The Des Moines River caused excessive bank erosion at two sites in Van Buren County. The erosion rate was estimated to be about 2 m/yr, over the last five years (1).

The observed bank loss was along a 600 ft. at site 1 and along 1,800 ft. stretch at site 2. The erosion rate was estimated to be about 2 m/yr, over the last five years (1). And the problem was even worse!

The combination of barbs & spurs is the only cost-effective solution which provides bank protection for overbank flows (1). The scour around the barbs cannot be predicted accurately (2).

The design of efficient hydraulic structures to control bank erosion was complex due to:

Complex hydrodynamics:
A river tributary in front of site 1

Complex near-bank terrain:
The terrain next site 1 is a Native American historical site. Therefore, there were construction limitations which prevented the possibility of moving the local route inwards and the construction of large and invasive structures foundation.

Sensitivity analysis

1) The combination of barbs & spurs is the only cost-effective solution which provides bank protection for overbank flows (1).
2) The scour around the barbs cannot be predicted accurately (2).

Design Procedures and Numerical Modeling of Streambank Protection of the Acorn Avenue and Hawk drive at the Des Moines River

From field work and lab analysis...
River bathymetry recorded with a Sonar Scanner
Banks inspection
Collection of riverbed samples
ADV
Sieve analysis

...to numerical modeling
The FHWA 2D hydrodynamic model FESWMS was chosen to model the river due to its record of successful applications in similar problems (2). FESWMS advantages:
1. Allows drying and wetting of single elements
2. Allows to adapt the grid to a complex bathymetry.
3. Parameters can be modified locally to represent various materials.

Our objectives were:
1) Analyze the regime of the Des Moines River in order to:
2) Identify various bank protection solutions.

RESULTS: identifying the optimal solution to control bank erosion
Des Moines River Regime and bed characteristics

Since 2006 the river has been characterized by larger flow rates and increased high-flow frequency. This may have led to the bank retreat observed by the County engineer. The riverbed was coarse sand.

PARAMETER | SYMBOL | ESTIMATION METHOD
--- | --- | ---
Channel roughness | $n$ | Published data for a similar river (3)
Channel eddy viscosity | $\varepsilon$ | Dispersion coefficient
Channel grid size | $\Delta x$ | Peclet Number criterion $Pe = \frac{U \Delta x}{\varepsilon}$
Barb eddy viscosity | $\varepsilon_B$ | Field measurements (2)
Permissible velocity | $U_c$ | Sieve analysis & Flood frequency analysis

Bibliography


CONCLUSIONS & FURTHER RESEARCH
1) The combination of barbs & spurs is the only cost-effective solution which provides bank protection for overbank flows (1).
2) The scour around the barbs cannot be predicted accurately (2).

Scenario development and modeling

Site 1
Site 2

Site 1
Site 2

Site 1
Site 2

Site 1
Site 2

Site 1
Site 2

Site 1
Site 2