

U.S. Army Corps of Engineers restores eroding fish passage with help from Simpson Strong-Tie



Completed project with damaged sections repaired, strengthened, protected and seamlessly blending with the original design.

BACKGROUND Decades-old concrete water diversion system required repair and strengthening

In 1983, the U.S. Army Corps of Engineers constructed the Mill Creek Fish Passage along the Kingfisher Trail in Walla Walla, Washington. The passage was intended to facilitate the migration of steelhead, bull trout and spring Chinook salmon to and from their spawning grounds upstream. The channel consists of a hybrid concrete and natural cobble bottom that runs seven miles, including more than two miles through downtown Walla Walla.

In 2017, sales and technical representatives from Simpson Strong-Tie visited the Walla Walla District Corps of Engineers to give a presentation regarding fiber-reinforced polymer (FRP) and fabric-reinforced cementitious matrix (FRCM) products from their Composite Strengthening Systems™ (CSS) line of concrete repair, protection and strengthening solutions.

THE CHALLENGE Devise a repair, strengthening and protection solution to renew the life of the structure without replacing it

The entire concrete fish ladder passage, including the water diversion system, was showing its age and in need of extensive repair or even replacement. Corbels were spalled, with some portions deteriorated badly enough to expose their steel reinforcement. Concrete piers likewise were worn and required protection from the elements. Any solution would require some dewatering. If an adequate repair wasn't feasible, the structure might need to be replaced in its entirety, which of course would be much more expensive and require a lengthy disruption to fish migration.



The corbel was deteriorated beyond what was expected, creating significantly more repair work prior to FRP installation.

PROJECT INFORMATION

Project

Mill Creek Division Works Fish Ladder, Corbel Upgrades and Pier Rehabilitation

Project Category

Retrofit

Project Owner

U.S. Army Corps of Engineers

Application

Concrete repair and strengthening

Simpson Strong-Tie Products

CSS-CUCF11 code-listed unidirectional carbon fabric; CSS-ES epoxy saturant; CSS-EP epoxy paste; RPS-RAPID Rapid-Setting Mortar; RPS-406 zinc-rich primer; CI-LV low-viscosity structural injection epoxy; RPS-752 bonding agent; RPS-263 rapid-hardening vertical/overhead repair mortar; RPS-207 slurry seal

CHALLENGE

Rebuild and strengthen spalling concrete corbels; rehabilitate damaged concrete piers while ensuring a blend with surrounding concrete.

SOLUTION

Use zinc primer to protect rebar; crack repair products, RPS mortar and bonding products to rebuild, and FRP to strengthen corbel concrete; rapid-setting RPS mortar to restore pier ends.

RESULTS

Three-month FRP repair solution effectively bypassed the need to demolish and replace the fish passage, while restoring the structure to its original integrity.

THE SOLUTION Rebuild the corbels with multiple applications of Simpson Strong-Tie mortar before strengthening them with code-listed carbon FRP



CSS-CUCF11 carbon FRP was installed over the repaired corbel to extend the life of the structure and assist in preventing future deterioration.

Simpson Strong-Tie engineering services proposed an RPS mortar solution to rebuild the eroding corbels, followed by application of CSS-CUCF11 code-listed unidirectional carbon fabric for strengthening. The contractor liked the design, and the Army Corps of Engineers approved it as well. Simpson also worked extensively with the teams to provide installation training and technical advice as installations were completed.

Repair work began in July 2020. First, Simpson Strong-Tie RPS-406 zinc-rich primer was applied to the exposed steel reinforcement bar to protect it from corrosion. Crack injection was done here with CI-LV prior to any mortar repairs. Next, alternating layers of RPS-752 epoxy bonding agent and RPS-263 rapid-hardening vertical/overhead repair mortar were used to rebuild the deteriorated corbels to their original size. Finally, the repaired corbels were strengthened with applications of CSS-CUCF11 carbon fabric. On-site samples were created and tested offsite. Test values for the layers of mortar in the vertical repairs were very high, showing excellent adhesion, as were those for the FRP applications.

The project proceeded smoothly and according to schedule, the Corps were so pleased with the progress and test values of the repairs that the contract was modified to include rehabilitation of the concrete piers as well. So RPS-406 zinc primer was used again for steel protection and CI-LV low-viscosity structural injection epoxy to fill cracks in the existing concrete, after which RPS-752 epoxy bonding agent and RPS-RAPID Rapid Setting Mortar were applied to rebuild the ends of the piers. The rebuilt concrete was then coated with RPS-207 slurry seal for waterproofing and to make it blend in better with the aged concrete surrounding it.

THE RESULTS Repair complete within three months, restoring the structure to its original integrity

On October 15, 2020, hardly three months after work started, the repair was complete. The Army Corps of Engineers and TDX Power Services were impressed that the Simpson Strong-Tie design relied only on tested materials, as was evident in all the CSS Technical Data Sheets. They were also thrilled to land upon a design solution that saved them the time and expense of having to replace the structure entirely.

In the words of the Army Corps of Engineers, Walla Walla District, Project Delivery Team, Technical Lead:

This was the first time we have used a Composite Strengthening System within the Walla Walla District. Initially, there was hesitation to use this method for rehabilitation; however, the final product exceeded expectations in both strength and appearance. We are looking forward to exploring further applications... of Composite Strengthening Systems in marine environments....

They were equally grateful for the complimentary engineering, training and technical services:

Simpson Strong-Tie engineers were very helpful to provide recommendations for both products and



The contractor fabricated custom forms to enable access to the repair area for application of the RPS-752 bonding agent and speedy pour of RPS-263 rapid-hardening repair mortar.

methods for the repair application. They not only trained contractors on proper installation of their products, they also provided onsite representation to address concerns [and] ensure successful execution.

When the work was done, the FRP design had restored both the corbels and the piers to their original structural integrity while simultaneously helping protect them from further deterioration, in effect giving the structure a second lease on life.

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INFO**

For complete information regarding specific products suitable to your unique situation or condition, please visit strongtie.com/css or call your local Simpson Strong-Tie RPS Specialist at **(800) 999-5099**.