GIS TO SUPPORT THE PLANNING, THE MANAGEMENT AND THE PROJECT OF CONSERVATRION OF HISTORICAL CENTRES

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ABSTRACT

The research carried out deals with the aim to organize a GIS applied to the Historical Centres: it get the reason from the complexity of the state of the art and from the complexity of the interventions from the urban planning till to the environment protection and to the project of restoration on the single architectural object. The project has to answer to the conservation of cultural heritage through the conservation of the material signs and traces of an history which reduce and make thin itself under our sight. But the project has to help the improvement of the quality of life to satisfy not only the minimum standard of services, but the best reachable level, beginning to the condition and to the resources available, of the services (safety, wholesomeness, sanitary service, technology, ...) and of culture. That's to say that this process goes through the development of chances for the citizens and the development of the cultural consciousness and awareness of the complex reality to which oneself is related every day.
GIS on Network can be one of the solution to these problems and aims.
Data validation, simulation, quality check of data, evaluation risk, sustainable intervention, definition and verification of the models adopted from time to time are open problems to the certification procedures of the GIS organisation and of the results obtained through them.
The *level of data acquisition*, surveys and representations, in the architectural objects like in the urban cartographic scale, will be more and more differentiated from *the level of the information access.*
T*he level of the information access* can be differentiated due to the typologies of users: from the virtual citizen service windows to the specialised users. Client/Server architecture would be the core of this "GIS Data Bank Organization on Network".

1. INTRODUCTION

Environmental risk information, Data acquisition and Management, correlation between human activity and available resources, govern of change and forecast are some of the basic topics to guaranty the quality of complex project like it is the one on the Historical Centres.
It is now a consolidate opinion that to answer and face to complex reality is not possible to use simple model: we have to build up complex models.
For the Public Administration it's mandatory to use geographic information for the description of possible dangerous events, natural phenomena, degree of the cities, social and economic depression: all these aspect cannot be separately treated, since they are strictly related once to the other through logical connections which require an effort to build congruent description in open systems.
The mathematical translation in dynamic and analytical functions have to be interfaced with appropriate algorithms by which customize GIS Software, like ArcInfo and ArcView.
Therefore for decision makers it's important to use organized information in a suitable GIS.
Such a GIS operates in geographic domain and has to be able to acquire, handle, produce georeferenced data, that is the Numerical Cartography with all the linked data.
GIS technology has developed in these years tools to support environmental problems.

Two main arguments are focused in this proposal: on one side *Remote and Relational Data Banks Management System*; on the other side *Standard and International*

format to support and facility Public Administration DATA BANK access.
At least it's related an example of developing GIS model apply to the Historical Centre of Genoa that is only at the beginning.

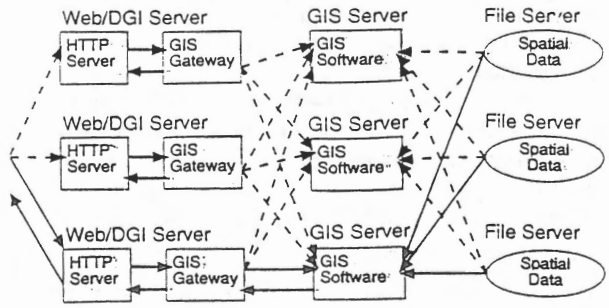
2. STANDARD, INTERNATIONAL FORMAT AND MODELS TO FACILITY AND SUPPORT PUBLIC ADMINISTRATION ACCESS TO DIFFERENT DATA BANK

Study of *models control and testing* built up from qualitative and quantitative information is necessary to decrease the uncertainty of final product. Special mathematical models will be developed in GIS Software (such as ArcInfo) just to certify the products possibly in a *Standard and International* format. Since the user of Environmental data normally is a Public Administration, it's required the study of special forms useful both for the contract and for the final test certificate and inspection.
An important role will be assumed by Digital Cartography, if available, and *GPS techniques* in the punctual description of the territory in a static or dynamic way; the thematic maps are an important input in a GIS and recently the updating seems to be more important then the description accuracy. An important role will be played by *Satellite Remote Sensing* techniques which produce thematic maps and regular updating with accuracy satisfying up to the scale 1:50000 (the data are available since 1972), so that the dynamic control of the environment is a reality. These information, related in a GIS to the "geotopocartographic" ones, allow a quick access to the Environmental parameters control; the radar images are able to describe the physical natural and human phenomenon in a very short time. Particularly care will be devoted to the use of standard procedures, to conform to the EEC directives, normative and rules in order to speed up the information transfer to the people not strictly connected to the Scientific Community. But in order to this aim is always necessary to relate and manage different Cartographic Projections, different Reference frames Systems and Datum, which need transformation to be superimposed in a congruent and metric Cartography. It has to be scheduled the step of each transformation and classified the most recurrent cases; than it has to be interfaced through tested algorithms in the GIS Software. Perhaps in Italy Cadastral Cartography in in the Cassini-Soldner Projection, Photogrammetric Restitutions to support PRG, Regional and Urban Planning are in the Gauss-Boaga Projection, Satellite Images are in processed in the UTM Projection and so on.

But is a problem of standard too, defining protocol and architectures of Relational Data Bank, like ORACLE.
Data validation, simulation, quality check of data, evaluation risk, sustainable intervention, definition and verification of the models adopted from time to time are open problems to the certification procedures of the GIS organisation and of the results obtained through them.

3. GIS DATA BANK ORGANIZATION on NETWORK

The geographical spatial temporal information updating is required to avoid the redundancy and the efforts made to collect data; for this purpose several client/server Architectures have to be designed for the data transferring and remote management: on one side there are *Numerical Data Banks* (it will be tested the use of RDBMS, relational Data Banks Model System, such as **Oracle** and **SQL** link methodologies which run on Line without needing GIS Software on the client side); and in the other side there are *Geographical Data Banks* to manage millions of geographic objects with multi-access connections on Network, such as **SDE-Esri, SDO-Oracle.** The research has to improve type of *net data handling* defined following different procedures: from GIS Softwares, such as ArcInfo used as Client to connect to the *Remote Data Bank on different Servers* till to the Distributed Geographic Information System **(DGI)** on Line to support citizens services through GIS tools developed on WEB Servers by different Software (i.e. Map Object Internet Server).
The *level of data acquisition*, surveys and representations, in the architectural objects like in the urban cartographic scale, will be more and more differentiated from *the level of the information access.*
T*he level of the information access* can be differentiated due to the typologies of users: from the virtual citizen service windows to the specialised users. Client/Server architecture would be the core of this "GIS Data Bank Organization on Network".
From the segretation of data procedures, to the public domain access, in any case it's necessary to project network system of GIS (on Internet or Intranet) determining standard procedures, formats, protocols to make possible the free transmission of data, limiting the loosing of time and data knowledge and avoiding the duplication of the efforts to collect data already acquired from everybody else in the fixed rules.
SDE (spatial Data Base Engine) Server
ORACLE Server
are connected on Network (Internet or Intranet) with
SW GIS Client (ArcInfo)
to build complex GIS or/and with a
Gis On Line Client (Map Object Internet Server)
to support basic query



A large installation with distributed Web servers. DGI servers. GIS servers, and data servers.

4. AN EXAMPLE OF DEVELOPING GIS MODEL: THE HISTORICAL CENTRE OF GENOA

The project to develope a GIS Model with the characteristics and architecture just summarised is only at the beginning. But the object is exceptionally in order to different points of view. Both for the richness of Cultural Heritage of a famous and ancient sea-town like it is Genoa, and for the richness of problems connected to a City characterized in the centuries by commercial , architectural, social and economic events. This require an organic effort to protect all the environment, the Historical Centre, the social-economic tissue and fabric of the City.

But the occasion of the research is exceptional too: infact thank to a financed UE project "Cives Ambiente" just completed in this year, the Comune of Genoa though the "Osservatorio of the Historical Centre", with the collaboration with the Faculty of Architecture of Genoa, has collected more of four hundred thousand of data about single architectural units: all this data, in digital, raster, vector format are georefenced by MGE SW and MapInfo SW. So there are enough data to test the level of contribution that these Data Banks can give to the urban Planning and to the Architectural project of restoration. The aim is to build up an organized and structurized GIS model based on Remote and Relational Data Bank Management System with network access typologies.

The result is not given from the simple addition and sum of the different aspects superimposed on to the others, whose correlation depend instead on logical keys which have to be explained and validate defining the contour fields. The challenge is the use of GIS technology to optimise the interaction between the knowledge and the information related on the architectural objects (information which range from historical, material, brick block masonry technology used in the centuries to the archeometrical one, to the technological network, to the survey and static check and so on) due to improve the quality of the plan of the cities and viceversa.

The architectural level

The GIS get up from the single architectural units. Digital images archives, vector and alfa-numerical data banks are collected in different standard formats (Fig.1).

Within the research project *"Cives Ambiente"* it has been collected different data on the single architectural units (from the historical carthography, to the analysis of the properties and of the transfer properties inside each possible units, to the geometrical, material, technological and structural state of art, the distribution schemes (horizontal and vertical connection), the change in the functional destination, the principal transformations, etc.

Here it's explained the case of *"Vico dei Ragazzi"* quarter with the civic number reference, on which there is a Thesis in course of definition in the School of Specialisation of Restoration of Monuments of the Politecnico of Milan.

All the data are geographically referred with MGE SW to the geometric *entities (i.e. line for the elevation structures and for the faces with its own alphabetical letter, areas for the bodies of the building and so on)* through which the building is summarised. These data bank can be now represent the input to build a GIS with ArcInfo used like a Client Software.

The table attribute fields are: the building units of each part (*each description is about building number 1, 2, 3*) , typology, number of plans, number of apartment (number of that one surveyed, number of occupied, structural typology (*i.e. continuous, mixed masonry)*, principal ages (XVI...), type of actual *use (rented, multicellular...)*, level and different kind of *degree (i.e. structural, cracks on the faces, inflexion of wooden beam floor, bulged faces...),* humidity (degree and location with related causes) , type of interventions (the presence of ordinary or extraordinary maintenance, structural propping and cribs...), annotations, photo and details (Fig.2).

From the architectural level to the urban level.

The sector of S. Lorenzo quarter with the area of Vico Ragazzi is selected to show the methodology.

All the architectural unit *areas* are referred to an *attribute table* with the *shape filed through the Id-number of the building bodies of the area.* The description of Fig.2 is related to this attribute table. All other urban level information can be related by GIS.

The aim of the research is, which is only at the beginning, is to build a GIS with ArcInfo SW (it's shown in Fig. 3 a coverage built on the MGE and MapInfo data input), in order to create, as first step, a GIS based on topological relations between data set to support decision makers in both levels (architectural and urban one) and to test the quality of results obtained using data related to the different scale of intervention and planning; second step will be the experimentation, in case of abundance of serial data, of the chances offered by the System Query Language to connect to the Archives: it will consist on the study of a network architecture to connect remote and different located numerical Data Bank through Relational Data Bank System Management (RDBMS), using ORACLE packages, to the Geographical Data Bank using SDE or SDO packages.

An example of the WEB Site of the Historical Centre of Genoa built with the information related through HyperTextMacroLanguage: these information would be now structured in a "*On Line GIS*". It is shown the Web page of an old part of the City, the quarter of S. Lorenzo. Citizens would be access to data through a GIS on Line *(Fig.4).*

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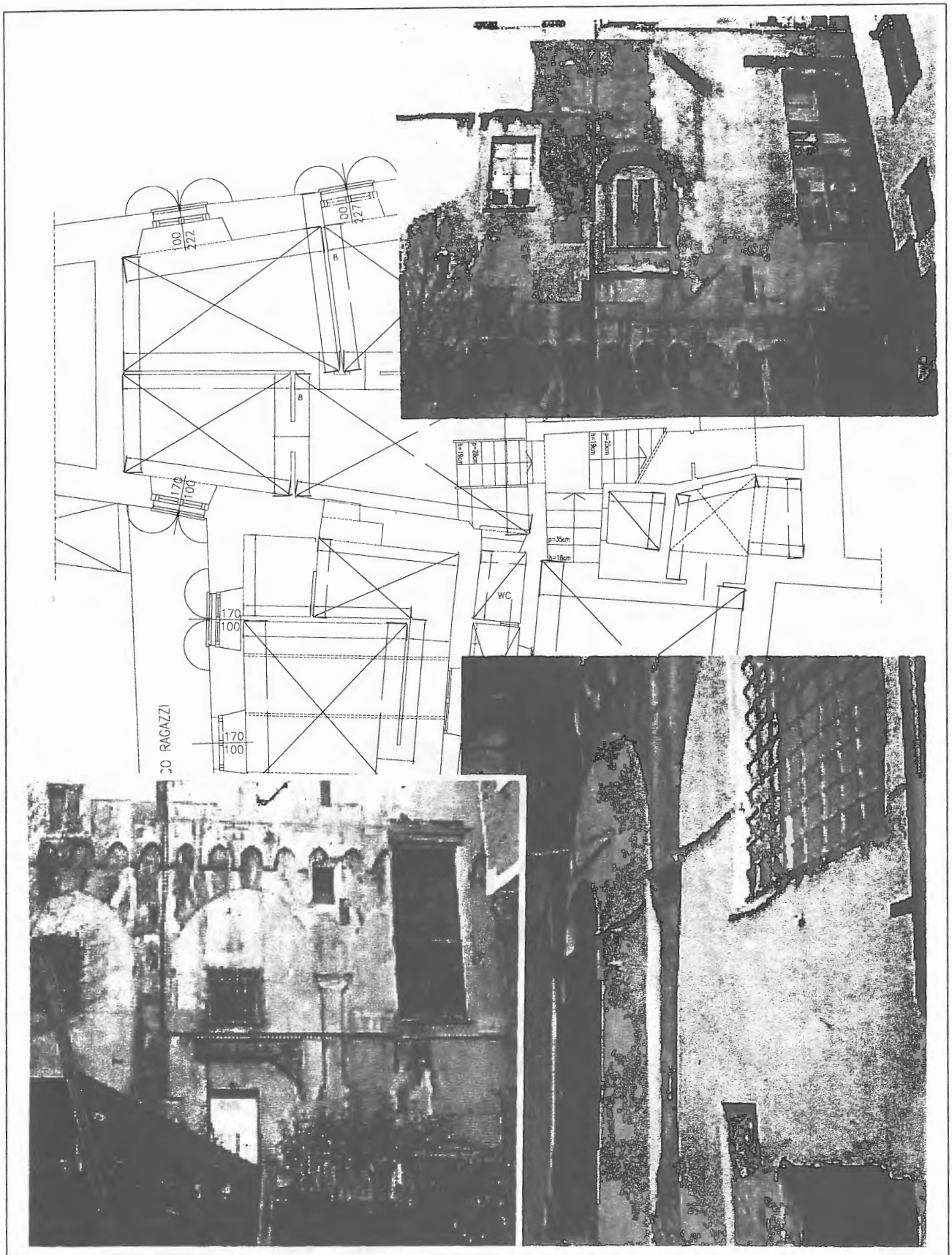
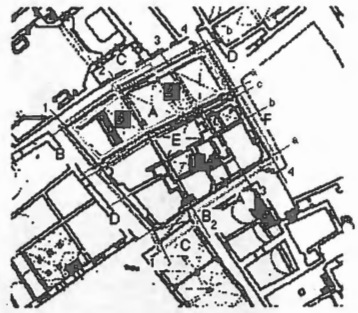


Fig.1 The GIS get up from the single architectural units. The challenge is to use of GIS technology to optimise the interaction between the knowledge and the information collected and related on the architectural units, due to improve the quality of the plan of the cities and viceversa: the information range from historical, material, brick block masonry technology used in the centuries to the archeometrical one, to the technological network, to the survey and static check and so on. Digital images archives, vector and alfa-numerical data banks are collected in different standard formats

VICO DEI RAGAZZI, 3

Fig.2. Within the research project "Cives Ambiente" it has been collected more than 300 hundred thousands of data on the single architectural units.
Here it's explained the case of *"Vico dei Ragazzi" quarter with the civic number reference.*
All the data are geographically referred with MGE SW to the geometric *entities (i.e. line for the elevation structures and for the faces with its own alphabetical letter, areas for the bodies of the building and so on)* through which the building is summarised.

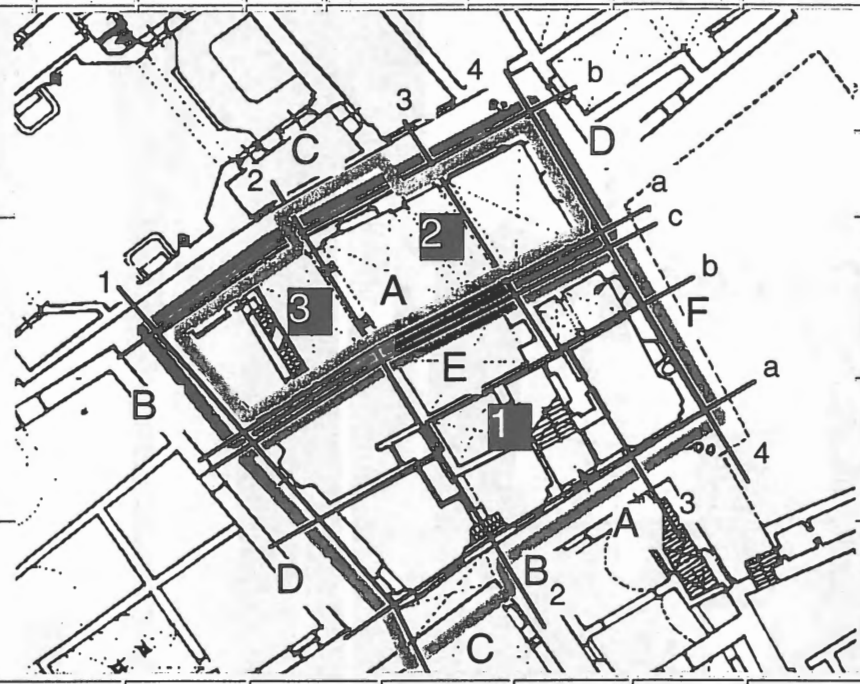


schema aggregativo

The table attribute fields are: the building units of each part (*each description is about building number 1, 2, 3*) , typology, number of plans, number of apartment (number of that one surveyed, number of occupied, structural typology (*i.e. continuous, mixed masonry)*, principal ages (XVI...), type of actual *use (rented, multicellular...)*, level and different kind of *degree (i.e. structural, cracks on the faces, inflexion of wooden beam floor, bulged faces...)*, humidity (degree and location with related causes) , type of interventions (the presence of ordinary or extraordinary maintenance, structural propping and cribs...), annotations, photo and details.

Edifici

edificio	tipo edificio	piani f.t./ accesso	appartam. tot./ rilev./ occup.	tipo strutturale	epoche preval. (antiq.)	tipi connot./ attuat.	degrado	umidità	interventi	annotazioni	foto
edificio 1 (C) del civ 3 di VICO DEI RAGAZZI	g4N (cavedio)	8 0	13 2 11	setti continui misti (terreno voltato)	XVI (XIII)	casa da affitto contemporanea edilizio pluricellulare	strutturale lesioni passanti nelle facciate B e D; pendenze di alcuni solai (piano terra e 5° piano).	NO localizzazione: causa:	puntellazione	Gli appartamenti sono in parte nel 5202003_1 e nel 5202003_3, ma sono stati totalmente attribuiti al 5202003_1.	
edificio 2 (C) del civ 3 di VICO DEI RAGAZZI	b4D 0	4 0									
edificio 3 (C) del civ 3 di VICO DEI RAGAZZI	b4D 0	4 5								Gli appartamenti sono in parte nel 5202003_1 e nel 5202003_3, ma sono stati totalmente attribuiti al 5202003_1.	



edificio	elemento	posizione/piano	localizzazione	descrizione el.	decorazione	degrado	pavimento	annotazioni	foto
edificio 1del civ 3VICO DEI RAGAZZI	volta	b1c3 6		Tipovolta botte Materiale: laterizio Presenza di sostegni (cornici)	Presenza di cassettonati	Funzionale: assente Materiali: assente	Materiale: graniglia Piastrelle: assenti Degrado: assente	Corridoio di notevoli dimensioni (lz/lh) in cui si aprono cinque porte di legno di piccole dimensioni con stipiti in pietra nera; numerose sono le lesioni sulle pareti ed il pavimento è in pendenza verso la facciata C, del corpo 3.	

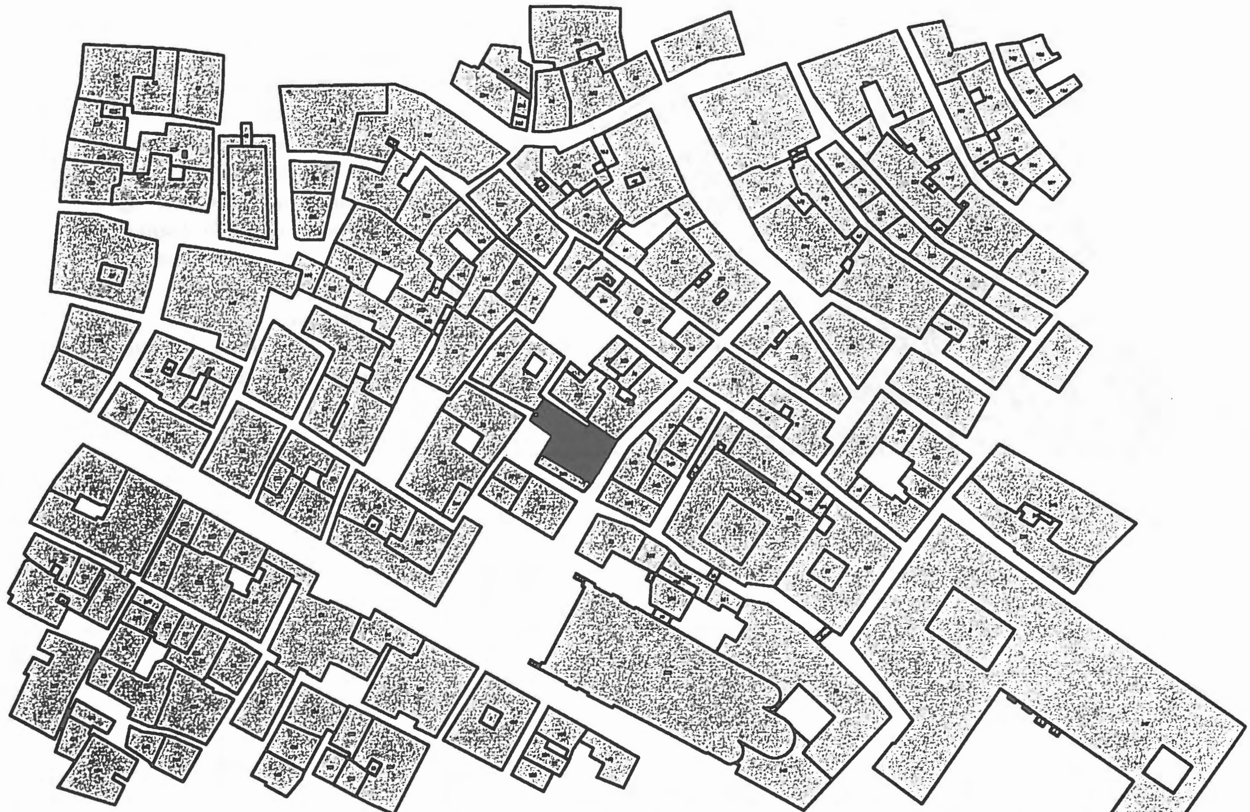


Fig. 3 From the architectural level to the urban level. The sector of S. Lorenzo quarter with the darken area of Vico Ragazzi .
All the architectural unit *areas* are referred to an *attribute table* with the *shape filed, the Id-number of the building bodies of the area, the Code_ civic number, the Code_ buildings, etc*. The description of Fig.2 is related to the attribute table.

Shape	Viraga_id	[illegible] Id	Giusto	Cod_civico	Cod_corpo	Degrado	
Polygon	94	0	T	3426013	3426013_0	0	F
Polygon	95	0	T	5656007	5656007_0	0	F
Polygon	96	0	T	1144011	1144011_0	0	F
Polygon	97	0	T	1144007	1144007_0	0	F
Polygon	98	0	T	1142011	1142011_1	0	F
Polygon	99	0	T	1142009	1142009_0	0	F
Polygon	100	0	T	5660004	5660004_0	0	F
Polygon	101	0	T	1142001	1142001_0	0	F
Polygon	102	0	T	6010003	6010003_0	0	F
Polygon	103	0	T	5656005	5656005_0	0	F
Polygon	104	0	T	1144013	1144013_0	0	F
Polygon	105	0	T	1144015	1144015_0	0	F
Polygon	106	0	T	3426009	3426009_0	0	F
Polygon	107	0	T	1142002	1142002_0	0	F
Polygon	108	0	T	1142010	1142010_0	0	F
Polygon	109	0	T	3426003	3426003_0	0	F
Polygon	110	0	T	3426002	3426002_0	0	F

The aim of the research is, which is only at the beginning, is to build a GIS with ArcInfo SW (it's shown a coverage built on the MGE and MapInfo data input), in order to create, as first step, a GIS based on topological relations between data set to support decision makers in both levels (architectural and urban one) and to test the quality of results obtained using data related to the different scale of intervention and planning; second step will be the experimentation on the exceptionally richness and abundance of the archives collected by the "Cives Ambiente" research project just brought to an end: it will consist on the study of a network architecture to connect remote and different located numerical Data Bank through Relational Data Bank System Management (RDBMS), using ORACLE packages, to the Geographical Data Bank using SDE or SDO packages.

4. Settore 4 (S. Lorenzo)

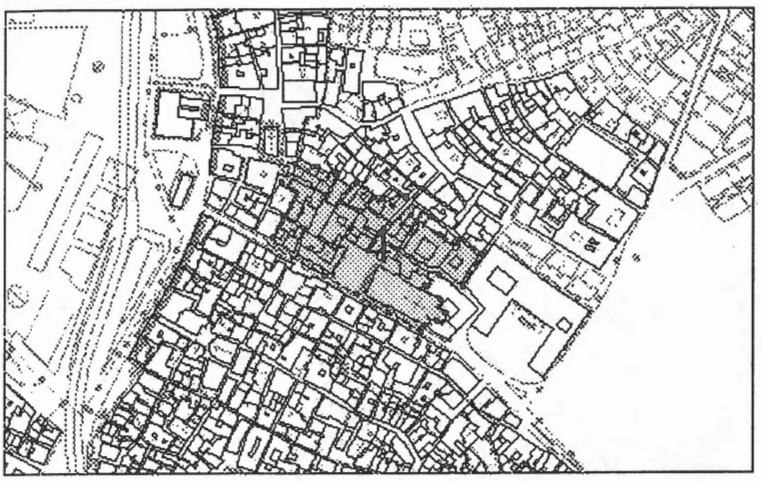


Fig.4 An example of the WEB Site of the Historical Centre of Genua with the information related through HyperTextMacroLanguage: these information would be structured in a *"On Line GIS". It is shown an old part of the City, the quarter of S. Lorenzo, with the prevalent ages (century and number of the bodies of the buildings), its own dated body and the description of the most important historical project and interventions, demolition, changes, reconstruction and restorations*

4.1. Epoca prevalente

secolo	corpi	%
XII sec.	--	--
XIII sec.	--	--
XIV sec.	--	--
XV sec.	--	--
XVI sec.	14	29.8
XVII sec.	1	2.1
XVIII sec.	8	17
XIX sec.	18	38.3
XX sec.	3	6.4
non compilato	3	6.4
totale	47	100

Il settore *S. Lorenzo* (n .4) comprende, nella sua globalità, 47 corpi e 68 edifici.

La maggiore concentrazione di edifici del XVI secolo si rileva intorno a vico Scuole Pie e piazza Cinque Lampadi, e tra via Scurreria e via Scurreria La Vecchia, due nuclei compatti sopravissuti al secondo intervento su piazza Scuole Pie, nel XVIII secolo, alle ristrutturazioni conseguenti il taglio di via San Lorenzo nel XIX secolo, alle demolizioni belliche e successive ricostruzioni del XX secolo.

4.2. Epoca antiquaria

secolo	corpi	%
XIII sec.	19	40.4
XV sec.	--	--
XVI sec.	2	4.3
XVII sec.	--	--
non compilato	26	55.3
totale	47	100