

Center for Photogrammetric Training
Ferris State University

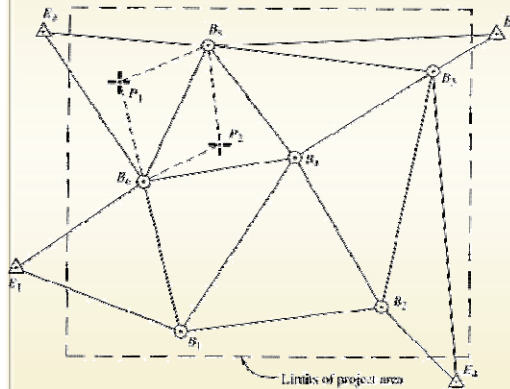
Ground Control for Aerial Photogrammetry

Introduction

- Photogrammetry Control (Ground Control)
 - Any point whose positions known in object space and whose images can be positively identified on the image
 - Used to orient/relate imagery to the ground
- Classified as
 - Horizontal control – position wrt to horizontal datum
 - Vertical control – elevation wrt to vertical datum
- Historically – 2 step process, but with GPS, this is not as clear
 - Basic control
 - Photo control



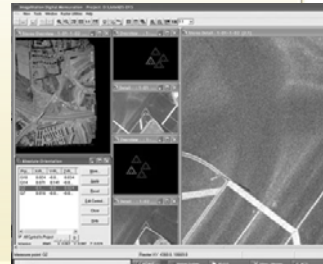
Introduction



- Existing control network – points E₁ – E₄
- Basic control network – points B₁ – B₆
- Photo control network - P₁ – P₂

Introduction

- Important element in almost every project
- Accuracy of photogrammetric project no better than the control upon which they are based
- Need to be carefully planned and executed
- Cost substantial
 - 10 – 50% of cost of total project

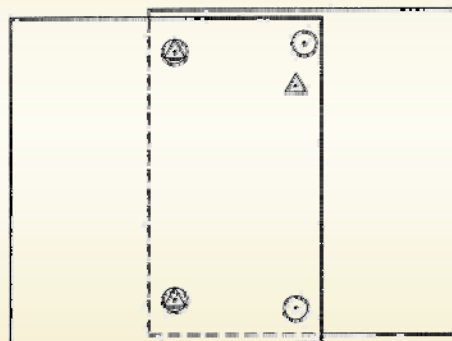


Number and Location of Photo Control



- Depends on use
 - For calculating flying height: only horizontal length and elevations of endpoints
 - For mosaics: sparse network needed
 - Uniformly distributed
 - Space resection: determine position & orientation of photo – minimum 3 XYZ control points
 - Ideally form large, nearly equilateral triangle
 - Orienting stereomodels for topographic mapping: 3 vertical and 2 horizontal control points

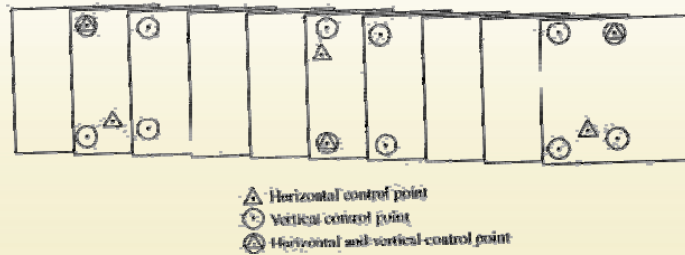
Control recommended for orienting stereomodels in stereoscopic plotting instrument



- △ Horizontal control point
- Vertical control point
- ◻ Horizontal and vertical control point

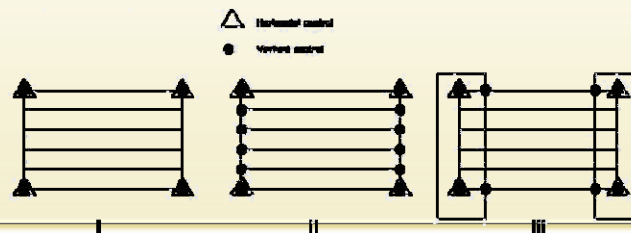
Number and Location of Photo Control

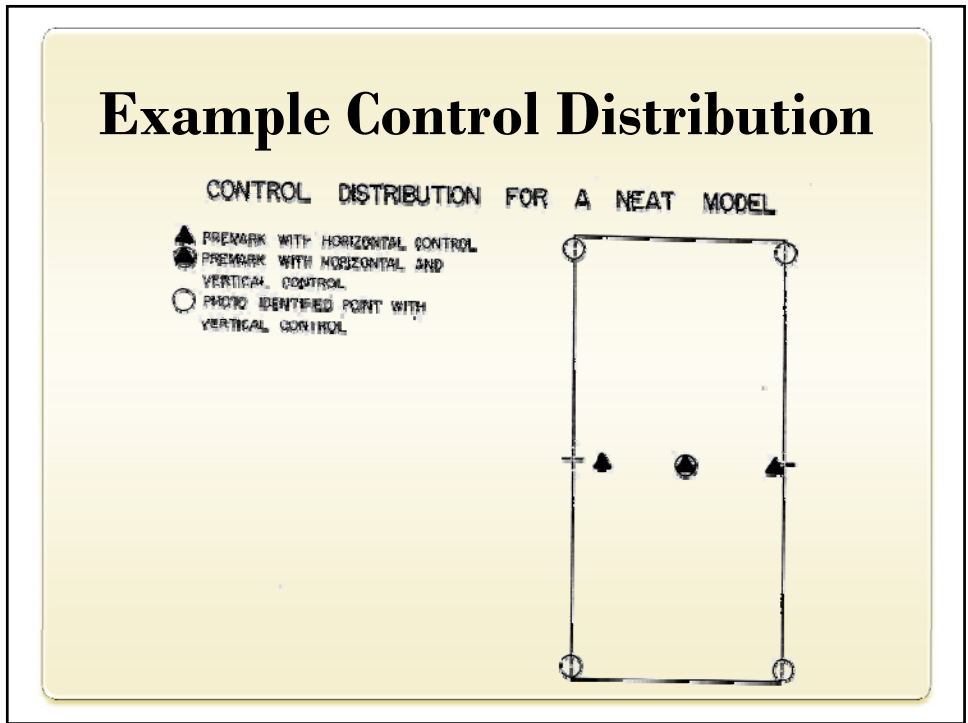
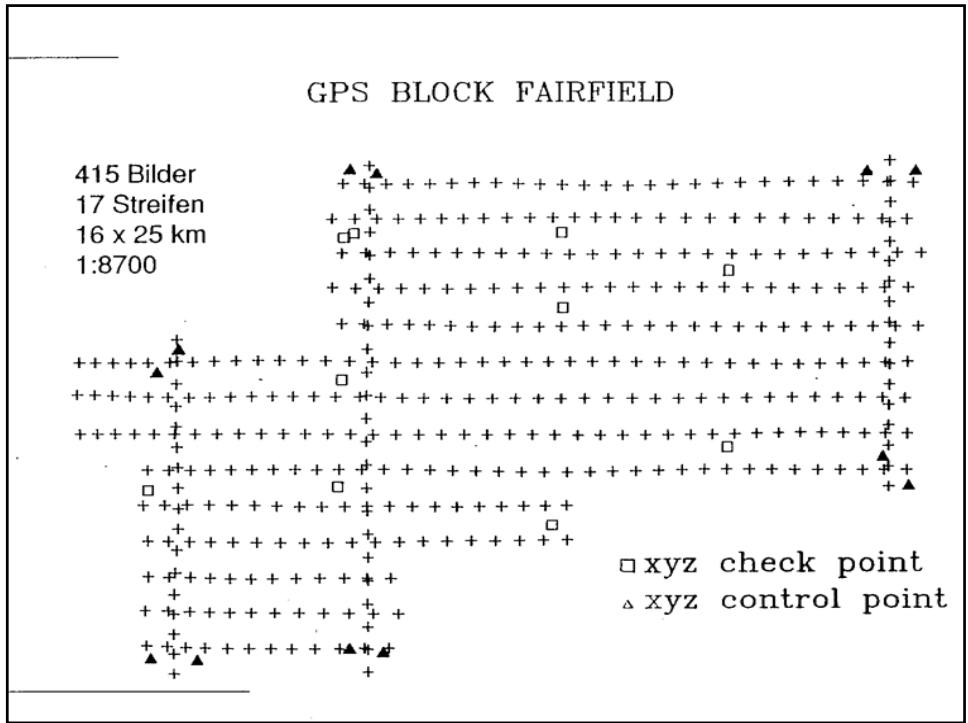
- Aerotriangulation: fewer ground control required
 - Varies depending on size, shape, nature of area, required accuracy, and procedures, instrument and personnel



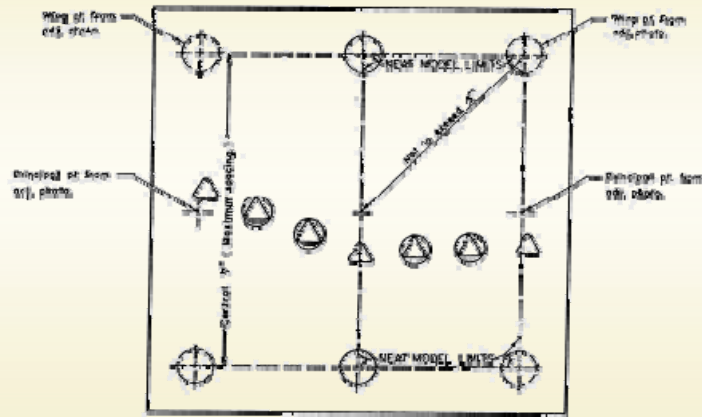
PROCESSING AIRBORNE GPS OBSERVATIONS

- Using both 60% end- and 60% side-lap
- Using 60% end-lap and 20% side-lap and adding additional vertical control point at ends of each strip, and
- Use conventional overlap and flying at least 2 cross strips of photograph





Example Control Distribution

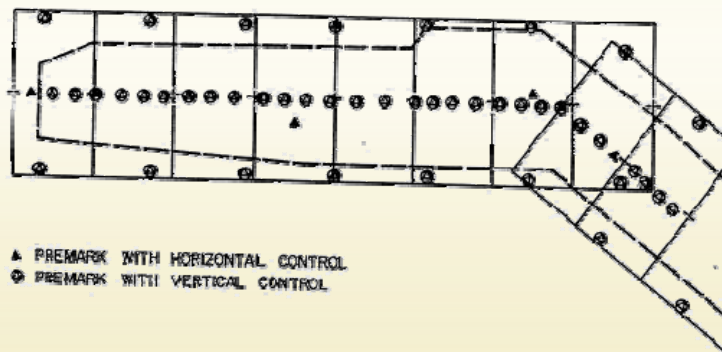


CONTROL DISTRIBUTION ON AN AERIAL PHOTOGRAPH

Shows position of control with respect to adjacent aerial photographs.
 Occasional vertical control (wing points) shown on each aerial photograph.
 Horizontal control points are shown on every other aerial photograph.

Example Control Distribution

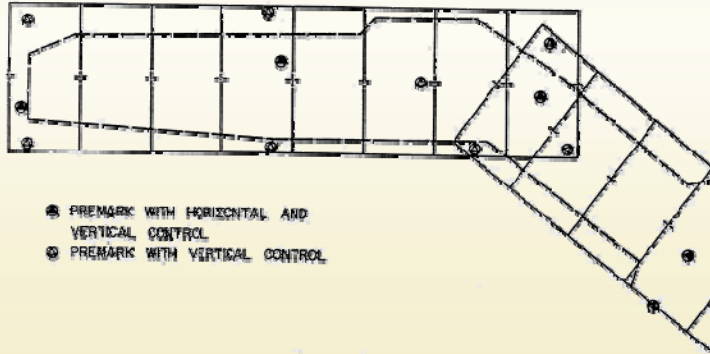
CONTROL DISTRIBUTION FOR
 50 SCALE MAPPING WITH
 PREMARKED WING POINTS
 AND A HORZ. AND VERT. BRIDGE



▲ PREMARK WITH HORIZONTAL CONTROL
 ● PREMARK WITH VERTICAL CONTROL

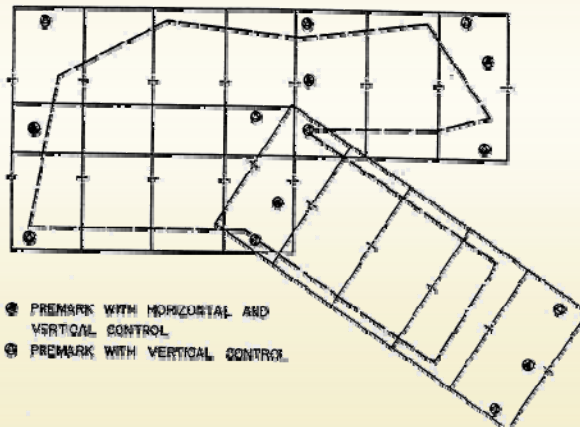
Example Control Distribution

CONTROL DISTRIBUTION FOR
100 SCALE MAPPING WITH A
HORIZONTAL AND VERTICAL BRIDGE



Example Control Distribution

CONTROL DISTRIBUTION FOR
RECONNAISSANCE MAPPING,
200 SCALE AND SMALLER



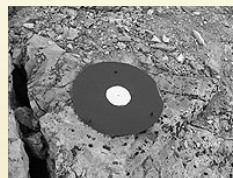
Planning Control Survey

- What is required accuracy?
 - Controls equipment and survey techniques
- Standards to consider in process
 - National Map Accuracy Standards
 - Geospatial Positioning Accuracy Standards
 - American Society for Photogrammetry and Remote Sensing
 - Federal Highway Administration Standards
 - American Society of Civil Engineers



Artificial Targets

- Some cases – need to set artificial targets
 - Called panel points
- Placed in field prior to aerial photography
 - Called premarking or paneling
- Used for controlling most precise photogrammetric work
 - Also used to mark section corners/boundary lines for photogrammetric cadastral work
- Unique appearance makes misidentification unlikely



Artificial Targets

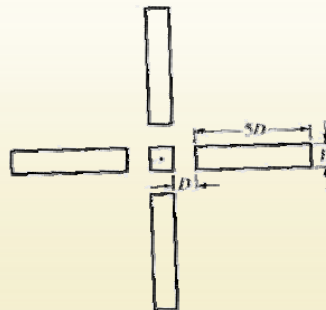


- Disadvantages
 - Extra work and expense in placement
 - Targets could be moved
 - May not appear in favorable locations
- Photography should be obtained as soon after target placement as possible
- For favorable placement – mark exposure stations on flight plan



Artificial Targets

- Main element
 - Good color contrast – best to use light target on dark background
 - Symmetry over control point
 - Target size yielding satisfactory image on photo
- Good design:



Artificial Targets

- Target size designed on intended photo scale


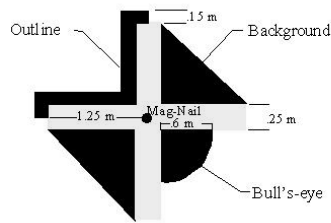


PHOTO SCALE		PANEL DIMENSIONS	
F = _____	I = _____	LENGTH (FEET)	WIDTH (INCHES)
100	1200	.2	2
200	2400	.3	4
300	3600	.5	5
400	4800	.6	7
500	6000	.8	9
600	7200	.9	11
700	8400	1.1	13
800	9600	1.2	15
900	10800	1.4	16
1000	12000	1.5	18
1500	18000	2.2	27
2000	24000	3.0	36

Artificial Targets

Standard Aerial Photography Targets



Standard MDOT target design

