EMERISDA

Summary report defining number, size and materials for scale models

Lead beneficiary: ISAC-CNR

Participants: RESP, UNIVE, DIASEN

D4.1 version 01-10-2014

SUMMARY REPORT DEFINING NUMBER, SIZE AND MATERIALS FOR SCALE MODELS

1. Introduction

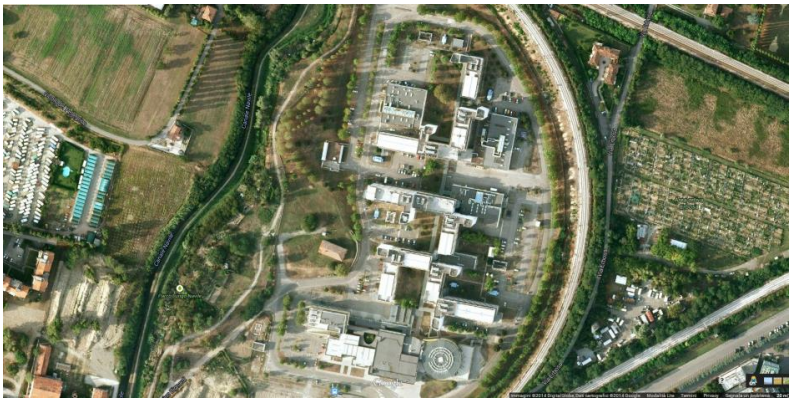
The construction of scale models was scheduled in the EMERISDA project to verify in new masonry, specially designed and placed outdoors, the effectiveness of some of the interventions against rising damp selected in the D2.2 (Report identifying possible methods against rising damp to be tested in the project, month 9).

The scale models constitute an intermediate level between the laboratory and the field application. Scale models are, because of their size and complexity, more reliable than small laboratory specimens. Moreover on scale models it is possible to control some essential and specific conditions (as moisture supply), apply novel methods against rising damp of still unknown effects with no risk of damage to cultural heritage and carry out a series of minimally destructive investigations, which are also used for calibration of non-destructive future techniques.

The effect of rising damp on the scale models will be simulated through partial immersion of the masonry in a salt solution.

2. Structure of the scale models

The scale models will be located in a delimited zone of the CNR campus "Bologna Research Area" (Fig1-3), they will be placed in the green area between two institute buildings ISAC and IMM, their location can be seen in the following pictures. The CNR campus is located 4km from Bologna center, in the middle of the Po Valley (Fig.1b), in a polluted area.



A

b

Fig. 1 – a) https://www.google.it/maps/@44.5237119,11.3383803,398m/data=!3m1!1e3?hl=it, Scale models location, site retrieved on 7 July 2014; **b)** Geographical location of Bologna.

Fig. 2 - CNR campus "Bologna Research Area" http://www.bo.cnr.it/GalleriafotoArea/galleria-mag14/index.html, site retrieved on 7 July 2014.

Fig. 3 – CNR campus plan, location of the area destined to the scale models experiment.

The structure of the scale models will be constructed by RESP and will be kept on site from July 2014 until the end of 2015. The area in which the scale models will be placed will be fenced-in with wire mesh temporary used in yard, in such a way to avoid the animal intrusion. The structure will have a dimension of 7x3.5x2 m (lxdxh) and one door access to allow the entrance to authorized personnel (Fig.4). In order to avoid the direct impact of rainfall on the scale models, these will be covered with a transparent plexiglas roof, not wavy and sloping to avoid particularly the snow accumulation during the winter period. The masonry will be hosted in euro pallets to allow the stability of the structure, the anchoring of the cover and easily perform the measurements.

Fig.4 – Simulation of the structure.

During the kick – off meeting held in Brussels (March 2014) and the meeting of Italian partners at ISAC-CNR in Bologna (May 2014) the following details were chosen, considering the scientific literature and the suggestions of the project participants.

Number of the scale models:

Bricks and mortars are combined to form 4 single walls (Fig.5) each of the dimension of 77x25x100cm (lxdxh).

Building materials of the scale models:

- San Marco “facing bricks” (kind “soft brick”), dimension of 12x5.5x 5cm (lxdxh);
- Mortar of lime and cement, the so called “malta bastarda”, utilized for thin joints and embedded mortar

The composing materials of the walls, bricks and mortar, will be used also to prepare test samples.

Each masonry will be placed in a specific tank of plexiglas (Fig.5), specifically made containing a solution of NaCl, sodium chloride, (salt concentration of 5 %) in such a way that the walls are partial immersed into the solution until a height of about 12 cm. The walls should be kept in contact with the saline solution until the rising damp reaches the maximum height level.

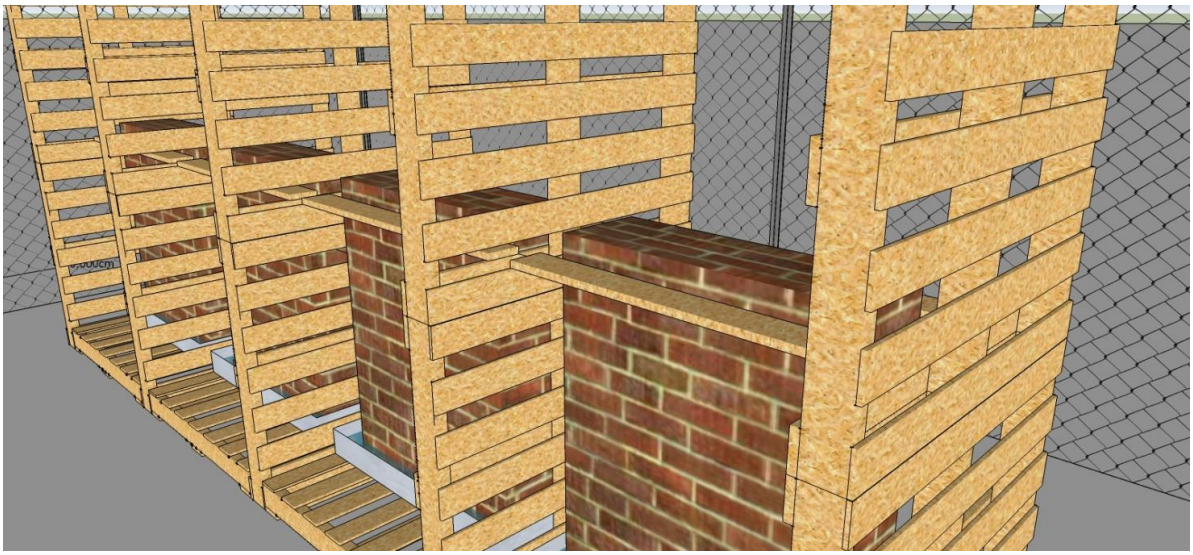


Fig. 5 – Simulation of the scale models.

The concentration of saline solution will be controlled during the time with conductivity meter and will be kept constant. The tank will be covered with a layer of removable plexiglas to avoid variations of the solution due to evaporation of water during the summer and the contribution of the rains.

One of these four models will be left as such, without any treatment, while the others will be treated according to the methods explained in the D2.1 – Summary report on existing methods against rising damp.

3. Future step

The scale models will be exposed to the outdoor environmental parameters and immersed in the saline solution throughout the duration of the project.

A procedure will be defined for assessing the state of conservation of the scale models before and after the intervention. A common template will be developed for reporting data collected during survey campaign on scale models (D4.2 - Description of procedure and reporting form for survey and monitoring on scale models, month 6).

Samples of the brick and mortar employed will be characterized and their properties most relevant for moisture transport will be determined, such as total porosity and pore size distribution (determined by Mercury Intrusion Porosimetry), total porosity accessible to water (measured according to RILEM Recommendation CPC 11.3 “Absorption of water by immersion under vacuum”), water absorption by capillarity (according to EN 1015-18 standard). Characterization of the scale models with determination of the level reached by rising damp, moisture content at different height and salt content will be carried out before applying the methods against rising damp. The results will be reported in D4.3 (Report on initial state of scale model, month 12).

On the 4 masonry scale models three different methods against rising damp, among those identified in the D2.2 (Report identifying possible methods against rising damp to be tested in the project), will be applied.

The effectiveness of the interventions applied will be evaluated through tests on masonry using the techniques of analysis, common procedures and criteria defined in D2.4 (Description of techniques, procedures and criteria for assessment of effectiveness of intervention).

References

1. RILEM CPC 11.3, Absorption of Water by Immersion Under Vacuum - Materials and Structures, No. 101, pp. 393-394, 1984.

2. EN 1015-18 EUROPEAN COMMITTEE OF STANDARDIZATION (CEN), Methods of test for mortar for masonry – Part 18: Determination of water absorption coefficient due to capillary action of hardened rendering mortar, Brussels, 1999.