WEATHERING STEEL 30 YEARS OF EXPERIENCE IN BANEDANT

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RAMBOLL



INTRODUCTION

- 1st major electrification project in 1980s
- State of the art design required 'year 2000 design'
- 50-years service life with minimum maintenance
 - Concrete
 - Aluminium

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- Stainless steel
- Weathering steel

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 - Weathering steel preferred to concrete





INTRODUCTION

- Aesthetical impact on the scenery of the country
 - 2100km single track
 - 40.000 masts
- Focus on architectural design
- Use of clamps
- Innovative design awarded ECCS design award in 1987
- Performance of weathering steel has been registered since the beginning





WEATHERING STEEL

- Regular dry/wet cycles
- Dense and well-adhering layer of corrosion products
- Slow corrosion rate
- Specific attention to detailing
- Low maintenance cost
- Aesthetic solutions
- Sacrificial thickness





DESIGN PHILOSOPHIES

- Gap between structures, if sufficient contact pressure cannot be ensured
- i.e. thin plates and clamps
- Avoid ponding water or cavity effects
- Avoid collection of corrosion products or dirt
- Discolouring of structure below (bridges)
- Stainless bolts
- Avoid self-adhesive stickers
- Avoid graffiti





GRAFFITI ISSUES

- Easy removal of offensive graffiti: Paint on top
- Can lead to accelerated corrosion if not done correct
- Horizontal faces most critical





SELF-ADHESIVE STICKERS

- Initially self-adhesive
- Replaced with spacers in corners to keep gap between steel and yellow tape









TEST-PROGRAMME

- Designated test masts
- Monitoring corrosion conditions in details
- Determine general corrosion rates
- 6 different locations in Denmark Rural, industrial and coastal area
- Test regime of 238 test plates







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THE DETAILS STILL WORK AFTER 30 YEARS













TEST PLATES

- Given direction of exposure
 Up / down / vertical
- Plates cleaned chemical not mechanical
- Weight loss
- Back side and edges => conservative values
- Effect of stainless bolts?





EXPOSURE TESTS

- Sacrificial thickness chosen for design
- Corrosion rate decreases over time
- Experimental data not always easy to compare direct
- In general most exposure tests gives values after max 10 years
- Which curve is the one to use?





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30 YEARS CORROSION RATES

- Unique data from 30 years exposure
- Clear tendency on orientation during exposure
- Clear tendency on environment coastal vs. non-coastal (medium)





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30 YEARS CORROSION RATES

- Simplifying to steady-state corrosion rate
- Indication of expected service life exceeding 80 years or more
- At least for rural conditions





BRIDGES

- Bridges made from COR-TEN
- Welded sections not as many details
- 25 years of exposure









BRIDGES

- Test regime similar to masts
- Test plates measured at intervals
 - Top of bridge
 - Soffit of bridge (abutment)
 - Soffit of bridge (railway tracks)









CORROSION RATES ON BRIDGES

- Tendency on orientation not as clear as on masts
- Clearly faster corrosion above railway tracks (diesel engines?)
- In general a tendency to faster corrosion on bridges

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THANK YOU

