Introduction to Measurements

Precision of survey

The sides of a closed figure have been measured and found to have a total length of 3,264.76 ft. If the error in the measurements is estimated to be 0.17 ft., what is the precision of the work? Hint: Remember your rules for significant figures.

$$precision = \frac{\text{error of measurement}}{\text{distance measured}}$$

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Introduction to Measurements

Precision of survey

The sides of a closed figure have been measured and found to have a total length of 3,264.76 ft. If the error in the measurements is estimated to be 0.17 ft., what is the precision of the work? Hint: Remember your rules for significant figures.

$$\frac{0.\overline{17}\text{ ft.}}{3{,}264.76\text{ ft.}} = \frac{1}{N} \Rightarrow N = \frac{3{,}264.76\text{ ft.}}{0.\overline{17}\text{ ft.}} = 19{,}204.4705\ldots$$

$$= \boxed{\frac{1}{19{,}000}}$$

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Error #1

An error of ±0.005 ft. is estimated for each of 28 length measurements, which are to be added together to get the total length.

Estimated total error?

$$E_{Total} = \pm E\sqrt{n} = \pm 0.00\overline{5}\text{ ft.}\sqrt{28} = \pm 0.0\overline{2}6458\ldots$$

$$= \boxed{\pm 0.\overline{3}\text{ ft.}}$$

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Error #2

It is desired to tape a distance of 1,600 ft. with an estimated total error of not more than ±0.025 ft.

How accurately should each 100-ft. distance be measured so that the permissible value is not exceeded?

$$E_{Total} = \pm E\sqrt{n} \Rightarrow \pm E = \frac{E_{Total}}{\sqrt{n}}$$

$$\pm E = \frac{\pm 0.0\overline{25}\text{ ft.}}{\sqrt{16}} = \pm 0.00\overline{625}\text{ ft.} = \boxed{\pm 0.0\overline{63}\text{ ft.}}$$

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Error #3

Estimate the total error for these four measurements: 511.33, 726.32, 954.86, and 1,410.11 ft., if the estimated error per 100 ft. is ±0.04 ft.

$$E_{Total} = \pm\sqrt{E_1^2 + E_2^2 + \ldots + E_n^2}$$

$$E_1 = \pm 0.0\overline{4}\text{ ft.}\sqrt{5.1133} = \pm 0.0\overline{9}04\text{ft.} = \pm 0.0\overline{9}\text{ ft.}$$

$$E_2 = \pm 0.0\overline{4}\text{ ft.}\sqrt{7.2632} = \pm 0.\overline{1}078\text{ ft.} = \pm 0.\overline{1}\text{ft.}$$

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Error #3

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$$E_{Total} = \pm\sqrt{E_1^2 + E_2^2 + \ldots + E_n^2}$$

$$E_3 = \pm 0.0\overline{4}\text{ ft.}\sqrt{9.5486} = \pm 0.\overline{1}236\text{ ft.} = \pm 0.\overline{1}\text{ft.}$$

$$E_4 = \pm 0.04\text{ ft.}\sqrt{14.1011} = \pm 0.\overline{1}502\text{ ft.} = \pm 0.\overline{2}\text{ ft.}$$

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Error #3

Estimate the total error for these four measurements: 511.33, 726.32, 954.86, and 1,410.11 ft., if the estimated error per 100 ft. is ±0.04 ft.

$$E_{Total} = \pm\sqrt{E_1^2 + E_2^2 + \ldots + E_n^2}$$

$$E_{Total} = \sqrt{\left(\pm 0.0\overline{9}\text{ ft.}\right)^2 + \left(\pm 0.\overline{1}\text{ ft.}\right)^2 + \left(\pm 0.\overline{1}\text{ ft.}\right)^2 + \left(\pm 0.\overline{2}\text{ ft.}\right)^2}$$

$$= \sqrt{\left(\pm 0.00\overline{81}\text{ ft.}^2\right) + \left(\pm 0.0\overline{1}\text{ ft.}^2\right) + \left(\pm 0.0\overline{1}\text{ ft.}^2\right) + \left(\pm 0.0\overline{4}\text{ ft.}^2\right)}$$

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Error #3

Estimate the total error for these four measurements: 511.33, 726.32, 954.86, and 1,410.11 ft., if the estimated error per 100 ft. is ±0.04 ft.

$$E_{Total} = \pm\sqrt{E_1^2 + E_2^2 + \ldots + E_n^2}$$

$$E_{Total} = \sqrt{\left(\pm 0.0\overline{681}\text{ ft.}^2\right)} = \sqrt{\left(\pm 0.0\overline{7}\text{ ft.}^2\right)}$$

$$= \pm 0.\overline{2}646\text{ ft.} = \boxed{\pm 0.\overline{3}\text{ ft.}}$$

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Error #3 – Alternate Solution

Estimate the total error for these four measurements: 511.33, 726.32, 954.86, and 1,410.11 ft., if the estimated error per 100 ft. is ±0.04 ft.

$$E_{Total} = E\sqrt{n} = \pm 0.0\overline{4}\text{ ft.}\sqrt{\frac{3{,}602.62\text{ ft.}}{100\text{ ft.}}}$$

$$= \pm 0.0\overline{4}\text{ ft.}\sqrt{36.0262} = \pm 0.\overline{2}481.....$$

$$= \boxed{\pm 0.\overline{2}\text{ ft.}}$$

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Any Questions?

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