Stream Crossing Guidance -- Constructed Banks Connected to Natural Stream Banks

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Purposes:
1) Focuses flow within natural channel dimensions, providing deeper water for fish passage at low flows,
2) Built-in armoring to protect footings/abutments from scour, and
3) Provides for terrestrial animal passage along a relatively smooth and flat surface connected to natural stream banks away from the crossing at all four corners.

Make shelves at the base of road embankment at all four corners.
Bank foundations are built up of properly sized* angular rock to remain stable in high flows.

* see USACOE Engineer Manual 1110-2-1601 for sizing based on slope, active width & discharge

Banks foundations are built up in layers with finer material (e.g., 6-inch-minus gravel) “watered in” to fill voids and to provide a relatively flat surface for animals.
Banks are continuous and connect at all four corners of the crossing to the natural banks.
Banks are built of large rock, with voids filled by smaller rock and fines “watered in”, with a relatively flat top surface. Note active/low-flow channel.

**Bed and Bank Schematic:**

**Typical 1.5-3% gradient stream**

- Banklines are composed of 6-18 inch (average intermediate dimension – not longest or shortest measure) competent, angular to sub-angular rock.
- Bed roughness elements are to be set in clusters of larger rock, 12-18 inches, with 3-6 inches protruding above the stream bed—minimum of 3 pieces per cluster to lock together.
- Banklines are meant to connect to the natural stream banks on both sides upstream and downstream to improve scour protection and terrestrial organism passage. Additional smaller rock and fine material is necessary for filling voids in the larger material to provide a stable bed and banklines. Fines must be watered into bed and banks to fill voids, and to avoid stream flow percolating into bed and banks.

**General schematic examples ONLY**

**Typical 0.1 - 1.5% gradient stream**
Hardened shelf to withstand erosion from ditch drainage.

Base of critical bank areas (outside bend) hardened with large boulders.

Base of critical bank areas (bottom of road embankment) hardened with large boulders.

Hardened shelf to withstand erosion from ditch drainage.