Stake-Out in Total Station

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Content

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I、General Introduction

i、Surveying Concept:

Surveying is an old and young discipline. It studies the shape and size of the Earth and determines points positioning on Earth's surface. The research objects are mainly the various objects on the Earth and the Earth's surface, including their geometry, spatial positioning and other information.

The main tasks of surveying and mapping have three aspects: first, research determines the shape and size of the earth, and provides necessary data and materials for the earth science; second, maps the features and geomorphology of the earth's surface into map; third, designs on the drawings. The results were measured and set on field. It is stake out or positioning.

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I、General Introduction

ii、 Engineering measurement definition

Engineering surveying is widely used in the national economy and national defense construction, and its role is also very important. Generally defined as: various measurement work carried out during the stage of engineering construction survey, design, construction and management is collectively referred to as engineering measurement.

I、General Introduction

iii、Classification of engineering survey

According to the project construction, it can be divided into: construction engineering survey, power engineering survey, hydraulic engineering survey, traffic engineering survey (railway, highway, bridge), mine survey, municipal engineering survey, ocean survey and defense engineering survey.

According to the order of work and nature, it is divided into:

a. Measurement work in the survey and design stage.

b. The measurement work in the construction stakeout stage

c. The measurement work in the operation and management stage .

I、General Introduction

iv、Features of engineering survey

The most features of engineering surveys are closely integrated with the design, construction and operation management of the project.

Before the implementation of engineering measurement tasks, technical design must be written. The technical design book is the basis for the implementation of engineering measurement tasks, and must be designed and implemented.

After the completion of the engineering measurement task, a summary of surveying and mapping technology should be prepared. The surveying and mapping technology summarizes the implementation of technical design documents and technical standards and specifications. The main technical problems and processing methods appearing in the implementation of technical design schemes, the quality of results (or products), new Analytical research, careful summarization, and objective description and evaluation of the application of technology.

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I、General Introduction

The engineering measurement task implementation unit carries out process inspection and final inspection on product quality. After the final inspection, the application shall be submitted to the commissioned task unit or the task release department in writing, and the final inspection report shall be submitted.

The acceptance work shall be organized and implemented by the commissioned task unit of the engineering measurement task, or the inspection agency that has the qualification for inspection shall be entrusted by the unit for acceptance. After the final inspection of the surveying and mapping products, the upper process is responsible for the next process; the production personnel are responsible for the quality.

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I、General Introduction

v、The relationship between engineering surveying and other disciplines

Engineering surveys are closely related to other disciplines. On the one hand, engineering surveying is the application of the surveying and mapping discipline in the determination of the geometric shape and shape of a series of objects in engineering construction and national defense construction. On the other hand, the practical experience of engineering survey has been improved and improved to the theory. In turn, it promotes the development of other sub-disciplines.

I、General Introduction

vi、Development trend of engineering measurement

In recent years, as traditional surveying and mapping technologies have become digital and informatized, the services of engineering surveys have been continuously expanded, and the mutual penetration and cross-cutting with other disciplines has been continuously strengthened, making the measurement data collection and processing of engineering surveys integrated, real-time and digital. Development, measuring instruments to precision, automation, intelligent development, engineering measurement products to diversification, network, information and social development.

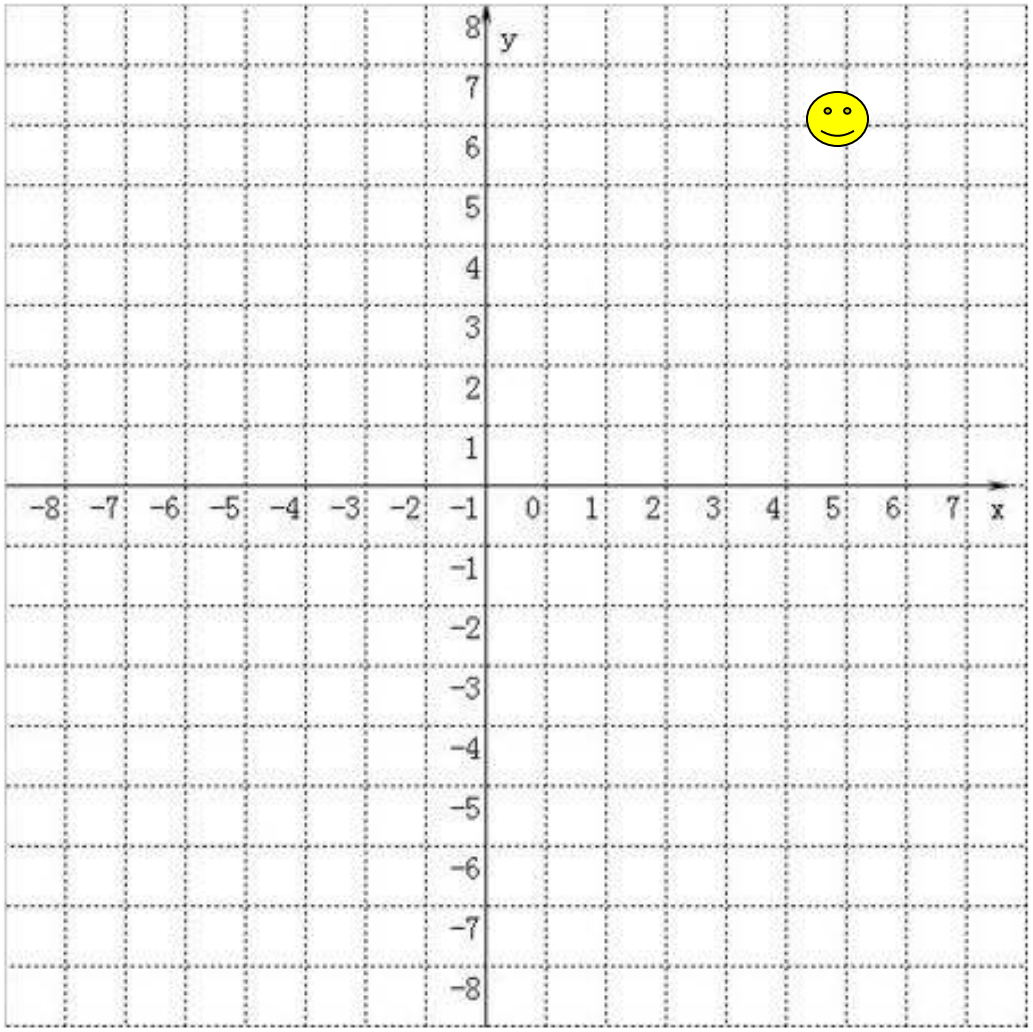
II、General Concepts of Stake-Out

i、Plane Coordinate System in Mathematics

Positioning is one of the main tasks of surveying and mapping.

First of all, we need to build a plane coordinate system before positioning. The plane coordinate system in mathematics includes the origin of coordinate, X axis, Y axis and the unit of length. (as picture shown)

EG. We can use a rule to locate the position of point P(4, 6) in the plane coordinate system.



II、General Concepts of Stake-Out

ii、Plane Coordinate System in Civil Engineering

Actually, the stake-out in civil engineering is a kind of positioning under the plane coordinate system.

Compare with the coordinate system in mathematics, the plane coordinate system in civil engineering is close to the ground, with a large scope and more obstacles. The origin of coordinate and axis might be virtual, not existed on the ground. The origin of coordinate in this case is just a reference point in nominal. So in this situation, we can't measure the position of points by rule.

How to get the position of these points on the ground? we can set some occupied point on the ground before measurement. The occupied point is the basis to support and maintain the coordinate system in civil engineering.

Occupied point: the point that been marked with coordinate on the ground

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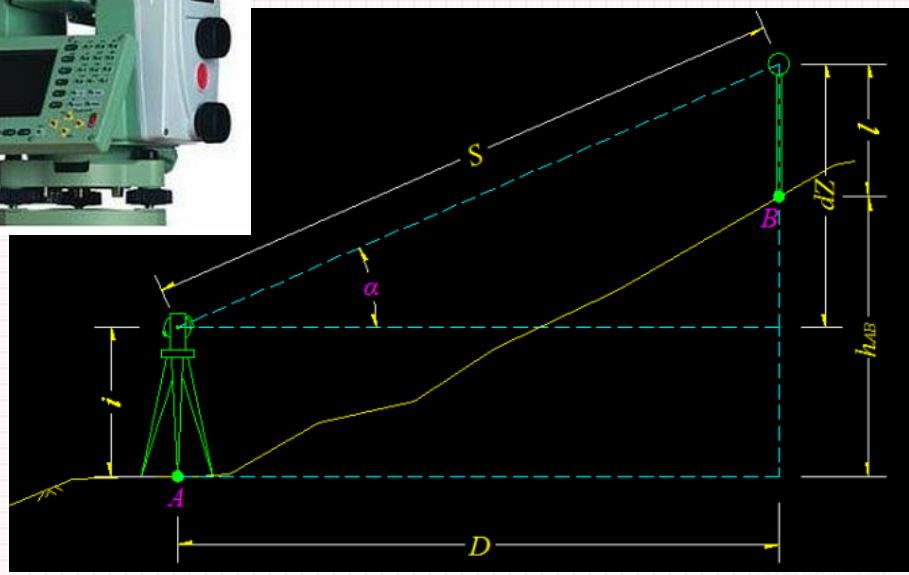
II、General Concepts of Stake-Out

iii、Distance

Distance means length of two points in spatial. Unit is normally meter, mostly using method is by tape or by EDM. (electronic distance meter)



II、General Concepts of Stake-Out

iv、Horizontal angle

The horizontal angle is the sandwiched dihedral angle projected on the horizontal plane by the direction line from the station to the two targets.

we can use total station to survey the horizontal angle 。

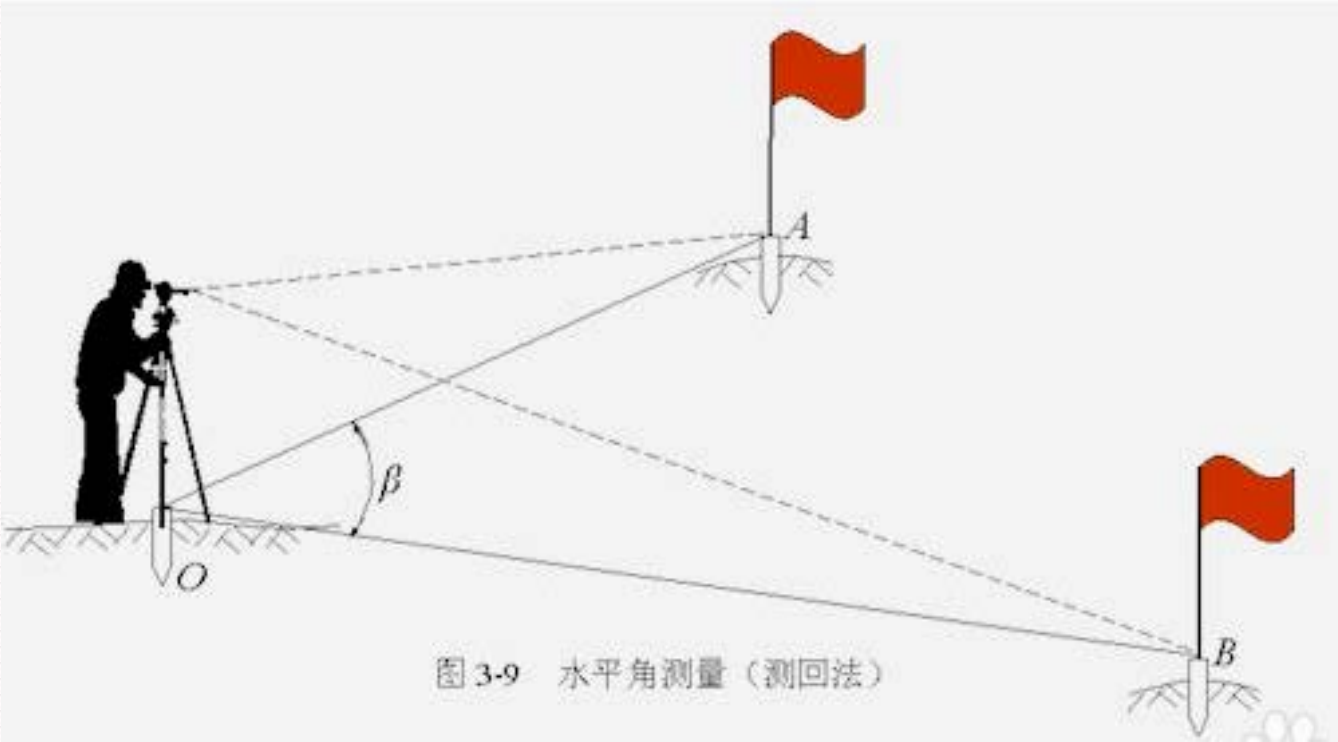


图 3-9　水平角测量（测回法）

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Ⅱ、General Concepts of Stake-Out

v、Azimuth

Azimuth refers to the angle between the north direction line of the starting point of two points in space and the direction line of the starting point to the end point in a clockwise direction.

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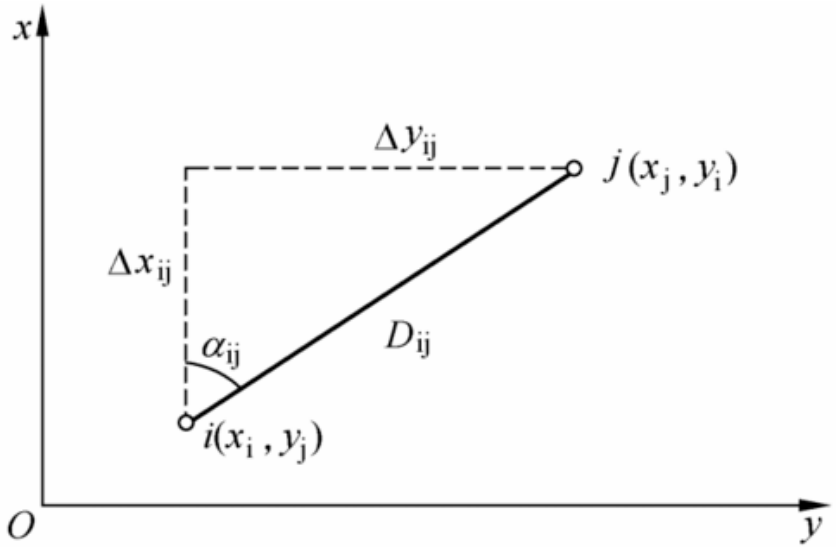
II、General Concepts of Stake-Out

vi、Calculation of plane coordinate

Two points i and j in the plane coordinate system. If the coordinate (xi, yi) of i and the distance and azimuth between i and j are known, the coordinates(xj, yj) of j can be calculated.



Formula:

$$\left.\begin{aligned} x_j &= x_i + \Delta x_{ij} = x_i + D_{ij}\cos\alpha_{ij} \\ y_j &= y_i + \Delta y_{ij} = y_i + D_{ij}\sin\alpha_{ij} \end{aligned}\right\}$$

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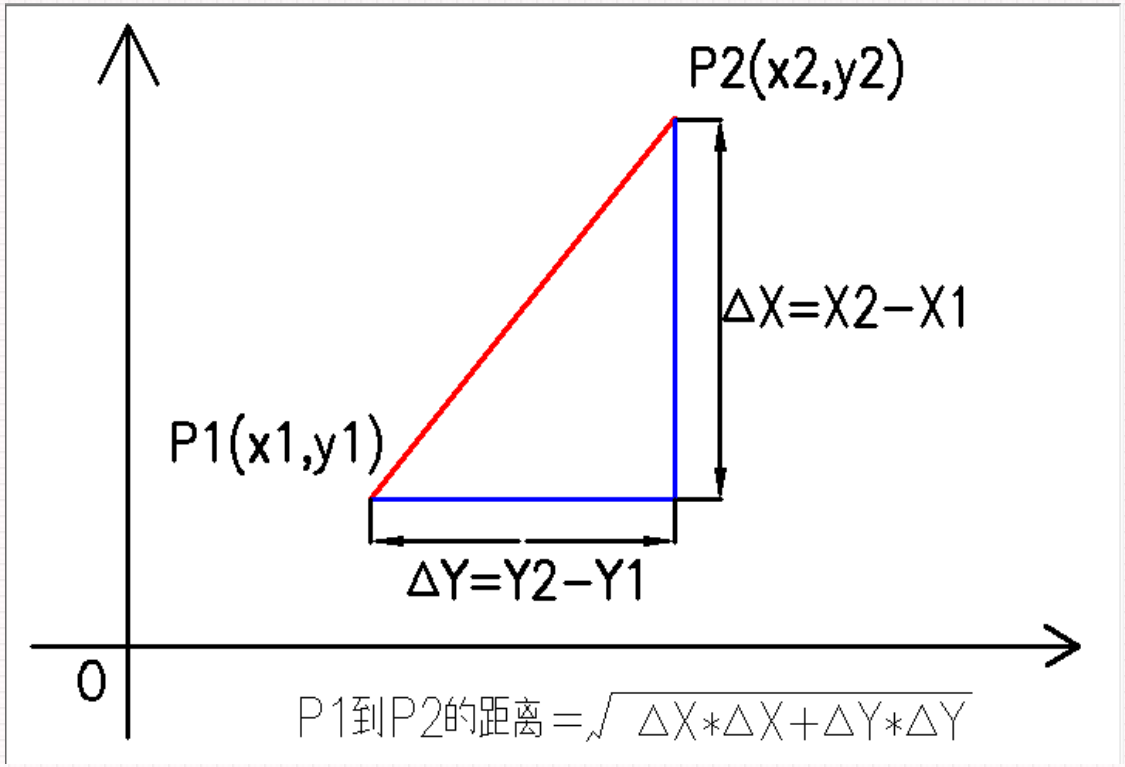
II、General Concepts of Stake-Out

vii、Reverse calculation of plane coordinate

If you know two points P1(x1, y1) and P2(x2, y2) in the plane coordinate system, you can calculate the distance and azimuth between P1 and P2.



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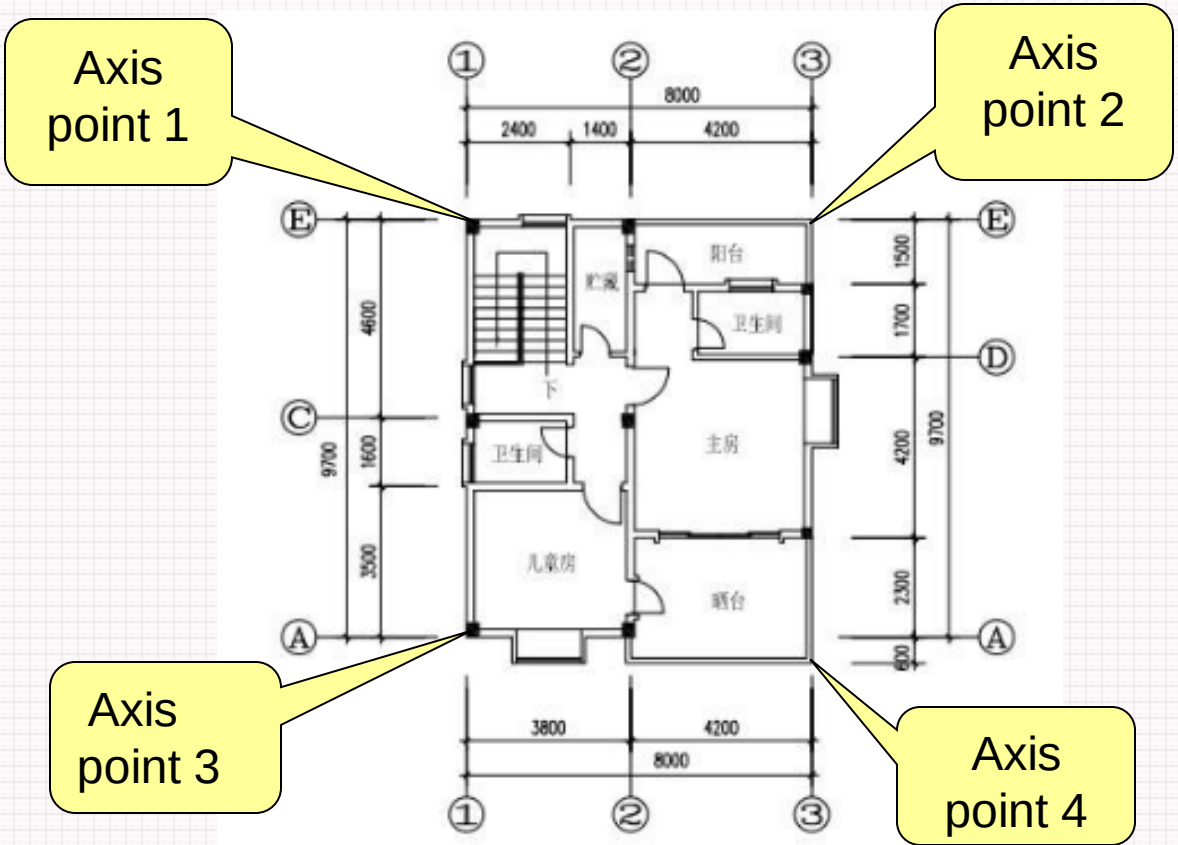
II、General Concepts of Stake-Out

viii、Stake-out in Plane Coordinate System

Stake-out is to use the equipment and occupied points to mark the points on actual places, by calibrate the main axis points or outline points of the designed draft under the required accuracy.



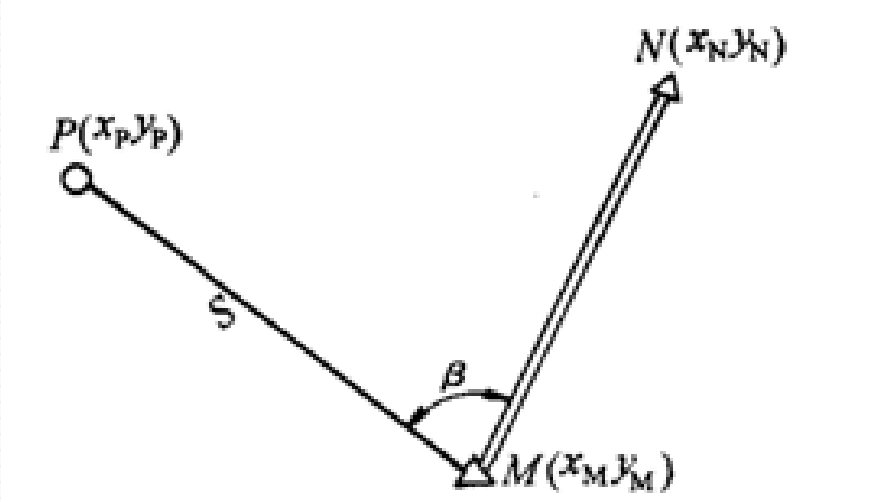
Ⅱ、General Concepts of Stake-Out

The main method of Stake-Out is by the polar coordinate method.

As picture shown below, Point M/N is occupied point, Point P is stake-out point. The coordinate of P is unknown, while the plate coordinate system is known. We can calculate the Angle β and Distance S by Point M/N and P.

Combine with the function of angle measurement and distance measurement in Total Station.

Set the equipment at Point M, set the prism/target at point N. Aim at point N to record the BS point (backsight). The backsight direction is from point M to N. Rotate the EDM to aim at Point P, measure the distance from Point P to M. The coordinate of Point P will shown on the equipment.



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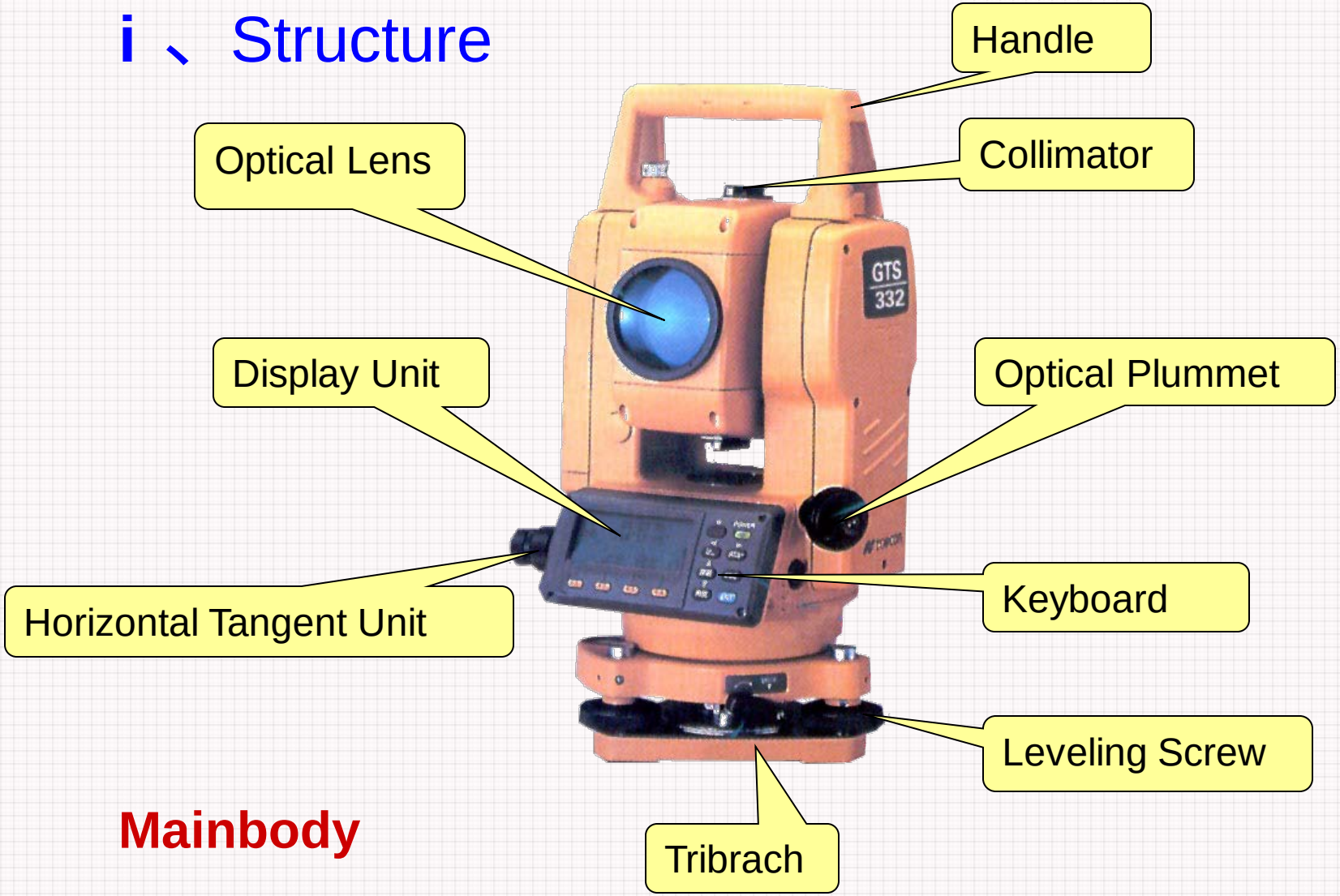
Ⅲ、Structure and Functions

i 、Structure



Mainbody

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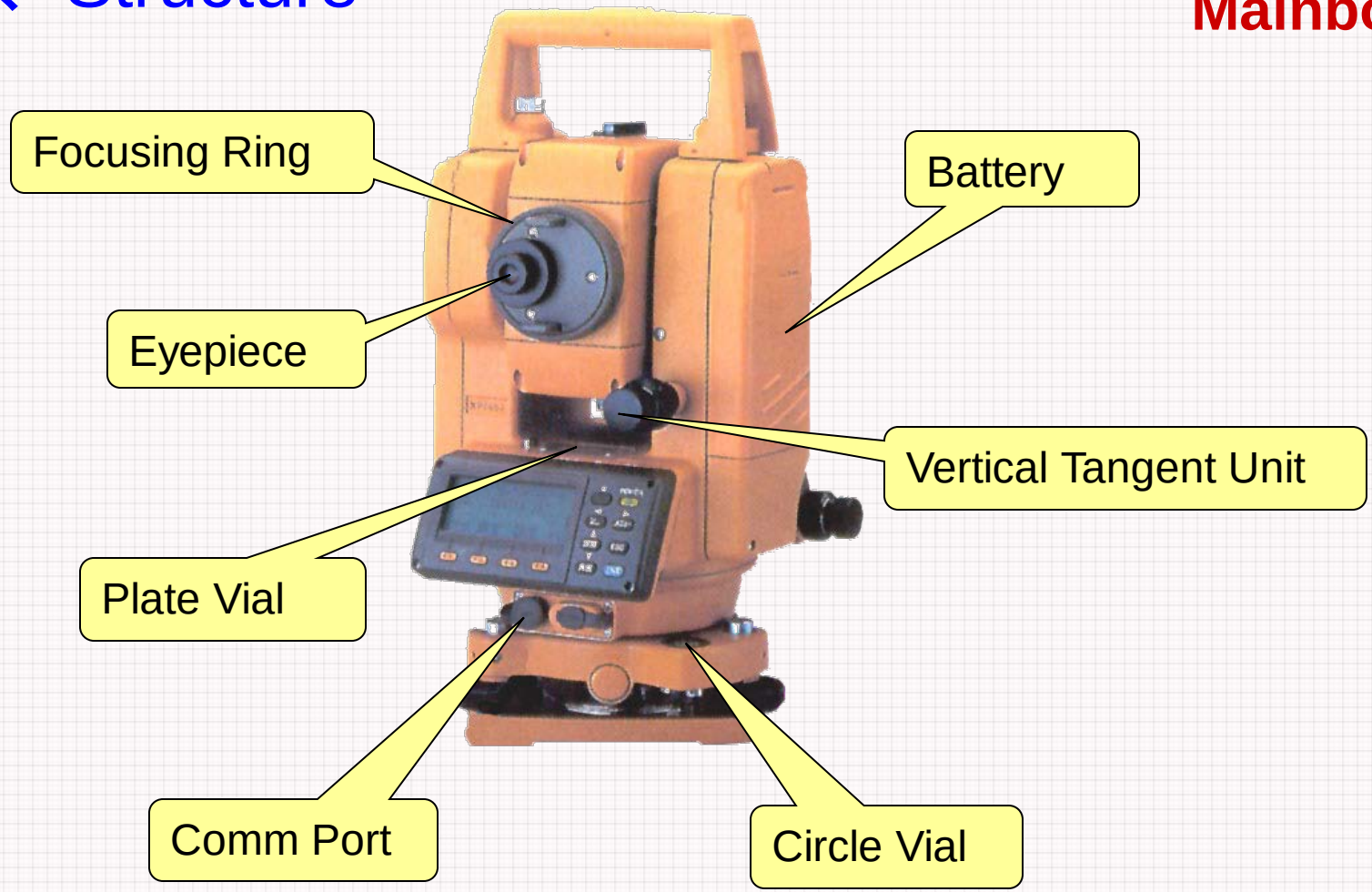
Ⅲ、Structure and Functions

i 、Structure

Mainbody



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Ⅲ、Structure and Functions

i 、Structure

Prism

Wooden Tripod

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Ⅲ、Structure and Functions

i 、Structure

Scale

Compress Lock

Circle Vial

Twist lock

Compress Lock

Prism Pole

Twist Lock

Bipod

Bipod and Prism Pole

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III、Structure and Functions

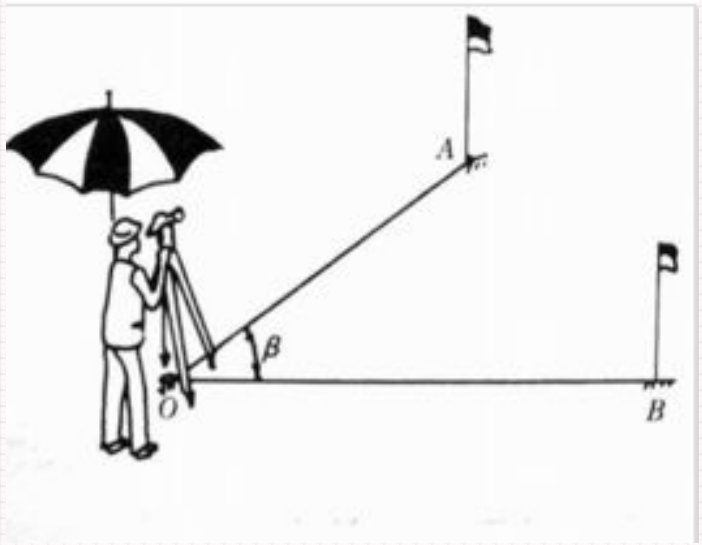
ii 、Functions

a Angle Measurement – HA

HA is the dihedral angle projected on the horizontal plane from the station point to target.

In measurement, the actual horizontal angle will projected on the horizonal disk in total station, and the equipment will calculate the angle based on the record. The HA is an important data to calculate the length, azimuth angle and coordinate of the target.

Normally, it is measured in clockwise direction, under the range of 0-360 degrees.



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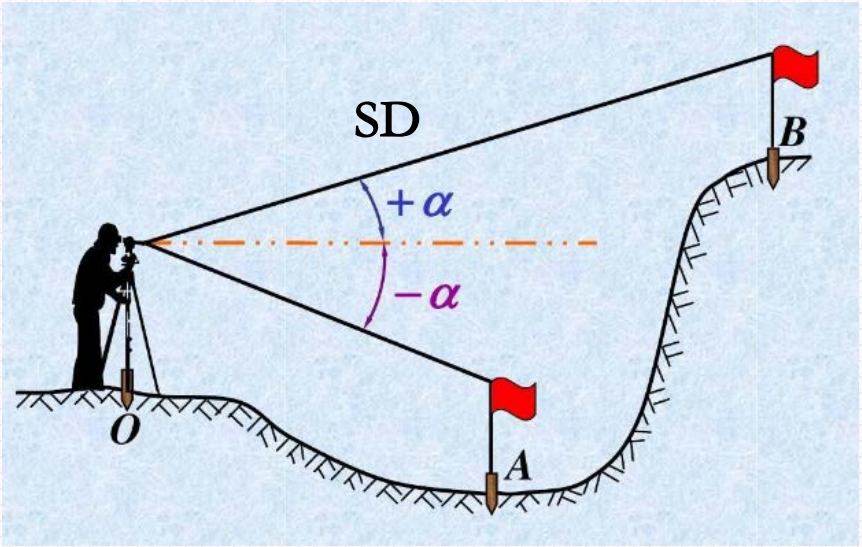
III、Structure and Functions

ii 、Functions

b Angle Measurement – VA

VA is the intersection angle between the horizontal azimuth of station point and the target in vertical direction.

It is mainly used to calculate the dH and VD by SD.



VD=SD*COS(a)

dH=SD*TAN(a)

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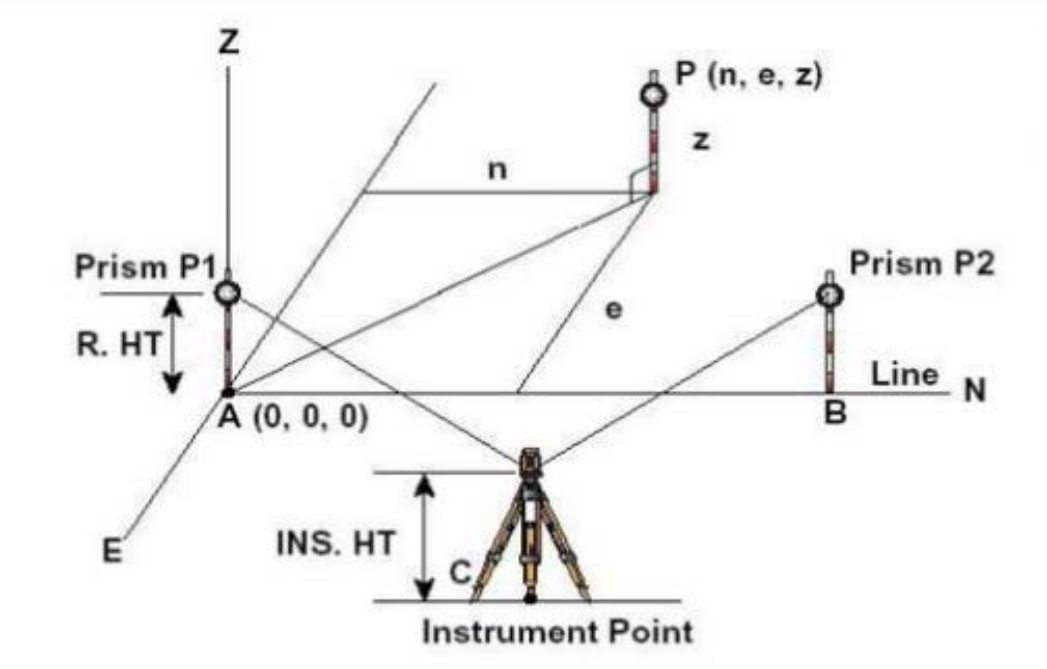
III、Structure and Functions

ii 、Functions

c Distance Measurement

d Coordinate Measurement



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IV、Stake-Out Steps

i、reconnaissance trip

Looking for the occupied points in construction site.

IV、Stake-Out Steps

ii、Written technical design book.

（1） According to the existing control points on the site to determine whether to add control points, if necessary to supplement, design a supplementary control point program.

（2） Determine the axis or contour point of the building or structure that needs to be staked

（3） The measurement stakeout method and stakeout accuracy requirements are selected. According to the scale of the building, the relative accuracy of the side length after the lofting, the error in the angle and the angle check tolerance are determined. For high-rise buildings, the deviation of the main contour points of the building should be less than 4mm, and the deviation of the adjacent building axis points should be less than 5mm; for the bottom building, the deviation of the main contour points of the building should be less than 5cm.

（4） Arrange the people. prepare the instrument, and use the instrument within the valid verification period. Charge the instrument battery.

（5） Stakeout preparation tools and materials, such as stakes, nails, hoes, markers, walkie-talkies, etc.

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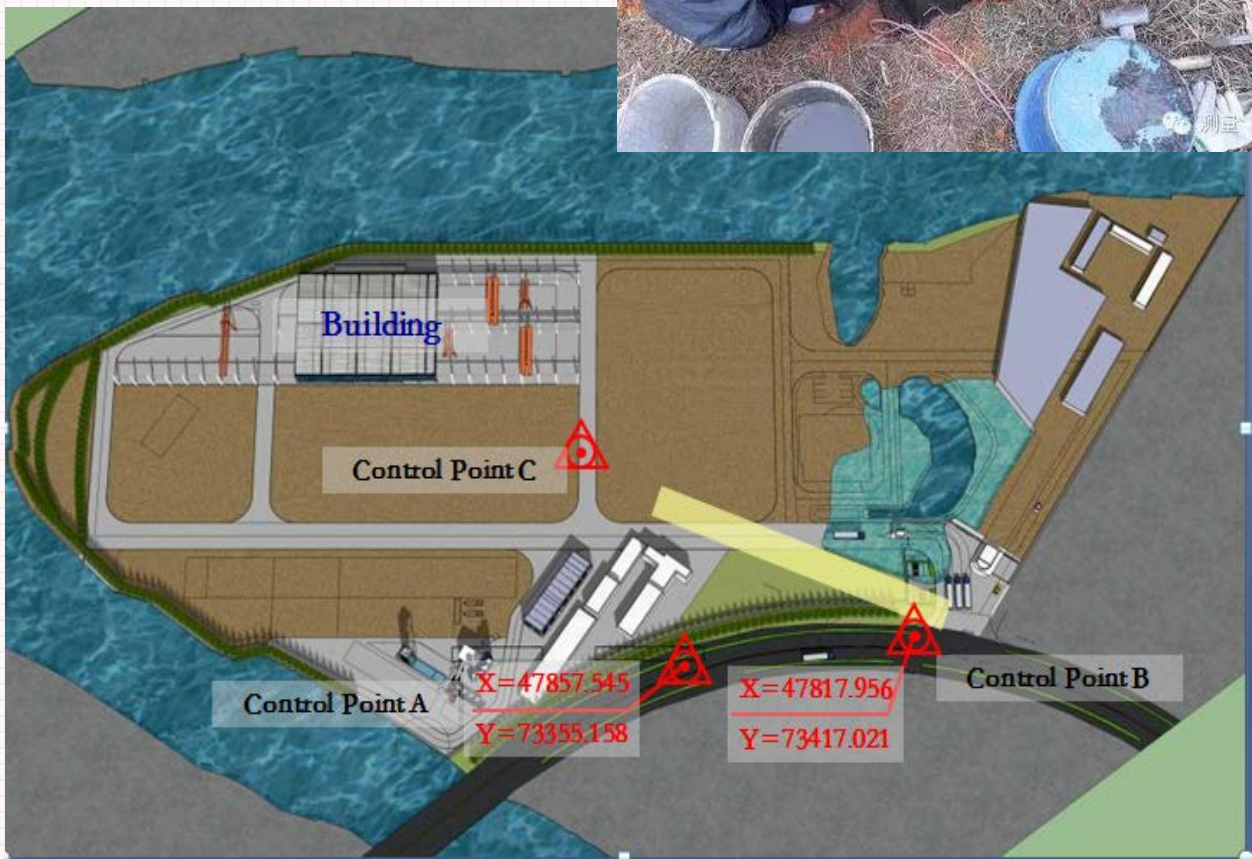
IV、Stake-Out Steps

iii、Fill up the occupied points

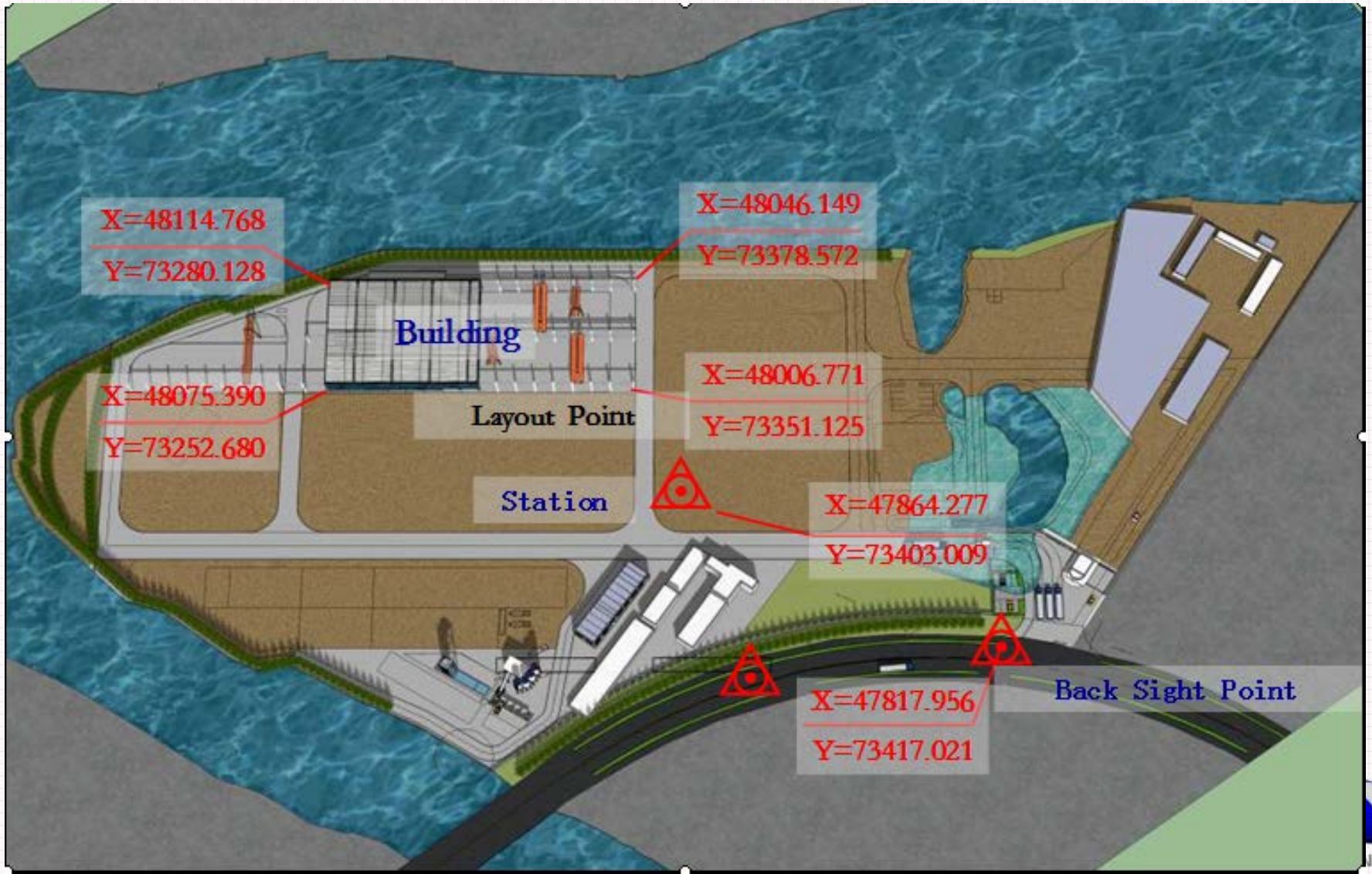
If the occupied point is far away from the construction, please fill up points as the occupied points.

As picture shown, fill up a new occupied point C besides the occupied point A and B.



IV、Stake-Out Steps

iv、Do the stake-out work in site



IV、Stake-Out Steps

v、Stakeout technology summary

（1） Detailed recording of the stakeout process (date of task completion, amount of work completed, etc.).

（2） Submission of results and drawings.

（3） Check the result record and relevant person sign it, in order to trace the responsibility.

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IV、Stake-Out Steps

vi 、Inspection and acceptance

（1）Organize the inspection of the stakeout results by the implementation unit of the stakeout, form a written report of the inspection, and sign the relevant personnel to trace the responsibility.

（2）The owner or the owner entrusts the supervision unit to check the results of the stakeout and sign the relevant personnel to trace the responsibility.

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Thank you !

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