Du document à la maquette, de la maquette au document.
From documents to 3D models, from 3D models to documents.

J.Y Blaise, I.Dudek

ARKIW - PICS 1150 CNRS/KBN*

(*Centre National de la Recherche Scientifique / Komitet Badań Naukowych)

Un système d'information et de représentation des connaissances relatives aux édifices patrimoniaux et à leurs évolutions architecturales.

UMR CNRS/MCC 694 MAP / Institut HAIKZ WA PK

APN - SHS*

(*Centre National de la Recherche Scientifique, Département Sciences de l 'Homme et de la Société)

Multi représentations dans un Système d'informations sur le patrimoine architectural et urbain pour le réseau Internet.

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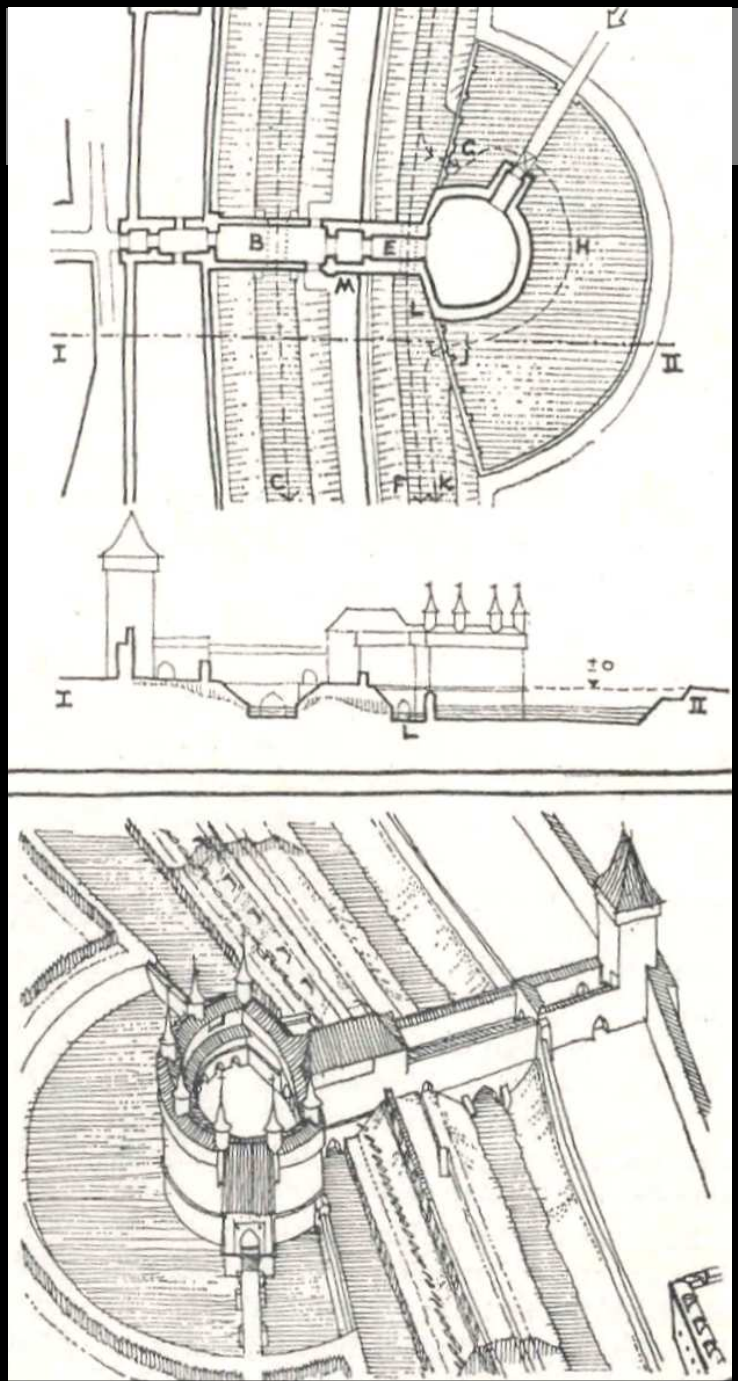


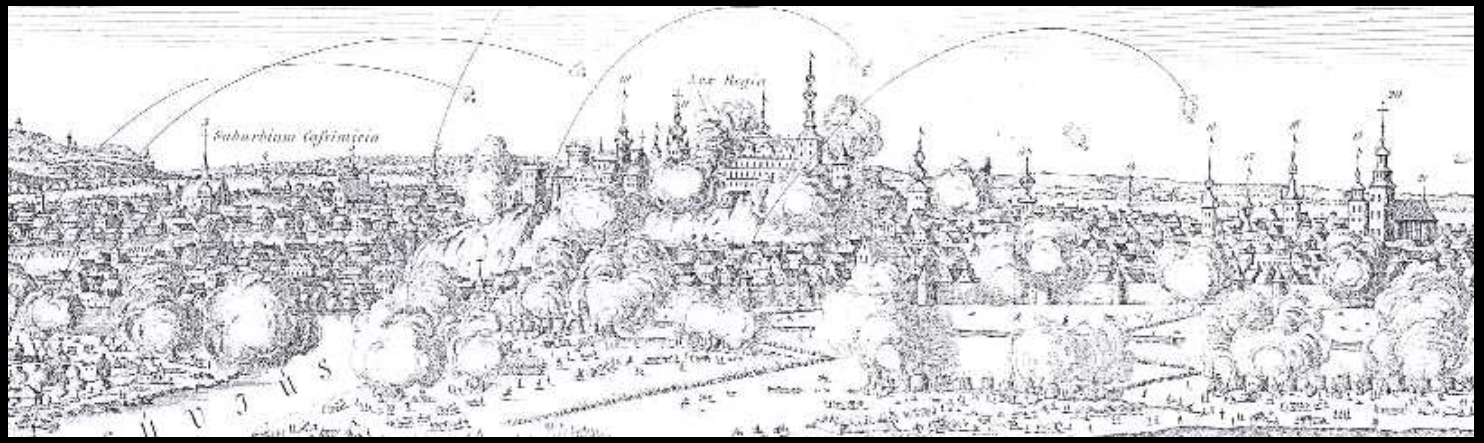
Field of experimentation : The city of Kraków.

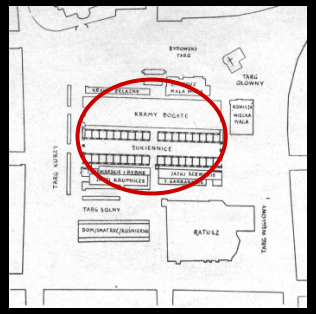
The layout of the old town is a result of successive additions and of the evolution of various urban structures :

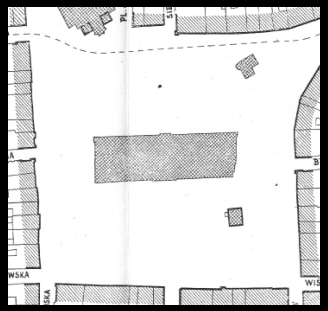
- ensemble of the Wawel Hill
- the suburbium called Okół
- the medieval town located in 1257.

In 1684 forty seven flanking towers were defending the town Four of them areleft (13th-century Florian Gate, Baszta Pasamoników, Baszta Stolarska, Baszta Mieczników).
Europe's biggest *Barbican* (a 15th-century circular-like structure with 3-metre thick brick walls, built in the adjacent to the Florian Gate's propugnaculum) and two arsenals.

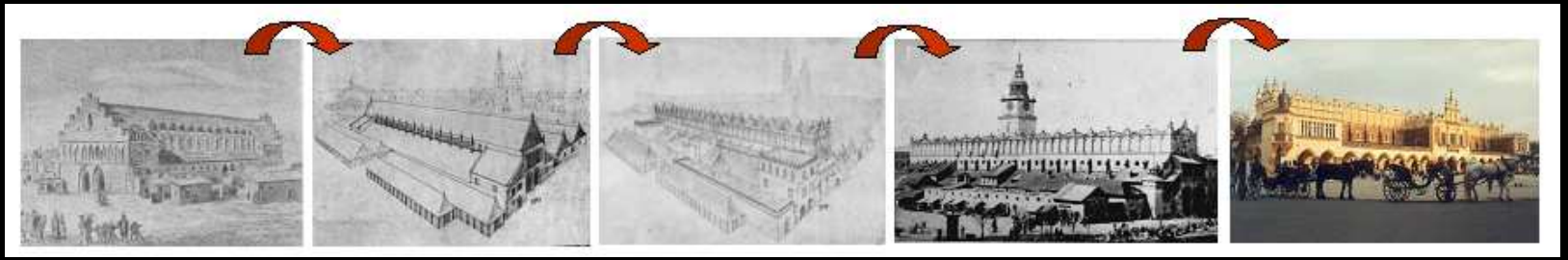
Field of experimentation : The city of Kraków.



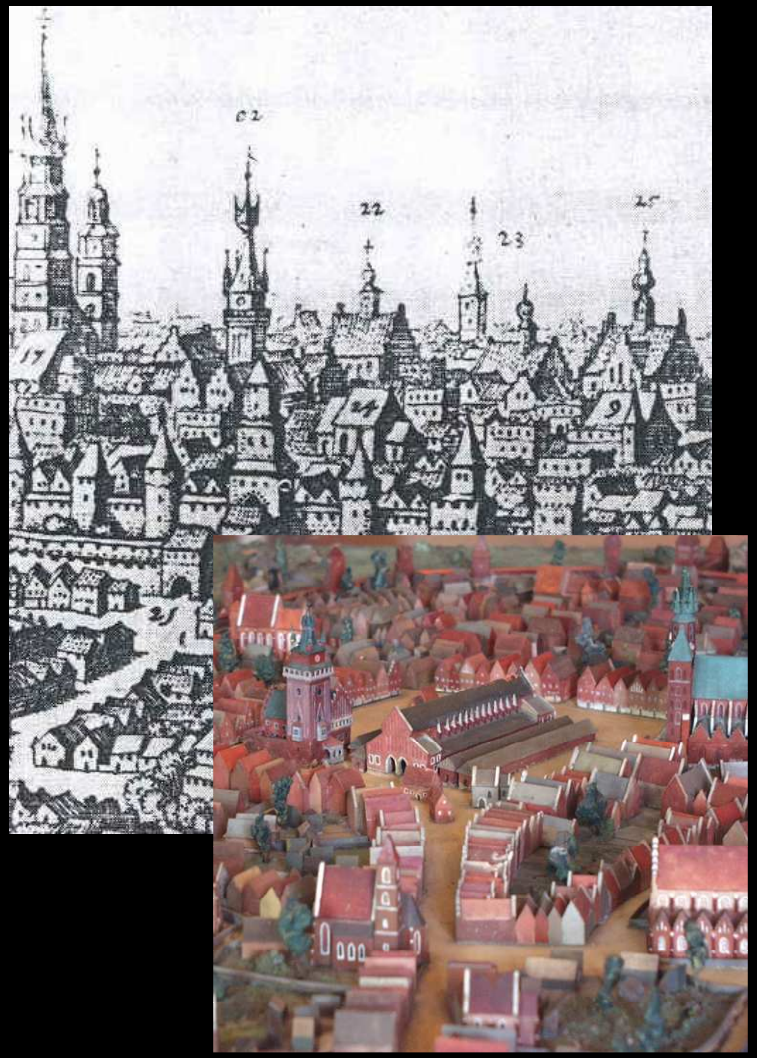




Stratigraphic layers keep numerous traces and proofs each edifice’s successive states.



Field of experimentation : issues.



-A complex evolution at various scales.

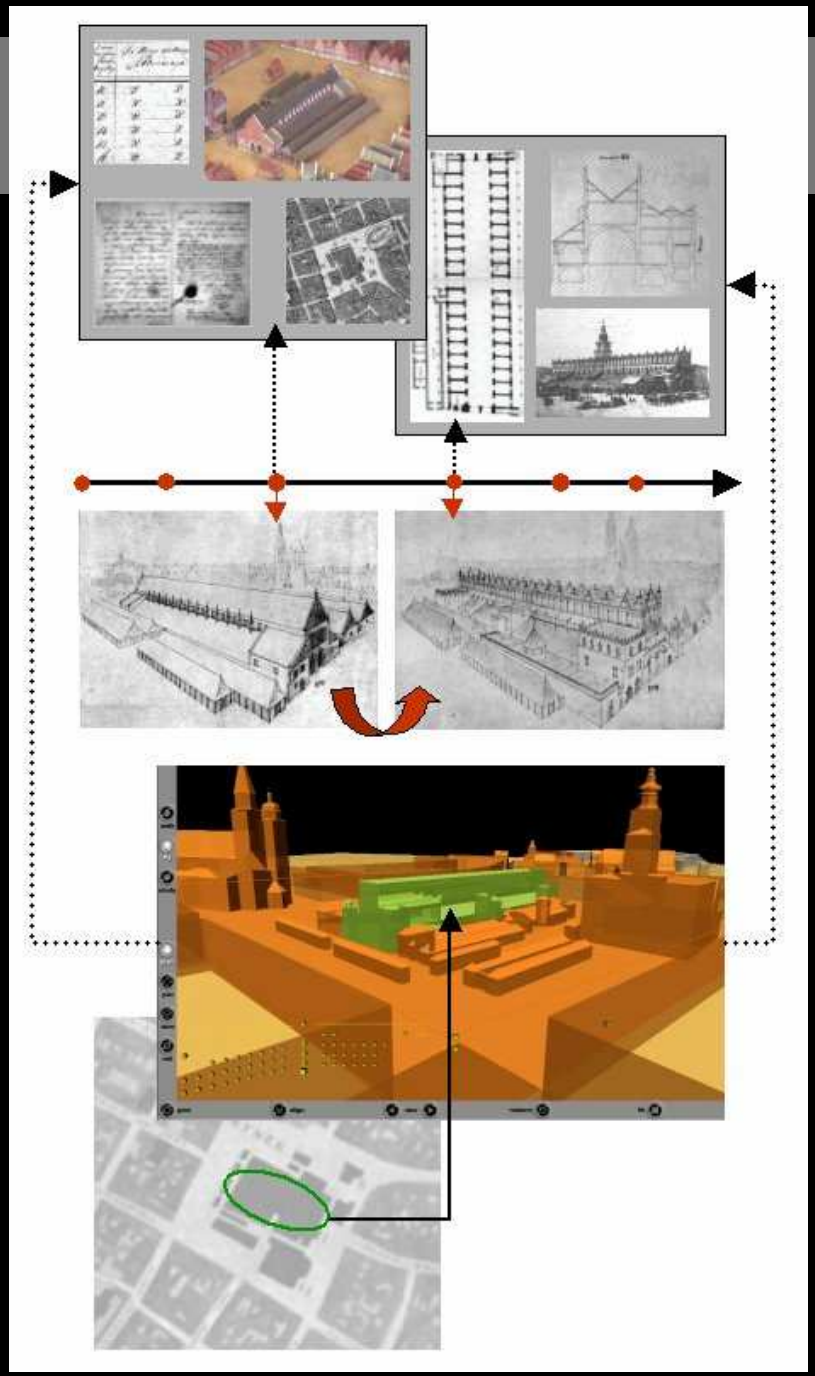
-Traces present at various scales .

-Years of conservation actions, examinations and research : a very significant quantity of various documents (descriptions, analysis, drawings, photographs, maps, reconstructive hypothesis, paintings …) that need to be gathered, organised and visualised.

-Objective : exploit the potential benefits of computer technologies in the management and preservation of the documentation

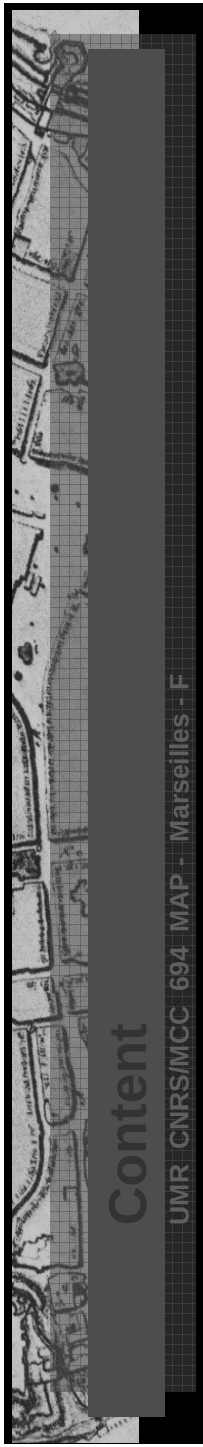
-Constraint : ensure a control of the collection holders on the data they own, i.e favour technological solutions that do not imply a dependance of the collection holder on a particular software.

The project's proposal.



-use the 3D representation of architectural objects in order to retrieve information and to visualise information.

i.e :
use architectural objects as filters on the data collection



Discussion content.

-Initial statement and hypothesis

-Theme 1 : Documentation problems

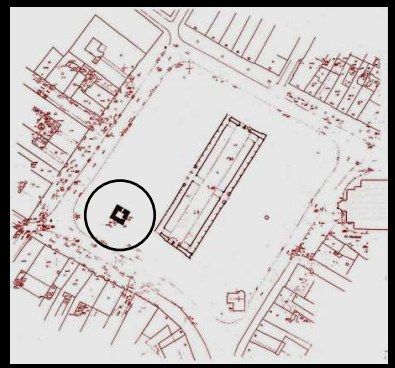
-Theme 2 : Architectural modelling

- Theme 3 : scale issue

-Theme 4 : Domain-specific constraints

Documentation is our concern.

-An example of the documentation's variety : the case of Ratusz Krakowski, the old town hall



Initial statement and hypothesis

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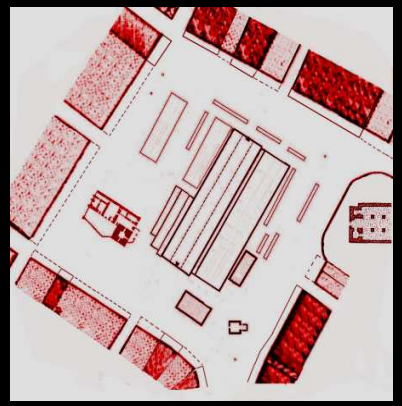

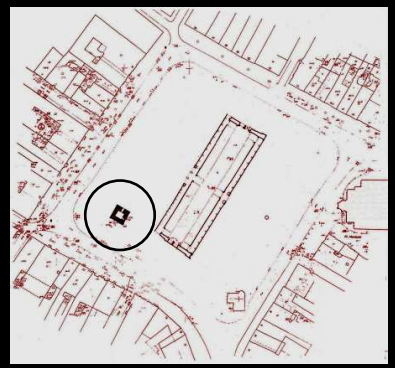

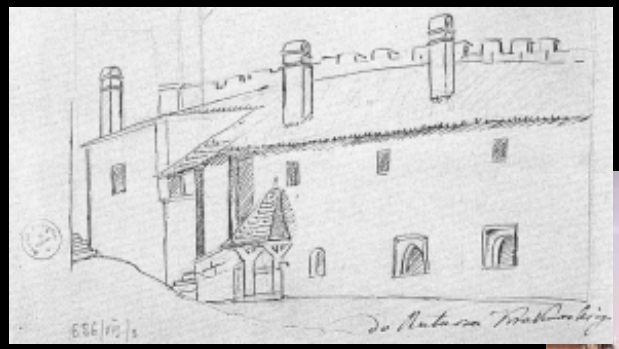

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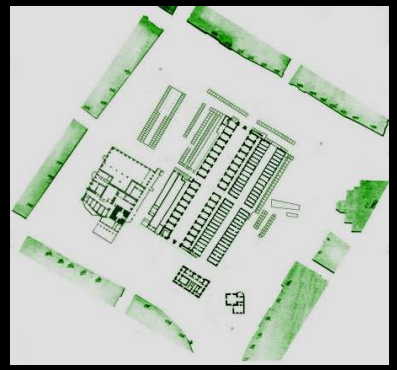

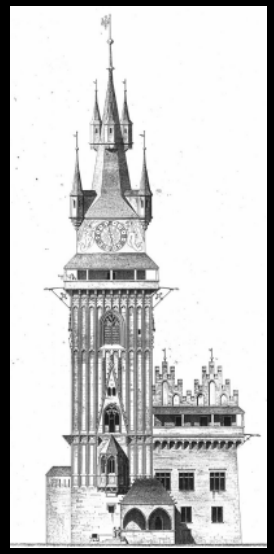

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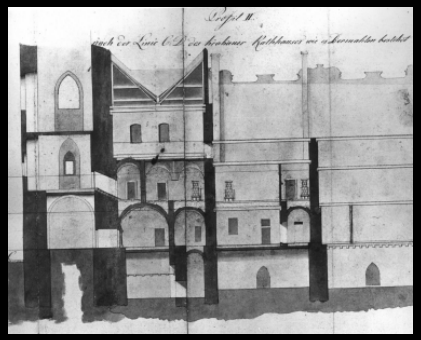

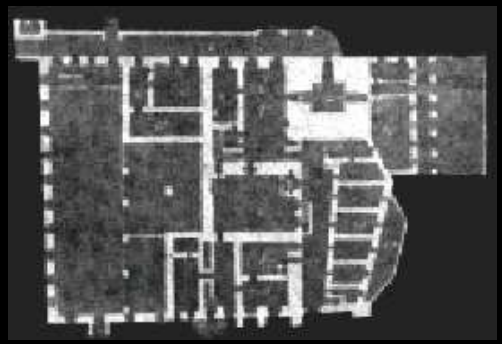

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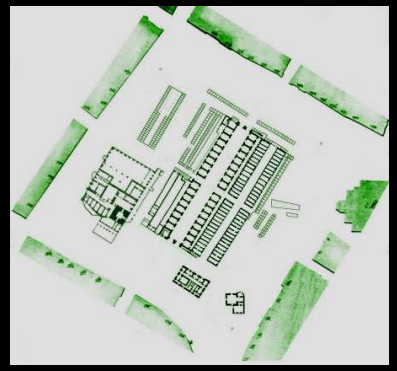

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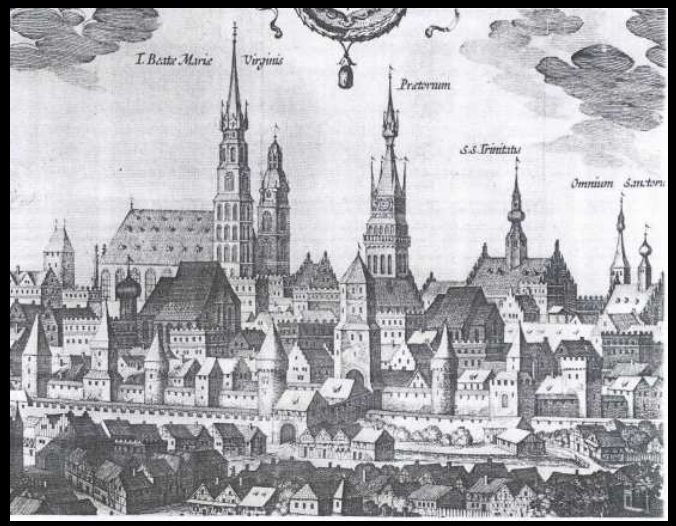

Initial statement and hypothesis

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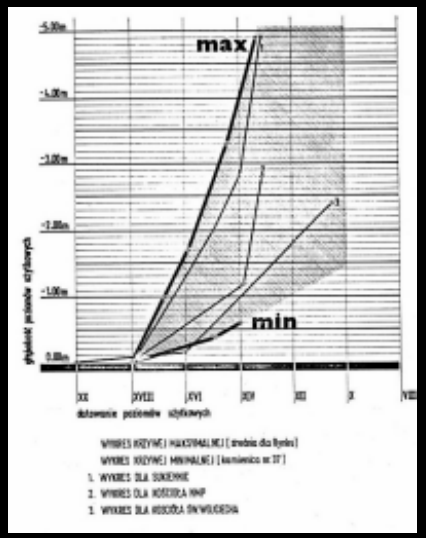

-A step of interpretation

Initial statement and hypothesis

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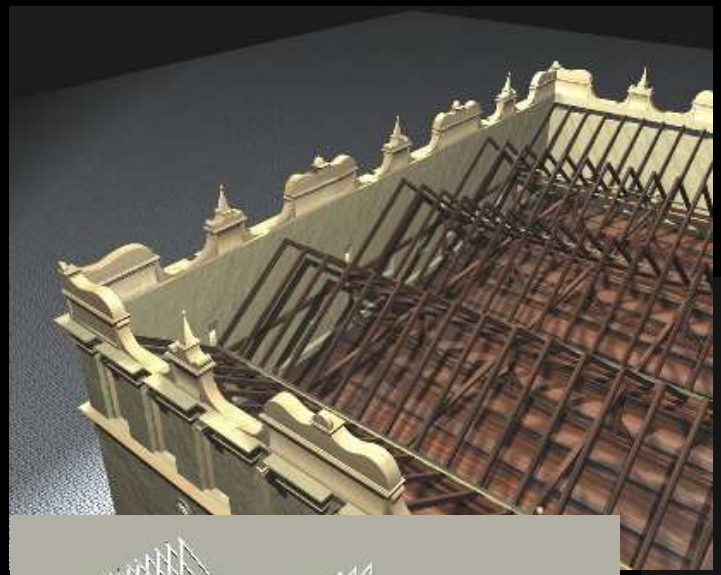
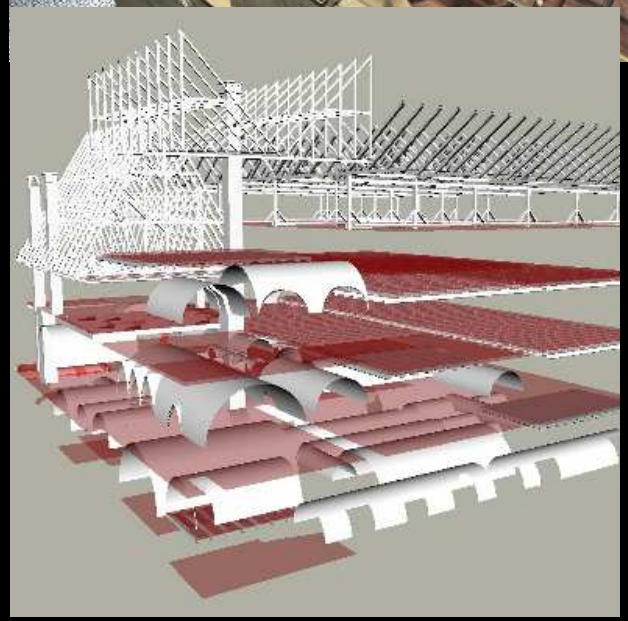


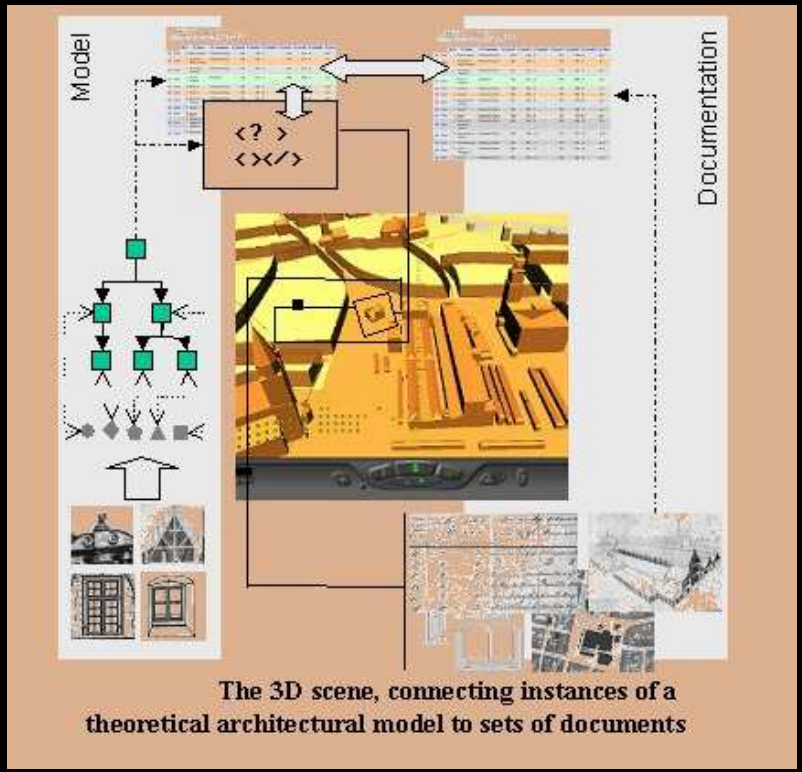


-A step of interpretation

The project's hypothesis.

-The edifice is not the information,

but the information is relative to the edifice



The 3D scene, connecting instances of a theoretical architectural model to sets of documents

The morphology as an anchor for the documentation, consequently:

documentation analysis step

definition of architectural shapes

Can 3D models be efficient in data visualisation or retrieval?

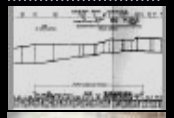
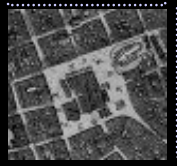
Can they offer a view on the data that other media forbid?

Can they localise pieces of information with regards to a position in space and a moment in history?

Can they inform the system's user on whether the proposed shape is original or reused, documented or hypothetical, etc.?

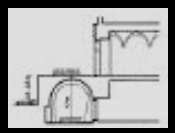
The role of resources.



documentary sources

hypothesis is always based on
a set of documentary sources

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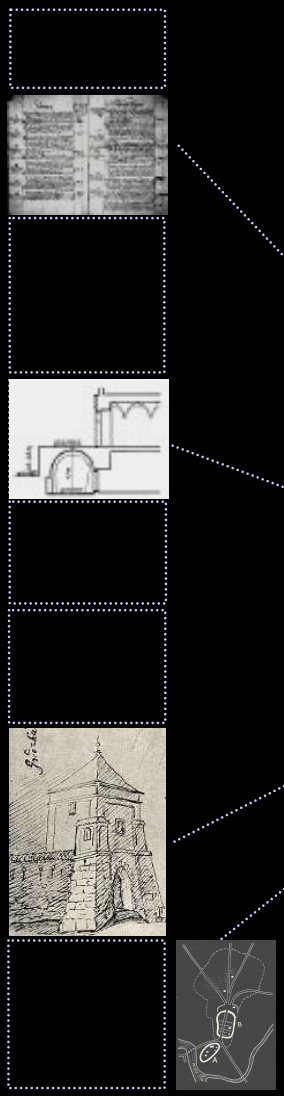

documentary sources

Pieces of information that characterise the 3D scene are:

- *heterogeneous,*
- *distributed,*
- *related after analysis to pieces of architecture,*
- *related to pieces of architecture corresponding to various scales,*
- *often incomplete, contradictory, interpreted,*

It is important to :

- show on which sources a hypothesis is based
- give access to all documents that may be related to the analysed case ?

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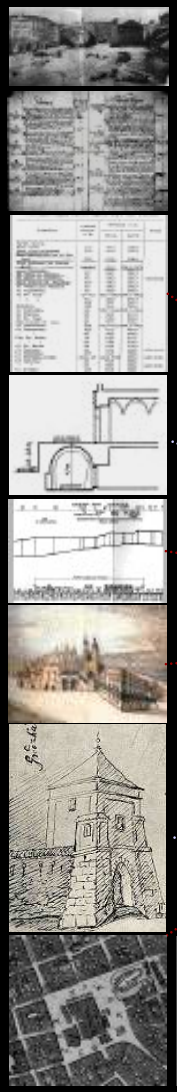

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Documentation problems

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Resources analyses step.

Step needed : add descriptors of the resources that concern not what the resource is but what edifice it documents

standard data identification

- describing what the document is

full source references

author

title

date

technique

edited (where, when, ...)

archives

...

interpretation of data-content

- used in art and architectural historical studies

identify what the source is about

what period is shown ?

what buildings are shown ?

credibility of the source

...

Expected results.

Our approach aims at :

- visualising the current state of our knowledge about architectural evolutions

  according to the documentation gathered in database

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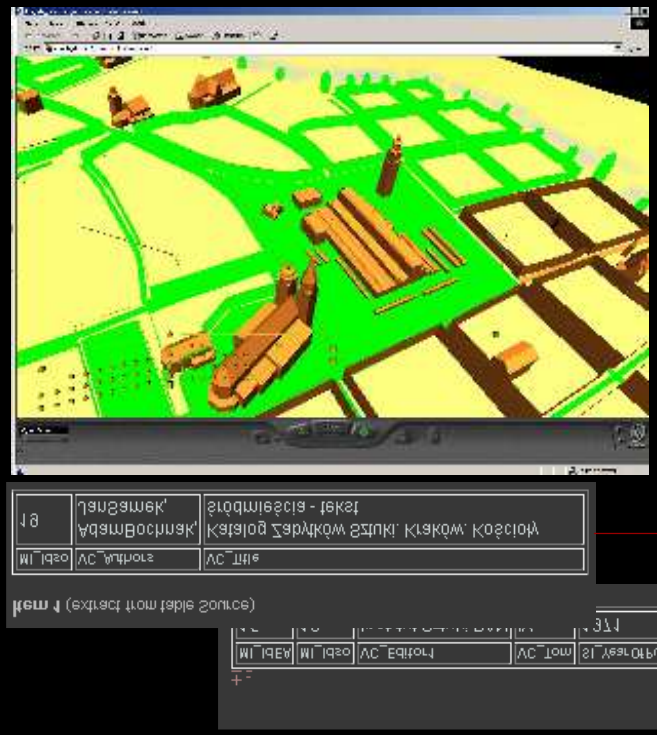

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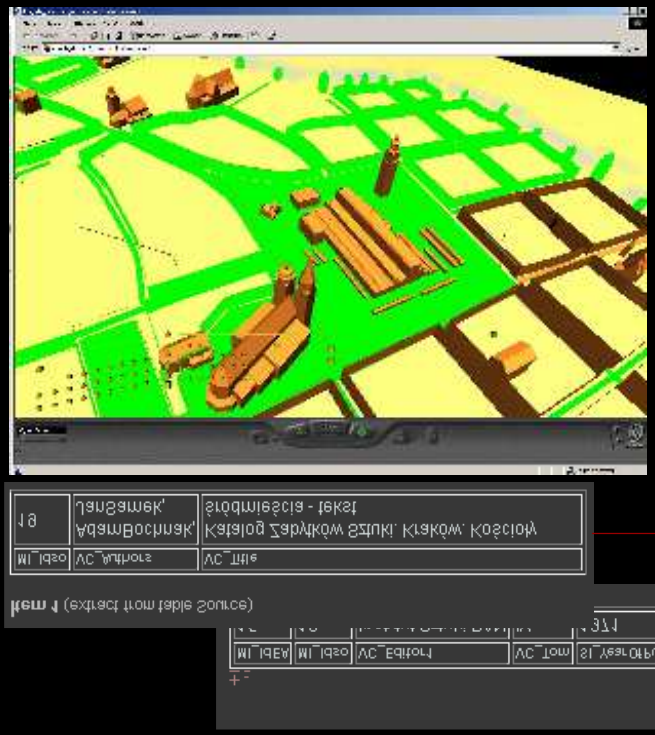

- giving access to a description of the documentation

- searching for documents using criteria of :

Documentation problems

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Expected results.

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Documentation problems

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what period is shown ?

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- searching for documents using criteria of :

  interpretation of data-content

The ongoing experience : VIA.

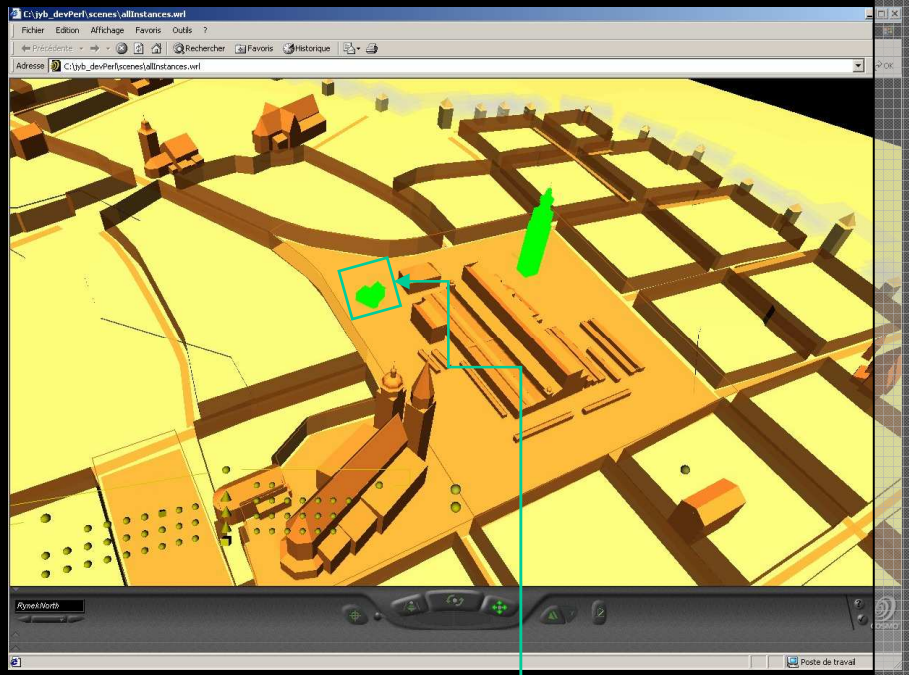
VIA - visualisation of our knowledge on historical evolutions of a town (Old Cracow)

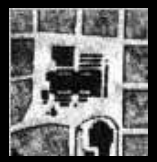
- choose a moment in history
- visualise our knowledge about it (VRML scene)

- visualise what types of documentation exist for particular objects
  (considered objects are highlighted in green)

- access to sources related to the hypothesis that we show

Architectural modelling : objects or concepts > qualitative information





The hypothesis :

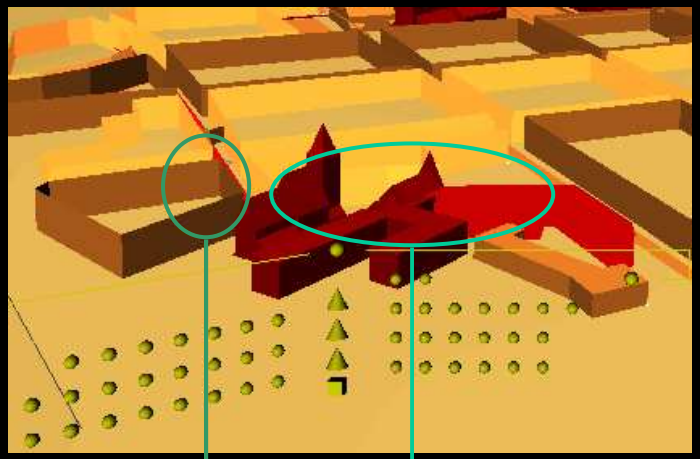
Built shapes can be an intermediate between various points of views on the edifice, between various pieces of information partially characterising it.

3D scenes represent and localise pieces of information :

- *They represent pieces of information since they show through a morphology and an appearance what we know about pieces of architecture,*

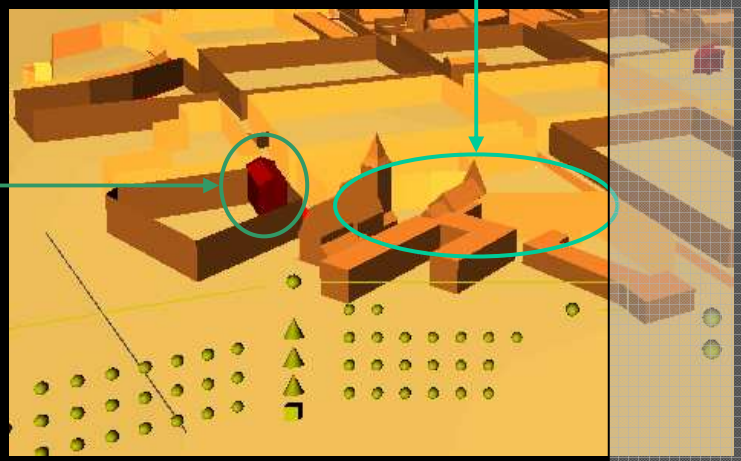
- *They localise pieces of information, in the space of the town and at a given period, since they show through a morphology and an appearance we know about pieces of architecture at that given time,*

Information evolution > shape evolution



Information better defined

New information

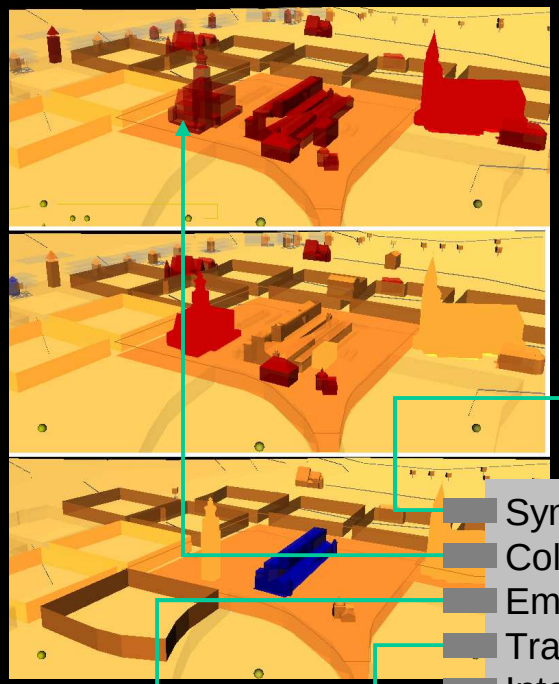


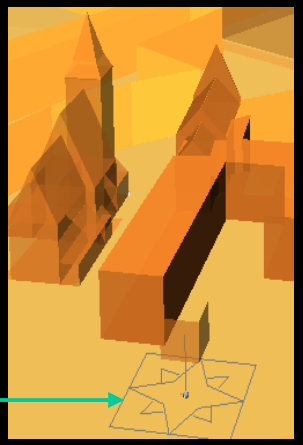
The two issues:

- *How to retrieve pieces of information from a 3D scene ?*
- *How to represent objects displayed in the scene with an indication of the type of information we have about them?*

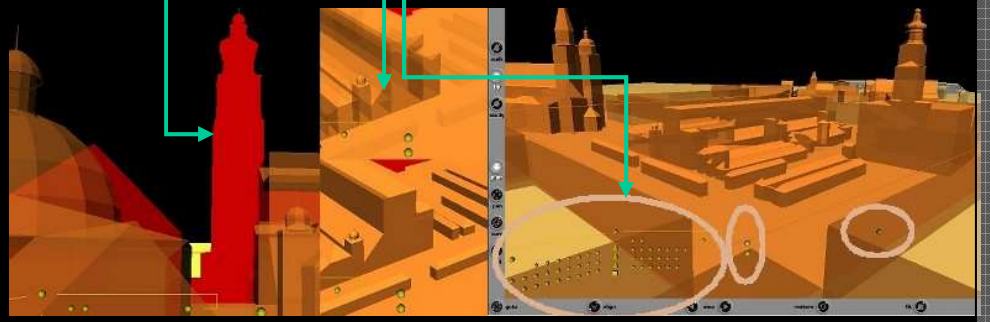
Implication: pieces of information and 3D scenes used as interfaces have to be upgradeable.

The appearance of objects: a result of the documentation's reading





- Symbols
- Colour
- Emissivity
- Transparency
- Interaction disposals

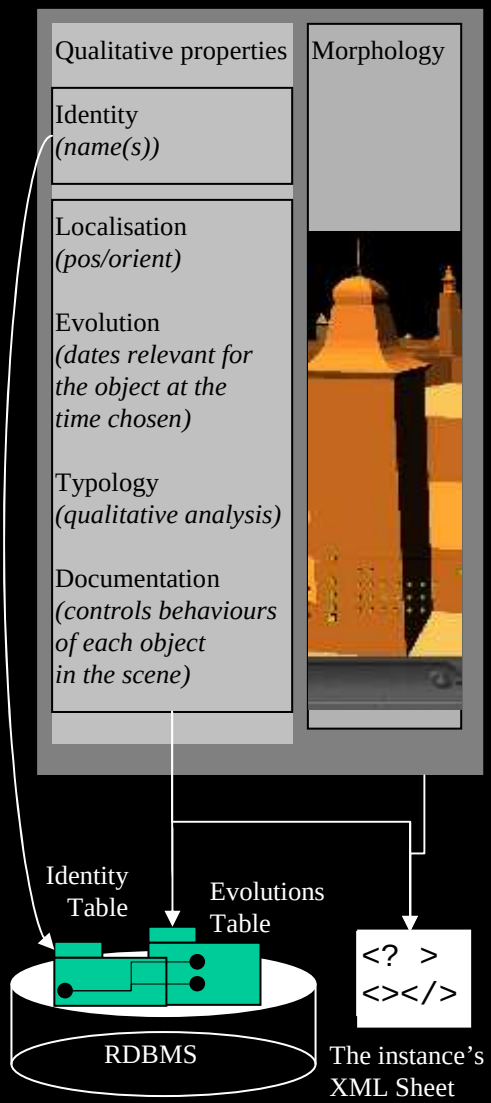


Accordingly, 3D scenes use a predefined theoretical architectural model.

This model defines a set of univocal concepts, gathering qualitative and quantitative information.

3D scenes show what we know as well as represents what we ignore: concepts are given an appearance that is monitored by our current state of knowledge on them.

Shapes identification : the architectural model

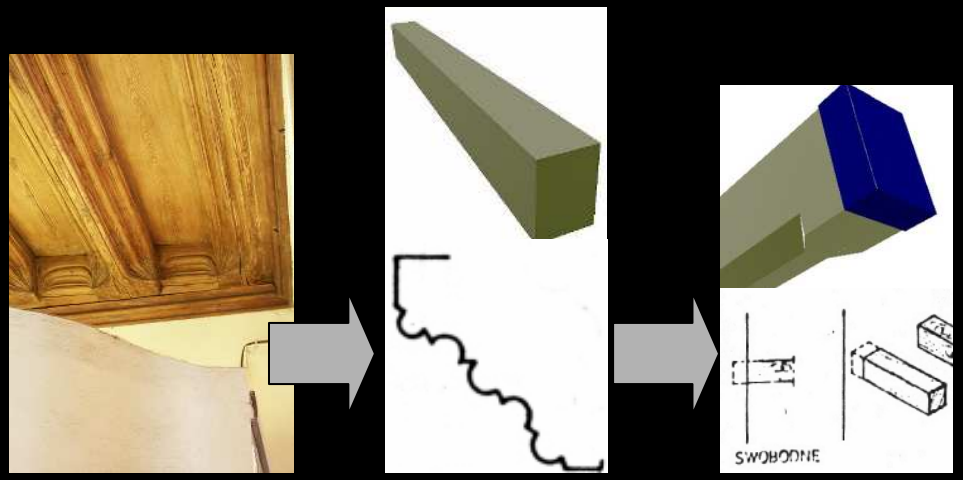


Methodology : a set of rules proposed in order to recognise meaningful architectural elements to which documentation can be attached.

Step 1, reading of terms in references

Step 2, extract morphological derivations of the term

Step 3, extract the element from the context in which it is used



A univocal term identifies shape and role of the architectural element.

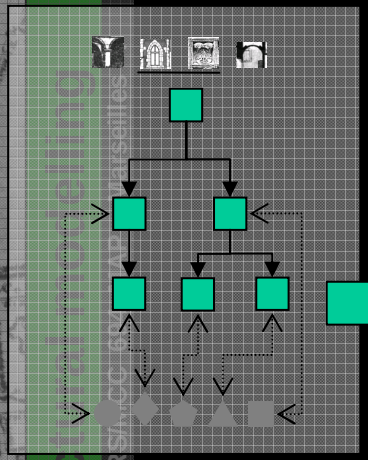
Implementation

Distributed object and justifications

RDBMS

Instances

Documentation



Model
set of concepts
(classes)

Qua… properties

Identity
(name(s))

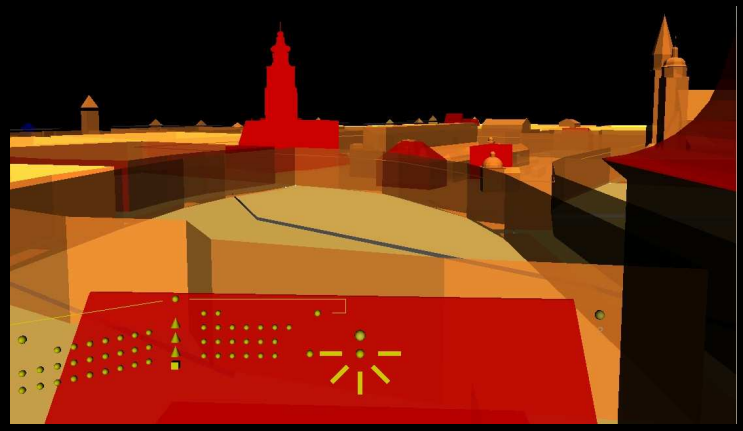
Localisation
(pos/orient)

Evolution
(dates relevant for the object at the time chosen)

…ology
…ualitative analysis)

Documentation
(controls behaviours of each object in the scene)

Morphology



XML

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</Origin>
</Meta>
<Identity>
<Id value="300"/>
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<Class value="UrbanEdifice"/>
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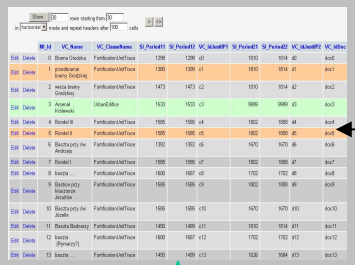
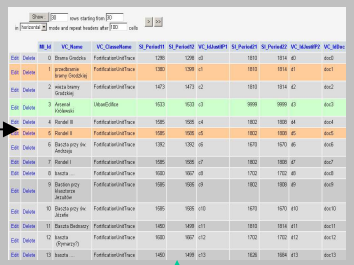
Implementation

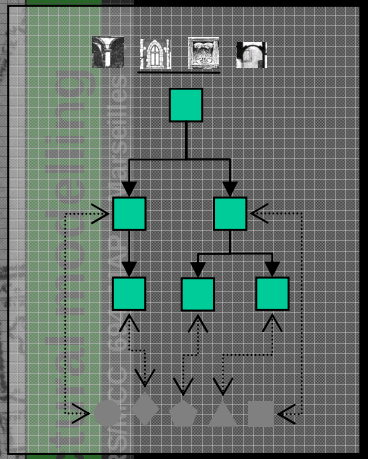
RDBMS

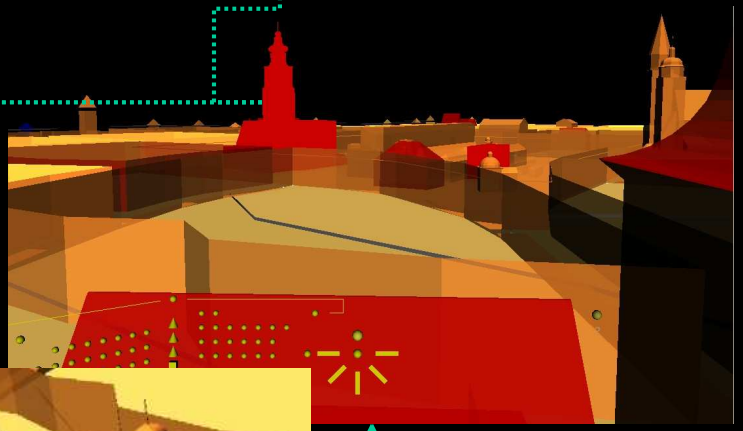
Instances



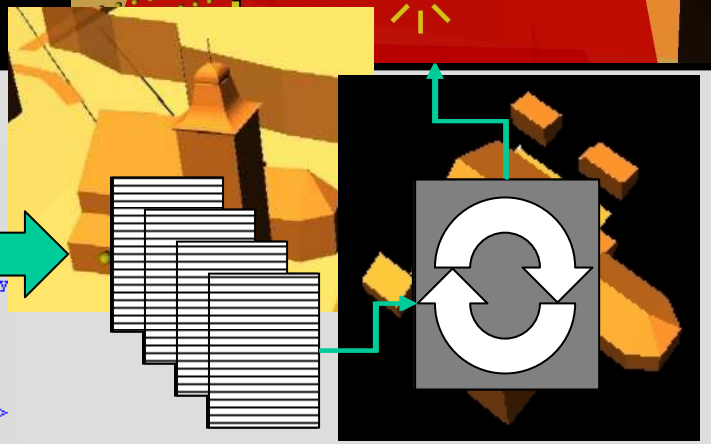
Documentation







```
<?xml version="1.0" encoding="utf-8"?>
<ArkiwInstanceRecord id="300_587">
<Meta>
<CreationDate value="20021612"/>
<Origin>
<Country>fr</Country>
<Agency>MAP-ARKIW TEAM- PICS 1150</Agency
</Origin>
</Meta>
<Identity>
<Id value="300"/>
<EvolutionId value="587"/>
<Name lang="pl">klasztor JezuitÃ³w</Name>
<Class value="UrbanEdifice"/>
```



XML

Architectural modelling

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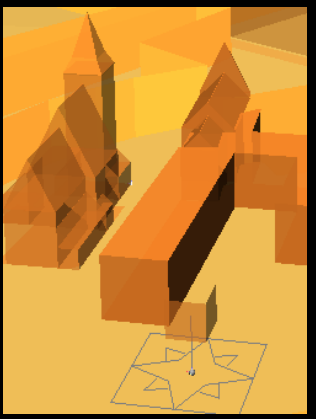
Implementation

Translucency : marks absence of documentation or its evaluation

Emissive colouring: marks objects that are documented but not justified

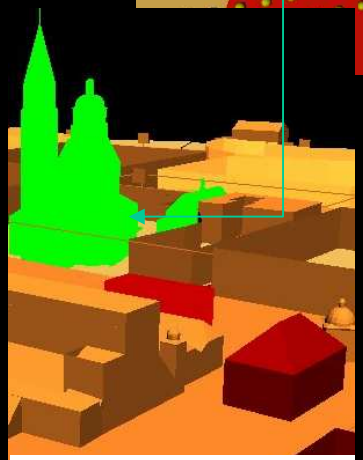
Symbolic shapes : visualise presence of an object that has not been given morphological properties.



Appearance Selector:
Cones controls the level of translucency of objects ,
Spheres control the highlighting of objects

Anchor Selector:
controls which resource will be queried when an object is clicked

Red/Blue colouring: States whether the morphology relates to the scene's date



Highlighting : visualises presence of a document type for the object (each sphere corresponds to a given type of document)

If the scene reflects the documentary sources, it requires graphical marking of the information available on objects.

Implementation

- Colour of objects : is the object ’s shape this of the selected date?
- Emissive colour : a documentation that has not been analysed
- Highlighting : selection of objects with regards to the type of their documentation
- Data access : from the object to its documentary sources
- Evolutions simulation

Stating the problem

Scale issue

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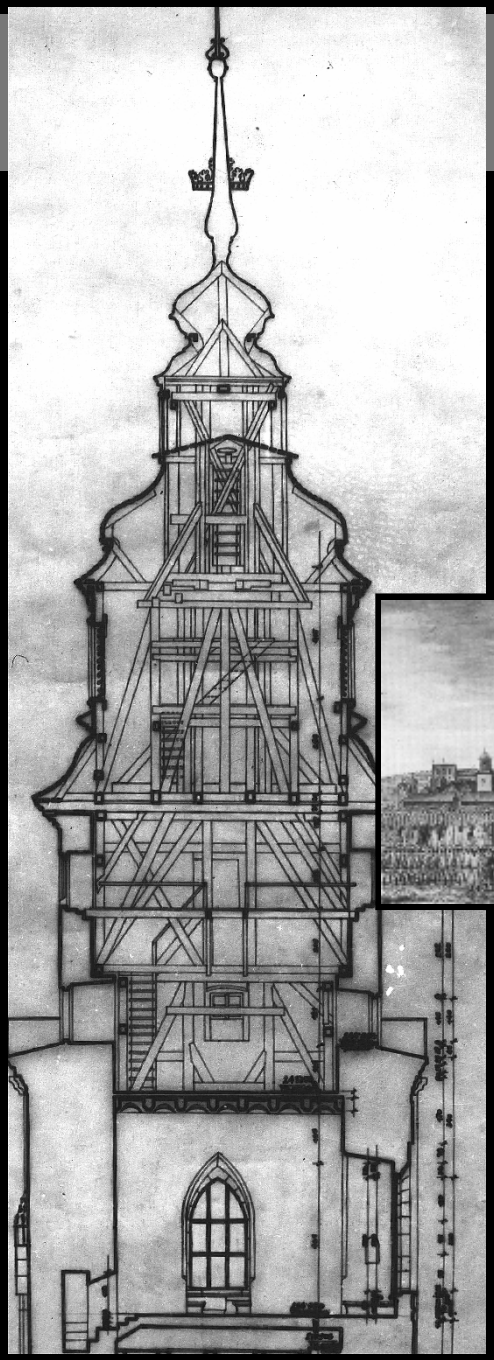
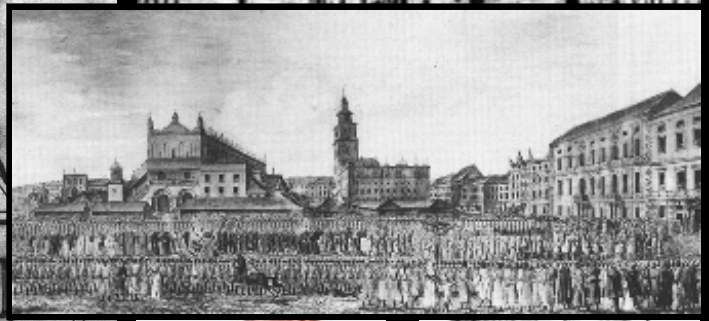
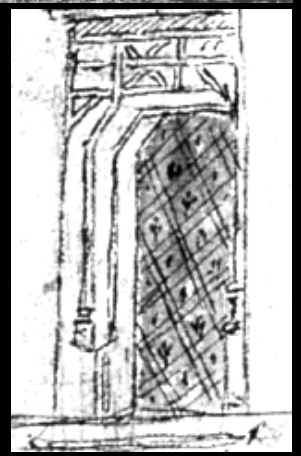
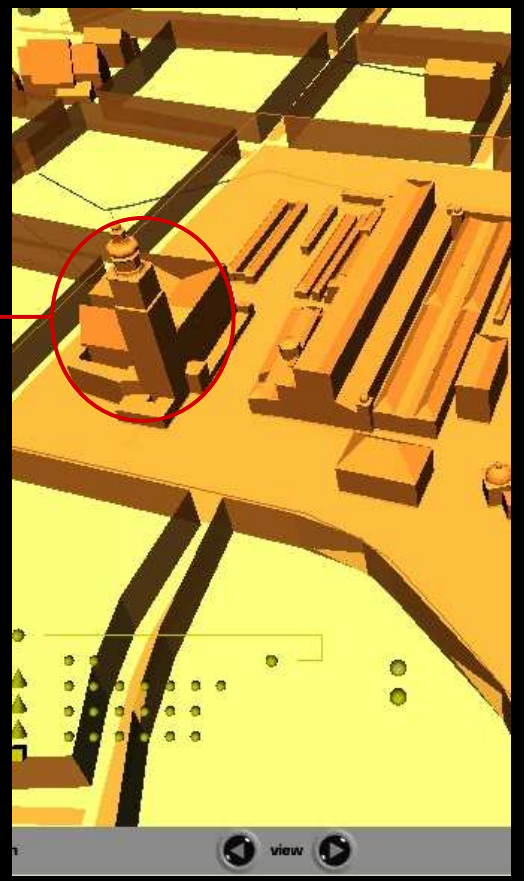








A methodological proposal

In a case of architecture the mono-scale representation does not match the variety of the data related to the object, the data that is the base of object's description.

– compositional schema
– changes of the water system
– state of property
– elements of decoration
– relations between the edifice
– and ground
– descriptions of urban blocks
– inventory drawing/descriptions
– of the object ...

necessity to re-introduce the notion of multi-scale

- better support the documentation's variety
- to deliver appropriate type of representation (levels of detail/symbolism different)

urban scale

compositional
compositional plan of the city

structural
urban space

morphological
silhouette of the town

architectural scale

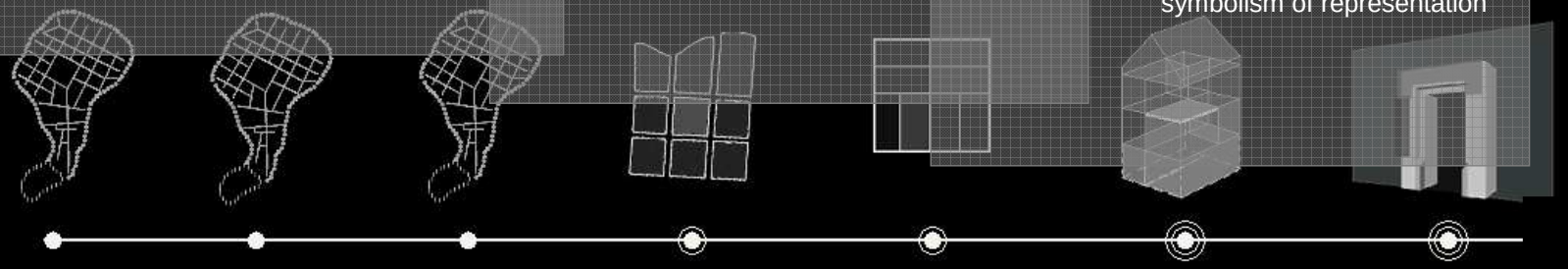
urban block
relations between edifices

architectural
morphology of architecture

scale of architectural detail

entity
architectural detail

decoration level
symbolism of representation



Scale issue

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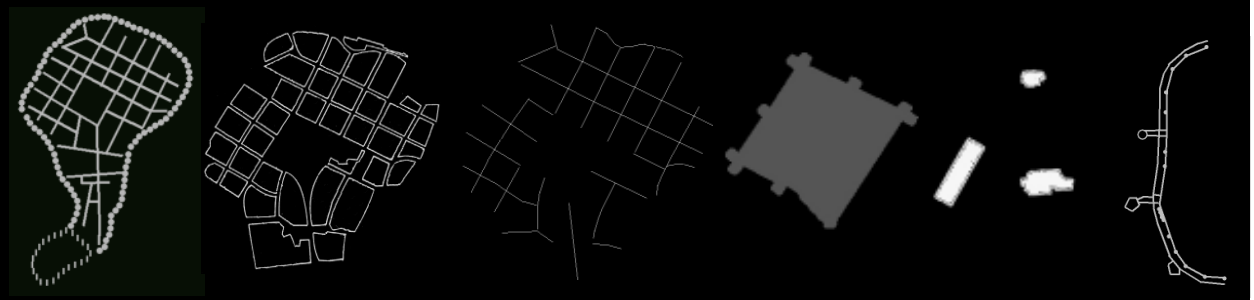
A methodological proposal

questions related to urban problems - all town

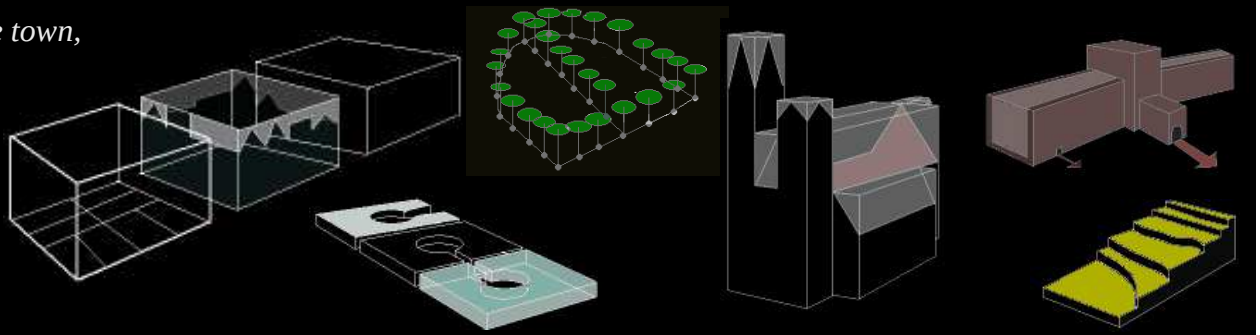
compositional scale

schema of city layout,
changes of the city organisation
(ex. blocks integration),
intensity of: population,
intensity of: edifices,
trade routes,
...

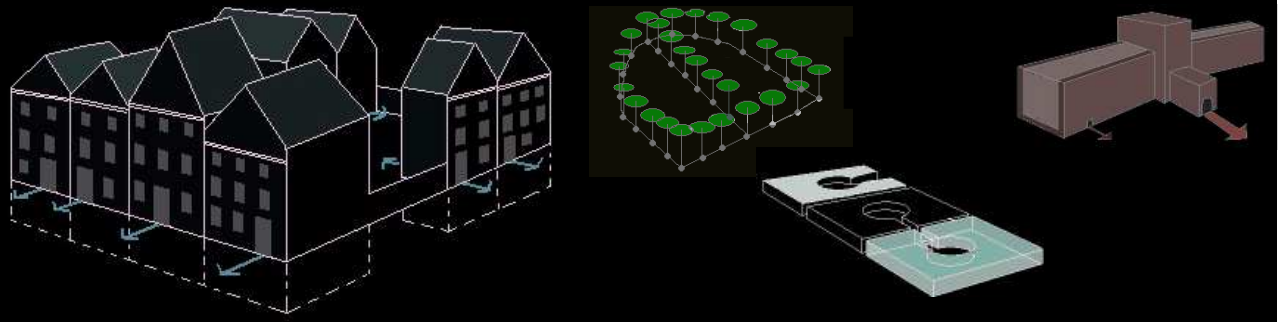


structural scale

changes in a space structure of the town,
urban interiors (proportions, ...)
connections of the urban interiors,
arrangement of the green zones,
urban spaces - types of the usage,
...



morphological scale



Scale issue

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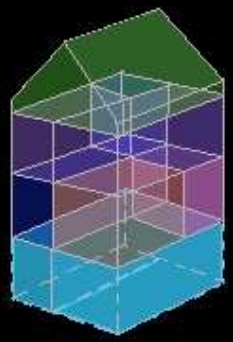
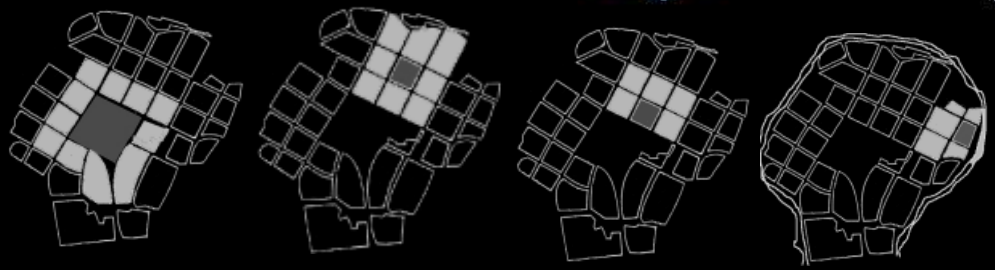
A methodological proposal

questions related to architectural problems - zones of a town

scale of an urban block

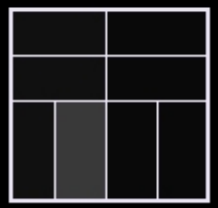
functional analysis,
changes in form and composition of a frontage,
stratigraphy,
utilisation of a parcel,
schemas of communication in objects
...

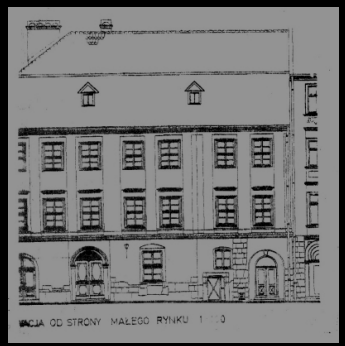


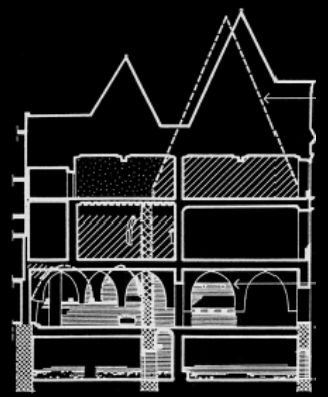


architectural scale

morphological analysis,
stylistic analysis,
structure of an edifice,
stratigraphy of an edifice,
relations between an edifice and the ground,
compositional, functional axes,
compositional features of the facade,
...







Scale issue

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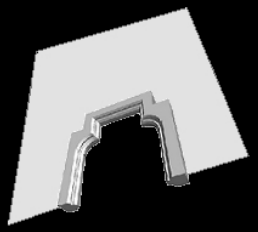
A methodological proposal

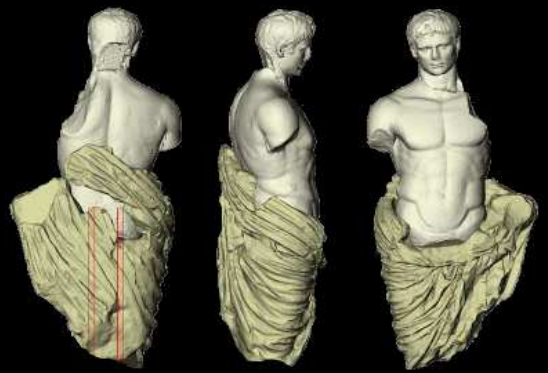
questions related to architectural decoration - zones of an object

entity scale

particular detail with it's specificity,
presence of the decoration,
stratigraphy of the elements,
analogies,
stylistic and distinctive features of a detail,
originally present in an edifice / added (introduced) later,
consecutive layers,
...



symbolism of representation,
analogies,
archetypes,
inspirations,
influences,
novelties,
artistic aspects,
...



Scale issue

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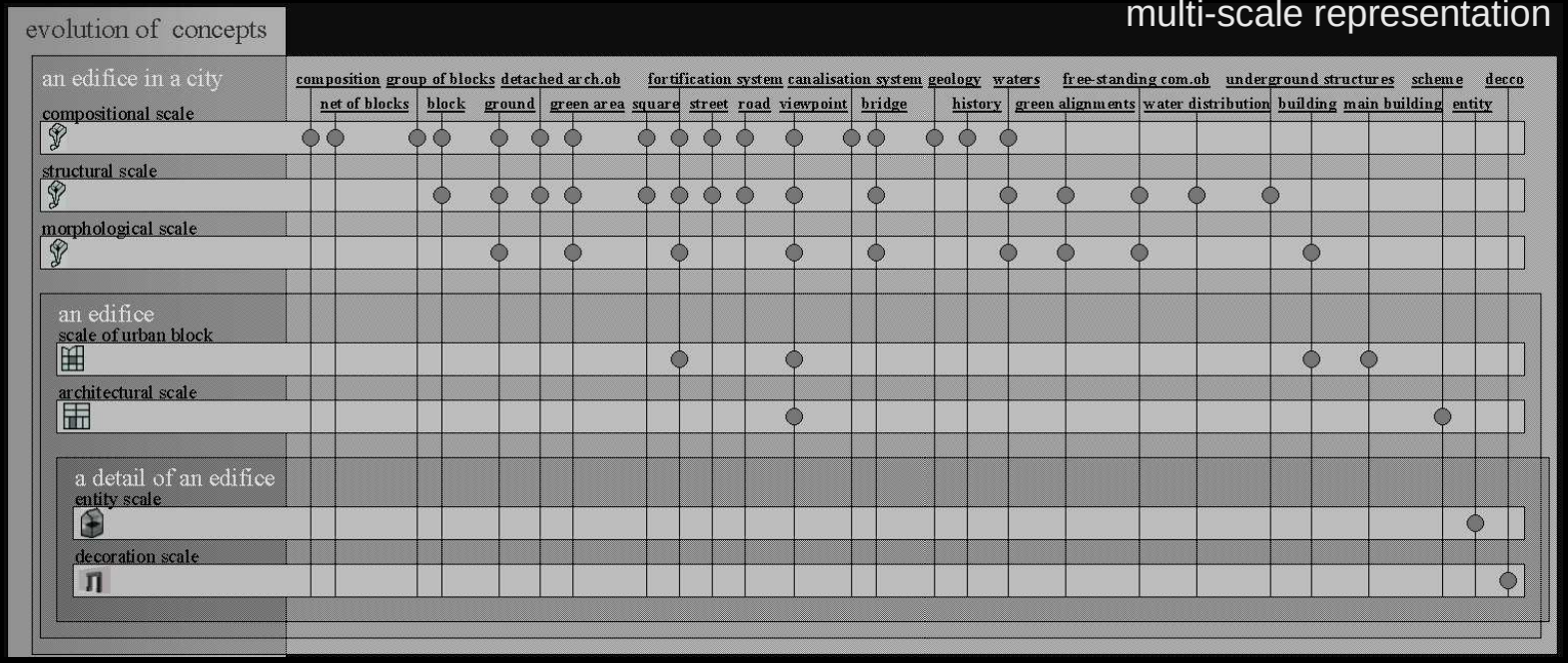
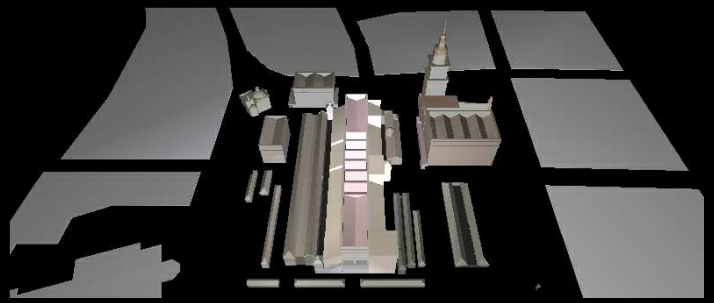
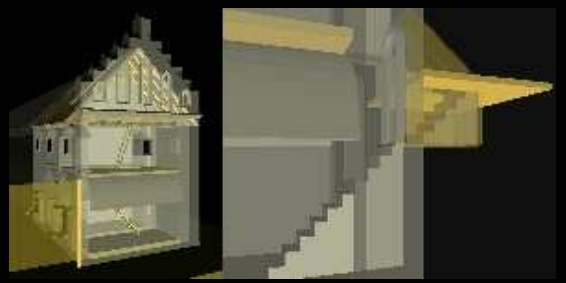
A methodological proposal

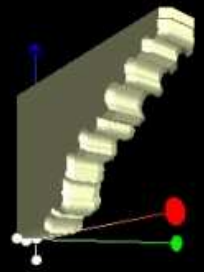
multi-scale representation



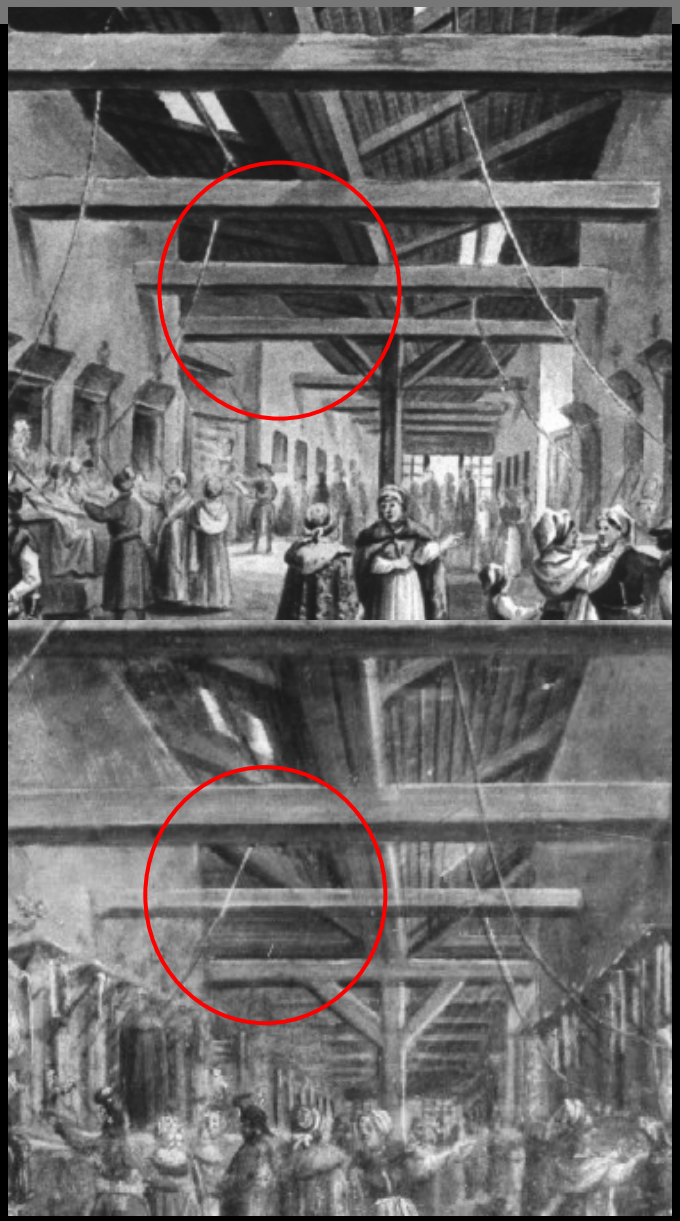
for each scale level of detail is precisely defined







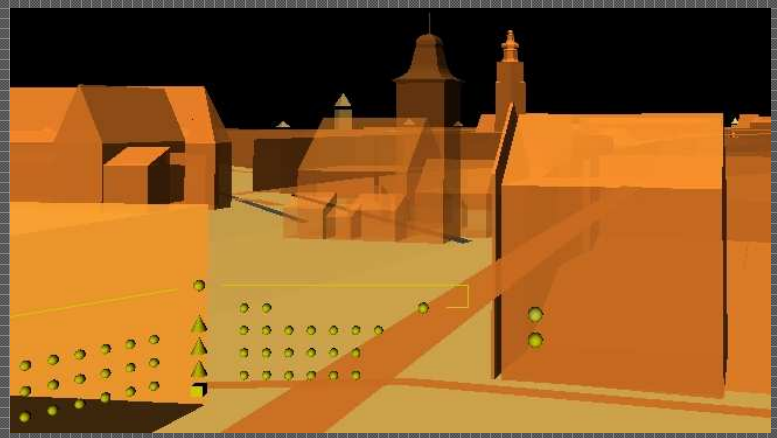
Data uncertainty



Edifices that we study have been widely transformed throughout the centuries when they have not been totally destroyed.

A challenge to visualise shapes that in all cases are hypothetical:

Propose visual markings of the objects represented in a 3D scene that correspond to the type and content of their documentation, and to the hypothesis' evaluation.



Objects deformations

From documentation to reconstruction : data interpretation.

Inside an edifice that can be widely transformed, individual elements of architecture can be reused or even moved somewhere else in the city.

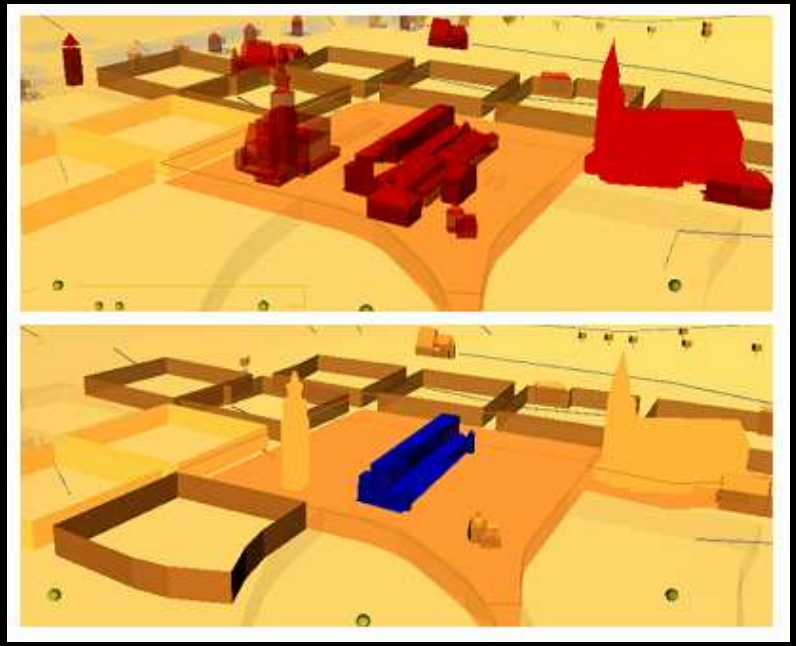
Yet another pitfall : localise in the space of the city architectural elements in relation with a given period of time.

Successive coherent phases.

Evolution of information, data interpretation can include an evaluation of credibility.

The theoretical definition of concepts may match only partially this of the individual elements.

Objects evolutions



Results of the transformation of buildings furnishing the Main Square in Cracow. State in XVII century (*top*) and after 1875 (*bottom*).

Handling evolutions

Document and represent each phase of the edifice's evolution

Formalise a theoretical model of architectural elements in which each meaningful individual concept can be given identity persistence, but state evolutions

State evolutions, an interactive qualitative simulation (cityscape)

State evolutions, an interactive qualitative simulation (closer view)

Domain-specific constraints

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Knowledge evolutions

Morphology

object has been instanced without documentation references

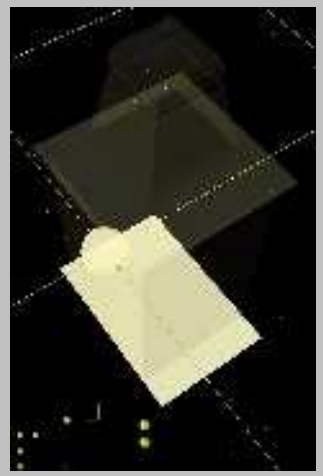
documentation ?

?

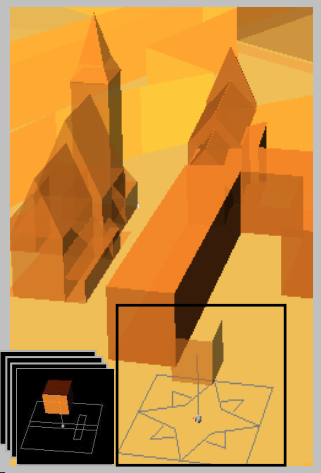
object instanced and documented but its morphology is undefined

documentation

Solution:



undocumented object ◁



morphology undefined ◁

particular level of transparency

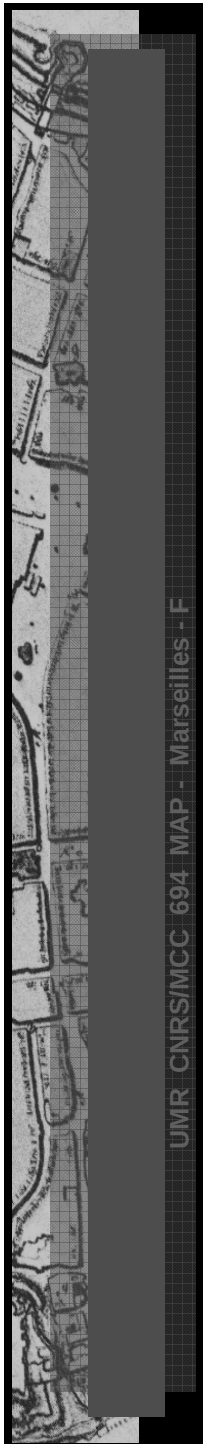
library of 3D graphical signs

Managing with undocumented and non-dimensioned objects

Possible inconsistencies appear when we have not gathered enough data on either the morphology or the documentation of the object

In both cases, how can we still visualise something ?

The solution we propose is to stress the lack of information by a visual sign in the 3D scene.



Conclusion

Dealing with historical edifices or sites raises problems that traditional CAD or DB systems are not the best at solving : uncertainty, imprecision, partial data sets, alternative hypothesis, etc…
Addressing those questions can be a fruitful contribution from the field of the architectural heritage.

possible benefits of our approach:

A central improvement in the actual practice is the fact that architectural data finds its natural media, shapes, whereas it has traditionally up to now been centred on documentary descriptions (authors, editors, keywords, etc)

On the documentation side, other benefits include the possibility given to reuse existing data sets, the possibility to visualise what a particular document *is about* (edifices quoted in it), the possibility to compare levels of information between various sectors or objects types inside the territory observed.

On the virtual reconstruction side, the approach we defend helps the architects to build from his own words rather than from those of geometry, allows the author of the reconstruction to build an object *on which he has doubts* and to represent along with a morphology *the doubt itself*.

The emergence of a vision of 3D modelling that says a 3D model can be a sustainable research tool if it reaches the readability of a geographical map.