Othmar Ammann and the George Washington Bridge

Iconic bridge with thin deck – First Interstate Compact
World’s longest suspension bridge – doubling previous record

CEE 102: Prof. Michael G. Littman
Course Administrator: Arianna Sherman  ariannas@princeton.edu

Computers for NOTETAKING ONLY
Please - NO Cell Phones, Texting, Internet use
Gustav Lindenthal
(1850 – 1935)
19th Century Engineer
Railroads
Gustav Lindenthal
(1850 – 1935)
19th Century Engineer
Railroads

Othmar Ammann
(1876 – 1965)
20th Century Engineer
Automobiles
Structures

Static

Custom-made

Public Works

Gustav Lindenthal (1850 – 1935)
19th Century Engineer
Railroads
Gustav Lindenthal
(1850 – 1935)
19th Century Engineer
Railroads

Hell Gate PRR Bridge - 1917
Hell Gate PRR Bridge - 1917

Ammann

Lindenthal
Lionel Scale-Model Bridge

Hell Gate PRR Bridge - 1917
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Hell Gate PRR Bridge - 1917
Hell Gate PRR Bridge - 1917
Worlds’ longest arch - 1017 ft
Tennessee River - Chattanooga

Market Street Bridge - 1917
## Regional Restructuring (1914 – 1964)

<table>
<thead>
<tr>
<th>Region</th>
<th>Metropolitan New York</th>
<th>Hudson River</th>
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<tbody>
<tr>
<td>congested region</td>
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![Market Street Bridge - 1917](image)

![Tennessee River - Chattanooga](image)
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Railroad Ferry – Hoboken NJ
“People living there are fine, each one has a friend named Stein …”

Prohibition 1920 - 1933
Port of New York Authority

1909 - Port of London Authority

1917 - Harbor Development Commission of NY and NJ

1921 - Port of New York Authority
Port of New York Authority

1909 - Port of London Authority

1917 - Harbor Development Commission of NY and NJ

1921 - Port of New York Authority

US Constitution
(Article I, Section 10, Clause III)

“… no state shall, without the consent of Congress, enter into any agreement or compact with another state.”
Port of New York Authority

1909 - Port of London Authority

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Proposals for the first Hudson River crossing connecting NY and NJ

Lindenthal 23rd Street - 1889
Port of New York Authority

1909 - Port of London Authority

1917 - Harbor Development Commission of NY and NJ

1921 - Port of New York Authority

Proposals for the first Hudson River crossing connecting NY and NJ
Lindenthal Design
RR and Cars at 57th
12 tracks, 24 lanes
6000 ft span
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“... I ... have been fighting against the unlimited ambition of a genius who is obsessed with illusions of grandeur.”

Ammann writes to his mother - 1922
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Ammann writes to his mother - 1922
The George Washington Bridge
SYMBOLIC

Gustav Lindenthal - inflexibility in the pioneer
George S. Silzer - the governor as technological promoter
Othmar H. Ammann - the engineer as entrepreneur and artist

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The George Washington Bridge
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George S. Silzer - the governor as
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Othmar H. Ammann - the engineer
as entrepreneur and artist
“... a great bridge in a great city ... should ... be a work of art to which Science lends its aid.”

Othmar Ammann
The George Washington Bridge
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The George Washington Bridge

**SCIENTIFIC**

**dead weight** - heaviest bridge ever

**traffic weight** - low probability of full truck loading

**wind force** - neglect of vertical motion due to horizontal loading
The George Washington Bridge

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**DEFLECTION THEORY**

The heavier the span weight, the greater the cable tension: \[ H = \frac{qL^2}{8d} \]

The greater the cable tension, the stiffer the span: **STIFFNESS OF TAUT CABLE**

The stiffer the span, the less need for deck trusses: **ELEGANCE OF THIN DESIGN**
DEMONSTRATION

Ammann Design
Cars at 178th

The George Washington Bridge

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The stiffer the span, the less need for deck trusses: ELEGANCE OF THIN DESIGN
Loaded Length Factor:

$K = 0.2 + \left[ \frac{160}{200 + L} \right]$  

Number of Lanes Factor:

$C = 0.5 + \left[ \frac{2}{n + 3} \right]$
Minimum $K = 0.2 + \frac{160}{3700} \approx 0.25$
(L = 3500)

Minimum $C = 0.5 + \frac{2}{11} = 0.682$
(n = 8)

$C \times K = 0.25 \times 0.682 = 0.17$

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\[ q_L = 0.17 \times 46,000 = 7820 \text{ lb/ft} \]

Ammann Design
Cars at 178th
The George Washington Bridge

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Ammann Design
Cars at 178th

Tacoma Narrows Bridge – 1940
Deflection theory error – ignores wind load
The George Washington Bridge

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Carmody Report
Ammann, Von Karman, and Woodruff

(1) 1940 Narrows Bridge failed because of "excessive flexibility;"
(2) Solid plate deck acted like a wing, creating "drag" and "lift;"
(3) Suspension bridge designs should be tested in a wind tunnel.
The George Washington Bridge

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Ammann Design
Cars at 178th

Bronx Whitestone addition – 2003
Wing-like ‘fairing’ reduces flutter
The George Washington Bridge

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Ammann Design
Cars at 178th
The George Washington Bridge

SOCIAL

a new political instrument –
 a bi-state agency
the necessity of low cost -
 light deck, reduced traffic load
transformation of communities —
 trains to cars, rural to suburban
The George Washington Bridge
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**SOCIAL**

*a new political instrument* —
a bi-state agency

**the necessity of low cost** -
light deck, reduced traffic load

**transformation of communities** —
trains to cars, rural to suburban
The George Washington Bridge

**SOCIAL**

- a new political instrument – a bi-state agency
- the necessity of low cost - light deck, reduced traffic load
- transformation of communities — trains to cars, rural to suburban

**Ammann Design**

Cars at 178th

**George Washington Bridge - 1931**
George Washington Bridge - 1931
Bayonne Bridge - 1931

George Washington Bridge - 1931
Bayonne Bridge - 1931

Hell Gate Bridge - 1917

George Washington Bridge - 1931

Bayonne Bridge - 1931
Bayonne Bridge - 1931
Hell Gate Bridge - 1917
George Washington Bridge - 1931
Bayonne Bridge - 1931
“... the controlling criteria in selecting the system ... (are) structural simplicity, maximum economy ... , and aesthetic conception”

Othmar Ammann - 1933
Life Magazine – Margaret Bourke-White
Chrysler Building

NEW YORK, NY

USA 37

1930

2005

75th Anniversary Stamp
Chrysler Building
NEW YORK, NY
USA 37
1930
2005

75th Anniversary Stamp
Port Authority Airports

- LGA
- JFK
- EWR
To identify and meet the critical transportation infrastructure needs of the bi-state region’s businesses, residents and visitors: providing the highest quality, most efficient transportation and port commerce facilities and services that move people and goods within the region, provide access to the rest of the nation and to the world, and strengthen the economic competitiveness of the New York-New Jersey metropolitan region.
National Medal of Science - 1964
National Medal of Science - 1964

George Washington – 1931
Bayonne – 1931
Robert F. Kennedy – 1936
Bronx-Whitestone – 1939
Throgs Neck – 1961
Verrazano Narrows – 1964
Key Ideas

Scientific: Lane Loading Analysis
Social: First Bi-State Agency
Symbolic: Iconic Structural Art

- George Washington – 1931
- Bayonne – 1931
- Robert F. Kennedy – 1936
- Bronx-Whitestone – 1939
- Throgs Neck – 1961
- Verrazano Narrows – 1964