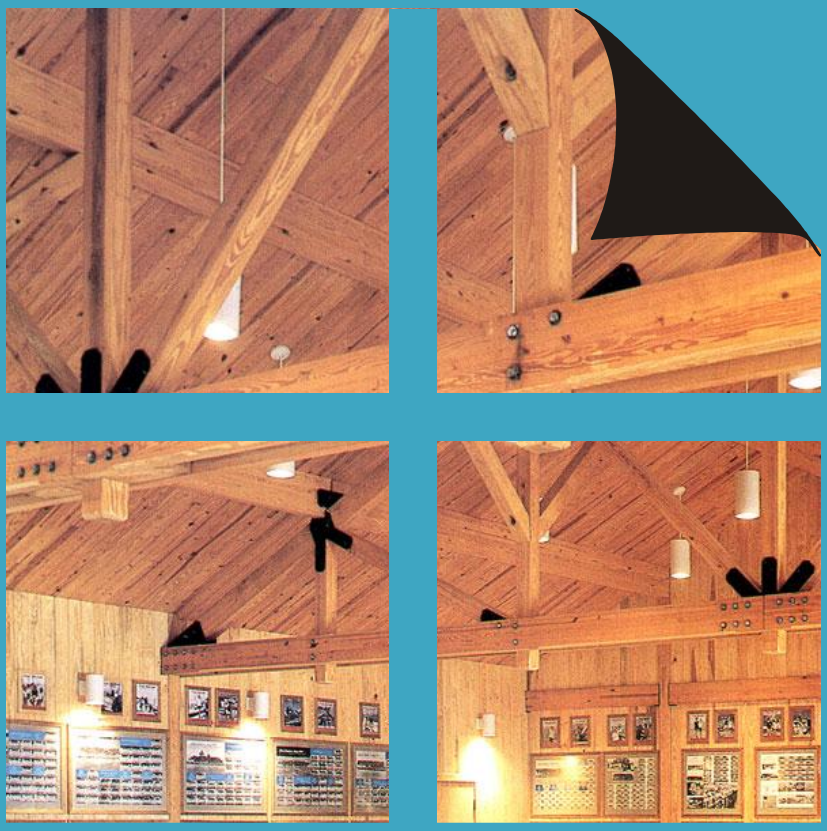
HEAVY TIMBER CONSTRUCTION



American Wood Council

5 Wood Construction Data

American Forest & Paper Association

HEAVY TIMBER CONSTRUCTION

The American Wood Council *(AWC) is the wood products division of the American Forest & Paper Association (AF&PA). AF&PA is the national trade association of the forest, paper and wood products industry, representing member companies engaged in growing, harvesting and processing wood and wood fiber, manufacturing pulp, paper and paperboard products form both virgin and recycled fiber, and producing engineered and traditional wood products. For more information see www.afandpa.org.*

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FOREWORD

Heavy timber construction is one of the oldest types of buildings used in the development of this country. Its superior performance has been demonstrated in thousands of buildings during the past hundred and fifty years, many of which are still in satisfactory use.

As originally conceived, the heavy timber building was a multi-story structure, designed and used primarily for industrial and storage purposes. Today, its use has been expanded to include many other occupancies. It is commonly used for assembly and mercantile buildings, such as schools, churches, auditoriums, gymnasiums, supermarkets, and for various other structures.

Many of the modern heavy timber buildings are large in area and one story in height. However, the modern multistory heavy timber building has proved to be entirely practical and satisfactory.

By using stress-graded lumber, either sawn or glued laminated timbers, precise structural design procedures can be applied to heavy timber framing, resulting in a completely engineered structure. With properly designed fastenings such building can be relied upon to safely support anticipated loads.

Information on structural design is provided in the National Design Specification® for Wood Construction published by the American Forest & Paper Association.

The excellent fire resistance of heavy timber framing has been demonstrated in many building fires over the years. Building codes recognize its superior performance by allowing larger sizes for buildings of this type. Heavy timber construction is also recognized in fire insurance rating schedules through lower rates.

The beauty of exposed wood combined with the fire resistance of the heavy timber framing has produced highly desirable results. Outstanding examples of modern church architecture have used this method of construction. It is to be found in many fine auditoriums and schools. These are the show places where esthetics are important. But it also is widely used in commercial, industrial and storage buildings where utility and economy are prime factors to be considered.

This publication defines the minimum requirements for heavy timber construction, and provides illustrations of good construction details. These are recommended to the architect and builder as a guide in developing a safe and economical form of construction.

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GENERAL

Heavy timber is a type of construction in which fire resistance is attained by placing limitations of minimum sizes on wood structural members and on minimum thickness and composition of wood floors and roofs; by avoidance of concealed spaces under floors and roofs; by use of approved fastenings, construction details, and adhesives; and by providing the required degree of fire resistance in exterior and interior walls.

Special effort has been made to ensure the accuracy of the information presented. It is intended that this document be used in conjunction with competent engineering design, accurate fabrication, and adequate supervision of construction. However, the American Forest & Paper Association does not assume any responsibility for errors or omissions in WCD No. 5, nor for engineering designs or plans prepared from it. The reader is encouraged to consult the current edition of the code and to consult the authority having jurisdiction.

MATERIALS

Decay Resistance

Structural members that are exposed to weather shall be preservatively treated or be from the heartwood of a naturally durable wood.

Sawn Lumber

The lumber used in heavy timber framing members and decking shall be graded in accordance with the grading rules under which the species is customarily graded. Specific grading rules may be obtained from the respective rules writing agencies:

1. "Standard Grading Rules for Northeastern Lumber," Northeastern Lumber Manufacturers Association, 272 Tuttle Rd., PO Box 87A, Cumberland Center, ME 04021 (NELMA)
2. "Standard Specifications for Grades of California Redwood Lumber," Redwood Inspection Service, 405 Enfrente Dr., Suite 200, Novato, CA 94949 (RIS)
3. "Standard Grading Rules For Southern Pine Lumber," Southern Pine Inspection Bureau, 4709 Scenic Highway, Pensacola, FL 32504 (SPIB)
4. "Standard Grading Rules for West Coast Lumber, No. 17," West Coast Lumber Inspection Bureau, P.O. Box 23145, Portland, OR 97223 (WCLIB)
5. "Western Lumber Grading Rules," Western Wood Products Association, 522 SW Fifth, Suite 500, Portland, OR 97204 (WWPA)
6. "NLGA Standard Grading Rules for Canadian Lumber," National Lumber Grades Authority, 960 Quayside Dr., New Westminster, B.C., Canada V3M 6G2

Structural Glued Laminated Timber

1. "ANSI/AITC A190.1-1992 American National Standard, Structural Glued Laminated Timber," American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, CO 80112
2. "AITC 117-2001 Standard Specifications for Structural Glued Laminated Timber of Softwood Species," American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, CO 80112
3. "APA EWS Technical Note Y117," P.O. Box 11700, Tacoma, Washington 98411-0700

FRAMING MEMBERS

Columns

1. Wood columns may be sawn or glued laminated and shall be not less than 8 inches, nominal, in any dimension when supporting floor loads, and not less than 6 inches, nominal, in width and 8 inches, nominal, in depth when supporting roof and ceiling loads only.
2. Columns shall be continuous or superimposed throughout all stories by means of reinforced concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other methods.

Floor Framing

1. Beams and girders of wood may be sawn or glued laminated and shall be not less than 6 inches, nominal, in width and not less than 10 inches, nominal, in depth.
2. Wood-frame or glued laminated arches which spring from the floor line and support floor loads shall be not less than 8 inches, nominal, in any dimension.
3. Sawn timber trusses supporting floor loads shall have members of not less than 8 inches, nominal, in any dimension.

Roof Framing

1. Wood-frame or glued laminated arches for roof construction which spring from the floor line or grade and do not support floor loads shall have members not less than 6 inches, nominal, in width and 8 inches, nominal, in depth for the lower half of the height and not less than 6 inches, nominal, in any dimension for the upper half of the height.
2. Wood-frame or glued laminated arches for roof construction which spring from the top of walls or wall abutments, sawn timber trusses and other roof framing which do not support floor loads, shall have members not less than 4 inches, nominal, in width and not less than 6 inches, nominal, in depth. Spaced members may be composed of two or more pieces not less than 3 inches, nominal, in thickness when blocked solidly throughout their intervening spaces or when such spaces are tightly closed by a continuous wood cover plate of not less than 2 inches, nominal, in thickness, secured to the underside of the members (See Figure 11). Splice plates shall be not less than 3 inches, nominal, in thickness. When protected by automatic sprinklers under the roof deck, such framing members shall be not less than 3 inches, nominal, in width.

Construction Details

1. Wall plate boxes of self-releasing type, or hangers, shall be provided where beams and girders enter masonry. An air space of 1/2 inch shall be provided at the top, end and sides of the member unless naturally durable or preservatively treated wood is used.
2. Girders and beams shall be closely fitted around columns and adjoining ends shall be cross-tied to each other, or inter-tied by caps or ties, to transfer horizontal loads across the joint. Wood bolsters may be placed on tops of columns which support roof loads only (See Figures 4-6).
3. Where intermediate beams are used to support floors, they shall rest on top of the girders, or shall be supported by ledgers or blocks securely fastened to the sides of the girders, or they may be supported by metal hangers into which the ends of the beams shall be fitted closely (See Figure 9).
4. Columns, beams, girders, arches and trusses of material other than wood shall have a fire resistance rating of not less than one hour.
5. Wood beams and girders supported by walls required to have a fire resistance rating of two hours or more shall have not less than 4 inches of solid masonry between their ends and the outside face of the wall, and between adjacent beams.
6. Adequate roof anchorage shall be provided.

DECKING

Floor Decks

Floor decks shall be without concealed spaces, except that building service equipment may be enclosed provided the enclosed space is fire blocked or protected by other acceptable means. Floor decks shall be of sawn or glued laminated plank, splined, or tongued and grooved, of not less than 3 inches, nominal, in thickness; or of planks not less than 4 inches, nominal, in width set on edge and well spiked together.

The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be covered with 1-inch, nominal, tongued and grooved flooring laid crosswise or diagonally or with 1/2 inch structural panels. Planks and flooring shall not extend closer than 1/2 inch to walls to provide an expansion joint, and the joint shall be covered at top or bottom (See Figures 7 and 8).

Roof Decks

Roofs shall be without concealed spaces and roof decks shall be sawn or glued laminated, splined or tongued-and-grooved plank, not less than 2 inches, nominal, in thickness; or of planks not less than 3 inches, nominal, in width set on edge and spiked together as required for floors; or of 1-1/8 inch thick tongued and grooved plywood bonded with exterior adhesive. Other types of decking may be used when approved by the building official. See WCD No. 2 for design guidelines for roof decking.

WALLS

Bearing Walls

Bearing portions of exterior walls shall be of non-combustible material or fire retardant treated wood and shall have a fire resistance rating of 2 hours except that for fire separation distances less than 5 feet in group H facilities the walls shall have a fire resistance rating of 3 hours. Interior walls shall be solid or laminated wood without concealed spaces or shall have a fire resistance rating of 1 hour.

Non-Bearing Walls

Non-bearing portions of exterior walls shall be of non-combustible materials or fire retardant treated wood except as otherwise noted and:

1. Where a horizontal separation of not more than 5 feet is provided, non-bearing exterior walls shall have a fire resistance rating of 2 hours, except that group H facilities shall have a fire resistance rating of 3 hours.
2. Where a horizontal separation of more than 5 feet but less than 10 feet is provided, non-bearing exterior walls shall have a fire resistance rating of 1 hour, except that group H facilities shall have a fire resistance rating of 2 hours.
3. Where a horizontal separation of 10 feet to 30 feet is provided, non-bearing exterior walls shall have a fire resistance rating of 1 hour.
4. Where a horizontal separation of 30 feet, or more, is provided, non-bearing exterior walls are not required to have a fire resistance rating.
5. Where a horizontal separation of 20 feet, or more, is provided wood columns and arches, conforming to heavy timber sizes may be used externally.

Non-bearing portions of interior walls shall be of solid wood construction formed by two or more layers of 1-inch matched boards or laminated construction 4 inches thick, or shall have a fire resistance rating of 1 hour.

MINIMUM GLUED LAMINATED DIMENSIONS FOR TYPE IV HEAVY TIMBER CONSTRUCTION

Minimum solid sawn nominal dimensions are required for structures built using type IV construction (Heavy Timber) per the building code. For glued laminated members the equivalent net finished width and depths corresponding to the minimum nominal width and depths required are specified in the following table:

Minimum Nominal Solid Sawn Size		Minimum Glued Laminated Net Size	
Width, in.	Depth, in.	Width, in.	Depth, in.
8	8	6-3/4	8-1/4
6	10	5	10-1/2
6	8	5	8-1/4
6	6	5	6
4	6	3	6-7/8

ILLUSTRATIONS

The illustrations on the following pages include recommended construction details which have been found through experience to be satisfactory. The number and size of bolts, lag screws or connectors should be determined through analysis of the loads to be supported.

Figures 1 and 2 show sections through multi-story buildings with the connections between members indicated by an encircled letter, such as B . Details pertinent to each encircled letter are included in Figures 3 through 9. Various alternate methods are shown for each connection with the choice left to the designer on the basis of job conditions.

Figures 10 through 12 include miscellaneous construction details.

Figures 13 and 14 include illustrations and details for one-story buildings. These represent only a few of the many methods used in one-story heavy timber buildings. Because of the varied forms and arrangement of members in such buildings the timber fabricating firms find it practical to design each joint and its fastenings to meet the specific job conditions. Thus no attempt was made to completely cover details for these buildings in this publication.

Figure 1. Multi-Story Building with Decking on Beams (Refer to details in Figures 3-9)

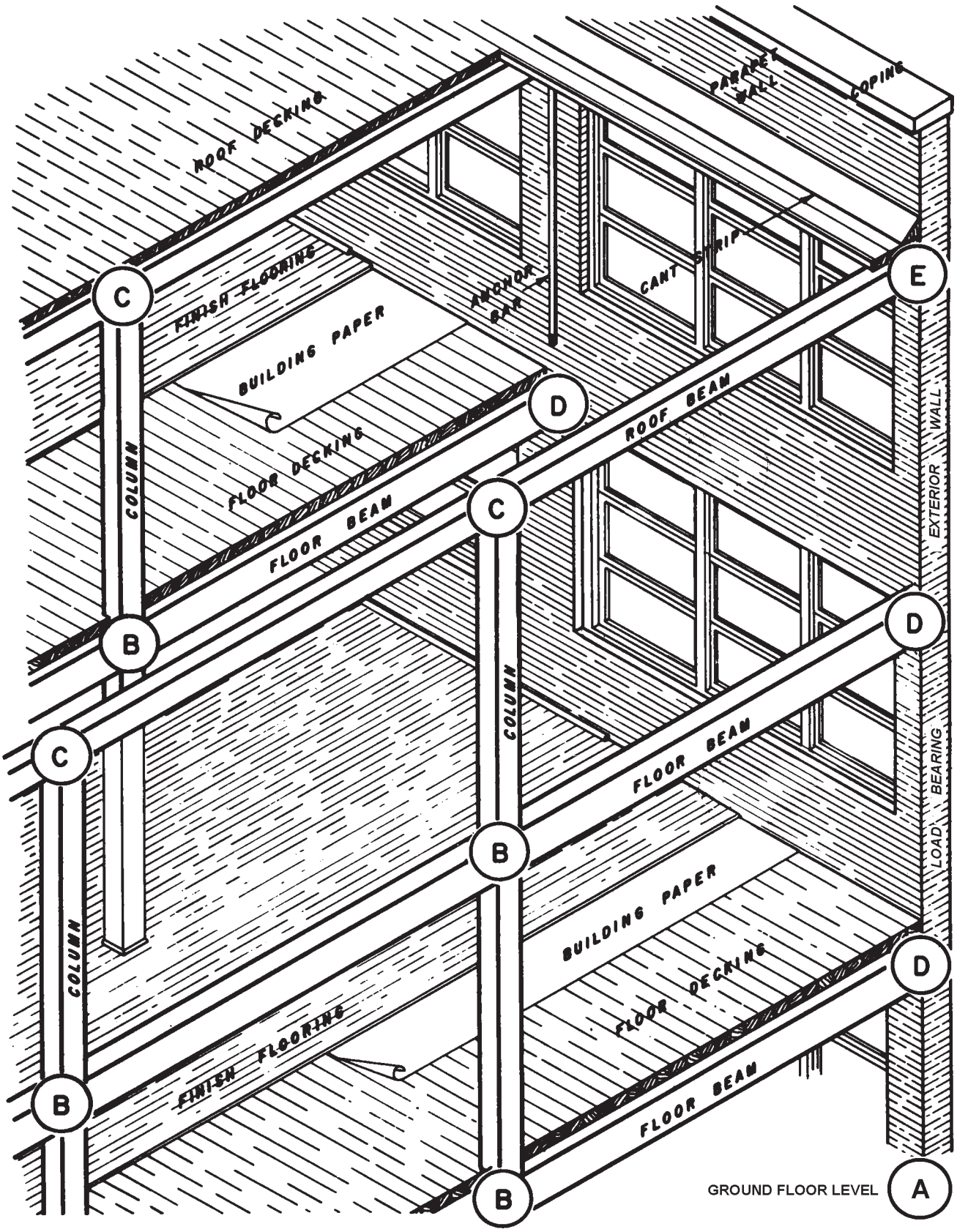


Figure 2. Multi-Story Building with Decking on Beams and Girders (Refer to details in Figures 3-9)

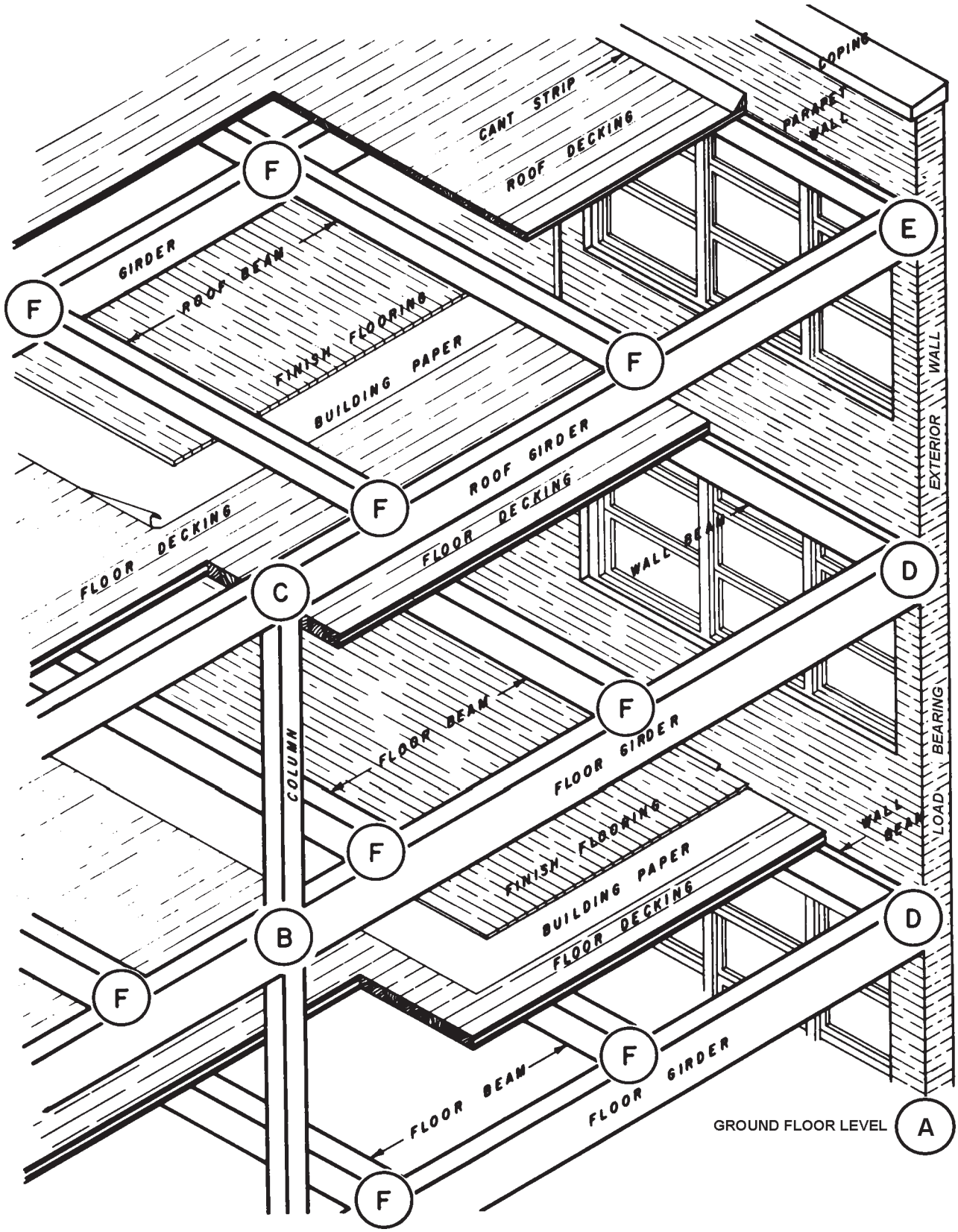


Figure 3. Column Anchorage

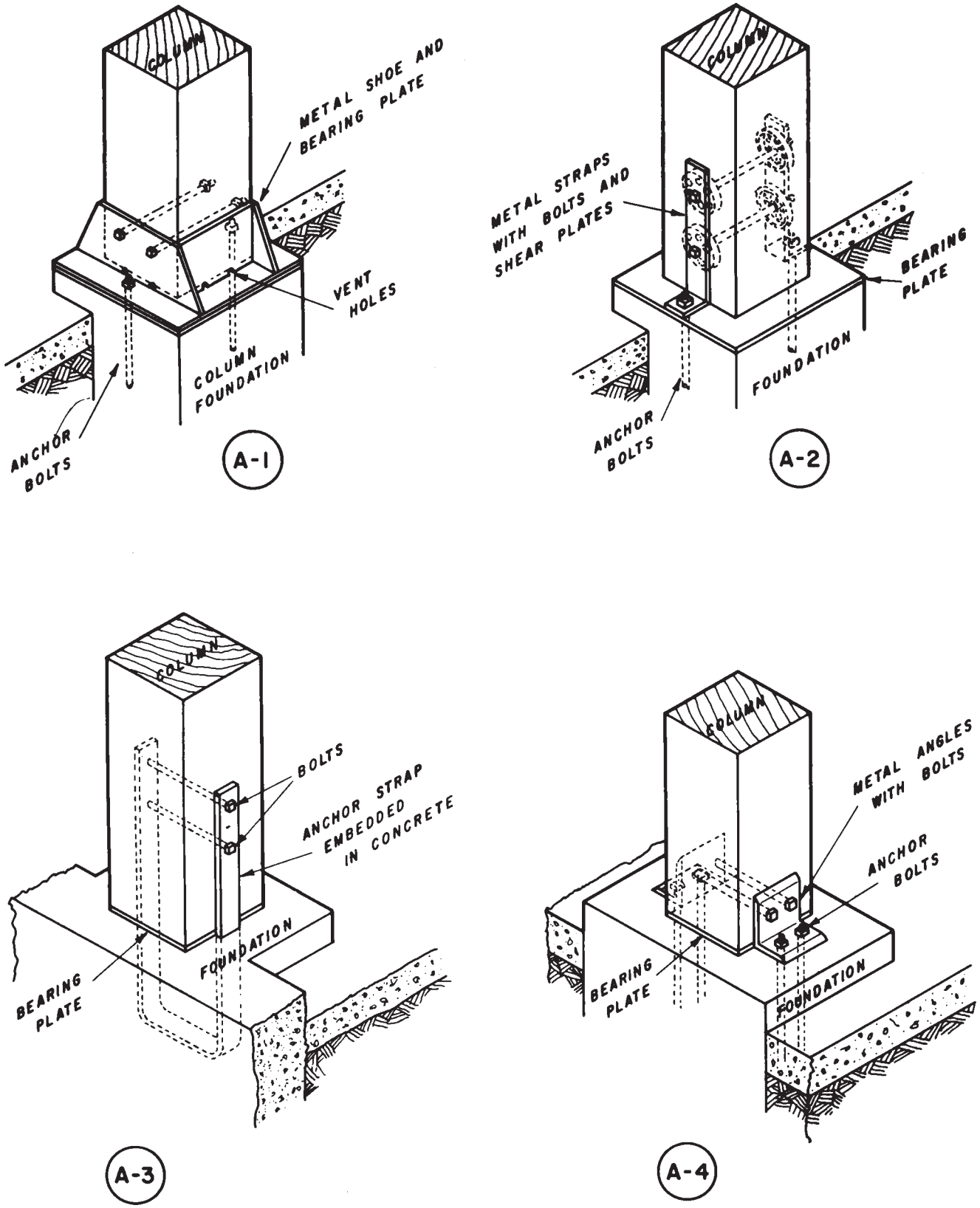


Figure 4. Floor Beam and Column Framing

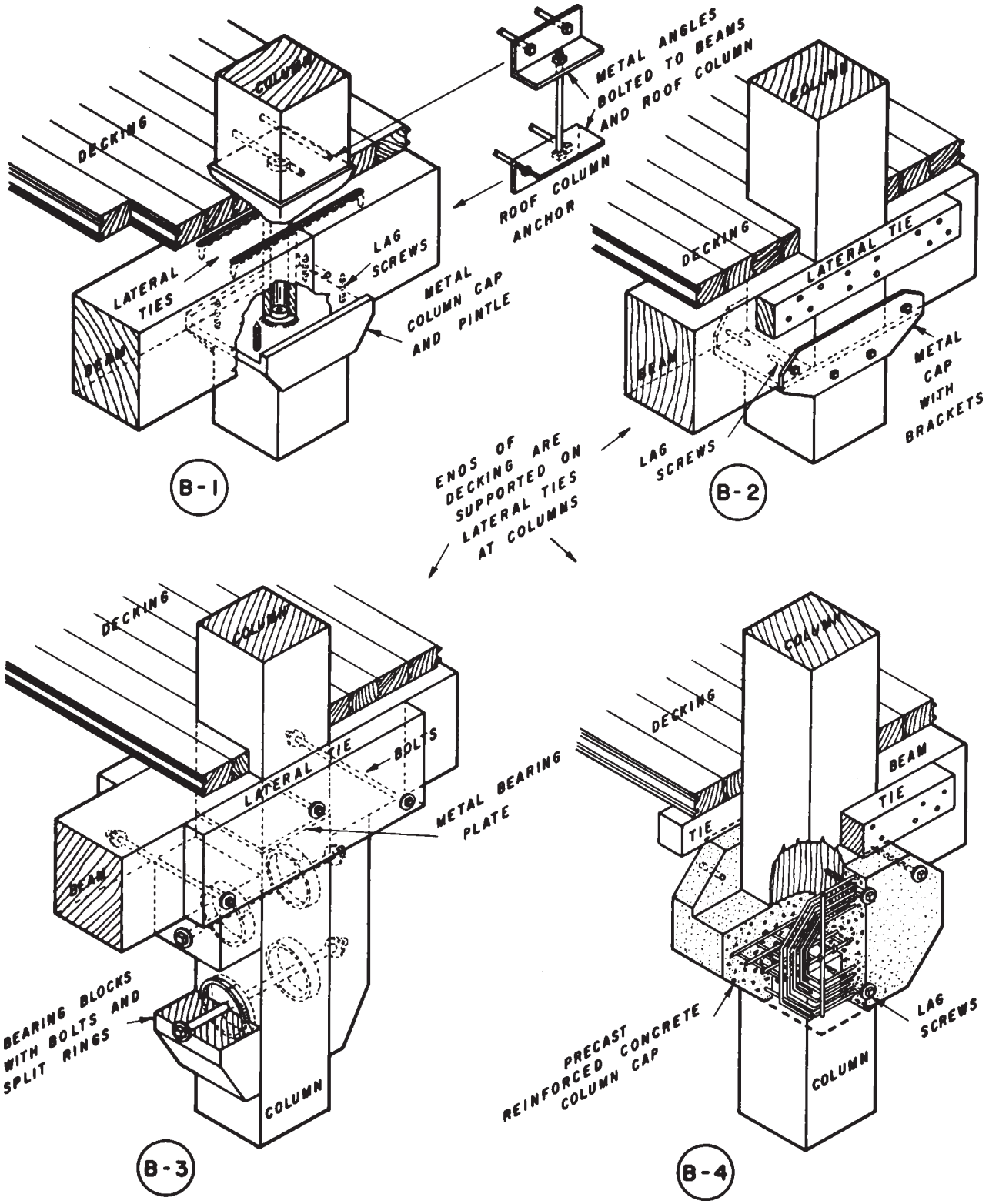


Figure 5. Floor Beam and Column Framing

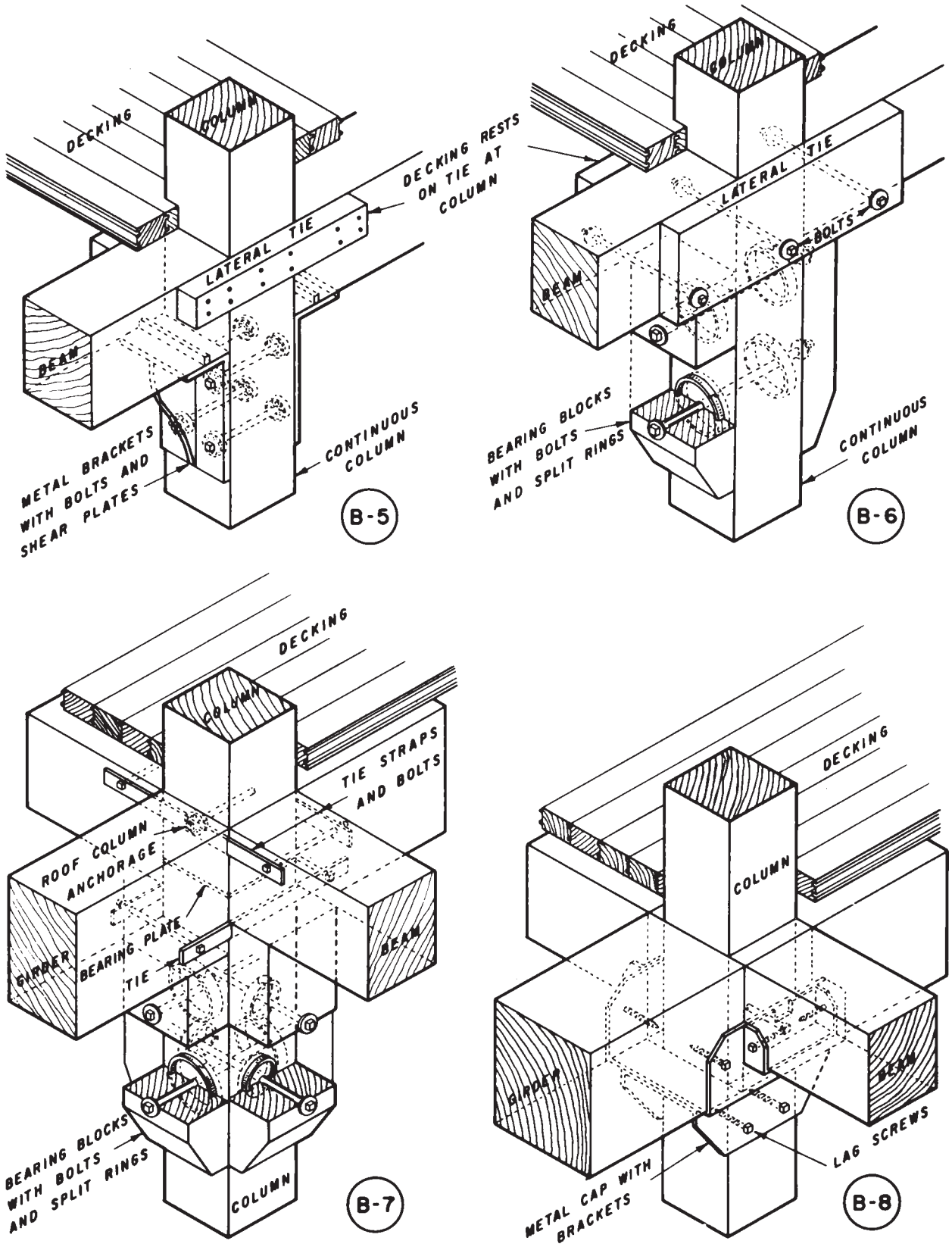


Figure 6. Roof Beam and Column Framing

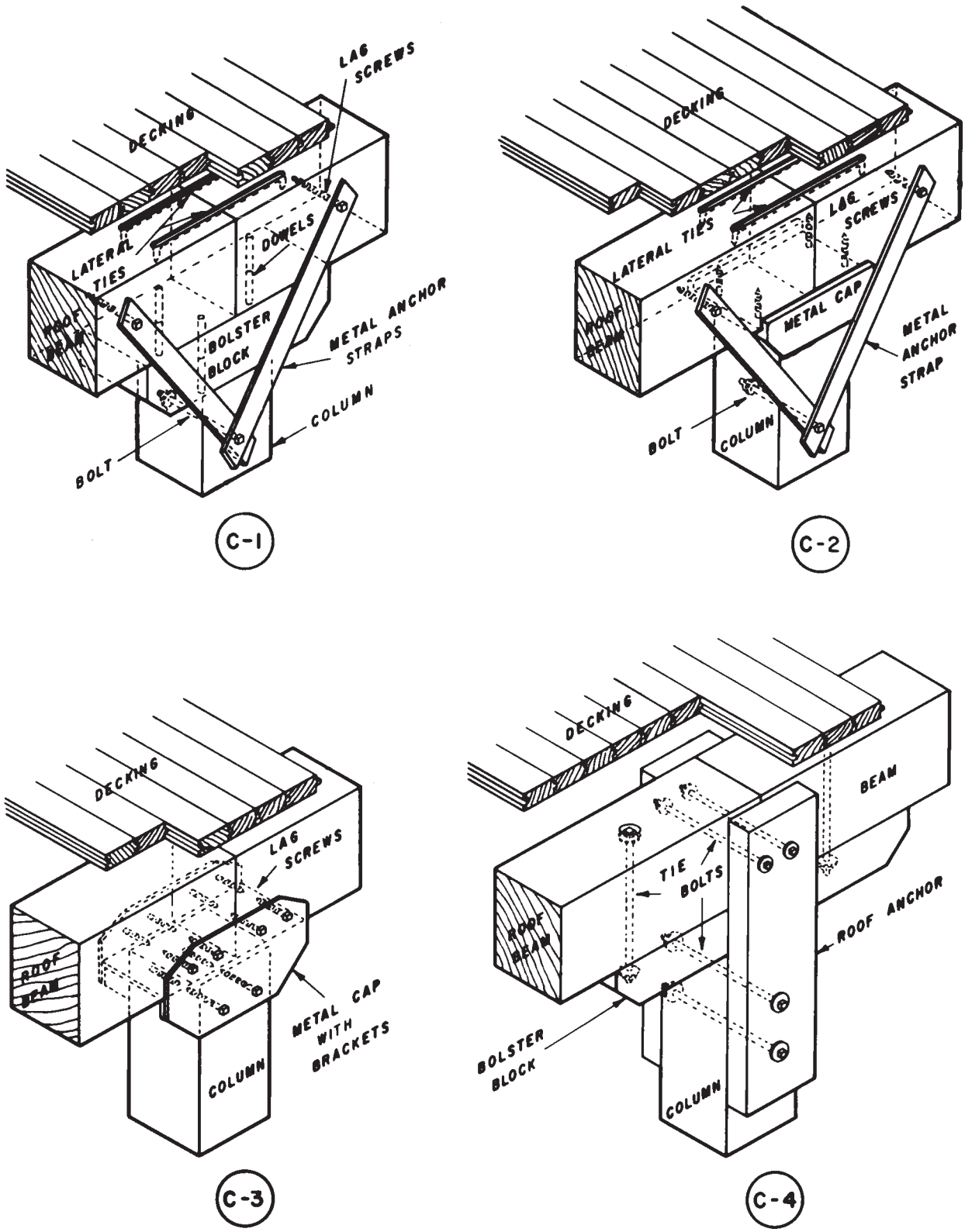


Figure 7. Floor Framing at Exterior Walls

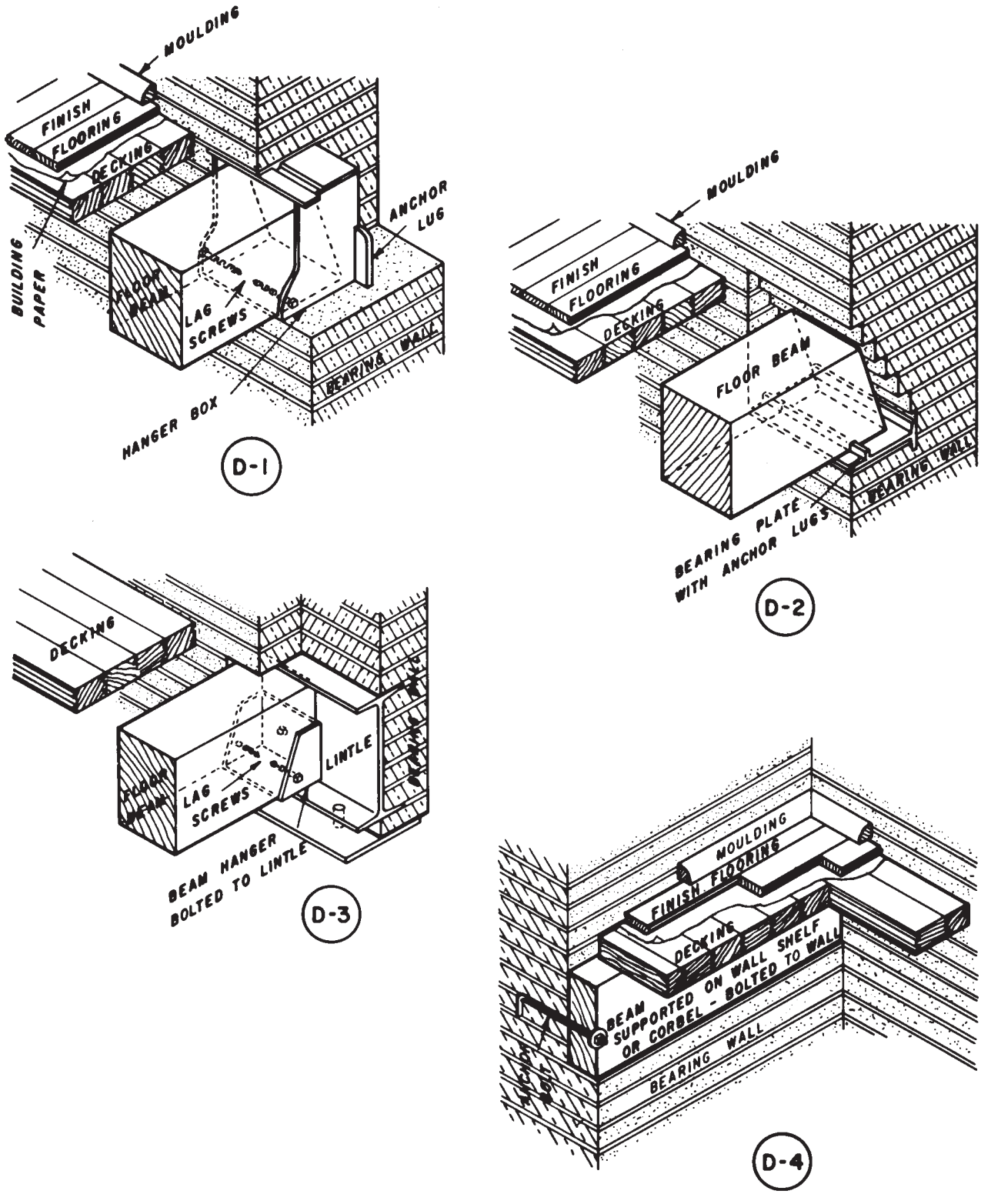


Figure 8. Roof Framing at Exterior Walls

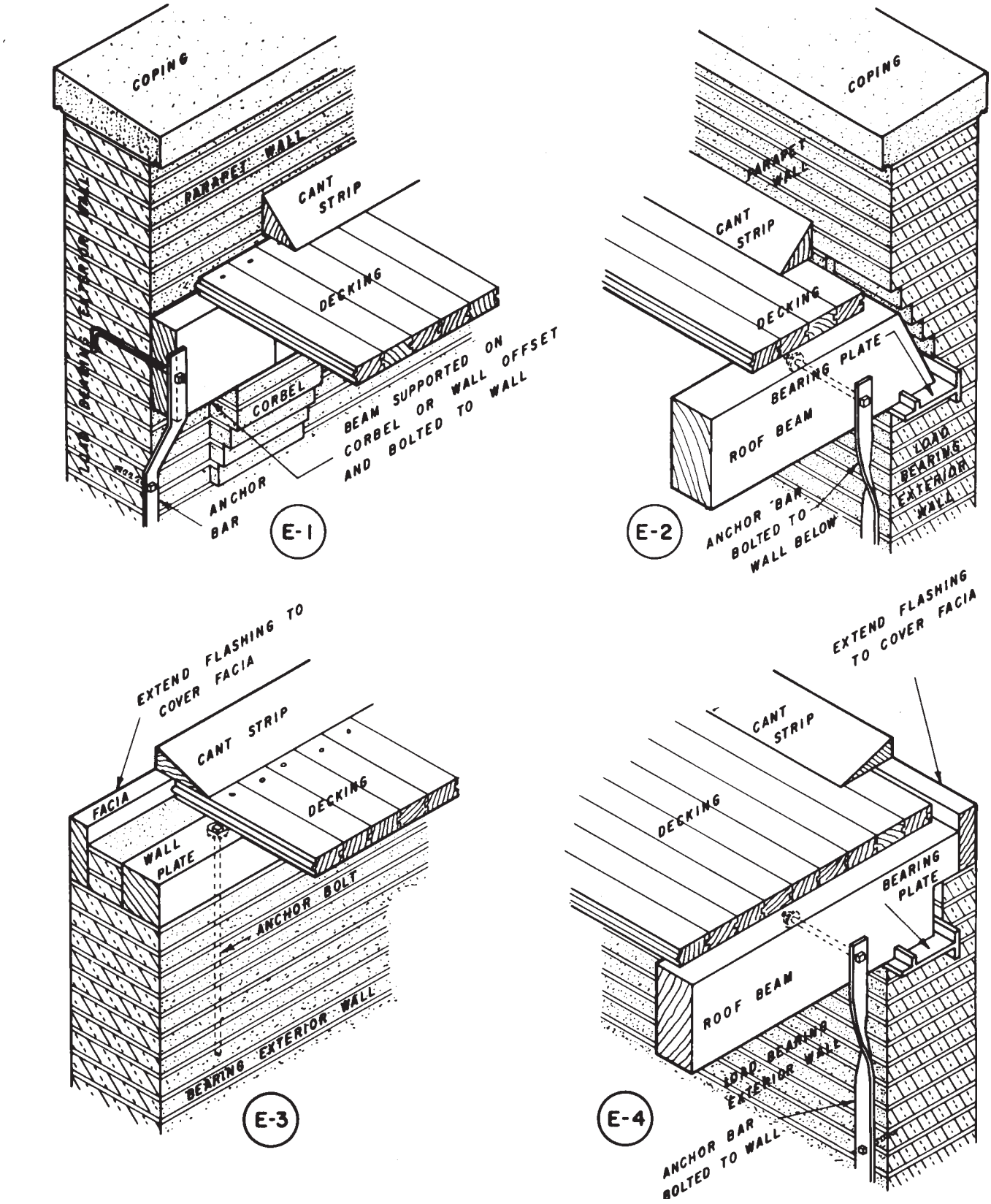


Figure 9. Beam and Girder Framing

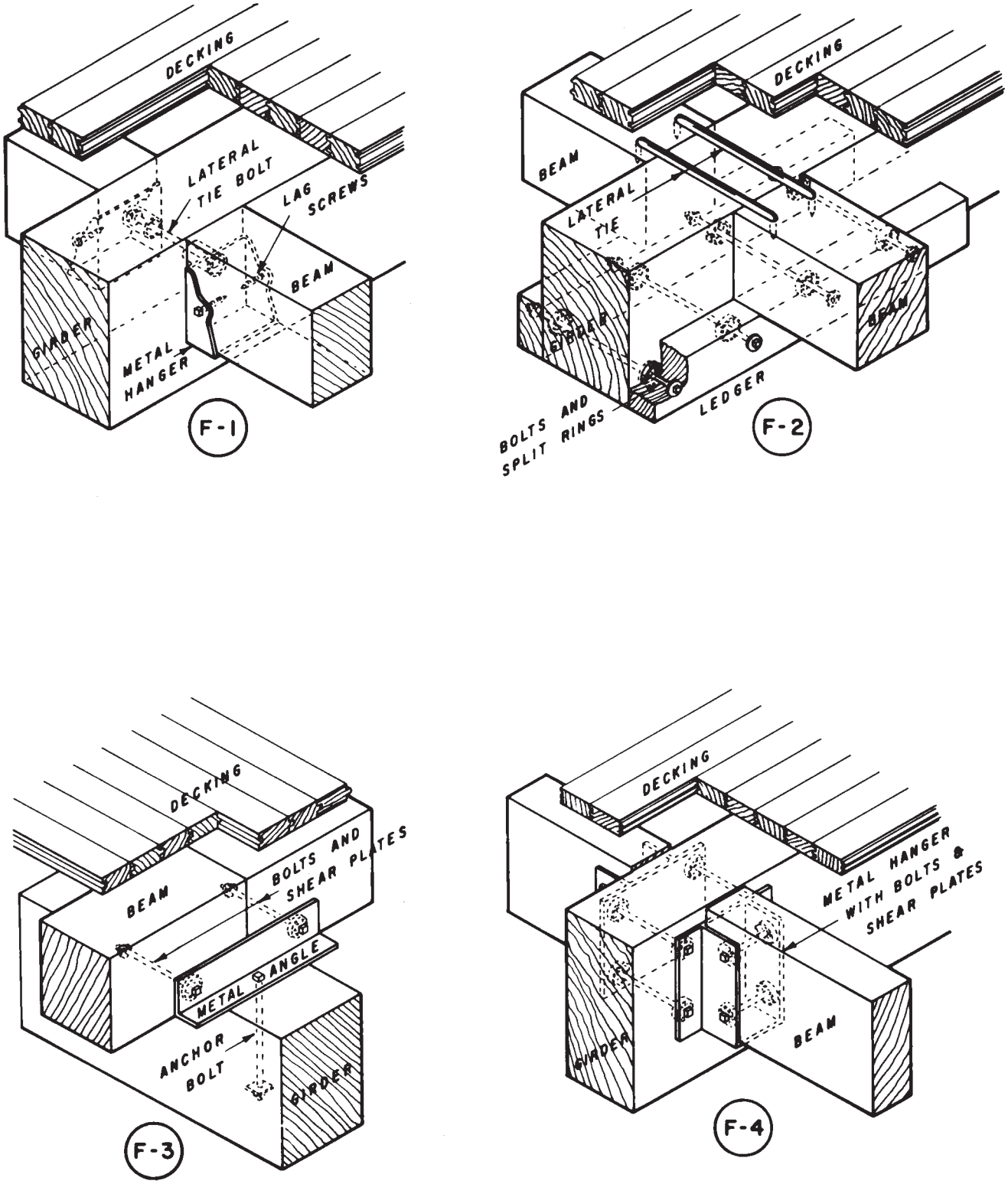
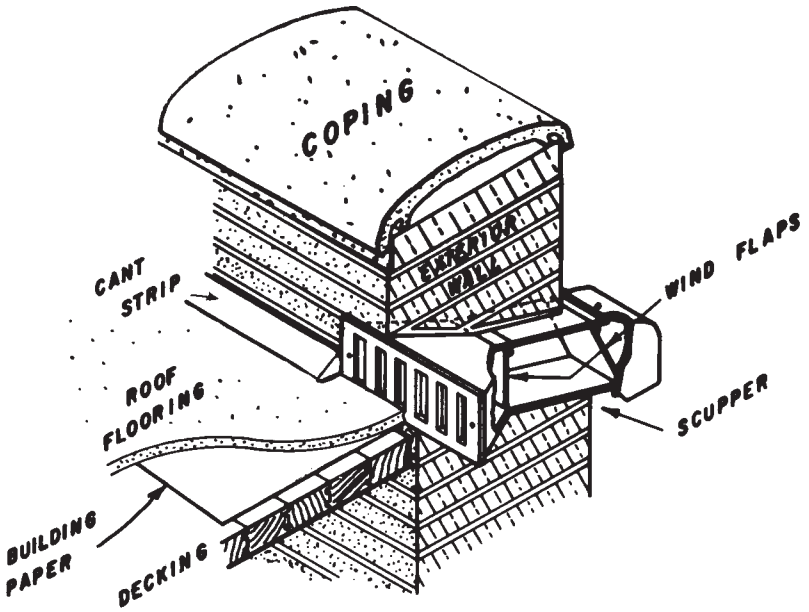


Figure 10. Typical Framing at Fire or Party Wall



DETAIL AT SCUPPER

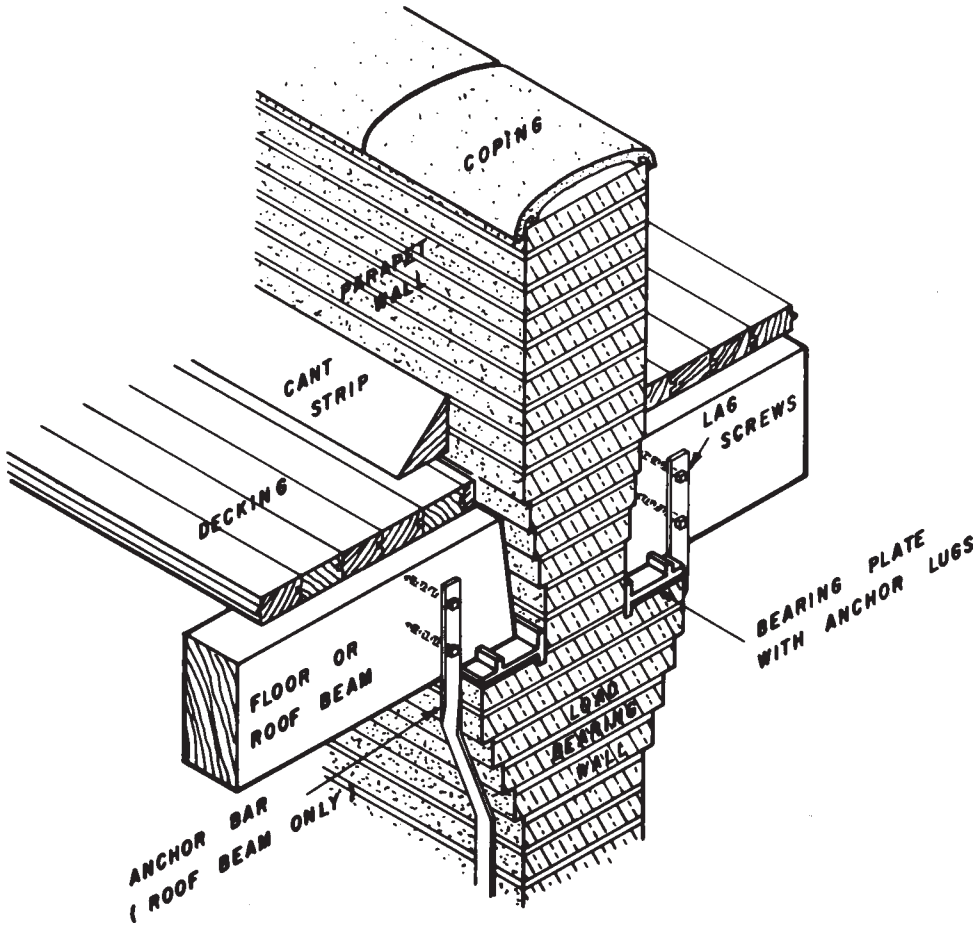


Figure 11. Protection of Spaced Members

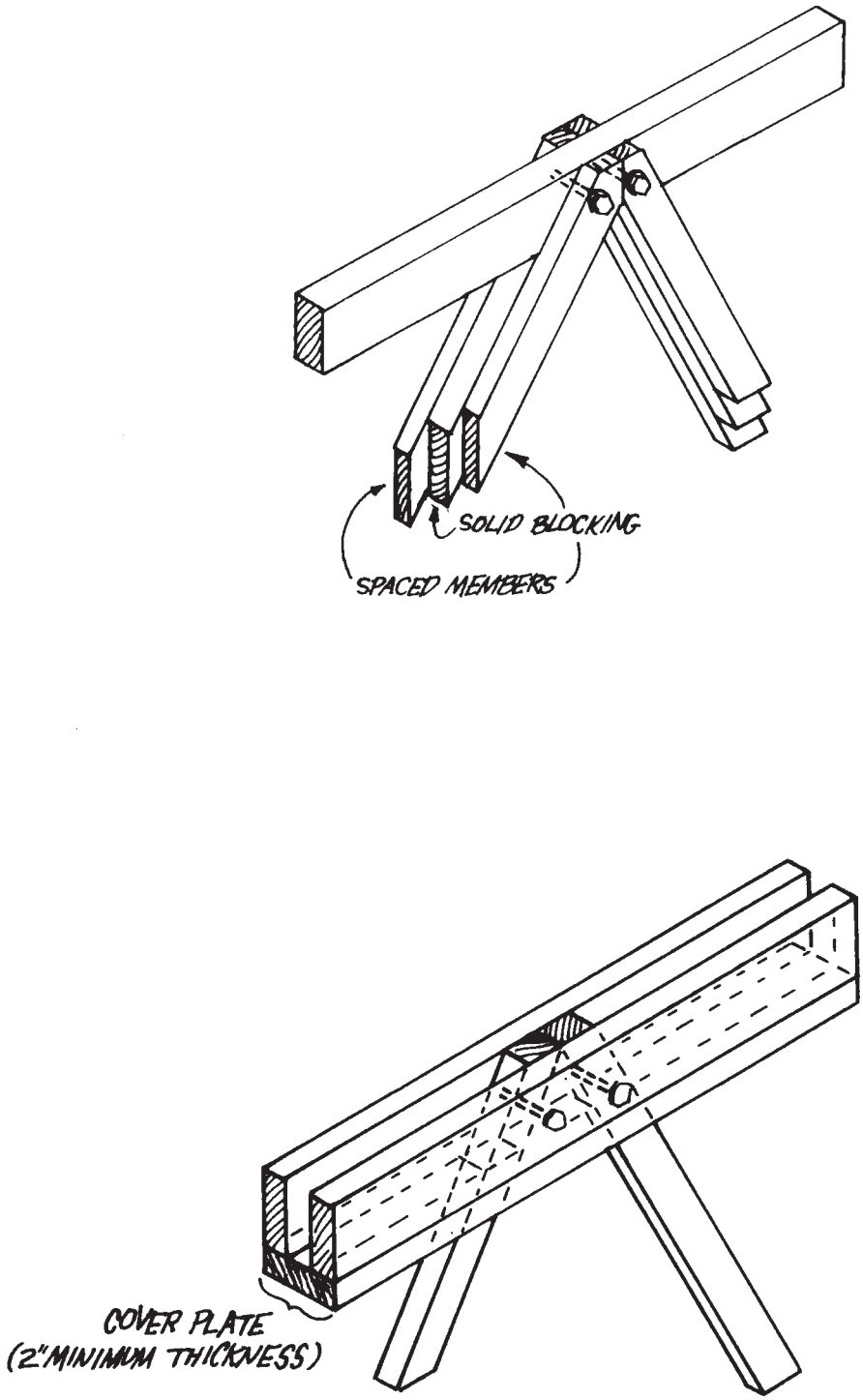
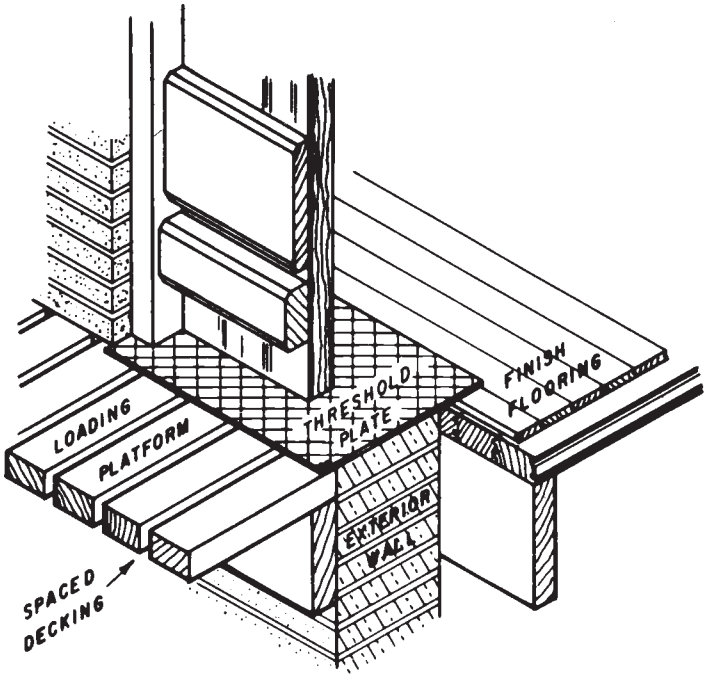
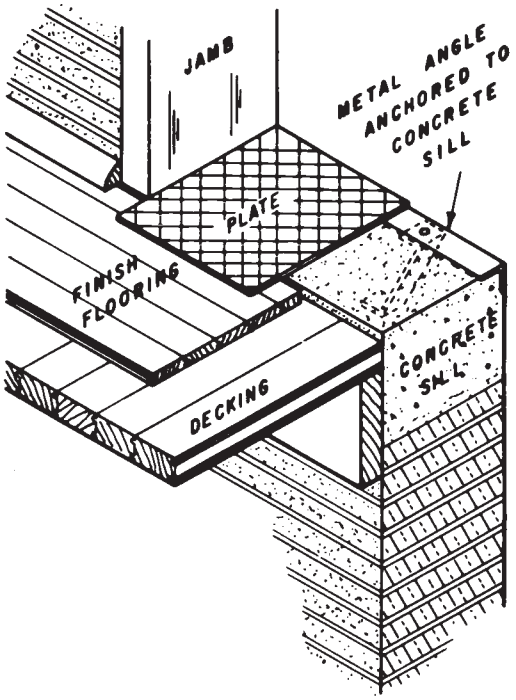


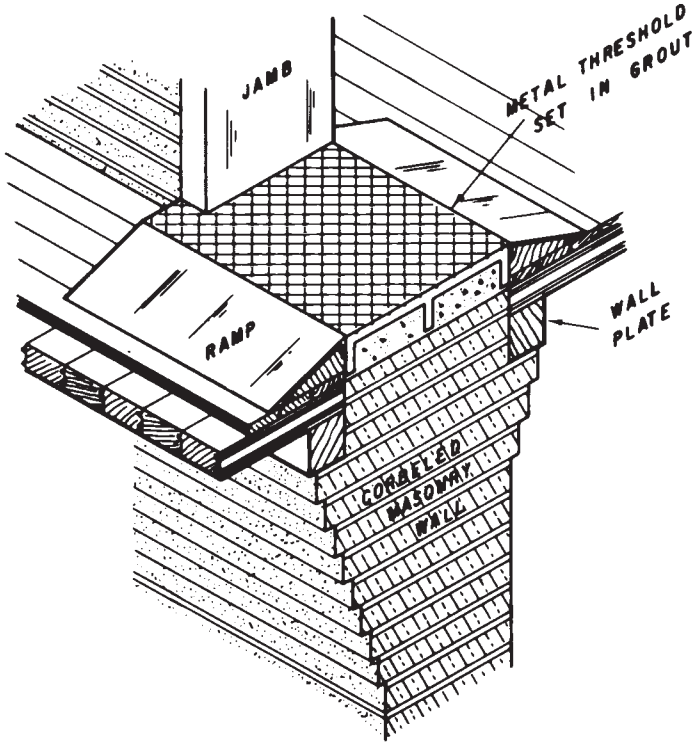
Figure 12 Typical Fire Door Sill Details



LOADING PLATFORM DOOR SILL



ELEVATOR DOOR SILL



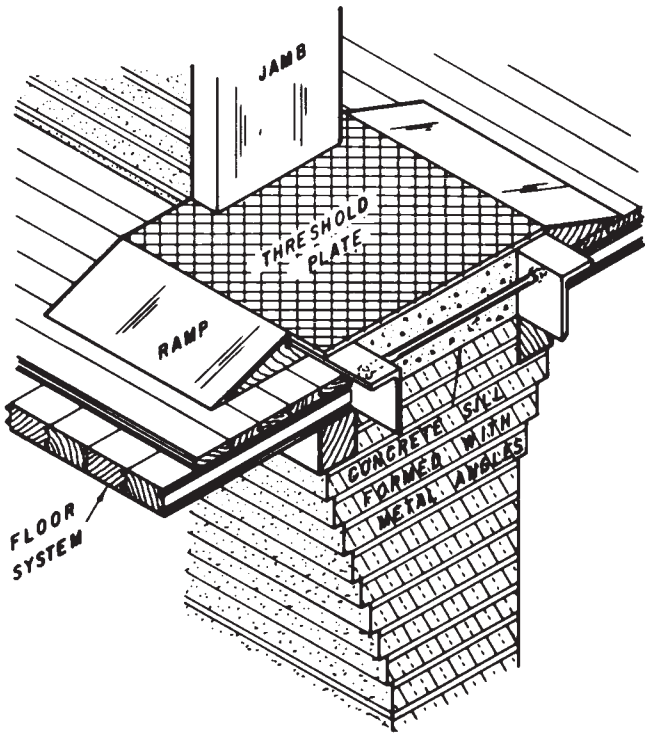


Figure 13 Rigid Arch Supported at Floor

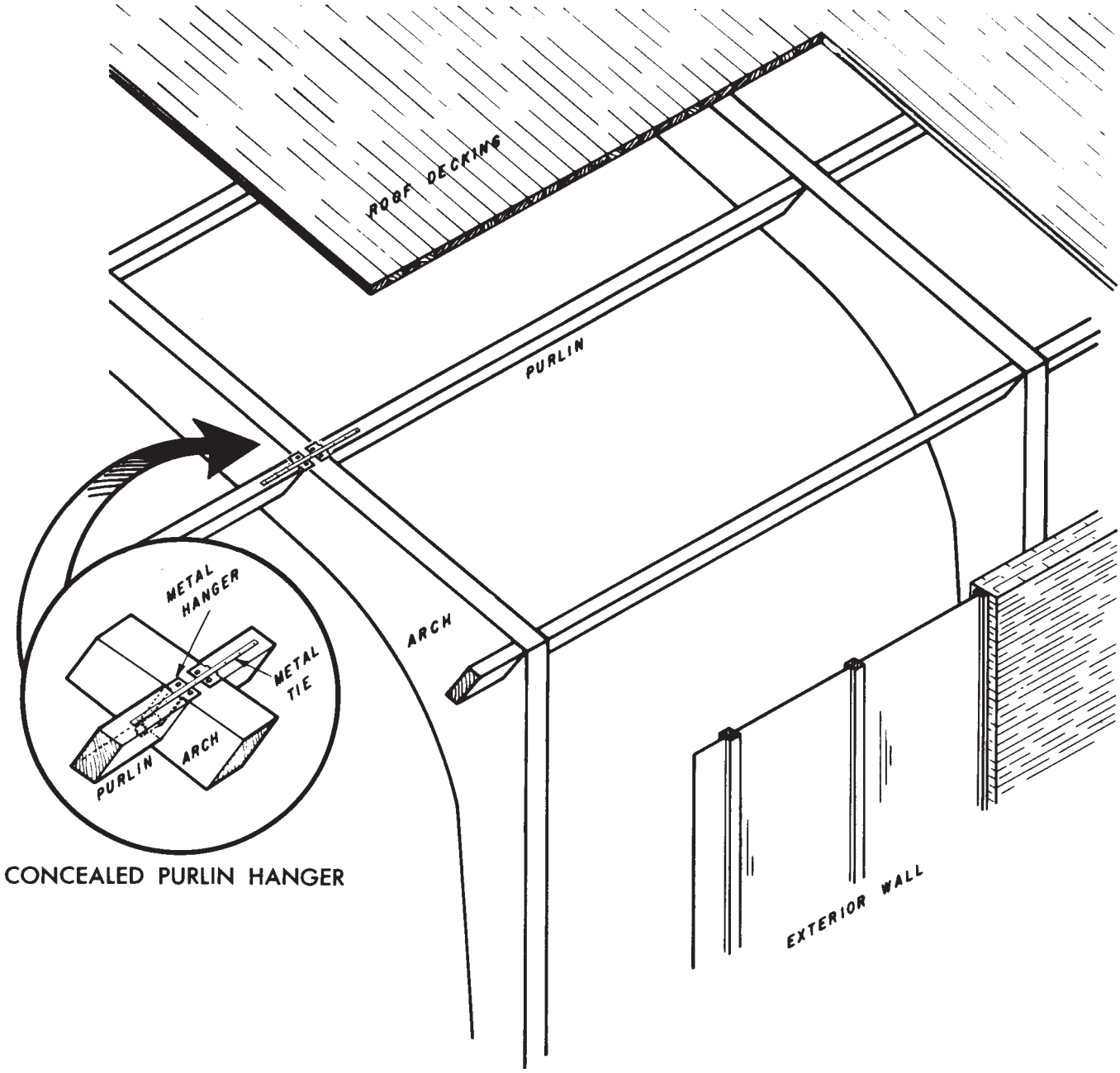
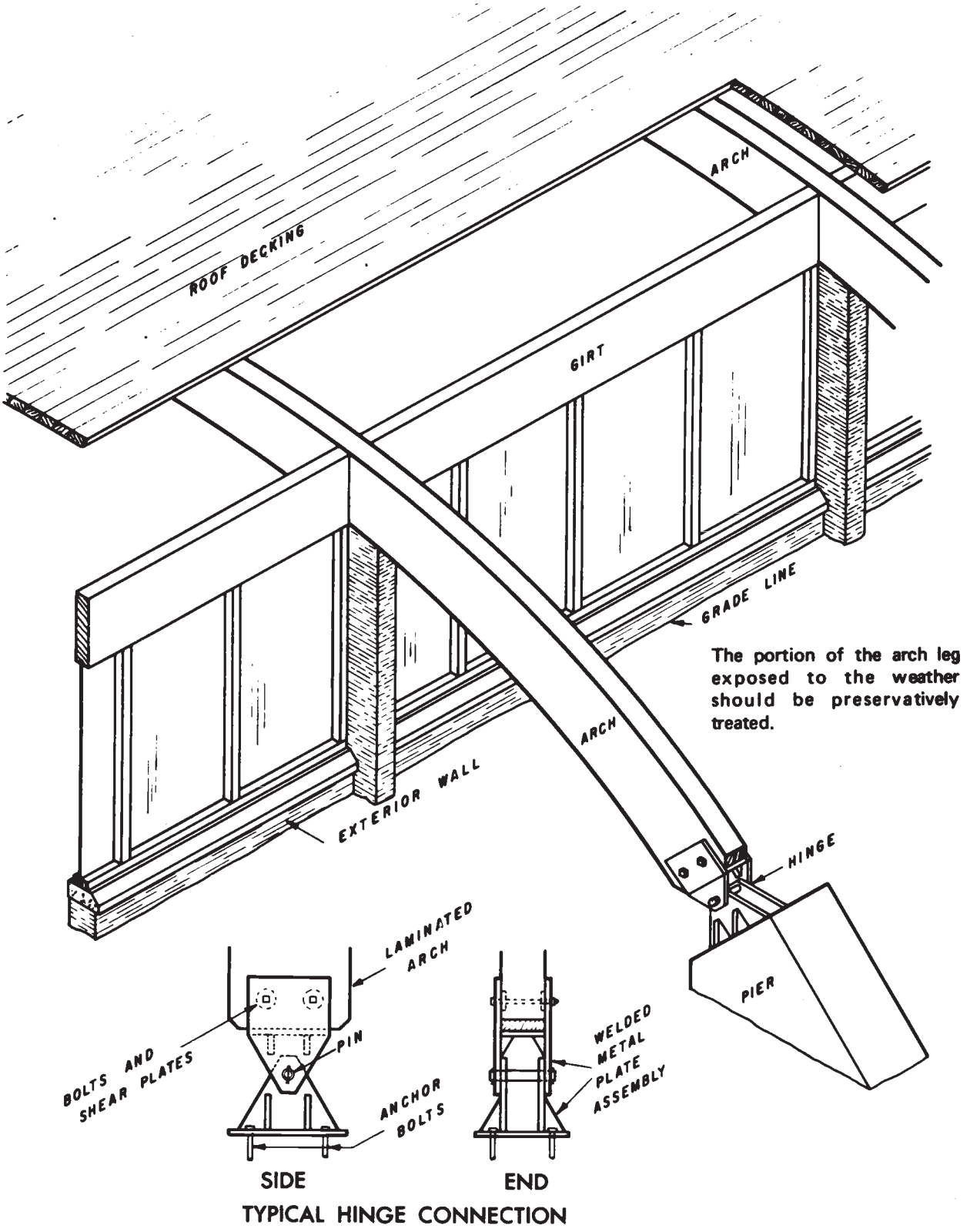


Figure 14 Barrel Arch on Exterior Pier



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