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Sustainable Urban Rehabilitation in Europe

Methodological approach to conservation

Erasmus+

Sustainable Urban Rehabilitation in Europe

3rd Semester

Susana Mora Alonso-Muñoyerro
Ignacio Mora Moreno
David E. García García
M. Carolina Hernández Martínez
Camila Burgos Vargas

Methodological Approach to Conservation: Physical Approach

2 ECTS

SH
Sustainable Heritage

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SURE
SUSTAINABLE URBAN REHABILITATION IN EUROPE

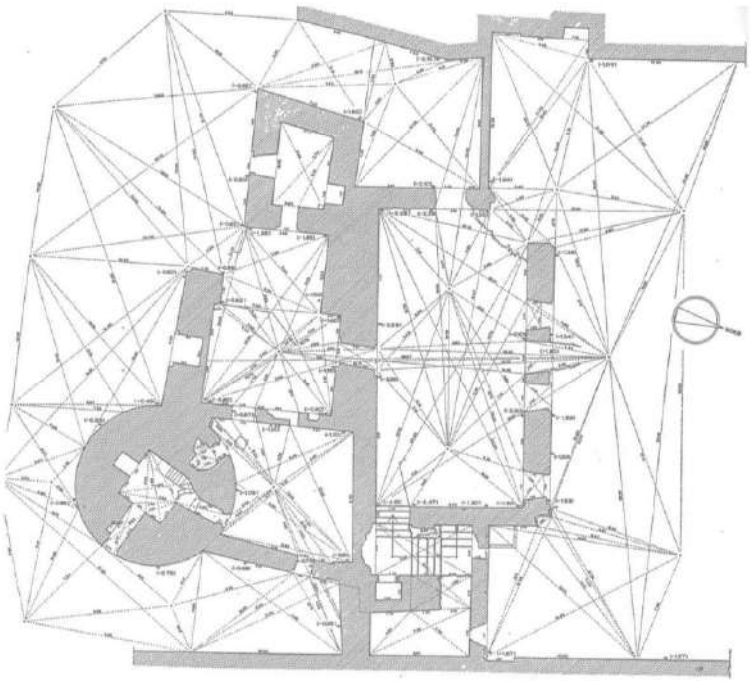
UNIVERSIDAD POLITÉCNICA DE MADRID

Sustainable Urban Rehabilitation in Europe

Methodological Approach to Conservation: Physical Approach

1. Introduction to Methodological Approach
2. Geometrical Survey
3. Geometrical Survey: traditional method
4. **Geometrical Survey: new tools**
5. Material Survey.
6. Mechanical Survey.
7. Damage maps I: degradation problems
8. Degradation types.
9. Damage maps II: fissure and crack problems
10. Damage maps III: moisture problems
11. Damage tests on masonry constructions I
12. Damage tests on masonry constructions II
13. Survey, maps and tests on wooden contruction.
14. Archaeology.
15. Stratigraphy.

Methodological Approach to Conservation: Physical Approach



LESSON 04. GEOMETRICAL SURVEY: NEW TOOLS

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MEASURE METHODS

The measurement systems can be grouped according to the complexity of the instruments used.

- TRADITIONAL SURVEY
  - A. Direct or simple measure
- **NEW TECHNOLOGIES APPLIED TO SURVEY**
  - B. Topographic survey
  - C. Stereographic photogrammetry
  - D. Photogrammetric restitution
  - E. Laser scanner

MEASURE METHODS

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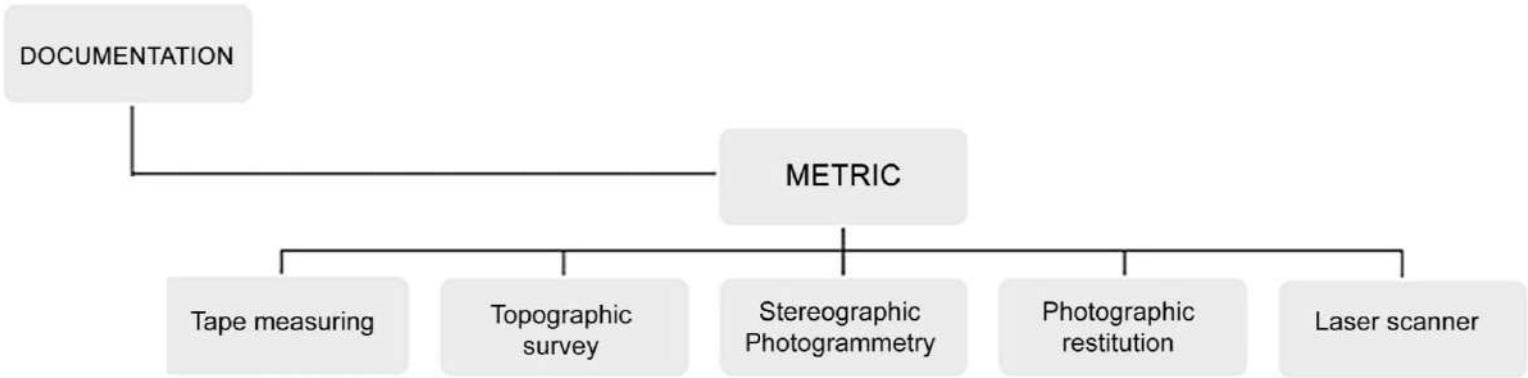


TOPOGRAPHIC SURVEY

In general, an adequate analysis of an architectural work requires us to always consider it as a three-dimensional object and to make its measurement by means of systems that provide us with the location in the space of its various elements. The measurement and survey of existing buildings and constructions using traditional methods (tape measuring) poses difficulties due to the inaccessibility of many parts, especially in spaces of great heights and dimensions.

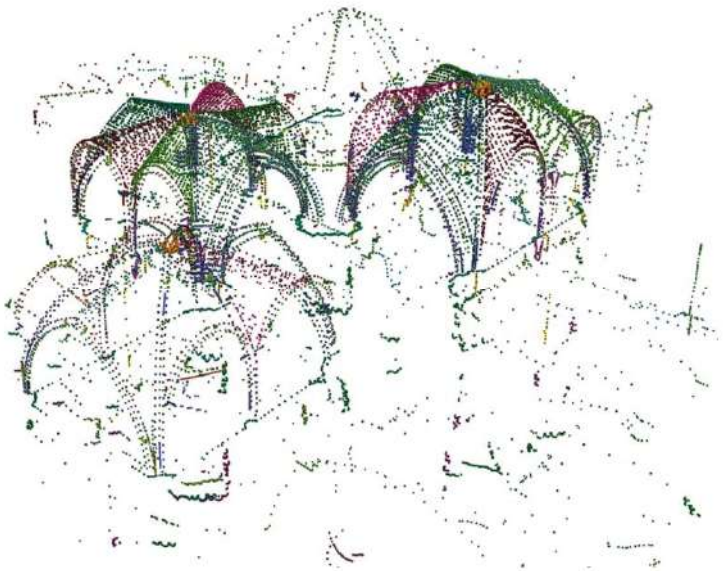
LXXXIV. THE BATHS OF CARACALLA

1927 halftone print of a drawing by S. Iwanow

TOPOGRAPHIC SURVEY

Total station and point clouds

These fixed points are the ones that allow sketched elements to be drawn on the screen, essentially through lines that connect these points. When working with optical devices (digital or analog) there can be some advantages in terms of accuracy, angle measurements, really horizontal and flat polygons, greater distances ...) with respect to the measurements obtained with tape (traditional or laser).

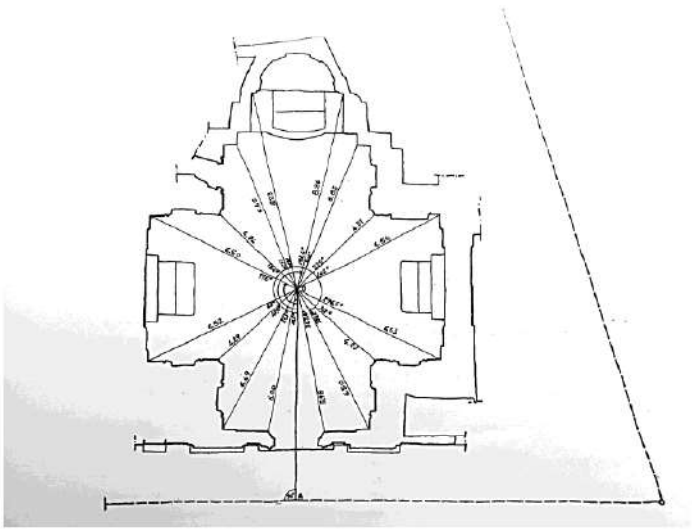


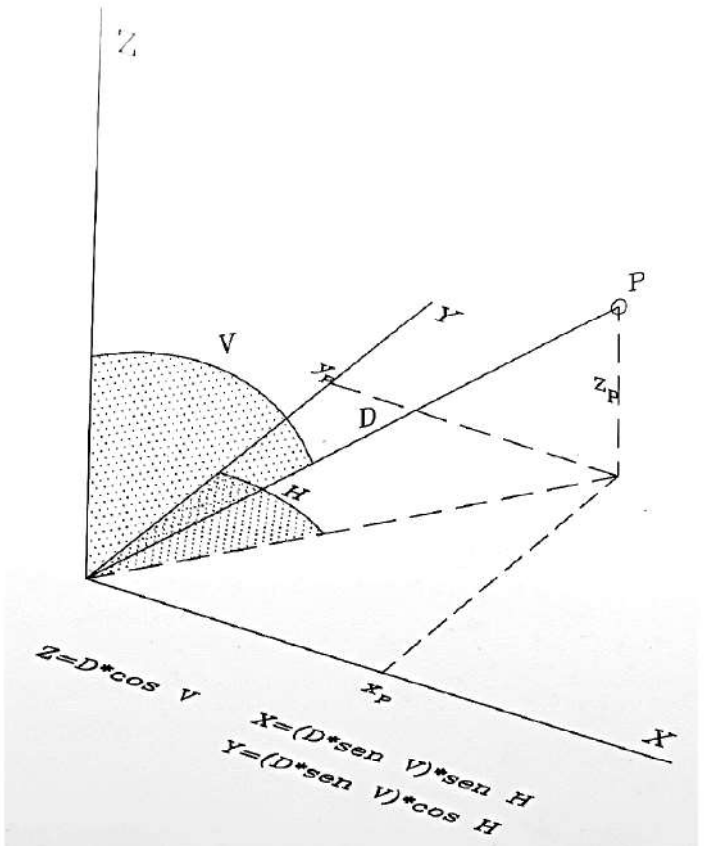
Total station survey of the vaults sexpartitas of the presbytery and the cruising arm of the Cathedral of Santa María (Sigüenza). Rocío Maira Vidal. Enjarje Arquitectura

TOPOGRAPHIC SURVEY

Polar and Cartesian coordinates.

The topographic survey allows identifying significant points of the object, the more the better, and then determining its three coordinates, either directly or indirectly.





TOPOGRAPHIC SURVEY

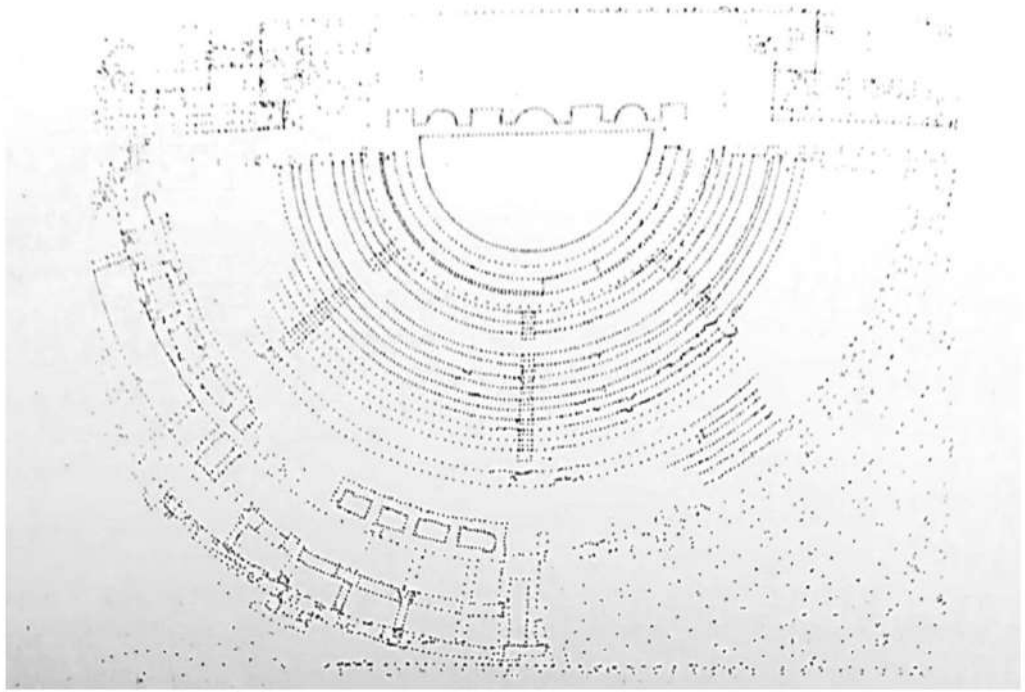
Nowadays, topographic devices are used, called total stations, infrared-based apparatuses that, by means of a prism, allow us to obtain the three coordinates of the point where the prism is located and automatically collect them in an attached computer, with a capacity up to 8,000 points.

Technicians setting up the prisms

Total station in the cloister of Santa María de Sasamón

TOPOGRAPHIC SURVEY

Using a total station was made at the end of the 80's this survey from Italica's Roman Theatre. The drawing consists of 12,927 points located in space. At present, there are stations that allow obtaining points without the need for prisms.



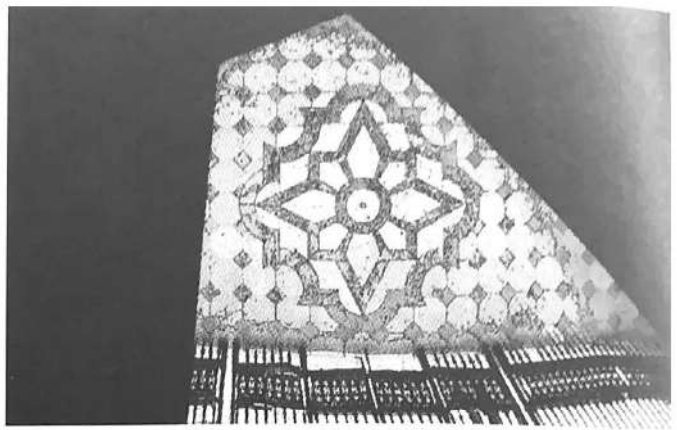
Cloud point collected with a total station on the Roman Theatre of Italica (1990-91)

PHOTOGRAMMETRIC RESTITUTION

Photography provides a large amount of information about the geometry, decorations and textures of a building, but it is not a document that we can measure. In the case of photographs of flat surface objects, such as a facade, we can obtain, through photographic restoration, an image that preserves the angles and distances of the original object. In other words, this methodology allows to eliminate the deformations that photography imposes on objects, provided that they are flat or decomposable elements in planes.

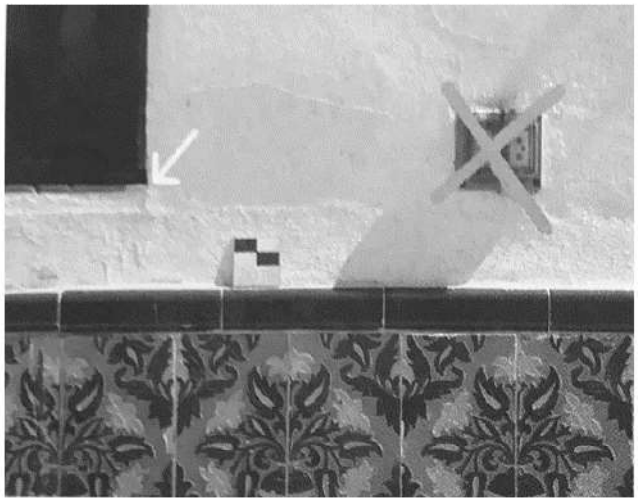
PHOTOGRAMMETRIC RESTITUTION

In the restoration the vertical lines, which converge strongly in the photograph, return to recover their parallelism, while the frame of the photograph, which is presented as an orthogonal rectangle is transformed into a trapezoid.



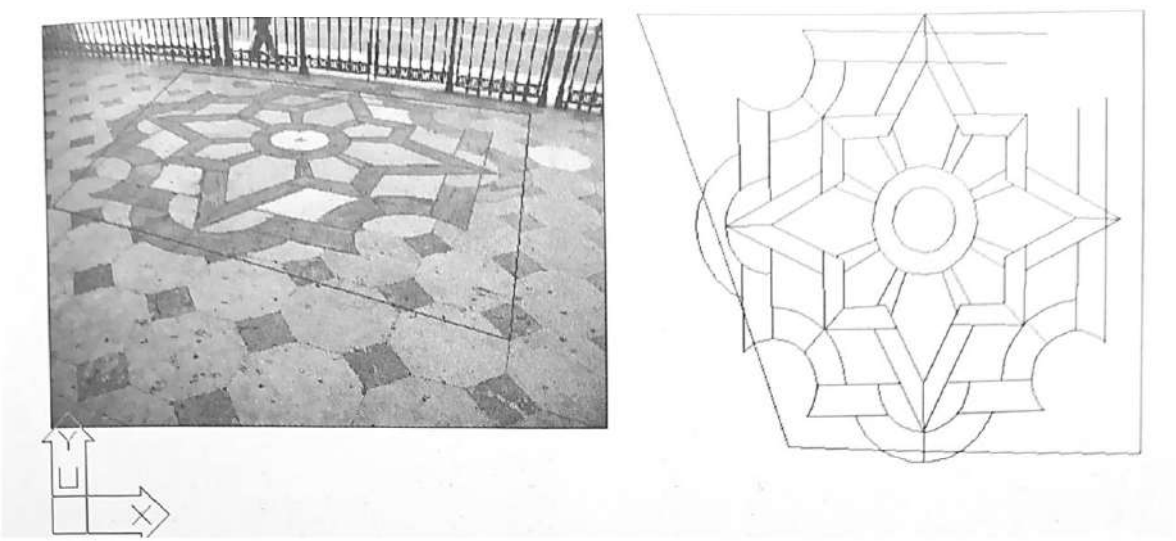
PHOTOGRAMMETRIC RESTITUTION

In order to carry out the restitution of an image, it is necessary to clearly define the points of support (or rectification, control or calibration), at least four of them. The points must be clear and unequivocally locatable in the image as in reality. From these points we must know its exact position, either with measurements triangulated with a tape measure or with the support of a total station. They should also preferably be end points of the object, as far apart as possible, for greater accuracy.

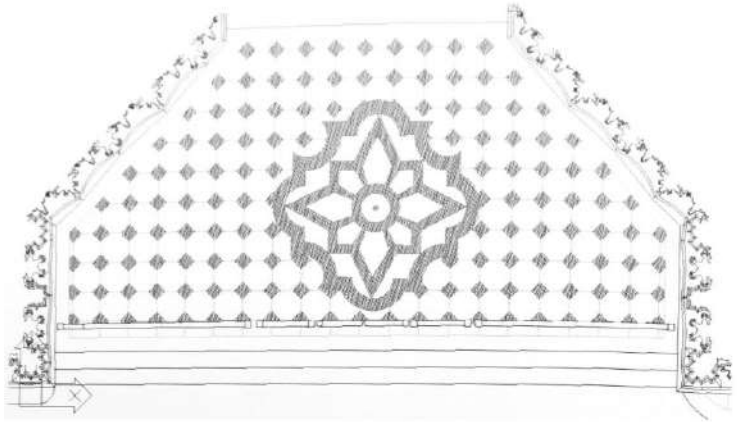


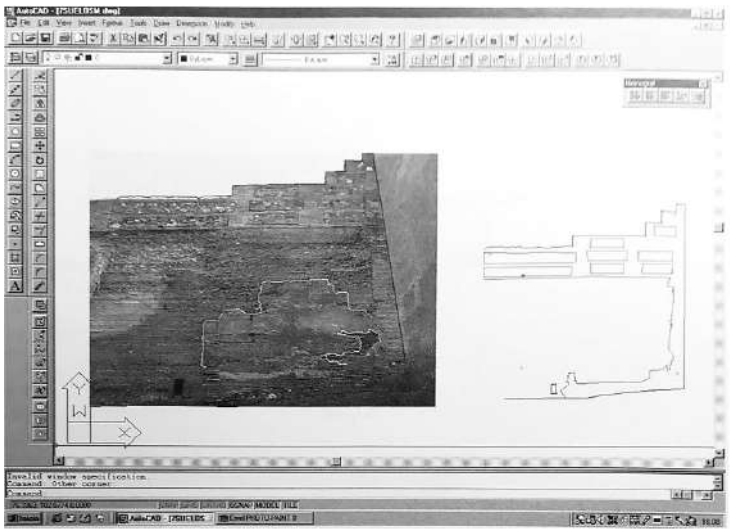
PHOTOGRAMMETRIC RESTITUTION

With the help of the corresponding software (rectification programs or plugins) we will point out the support points on the photograph, assigning them the Cartesian coordinates that correspond to them in reality (x, y). The program will distort the image until a rectified photograph is obtained. There will be inaccuracies in the objects of the photograph that are delayed or advanced. With the help of CAD programs we can perform the survey of all the details gathered in the image: materiality, state of conservation, complex ornamentations, paintings, etc.



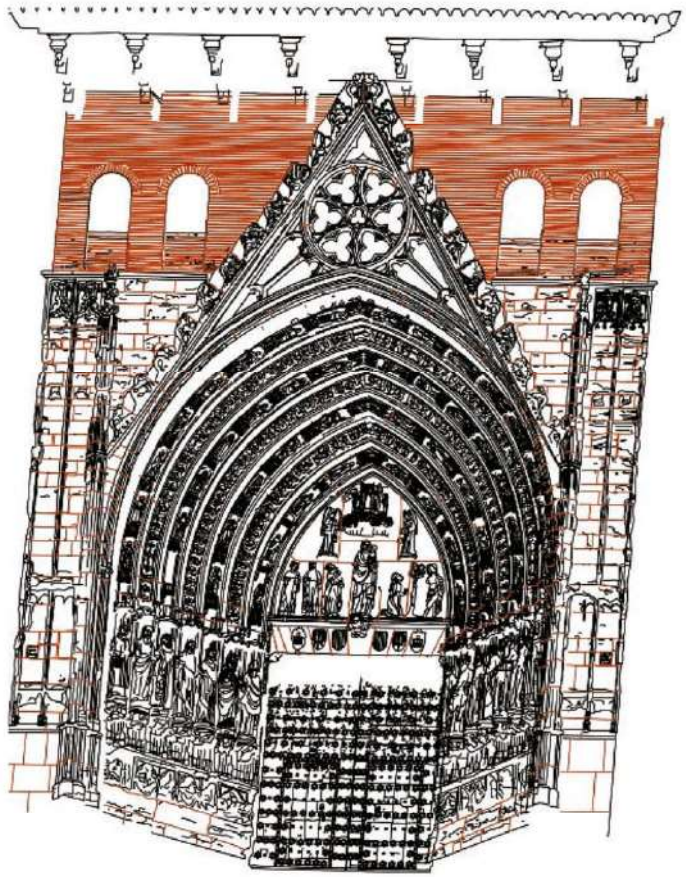
PHOTOGRAMMETRIC RESTITUTION





STEREOGRAPHIC PHOTOGRAMMETRY

Photogrammetry as that technique that allows to measure objects, buildings or the same terrestrial surface, from perspective images obtained by photographic procedures. It is based on the principle of stereography, that is, the use of two images of the same object, but with different perspective and, therefore, with two different projective beams. The intersection of these two beams will allow us to know the position of all those points that appear in both photographs. The result is a cloud of accurately situated points, which can be used as the base for the survey.



STEREOGRAPHIC PHOTOGRAMMETRY

Photography is an automatic system for recording perspective images. The perspective, as a centered projection representation system, is the result of the intersection with a projection plane or image plane, of the beam of directions generated by joining the points to be represented with the projection center. This means that if we have a photographic image and we know the relative position of its projection center (internal orientation), we can reconstruct the projective beam and with it the addresses of all the points that appear registered in the picture.

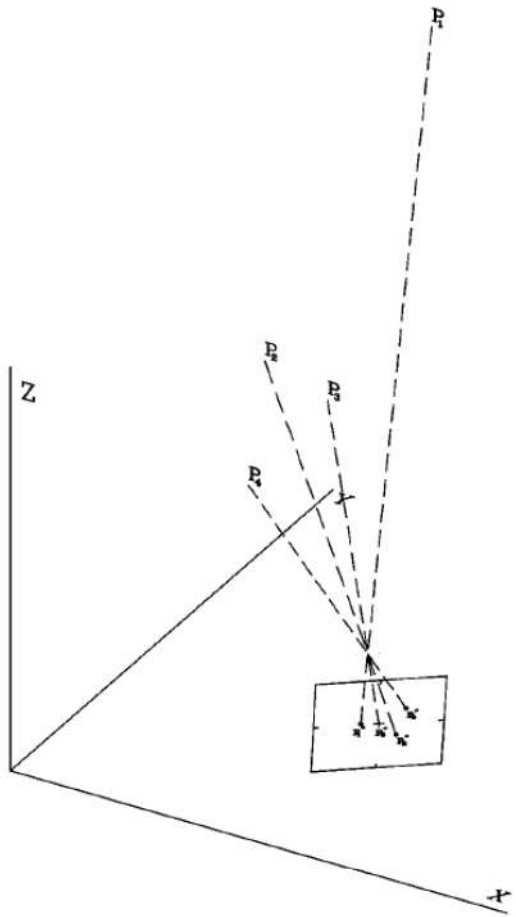


Fig21.tif

STEREOGRAPHIC PHOTOGRAMMETRY

With a single image, that is, with a single beam of directions, we can not determine the position in space of any point, unless we know some other data, such as belonging to the same plane perfectly defined in its situation and orientation . But if we use two perspectives, or two photographs, taken from two different points, we will have enough data to determine the spatial position of all those points that are visible in the two images. It will be sufficient to determine the intersections of the two projective beams as we do with theodolite measurements obtained from two stations.

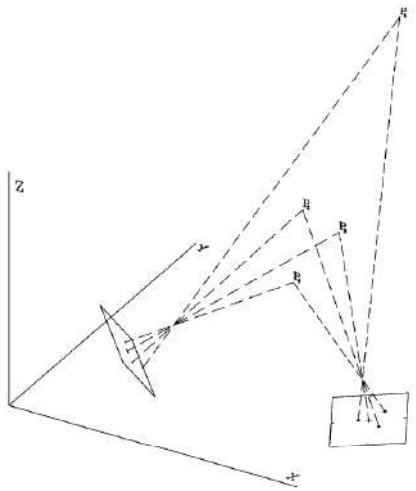
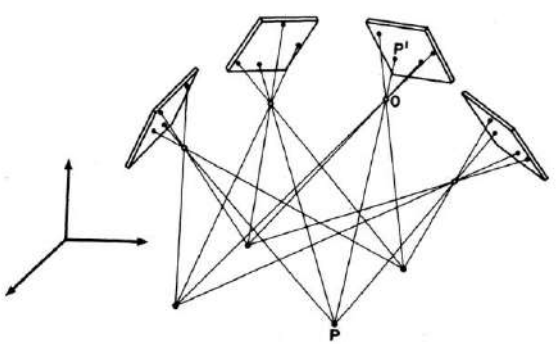


Fig22.tif



Restitución espacial de un objeto por medio de haces de rayos fotogramétricos
P punto del objeto P' punto de la imagen O centro de perspectividad

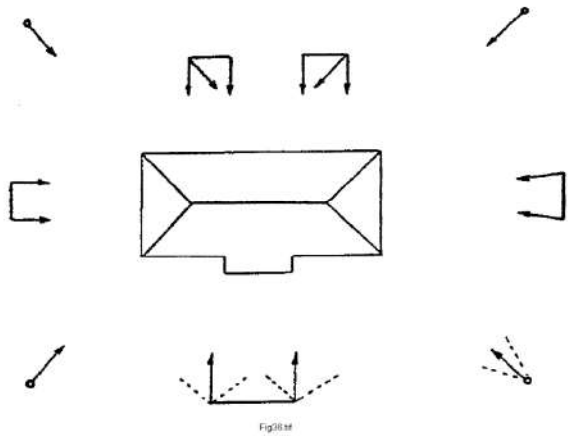
Fig33.tif

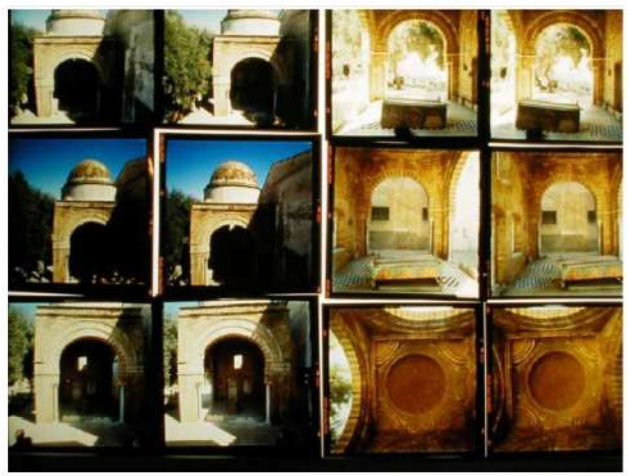
STEREOGRAPHIC PHOTOGRAMMETRY: PROCESS

Photogrammetric survey only requires a camera, a computer and measuring tape. Previous tasks: calibrate the digital camera, use preferably a monofocal objective and write down its geometric characteristics of the lens.

1. Fieldwork. There are two different tasks involved:

- To take photographs. They should be taken as a series of overlapping pictures, correctly focused and well-contrasting. Its important to capture easily identifying points, such as marks, corners, angles, etc. An excessive deformation (convergence) of vertical or horizontal lines should be avoided.
- Anchor point. These should be easily identified and far the one to the other. They should be set in a sketch as well as the distance between them following trilateration rules.





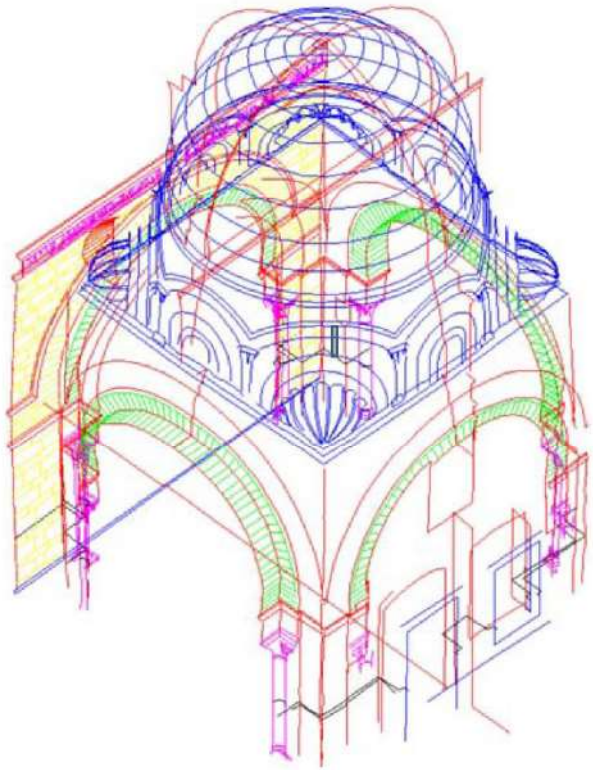
Survey of the qubba-mausoleum of Sidi Bu-Jrisan (Tunisia)

STEREOGRAPHIC PHOTOGRAMMETRY

3. Studio work.

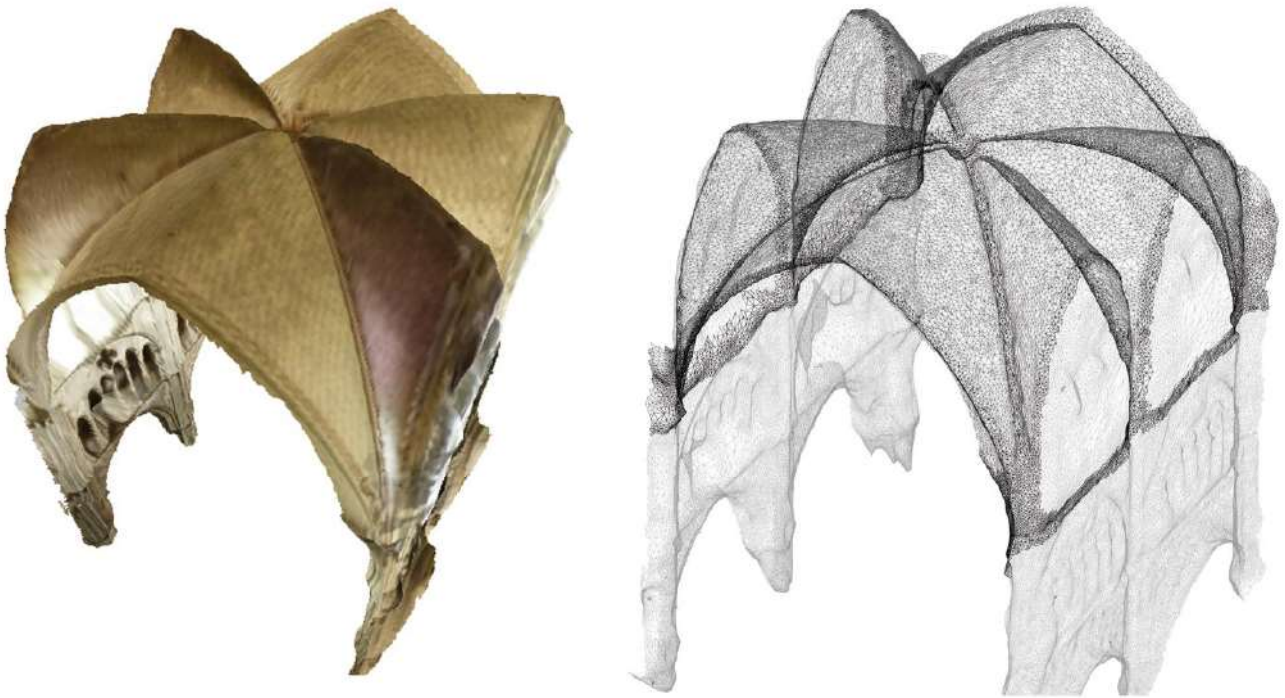
We will use some restitution software, introducing the camera calibration and the photographs taken.

- Point selection. In order to set the 3D position of a certain point, we will identify it in every photograph it appears. We will repeat this process with every point we need. There is some available software which can detect this point automatically.
- Identification of anchor point. Having selected these points, we will introduce its cartesian coordinates.
- Computer process. The program does the calculations to place the points. The result will be a cloud with the selected points. This method gives a precise information about the 3D geometry of the building. The outcome can be visualized as a point cloud, as a mesh, and as a texture mapped mesh, reproducing the aspect of the building.

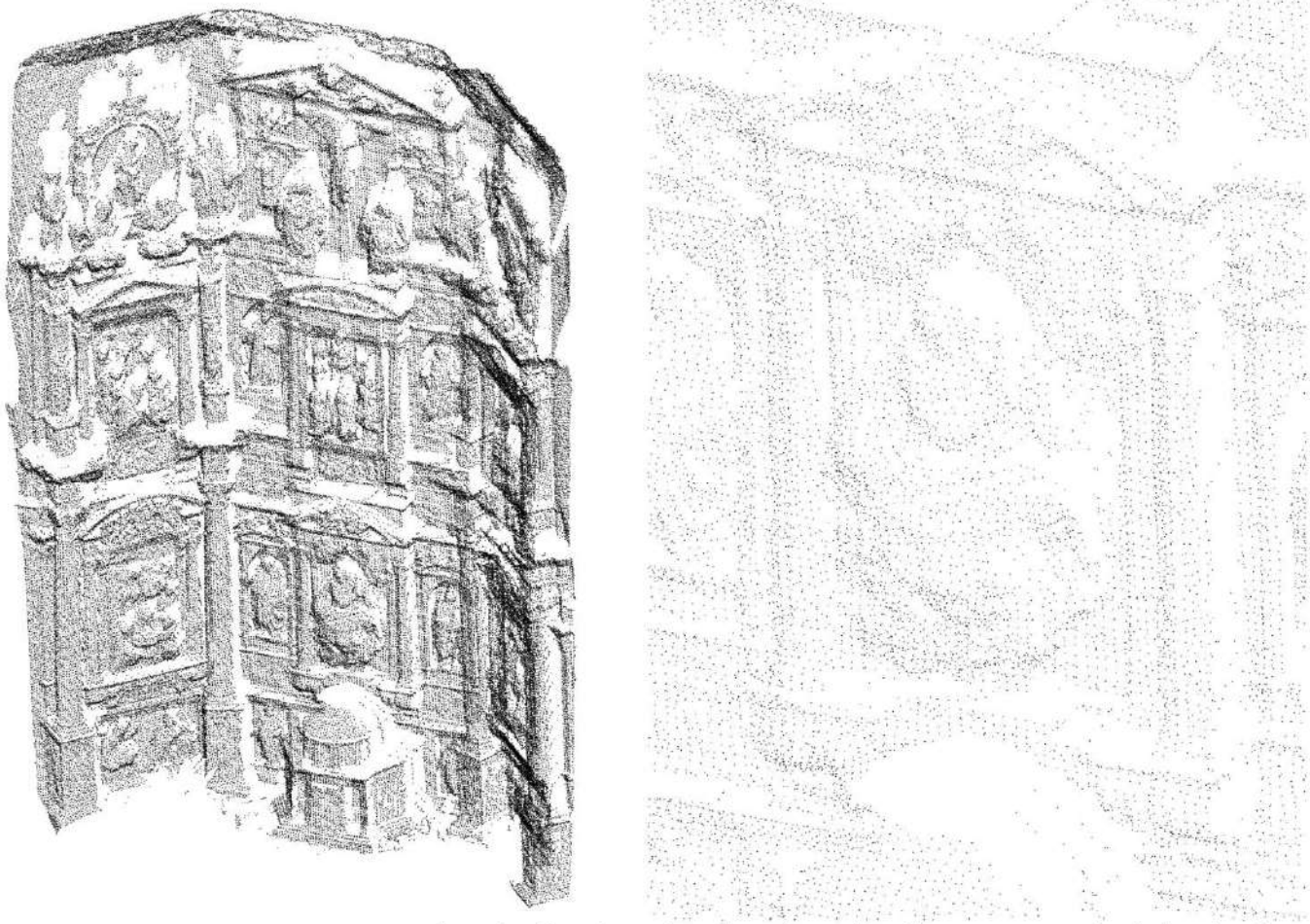


3D line drawing of the qubba-mausoleum of Sidi Bu-Jrisan (Tunisia)

The outcoming information can be displayed in 3D or used for the drawing of 2D documentation.



Survey of the sexpartite vaults of the Cathedral of Bourges (France). Made with 123D Autodesk Catch from convergent or multi-image photogrammetry. On the left photographic model, on the right triangulated mesh. Realization, Rocío Maira Vidal. Enjarje Arquitectura



Cloud of points in the church of Santa María (Alaejos).
General view to the left and detail to the right.

https://polipapers.upv.es/index.php/EGA/article/view/10937

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