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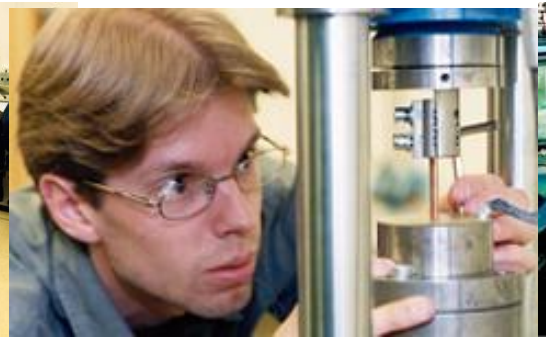
ICP Materials 2012

ICP Materials 2012-2013 work plan items

Ongoing activities

a) An updated report on trends in pollution, corrosion and soiling;

   - Technical manual for the 2011 exposure program for trend analysis

b) An updated report on the pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites.

   - Presentation by Stefan D. Will continue in 2013.

New activities

a) Elaborate report on the effect of black carbon on soiling of materials (2012);

   - Presentation in the following

b) Elaborate report on exposure of modern glass 2008-2012 and soiling dose-response functions (2013).

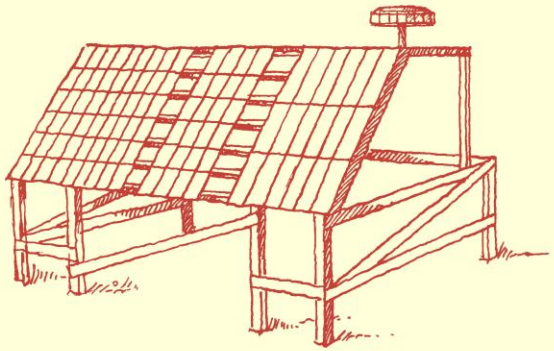
No need to update the workplan for 2013

Background and policy aspects BC

- Decision 2010/2 Short-lived climate forcers / Climate change
- Expost/Impact analysis showing that soiling is an important factor contributing to the exceedance of thresholds for materials and inclusion in guidance document as %area at risk.

CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

UN/ECE INTERNATIONAL CO-OPERATIVE PROGRAMME ON EFFECTS ON MATERIALS, INCLUDING HISTORIC AND CULTURAL MONUMENTS



Report No 71:

The effect of black carbon on soiling of materials

September 2012

PREPARED BY THE MAIN RESEARCH CENTRE

swerea KIMAB Swerea KIMAB AB, Stockholm, Sweden

Contents

What is BC and why has it an effect on soiling of materials?

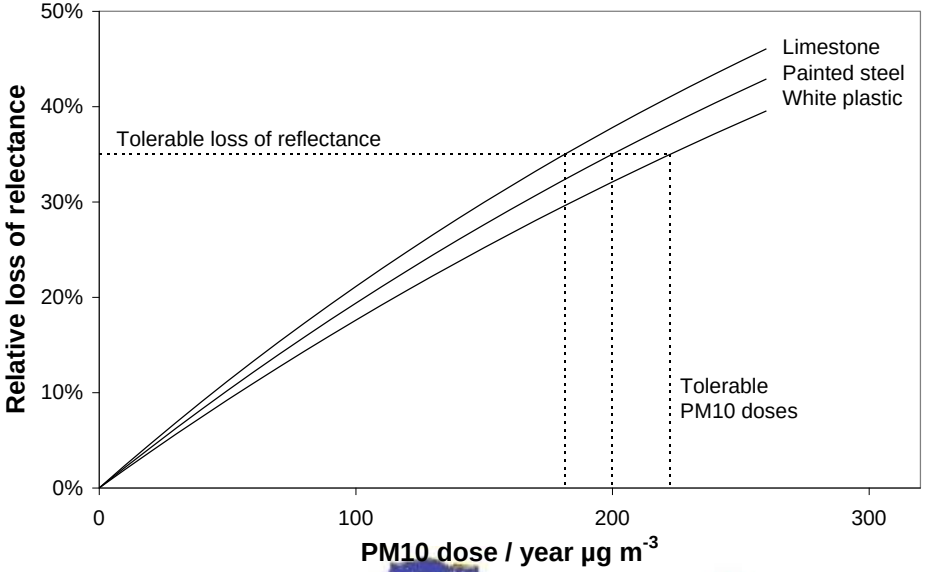
- BC is a term that is used to describe the light-absorbing component of PM;
- Soiling is a phenomena experienced as darkening of buildings/materials and is measured as loss of reflectance compared to unexposed objects;
- Therefore it is more or less self-evident that BC contributes to the soiling of materials;
- The report focus of dose-response functions and aesthetic thresholds of non-transparent and transparent materials.

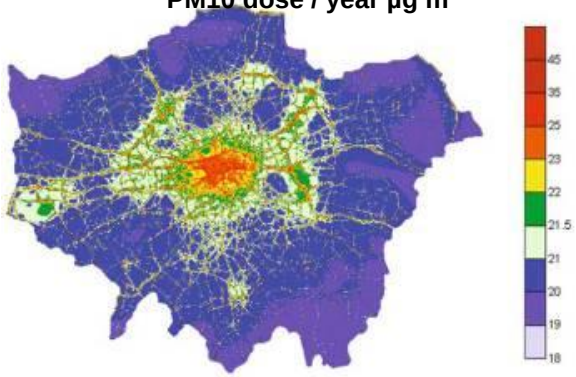
Aestethic thresholds and dose-response functions

Loss of reflectance compared to unsoiled surface:

35% = “tolerable”

A soiled building in Belfast, Northern Ireland
Watt et al, Sci. Total Env. 400 (2008) 415-424





Soiling of white painted steel (%loss after 5 years), London

Dose-response functions

- There are a number of established soiling DRF's in existence for non-transparent materials:
  - Difference depending on the measured parameter
    - BC (black carbon); PEC (particulate elemental carbon); DS (dark smoke); TSP (total particles); PM10
  - Difference between models
    - Square root model, exponential model
  - Difference between materials
    - Painted steel, wood, calcareous stone
- Dose-response functions specifically developed for modern glass are only found within ICP Materials – report next year.

Aestethic thresholds

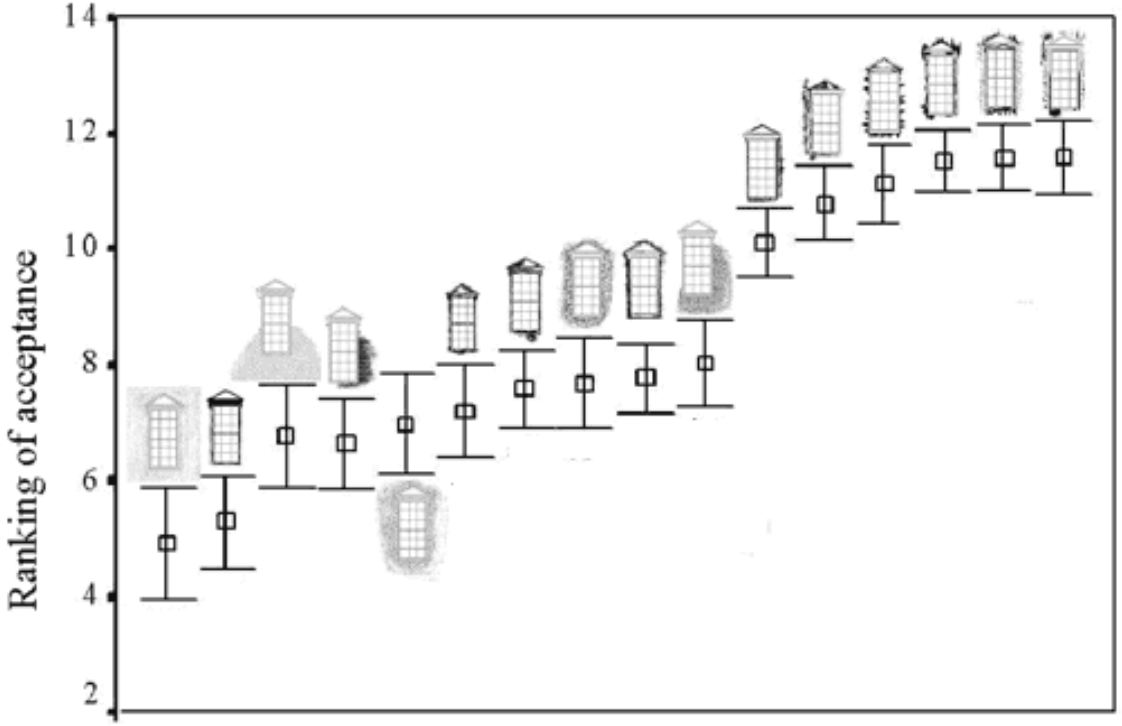
- **ICP Materials has earlier established a target for tolerable soiling when the loss in reflectance of non-transparent materials compared to unsoiled surfaces exceeds 35%. This value should be considered conservative and a less conservative tolerable level would lead to larger %area at risk in the guidance document.**
- Transparent materials have not been studied to the same extent, and a measurement of haze is usually applied by manufacturers when assessing quality. At current stage it is not possible to propose a threshold for transparent materials.

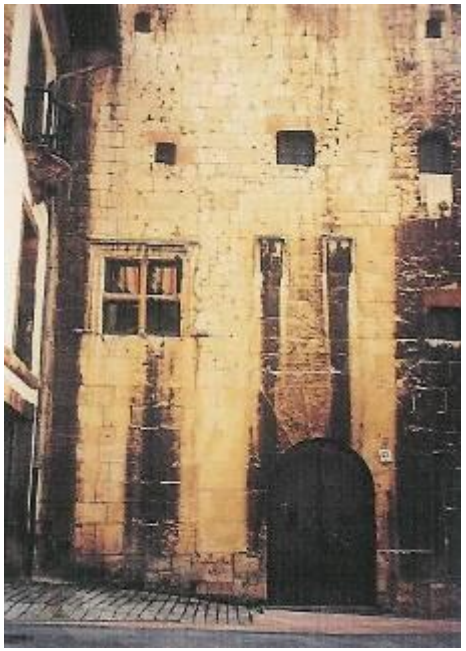
Complicating factors for the assessment of aestethic thresholds and dose-response functions

- It is a fine line between ”aged with dignity” and ”old, dirty and ugly”
- The perception of soiling is more pronounced in less polluted areas, neighboring buildings/objects “set the standard”
- It is not only the degree of soiling that matters but also the soiling patterns
- Confounding factors; biological activity

It is difficult to assess soiling in unsheltered locations due to the redistribution effect of rain

Lighter or darker is OK but not like that!





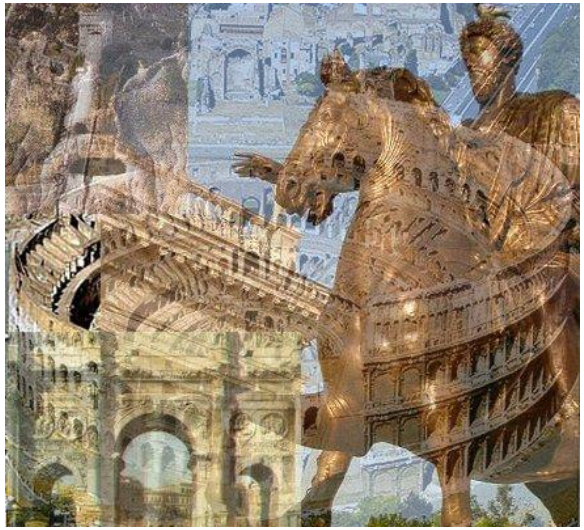
General preference for features that outline or shadow architectural elements

Soiling costs

- Soiling costs are substantial and comparable to other air pollution costs to materials;
- It is not only cleaning costs; if a cultural heritage building is looked upon as ill-cared and ugly it has implications on the aestethic value and can have impact on i.a. tourism.
- The most popular relation of soiling to economics is still through CBA, and is often based on cleaning and/or maintenance costs from past works carried out on particular sites;
- More work is required to establish the tools required to produce robust economic models for damage to materials from soiling.

Italian Agency for New Technologies, Energy and the Environment

Pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites



XXXI Session of UN ECE WGE
19 – 20 September 2012, Geneva

Prepared by the sub centre of cultural heritage and mapping

Updated report on the pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites - Report 70

Methodology

The surface of monuments and use of materials was obtained:

- **Greece, Athens – The Parthenon:** official technical documents and literature
- **France, Paris – The Facades in the Centre:** direct measurement facade by facade,
- **Czech Republic, Prague - The Klementinum Nat. Library:** technical documents
- **Germany, Berlin - Neues Museum:** technical documents, images
- **UK, City of Bath - Royal Crescent:** technical documents, images

Dose Response Function

- *Portland limestone*
- $\mathbf{R = 4.0 + 0.0059[SO_2]RH_{60} + 0.054Rain[H^+] + 0.078[HNO_3]Rh_{60} + 0.0258PM_{10}}$

Background corrosion rate for limestone is **3.2 µm**;
target for 2020 is **8.0 µm year^{-1}**; target for 2050 is **6.4 µm year^{-1}**

Greece, Athens – The Parthenon

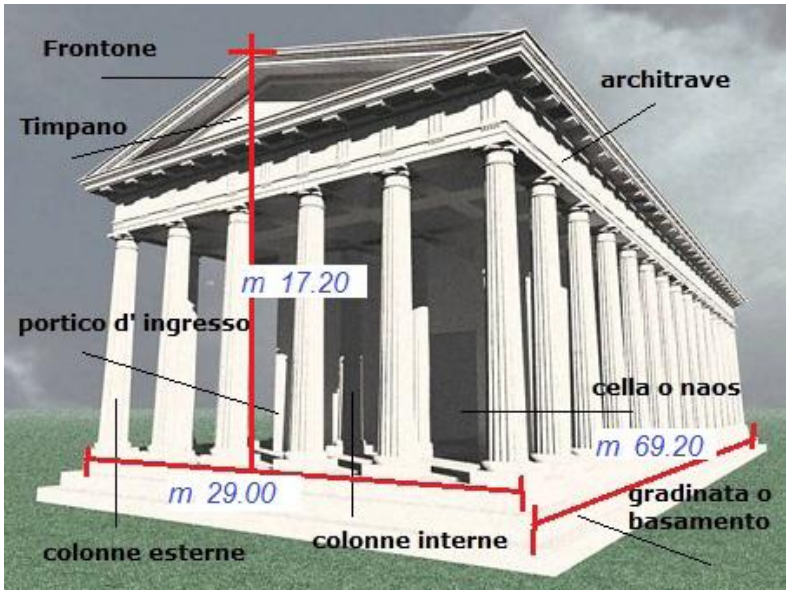
Columns (47) – 3 172.3 m^2

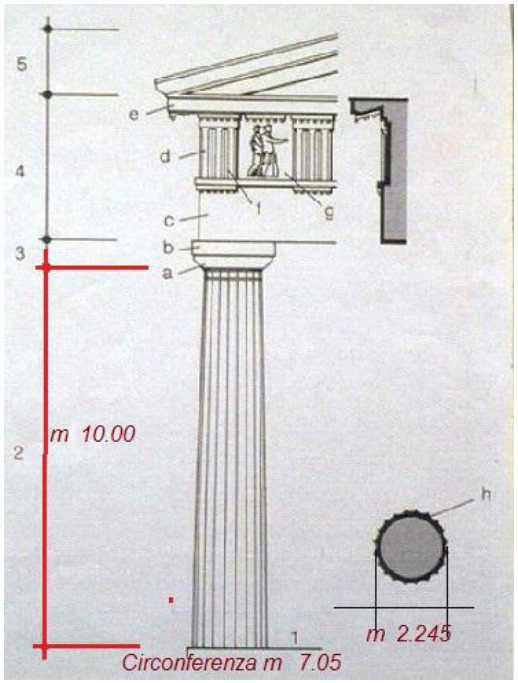
Lintel - 549.5 m^2

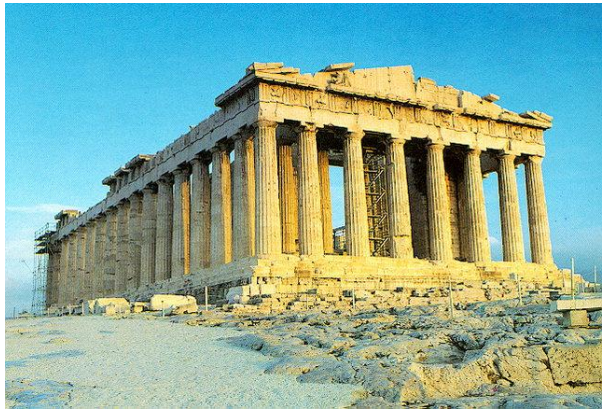
Tympanums - 75.9 m^2

Total visible surface of the Parthenon is - **3 798.1 m^2**

DRF-the corrosion depth after one year of exposure in 2009-2010 is **5.60 µm.**

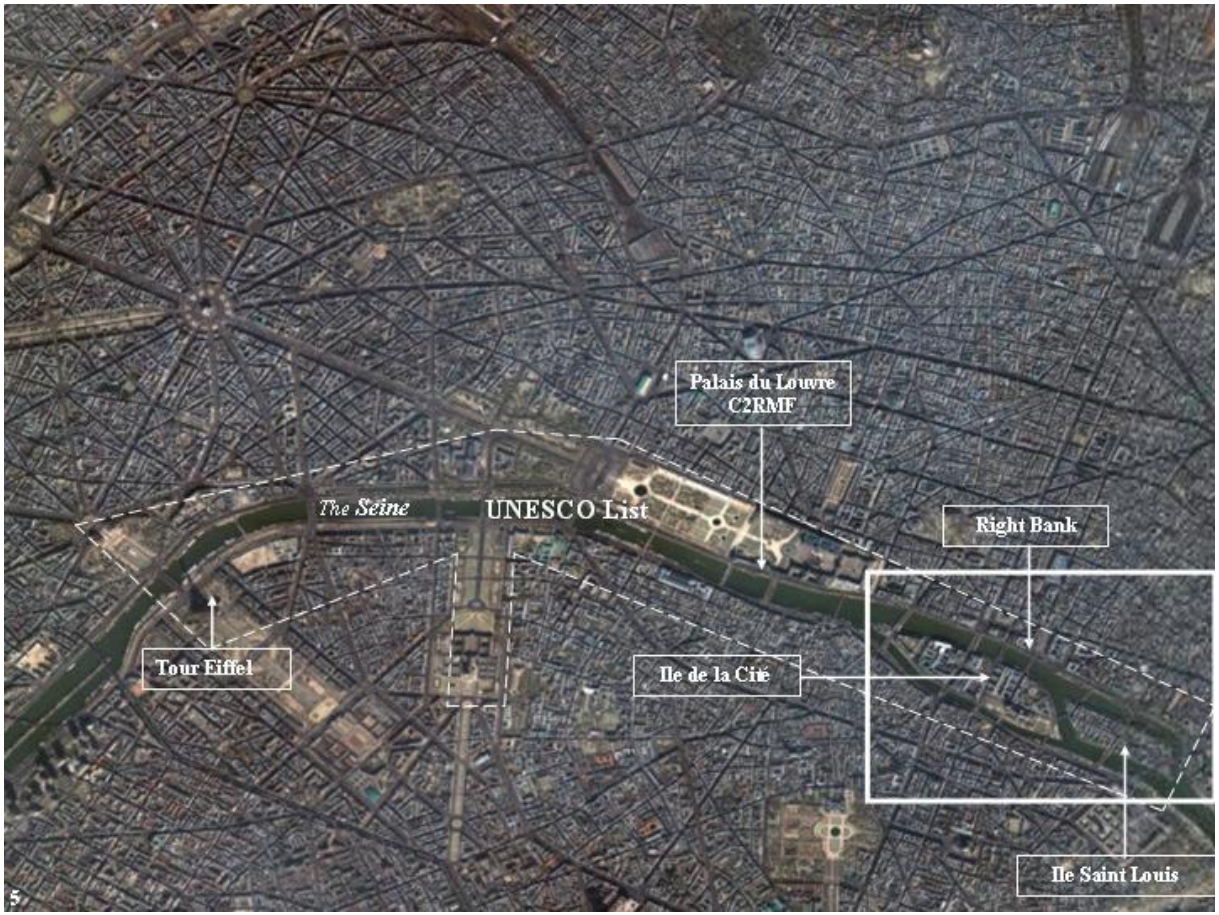






France, Paris – The Facades in the Centre of City

Total Paris Centre: 525 façade= **200,305 m^2**, (Monuments): **72,354m^2**
DRF –the corrosion depth after one year of exposure in 2009 – 2010 is **5.75 µm.**



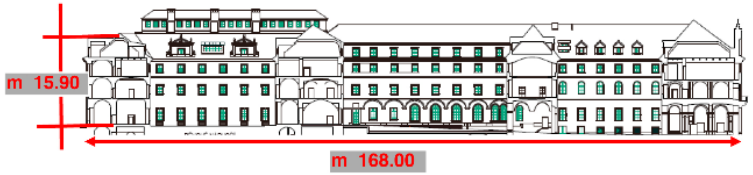
Czech Republic, Prague - The Klementinum National Library

Total surface 8644.6 m^2 - 50 % = **4 322.3 m^2**

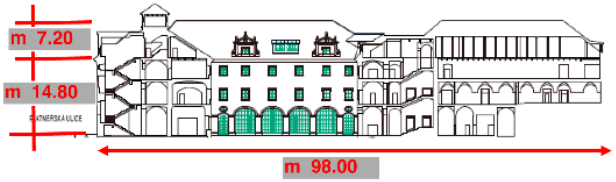
DRF - the corrosion depth after one year of exposure in 2009-2010 is **6.16 µm.**

1. north view, Parlerska street

2. south view, inside courtyards

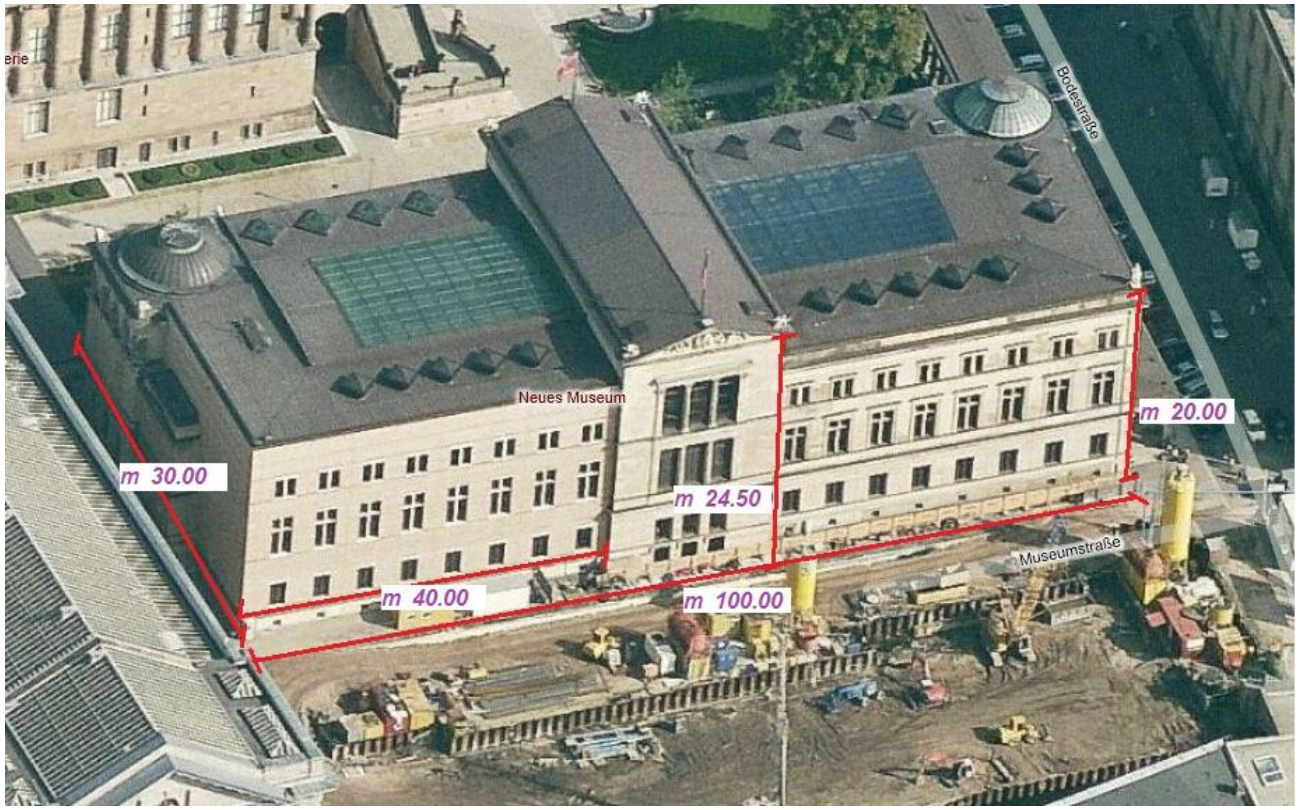


west view, Parlerska street



Germany, Berlin - Neues Museum

Total surface is **5 400 m² – 50 % = 2 700 m²**



- DRF - the corrosion depth after one year of exposure in 2009 – 2010 is **8.36 µm.**

UK, City of Bath - Royal Crescent

Total surface **8 293.5 m²** - 50% = **4 146.8 m²**

DRF - the corrosion depth after one year of exposure in 2009 – 2010 is **4.87 µm.**

Conclusions

- The valuation of the dimensions of the monuments was done,
- The percentage presence of the main materials in the monuments were elaborated,
- The air pollution data were individuated,
- The DRF for limestone was applied,
- The corrosion of materials for 2009 – 2010 were valuated.

Future study of the same monuments in 2013

- Economic effect will be valuated applying the indicative price list of the restoration works from which we may calculate the cost for Maintenance and Repair.
- Give indications of the propose maintains intervals for some CH materials.
- Indicate a critical levels of damage when the corrosion is higher then the tolerable corrosion rate.
- Propose measures to be adopted to prolong the maintains intervals for restoration works for the studied monuments.

Welcome to the 29th meeting of
ICP Materials
17-19 April
Bern, Swizerland