Introduction to Bridge Scour

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Bridge Scour Can Be Serious: Abutment Failure in Iowa

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Pier Failure in Taiwan

ON THE BRINK ... Cars lying on a collapsed bridge that links Taiwan's Kaohsiung and Pingtung counties yesterday. At least 16 cars came down with the bridge when it collapsed, injuring 22 people. Two beams of the Kaoping bridge snapped following the collapse of a pier. The collapse was suspected to have been triggered by illegal stone quarrying of the pier, which was weakened further by waters swollen by Typhoon Bilis last week. — AFP picture

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Failure by Contraction Scour

- For some bridges the width of the river has been narrowed to reduce span length.
- This smaller flow cross-sectional area leads to higher velocity (V=Q/A)
- If increased velocity is high enough, then the sediment will start to erode.

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Contraction Scour Schematic

- Original riverbanks
- Reduced flow area
- Bridge Abutments

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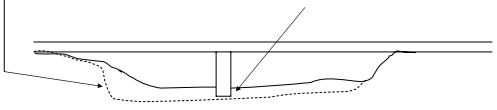
Riverbed Degradation

- Some rivers have beds that are naturally degrading due to conditions upstream or downstream.
- Any bridge piers or abutments built will need to have a deeper foundation.



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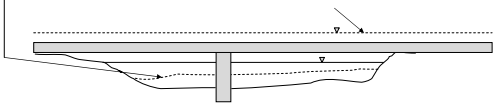
Riverbed Aggradation

- Some rivers have beds that are naturally aggrading due to conditions upstream or downstream.
- Higher riverbed leads to increased flow depth and bridge over-topping.



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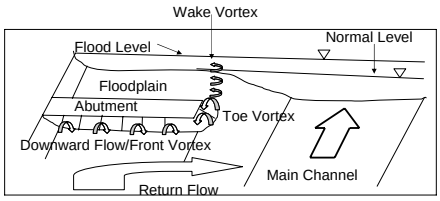
Vortices Around Abutments



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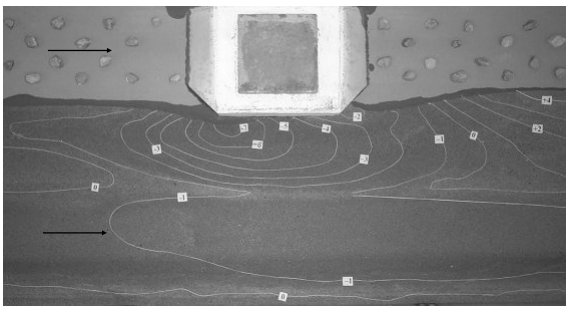
Scour Around Abutment with Floodplain Flow



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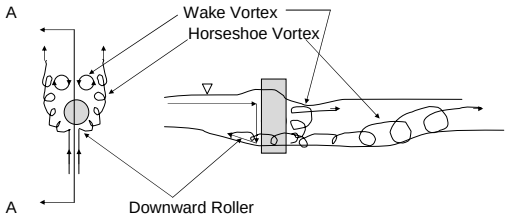
Vortices Around Pier

- PLAN SECTION A-A



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Scour Design Method Summary

- HEC 18, “Evaluating Scour at Bridges” FHA, Publ # FHWA HI-96-031
- 1: Determine scour analysis variables
- 2: Analyze long-term bed elevation change
- 3: Evaluate scour analysis method
- 4: Compute contraction scour magnitude
- 5: Compute local pier scour magnitude
- 6: Compute local abutment scour magnitude
- 7: Plot and evaluate total scour

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Potential Pitfalls With the Design Method

- From lab studies of constant flow for many days
- Tends to over-estimate scour depth
- No analysis of scour hole filling in when the flood is receding

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Scour Countermeasures

- Bank-Hardening (riprap, cable-tied blocks, geobags)
- Flow-Altering (spur dikes, guidebanks)

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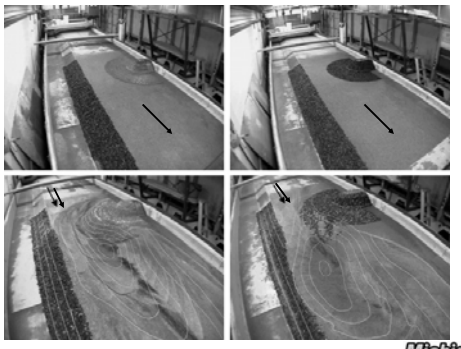
Riprap and Cable-Tied Blocks



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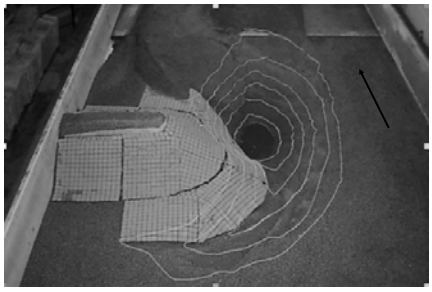
Cable-Tied Blocks

- Large mattresses of blocks tied together with cable



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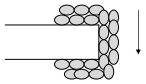
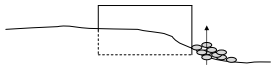
Geobags

- Pervious Bags Filled with Gravel
  - PLAN



  - SECTION
    - Vertical water seepage
    - No winnowing of fines



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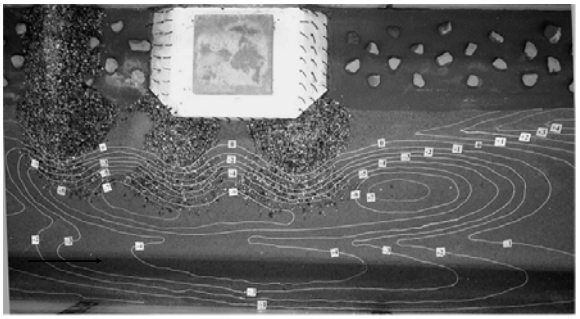
Spur Dikes at Abutment (Rock walls perpendicular to flow to divert flow away from abutment)



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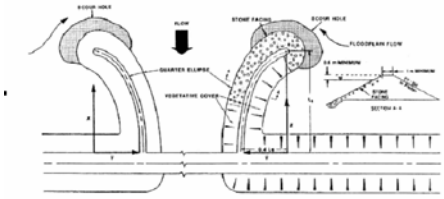
Guidebanks

- Guide flow smoothly through bridge opening



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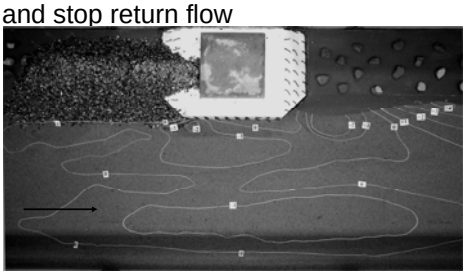
Parallel Walls

- Rock walls parallel to flow to guide flow and stop return flow



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NCHRP 24-18A: Abutment Scour Countermeasures

- Project sponsored by National Academy of Sciences,
- Transportation Research Board,
- National Cooperative Highway Research Project

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Goals and Outcomes

- To produce design guidelines for abutment scour countermeasures
- First study to do this for compound channel flow with flow on floodplain
- Final Report finished by July 2006

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More questions?

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