Successful Collaboration and Stewardship Preserve Prestressed Concrete Bridge

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In August 2023, following a heavy rainstorm in central Washington state, a truck driver reported that Bridge 202 in Grant County "wobbled" during crossing, which was the first hint that something was amiss.[1] The bridge was immediately closed, and an emergency inspection revealed a critical substructure failure that resulted in one prestressed concrete girder without bearing support. While such damage could necessitate a full bridge replacement, this project instead became an example of concrete bridge stewardship—demonstrating how careful evaluation and innovative design preserved a prestressed concrete bridge and extended the life of local agency infrastructure.

In August 2023, a truck driver reported that Grant County (Washington) Bridge 202 "wobbled" and a subsequent emergency inspection revealed that significant erosion had occurred around the north abutment after heavy rains. Photo: Nicholls Kovich Engineering.

Background

Bridge 202 is a 130-ft-long, single-span prestressed concrete bridge constructed in 1989. The structure crosses the Rocky Coulee Wasteway Canal with a 34-degree skew. The canal, built by the U.S. Bureau of Reclamation, is an integral part of the Columbia Basin Project, which serves about 671,000 acres in east central Washington.

The bridge's superstructure consists of five prestressed concrete I-girders supporting an 8-in.-thick cast-in-place composite deck. Each girder weighs 105,000 lb and is supported on shallow concrete spread-footing abutments.

Failure Mechanism and Structural Assessment

The emergency inspection identified severe erosion around the northwest corner of the bridge, which had resulted in a large void beneath the north abutment footing. The abutment wall exhibited significant vertical cracking and spalling, and one exterior girder had completely lost bearing support. The void also extended below the concrete-lined canal.

Despite this loss of support, the prestressed concrete girders and deck remained structurally intact, with no visible signs of distress-related cracking. This performance is consistent with the inherent redundancy and load-distribution characteristics of prestressed concrete girder systems. Load redistribution through the deck, girders, and diaphragms likely limited demand increases in the unsupported girder, preventing structural distress.

Subsurface exploration confirmed that the original spread footing was founded on erodible silty sand, with competent basalt located 3 ft below the footing elevation. The abutment failure was attributed to a combination of surface runoff, groundwater seepage, and soil erodibility—conditions that led to catastrophic undermining of the abutment.

Evaluating Preservation Versus Replacement

With canal irrigation flows scheduled to resume in March 2024, less than seven months after discovering the damage,

To preserve the bridge superstructure, all five prestressed concrete girders at the north abutment were simultaneously jacked and temporarily supported by cast-in-place concrete shoring columns founded on micropiles. Photo: N. A. Degerstrom Inc.

the project team faced a constrained construction window. A multidisciplinary team—including Nicholls Kovich Engineering, Budinger & Associates Inc., N. A. Degerstrom Inc., and Grant County Public Works—evaluated repair alternatives. Nicholls Kovich Engineering, which provides on-call services to the county, was able to subcontract with the geotechnical engineer, and the contractor was retained by the county through an emergency contracting process.

A key decision point was whether the prestressed concrete girders remained viable for continued service. Field observations and engineering judgment confirmed the following:

- No evidence of overstress or excessive deformation in the girders
- No strand exposure or loss of prestress capacity
- No deck cracking indicative of redistribution-induced distress

Based on these findings, the superstructure was deemed salvageable. Keeping the girders avoided significant material costs, shortened the duration of construction and road closures, and minimized disruption to canal operations.

Stabilization and Temporary Support

The repair strategy involved complete removal and replacement of the north abutment while the bridge girders were temporarily shored. Initial stabilization included construction of a 5-ft-wide access pathway beneath the bridge and placement of approximately 80 ft^3 of lean concrete to fill undermining voids and stabilize the existing footing. The unsupported exterior girder was also shimmed to restore temporary bearing.

Extensive excavation was not possible close to the canal. Therefore, to temporarily support the bridge during reconstruction, a micropile-supported shoring system was designed and installed. Workers used a limited-access drill rig to install thirty 3.5-in.-diameter production micropiles and one test pile into the underlying basalt. The micropiles supported a continuous footing, which in turn supported five cast-in-place concrete shoring columns and steel jacking beams—one positioned beneath each girder. This system temporarily transferred superstructure loads directly to competent bedrock, bypassing the weaker soil zone and facilitating the safe removal of the damaged abutment.

The temporary supports were 10 ft from the end of the girder. The girders and deck were checked to ensure that there was no overstress in the temporary condition.

Abutment Reconstruction and Long-Term Mitigation

Following the successful transfer of load to the temporary support system, crews carefully removed and reconstructed the damaged abutment. A concrete leveling pad was placed directly on basalt to support a new spread footing, improving foundation reliability relative to the original design. The new substructure includes the following:

- 8-ft-wide concrete spread footings with a 6-ft-tall, cantilevered concrete abutment wall
- 13-ft-tall reinforced concrete wingwalls
- A structural earth retaining wall to support the approach embankment

A drainage gallery was incorporated into the design to intercept and convey groundwater and stormwater. This feature reduces the potential for future erosion and hydrostatic pressure buildup behind the abutment, thereby addressing the root cause of the abutment failure. Grant County further supplemented the repair with a stormwater management plan addressing runoff from adjacent roadways and agricultural lands.

The damaged north abutment was carefully removed, and a new concrete abutment and wingwalls were constructed on basalt bedrock. Photo: Nicholls Kovich Engineering.

Design and Construction Challenges

The project team adapted the original design approach during construction to address several key challenges. Temporary support of the superstructure using shallow footings was initially planned. However, concerns related to excavation stability and worker safety prompted a shift to a micropile-supported system. This change allowed loads to be transferred directly to underlying basalt, without extensive excavations.

Vertical clearance beneath the bridge was limited to approximately 5 ft, which constrained construction means and methods. As a result, specialized equipment and careful sequencing of micropile installation and shoring system assembly adjacent to the canal were required.

During operations before jacking, field measurements confirmed that the exterior girder had deflected more than 1 in. lower than the interior girders. This finding proved that some load redistribution had occurred. Therefore, the jacking system was carefully synchronized to apply uniform pressure across all girders. This controlled approach minimized the risk of inducing additional stresses in the superstructure and allowed the girders to be reset onto new elastomeric bearing pads at consistent elevations.

Stewardship in Practice

This project illustrates the value of engineering stewardship in concrete bridge rehabilitation. Rather than defaulting to replacement, the project team evaluated the true condition and performance of the prestressed concrete girders and identified an opportunity to preserve them.

By maintaining the existing superstructure and focusing on intervention to address the failed substructure, the team

- extended the service life of the bridge;
- minimized environmental impact through material reuse; and
- maintained structural reliability through improved foundation and drainage design.

The completed Bridge 202 project illustrates successful concrete bridge stewardship, in which a critical substructure failure offers an opportunity to preserve the existing prestressed concrete girders and extend the bridge's service life. The bridge's projected service life is 50 years from the time of the repair. Photo: Nicholls Kovich Engineering.

Additionally, the team was able to contain the budget while accelerating the construction timeline. The project was completed in just 5 months with a construction cost of $1.23 million, compared with 3 years and an estimated $5 million cost to replace the bridge.

The success of the project depended on close coordination among the owner, engineer, geotechnical consultant, and contractor, as well as the team's willingness to pursue a technically rigorous rehabilitation approach under tight constraints. The project's achievements were recognized when the contractor, N.A. Degerstrom Inc., received the 2024 Build Northwest Award from the Inland Northwest Associated General Contractors in the Highway and Transportation Renovation category.

In an era of aging infrastructure and limited resources, this project demonstrates that preserving a prestressed concrete girder bridge can be both a practical and responsible solution when the strategy is supported by sound engineering evaluation.

Reference

1. Schweizer, S. 2024. "Grant County Bridge Work Under Way." *Columbia Basin Herald*, March 12, 2024. https://columbiabasinherald.com/news/2024/mar/12/grant-county-bridge-work-under-way.

The temporary shoring system and new abutment cross section show the tight physical constraints of the reconstruction adjacent to the irrigation canal. Figure: Nicholls Kovich Engineering.