Duplex Stainless Steels for Durable Bridges

By Anders Finnås, Outokumpu Stainless AB, Sweden

Stainless Steel in Construction , 10th June 2015, Metalforum Fair , Poland

The ZRU first footbridge in Outokumpu DuplexLDX 2101®

Acrossthe rapids, Likholefossen, Norway- 2004

- Stainless LDX 2101
  - No maintenance
  - Cost efficiency
  - Aesthetics
  - Stiffness
  - Strength= low weight = easy erection (by helicopter)
  - Location: Mountains, above a fjord

The Apate Bridge, Stockholm, Sweden

- Pedestrian bridge - 2002
- Built in grade Outokumpu duplex 2205
- Supplied prefabricated segments at our Degerfors mill, tailor-made to customer requirements.
- Stainless steel selected for:
  - 100% recyclable
  - 120 years life time
- Location: Capital Stockholm

The Apate Bridge, Stockholm, Steel grade: 2205 (Photo: SBI) The right hand photo shows the inner structure of the bridge body.

Ruffolo Footbridge, Siena, Italy, 2005

- Grade: Lean Duplex LDX2101®
- Location: Country side
- Composite bridge with stainless steel load-bearing structure
- Design life: 120 years
- Stainless steel selected for:
  - Low maintenance
  - Green material (recyclable)
  - Aesthetics
  - Strength

PasarelaPadreArrupe, Bilbao, Spain 2003

- Duplex2304
- Location: Costal/Urban; Over fresh water river
- Mixed Stainless / Carbon steel design
- Design life:50 years
- Stainless steel selected for:
  - Durability
  - Aesthetics
  - Strength
  - Prefabricated plate segments delivered

First stainless railway bridge in the world!

AñorgaBridge ² Spain, 2011

Old bridge in carbon steel replaced due to:

- Heavy corrosion damage
- Heavy maintenance demand

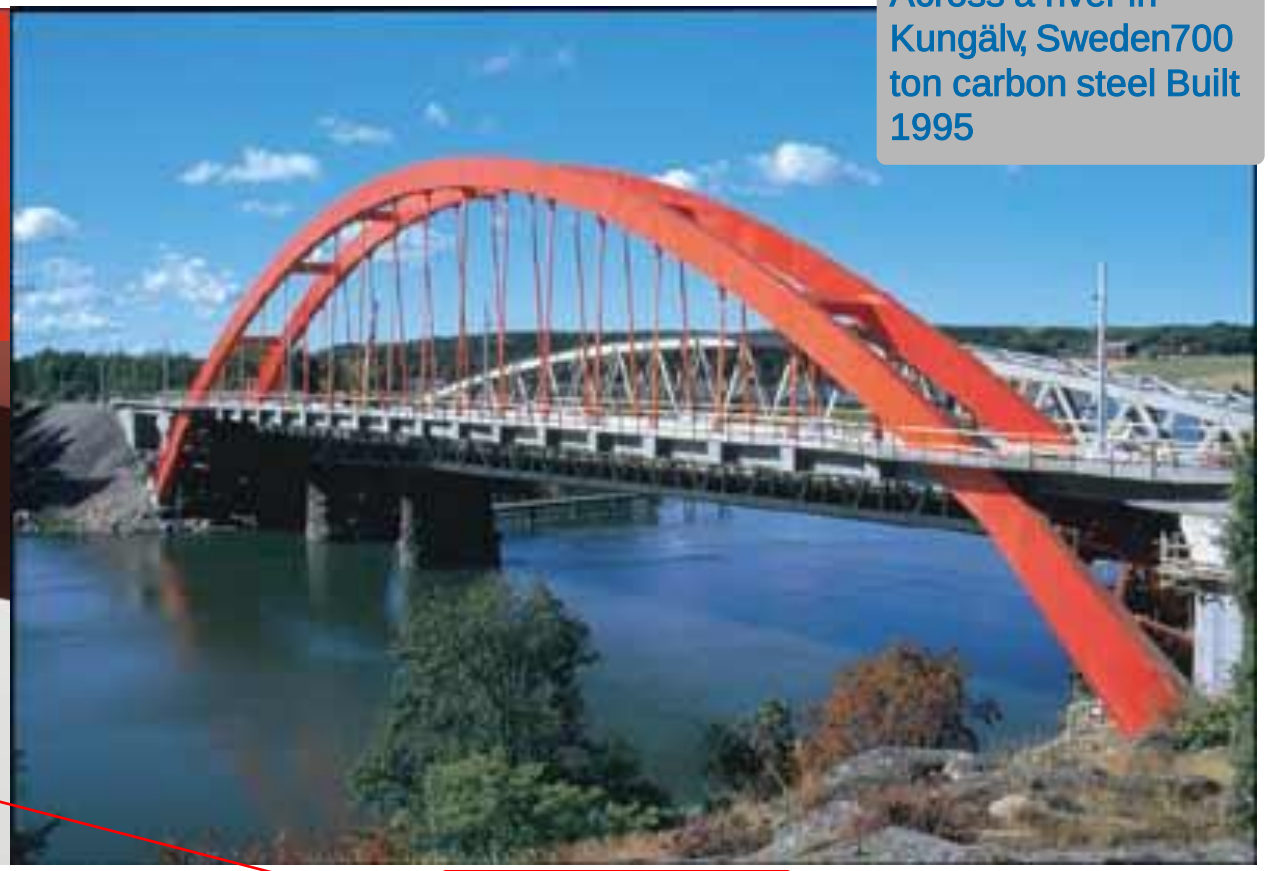
New bridge in Duplex LDX 2101

The owner required:

- 120 year design life
- Minimized maintenance
- Light weight (high strength) structure due to access during construction.
- Solution: OutokumpuLDX2101
- Location: Few kilometers from the ocean

The entire truss structure in Duplex LDX 2101, thickness 12-23 mm, 130 tons

Dual Construction
- Railway bridge heavily attacked by corrosion
- Year 2003 , Newhanger parts in Duplex 2205



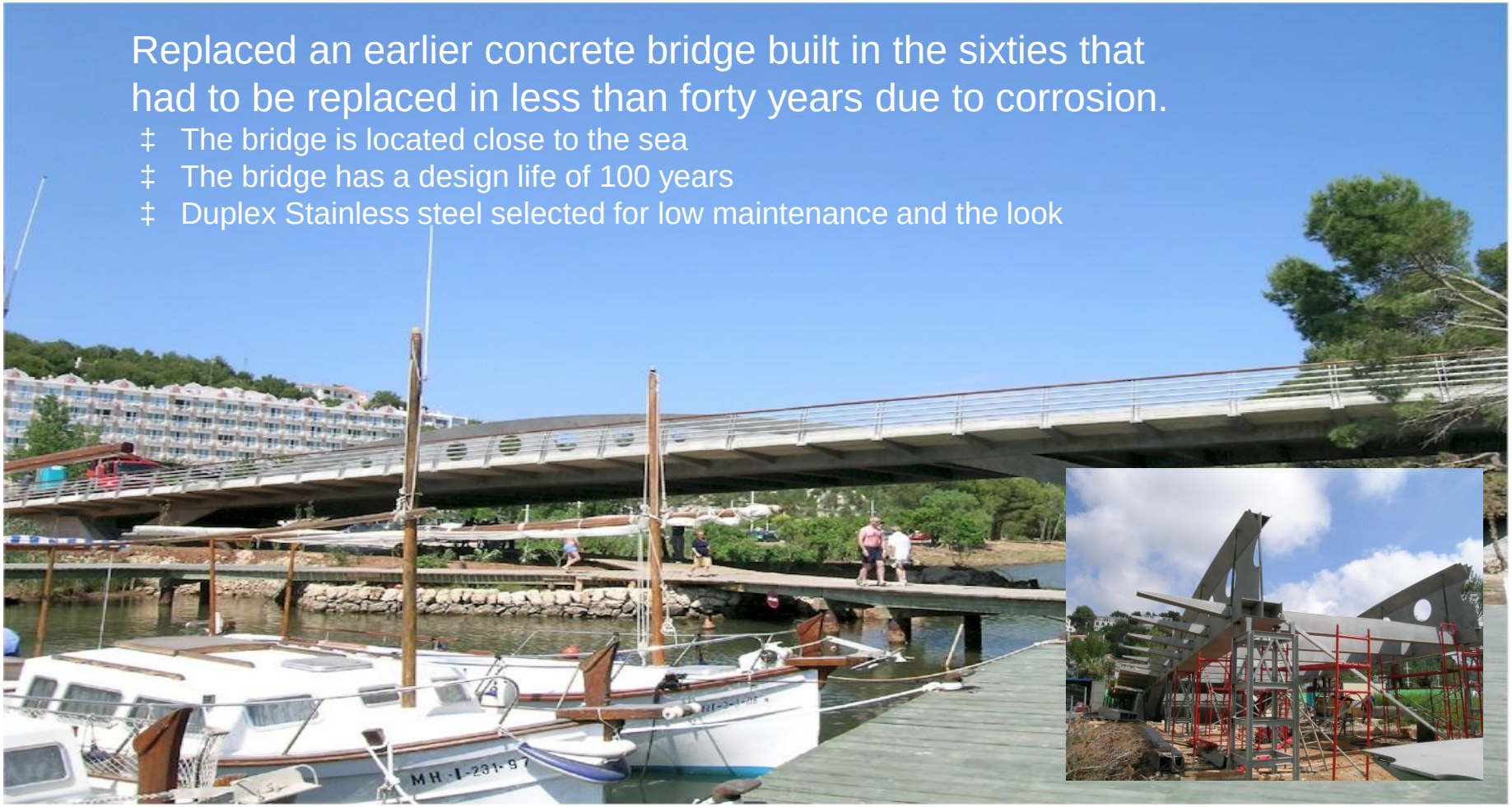
Across a river in Kungälv, Sweden700 ton carbon steel Built 1995

Duplex 2205

The world's first stainless traffic road bridge located on the island of Menorca, 2005

Replaced an earlier concrete bridge built in the sixties that had to be replaced in less than forty years due to corrosion.

- The bridge is located close to the sea
- The bridge has a design life of 100 years
- Duplex Stainless steel selected for low maintenance and the look



The Cala Galdana Bridge, Menorca, showing both the finished bridge and the assembly of the bridge from prefabricated section. Steel grade: 2205 (Photo: Pedelta)

outokumpu

Stonecutters Bridge, Hong Kong, China

- Duplex Stainless Steel selected for:
  - Minimum Strength 450 MPa
  - Minimal maintenance over 120 year life
  - Specific finish requirements
  - Marine environment

Bridge characteristics:
1,596m long dual 3 lane high level cable stayed bridge with a clear span 1.018m.
Tower height: 295m.

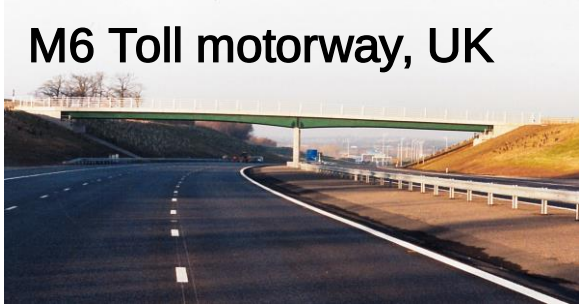
Stonecutters Bridge, Hong Kong. Opened to traffic 2009
20mm outer skin of 2205 Duplex Stainless Steel plate reinforce the tower 120m upper part

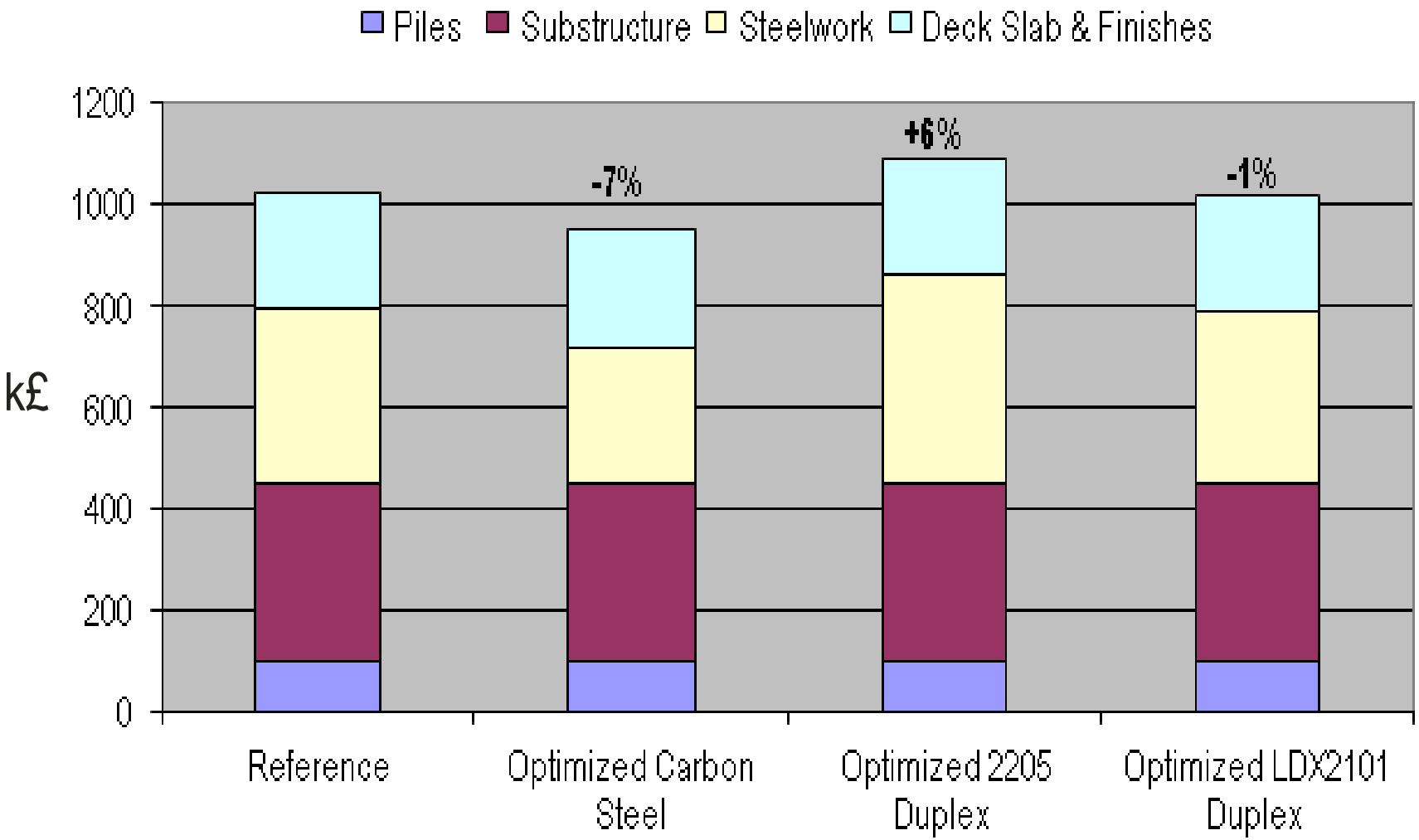
Main span 1018 m, Stonecutters Bridge, Hong Kong, China

Spans Rambler Channel entrance to Hong Kong container port

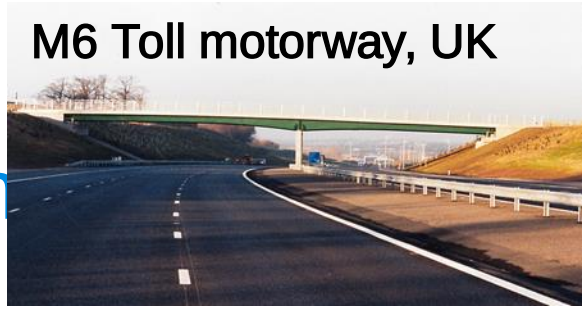
Towers 300 m high, top 120m steel concrete composite section

Construction Cost[2] Typical
Composite Highway Bridge Design

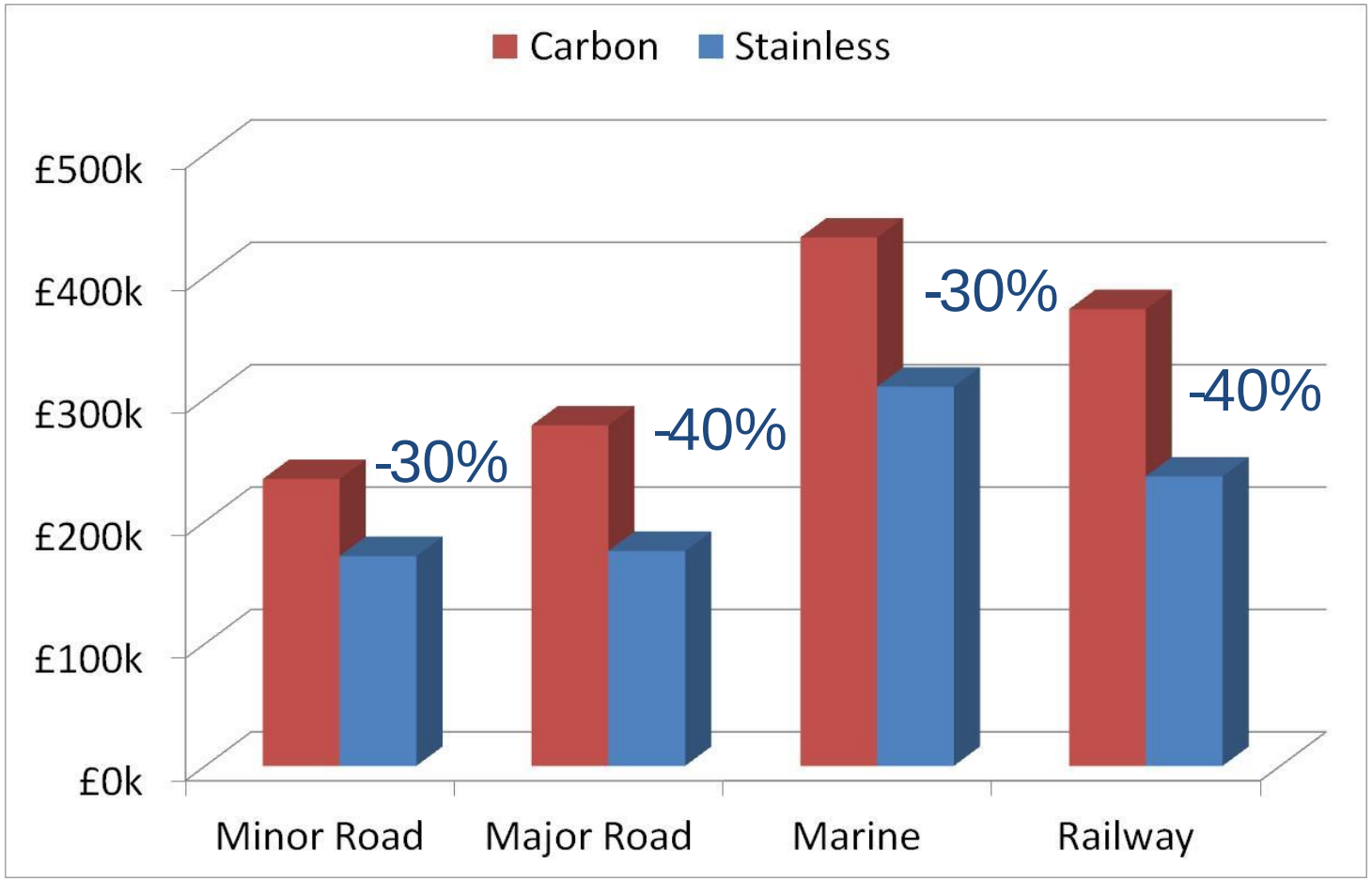




Life Cycle Costs[2] Typical Composite Highway Bridge Design



- On a simple bridge, savings can be in range of 30-40 %



Innovation

The Nynäshamn composite bridge Sweden 2011

Innovative design enable use of sustainable stainless steel without cost disadvantage

Stainless steel selected for: long trouble free service life

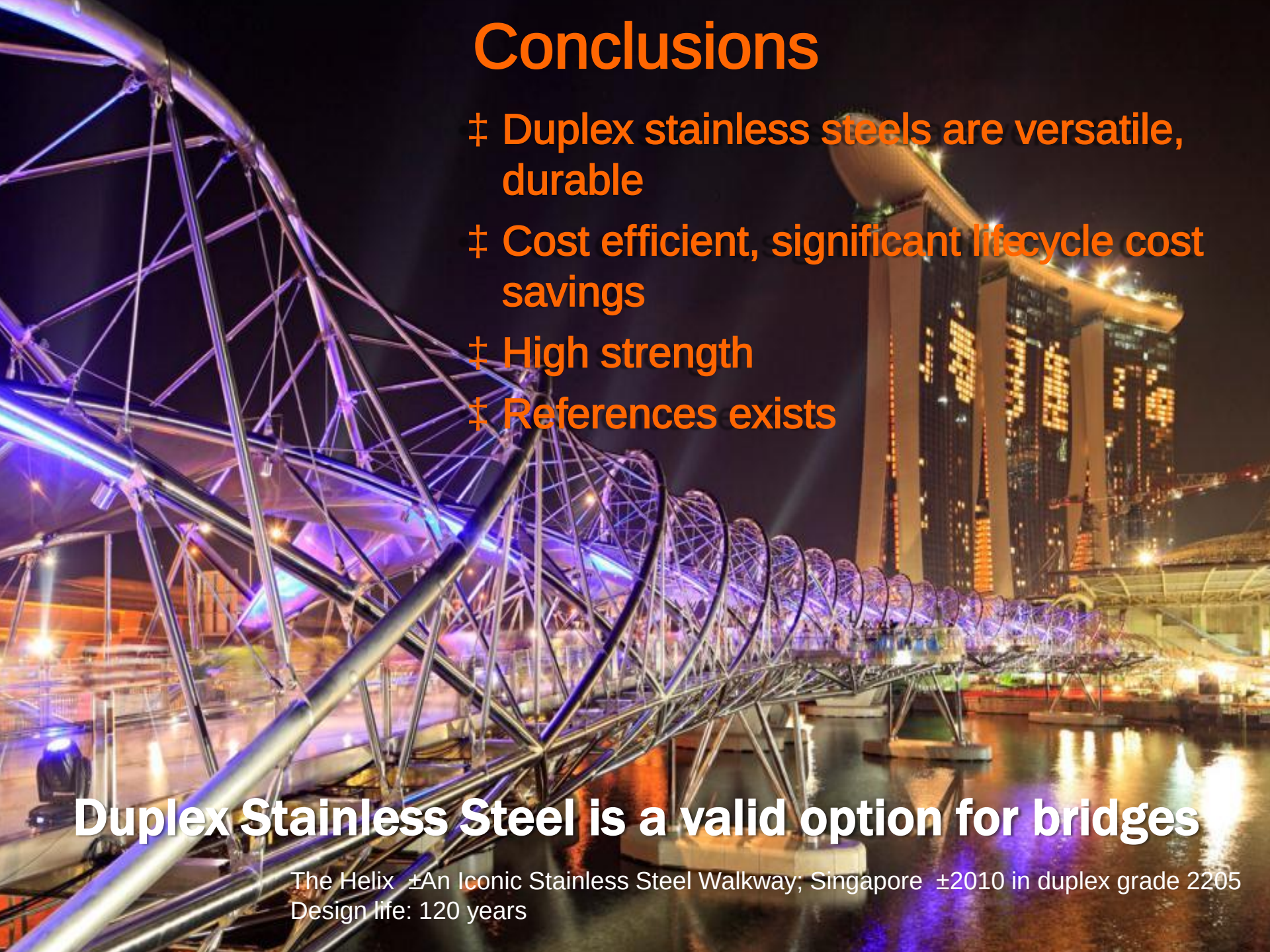
Right hand photo shows one of the duplex LDX2101 stainless beams of the load bearing structure (Photos courtesy of NCC Construction)

Flat shapes in High Strength Stainless Steel

- LDX 2101® heavy plates for the Nynäshamn bridge girders tailor-made at the plate mill in Degerfors, Sweden

Conclusions

- Duplex stainless steels are versatile, durable
- Cost efficient, significant lifecycle cost savings
- High strength
- References exists



Duplex Stainless Steel is a valid option for bridges

The Helix ±An Iconic Stainless Steel Walkway; Singapore ±2010 in duplex grade 2205
Design life: 120 years