



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 04, April 2026)

Design of a Smart Signalized Intersection for a Rural-Urban Node – Somatane

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Abstract— Somatane Phata, located along National Highway 48, functions as a critical rural-urban junction experiencing increasing traffic due to rapid local development and through highway movement. The lack of signalization, poor intersection geometry, and unregulated vehicle flow have resulted in frequent congestion, delays, and safety concerns, particularly during peak hours. This project aims to design a smart signalized intersection at Somatane by analyzing current traffic patterns and movement, applying IRC: SP guidelines, and integrating geometric and signal timing improvements. The approach involves detailed traffic volume studies, peak hour analysis, and evaluation of existing intersection performance. Based on the findings, an optimized signal timing plan and geometric redesign — including lane configuration, channelization, and pedestrian considerations — are proposed to enhance efficiency and safety. The design serves as a model for addressing similar traffic challenges at rural-urban nodes, offering a replicable and scalable framework in line with Indian road standards. Furthermore, the project supports smart traffic management adoption by local authorities and encourages data-driven infrastructure planning in semi-urban and developing areas.

Keywords—Smart intersection, adaptive signals, traffic flow, IoT, ITS, congestion control, traffic optimization, signal timing, road safety, traffic management.

I. INTRODUCTION

Somatane Phata is a rural–urban junction along NH-48 experiencing increasing traffic due to rapid local development and continuous highway flow. The intersection handles mixed traffic, including local vehicles and heavy highway traffic, leading to complex traffic movements^[1]. The absence of proper signalization, poor road geometry, and unorganized traffic conditions result in frequent congestion, increased delays, and safety issues, especially during peak hours.

This project aims to design a smart signalized intersection using IRC (Indian Road Congress) guidelines, with a focus on optimized signal timing, improved geometric design, and better traffic management strategies. The proposed solution intends to enhance traffic flow, reduce vehicle delays, and improve overall safety and efficiency of the intersection.

II. PROBLEM STATEMENT

- Somatane Junction experiences frequent traffic congestion, delays, and unsafe conditions due to unregulated vehicle movement and inadequate intersection design.
- The absence of signal coordination and geometric planning has led to inefficient traffic flow, especially during peak hours.
- There is a need to develop a signalized intersection with optimized timing and appropriate geometric enhancements to improve overall intersection performance and road user safety.

III. OBJECTIVES

- To analyze existing traffic patterns and movement at Somatane Junction.
- To design a signalized intersection as per IRC: SP guidelines.
- To optimize signal timing using traffic volume and peak hour data.
- To propose geometric improvements including lane configuration and channelization.

IV. RESULT AND ANALYSIS

Graphical Analysis — 20-Day Traffic Data.
Total Daily Peak Hour Volume – All 20 Survey Days

TABLE I

No	Warrant	IRC Threshold	Observed	Status
W1	Minimum Vehicle Volume	Major road: 600 PCU/hr; Minor road: 150 PCU/hr	Major: 844 PCU/hr; Minor: 210 PCU/hr	EXCEED ED — Signal Warrant
W2	Interruption of Continuous Traffic	Major road volume: 900 PCU/hr	Average: 844 PCU/hr; Peak day: 977 PCU/hr	SATISFIED on 14 of 20 days
W3	Minimum Pedestrian Volume	150 pedestrians/hr crossing major road	~200–300 pedestrians/hr (estimated)	EXCEED ED — Pedestrian Warrant
W4	Accident Experience	≥3 accidents in 12 months correctable by signal	Field observation: frequent near-misses; reports confirm accident	SATISFIED — Safety Warrant

V. SOLUTIONS

Signal Control Solution (Immediate Solution)

A pre-timed, 4-phase traffic signal system is proposed based on IRC guidelines to manage high traffic volumes (~1748 PCU/hr) and current LOS D–E conditions. The optimized cycle length is 150 seconds (Webster method) with proper phase distribution for all six approaches.

Along with signals, geometric improvements such as channelizing islands, dedicated right-turn lanes, left-turn slip roads, approach widening, pavement markings, and pedestrian crossings are included [2].

This solution is low-cost (₹74–108 lakhs) and can be implemented within ~10 months. It reduces delay by ~50–60% and improves performance to LOS C. It is highly economical with a payback period of less than 3 months, making it the most practical short-term intervention.

Grade-Separated Bridge (Flyover) Solution (Primary Long-Term)

A vehicular overbridge (flyover) is proposed to carry the main NH-48 traffic over the intersection, eliminating conflict points and ensuring free-flow movement. Designed as a 2-lane PSC T-beam structure with ~60–75 m span, it follows IRC standards for loads, geometry, and durability (100-year design life).

This solution significantly upgrades performance to LOS A–B, reduces delay by 85–95%, and increases capacity beyond 3500 PCU/hr. However, it involves high cost (₹9.8–15 crore), land acquisition, and a long implementation period (3–5 years). It is recommended as the primary long-term infrastructure solution, especially considering traffic growth due to industrial expansion.

Vehicular Underpass Solution (Alternative Long-Term)

An RCC box-type vehicular underpass is proposed to carry local/minor road traffic beneath the highway, reducing surface-level conflicts. It includes 2-lane carriageway (7 m width), 5.5 m vertical clearance, drainage systems (sump + pumps), and proper lighting/ventilation.

While performance improves to LOS C–D for local traffic, it is slightly less efficient than a flyover for main traffic. The cost is ₹11–17 crore, and construction is more complex due to excavation, groundwater control, and traffic diversion issues. This option is suitable where land constraints exist or as a secondary alternative to the flyover [3].

VI. CONCLUSION

The design of a smart signalized intersection at Somatane Phata demonstrates an effective approach to addressing traffic congestion and safety issues at rural–urban junctions. By applying IRC (Indian Road Congress) guidelines along with modern traffic engineering principles, the study provides an optimized solution for signal timing, geometric design, and traffic control.



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The integration of smart techniques helps in improving traffic flow, reducing vehicle delays, and minimizing conflict points. The proposed design also enhances road safety for both vehicles and pedestrians. Overall, the project highlights the importance of intelligent and well-planned intersection design in managing increasing traffic demand. It can further be extended using advanced technologies like IoT and adaptive signal systems for real-time traffic management.

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