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Bridge Failures in Nepal: Systematic Review and Quantitative Characterization of Causal Mechanisms

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Abstract

This comprehensive systematic review of 56 reported incidents synthesizes quantitative analysis of motorable bridge failures in Nepal over the past two decades. The study gathers failure data from news archives, academic literature, and grey reports, sorting causes into hydraulic/hydrological events, construction errors, design and structural flaws, overloading, and other miscellaneous factors. The findings reveal that hydraulic failures, which are primarily linked to floods and scour, dominated by 39.29% of cases, followed by construction failures at 28.57%. The remaining causes comprise design flaws, overloading, and external events. The results underscore the structural flaw in engineering and construction methods, and the serious difficulties posed by Nepal's dynamic river systems, monsoonal intensity, and seismicity. In order to enhance the resilience of Nepal's vital transportation infrastructure, this review suggests upgrading hydrological design standards, improving quality assurance in construction, enhancing design review, and establishing a national bridge management system.

Keywords: Bridge failure, Hydraulic and Scour Effects, Nepal Infrastructure, Structure Reliability, Construction Deficiencies

1. Introduction

Bridges are a critical pillar of modern transport systems, essential for the economic and societal development of a region (Lair, 2020). However, their operational sustainability is perpetually challenged. Globally, bridge failures are attributed to a range of factors, including natural catastrophes like floods and earthquakes (Saini, 2014; Farook et al., 2014), fundamental design and material flaws (Burgoyne and Scantlebury, 2008; Ye et al., 2014), and manmade issues such as poor maintenance and excessive loading (Deng et al., 2016).

Global reviews of over 5,000 failures identify hydraulic causes (e.g., scour and flooding) as the dominant factors, accounting for 40–50% of failures, followed by construction faults at 25–33% (Zhang et al., 2022). These statistics underscore the need for regional assessments, particularly in environmentally vulnerable areas like Nepal.

Nepal's active Himalayan geology, aggressive monsoonal rivers, and intense seismicity create a challenging environment for bridge engineering. Notable events, including the scour-related failure of the Triyuga Bridge, the collapse of the Jabdighat Bridge while under construction, and structural failures that occurred after the 2015 Gorkha Earthquake (Xie et al., 2017), highlight inherent shortcomings in design, construction, and maintenance practices.

While single case studies exist, a systematic, quantitative review of bridge failure causes across Nepal has been a significant knowledge deficit. This study aims to bridge this deficit by analyzing data from secondary sources to identify and quantify the principal causes of bridge failure. By developing a percentage-based breakdown of failure causes from 56 documented incidents, this study provides a foundational dataset for engineers, policymakers, and planners to enhance the resilience of Nepal's vital transportation infrastructure.

2. Methodology

To address the absence of a centralized, authoritative database on bridge failures in Nepal, this study employed a systematic review and analysis of secondary sources. The methodology was designed to first compile a comprehensive database of failure incidents and then to classify and quantify the relative contribution of each cause.

2.1 Data Compilation

A database of 56 distinct motorable bridge failures occurring over the past two decades was compiled. This period was selected to reflect modern engineering practices and environmental conditions. Data were gathered from three primary source types:

1. Academic and Engineering Literature: Peer-reviewed journals and technical reports were retrieved from academic databases using keywords such as "bridge failure Nepal," "bridge collapse Nepal," and "scour failure."
2. News Media Archives: A systematic search of major national English-language newspapers (e.g., The Kathmandu Post, The Himalayan Times, My Republica) was conducted to identify and confirm incidents not documented in academic literature.
3. Grey Literature: Reports and articles from official and unofficial agency websites were used for supplementary background information on project timelines and attributed causes.

For each of the 56 incidents, key data points were recorded: the bridge name, location, collapse date, and the primary reported cause of failure.

2.2 Data Classification and Analysis

The gathered information underwent analysis through a two-step procedure. First, a qualitative categorization was performed, assigning each incident to a primary failure cause based on the reported information. The categories used were adapted from international research (Zhang et al., 2022) and tailored to the Nepali context.

Following this, a quantitative analysis was conducted. The incidents within each category were counted to ascertain the relative percentage distribution of each failure cause among the total incidents recorded. This quantitative result is the main finding of this paper. The primary failure categories used for classification were:

- Hydraulic/Hydrological Failure
- Construction Failure/Mistake
- Design Error / Structural Failure
- Overloading
- Other Causes (including landslides, collisions, and pending investigations)

3. Findings

The analysis of 56 documented motorable bridge failures in Nepal reveals that failures are driven primarily by two factors: environmental hazards and human error. The quantitative breakdown of the principal causes is summarized in Figure 1, with each category detailed below.

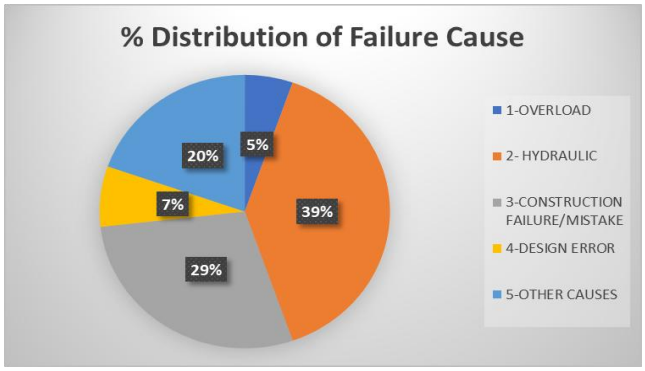

Figure 1. Percentage Distribution of Bridge Failure Causes in Nepal (n=56)

3.1 Hydraulic/Hydrological Failure (39.29%)

The most prevalent cause, responsible for 22 of the 56 incidents, was hydraulic and hydrological events. These failures are overwhelmingly linked to intense monsoon flooding, riverbank erosion, and foundation scour. This highlights the challenge of applying traditional design strategies to Nepal's active river morphology (Inoue *et al.*, 2020). The collapses of the Kamala and Jabdighat bridges during flood events underscore the central role of these hydrological forces (The Himalayan Times, 2021).

1. **Mauwa River Bridge:** In July 2020, segments of this bridge along the Prithvi Highway in Dhading were washed away by flooding that surpassed its design capacity, highlighting the oversight of flood risks in water management planning.
2. **Chhabdi Khola Dovan Bridge:** This bridge in Tanahun experienced total structural failure in July 2021 due to intense flooding overwhelming its narrow outlet, highlighting a design flaw in accommodating peak water flow.
3. **Bhotekoshi Bailey Bridge:** Situated at the Tatopani border, this bridge was carried away by the river in September 2024, severing a vital trade route between Nepal and China.
4. **Sandhi Stream Bridge:** In August 2018, this bridge in Barhabise Bazaar was destroyed and swept away due to flooding from the Sandhi stream, cutting off access to northern Sindhupalchowk.
5. **Myardi River Bailey Bridge:** This Bailey Bridge, which connects Manang and Lamjung, was washed away by flooding in June 2019, isolating the Manang district.
6. **Pokhara Seti River Bridge:** In August 2024, this 72-meter-long bridge in the Kaski district collapsed during a flood that caused erosion of its foundations, disrupting transportation between two wards of Pokhara Metropolitan City.
7. **Sindhuli Truss Bridge:** This bridge over the Sunkoshi River in Sindhuli failed in October 2024 after flooding from three days of continuous rain, interrupting a critical route.
8. **Miteri Bridge:** A flash flood in July 2025 caused this bridge over the Bhotekoshi River in Rasuwagadhi to collapse, halting cross-border movement between Nepal and China.
9. **Seti River Bridge:** In June 2019, this bridge over the Seti River in Kaski collapsed due to monsoon flooding, leading to transportation disruptions that necessitated an alternative route.
10. **Ratu Khola Bridge:** On August 13, 2014, the Ratu Khola Bridge in Bardibas experienced a foundation collapse due to the settlement of its piers caused by severe flooding and riverbed scour.
11. **Bhapsi Khola Bridge:** Located along the E-W Highway, this bridge encountered foundation failure in the past due to excessive floodwaters and erosion.
12. **Charnawati Khola Bridge:** At an unspecified past date, the foundation of this bridge on the E-W Highway gave way due to intense flooding and scour.
13. **Dudhaura Khola Bridge:** Historically, this bridge on the E-W Highway collapsed because its foundation was critically compromised by overwhelming floods and riverbed erosion.
14. **Dholi Khola Bridge:** The foundation of this bridge on the E-W Highway failed at some point previously due to the detrimental effects of excessive flooding and scour.
15. **Ghodaha Bridge:** In 2021, this newly completed bridge on the East-West Highway in Rupandehi experienced a total collapse due to a fundamental failure in its foundation.
16. **Turiya Khola Bridge:** Also found on the East-West Highway in Rupandehi, this finished structure suffered foundation failure in 2021.
17. **Lodari Khola Bridge:** The foundation failure of this bridge in 2021, located on the road from Parsa to Chainpur, was primarily attributed to concentrated water flow and ensuing scour.

18. **Sadi Khola Bridge:** This bridge was destroyed and swept away by a powerful flood on August 18, 2018; its specific location is not provided.
19. **Khaireini Bridge:** Located in Nepalthok within the Koshi Basin, this bridge was destroyed between September 27-28, 2024, as a direct consequence of unprecedented extreme flood levels.
20. **Triyuga River Bridge:** In July 2024, the eastern pier and its retaining wall of the 120-meter-long bridge began collapsing after 4 days of continuous rainfall and flooding.
21. **Foxingtar Bridge:** A catastrophic and record-breaking flood event in the Koshi Basin exceeded the capacity of this bridge, leading to its complete structural failure on September 27-28, 2024.
22. **Sunkoshi Bridge, Nepalthok:** Sources from Nepalthok indicate that the bridge collapsed between September 27 and 28, 2024, due to being inundated by an unprecedented flooding event of significant magnitude in the Koshi Basin.

3.2 Construction Failure/Error (28.57%)

The second leading cause was failures during or shortly after the construction phase, accounting for 16 of the 56 incidents. These cases point to systemic issues in quality control, contractor performance, and project monitoring. A notable instance is the Jabdighat Bridge, which fell down only a month after its unofficial inauguration because of the contractor's oversight in inadequately deepening the foundation piles. Similarly, the Mahesh Khola Bridge failed during construction when its temporary falsework supports were scoured out, indicating inadequate planning for hydraulic forces during the construction process.

1. **Jabdighat Bridge:** In August 2017, this significant bridge in Bardiya fell apart merely a month after it was informally opened to the public. Investigations indicated that the collapse was a result of negligence on the part of the contractor, particularly for not constructing the piles to a sufficient depth.
2. **Thimura Bridge:** The 200-meter Thimura Bridge, located in Chitwan, experienced partial collapse in April 2021 due to weak concrete strength, representing a straightforward case of design error.
3. **Trishuli River Bridge:** This bridge, situated at the Bagmati-Gandaki Border, collapsed in April 2021 while still under construction, with the failure attributed directly to mistakes in construction and procedures, leading to considerable delays in the project.
4. **Mahesh Khola Bridge:** During construction in 2019, this bridge in Dhading collapsed when its falsework supports were washed away, highlighting inadequate planning for potential hydraulic forces during the construction process.
5. **Tallo Bagar Bailey Bridge:** In April 2023, the collapse of this bridge over the Bheri River during its construction phase resulted in two fatalities and three individuals reported missing, showcasing the severe human toll of construction failures.
6. **Marsyandi River Bridge:** In 2012, the construction of this bridge on the Bhoteodar-Bharate link was disrupted when it collapsed mid-build.
7. **Panchthar Bailey Bridge:** The 70-meter Bailey Bridge over the Hewa Khola fell apart during its installation in June 2025, and the cause is believed to be a structural failure. This incident led to injuries for three workers.
8. **Jhimruk Khola Bridge:** In 2021, the Jhimruk Khola Bridge on the Dabra Majhidmar Road encountered a construction failure when its temporary staging and formwork collapsed before the prestressing stage was initiated.
9. **Trishuli Bridge, Masstar:** On April 17, 2021, construction of the Trishuli Bridge in Masstar was suddenly stopped as the incomplete structure could not endure the high-velocity winds and failed.
10. **Trishuli Bridge Dashdhunga:** At an unspecified time, the Trishuli Bridge in Dashdhunga failed during construction due to the influence of intense, high-velocity wind loads on the building.

11. **Solabang Khola Bridge:** The collapse of the Solabang Khola Bridge on the Rapti Highway in Rukum during 2021 occurred due to a critical failure of its supporting formwork and staging before the prestressing phase was conducted.
12. **Sunkoshi River Bridge:** In 2021, the Sunkoshi River Bridge in Nawalpurghat faced a collapse during construction as its staging and formwork failed before the structure was properly prestressed.
13. **Phuljor River Bridge:** While on the Lalbandi-Rampur Belbas Road in Sarlahi, the construction of the Phuljor River Bridge came to a halt in 2021 when its temporary support structures gave way unexpectedly.
14. **Lugreli Gad Bridge:** The Lugreli Gad Bridge is recorded to have collapsed in 2021 due to a breakdown of its formwork and staging system, although its exact location is not provided.
15. **Tamakoshi River Bridge:** A bridge being constructed over the Tamakoshi River in Ramechhap district suffered a collapse on June 22, 2025. This bridge was intended to connect wards within Manthali Municipality, but failed when a slab collapsed during the repair work.
16. **Sotang Khola Bridge:** On May 27, 2025, the Sotang Khola Bridge in Thakre Rural Municipality, Dhading, succumbed to structural damage caused by vibrations from nearby construction activities.

3.3 Design and Structural Failure (7.14%)

Fundamental design issues or structural weaknesses were the main reasons behind 4 of the 56 failures. This category includes cases where the engineering design was intrinsically flawed or structural elements failed under normal service conditions. The Lamgadi Bridge collapse, which occurred even before the bridge was opened to traffic, was attributed to a fundamental design flaw in its support system and a lack of adequate numerical simulation during the design phase (Adhikari et al., 2024).

1. **Lamgadi Bridge:** In February 2024, the Lamgadi Bridge, spanning the Seti River in Pokhara, fell before it could be opened to vehicles. The cause of its collapse was determined to be a critical design flaw in its support system and insufficient numerical simulation during the design phase (Adhikari et al., 2024).
2. **Kamala River Bridge:** In July 2021, during the monsoon floods, the Kamala River Bridge that connects Siraha and Dhanusha suffered from pillar settlement. This issue was linked to a foundation design that was inadequate to withstand the high-velocity water flow and resultant scour, ultimately failing one of the bridge's sections.
3. **Rudi Khola Bridge:** The collapse of the Rudi Khola Bridge, which links Lamjung and Kaski, led to a devastating bus accident with fatalities in July 2017. This incident was a direct consequence of foundation scour, exemplifying scour-induced failure.
4. **Larcha Bailey Bridge:** The Larcha Bailey Bridge in Sindhupalchok fell apart on February 20, 2018, just before its official public opening. The collapse was attributed to a critically weak foundation.

3.4 Overloading (5.36%)

Failures caused by vehicles exceeding the design load capacity accounted for 3 of the 56 incidents. While it's not as common, this continues to be an important issue on major highways where the enforcement of vehicle weight regulations is inadequate. The collapses of the Binayi Khola and Chormara bridges on the vital East-West Highway were both directly attributed to overloaded freight trucks.

1. **Binayi Khola Bridge:** On January 10, 2025, the Binayi Khola Bridge in Nawalparasi East gave way under the weight of an overloaded freight truck, causing traffic to come to a standstill on the East-West Highway, one of Nepal's key transport arteries.
2. **Chormara Bridge:** A separate failure due to overloading occurred in Nawalparasi East on May 12, 2025, when the Chormara Bridge collapsed under a 16-wheel trailer, necessitating a significant traffic detour on the East-West Highway.

3. **Punyamata Khola Bridge:** The Punyamata Khola Bridge, which connects Ward 1 and Ward 4 of Banepa Municipality in Kavre, collapsed on July 5, 2025. The failure is thought to stem from the excessive weight of heavy trucks, potentially exacerbated by the bridge's aging condition.

3.5 Other Causes (19.64%)

The remaining 11 incidents were attributed to a broad category of miscellaneous or external factors. This encompasses geological instability, like the landslide that led to the destruction of the Larcha Motorable Bridge, and vehicle accidents, which resulted in the downfall of the Baulaha River Bridge. This category underscores the diverse range of threats facing Nepal's bridge infrastructure beyond hydraulic and construction-related issues.

1. **Larcha Motorable Bridge:** The Larcha Motorable Bridge, located on the Araniko Highway in Sindhupalchowk, was destroyed by a landslide in July 2017, emphasizing the dangers posed by mountainous regions.
2. **Baulaha River Bridge:** The Baulaha River Bridge in Nawalparasi collapsed in December 2016 following a truck collision, an unforeseen incident that highlights the necessity for protective barriers and the resilience of infrastructure to withstand impact forces.
3. **Baitadi Bailey Bridge:** In 2023, the Baitadi Bailey Bridge on the Dilashaini-Karkale route failed due to damage from a landslide, causing major transportation disruptions.
4. **Sunkoshi River Bridge:** The Sunkoshi River Bridge in Khotang fell due to structural failure in April 2014, cutting off a critical link in connectivity.
5. **Janakpur Railway Bridge:** On February 28, 2024, the Janakpur Railway Bridge in Mahottari experienced failure, attributed to stress from track misalignment, resulting in the halting of cross-border rail services.
6. **Timang Khola Bailey Bridge:** In 2021, the Timang Khola Bailey Bridge on the Dumre-Besisahar-Chame-Manang Road was adversely affected by the substantial impact of a debris flow triggered by a landslide.
7. **Melamchi Bazar Bridge:** The Melamchi Bazar Bridge on the Melamchi-Nawalpur-Chautara Road was entirely lost on August 1, 2021, as it was completely swept away by a severe landslide-induced debris flow.
8. **Fatte Khola Bridge:** Found on the Melamchi-Fatte-Duvachaur Road, the Fatte Khola Bridge sustained considerable damage in 2021 when a debris flow resulting from a landslide struck the structure.
9. **Nakatte Bridge:** As an essential part of the Melamchi Drinking Water Project, the Nakatte Bridge was compromised in 2021 after being impacted by a debris flow caused by a landslide.
10. **Timbu Bridge:** Also, part of the Melamchi Drinking Water Project, the Timbu Bridge experienced damage in 2021 due to a powerful debris flow initiated by a landslide.
11. **Akase Bridge:** The Akase Bridge, which supports the Melamchi Drinking Water Project, suffered substantial damage in 2021 as a result of a debris flow caused by a landslide.

Table 1. Recorded Incidents of Bridge Failures in Nepal

SN	Bridge Name	Location	Date of Collapse	Cause	Source
1	Binayi Khola Bridge	Dumkibas, Nawalparasi East	10-Jan-2025	Overloaded freight vehicle	https://kathmandupost.com/national/2025/01/10/dumkibas-bridge-collapse-halts-traffic-on-east-west-highway
2	Chhabdi Khola Dovan Bridge	Chhabdi Khola, Tanahun	01-Jul-2021	Intense flood & narrow outlet	https://thehimalayantimes.com/nepal/temporary-provision-put-up-for-crossing-chhabdikhola-in-tanahun-district

SN	Bridge Name	Location	Date of Collapse	Cause	Source
3	Thimura Bridge	Chitwan	20-Apr-2021	Inadequate concrete strength	http://dx.doi.org/10.13140/RG.2.2.18178.20162
4	Mauwa River Bridge	Dhading District	01-Jul-2020	Floodwaters exceeding capacity	https://thehimalayantimes.com/nepal/reconstruction-of-bridge-swept-by-flooded-river-expedited-in-dhading
5	Kamala River Bridge	Siraha-Dhanusha	01-Jul-2021	Inadequate foundation design	https://english.khabarhub.com/2021/20/215761
6	Jabdighat Bridge	Bardiya District	14-Aug-2017	Contractor negligence	https://thehimalayantimes.com/business/contractors-negligence-responsible-collapse-jabdighat-bridge
7	Mahesh Khola Bridge	Dhading District	2019	Washout of falsework supports	https://iihr.org.np/bridge-failures-in-nepal-diagnosis-and-solutions
8	Trishuli River Bridge	Bagmati-Gandaki border	06-Apr-2021	Construction failure	https://kathmandupost.com/province-no-3/2021/04/06/under-construction-bridge-above-trishuli-river-collapses
9	Bhotekoshi Bailey Bridge	Tatopani border, Sindhupalchok	28-Sep-2024	River erosion	https://kathmandupost.com/national/2024/09/28/bhotekoshi-bailey-bridge-collapse-cuts-off-tatopani-trade-route-with-china
10	Marsyandi River Bridge	Bhoteodar-Bharate link	2012	Construction collapse	https://www.globalhighways.com/wh10/news/bridge-under-construction-collapses-nepal
11	Chormara Bridge	Kawasoti, Nawalparasi East	12-May-2025	Overloaded 16-wheel trailer	https://kathmandupost.com/gandaki-province/2025/05/13/transport-resumes-via-diversion-after-bridge-collapse-in-nawalparasi-east
12	Larcha Motorable Bridge	Sindhupalchok District	23-Jul-2017	Landslide	https://kathmandupost.com/national/2017/07/24/bridge-over-bhote-koshi-river-collapses-in-sindhupalchok
13	Rudi River Bridge	Lamjung-Kaski border	27-Jul-2017	Foundation failure	https://kathmandupost.com/national/2017/07/27/bus-falls-into-rudi-khola-as-bridge-gives-away-25-injured
14	Larcha Bailey Bridge	Sindhupalchok	20-Feb-2018	Weak foundation	https://kathmandupost.com/national/2018/02/21/larcha-bridge-topples-weeks-before-opening
15	Sandhi Stream Bridge	Barhabise Bazaar	18-Aug-2018	Flooding	https://kathmandupost.com/national/2018/08/20/bridge-swept-away-in-bahrabise-bazaar
16	Myardi River Bailey Bridge	Manang-Lamjung connection	23-Jun-2019	Flood damage	https://kathmandupost.com/gandaki-province/2019/07/24/delay-in-replacing-bridge-has-disrupted-movement-in-manang

SN	Bridge Name	Location	Date of Collapse	Cause	Source
17	Baulaha River Bridge	Devchuli-12, Nawalparasi	11-Dec-2016	Truck collision	https://thehimalayantimes.com/nepal/bridge-baulaha-river-collapses-trucks-impact
18	Tallo Bagar Bailey Bridge	Bheri River, Nalgad Municipality	20-Apr-2023	Construction collapse	https://kathmandupost.com/karnali-province/2023/04/20/two-dead-three-missing-in-bridge-collapse
19	Baitadi Bailey Bridge	Dilashaini-Karkale route	2023	Landslide damage	https://english.khabarhub.com/2023/25/327753
20	Sunkoshi River Bridge	Khotang District	09-Apr-2014	Structural failure	https://kathmandupost.com/miscellaneous/2014/04/09/bridge-over-sunkoshi-river-collapses
21	Punyamata Khola Bridge	Banepa Municipality, Kavre	05-Jul-2025	Overloading	https://nepalverifiednews.com/news/bridge-collapse-in-kavrepalanchowk-halts-traffic-i
22	Lamgadi Bridge	Seti River, Pokhara	02-Feb-2024	Inadequate design	https://aben.springeropen.com/articles/10.1186/s43251-024-00115-7
23	Pokhara Seti River Bridge	Ward 19-20, Pokhara Metro	08-Aug-2024	Foundation erosion from floods	https://myrepublica.nagariknetwork.com/news/flooded-seti-river-washes-away-a-bridge-in-pokhara-disrupting-transportation
24	Sindhuli Bailey Bridge	Sunkoshi River, Sindhuli	01-Oct-2024	Flooding	https://english.pardafas.com/heavy-rainfall-causes-severe-damage-to-bridges-in-sindhuli-disrupting-transportation
25	Tamakoshi River Bridge	Manthali Municipality, Ramechhap	22-Jun-2025	Construction Failure	https://kathmandupost.com/province-no-3/2025/06/22/under-construction-bridge-collapses-for-the-second-time
26	Seti River Bridge	Kaski District	15-Jun-2019	Monsoon scouring	https://doi.org/10.1016/j.istruc.2023.01.045
27	Sotang Khola Bridge	Thakre Rural Municipality, Dhading	27-May-2025	Structural damage from construction vibrations	https://nepalnews.com/s/society/bridge-collapse-shuts-prithvi-highway-in-dhading
28	Janakpur Railway Bridge	Mahottari District	28-Feb-2024	Track alignment stress	https://www.railwaygazette.com/infrastructure/nepal-india-rail-link-disrupted-by-bridge-failure/70009.article
29	Miteri (Friendship) Bridge	Timure, Rasuwagadhi	08-Jul-2025	Flash flood	https://thehimalayantimes.com/nepal/kailash-mansarovar-pilgrims-stranded-after-miteri-bridge-collapse-taan-urges-alternate-routes-visa-facilitation
30	Panchthar Bailey Bridge	Hewa Khola, Mechi Highway	11-Jun-2025	Structural failure during installation	https://thehimalayantimes.com/nepal/three-workers-killed-in-panchthar-bailey-bridge-collapse
31	Ratu Khola Bridge	Bardibas	13-Aug-2014	Foundation failure (pier settlement) due to flooding/scouring	https://dor.gov.np/home/page/dor-insight-volume-32

SN	Bridge Name	Location	Date of Collapse	Cause	Source
32	Bhapsi Khola Bridge	Along E-W Highway	In the past	Foundation failure due to excessive flooding/scouring	https://dor.gov.np/home/page/dor-insight-volume-32
33	Charnawati Khola Bridge	Along E-W Highway	In the past	Foundation failure due to excessive flooding/scouring	https://dor.gov.np/home/page/dor-insight-volume-32
34	Dudhaura Khola Bridge	Along E-W Highway	In the past	Foundation failure due to excessive flooding/scouring	DoR Insight (Volume 32) || Department Of Roads
35	Dholi Khola Bridge	Along E-W Highway	In the past	Foundation failure due to excessive flooding/scouring	DoR Insight (Volume 32) || Department Of Roads
36	Ghodaha Bridge	East-West Highway, Rupandehi	2021	Foundation failure (Completed Bridge)	DoR Insight (Volume 32) || Department Of Roads
37	Turiya Khola Bridge	East-West Highway, Rupandehi	2021	Foundation failure (Completed Bridge)	DoR Insight (Volume 32) || Department Of Roads
38	Lodari Khola Bridge	Road from Parsa to Chainpur	2021	Foundation failure due to flow concentration and scour	DoR Insight (Volume 32) || Department Of Roads
39	Sadi Khola Bridge	N/A	18-Aug-2018	Washed away by a flood	DoR Insight (Volume 32) || Department Of Roads
40	Jhimruk Khola Bridge	Dabra Majhidmar Road	2021	Failure to stage or formwork before prestressing	DoR Insight (Volume 32) || Department Of Roads
41	Trishuli Bridge, Masstar	Masstar	17-Apr-2021	Failure during construction due to high-velocity wind load	DoR Insight (Volume 32) || Department Of Roads
42	Trishuli Bridge Dashdhunga	Dashdhunga	Not specified	Failure during construction due to high-velocity wind load	DoR Insight (Volume 32) || Department Of Roads
43	Solabang Khola Bridge	Rapti Highway, Rukum	2021	Failure to stage or formwork before prestressing	DoR Insight (Volume 32) || Department Of Roads
44	Sunkoshi River Bridge	Nawalpurghat	2021	Failure to stage or formwork before prestressing	DoR Insight (Volume 32) || Department Of Roads
45	Phuljor River Bridge	Lalbandi-Rampur Belbas Road, Sarlahi	2021	Failure to stage or formwork before prestressing	DoR Insight (Volume 32) || Department Of Roads

SN	Bridge Name	Location	Date of Collapse	Cause	Source
46	Lugreli Gad Bridge	N/A	2021	Failure to stage or formwork before prestressing	DoR Insight (Volume 32) || Department Of Roads
47	Timang Khola Bailey Bridge	Dumre-Besisahar-Chame-Manang Road	2021	Damaged by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
48	Melamchi Bazar Bridge	Melamchi-Nawalpur-Chautara Road	01-Aug-2021	Washed away by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
49	Fatte Khola Bridge	Melamchi-Fatte-Duvachaur Road	2021	Damaged by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
50	Nakatte Bridge	Melamchi Drinking Water Project	2021	Damaged by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
51	Timbu Bridge	Melamchi Drinking Water Project	2021	Damaged by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
52	Akase Bridge	Melamchi Drinking Water Project	2021	Damaged by landslide-induced debris flow	DoR Insight (Volume 32) || Department Of Roads
53	Khaireini Bridge	Nepalthok, Koshi Basin	27-28 Sep 2024	Collapsed due to record-breaking extreme flooding	DoR Insight (Volume 32) || Department Of Roads
54	Triyuga River Bridge	Chaudandigadhi municipality-5, Udayapur	July 3, 2021	Structural failure due to flood	https://thehimalayantimes.com/environment/deluge-damages-bridge-in-udayapur
55	Foxingtar Bridge	Foxingtar, Koshi Basin	27-28 Sep 2024	Collapsed due to record-breaking extreme flooding	DoR Insight (Volume 32) || Department Of Roads
56	Sunkoshi Bridge, Nepalthok	Nepalthok, Koshi Basin	27-28 Sep 2024	Collapsed due to record-breaking extreme flooding	DoR Insight (Volume 32) || Department Of Roads

4. Discussion

The findings confirm that bridge collapses in Nepal are driven by a dual crisis: the country's harsh environmental conditions and systemic weaknesses in its engineering and construction practices. The prominence of hydraulic failures (39.29%) and construction-related failures (28.57%) warrants further interpretation in both global and local contexts.

Globally, hydraulic causes are the single largest contributor to bridge failures (Zhang et al., 2022). This study's findings align with this benchmark and confirm that Nepal's dynamic rivers pose a primary threat. Scour—the erosion of sediment near foundations—is a leading mechanism (Wang et al., 2017), and its risk is amplified by climate change-driven increases in severe flood events (Pregnolato et al., 2022). The failures of major highway bridges like Kamala and Mauwa suggest a systematic underestimation of these hydrological hazards.

The rate of construction failures in Nepal (28.57%) is consistent with the global average but is contextually more severe. Most collapses occur during the construction stage itself (Lee et al., 2013), often due to defective materials, techniques, or inadequate supervision. The dramatic, post-completion failure of the Jabdighat Bridge points not to minor errors but to fundamental deficiencies in quality control and regulatory enforcement. This is compounded by maintenance issues, where factors like corrosion can significantly shorten a bridge's lifespan (Biezma & Schanack, 2007).

The less frequent but still significant design failures (7.14%) highlight other weaknesses. These can stem from inadequate geotechnical investigation leading to poor foundation design (Neupane, 2016; Sigdel et al., 2021) or from inherent flaws in the structural concept, as seen in the internationally studied collapse of the Palau bridge (Burgoyne & Scantlebury, 2008). Similarly, overloading failures (5.36%) represent a critical threat, stemming from either acute events or gradual fatigue damage from cumulative stress cycles, which can lead to brittle fracture in aging structures (Ghosn & Moses, 1998; Nowak & Collins, 2012).

This study is constrained by its reliance on secondary data and a small sample size. Future work should prioritize forensic engineering investigations to build a more robust, standardized national failure database.

5. Conclusion and Recommendations

This study provides the first quantitative overview of motorable bridge failure causes in Nepal based on a systematic review of 56 incidents. The findings authoritatively establish that bridge collapses are driven by a dual crisis: hydraulic events (39.29%) and construction failures (28.57%). This combination of a harsh natural environment and systemic human miscalculation necessitates a comprehensive, interdisciplinary approach to enhance the resilience of Nepal's critical transport infrastructure.

Based on these conclusions, the following recommendations are proposed for engineers, policymakers, and infrastructure planners:

1. **Revise Hydrological Design Standards:**
    - Move beyond fixed design flood levels to embrace dynamic hydrological modeling that accounts for sediment transport, channel shifting, and climate change impacts.
    - Mandate the inclusion of robust river training works and scour protection as a non-negotiable standard for all new riverine bridge construction.
2. **Enforce Rigorous Construction Quality Assurance:**
    - Establish a system of independent, third-party quality audits at critical stages of all major bridge construction projects.
    - Strengthen pre-qualification standards for contractors to ensure technical proficiency and vet past performance, introducing direct accountability measures for failures caused by negligence.
3. **Enhance Engineering Design and Review Processes:**
    - Require independent peer reviews for the structural design of all bridges with significant span, complexity, or non-standard features.
    - Invest in national capacity building for advanced numerical modeling to better predict structural performance.
4. **Establish a National Bridge Management System:**
    - Develop a comprehensive national bridge inventory that includes design, construction, and condition data.
    - Implement a policy of regular, systematic inspections and structural health monitoring to address deterioration proactively.
    - Strictly enforce vehicle weight regulations with weigh-in-motion stations at strategic locations to prevent overloading.

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