Development of a Security Manual for Historic Covered Bridges

National Center for Wood Transportation Structures
Acknowledgement

• Federal Highway Administration
• USDA Forest Products Laboratory
All But a Lost Art

• Design, construction of covered bridges.
• Many existing bridges are preserved only because of their status on the National Registry.
• Or, due to diligent maintenance and care by owners and other interested parties.
• Arson, vandalism, neglect, natural disasters...
Objective

• Provide covered bridge engineers with tools to quickly and efficiently design and implement security measures.
  – Usable
  – Flexible
  – Practical
  – Adaptive
  – Low-tech to high-tech
Approach

• In-depth analysis of options ranging from control of terrain to installation of automated systems.

• Consideration of needed expertise, value, limitations, practicality.

• Also reviewed maintenance needs, power requirements, expertise needed, etc.
Case Studies

• Detailed information on systems installed at multiple locations.
• Fictitious cases where multiple options (and costs) are considered.
Structural Security

• Blue Ribbon Panel on Bridge and Tunnel Security.
  – Five levels of security for bridges
    • Deterrence, deny access, detect presence, defend the facility, and design structural hardening
Deter

• Discourage action by means of fear or doubt.
• Fear/doubt is that you would be caught and prosecuted.
• Equipment
  – Alarm system: audible or silent, detect-transmit-alert-react
  – Lighting: eliminate/reduce the cover of darkness; perimeter, area, flood, gatehouse
  – Signage: effective at causing doubt
Deny

• Limit or eliminate access to the bridge.
• One of the more difficult security options.
• Equipment
  – Barricades: natural (rivers, brush, etc.), man-made (planters, bollards, k-rail, guard rails, berms)
  – Fences: chain link, barbed wire, wrought iron, wood, block wall
Detection

• Detection of threats can be an invaluable portion of a security system design.
• Facilitates alerting of authorities.
• Equipment
  – Camera: CCTV, infrared
  – Heat detector: fixed temperature or rate of rise
  – Smoke detector: vulnerable to dust, etc.
  – Flame detector: detect heat and flicker rate
Defend

• Ability to react to an attack.
• Different from hardening in that defend mechanism are not structural in nature.
• Equipment
  – Fire hydrant
  – Sprinkler system: dry-pipe systems are preferred
  – Fire retardant materials: reduce the ability of wood to burn
  – Intumescent coatings: chemically bound water is released when exposed to heat
Considerations

• Infrastructure placement: aesthetics, line of sight, functional.
• Enclosures: aesthetics, environmental protection.
• Power: grid power, renewable (wind, solar), storage
Madison County Case Study

• Covered bridges are an important economic draw to Madison County
  – Made famous by the book and movie.

• Madison County received a grant to upgrade security of all bridges following arson of the Cedar Bridge and Francesca’s house.
Components

• Internal communication equipment
• Video camera
• IR camera
• Flame detectors
• Renewable energy source
• 3G internet access
• On-site data processing
• Text/page/email alerts in the event of a trigger
  – Sherriff, fire department, police chief
Communication and Processing
Video Camera
IR Camera
Flame Detector
Storage
Power
Slaughter House Bridge Hypothetical

• Option 1 – Intumescent coating plus signage
  – Cost: Low
  – Protection: Moderate
  – Maintenance: Low-Moderate
  – Goal: Provide some protection and minimize damage.
  – Reason: Proximity to medium sized-city with fire-department felt to provide good safety net as long as threats can be quickly identified.
Slaughter House Bridge Hypothetical

- Option 2 – Lighting plus flame detectors
  - Cost: Moderate
  - Protection: Moderate-High
  - Maintenance: Moderate
  - Goal: Deter trespassers
  - Reason: Proximity to major highway and residential area provides significant deterrence. These technologies upgrade the security to include detection.
Slaughter House Bridge Hypothetical

• Option 3 – Lighting plus sprinkler system
  – Cost: High
  – Protection: High
  – Maintenance: Moderate
  – Goal: Ensure survival of bridge by protecting middle of span.
  – Reason: Relatively easy access to water source reduces cost of sprinkler system.
Other Case Studies

• Union County Covered Bridges – linear heat detection cable with alarming plus LED lights
• Knecht’s Covered Bridge – alarm system with strobes and horns connected to linear heat detection plus dry sprinkler system.
• Pomeroy-Academia Covered Bridge – Eight cameras plus fire retardant.
• Red Covered Bridge – Internal lights controlled by photocells plus five cameras.
Concluding Remarks

• A tool does exist to help covered bridge engineers improve/upgrade security.
• Tools range from low-cost to high-tech.
• Tools help engineers match budget limitations with the best security value.
Thank You!

Questions?

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