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# 50+ years of weathering steel in Finnish road bridges

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# Speaker

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Activities with steel bridges:

- FTIA approver of structural bridge design, FTIA author of bridge and tunnel requirements and guidelines, FISE committee member (personal certifications for steel construction professionals in Finland)

# What is Weathering Steel?



- High-strength low-alloy steel forming protective rust (patina)
- Key alloys: copper, chromium, nickel, phosphorus etc.
- Patina formation requires wet/dry cycles; slows corrosion
- No painting needed
- Developed in U.S., widely adopted for low-maintenance structures
- Brands e.g. COR-TEN<sup>®</sup>, SSAB Weathering<sup>®</sup>
- Example: Heikkilä bridge 1978

# Typical Main Structure Steel Grades in Finnish Steel Bridges

- Conventional painted structural steel
  - Historically common: Approximately 1700 road bridges (FTIA, cities, communes) + hundreds of private road bridges
  - Today: Typically CE-marked S355...S460 + “over-specified” C5-VH painting
- Weathering steel
  - Around 110 road bridges (FTIA, cities, communes) + over 50 private road bridges
  - Corten B introduced in the 1970s
  - Today: Typically CE-marked S355W...S460W

# Weathering Steel Standards and FTIA

## Weathering Steel Bridge Main Guidelines



- Standard EN 10025-5:2019 Hot rolled products of structural steels. Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance
- FTIA Application Guideline for the Eurocode: Design of Steel and Composite Structures – NCCI 4, 25.8.2016
- FTIA Guideline for the Application of Standard SFS-EN 1090-2: Execution of Steel Structures – NCCI T, 16.1.2020
- Other guidelines e.g. European design guide for the use of weathering steel in bridge construction, ECCS 2021

# FTIA Weathering Steel Bridge Practice



- Selection between conventional painted steel and weathering steel is based on investment cost, aesthetics, maintenance strategy, environment e.g. road salt
- No written guidance on selecting a steel type when both are suitable
- FTIA guidelines NCCI 4 and NCCI T: Specify conditions that limit the use of weathering steel

# Advantages of Weathering Steel



- Manufacturing and erection: No workshop or on-site painting; no paint touch-ups needed
- Reduced maintenance: No re-painting. Patina stabilizes surface. Durable in Finnish climate and road conditions
- Graffiti removal: No special precautions required
- Lower lifecycle cost
- Example: Ala-Temmes bridge 1979

# Disadvantages of Weathering Steel



- Higher initial cost
- Initial corrosion until patina forms
  - Not suitable for constantly wet or splash zones
  - Avoid water traps and debris accumulation, e.g. proper drainage important
  - Runoff staining (rust stains, process will end in 2-6 years) may affect aesthetics
- Environmental limits
  - Baltic Sea conditions OK, ocean conditions harmful
  - Conventional road salt (usage likely to decrease?)
- Welding/fabrication is not difficult, but requires correct procedures
- Example: Lehtosalmi bridge 1980

# Controversial Topics with Weathering Steel



- Climate impacts, carbon footprint, environmental sustainability
- Aesthetic appeal
  - Natural rust-colored finish
  - Color range yellow orange - light brown - dark reddish brown
- Weathering steel + painting

# Conventional vs Weathering Steel

Feature	Conventional Steel	Weathering Steel
Maintenance	Regular painting	Minimal or none
Initial cost	Lower	Higher
Lifecycle cost	Higher	Lower
Appearance	Any colors	Rust-colored patina
Aesthetics over time	Changes	Remains constant
Detailing sensitivity	Less critical	More critical

# FTIA Key Observations - Weathering Steel Bridges



- 50 years of positive experience
- Suitable for Finnish climate & road conditions with proper detailing
- Minimal unexpected corrosion beyond patina
  - Bridge study 1982-2014, VTT Technical Research Center of Finland: COR-TEN B cumulative corrosion loss 1.9–3.1  $\mu\text{m}/\text{year}$
- Benefits: Lower maintenance, durability, aesthetics
- Challenges: Design must ensure proper exposure, drainage, road salt
- Bridges remain operational without weathering steel maintenance

# Example: Tervola Bridge 1975



- Total length 494 m
- COR-TEN B
- Several bridge maintenance works – routine upkeep and minor repairs
- One bridge rehabilitation – major repair or structural renewal
- No maintenance or rehabilitation work needed for weathering steel

# Example: Ivalojoen silta 1979



- Total length 152 m
- Some bridge maintenance works
- No bridge rehabilitation yet
- No maintenance or rehabilitation work needed for weathering steel

# Example: Tornio bridge 1979



- Total length 318 m
- Outer sides of main beams: Painting
- Several bridge maintenance works
- First bridge rehabilitation underway
- Maintenance work under way for weathering steel
  - Paint damage on the bridge's steel girders will be repaired.

# Example: Itäkeskus pedestrian bridge 1979



- Total length 158 m
- The road below is salted more than the requirements for weathering steel allow
- Several bridge maintenance works
- No bridge rehabilitation yet
- Unexpected corrosion beyond patina, maintenance work is needed for weathering steel locally

# Example: Itäkeskus pedestrian bridge 1979



- Leaf rust on lower flanges of the horizontal wind braces (UPE)
- Main beam at ground level, and in winter, plowed chloride-containing snow accumulates on it. Web steel surface is flaking



# Example: New Mylly bridge 2011



- Total length 99 m
- No bridge maintenance works or bridge rehabilitation yet
- Weathering steel beams clad with stainless steel cladding panels

# Example: Sipoonkorpi pedestrian bridge 2019



- Total length 126 m
- Bridge of the year price
- No bridge maintenance works or bridge rehabilitation yet
- Bridge pier and parapets also weathering steel

# Example: Vanhankirkon pedestrian bridge 2021



- Total length 293 m
- No bridge maintenance works or bridge rehabilitation yet
- Also bridge piers and arches weathering steel

# Example: Jokikylä bridge 2023



- Total length 119 m
- First bridge with S420W
- No bridge maintenance works or bridge rehabilitation yet

# Example: Huikku bridge 2026



- Total length 767 m
- First bridge with S460W
- Outer sides of main beams: Painting
- Under construction





VÄYLÄ