INTRODUCTION TO LINEAR MEASUREMENTS

Many pay items are measured on the basis of linear measurements - items such as guardrail, pipe culvert, curb and gutter, fencing, etc. These measurements usually are not as complex as area or volume measurements, but there are some things you should know about properly performing and recording the measurements.

Note: Guardrail, storm sewer, cross drain pipe and curb & gutter are plan quantity items. Plan quantity guidelines shall be followed as per section 9-3 in the specifications. The problems in this chapter are examples only (measuring Plan Quantity Pay items are examples of either plan errors or field revisions)

UNITS OF MEASUREMENT

Most linear measurement pay items are measured in linear feet and sometimes decimals thereof. Fortunately, most field surveys (both vertical and horizontal) are in the same measurement units. But, when there is need to convert units, the following relationships are applicable:

- 1 inch = 0.0833 foot
- 1 foot = 12 inches
- 1 yard = 3 feet
- 1 station = 100 feet
- 1 mile = 5,280 feet

METHODS

The several methods for making linear measurements are quite simple and straightforward. They are described below:

1. **Stationing** - When the pay item is constructed parallel to the base survey line (curb and gutter, for example), and the beginning and end of the construction is identified with right angle ties to the stationing of the survey line, the difference in stationing is an acceptable basis for linear measurement.

2. **Chaining** - Some items which are not related to stationing may be measured directly by chaining.
3. **Level Notes** - As one example, elevation measurements made with a level are a convenient way of measuring the lengths of piling in place.

Each of the methods above has certain advantages for particular situations. Some measurements may involve a combination of methods.

**FENCING**

Fencing is a plan quantity pay item paid by linear feet. When changes are authorized or disputes over quantities are present and measurements are required, seldom can these changes be measured by stationing alone, unless they are parallel to and a uniform distance from the centerline. Usually there are irregular breaks in fencing, which require field measurements (chaining).

### 5 Linear Measurements

Fencing can always be measured by stationing. True or False?

- True
- False
B. Cubic Yards.
C. Linear Feet.
D. Linear Inches.
E. None of the above.

5 Linear Measurements

The methods for making linear measurements are:

A. Stationing, Chaining, and cubic yard measurements.
B. Stationing, Chaining, and Square Yard measurements.
C. Stationing, Chaining, and Level Notes.
D. All the above.
E. None of the above.

PILING

Piling for structures is paid for on a linear foot basis. This is a good example of how level notes are used for determining lengths.
There are a few miscellaneous related pay items described in the specifications, such as test loads, shoes for timber piling and pile splices, but for now let's consider just the linear feet measurements.

Example: (see Figure 5–1, below) 90 ft. pile that was furnished by the contractor and was driven to cutoff elevation (90 ft.).

What is the length of piling driven?

**Driven length = cutoff to pile tip**

**Answer:** 90 ft.

In this case, if you had a benchmark at elevation 87.5 ft. and a back sight of 5.00 ft. your height of instrument would be elevation 92.5 ft. If you then shot the top of the pile (cutoff) you would have foresight reading of 2.5 ft. making the top of the pile elevation (cutoff) elevation 90.00. You could then subtract the pile length of 90.00 from the cutoff elevation of 90.00 and arrive at a pile tip elevation of 0.00.
FIGURE 5-1

<table>
<thead>
<tr>
<th>STA.</th>
<th>BS (+)</th>
<th>HI</th>
<th>F.S. (-)</th>
<th>ELEV.</th>
<th>BM Elev.</th>
</tr>
</thead>
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<tr>
<td>BM #1</td>
<td>5.00</td>
<td>92.50</td>
<td></td>
<td></td>
<td>87.50</td>
</tr>
<tr>
<td>E.B. #1</td>
<td>2.50</td>
<td>90.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Cut Off EL = 90.00'
- Pile Tip EL = 0.00'
- Pile Length = 90.00'
- End Bent #1
- Pile #1
- Fore Sight (-) Rod Reading = 2.50'
- Bench Sight (+) Rod Reading = 5.00'
- Height of Instrument EL = 92.50'
- Bench Mark No.1 EL = 87.50'
5 **Linear Measurements**

If you have a benchmark at elevation 80.25 Ft. and a backsight of 5.45 Ft., what would the instrument height be?

A. 85.70 Ft.
B. 74.80 Ft.
C. 80.25 Ft.
D. 90.00 Ft.
E. None of the above.

5 **Linear Measurements**

If you have pile cut off elevation at 50.00 Ft. and a tip elevation of 10.00 Ft., what would your pile length be?

A. 10 Ft.
B. 60 Ft.
C. 40 Ft.
D. 50 Ft.
E. None of the above.