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## *chapter 11.* EXPOSED HEAVY TIMBER

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### 11.1 THE PROBLEM

Heavy timber members, either sawn or glued laminated, are generally subject to severe and early decay when exposed to the weather. Nail-laminated and other built-up sections, if the joints between members are tight, are even more vulnerable: these joints provide additional opportunities for water to collect. In most locations, the actual decay hazard is more dependent on cross-sectional dimensions and upon joint detailing than it is upon the local climate. In worst-case combinations of size, detailing, and climate, the decay hazard can be as severe as that of wood in contact with soil.

Field experience suggests that the hazard with exposed glue-laminated beams is worse than with solid-sawn material. Factors related to wood structure and properties support the principle that laminated members are more prone to deterioration in exposed conditions. In large-sawn timber the problem is basic to the nature of the wood mass and the development of checks. Moisture is trapped in these checks, and water will enter to the deep interior of the member, where it is absorbed. These checks also allow decay fungi to enter, and because the moisture is slow to evaporate, decay results. In glue-laminated beams, much larger sections are available than in solid-sawn material, and this sectional size makes a difference,

as discussed below. Also, sapwood and interlaminar grain differences contribute to the decay potential. Built-up members laminated with nails or bolts and without glue have joints that serve as man-made deep checks and are particularly prone to decay.

The behavior is different in sawn than in glue-laminated beams. With sawn members, particularly those beams containing the pith (e.g., boxed heart or heart center), the shrinkage patterns on initial drying invariably result in check development due to the difference in radial and tangential shrinkage rates. These checks can be severe.

The problem is different in glue-laminated beams. They do not have the same problem of drying from an initial high-moisture content, because the beams are assembled from individual laminations that are already dried. However, they do possess substantial differences from lamination to lamination in moisture and thermal movement, which cause stresses at the glueline as the beams change in moisture content and temperature. Exterior exposure imposes extensive cyclic wetting and drying on the members, with the exterior shell leading the more stable interior in changes in moisture and temperature. The surface zone thus

undergoes cyclic tensile and compressive stresses that eventually lead to ruptures. Over time, these ruptures progress more deeply into the beam. Typically, in a glue-laminated member wider than about 6 inch, a check will appear near the middle of the top lamination and may penetrate the beam as deep as three laminations. This check will invariably result in an eventual loss of integrity due to decay of the beam's interior. In addition, as cyclic changes take place, stresses become most severe at the gluelines, and checks will frequently develop immediately adjacent to them. These checks, when viewed from the exterior, often look like delamination or failure of the glueline. Generally, this is not the case; the failure has occurred in the first few layers of wood cells immediately adjacent to the glueline. These openings are also prone to water entrapment and consequent decay.

As noted earlier, members with large sections, whether sawn or laminated, are particularly susceptible to checking and consequent decay. For example, the normal protected outdoor equilibrium moisture content for wood in most of California averages 12%. When exposed to rainfall, the surface fibers of a beam will try to reach a size appropriate for the fiber saturation point. Thus it is normal for the surface zone to attempt to swell by 2% to 4% after a period of rainfall and shrink by a similar amount in dry weather; in both cases, the surface is restrained by a relatively stable interior. This is insignificant with a small cross-section, but given the substantial dimensions of large-size members, the stresses between the surface zone and the beam interior can be

great. The problem at the ends of beams is particularly severe because the changes in moisture content occur much more rapidly and there is the discontinuity in wood structure caused by cross-cutting. The resulting checking is a serious source of beam deterioration.

## 11.2 TYPES OF PROTECTION

### 11.2.1 Design Configurations

The building configuration around the exposed members will affect their performance. In general, members will perform best when they are most protected from sun, rain, and incidental water.

The roof, or other overhang, is probably the oldest and the best protection for exposed wood members. It minimizes weathering and water absorption. Optimally, the overhang should shield the most vulnerable areas of the member: end grain surfaces, top surfaces, and joints between members. The width of this overhang should approximate one-eighth of the height of the vertical surface to be protected.

Building orientation will also affect performance. In general, members located on the north and east sides of the building will be less subjected to weathering checks and distortion than those exposed to the south and west because of higher temperatures on the south and west sun exposures. Conversely, the north and east exposures may be more subject to decay because of slower drying. The orientation will also govern the exposure to water

where there is wind-driven rain. The leeward side of the building receives less moisture. The shading created by the surrounding buildings and trees usually helps the performance of exposed members, except when shading substantially delays the drying of wood.

### 11.2.2 Flashing and Covers

Flashing and covers can provide local protection from sun and water. Again, the most critical areas are the end-grain and top surfaces. Metal flashing over exposed beam ends is a common and relatively effective protection (see **Figure 11-1**). Note that a ventilation space is necessary between the wood and metal to prevent condensation wetting. Moisture in sun-heated beams will continue to move to the surface when shaded or at nightfall, condensing on the inside surface of the flashing if airflow is restricted. Wood covers shown in **Figure 11-2** are a simpler alternative method, which may be appropriate for less severe conditions. Neither of the methods shown protects the side of the member, where the checks may collect water. For complete protection, treated millwork can be used to cover exposed structural members.

### 11.2.3 Finishes, Preservative Treatment, and Coatings

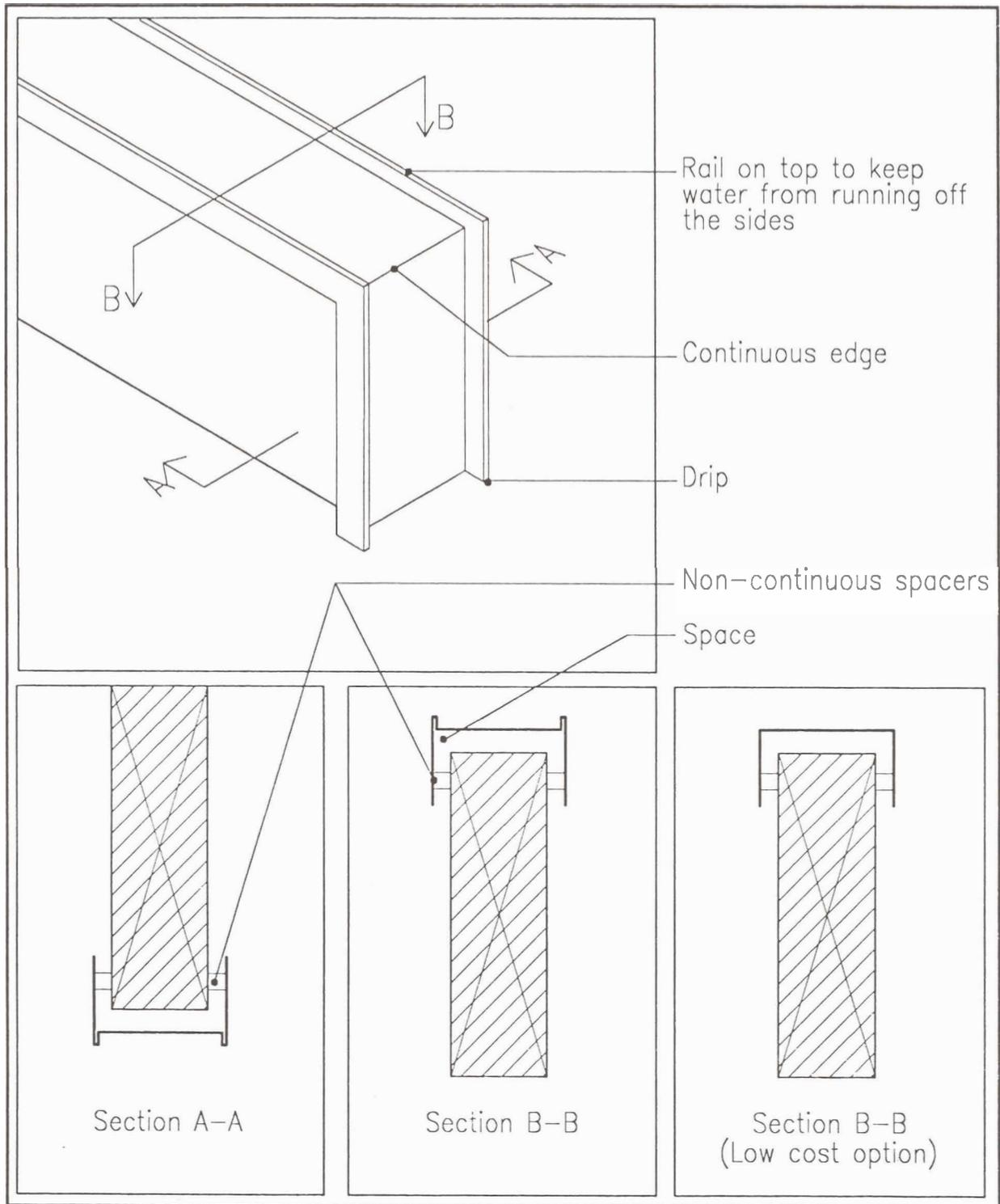
Paints and stains do little to protect large exposed members effectively. Paints and solid-body stains may form a film over the wood surface that will reduce the transmission of liquid moisture, if they are

maintained adequately. However, absorption can still occur at checks, and then the coating prevents its evaporation. Water-repellent finishes are similarly ineffective. (See Chapter 15 for more discussion).

Large architectural members are seldom pressure treated, but should be when used in moist or humid exposures. A dip or spray treatment applied at the manufacturing plant may be adequate in dry or marginal exposures. In any case, preservative treatment for large members will protect only the exterior surface and not the interior of the member. Treated members may still be vulnerable to decay due to water absorption via checks or joints, because these cuts may penetrate through the treated zone.

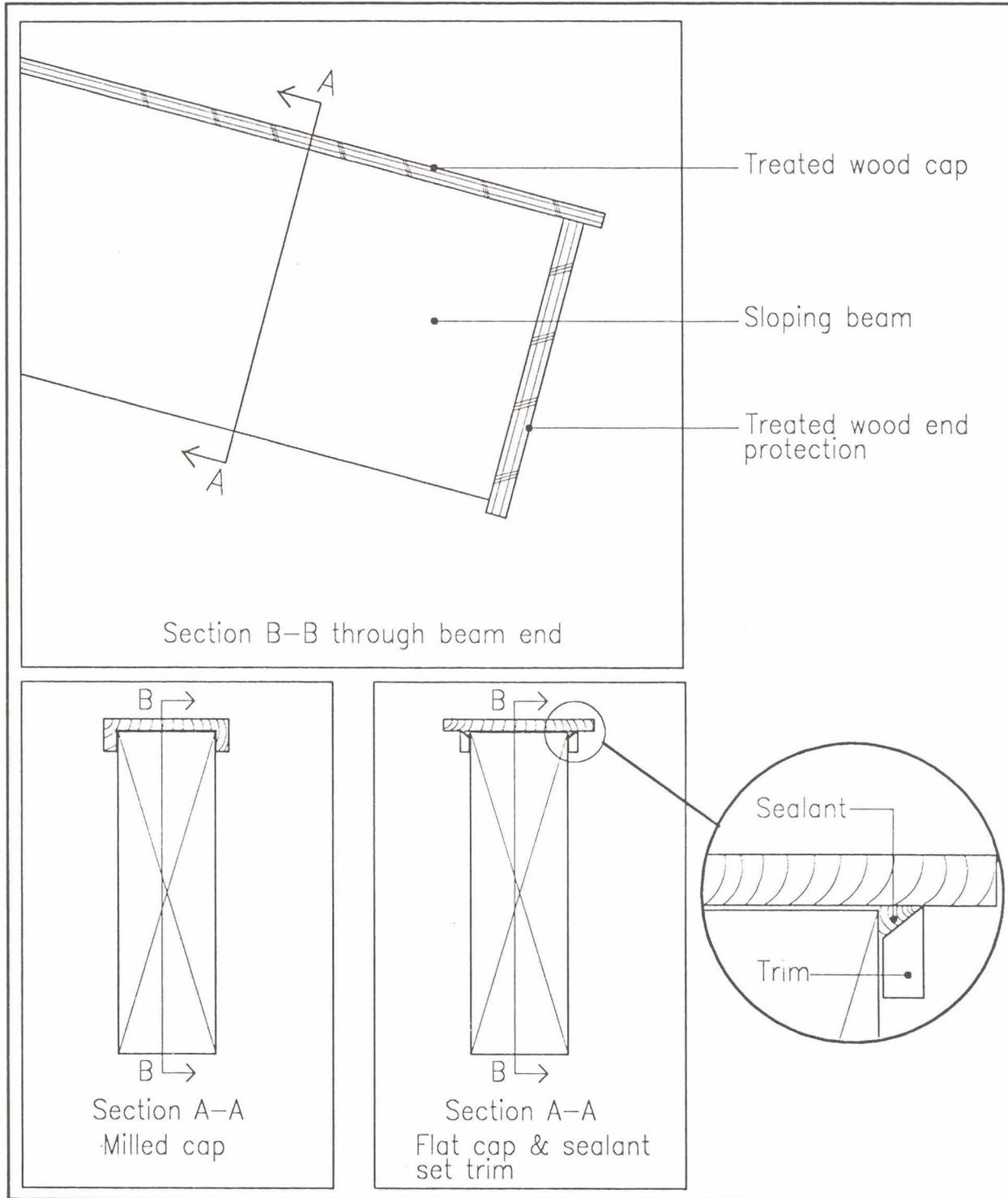
### 11.2.4 Mechanical Methods

Shaping a member or introducing saw kerfs can improve performance by reducing the stresses that cause checking (see **Figure 11-3**). The bevel cut receding from top to bottom at the end of the beam minimizes the unshaded exposed end grain area and thus reduces checking. Cutting saw kerfs in wood members can control checking by dividing the end into sections of effectively smaller dimensions so that stresses are kept below the tensile strength perpendicular to the grain. A deep longitudinal saw kerf may greatly reduce checking, it is equally effective in round or sawn timbers. The principle involved is the same as with kerfs on beam ends and the relief patterns often included on the back of millwork patterns, such as door casing, and on strip flooring.



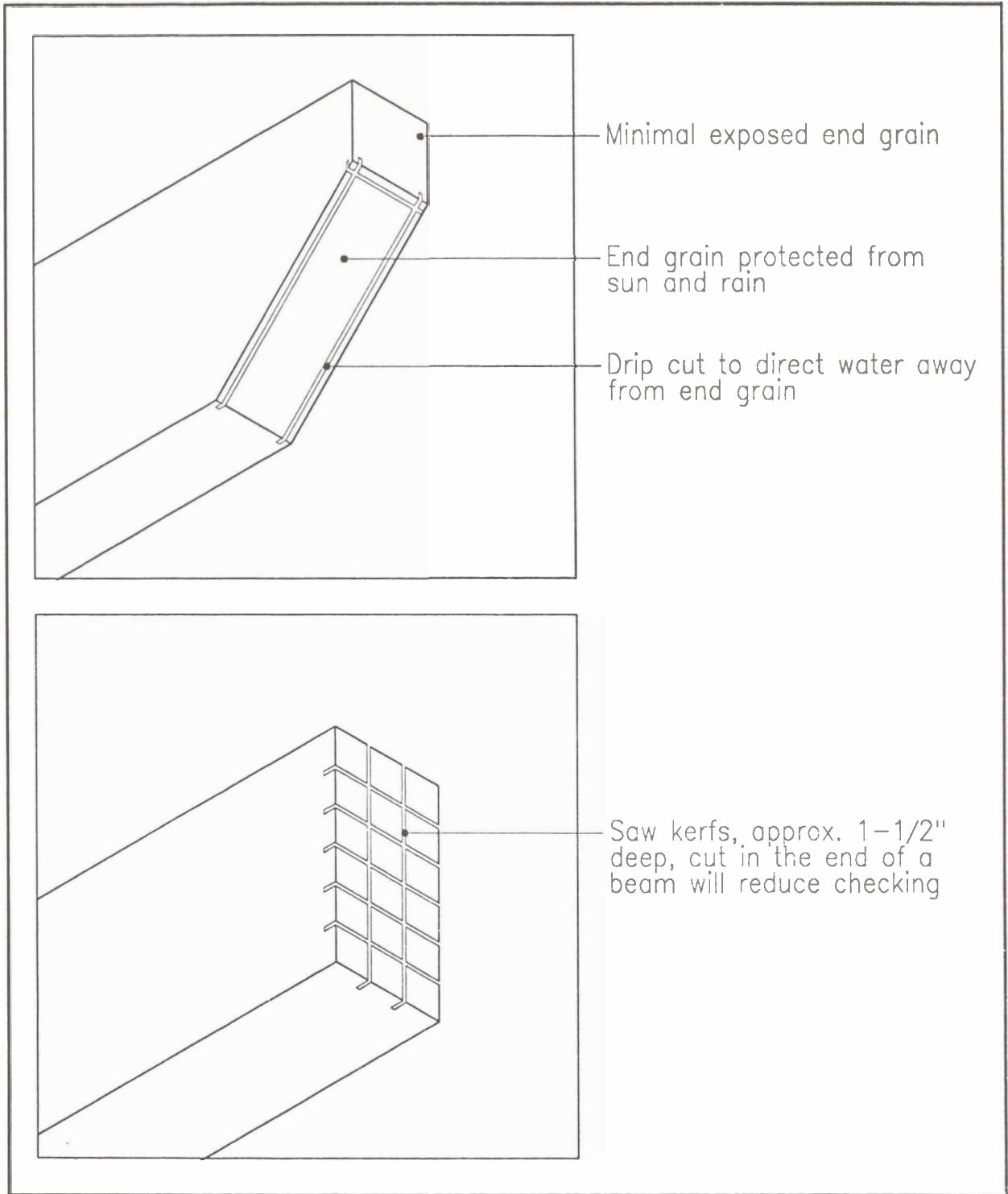
# EXPOSED BEAM END FLASHING DETAIL

Figure 11-1



# EXPOSED BEAM END PLYWOOD COVER DETAIL

Figure 11-2



## EXPOSED BEAM END PROTECTION BY CUTS AND KERFS

Figure 11-3

In exposed horizontal members, the kerf must be located on the bottom, so as not to trap moisture; it is generally located on the least noticeable face or on a covered face in columns. Kerfed members should be treated after sawing or placed in the structure where the cut surface cannot be wetted.

Mechanical methods only reduce the number of checks and do not eliminate them. The exposure condition should be considered when employing these techniques.

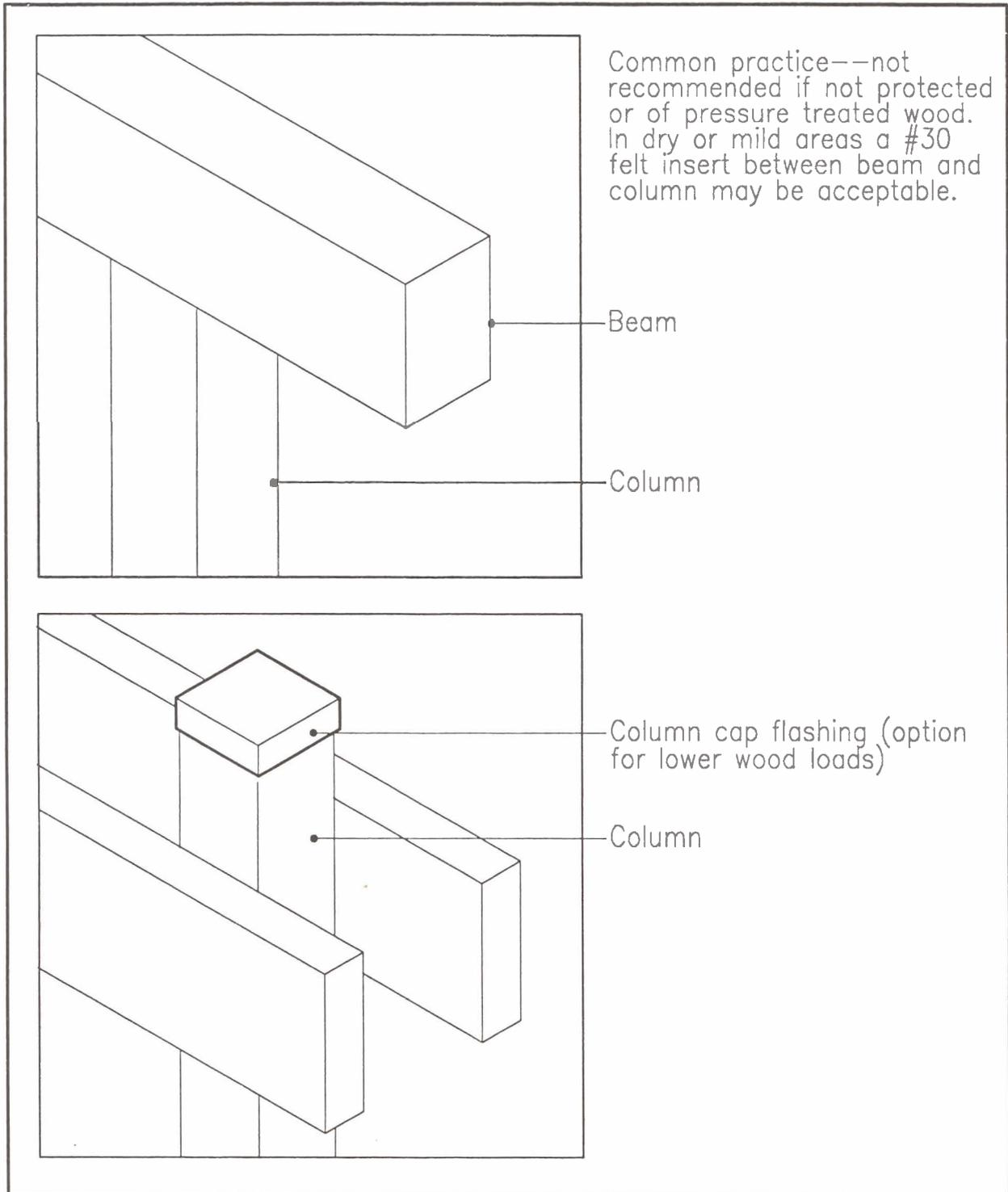
### 11.3 DETAIL DESIGN

When possible, it is better to use many smaller members rather than a few large members to satisfy the same structural requirement, provided they are spaced or the joints between them can be protected (see **Figure 11-4**). The latter may be extremely difficult. The reduced minimum dimension of smaller members substantially decreases the drying time, because the drying time is approximately proportional to the square of the thickness. The column top surface in **Figure 11-4** is vulnerable to capillary water. Preservative treatments are not dependable or effective for the exposed tops of these large members unless the top is the uncut and undamaged treated end of the piece as shipped from the treating plant.

Large members in exposed conditions should not be notched or flush fastened unless adequate local protection is provided (i.e., effective flashing or a preservative-soaked fiber felt, not a swab-on coat of preservative). Notching usually exposes the vulnerable end-grain surfaces. This is particularly critical at structural joints where there are contact surfaces.

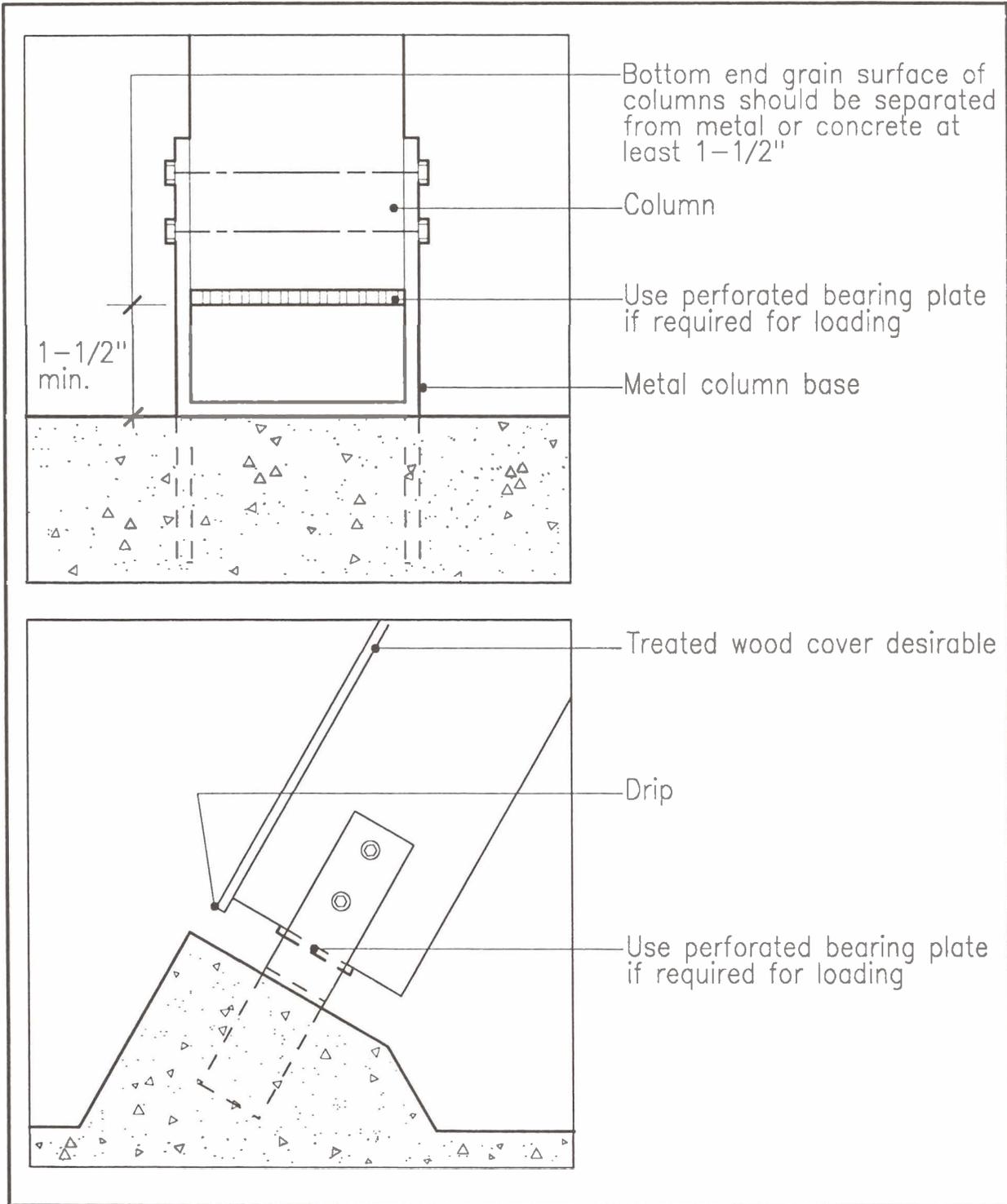
For column-beam connections and column bases where fit is tight, the authors have seen installations with a #30 saturated asphalt felt that have given remarkable long-term performance. We do not know why this works or if it will work all the time. For untreated wood, it appears to be significantly better than nothing. We would be very happy to hear of others' experiences with this detail.

At the base of a column or arch, enough space should be provided so the member does not contact water sitting on the ground, concrete, or a metal column base. The weep holes and other drainage features now common in the shoes and other column supports must not be compromised during installation (see **Figure 11-5A** and **11-5B**). When bearing cannot be carried by bolts, design must provide for deflection of moisture away from base.



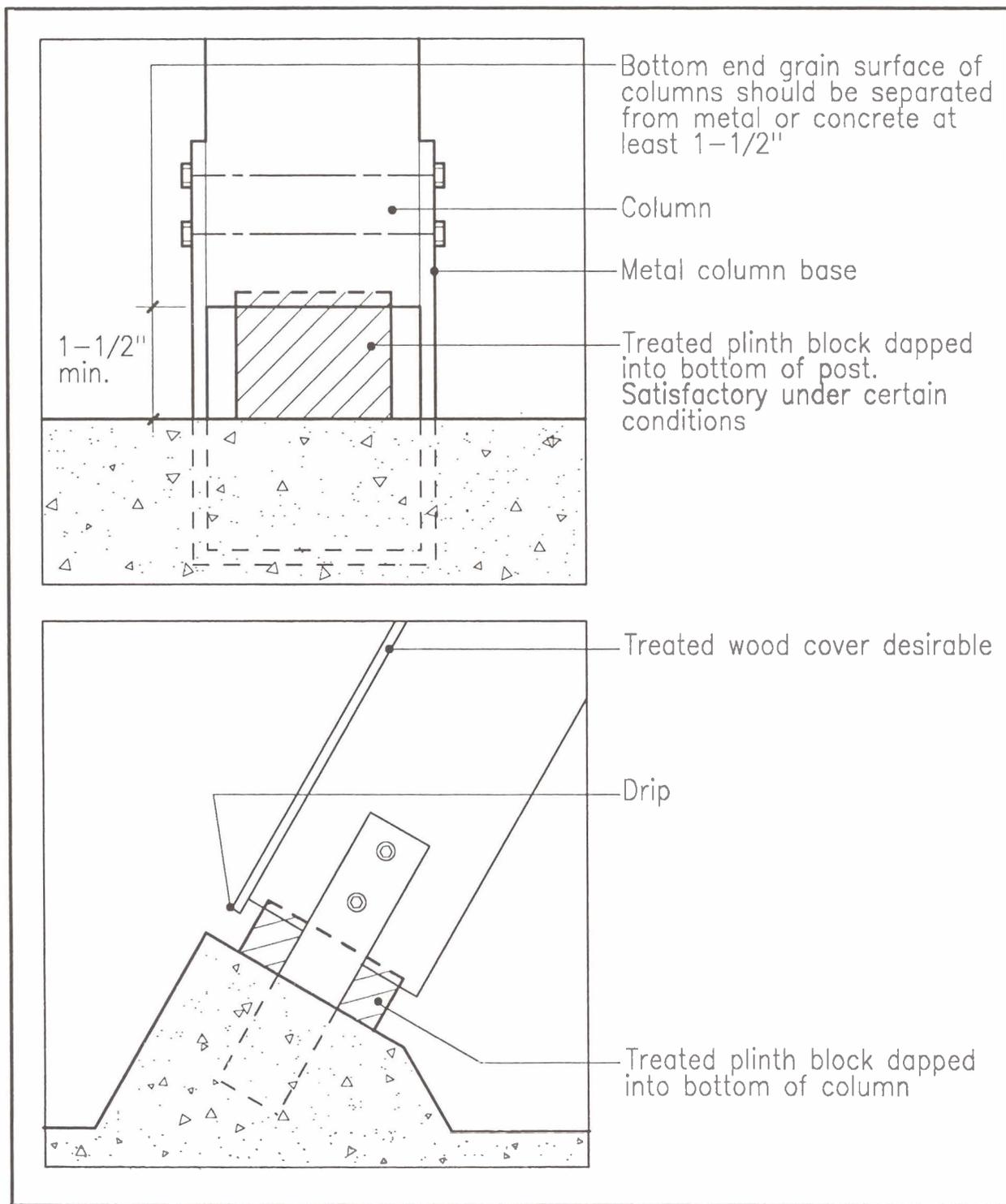
## EXPOSED CONNECTION BEAM COLUMN JOINT

Figure 11-4



# EXPOSED CONNECTION COLUMN BASE JOINT

Figure 11-5A



# EXPOSED CONNECTION COLUMN BASE JOINT

Figure 11-5B