Jetty Fields

Caitlin Fogarty

April 7, 2020

CIVE 717: River Mechanics

Contents

Purpose

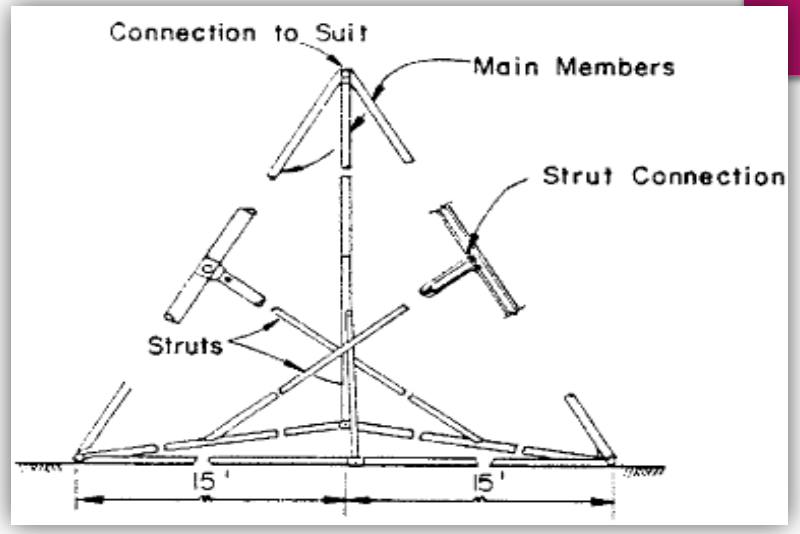
- Add roughness to the channel floodplain and along riverbanks.
  - Reduces velocity along the bank to promote sedimentation to protect the riverbank.
- Work best in rivers with high suspended sediment loads.
- Force river to flow in desired direction (e.g. in a designed channel).

Description/Placement

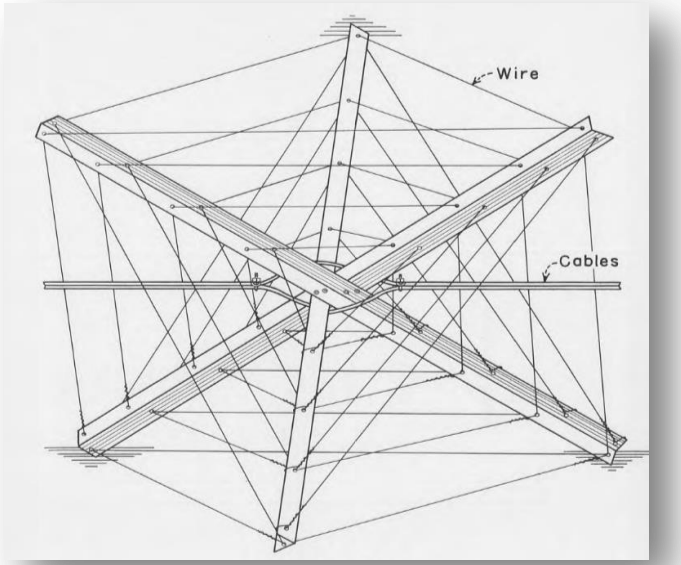
- Permeable and flexible
  - Permeability reduces the risk that the river will become overconfined and cause scour.
  - Flexibility allows rows of jacks to conform to the bed when scour occurs, making them more effective.

- Two types of jacks:
  - Tetrahedral shape (triangular frame)
  - Kellner Jacks which consist of 3 L-shaped steel bars (approximately 12' – 15' in length) that are tied together with wire.

Tetrahedron

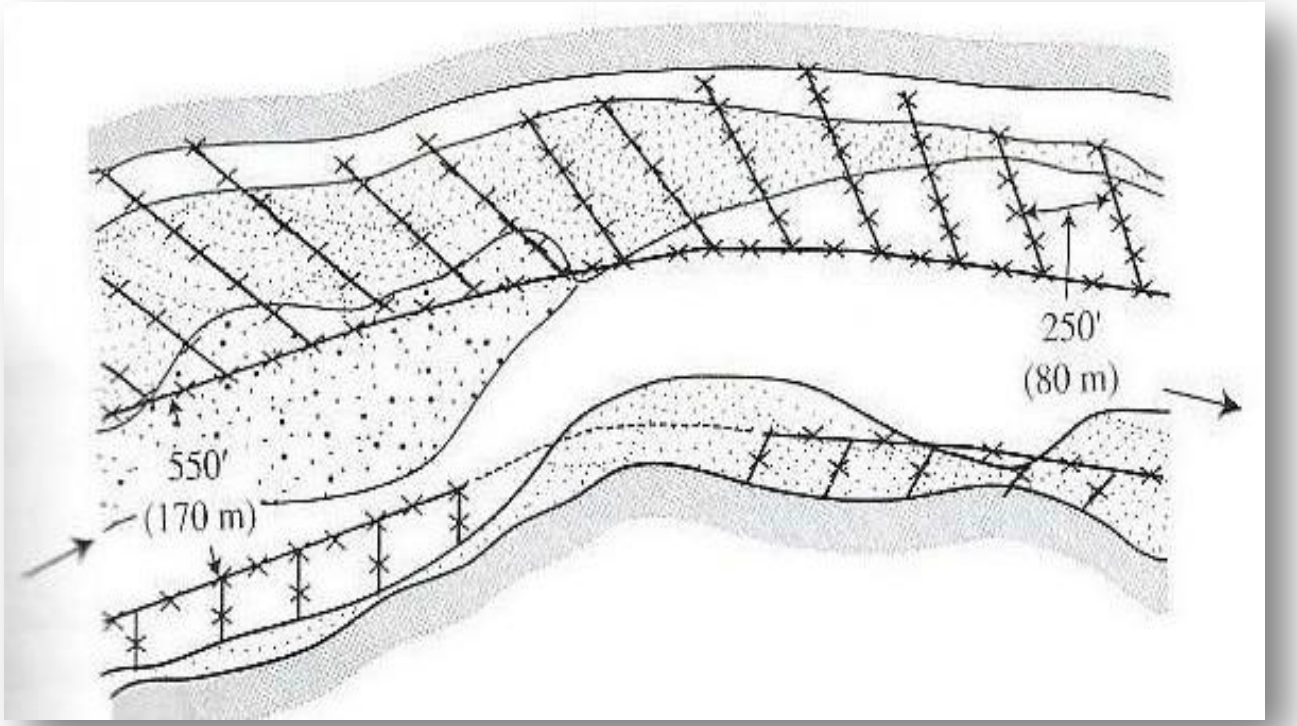


Kellner Jacks



Description/Placement

- Jacks are placed in rows along the riverbank line
  - Spaced 50 to 250 ft apart depending on suspended sediment and debris in the river.
  - Angled 45° -70° downstream from the bank
- Jack units are strung together by a common cable, forming a jetty field.
- Should be used on both sides of the river to ensure that a chute channel across the point bar does not develop during floods.



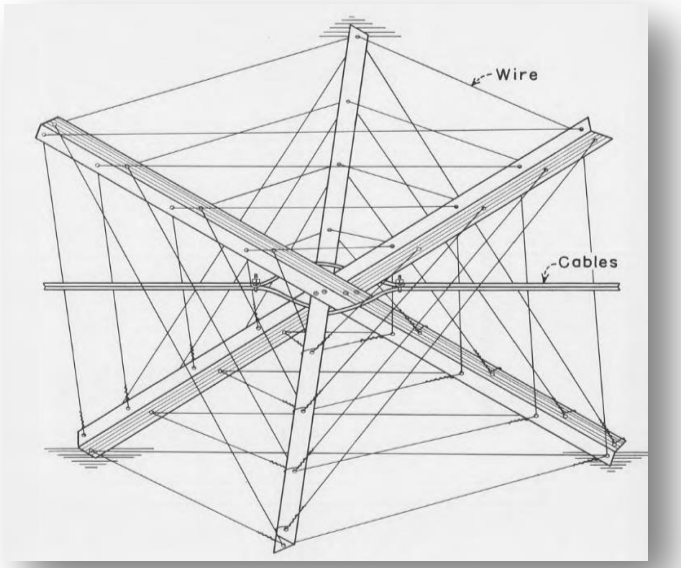
Common Applications

- Trap organic debris and large amounts of sediment to promote growth of vegetation on the floodplain.
- Help to maintain a stable non-vegetated channel width and attenuates flood waves due to the increase in floodplain roughness.
- Provide protection for the toe of levee systems.
- Rebuild banks through sedimentation
- Protect banks that are eroding

History

- H.F. Kellner invented the Jetty Jack in the 1920's
  - Lower cost than it's non-permeable competitor. In 1953, the average cost of a jetty field was $67.58.
  - First jack was comprised of three willow poles tied together in the middle. To keep the poles extended, he laced the poles with wires.
- Railroad and highway departments were the first public organizations to utilize Kellner's jacks
  - Wanted to strengthen vulnerable river systems that threatened their infrastructure.

Kellner Jacks



Example: Rio Grande

- Some of the first installations of jetty fields was to the Rio Grande in New Mexico in the 1950s.
- Prior to dams being built, the Rio Grande threatened nearby irrigation acreage because of high sedimentation rates that led to the riverbed rising and more flooding.
  - Therefore, people wanted to stabilize the channel.
- By 1962, 115,000 jacks were installed, creating a stable channel from Cochiti to Bernardo that had vegetation growing on the banks.

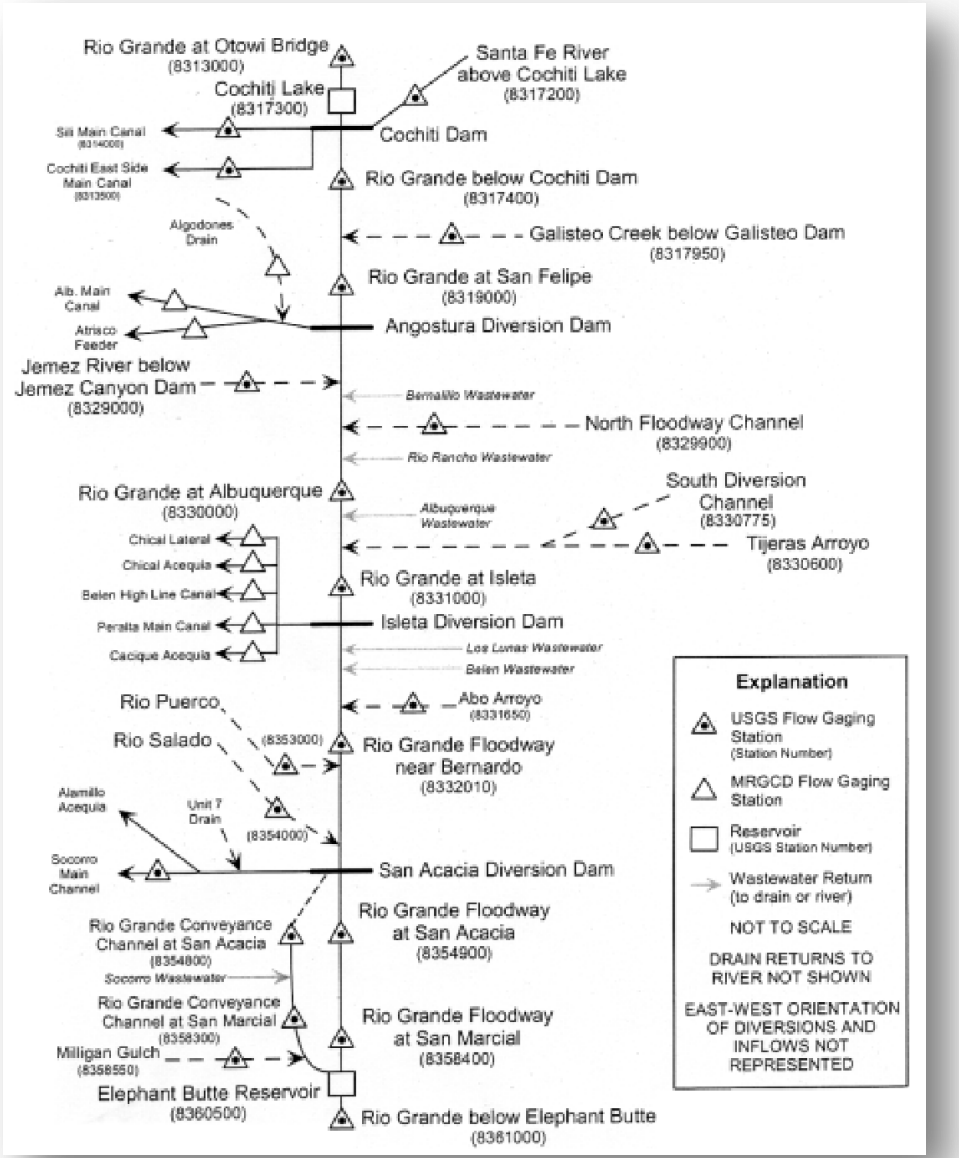


Fig. 9: Installation of jetty field on the Rio Grande near Bernalillo, NM.
Aerial photos by the Corps of Engineers.

Fig. 9(a): Location of the jetty installation. Photo: Dec. 12, 1952.

Fig. 9(b): Jetty field installed. Photo: Aug. 12, 1953.

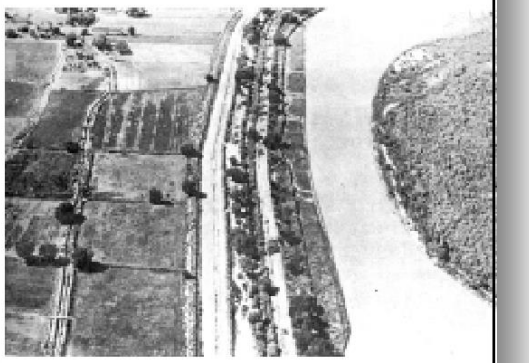
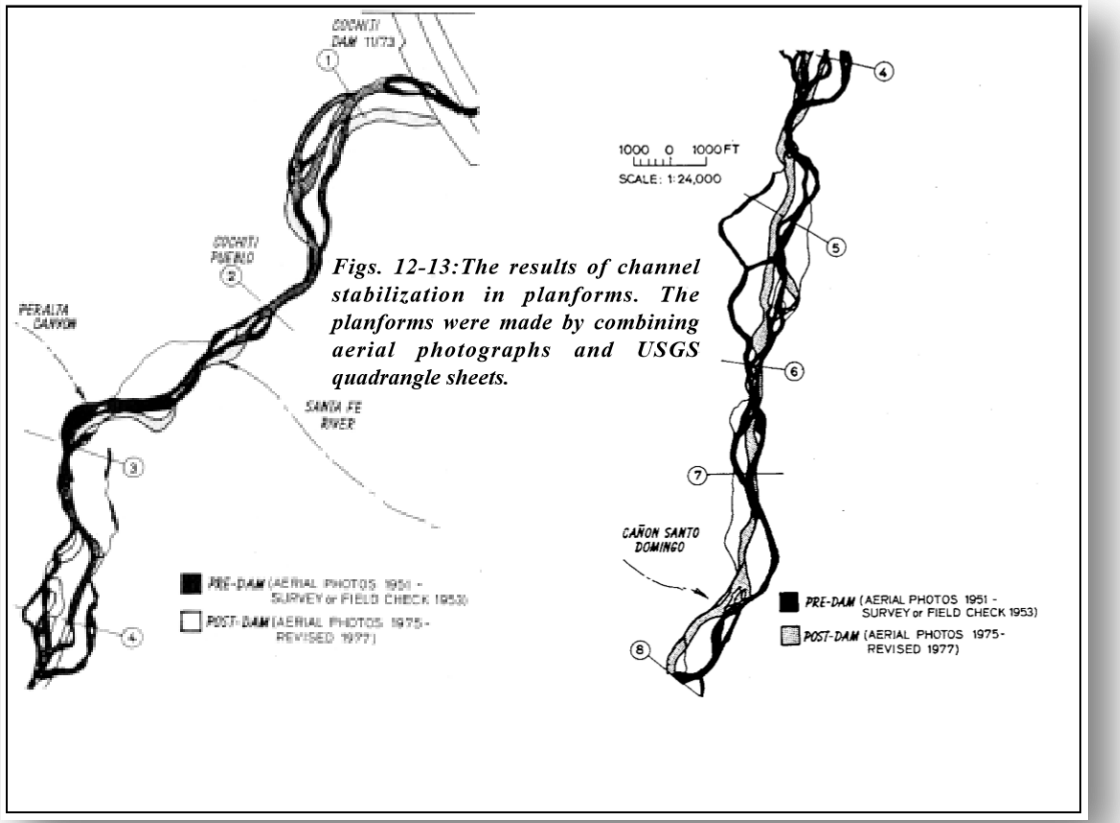


Fig. 9(c): Vegetation dominates in the mature jetty field. Photo Sept. 2, 1955.

Example: Rio Grande

- By 1970, the Jetty fields accomplished what they were put in place to do, lowering bed elevations and reversing aggradational trends
- However, with the installation of Cochiti Dam in 1973, the jetty fields were deprived of sediment, making them less effective at protecting the banks.
- Studies predicted that the jetty fields would be buried due to scour induced from reduced sediment supply and a degradational environment.



Figs. 12-13: The results of channel stabilization in planforms. The planforms were made by combining aerial photographs and USGS quadrangle sheets.

Jetty Jack Removal in the Rio Grande

- There is debate over whether to remove jetty fields in certain reaches of the Rio Grande. Some jetty fields have minimal functionality since the implementation of Cochiti Dam.
- Removal of jetty fields could be imperative for restoring riverine function.
- However, some of these jetty fields may still be important for protecting levees and ensuring agricultural water demands are met.
- Examples of jetty jack removal projects in the Rio Grande:
  - Los Lunas → 1,355 jetty jacks removed (habitat restoration project)
  - Santa Ana Pueblo → 1,600 jetty jacks removed from abandoned floodplain near river.

Fig. 17: Los Lunas, west bank. The first day of jetty jack removal, Apr. 9, 2002. Bankline jacks are the first to be removed. The job of removing 1,355 jacks is expected to take one to several months. Photo by Mark Horner, U.S. Army Corps of Engineers.

Figures 23-24: Before and After: At left is a jetty jack installation at Santa Ana, photo 1974 (Lagasse 1980). Below is the result of bank restoration using bio-engineering methods and native willow planting.

References

- Carlson, E and Dodge, R. "Control of Alluvial Rivers by Steel Jetties." U.S. *Bureau of Reclamation*. The First Water Resources Engineering Conference of The American Society of Civil Engineers. May 14-18, 1962.
- Grassel, K. "Taking Out the Jacks: Issues of Jetty Jack Removal in Bosque and River Restoration Planning." *Water Resources Program*. The University of New Mexico. July 2002.
- Julien, P. "River Mechanics." *Colorado State University*. 2018.
- Sharmar, N and Shriwastava, A. "Investigation of RCC Jack Jetty as a Cost Effective River Training Structure." International Conference on Agricultural, Environmental and Biological Sciences. Apr 24-25, 2014.
- Some images taken from last year's presentation by David Cortese