



International Association  
Bridge Earthquake Engineering

# The 3<sup>rd</sup> International Bridge Seismic Workshop(III IBSW)

## **Analysis on Seismic Response of Deep-Water Composite Bridge Piers Considering Fluid-Structure Interaction**

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Tianjin University





# Report Outline



- **Background**
- **Analysis of Deep-water Composite Bridge Pier under EQ Excitation**
- **Analysis of Deep-water Bridge Pier under Combined Action of EQ and Wave**



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# Deep-water Bridge Projects



## Cross-sea bridges



**Hong Kong-Zhuhai-Macao Bridge**  
22.9 km, China, 2018



**San Francisco-Oakland Bay Bridge**  
USA, 2013



**Rion-Antirion Bridge**  
22.52 km, Greece, 2004

## Cross-river bridges



**Runyang Bridge**  
35.66 km, China, 2004



**Su Tong Yangtze River Bridge**  
32.4 km, China, 2008



**Fengjie Yangtze River Bridge**  
930m, China, 2006





# Bridge Damage under EQ and Hurricane



**Wenchuan Earthquake  
China, 2008**



**Girder Falling**



**Underwater pier cracks**

**Hurricane Katrina  
USA, 2005**



**Girder shifting**



**Pier failure**



# Pier Damage under EQ



**Chichi Earthquake,  
Taiwan, 1999**



**Kobe Earthquake,  
Japan, 1995**



**Northridge Earthquake, USA, 1994**



**Kobe Earthquake, Japan, 1995**





# Application of Composite Pier in China



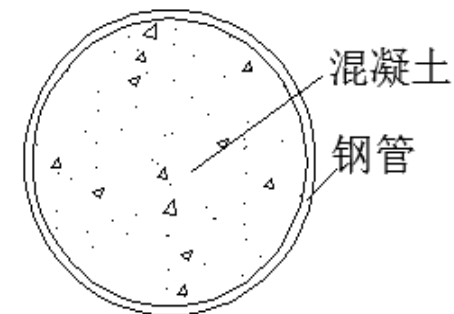
Ganhaizi Bridge



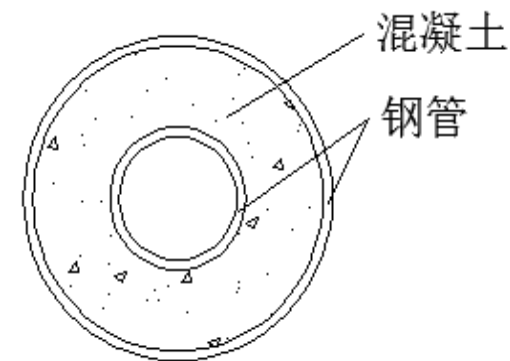
Beijing South Station Elevated Bridge

## Advantages

- High bending stiffness
- Light weight
- Good seismic behavior
- High bearing capacity
- Good ductility performance
- Construction convenience



CFST pier



CFDST pier



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# Dynamic Analysis of Deep-water Composite Bridge Pier under Earthquake Excitation



- **Model Analysis**
- Seismic Analysis
- Applicability of Morison Additional Mass Methods(MAM)
- Incremental Dynamic Analysis(IDA)
- Conclusions



**Will publish later ...**