The Passage Bench

Lessons learned from their construction as standard riprap design at river crossings in Minnesota.

Introduction:
The Passage Bench is a gravel bench incorporated into bridge riprap. Its primary function is to allow wildlife to pass beneath bridges uninterrupted as they travel along the streambank. In 2005 the Passage Bench was considered an "experimental design." This was a collaborative effort of the Minnesota Department of Natural Resources (MDNR), the US Fish and Wildlife Service (USFWS’s Twin Cities Field Office), and the Minnesota Department of Transportation (MDOT). Early designs were installed at several bridge locations around Minnesota. These were experimented with design parameters such as bench width, vertical clearance, and location. Initial study and continued observations have shown that this feature is utilized successfully by wildlife throughout Minnesota and in a variety of settings. Simultaneously, other benefits were realized for MDOT, such as-ass in bridge inspection, a riprap design change from aggregate base to a geotextile base, and flexibility in design for the cross-section of the normal channel and its flood profile. Bridge length also is not necessarily increased with this design. With the initial design of the Passage Bench was considered in 2005 for wildlife crossings, these additional benefits worked in its favor. In 2013 the feature became part of the MDOT Standard Plan for use on all bridges over water in Minnesota. This feature is now being installed as a standard practice. We have learned a few things along the way of these observations is primarily for the

The Success
In 2005, MDOT funded a two-year study of the passage bench as a wildlife underpass. Data was collected at three locations in northern Minnesota. This report remains unpublished, though data show a wide variety of species utilizing benches during the study period. Various small creatures, including various vertebrate species were identified, including black bear, red fox, grey fox, boleol, white-tailed deer, and humans.

Encouraging trends
Very few benches are fenced, yet almost all are utilized by animals. One crossing is providing evidence that white-tailed deer are taking much longer way to get under the bridge rather than the short way over the highway. No deer tracks were observed on the structures for a direct route over the road crossing, yet the passage bench does have active use with traffic forming to surrounding habitat. There is no fencing at this location. These benches were constructed in 2009.

Installation lesson (too low or too high)
Bench height or too low or too high are more vulnerable to turbulent flood waters. Installation too high and they appear to be less likely to be utilized by animals. There is a range of too low and too high that is just right. Solution: Plans should allow for sit adjustment to weather conditions.

Installation lesson (not wide enough)
The plan shows a required three foot minimum width, yet many have been constructed with less width. Narrow benches are more prone to longitudinal scour during flood events. They also appear to be utilized by animals less than the three foot width versions. Solution: More education is needed for contractors and inspectors on the importance of the three foot minimum width.

Installation lesson (staging)
Several projects have had benches eliminated from plans after construction discovered the feasibility of mechanical installation after benches are set. Solution: Installation of the passage bench should be prior to setting of bridge beams, preferably at the knee of the bridge installation.

Design lessons (grading plans)
The passage bench is a default standard in the bridge plans, but is not always carried through in the grading plan. This results in a downsloping (and unused) bench. Solution: Check during design and permit review.

Design lessons (stormwater outfalls)
Crossflow from drainage into the bench rivulet will wash out the bench, making it impassable. Solution: Water resource design folks need to be aware of the passage bench and set minimal outfalls below the bench.

Design lessons (low beam)
Bench height is under low bridge is utilized, though only by smaller animals. However, reducing the number of small animals from a bridge approach is a benchmark to say where improvement is necessary for vehicle. Solution: None, MDOT continues to "test" passage benches on lower profile bridges.

Flood Flow
Flows can and do take out materials from the benches. Typically enough remaining that they are still passable. Subsequent floods redelivered materials from low beam to same benches. Solution: None, we have accepted this variability and have not required maintenance.

Human Use
Bench have been utilized by people while fishing or hunting. They are also utilized by fire inspection crews and bridge maintenance crews. Concerned regarding crop losses of livestock (Polar animals continue, but have not been reported as a problem.

Standard Plan
Two erosion plan details during installation:
- 3' minimum width
- Tie benches to native ground, gravel, and outside of bridge

Maintenance lesson (drainage repair)
Maintenance folks may not be aware of the existence of a passage bench when making repairs to need ditch drainage. Solution: Work with district maintenance folks to identifying Passage Bench locations.

Location lesson (sighting)
- Outside limits of river are not good locations for a passage bench. Higher velocity and more turbulent flows during flood events tend to wash them out. They also are less likely to withstand with successive flood events.
- Flowing to direct animals under the bridge has not been a required feature in Minnesota. Considerations for such a feature should include mode of read out in the area, presence of rare species or target species, and maintenance concerns.
- The presence of large roadbeds, cliffs or stormwater outfall structures should have additional design to prevent damaging sensitive wetland areas (bridge or design basin areas).
- Costs are minimal, thus they are being built even when there are known limitations with a site. Installation is a standard practice, however, when justified, they may be eliminated from the plans.
- When target species in the area, additional design is sighted and construction is to be prioritized.

Modification by other states
- Nebraska Department of Roads has used interlocking block on their passage bench design to protect against erosion.
- Wisconsin Department of Transportation has constructed provisions for F1 viables in the entire scope of riprap with smaller aggregate. This is being considered in Minnesota where riprap installations are without a Passage Bench.
Details to watch for during construction:
- Tie benches to natural groundlines outside of bridge
- 3ft minimum width