### SSAB Weathering OPTIMIZED FOR YOU AND LONG LIFE

SSAB

Ståldag 13.11.2019

## WHAT IS SSAB WEATHERING STEEL?





# "When rust becomes a coating"



## WHY USE WEATHERING STEELS IN GENERAL?



- Weather resistant no need for corrosion protective treatment
- Low life-cycle costs no painting or repainting needed – a carefree solution
- When painted great paint adhesion and doubles the intervals between repaintings
- Environmentally friendly 100% recyclable and blends well into nature surroundings





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## WHY CHOOSE WEATHERING STEELS FROM SSAB?





# Why choose weathering steels from SSAB?



# **COR-TEN**<sup>®</sup> =

Increased Corrosion resistance and Tensile strength



U.S. Steel introduced COR-TEN<sup>®</sup> steel Originally developed for the railway industry



# Why choose weathering steels from SSAB?



High strength

		Thickness [mm]	Yield strength min (MPa)	Tensile strength min – max (MPa)	
	SSAB Weathering 550	3 – 12	550	600	-
	SSAB Weathering 700	3 - 6,1	700	750	-
Hot Rolled	SSAB Weathering 960	2,5 - 6,4	960	1000	-
	SSAB Weathering 420*	Up to 65	420	500	660
	SSAB Weathering 460*	Up to 65	460	530	710
Cold Rolled	SSAB Weathering 700	0,98 - 2,1	700	800	-
Tubes & Sections	SSAB Weathering Tube 500WH	2 – 12,5	500	580	760

\* Under development. Has been included to the update of EN 10025-5 2019







High strength



**Tolerances** 

#### **Flatness tolerance example:**

Hot rolled SSAB Weathering 355 – 1500 mm wide



### Why choose weathering steels from SSAB?



**Tolerances** 

Dimensions





## THE SURFACE OF SSAB WEATHERING STEELS





### Patina formation

- In the beginning the Weathering steels starts to rust as ordinary mild steel
- Patina formation is dependent on the atmospheric conditions

Alternating wet and dry cycles. Faster if the wet and dry cycles are more frequent.
High Sulphur atmosphere accelerates the patina formation.



### Patina formation

- In the beginning the Weathering steels starts to rust as ordinary mild steel
- Patina formation is dependent on the atmospheric conditions
- The colour changes from fresh, newly developed orange-brown towards light or dark brown
- Uniform patina cannot form in dry conditions and constantly wet conditions



Time

- The higher the pollution, the darker the patina.
- It takes approximately 2–6 years for the patina to fully develop.

# Atmospheric corrosion

- Patina layer on the steel surface of weathering steels is adherent and resists cyclical corrosion loss
- Corrosion loss continues strong with normal carbon steel with scaling and regenerating rust layer (cyclical corrosion loss)
- Corrosion loss is higher in the beginning during patina formation on weathering steel but when the protective layer is formed – corrosion loss is then on low lever.

## Corrosion behavior compared to normal carbon steel



### **32-years COR-TEN B** corrosion in Bridges



Annual corrosion loss during 32 years (trend is descending: SO<sub>2</sub> emissions were decreased after 1980's with less corrosion) A = Mikkolantie and B = Itäkeskus bridge (Helsinki) C = Olkinen bridge (Mäntsälä) D = Vårdö bridge (Åland)



conditions after 32 years

Source: VTT-CR-05247-14, Säänkestävien teräslevyjen korroosiotutkimus v. 2014, Leena Carpen, VTT Technical Research Center of Finland

## PAINTING SSAB WEATHERING STEELS





## **Painting benefits**

- Good paint adhesion paint sticks to material
- The "self healing effect" minimize creepage of corrosion under paint
- No porous expanding rust is produced, which is the case for carbon steel
- Repainting costs are reduced
- The useful life is normally around two times longer compared to ordinary plain carbon steel



#### **EIFFEL TOWER – PARIS, FRANCE**

- Designed by Gustave Eiffel
- Construction finalized in 1889
- ► Total height 317 meters
- 7.300 tons of wrought steel
- If only Mr. Eiffel could have used Weathering Steel for his world-famous structure...
- The City of Paris could have saved 8,6 tons of paint, every year!
- 1.120 tons paint year-to-date
- ▶ 8.400 tons reduction of CO2 year-to-date



\*Source: https://www.toureiffel.paris/en/the-monument/painting-eiffel-tower



### **Corrosion test in Bohus Malmön island 2012-2018**

- Paint system: Sa2½

   x 80 µm epoxy primer
   x 40 µm epoxy primer
   x 40 µm polyurethane paint
   Coating thickness 160 µm
- Corrosivity/durability class given for paint system: C3/M
- Corrosivity class in the test site: C5





### **Test results**

- Paint was removed from sample surfaces and penetration of corrosion under the paint layer was evaluated according to ISO 4628-8<sup>2</sup>
- It was easy to remove the paint from rusted area in basic carbon steel samples.
- It required quite much force to remove paint from corroded area in weathering steel samples.
- Paint layer had still good adhesion to surface on rusty area of weathering steel.



Basic carbon steel (S420)

SSAB Weathering 355



### **Environmental** aspects: bridge case

- Steel surface exposed to severe climate conditions C4/C5 e.g. steel bridges are often painted with Polyurethane paint systems
- Paint thickness layer commonly 320μm
- A rule of thumb is that 1m<sup>2</sup> of 320µm of Polyurethane paint system release 5kg CO<sub>2</sub>\*.
- Steel structures are often re-painted every 15-20 years and structure often lasts 80 years which means that it's re-painted 3 times
- Paint thickness when re-painting often 200µm which release 3,1kg CO<sub>2</sub>\*

\* Carbon Dioxide Equivalents (kg CO<sub>2</sub>-equivalent)

Total CO<sub>2</sub> emissions for a structure painted with 320μm first time and re-painted 3 times with 200μm paint thickness is 14,4kg per m<sup>2</sup>.

#### How much is 14,4 kg $CO_2^*$ ?

The average  $CO_2$  emission of a Swedish passenger car in 2017 was 2.130 kg  $CO_2$  per year\*\*

CO<sub>2</sub> emission from one car is equivalent to 149m<sup>2</sup> steel painted



ONE YEAR = 149m<sup>2</sup>

\*\*Sources: <u>Swedish Environmental Protection</u> <u>Agency</u> and <u>Statistics Sweden</u>.

## What if the Öresund bridge was made of weathering steels?

Facts about Öresundsbron

- Opened in year 2000
- Expected life 100 year
- 82.000 ton of steel and 260.000 liters of paint used when constructing the bridge <sup>1)</sup>

Maintenance painting <sup>2)</sup>

- Around 300.000m<sup>2</sup> is re-painted
- Maintenance painting every 20 years



Assumptions for maintenance painting:

- Paint thickness:  $200 \mu m^{3)}$
- 75.000 liters of paint used each time
- 7,5kg CO<sub>2</sub> released for each liter of paint used <sup>4)</sup>
- Bridge re-painted every 20 years, totally 4 times

	Liters of paint	CO2 (ton)	
Construction	260.000	1.950	
Maintenance x4	300.000	2.250	
Total	560.000	4.200	

SSAR

- 1) Skanska web-page: https://www.skanska.se/vart-erbjudande/vara-projekt/57321/Oresundsbron%2C-Malmo
- 2) https://www.metal-supply.se/article/view/670210/tyskt foretag inleder ommalningen av oresundsbron
- 3) Recommendation according paint producer Tikkurila https://new.tikkurila.com/industry/products/temabond\_st\_200#data%20sheets

4) Density of paint, 1,5 kg / liter. CO2 released when producing 1 kilo of paint is 5kg CO2.

### Cost aspects of painting steel structures

- Costs related to painting or re-painting of steel structures; Labour costs, Paint costs, Scaffolding costs
- To avoid release of flakes, dust and plastic particles into nature, especially during shotblasting before re-painting, costly protection needs to be built
- Close to water protection to avoid paint dropping into water often demanded
- Parts of steel structures can be hard to reach



Protection built for re-painting of bridge in Sundsvall, Sweden link



## WHERE TO USE SSAB WEATHERING STEELS?

## **SUMMARY!**







BUILDINGS AND ART



STRUCTURES AND BRIDGES



HEAVY TRANSPORT



SULPHUR RICH OR HIGH TEMPERATURE ATMOSPHERES



### STRUCTURES AND BRIDGES

#### LOW LIFE-CYCLE COST

- Low production cost = no painting needed
- Low maintenance cost = no re-painting necessary
- ► If the steel is painted, longer intervals between re-painting

#### **ENVIRONMENTALLY FRIENDLY**

- ► No painting means no risk of polluting surroundings with chemicals
- ► 100% recyclable
- If wood is substituted, no need for poisonous impregnation



### STRUCTURES AND BRIDGES

• Appearence that blends into the landscape





## SSAB Weathering steel – when rust becomes a coating





## **HYBRIT**<sup>®</sup>

### A fossil-free future for iron- and steelmaking



A joint venture between SSAB, LKAB and Vattenfall



### HYBRIT <sup>®</sup> TECHNOLOGY



### WHERE ARE WE NOW?





### HYBRIT<sup>®</sup> Initiative towards fossil-free steel







# SSAB

A stronger, lighter and more sustainable world