A software for the shear design of rectangular reinforced Concrete beams

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The shear design (stirrup spacing) of structural reinforced concrete is an important aspect of the overall design process for reinforced concrete beams. Using the 318-05: building code requirements for Structural Concrete, this software is able to show details of stirrup pattern for the entire length of the beam.

Designing the stirrup spacing can be an intricate and time consuming task for students as well as the practicing engineer. This is because there are a quite a few code requirements to satisfy depending upon the type of beam supports as well as the type of loading conditions. This software was designed in a detailed and "spelled out" manner, primarily for the benefit of engineering students.

Users have the option to choose two types of beam types. i.e. - simply supported beams or a cantilever beams. Loading conditions are limited to one uniformly distributed load that span the entire beam and two concentrated loads. Users have the freedom to choose the location and the magnitudes of the concentrated loading.

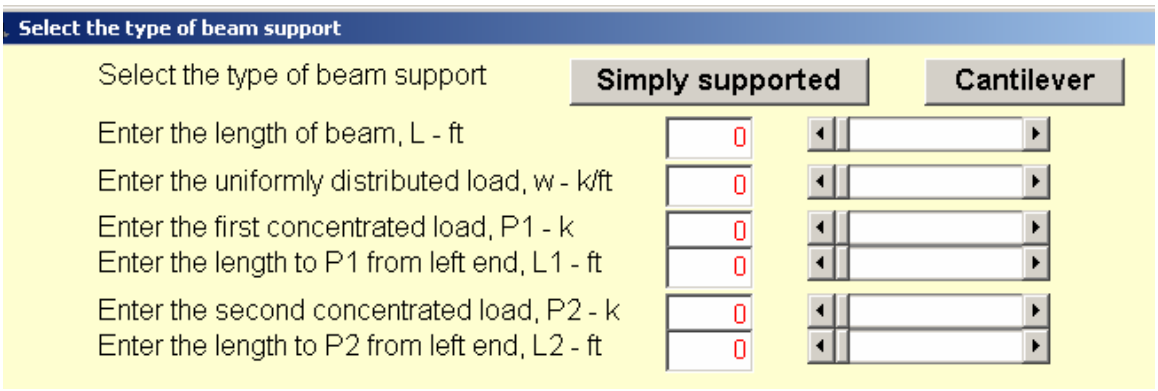
Once the type of beam and loading conditions are entered, the program will show a complete shear force diagram along with all pertinent numerical values.

Users will then have the choice to enter the beam depth and width dimensions along with the ultimate concrete stress and the steel yield stress.

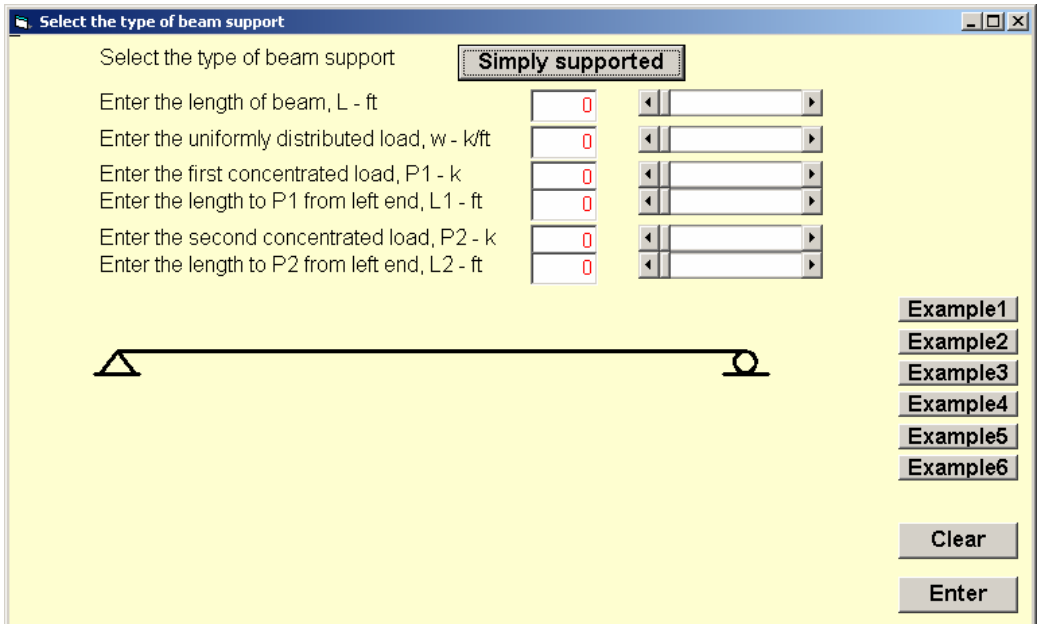
The program will then show all the critical values to satisfy the code requirements and the corresponding practical stirrup pattern.

Following is the first of two demonstrations of the program:

When the program is initiated, the following screen is shown.

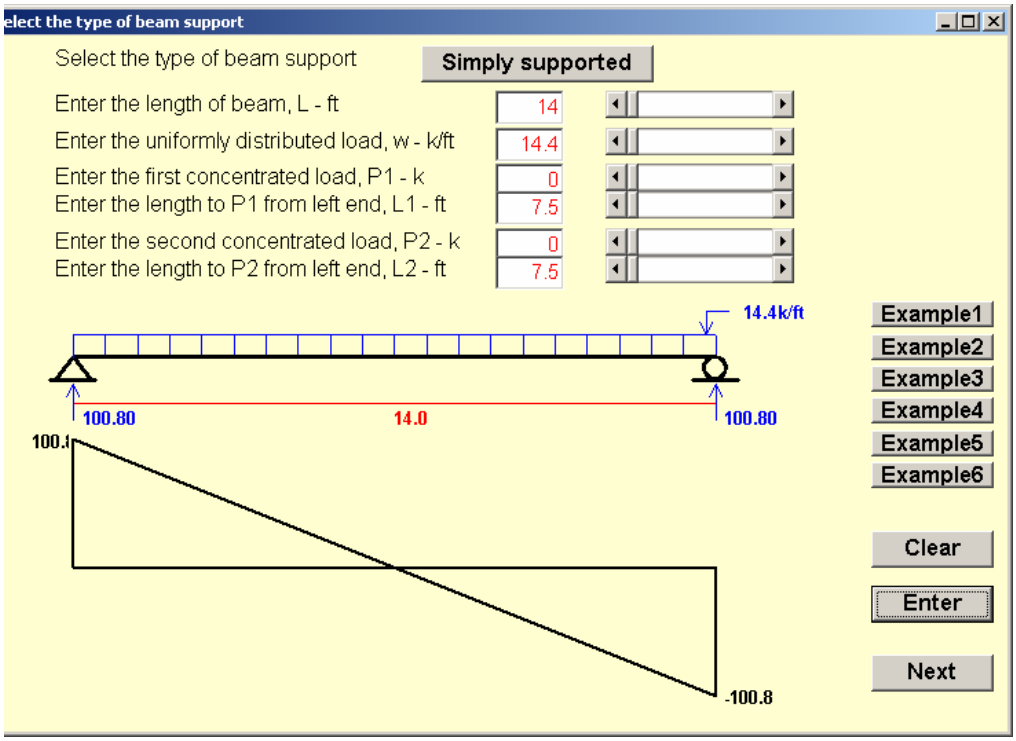


The user has the choice to select the type of support. ie-simply supported or fixed. For this example, we will select simply supported. Then the screen will be modified as follows:

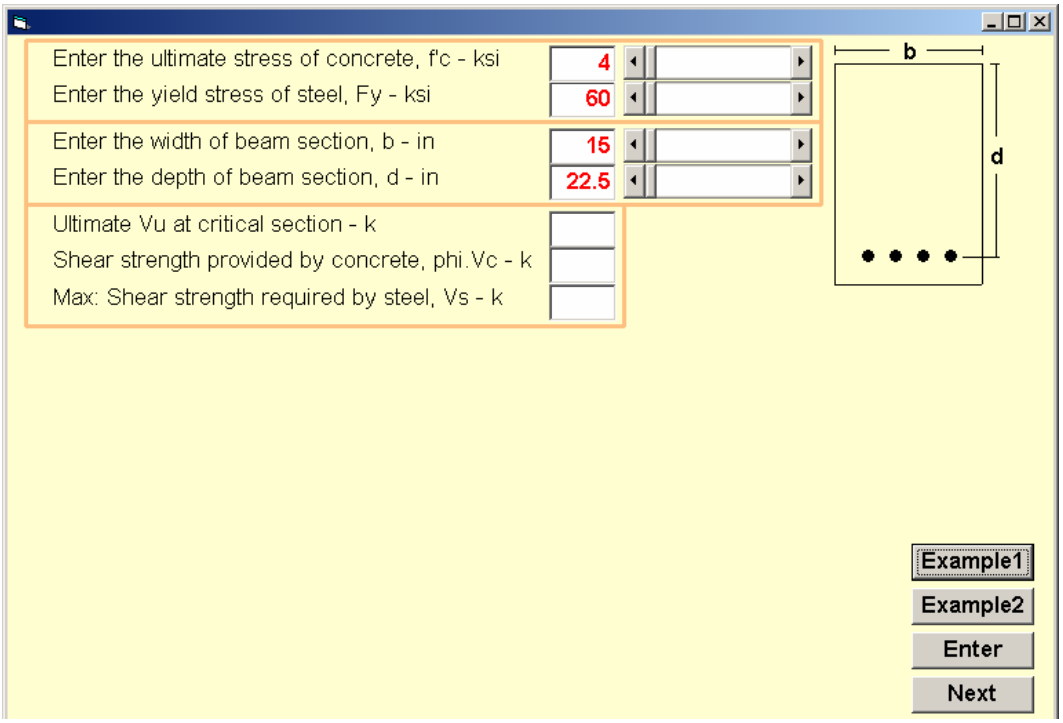


By using the appropriate scroll bars, the user can then select numerical values for the length of beam and uniformly distributed load. The user can also add numerical values for two concentrated loads. For this example, we will use one of the set of numerical values given in “Example5” (these Examples were chosen for illustration purposes and to expedite the process).

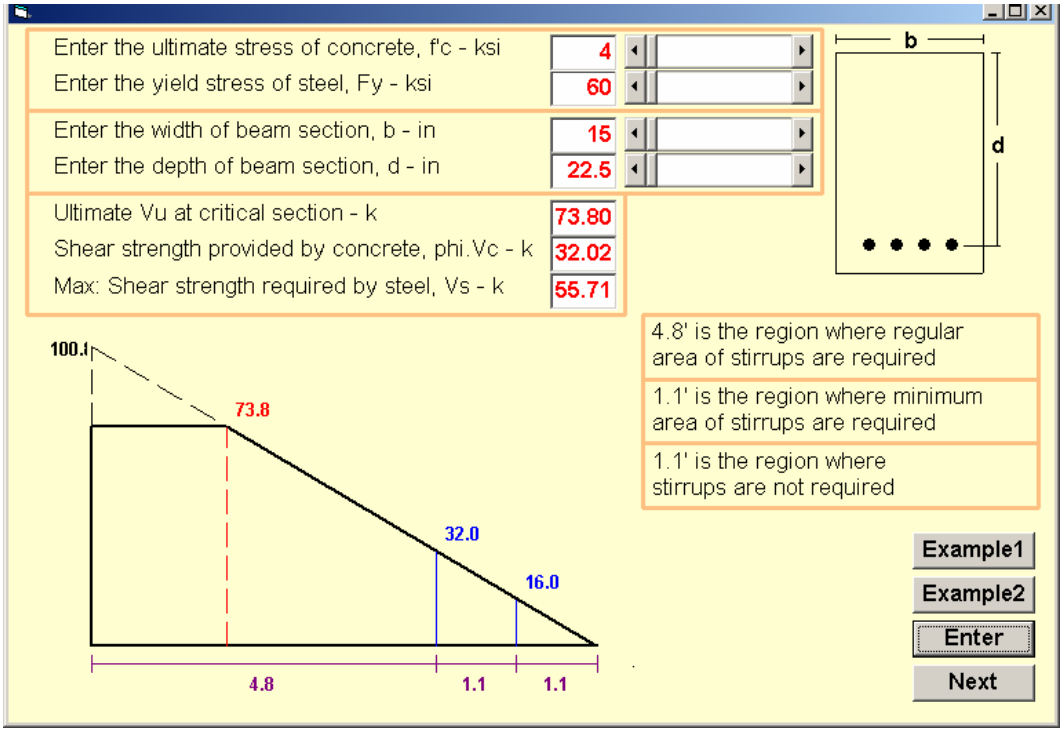
Once the “Example5” button is selected, most of the numerical fields will be populated. Then, press the “Enter” button and the following screen will be shown. The beam and the indicated loading as well as the corresponding shear force diagram are shown. (note, the program was designed to handle, only, symmetrical loading).



To move to the next window, subsequently, press the “Next” button. This will prompt the following screen as shown below.



The numerical values for “f’c”, “Fy”, “b” and “d” can be changed by adjusting the appropriate scroll bars. For this example, the numerical values shown correspond to values stored in “Example1” button. Then, press the “Enter” key and the following screen will be shown.



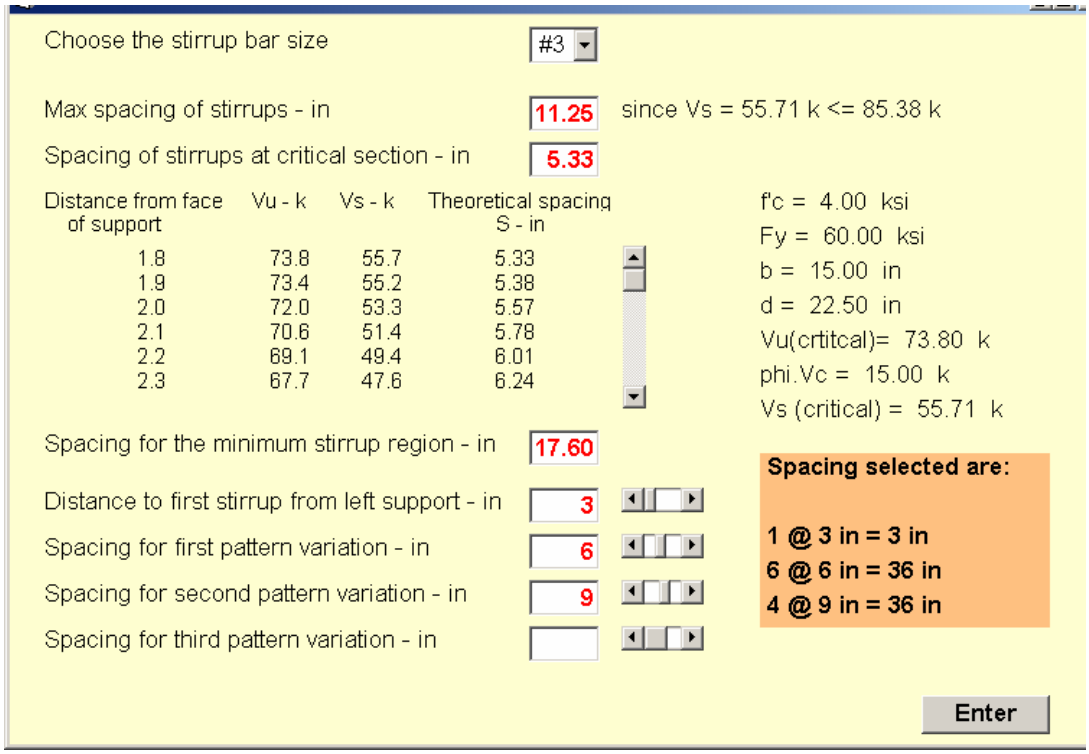
The numerical values for Vu at the critical section, Vc and Vs at the critical section will be displayed.

Two of those three numerical values are shown superimposed on half the shear diagram. The lengths separating the “three possible” zones are shown underneath the shear diagram. Also shown, to the right of the shear diagram are the descriptions of the “three zones”.

As before, to move to the next window, again, press the “Next” button. This will prompt the following screen as shown below.

Using the drop down menu at the top of the screen, choose the stirrup bar size (#3, #4 or #5). Then, choose the distance to the first stirrup from the left support (in this example, we chose 3”), the desired spacing for the first pattern variation (we chose 6”) and if need be, the spacing for second and third pattern variations (we chose, 9” for the second pattern variation).

Then, finally, press the “Enter” button, and the spacing patterns will be shown. This is the desired goal of the software program.

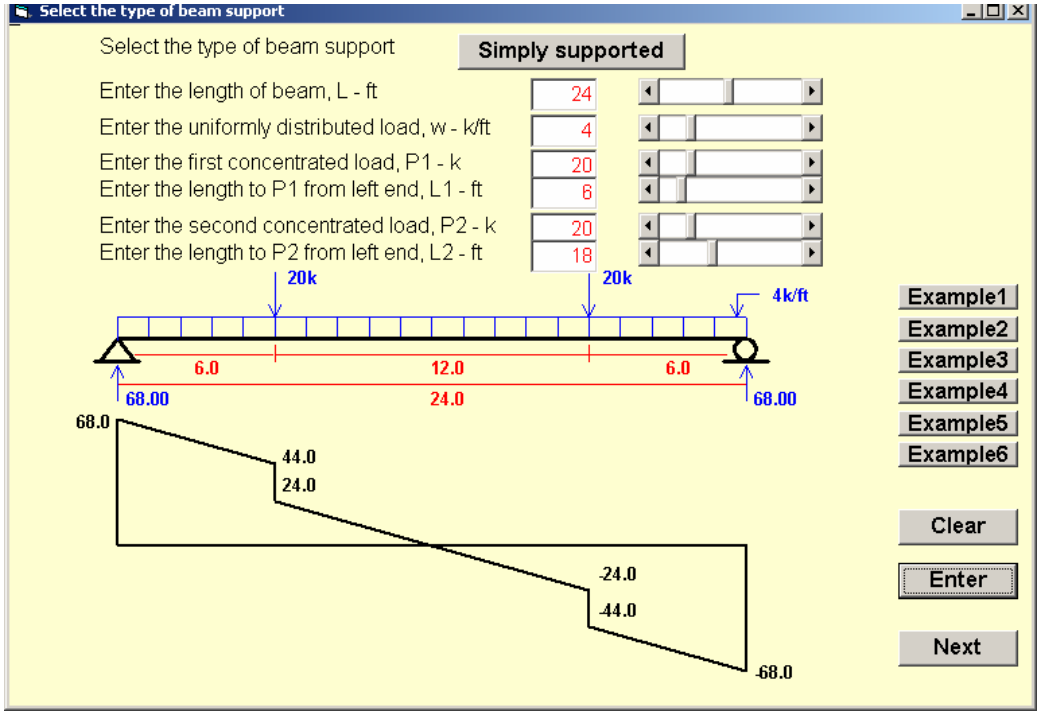


As you can expect, the amount of variations that can be analyzed using this program is quite vast considering the different combinations of loads, different values of concrete and steel stresses and different beam cross section dimensions.

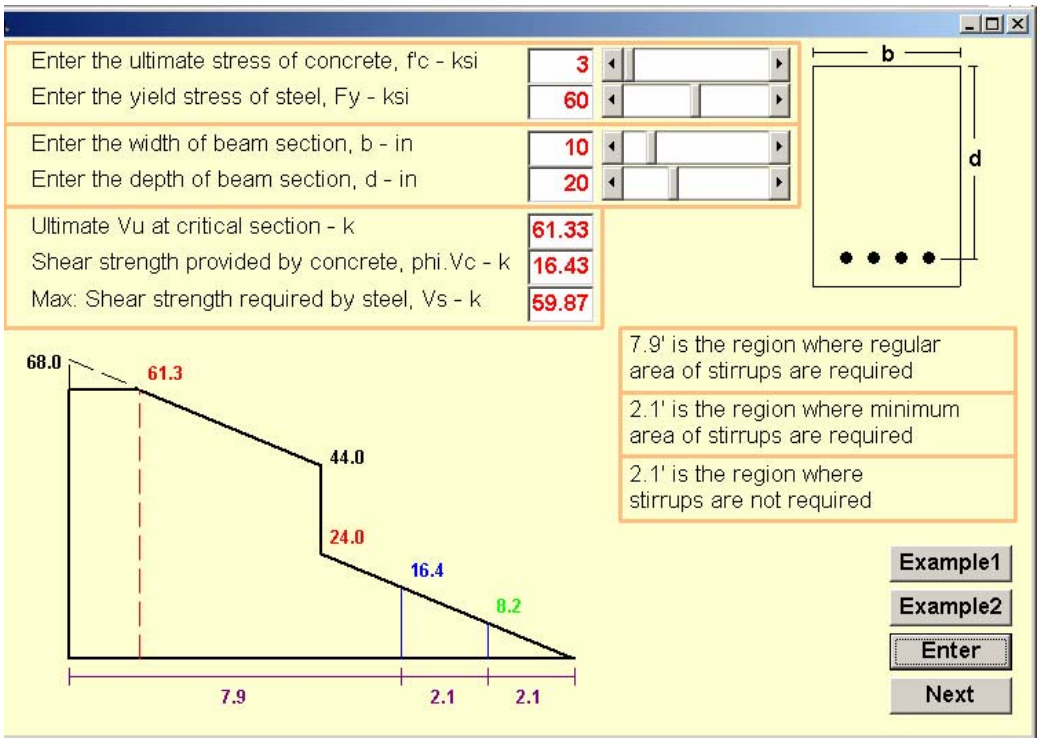
Next, is the second example: Here most of the step by step procedures mentioned in the previous example will be omitted.

In this example, again, we chose a simply supported beam and to populate the numerical fields, the stored values of “Example3” were used. From which the following screen can be shown. The main differences

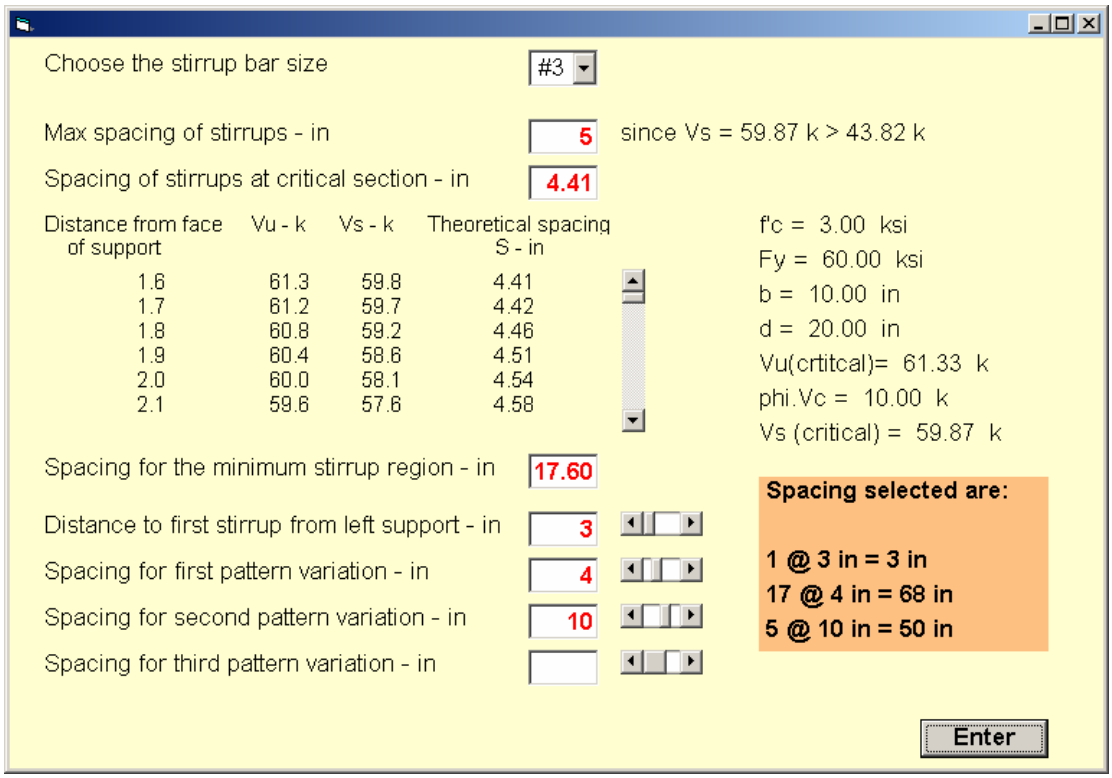
between this example and the previous are that now we have two concentrated loads on top of the distributed loads.



We chose the numerical values corresponding to “f’c”,”Fy”, “b” and “d” as shown. Then, the following screen comes to life.



Finally, we have the desired stirrup spacing patterns as shown in the next screen.



Bibliographic Information:

1. American Concrete Institute: ACI 318-05 Building Code Requirements for Structural Concrete and Commentary.

2. Design of Reinforced Concrete by Jack C. McCormac and James K. Nelson, Wiley publishing.