CIV2202.11: SETTING OUT

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PREVIEW

Introduction

Setting out is the opposite of measurement (which we've considered so far). In setting out, we transfer design measurements into the field. Normal techniques and instruments are used.

This chapter describes common techniques for setting out various engineering works in preparation for construction. If you watch local construction sites, you will see some of these techniques in action.

Objectives

After completing this topic you should be able to:

- Understand the principles of setting out
- Know the range of instruments and equipment used
- Choose a method appropriate to the site and type of construction

Readings

Read *Muskett* Chapters 9, 11 and 12

REQUIRED

AIMS

You need to understand **horizontal and vertical control points**, and the use of **sight rails** for projects such as roads, slopes, pipelines and buildings.

- A structure must be correct in all 3 dimensions.
- Setting out must not delay the works.

Principles

We need **Horizontal Control** Points, and we need points of known elevation - **Vertical Control** points. Set out design points from these control points.

The control points are established during the original measurement phase using a theodolite traverse or similar. (See chapter on **Survey Methods**).

CONSIDERATIONS

1. **Recording and filing** large numbers of field books etc requires some systematic procedures.

2. **Regular inspections** and adjustment of instruments are necessary. They should be stored carefully and protected from site equipment.

3. **Design points** must be set out from control framework, not from other design points. This avoids an accumulation of errors.

4. Do **site inspections** at regular intervals, and check for moved pegs.

5. **Checks** where possible - independent check of design points from additional control points

STAGES

First stage

Establish horizontal and vertical control points.
Fix corners of buildings, road centrelines, etc.
Establish site clearance markers (for earthworks operator).

Second stage

Ensure horizontal and vertical control of buildings.
Peg batter slopes for cuttings and embankments etc.

PRELIMINARIES

1. **Check design**. Look for obstacles to setting out.

2. **Reconnaissance**: Do an on-site check. Decide the location of control points.

3. **Traverse points** for initial survey can become horizontal control points later.

4. Choose **Bench Marks** which should be referred to nearby AHD marker or Arbitrary Datum established.

A survey for engineering design usually produces a **contour plan**.

Works are superimposed on this initial plan as part of the working drawings, which form part of the contract.

Modifications to the design usually require production of "as-built" drawings from an "as-built" survey.

HORIZONTAL CONTROL

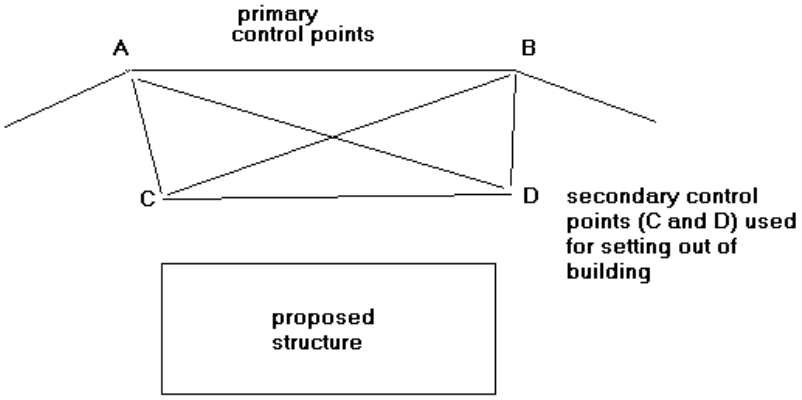
Setting out is about working from the **whole to the part**.

Secondary points (established from the primary control points) are used close to the site to enable fast location of design points.

Primary control points should be far enough away from building activity to **avoid damage**.

Primary control points should be set in **concrete**.

A **subsidiary baseline** may be established from primary control points (traverse stations) and used to locate building.



REFERENCE GRIDS

1. **survey grid** - usually based on original traverse
   - known as eastings and northings
   - control points are original traverse points.

2. **site grid** - specified by designer - usually coincides with survey grid.

3. **structural grid** may be used to ensure building accuracy (particularly of the verticals)

POSITIONING TECHNIQUES

1. from existing detail - prone to error

2. co-ordinates:
   (a) polar co-ordinates from at least 2 control points.
   (b) bearings only from 3 control points.
   (c) offsets from baselines (check from another control point)

PRECAUTIONS

1. instruments must be **adjusted**

2. measure **horizontal** distances, not slope distances. If you need to set out along the slope, ADD slope correction.

3. make **checks** from other control points

4. drive peg into ground at location of design point, and use nail driven into peg to mark the exact point, where high accuracy is required.

VERTICAL CONTROL

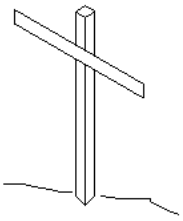
Points of Horizontal control are often used for levels (vertical control) as well.

One of these is usually made the **Master Bench Mark**, while others become Temporary Bench Marks (TBMs).

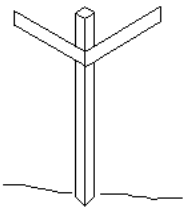
TBMs can be established in existing structures, or could be a steel bar set in concrete. Accuracy must be appropriate to the type of construction.

Bench marks should be Checked regularly.

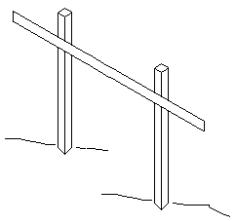
SIGHT RAILS



Used for roads, footings, small pipes.



Used for corners of buildings.



Used for buildings and for large pipes.

USE OF SIGHT RAILS

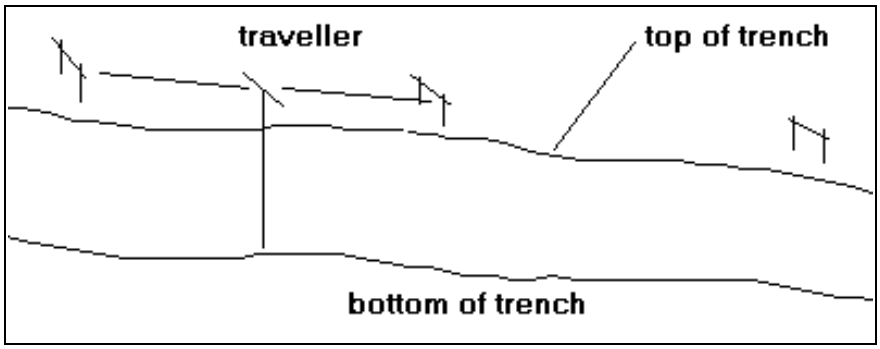
The rail is set at a **convenient height** (eg. 0.5 m, 1.0 m, 1.5 m) above the required finished level.

A height is chosen so that a person can sight along (eg. a metre or 1.5 m above the ground).

A T-shaped **Traveller** of known length (eg. 2.00 m) is used to check the finished surface.

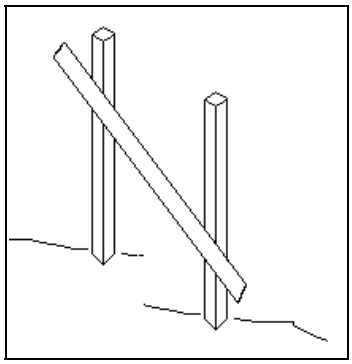
A sight is made between adjacent sight rails, and the top of the traveller lines up with it when the excavation depth is correct.

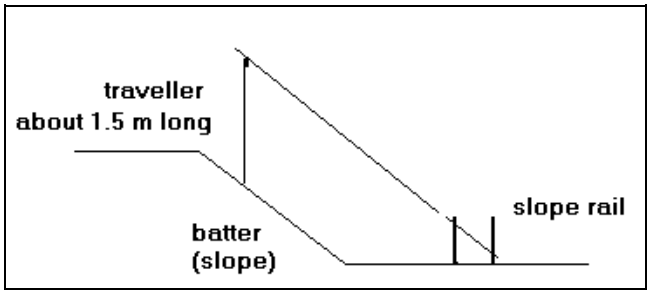
EXAMPLE - TRENCHING A PIPELINE



When the top of the sight rails and traveller are all in line, then the required depth has been reached.

SLOPE RAILS



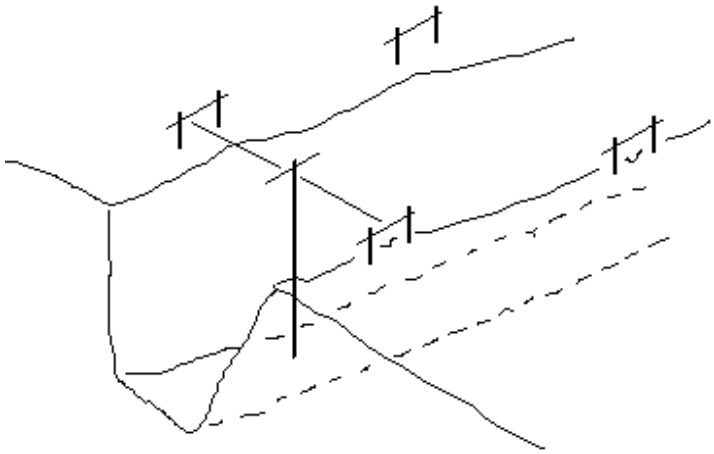


Used to control batter (slope) on cut and fill eg: road cuttings and embankments, dam embankments

PROFILE BOARDS

Use to define corners of buildings. Can also be used with a traveller to control depth of excavation.

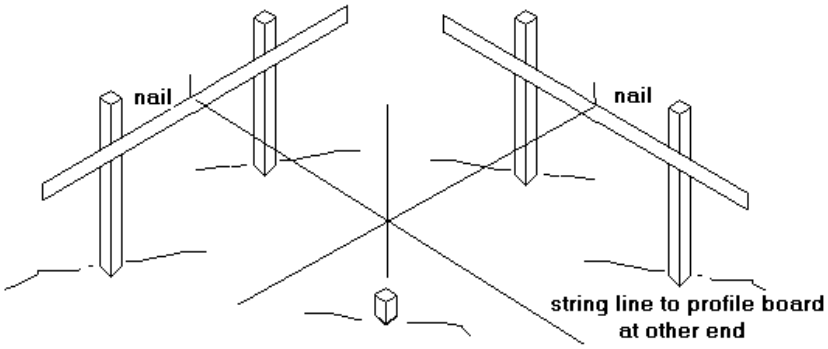
Transverse profile boards can be used for deep trenches:



EXAMPLES

Profile boards

Profile boards for building corners enable corners to be re-established after excavation.



Sewer Pipeline

Sewer pipelines tend to **follow natural surface levels**.

The **centreline** is pegged every 20 to 30 m from existing reference points (eg. by using a theodolite and tape).

Manhole often every 100 m, and at junctions and changes of grade.

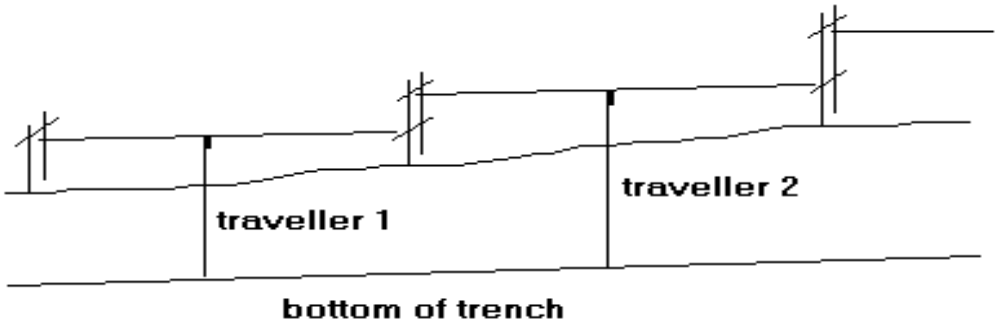
Sight rails offset or straddle the excavation.

Uprights hammered in and levels of tops of pegs obtained. From known excavation level and length of traveller, distance down to rail can be determined.

Mark made on each upright, and cross rail nailed in place.

Double sight rails

Double sight rails can be used where formation is not parallel to natural surface.



Pipelaying traveller can be used to set the **invert level** of the pipe.

Buildings

2 corners established and a theodolite used to turn off 90° for the other 2 corners.

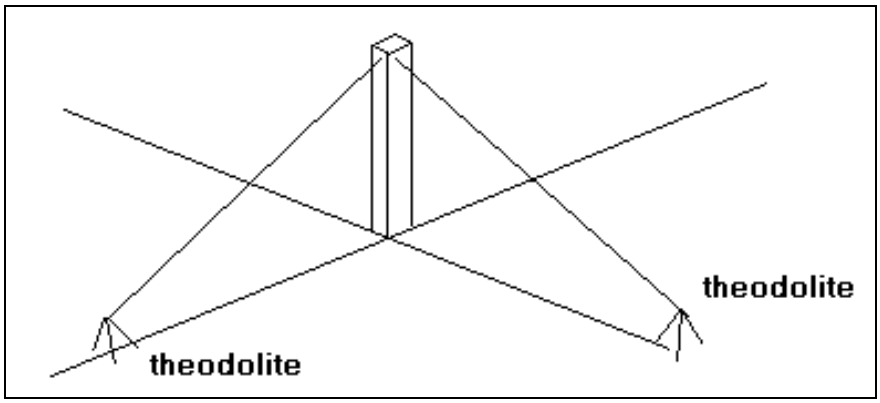
Diagonals checked; make sure distances measured are **horizontal**.

Profile boards are used at the corners.

Formwork for slab on ground set up using levels established on profile boards.

Horizontal and vertical **reference points** can be established on the slab.

Formwork and columns can be positioned from a grid or reference lines on slab. Verticality controlled from reference lines:



Appropriate accuracy depending on construction tolerances.

REVIEW QUESTIONS

1. Describe the differences between setting batter rules for cut batters and fill batters.

2. Describe the following – where and how they are used:
   - profile board
   - traveller