Survey of bridges washed out in MinamiAizu, Fukushima Prefecture. Sep 18, 2015. Jeremy D. Bricker and Kazuhisa Goto.

Shizugawa, Takahashi Bridge

On Sep. 18, 2015, we investigated damage to bridges in Minami Aizu, Fukushima Prefecture. In the Shizukawa neighborhood of Minami Aizu, we investigated the failure of the Takahashi Bridge (Map 1). This was a concrete girder bridge with 3 deck sections, each 15 m long, standing atop 2 piers in the river and 2 abutments on either bank. As shown in Photo 1, the south deck, abutment, and pier survived. The bridge did not appear to have been overtopped by the flood. The north pier toppled sideways, likely due to scour at its base. The north abutment also toppled into the river likely due to scour. The north deck and middle decks both toppled into the river when the pier and abutment toppled. The middle deck can be seen partially buried in the riverbed, though the north deck had already been removed by construction crews. The north bank suffered severe erosion. Remains of the north embankment concrete armor wall can be seen in the photo.

Photo 2 shows the surviving south deck, pier, and abutment. The south embankment and its armor wall are also intact. The large item in the middle of the photo is an overturned slab of concrete embankment armor from the north bank.

Photo 3 shows the surviving south deck. Construction scaffolding on the upstream side of the girder caused debris (mostly grasses) to accumulate. The resulting debris damming did not damage this deck, but it may have caused more flow to divert toward the middle and north sections of the bridge, increasing flow speed and thus scour potential there.

Photo 4 shows the toppled north pier. As well as toppling, the pier is rotated 90 degrees from its original orientation. This same rotation of toppled bridge piers had been observed during bridge failure in Shizukuishi, Iwate Prefecture in 2013.



Map 1. Shizukawa neighborhood, Takahashi Bridge. Yellow arrow shows flow direction.



Photo 1. Takahashi Bridge. Taken from south deck, looking northeast. Yellow square is partially buried middle deck. The toppled north deck had already been removed by construction crews. Red circle is toppled northern pier. Orange rectangle is toppled portion of northern abutment. Red rectangle is scoured northern approach.



Photo 2. Takahashi Bridge. Taken from northern approach, looking southwest.



Photo 3. Takahashi Bridge. Taken from west of southern approach, looking northeast.



Photo 4. Takahashi Bridge. Upper surface of toppled northern pier. Taken from southern bank, east of approach.

Shizukawa, Mukaiyama Bridge

Photo 5 shows this concrete girder bridge had been overtopped and dammed with debris, but it did not fail. Scour of one of the approaches began, but it did not proceed to failure because the fill behind the abutment consisted of large boulders, which were too large to be displaced by the overtopping flow.



Photo 5. Mukaiyama Bridge.

Shizukawa, second bridge (name unknown)

Map 2 shows the second bridge scoured in Shizukawa, about 1.5 km upstream of the Takahashi Bridge. Since construction crews were already on side, much of the evidence of the cause of failure had already been erased. It was obvious that the bridge was not overtopped, but the south approach to the bridge was nonetheless scoured away (Photo 6). The bridge itself was undamaged.



Map 2. Shizukawa neighborhood. Second bridge washout location. Yellow arrow shows flow direction.



Photo 6. Shizukawa second bridge washout location, showing scoured south approach.

Highway 352 washout

Map 3 shows a bend in a river where Highway 352 was washed out. Photo 7 shows this washout. Most of the soil on the south bank was scoured away down to the level of bedrock. This appears to have been due to the natural river meander-building process, where the flood undercut the bank on the outside of the bend, causing it to migrate further outward.

Mizuishi Bridge

Photos 8 and 9 show the nearby Mizuishi Bridge. This steel girder bridge was submerged by the flood, but survived except for railing damage. Fine material under both abutments suffered scour, but since the abutments were founded on bedrock, the bridge survived with little structural damage.



Map 3. Washout of Highway 352 (yellow placemark) and surviving Mizuishi Bridge (red circle). Yellow arrows show flow direction.



Photo 7. Washout of Highway 352.



Photo 8. Mizuishi Bridge, looking south from north bank.



Photo 9. Mizuishi Bridge, looking north from south bank.

Bridge in northern Miyagi Prefecture

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The small bridge located on Map 4 was not overtopped, but suffered scour of its north abutment (Photos 10 and 11). The abutment collapsed, causing the northern edge of the bridge deck to topple into the stream. The southern edge of the deck remained upon its abutment, but this abutment (together with the deck upon it) pulled away from the southern approach when the northern edge toppled, and then settled (Photo 12). The sidewalk west of the bridge is a separate structure (Photo 13), but failed in a similar manner, as the north approach suffered scour after the north bridge abutment failed.



Map 4. Bridge in northern Miyagi Prefecture. Yellow arrow indicates flow direction.



Photo 10. North Miyagi bridge. Photo taken from southwest of bridge.



Photo 11. North Miyagi bridge. Photo taken from southeast of bridge.



Photo 12. North Miyagi bridge. Photo taken from northeast of bridge.



Photo 13. North Miyagi bridge. Photo taken from south approach.