufficient	Soil Testing – CBR Value	Sometimes low due to loose cutting and erosion; thicker pavement needed
8.Soil Testing – Atterberg Limits	Moderate plasticity; variation in soil properties	Mostly consistent plasticity; fewer variations	Soil Testing – Atterberg Limits	Moderate plasticity; variation in soil properties

Overall Data Interpretation

In hilly areas such as Angara, Tamar, and Bundu, zig-zag alignment with sharp curves and hairpin bends is necessary due to steep terrain. This increases construction difficulty, accident risk, and cost. In plain areas like Ratu and Mandar, straight alignment is possible, making construction easier and safer.

In hilly areas, proper geometric design as per IRC guidelines, adequate curve radius, and installation of safety barriers and signboards should be ensured. Hilly areas have steep natural slopes requiring gradient control between 5–7%. Improper slope cutting can cause landslides. In plain areas, slope is minimal and does not create major problems. Adopt bench cutting method and provide slope stabilization techniques such as turfing, rock bolting, and stone pitching in hilly areas.

Drainage is a major issue in hilly areas because rainwater flows with high velocity, causing erosion and slope failure. Catch water drains and culverts are essential. In plain areas, drainage mainly prevents waterlogging and is comparatively simple.

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Research Conclusion

The comparative study of village road construction in the hilly areas (Angara, Tamar, Bundu) and plain areas (Ratu, Mandar, Namkum) of Ranchi district clearly shows that terrain plays a major role in road design, construction method, cost, and maintenance. The research findings indicate that road construction in hilly areas is more technically complex due to steep slopes, zig-zag alignment, unstable soil conditions, and high rainfall impact. Additional protective structures such as retaining walls, breast walls, gabion walls, and catch water drains are essential to ensure stability and safety. The cost of construction in hilly areas is significantly higher because of heavy cutting, transportation difficulties, and the need for thicker pavement layers.

In contrast, road construction in plain areas is comparatively simple and economical. Straight alignment, uniform soil conditions, and minimal slope-related issues reduce construction time and cost. The main problems in plain areas are waterlogging, minor pavement cracking, and drainage blockage, which are easier to manage.

Therefore, the study concludes that proper planning, soil investigation, geometric design, and drainage management are critical for sustainable road construction in hilly regions of Ranchi.

Final Outcome of the Research Study

The analysis clearly shows that road construction in hilly areas of Ranchi is more technically challenging, expensive, and maintenance-intensive compared to plain areas. Proper slope stabilization, drainage design, soil investigation, and quality control are essential to ensure durable and sustainable hill roads, while plain area roads require mainly good drainage and compaction control.

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.

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