JOHNSON COUNTY BUILDING OFFICIALS ASSOCIATION

RESIDENTIAL FOUNDATION GUIDELINE

Johnson County Building Officials Association

Residential Foundation Guideline

This document is provided through endorsement by the Johnson County Building Officials. ***The Johnson County Building Officials Association does not warrant the accuracy, completeness, or timeliness of the information contained in this handout. To verify the requirements where you are working, please refer to the official version of the ordinance for the jurisdiction you are performing work in.***

Foundation designs for one-and two-family dwellings may use the approved standard designs provided in this policy in lieu of the prescriptive requirements of the International Residential Code (IRC). This policy does not preclude the right of the jurisdiction to require a foundation designed by a licensed architect or engineer. This document is applicable only to foundation systems with adequate surface drainage away from the foundation walls, not affected by groundwater, and without surcharge on wall backfill. Situations not addressed by this standard shall follow the prescriptive requirements of the IRC or approved alternate method. This document does not address insulation of the building foundation. Some methods of insulating foundations may preclude the use of the details referenced in this standard.

Foundation Design and Engineering

Soil tests and/or assistance from a licensed structural and/or geotechnical engineer shall be obtained when unusual conditions are encountered. Unusual conditions include:

- Foundation walls over 10 feet in height, measured from the top of the wall to the top of the slab. Such walls shall be designed by a licensed architect or engineer. A design shall be submitted for approval prior to obtaining a footing inspection.
- Fill soils below footing level.
- Fill over creeks, ponds, or lagoons.
- Sloping lots steeper than 4 to 1 before grading.
- Foundations that do not meet the minimum clearances from ascending slopes as provided in the IRC.
- Lots where some footings will bear on soil and others will bear on rock.
- High water table or other severe soil-water conditions are known to exist.
- Areas where problems have historically occurred.
- Foundation walls, unrestrained at the top, with more than 4 feet of unbalanced fill except as specifically permitted in this document.

If it is determined an engineered design or report is required, the design or report shall be approved by jurisdiction prior to the footing or foundation inspection.

Foundation Plan

The following items shall be included on drawings for permit issuance:

a) A complete, detailed foundation plan reflecting the lower level construction proposed on the plot plan, frost footing depth, reinforcing schedule, hold down placement and anchor bolt spacing.
b) Plans shall indicate door locations, window locations and correctly sized escape/rescue openings for all sleeping rooms and basements.
c) Accurate building elevations, reflecting the foundation and grading conditions proposed on the plot plan, including jumps, grade level window locations, and water resistant continuously poured concrete window or door wells may be required by the local jurisdiction.

Soils

Soil bearing capacities shall comply with IRC Table R401.4.1. A soils report is not necessary unless specifically required based on site conditions. In lieu of a complete geotechnical evaluation, a load bearing value of 1,500 psf and an equivalent fluid pressure of 60 pcf (60 psf/ft) will be assumed.

Recommendation: *With a predominance of clay soils with varying expansive characteristics, maintaining soil moisture content equivalent to the content existing during excavation while concrete operations are performed will help minimize problems associated with differential settlement or displacement. Placing foundations and floor slabs on dried and shrinking clay soils may cause cracks and heaving after the soil returns to normal moisture content.*

Concrete

Concrete strength shall comply with the following minimum strength requirements at 28 days and shall be 6% (+/- 1.5%) entrained air for footings, walls or exterior flatwork and no air added (entrapped air) for interior flatwork:

- 2,500 psi for basement floor slabs on undisturbed grade.
- 3,000 psi for footings, foundation walls, structural floor slabs.
- 3,500 psi for carport and garage floor slabs on undisturbed grade.
- 3,500 psi for structural floor slabs or per engineered design, whichever is greater.

Recommendation: *Minimum allowable footing concrete cure time prior to wall placement is 24 hours.*

Footings

Exterior walls, bearing walls, columns and piers shall be supported on continuous solid masonry or concrete footings, or other approved structural system to safely support the imposed loads and shall be sized and reinforced in accordance with Table 1 or designed for the imposed load. Footings under foundation walls shall be continuous around the structure and from one level to the next. The continuous transitions between footings at different levels enclosing usable space shall be made by approved solid jumps or support systems to provide safe support of the structure. (See 2/S2).

Foundation Footing Reinforcement Schedule - Table 1

MINIMUM FOOTING SIZES-WALL FOOTING AND ISOLATED PAD[1]				
FOOTING DIMENSIONS	ONE STORY WITH STUCCO OR BRICK		MIN. 8"X16" FOOTING	
	TWO STORY WITH STUCCO		MIN. 8"X16" FOOTING	
	TWO STORY STUCCO WITH BRICK OR STONE MORE THAN 5 FT IN HEIGHT		MIN. 10"X20" FOOTING[1]	
	MINIMUM 2-#4 BARS CONTINUOUS		IF USABLE SPACE UNDER GARAGE MIN. 8"X24" W/ 3-#4 CONTINUOUS[3]	
ISOLATED FOOTING COLUMN PADS[1]	**36x36x12 6-#4 bars e.w**	**42x42x14 7-#4 bars e.w**	**48x48x16 8-#4 bars e.w**	**60x60x18 9-#4 bars e.w**

Footnotes:

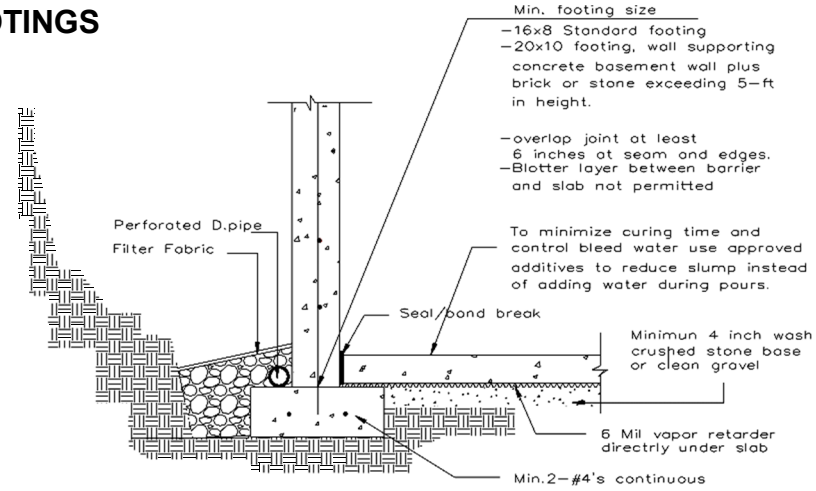
Footing widths and pads may be designed using:

1. ***The actual applied design live/dead loads using an allowable bearing capacity of 1,500 psf; IRC Table R403.1;***
2. ***Separate engineering determination with calculations;***
3. ***Where the garage slab has usable space under the garage, footing shall be per detail 1/S2 (8x24 w/3 #4's continuous).***

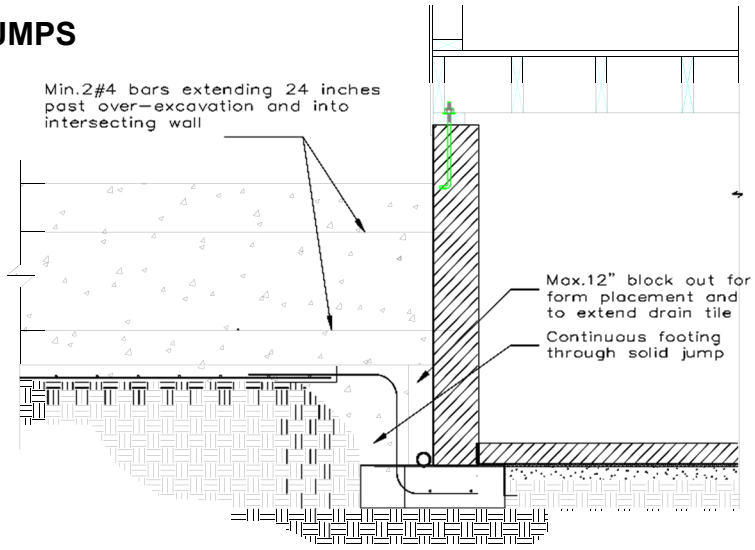
Footings – Minimum Depth

The minimum frost footing depth shall be not less than 36” below grade. Footings for freestanding accessory structures with an area of 600 square feet or less and an eave height of 10 feet or less are permitted to extend below grade 12” and have a minimum width of 12”.

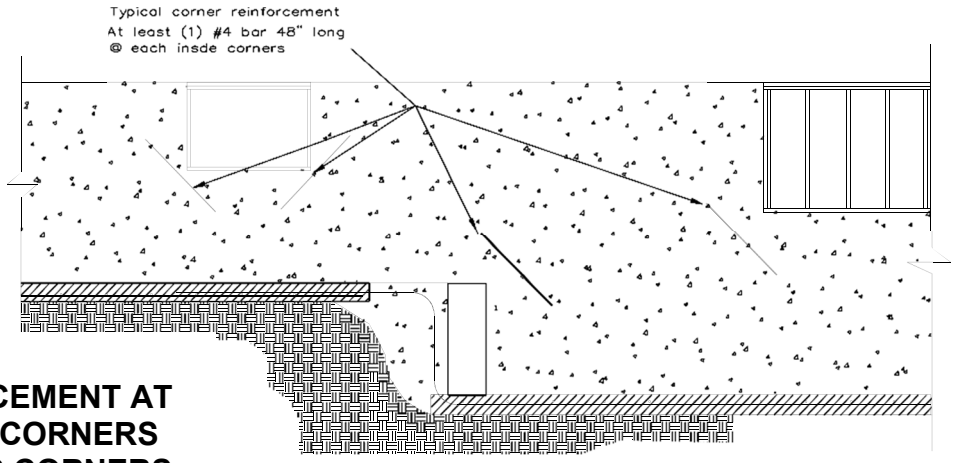
1/S2 – FOOTINGS



2/S2 - SOLID JUMPS

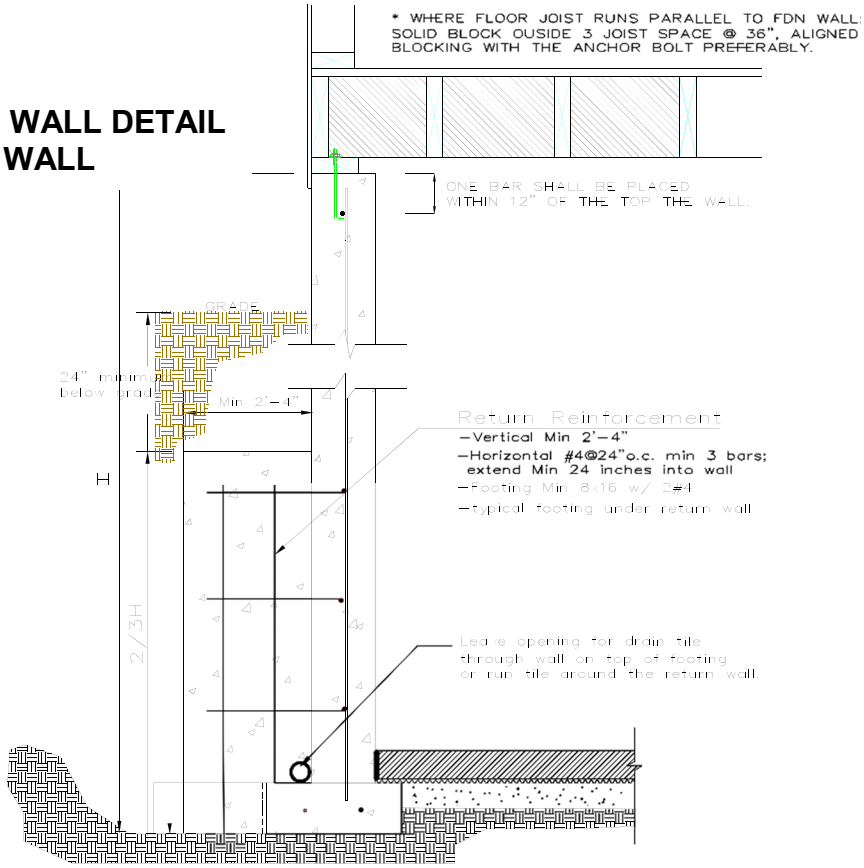


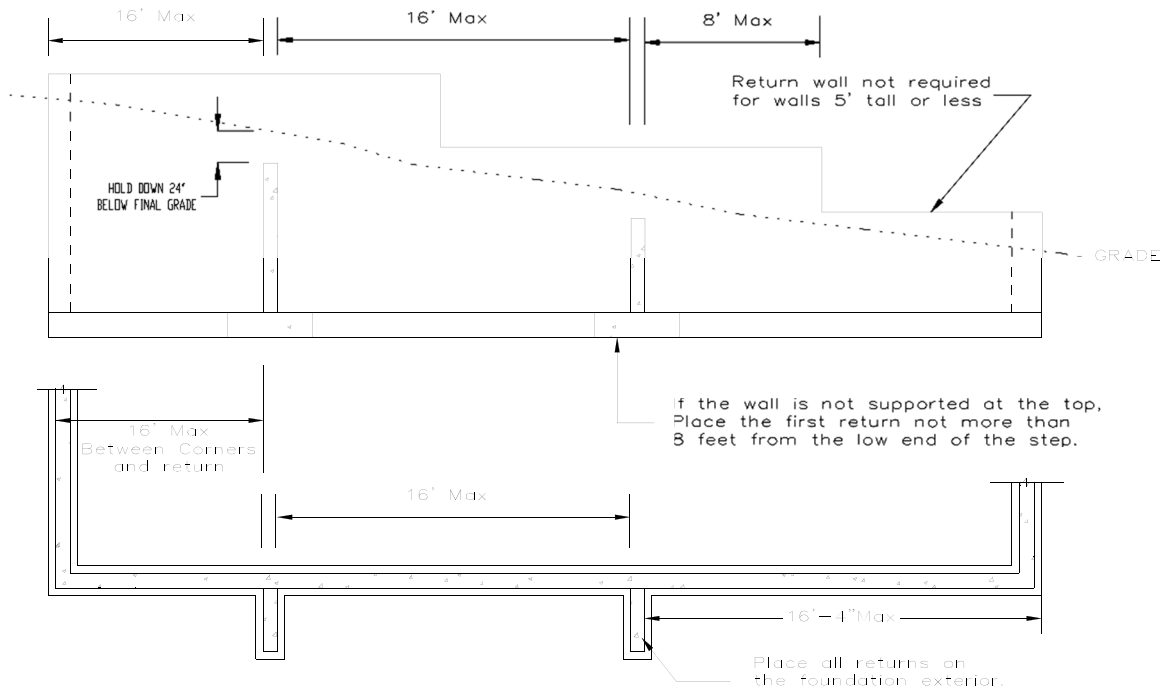
Where openings or abrupt elevation changes occur in the top or bottom of the wall at least one #4 bar 48 inches long shall be diagonally as close as practical to the corner.



10/S2
REINFORCEMENT AT OPENING CORNERS AND STEP CORNERS @ INSIDE CORNERS

3/S2 – RETURN WALL DETAIL UP TP 9' WALL





7/S2 – RETURN WALL PLACEMENT FOR LONG WALLS

Vertical reinforcement spacing 60 psf soil						
Concrete strength/Grade	8 inch thick wall			10 inch thick wall		
Reinforcement #4 bar	8'	9'	10'	8'	9'	10'
3,000 psi / Grade 40	16	12	NP	24	16	12
3,500 psi / Grade 40	16	12	NP	24	24	12
3,000 psi / Grade 60	24	16	NP	24	20	16
3,500 psi / Grade 60	24	16	NP	24	24	16
Horizontal reinforcement – Minimum Grade 40 steel #4 bar						
One bar 12" from top of wall; maximum spacing 24" o.c.	4-#4	5-#4	6-#4	4-#4	5-#4	6-#4

Footnotes:

1) Wall height is measured from the top of the wall to the top of the floor slab.
2) Vertical reinforcement for concrete walls that are not full height, and for reinforcement spacing 24 inch on center, reinforcement may be placed in the middle of the wall. Other walls shall have vertical reinforcement place as follows:
   a) 8-inch wall - Minimum 5 inches from the outside face.
   b) 10-inch wall – Minimum 6.75 inches from the outside face.
   c) Extend bars to within 8 inches of the top of the wall.
3) Reinforcement clearances:
   a) Concrete exposed to earth – minimum 1-1/2 inches.
   b) Not exposed to weather (interior side of walls) – minimum 3/4 inch.
   c) Concrete exposed to weather (top clearance in garage and driveway slabs)- 1-1/2 inches.
4) Horizontal reinforcement:
   a) One bar shall be placed within 12 inches of the top of the wall.
   b) Other bars shall be equally spaced with spacing not to exceed 24 inches on center.

c) Horizontal bars should be as close to the tension face as possible (interior) and behind the vertical reinforcement (i.e.2" towards the inside).
d) Supplemental reinforcement at corners - Place 1 #4 bar 48 inches long at 45 degree angle at corners of openings per Figure 10/S2. Place reinforcement within 6" of the edge of inside corners.

5) Reinforcement shall be lapped a minimum 24 inches at ends, splices, and around corners.
6) At masonry ledges the minimum wall thickness shall be 3-1/2 inches. Ledges shall not exceed a depth of more than 24 inches below the top of the wall. For wall thicknesses less than 4 inches provide #4 bars at maximum 24 inches on center to within 8 inches of the top of the wall.
7) Straight walls more than 5 feet tall and more than 16 feet long shall be provided with exterior braced return walls. Wall length shall be measured using inside the shortest dimension between intersecting walls (See 7/S2).

Damp Proofing

One coat (minimum) of damp proofing or equivalent foundation membrane shall be applied to exterior wall surfaces below grade. Sealing tie holes, voids and honeycombed areas with sealant before damp proofing is recommended. Waterproofing in accordance with the IRC will not be required unless a groundwater investigation indicates excessive hydrostatic pressure, a high water table, or other severe soil-water conditions are known to exist and the foundation walls retain earth.

Recommendation: *The use of waterproofing in accordance with the IRC combined with a minimum 4"perforated foundation drainage pipe.*

Foundation Drainage

Installation of a continuous foundation drain consisting of a minimum 4 inch perforated pipe around the entire structure is required where habitable or usable space for any portion of the structure is located below grade. The top of the perforated pipe shall be at or below the area being protected. The pipe shall be placed with positive or neutral slope to minimize the accumulation of deposits in the drainage pipe. Placement of the drain tile on top of the footing is acceptable. Vertical drains shall be installed in window wells and connected directly to the perimeter foundation drain. *Coarse, clean, rock shall extend 2 inches below and 6 inches above the perforated pipe, and extend 12 inches beyond the outside edge of the footing and* ***covered with an approved filter membrane***. The perforated pipe shall terminate to grade or be connected to the required minimum 24 inch diameter or 20 inch square sump pit which shall extend a minimum 24 inches below the bottom of the basement floor per the IRC. The sump shall be capable of positive gravity or mechanical drainage to remove any accumulated water and discharge to daylight.

Backfill

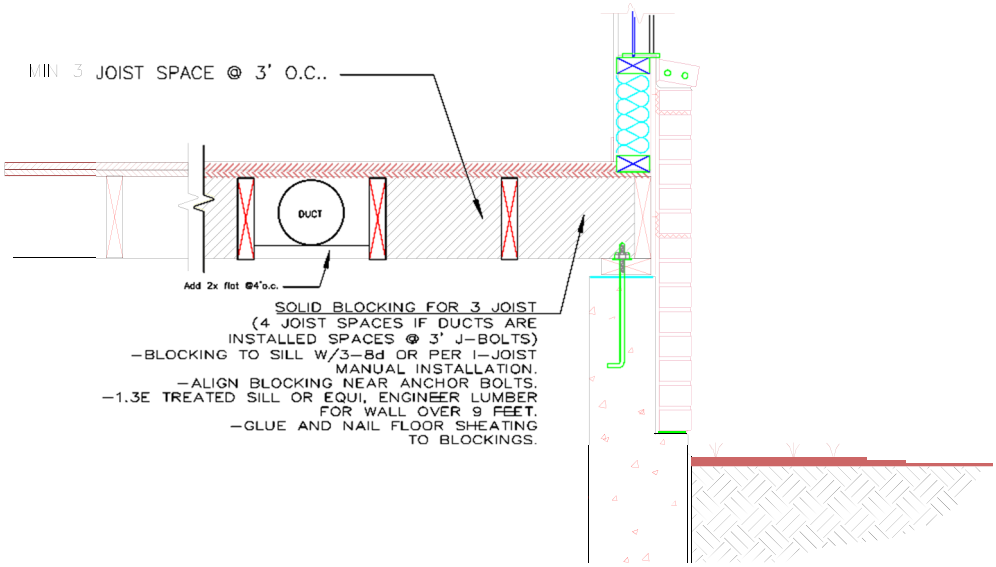
Placing backfill prior to bracing or supporting the top of the foundation wall may cause foundation walls to become displaced or cracked. Backfilling any wall before seven days to allow the wall to gain sufficient strength to support the imposed loads is prohibited. Inspectors may require engineering certification and correction of any cracked or bowed wall conditions observed.
Recommendation: *Do not backfill an unsupported straight run of wall over 16 feet in length between corners and cross walls unless adequate bracing is provided or the floor framing has been set and nailed in place and anchor bolts tightened. To improve foundation drainage, backfill with washed gravel or clean crushed rock at least one sieve size larger than drain pipe perforations, to a point not less than 2' below finished grade. Encase bottom, dirt side and top of backfill with approved filter membrane. Backfill high enough so there is a minimum 6" fall in the first 10' away from the house.*

Foundation Anchorage

Where floor joist and/or blocking are connected to the sill to provide top of wall bracing anchor bolts shall be spaced not more than 3 feet on center. Walls with monolithic slabs may have anchor bolts spaced at 6 feet on center. Sill plates shall be bolted to the foundation with minimum 1/2-inch diameter anchor bolts embedded at least 7 inches into the concrete. A bolt shall be placed within 12 inches, and not closer than 7 bolt diameters, of the end of each plate section. A properly sized nut and washer shall be tightened on each bolt to the plate. **For walls over 9 feet use a minimum 2x6 plate and blockings shall be in line with anchor bolts.** Design specific anchoring may be required by the designer for walls 9 feet tall or more. These anchoring devices may be required to be secured in place to the forms prior to concrete placement. ***Recommendation:*** *It is recommended that a minimum 2x6 inch sill plate be used to ensure sufficient strength is provided to transfer loads from the anchor bolts to the floor system.*

Top of Wall Restraint

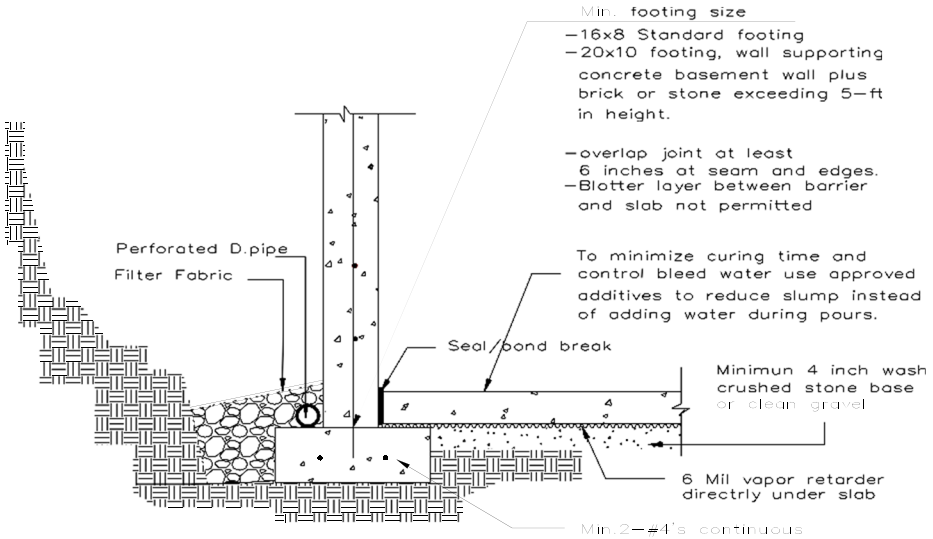
Where joists run perpendicular to foundation walls, they shall be fastened to plates with three 8d toenails. Where joists run parallel to full height foundation walls, solid blocking for a minimum of three joist spaces shall be provided at a maximum of 3 feet centers to transfer lateral loads on the wall to the floor diaphragm. The blocking shall be securely nailed to the joists and flooring. If ducts are installed in a joist space(s), nail 2 x 4's flat 3 foot o.c. within the joist space(s) and then provide the solid blocking as noted below in a total of 3 joist spaces. Secure each 2x4 to the sill plate with 3-8d nails. (See 7/S3)



7/S3 – BLOCKING FOR JOIST PARALLEL TO WALL

Vapor Retarder (Vapor Barrier)

A 6 mil polyethylene or approved vapor retarder with joints lapped a minimum of 6" is required between the concrete floor slab and the base course per the IRC. ***Commentary:*** *The American Concrete Institute's "Guide for Concrete Floor and Slab Construction" (ACI 302) does not recommends a blotter layer where spaces are finished and when vapor sensitive floor coverings are installed. All edges and seams should be sealed and punctures minimized. Use water reducing admixtures to reduce bleeding, shrinkage, and curing time. This vapor retarder minimizes moisture migration through the slab to: retard mold development, improve adhesion of grouted or cemented floor surfaces, control radon sources, and improve the livability of the basement spaces.*



1/S2 – FLOOR SLAB VAPOR RETARDER

Floor Slab Placement and Bond Break as Structural Supports

Basement floor slabs shall be a minimum 3 1/2 inches thick and placed on a 4-inch base of sand, gravel or stone. The vapor retarder (see below) is placed between the slab and the base course or prepared sub-grade in basements and living areas. The vapor retarder is not required for garage slabs, porches, stoops or other exterior slabs.

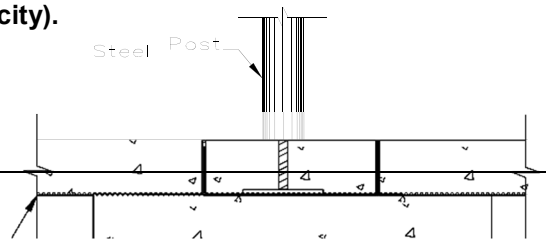
The basement floor shall be isolated from column pads, interior columns and interior-bearing walls by approved material to act as a bond breaker. Interior columns and bearing walls shall be supported on a separate interior footing (not on top of the floor slab). The vapor retarder will be considered adequate to act as a bond break between the basement floor slab, columns and column footings, and interior bearing wall footings (See 4/S2).

Note:

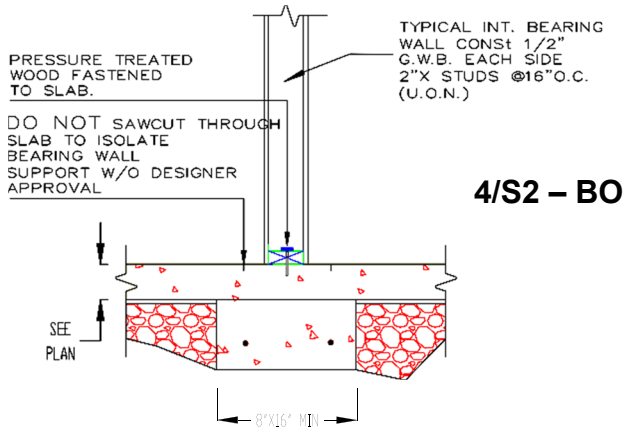
1. *Isolation of column from floor slab at column pedestals in the garage is not required.*
2. *Where structural slabs are specified, do not sawcut the slab without the approval of the design professional.*

Commentary: *Floor slab placement on expansive soils requires care to minimize problems associated with slab heaving and/or settlement. Soil moisture at the time of slab placement should be controlled so the moisture content is as close to a natural state as possible.*

- ☐ **Pads and bearing walls shall be isolated form the floor slab with a bond break**
  -minimum 6 mil vapor barrier, felt paper or other approved material
- ☐ **Size pads to support the imposed live and dead loads (Max 1,500 psf soil assumed bearing capacity).**



***Do not sawcut structural slab without the approval of the designer.**



4/S2 – BOND BREAK AS FLOOR SLAB

***Do not sawcut structural slab without the approval of the designer.**

Foundation and Lot Grading

Grades shall be sloped away from the foundation a minimum of 6 inches in the first 10 feet. Alternate approaches may be approved if the alternate design is equivalent in effectiveness and performance and provides for positive site drainage. Grading shall conform to that illustrated on the approved plot plan.

Concrete Slabs Placed on Fill

This section applies to concrete slabs placed on fill material which exceeds 24 inches of granulated material (sand or gravel) or 8 inches of earth. This may occur at garage floor fills, or over-excavated areas under floor slabs or patios exceeding the previously specified fill limitations. The design and installation details in this document, where applicable (based on size and spacing limitations), may be used in lieu of providing a separate design. Designs for structural slabs exceeding the spans and conditions of the approved details shall be designed by a Kansas-registered design professional.

Elevated Slabs

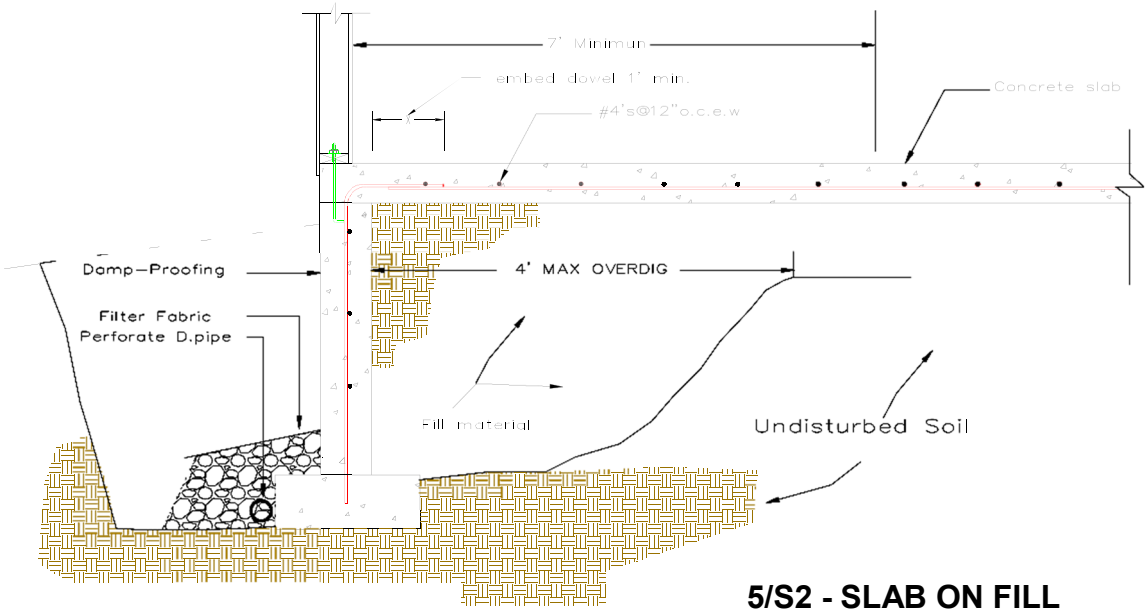
Elevated slabs are slabs constructed over usable, accessible space. All elevated garage slabs must be designed by a Kansas licensed Engineer or Architect or by using the approved details in this document. Engineered designs shall be supported with calculations. The design and calculations shall bear the seal and signature of the Kansas licensed designer and must reflect the concentrated load requirement specified in IRC Table R301.5, footnote a.

Elevated porch slabs spanning 6'-0" or less in any one direction can be constructed as follows:

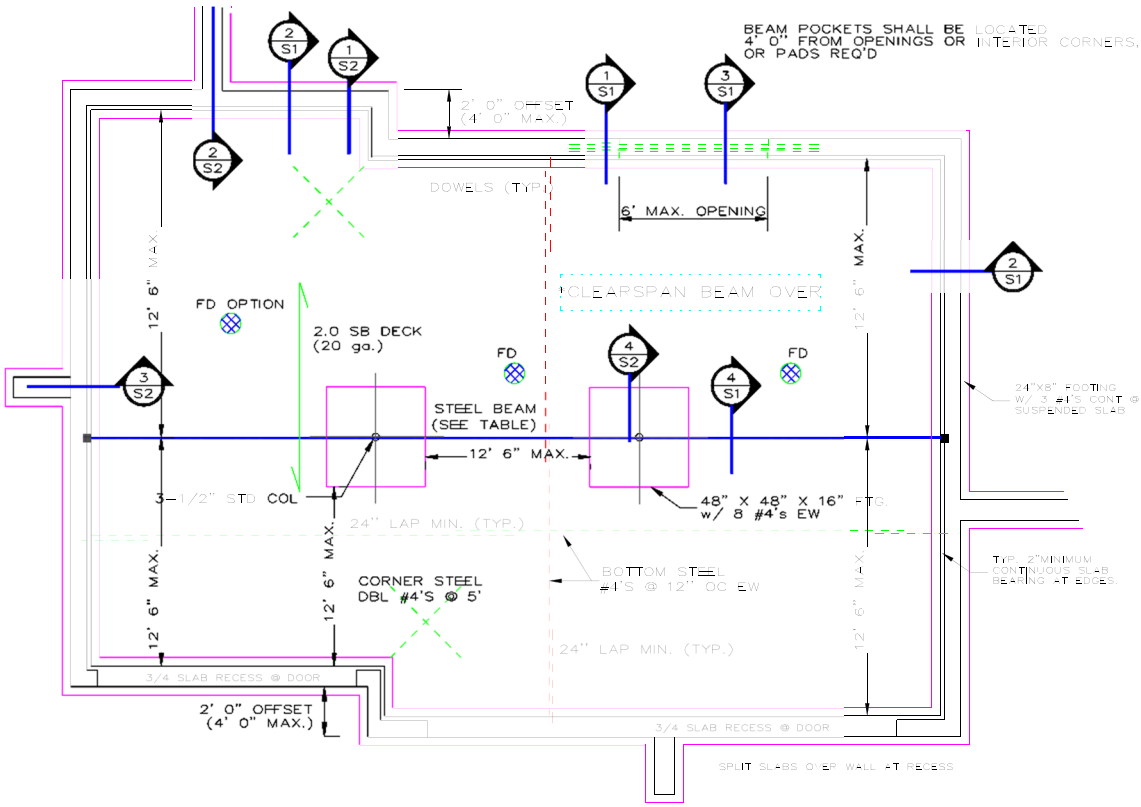
- Minimum 6" thickness.
- #4 bars at 12" o.c. each way placed 2-1/2" above bottom of slab.
- There shall be a minimum 2" continuous bearing at the edges of the slab.

Elevated porch slabs spanning more than 6’0” in shall comply with the reinforcement spacing for elevated garage steel schedule.

Accepted alternative designs details



5/S2 - SLAB ON FILL

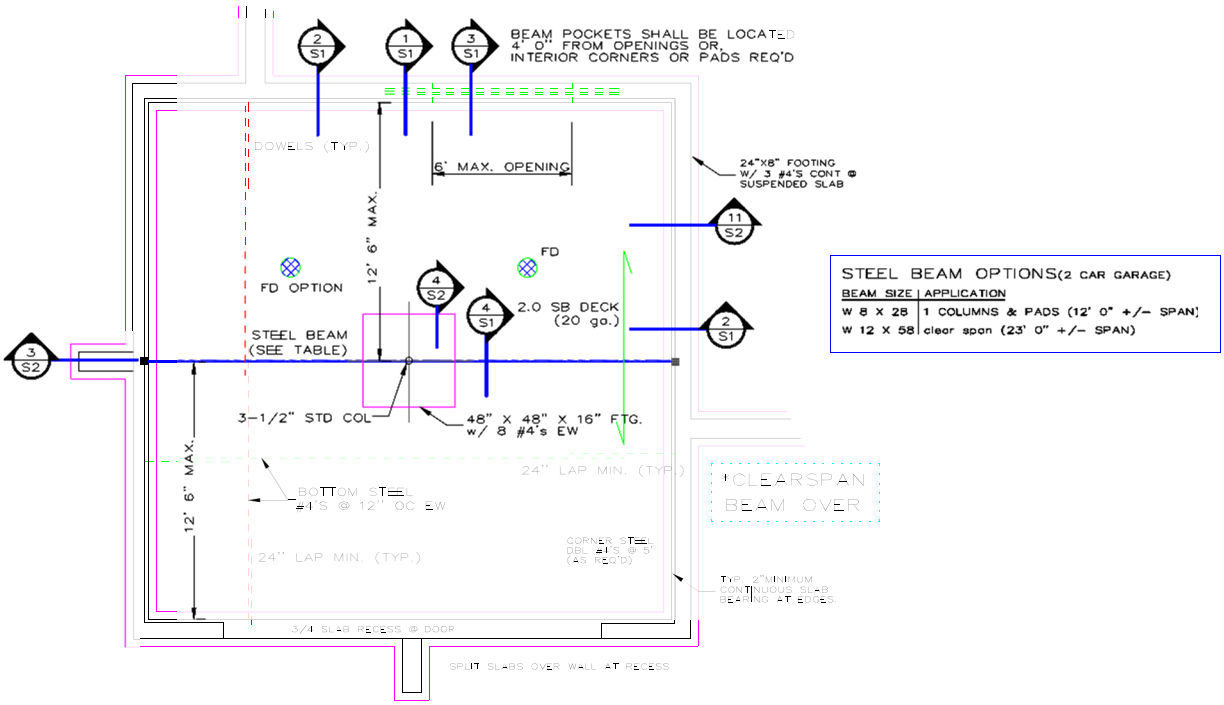


STEEL BEAM OPTIONS(3 CAR GARAGE)

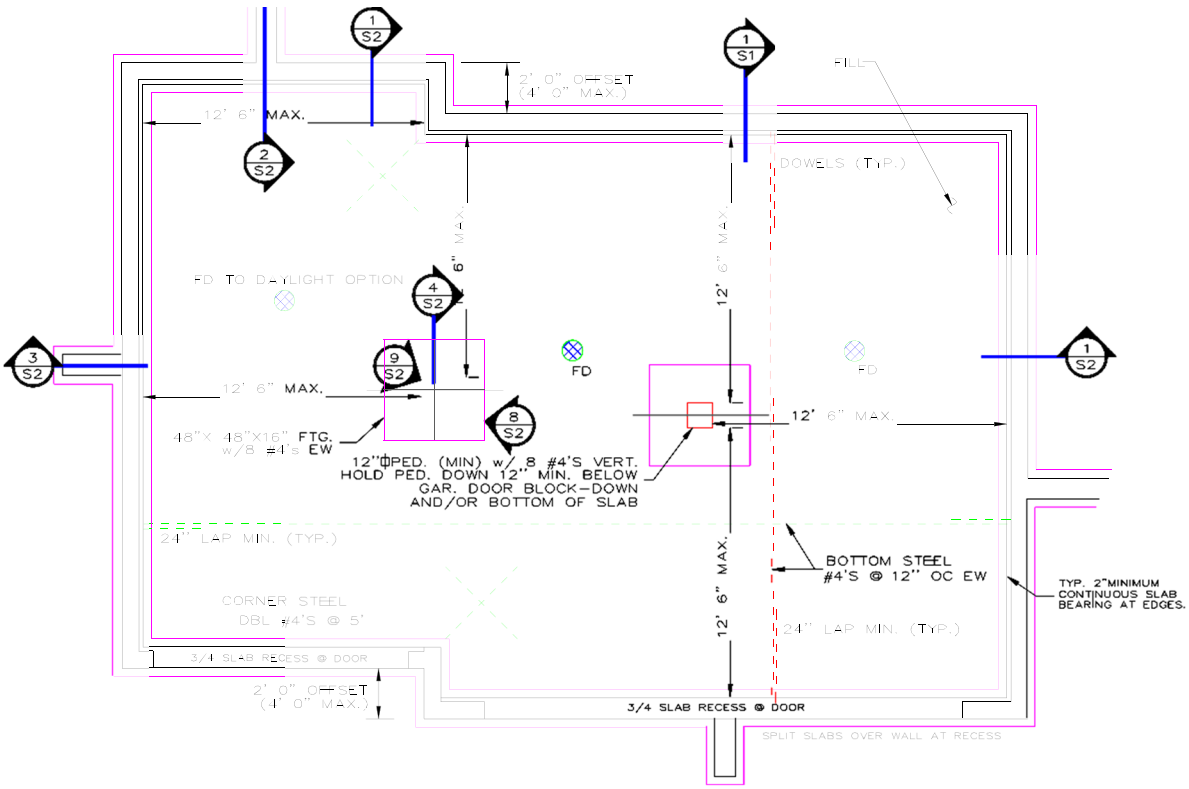
BEAM SIZE	APPLICATION
W 8 X 28	2 COLUMNS & PADS (12' 0" +/– SPAN)
W 12 X 58	1 COLUMN & PAD (23' 0" +/– SPAN)

ROTATE (90 DEGREES) STEEL AND BEAM(S) OPTION

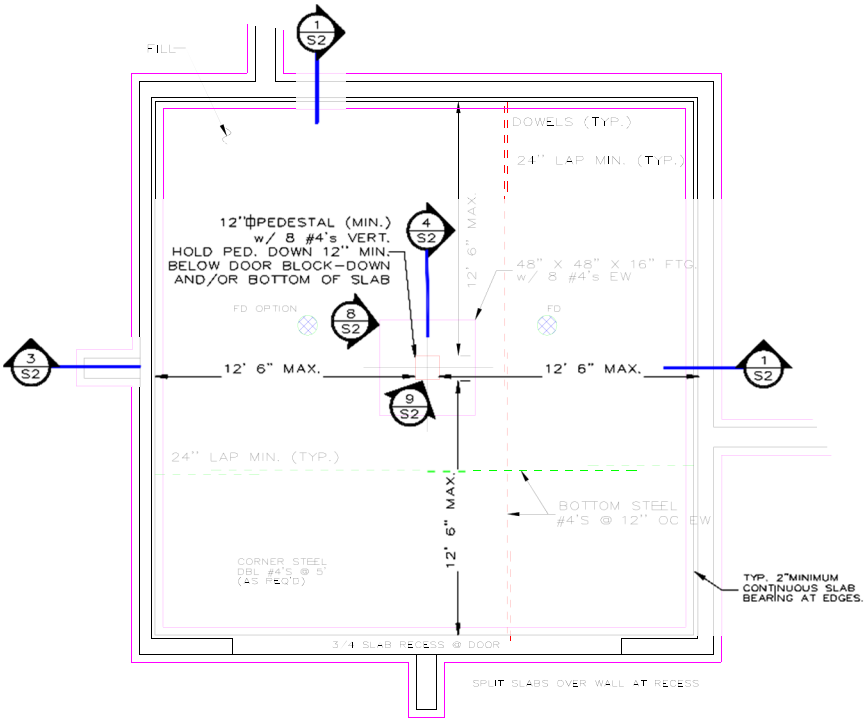
A/S1 GARAGE SLAB WITH BASEMENT UNDER



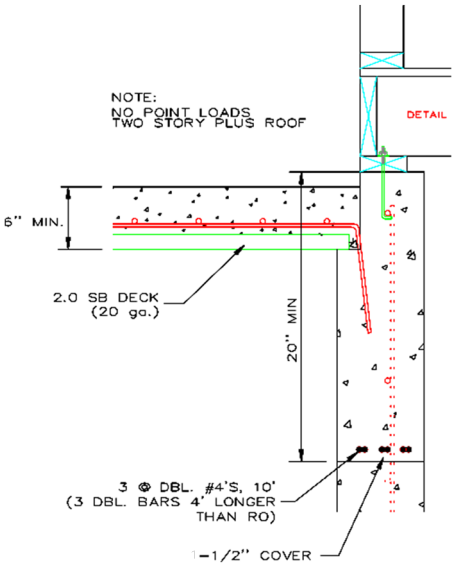
B/S1 GARAGE SLAB WITH BASEMENT UNDER



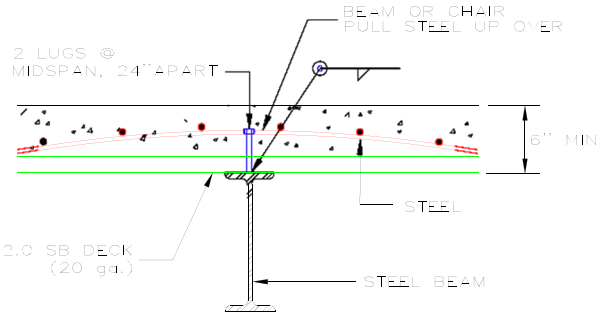
A/S1 GARAGE SLAB ON FILL



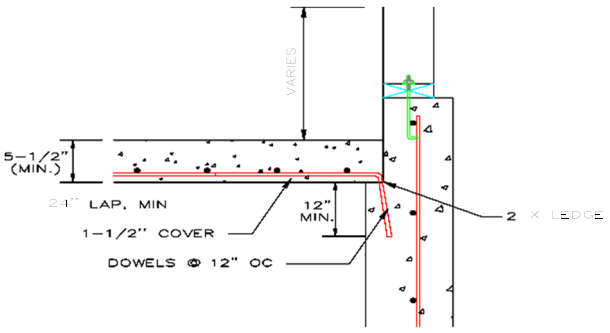
B/S1 GARAGE SLAB ON FILL



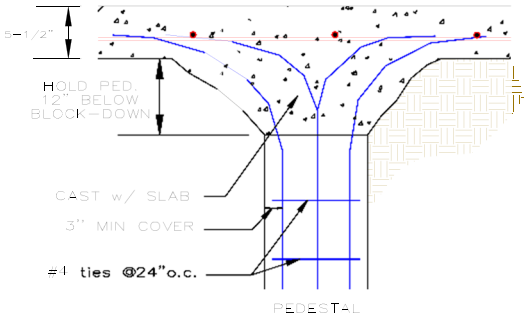
1/S1
6 FT MAX HEADER OPNG
80"x 88" RO (9' WALL)
(space under garage)



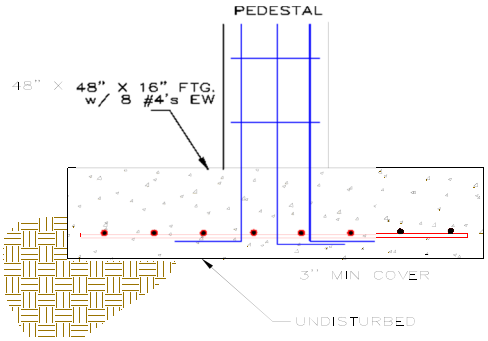
4/S1 SLAB OVER BEAM



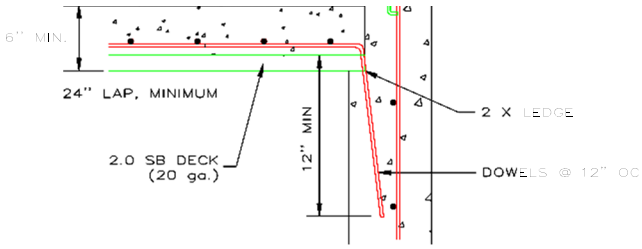
5/S1 SLAB AT WALL



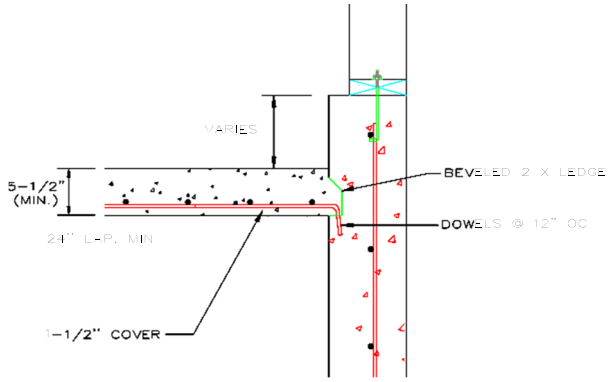
8/S2
SLAB AT PEDESTAL



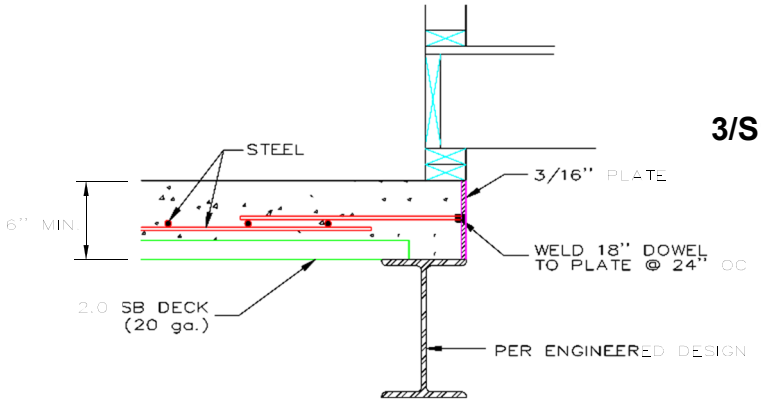
9/S2
PEDESTAL AT FOOTING



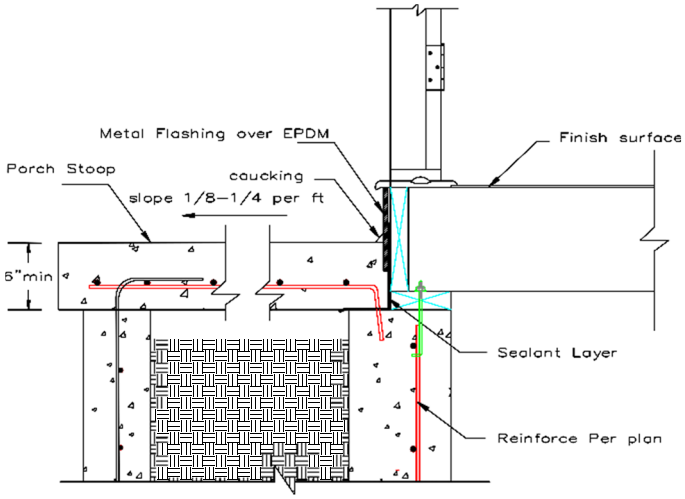
1/S1 SLAB AT WALL
Slab on fill



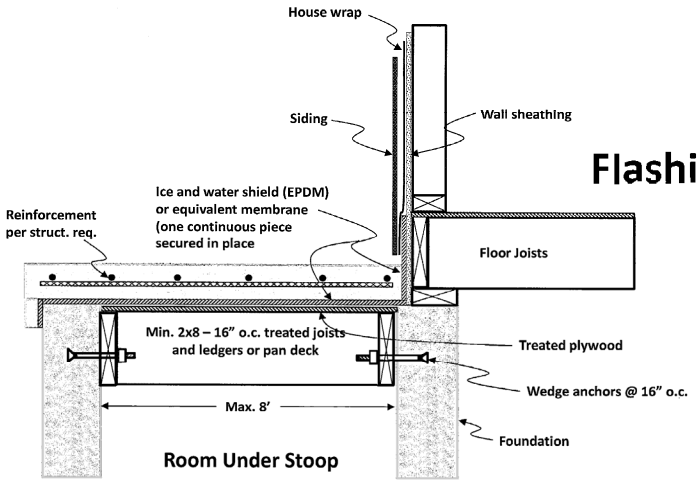
2/S1 SLAB AT SIDE WALL BEAM



3/S1 SLAB AT PERIMETER BEAM



11/S2 TYPICAL FRONT STOOP



Flashing Detail-Room Under Stoop