

## Requirements for the Teaching of Photogrammetric Usable Recordings

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### ABSTRACT :

We know that photogrammetry is an efficient way for recording and a tool which enables us to show future generations lost treasures of art. With modern computer technology and the definition of the 3x3 rules of architectural photogrammetry it is possible to encourage everyone to participate in the documentation work. The first group which should be motivated is the young generation which will have to take care of the cultural heritage in the future.

In 1996, "Austria Nostra", an organisation for the preservation of cultural and natural heritage, used the 3 x 3 - Rules for a school project in Austria. Its aim is to involve the scholars into the task to preserve the cultural heritage of their school's neighbourhood. The promising results were usable photogrammetric documentations which built the base for further work with pupils. In co-operation with schools the Institute of Photogrammetry and Remote Sensing of the University of Technology works on a project which introduces the documentation of cultural heritage as a part of education. This affects subjects like history, mathematics and art and offers scholars the possibility to create a useful work for their future.

A centre piece of the project is a database which can be entered and searched via internet. That provides the possibility for everyone on any place to put information into the database and to provide a quick way to find a documentation when needed. A prototype of an "Architectural Photogrammetric Information System" named APIS was designed at the Institute of Photogrammetry and Remote Sensing at the University of Technology in Vienna.

In the future such an information system will be a valuable tool. It will be easy to search for information about an object, to find either existing plans or at least photographs offering the capability to create new plans. There will be various further applications feasible such as time related studies to find environmental effects on certain objects, to detect changes, to compare old and new for judgement of the development. Information interesting for tourism, historians or politicians. This can be a way to focus the mind of many people on the importance of the cultural heritage and encourage them to be a part of the "conservation team".

The paper will show the structure and management of a school project in Austria using APIS - Architectural Photogrammetric Information System.

### 1. INRODUCTION

It is a fact that only a small part of mankind's architectural historical heritage is documented. Most of the work is done by professional recording teams with limited capacity facing increasing loss of valuable objects. The reasons which entail damage or demolition are manifold and greater in this century than ever before. Increasing pollution as well as crowds of tourists cause decay of structures. Destruction of cultural heritage in wars, accidents like fire or floods and all cases of art robbery show that documentation is vitally important. Obviously reconstruction can only be done if proper documentation is available. Art robbery needs documents to proof which objects found in museums or private collections have been stolen.



Loss of heritage in Nepal (Art, April 1986)

Without any documentation cultural heritage gets lost without recognition and without a chance to show the next generation interesting parts of their history.

Within the conservation field the use of photographs was focused on the image as a tool for the representation of the real world. During the last decades the demand for a measurable image of reality grew remarkably. Since the middle of the 19th century photogrammetry has been used for recording architecture. Still the percentage of photogrammetric documented objects is very poor. The technique and methodology of photogrammetry could only be used by a few specialists using metric cameras. Modern computer technology enables photogrammetrists to calculate the restitution of pictures taken by non - metric cameras. But further steps are needed to implement the use of amateur photogrammetry for the documentation.

Since the definition of the "3x3 rules for the architectural photogrammetric documentation" at the University of Technology, Vienna attempts have been made to implement amateur photogrammetry in conservation systems. The system "APIS Architectural Photogrammetric Information System" was developed to provide a platform for information and discussion about the documentation of cultural heritage. In co-operation with school and university classes the use of the 3x3 rules were tested to improve the explanation in the rules and the function of APIS. The work with the youth showed, which points will be additionally needed to emphasise the public to contribute their part to the conservation work. It is important to follow the requests of the interested amateurs raise their awareness of the importance of the cultural heritage. We have to consider

that those people will support our work in the field of conservation and protection of cultural heritage. So the methods for teaching useful of how to prepare useful documentation must be defined in a way, that people will easily understand it, will have fun in preparing records and at least can be proud of their work.

The paper shows the tools for teaching amateur photogrammetry and examples of their usage in the work with pupils and student.

## 2. PRELIMINARY PREPERATIONS

### 2.1. 3 x 3 Minimum Rules for Architectural Photogrammetry :

1988 Martin Brunner defined the minimum rules for photogrammetry. These rules conclude all steps which are necessary for a photogrammetric documentation using non metric cameras. The CIPA Karlsplatz Test showed that the use of non metric cameras with small format can obtain restitution results that are adequate for most architectural needs. But to get these results enough (minimum)control, proper pre - calibration or careful self - calibration is required. The 3x3 rules will ensure that an amateur photogrammetric documentation provides the information needed for a useful restitution. The rules have been written down in 3 chapters with 3 sub-chapters each, therefore called 3 x 3 rules:

#### 3 geometrical rules describe

- the preparation of control information (one distance and one plumb-line on each side of the object);
- the geometrical arrangement of photography (normal, diagonal and traversing shots in intervals specially explained as approx. 1/10 of the distance);
- the geometry of stereo-photography (normal case, exceptionally also convergent case).

#### 3 photographic rules explain

- that the „inner orientation“ has to be constant (no zoom, distance to indefinite or fixed);
- that the illumination should be soft (No hard shadows);
- that any film may be used with more or less advantage, but carefully cut and treated as the real document.

#### 3 organisational rules mention

- that proper sketches are necessary (ground plan and elevations);
- that a protocol should report about the object and the done work;
- the geometrical information to be prepared on the object,
- that care and final checks are required, on site as well as prior to archiving.

The rules as they where defined in the beginning were simple in terms of people working with photogrammetry or related disciplines. The next task therefore was to make them understandable for everyone. In our case especially for the use in the school project. At first the sequence of working steps has been tested practically and how a photogrammetric documentation with the 3 x 3 Rules can be realised for example by people on holidays.

On a trip through Asia the rules where tested in four different countries at four quite different sites.

The objects chosen where :

- the temple of Changu Narayan close to Kathmandu, Nepal,
- the temple Kandhariya Mahadev at Khajuraho, India,
- the tomb of Jehangir at Lahore, Pakistan and
- the Ghara Khelisa, an Armenian church at the Turkish border in Iran.



Armenian Church Ghara Khelisa, Iran, Test-object

The objects where chosen because of their good accessibility, shape and size. The configurations where chosen to make the test relatively easy and to show that even more complex shaped objects can be documented. It took between 2 to 3 hours to prepare all sketches and control information and to take the pictures. As a result of the test a revision of the 3 x 3 Minimum Rules concerning the description of the planning of the pictures had to be done. Other points have been cut to short, significant explanations. To create a complete manual for a photogrammetric documentation of an architectural object, the rules where extended by a step by step instruction.

For the intended use in schools it was necessary to add more detailed descriptions with sketches and self-explaining pictures. The prepared manual was used for lessons in several schools to improve the practicability of the 3x3 rules in this form. In co-operation with teachers and pupils the rules were discussed. The most difficult part was to ensure that the pictures made will provide stereo restitution. That concerns especially the geometrical part of the 3x3 rules. The experiments with the scholars showed that the explicit description of the making of stereo pairs seemed confusing. So these points have been re-written. The importance was focused more on the making of overlapped pictures than on the planning of stereo pairs.

The revised 3 geometrical rules read:

- Prepare minimum control information (one distance and one plumb-line on each side of the object);
- Look for a good geometrical arrangement of photography (normal, diagonal and traversing shots)
- Take a picture every 1 to 2 step depending on the size of the object (take care that the pictures are at least 60% overlapping).

In addition to the technical photogrammetric part of the documentation a form was developed which helps to make a simple but useful description of an object. The form was developed in co-operation with scientist and conservators who will be users of the collected material. The manual for the pilot tests and the revised rules where basis for a handbook which was prepared for the attending of the school-project. The book further contains a brief history of photogrammetry and an introduction into conservation. For the use in the field an extra card containing the checklist of the steps for the photogrammetric documentation and the points of the conservation-form is added.

This handbook will be the first tool for the implementation of practical conservation in education.

## 2.2. Information - System and data base

### 2.2.1. Main tasks

The aim is to provide a tool for the practical organisation of useful information for the preservation of cultural heritage. That needs to build a link between people who are interested in contributing their part for conservation. The information system will provide the information on the making of an useful documentation of an object, especially its photogrammetric recording. Further demands are the administration of the collected material and the bridge to those professionals who need and use it. An important part is the link to photogrammetrists who can use amateur-photogrammetric documentation in order to prepare materials for the renovation or restoration of objects. The most effective way is to install an information system which is accessible via internet.

A possible solution for these problems is realised with "APIS – Architectural Photogrammetric Information System" which is situated at the internet server at the Institute of Photogrammetry and Remote Sensing at the Vienna University of Technology. The internet-site [www.apis.org](http://www.apis.org) provides the access to a database where information on objects of cultural heritage and available documentations about them are stored. It includes the description of 3 x 3 Minimum Rules for Architectural Photogrammetry and a detailed step by step instruction for the realisation of a proper documentation. The site provides examples of used documentations and links to photogrammetric institutes which can handle non-metric pictures. Especially for the use in schools it provides a discussion-platform where information and experience can be exchanged.

APIS will help everyone who wants to work out a documentation of an object. It provides hints on how to take useful pictures and investigate good information about the documented item. So it makes collected data available for those, who will need this information, independent if this need is actual or will occur in the future.

### 2.2.2. Content of APIS

APIS provides a service for those who want to make a useful documentation.

People interested can

- copy the instruction for a proper documentation,
- ask for help,
- join the discussion about the conservation work,
- find photogrammetrists who can handle their pictures,
- read more about photogrammetry and conservation of cultural heritage,
- find links to related internet-sites,
- see examples of already used photogrammetric documentations,
- provide others with the information they collected by data input into the database. The latter is nothing but a systematic filling in of data sheets.

But APIS also provides facts for people who need material about objects.

They can

- search the database for a special object,
- get historical and background information,
- find people who could have material,
- find the archive which administers the needed

- photogrammetric documentation and
- people who can handle them.

The most important part of the information-system is the database which administers the information about the objects, documentations, plans, the archives and the photogrammetric institutes and offices.

### 2.2.3. Content of the database

The database is administered by "Basis *plus*" a software product by IDI, Information Dimensions Inc., Dublin, Ohio, USA, specially designed and used for text document management. It is used also by the „Canadian Heritage Administration". Most of the information provided by APIS is in form of text. Due to the still very slow data transfer possibilities it would not be practicable to save the scanned or digital pictures of all photogrammetric documentations themselves. But with the increasing power of internet-connections this might be changed. Nonetheless it is possible to insert other digital information about an object into the database like video or music documents. The administered data is divided into four main parts in an object list, a protocol list, an archives list and the plan list.

In the **Object list** address or geo-reference are collected, the names of persons to contact if necessary, and all historically relevant information like the year of construction, the style, involved artists and any stories which concern the object and its surroundings. This information can be enlarged by either available digital documents or links to other net sites which are of interest in relation to the object. It also provides links to other databases which could contain relevant information. Finally the object list contains information on the number of documents, photographs, plans already available, and each document leads to the protocol list which contains the detailed data about the document itself.

The **protocol list** includes the information on the photogrammetric documentation available for this object. Each documentation is described by the date of the shooting, the information on the camera and the films used, the description of the place where from the photo has been taken and, most important, the name of the archives where the pictures and where copies of them are being kept.

Detailed information on the actual photo-archives are collected in the **archives list**. It contains the address of the archives and who has to be contacted, or which conditions have to be fulfilled to get copies or pictures.

Similarly the **plan list** contains details about existing plans, maps, etc. and the name of the respective archives where plans are available. The plan list also shows the relevant addresses and the conditions under which the plans or copies thereof can be received.

### 2.2.4. Administration of APIS

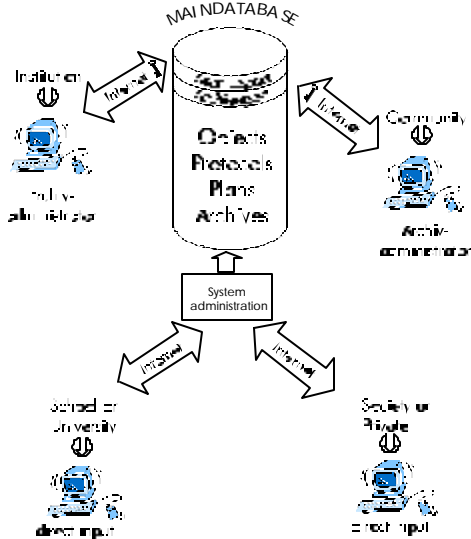
It is not intended to establish a central archive for photogrammetric documentation. So the main task of APIS is to co-ordinate many local archives which are situated in schools, in communities or other places where societies or people are interested to participate in

this preservation project.

Everyone who does a documentation should feed the system with the information about it. This can be done either via internet.

All incoming material will be first checked automatically by the data management system. Results of this check have to be revised by a system administrator who is also responsible for the update of the homepage and all information APIS provides beside the database.

A local archive can have its own authority. The archive administrator gets a key word which enables him to maintain the part of the data which concerns his archive.



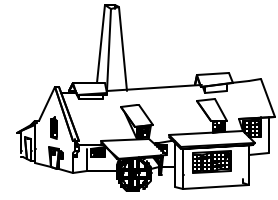
Administration of APIS-database

### 3. Teaching Conservation and Photogrammetry :

#### 3.1. Preamble

The pilot project for the implementation has been made in 1996 by an society in Austria which started a school project with the title "Das Alte erhalten - Die Zukunft gestalten", means "Preserve the old - shape the future". The idea of this project is, that pupils look for cultural or natural objects in the vicinity of their school which are worth to be preserved and possibly endangered in their existence. One of these objects should be documented and the historical meaning and importance for the environment should be investigated and evaluated. 300 schools participated in the project. The results are manifold and cover various aspects of preservation.

One of the examples was a stereo-photogrammetric documentation of an old smith's-shop. Schoolgirls of an agricultural technical college took pictures of this house which is now used as a museum. The 3 x 3 Minimum Rules were applied, and support had been provided by staff of the Vienna University of Technology. To prove the quality of the pictures they were used for a restitution by students of the Institute of Photogrammetry and Remote Sensing. The results showed that the photographs can be used to get a plan at an accuracy between 2 to 5 cm, good enough for many needs.



Object of a school project: An old smith's-shop in Lower Austria

The school received an award by the Ministry of Education and Arts which started the initiation of further activities in schools. A new school project is defined which will be the begin of the implementation of conservation and photogrammetry as a part of education. The project will be co-ordinated by the society Europa Nostra Austria. The society has been founded as an exponent of Europa Nostra in 1998. Its aim is the support of preservation of cultural and natural heritage in Austria. Its activities focus on research, adult education, scientific and artistic instructions, documentation, publications, etc. for the protection and the care of cultural as well as natural heritage.

#### 3.2. Schedule of a School-project

The first work has been done by creating the handbook. It can be used as an introduction into conservation and the meaning of photogrammetry. The step by step description and the form for the description of an object of cultural heritage will be used as the manual for the preparation of a useful documentation.

The project encloses several aspects of education, such as history, mathematics and art. Involved teachers will be invited to seminars. They will receive an introduction into the subject and will make their own documentation. Besides the documentation work the use of APIS will be explained. As shown in the first part of the paper APIS administers the incoming material and provides the platform for discussion, help and exchange of experience.

At the first stage the scholars are supposed to make up a list of objects and describe them using the given forms. The class then compiles a guideline for their search with regard to the history and development in the vicinity of their school together with the teacher. For their survey the scholars should be given a free hand.

Based on the collected data an object is chosen combining all relevant subjects to be recorded amateur photogrammetric. After the documentation the data are collected in APIS and the photogrammetric documentation will be sent to the centre of co-ordination. At this centre the quality and completeness of the documentations will be tested. In co-operation with a group of experts who could use these documentations the results will be discussed. The best result will be rewarded and presented via APIS.

Finally all participants and experts are invited to discuss the results of the project in a questionnaire and a discussion-forum via internet. A summary of this discussion and results of the project will be sent to all participants and presented via internet.

#### 3.3. Using the Documentation Tools for the Work with Pupils and Students

### 3.3.1. Lesson about building up a building inventory of a town

In this lesson held on the Institute of the History of Art, the Protection of Monuments and Archaeology of Industrial Buildings in co-operation with the Municipal Department for Architecture and Urban design Vienna. The task is to re-search the history of the building with all its details from the beginning, all changes and the state of the art.

The results are collected in a database administered by the municipal department, which is linked with APIS.

Additional the object is recorded pictorial using the 3x3 rules of architectural photogrammetry.

The discussion after the work showed that most of the students don't have a sufficient knowledge of the handling and the parts of the cameras they used. That is a result of the easy to use automatic cameras which are of common use.

It was also difficult for some of the participants to imagine the needed overlay of the single pictures.

The conclusion is again that the 3x3 rules can just be used after an adequate overview about photogrammetry and the techniques of a camera. It is also very important to point on the circumstance, that the cost of pictures is very low. So the number of picture can't be shortened by the economic factor. The highest priority has to be laid on the completeness of the documentation. Which is difficult to obtain, especially in consideration of all obstacles existing in an urban environment as shown in the picture.



Inventarisierung object Vienna

### 3.3.2 A class re-designs the wall of a church

In this example the photographs were used to find and show the future painting of the wall of a church.

Pupils of a high school made pictures of the church, which were used to prepare an orthophoto. Pupils used the orthophoto as the base for their design of the wall. The community was invited to select the future layout of the wall by sending picture postcards which were made from the drawings of the pupils and applied in the church.

Perhaps this church is not an example of a classical historic cultural monument. But the project showed, that the youth is very interested if they get the possibility to create their build environment. The use of the photographs facilitate their work. In that way this pupils got an insight into the use of photogrammetry in a basic and understandable way.

The conclusion of this project was that simple examples can emphasize the co-operation of the youth. It raises their attention for their build environment and could show them how they could involve themselves into the decision making process in their community.

Re-design of a church wall



## 4. SUMMARY

To introduce the public and especially the youth into the protection and conservation of cultural heritage gets more and more important. We have to emphasize the group of interested people to contribute their part to the recording of monuments, before a lot of them get lost without being documented in any way. To implement the protection of cultural heritage as a part of education will help to raise the awareness of the public of the value of their historic build environment.

We have to show that architectural heritage consists not only of our most important monuments: it also includes the groups of lesser buildings in our old towns and characteristic villages in their natural or manmade settings.

For many years, only major monuments were protected and restored and then without reference to their surroundings. More recently it was realized that, if the surroundings are impaired, even those monuments can lose much of their character. Only with the help of the public this can be prevented in the future.

The architectural heritage is an expression of history and helps us to understand the relevance of the past to contemporary life. This heritage should be passed on to future generations in its authentic state and in all its variety as an essential part of the memory of the human race. Otherwise, part of man's awareness of his own continuity will be destroyed.

Therefore the architectural heritage has an important part to play in education. The architectural heritage provides a wealth of material for explaining and comparing forms and styles and their applications. Today when visual appreciation and first hand experience play a decisive role in education, it is essential to keep alive the evidence of different periods and their achievements.

The survival of this evidence will be assured only if the need to protect it is understood by the greatest number, particularly by the younger generation who will be its future guardians.

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