to whatever degree of precision is deemed adequate (without clearing the intermediate value from the calculator if it can be used in the next computation). The final results should then be expressed to a precision consistent with this procedure, usually to one significant figure less than the intermediate results, to account for round-off error.

It is difficult to determine what the degree of precision should be for the typical structural steel design problem. Using more than three or four significant figures is probably unrealistic in most cases, and results based on less than three may be too approximate to be of any value. In this book we record intermediate values to three or four digits (usually four), depending on the circumstances, and record final results to three digits. For multiplication and division, each number used in an intermediate calculation should be expressed to four significant figures, and the result should be recorded to four significant figures. For addition and subtraction, determining the location of the right-most significant digit in a column of numbers is done as follows: from the left-most significant digit of all numbers involved, move to the right a number of digits corresponding to the number of significant digits desired. For example, to add 12.34 and 2.234 (both numbers have four significant figures) and round to four significant figures,

$$\begin{array}{r} 12.34 \\ \underline{+\ \ 2.234} \\ 14.574 \end{array}$$

and the result should be recorded as 14.57, even though the fifth digit of the result was significant in the second number. As another example, consider the addition of the following numbers, both accurate to four significant figures:

$$36{,}000 + 1.240 = 36{,}001.24$$

The result should be recorded as 36,000 (four significant figures). When subtracting numbers of almost equal value, significant digits can be lost. For example, in the operation

$$12{,}458.62 \quad 12{,}462.86 = \quad 4.24$$

four significant figures are lost. To avoid this problem, when subtracting, start with additional significant figures if possible.

When rounding numbers where the first digit to be dropped is a 5 with no digits following, two options are possible. The first is to add 1 to the last digit retained. The other is to use the •odd-addŽ rule, in which we leave the last digit to be retained unchanged if it is an even number, and add 1 if it is an odd number, making it even. In this book, we follow the first practice. The •odd-addŽrule tends to average out the rounding process when many numerical operations are involved, as in statistical methods, but that is not the case in most structural design problems. In addition, most calculators, spreadsheet programs, and other software use the first method, and our results will be consistent with those tools; therefore, we will round up when the first digit dropped is a 5 with no digits following.

Problems

Note All given loads are service loads.

2-1 A column in the upper story of a building is subjected to a compressive load from the following sources: dead load = 30.8 kips, occupancy live load = 1.7 kips, roof live load = 18.7 kips, and snow load = 19.7 kips.

a. If load and resistance factor design is used, determine the factored load (required strength) to be used in the design of the column. Which AISC load combination controls?

b. What is the required *design* strength of the column?

c. What is the required *nominal* strength of the column for a resistance factor ϕ of 0.90?

d. If allowable strength design is used, determine the required load capacity (required strength) to be used in the design of the column. Which AISC load combination controls?

e. What is the required *nominal* strength of the column for a safety factor Ω of 1.67?

2-2 A column is subjected to the following loads: dead load = 26 kips, occupancy live load = 15 kips, roof live load = 5 kips, snow load = 8 kips, rain load = 5 kips, and wind load = 8 kips. All loads are compression except for the wind load, which can be either tension or compression.

a. If load and resistance factor design is used, determine the factored load (required strength) to be used in the design of the column. Which AISC load combination controls?

b. What is the required *design* strength of the column?

c. What is the required *nominal* strength of the column for a resistance factor ϕ of 0.90?

d. If allowable strength design is used, determine the required load capacity (required strength) to be used in the design of the column. Which AISC load combination controls?

e. What is the required *nominal* strength of the column for a safety factor Ω of 1.67?

2-3 The loads on a roof beam consist of a dead load of 0.2 kips/ft, a roof live load of 0.13 kips/ft, and a snow load of 0.14 kips/ft.

a. If load and resistance factor design is used, determine the factored load (required strength) to be used in the design of this beam. Which AISC load combination controls?

b. If allowable strength design is used, determine the required load capacity (required strength) to be used in the design of the column. Which AISC load combination controls?