Columbia University | CBIPS
Research Collaboration With
NYC Department of Parks and Recreation

NYC Parks

Presentation #5

Fellows:

Rohan Choudhury | Mohammed Maseeh Ibrahim | Alican Sevim | David Chitanava

Instructors:

Prof. Feniosky A. Peña-Mora | Fredric M. Bell | Charles Shen

Columbia University
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Outline

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- Initial Research Methodology
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- Design Considerations For The Waterfront railings
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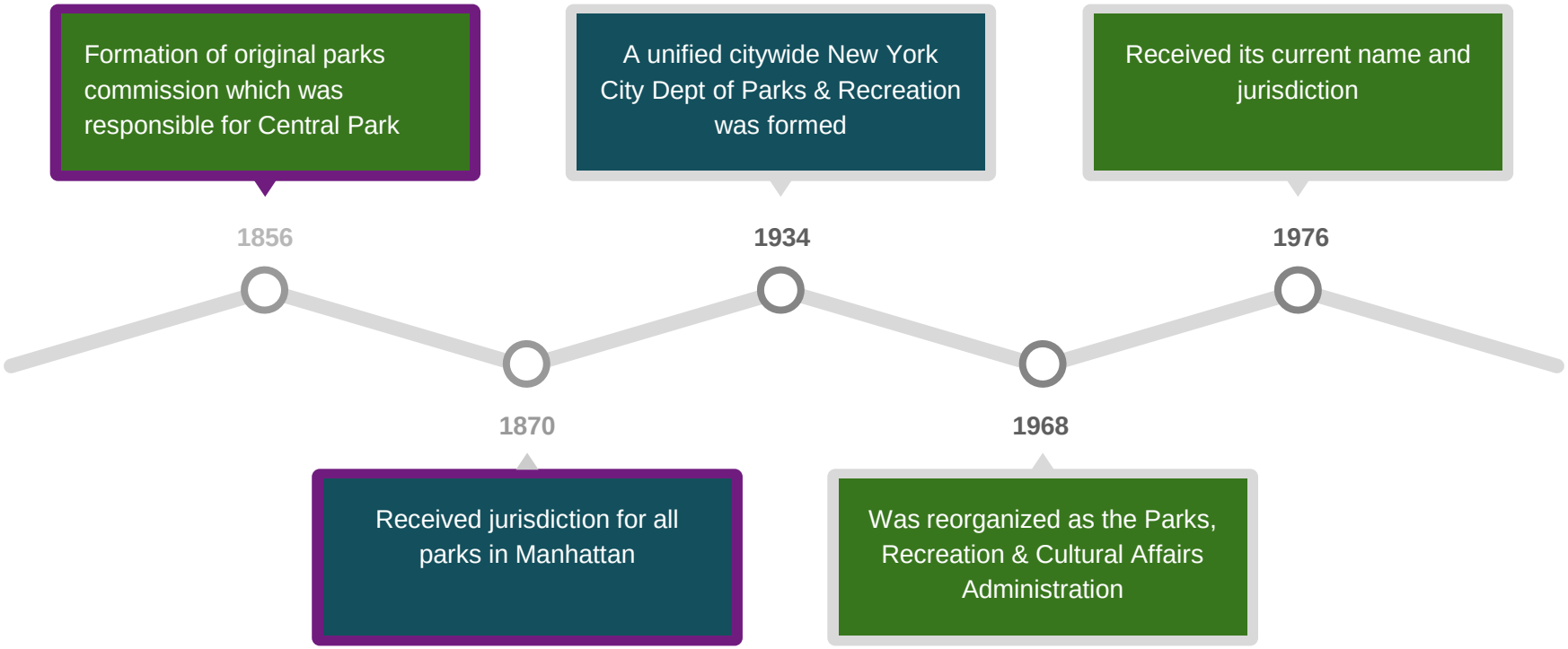
- Conclusions and Recommendations
- References

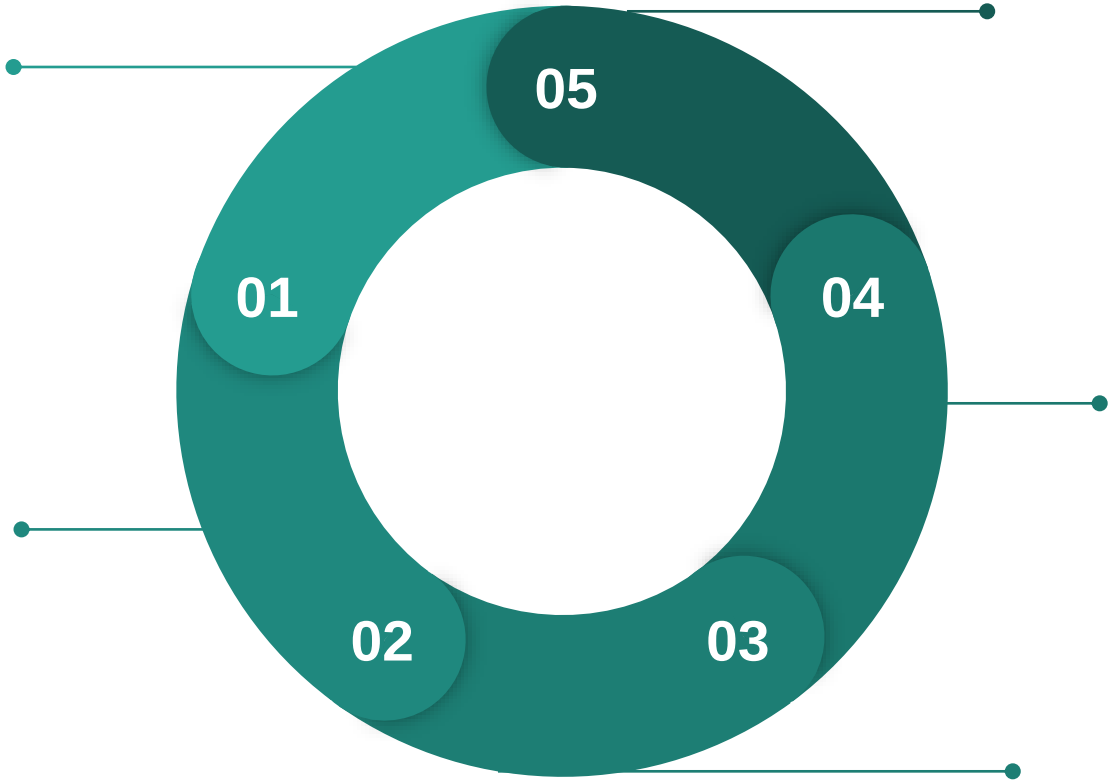
Brief History of Parks Department



Objective

How to optimize design for 25 miles of waterfront railing?

Inventory analysis with respect to material, environment, condition and age



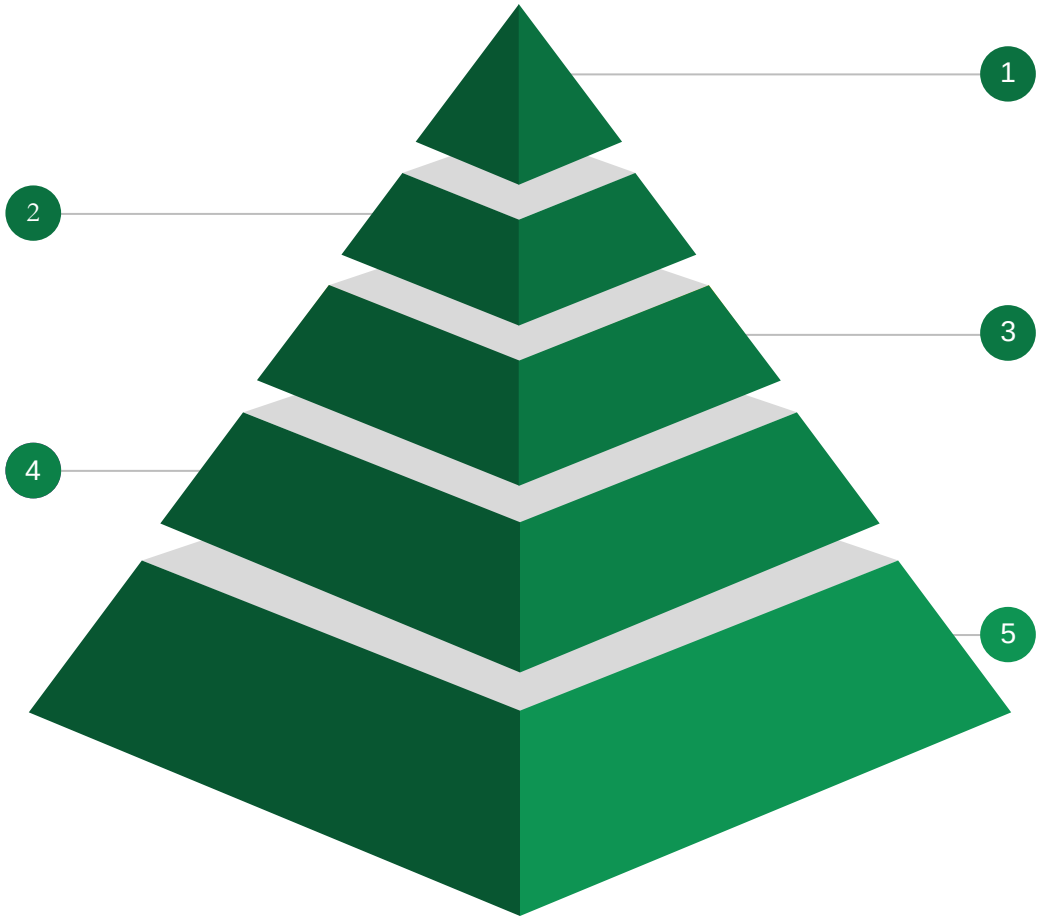
Calculating lifecycle costs with respect to installation and maintenance

Taking various design aspects such as shape and aesthetics to reach a uniform waterfront railing design

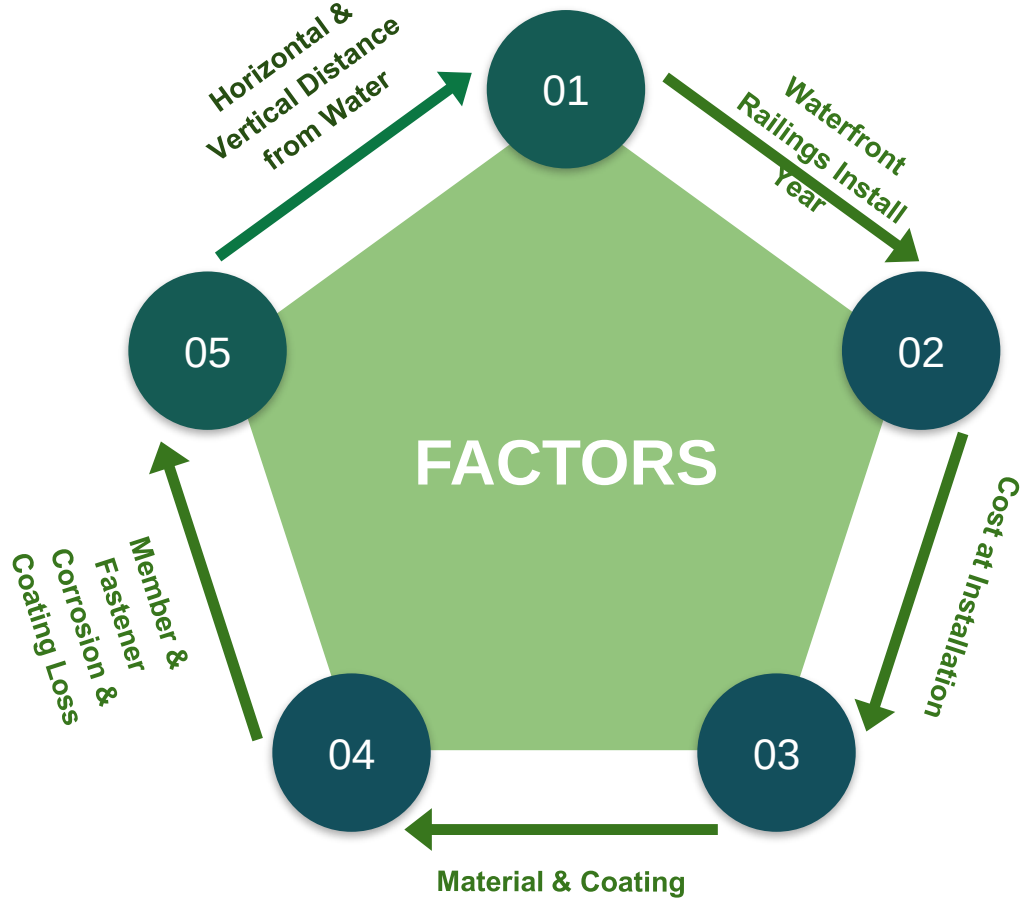
Researching on the applicable standards of waterfront railings construction

Initial Research Methodology

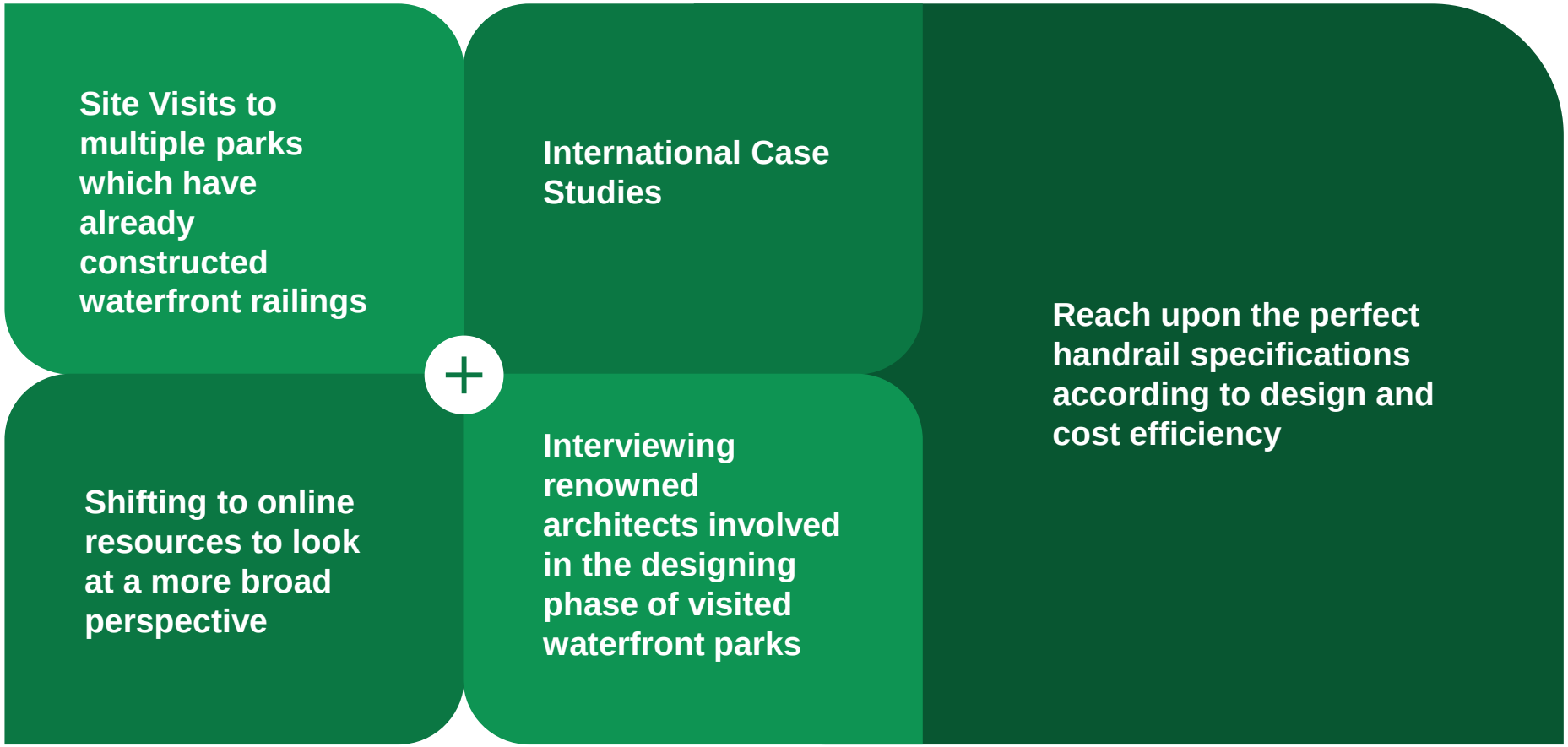
1. Identification of list of parks with sea rails using google maps
2. Visiting NYCDPR office to collect data regarding the parts which fall into our criteria
3. Visiting the parks manually and sorting them on a list of selected factors
4. Contacting various subcontractors involved in construction and maintenance process
5. Provide a set of initial recommendations suggesting the best economic, sustainable and resilient solution



Factors Considered in Research



Discrepancies & Modifications due to COVID 19



Professional Opinion - Thomas Balsley

Thomas Balsley

swa/Balsley

Waterfront railings are designed as a part of the landscape of the park and contribute to its aesthetics. It is a symbol of the urban design. Advices to focus on coastal access at possible locations to enhance user experience. Also suggests that standardization is not essential as different areas have different conditions and this may increase initial costs.

Functionality: Designs railings which are multi-functional, and integrates lighting system into the railing design.

Recommendation: Kebony Lumber can be integrated with the existing materials as an alternate for top rails. It is a very durable and sustainable material and has very low maintenance.

Source: https://swabalsley.com/principals/thomas-balsley/

Professional Opinion - Alison Shipley

Alison Shipley

Quennell Rothschild & Partners

Waterfront railings are designed to emulate user experience, and standardisation of railings is not preferred as it reduces the efficiency and does not allow for creative design.

Advised to think about the need for railings, and suggested that not only installation budget be considered for evaluation but also maintenance costs over the design period.

Functionality: Waterfront railings can be used for signages, public support attachments such as coffee holders and fishing attachments.

Recommendations: Aluminium as it has very high corrosion resistance and has very low maintenance.

Source: http://www.qrpartners.com/firm/people/alison-shipley/

Professional Opinion - Gullivar Shepard

Gullivar Shepard

MICHAEL VAN VALKENBURGH ASSOCIATES INC

Waterfront railings should be designed to enable easy maintenance and economic and efficient replacement.

Advised that modular design of railings is an efficient technique, and promotes diverse mixture of guarded and unguarded access to waterfront to improve user experience.

Functionality: Multifunctionality is important. Lighting design integrated with railings and at some locations integration of access structure such as gates with railings.

Recommendation: Suggested use of easily replaceable material such as wire mesh to durable posts. Special attention to ecological impact as well as economic impact such as shipping costs.

Source: https://mvvainc.com/staff.php?id=15

Corrosion as a Risk

1. **Risk Assessment**

These risks might be associated with the risks to,

- The safety and integrity of physical assets,
- Environment,
- Financial risks from various decisions,
- And also risks from corrosion or poor corrosion mitigation procedures,
- Corrosion-related failures can be considered as a major source of risk for NYC Department of Parks since corrosion related failures or damages may lead to significant loss of production, in addition increased costs for maintenance, repair, or replacement.

Corrosion Engineering Principles and Practice, Pierre R. Roberge, Ph.D., P.Eng., Mc Graw Hill, 2008

Corrosion as a Risk

2. **Risk Analysis**

- Thanks to the application of general risk analysis principles, we can prioritize and manage the inspection program for equipment, which is called as risk-based inspection (RBI),
- Risk analysis techniques includes identifying, characterizing, and evaluating hazards,
- However, how to identify risk;

« Risk = Probability of Failure (POF) ✖ Consequence of Failure (COF)»

- *In the equation, the POF refers to failure frequency or remaining lifetime, while COF usually refers to safety, environment, and economic issues*

Corrosion as a Risk

In order to avoid challenges we mentioned early on, some certain systematic procedures have been offered by Materials Technology Institute (MTI) to guide an investigator through the failure analysis process.

Risk Criteria	Expressed in
Financial risk	Outage cost / day
Investment risk (asset damage)	Equipment cost / m^2
Environment	Cost / year
Potential of loss of life (PLL)	Events / year
Probability / likelihood of failure	Events / year

Examples of Risk Criteria and Their Units

Corrosion as a Risk

3. **Risk and Corrosion Control**

Since NYC Department of Park and Recreation has tight budget, and need to take into account the selection and prioritization of the components, parts that should be inspected of paramount significance. In order to mitigate related risks, NYC Department of Parks should;

- Has a good knowledge and experience of designs.
- Has a good material selection.

Aluminium Vs. Stainless Steel

Advantages

- Aluminium is lightweight than steel
- Weighs only one quarter as steel
- Aluminium is much more resistant to corrosion
- Does not rust
- Highly resistant to corrosion
- Does not require any coatings or paint

Disadvantages

- Procurement must consider lead time for manufacturing and shipping
- Aluminium is expensive than stainless steel

CASE STUDY

- Advantages: Crack Control, Shear, Bar Detailing
- Corrosion is one of the most critical problem. It can not show high performance in very aggressive conditions
- On the market, there are several types of stainless steel. Thus, it is not easy to determine of the most proper grade of stainless steel for a specific environment
- To illustrate, a couple of experimental tests were carried out on 4 grades of stainless steel exposed to different conditions. Results show that all of them were suitable when exposed in seawater concrete. However the final choice can be made only through a proper design of the service life

Source: WWW.CAMX.COM

LESSONS WE LEARNED!

- Although different materials like aluminium should always be considered as an alternative materials, challenges like procurement challenges should always be under consideration,
- As a result of interviews and discussions we have had so far, stainless steel would be one of the most feasible materials among others,
- Material selection, which should be based on a thorough knowledge of process conditions, materials of sea rails, design of the system, external factors and historical records is the most vital step to keep the searails feasible and resilient against corrosion

Applicable Standards For The Waterfront Railings

Recap from the previous presentations:

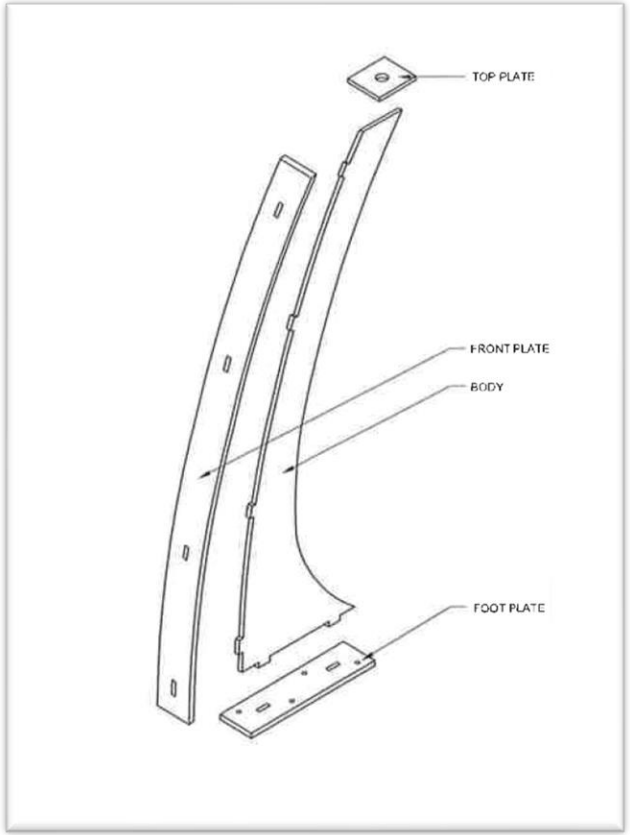
- The applicable standards for design of guardrail systems:
- International Building Code (IBC)
- NYC Department of Buildings building codes
- The American Concrete Institute – Code ACI 318
- OSHA - Occupational Safety and Health Administration
- AISC - American Institute of Steel Construction
- ASTM - American Society for Testing and Materials
- ADA - Americans With Disabilities Act
- ABA - Architectural Barriers Act
- ANSI - American National Standards Institute
- NAAMM - National Association of Architectural Metal Manufacturers

Selecting The Materials For The Waterfront Railings

Requirements designers must consider to select the optimum material:

- Physical/mechanical properties
- Corrosion resistance
- Past experience
- Analyze the operational environment

- Final selection as a compromise between:
  - Technical competence and
  - Economic considerations
- Life-cycle cost analysis:
  - Systematic condition assessment surveys
- Important aspects which should be considered during the design of the waterfront railings



Corrosion Engineering, Principles and Practice, Pierre R. Roberge The McGraw-Hill Companies, Inc. 2008
Photo: Standard detail WXY river railing, Contract drawings for the construction of a park at the former WNYC Transmitter Site. Feb 2010, NYC DPR

Design Considerations For The Waterfront Railings

The main materials used in railings are:

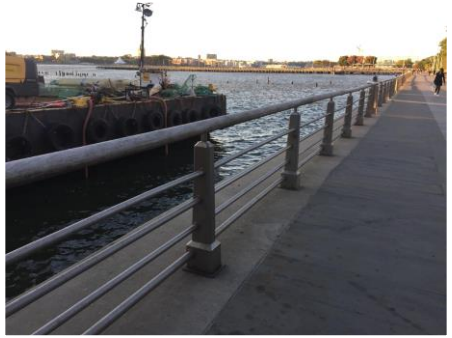
- Galvanized steel (Hunter's Point park)
- Stainless steel (Hudson river park)
- Powder-coated steel (Riverside park south)
- Painted steel (Battery park)
- Aluminum (Coney Island)

Top rail combinations: wooden, bead blasted, etc.

Functions of the waterfront railings:

- Provide stability/support
- Prevent injurious falls
- Landscape architectural design element

Railing structure should neither be under-designed nor over-designed



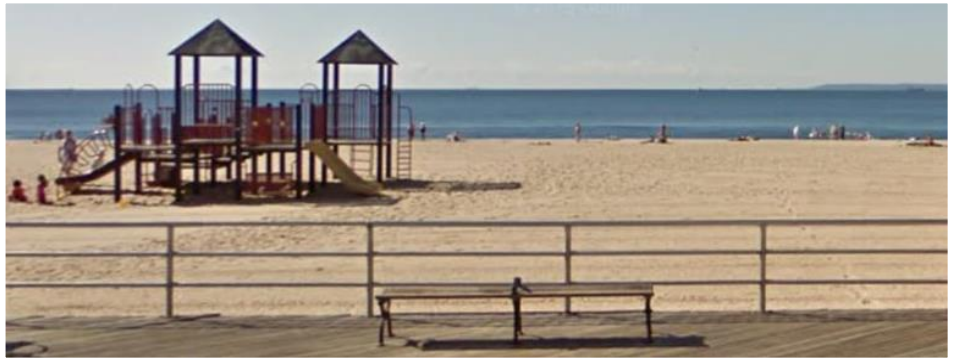


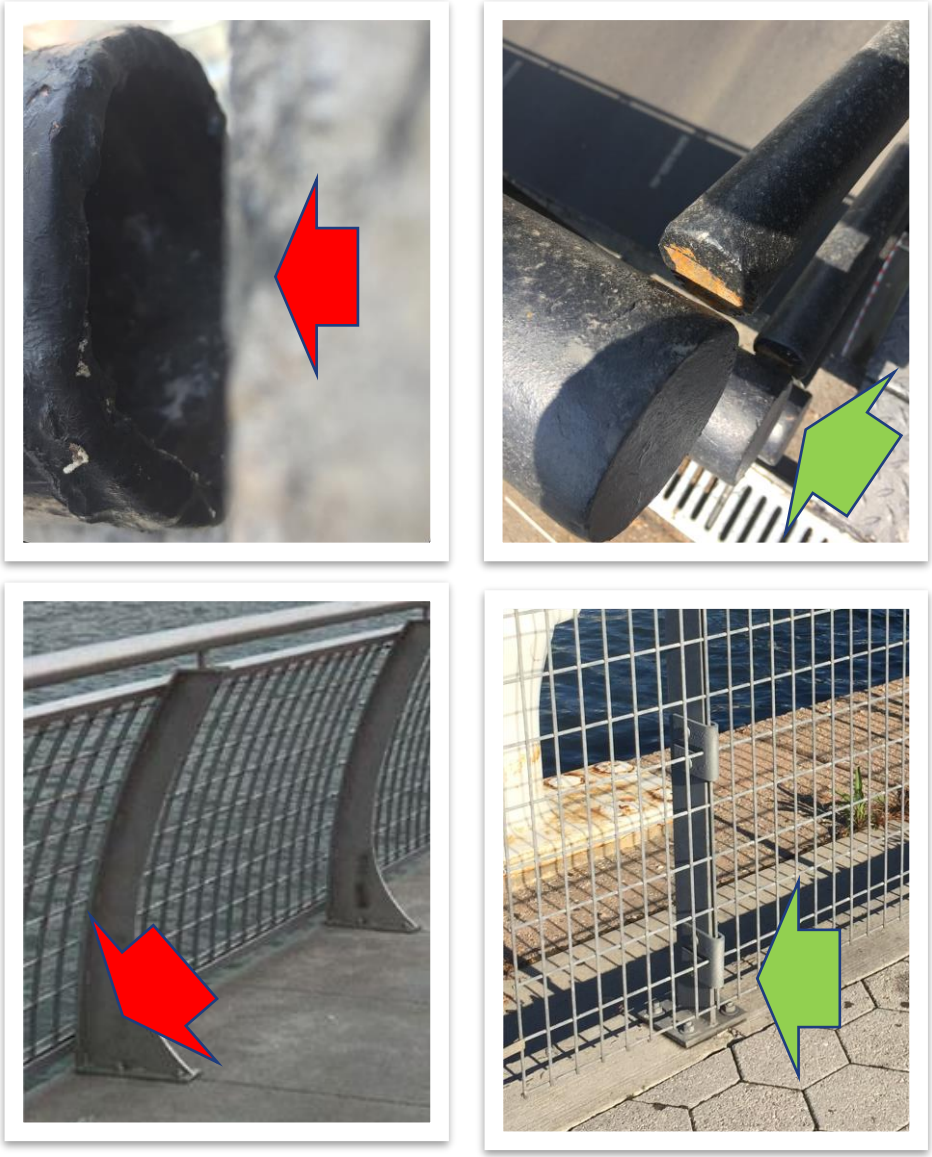
Photo: Hunter's Point park, Battery Park, Hudson river park - David Chitanava
Photo: Riverside park south - https://swabalsley.com/projects/riverside-park-south/
Photo: Coney Island – Google map, Captured 2012

Design Considerations For The Waterfront Railings

Example of design features to avoid corrosion risks:

- Tubular structures: Top rails, handrails, horizontal rods, stanchions

- Channels, sharp corners, angles: Stanchions



Corrosion Engineering, Principles and Practice, Pierre R. Roberge The McGraw-Hill Companies, Inc. 2008
Photo: Riverside park, Gelovani Avenue overpass in Tbilisi, Hunter's point park – David Chitanava
Photo: WNYC Transmitter Park - Yu Tianmin, Google map, Capture 2016

Design Considerations For The Waterfront Railings

Example of design features to avoid corrosion risks:

- Base and bolts at ground level - Column baseplates

- Base and bolts floating above the ground - Column baseplates

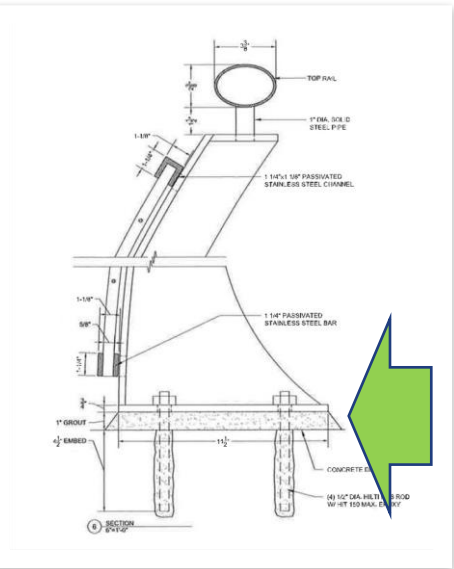


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Photo: Riverside park – Mohammed Masseh Ibrahim
Photo: Standard detail WXY river railing, Contract drawings for the construction of a park at the former WNYC Transmitter Site. Feb 2010, NYC DPR

Design Considerations For The Waterfront Railings

Example of design features to avoid corrosion risks:

- Flat horizontal bases - Vertical rods

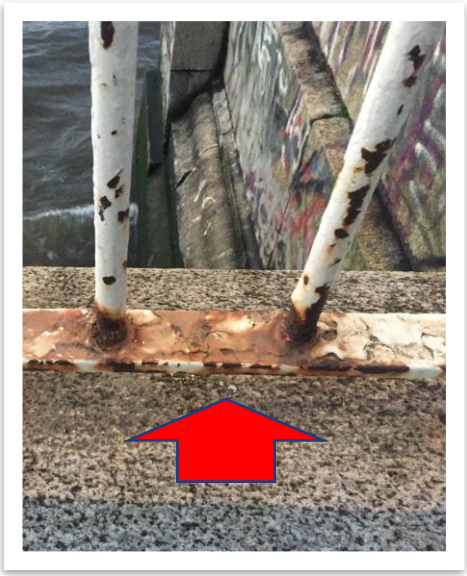

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Photo: Themes river esplanade, Riverside park – David Chitanava

Unification Of The Railing Design

Benefits:

- Economic benefits
- Material accessibility
- Economy on the scale
- Repetition in production phase
- Stock

Negative effects:

- Design restrictions
- Metal pricing
- Microclimate factors
- Environmental factors
- Selecting process
- Urban elements as art objects
- Impact of architecture on human psychology

Atmospheric corrosion testing in Southern Africa by B G Callaghan, Division of Materials Science and Technology, CSIR
What is Architectural Psychology?, Dr. Morgan Williams, http://www.apex1design.com; Impact of Architecture on Human Psychology, Shivangi Vats, Sep 12, 2017 https://medium.com
Metal Price Factors. http://www.columbusrecycling.com/
Repetition and the lean manufacturing road map, By Jeff Sipes, March 2019, https://www.thefabricator.com/

Conclusions And Recommendations

- Every metal corrodes
- There is not the best material for the waterfront railings
- Corrosion resistance depends on microclimate and specific environmental condition
- Designers must select the optimum material and design by applying specific requirements
- The design should be adaptable to each site conditions
- Unification has economic benefits, but none the less negative effects
- Systematic condition assessment survey as tool for quick repair responses
- Survey can be used to detail analyze of existing railing design features
- Creation of environmental map
- Increase places with an access to the water in future reconstruction projects

References

- Corrosion Engineering, Principles and Practice, Pierre R. Roberge The McGraw-Hill Companies, Inc. 2008
- Atmospheric corrosion testing in Southern Africa by B G Callaghan, Division of Materials Science and Technology, CSIR
- What is Architectural Psychology?, Dr. Morgan Williams, http://www.apex1design.com;
- Impact of Architecture on Human Psychology, Shivangi Vats, Sep 12, 2017 https://medium.com
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Thank You!