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IMPACT OF GEOMETRIC CHARACTERISTICS ON CAPACITY OF HILL ROADS

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Introduction

Capacity

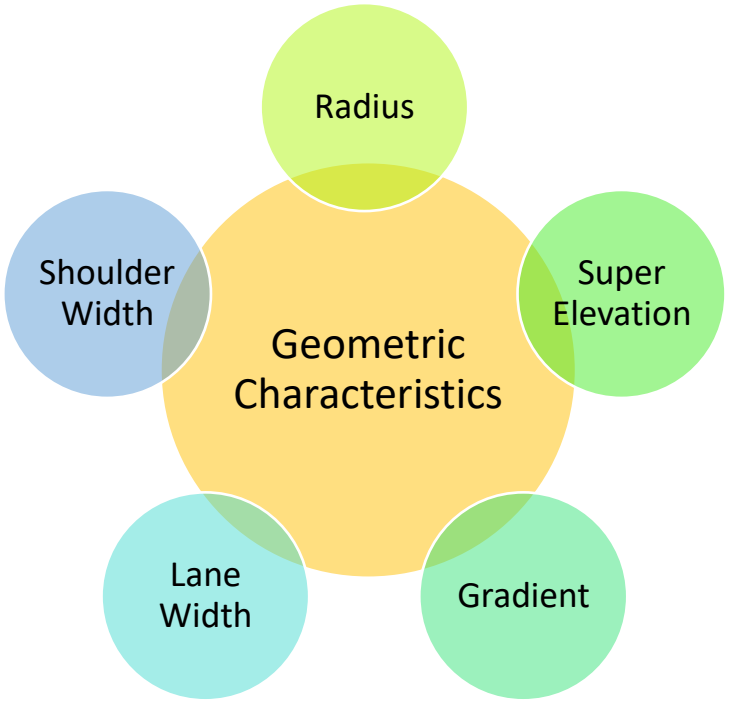
- The maximum numbers of vehicles or traffic volume that a road can accommodate within a given time period under ideal conditions.

Need of Study

- To study the significant effect of steep gradients, sharp curves and elevation changes on capacity in Hilly terrains.
- Accurate estimation of capacity for ensuring optimal road performance, efficient traffic flow and improved safety

Objectives

- Relationship between Gradient of tangent and capacity
- Estimate Capacity Loss and establish relationship between capacity loss, curve radius and tangent gradient



Literature Review

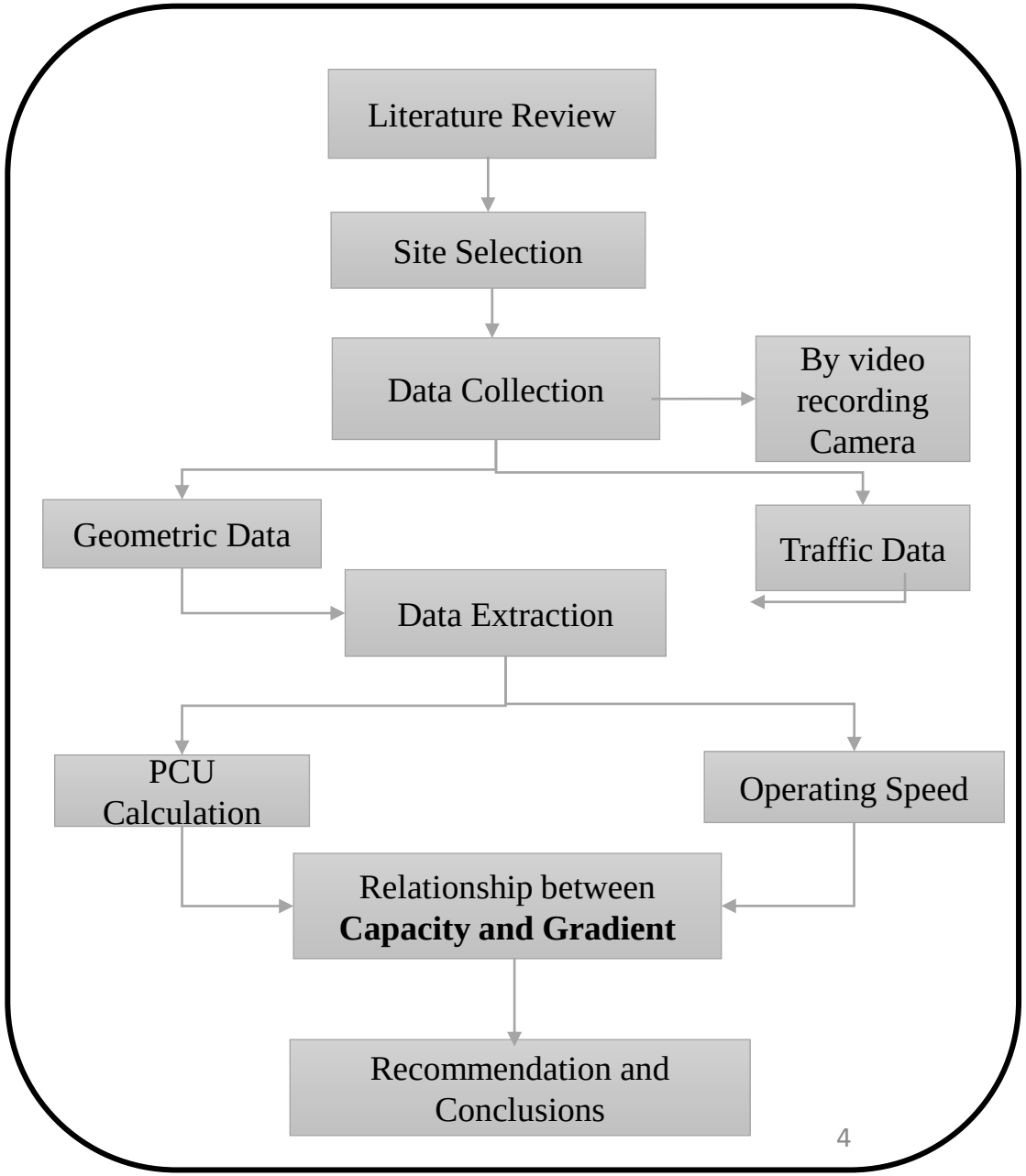
S.No,	Name	Year	Review
1	Chandra and Kumar	2003	Chandra and Kumar discovered a second-degree curve relationship indicating capacity growth with lane width, useful for estimating two-lane road capacity within 5.5-8.8 m carriageway widths.
2	Hashim et al.	2012	Regression models were created to analyze capacity on rural two-lane roads, revealing a critical 600 m curve radius for mitigating capacity loss. However, the observed sites fell short of the HCM 2000 ideal capacity due to non-ideal geometric characteristics.
3	Semeida et al.	2017	This study assesses the impact of road geometry and traffic characteristics on right lane capacity, revealing that increasing curve radius reduces capacity loss (from 225 to 100 veh/h/lane), while higher heavy vehicle percentage and lane width increase capacity loss (from 125 to 210 veh/h/lane).
4	Shalkamy et al.	2015	Developing a design tool for quantifying capacity loss from reduced curve radius is crucial due to limited research on geometric factors' influence on capacity loss between tangents and curves, highlighting its importance in the design phase.

Methodology

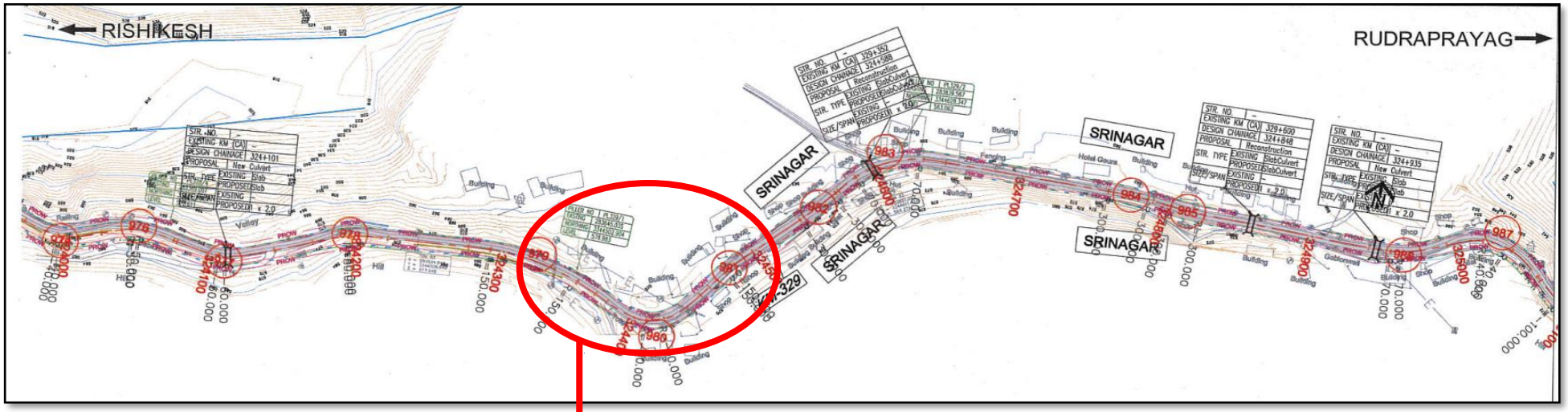
Study Site

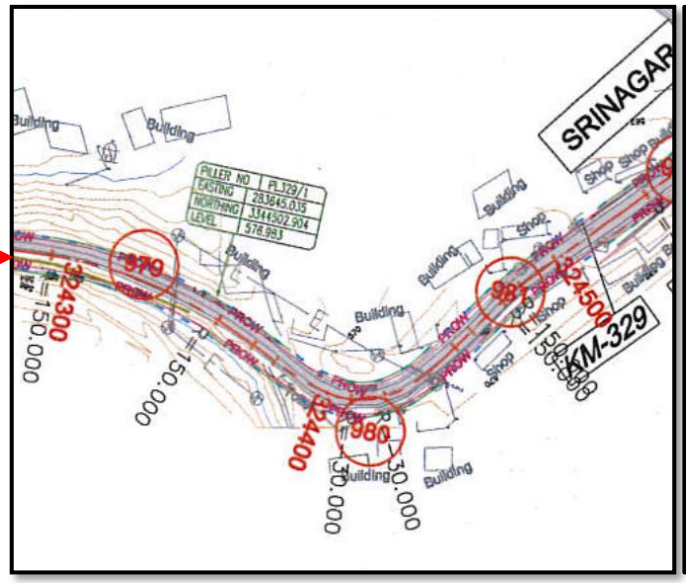
Ufalda, Srinagar Uttarakhand

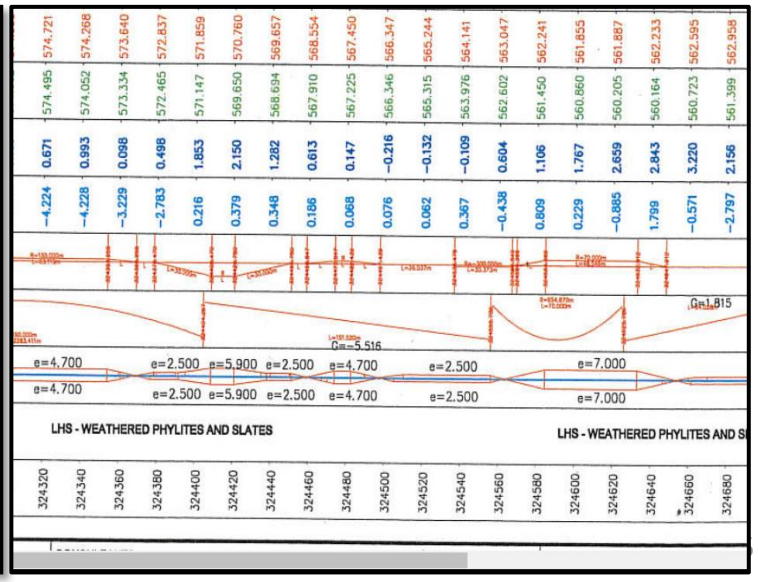
Study Site	Tangent Gradient (in %)	Curve Radius (in m)	Super Elevation (in %)
1	6.95	100	7
2	2.66	20	7
3	5.51	30	5.93
4	1.66	20	7



Selection of Site and Geometric Characteristics

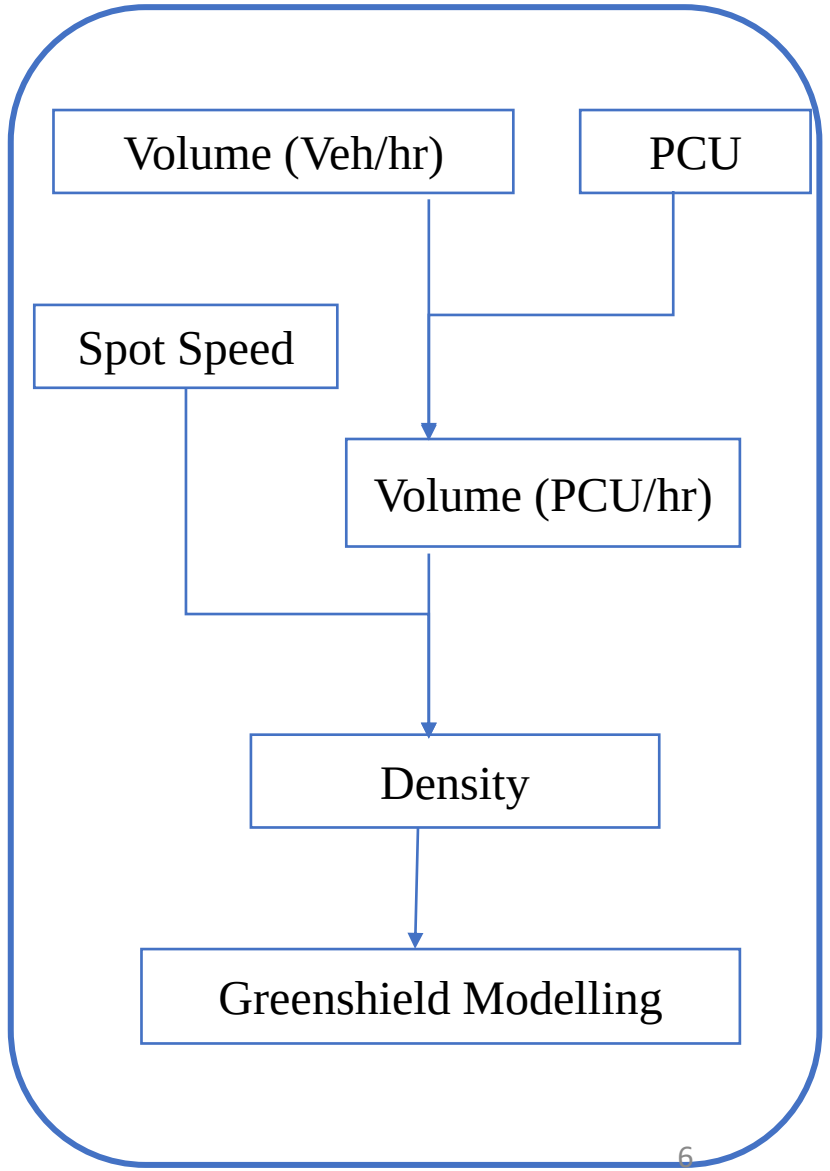




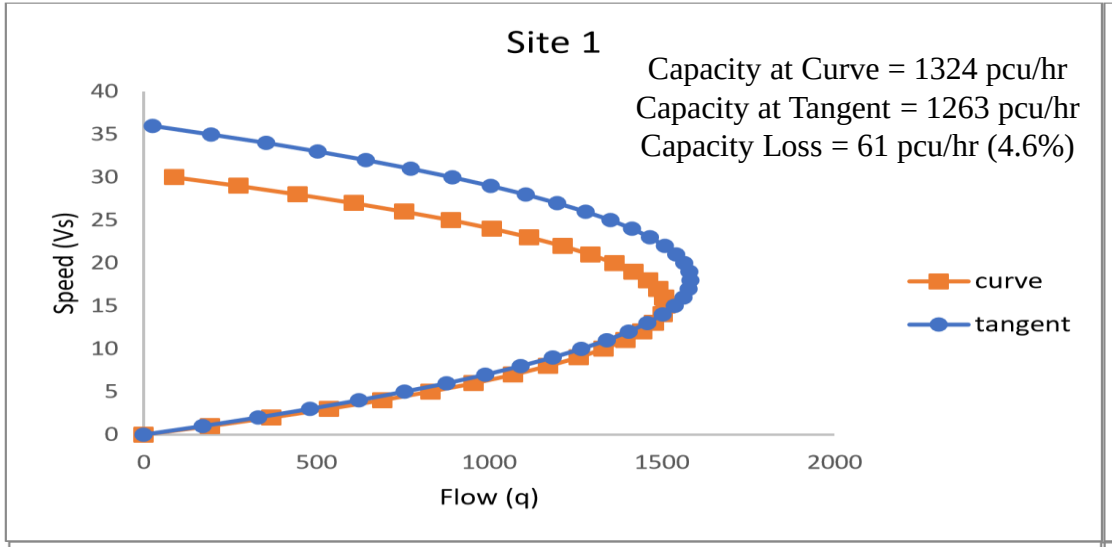


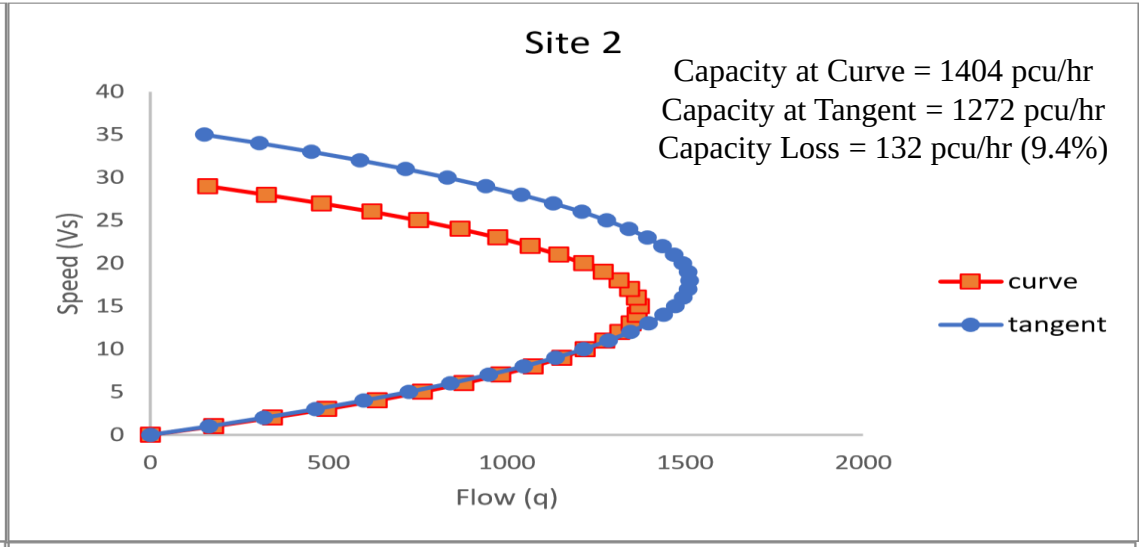
Preliminary Data Analysis and Results

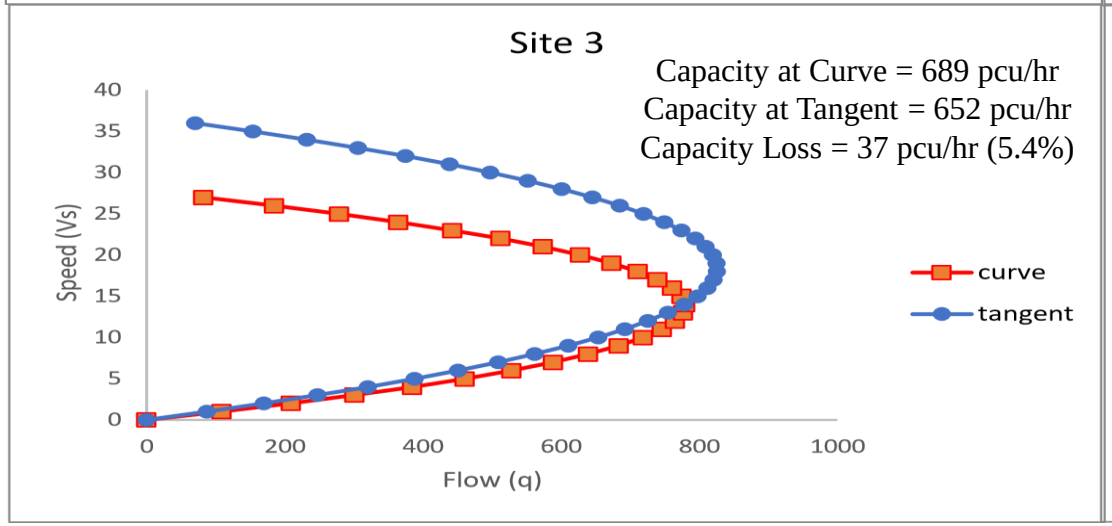
Site No.	FFS (U_f) (km/hr)		Jam Density (k_j) (PCU/km)		Base Capacity (C_o) (PCU/hr)		Adjusted Capacity (C_a) (PCU/hr)	
	Curve	Tangent	Curve	Tangent	Curve	Tangent	Curve	Tangent
1	30.45	36.15	198	175	1511	1584	1263	1324
2	29.90	35.92	183	169	1371	1371	1272	1404
3	27.75	36.79	112	90	780	824	652	689
4	29.98	31.45	326	322	2360	2542	2409	2593

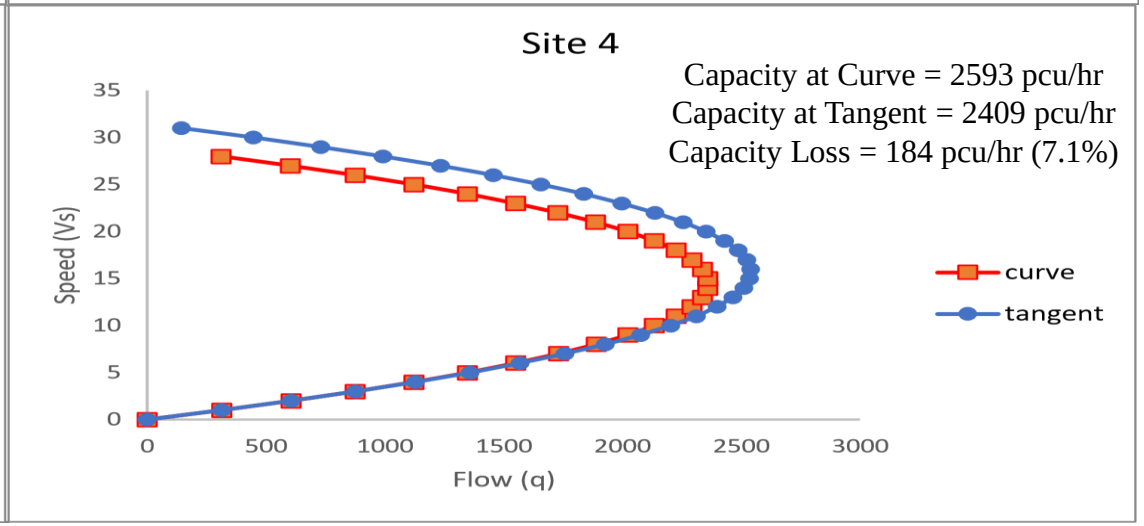


Capacity at Curve and Tangent

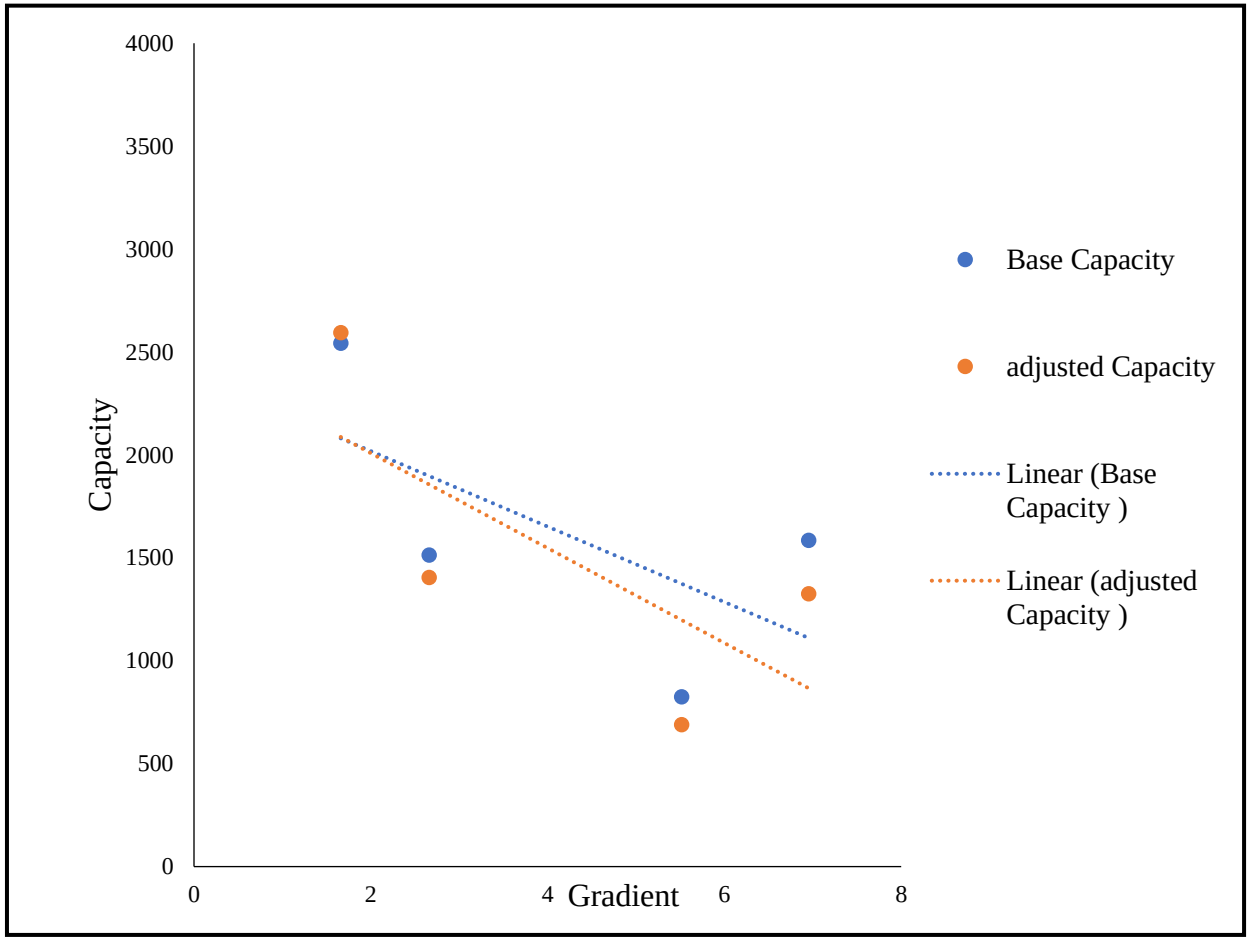






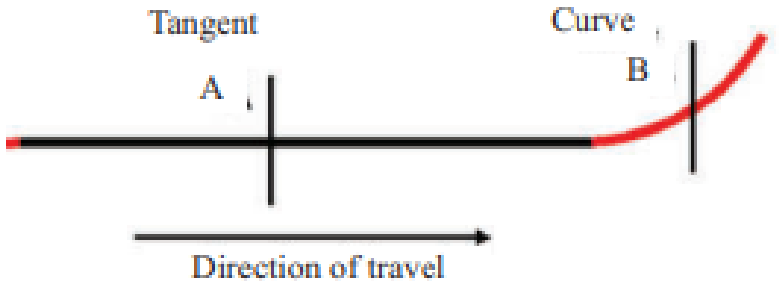


Relationship between Capacity and Gradient



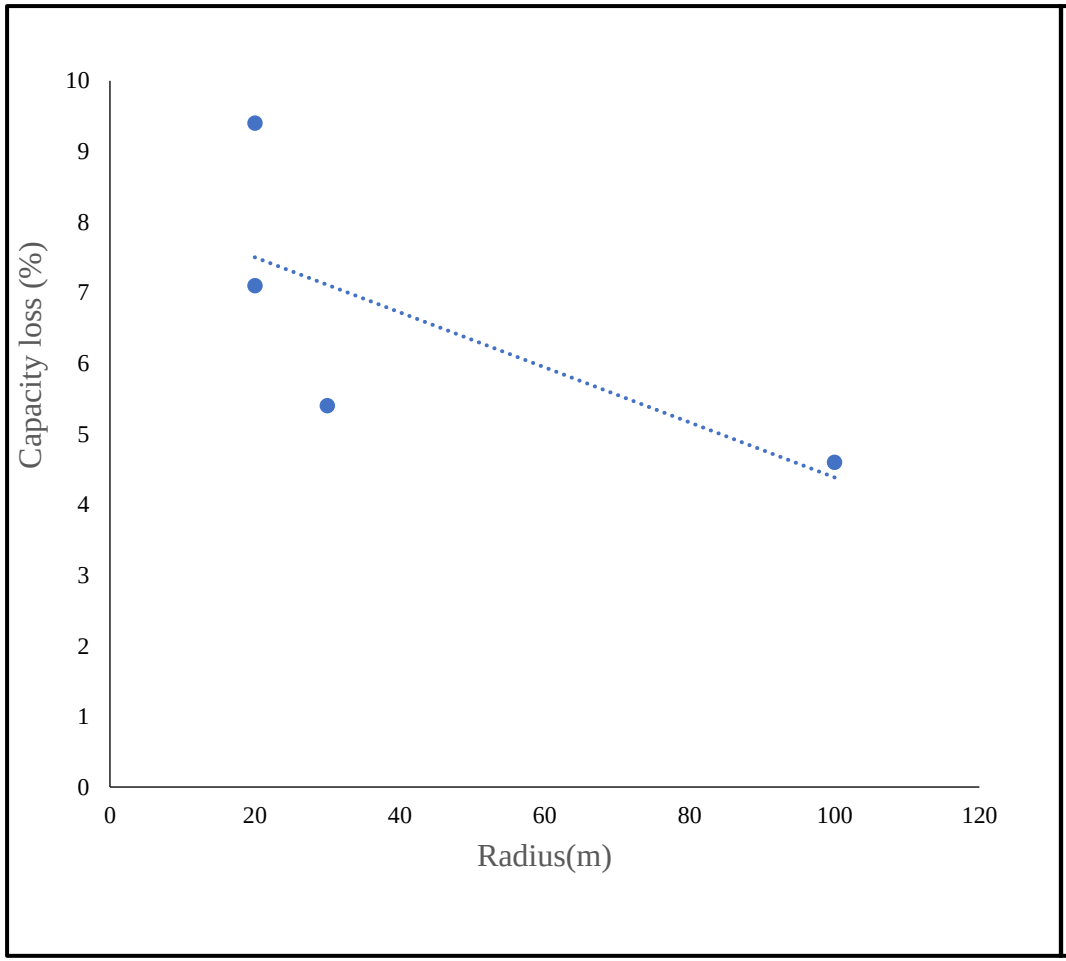
Capacity Loss

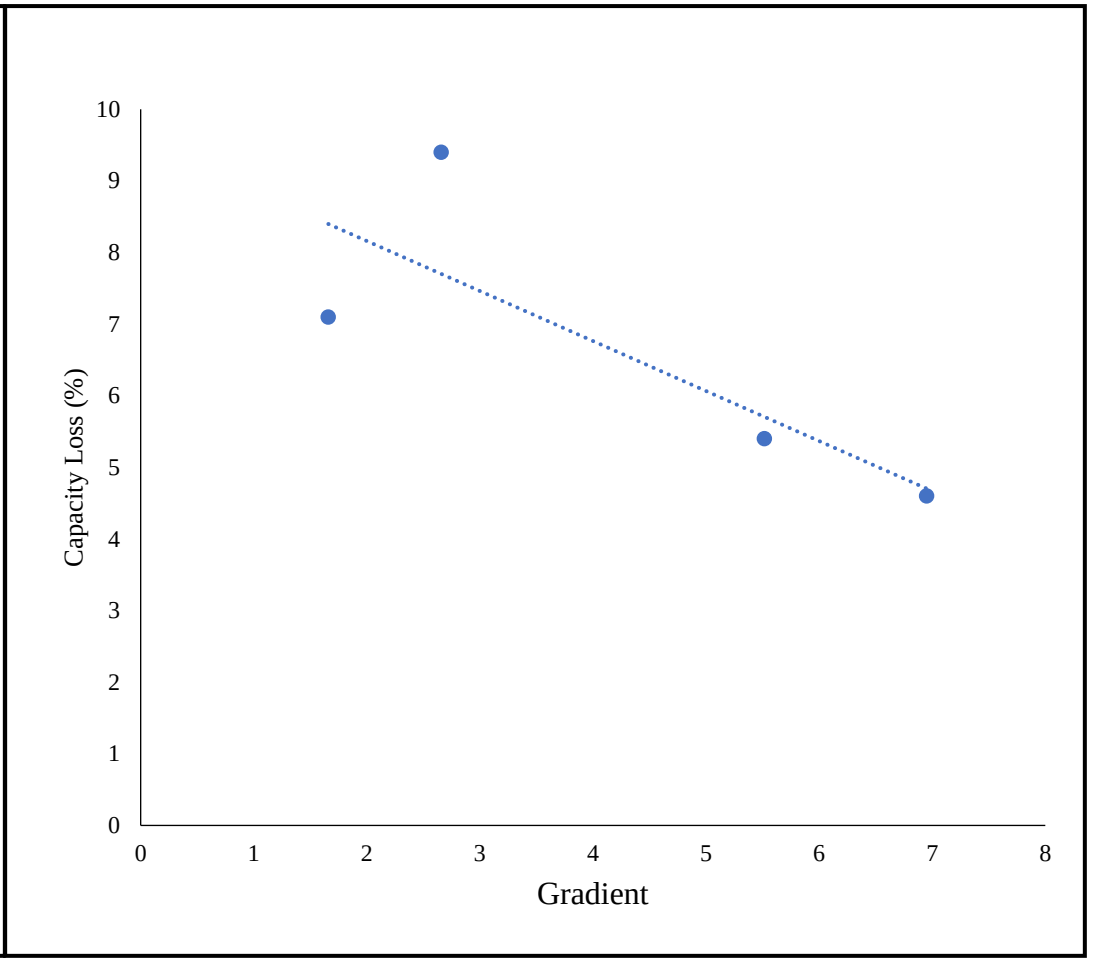
Capacity Loss = Capacity at tangent – Capacity at Curve



Site No.	1	2	3	4
Capacity Loss (in %)	4.6	9.4	5.4	7.1

Relation between Capacity Loss and Geometric Characteristics





Conclusions

- Capacity values were lower in curve sections compared to tangent sections, with curve capacity ranging from 652 PCU/hr to 2409 PCU/hr.
- Tangent sections had capacity ranging from 689 PCU/hr to 2593 PCU/hr, with the maximum capacity at Site 4 and the minimum at Site 3.
- The capacity of road decreases as the gradient of tangent section increases.
- The capacity loss decreases as the radius of the curve and the gradient of the tangent increases, means larger curve radii and steeper tangent gradients are associated with reduced capacity losses

Limitations

- Site selection can ensure a diverse range of data types and variations in geometric features for comprehensive insights.
- Utilizing software tools can improve speed measurement accuracy at curves, complementing manual methods.
- Collecting data from a greater number of sites can enhance result accuracy and study representativeness.
- The study is focused on two-way, two-lane roads in hilly regions.

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