CASOB

Simultaneous Surveying and Drawing

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Accurate planning and economical building within an existing structure require a complex building analysis based upon detailed scale plans. Work has shown unsatisfactory of measuring tools:

1. Recording of measurements with meterrule and measuring tape often results in mistakes and wasted time. Since the data is not digitized the measurements cannot he used by a CAD system.

2. Commercially available CAD software is made only for new planning but not for planning with an existing structure. Up till now architects who predominantly work with existing structures were not able to take advantage of products in the software- and hardware market which would satisfy their needs.

   The problems already begin with the search for appropriate tools for the surveying of existing structures and the simplest possible transfer of the data to a CAD System.

   There is an increased demand for quality surveying of existing structures. In Germany, far more than 60 % of all construction planning is related to existing structures. Due to the special situation in the five new states this percentage will grow significantly. Other countries will find themselves in a similar situation. A large number of precise and analytical surveys of existing structures will be needed in a relative short time. Time pressure and stress factors at construction sites can for quality planning and economical construction which can only be accomplished with reliable and exact surveying of structures.

Frustrating experiences in the field have led me to develop systems for the surveying of existing structures. With CASOB (Computer Aided Surveying of Buildings) we have a tool today that simultaneously surveys and creates a CAD compatible drawing.

In addition we make use of the stereophotogrammetry with analytical evaluation (see facade-plan, New castle at Herrenchiemsee, Foil 1).

This development began with the so called analytical measurement in the field of historic preservation.

The results are:

- pencil drawings on construction paper or foil;

- heavily darkened plans with dense contents due to the demand: write all information in one plan;

- many levels of different informations, which are hard to read and to interpret. (Foil 2, manual drawing, Castle Straubing, longitudinal section).

To create such drawing requires considerable know how and time. A scientific evaluation is almost impossible. Due to the limited handling of the originals, (reprography of all kinds have considerable information deficits) the limited data structure and the impossibility of calling up selected information, computers can not be utilized, not even with the new scanning technology.

Manual surveying requires a great deal of knowledge, not just for the surveyor but also for the planner when reading these plans.

Therefore it is better not to use surveying engineers to survey existing buildings. Their knowledge in the architectural and construction field is limited. Nevertheless the basis for qualified surveying of existing buildings has to be the geodetical measuring network. Only with a three dimensional measuring network can you measure points with its 3d coordinates. This is the only way to measure, recognize and represent a deformation of a building.

Boring routine work with many repetitive stereotypes call for the use of a machine that makes work easier. In developing a new system the following demands should be addressed:

1. The respective engineer of a specific field should be in the position to handle the surveying system.
2. The process of measuring has to be faster and simplified.
3. The drawing of the measured data with high speed and accuracy ought to be automatic.
4. The measured data have to be available at any time for different applications.
5. Free points, for example vaults, roof-trusses, stairs, facades, roofs or landscape formations should be fast determined without additional aid.
6. Also distances of 100 meters and more should he measurable without loss of accuracy and without additional expense.
7. The measuring should not to be done by hand.
8. Everything from details of buildings to entire neighborhoods should measure with equal ease.
9. Information related to a room should be automatically transferable into a building log-book.
10. Repetitive elements should be insertable in the drawing by match point determination.
11. The system has to be flexible and easy to handle.

What is needed is a tool which generates a CAD processed drawing of the inventory, which meets the standards of measurement accuracy, reliability and density of information (as established by the analytical measurements of structures).

Today only the use of computers can meet all the above mentioned requirements. Many of these requirements are met with CASOB. Others are in the developmental stage.

The use of CASOB

The following information shows the possibilities to digitalize existing buildings with the computer aided measuring system CASOB. CASOB fulfills all essential requirements that should be met by todays surveying of buildings:

- minimal time for measuring;
- sophisticated recording of measurement;
- simple and easy in handling;
- immediate graphic data production during measurement;

- direct interface to common CAD software.

Finally CASOB is a tool, which can be applied for planning and building of existing structures. Consequently the CAD system is useful for all the related applications like building log-book, listing of established measurements, cost calculation and the building management.

System Components

The central sensor is composed of a common electronic theodolite coupled with an electronic distance measuring instrument(Foil *3).* ACASOB target laser is fixed on top of this standard instrument arrangement to identify the required point to he measured. This combination of instruments is connected to a laptop which stores the data and calculates and generates the first control graphic and later the CAD graphic.

Characteristics of performance

The new computer aided measure system CASOB can be used for:

- the digital measuring of 3d-Coordinates;
- the reading of data into a CAD System on site;
- the plotting of the measured plan on site without any CAD revision.

CASOB can measure 1.800 points a day. This depends on the number of instrument positions, the measure point density, the accessibility of points and the local conditions.

With one press of a button the theodolite triggers the measurement, calculation, registration and drawing procedures.

CASOB instruments measure with a precision tolerance of more than +/- 10 mm. The margin of accuracy between two points is less than 5 mm. With some training the results will even be more accurate.

Working method of CASOB

CASOB is a very exact and fast measurement technique. The drawing is prepared automatically and simultaneously with the measurement. The measurement data and the electronic drawing are calculated and stored in a Laptop computer. Data prepared on site can be drawn immediately with a plotter. The plan can be processed further with a CAD system. All consecutive CAD programs (like the building management program for example) may then be applied.

Five systems of measurement are available using the CASOB instruments:

1. Polar measurement with reflector

This is the standard measurement procedure. An electronic theodolite is coupled with an electronic distance measuring instrument. This instrument determines the distance, by measuring the time difference between transmission and reception of an infrared beam within the range of a millimeter. A reflector is positioned at the point to be measured. A CASOB target laser is fixed on top of this standard instrument arrangement and produces a visible red beam identifying the required point to be measured (also applicable in the following procedures 2, 3 and *4)*.

This method is suitable for the majority of measurement tasks. All standard measurements are possible with equipment which is available on the market with the exception of the CASOB target laser.

2. Polar measurement without reflector

The electronic distance measuring instrument which 1 described A just now should be exchanged with one that works without reflectors (timed - pulse electronic distance - measuring instrument). This method is applicable only in exceptional cases in surveying, because exact measurement of comers and edges is not possible.

3. **Intersect procedure with two electronic theodolites**

The basis of the two theodolite positions is known. The horizontal and vertical angle of the point of intersection of the theodolite tuget axis is calculated. (Otherwise as described under I.)

This method is suitable for extremely precise measurement of points where access with reflector is difficult (for example a church spire).

4 . Intersect procedure with an electronic and a graduated dial theodolite

This application works as 1 talked about before. The angle measured in this case by the scale reading theodolite is transferred manually. The investment costs are less. In most cases only a few points which cannot be reached with a reflector have been observed.

5. Definition of a "Durchstoßebene" and the measuring of points on it with a theodolite (will he available soon):

A horizontal or vertical plane is defined with at least three points using one of the above described systems of measurement. Subsequently the position of the respective point to be measured in the plane is solely determined by measurements of angles. 7be continuing procedure follows the first method.

This method is the opposite of the others described in 1 - 4; it is hard to control and less accurate, because the plane is not exactly defined by actual fixed points. While using this method caution is suggested.

CASOB freely permits switching between the 5 methods without program interruption. The simplified measurement proceedings do not require any particular skills in geodesy. This is the CASOB "philosophy":

different specialized fields (architecture, archeology, civil engineering etc.) make use of a measurement and drawing system which requires no further qualifications in a foreign discipline.

Procedures

First a local measuring grid is established, if at all possible orthogonal to the principal face of the main building. We have to establish a hierarchy of measuring points. There will be a main point from which positions of instruments on all levels inside the building are determined. From all these points measurements are taken, which are translated into an drawing (see Foil 4).

The operator has to decide how much and what he wants to observe with CASOB, what he or she wants to supplement with CAD and whether or not manual additions make sense (Foil 5, Entrance door; Foil 6, Franciscan monastery Landshut, drawing in ink; Foil 7, Franziskanerkloster Landshut, drawing in pencil, completed by hand). A In a second passage of the building a graph with all the relevant measurements will he completed on site with a Laptop by using a CAD program. In the office the measurements will be added and the plan finished.

In the field of historic preservation, a plot of the plan by A pencil is often required, so the plan can be expanded on site by historic building information. The reason for this procedure is that the eye-hand-coordination is still by far the best tool to transfer detailed structures and drawings. Sensor technique and CAD-systems won't he able to offer a better technology in the foreseeable future.

Program "comfort"

The CASOB - surveying- and drawing program has many functions and options which make work easier in surveying technical components as well as in graph control. For example:

1. Surveying technique: to position and setup the Theodolite takes less than 15 seconds. This fulfills all the geodetic requirements.

2. Graph control: Vaults and arches are commonly shown in the ground plan as a dotted curved line. One single command is sufficient to match the edge of a header, or to show the arch and both dotted lines (Foil 8).

Data output

CASOB produces plans in any required form:

- tables of single points in ASCII-format;
- drawings to any desired scale and media, including graphite.,
- detail drawings as well as drawings of large areas.,
- digitized plans and data stored on disc or tape.

Data base

CASOB has its own data base where all measured information is stored. The correction program use the raw data as they were recorded by the theodolite. A new file is opened while the original data remain intact.

Interface

All standard interfaces result in structural changes and are interpreted in different ways by different CAD software programs. Therefore, we decided to write for every CAD software a suitable interface-program. The expense is relatively small and the CAD manufacturers are very cooperative. However. the realisation of STEP 2 DBS would be desirable in the near future. The interface transfers the CASOB data files with five columns including a code with the CAD- and building informations (Foil 9).

Areas of applicability

Surveying with CASOB is worthwhile where existing structures have to he transferred onto graphs/drawings (Foil 10) such as:

- surveying of real estate;
- town planning;
- redevelopment of old buildings;
- historic preservation;
- archeology;
- renovation of towns;
- branches of geodetic surveying;
- tunnel construction;
- mining surveying.

With CASOB you obtain precise measurement results, immediate digitalization in 3D-coordinates and online graphics in the range of 0 - 500 meters.

CASOB does not compete with other known techniques as for example all photogrammetry - based systems. We use all commonly known systems including CASOB - depending on the needs or objectives.

CASOB however, because of its strength and versatility, has developed into a standard tool.

Advantages of CASOB

- All kinds of surveying and drawing of buildings can be done quickly, precisely and objectively with CASOB.

- CASOB is suitable for measuring building details as well as large objects.

- Labor costs are low.

- Houses can be surveyed with little effort creating hardly any inconvenience for the inhabitants. No furniture needs to he moved, because hidden parts of structures are measured with subsidiary points.

- With the five measurement procedures, the application of CASOB has almost no limitations.

- Little effort is needed for very accurate measurements.

- Multiple measurements to determine two different positions are not necessary, since accuracy for analytical purposes is high. WILD instruments are very reliable. The margin of error within the accuracy range given by the manufacturer. is often even lower.

- The accuracy in measurements provides assurance in the planning process.

- The strength of construction that commonly cannot he measured directly (for instance no opening can he found in a wall) can be determined with the above mentioned accuracy of less than 1 cm and without additional expense. This applies for ground-plans as well as for sections.

- All measurements are verifiable at any time.

- Fast and easy supplementary measurements are possible.

- There are no "forgotten" measurements.

- Plans once digitized can be added with little effort.

- All digitized data can be recalled simultaneously from terminals in different locations.

- The results of the measurements are CAD-calculated plans, the transfer of data to the CAD programs is guaranteed, even with DXF-Files.

  ... and in connection with CAD

- Plotting of original plans in any desired number and scale is inexpensive, accurate and fast.

- Through the layer technique, the contents of the plan may be stored on different "view graphs". Any combination of these layers permit plotting a variety of plans without redrawing.

- Completed project plans can be stored and preserved on floppy discs, tapes or hard drives.

- Access is given to the building log book, the established measurements, the cost calculation- and the building management programs.

- Plans can be extended or modified during and after construction.

CASOB has been proven extremely useful where common methods are insufficient, for example

- at large objects with many points are to be measured;
- at stereotype building elements;
- if high accuracy is required;
- where extension of the plan is necessary;
- where accurate building mass measurements are important;
- at short or long range distances;
- at large elevation jumps;
- where there are complicated architectural structures such as vaults and roof-trusses;
- baroque curvings or spiral staircases.

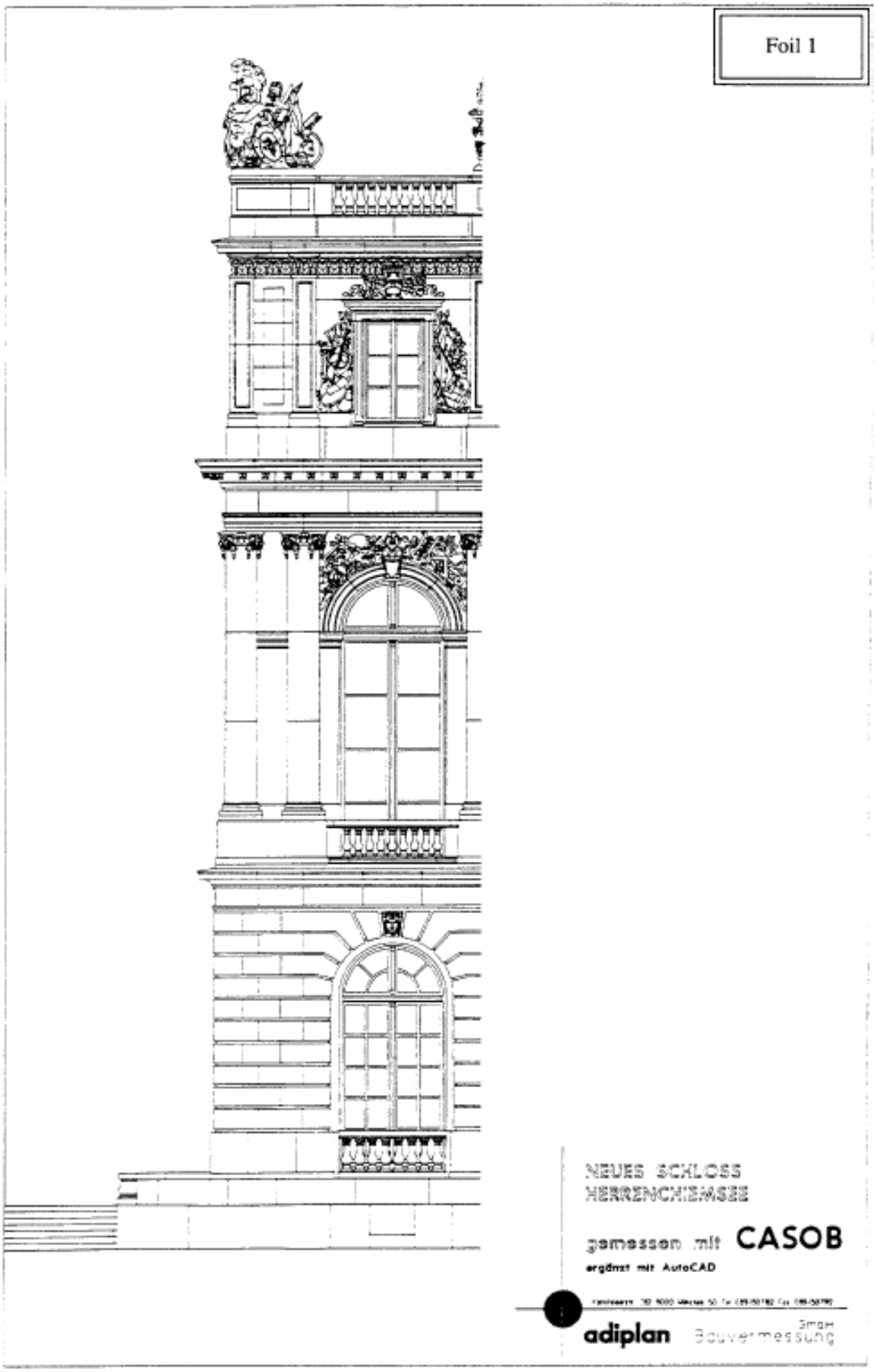
Log book

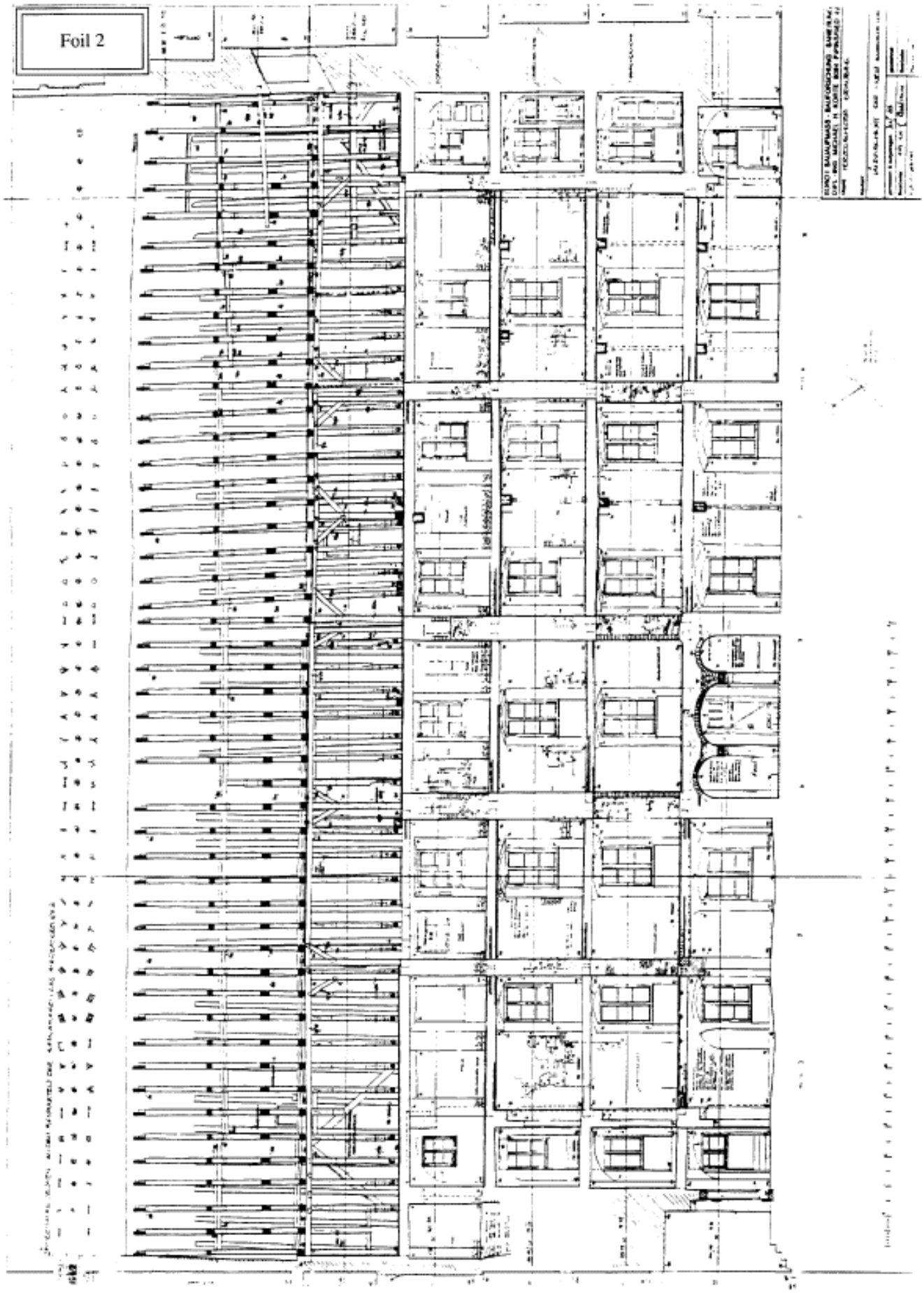
Quality recording in a log book is still unsatisfactory. This concerns in particular automatic processing of consecutive CAD software with the two way interfaces.

Our ongoing research informs us what the market has to offer. Standardized interfaces are urgently needed. We do appreciate any suggestions.

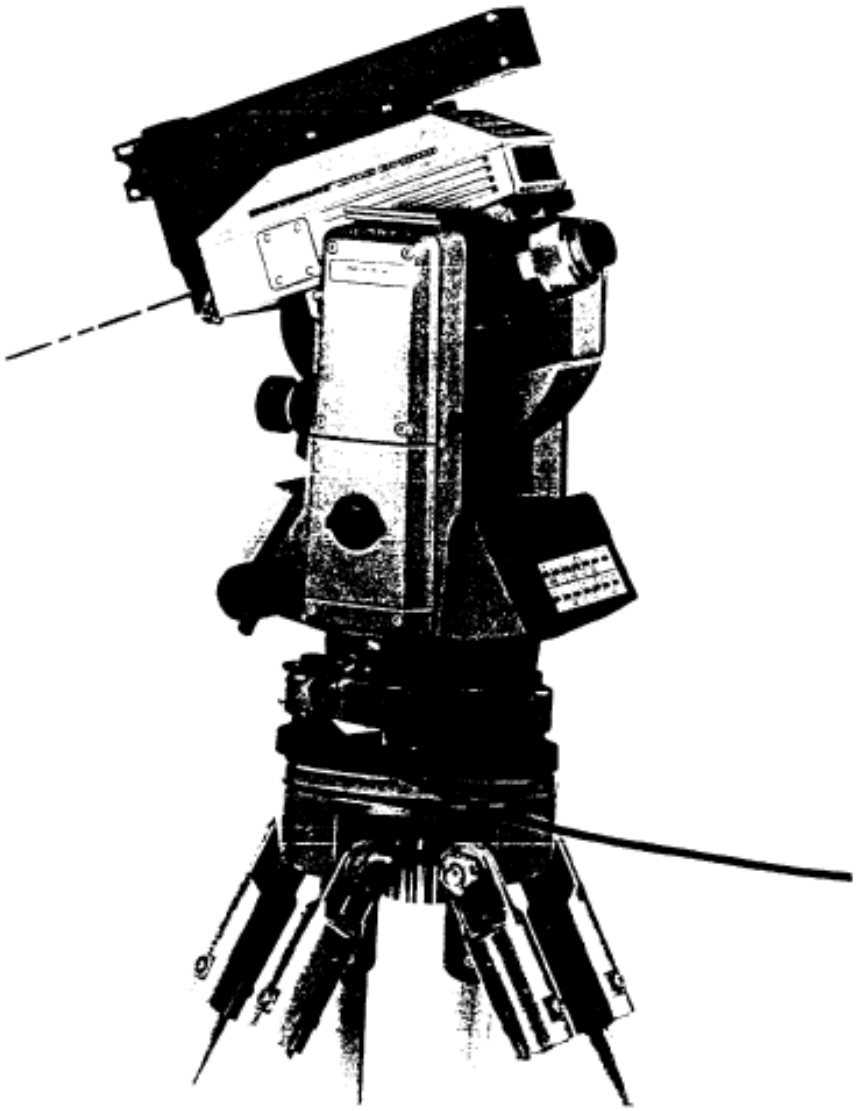
Future developments

The CASOB concept is tested continuously and the next step will be the development of a complete budding information system, commonly called facility management. This should run simultaneous with the recording of the measurement data.


Foil 1
NEUES SCHLOSS
HERRENCHIEMSEE
gemessen mit CASOB
ergänzt mit AutoCAD
adiplan
Bauvermessung


Foil 2

Foil 3



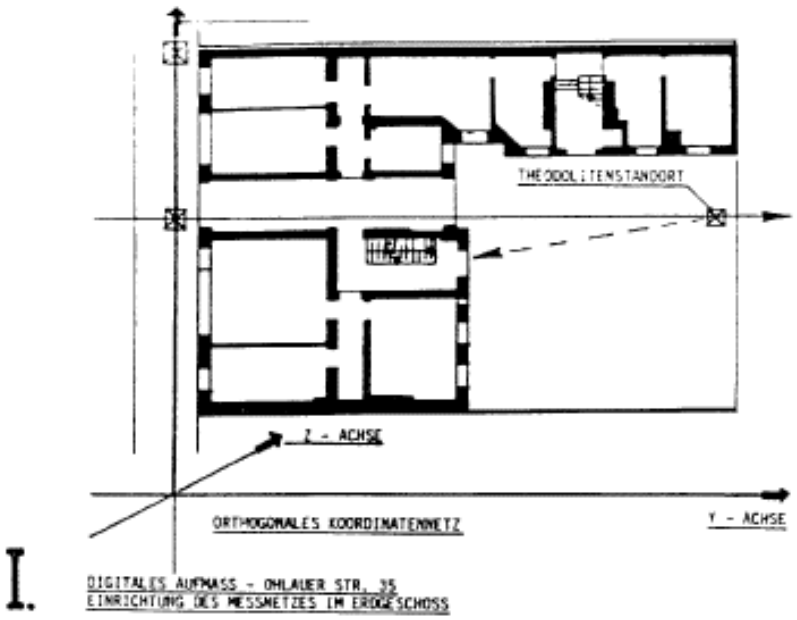
elektronischer Theodolit mit elektronischem Distanzmeßgerät und aufgesetztem Ziellaser

DIGITALES AUFMASS

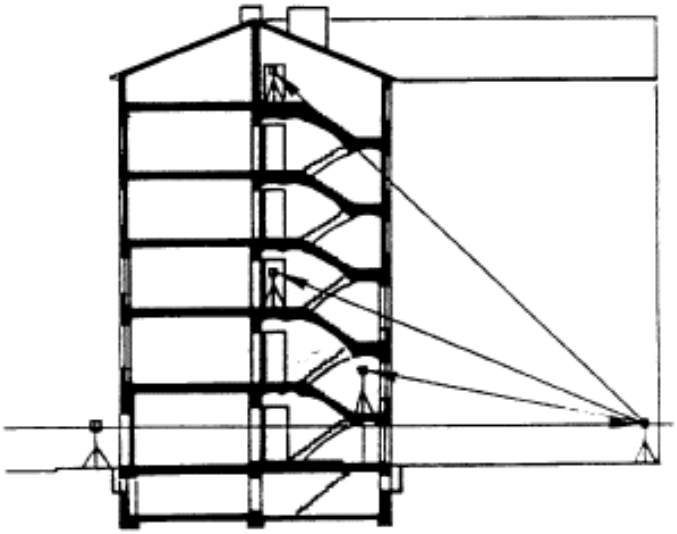
OHLAUER STR. 35

SKIZZEN ZUR VORGEHENS-
WEISE BEIM AUFMASS

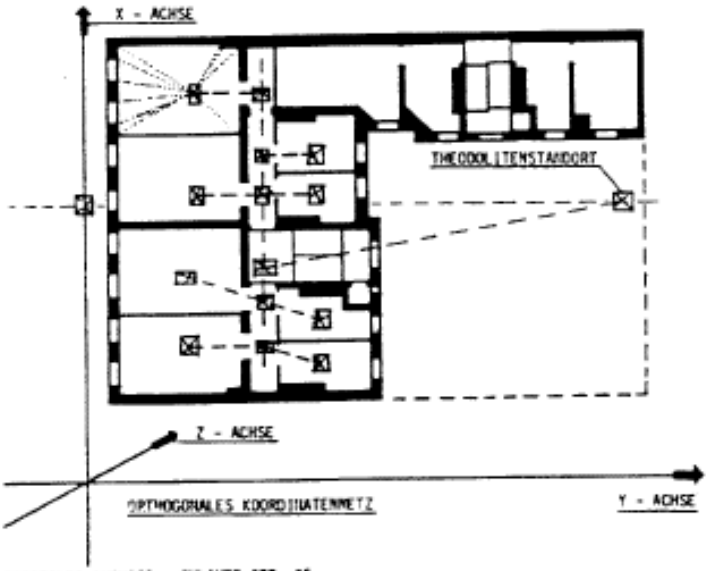
Foil 4



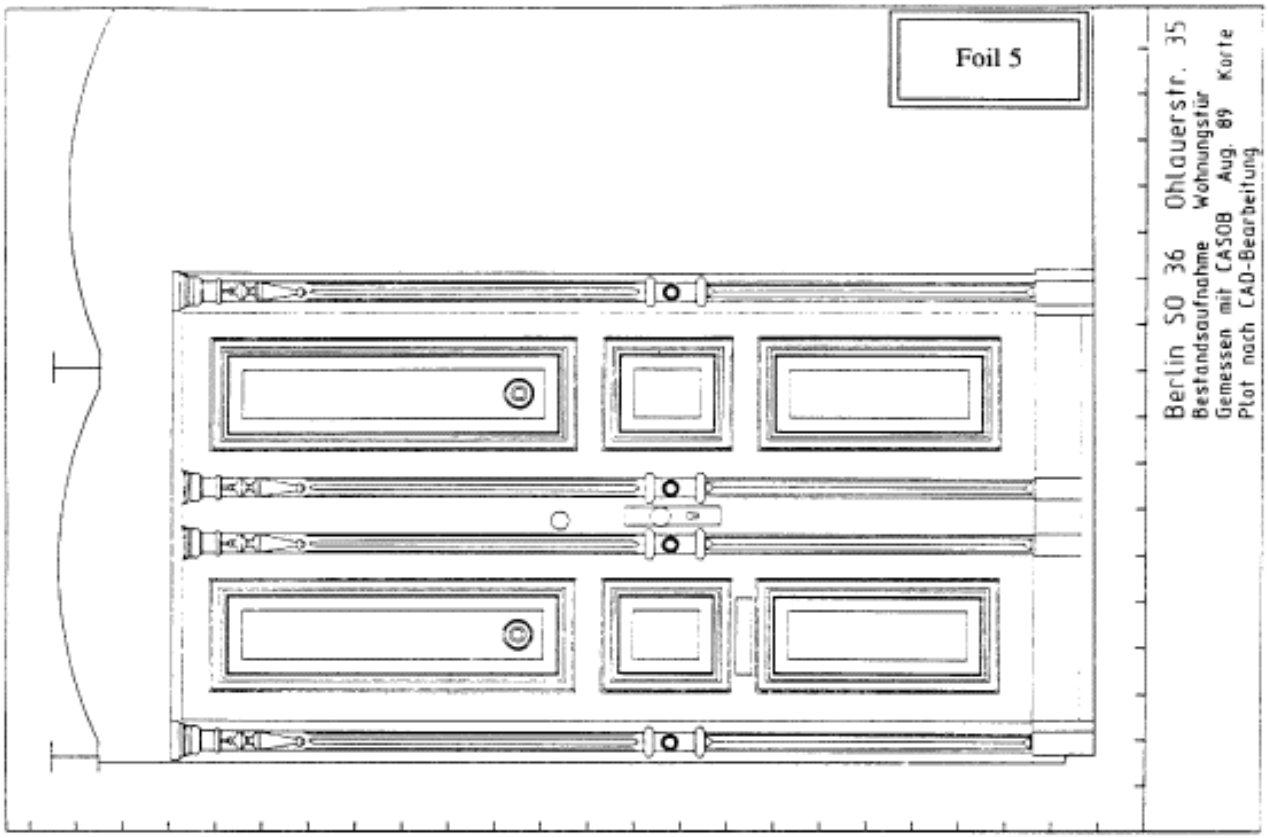
I. DIGITALES AUFMASS - OHLAUER STR. 35
EINRICHTUNG DES MESSNETZES IM ERDGESCHOSS



II. DIGITALES AUFMASS - OHLAUER STR. 35
EINRICHTUNG DER HAUPTMESSPUNKTE IN DEN GESCHOSSEN



III. DIGITALES AUFMASS - OHLAUER STR. 35
EINRICHTUNG DER HAUPTMESSPUNKTE IN EINEM GESCHOSS / EINZELPUNKTMESSUNG IN EINEM RAUM


Foil 5
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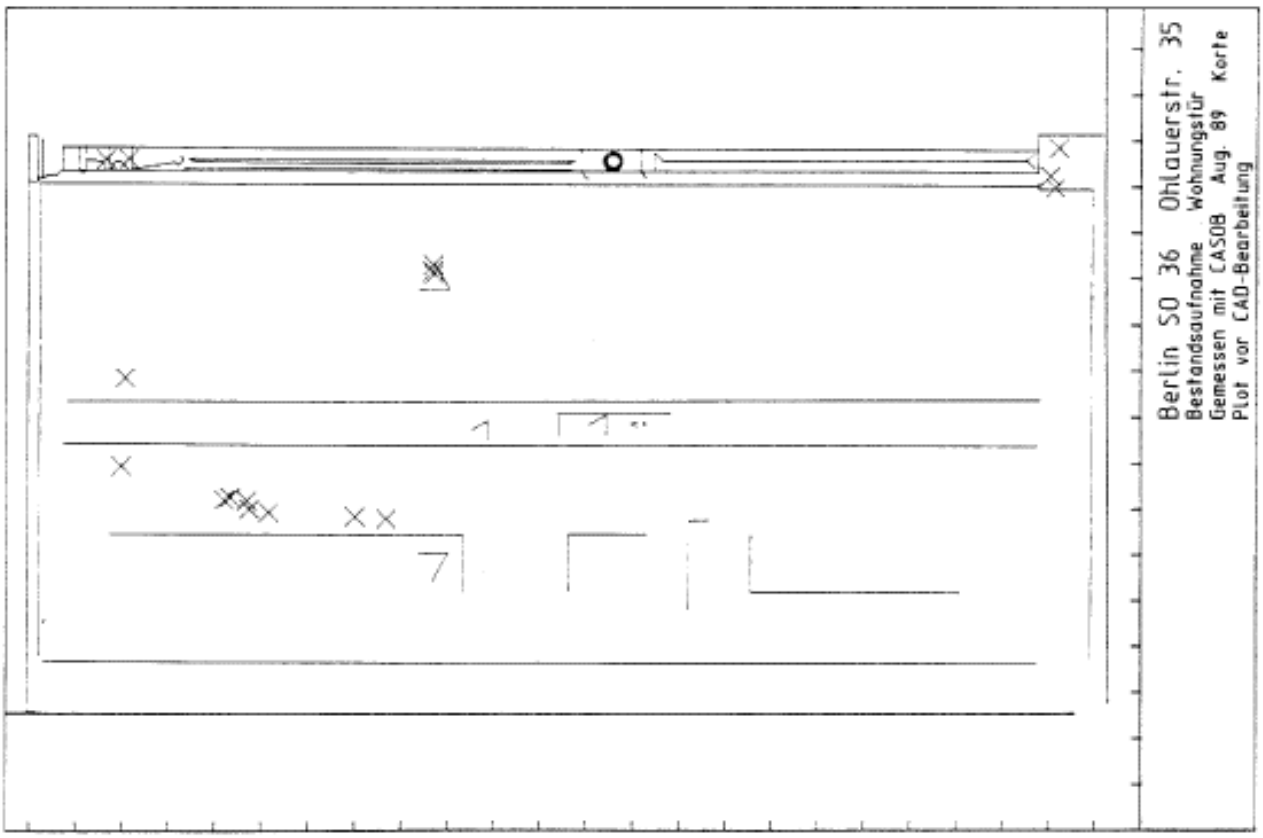
Bestandsaufnahme Wohnungstür
Gemessen mit CASOB Aug. 89 Korte
Plot nach CAD-Bearbeitung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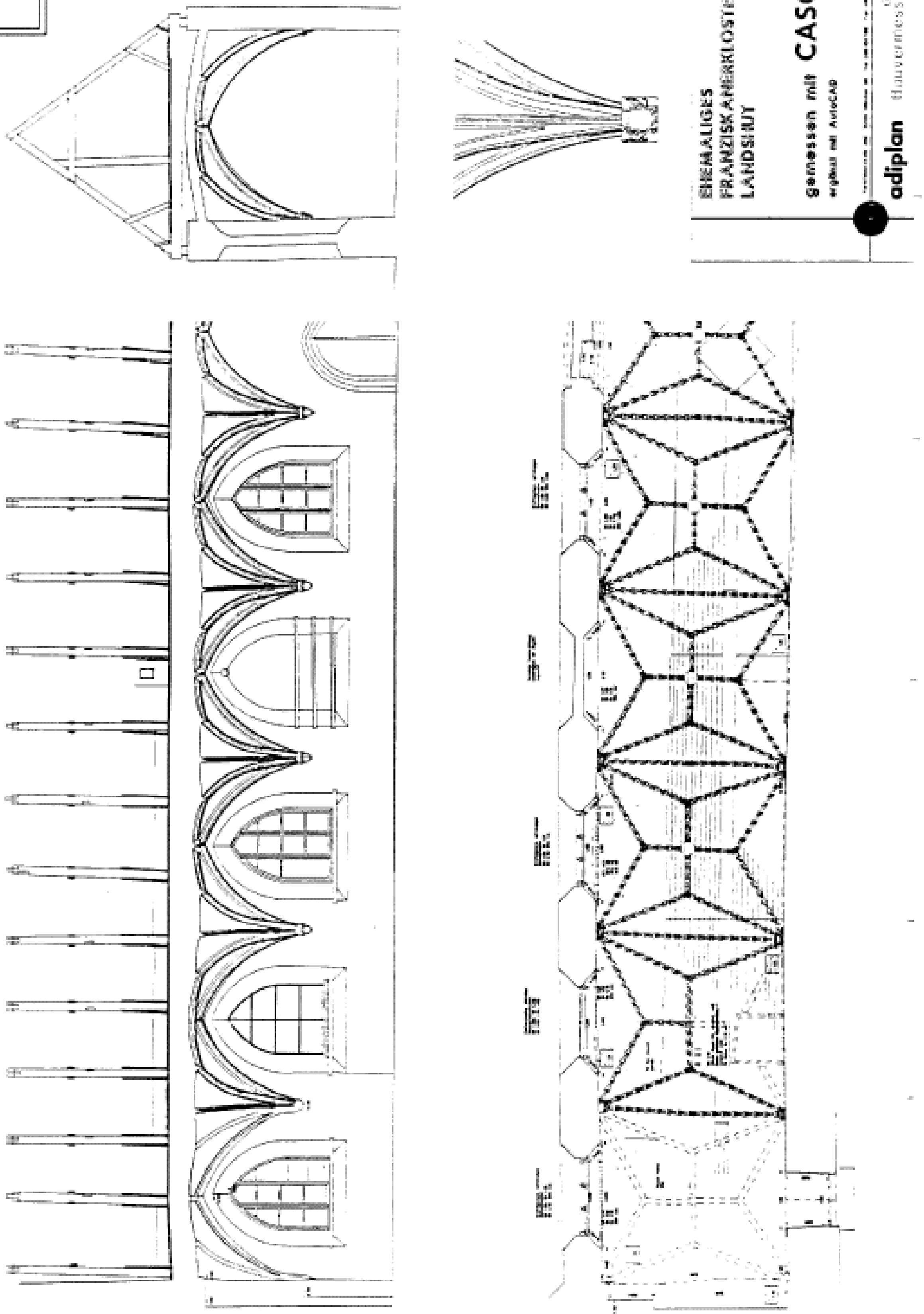
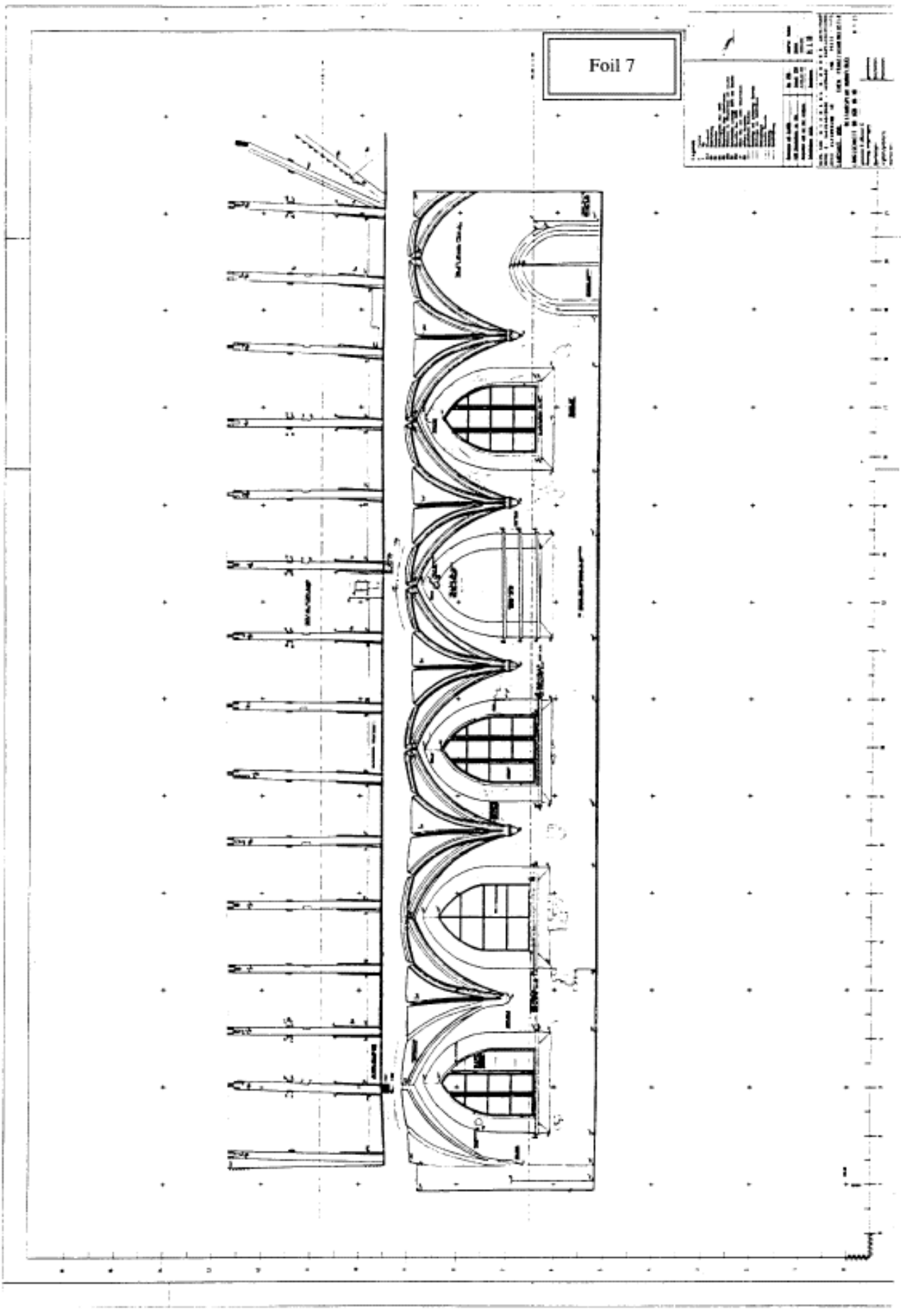
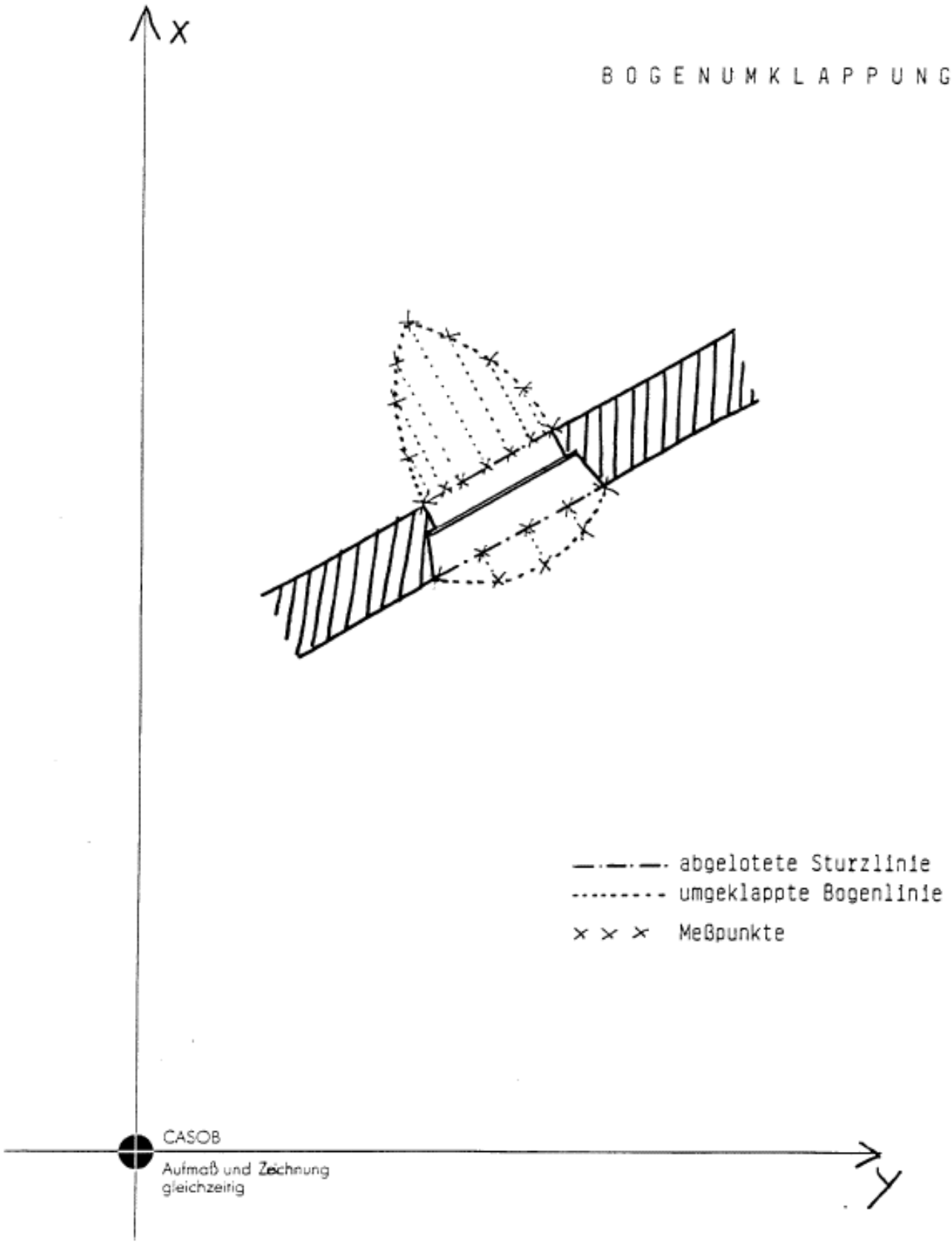
Bestandsaufnahme Wohnungstür
Gemessen mit CASOB Aug. 89 Korte
Plot vor CAD-Bearbeitung

Foil 6

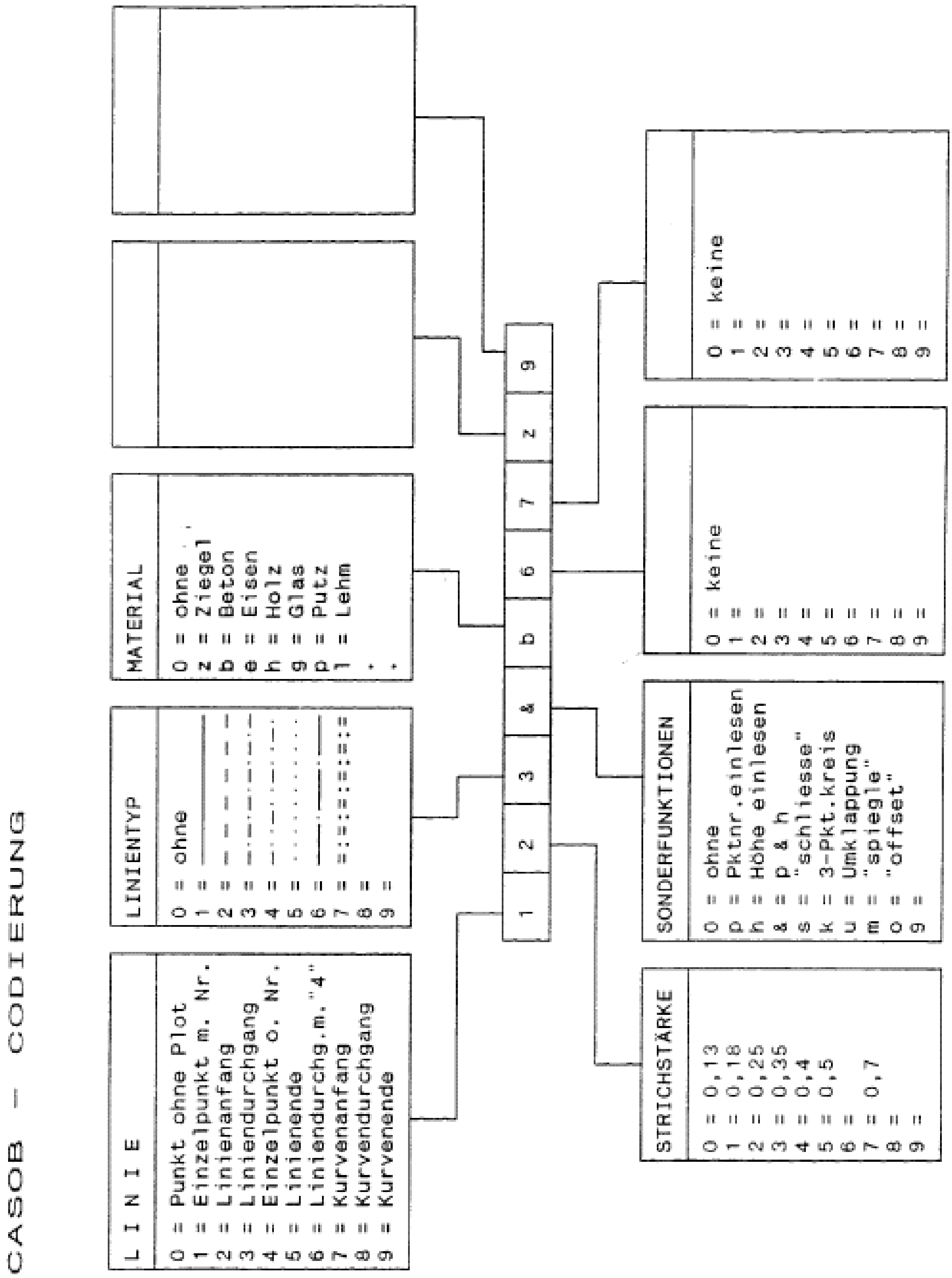

EHEMALIGES
FRANZISKANERKLOSTER
LANDSHUT
gemessen mit CASOB
ergänzt mit AutoCAD
adiplan


Foil 7

Foil 8


X
BOGENUMKLAPPUNG
abgelotete Sturzlinie
umgeklappte Bogenlinie
Meßpunkte
CASOB
Aufmaß und Zeichnung
gleichzeitig
Y

Foil 9


CASOB – CODIERUNG
L I N I E
0 = Punkt ohne Plot
1 = Einzelpunkt m. Nr.
2 = Linienanfang
3 = Liniendurchgang
4 = Einzelpunkt o. Nr.
5 = Linienende
6 = Liniendurchg.m."4"
7 = Kurvenanfang
8 = Kurvendurchgang
9 = Kurvenende
LINIENTYP
0 = ohne
1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
MATERIAL
0 = ohne
z = Ziegel
b = Beton
e = Eisen
h = Holz
g = Glas
p = Putz
l = Lehm
1
2
3
&
b
6
7
z
9
SONDERFUNKTIONEN
0 = ohne
p = Pktnr.einlesen
h = Höhe einlesen
& = p & h
s = "schliesse"
k = 3-Pkt.kreis
u = Umklappung
m = "spiegle"
o = "offset"
9 =
STRICHSTÄRKE
0 = 0,13
1 = 0,18
2 = 0,25
3 = 0,35
4 = 0,4
5 = 0,5
6 =
7 = 0,7
8 =
9 =
0 = keine
1 =
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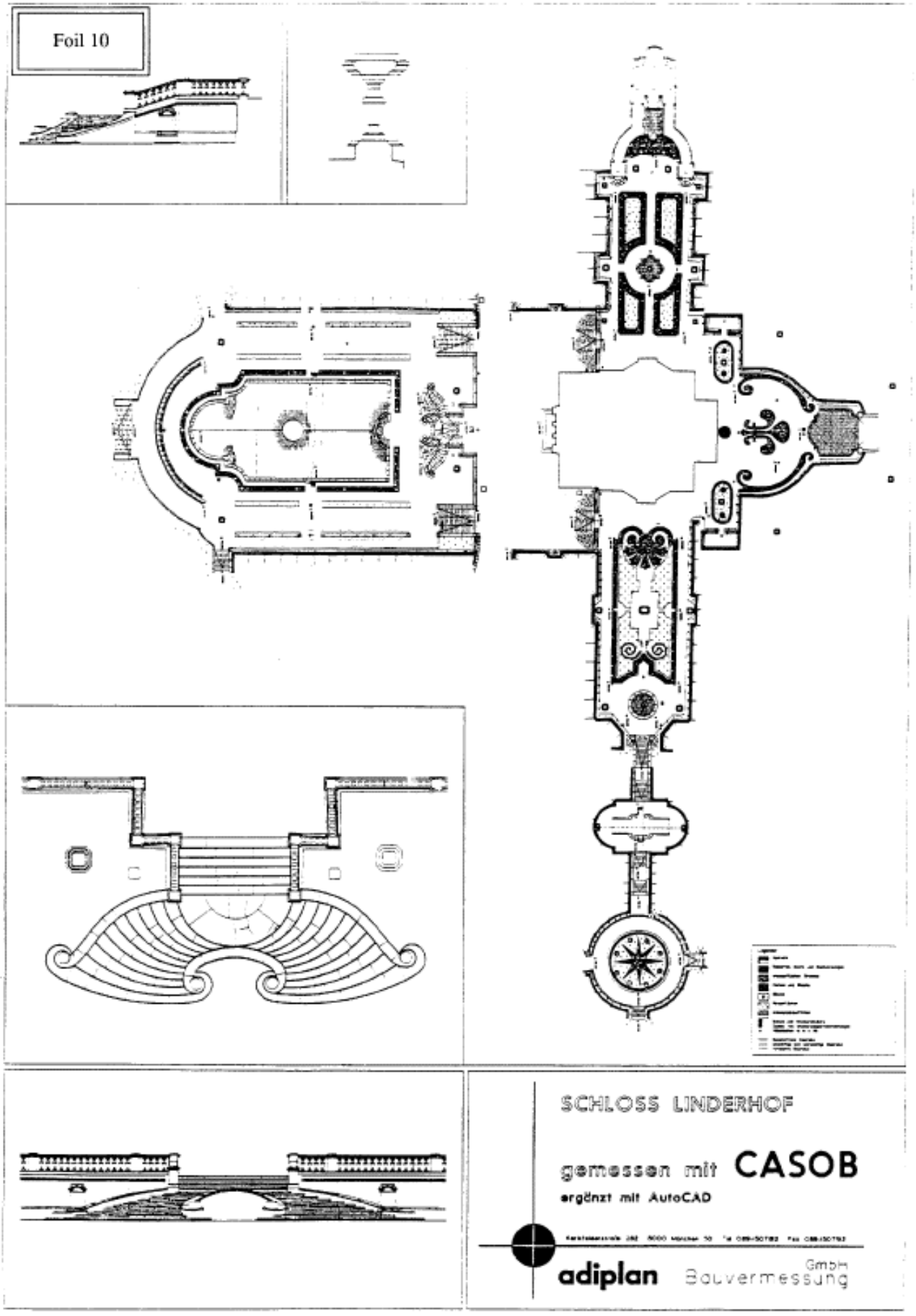
Foil 10
SCHLOSS LINDERHOF
gemessen mit CASOB
ergänzt mit AutoCAD
adiplan GmbH Bauvermessung