Development of a Security Manual for Historic Covered Bridges

National Center for Wood Transportation Structures
Acknowledgement

Federal Highway Administration
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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
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
Equipment Selection Flowchart for Covered Bridges

**Deter**
- Alarm System
- Lighting
- Signage

**Deny**
- Barricades
- Fences

**Detection**
- Infrared Camera
- Video Surveillance
- Heat Detector
- Smoke Detector
- Flame Detector
- Fiber Optic Sensor

**Defend**
- Fire Hydrant
- Sprinkler
- Fire Retardant Material
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
- 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
- Videocamera
- IR camera
- Flame detectors
- Renewable energy source
- 3G internet access
- On-site data processing
- Text/page/email alerts in the event of a trigger
  - Sheriff, fire department, police chief
Communication and Processing
Video Camera

[Images of a video camera and a scene]
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.
Concluding Remarks

- A tool does exist to help covered bridge engineers improve/upgrade security.
- Tools range from low-cost to high-tech.
Covered Bridge
Security Manual

Chapter 1: Introduction

Chapter 2: Design

Chapter 3: Construction

Appendices

Figure 1.1: Example Covered Bridge

Figure 2.1: Covered Bridge Design

Figure 3.1: Covered Bridge Construction

Figure A.1: Covered Bridge Appendices