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
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
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

A Joint Venture of

SKANSKA
Lead Firm

and

Parsons Brinckerhoff
Partner

With

Palmetto Bridge Constructors

Flatiron Structures Company
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
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
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
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
PROJECT CHALLENGES

- Bridge Span Length / Height / Width
- Foundation Conditions
- Ship Collision / Rock Islands
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)
Tower Construction
Cooper River Bridge
Project Challenges
Cooper River Bridge

PROJECT CHALLENGES

• Bridge Span Length / Height / Width
• Foundation Conditions
• Ship Collision / Rock Islands
• High Seismic Zone
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 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
PROJECT CHALLENGES

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

• Bridge designed for wind speeds up to 190 mph
• Design Wind Load varies from 50 to 142 psf
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
Stay Cables
Cooper River Bridge

CABLE - STAY TUBE

• External layer
  – Colour and UV protection

• Internal layer
  – Mechanical resistance

• Two helical fillets
  – Reduces rain & wind induced instability
STAY CABLES

Individual corrosion protection

Wax

HDPE sheath

Designed for strand by strand replacement

Stay Cables
Cooper River Bridge
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
# Project Challenges
## Cooper River Bridge

## DESIGN BUILD SCHEDULE

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PB Signed Contract</strong></td>
<td>Aug 2001</td>
</tr>
<tr>
<td>Design</td>
<td>Aug 2001 – Mar 2003</td>
</tr>
<tr>
<td>Construction Services</td>
<td>Apr 2002 – Mar 2005</td>
</tr>
<tr>
<td>Contract Completion Date</td>
<td>Mar 2005</td>
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<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td>PBC Notice To Proceed</td>
<td>July 2001</td>
</tr>
<tr>
<td>1st Drilled Shaft</td>
<td>April 2002</td>
</tr>
<tr>
<td>Open To Traffic</td>
<td>June 2005</td>
</tr>
<tr>
<td>PBC Contract Completion Date</td>
<td>July 2006</td>
</tr>
</tbody>
</table>
UNFORESEEN SITE CONDITIONS