

HIGHWAY BRIDGE DESIGN CODE: AN INTRODUCTION

Overview

The Khyber Pakhtunkhwa (KP) government has introduced Pakistan's first Highway Bridge Design Code 2025 (HBDC-25), a major milestone in infrastructure development and investment management. This code provides a structured framework and a set of rules and guidelines for the design, construction, and maintenance of bridges, ensuring safety, durability, and suitability to local conditions. Replacing the West Pakistan Code of Practice for Highway Bridges (1967), which was based on colonial-era standards, HBDC-25 incorporates modern safety features and engineering advancements.

Developed through a collaborative effort involving engineers, geologists, and environmental scientists, the HBDC-25 was supported by the UK's Foreign, Commonwealth & Development Office (FCDO) via its Sustainable Energy and Economic Development (SEED) programme.

The Need for an Indigenous Bridge Code

In recent years, floods, earthquakes, and overloading have led to multiple bridge failures across Pakistan. In Khyber Pakhtunkhwa alone, 107 bridges were damaged in the 2022 floods, and over 150 in the 2010 floods. An updated, context-specific code was needed to mitigate such risks. Four major gaps needed to be addressed:

- **Modern vehicular loads:** The previous code relied on colonial-era vehicle load models, failing to account for modern traffic density and vehicle loads leading to safety concerns and frequent failures
- **Seismic risks:** Pakistan is located in a seismically active region, with KP at particularly high risk of earthquakes due to its proximity to multiple fault-lines. Seismic hazard risks were not systematically addressed.
- **Climate change:** Flood forecasting depended on probability-based projection of historical flood data, rather than using models that factored in the effects on climate change on future flood levels.
- **Universal accessibility:** Special needs of differently abled pedestrians were not included in design requirements.





Key Features

- 1. Live Load Calibration Factor:** The Calibration Factor for Live Load (CFL) is adjusted to 1.25 to reflect the on-average 25% heavier loads experienced on Pakistani roads, reducing failure risks.
- 2. Seismic Provisions:** Includes tehsil-level seismic hazard maps and adheres to the American Association of State Highway and Transportation Officials' (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications (9th Edition, 2020) for earthquake resilience.
- 3. Climate Change Considerations:** Requires site-specific hydrological and hydraulic studies using Global Climate Change Modelling (GCM) techniques, ensuring reduced risks.
- 4. Inclusivity and Accessibility:** Provides for ramps, handrails, and walkways to ensure safe access for all, including women, children, and physically challenged individuals.
- 5. Vehicle Permitting:** Provides guidelines for routing of extremely heavy loads (including industrial equipment e.g. hydropower turbines) to ensure bridge longevity and safe transport.
- 6. Wind Provisions:** Implements rigorous wind speed resistance measures, incorporating a 3-second wind gust speed probability analysis.

Development Process

The HBDC-25 was formulated through a collaborative effort involving a Core Working Group (CWG) of experts from academia, industry, and government departments. The process included:

- **Reviewing International Codes:** Benchmarked against bridge codes from the USA, Canada, and the UK.
- **Local Calibration:** Adjusted to Pakistan's specific conditions, including load, seismic, and climate challenges.
- **Legal and Technical Approvals:** Reviewed by the Provincial Development Working Party (PDWP) and endorsed for implementation.
- **Copyright Agreement:** Secured with AASHTO allowing the use of their specifications as the base code.
- **Official Launch:** The KP government formally adopted the code, making it the first indigenous bridge code in Pakistan.

Impacts



Improved Safety: Standardised, scientifically validated guidelines enhance bridge durability and reduce failure risks.



Economic Resilience: Preventing failures saves money and ensures uninterrupted transport networks.



Sustainability: Climate adaptation features support long-term infrastructure resilience.



Encouraging Innovation: Provides clear design standards, fostering advanced and cost-effective construction techniques.



National Standardisation: Sets a precedent for other provinces to develop unified infrastructure codes.

Future Updates and Expansion

HBDC-25 will be periodically updated by a Standing Code Review Committee to incorporate new research, technological advancements, and environmental considerations. The KP government also plans to introduce a comprehensive "Highway Code" to improve overall road infrastructure management.

The Way Forward

Launched in March 2024 under the guidance of Chief Minister Ali Amin Gandapur, HBDC-25 is now the official standard for bridge design across Khyber Pakhtunkhwa. The government is developing a legal framework to ensure compliance across all bridge projects. Efforts are underway to engage the Pakistan Engineering Council (PEC) for national adoption, positioning HBDC-25 as the foundation for standardised, resilient infrastructure across Pakistan.