LISA
Geo-Software GmbH

Ludwig-Erhard-Ring 30
D 54296 Trier
www.lisa-geosoftware.de

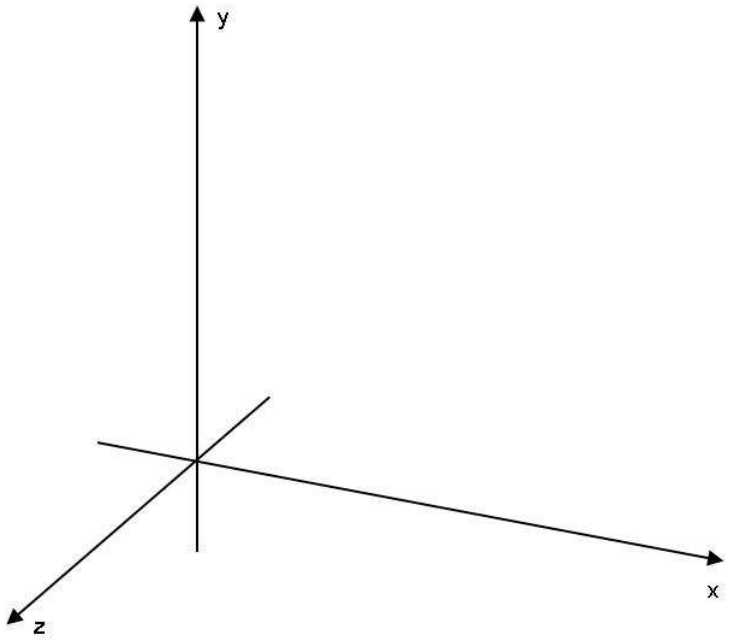
Selection and arrangement of control points

Before images can be processed in a photogrammetric way they first must be oriented. This means the calculation of the camera positions for the moment the photos were made. For this you need control points. These are points from which the three-dimensional co-ordinates (x, y, z) are known and which are clearly visible within the images.

First, a three-dimensional Cartesian co-ordinate system must be defined. In detail: There are three co-ordinate axes (x, y, z) which are each located perpendicular to each other and which all have the same length units (e.g. metres).

Within the „classical" aerial case this means usually the x-axis running from west to east, the y-axis running from south to north and the z-axis in direction to the aircraft (the z-value giving the terrain height). Here we have the arrangement of the axes which is also valid for all other cases (close-range, for instance for images from buildings):

x-axis to the right, y-axis to the top, z-axis to the camera



In principal we use a „right-hand" co-ordinate system for which you can use the „three-finger-rule": Spread thumb, index- and middle finger of your right hand. The thumb now shows into the direction of the x-axis, the index finger into the direction of the y-axis and the middle finger into the direction of the z-axis.

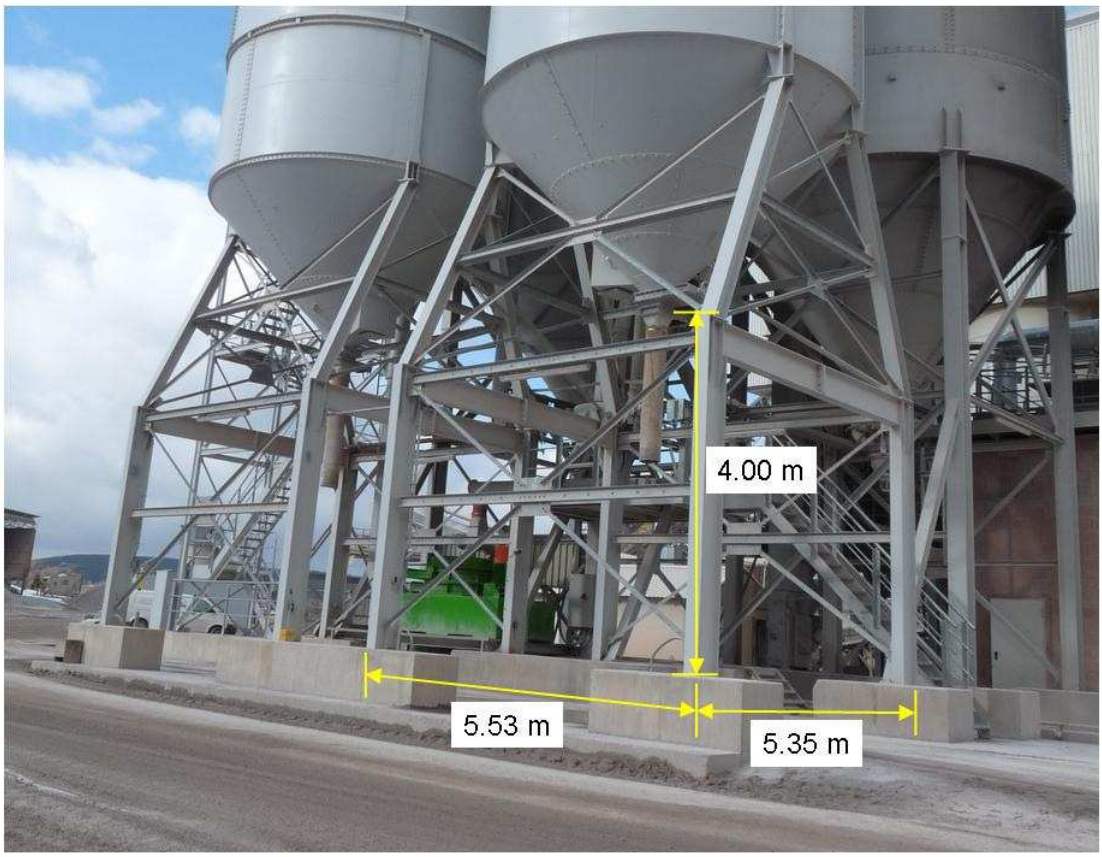
In relation to this co-ordinate system now control points must be defined and their co-ordinates must be determined. Take care that each image contains at least 4 to 6 well distributed and well visible points – the more, the better! The control points can be located directly on the object you want to measure or they can be positioned in front or beside of it. Make sure that the points are well-distributed in all of the three dimensions. This means in particular, that whenever possible also in z direction different values should appear or, in other words, that the points should not be all within one plane!

It is of no meaning where the origin (zero point, axes intersection point) is located. For instance you may chose the x-value 0 for the point quite left, but you can also chose any other value – e.g. 100 to avoid negative values in the whole project. The same is valid for y and z.

Important: The final accuracies depend beneath others strongly on the number, distribution and accuracy of the control points! If you for instance survey the control points coarse with a ruler, you cannot later expect accuracies in a range of microns.

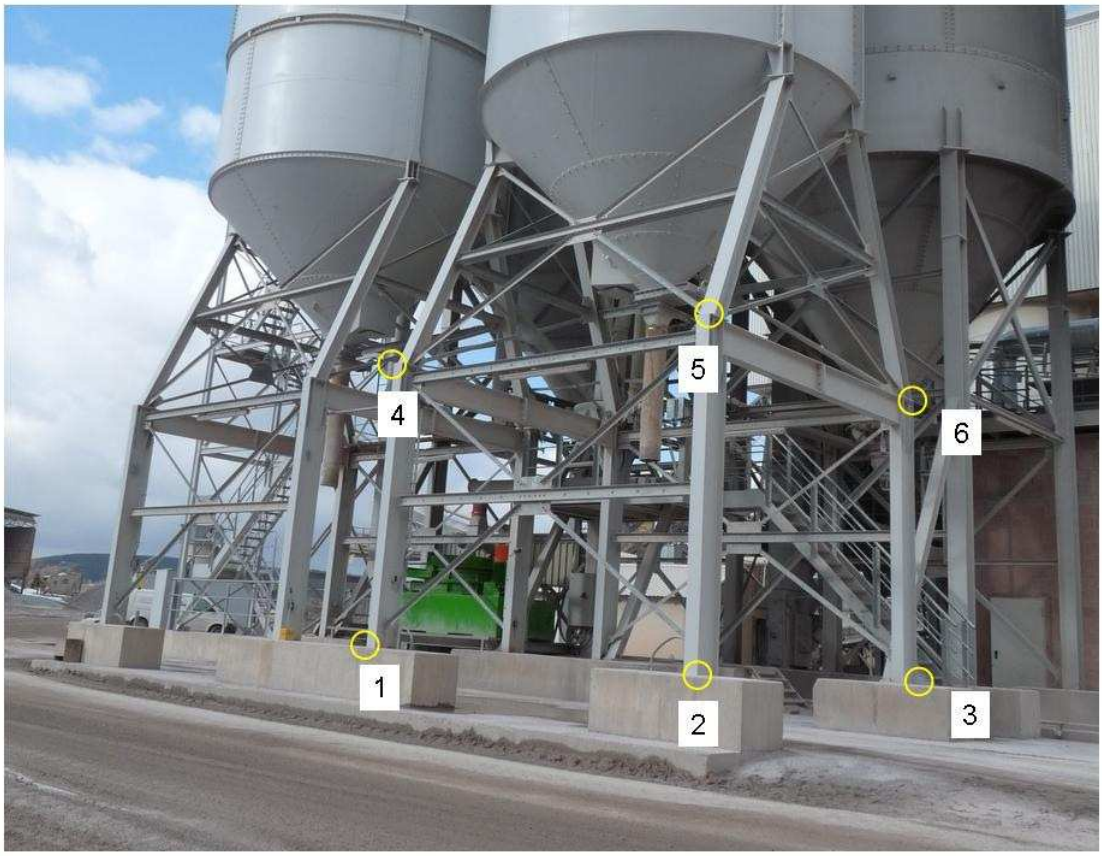
Also important: Ideally the objects which should be measured are situated within the control points field. The more they are situated outside, the bigger will be the errors at the measured co-ordinates.

An example:



(1) Measurement of distances

(2) Definition of co-ordinate axes and origin



(3) Definition of the control points

From this, the following control point co-ordinates result:

Point number	x value	y value	z value
1	0.000	0.000	5.350
2	5.530	0.000	5.350
3	5.530	0.000	0.000
4	0.000	4.000	5.350
5	5.530	4.000	5.350
6	5.530	4.000	0.000

Data from laser distance-measuring equipment

Another possibility is to measure control points with laser equipment. LISA can read and process files from the appliances Breithaupt LAPRO, Jenoptik LEM 300 and Leica GSI 8 / 16.

For your information: Equipments of this kind use a laser distance meter but also measure the horizontal and vertical angle between the appliance and a target point. Therefore polar co-ordinates are measured which then can be transformed into Cartesian co-ordinates in LISA (optional module).

GPS measurements

In the terrain, control points can of course also be measured using differential GPS. Please pay attention to the equipment's manual and technical literature, when required. The results are Cartesian (world) co-ordinates which can be processed in all LISA programmes. If the GPS equipment only gives geographic co-ordinates (longitude, latitude), these can be converted into the Cartesian systems Gauss-Krueger or UTM within LISA BASIC.