

IMPLEMENTATION OF DESIGN AND SPECIFICATION IN DIFFERENT ROADS OF SURYABINAYAK MUNICIPALITY, NEPAL

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ABSTRACT

Road infrastructure plays a vital role in the socio-economic development of Nepal by improving connectivity, mobility, and access to essential services. However, many roads in Nepal suffer from premature deterioration, safety issues, and functional inefficiency, mainly due to inconsistencies between design specifications and actual field conditions. This study, titled “Implementation of Design Specification in Different Roads of Suryabinayak Municipality, Nepal” aims to evaluate the adequacy, applicability, and implementation status of existing road design specifications in selected road sections of Nepal. The study primarily focuses on assessing geometric design elements, pavement structure, drainage provisions, traffic safety measures, and material specifications as prescribed by national road standards and guidelines. Several roads representing different categories such as urban roads, rural roads, and highways were selected for the case study approach. Both primary and secondary data were used in this research. Primary data were collected through field surveys, visual inspections, and basic measurements of road elements, while secondary data were obtained from design manuals, departmental guidelines, previous studies, and official project reports. The analysis reveals that although standard design specifications exist, their application in practice is often inconsistent due to factors such as limited budget, difficult topography, traffic growth beyond design assumptions, inadequate supervision, and lack of proper maintenance. In many cases, deviations from standard geometric design, insufficient drainage systems, and improper pavement layer thickness were observed, which significantly affect road performance and safety. The study concludes that strict adherence to design specifications alone is not sufficient unless supported by proper site-specific adjustments, effective monitoring, and regular maintenance. The findings highlight the need for flexible yet technically sound design practices, capacity building of technical personnel, and improved coordination among responsible agencies.

Keywords: *impacts, geography, poor, rescue and relief, road design, specifications, topography, geometric design, proper maintenance, road performance, capacity building*

1. INTRODUCTION

Road infrastructure is a fundamental driver of socio-economic development, underpinning mobility, trade, and access to services; in Nepal, where topography and limited alternative transport modes make roads the dominant mode of transportation, the effectiveness of this infrastructure depends heavily on planning, design, and construction that adhere to established design standards [1]. Well-defined design specifications geometric elements such as curve radii, sight distance, and lane width; pavement structure; drainage provisions; and material quality are consistently identified in the transportation literature as central to reducing accidents, sustaining

efficient traffic flow, and extending pavement service life [2,3]. Documented relationships between alignment and crash risk make geometric design specifically critical to safety outcomes, with design parameters shown to either mitigate or exacerbate risky driving behavior depending on how well they are specified [4,5]. In rural and developing road networks specifically, strict compliance with geometric standards has been shown to substantially improve safety outcomes where terrain constraints and mixed traffic composition are significant, while international best-practice guidance frames design standards not merely as technical requirements but as tools harmonizing infrastructure functionality with user needs and economic access [6,7].

In Nepal, the Department of Roads has developed the Nepal Road Standards (NRS) and Nepal Rural Road Standards (NRRS) to regulate road classification, design speed, geometric parameters, pavement structure, and drainage across different terrain and traffic conditions [1]. Despite this regulatory framework, implementation frequently falls short in practice: financial constraints, rapid urbanization, limited technical supervision, and the absence of systematic post-construction evaluation mean that many roads are constructed or upgraded without strict adherence to design specifications [1]. The consequences are well documented prior research on the Narayanghat–Muglin road section found that many horizontal curves exhibited poor design consistency, contributing to unsafe driving conditions and elevated crash risk [8], while broader evidence links deviation from prescribed material and gradation standards to reduced pavement durability under load [9]. Climate-responsive design literature further emphasizes that specifications failing to integrate local precipitation and moisture conditions leave pavement structures prone to premature deterioration, a particularly acute concern given Nepal's monsoon-dominated climate and diverse terrain [10]. These recurring problems premature cracking, potholes, rutting, drainage failure, and slope instability impose a substantial and repeated financial burden on maintenance and rehabilitation budgets.

Suryabinayak Municipality, on the eastern edge of the Kathmandu Valley in Bhaktapur District, exemplifies these pressures concentrated at municipal scale. As a strategic transportation corridor connecting Kathmandu with eastern Nepal via the Araniko and B.P. Koirala Highways, the municipality has experienced rapid residential, commercial, and infrastructural growth, placing increasing traffic demand on a road network of roughly 15 km of national highway alongside feeder, urban, and municipal roads [11]. This growth has frequently outpaced strict compliance with design standards, with visible consequences including inadequate carriageway width, insufficient sight distance, unsafe geometric alignment, and inadequate drainage provision.

Existing research on road performance in Nepal has largely examined individual design components in isolation geometric non-compliance and crash frequency, Marshall mix design and material quality, drainage effectiveness, and landslide-related slope failure have each been studied separately [12–14]. While these studies identify specific design weaknesses, none provide a consolidated, multi-parameter assessment of design specification compliance spanning geometric, structural, hydrological, and safety dimensions jointly for a given road network, and no such systematic evaluation exists for Suryabinayak Municipality specifically despite the scale of its ongoing road development.

This study addresses this gap by assessing the design specifications of two road sections in Suryabinayak Municipality Suryabinayak–Gundu Road to Krishna Mandir–Gundu Road, and Subarneshwor Mahadev Temple to Likhannarayan Temple Road, totaling approximately 3.789 km evaluating geometric design compliance, pavement structural adequacy, and drainage and slope protection provisions against Nepal Road Standards, supplemented by field measurement and stakeholder assessment. By providing an integrated, multi-parameter compliance evaluation rather than a single-component assessment, this study aims to identify concrete deficiencies in current road design and construction practice and inform improved transportation planning and design enforcement in the municipality.

2. MATERIALS AND METHODS

2.1 Study Area

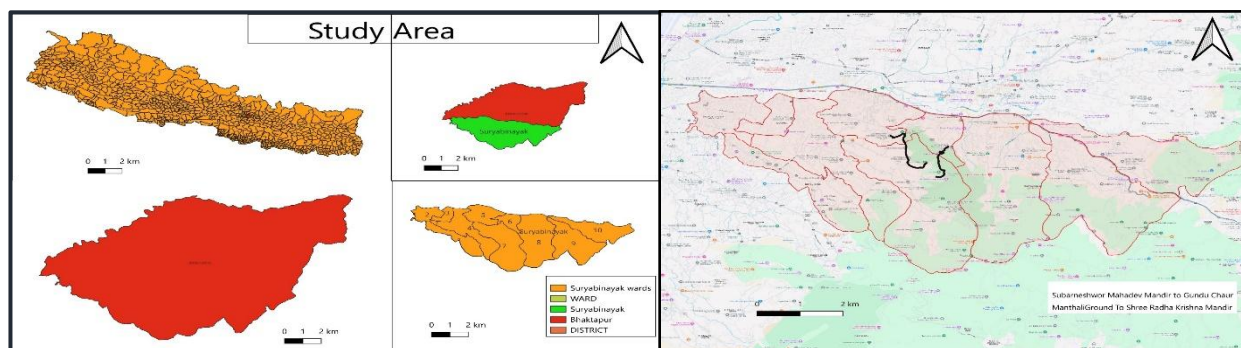


Fig. 2.1: Study Area

The study was conducted in Suryabinayak Municipality, Bhaktapur District, Bagmati Province, Nepal ($27^{\circ}39'N$, $85^{\circ}26'–85^{\circ}30'E$), on the eastern edge of Kathmandu Valley at an elevation of 1,300–1,600 m, with mixed topography spanning urban plains, gentle slopes, and hilly terrain under a subtropical, monsoon-influenced climate. Two road sections spanning three municipal wards were selected: the Manthali Ground–Shree Radha Krishna Mandir Road (1.589 km) and the Subarneshwor Mahadev Mandir–Gundu Chaur Road (2.20 km), together totaling approximately 3.789 km. Both roads were designed with an approximately 3 m carriageway, 1 m shoulders on each side, and a 10.4 m formation width including drainage provision. The two sections were selected via purposive sampling on the basis of (i) availability of complete engineering documentation Detailed Project Reports, topographic survey data, plan/profile and cross-sectional drawings, pavement design reports, traffic studies, hydrological analyses, and Bills of Quantities enabling direct design-vs-actual comparison, and (ii) visible field indicators of implementation deficiency, including pavement cracking, potholes, inadequate drainage, edge failure, and irregular road width, identified during preliminary site visits.

2.2 Data Sources

Both primary and secondary data were collected. Primary data comprised field observation, in-depth interviews, focus group discussions, and a structured questionnaire survey; these methods jointly captured geometric design compliance, construction quality, drainage performance, and stakeholder-reported institutional issues, with findings triangulated across sources to strengthen reliability. Secondary data comprised Detailed Project Reports, approved design drawings, topographic and cross-sectional surveys, pavement design reports, traffic and hydrological studies, Bills of Quantities, quality assurance test reports, municipal records, and relevant government standards and guidelines, obtained from Suryabinayak Municipality and associated implementing agencies; these provided the design baseline against which field-measured conditions were compared.

2.3 Sampling

Field observation points, measurement locations, and respondents were selected via purposive sampling to ensure the sample reflected the full range of conditions along each corridor sections in good and poor pavement condition, drainage-deficient and waterlogged points, intersections, narrow/congested stretches, and areas of visible edge failure or cracking (Table 1). Questionnaire respondent sample size was determined using Cochran's formula for an effectively infinite sampling population, appropriate here because the underlying population of quality-relevant technical events (compaction trials, material tests, geometric inspections) recurs continuously across the project lifecycle rather than existing as a fixed count:

$$n_0 = \frac{(Z^2 \times p \times q)}{e^2}$$

with $Z = 1.96$ (95% confidence level), $p = 0.0825$ (estimated proportion of quality-control deficiency, from preliminary pilot assessment of regional hilly-terrain road projects), $q = 1 - p = 0.9175$, and $e = 0.05$ (margin of error), giving $n_0 = 116$.

Table 2.1. Sampling framework

Data Type		Sample Size
Field observation points	10 locations	
Pavement thickness measurement points	5 locations	
Drainage assessment locations	6 locations	
Interview respondents	15 (municipal engineers, contractors, supervisors, consultants)	
Questionnaire respondents	116 (road users and technical professionals combined)	

2.4 Field Observation

Field observation involved direct site inspection to verify actual road condition against approved design drawings and specifications, covering pavement surface condition (cracking, potholes, rutting, edge failure), geometric alignment (width, cross slope, shoulder condition), and drainage condition (side drain continuity, blockage, stagnation, culvert condition), recorded through field notes, measurement, and photographic documentation.

2.5 In-Depth Interviews and Focus Group Discussions

In-depth interviews were conducted with municipal engineers, consultants, contractors, and project supervisors to gather detailed technical insight into design implementation, construction practice, and project management constraints. Focus group discussions were held with local road users, community representatives, municipal officials, and technical personnel to capture stakeholder perspective on road performance, maintenance needs, and implementation constraints, providing qualitative corroboration for the quantitative field and survey findings.

2.6 Relative Importance Index (RII)

A structured Likert-scale questionnaire was administered to rank the relative severity of geometric and institutional/stakeholder problems affecting road design implementation, analyzed using the Relative Importance Index (RII):

$$RII = \frac{\Sigma W}{(A \times N)}$$

Where, ΣW is the sum of weights assigned by all technical respondents, A is the highest weight on the rating scale, and N is the total number of respondents. RII values range from 0 to 1, with higher values indicating greater relative severity or importance; the method was applied separately to technical/geometric problems and to stakeholder/institutional problems, and computed independently for each of the two road sections to allow direct comparison.

2.7 Data Analysis

Field-measured geometric and pavement parameters were compared directly against Nepal Road Standards design values to quantify compliance deviation for each road section. RII results were tabulated and compared between road sections to identify shared versus section-specific priority problems. Qualitative data from field notes, interviews, and focus group discussions were analyzed thematically and cross-referenced against the quantitative RII rankings to assess consistency between stakeholder perception and measured/ranked findings.

3. RESULTS AND DISCUSSION

3.1 Pavement Design and Compliance: Road Section 1 (Manthali Ground–Shree Radha Krishna Mandir, 1.589 km)

Pavement design was calculated using both IRC Road Note 37 (2001) and the Department of Roads (DOR) method for comparison. Under IRC Road Note 37, with a subgrade CBR of 7% and a cumulative standard axle load of 1.082 msa over a 20-year design life, the design pavement thickness was 385 mm (20 mm wearing course, 225 mm granular base, 150 mm granular sub-base). Under the DOR method (CBR = 7.49%, cumulative standard axle load = 1.247 msa, 23-year design life), design thickness was calculated at 370 mm (20 mm wearing course, 150 mm granular base, 200 mm granular sub-base).

Field measurement against the design values showed consistent under-specification across all parameters (Table 1). Actual road width (5.5 m) fell 0.5 m short of the 6 m design value; actual pavement thickness (300 mm) fell 70 mm short of the 370 mm DOR design value; gradient exceeded the design maximum by 3 percentage points (15% actual vs. 12% design); and drainage capacity delivered only about half the design requirement (0.18 m³/s vs. 0.35 m³/s). Subgrade CBR tested slightly below the design assumption (5.71% vs. 7%), while average daily traffic (792 PCU/day) already exceeded the design traffic estimate (755 PCU/day).

Table 3.1. Design vs. actual construction, Road Section 1

Parameter	Design Value	Actual Value	Deviation
Road width	6 m	5.5 m	−0.5 m
Pavement thickness	370 mm	300 mm	−70 mm
Gradient	12%	15%	+3%

Drainage capacity	0.35 m ³ /s	0.18 m ³ /s	−0.17 m ³ /s
CBR value	7%	5.71%	−1.29%
ADT	755 PCU/day	792 PCU/day	+37 PCU/day

3.2 Pavement Design and Compliance: Road Section 2 (Subarneshwor Mahadev Temple–Likhanarayan Temple, 2.2 km)

The same dual-method design approach was applied to Section 2. Under IRC Road Note 37 (CBR = 7.49%, N_s = 1.082 msa), design pavement thickness was again 385 mm. Under the DOR method (CBR = 7%, N_s = 1.082 msa), design thickness was calculated at 380 mm (20 mm wearing course, 150 mm granular base, 210 mm granular sub-base).

Field measurement showed a similar, and in some respects more pronounced, compliance gap than Section 1 (Table 2). Road width again fell short by 0.5 m (5.5 m actual vs. 6 m design); pavement thickness fell 80 mm short of the 380 mm design value (300 mm actual) a larger absolute deficit than Section 1's 70 mm shortfall; gradient exceeded design by 1 percentage point; drainage capacity again delivered roughly half the design requirement; and CBR tested substantially below design assumption (5.78% vs. 7.49%, a 1.71-point deficit). Traffic again exceeded design estimates (676 vs. 625 PCU/day).

Table 3.2 Design vs. actual construction, Road Section 2

Parameter	Design Value	Actual Value	Deviation
Road width	6 m	5.5 m	−0.5 m
Pavement thickness	380 mm	300 mm	−80 mm
Gradient	12%	13%	+1%
Drainage capacity	0.35 m ³ /s	0.18 m ³ /s	−0.17 m ³ /s
CBR value	7.49%	5.78%	−1.71%
ADT	625 PCU/day	676 PCU/day	+51 PCU/day

3.3 Cross-Section Comparison

Both road sections show a strikingly consistent compliance signature despite being independently designed and constructed: road width deficit is identical (−0.5 m) on both, drainage capacity deficit is nearly identical (−0.17 m³/s on both), and both carry traffic volumes already exceeding their original design estimates by 5–8%. This consistency across two geographically distinct sections suggests the compliance gap reflects a systemic implementation weakness in the municipality's road delivery process, rather than a site-specific anomaly attributable to either location's particular terrain or contractor. The main distinguishing feature between the two sections is pavement thickness deficit, which is notably larger on Section 2 (−80 mm) than Section 1 (−70 mm), alongside a larger CBR shortfall on Section 2 (−1.71 vs. −1.29 percentage points) indicating Section 2's subgrade and structural compliance gap is somewhat more severe.

3.4 Stakeholder Perception

Consistent with the measured deviations, stakeholder feedback across both road sections converged on the same core concerns. Local residents cited poor drainage, frequent potholes, and inadequate width as primary problems and called for stronger supervision and timely maintenance. Road users and transport operators reported that substandard thickness and surface quality were causing vehicle damage and increased travel time, and called for stricter adherence to design specifications. Municipal engineers and authorities attributed implementation gaps

primarily to limited budget allocation and political interference, emphasizing the need for improved planning, monitoring, and transparent tendering. Contractors cited late payments, skilled labor shortages, and unforeseen field conditions, while acknowledging the need for stricter design adherence. This convergence across stakeholder groups residents, users, engineers, and contractors all independently identifying supervision, budget, and governance as root causes reinforces that the measured technical deviations reflect institutional and process failures rather than an absence of adequate design knowledge.

3.3 Relative Importance Index (RII) Analysis of Geometric Problems

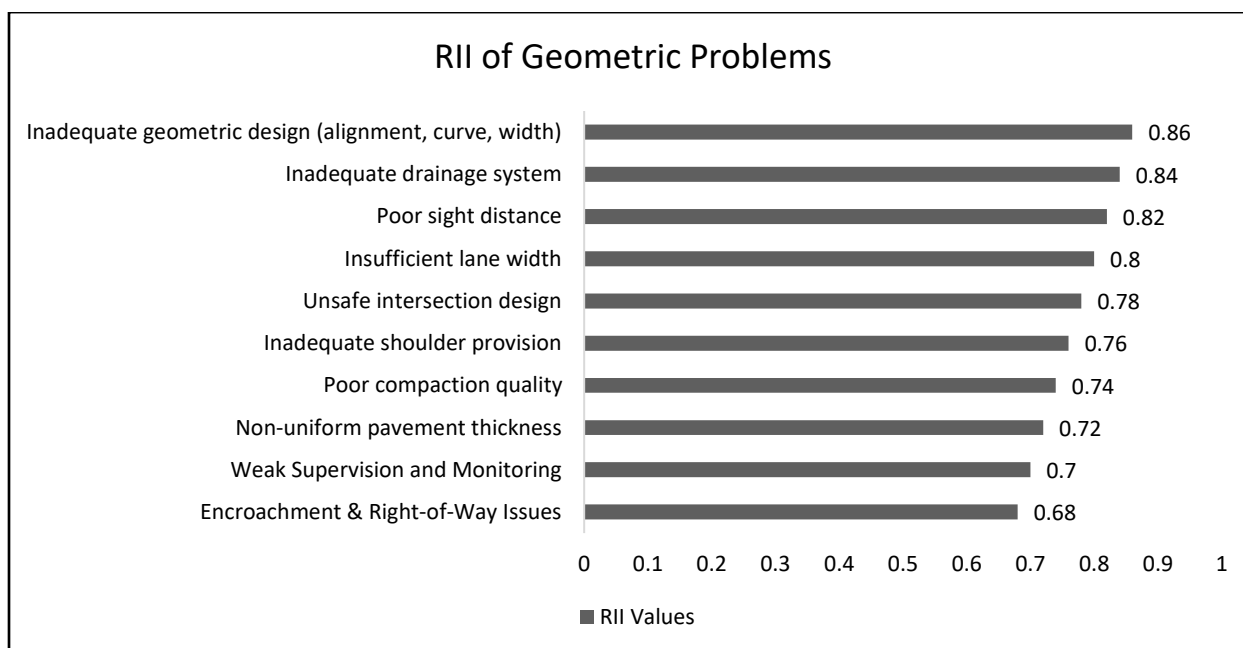


Fig. 3.1 Causes of Geometric Problems

RII analysis of technical/geometric problems, conducted separately for each road section, identified a consistent hierarchy of concern with some section-specific variation in severity (Table 3). Inadequate drainage system ranked as the single most critical problem on both roads, with an identical RII of 0.93 the highest value recorded across the entire technical assessment corroborating the measured drainage capacity shortfall in Tables 1 and 2 and confirming drainage as the dominant technical deficiency in the study area rather than an artifact of one section's specific conditions. Insufficient lane width ranked second overall and was notably more severe on Road 2 (RII = 0.91 vs. 0.89), consistent with that section's more constrained terrain and right-of-way. Inadequate geometric design (0.85–0.86) and poor sight distance (0.81–0.82) showed near-identical severity across both roads, while poor shoulder provision, weak supervision, and compaction quality clustered in the 0.74–0.80 range on both sections. Encroachment and right-of-way issues were the only problem ranked more severe on Road 1 (0.68) than Road 2 (0.65), consistent with Road 1's more urbanized corridor and greater exposure to settlement and commercial encroachment pressure.

Table 3.3 RII comparison of geometric problems, Road 1 vs. Road 2

Rank	Problem	Road 1 RII	Road 2 RII	Comparative Note
1	Inadequate drainage system	0.93	0.93	Critical in both
2	Insufficient lane width	0.89	0.91	More severe, Road 2
3	Inadequate geometric design	0.86	0.85	Similar
4	Poor sight distance	0.82	0.81	Nearly identical
5	Poor shoulder provision	0.80	0.78	Slightly higher, Road 1
6	Weak supervision & monitoring	0.79	0.78	Similar
7	Poor compaction quality	0.77	0.76	Comparable
8	Unsafe intersection design	0.74	0.75	Slightly higher, Road 2
9	Non-uniform pavement thickness	0.70	0.71	Similar
10	Encroachment & ROW issues	0.68	0.65	More severe, Road 1

3.3.2 RII comparison of Geometric Problems in the in Manthali Ground to Radhakrishna Mandir Road (Road 1)

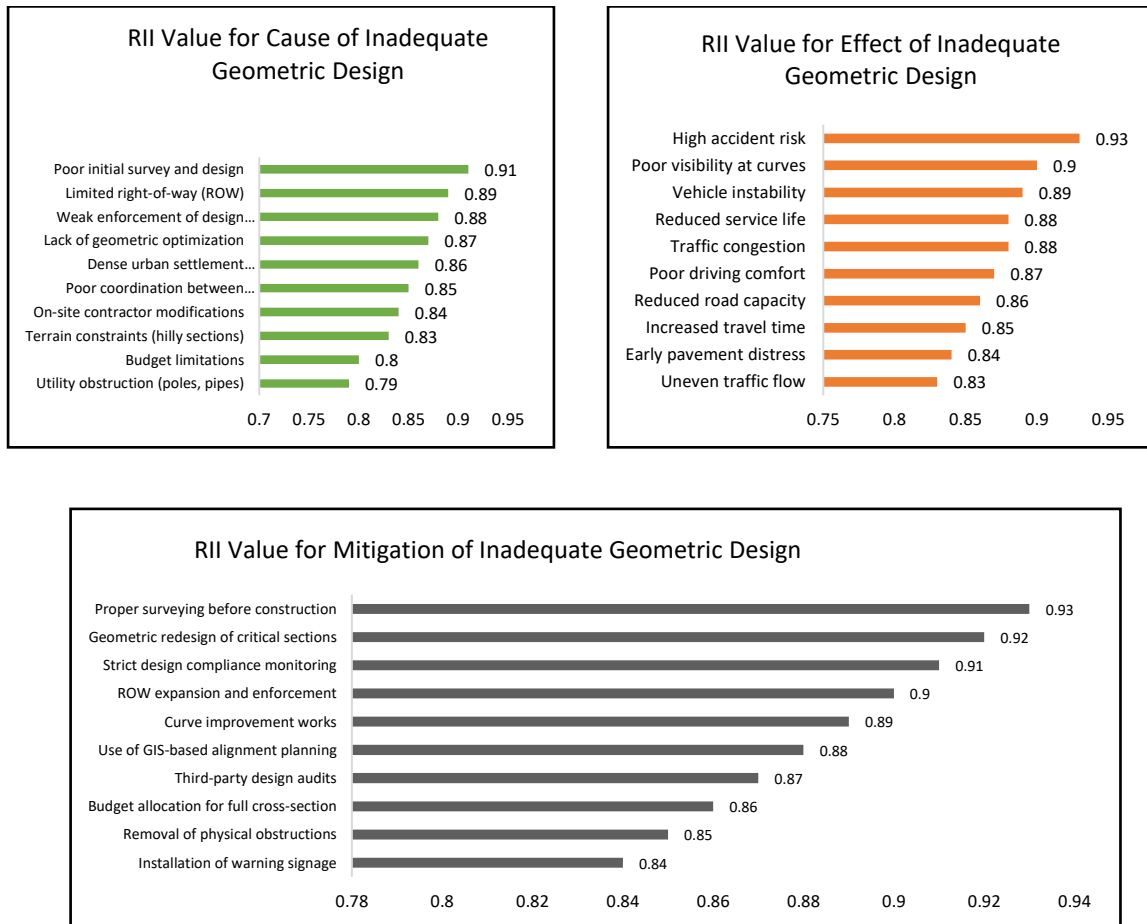


Fig. 3.3a) RII of Causes, Effects and Mitigation of Inadequate Geometric Design

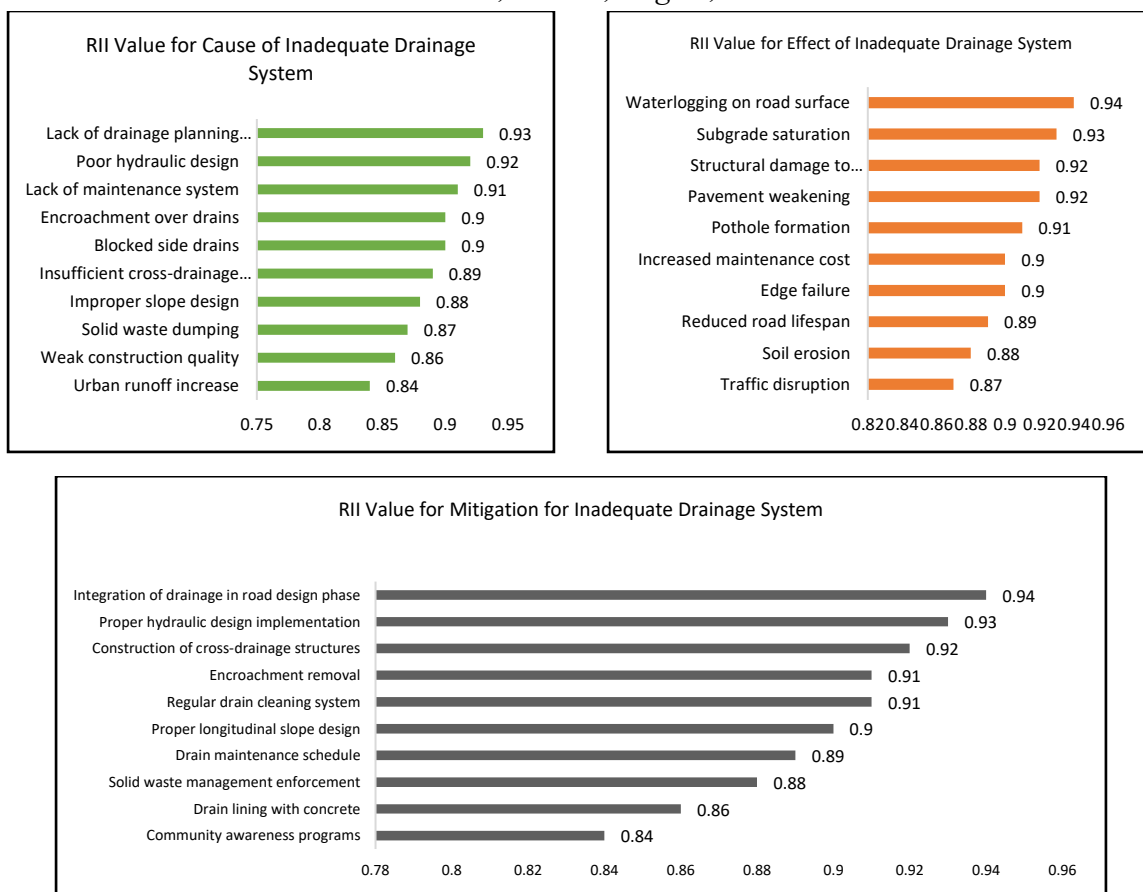
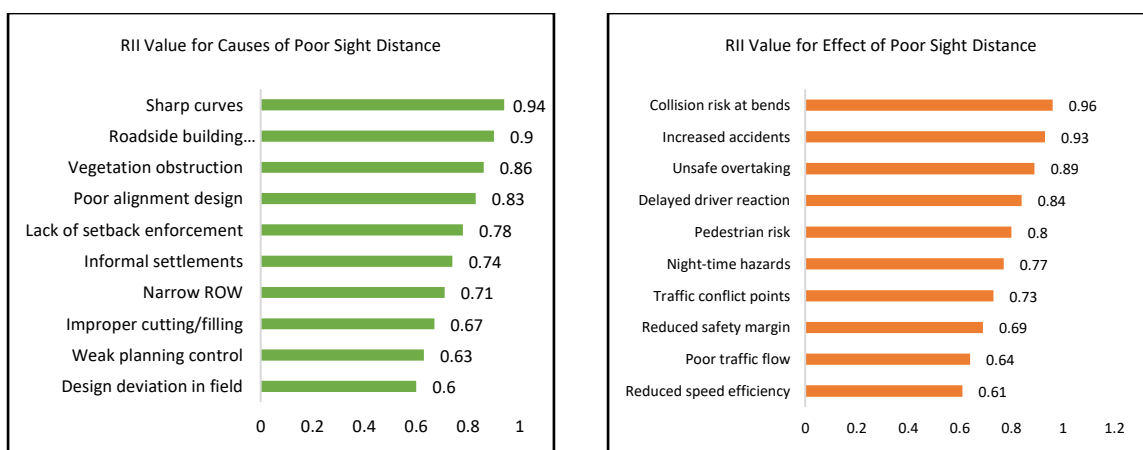


Fig. 3.3b) RII of Causes, Effects and Mitigation of Inadequate Drainage System



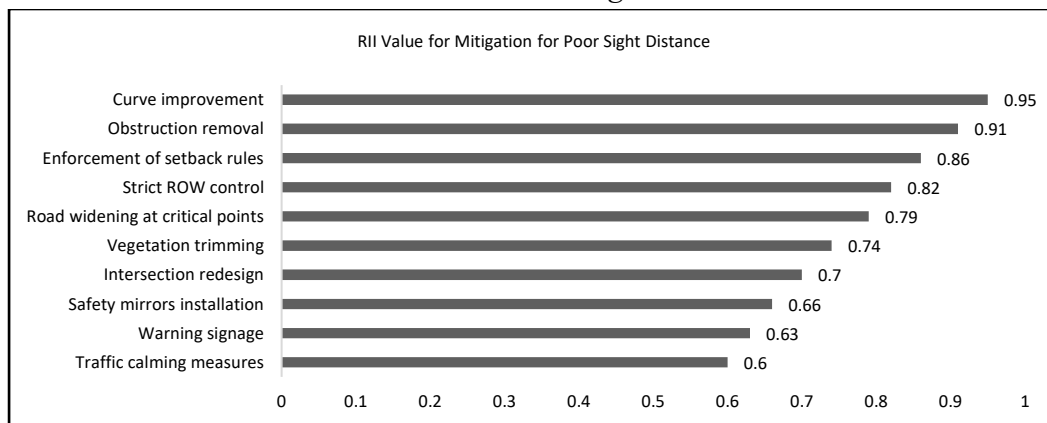


Fig. 3.3c) RII of Causes, Effects and Mitigation of Poor Sight Distance

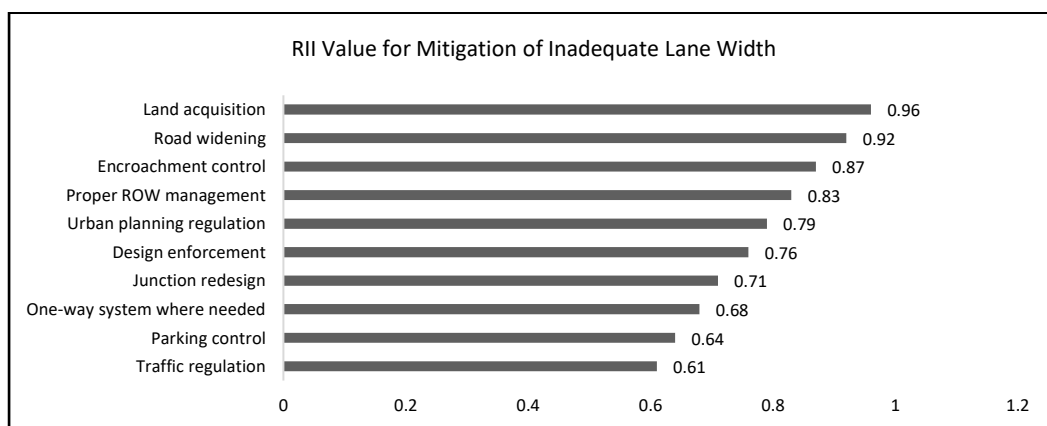
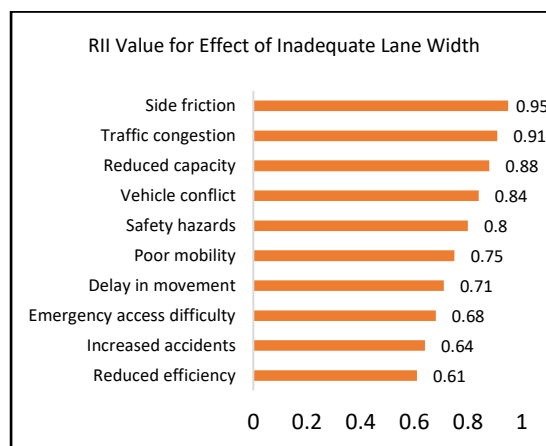
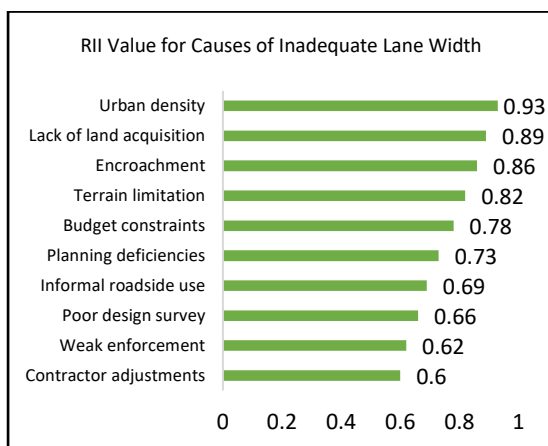


Fig. 3.3d) RII of Causes, Effects and Mitigation of Inadequate Lane Width

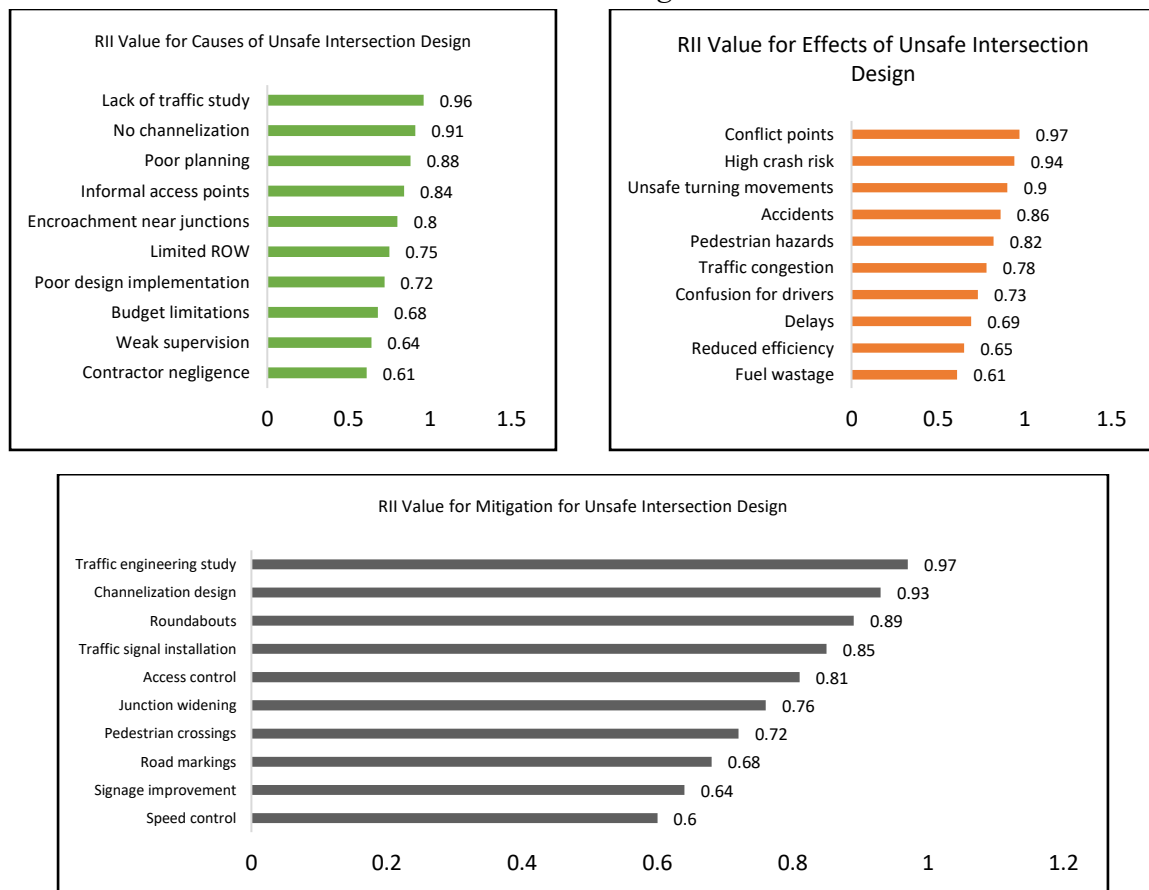
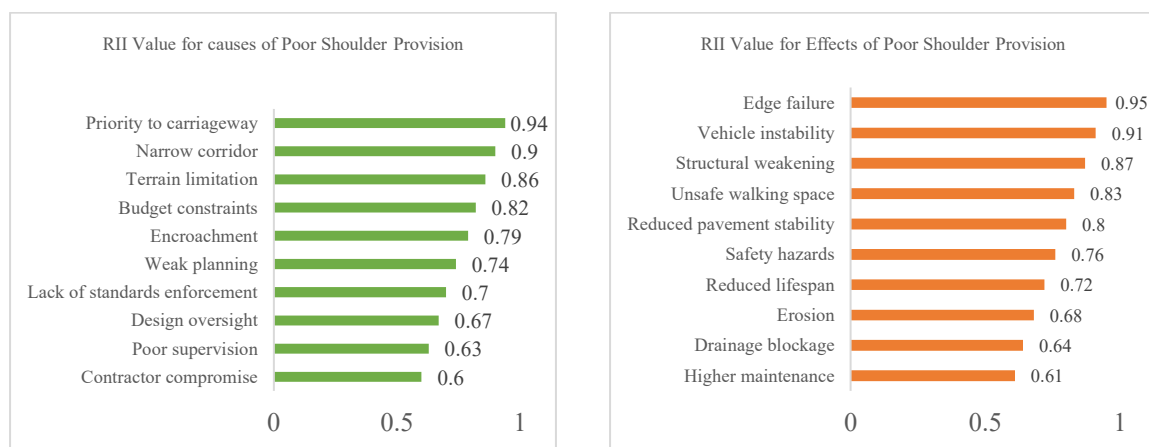


Fig. 3.3e) RII of Causes, Effects and Mitigation of Unsafe Intersection Design



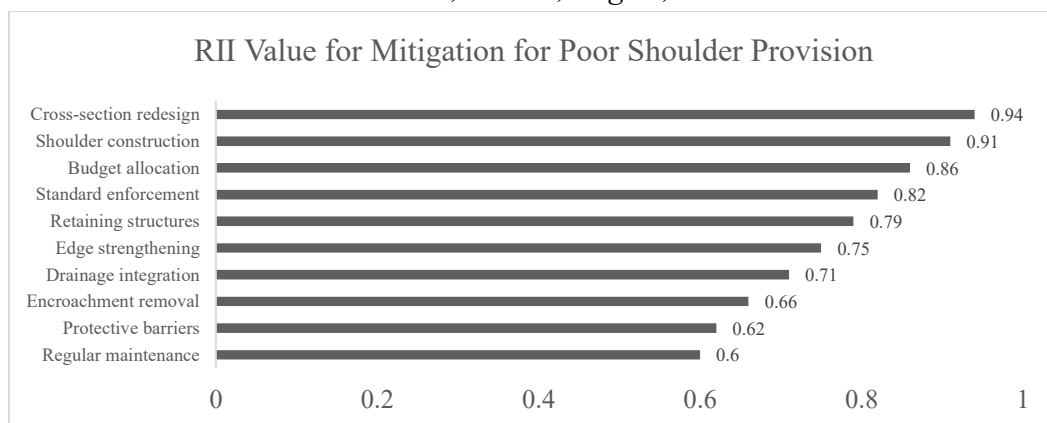


Fig. 3.3f) RII of Causes, Effects and Mitigation of Poor Shoulder Provision

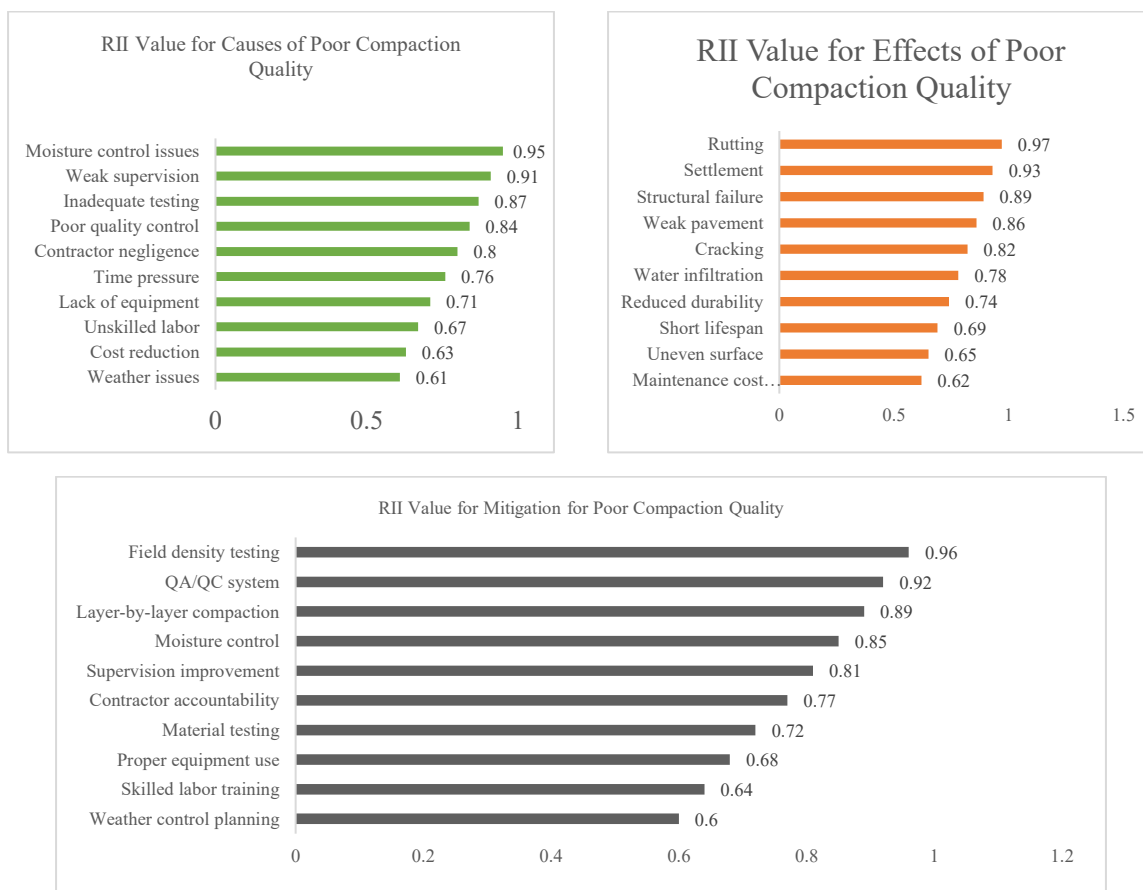


Fig. 3.3g) RII of Causes, Effects and Mitigation of Poor Compaction Quality

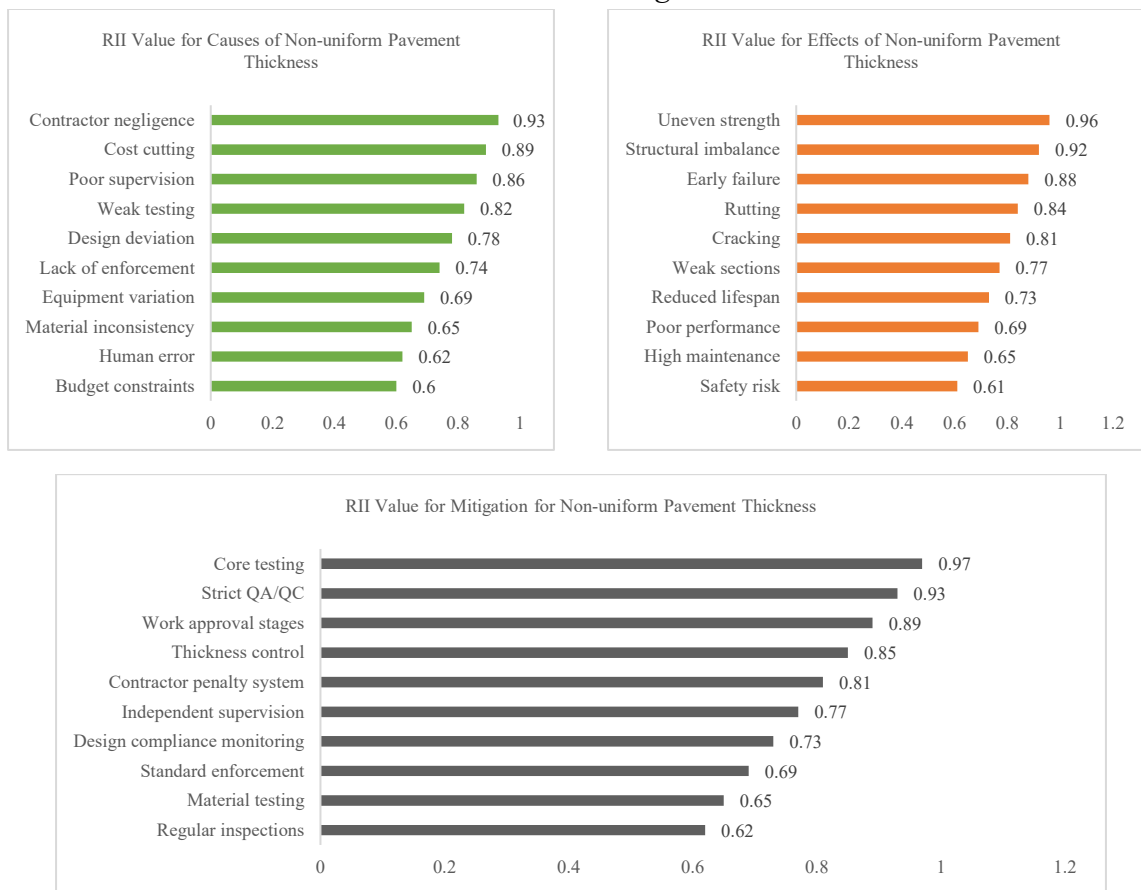
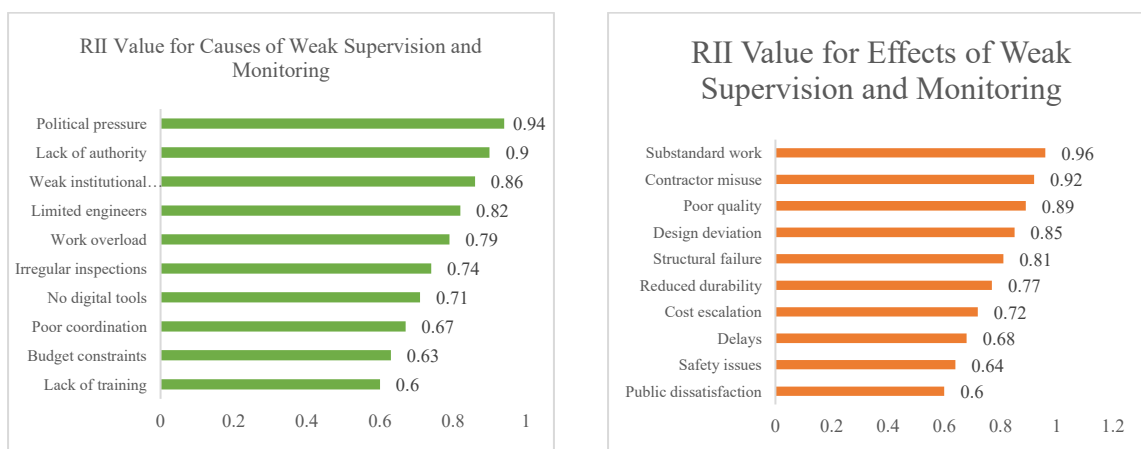


Fig. 3.3h) RII of Causes, Effects and Mitigation of Non-uniform Pavement Thickness



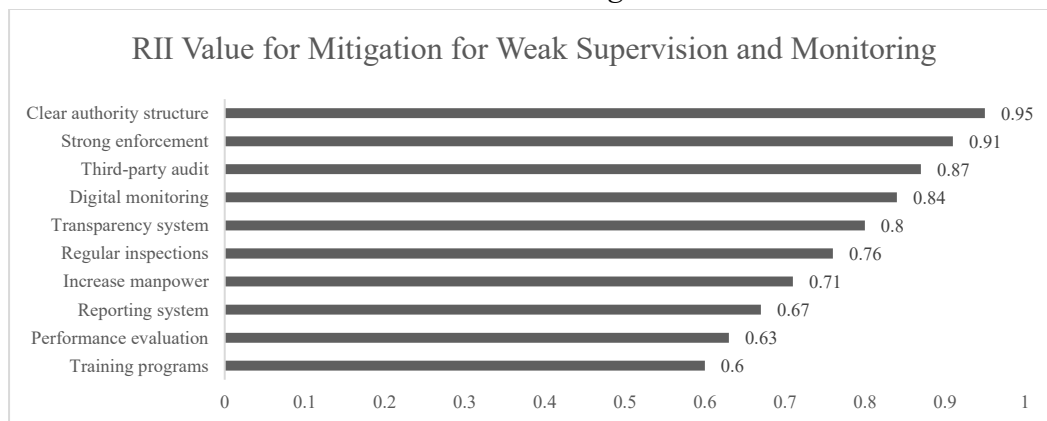


Fig. 3.3i) RII of Causes, Effects and Mitigation of Weak Supervision and Monitoring

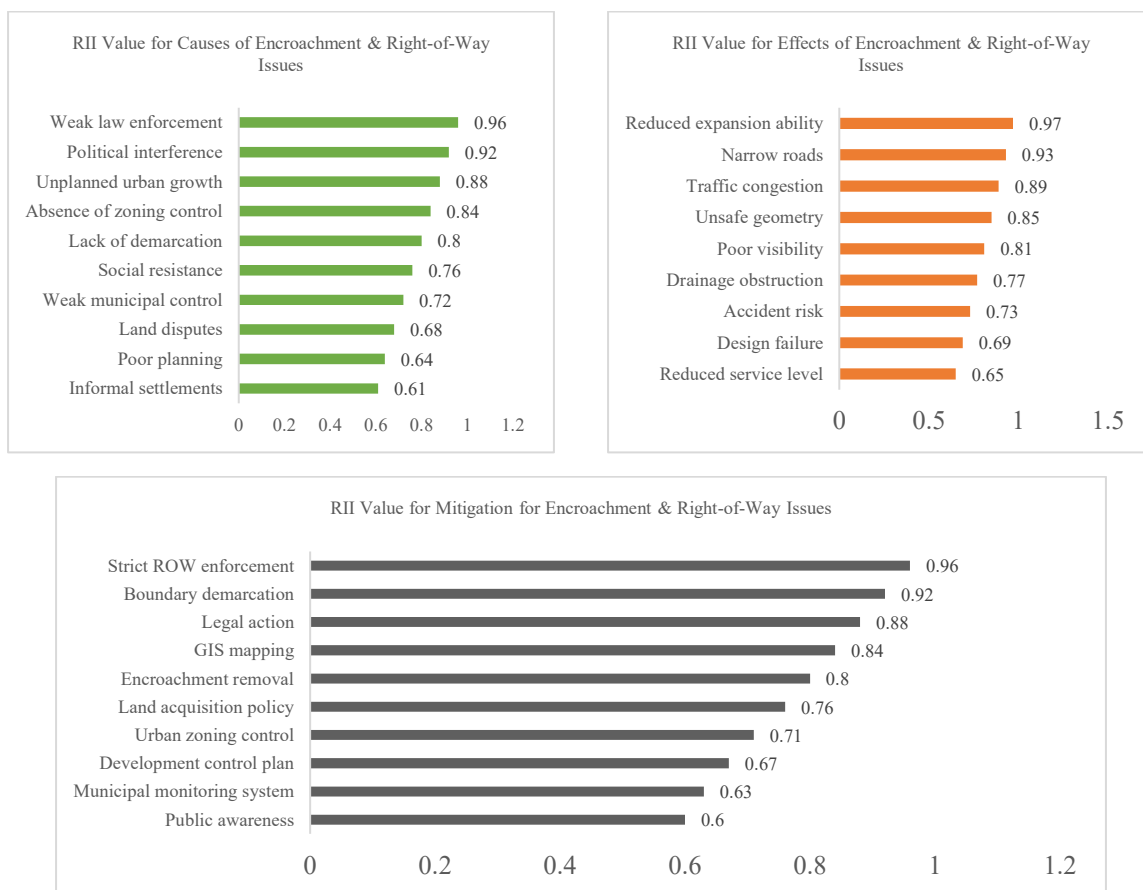


Fig. 3.3j) RII of Causes, Effects and Mitigation of Encroachment & Right-of-Way Issues

3.3.2 RII comparison of Geometric Problems in the Subarneshwor Mahadev Mandir to Gundu Chaur road section(Road 2):

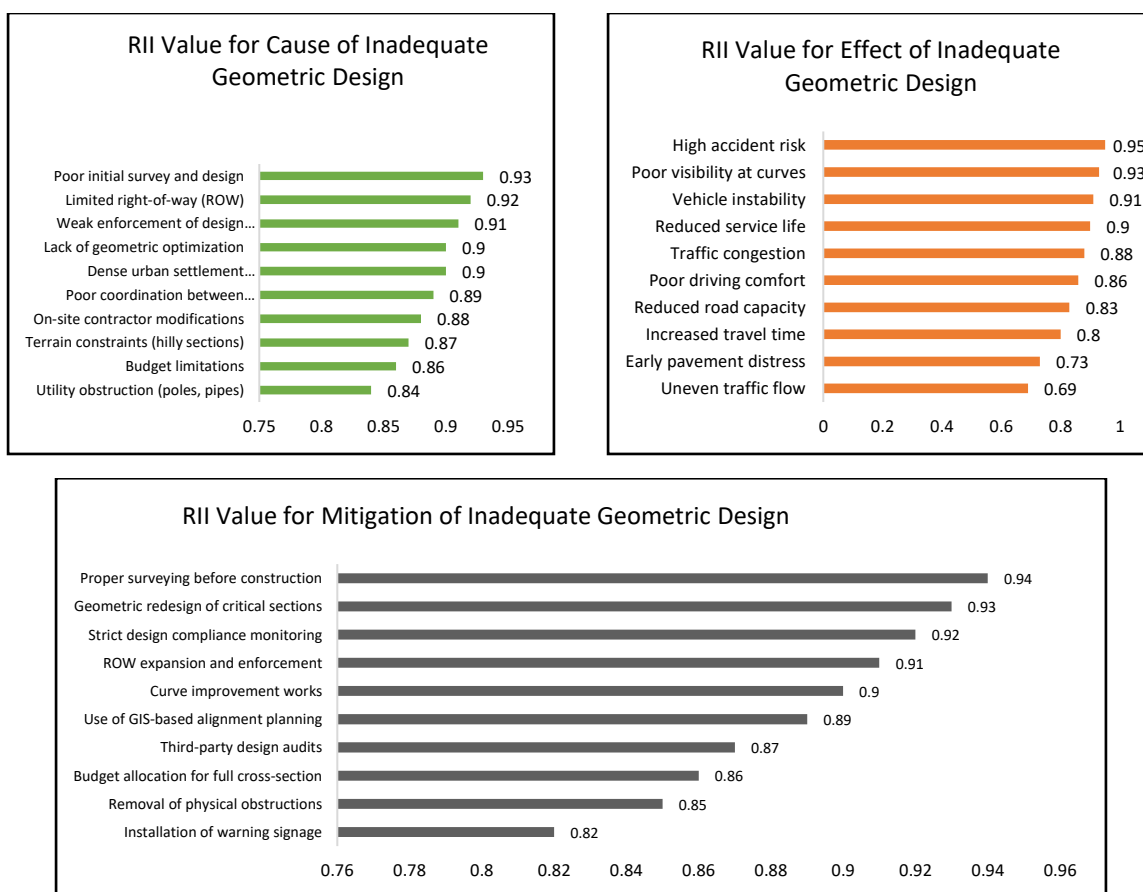


Fig. 3.4a) RII of Causes, Effects and Mitigation of Inadequate Geometric Design

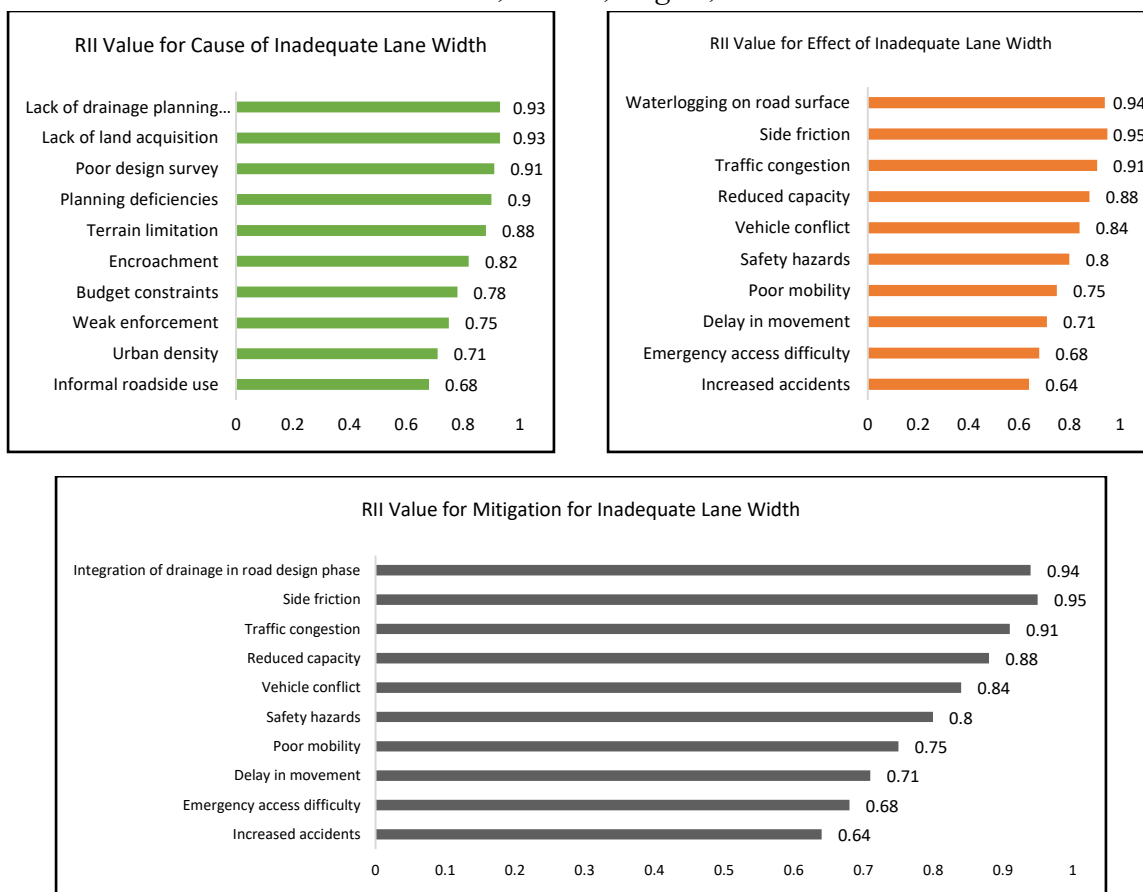
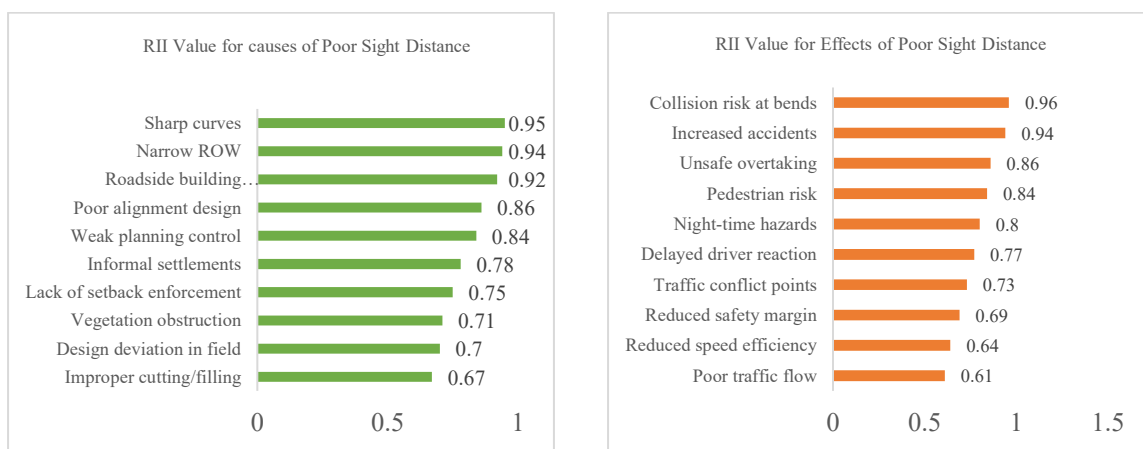


Fig. 3.4b) RII of Causes, Effects and Mitigation of Inadequate Lane Width



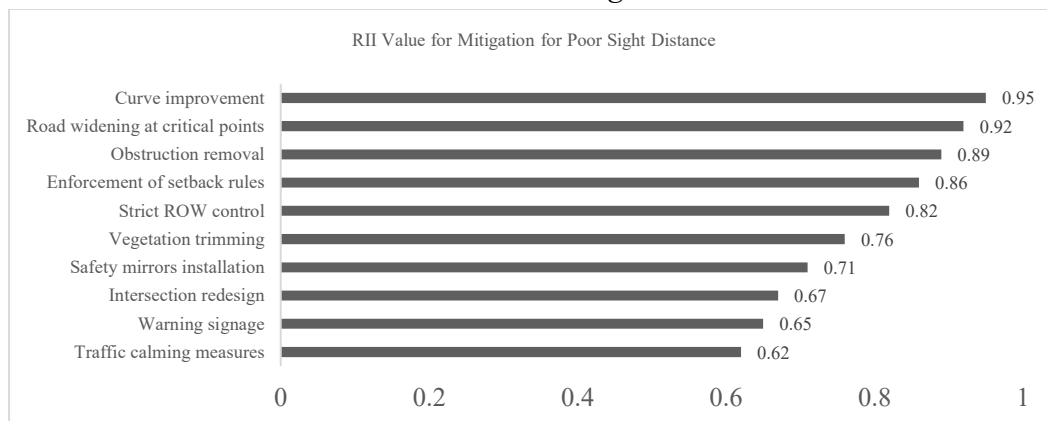


Fig. 3.4c) RII of Causes, Effects and Mitigation of Poor Sight Distance

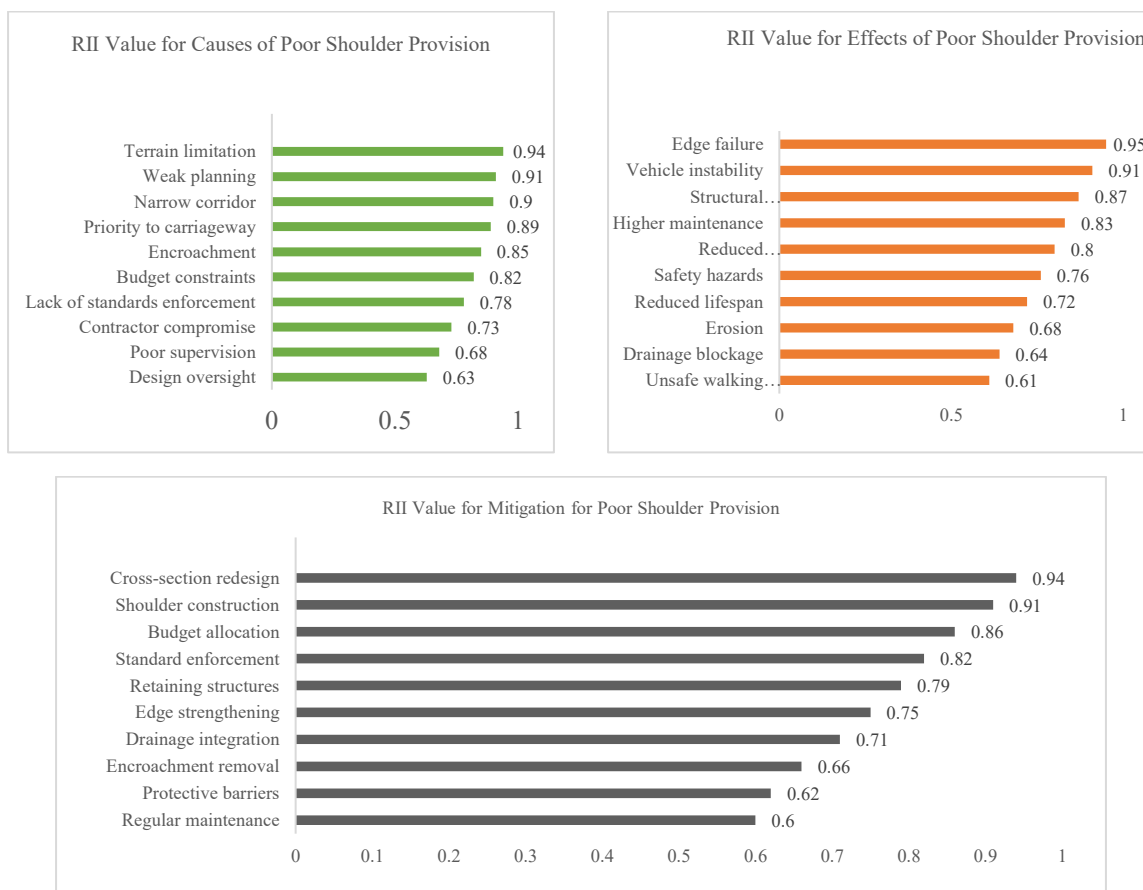


Fig. 3.4d) RII of Causes, Effects and Mitigation of Poor Shoulder Provision

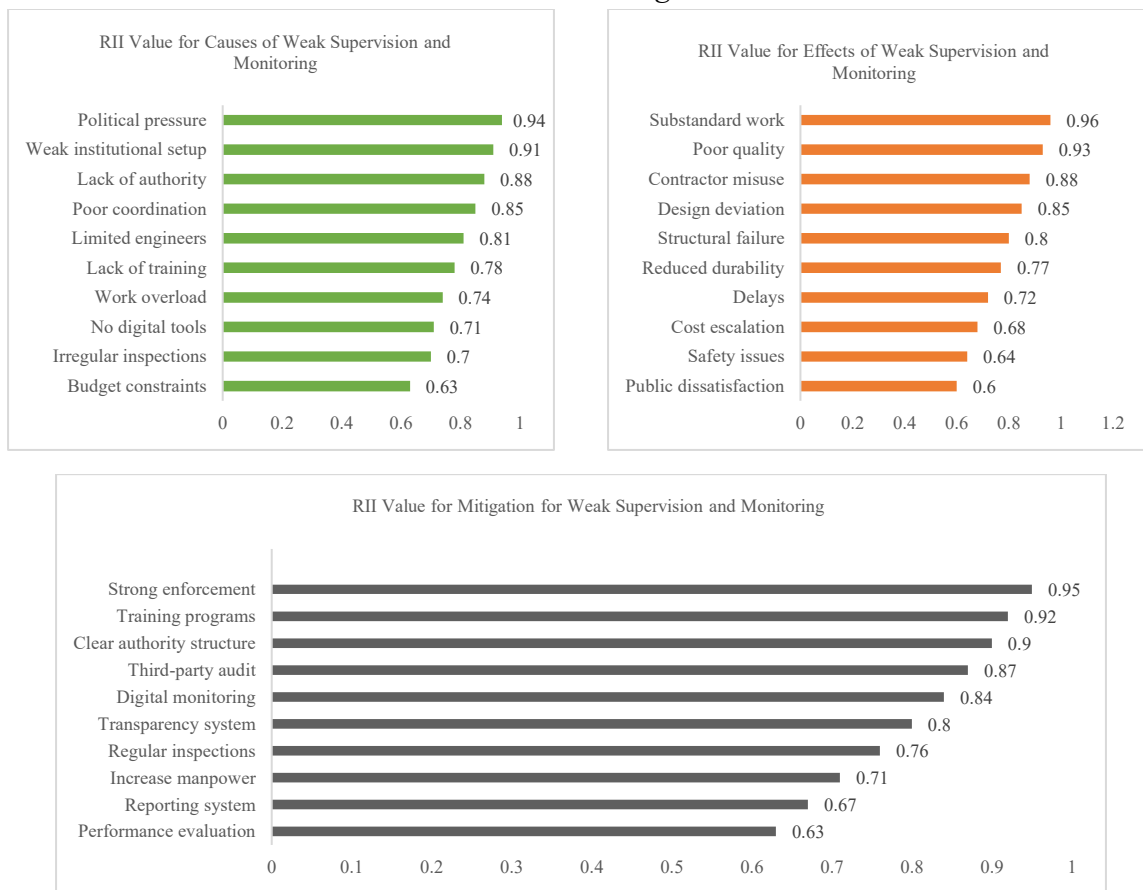
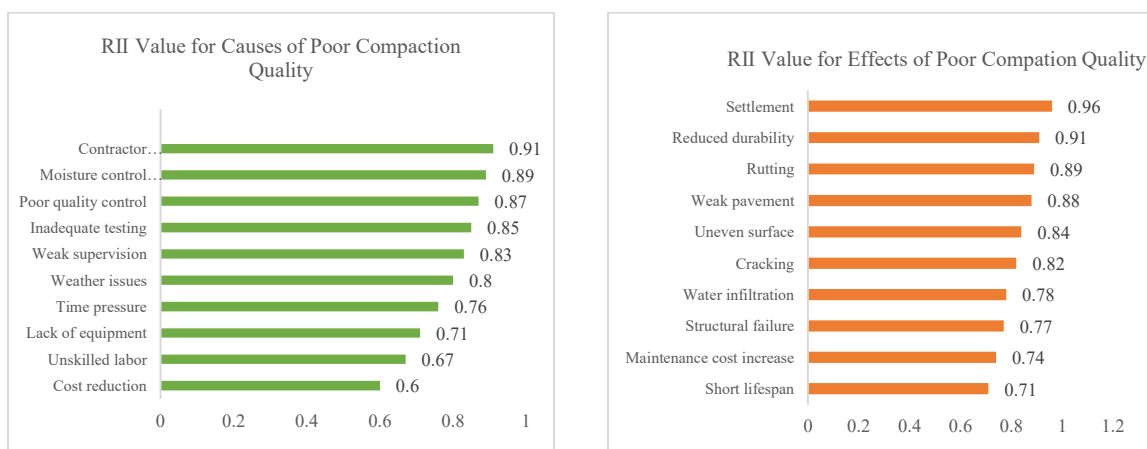


Fig. 3.4e) RII of Causes, Effects and Mitigation of Weak Supervision and Monitoring



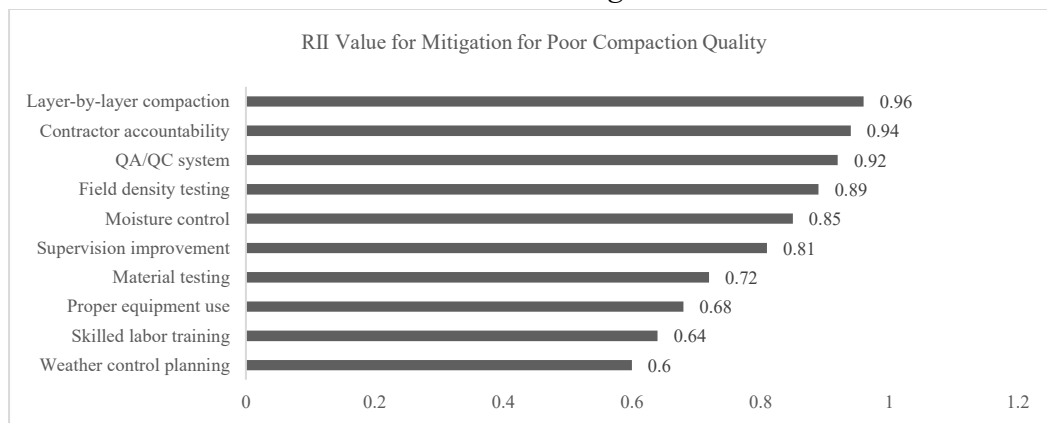


Fig. 3.4f) RRI of Causes, Effects and Mitigation of Poor Compaction Quality

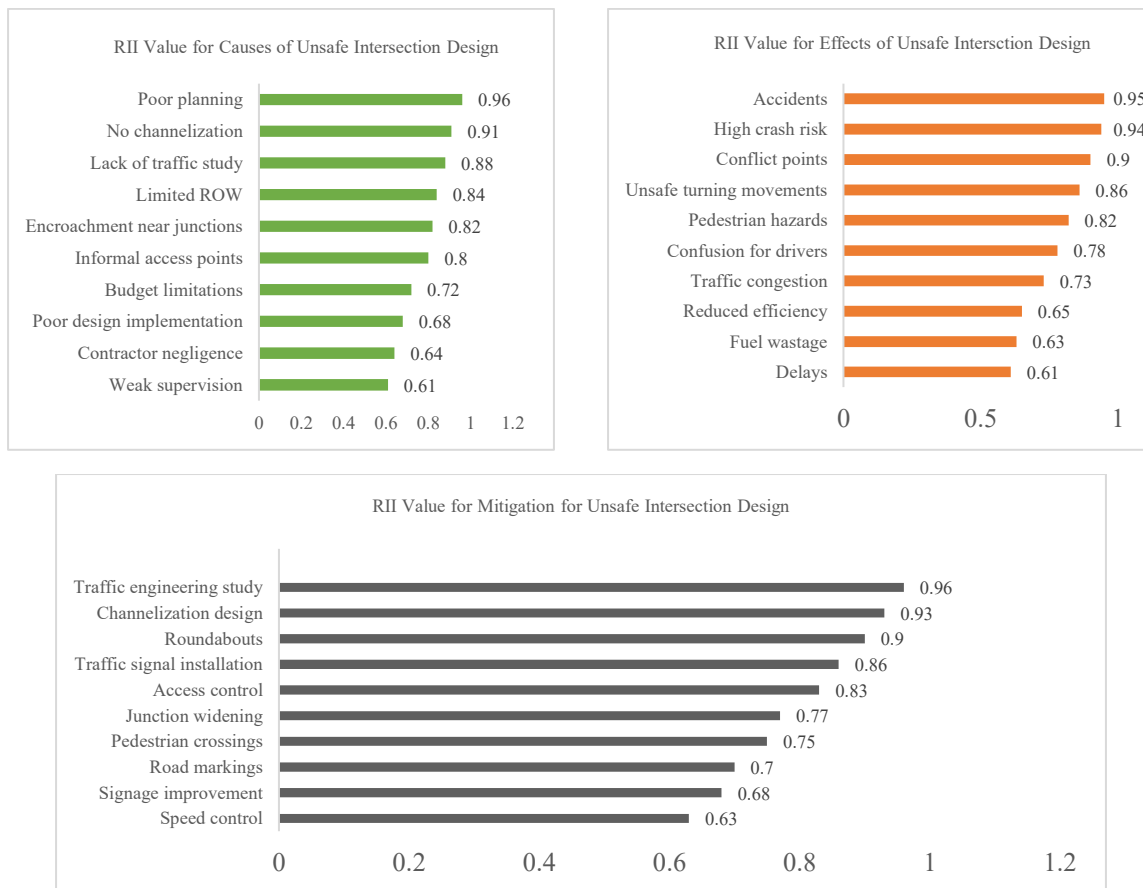


Fig. 3.4g) RRI of Causes, Effects and Mitigation of Unsafe Intersection Design

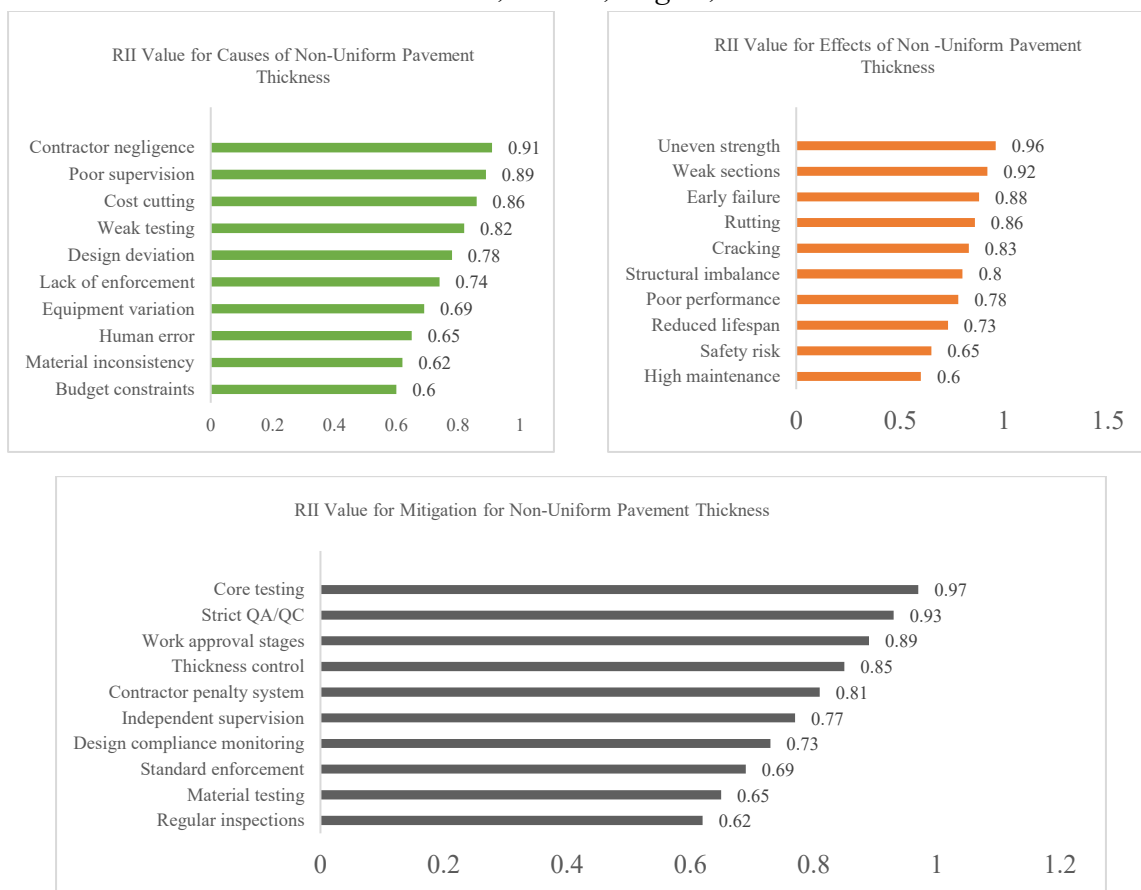
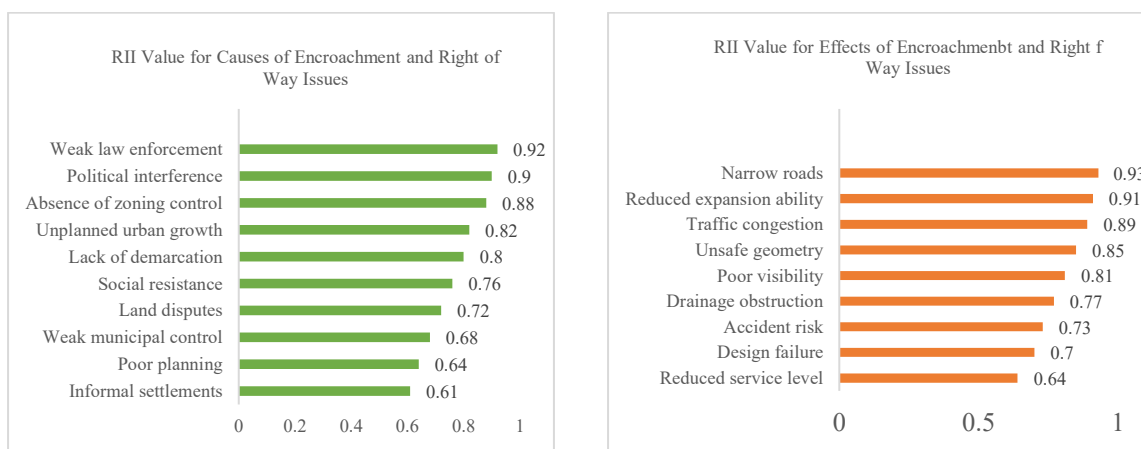


Fig. 3.4h) RII of Causes, Effects and Mitigation of Non-uniform Pavement Thickness



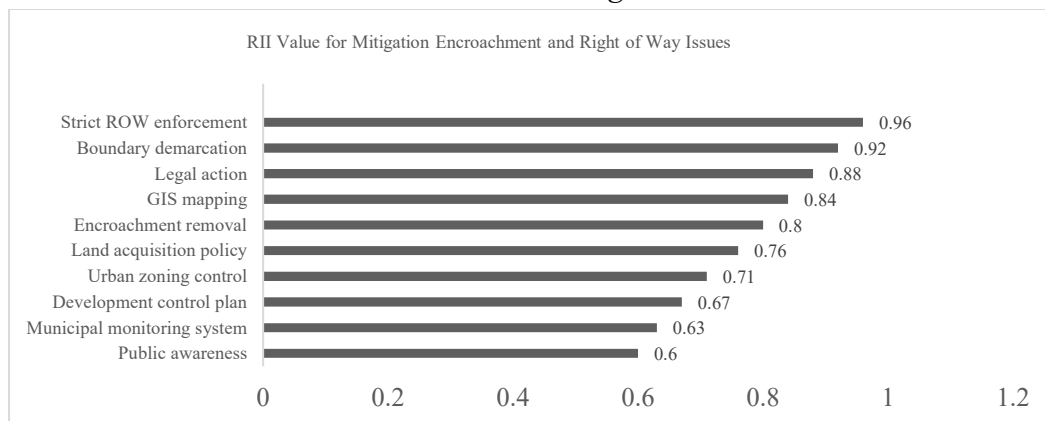


Fig. 3.4i) RII of Causes, Effects and Mitigation of Encroachment & Right-of-Way Issues

3.4 RII Analysis of Stakeholder and Institutional Problems

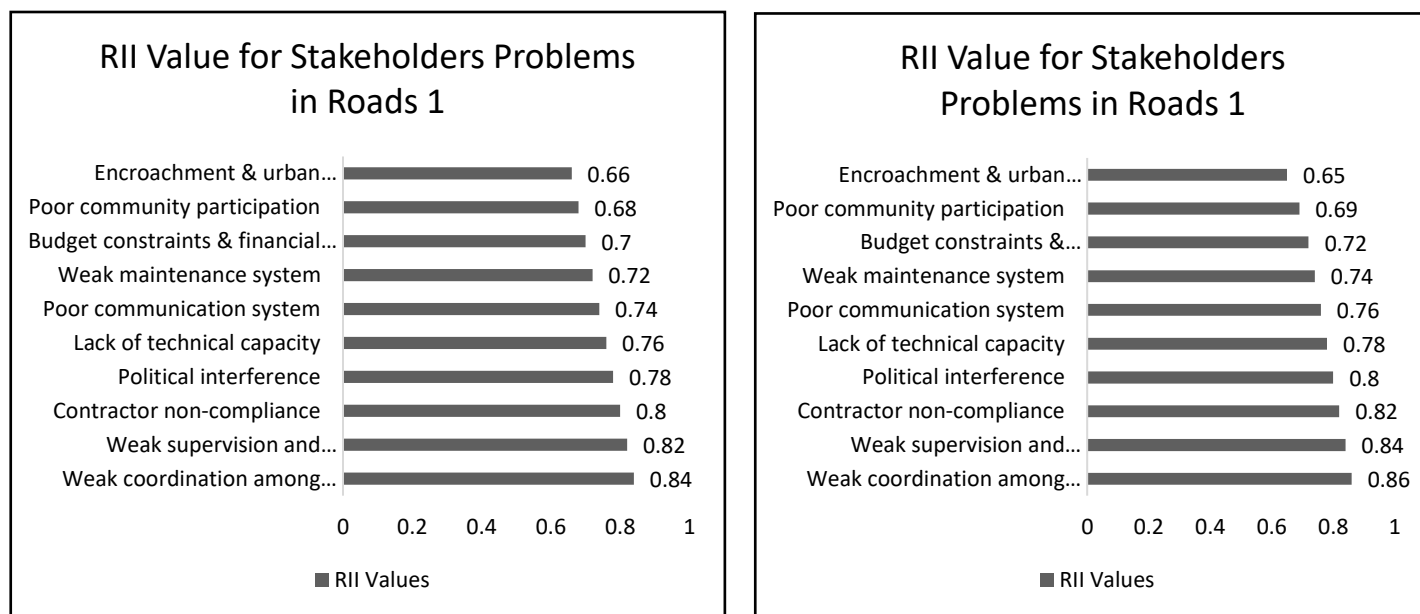


Fig. 3.5: RII value of Stakeholders Problems in Road 1 and Roads 2

A parallel RII analysis of stakeholder-reported institutional problems showed a distinct pattern: nearly every institutional factor scored higher on Road 2 than Road 1 (Table 3.4), the reverse of the encroachment finding above. Weak coordination among stakeholders ranked highest overall (0.84 Road 1, 0.86 Road 2), reflecting the number of agencies, contractors, consultants, and local authorities involved in implementation a challenge the FGD findings attribute to delays, design modifications, and utility conflicts arising from ineffective multi-party decision-making. Weak supervision and monitoring (0.82/0.84) and contractor non-compliance (0.80/0.82) followed closely, both consistently elevated on Road 2, which in-depth interviews linked to that section's more

complex terrain and construction difficulty. Political interference (0.78/0.80) and limited technical capacity (0.76/0.78) were also consistently more pronounced on Road 2. As with the geometric problem set, encroachment and urban development pressure was the sole institutional factor ranking higher on Road 1 (0.66 vs. 0.65), reinforcing that Road 1's core challenge is urban-development-driven space constraint, while Road 2's core challenge is terrain- and coordination-driven implementation difficulty.

Table 3.4. RII comparison of stakeholder/institutional problems, Road 1 vs. Road 2

Problem	Road 1 RII	Road 2 RII	Comparative Note
Weak coordination among stakeholders	0.84	0.86	Higher, Road 2
Weak supervision and monitoring	0.82	0.84	Higher, Road 2
Contractor non-compliance	0.80	0.82	Higher, Road 2
Political interference	0.78	0.80	Higher, Road 2
Lack of technical capacity	0.76	0.78	Higher, Road 2
Poor communication system	0.74	0.76	Higher, Road 2
Weak maintenance system	0.72	0.74	Higher, Road 2
Budget constraints	0.70	0.72	Higher, Road 2
Poor community participation	0.68	0.69	Similar
Encroachment & urban development pressure	0.66	0.65	Slightly higher, Road 1

3.5 Qualitative Corroboration (FGD and Field Observation)

Focus group discussion findings corroborate both RII tables directly. Road 1 participants emphasized limited space, roadside encroachment, inadequate drainage continuity, and pedestrian safety matching that section's comparatively higher encroachment RII. Road 2 participants instead emphasized terrain-related difficulty, slope instability, and drainage discharge problems consistent with that section's higher lane-width and institutional-coordination RII scores. This alignment between quantitative RII ranking and independently gathered qualitative FGD themes strengthens confidence that the RII results reflect genuine, location-specific conditions rather than survey artifact.

3.6 Discussion

Read together, the two case-study road sections indicate that the central problem in Suryabinayak Municipality's road delivery is not an absence of design standards but the inconsistent implementation of standards that are, on paper, adequate. Three findings support this interpretation. First, geometric under-width (both sections narrower than design by the same 0.5 m) is consistent with right-of-way constraints and weak construction-stage supervision rather than a design flaw. Second, pavement thickness deficits of 70–80 mm below design are structurally significant: reduced thickness directly compromises load-bearing capacity, and combined with traffic volumes already exceeding design estimates on both sections, indicates a materially elevated risk of early-onset cracking, rutting, and pothole formation well before the 20-year design life is reached. Third, drainage capacity delivering only about half its design requirement on both sections is likely the single most consequential deficiency: given Nepal's monsoon intensity, undersized drainage accelerates subgrade weakening and pavement deterioration regardless of how well other parameters comply, and field observation of water stagnation on both sections corroborates this as an active, ongoing failure mode rather than a latent risk.

The consistency of these gaps across two independently constructed road sections, combined with converging stakeholder attribution to supervision, budget, and political interference, is consistent with patterns reported in other hilly-region rural road studies in Nepal [15] and in the broader international literature on design–

implementation gaps in developing-country road construction [16], suggesting this is not an isolated municipal issue but a structural characteristic of resource-constrained road delivery more broadly.

4. CONCLUSIONS

This study assessed the compliance of two road sections in Suryabinayak Municipality totaling 3.789 km with Nepal Road Standards, evaluating geometric design, pavement structure, and drainage provision against both design specifications and field-measured conditions. Both sections showed a consistent pattern of under-compliance: road width fell 0.5 m short of design on both sections, pavement thickness fell 70–80 mm short of design, drainage capacity delivered only about half its specified value, and both sections already carry traffic volumes exceeding their original design estimates. The consistency of these deviations across two independently constructed, geographically distinct road sections indicates a systemic implementation gap reflecting inadequate supervision, budget constraints, limited technical capacity, and political interference rather than an absence of adequate design standards. Stakeholder feedback across residents, road users, municipal engineers, and contractors converged on the same root causes, reinforcing this interpretation. These findings demonstrate that road durability, safety, and serviceability in the municipality depend not only on the existence of technically sound design specifications but on the rigor with which those specifications are enforced during construction, and that current monitoring and enforcement mechanisms remain insufficient to close this gap.

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