**48\_Designing concrete frames**

In this lecture we will design this concrete frame. The first step after analysis has run to design this concrete frame is to go to design menu and then in concrete frame design and then to select design load combinations. Here we will include all strength design load combinations in right box.

ETABS will design this frame only on these load combinations. You can view any load combination by clicking this show button. You cannot add or edit load combinations here. To do this you have to go back to define menu to define load combinations. You can change or add these load combinations even after the model is locked in post processor phase.

We will not adjust design preferences for this frame from options menu. Click on options menu then preferences and then on concrete frame design. From this window you can set up code parameters. For example lets choose ACI 318 2008 code from this list.

You can define seismic category from this list. We will discuss in great detail on how to determine these parameters in our star analyst course in seismic design section.

Keep all the remaining options as it is. Now we have setup seismic design category to be B so we must also tell ETABS that this frame is sway ordinary by going back to design menu and clicking on concrete frame design and then clicking on view/revise overwrites.

Here we will check the second option of frame type and select sway ordinary frame. Make sure you do this whenever any changes or new elements or added to your model.

After setting up design combinations and design preferences, you can start design by either directly clicking on this shortcut or choosing start design of structure from this list that you can open by clicking on this small arrow button or from inside the design menu.

This progress bar will display design progress and the currently designed sections will be highlighted. This process can variable time from few seconds to many minutes depending on your model.

By default you will see longitudinal reinforcement in these units. Let's show reinforcement values in mm² by choose N.mm units from units list.

ETABS automatically checks for minimum reinforcement from selected code.

This information is for longitudinal reinforcement. Lets zoom at one beam.

Bottom reinforcement is displayed at bottom of the beam and top reinforcement at top of the beam.

You will notice 3 values. This is because these values are reported on design stations which we setup in lecture 3 in assigning properties to your model section.

For making reinforcement drawing we can use the maximum bottom reinforcement as bottom reinforcement of this beam

And can use different left hand side and right hand side top reinforcement.

ETABS already takes into account all clauses of sway frame, for example sway ordinary or sway special etc according to the selected code for different reinforcement restrictions. In this case we have aci 318 code. Here at top middle we don't need any bar but in reinforcement drawings we will put some bars here for structural integrity.

You can show design information by clicking on this small arrow and then clicking on display design results. From this list you can choose shear reinforcement torsion reinforcement etc.

For example lets show shear reinforcement of this beam in mm units.

These values are again at 3 stations left middle and right. You can choose uniform shear by taking the maximum value if you want.

For instance 0.119 here is the value of Av/s where Av is the total area of shear legs and s is their spacing in mm.

If we choose to put dia 10 stirrups having 2 legs at 200mm spacing it will give 2 into 78.5 divided by 200 Av/s that is 0.795 mm²/mm.

This 0.795 is more than what is required here 0.119 so we can put dia 10 stirrups having 2 legs at 200mm spacing throughout this beam.

You can make a standard table in excel for different sets of bars and spacing you work in your company so its easy for you to choose the appropriate shear reinforcement based on these Av/s values.

Now let's show torsion reinforcement for this beam.

In torsion reinforcement you will see at bottom of this line, values of longitudinal torsional reinforcement. This longitudinal torsional reinforcement has to be divided around the parameter of this beam. This is covered in any good book on reinforced concrete design.

For example let's take the maximum of this bottom value for torsion longitudinal reinforcement. Assume this beam section is a square section so this torsion reinforcement will be divided by four and then added to flexural top and bottom reinforcement. Similarly to the sides of this beam.

Now the reinforcement values at top you see here for torsion are the torsional shear reinforcement. You will add these values to normal shear reinforcement values which we have covered some moments ago.

But one very important thing to keep in mind here is that this torsional shear values are reported for one leg only. We will cover these things in more detail in design course.

You can right click on this beam to see all load combination results at each design station.

By default the worst load combination at worst station will be selected if you right click at this stage.

Then you can view the overwrites summary flexural or shear details by these buttons.

A red color by default means the section has failed. You can open the model again and increase this section and then run and design again.

Now let's see reinforcement for columns. Column reinforcements can be seen in 3d view or elevations. You can turn off beams as well.

From design menu display longitudinal reinforcement in the same way as we did for beams in these units.

Or you can simply show percentage of rebar in this column.