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A SYSTEM FOR TIGHTER WOOD-FRAME CONSTRUCTION

by

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Ottawa, January 1984

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INTRODUCTION

Most current approaches to improving the airtightness of new wood-frame construction concentrate on using a plastic film vapour barrier as an air barrier.[1,2] This material is prone to accidental damage during construction and any unnoticed openings, tears or gaps in the material are concealed by application of the interior finish. When the film is not bonded to or held against the interior cladding or other support, air can move laterally behind the interior finish to leak through such openings.

The amount of water vapour that will diffuse through these gaps and tears under a vapour pressure difference is relatively small compared to the amount of vapour that can be carried through such openings by air movement under an air pressure difference. If the airtightness of the enclosure can be achieved in some other way, the sealing of these gaps and joints is not so important and the plastic film might even be replaced by some other form of vapour barrier.[3]

Most of the primary air leakage paths through the exterior house envelope occur at openings through and around the interior cladding. This Note describes an approach that utilizes the interior cladding as the barrier to air flow, with the vapour barrier provided by interior painting or wallpapering or by a vapour barrier film, factory-applied to the interior cladding elements. A somewhat similar approach was utilized in the HUDAC Mark VII project in 1972 in Surrey, B.C., where 9.53 mm (3/8") fir plywood was used on the inside of wall and roof framing as structural sheathing and as the air and vapour barrier.[4]

THE BASIC CONCEPT

The basic concept is illustrated in Figure 1. It employs 12.7 mm gypsum board interior finish as the structurally supported air barrier and utilizes 12.5 mm exterior grade plywood strips to provide continuity of the air barrier at floor and wall intersection details. These strips of plywood extend 25 mm to 35 mm on each side of the intersecting framing members to provide a surface adjacent to the interior gypsum board so the butt joint can be filled with a sealant, with flexible adhesive tape or by the normal application of drywall tape and filler.

At upper floor intersections, joist hangers are suggested to allow the 12.5 mm plywood to provide vertical continuity with the interior finish. These same joist hangers can be used in an "upside down" arrangement to allow for continuity to be maintained when floors are cantilevered outward to support upper walls, as suggested in the inset of Figure I.

Although "storey height" studs or full balloon framing could be employed, the framing system illustrated in Figure 1 has some potential advantages. It utilizes a "semi-box beam" (shown in Figure 2a and b) that could be factory- or site-fabricated, with or without joist hangers applied.

FOUNDATION WALL INTERSECTIONS

Box-Sill Method

Figure 3 illustrates an approach for the box-sill method where the semi-box beam is secured to the outer half of the foundation wall and the floor joists set on a 38 × 89 mm sill plate. A conventional header joist could be used, provided there was sufficient bearing on the sill plate for the joists or a 38 × 89 mm nailer inserted between the joists to provide support for the edge of the sub-floor.

The sub-floor is placed on top of the joists and butted against the 12.5 mm-thick plywood strip. The first floor wall framing is set on top of the semi-box beam to the second floor level. The detail shown has the stud spaces filled with fibrous insulation, with an additional insulating sheathing applied to the exterior of the studs. A thickness of insulation equal to the sheathing is shown extending down over the outer face of the foundation wall.

Figure 4 indicates a suggested arrangement for a box-sill method utilizing brick veneer construction with a 250 mm foundation wall.

Preserved Wood Foundation

The semi-box beam approach could be used but continuity could be provided by a preserved wood foundation. Figure 5 illustrates a method utilizing joist hangers over a 12.5 mm thick plywood strip to support the floor joists. If the joist hangers are intermediate between the vertical studs of the foundation wall, it will be necessary to provide backing as illustrated by the dotted section between the foundation wall studding. If the joist hangers are coincident with the vertical members of the foundation wall, this may not be necessary.

"Beam Fill" (Embedded Joist) Method

The semi-box beam could form the outer top section of the foundation wall form work, with the ends of the floor joists butted to the plywood face with a 38 × 89 mm sub-floor nailing stip as a spacer (Figure 6).

INTERMEDIATE FLOOR-WALL DETAIL

Walls in Line

The semi-box beam set on top of the first floor wall framing as in Figure 7 allows the 12.5 mm plywood strip to provide continuity of the air barrier through the second floor detail. Side and upward nailing of the joist hanger to the joist would be necessary to provide lateral support. The joist hangers might best be used with straps extending over and under the semi-box beam.

The top surface of the joist is 25-35 mm below the top of the beam and the under surface of the joist is set above the bottom. The sub-floor and underlay applied on top of the joist should thus leave a portion of the plywood extending upward for connection to the gypsum wallboard, when it is subsequently installed. A sealant could be used to fill the joint and covered with a flexible pressure-sensitive tape. The joint would be concealed beneath the baseboard when it is installed. The joint between the lower edge of the semi-box beam and interior drywall might simply be sealed by conventional drywall taping.

Offset for Brick Veneer

Figure 8 illustrates a method for handling the offset required when brick veneer construction is used as cladding for the first floor. A 12.5 mm plywood strip is installed on top of the upper wall plate extending outward to the ends of the joists and inward sufficiently to provide continuity with the drywall. The semi-box beam, with joist hangers attached, is installed upside down on the projecting ends of the joists. The loading on these joist hangers would be that due to roof loading and the system would have to support the required loads.

A flexible tape or sealant could be utilized between the joists to provide continuity for airtightness between the horizontal 12.5 mm-thick plywood strip above the top plate and the plywood joist header, but it might best be utilized at the outer junction with the lower wall sheathing.

Cantilevered Floor

Figure 9 illustrates a method for the same system applied to second floor wall intersections where the offset is greater. Twelve point five millimetre-thick plywood strips, as in the previous case, are applied to the top of the first floor wall extending inward to join with the gypsum board and outward to the ends of the joists. The joint between this strip and the lower wall and ceiling gypsum board could be sealed in the conventional manner with joint tape and filler. The butt joint between this horizontal plywood strip and the vertical plywood of the semi-box beam could sealed from the exterior to ensure continuity of airtightness.

WALL/CEILING JUNCTIONS

Exterior Walls

No special detailing is suggested for the exterior wall and top floor ceiling junction since the interior gypsum board is taped and sealed at this location in normal practice (Figure 10a).

Interior Partitions

Figure 10b shows a plywood strip applied to the top plate of the partition wall to provide continuity across this intersection. The plywood extends out beyond the plate 25 mm or so to allow a base for application of a flexible tape or for the normal drywall taping and filling operations.

EXTERIOR WALL/PARTITION WALL JUNCTION

A similar detail could be arranged at the exterior wall/interior partition intersection, as in the plan view of Figure 11; here the plywood strip, nailed to two exterior wall studs, also acts as a structural tie. It will provide continuity of the air barrier through the intersection as well as securing the intersecting wall to the exterior framing, which in turn can provide backing for the application of the gypsum board. Here again the joint could be sealed with flexible tape or tape and filler.

WINDOW/WALL JUNCTION

No special detailing would be required at the window but improved airtightness might be obtained by sealing the joint between the gypsum board and the window frame with a flexible tape after packing the clearance space with sealant or insulation. This tape would subsequently be covered by the window trim as in Figure 12.

ELECTRICAL WIRING AND PLUMBING PENETRATIONS

It would be useful to minimize the extent to which electrical wiring is run into exterior walls and particularly up into the attic space, but should wiring penetrate through the upper plates and studs or lower plates of exterior walls, these openings should be sealed to minimize air leakage. Outlet box locations on the exterior walls could be sealed from the interior, using plastic film or gasketed covers if these are deemed to be necessary.

CONCLUSION

The approach outlined in this Note involves some changes in current practices but is a direct and positive way to provide an accessible structural air barrier to avoid unwanted air leakage through the exterior envelope of wood-frame housing.

Suggested details using this approach are provided for different locations and intersections, with some consideration for different regional construction practices. No doubt other modifications can be developed to utilize specific local or regional requirements, practices and traditions.[5] Although adequate water vapour diffusion resistance (vapour barrier requirements) can be met through the application of suitable interior paint or wallpaper after construction, there may be advantages to the use of wallboard incorporating a factory-applied vapour barrier. Although 38 × 89 mm studs are shown, 38 × 140 mm framing members could be used to allow added insulation. Insulated sheathing or horizontal strapping could allow increased thicknesses of insulation to be applied.

Figure 13 shows a one-half scale model constructed to illustrate application of the method to various details. The help and advice of J.D. Scott of DBR in the development of the method and construction of the model was greatly appreciated.

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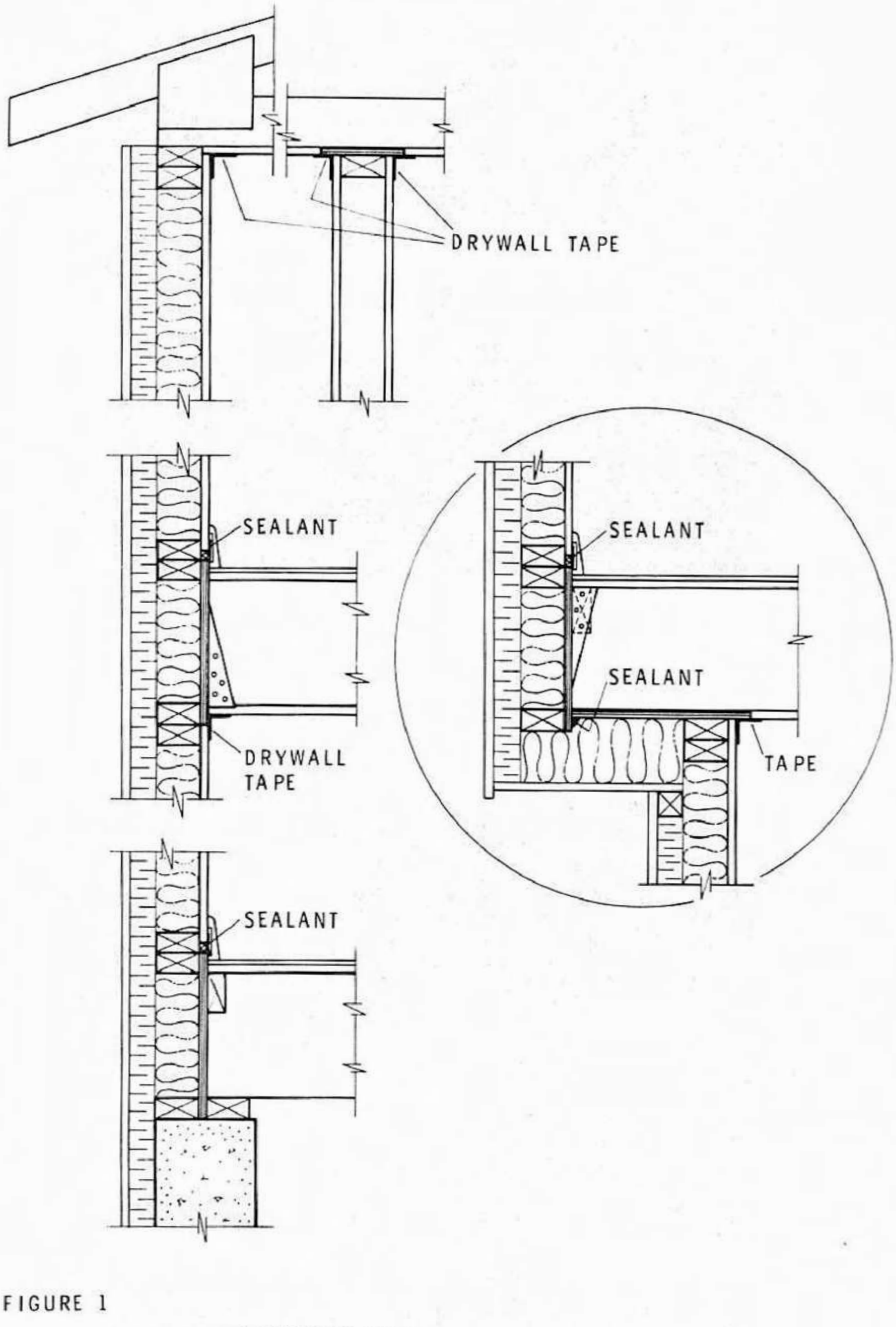
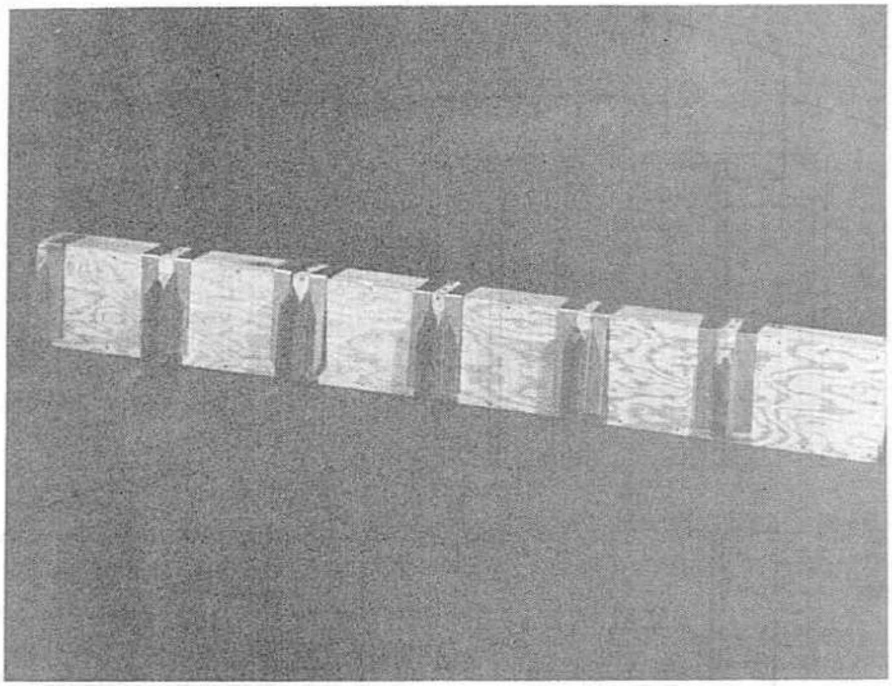


FIGURE 1

A SYSTEM FOR AIRTIGHTNESS IN WOOD-FRAME CONSTRUCTION

BR 6467-1



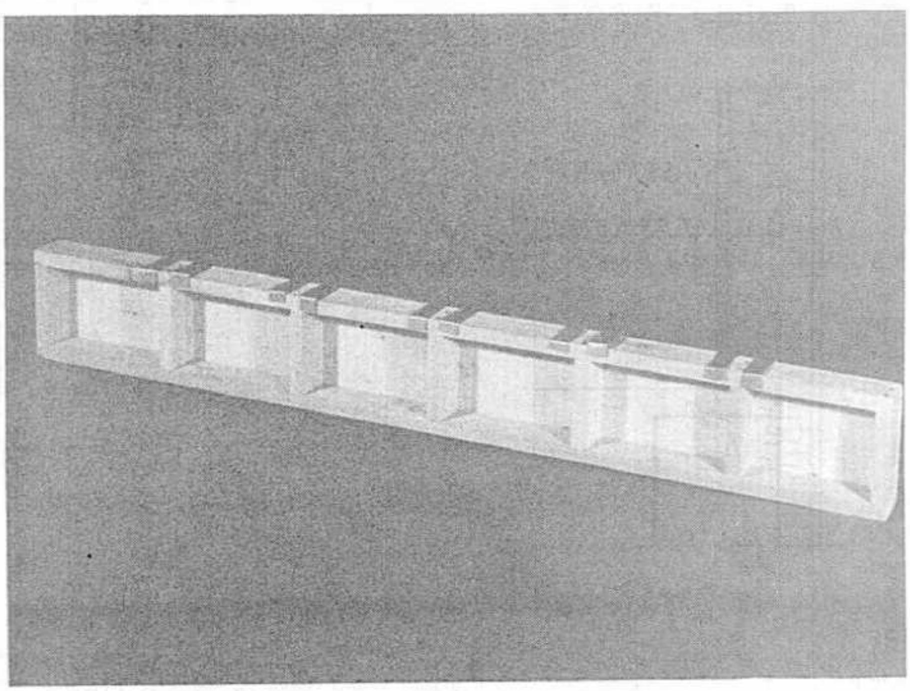


FIGURE 2

SEMI-BOX BEAM (2 VIEWS)

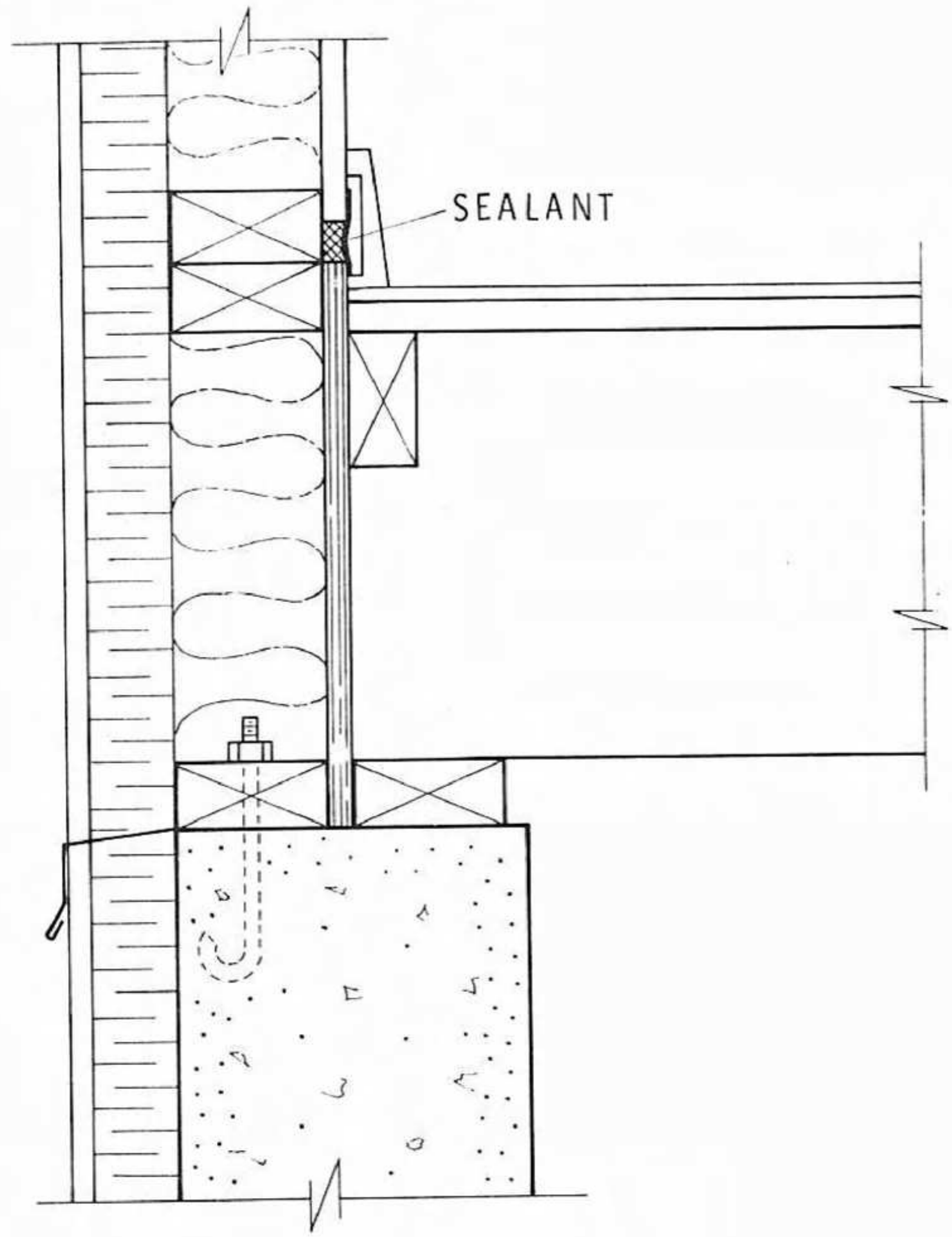


FIGURE 3
BOX SILL DETAIL

BR 6467-2

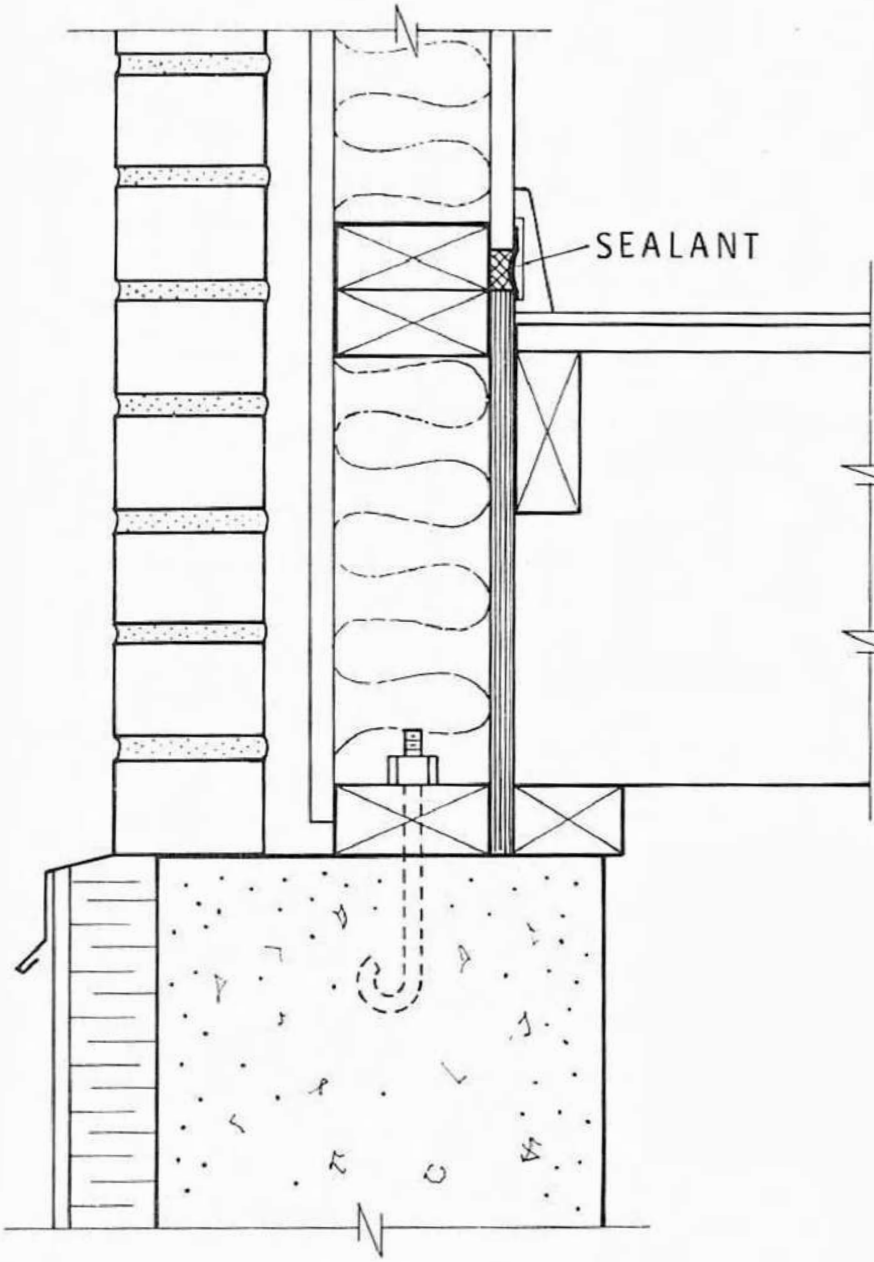


FIGURE 4

BOX SILL DETAIL, BRICK VENEER

BR 6467-3

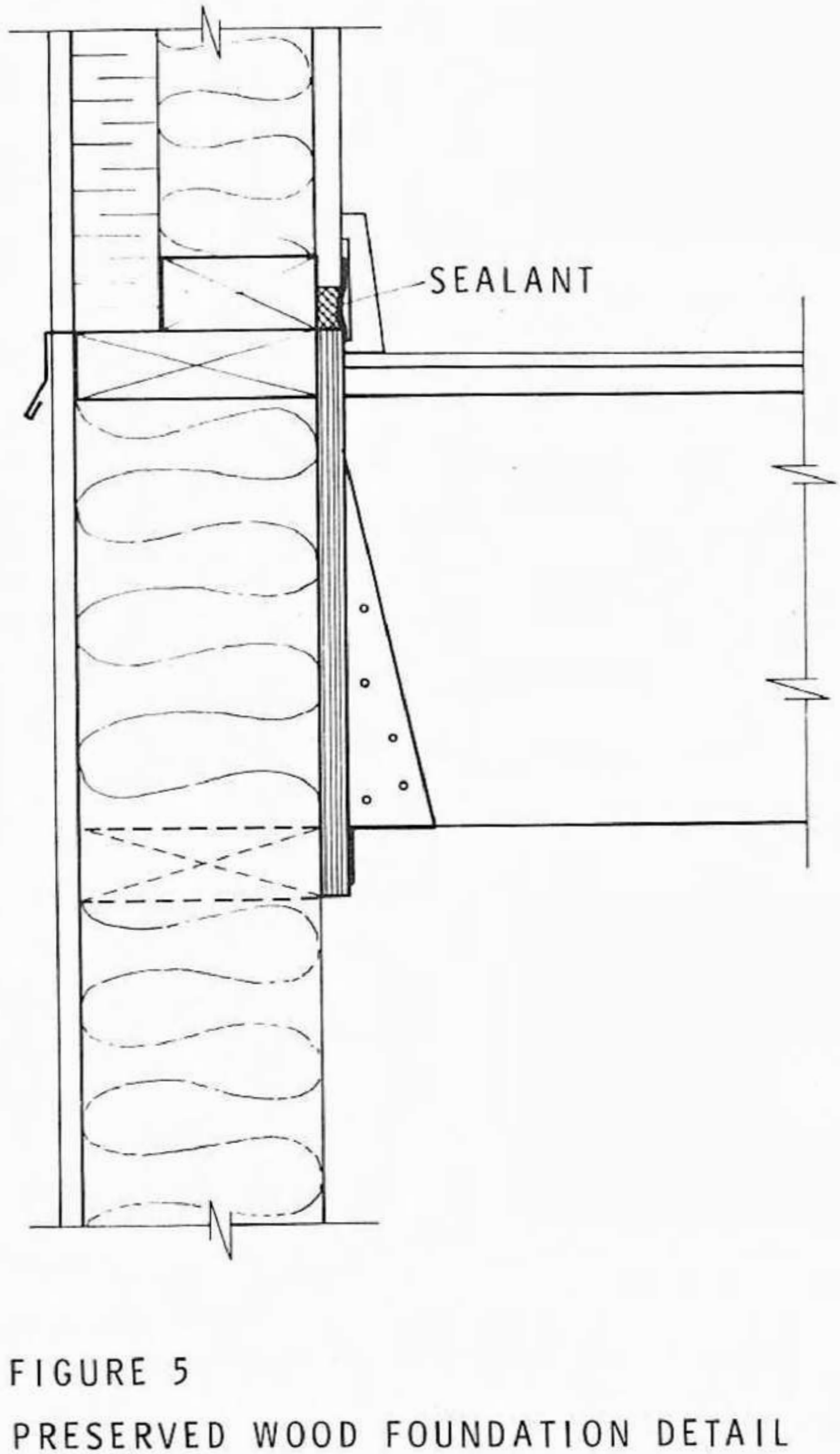


FIGURE 5

PRESERVED WOOD FOUNDATION DETAIL

BR 6467-4

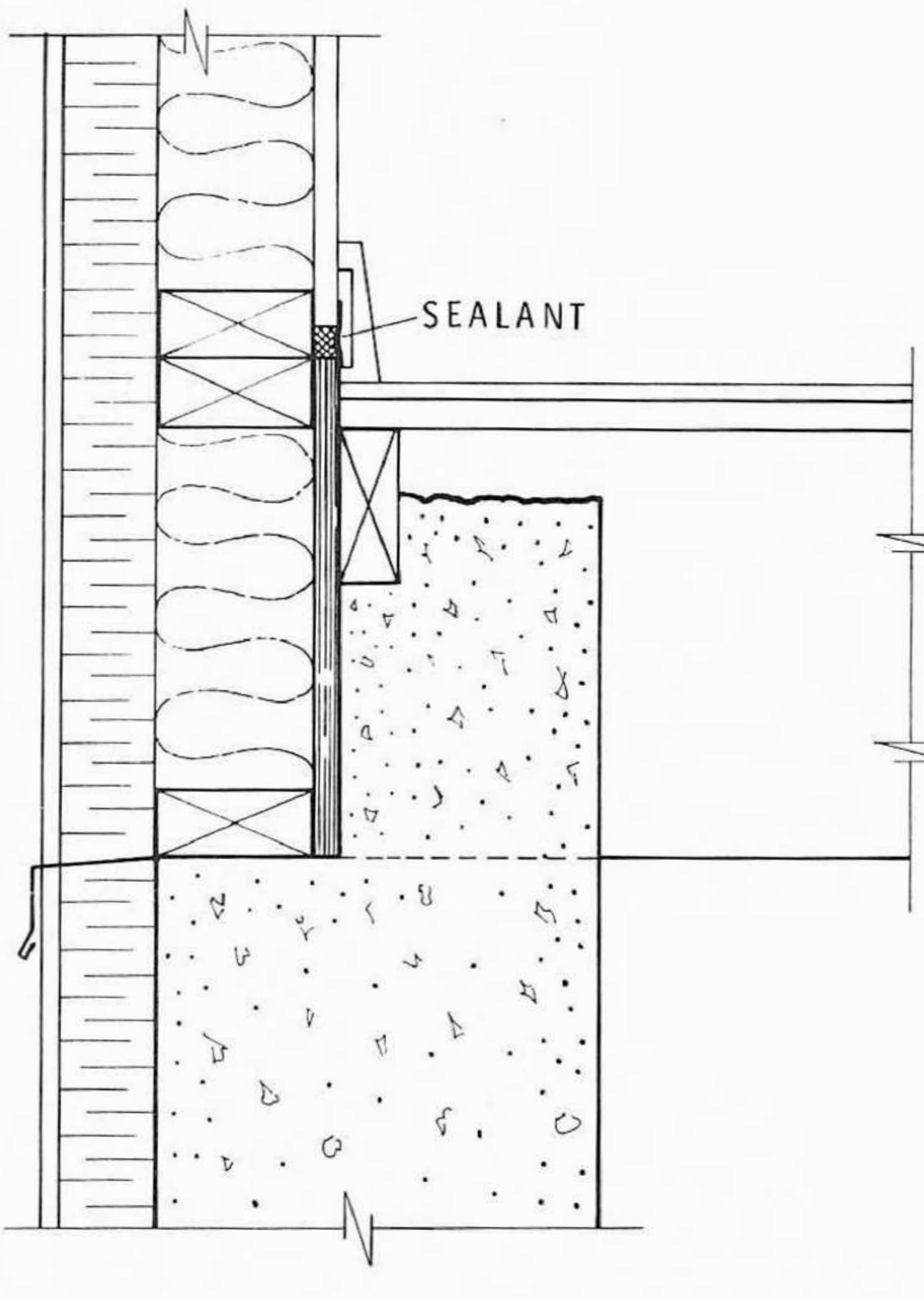


FIGURE 6

"BEAM FILL" (EMBEDDED JOIST) DETAIL

BR 6467-5

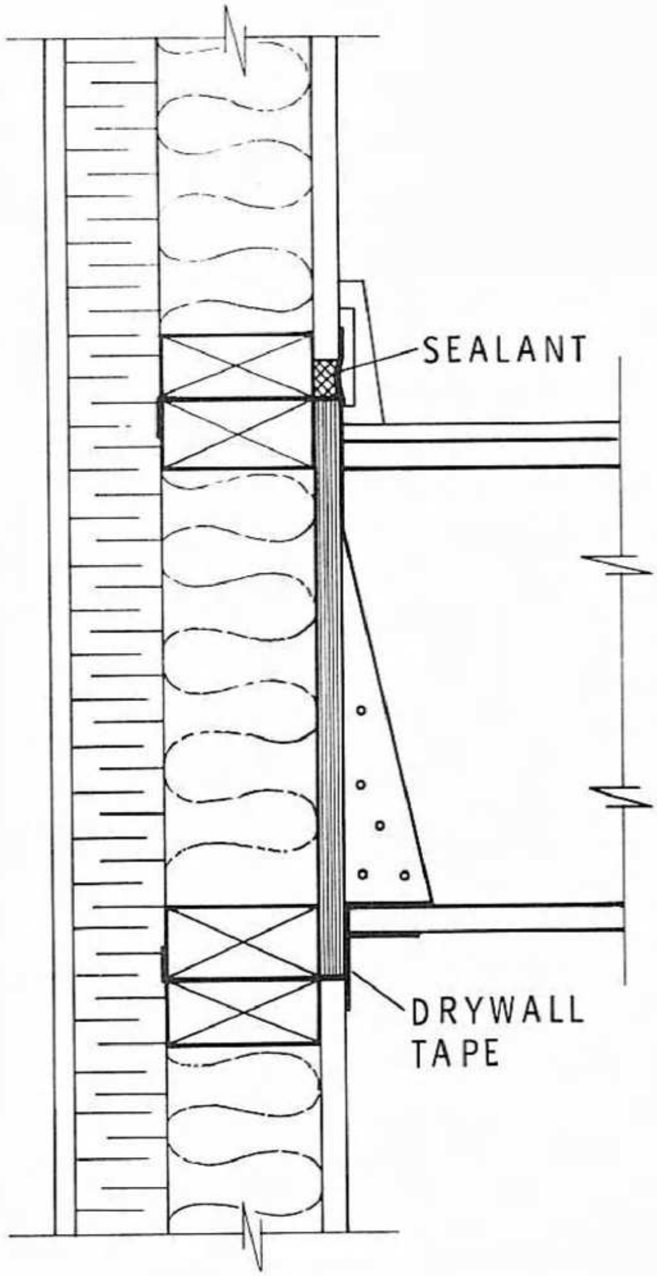


FIGURE 7

SECOND FLOOR INTERSECTION -
NO OFFSET

BR 6467-6

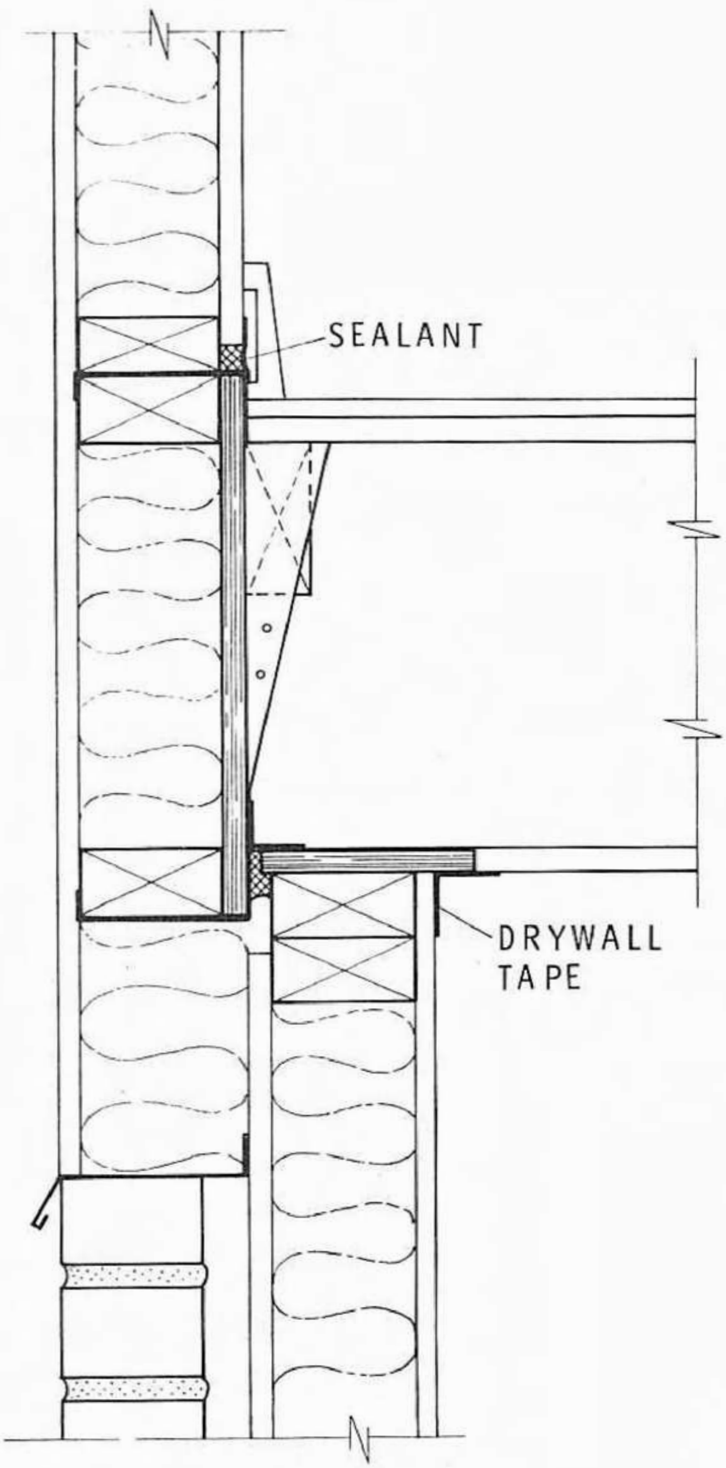


FIGURE 8

SECOND FLOOR - WALL INTERSECTION
- OFFSET FOR BRICK VENEER

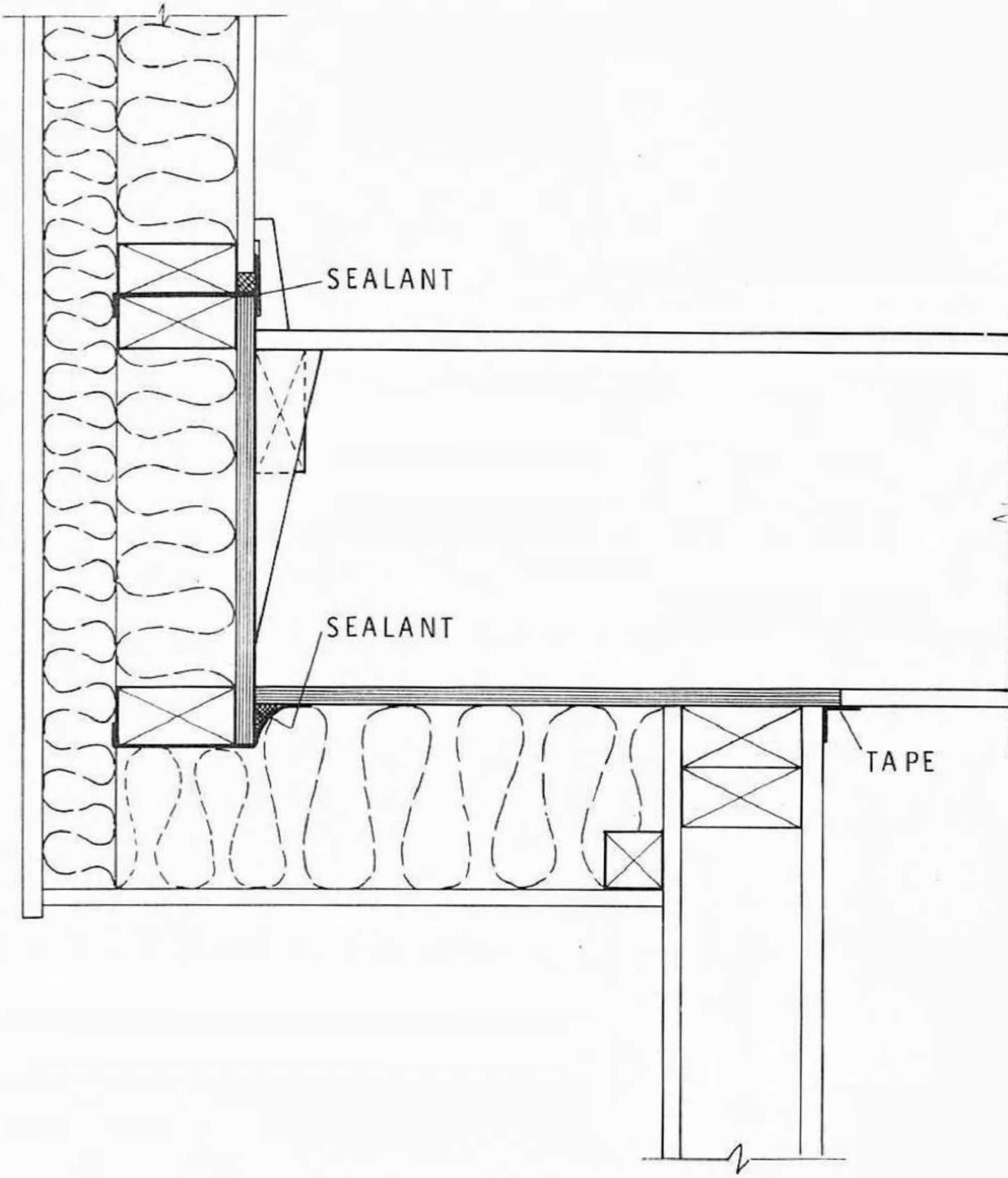


FIGURE 9
SECOND FLOOR - WALL INTERSECTION - CANTILEVER

BR 6467-8

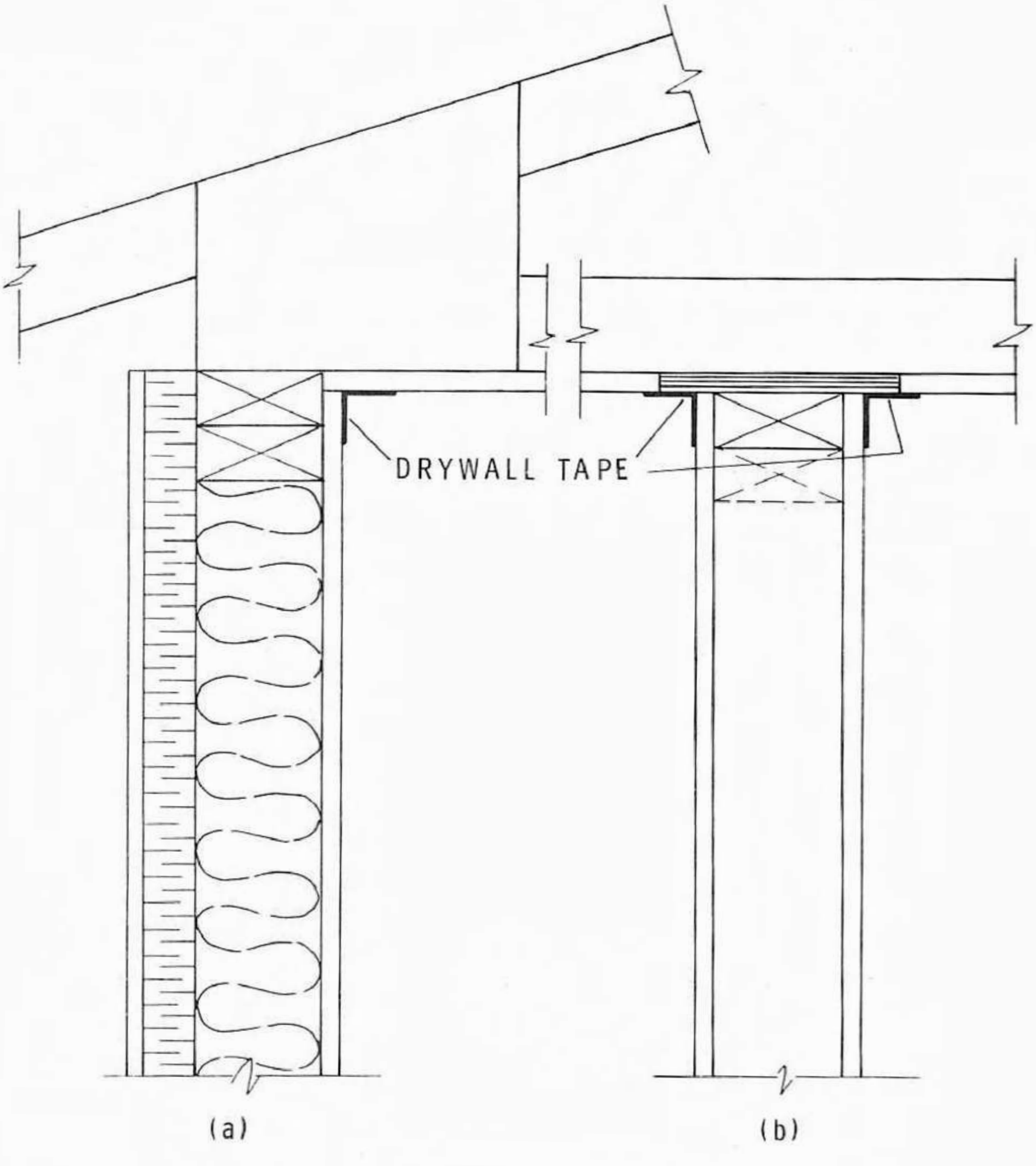


FIGURE 10

(a) WALL-CEILING DETAIL; (b) PARTITION WALL-CEILING DETAIL

BR 6467-9

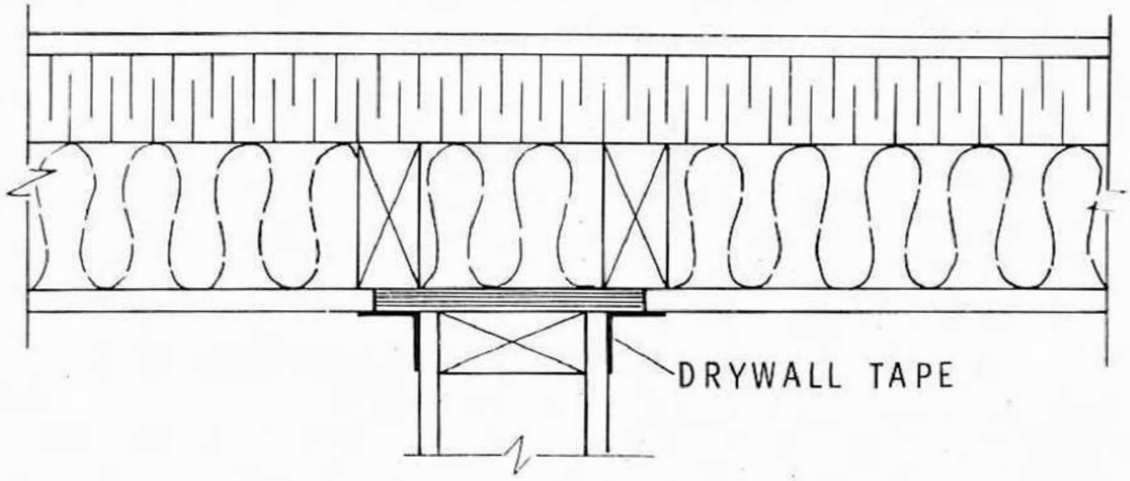


FIGURE 11

PARTITION - EXTERIOR WALL INTERSECTION
(HORIZONTAL SECTION)

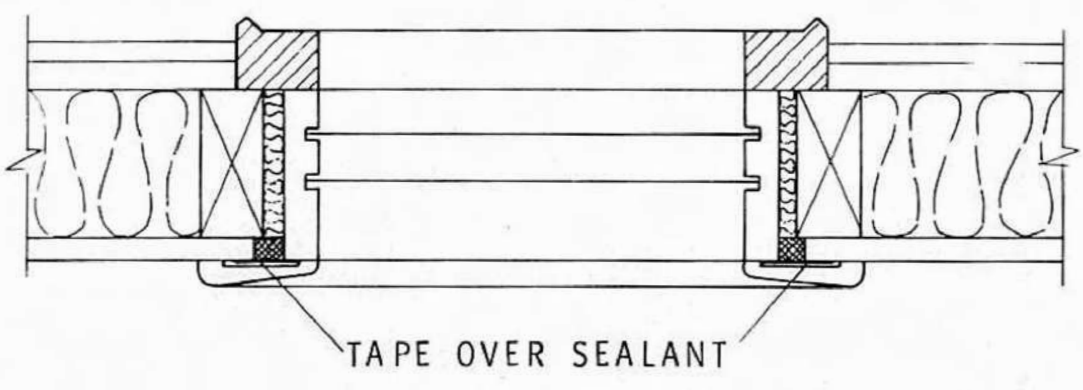


FIGURE 12

WINDOW - MULLION DETAIL (HORIZONTAL SECTION)
(SILL AND HEAD SIMILAR)

BR 6467-10

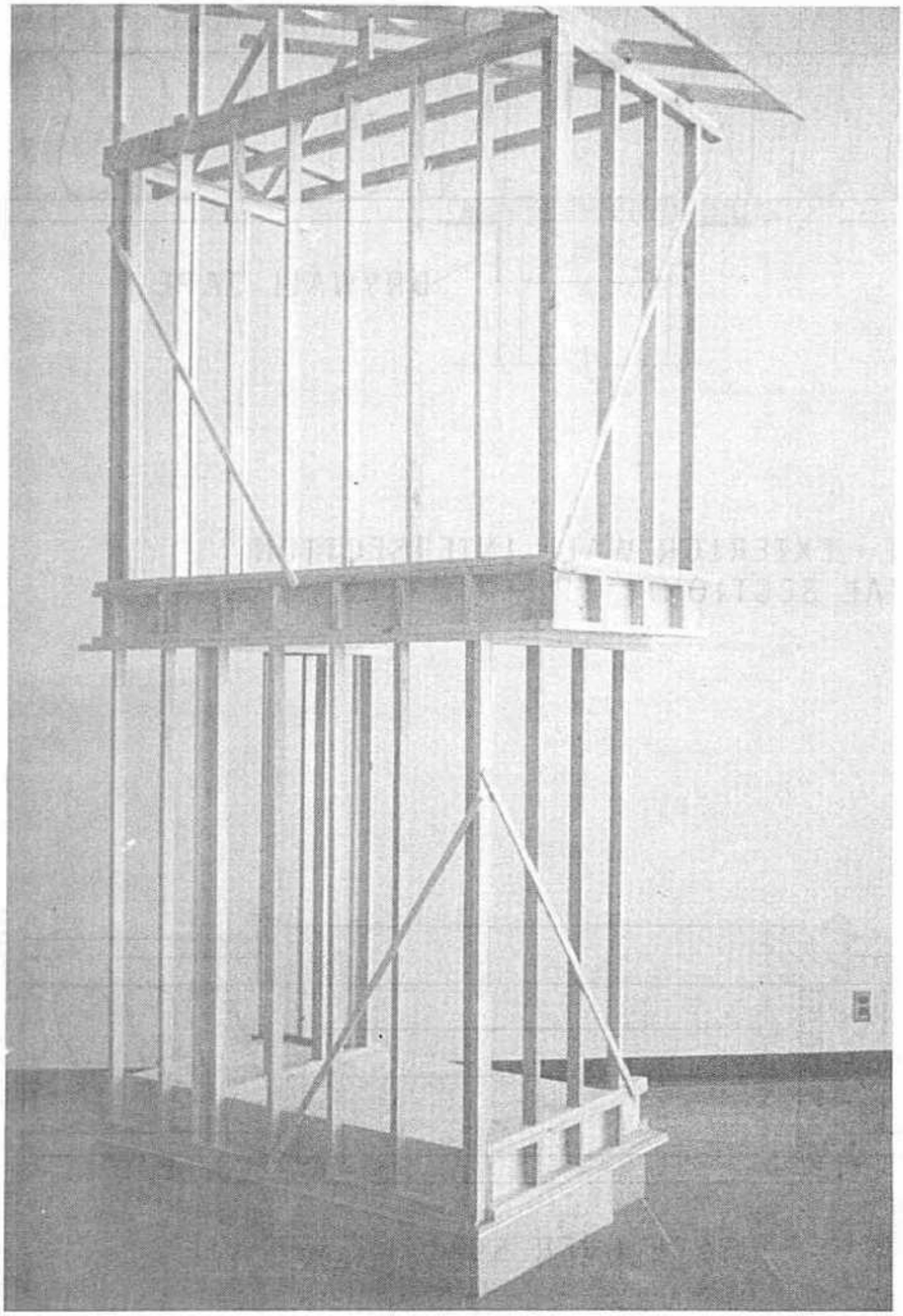


FIGURE 13

ONE-HALF SCALE MODEL CONSTRUCTED TO ILLUSTRATE APPLICATION OF METHOD