DESIGN FORMS FOR A CONCRETE COLUMN

Subcourse EN5152

EDITION C

United States Army Engineer School
Fort Leonard Wood, Missouri

2 Credit Hours

Edition Date: June 2005

SUBCOURSE OVERVIEW

This subcourse addresses the procedures used to design a wooden form for a concrete column. The primary purpose of a form is to support the concrete during its placement and initial set period. An engineer carpenter must understand the basic principles concerning the design of wall forms for concrete columns to ensure that they are designed for the necessary strength and durability.

Appendix C contains a metric conversion chart.

There are no prerequisites for this subcourse.

This subcourse reflects the doctrine that was current at the time this subcourse was prepared. In your own work situation, always refer to the latest official publications.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

TERMINAL LEARNING OBJECTIVE:

ACTION:	You will learn the procedures used to design a wooden form for a concrete column.
CONDITION:	You will be given the material contained in this subcourse.
STANDARD:	To demonstrate proficiency, you must achieve a minimum score of 70 percent on the subcourse examination.

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EN5152 Edition C Examination

LESSON

FORMS DESIGN

Critical Task: 052-239-3039

OVERVIEW

LESSON DESCRIPTION:

After completion of this lesson, you will be able to describe the procedures used to design a wooden form for a concrete column.

TERMINAL LEARNING OBJECTIVE:

ACTION:	You will describe the procedures used to design a wooden form for a concrete column.
CONDITION:	You will be given the material contained in this lesson.
STANDARD:	You will correctly answer the practice exercise questions at the end of this lesson.
REFERENCES:	The material contained in this lesson was derived from *Field Manual (FM) 5-426 and FM 5-428*.

INTRODUCTION

As a carpenter, one of the most important concerns is to ensure that all concrete-column wall forms are designed for strength and durability. This lesson discusses how to select the proper materials and how to determine the correct yoke spacing to gain the desired strength. A carpenter must be able to construct these wall forms to support the concrete during the placement and initial set period. This process is done according to *FM 5-428* specifications.

1. **Concrete Columns.** You need to know the elements of wooden forms and the types of materials used when designing wall forms for concrete columns *(Figure 1)*. Important elements and materials of wooden forms for concrete columns are as follows:

- **Sheathing.** The sheathing shapes and holds the concrete in the column form. The number of required saw cuts is reduced by running sheathing vertically in the column forms. The corner joints of sheathing must be firmly nailed to ensure water tightness.

- **Batten.** A batten (cleat) is a strip of board that is placed horizontally and directly over the joints to fasten several pieces of vertical sheathing together.

- **Yoke.** A yoke is a rectangular horizontal brace that supports the column on all four sides. Its purpose is to wrap around a column to keep the concrete from distorting the form. The small horizontal dimensions of a column do not require vertical reinforcement.

- **Yoke lock.** A yoke lock is designed to ensure that members of the yoke do not move out of position. A yoke lock can be made of various materials. These include sheathing-, scab-, or bolt-type locks.

- **Footing form.** A footing form is a wooden or steel structure that holds concrete in place to form a desired shape. It acts as a foundation for the column form.

- **Stake.** A stake is a piece of wood or metal that is driven into the ground. Stakes are attached to all four sides of the footing form to strengthen and hold the form in the exact position on the ground.

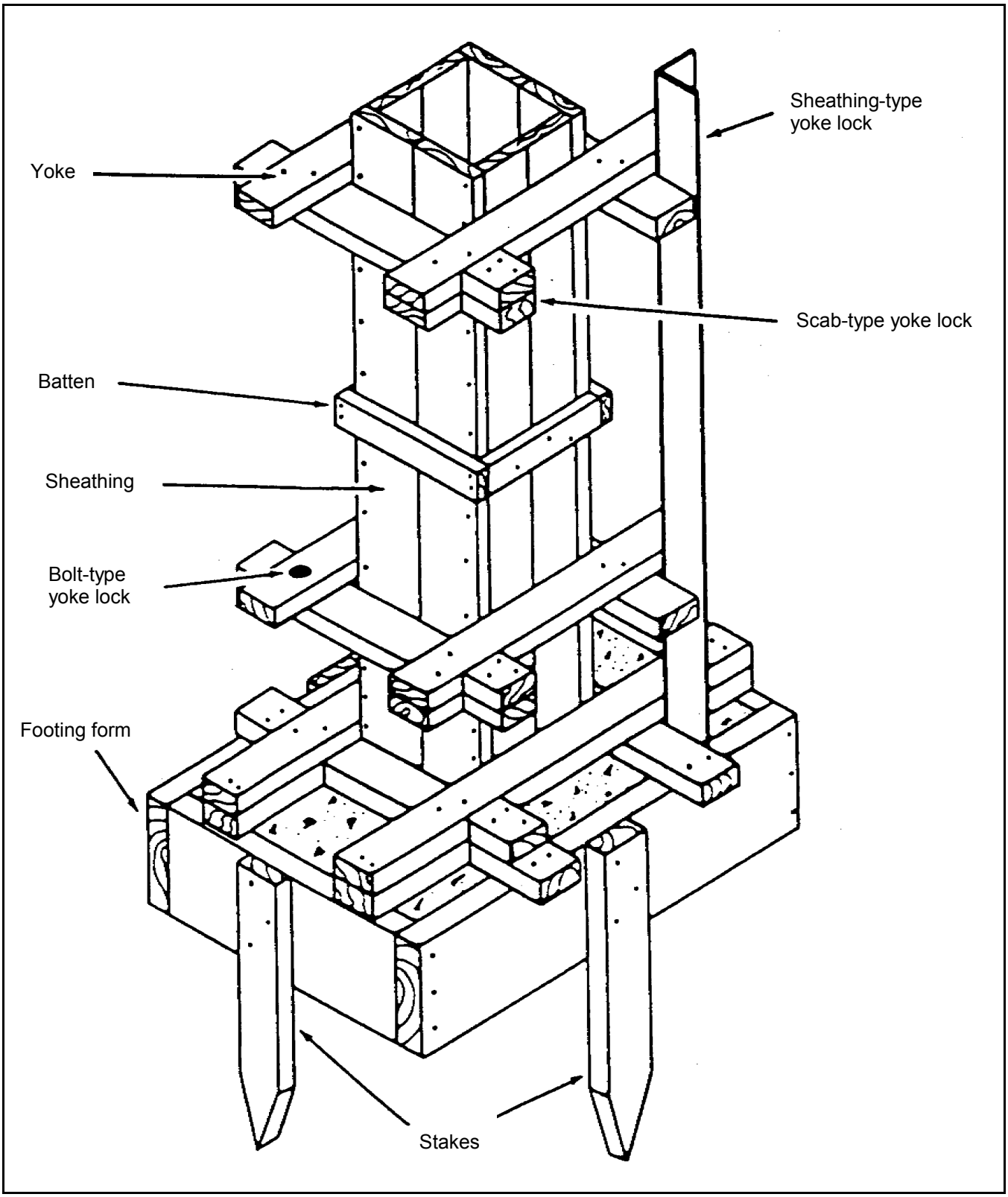


Figure 1. Elements of Wooden Forms for Concrete Columns

2. **Proper Materials Selection.** The first step in designing a form or a column is to select the materials to be used for sheathing, yokes, and battens.

- **Sheathing.** One-inch boards are used for sheathing. For economical purposes, 1- x 4-inch or 1- x 6-inch material is used. If these sizes are unavailable, 5/8- or 3/4-inch plywood may be used. Plywood or solid sheet metal is the best choice of material.

- **Yokes and battens.** The type of materials for yokes and battens are not specified in the design of a form; however, yokes are usually found in sizes of 2 x 2, 2 x 4, or 2 x 6 inches. If these sizes are unavailable, use whatever is available.

3. **Yoke Spacing.** Yoke spacing is determined by following the step-by-step procedure discussed below.

Step 1. Change the height of the column from feet to inches by multiplying the number of feet times 12. The product is the height of the column in inches which will be used in step 3b. The first yoke is always placed at the base of the column, flush with the top of the footing form *(Figure 2)*.

Step 2. Follow the intervals given in *Table 1*, and then total the spacing as you move up the table. Use *Table 1* to find the "maximum" yoke spacing as follows:

- Read down the height column until you reach the correct height of column as specified in the construction print.

- Read horizontally across the table to the column headed by the largest cross-sectional dimension as specified in the construction print.

  The center-to-center spacing of the second yoke above the base (first) yoke will be equal to the value in the lowest interval that is partly contained in the column height line.

- Obtain all subsequent yoke spacing by reading up this column to the top, except for the last yoke spacing.

NOTE: Do not count the last yoke spacing during this step. This is the area that you will be adjusting.

Step 3.

- ***3a.*** Adjust the spacing of the last yoke by first adding the already determined spacings together. The last yoke should be located at the top of the column.

  NOTE: As you total the spacing, use the whole number found in the first space where you entered the cross-sectional dimension column. You will adjust for any discrepancies in step 3b.

- ***3b.*** Subtract the yoke spacing, as determined in step 3a, from the total column height in inches. This will give you the correct yoke spacing for the remaining yoke. Ensure that your yoke spacing is correct so that you will not have more yokes than necessary.

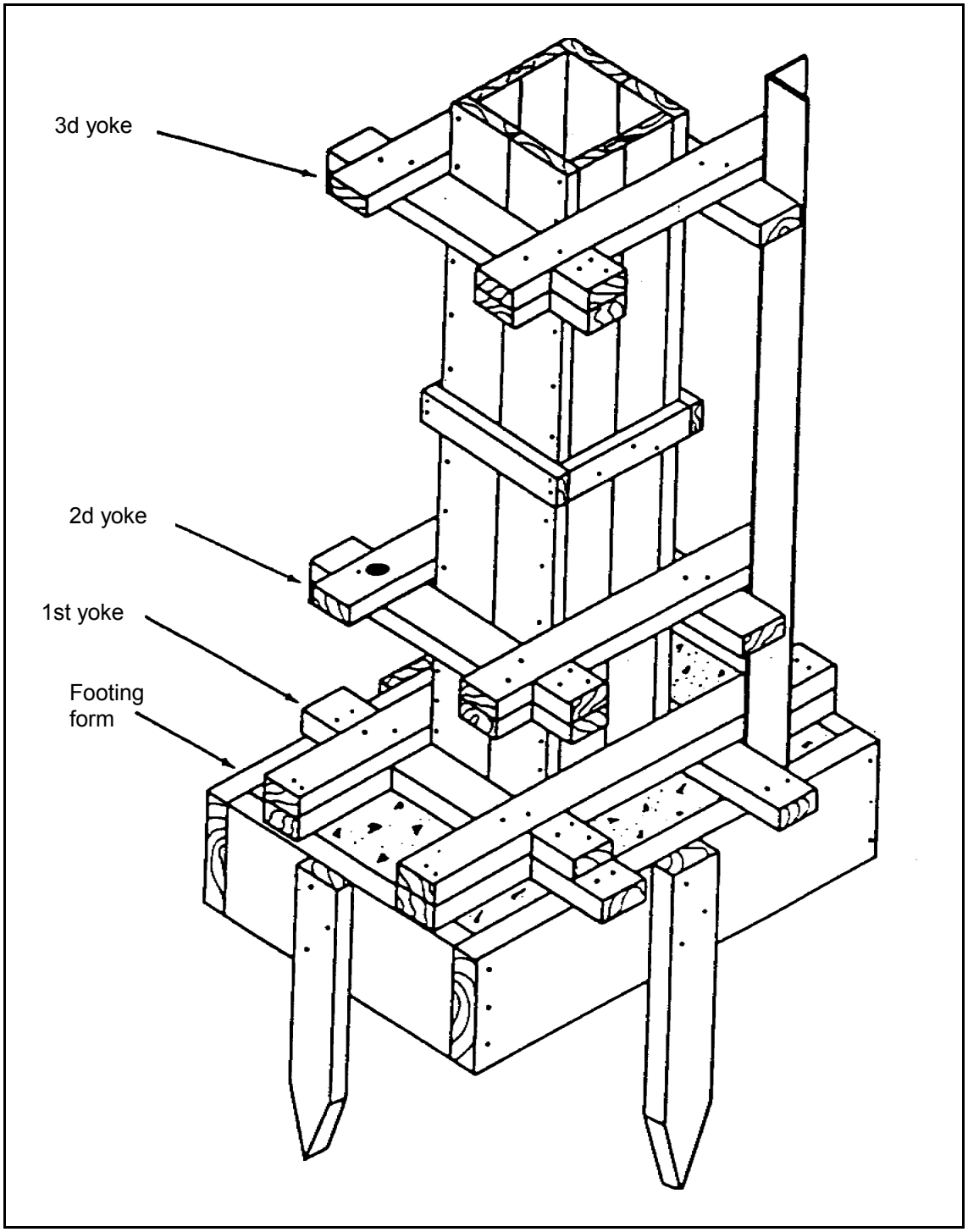
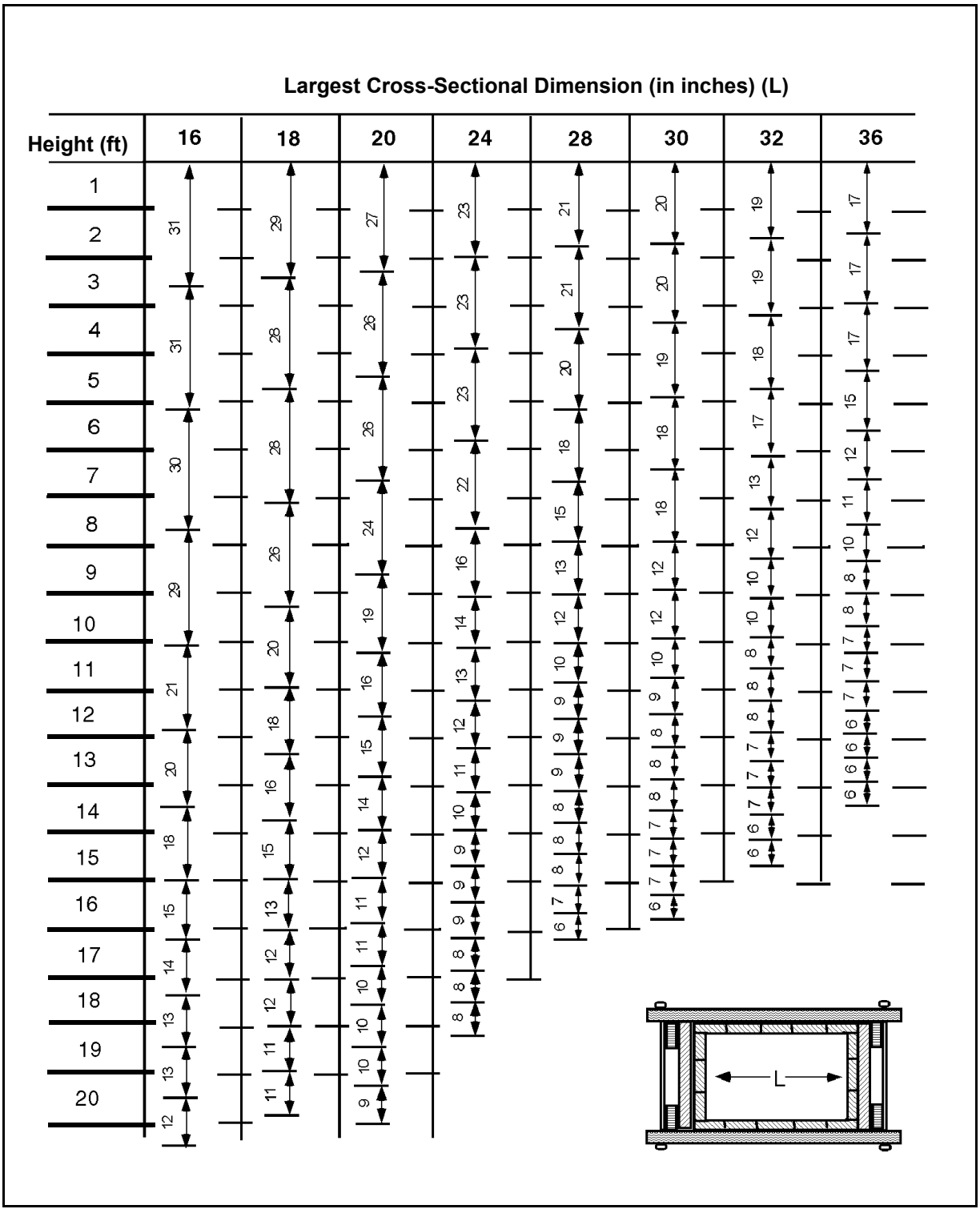


Figure 2. Placement of the First Yoke

Table 1. Column Yoke Spacing Based on the Use of 2- x 4- and 1-Inch Sheathing



4. **Example.** Determine the maximum (total) yoke spacing, the height of and distance between each of the yoke spacings, and the distance for the last yoke spacing for a column that is 13 feet high with a 24-inch cross-sectional dimension.

Step 1. Determine the total column height (in inches) as follows:

Total column height (in inches) = column height (in feet) x 12

13′ x 12″ = 156″

Step 2. Enter the 24-inch cross-sectional dimension column in *Table 1* at 13 feet.

Step 3.

- ***3a.*** Determine the maximum (total) yoke spacing as follows:

  Maximum (total) yoke spacing = sum of all but the last yoke spacing found in the column

  Yoke: **2d 3d 4th 5th 6th 7th 8th 9th**
  Yoke spacing: *11″ + 12″ + 13″ + 14″ + 16″ + 22″ + 23″ + 23″ = 134″*

- ***3b.*** Determine the distance for the last (tenth) yoke as follows:

  Distance for the last yoke = height of column - maximum (total) yoke spacing

  156″ - 134″ = 22″

The distance for the tenth yoke will be 22 inches from the ninth yoke *(Table 2 and Figure 3)*.

Table 2. Yoke Spacing

Yoke	Yoke Spacing (in)	Column Height (in)
2d	11″	11″
3d	12″	11 + 12 = 23″
4th	13″	23 + 13 = 36″
5th	14″	36 + 14 = 50″
6th	16″	50 + 16 = 66″
7th	22″	66 + 22 = 88″
8th	23″	88 + 23 = 111″
9th	23″	111 + 23 = 134″
10th	? ″ = 22″	134 + ? = 156″

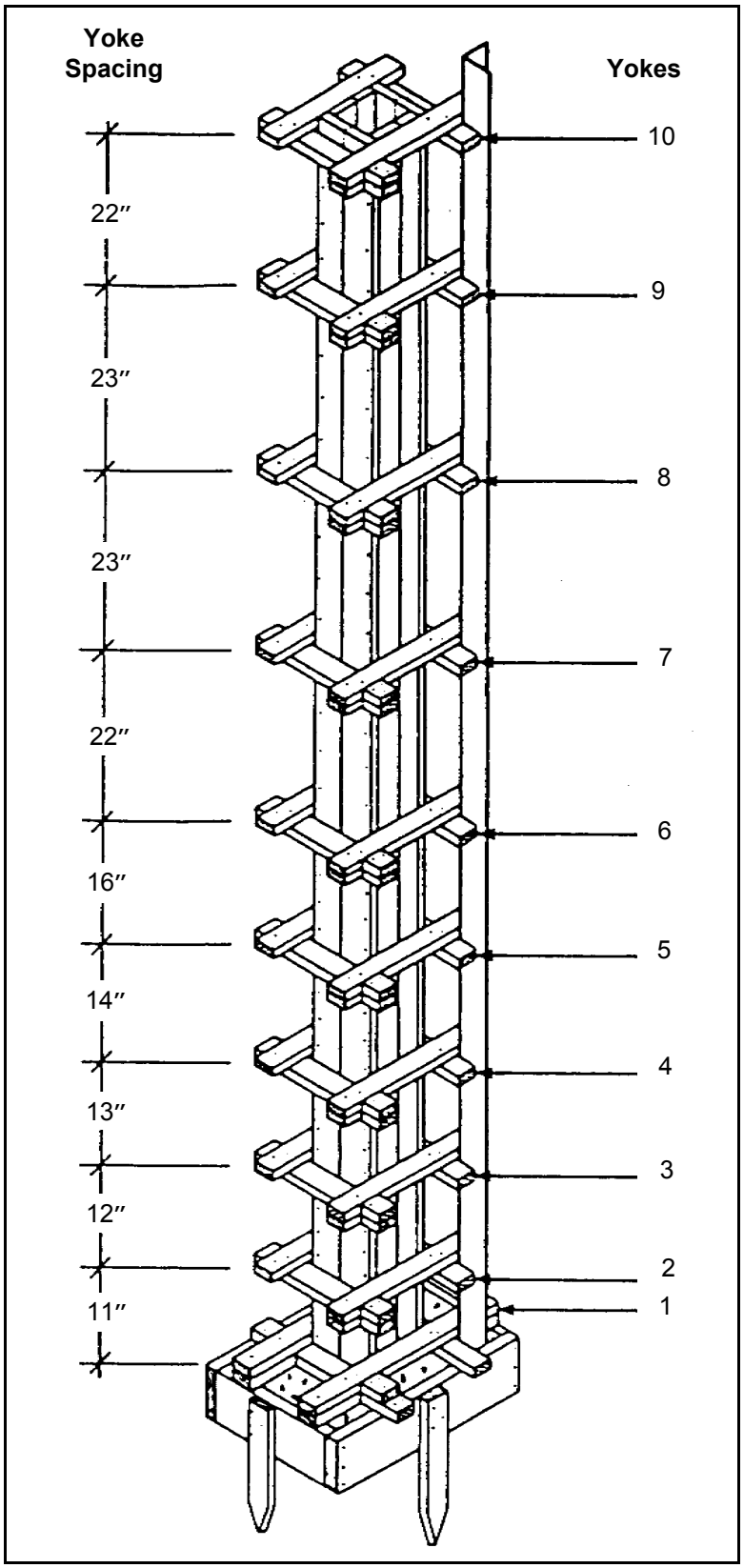


Figure 3. Yoke Spacing for a Concrete Column

LESSON

PRACTICE EXERCISE

Instructions: The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the key that follows. If you answer any item incorrectly, restudy the part of the lesson that contains the portion involved.

1. From the following list, what is the most appropriate material to use for sheathing on a column?

   A. 3/4-inch plywood

   B. 1- x 1-inch material

   C. 2- x 2-inch material

   D. 2- x 4-inch material

2. From the materials listed below, what is the best selection for yokes and battens?

   A. 1/2-inch plywood

   B. 1- x 1-inch material

   C. 2- x 6-inch material

   D. 4- x 4-inch material

3. What is the spacing of the fifth yoke if the column is 10 feet high with an 18-inch cross-sectional dimension?

   A. 20

   B. 22

   C. 28

   D. 30

4. What is the spacing of the fourth yoke if the column is 9 feet high with 28-inch cross-sectional dimension?

   A. 15

   B. 18

   C. 20

   D. 21

LESSON

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

1. From the following list, what is the most appropriate material to use for sheathing on a column?

   A. 3/4-inch plywood (paragraph 2)

   B. 1- x 1-inch material

   C. 2- x 2-inch material

   D. 2- x 4-inch material

2. From the materials listed below, what is the best selection for yokes and battens?

   A. 1/2-inch plywood

   B. 1- x 1-inch material

   C. 2- x 6-inch material (paragraph 2)

   D. 4- x 4-inch material

3. What is the spacing of the fifth yoke if the column is 10 feet high with an 18-inch cross-sectional dimension?

   A. 20

   B. 22

   C. 28 (paragraph 3)

   D. 30

4. What is the spacing of the fourth yoke if the column is 9 feet high with 28-inch cross-sectional dimension?

   A. 15

   B. 18 (paragraph 3)

   C. 20

   D. 21

APPENDIX A

LIST OF COMMON ACRONYMS

EN	engineer
FM	field manual
ft	foot; feet
in	inch(es)
SM	soldier's manual
STP	soldier's training publication
TG	trainer's guide

APPENDIX B

RECOMMENDED READING LIST

The following publications provide additional information about the material in this subcourse. You do not need these materials to complete this subcourse.

FM 5-426. *Carpentry.* 3 October 1995.

FM 5-428. *Concrete and Masonry.* 18 June 1998.

APPENDIX C

METRIC CONVERSION CHART

This appendix complies with current Army directives which state that the metric system will be incorporated into all new publications. *Table C-1* is a metric conversion chart.

Table C-1. Metric Conversion Chart

English Units	Multiplied By	Metric Units
Feet	0.30480	Meters
Inches	2.54000	Centimeters
Inches	0.02540	Meters
Inches	25.40010	Millimeters
Pounds	453.59000	Grams
Pounds	0.45360	Kilograms
Yards	0.91440	Meters
Metric Units	**Multiplied By**	**English Units**
Centimeters	0.39370	Inches
Grams	0.03527	Ounces
Kilograms	2.20460	Pounds
Meters	1.09360	Yards
Meters	3.28080	Feet
Meters	39.37000	Inches
Millimeters	0.03937	Inches