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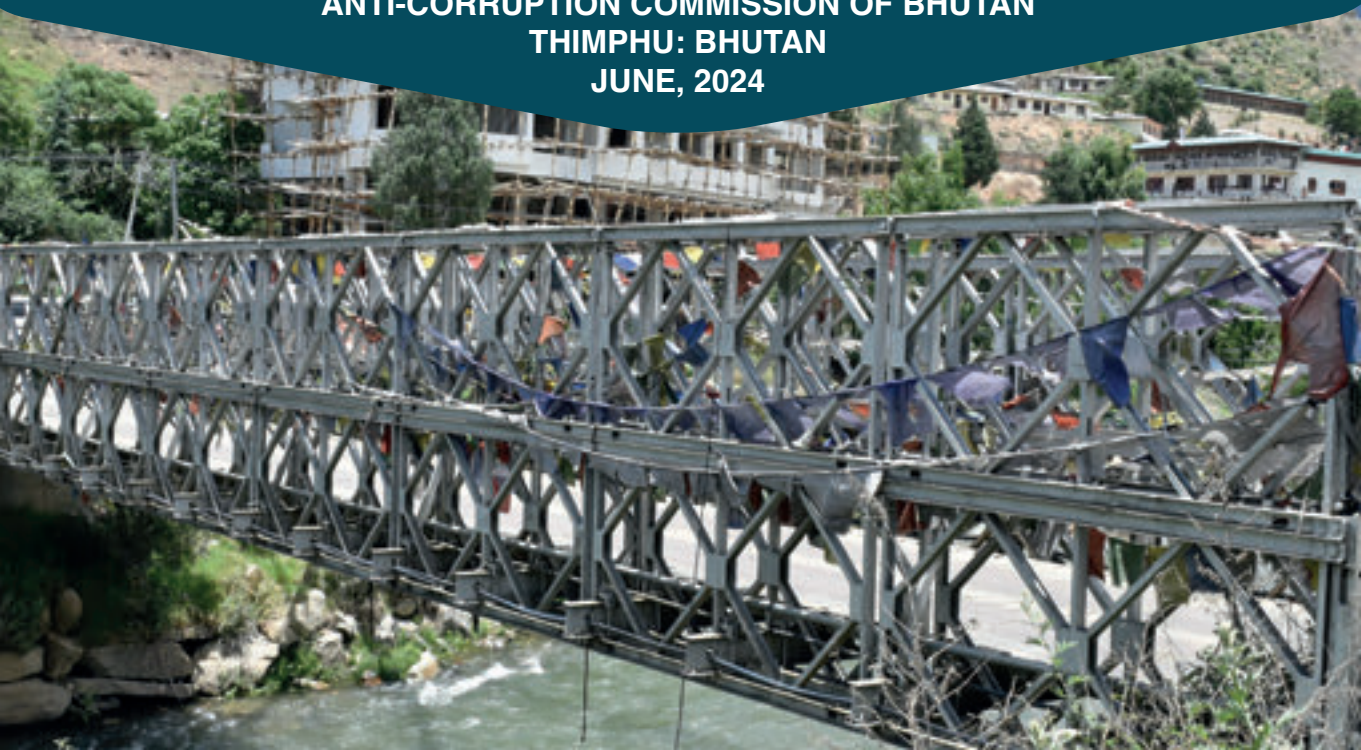
ACC
ANTI-CORRUPTION COMMISSION

System Study on Bailey Bridge Construction

ANTI-CORRUPTION COMMISSION OF BHUTAN
THIMPHU: BHUTAN
JUNE, 2024



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ANTI-CORRUPTION COMMISSION OF BHUTAN
THIMPHU: BHUTAN
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ANTI-CORRUPTION COMMISSION (ACC) BHUTAN

Anti-Corruption Commission of Bhutan is a constitutional body mandated to prevent and fight corruption in the country. Established on December 31, 2005, by Royal Decree, its mission is to tackle corruption by leading by example, achieving excellence in partnership, and mainstreaming anti-corruption measures in public or private organizations.

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About this Report

The system study report on Bailey Bridge construction was conducted to examine and review the processes, procedures, practices, and systems instituted for the planning, construction, and maintenance of Bailey Bridges in Bhutan.

Every effort was made to verify the accuracy of the information contained in this report. All information was believed to be correct as of June 2024.

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Lastly, we acknowledge the tireless efforts of our study team. Their dedication, thorough discussions, and reviews have been fundamental to the conduct of this study.

We hope the findings and recommendations presented in this report will help streamline the Bailey Bridge construction and maintenance system in the country.

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ABBREVIATIONS AND ACRONYMS

ACC	Anti-Corruption Commission of Bhutan
ANH	Asian National Highway
BoQ	Bill of Quantities
CBF	Competency-Based Framework
DLP	Defect Liability Period
DoST	Department of Surface Transport
DT	Dzongkhag Tshogdu
GT	Gewog Tshogde
ISO	International Organization for Standardization
LG	Local Government
MoAF	Ministry of Agriculture and Forests
MoF	Ministry of Finance
MoIT	Ministry of Infrastructure and Transport
MT	Metric Tons
NGOs	Non-Governmental Organizations
OIP	Organizational Integrity Plan
PNH	Primary National Highway
PRR	Procurement Rules and Regulations
RAA	Royal Audit Authority
RBMP	Routine Bridge Maintenance Plan
SBD	Standard Bidding Documents
SNH	Secondary National Highway
SOP	Standard Operating Procedure

"The highest probable risk to development that I foresee is corruption. Our national development efforts will be hindered by unchecked corruption. The formulation of plans and programs may be done well, aimed at the wellbeing of the people of the people. Impressive amount of budget may be disbursed in line with these plans. But as the activities become too numerous, oversight and monitoring may fall short, allowing some people to be corrupt. Although a large amount of resources are spent, projects may not accomplished as designed and quality of the projects may suffer seriously. At the end, such activities may become a matter of regret and disillusionment for the people and immense loss for the government and the country".

- His Majesty the King
107th National Day Address – 17th December 2014

EXECUTIVE SUMMARY

The construction of motorable bridges in Bhutan began as early as 1959 with the construction of the Phuentsholing-Thimphu National Highway. Since then, the Department of Surface Transport (DoST) has established and managed a network of roads and bridges in the country. Apart from the DoST, various agencies construct and maintain the country's roads and bridges, as per the Road Rules and Regulations of the Kingdom of Bhutan 2016 and the Road Classification and Network Information of Bhutan 2020.

The Corruption Vulnerability Assessments of Public Services conducted by the ACC, revealed that Bhutan's public procurement sector is one of the high-risk areas vulnerable to corruption. Further, irregularities, lapses, and cases of fraud and corruption in public procurement were revealed by the Annual Audit Reports (2016-2023). Bailey Bridge construction, being a part of public procurement, was selected for the study to proactively review and streamline the processes of Bailey Bridge construction and maintenance in light of several Bailey Bridge collapses in the country in recent times. The study was aimed at determining potential corruption risks or systemic lapses in the Bailey Bridge construction process and providing corrective measures, if any.

The study was conducted by reviewing relevant documents and interviewing officials from DoST and the Dzongkhag Engineering Sectors. For further validation, field visits to the relevant agencies and bridge construction sites were also made. The findings were then discussed and validated with the relevant stakeholders.

The study examined the planning, tendering, construction, and maintenance processes and procedures of Bailey Bridges. The study generally noted adequate overall processes, procedures, and systems in Bailey Bridge construction. However, the study identified some areas that warrant improvement. While these findings do not necessarily indicate the prevalence of corruption, not addressing these issues may create breeding grounds for corrupt practices in the Bailey Bridge construction process.

The recommendations in this report are neither exhaustive nor intended to be prescriptive. The ACC encourages the relevant agencies to carefully review these recommendations and implement them based on

their institutional priorities, resources, and other considerations. Table 1 presents an overview of the findings and recommendations.

Table 1. Matrix of Findings and Recommendations

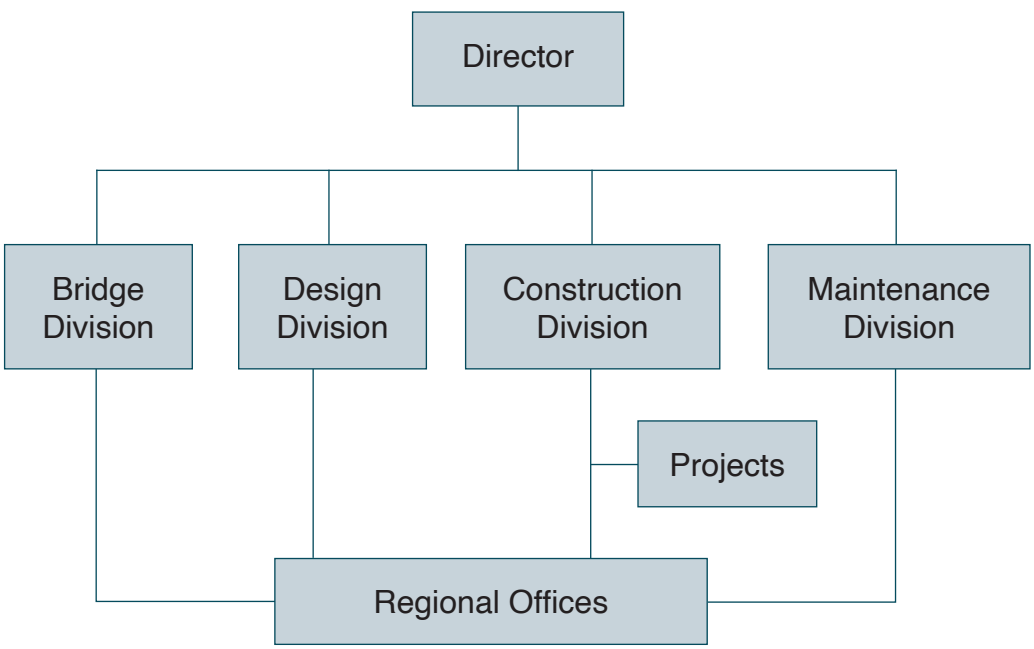
SN	Findings	Recommendations
1	Competencies for key technical personnel	a. Develop a Competency-Based Framework (CBF) for Bridge engineers. b. Standardardize competency requirements for key technical personnel for Bailey Bridge constructions.
2	Quality control of Bailey Bridge parts	a. Insert provision of pre-delivery inspection at the manufacturing yard in the SBD. OR b. Explore the possibility of setting up laboratories/ facilities for testing the Bailey Bridge parts in the country. DoST may collaborate with Bhutan Standards Bureau (BSB) for standards on materials and in-country testing facilities.
3	SOP for Bailey Bridge launching	Develop and implement SOP for Bailey Bridge launching.
4	Routine inspection and maintenance of Bailey Bridges	a. The Dzongkhag Engineering Sectors should include routine inspection and maintenance of bridges under their purview in their annual plans and implement accordingly. A maintenance log can be maintained for every Bailey Bridge. b. The DoST should maintain inventory of all the Bailey Bridges in the country with records of construction date, maintenance log and life span. The DoST should also have regulatory functions over all the Bailey Bridges in the country in terms of technical standards, capacity building of engineers, and monitoring and evaluations. c. Local government (DT and GT) may also be involved in monitoring the maintenance of Bailey Bridges as part of social accountability. NGOs like Bhutan Transparency Initiative (BTI) may also be involved in such social accountability measures.
5	Overloading issues	a. Conduct sensitization to transportation firms or explore other means of addressing the issue. b. Strict enforcement and penalties for non-compliances to load limit. Local government authorities or communities can be involved in monitoring and reporting the non-compliances.

1 INTRODUCTION

Bridges play a vital role in connecting communities and enabling accessibility to essential services thereby helping economic growth and development. The construction of motorable bridges in Bhutan began as early as 1959 with the construction of the Phuentsholing-Thimphu National Highway. The Bhutan Road Project was the first office in 1959 to construct roads in the country. It was renamed as the Bhutan Engineering Services in 1961, then the Public Works Department in 1979, then the Department of Roads in 2000, and currently the Department of Surface Transport (DoST) with the Civil Service Reform Act of Bhutan 2022.

The Department's vision is to construct and maintain a safe, reliable, and excellent network of climate-resilient road infrastructure in the country. It constitutes four functional divisions at the headquarters and nine regional offices. The Department organogram is shown in Figure 1.

Figure 1. Organogram of the Department of Surface Transport



Over the years, the Department has established an extensive network of roads in the country. Within this road network exist crucial bridges that ensure smooth and continuous transportation. The roads and bridges on the national highways are constructed and maintained by the Department's Bridge Division. The Bridge Division is responsible for planning, designing, monitoring, and maintaining the bridges under its jurisdiction and providing technical support to other agencies.

Apart from the Bridge Division, various agencies construct and maintain the country's roads and bridges, as per the Road Rules and Regulations of the Kingdom of Bhutan 2016 and the Road Classification and Network Information of Bhutan 2020, as shown in Table 2.

Table 2. Agencies responsible for construction and maintenance of roads and bridges

SN	Classification of Roads	Construction and Maintenance Responsibility
1	National Highway (ANH, PNH & SNH)	The Department of Surface Transport.
2	Dzongkhag Road (Dzongkhag and Gewog Centre Roads)	Dzongkhag/Dungkhag/Gewog Administration.
3	Thromde Road	Thromde.
4	Farm Road	Concerned LG.
5	Access Road (Forest, Health, Education, Telecommunication, Hydro Power, Public Institution, and Private)	Concerned agencies/ communities/ individuals.

According to the Ministry of Infrastructure and Transport (MoIT)'s Annual Information Bulletin 2022, there are 12 different types and 382 motorable bridges in the country, of which 170 (44.5%) are Bailey and Bailey Suspension Bridges (Details attached in Annexure 1).

Bailey Bridges are prefabricated steel bridges with a single-lane carriageway width of 3.277 meters and a general 24 Metric Tons (MT) load-carrying capacity. Most bridges in Bhutan are Bailey Bridges because they were constructed in the past when traffic was less and there was limited expertise in bridge engineering and construction. Bailey Bridges are also cheaper and can be constructed more quickly than permanent bridges.

However, Bailey Bridges have several disadvantages, such as their limited load-carrying capacity of only 24MT mostly, with few up to 40MT.

With technological development and emerging needs, the load-carrying capacities of trucks plying on our roads have increased drastically, outperforming the capacities of our Bailey Bridges, which have now become a bottleneck to economic development as well as concerns for the safety of commuters. Likewise, ordinary Bailey Bridges come with only a single lane, limiting the passage of two vehicles at a time. In addition, Bailey Bridges can only be used for a short period as their design life span is generally less than 25 years.

Bailey Bridges are still used on Gewog and Farm Roads while on national highways, the Department is replacing them with permanent bridges. Almost all bridge constructions are executed under contract. In the past, under unavoidable circumstances, such as when the contracts were terminated, and there was urgency to complete the balance work, the Department stepped in and completed the work.

1.1 Rationale

Often corruption is attributable to systemic lapses, and non-compliance to regulatory requirements which corrupted government officials exploit for personal gain. Therefore, it is imperative to proactively review the processes, procedures, and systems to plug the loopholes in the system.

The public procurement sector in Bhutan is one of the high-risk areas vulnerable to corruption, as revealed by the Corruption Vulnerability Assessments of Public Services conducted by the ACC in 2023. The Annual Audit Reports (2016-2023) also revealed irregularities, lapses, and even instances of fraud and corruption amounting to Nu. 42.642 million in bridge construction works, of which Nu. 25.704 million were related to Bailey Bridges (Details in Annexure 2).

In the recent past, Bhutan witnessed several Bailey Bridge collapses causing loss of lives and injuries, among other issues. A desk review of Bailey Bridge collapses from the media reports revealed that some collapses occurred during the launching or construction process. Others occurred due to overloading and flash floods (Summary attached in Annexure 3). Such collapses lead to the resource drain and disruption of essential services. The recurring bridge collapses can also undermine public trust in our infrastructures.

Therefore, this study provides an opportunity to review and streamline the existing processes of Bailey Bridge construction and maintenance in

collaboration with the relevant stakeholders, and bring about improvement in the quality of our Bailey Bridge construction process.

1.2 Mandate

The Anti-Corruption Commission is mandated by the Constitution of the Kingdom of Bhutan and the Anti-Corruption Act of Bhutan 2011 to take necessary steps to prevent and combat corruption in the Kingdom.

Further, Section 25 (1) b) of the Anti-Corruption Act of Bhutan 2011 stipulates that one of the Commission's functions is to examine the practices, procedures, and systems of public or private sector entities to facilitate the discovery of offenses under Chapter 4 of this Act and to secure the revision of such practices, procedures, or systems which in the opinion of the Commission, may be conducive to corruption.

1.3 Objective

This system study aims to proactively review the process and procedures instituted for Bailey Bridge construction in Bhutan to determine potential corruption risks or systemic lapses and provide corrective measures, if any.

1.4 Scope of the Study

The study examined the system, processes, procedures, and practices of Bailey Bridge planning, construction, and maintenance by the Department of Surface Transport and the local governments in Bhutan.

1.5 Study Methodology

1.5.1 Documents Analysis

For the study, the following documents were reviewed and analyzed:

- Road Act of Bhutan 2013;
- Road Rules and Regulations of The Kingdom of Bhutan 2016;
- Road Classification and Network Information of Bhutan 2020;
- Annual Information Bulletin 2022;
- Reference Manual, Bridge 2005;
- General Specifications for Bridges 2015;
- Investigation Reports for sampled bridge collapse;
- Media reports on collapsed bridges;

- Other relevant reports, manuals, documents, and media reports.

1.5.2 Semi-Structured Interviews

The semi-structured interview method was used to obtain specific information on the process of Bailey Bridge construction from critical stakeholders, such as the Department of Surface Transport, the Bridge Division, Regional Offices, and the Dzongkhag Engineering Sectors.

Table 3. Offices visited

SN	Name of office/place	Date
1	Bridge Division, DoST	01/04/2024 and 24/04/2024
2	Regional Office, DoST, Lobeysa	11/04/2024
3	Regional Office, DoST, Phuentsholing	17/04/2024
4	Samtse Sub-Division, DoST	19/04/2024
5	Dzongkhag Engineering Sector, Samtse	19/04/2024
6	Dzongkhag Engineering Sector, Thimphu	25/04/2024
7	Tongchhudra Bailey Bridge construction site	10/05/2024

The interviewees were selected using purposive sampling to gain a comprehensive understanding of the processes and procedures. The participants were selected purposively based on key officials providing the services. The team developed an interview guide to facilitate the smooth conduct of the interviews. The responses were recorded and then transcribed for analysis.

1.5.3 Site Visit

The team also visited the ongoing Bailey Bridge construction sites at Tongchhudra, Gasa, to interview the site engineer and the contractor.

1.5.4 Data Analysis

The quantitative data collected from the field were analyzed in Microsoft Excel. The qualitative data was analyzed using content analysis methods in consultation with the Evaluation and Assessment Division, Department of Prevention and Education, ACC.

1.5.5 Reporting

The data collected were compiled and analyzed, based on which the findings were derived. The findings were then discussed and validated with the relevant stakeholders. After the validation, recommendations were proposed for implementation by the relevant agencies to improve the systems, processes, and procedures.

2 BAILEY BRIDGE CONSTRUCTION PROCESS

The Bailey Bridge construction process followed by the DoST and Dzongkhag Engineering Sector comprises three key phases: planning, work execution, and monitoring as discussed below.

2.1 Planning

The planning process includes site identification, feasibility study, design and drawing, and preparing Bill of Quantities (BoQ) and cost estimates. Wherever there is a need for bridges, the Regional Offices of the DoST propose a feasibility study involving the Bridge Division. An Environmental Impact Assessment (EIA) is not required for short-span bridges like Bailey Bridges because the area is concentrated in a particular small area. However, environmental clearance is sought from the Department of Environment and Climate Change after conducting an Initial Environment Examination (IEE).

The Bridge Division selects bridge types based on the General Specifications for Bridges, 2015, and the Bridge Reference Manual, 2005. It is based on factors such as the span of the bridge, constructability, and construction and maintenance cost. After selecting the bridge type, the Bridge Division prepares the design and drawing, and BoQ of the bridge. It is then submitted to the Regional Offices which carry out the rate analysis and prepare the cost estimates. Then, the tender documents are processed to procure the bridge parts and contractors.

Regarding the local governments (Dzongkhags and Gewogs), the Dzongkhag Engineering Sectors undertake the bridge construction works. However, since the Dzongkhag Engineering Sectors do not have expertise in bridge construction, they seek assistance from the DoST for feasibility studies, design, and drawing. Previously, the Ministry of Agriculture and Forests (MoAF) used to design and draw short-span bridges on farm roads. Dzongkhag prepares the BoQ and cost estimates based on the design and drawing.

2.2 Execution

The execution includes procuring contractors and Bailey Bridge parts, constructing the foundation/abutment, and launching the bridge.

After completing the design works and securing the funds for the construction, the Department invites bids for the construction of the bridge foundation/abutment and procurement of bridge parts through the Open Tendering Method as per the Procurement Rules and Regulations (PRR). If there is limited time, the Limited Tendering Method is followed. The Bridge Division tenders the works above Nu. 100 million, and the regional offices tender and contract for works below Nu.100 million. The Dzongkhag Engineering Sector does the tendering for bridge construction works in Dzongkhags.

Generally, the work for launching the bridge is clubbed with the main contract for constructing the bridge foundation/abutment. Due to the limited expertise and experience of the contractors, it is up to the contractor whether to launch the bridge by themselves or hire experienced firms like Construction Development Corporation Limited. Bridges, unlike other structures, require strict criteria regarding qualification and experience for recruiting contractors and engineers. In the Department's procurement, bids for the construction of bridge foundations/abutments and procurement of bridge parts are invited separately. Conversely, Dzongkhags sometimes tender the construction of bridge foundations/abutments and procurement of bridge parts together. While national contractors work on bridge foundations, Bailey Bridge parts are manufactured and supplied mainly through Indian manufacturers/suppliers.

So far, the Department has procured Bailey Bridge parts from six manufacturing firms, all based in Kolkata, India (List in Annexure 4). These firms are certified by the Ministry of Defense of India and certified in IS0 9001:2015 Quality Management System. The Dzongkhags are also required to procure Bailey Bridges from these firms. The Department calls for proposals from these firms by specifying the span, number of parts, and other components. Then, these firms submit the proposals, and the contract is awarded to the lowest evaluated bidder.

After awarding the contract, the Department goes for a pre-delivery inspection at the manufacturing yard while the bridge parts are still being manufactured for quality assurance. The firm cannot instruct the officials to inspect pre-selected parts. The officials randomly choose

the parts for inspection and conduct a trial assembly of the parts. After manufacturing, the firm transports the bridge parts to the Central Store, DoST, in Phuentsholing. The officials at the Central Store inspect the bridge parts randomly and then only accept them. From there on, the relevant stakeholder (Either the Department/Dzongkhag/Contractor) transports the bridge parts to the construction site for launch when the bridge foundation/abutment is completed. The emergency bridge parts are stored at the storage facilities at the regional offices to be used in times of emergency.

Upon completion of the foundation/abutment, the Bailey Bridge is launched which is done according to the general guidelines outlined in the manufacturer's technical manual. The project engineers also formulate a launching plan and form a team of experienced manpower. After launching, load testing is done, and only then is the bridge opened for public utilization.

2.3 Monitoring and Maintenance Process

As per Section 4 of the Road Rules and Regulations 2016, "Subject to the overall monitoring by the Department, the management, development, rehabilitation, and maintenance of the:

1. Thromde Roads, including access roads, shall vest in the Thromde Administration;
2. Dzongkhag Roads, including access roads, shall vest in the Dzongkhag Administration; and
3. Farm Roads, including access roads, shall vest in the Gewog Administration."

During the foundation/abutment construction, experienced engineers are deployed at the site for monitoring and supervision. Sometimes, a Project Implementation Unit is set up for full-time supervision. The Department and the local governments are mandated to conduct monitoring/inspection during the service life of the bridges. The Department carries out three types of monitoring/inspection of the bridges: routine, periodic (After monsoon), and special inspection (After damage is reported).

Routine inspection/maintenance of the bridges is essential to maintaining their structural health. The Regional Offices maintain Bailey Bridges per the Routine Bridge Maintenance Plan (RBMP). Subsequently, the Bridge Division monitors and verifies the execution of maintenance works as

per the plan. The Bridge Division has developed a format for routine maintenance and circulated it to all the Regional Offices for implementation. The activities involved in routine maintenance are given in Table 4.

Table 4. RBMP activities and frequency

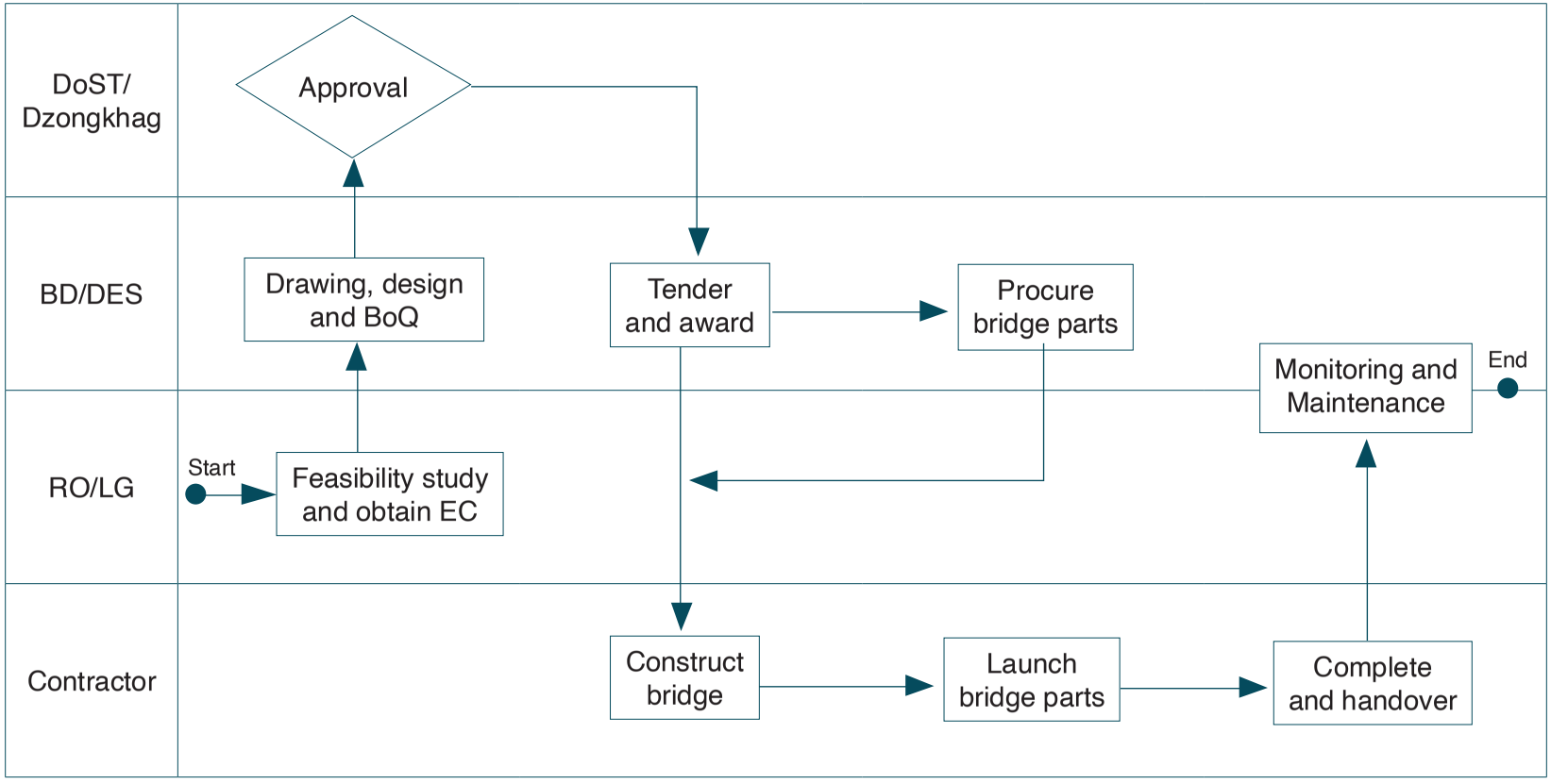
SN	Activities	Frequency
1	Cleaning of deck, footpaths, kerb beams, railings, expansion joints, drainage spouts, sign boards, etc.	4 times/year
2	Cleaning and greasing of bearings along with cleaning of bearing seats and stem cap	2 times/year
3	Vegetation clearance near the bridge	3 times/year
4	Railing repainting	1 time/year
5	Tightening of Bolts	2 times/year
6	Minor repainting	1 time/year

Moreover, the DoST has a Bridge Maintenance System that maintains the inventory of the bridges under its jurisdiction and records past maintenance works.

On the other hand, the Dzongkhag Engineering Sectors do not conduct routine inspection and maintenance of the bridges under their jurisdiction. They conduct inspections whenever they receive complaints from the public and when the bridges are affected by natural disasters. They request technical assistance from the DoST if necessary. Moreover, they do not get separate budget for bridge maintenance activities.

Figure 2 gives the overall process of planning, tendering, construction, and monitoring/maintenance of Bailey Bridges.

Figure 2. Bailey Bridge construction and maintenance process



Abbreviation: DoST: Department of Surface Transport; BD: Bridge Division; DES: Dzongkhag Engineering Sector; RO: Regional Office, DoST; LG: Local Government; BoQ: Bill of Quantities; EC: Environmental Clearance

3 FINDINGS AND RECOMMENDATIONS

The study has identified five critical findings related to the procurement, construction, and maintenance of Bailey Bridges. The recommendations under each finding aim to address the inconsistencies and enhance the overall Bailey Bridge management.

3.1. Competencies for Key Technical Personnel

It was found that both the DoST and the Dzongkhags follow the public procurement methods as per the PRR. In most cases, the open tendering method is used. However, there were no standard criteria for recruiting key technical personnel such as project/site engineers as evident from the requirements specified by Dzongkhags and DoST. The project/site engineers are pivotal for the safe and timely construction of bridges. Their expertise is a must, especially during the launching of Bailey Bridges. Therefore, it is imperative to recruit well-experienced engineers to ensure the successful construction and launching of Bailey Bridges. The key technical personnel are evaluated based on their qualifications and similar work experience. Tables 5 and 6 give samples of evaluation criteria for critical technical personnel for Dzongkhag and DoST.

Table 5. Sample of evaluation criteria for key technical personnel (Dzongkhag)

Tier	Position	Qualification and Experience	Score
Tier I	Project Manager	Bachelor's degree in civil engineering with minimum 5 years of experience OR bachelor degree in any other field with 8 years of experience in construction site	50
Tier II	Site Engineer	Bachelor's degree in civil engineering with minimum 3 years of experience in bridge work OR diploma in civil engineering with minimum of 5 years of experience in bridge work.	30
Tier III	Site Supervisor	VTI in civil, pass out from recognized institute with minimum of 3 years working experience in infrastructure work.	20

Table 6. Sample of evaluation criteria for key technical personnel (DoST)

Tier	Position	Qualification	Score
Tier I	Project Engineer	Bachelor's Degree in Civil Engineering with more than 7 years of experience in bridge construction OR Diploma in Civil Engineering with more than 10 yrs. experience in bridge construction	50
		Bachelor's Degree in Civil Engineering with more than 5 years of experience in bridge construction OR Diploma in Civil Engineering with more than 8 yrs. Experience in bridge construction	35
		Bachelor's Degree in Civil Engineering with 3-5 years of experience OR Diploma in Civil Engineering with 8 yrs. experience	20
		Bachelor's Degree in Civil Engineering with less than 3 and more than 1 years OR Diploma in Civil Engineering less than 5 yrs. And more than 2 of experience.	15
		Bachelor's Degree in Civil Engineering with less than 1 years OR Diploma in Civil Engineering less than 2 of experience.	10
		Any other level of qualification or experience	0
Tier II	Project Manager	Bachelor's Degree with 5 years of experience in OR Diploma with 8 years of experience.	30
		Bachelor's Degree with 3-5 years of experience OR Diploma with 5-7 years of experience	20
		Diploma with 3-5 years of experience	5
		Diploma less than 3 years of experience	3
		Any other level of qualification or experience	0
Tier III	Work Supervisors	VTI graduate(civil) 7 yrs. experience or Class XII with more than 10 years of experience	10
		VTI graduate(civil) 5 yrs. experience or Class X with more than 7 years of experience	5
		VTI graduate or Class X with less than 3 years of experience and Class X with 5 yrs. experience	3
		Any other level of qualification or experience	0
Tier III	Work Supervisors	VTI graduate(civil) 7 yrs. experience or Class XII with more than 10 years of experience	10
		VTI graduate(civil) 5 yrs. experience or Class X with more than 7 years of experience	5
		Any other level of qualification or experience	0

As shown in Tables 4 and 5, the evaluation criteria for the years of experience of the technical personnel are inconsistent between Dzongkhags and DoST. Likewise, the Zamdong Bailey Bridge collapse investigation report in Zhemgang showed that the procuring agency had not set the required criteria for recruiting key technical personnel (Project Engineer). The qualification criteria were a Bachelor's Degree in Civil Engineering or a Diploma in Civil Engineering with a minimum of 3 years of working experience. It led to awarding the work to a contractor who recruited an engineer claiming to have constructed several Bailey Bridges in the country. However, upon investigation, it was found that the engineer had experience constructing Bailey Bridges with relatively shorter spans.

Based on the above findings, the study recommends the following:

Recommendation 1:

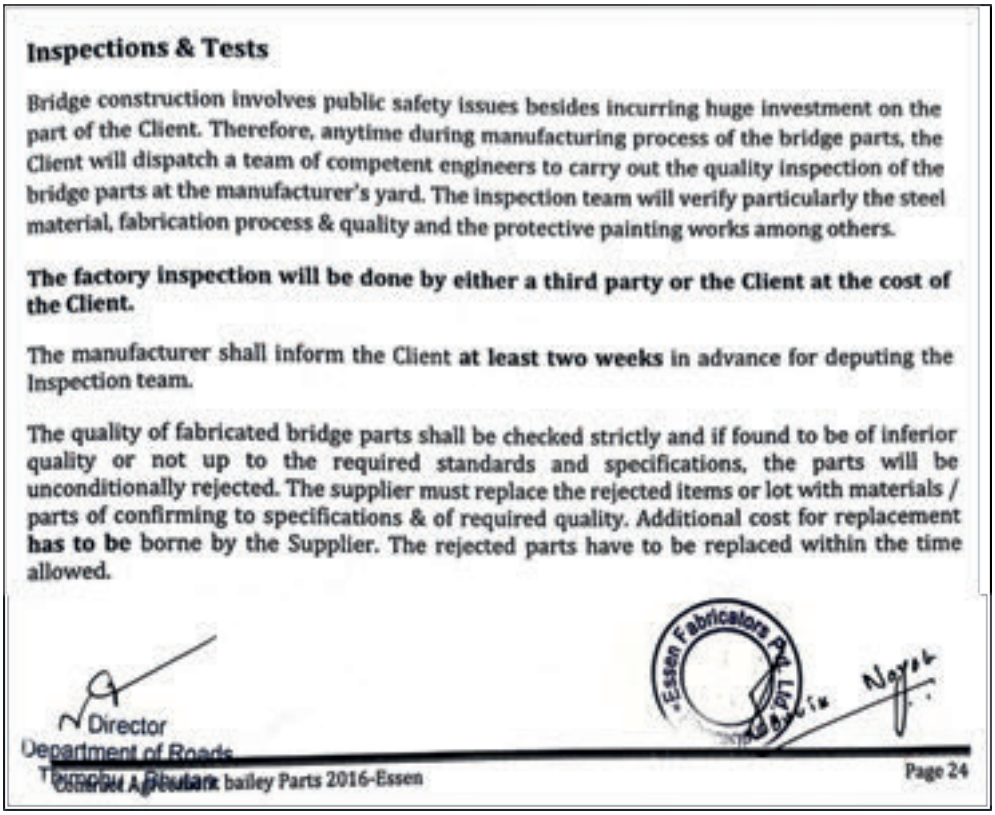
a. Develop a Competency-Based Framework (CBF) for Bridge engineers. Based on the CBF, the DoST, as the competent agency, should develop the technical capacities of all its engineers, Dzongkhag engineers, and private engineers on Bailey Bridge construction and launching.

b. Implement standard competency requirements for key technical personnel for Bailey Bridge constructions. The minimum years of experience and qualification in the relevant field should be standardized for all Bailey Bridge constructions in the country. Moreover, the key technical personnel should be evaluated based on prior experience of launching Bailey Bridges of a span equal to or greater than the span specified in the contract. The DoST should incorporate it in the Standard Bidding Documents (SBD).

3.2. Quality Control of Bailey Bridge Parts

The contract agreement with the manufacturers specifies the requirement for conducting a pre-delivery inspection of the Bailey Bridge parts at the manufacturing yard (Sample in Figure 3). The primary purpose of the pre-delivery inspection is to ensure that the quality of the bridge parts being manufactured and supplied is not compromised. The DoST uses a checklist and technical devices to inspect whether the bridge parts are manufactured according to the technical specifications.

Figure 3. Sample for the requirement of pre-delivery inspection in the contract agreement



Inspections & Tests

Bridge construction involves public safety issues besides incurring huge investment on the part of the Client. Therefore, anytime during manufacturing process of the bridge parts, the Client will dispatch a team of competent engineers to carry out the quality inspection of the bridge parts at the manufacturer's yard. The inspection team will verify particularly the steel material, fabrication process & quality and the protective painting works among others.

The factory inspection will be done by either a third party or the Client at the cost of the Client.

The manufacturer shall inform the Client **at least two weeks** in advance for deputing the Inspection team.

The quality of fabricated bridge parts shall be checked strictly and if found to be of inferior quality or not up to the required standards and specifications, the parts will be unconditionally rejected. The supplier must replace the rejected items or lot with materials / parts of confirming to specifications & of required quality. Additional cost for replacement **has to be** borne by the Supplier. The rejected parts have to be replaced within the time allowed.

Director
Department of Roads
Thimphu, Bhutan

Essen Fabricators Pvt. Ltd.

Contract Agreement bailey Parts 2016-Essen Page 24

However, the study also came across a case in Dzongkhag where the contractor was awarded the procurement of Bailey Bridge parts, and the pre-delivery inspection at the manufacturing yard was not conducted. Failure to carry out pre-delivery inspection can lead to the procurement of substandard bridge parts, undermining the bridge's life span.

Recommendation 2:

a. The DoST, in collaboration with the Ministry of Finance (MoF), should insert the provision of pre-delivery inspection at the manufacturing yard in the SBD. All concerned entities (Procuring agency and contractor) should conduct pre-delivery inspections of bridge parts at the manufacturing yard. This is to ensure that quality standards are met before the Bailey Bridge parts are transported and assembled on-site. OR

b. The DoST may explore the possibility of setting up laboratories/facilities for testing the Bailey Bridge parts in the country. DoST may collaborate with Bhutan Standards Bureau (BSB) for standards on materials and in-country testing facilities.

3.3. Standard Operating Procedure (SOP) for Bailey Bridge Launching

The study found that a standard process for Bailey Bridge launching in the country was lacking. Currently, the contractors and engineers rely on the general technical manual provided by the manufacturers although there is a requirement to develop a launching plan. The launching plan differs based on the span of the bridge. In general, the launching process includes the installation of rollers, assembling the bridge parts on one end of the gorge/river, adding counterweights, and pushing the assembled parts to the other end. The bridge parts are installed and assembled manually, whereas excavators push the bridge.

The lack of a standard process poses the risk of the bridge failing during the launching process, such as the collapse of the Zamdong Bailey Bridge. In this unfortunate event, the engineer lost his life. The investigation report cited the following probable causes:

i. Insufficient counterweight to counteract the weight of the bridge over the gap
ii. Error in the erection of the launching nose
iii. Lack of launching plan and launching team
iv. Poor supervision by the procuring agency during launching.

Recommendation 3:
The DoST, in collaboration with the Dzongkhag Engineering Sectors, should develop an SOP for the Bailey Bridge launching. All agencies undertaking Bailey Bridge construction should comply with the SOP. Developing an SOP for Bailey Bridge launching can streamline the process, reduce errors, and ensure consistency across the country.

3.4. Routine Inspection and Maintenance of Bailey Bridges

Periodic inspection of bridges is essential for maintaining their structural health and ensuring safe and uninterrupted traffic flow. Therefore, regular inspection by well-qualified and adequately experienced engineers is critical.

The study team visited two Dzongkhag Engineering Sectors and found that, unlike the DoST, they do not have routine bridge inspection and maintenance plans or practices. The inspection and maintenance are done reactively, i.e., conducted only when they receive complaints from

the public or instructions from the ministry. If there are significant structural damages or issues beyond their capacity, they seek assistance from the DoST. Some of the reasons cited for not carrying out routine inspection and maintenance are lack of expertise and budget constraints.

The DoST is going to take over the Dzongkhag and Gewog Center roads, but the farm and access roads will still remain with the respective local governments. The DoST has been conducting inspections and maintenance as per the RBMP. Likewise, the Dzongkhag Engineering Sectors are also encouraged to institute such systems.

In addition, the study also found some limitations in the existing method of inspection and maintenance. The existing method includes visual inspection of the bridge parts and minor maintenance like greasing, painting, cleaning, and tightening nuts and bolts. However, some parts of large bridges are inaccessible manually, particularly the bottom parts. In such cases, there are risks of bridge failures if left without maintenance for a long time. Therefore, such limitations underline the need for specialized or mechanized inspection and maintenance methods.

Recommendation 4:

a. The Dzongkhag Engineering Sectors should include routine inspection and maintenance of bridges under their purview in their annual plans and implement them accordingly. A maintenance log should be maintained for each bridge. Assistance from the DoST may be sought as and when required.

b. The DoST should maintain an inventory of all the Bailey Bridges in the country with records of construction date, maintenance log, and life span. The DoST may explore the possibility of leveraging technology for the inspection and maintenance of Bailey Bridges. The DoST should also have regulatory functions over all the Bailey Bridges in the country in terms of technical standards, capacity building of engineers, and monitoring and evaluations.

c. Local government (DT and GT) may also be involved in monitoring the maintenance of Bailey Bridges as part of social accountability. NGOs like the Bhutan Transparency Initiative (BTI) may also be involved in such social accountability measures.

3.5. Overloading Issues

The study analyzed 12 cases of Bailey Bridge collapses from 2011 to 2023 (List in Annexure 3), out of which four were due to overloading. The

study found that collapses due to overloading occur mainly due to the transporters' non-compliance with the bridges' weight limit. The DoST has made it mandatory to install sign boards showing the weight limit, speed limit, and arrows for diversion routes, if any, on both ends of all the bridges in the country. The transporters either do not weigh their vehicles or, even if they weigh, ignore the bridge's weight-carrying capacity. In one such case, a diversion route was explicitly made for heavy vehicles, but the driver chose not to take the route.

As per Section 327 of the Road Safety and Transport Regulations 2021, driving a motor vehicle carrying a load more than the load limit of bridges is an offence. The penalty for the offence is Nu. 45,000 per excess ton of load. Additionally, if overloading causes the collapse of bridges, the defaulters are penalized with the cost of de-launching and launching the bridge, including the replacement cost for damaged bridge parts.

Recommendation 5:

a. The DoST, in collaboration with relevant agencies such as the Bhutan Construction and Transportation Authority (BCTA), may sensitize transportation firms or explore other means of addressing the issue.

b. Bridge weight limits should be strictly enforced, and stricter penalties should be imposed for defaulters. Local government authorities or communities can be involved in monitoring and reporting the non-compliances.

3.6. Good Practices

Some gewogs have built temporary bamboo gates to disallow heavy vehicles through the Bailey Bridges, where diversion routes exist. The Department may also identify vulnerable bridges and explore measures to reduce collapses due to overloading.

Figure 4. Temporary bamboo gate at Tading, Samtse

Source: https://bit.ly/4bgL2x2

The DoST has constructed laboratories in the Regional Offices to test the construction materials. The Dzongkhag Engineering Sectors are encouraged to use the lab testing facilities from the regional offices for all road and bridge construction works.

Figure 5. Laboratory at Regional Office, Phuentsholing

The DoST has constructed storage facilities for bridge parts and other construction materials at the Regional Offices.

4 CONCLUSION

Bailey Bridges are crucial in a country such as Bhutan, providing essential connectivity across challenging terrains and remote areas, and enabling economic development. Their versatility and ease of construction make them invaluable, especially in regions where permanent bridge construction is not feasible. The DoST and local governments have done a commendable job constructing and maintaining these crucial infrastructures.

The study found well-established processes in the country's Bailey Bridge construction sector. Nevertheless, it has highlighted a few critical findings that need attention. While these findings do not necessarily indicate the prevalence of corruption, failing to address them may create breeding grounds for corrupt practices, thereby affecting the management of these crucial infrastructures.

While the relevant agencies plan, construct, and maintain the bridges, the citizens also have an important role in overseeing the quality of bridges constructed in their community and reporting accordingly.

The recommendations in this report are neither exhaustive nor intended to be prescriptive. The ACC encourages the relevant agencies to review these recommendations closely and implement them based on their institutional priorities, resources, and other considerations.

FOLLOW UP

To implement the recommendations, the agency concerned will prepare an Organizational Integrity Plan (OIP) based on the recommendation and submit it to the ACC for endorsement within three months of sharing this report. The format for OIP will be shared along with the report. Upon endorsement by the ACC, the agency will implement the OIP for one year, which will be reviewed biannually to ascertain the implementation status.

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ANNEXURES

1. Total number of motorable bridges by type and Dzongkhag as of July 2022

Dzongkhag	Types of Bridge												
	Composite	RCC Slab	RCC T-Beam/ Girder	RCC Arch	Multicell Box culvert	PSC Box Girder	Steel Arch	Steel Truss/ Girder	Steel Pony Truss	Steel Hemilton	Bailey Suspension Bridge	Bailey Bridge	Total
Bumthang	1	2	8	0	0	0	0	0	1	0	0	5	17
Chukha	1	1	2	0	2	6	0	1	3	5	0	7	28
Dagana	0	1	0	0	0	1	1	0	1	0	0	9	13
Gasa	0	0	0	0	0	0	0	0	0	0	0	5	5
Haa	0	0	3	0	0	0	0	1	2	0	0	5	11
Lhuntse	0	3	1	0	0	0	1	0	0	0	0	15	20
Mongar	0	4	6	0	0	1	0	2	1	0	1	12	27
Paro	2	1	2	0	1	3	0	2	0	0	0	10	21
Pema Gatshel	0	0	5	1	0	0	0	1	0	0	0	7	14
Punakha	0	1	1	0	0	0	0	0	0	0	0	9	11
Samdrup Jongkhar	5	0	2	1	0	1	0	0	1	1	0	12	23
Samtse	0	0	3	0	0	0	1	0	0	1	3	14	22
Sarpang	8	2	5	0	5	6	1	1	0	0	0	6	34
Thimphu	0	5	10	1	0	3	2	1	0	0	0	8	30
Trashigang	1	3	5	0	0	1	0	1	0	0	1	10	22

Dzongkhag	Types of Bridge												
	Composite	RCC Slab	RCC T-Beam/ Girder	RCC Arch	Multicell Box culvert	PSC Box Girder	Steel Arch	Steel Truss/ Girder	Steel Pony Truss	Steel Hemilton	Bailey Suspension Bridge	Bailey Bridge	Total
Trashi Yangtse	0	4	0	0	0	0	0	0	0	0	0	6	10
Trongsa	2	2	3	0	0	1	0	3	1	0	1	8	21
Tsirang	0	2	0	0	0	2	1	0	0	0	0	2	7
Wangdue Phodrang	1	2	4	1	0	4	0	1	1	0	0	7	21
Zhemgang	3	2	7	0	0	1	4	1	0	0	0	7	25
Total	**24**	**35**	**67**	**4**	**8**	**30**	**11**	**15**	**11**	**7**	**6**	**164**	**382**

2. Details of audit observations

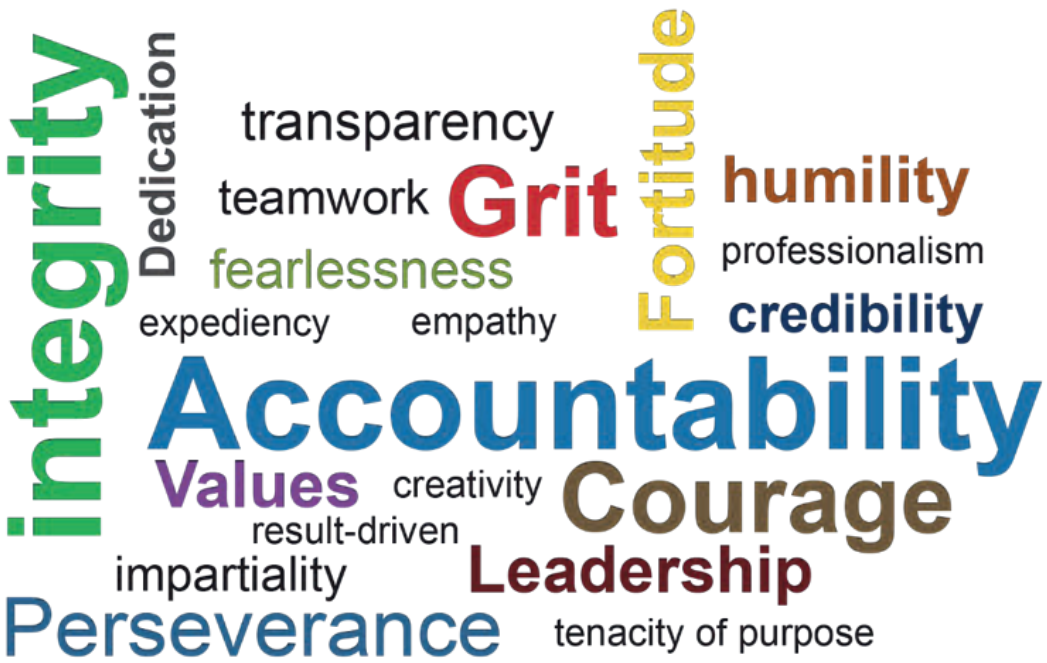
SN	Year	Audit Observations	Amount (Millions)
1	2016	Non-recovery of insurance from the contractor	1.066
2		Non-execution of works	0.031
3	2019	Non-levy of liquidated damages	0.692
4		Excess/double payments	3.411
5		Payment made without receipt of materials	0.078
6		Wasteful expenditure	7.599
7	2020	Excess payment to contractor	2.425
8		Payment for work not executed	0.399
9		Acceptance of substandard works	0.5
11		Irregular adjustment of advance	7.225
12		Non-levy of liquidated damages	1.112
13		Outstanding advance	0.954
14	2020-21	Wasteful expenditure	0.298
15	2021-22	Fictitious payment of DSA	0.026
16		Misappropriation	0.056
17		Irregular payment	1.546
18		Misuse of funds	6.9
19		Not recovered liability and penalty	1.328
20		Inadmissible payment	1.14
21	2022-23	Wasteful expenditure	4.11
22		Excess payment	1.154
23		Construction of Bailey Bridge and lapses thereof	0.592
Total			**42.642**

3. Summary of media reports on Bailey Bridge collapses.

SN	Name/ Location	Date	Reason for Collapse	Casualties/ Injuries
1	Samdingkha Bridge, Punakha	1/7/2011	During construction/ launching	4 died 2 minor injuries
2	Langchenphu Bridge, Lhuentse	15/1/2013	During construction/ launching	1 Injured
3	Amochhu Bridge, Samtse	11/7/2016	During construction/ launching	1 died, 7 missing 1 injured
4	Chumpathang Bridge, Samtse	Nov-2016	Overloading	None
5	Budhuni Bridge, Samtse	22/7/2016 & 24/7/2016	Flashflood	None
6	Namchu Bridge, Samtse	30/12/2018	Overloading	None
7	Kuchidiana Bridge, Samtse-Sipsu	4/5/2019	Overloading	None
8	Ipoli Bridge, Gelephu	13/8/2021	Flashflood	None
9	Thrimshing Bridge, T/ gang	Jun-2022	Flashflood	None
10	Maokhola Bridge, Sarpang	3/3/2023	Caused by the use of old panels	None
11	Kuri-Gongri Bridge, Mongar	23/5/2023 & 27/6/2023	Overloading	1st - None 2nd - 2 died
12	Shingkhar, Zhemgang	10/12/2023	During construction/ launching	One washed away

4. List of Bailey Bridge manufacturers

SN	Name of the firm
1	Vinayak Rail Track India Pvt. Ltd.
2	Essen Fabricators Pvt. Ltd.
3	Garden Reach Shipbuilders and Engineers Ltd.
4	Bridge and Roof Company India Ltd.
5	Titagarh Rail Systems Ltd.
6	Machine Works (International) Ltd.



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