SÖDERLEDSTUNNEL STOCKHOLM
FIRE PROTECTION OF THE WESTERN TUBE
A CASE STUDY

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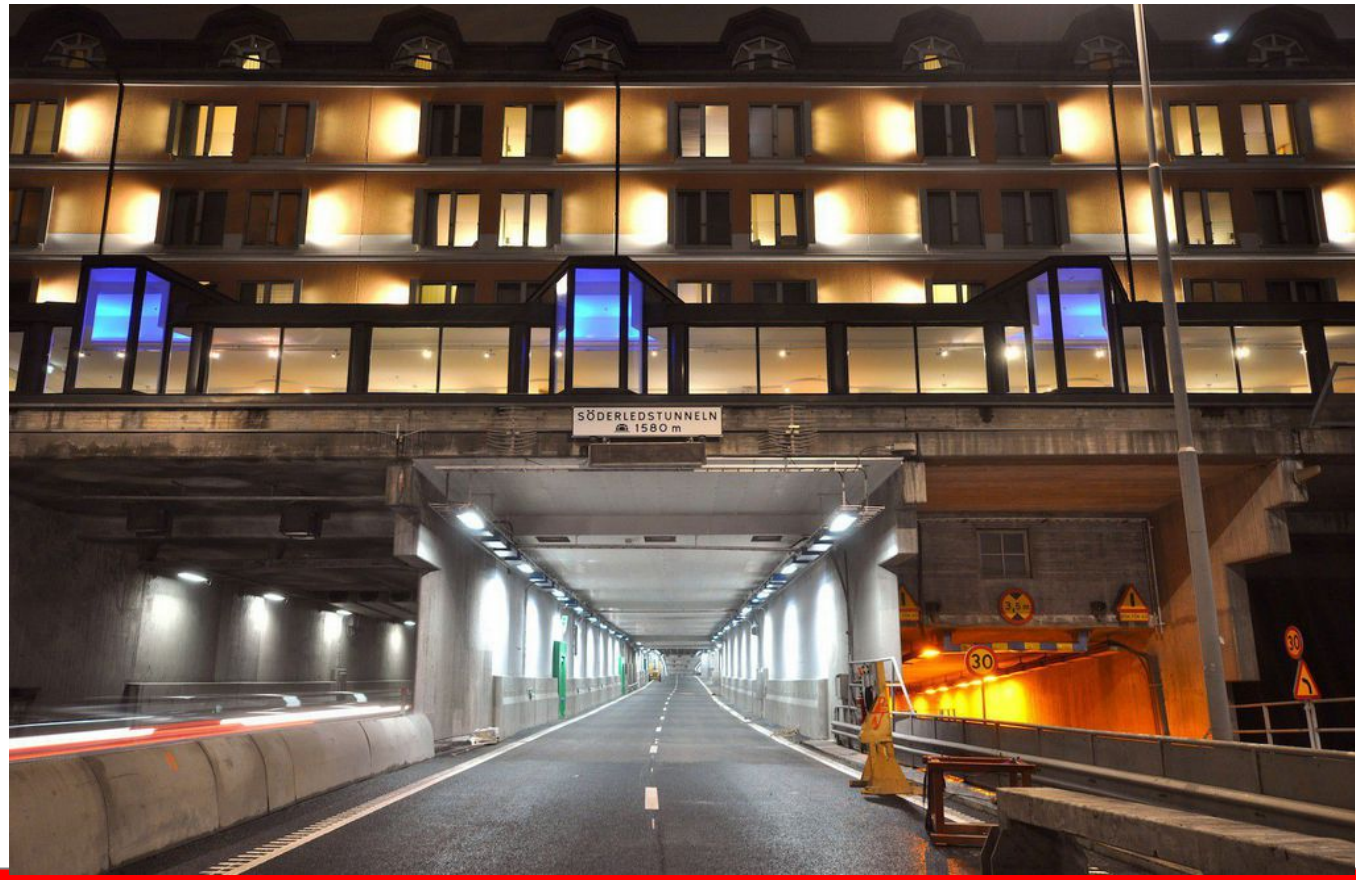
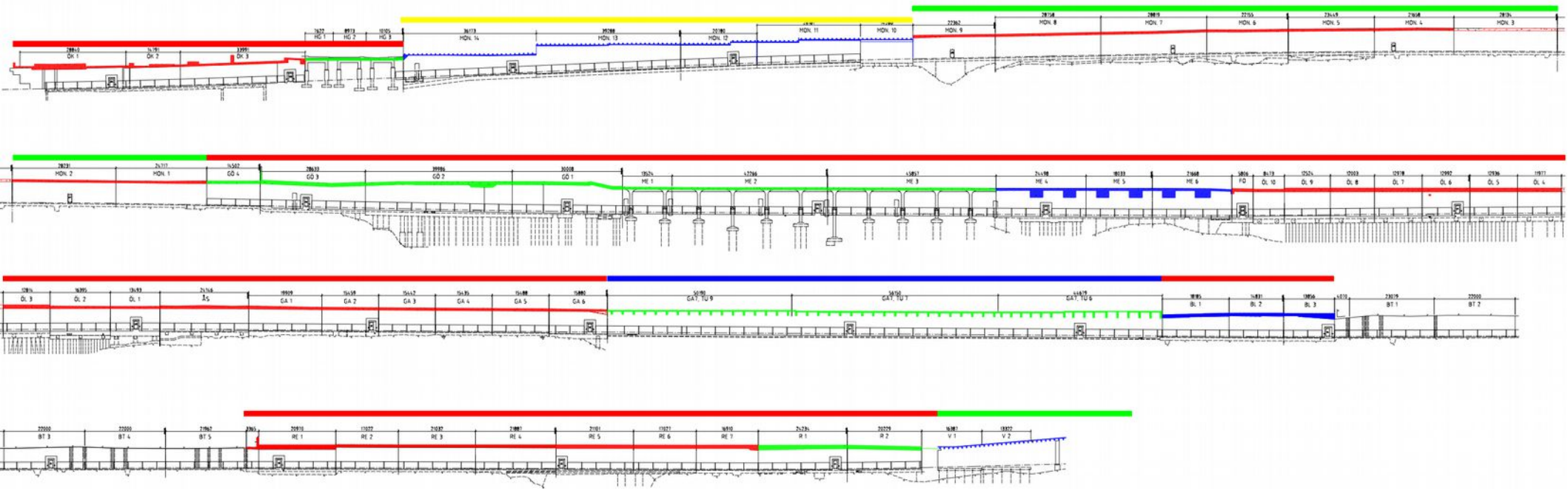
AGENDA

- INTRODUCTION / PROJECT OVERVIEW
- DESIGN / FIRE PROTECTION
- PROJECT
- DETAILS
- ABOUT TBT



INTRODUCTION

- UNDERPASSING ISLAND SÖDERMALM
- LENGTH 1.580 m
- CONSTRCUTION BETWEEN 1944-1991
- 2 TUBES / EASTERN TUBE REFURBISHED IN 3 SECTIONS BETWEEN 2004-2009
- WESTERN TUBE REFURBISHMENT IN 21 WEEKS / JV OF STRABAG SWE AND E-SCHAKT

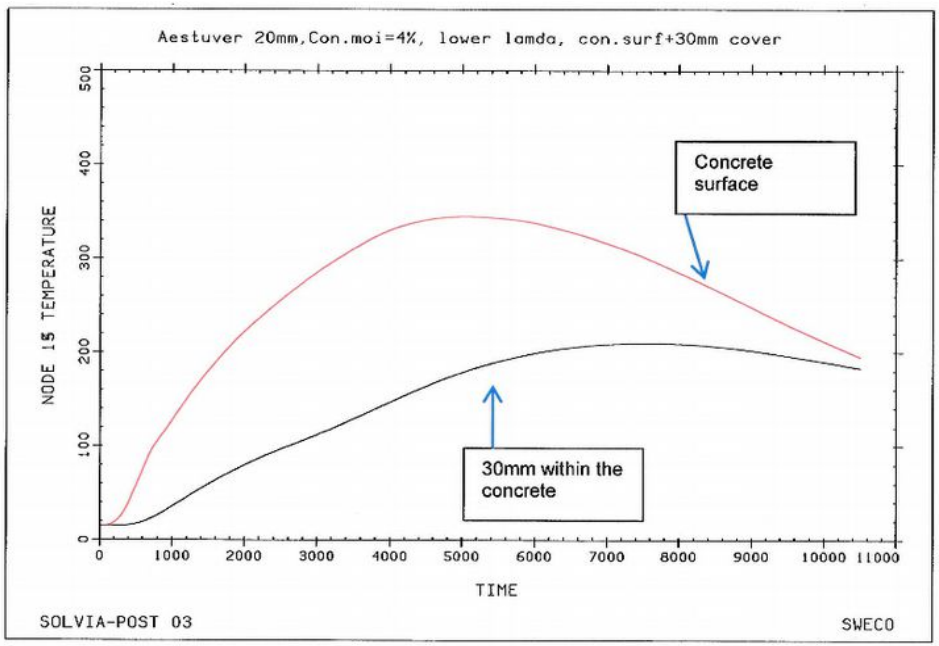


DESIGN AND APROVAL

- DIFFERENT SECTIONS = DIFFERENT STRUCTURE AND CONRETE COVER AND REINFORCEMENT
- FIRE CURVE: ZTV-ING 60 MIN
- CONCRETE ANALYSIS FOR SPALLING: 380°C MAX SURFACE TEMPERATURE
- STRUCTURAL CALCULATION: MAX TEMPERATURE FOR REBARS: 260°C – 560°C
- RISK ANALYSIS:
  - LOW RISK AREA: SREETS / YARDS – NO FP
  - HIGH RISK AREA: TOP STRUCTURE – PASSIVE FP = APPROX 70% OF CEILING
- ORIGINAL THERMAL CALCULATION BASED ON SPRAY MATERIAL 25-60 MM THICKNESS

DESIGN AND APROVAL

- DUE TO THE SHORT CONSTRUCTION PERIOD MAIN CONTRACTOR HAD BIG ISSUES WITH SPRAY APPLICATION
- ALTERNATIVE SOLUTION BASED ON PANEL – AESTUVER T
- THERMAL CALCULATION BASED ON FIRE TEST
  - SIMULATION OF FIRE TEST TO CALIBRATE PARAMETERS
  - CALCULATION OF SPECIFIC STRUCTURE DETAILS
  - RESULT: 20 MM AESTUVER T WITH BACKING STRIPS COVERS ALL DEMANDS
- BASED ON CALCULATION / TECHNICAL REPORT AND INSTALLATION METHOD APPROVED BY MC AND CLIENT



SAMPLE FOR BEAM CALCULATION

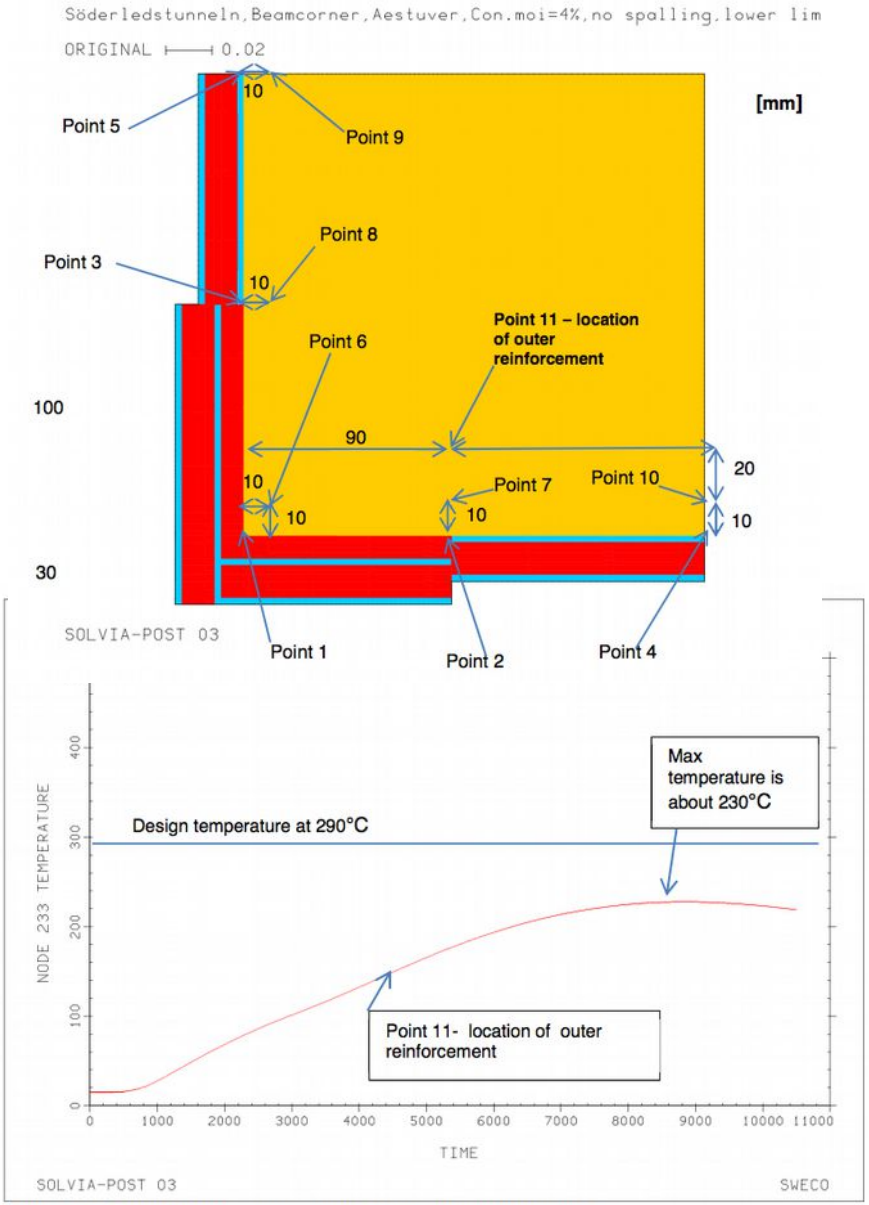


Figure 20: Temperature at the outer reinforcement (point 11).

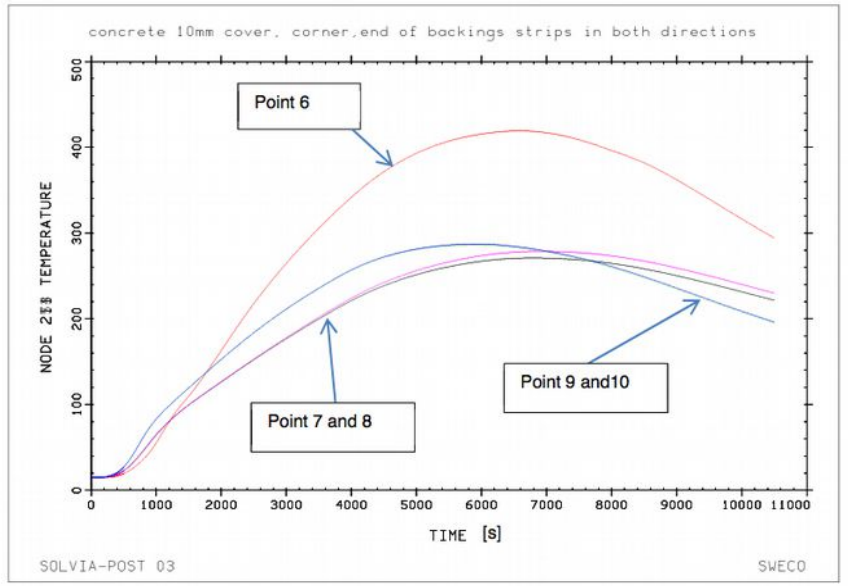


Figure 19: Temperatures over time for point 6 to point 10.

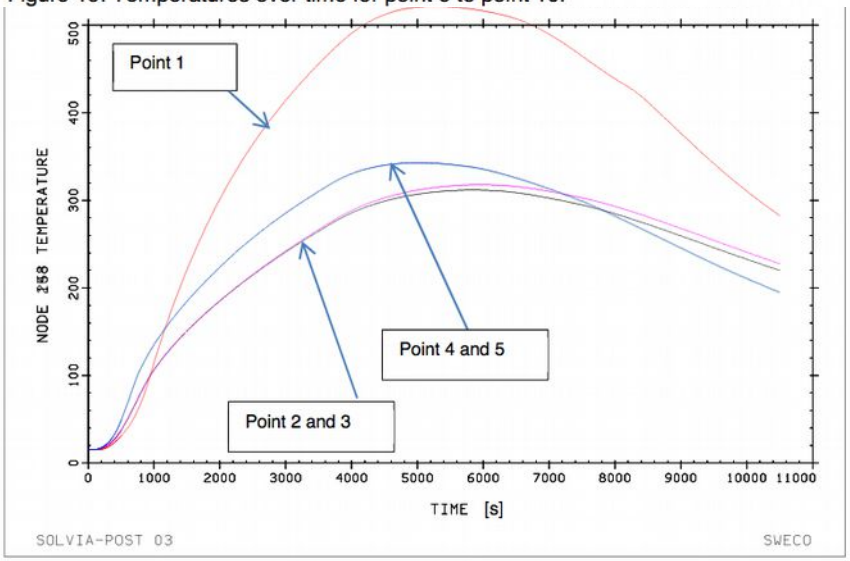
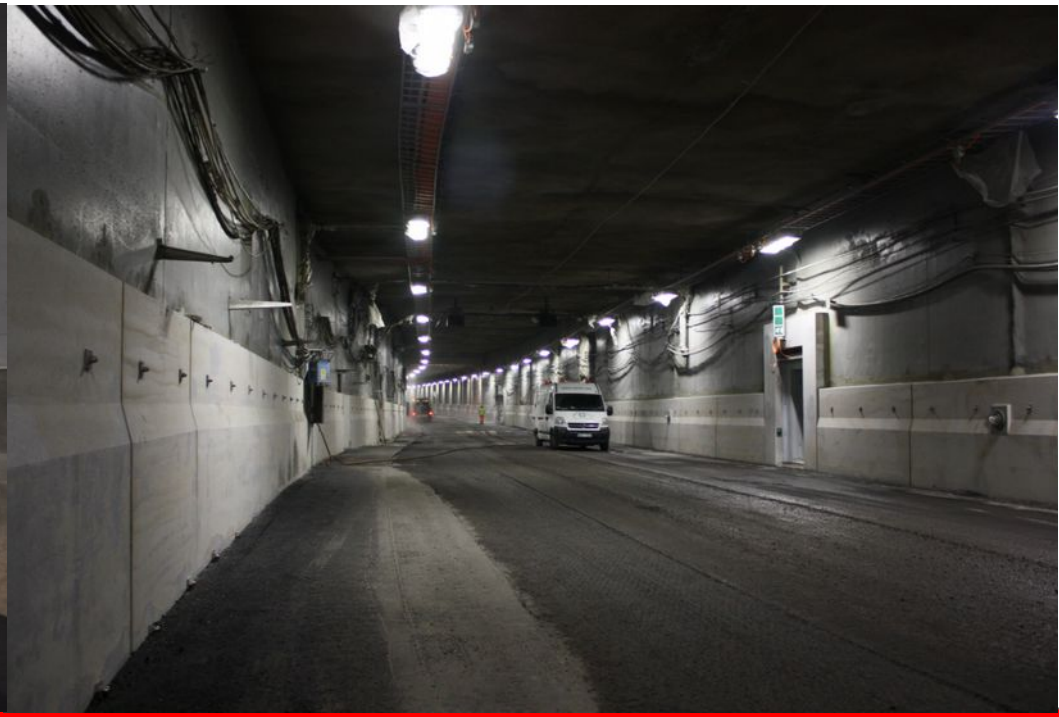


Figure 18: Temperatures over time for point 1 to point 5.

SYSTEM ADVANTAGES

- MAIN CONTRACTOR RECOGNIZE PROBLEMS TO INCOOPERATE SPRAY APPLICATION IN THE TOTAL REFURBISHEMT PROCESS
- FLEXIBLE IN TIMING AND LOCATION – ALWAYS A TRAFFIC LANE OPEN
- INSTALLATION UNDER REGULAR TRAFFIC POSSIBLE
- NO ENVIRONMENTAL ISSUES
- HIGHER REFLEXION AND BETTER CLEANING



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SYSTEM ADVANTAGES

- FAST REPAIR / REPLACEMENT AFTER FIRE
- ELBE TUNNEL FIRE 31.03.2011
- TUNNEL OPENS AFTER 10 DAYS

FIRE PROTECTION SYSTEM

ON FLAT CONCRETE / BEAMS

- 20 MM AE T PANEL / 100x10 MM BACKING STRIP
- 6x30/30 NAIL ANCHOR (5 MM TOLERANCE)

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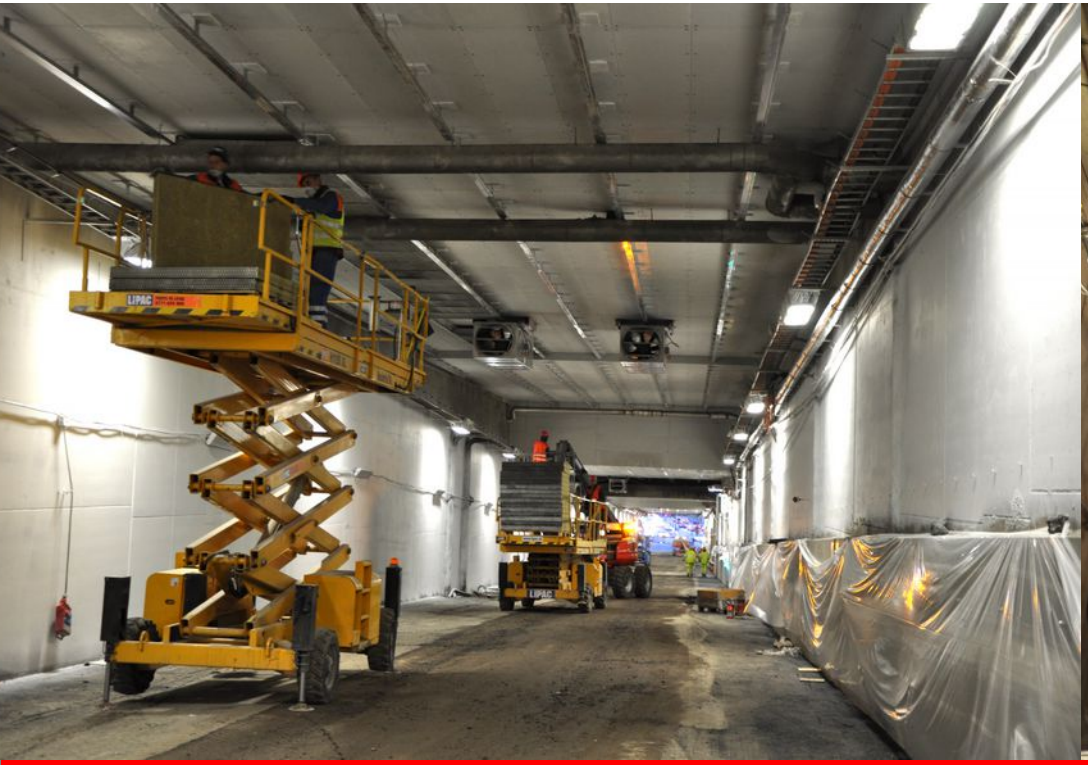
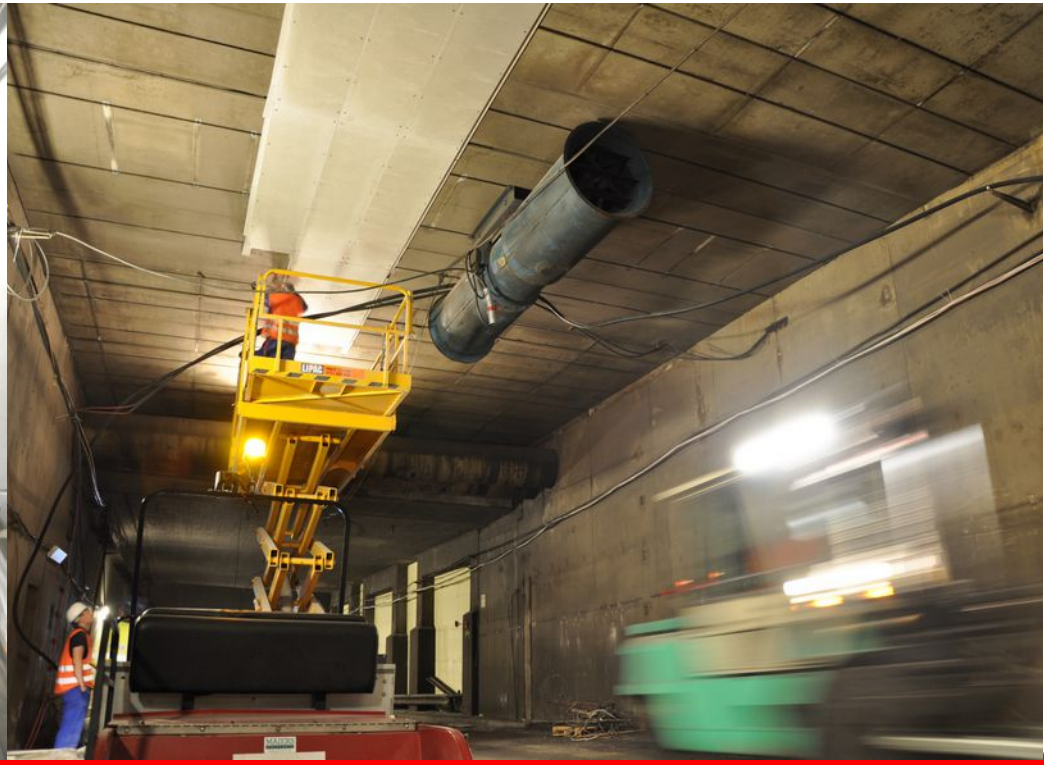
FIRE PROTECTION SYSTEM

ON FLAT CONCRETE WITH SUSPENDED NOISE PROTECTION

- 20 MM AE T PANEL
- 100x10 MM BACKING STRIP
- 6x30/30 NAIL ANCHOR (5 MM TOLERANCE)
- BRACKETS FOR NOISE PROTECTION FIXED TO CAST-IN CHANELS





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FIRE PROTECTION SYSTEM

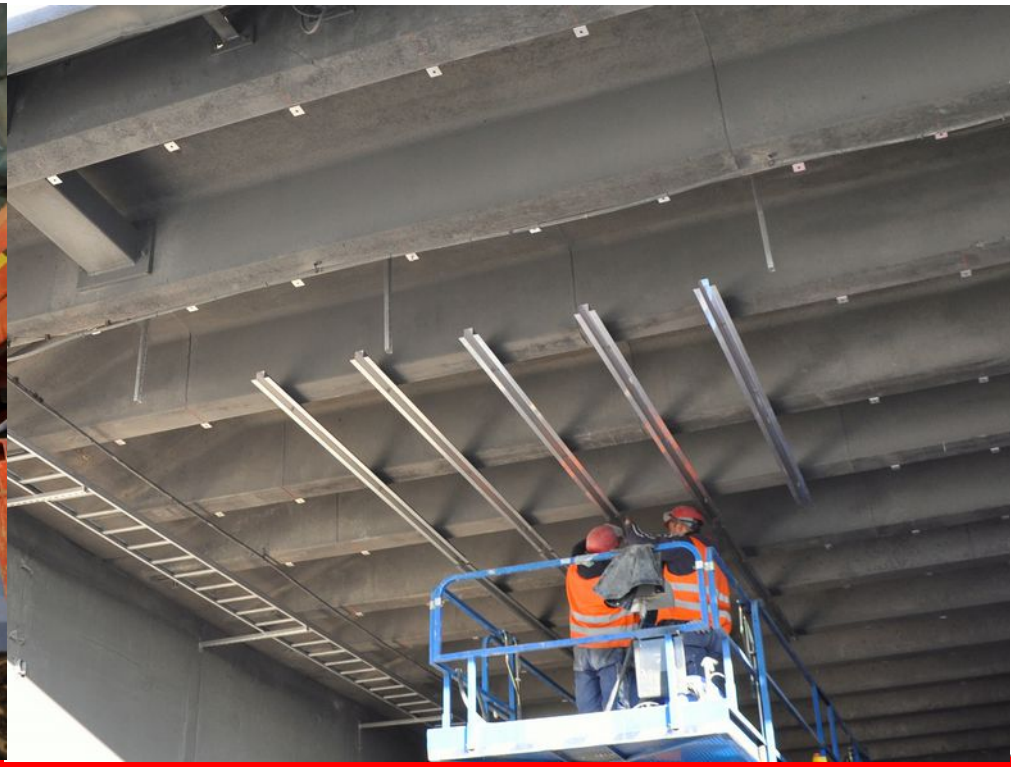
SUSPENDED CEILING UNDER NOISE PROTECTION

- TBT OMEGA PROFILES FIXED WITH HAMMERHEAD SCREWS HANGING DOWN FROM CAST IN CHANNELS
- 20 MM AE T PANEL / 100X20 MM BACKING STRIP AT THE PROFILE
- 5,5X58 MM SELF-DRILLING SCREW

FIRE PROTECTION SYSTEM

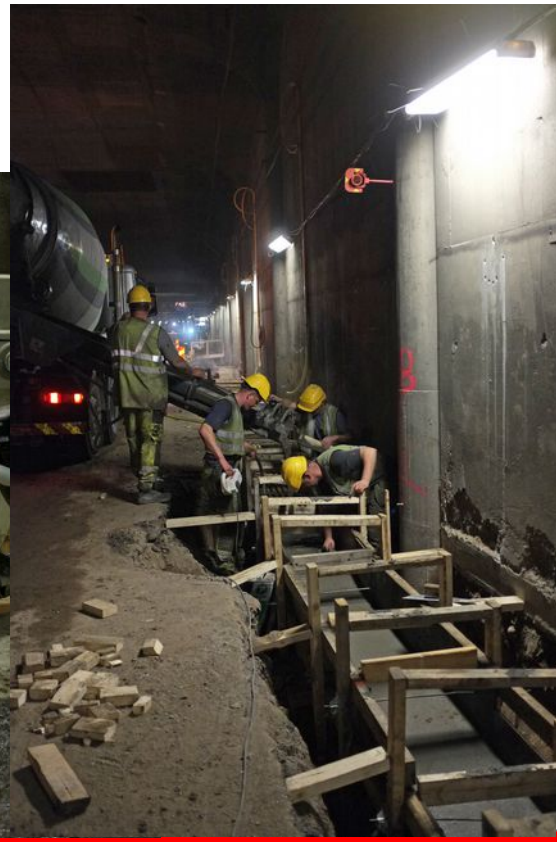
SUSPENDED CEILING UNDER POST-STRESSED TT-CASSETTES

- TBT OMEGA PROFILES FIXED ON BRACKETS ABOVE THE PRE-STRESSED AREA
- 20 MM AE T PANEL / 100X20 MM BACKING STRIP AT THE PROFILE
- 5,5X58 MM SELF-DRILLING SCREW



THE TOTAL REFURBISHMENT

- DISMANTLING EQUIPMENT
- DIGGING AND CASTING FOR NEW CABLE CHANELS BESID TEH ROAD
- PIPE WORKS
- CONCRETE REPAIR AT THE WALLS BY HYDRO DEMOLISHION AND SHOTCRETING
- BARRIER ELEMENTS
- FIRE PROTECTION
- NOISE PROTECTION
- LIGHTS
- VENTILATION
- TOP ASPHALT LAYER
- WALL PAINTING
- SIGNS



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THE TOTAL REFURBISHMENT

- UP TO 100 WORKERS FROM 7 NATIONS IN THE TUNNEL
- HIGH AMOUNT OF TRAFFIC FROM MACHIENERIES AND DELIVERY
- USING VISUAL PLANING SYTSEM FOR COORDINATION
- CLOSE COOPERATION WITH CLIENT TO SOLVE CONSTRCUTION DETAILS
- INCREASING THE FIRE PROTECTION FROM ONLY HIGH RISK AREAS TO THE COMPLETE TUNNEL CEILING (+30 %)

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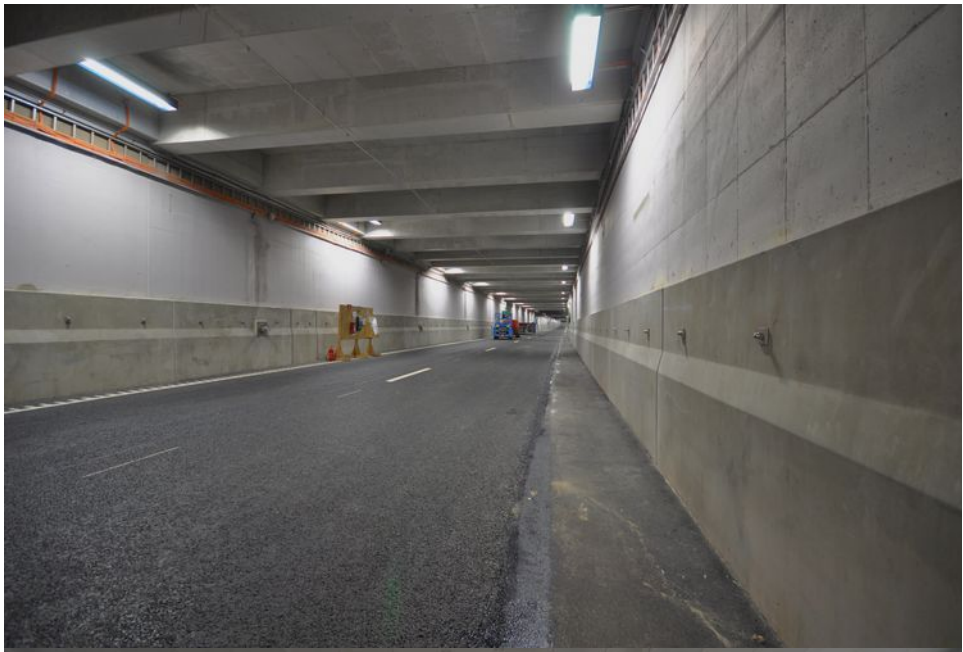
BEFORE AND AFTER



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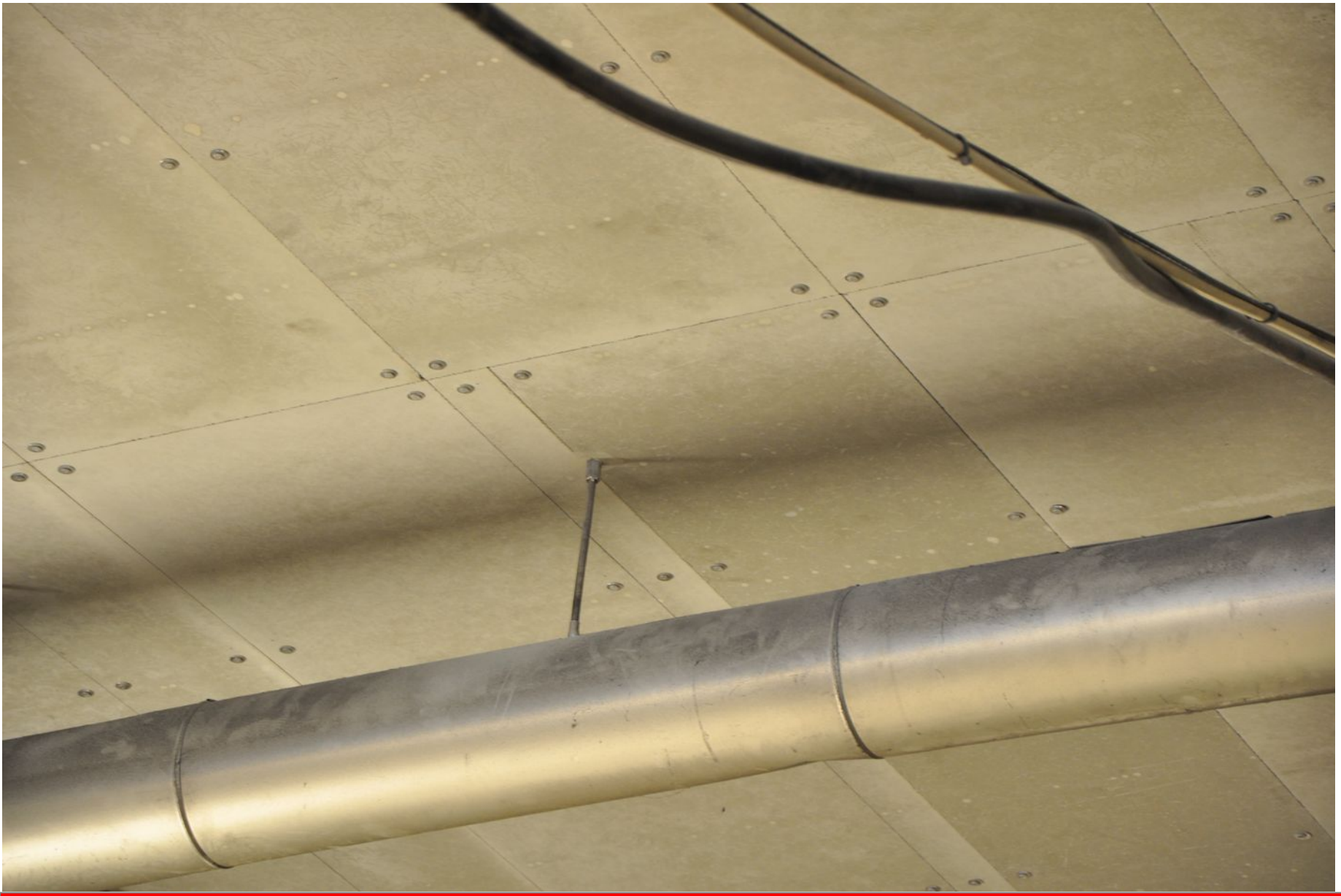
DETAILS: VENT OPENING

DETAILS: PIPE HANGER



DETAILS: MUSHROOM PILLAR 01

DETAILS: MUSHROOM PILLAR 02

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DETAILS: ISOLATED BOX FOR PIPE

DETAIL: BEAMS

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- DESIGN AND INSTALLATION FOR PASSIVE FIRE PROTECTION SYSTEMS, ARCHITECTURAL LININGS, NOISE PROTECTIONS AND COATINGS
- INSTALLATION CONCEPTS I.E. UNDER TRAFFIC, COORDINATION WITH OTHER WORKS
- MAINTENANCE / INSPECTIONS
- SUPERVISION

<u>LAST PROJECTS:</u>

SÖDERLEDSTUNNEL

RIDDARFJÄRDSAVFARTEN

NORRA LÄNKEN NL 35/51

PORT OF MIAMI TUNNEL

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THANK YOU FOR YOUR ATTENTION !

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