OTEC
2004

Dan Carrier
Parsons Brinckerhoff

Project Manager
Cooper River Bridge
Charleston, South Carolina

Dan Carrier
Background

- **Hazelet & Erdal** **1966 - 1984**
  (Cincinnati, Ohio Office)
  Bridge Designer

- **Parsons Brinckerhoff** **1984 - 2004**
  Project Manager

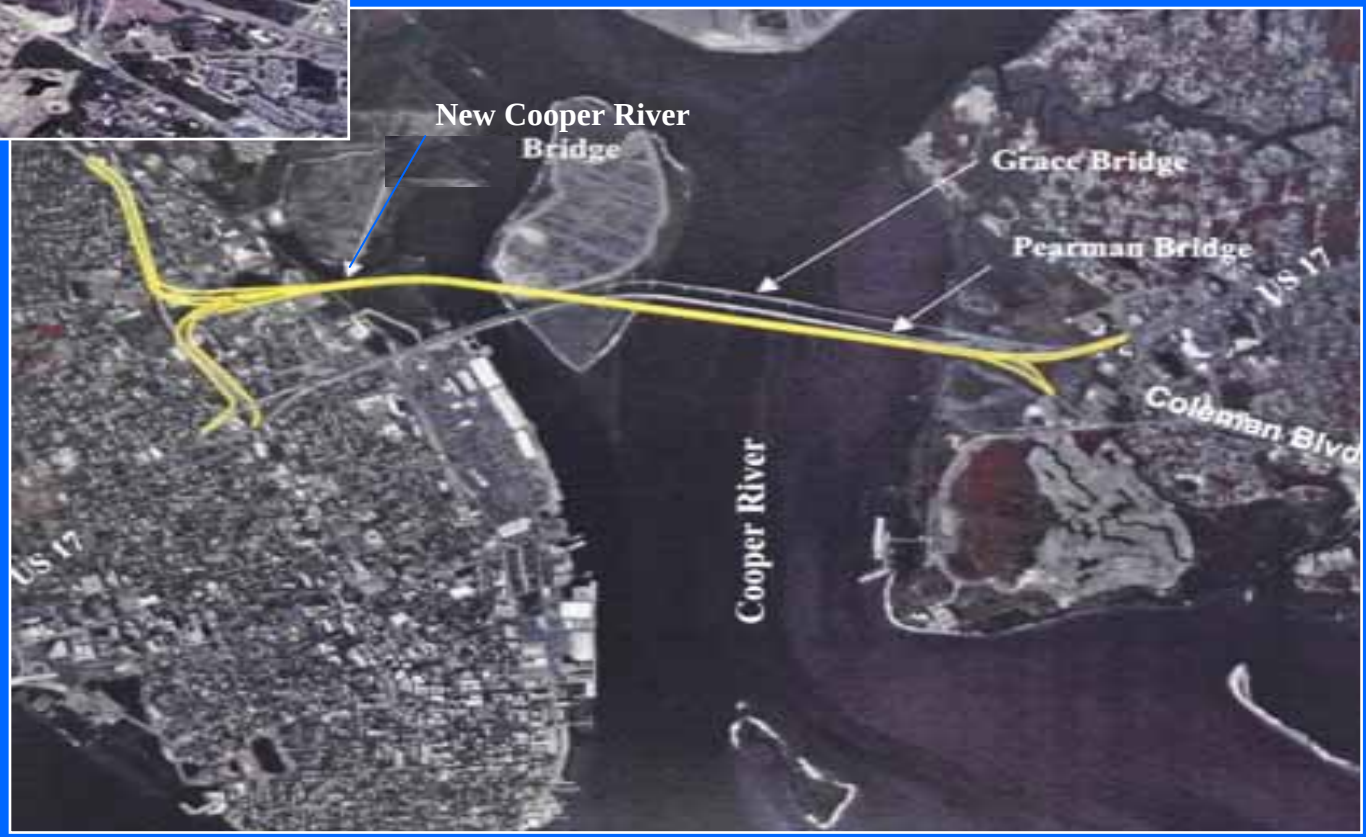
Dan Carrier
PB Project Experience

- **Ankara Motorway** — **Manager - Structures**
  Ankara, Turkey ($1.5 B)
- **Frankford Elevated Reconstr.** — **Project Manager**
  Philadelphia, PA ($495 M)
- **895 Bridge** — **Project Manager**
  Richmond, VA ($170 M)
- **Fort Washington Way** — **Project Manager**
  Cincinnati, OH ($330 M)
- **Cooper River Bridge** — **Project Manager**
  Charleston, SC ($531 M)

DESIGN AND CONSTRUCTION OF THE COOPER RIVER BRIDGE

Charleston, South Carolina

Bird's Eye View
Cooper River Bridges
Charleston, SC



Cooper River Bridge
Charleston, SC

Before

After

Cooper River Bridge
Charleston, SC

The new bridge has steel edge girders and floor beams. The total bridge length is 13,200 feet (2.5 miles) end to end.

Design/Construction Team
Cooper River Bridge

PBC
Palmetto Bridge Constructors

A Joint Venture of

SKANSKA
Lead Firm

and

hbg
Partner

FLATIRON
STRUCTURES COMPANY

With

PB PARSONS BRINCKERHOFF

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- Ship Collision / Rock Islands
- High Seismic Zone
- Hurricane Wind Area
- Fast Pace

PROJECT CHALLENGES

- Bridge Span Length / Height / Width

Project Statistics
Cooper River Bridge

OVERALL STATISTICS

- Total project cost $531 million
- Total bridge length is over 13,200 feet
- 4 lanes of traffic in each direction with a median barrier
- 12-foot wide sidewalk (south side of the bridge)
- New interchanges at both Charleston and Mt. Pleasant

CONSTRUCTION COST

Most expensive construction project in South Carolina history

Project Statistics
Cooper River Bridge

MAIN SPAN UNIT

- Main Span length of 1,546 feet is the longest cable- stayed span in North America
- The two Side Spans are 650 feet long each
- The two End Spans are 225 feet long each
- Total length of the Main Span Unit is 3,296 feet
- Maximum width of Bridge Deck is over 140 feet

Project Statistics
Cooper River Bridge

MAIN SPAN UNIT

- The two reinforced concrete Main Span Towers are 570 feet tall
- Both Main Span Tower Footings are supported on eleven Drilled Shafts
- Main Span Tower Drilled Shafts are 10-foot diameter and extend 230 feet down
- Both Main Span Towers and Tower Footings are protected from ship impact by Rock Islands

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- **Foundation Conditions**

Drilled Shaft Construction
Cooper River Bridge

Drilled Shaft Construction
Cooper River Bridge

Drilled Shaft Construction
Cooper River Bridge

Drilled Shaft Construction
Cooper River Bridge

Drilled Shaft Construction
Cooper River Bridge

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- **Ship Collision / Rock Islands**


MSC

NAVIGATION CHANNELS

Main Channel over the Cooper River

- Horizontal clearance - 1000 feet
- Vertical Clearance - 186 feet

Channel over Town Creek

- Horizontal clearance - 250 feet
- Vertical clearance - 65 feet

Architectural Rendering – Rock Island Cooper River Bridge

Rock Island Testing
Danish Hydraulic Institute
Copenhagen, Denmark

Rock Island Testing
Danish Hydraulic Institute
Copenhagen, Denmark

Rock Island Construction
Cooper River Bridge

- Environmentally friendly bridge protection, safer for ships and bridge
- Built with rock from Newfoundland (21 shiploads)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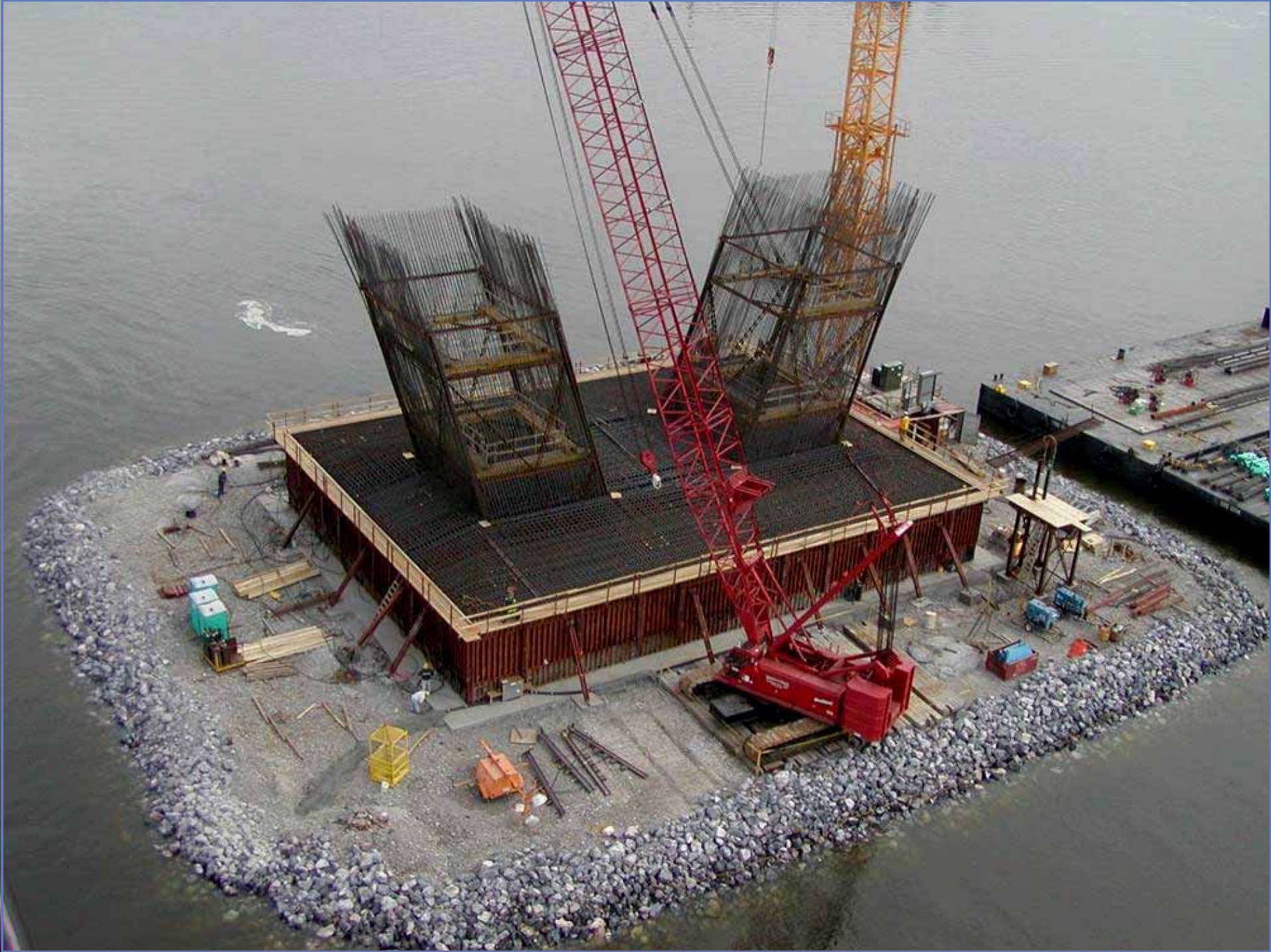
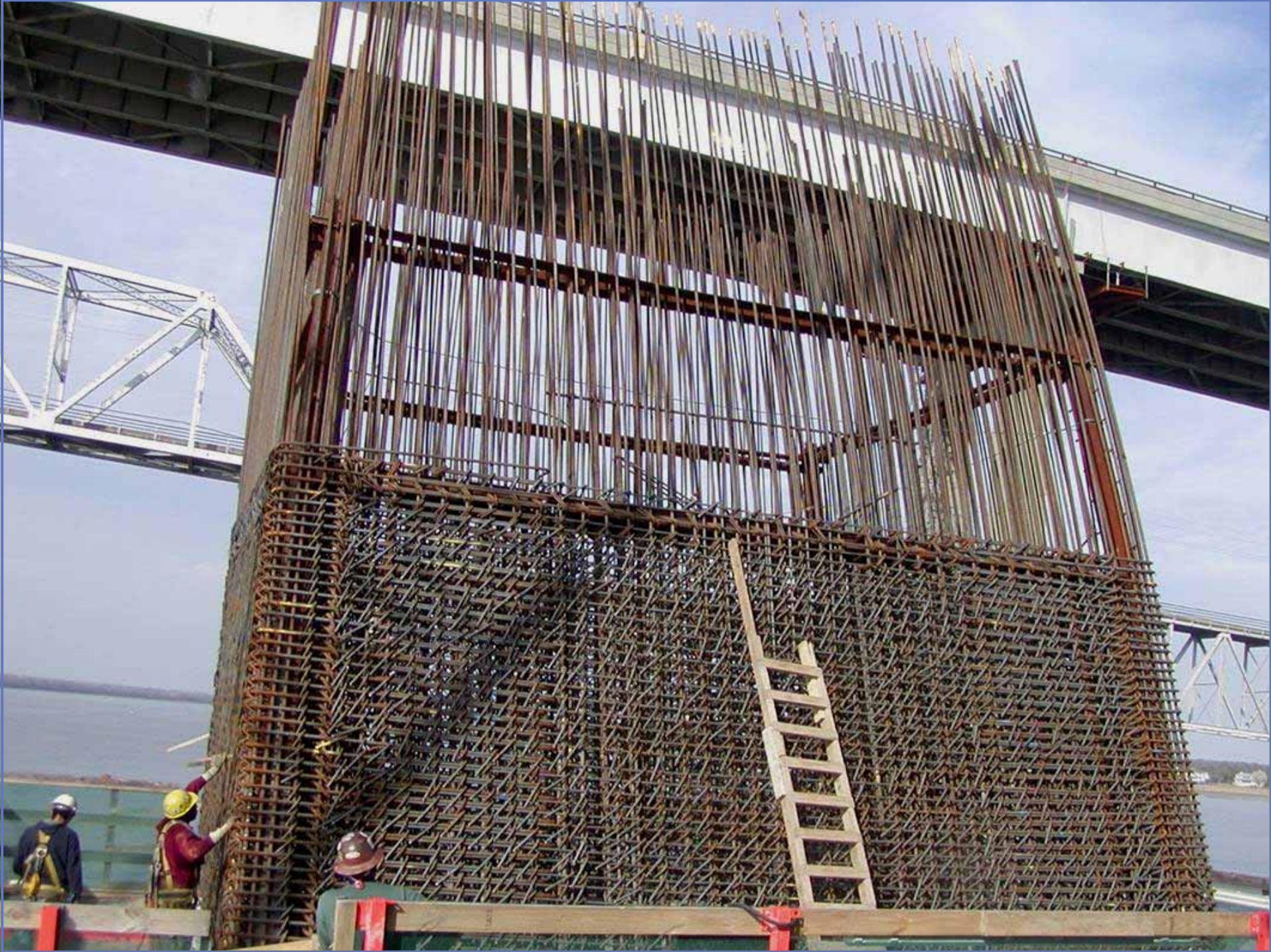


Tower Construction
Cooper River Bridge




The Charleston
FORGE

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- Ship Collision / Rock Islands
- **High Seismic Zone**

Seismic Design
Cooper River Bridge
Charleston, SC

News

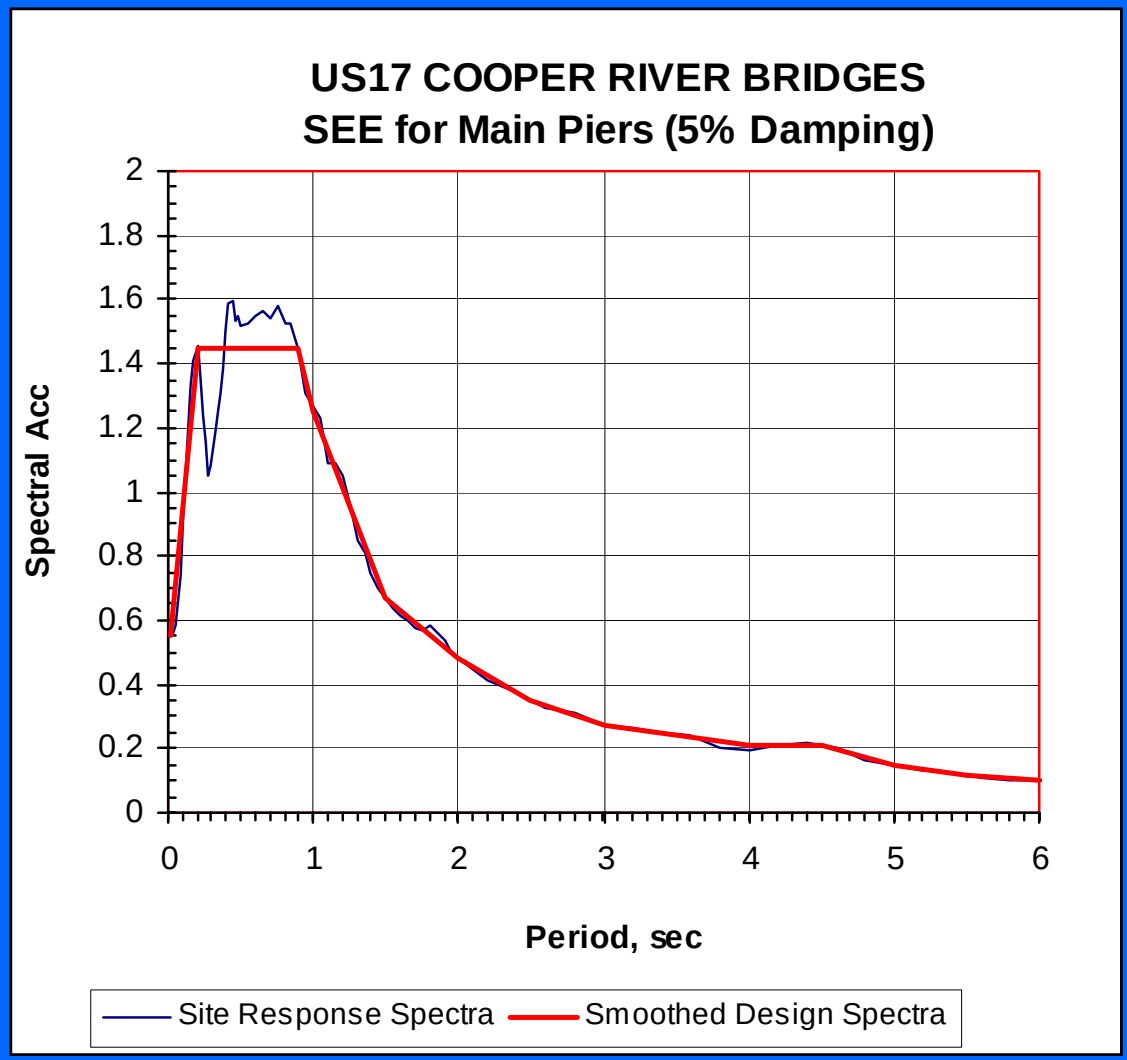
The Post and Courier Newspaper
11/12/02

Undersea Earthquake Rattles Lowcountry
4.2 on Richter Scale

SEISMIC CRITERIA

- **FEE earthquake 6.5 magnitude (Richter Scale), 500 year return period**
- **SEE earthquake 7.3 magnitude (Richter Scale), 2500 year return period**
- **Critical Access Path (CAP) structure designated**

Seismic Design
Cooper River Bridge



SEISMIC DESIGN STRATEGY

- Tall, slender Main Span Unit / High Level Approaches with few expansion joints, resulting in long period of structure (Over 5 seconds)
- Short, stiff Interchange structures to stabilize bridge
- Overall structure remains elastic under FEE earthquake, and must not collapse under SEE earthquake
- CAP structure must be serviceable immediately following SEE earthquake

High Level Approach Construction
Cooper River Bridge

High Level Approach Construction
Cooper River Bridge

Interchange Construction
Cooper River Bridge

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- Ship Collision / Rock Islands
- High Seismic Zone
- **Hurricane Wind Area**

Wind Design
Cooper River Bridge
Charleston, SC

HURRICANE CRITERIA

- Bridge designed for wind speeds up to 190 mph
- Design Wind Load varies from 50 to 142 psf

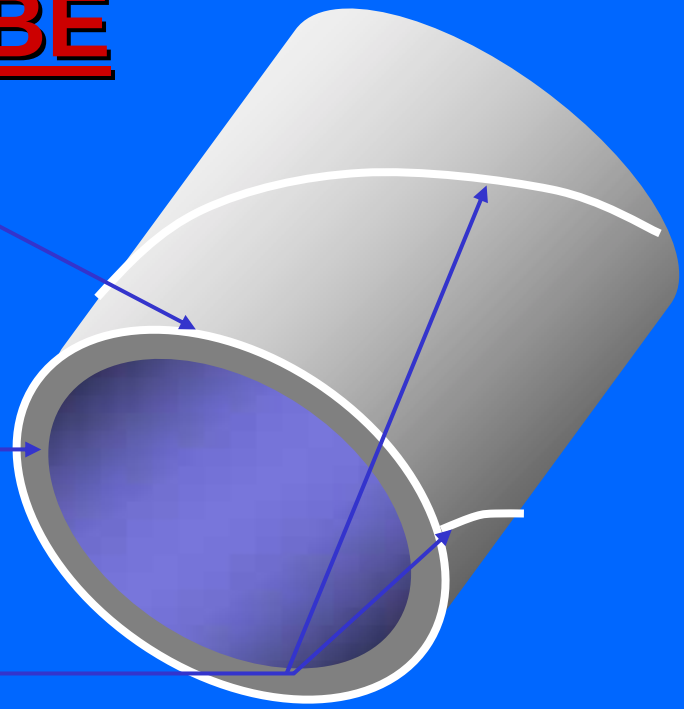
Wind Tunnel Testing
Rowan, Williams, Davies, Irwin (RWDI)
Guelph, Ontario

RWDI has done wind studies for numerous long span bridges and buildings in North America and overseas.

Wind Tunnel Testing
Rowan, Williams, Davies, Irwin (RWDI)
Guelph, Ontario

CABLE - STAY TUBE

- External layer
  - Colour and UV protection
- Internal layer
  - Mechanical resistance
- Two helical fillets
  - Reduces rain & wind induced instability

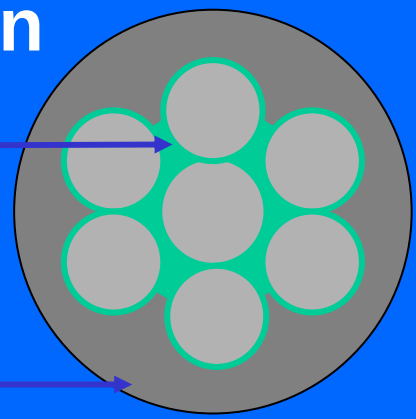


CABLES

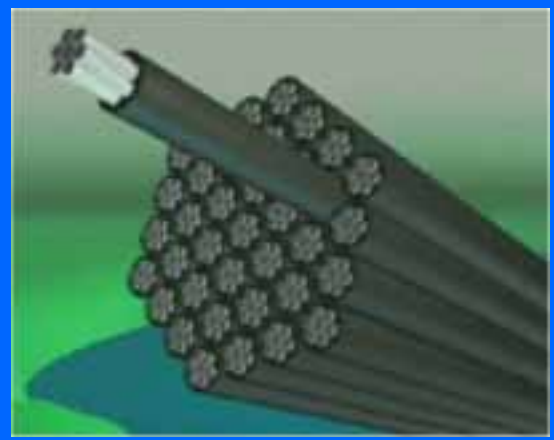
Individual corrosion protection

Wax

HDPE sheath



Designed for strand by strand replacement



Stay Cables
Cooper River Bridge

CABLES

- 64 at Each Tower – Total 128 cables
- Made up of 7 Wire Strands
- Vary From 31 to 90 Strands / Cable
- Sheathing Diameters Vary 8” to 12”
- Designed and Fabricated by Freyssinet
- Each Can Support Over 500 Tons

PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- Ship Collision / Rock Islands
- Seismic Design
- Hurricane Wind Area
- **Fast Pace**

DESIGN BUILD SCHEDULE

PB Signed Contract	**Aug 2001**
- Design	Aug 2001 – Mar 2003
- Construction Services	Apr 2002 – Mar 2005
- Contract Completion Date	Mar 2005

Construction	
- PBC Notice To Proceed	July 2001
- 1st Drilled Shaft	April 2002
- Open To Traffic	June 2005
- PBC Contract Completion Date	July 2006

Project Challenges
Cooper River Bridge

UNFORESEEN SITE CONDITIONS