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Multidisciplinary Data Collection for Structural Analysis: Application to the Studies for Conservation and Restoration of the "Insula del Centenario" [IX, 8] in Pompeii

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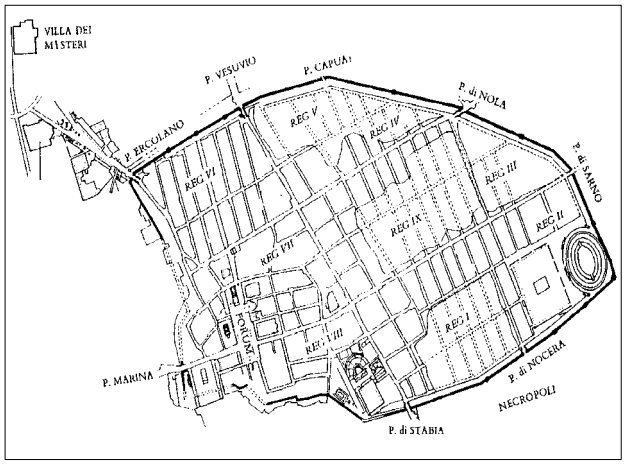
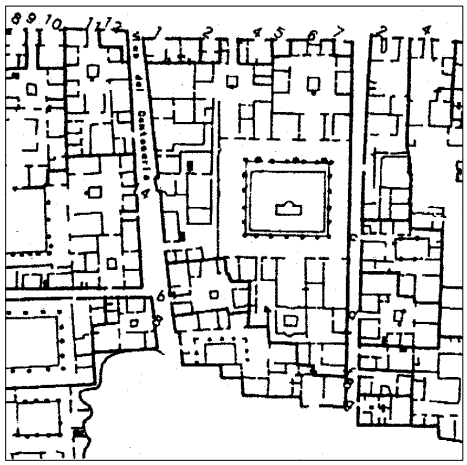
ABSTRACT: In this work, some experiences related to the computerization and organization of data from several teams of research working on 'Insula del Centenario' in Pompeii are presented. The data are collected in different times with different tasks, sometimes available only on hard 'paper made' support. The link and the management of the different databanks is described. A databank of databanks has been built using a very popular software in GIS framework. Then the publication of the data on the net has been addressed, with a distinction between a 'private' protected net (intranet or extranet) and a 'public' net (internet). In the first one the challenge is to have a complete management of the data with the possibility to integrate and or modify from remote positions, while in internet the task is to allow only the consultation.

1 INTRODUCTION

This work arises from 'Insula del Centenario' Project, an agreement stipulated in the framework of 'Pompeii Law' (L. 352, 8-10-1997, art. 10) between the Archaeological Superintendence of Pompeii and the University of Bologna, to study and to acquire data and to show off the 'Insula del Centenario' in Pompeii (see Figs. 1, 2 and 3).





Figures 1 and 2 : Plan of Pompeii with the zoom on Regio IX and the particular of the Insula 8.

The DISTART (The Department of Structural Engineering, of Transportation, of Water, of Survey and of Territory) has contributed with a project inter faculties to achieve the targets of such agreement sharing the knowledge in structural and topographical field.

Figure 3 : View of Insula from Di Nola street.

The Authors, in particular, belong to the DISTART, (Strength of Material Section) and they deal with the structural analysis of the masonry of the Insula.

The purpose of the analysis has been the recovery and the consolidation of the existing building as well as the proposition of new hypothesis for the covers using advanced building prototype solutions, in the perspective of a reopening to visitors (Custodi and Santarelli 2001), (Custodi 2001), (Custodi et al. 2002), (Custodi 2002).

In the meantime the Authors have been devoting themselves to the study of the data banks shared by the several research teams involved with the task to link the different data banks, creating a data bank of databanks, easily available (in internet) with modern tools.

Here, the achievement of 'data bank of databanks' and the possibility of the diffusion of its contents in internet has been considered.

Soon the typical problems of the digitalization of archaeological data has been met and solved: in particular, the heterogeneity of the data available due to the different times of collection, the different tasks of the research team involved in the data collection and the different type of data support.

The following data banks have been figured out from the available data (see Table 1):

Table 1 : Available data, collectors and description.

Available Data	Collector	Description and format
Survey of the plan	DISTART – Topografia	Computerized: vectorial, .dxf format
Survey of the front of the walls	Department of Archaeology, University of Bologna	Paper support: drown in 1:20 scale (early version in graph paper and final version on a tracing)
Wall surface report cards. Stratigraphical Masonry Unit (USM)	Department of Archaeology, University of Bologna	Text available in .doc format
Archaeometric analysis of the mortar and of the stone elements	University of Parma, research team of archaeometric and conservation diagnostics (EDAC)	Texts in .doc format and file in .xls format
Photographs documents	DISTART – Strength of Material	Original format: pictures with high resolution (..raw format); several derived formats (.tif, .jpg ecc.) with different resolutions.

After the definition of the computerization criteria for the data not yet available in digital format (in cooperation of each research team responsible for the data collection), the definition of a system with the maximum freedom in the consulting, using and updating the data of the bank of data banks is considered, to allow each team of research to satisfy any specific needs (archaeological, historical, structural, etc.).

The tools have been chosen between very popular software in the GIS framework (Geographic Information System) (Moscati 1998), which allows to link different data banks early built for different specific tasks, relating these data banks to one or more coherent graphic representations. Such tools give as well the basis to share the content of the data banks on the net on

two levels: a private net (intranet or extranet) where selected users (belonging to the different involved teams) can have a total remote data management (consulting, updating and/or modifying the data) and a public net (internet) where the service is limited only to the consultation.

2 PREDISPOSITION OF DATA BANKS

The preliminary activity has the task to computerize the data available only on hard 'paper' support and to organize in a 'logical' database the different storages, obtaining the summary in Table 2.

Table 2 : Available data, work done and final formats.

Available Data	Work done	Final formats
Survey of the plan	New organization based upon topological criterions.	.dxf formats (original version); .shp formats (reference for the management / diffusion of data).
Survey of the front of the walls	Data acquisition by scanner; vectorialization; topological control.	.tif format; .dwg format; .dxf format; .shp format.
Wall surface report cards. Stratigraphical Masonry Unit (USM)	Linking to the representation of the front of the wall topologically correct	.doc format
Archaeometric analysis of the mortar and of the stone elements	Linking to the representation of the front of the wall topologically correct	Text in .doc format and file .xls format
Photographs documents	Linking to the representation of the front of the wall topologically correct	Pictures (in .tif, .jpg and other formats) with different resolutions

In this organization, the popular standards have been respected (Bonincontro 2001) and the completeness of the data in the different data banks has been checked, (trying not to influence the contents of the data banks with specific needs), to increase the intrinsic value as well as the usability.

At this point the different data banks (which have been recovered for different tasks: in particular the topographic survey has been realized to give a basis of reference to localize the different Insula elements, the survey and the stratigraphical analysis of the masonry organized for specific archaeological-documental purpose) have been linked using the techniques and the tools proper in GIS framework, making a sort of georeferenzation of all the graphical elements in it (related to some alphanumeric information sometimes available).

A three-dimensional model of the Insula has been obtained by the assembly of the different data banks (Fig. 4). The final result does not substitute the initial data banks (which remain perfectly available) but is added to them.

The exam of this preliminary model lighted some (graphically evident) mistakes (statistically not avoidable): lack in the coherence between plan and views, or lack in the geometrical correspondence between two different view of the same masonry panel and so on (Fig. 5).

Starting from this background, a challenging new survey has been scheduled to solve the lacking of information and the inconsistency aroused in the previous analysis.

By the three-dimensional model of the Insula obtained, a numerical model has been recovered which has been used for structural analysis; the results obtained by the structural analysis have been collected in the data bank enriching the knowledge of the site.

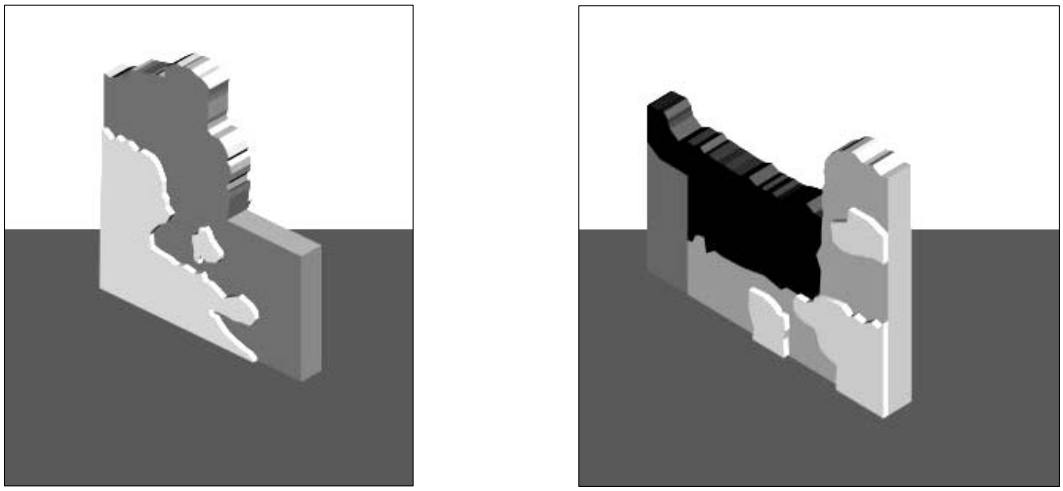


Figure 4 : 3D model of the walls.

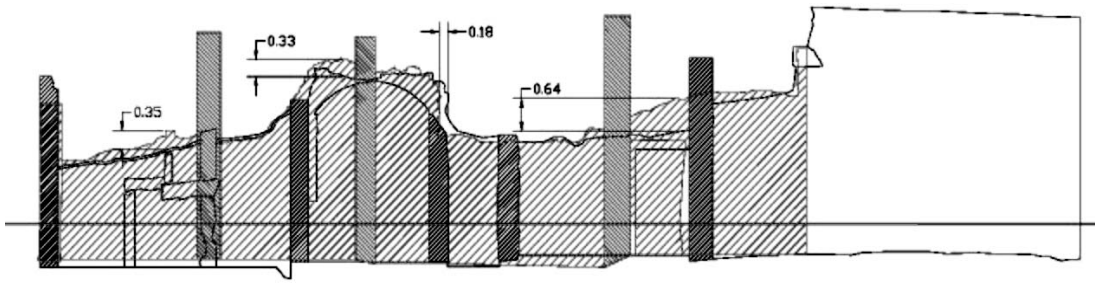


Figure 5 : Control of the geometry of the outside west wall of the main 'atrium' of Insula.

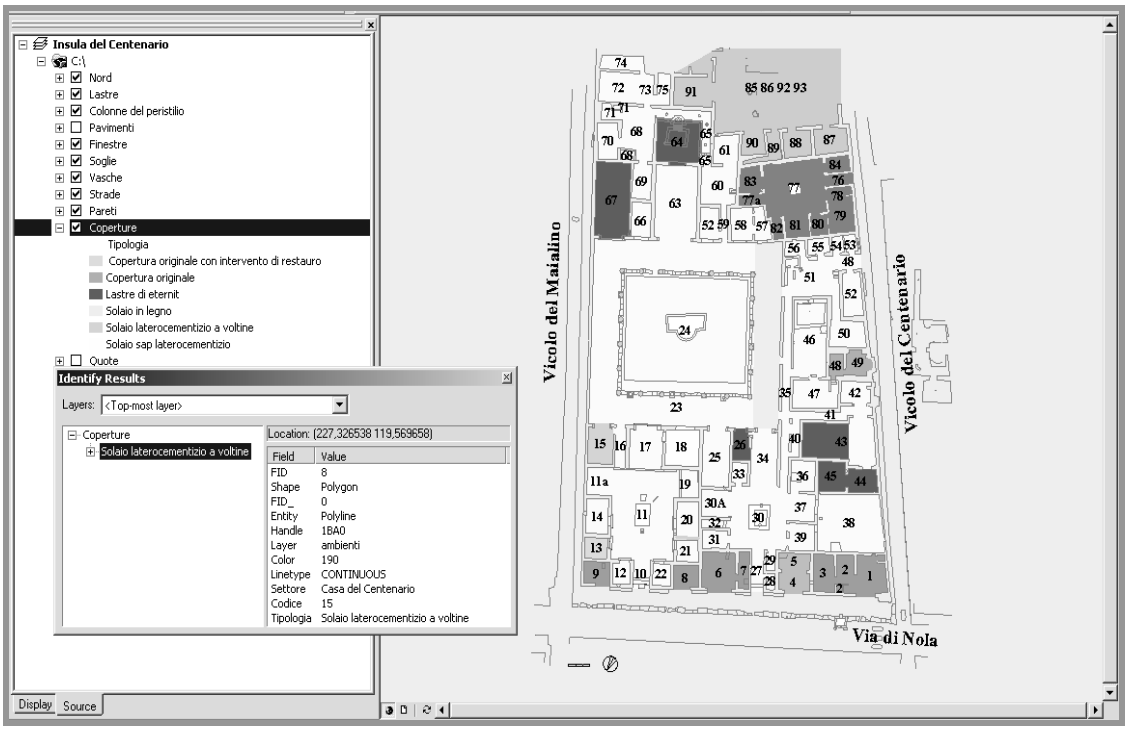


Figure 6 : The theme of covers ("Coperture" in italian) with the result of the graphical query.

3 THE MANAGEMENT OF THE DATA BANK IN A LOCAL NET

The data bank of data banks consulting starts from the Insula plan (Fig. 6) adopted as geometric reference. The plan continuously updatable, is based upon different layers of information in a coherent topological way:

- polygonal themes : environments, basements, covers, columns;
- linear themes: walls;
- punctual themes: dimensions, points of view.

The alphanumeric information related to each element of a layer are linked.

It is possible to ask the databank of databanks through an element on the plan as well as through the definition of one or more research parameters of alphanumerical type: the type of environment, the type of basement, the type of cover, masonry panel with plaster, or masonry panel with structural problem, and so on.

In the same way a query can be done in the view of a wall, acceding to other information related to the wall: Fig. 7 shows the view of a wall with all its USM and Fig. 8 with the result of a structural analysis of the same wall done with a finite element model of the entire Insula (stress map due to an earthquake).

In the same way pictures can be recalled as well as information of other types related to the themes or elements which are handled.

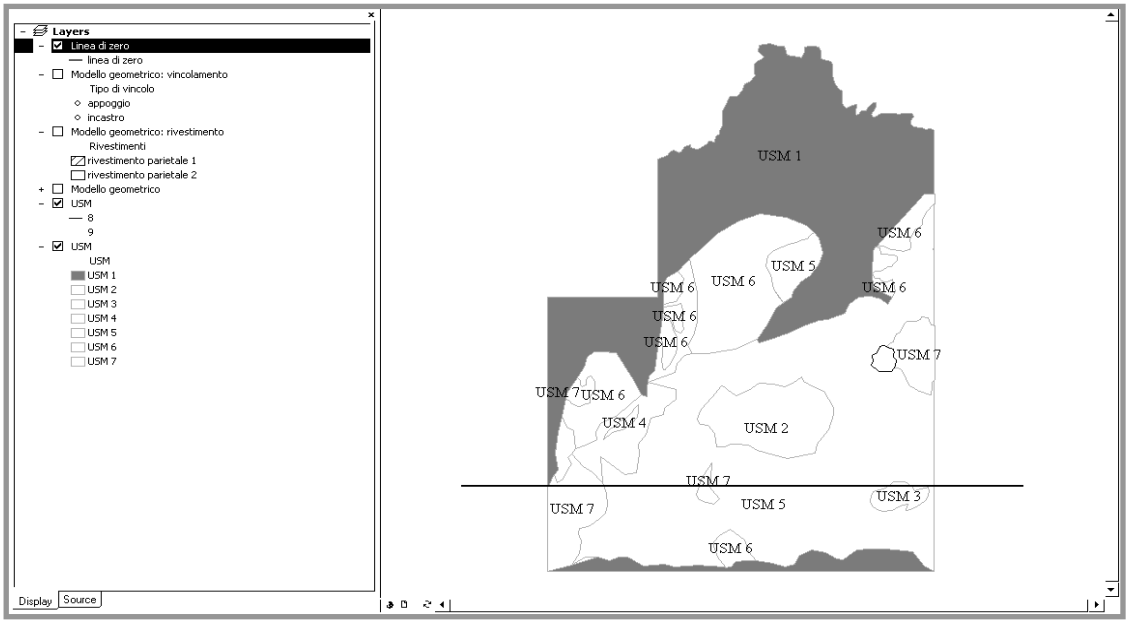


Figure 7 : View of 21c wall with its stratigraphical units.

4 THE MANAGEMENT OF THE DATA BANK IN PUBLIC NET

The availability of the information on the web, either private (intranet or extranet) or public (internet) is considered the natural evolution of the management of the databank, allowing the complete interaction with databanks to the different teams of research and showing off the research results (allowed to public) to wider public.

A web site has been created, located on a dedicated server of LAMC (Laboratory of Computational Mechanics – DISTART), which is the access to the consulting and management of the data. The software used allows, through a browser-type simple interface, to interact with data done by several GIS framework, and to create the pages for the WEB publication.

When the pages to visualize are done, the consulting of the data starts in a way similar to that described previously in the local net. The speed in the consulting depends upon the possible connection and can be improved creating pictures with high portability (using HTML or JAVA).

The Fig. 8 shows the plan of the Insula of Centenario, as can be focalized on the web, and the Fig. 9 the results of a query about the wall 20d meshed by finite elements.

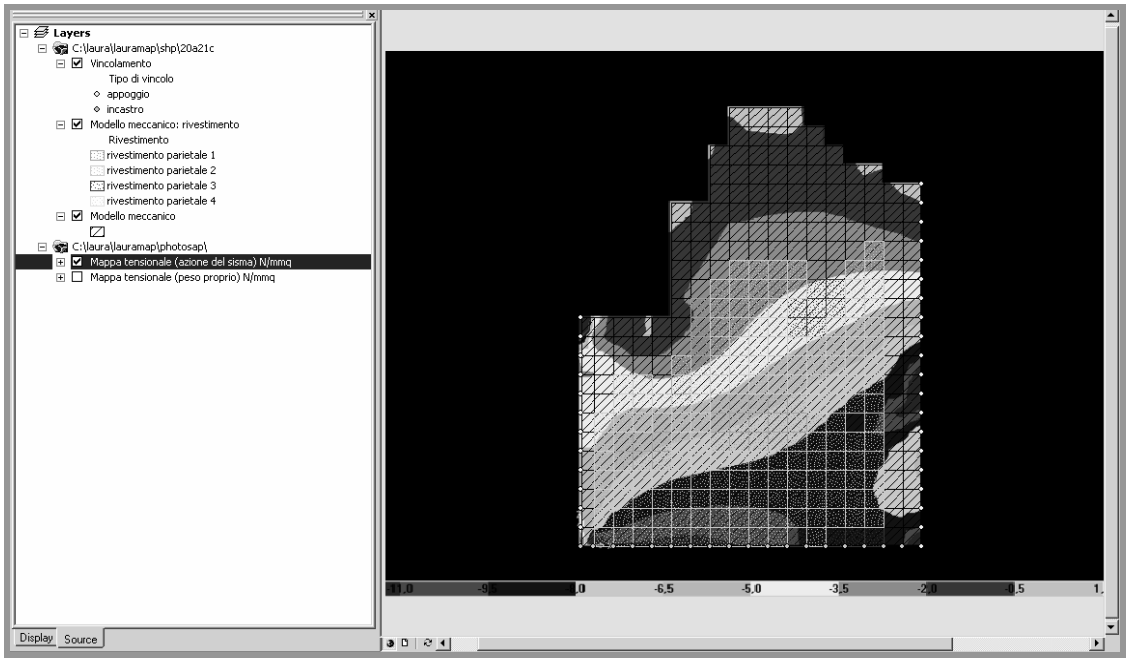


Figure 7 : View of 21c wall with its stress map due to an earthquake.

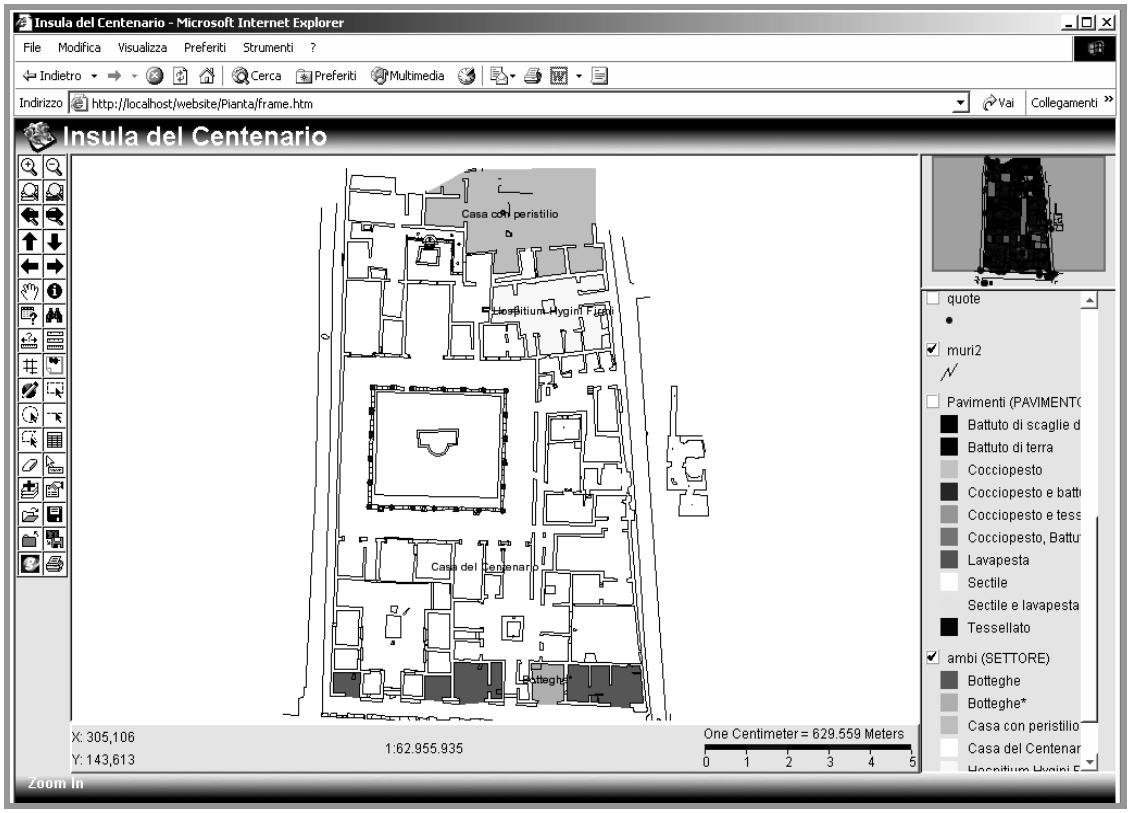


Figure 8 : The plan of Insula published on the web.

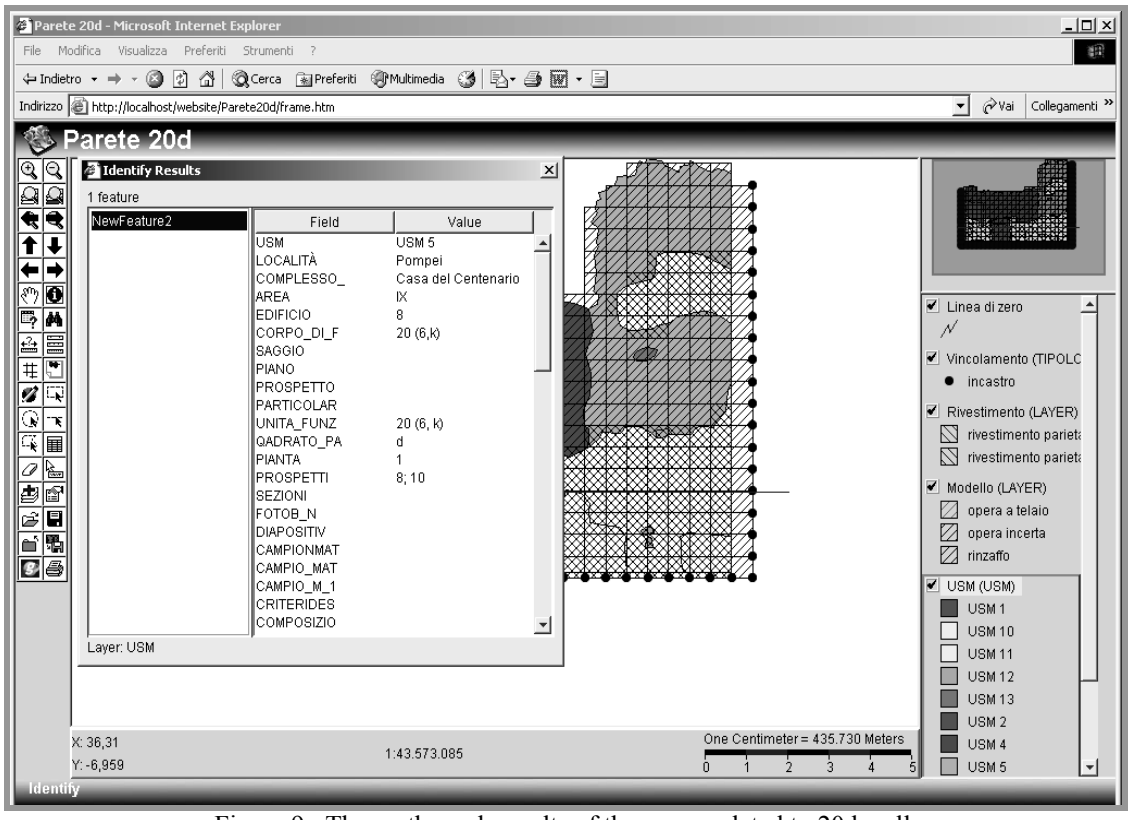


Figure 9 : The on the web results of the query related to 20d wall.

6 CONCLUSIONS

The decision to put all the data available on digital support and to share the data linking the different sources has been taken, due to the interaction among several teams of research.

An open and multidisciplinary collector of information has been created, a tool able to improve and increase the exchange of data among the different teams everywhere located.

Next step will be a refinement of the technique of distribution and the updating of the databank of databanks in a remote access.

ACKNOWLEDGEMENTS

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