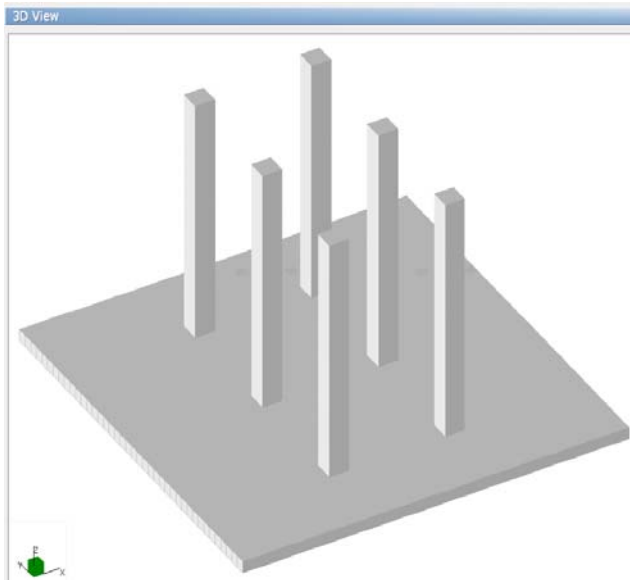


## ANALYSIS AND DESIGN OF SLABS ON GRADE WITH SINGLE LAYER OF REINFORCEMENT

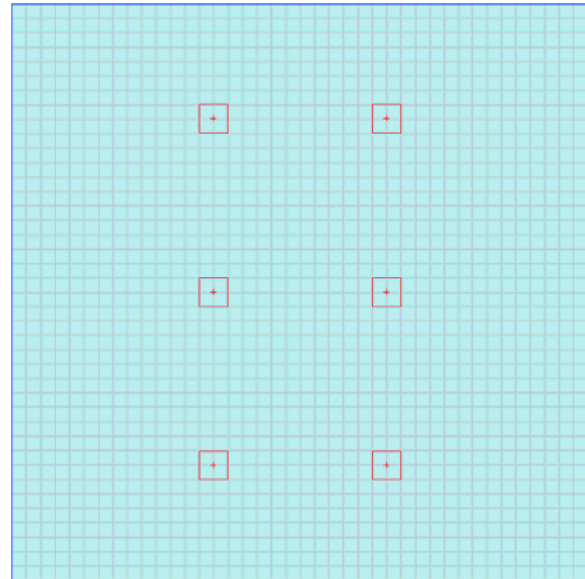
Ground supported slabs are frequently designed with a single layer of reinforcing. Such slabs are referred to as membrane slabs, floating slabs, or filler slabs and range in thickness from as little as 4" to 8" depending on the supported loads. In warehouses and storage facilities such slabs are subjected to concentrated point loads from storage rack posts or forklift wheel loads.

### Example Model with Sample Input:

In this example, a concrete warehouse floor with joints spacing 20' o.c. a slab is subject to modular racking posts loads of 1000 lbs each in a grid of 6'x6'. The 6" slab is supported on soil with a subgrade modulus of 100 kcf.



3D View

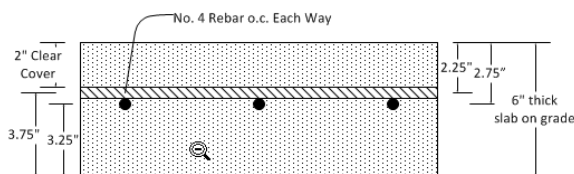


Plan View

To investigate or design a slab with a single layer or reinforcement, spMats design parameters definition input requires special attention in order to determine the correct area of steel required.

### Design Parameters Input

To model a single layer of reinforcing, cover distance for top and bottom reinforcement should be input such that they are at the same plane per each of the x and y directions. The reinforcement location is measured to the centerline of reinforcement. For a 6 in. thick slab on grade and assuming No. 4 bars with 2 in. clear cover at the top, the reinforcement location for single layer reinforcement is entered for top layer and bottom layer such that both are at the same horizontal plane. (i.e. 2.25 in. from top of the slab and 3.75 in. from bottom of the slab for a 6 in. thick slab)



Design Parameters			
Label	Gr60#4		
Min. Reinf. Ratio (% of Ag per layer)	0.18		
Reinforcement Location (in)			
	X-Dir	Y-Dir	
Top Layer	2.25	2.75	
Bottom Layer	3.75	3.25	

A small diagram to the right of the table shows a cross-section of a slab with reinforcement bars. Blue arrows point from the text 'To Y-Dir Bars' and 'To X-Dir Bars' to the respective bars in the diagram. The X and Z axes are also indicated.

The reinforcement location input should be adjusted depending on bar sizes. For example, if No. 6 bars are to be utilized, reinforcement locations will be as follows:

Top Layer - X-Dir. = 2.375 in. (2 + 0.75/2)

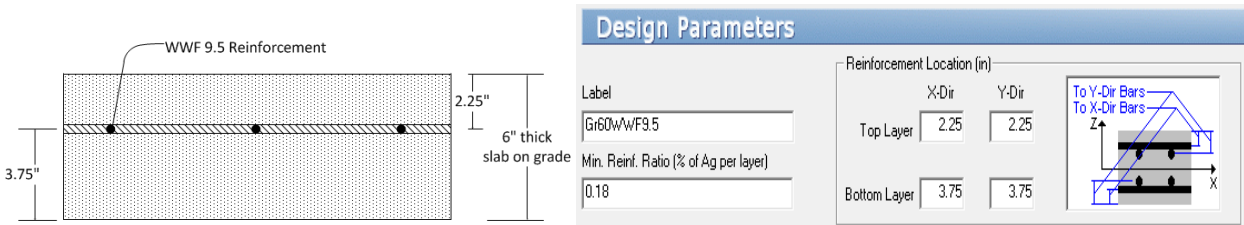
Top Layer - Y-Dir. = 3.125 in; (2.375 + 0.75)

Bottom layer X-Dir. = 3.625 in. (6 - 2.375)

Bottom Layer - Y-Dir.= 2.875 in. (6 - 3.125)

The top reinforcement layer input is used by the Program to calculate the reinforcement area required per unit length to resist tension at the top of the slab. Similarly, the bottom reinforcement layer input is used by the Program to calculate the reinforcement area required per unit length to resist tension at the bottom of the slab. Since both of these layers are in the same horizontal plane, the envelope value of the top and bottom reinforcement is to be selected as governing reinforcement in each direction. To meet code minimum reinforcement ratio (% of  $A_g$  per layer) input is entered as 0.18% of gross concrete area as opposed to 0.09% for models with two layers of reinforcement.

When Welded-Wire-Fabric (WWF) reinforcement is used, the Design Parameter Input for W9.5 wire is shown below as an example:



### Interpretation of Reinforcement Output:

spMats displays reinforcement provided as a contour view as well as a text output for each element. The contour view of required reinforcement in the X-Direction is shown below. The top layer reinforcement due to tension at the top of the slab indicates that the minimum reinforcement which is 0.13 in<sup>2</sup>/ft is sufficient. The bottom layer reinforcement due to tension at the bottom of the slab indicates that the minimum reinforcement which is 0.13 in<sup>2</sup>/ft is sufficient for most of the slab except 1'-0" to each direction from the center of the posts.

The maximum amount of reinforcement to be provided within that 2'-0" x 2'-0" square area is 0.212 in<sup>2</sup>/ft. As these results are enveloped, in X-Direction, No. 4 @ 18" base reinforcement with 1-No.4 additional rebar of length 2'-0" plus development length at the post centerline will satisfy the design requirement. The Y-Direction reinforcement is to be determined in the same way.

