SUSPENSION TRAIL BRIDGE USING SUSTAINABLE MATERIALS

Rattlesnake Creek, Missoula, Montana

Brad Miller PE
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HDR

PROJECT BACKGROUND

- Initial Concept by Others Showed Cable Stayed Bridge Using Smallwood

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Friends of Missoula Parks, Inc.

Forest Service U.S. Department of Agriculture

Montana Community Development Corporation

Intermountain Roundwood Association

The Garden City Missoula Hub of Five Valleys

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- Considered 90 Foot Cable Suspension and Prefab Steel Bridges in Preliminary Design
- Suspension Bridge Chosen for Aesthetics and to Take Advantage of Smallwood Grant

Friends of Missoula Parks, Inc.
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- 6 Inch Turned Logs From the Nez Perce NF Stress Rated and Stockpiled For This Project
- Use This Sustainable Design Resource For Bridge Members to Qualify for Grant

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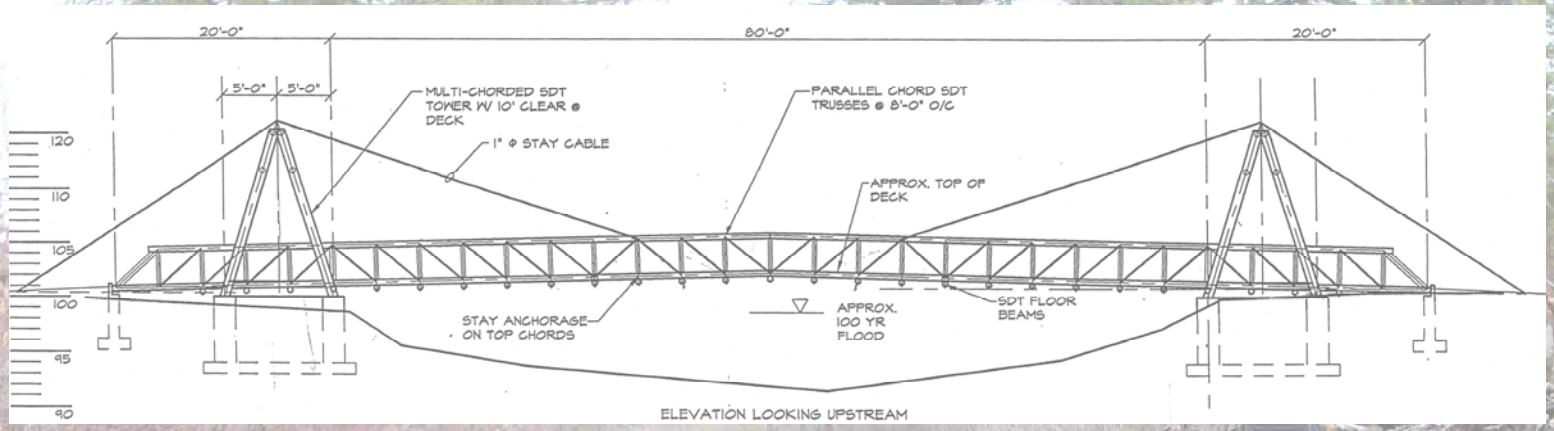
PRELIM DESIGN STRATEGY



- Original Cable Stayed Bridge Concept By Others

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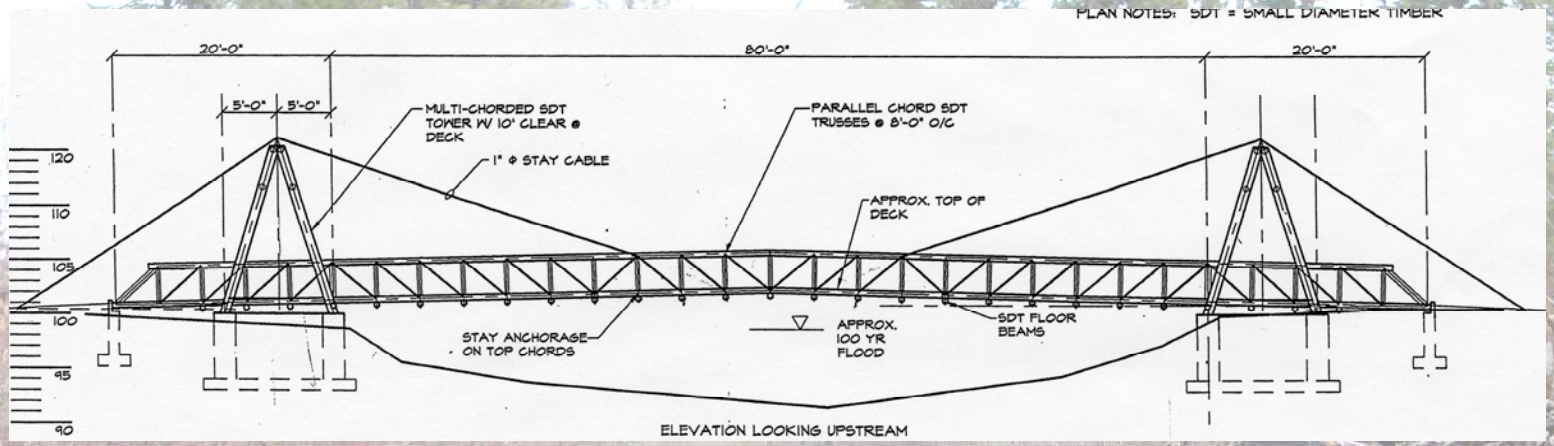

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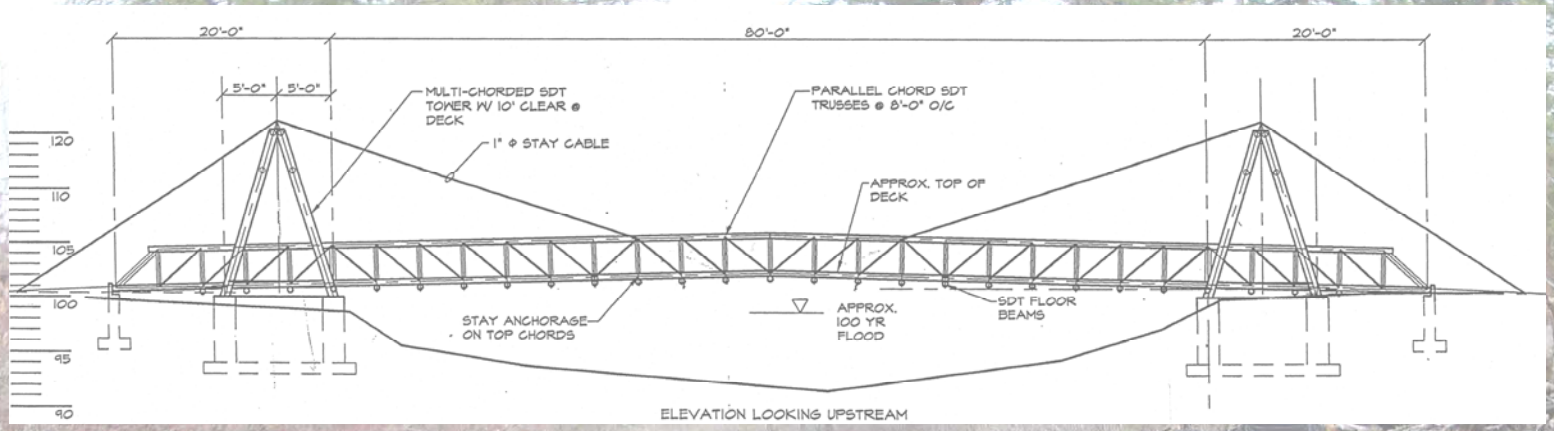

- Reduce Cost of Cable Stayed Concept, or Revise Concept – Incorporate Roundwood

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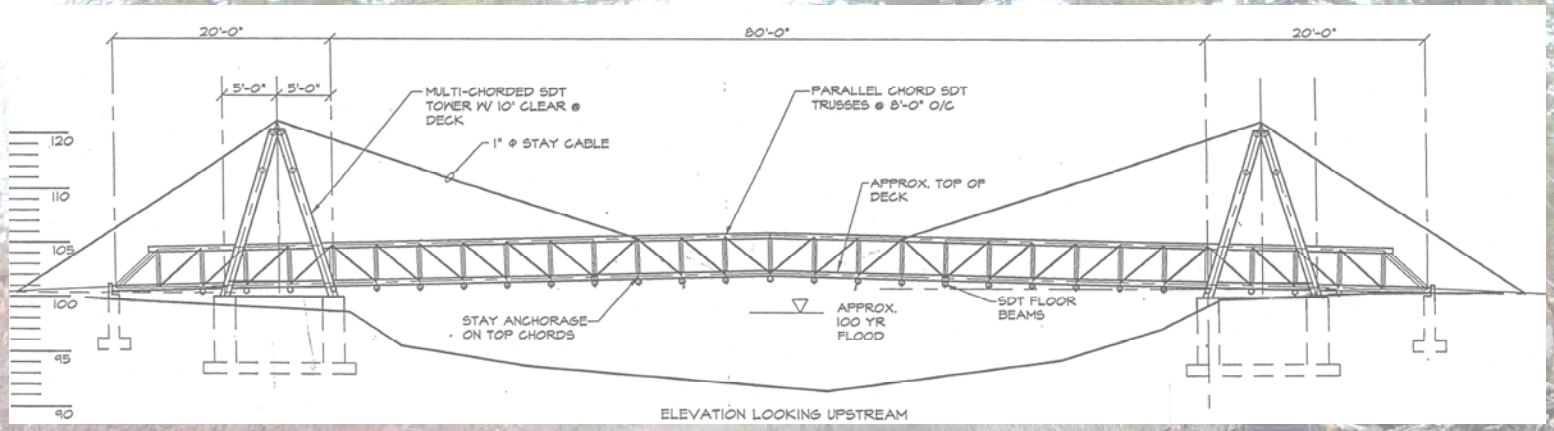

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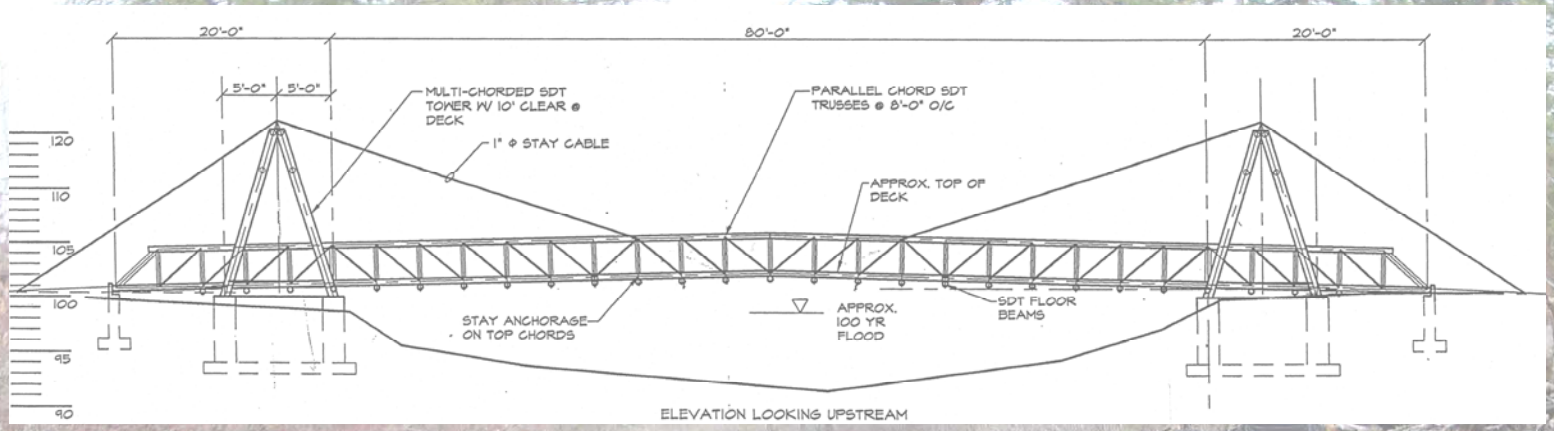

- Reduce Cost of Cable Stayed Concept, or Revise Concept – Incorporate Roundwood
- Simplify Details for Ease of Construction, Long Term Maintenance, and Aesthetics
- Improve What Works, Avoid What Doesn't Work

PRELIM DESIGN STRATEGY

Look at Existing US Forest Service Back Country Pack Bridge Designs

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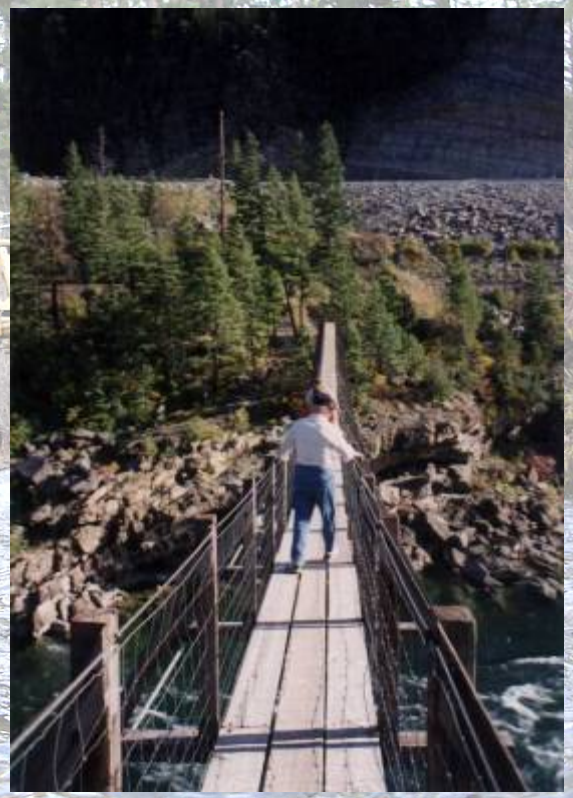
USFS SERVICE SUSPENSION BRIDGES



Typical USFS Suspension Foot Bridge,
Kootenai River Near Libby, MT

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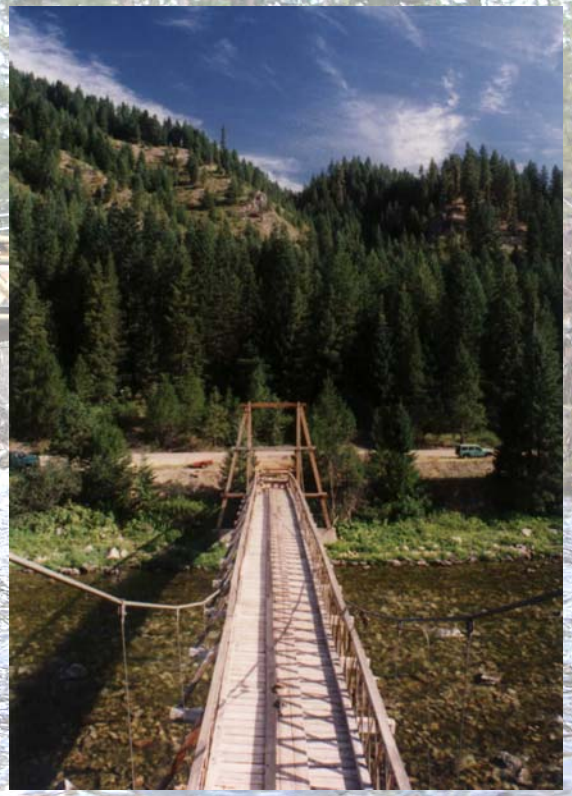
USFS SERVICE SUSPENSION BRIDGES



Typical USFS Suspension Pack Bridge With Hanger Cables, Lochsa River In Idaho

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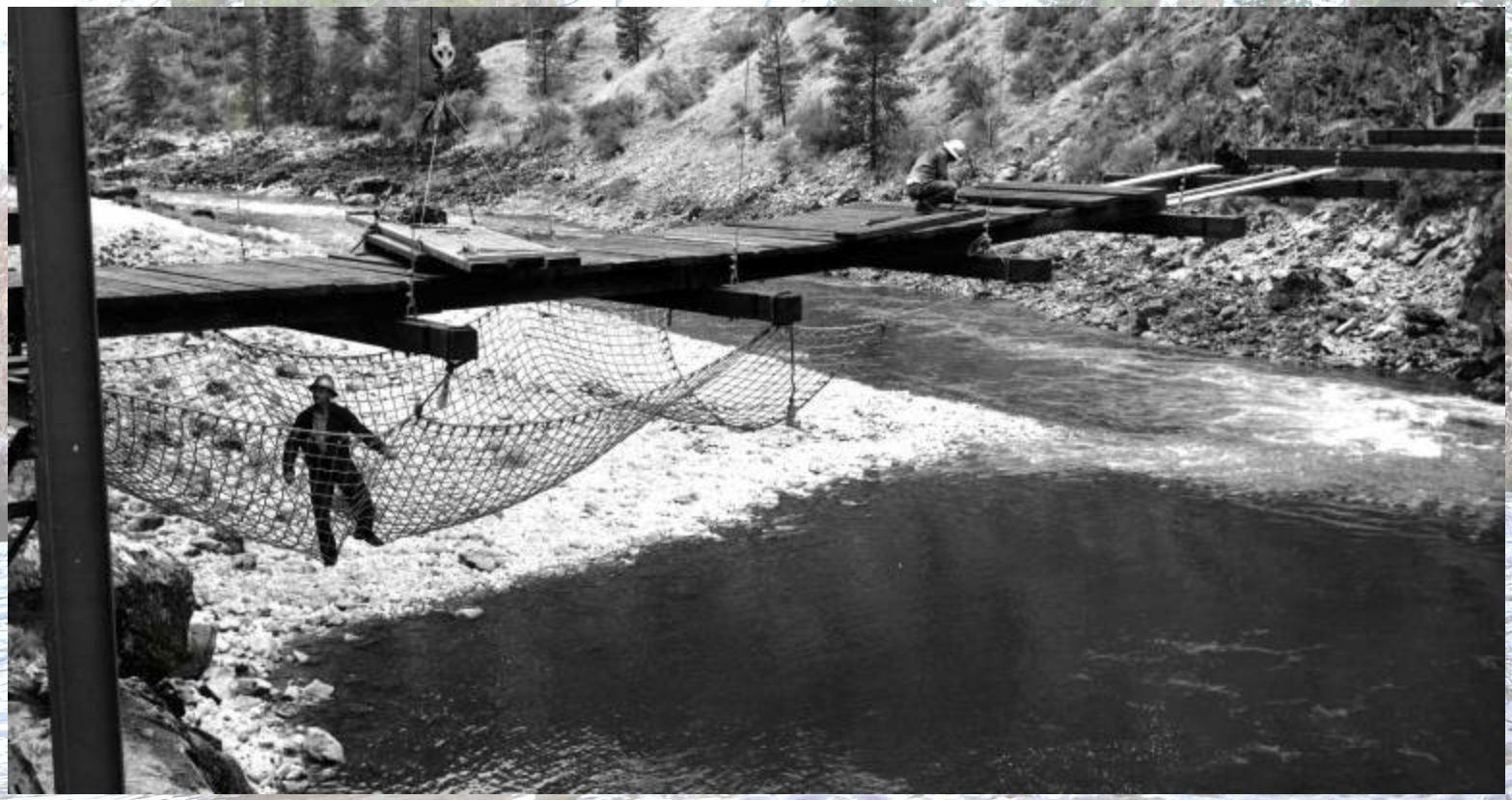
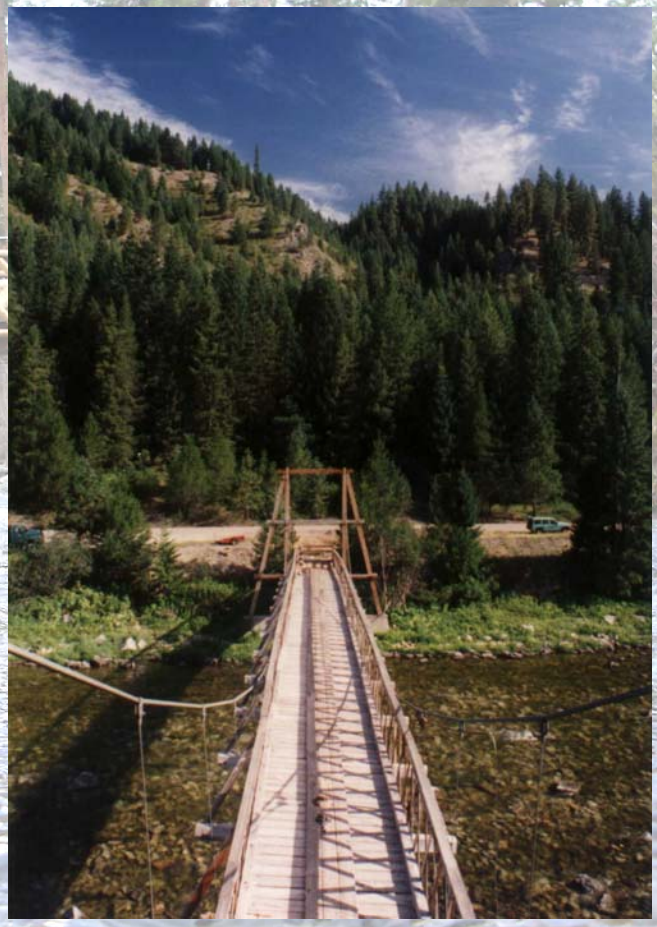
USFS SERVICE SUSPENSION BRIDGES



Construction of USFS Salmon River Pack Bridge Near Mouth of Wind River, ID (1960)

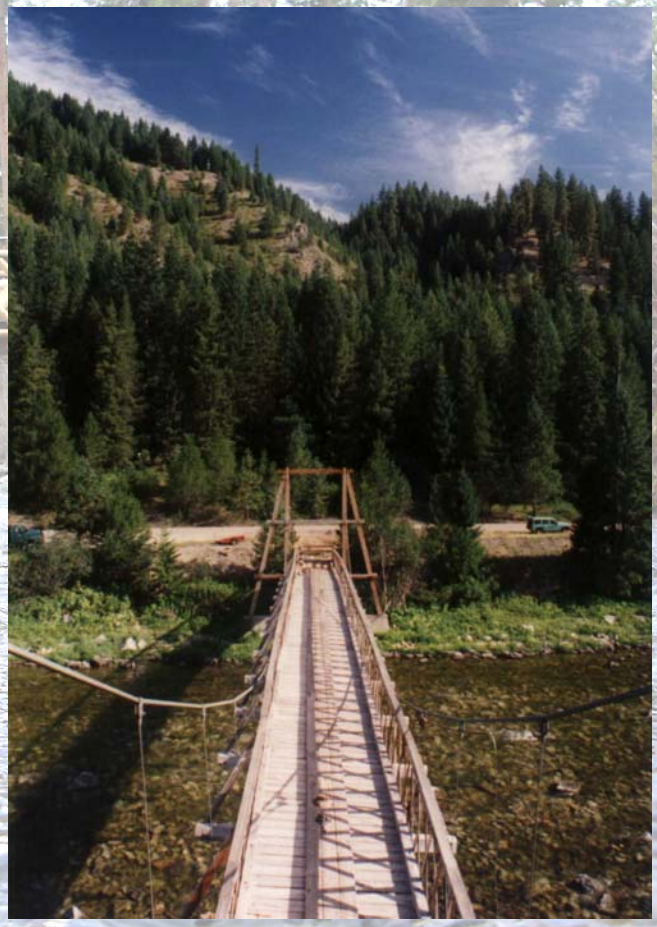
USFS SERVICE SUSPENSION BRIDGES

- 75 to 400 Feet, 1930 to 1960



USFS SERVICE SUSPENSION BRIDGES

- 75 to 400 Feet, 1930 to 1960
- Local Materials, Untreated, Replaced Later With Treated



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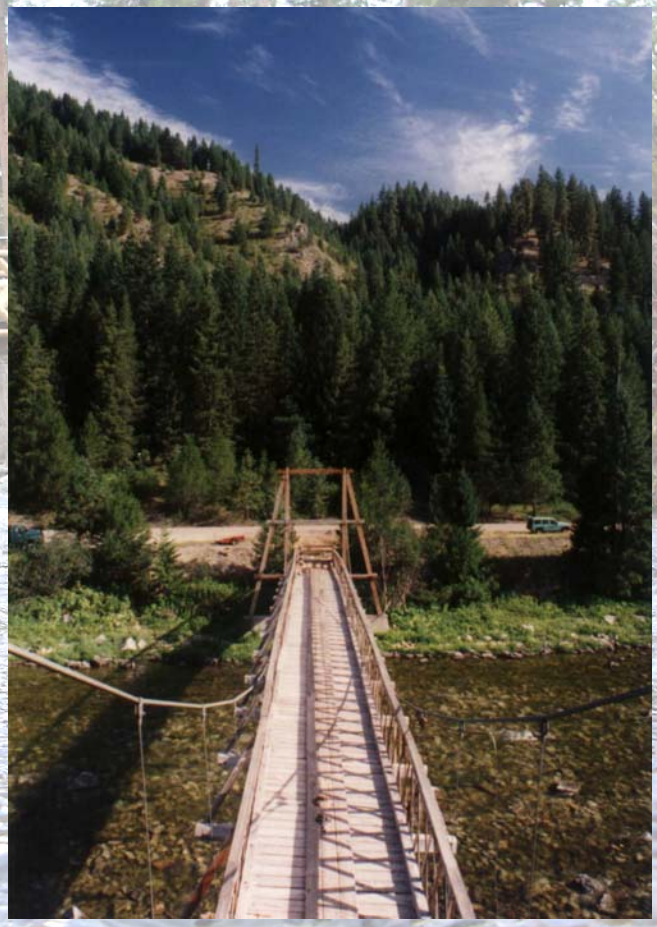

USFS SERVICE SUSPENSION BRIDGES

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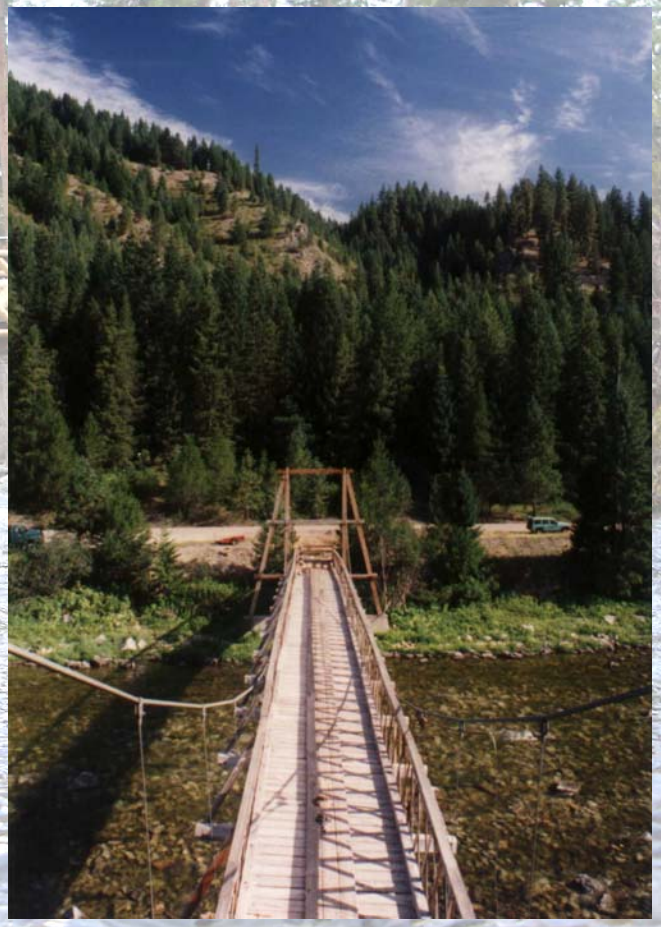
- Local Materials, Untreated, Replaced Later With Treated
- Later Bridges Treated Initially
- Stiffening Trusses Added Early On To Reduce Bounce



USFS SERVICE SUSPENSION BRIDGES

- 1X6 Lattice with 2~2X6 Top and Bottom Chords

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- Problems With Splices and Connections
- Towers Hard to Rehab
- Many of These Have Lasted 75 Years!

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FINAL DESIGN STRATEGY

- Use Lattice Stiffening Trusses, From Half Rounds, Face Flat Sides Toward Each Other

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- Use Structural-Tees Top and Bottom to Tie Everything Together

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- Eliminate Stringers For Simplicity and Savings

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- Run 3 1/8” Glu-Lam Deck* Longitudinally over Floor-Beams

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*Composite Deck Proposed Later & Used

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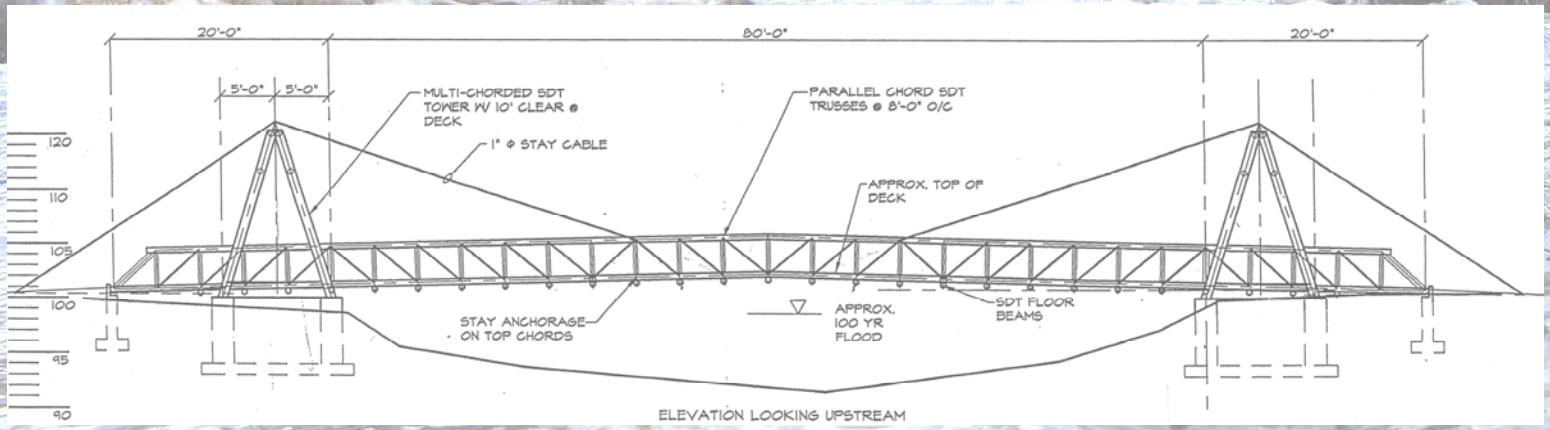
Suspension Bridge - Lattice Stiffening Truss



Original Cable Stayed Bridge Concept

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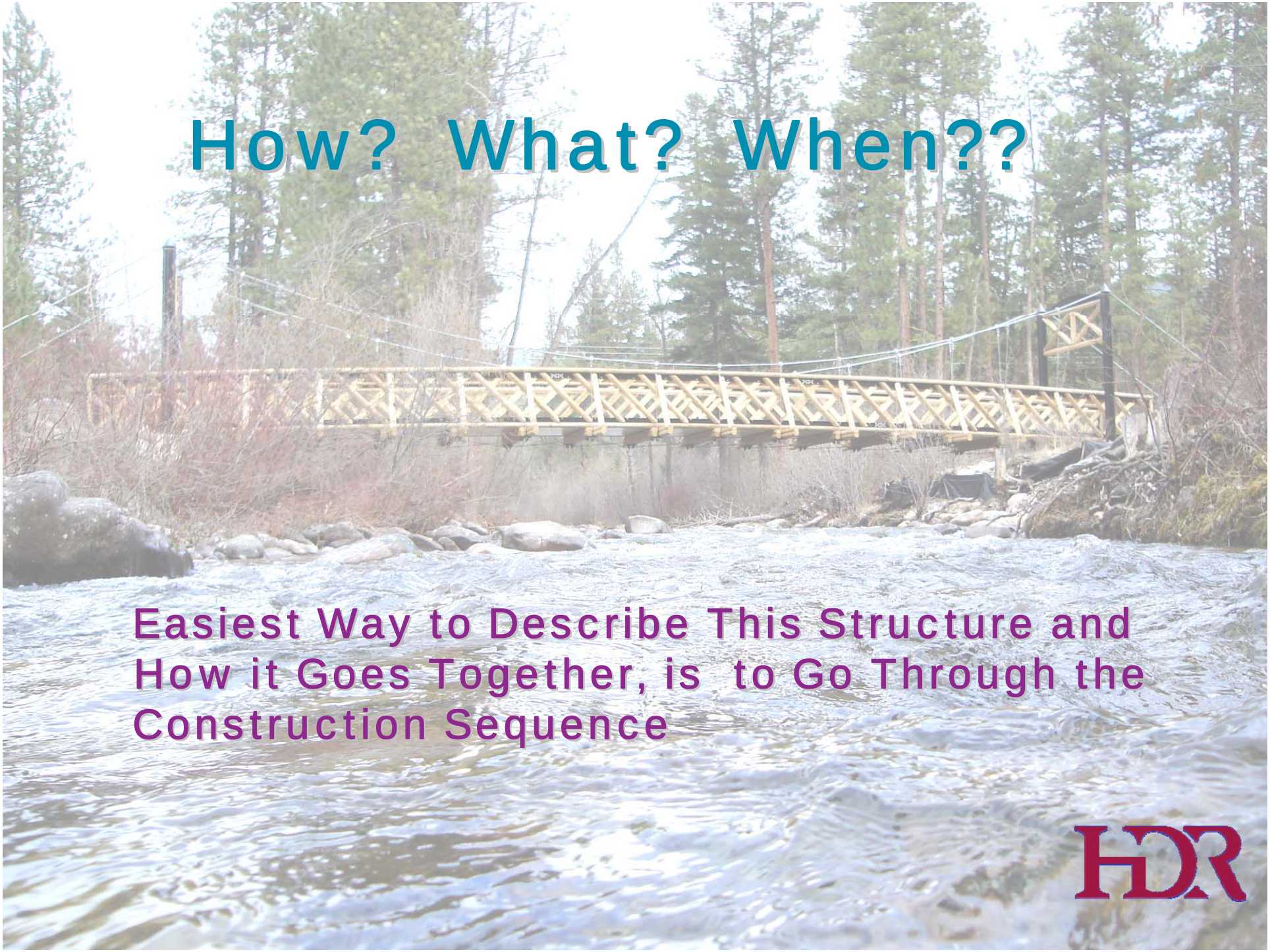
How? What? When??
Easiest Way to Describe This Structure and How it Goes Together, is to Go Through the Construction Sequence
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CONSTRUCTION SEQUENCE

Cable Anchors

Pier Tower Footings

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CONSTRUCTION SEQUENCE

Cables Connections

Towers and Cables

CONSTRUCTION SEQUENCE

Smallwood Floor-beams, Braces, and Stiffening Trusses With Split Ring Shear Connectors

SUSTAINABLE MATERIALS!

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CONSTRUCTION SEQUENCE

Floor-beams, Braces, and Stiffening Trusses

SUSTAINABLE MATERIALS!

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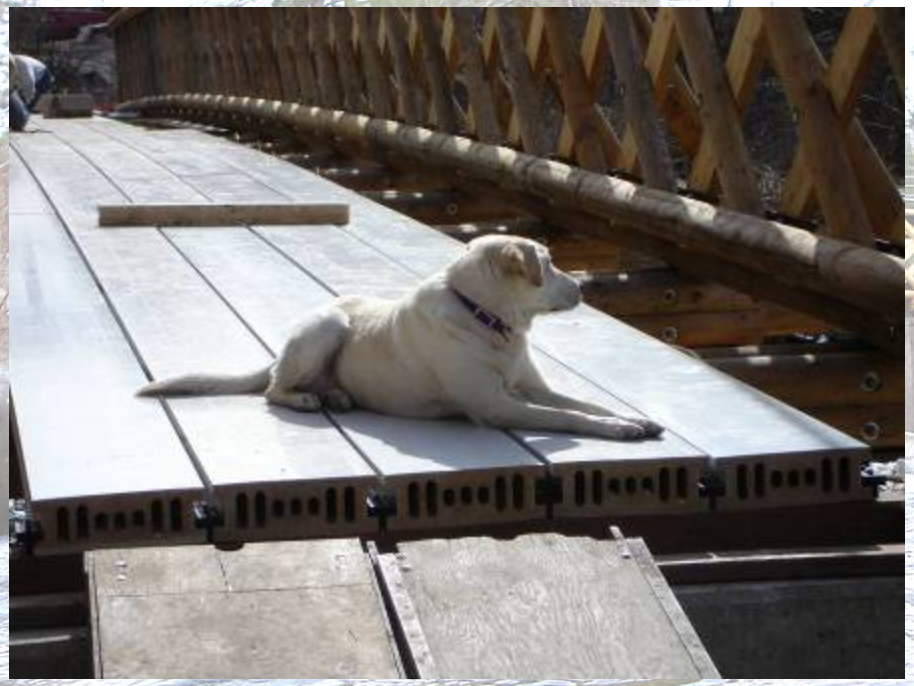
CONSTRUCTION SEQUENCE



Special 4X12 Composite Deck Made From
50% Sawdust and 50% Recycled Plastic

SUSTAINABLE MATERIALS!

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CONSTRUCTION SEQUENCE

Steel Plates and Cones Installed on Towers as Climbing Deterrent

CONSTRUCTION SEQUENCE

Concrete Approaches and Vinyl Coated Mesh

CONSTRUCTION SEQUENCE

4’x8’x¾” Rubber Mats – Recycled Tires

SUSTAINABLE MATERIALS!

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RIBBON CUTTING

April 21, 2006

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Rattlesnake Creek Pedestrian Bridge

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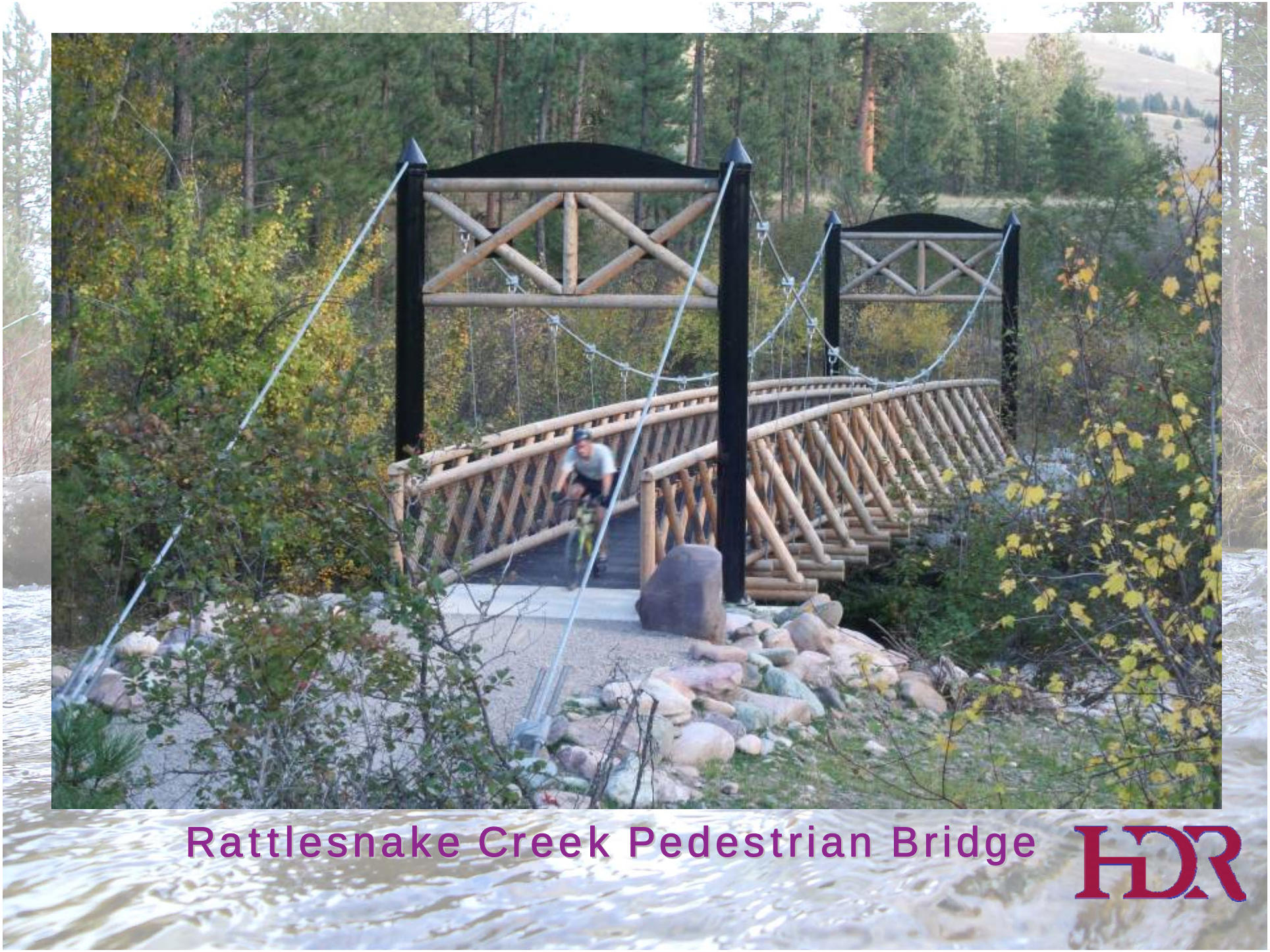

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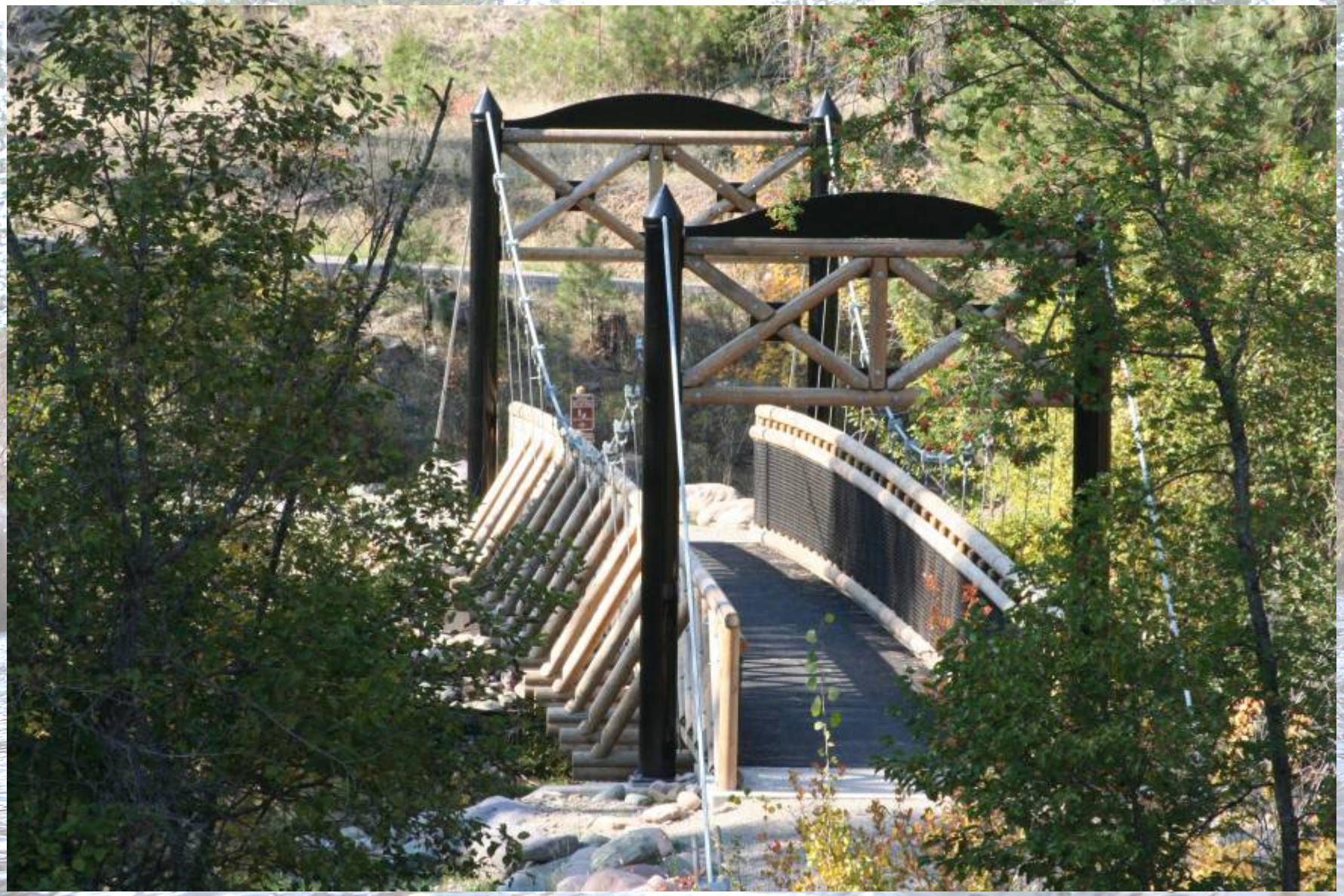

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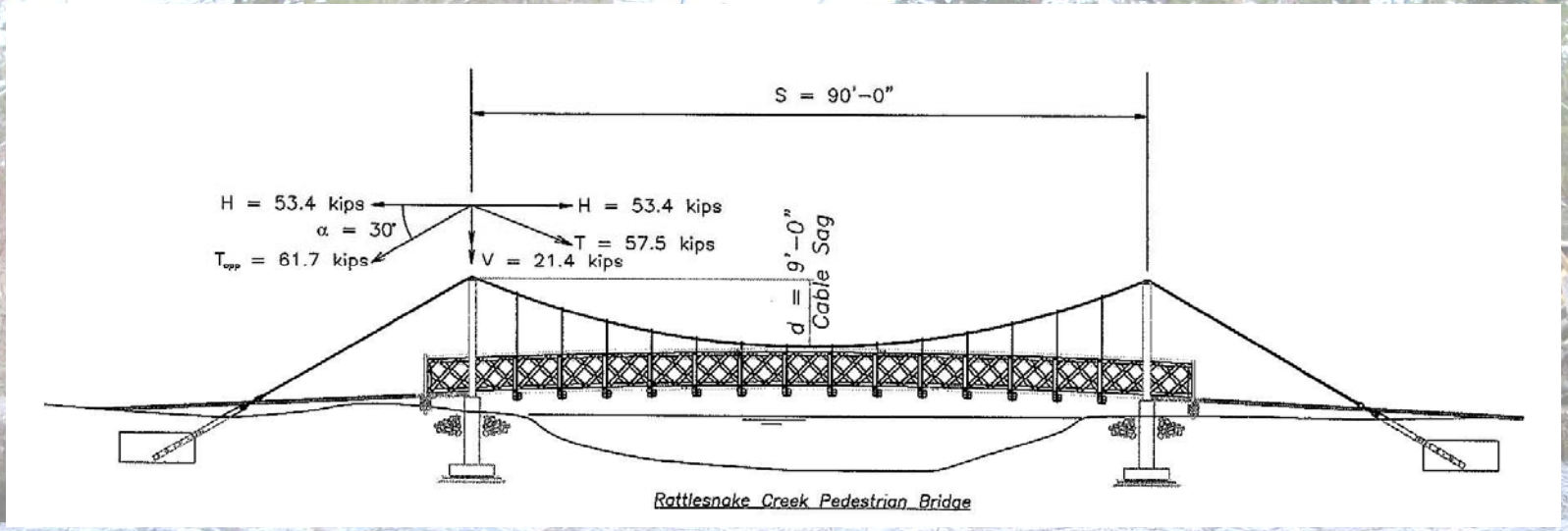
DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- Cable Sag Should be 8% to 10% of Span

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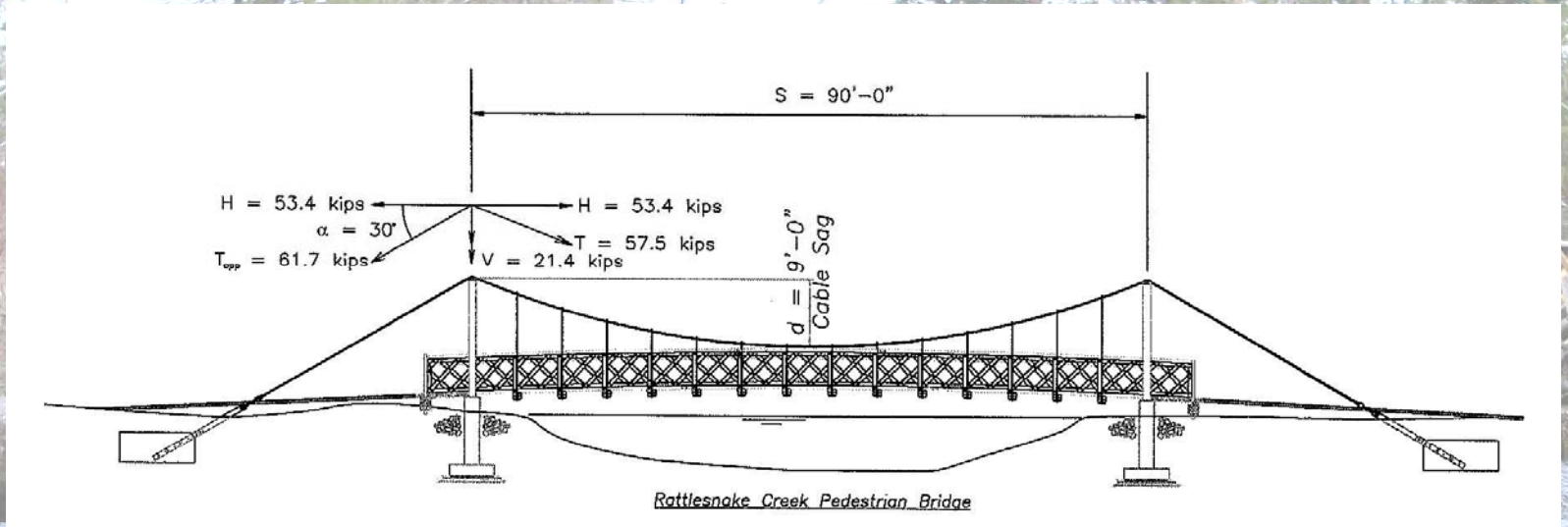
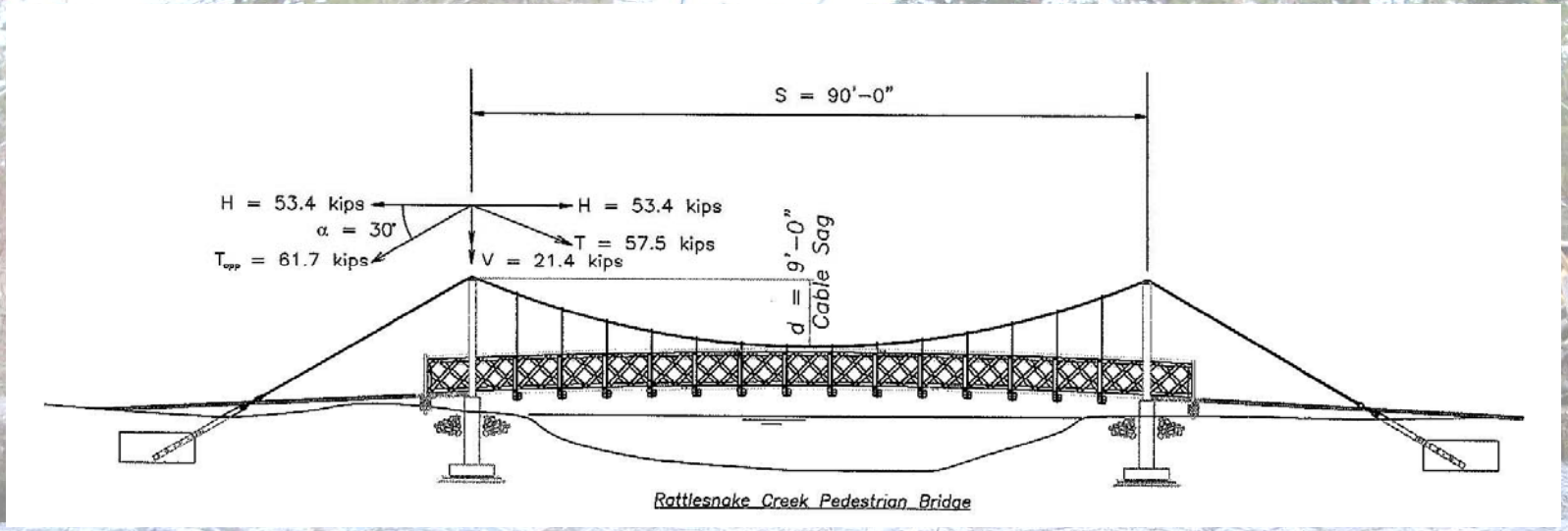


Rattlesnake Creek Pedestrian Bridge

- Cable Sag Should be 8% to 10% of Span
- Deck Camber is for Aesthetics etc, Consider 1% of Span, Check ADA

DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- 85 psf Pedestrian Load with Allowable Reduction According to AASHTO, but Not Less Than 65 psf

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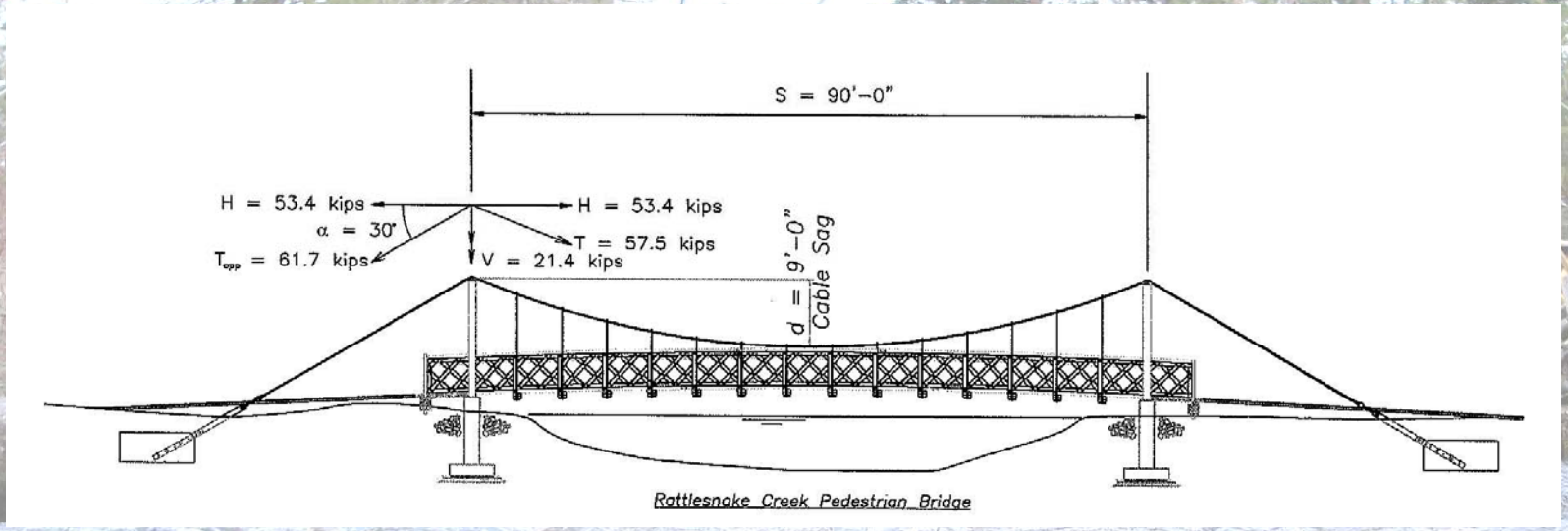
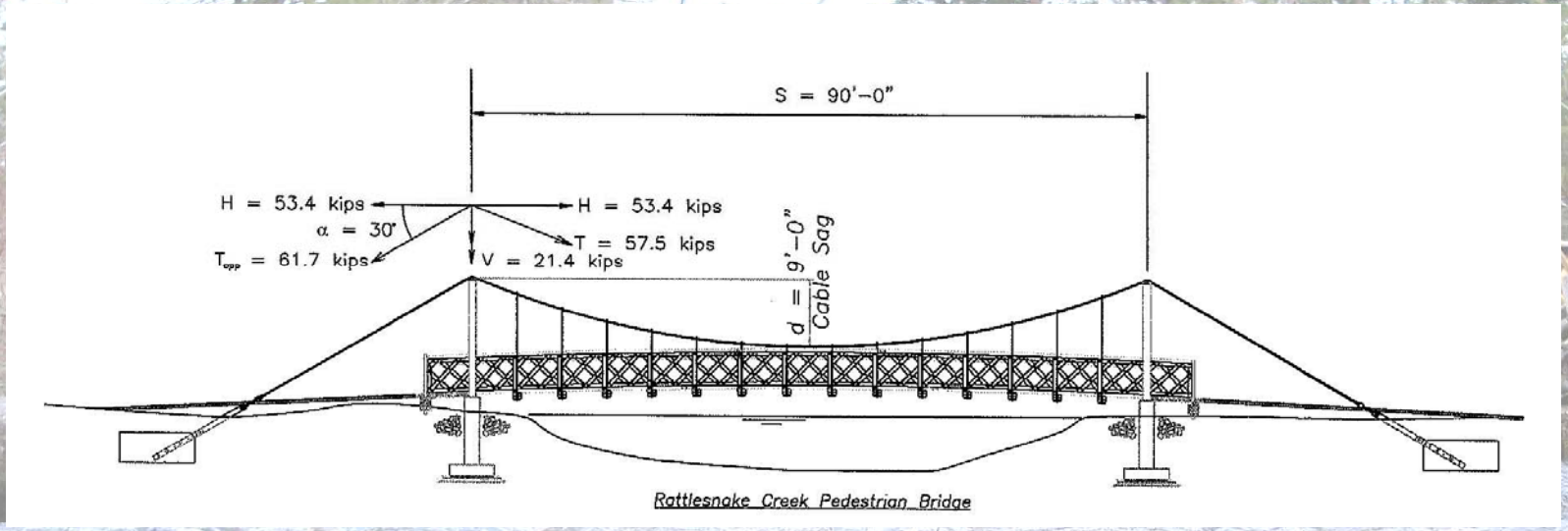


Rattlesnake Creek Pedestrian Bridge

- 85 psf Pedestrian Load with Allowable Reduction According to AASHTO, but Not Less Than 65 psf
- Consider Snow, Light Vehicles, and 1,000 Pound Point Load if the Bridge is for Horses

DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- Approximate Hanger Forces as Uniform Loads for Main Cables Forces, Close Enough for Small Br.'s

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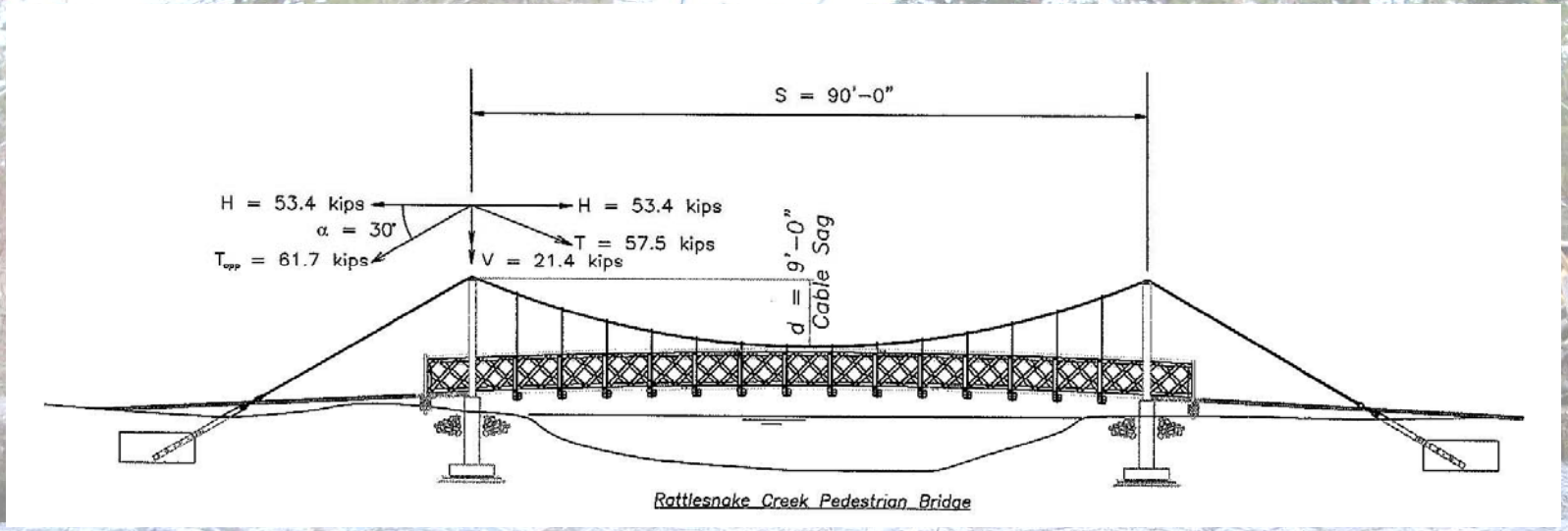

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- $H=wL^2/(8d)$ $V=wL/2$ $T=(H^2+V^2)^{1/2}$

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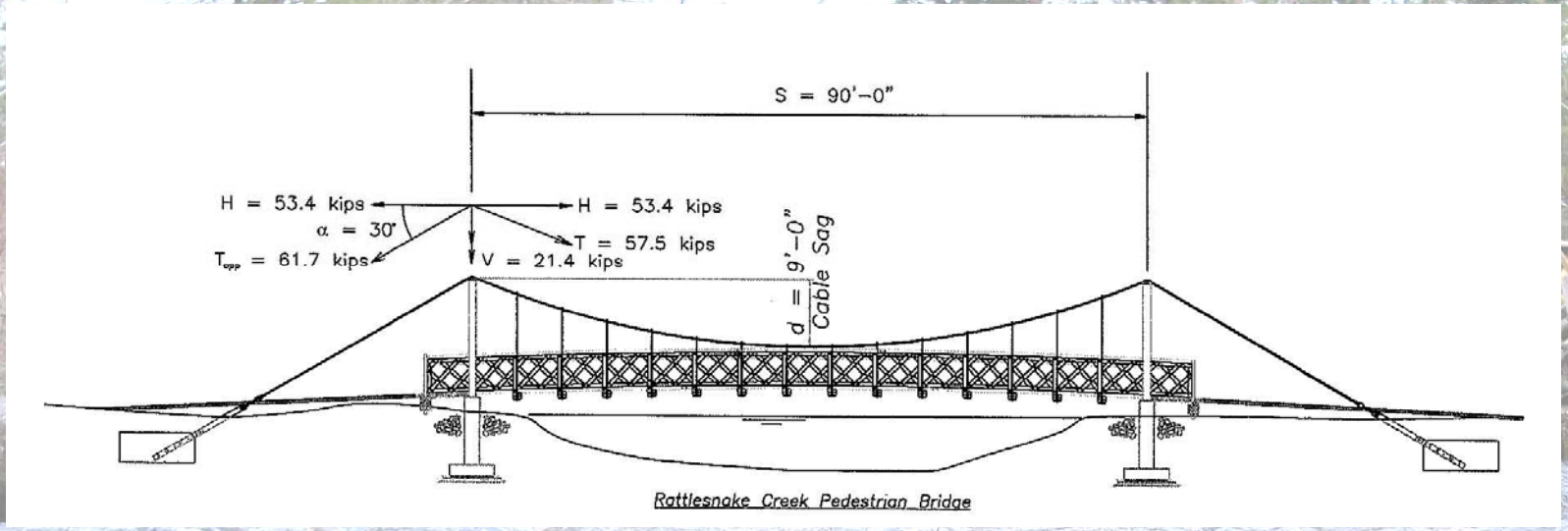

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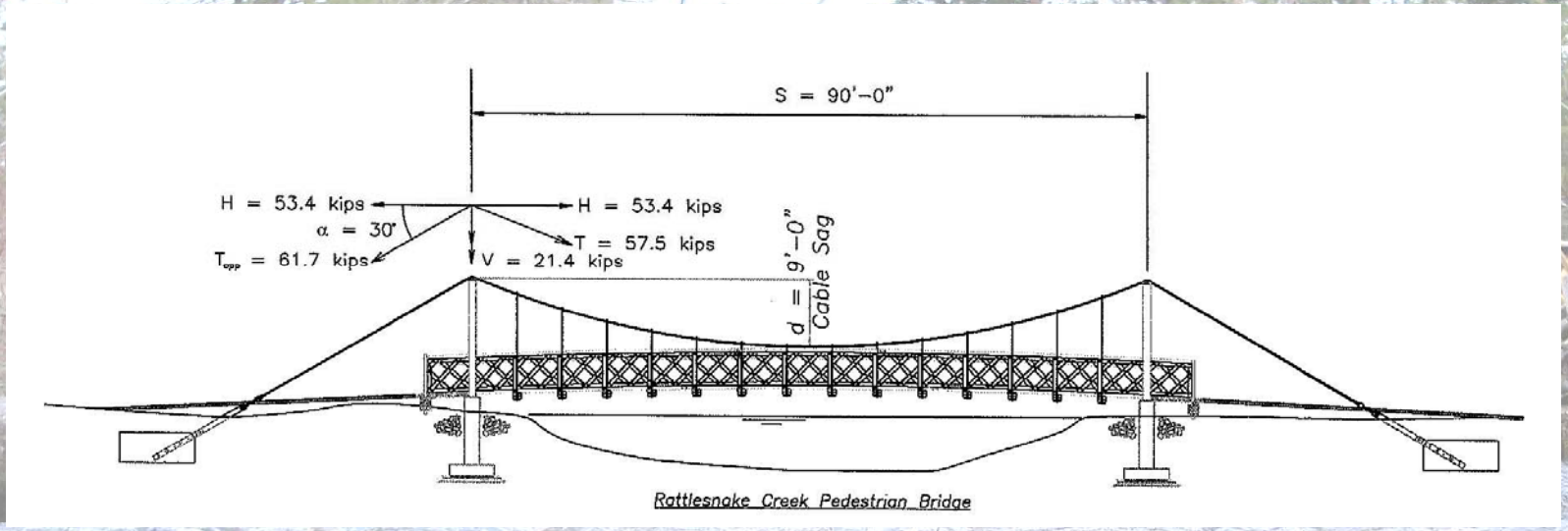
- Approximate Hanger Forces as Uniform Loads for Main Cables Forces, Close Enough for Small Br.'s
- $H=wL^2/(8d)$ $V=wL/2$ $T=(H^2+V^2)^{1/2}$
- Check T on Back Span if Angle is Different

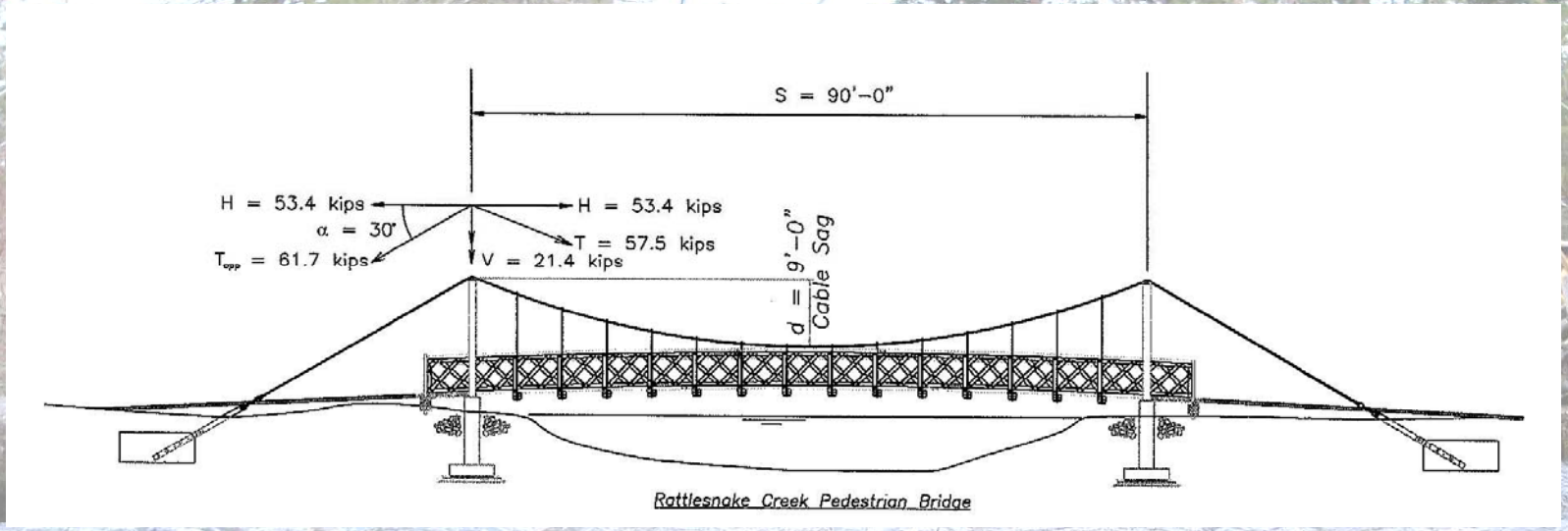
DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- Factor of Safety for Cables and Connections = 3.0

DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- Factor of Safety for Cables and Connections = 3.0
- Cable Anchors Sized So That $W_{anchor} > 2V$, and

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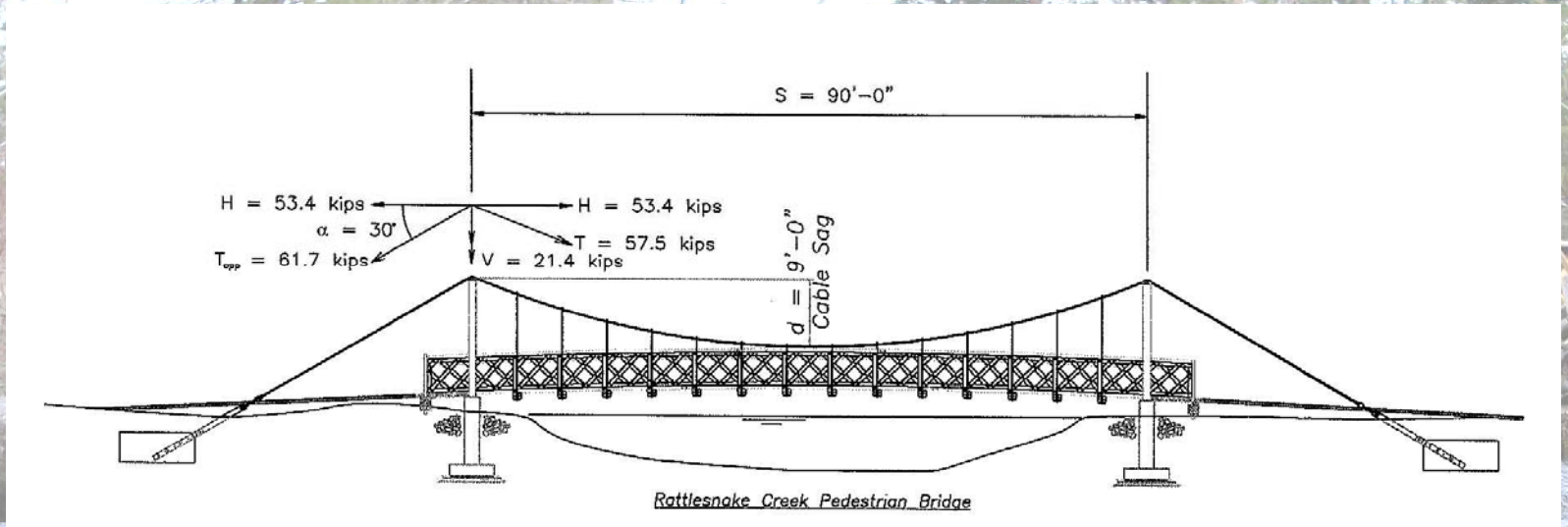
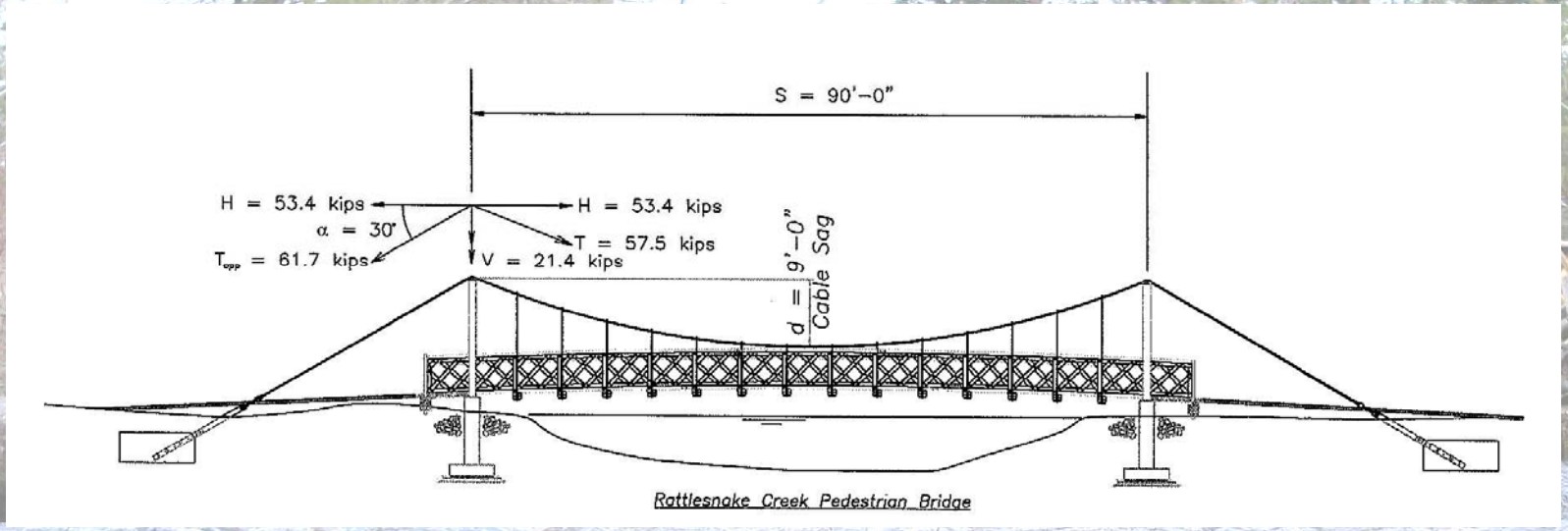


Rattlesnake Creek Pedestrian Bridge

- Factor of Safety for Cables and Connections = 3.0
- Cable Anchors Sized So That $W_{anchor} > 2V$, and
- Earth Pressure on Front Face < 2000 psf

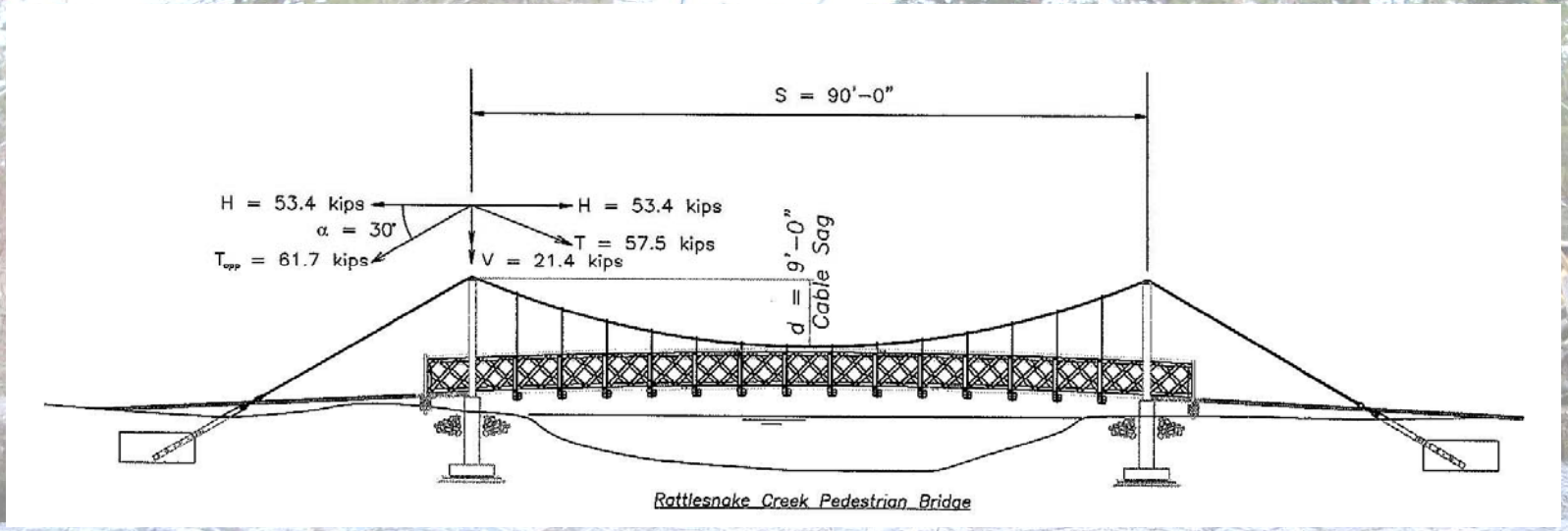
DESIGN GUIDELINES



Rattlesnake Creek Pedestrian Bridge

- Design Sway Bracing and/or Sway Cables for Wind

DESIGN GUIDELINES



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- AASHTO Specifications Control

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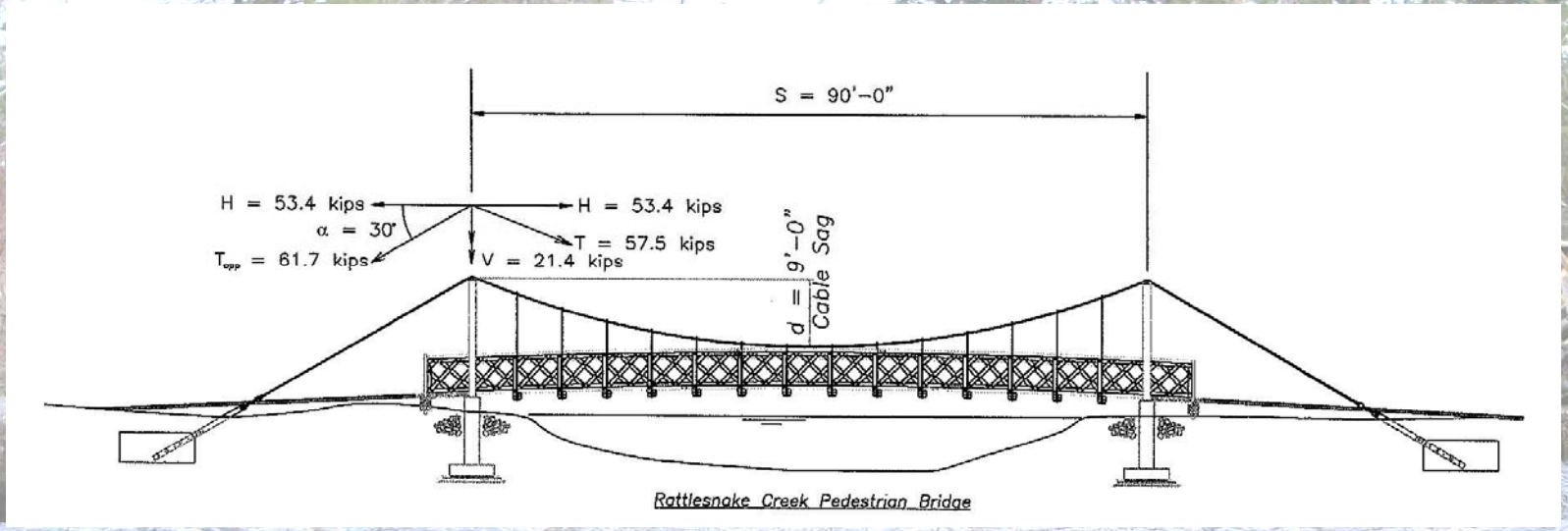

Rattlesnake Creek Pedestrian Bridge

- Use Rule of Thumb For Stiffening Truss by John Roebling

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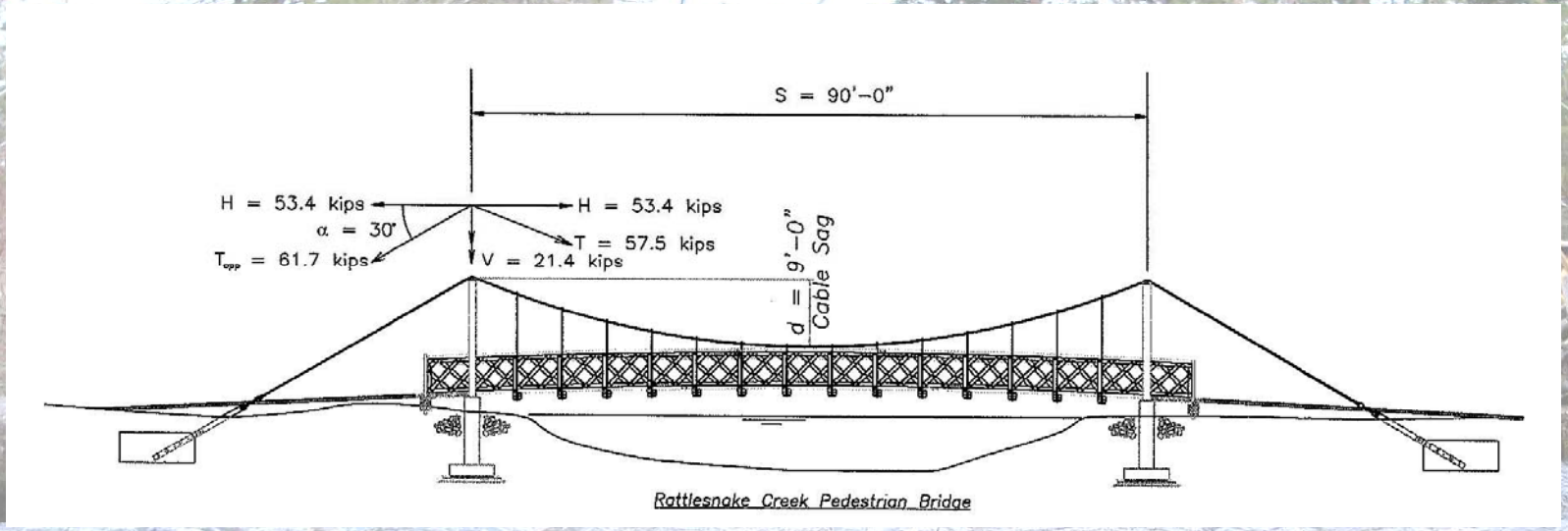

Rattlesnake Creek Pedestrian Bridge

- Use Rule of Thumb For Stiffening Truss by John Roebling
- Treat as Equivalent Simple Span = 0.4S for Live Load Only

Rattlesnake Creek Pedestrian Bridge
Questions????