STRUCTURAL CONCRETE SOFTWARE SYSTEM

ADAPT-Builder® 20

Column & Wall Design Manual

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Contents

1. Introduction

ADAPT-Builder includes an integrated design feature for concrete columns and walls, with partner software S-CONCRETE. Built-in building codes include American (ACI), International (IBC), Canadian (A23), British (BS), European (EC), Australian (AS), Brazilian (NBR), and Indian (IS). The program also includes a native wall design tool, **ADAPT Wall Designer**, that is fully integrated within the ADAPT GUI and is active when either **Floor Pro** or **Edge** is in use. More information related to this design tool can be found in the **ADAPT Wall Designer Operation and Theory Manual.** This document describes the back-end functionality of the design tool. Use of S-CONCRETE as the selected wall design tool requires a separate product license for this tool.

Accompanying software documentation can be found in those manuals located from the HELP menu item under the “Documentation” tab.

2. Design of Columns

Column design is available within **ADAPT-Builder** through integration with S-CONCRETE software. A valid license of this software must be present on the user's computer in addition to ADAPT-Edge to complete Design of Design Groups and Code Check of individual columns, as will be described in this section.

Some features described in this section require S-CONCRETE licensing, but not all. Each section will indicate the requirement.

Options available when you right-click on a column include:

- **Open Design Group** – Use this to launch the Design Group Manager (described below.)
- **Design** - These duplicate options available under *FEM Menu*. The following design options are available:
    - Design Design Groups.
    - Code Check.
    - Open in S-CONCRETE.
    - View Design Summary: (this option will not be available if a Design of the Design Groups has not yet been performed.)
- **Select** – Use these selection features to select columns as described.
    - All in Design Group – selects all columns assigned to the same Design Group.
    - All in Vertical Stack – selects all columns stacked vertically with the same center-point.

2.1 Design Groups

Design Groups can be defined in ADAPT-Builder models to define groupings of columns like what many engineers would use to schedule column size, concrete grade, and reinforcement. Often, columns are grouped by concrete material properties, size, and location within the structure. In the same way, users of **Builder** can choose to group columns into Design Groups according to personal preference or their company standards.

Defining, managing, and editing Design Groups does not require an S-CONCRETE license. Design groups are more generally referred to as *Section Types* and are created using the *Type Manager* from *Model→Type Manager→Define Section Type* or *Column Design→Type Manager→Define Section Type*  .

A Design Group is a comprehensive definition of a column section, including the

- Section geometry
- Shape
- Cover
- Effective length factor (k) in r-r and s-s directions
- Reinforcement percentage (Rho)
- Configuration of vertical reinforcing
- Configuration of horizontal reinforcing (ties)
- Concrete and mild reinforcing material properties

There are several ways to define Design Groups. We will simplify this example by stating the three ways in which most column elements may be defined:

- Import and Transformation from DWG/DXF file (See Section **Error! Reference source not found.**)
- Import of 3D structural model from Revit or Etabs by use of the .INP format (See Section **Error! Reference source not found.**)
- Manual generation of structural model within Builder (See Section **Error! Reference source not found.**)

In Case 1 above, when DWG files are imported and transformed into a structural model, the design groups are automated by default because the Design Group setting is set to "Assign existing at creation". To have the best experience with this, it is recommended to set up the column design section auto-roundup tolerance prior to importing a DWG file. Any transformed columns will be automatically assigned to a design group according to the size of the section. Due to the nature of integrating with third party (CAD) software, there is likely to be a very slight variation in the section size; i.e it may be imported as 11.99999999" instead of 12.0". Analytically there is little risk if the auto-roundup tolerance is not assigned. This is simply a step to help keep the values rounded to the nearest integer.

To set this up, navigate to *Column Design →Type Manager →Define Section Type* to bring up the screen shown in **FIGURE 2-1**. In the center section, under Properties, the third row *Enable column auto-assignment roundup* will be set to Yes by default. The *Roundup amount* shown in the row beneath can be defined by the user. You can choose any value; in this example you can set it to 0.10" and click OK. As shown in **FIGURE 2-2**, the value can be entered directly by using the keyboard, or the user can use the mouse to click up or down in the row to increase/decrease the tolerance value.

If the *Enable column auto-assignment roundup* feature is set to No, then the sections will not be rounded up or down by any amount and design sections and section properties will follow exactly based on imported and calibrated values, such as 11.99" x 11.99".

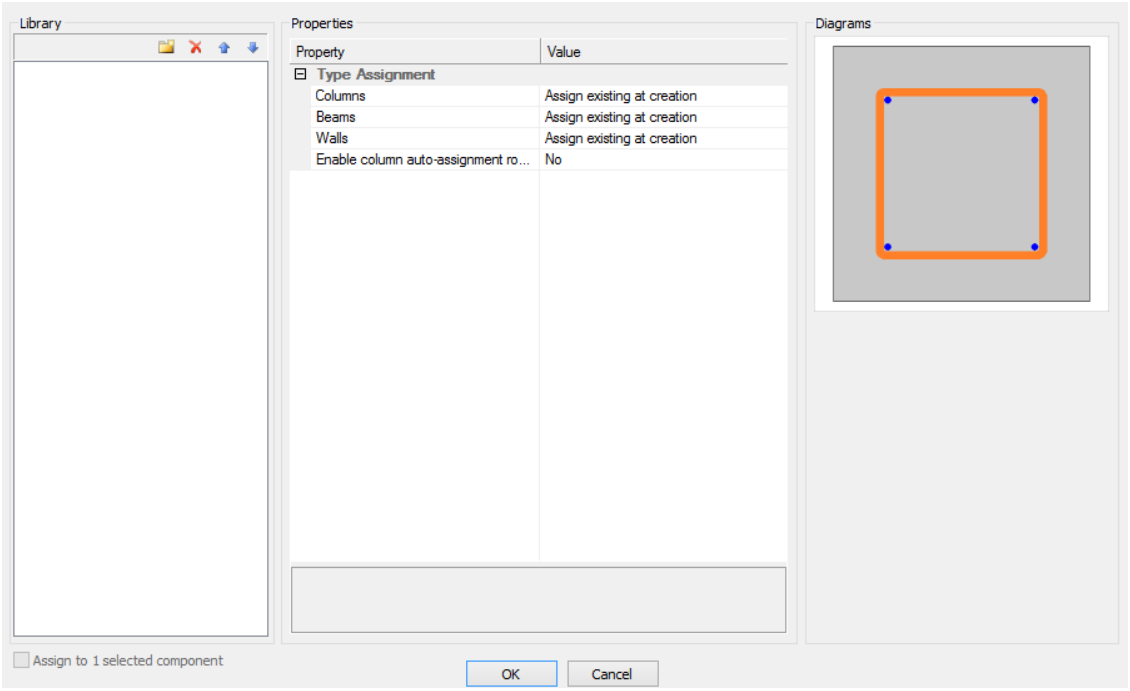


Figure 2-1 Design Group Manager – Roundup.

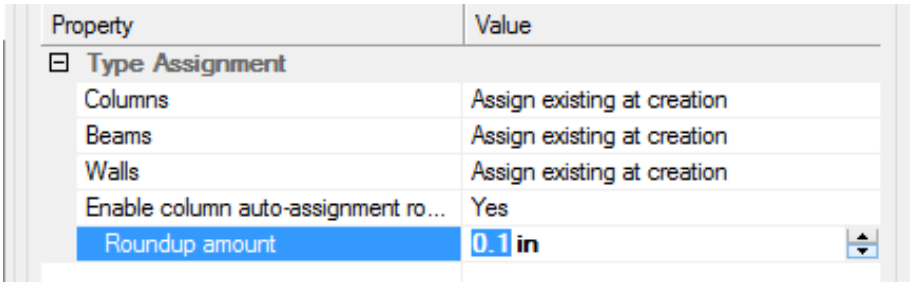


Figure 2-2 Enlarged view Roundup Amount.

In cases 2 and 3 above, it is a slightly different process. Importing from Revit (or any third-party program via ADAPT Exchange file), and modeling directly within Builder will not auto-generate Design Sections.

It is also recommended to utilize the Roundup Amount in the *Section Type Manager* in either of these cases if the user is not sure of the precision of column components, or to ensure round numbers in section properties.

Design Groups will ultimately be used to control section properties, and once assigned to a column section, the properties of the column will be controlled through the Design Sections rather than individually. To illustrate this point, the user may double click on a column to bring up Column Properties screen shown in **FIGURE 2-3** (or use Item's Properties icon). It is noted the top portion of this screen under the General tab indicates "None" for Design Group, and the cross section shape, angle, and A and B dimensions can be modified directly.

However, once the column section has been assigned to a Design Group, this portion of the Properties screen can be shown in **FIGURE 2-4** Figure 2-4 Column Properties (enlarged) after Assigned to Design Group. Here, you can see the Design Group, in this case, “22 x 22”, and the column cross section shape, angle, and A and B values are greyed out, meaning they cannot be changed in this screen.

An individual column can be assigned to a design group from the Properties screen by selecting any previously defined Design Groups from the *Design Group* drop-down. If no design groups are defined yet, the drop down will not be active.

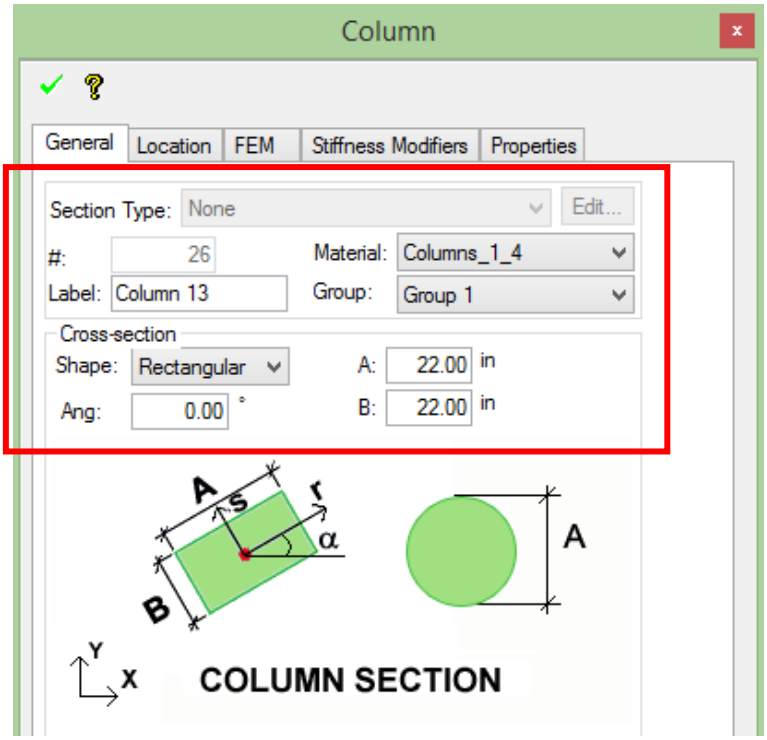


Figure 2-3 Column Properties before Assigned to Design Group

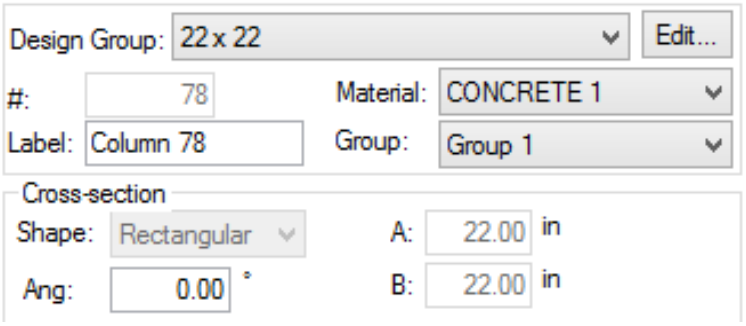


Figure 2-4 Column Properties (enlarged) after Assigned to Design Group

Names of Design Groups default to the size of the column used to define it. However, the names of these Design Groups can be changed by the user. To change the name of

one, highlight the Design Group name in the Library of the *Section Type Manager* and then left click in the name to make the text editable. The user can completely overwrite the default naming or add to it. For example, a column could be called 22 x 22 Levels 1-4, or 20" dia. L1-5. In this way, the user can keep track of not only the column size but also the level(s) of the structure in which it is intended. Note that the size of the column will be explicitly managed through the Design Group at that point and changing the A and B dimensions within a Design Group will not automate a name change. The name must be managed separately if desired.

2.1.1 Assigning Columns to Design Groups

An individual column or multiple columns can be assigned to design groups. One way to do this is to select the desired column/s, either by windowing them in plan or elevation, and/or by using the *Select by Type* tool  or other tools as described in Section 2 Once selected, navigate to *Modify Selection*  on the *Modify* ribbon. Select the *Column* tab, and click the check box next to *Design Group*, as shown in **FIGURE 2-5**. By default, there are three selections in the drop-down menu associated with this option.

- **Auto Assign to Existing***:* When no Design Groups are defined, the selected column/s will be grouped into Design Groups according to their section properties (A and B dimensions). When Design Groups are already defined and this option is selected, the program will look to see if the same column size has been assigned to a Design Group and if so, the selected columns will be added to that same Design Group.
- **Auto Assign New Grouped***:* This option will generate new Design Groups based on the sizes of the selected column/s, regardless of whether Design Groups of the same dimension already exists. If this operation is done and a new Design Group of the same size is created, the duplicate Design Group will be named with a (1) or (2), or with _001 and _002, etc, after the label, as shown in the Library of the Design Group Manager, enlarged in **FIGURE 2-6**.
- **Auto Assign New Individual***:* This option will generate a new Design Group for each individual column selected, without regard to pre-existing Design Groups of the same size or name. Again, duplicates will be indicated with (1), (2), or _001, _002, and so on.

Once Design Groups have been defined, they will also populate in the drop-down menu in this location. A column can be specifically added to a group which has already been defined; see **FIGURE 2-7**.

An individual column can be changed to a Design Group which has already been assigned through its property screen, as per **FIGURE 2-3**, by selecting the

desired Design Group from the drop down at the top of the column's Property screen.

Single or multiple columns can be added to a new or existing Design Group by selecting the column(s) and opening the Section Type Manage, highlighting the desired Design Group listed in the Library on the left, and by keeping the check-mark selected on the bottom left of the screen, *Assign to (x) selected components.* See **FIGURE 2-8Error! Reference source not found.**. This will overwrite any previously assigned Design Group, if one had been assigned to that column(s) already.

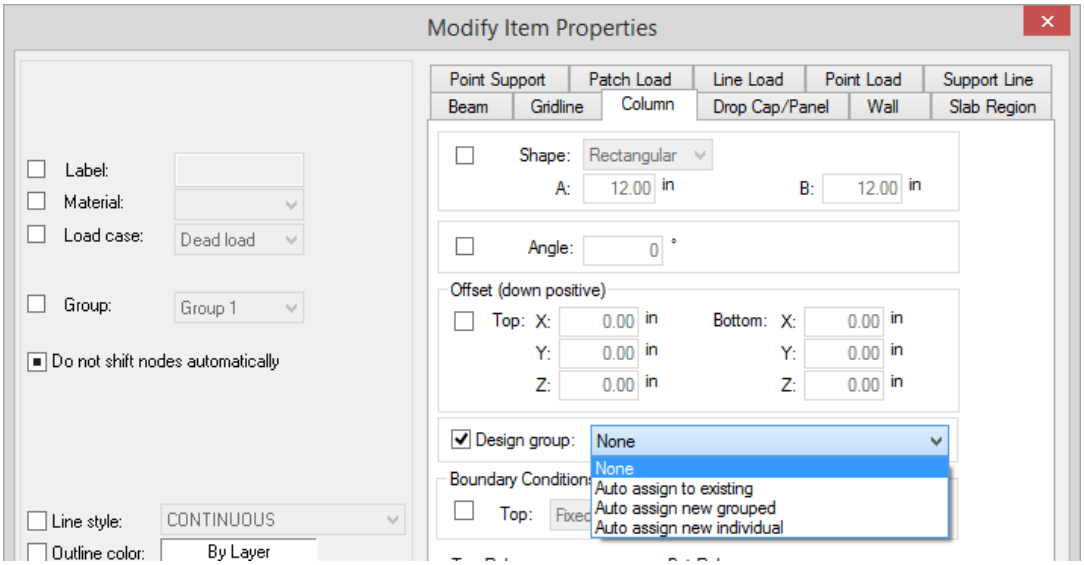


Figure 2-5 Column - Modify Item Properties Design Group Definition

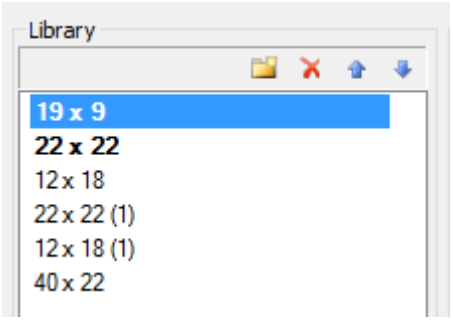


Figure 2-6 Enlarged Design Group Library with Duplicate Group Names

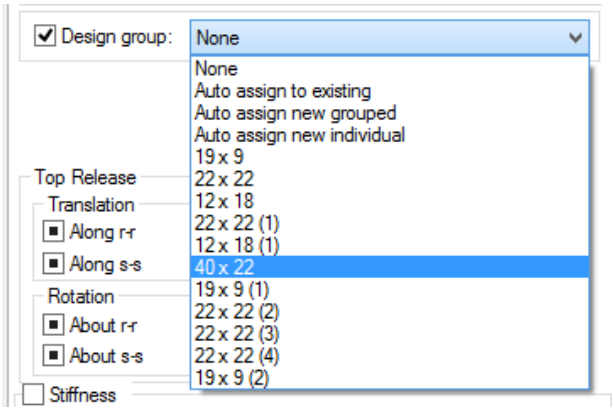


Figure 2-7 Design Group drop-down Menu

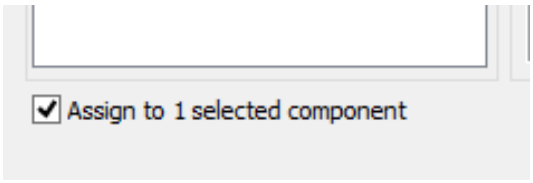


Figure 2-8 Assign Selected Columns to Design Group

- To assign design groups in the same example, ensure the program is in *Multi-Level* mode and opened with **ADAPT-Edge.**
- From *Select/Set View Items* to turn on only column visibility. Switch to a *Left view* .Select the columns using the cursor to window across those in the lower four levels. See **FIGURE 2-9Error! Reference source not found.**.
- Select *Modify Selection* , click to activate the Column tab, select the checkbox next to Design Group, and select *Auto assign new grouped* from the dropdown menu. Click *OK*.
- Open the Section Type Manager (*Column Design ➔ Type Manager)* or by right-clicking one of the columns that was just selected and select *Open Design Group* as shown in **FIGURE 2-10**.
- Double Left-click in each of the Design Group names which now show in the Library on the left, and add the text “Lower” to the end, as shown in **FIGURE 2-11Error! Reference source not found.**. Click *OK* to save and close this window.
- For the 24x24 Lower Design Group in this example, we will set the Number of vertical reinforcing bars (#Vertical Bars) by changing the bar size to #9 and 4 face bars in both A and B directions (*# Face Bars (A / Ny*) and (*#Rows (B / Nz*), leaving the *# Layers* equal to 1. Making these changes increases Rho from 0.07% to 2.08%. See **FIGURE 2-12Error!**

Reference source not found., noting the updated image on the right side.

- The user should go through each Design Group details and review and revise the parameters in each, including rebar configuration, materials, cover, etc. Rho (Reinforcement percentage As/Ag) will be updated automatically.
- Assign and modify additional columns to Design Groups as described earlier in this section.

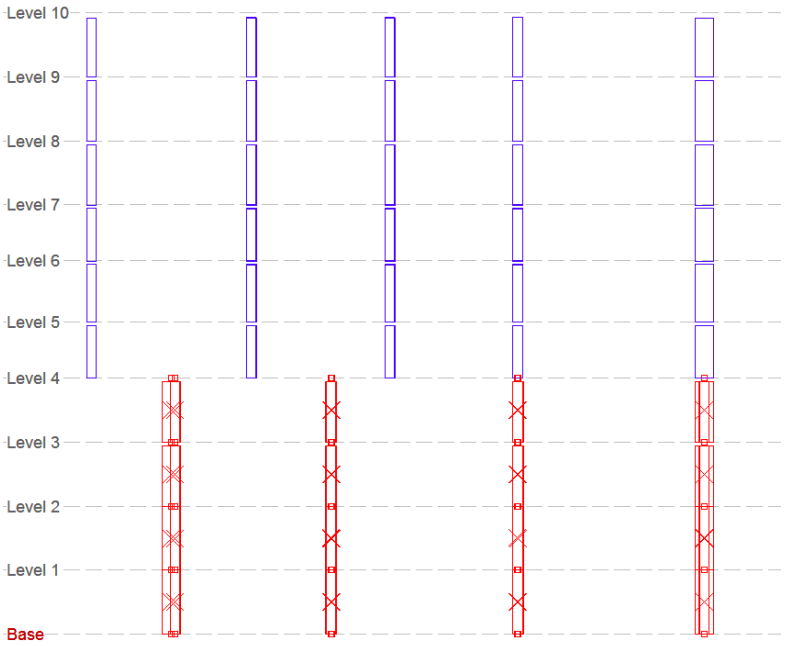


Figure 2-9 Columns-only Elevation View with Lower Levels Selected

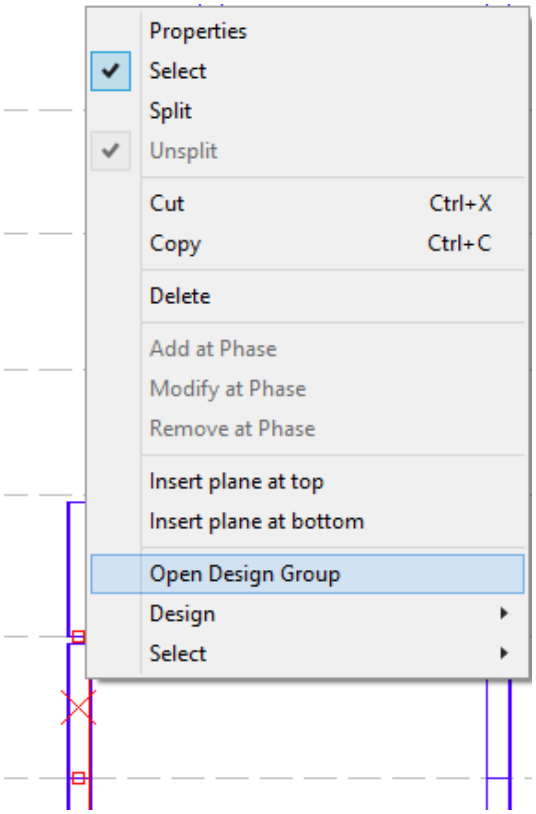


Figure 2-10 Right-Click Column Selection - Open Design Group

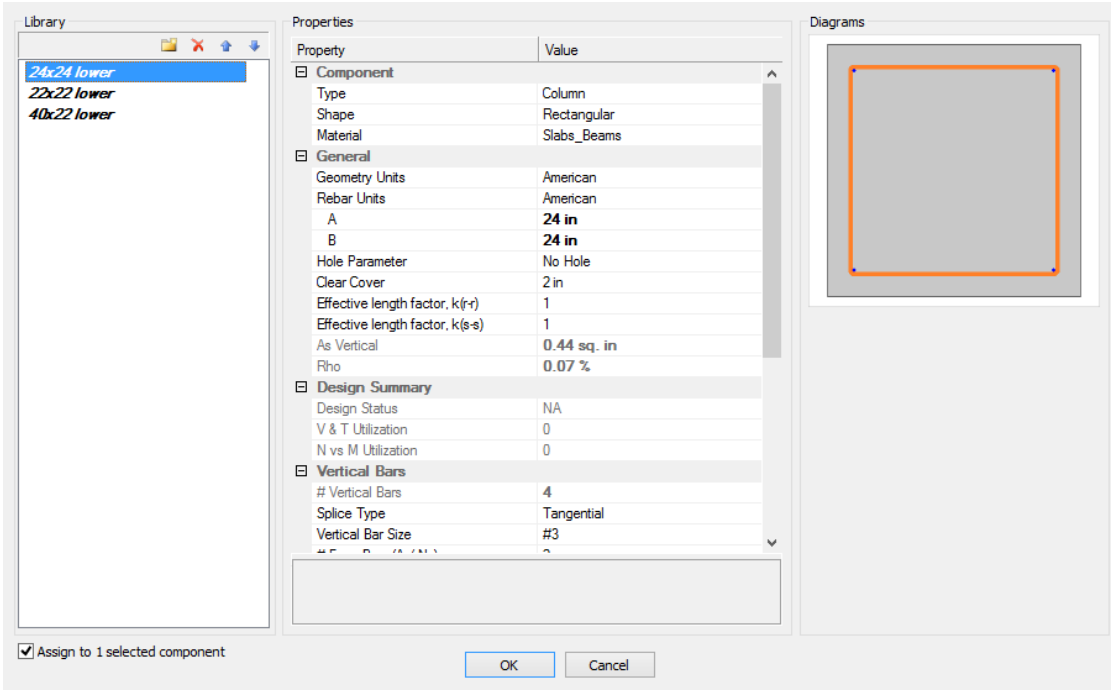


Figure 2-11 Edited Design Group Names and Design Group Details

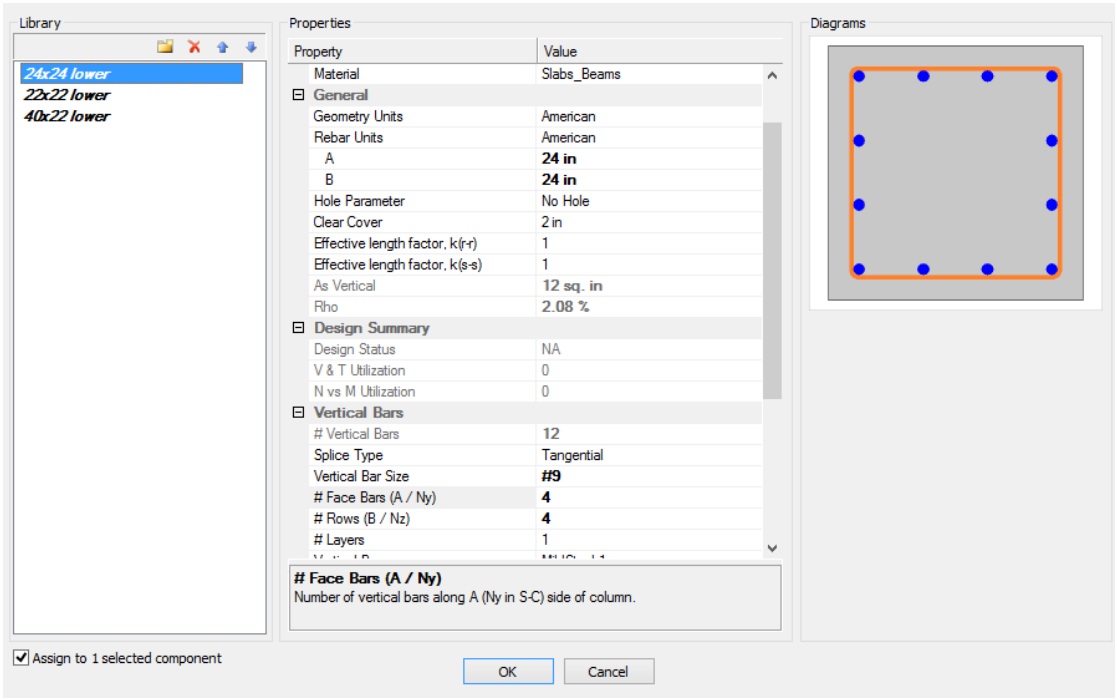


Figure 2-12 Modified 24x24 Lower Design Group Details

2.2 Column Unbraced Length

ADAPT-Builder allows users to define unbraced lengths of any or all columns. It calculates unbraced lengths automatically, that are equal to the clear unsupported length of the column. See **FIGURE 2-13**.

The calculation for each column can be done by clicking *Update.* The unbraced lengths can be overwritten for Individual columns by selecting *User Defined*, at which point the user may input a different value in the fields for *Individual Lu (s-s)* and *(r-r).* If the user clicks *Update* again, these values will be applied to the *Group Lu (s-s)* and *(r-r)* fields as well. In any case, as with all changes to the individual level, the green check box at the top left of the column property screen must be clicked to save these changes.

Unbraced length can be calculated and modified without a license of S-CONCRETE.

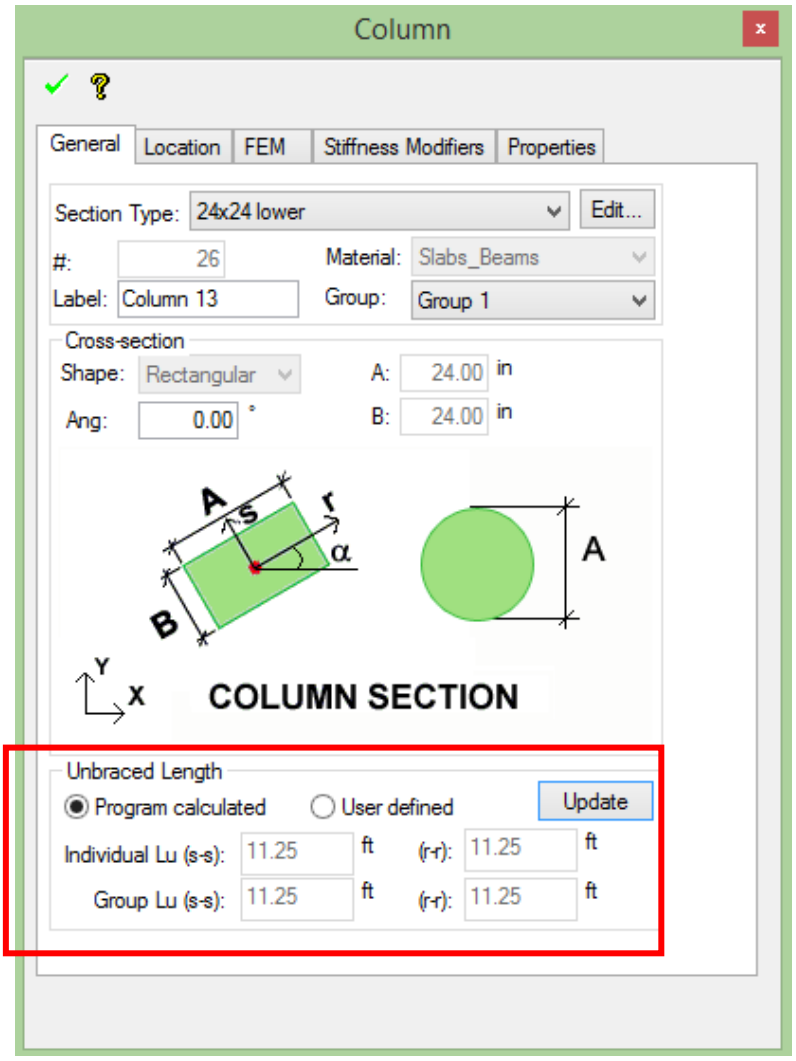


Figure 2-13 Column Unbraced Length

2.3 Component Design Options

Once *Design Groups* have been defined and assigned, the user will need to specify parameters by which column designs will be performed. The *Design Options* screen as seen in **FIGURE 2-14** can be accessed by *Column Design* ➔*Design Options* .

The top section of this screen shows the available load combinations which can be used for design of columns from the most recent FEM Analysis. These can be selected or deselected as desired. The user may use the *control* or *shift* keys to select multiple combinations.

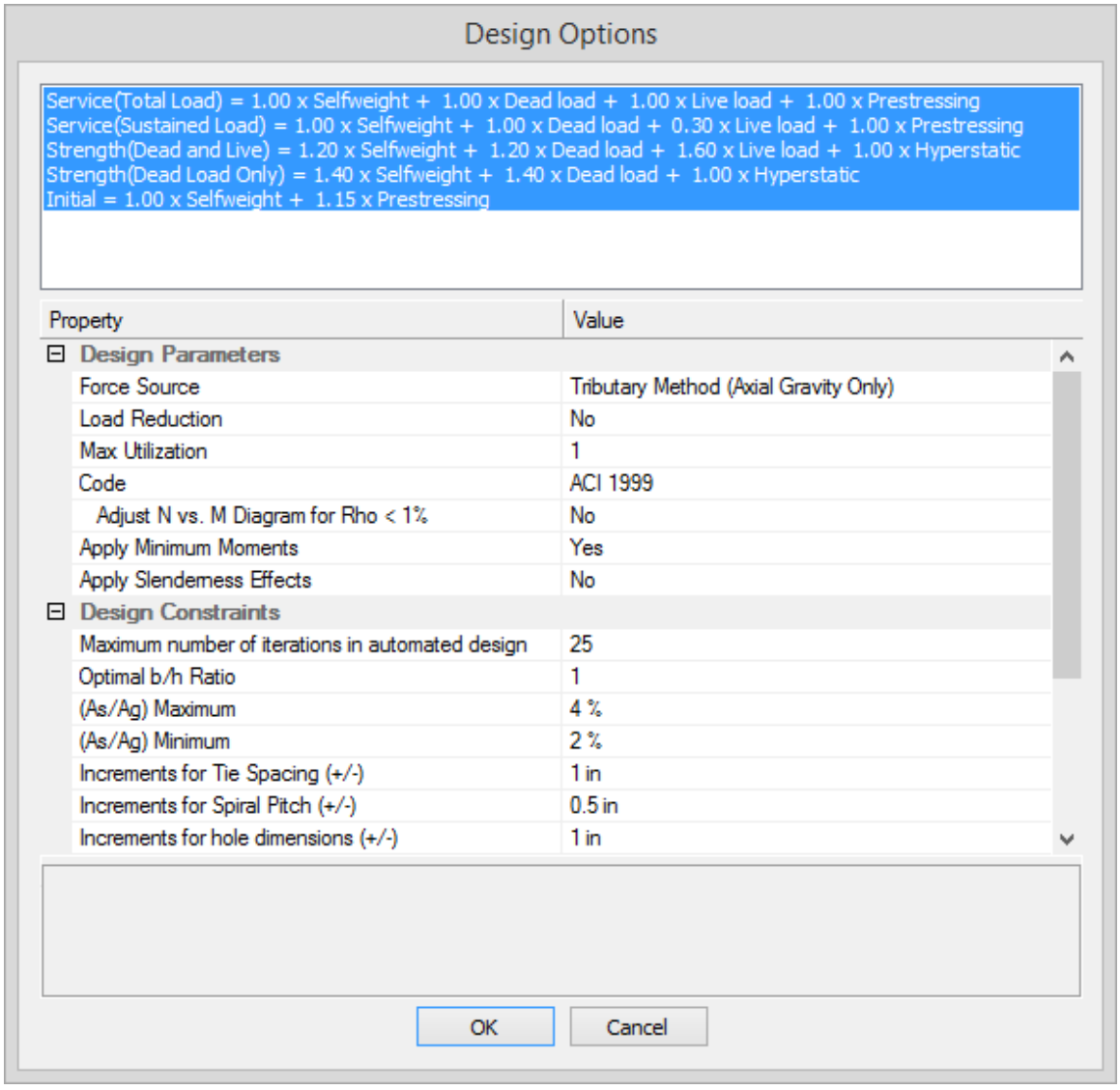


Figure 2-14 Component/Column Design Options

Design Parameters:

- *Force Source:* Define the source from which loading will be extracted to design column elements. See **FIGURE 2-15**.

    - *FEM:* Utilize the most recently run Finite Element global solution reactions
    - *Tributary Method (Axial Gravity Only):* Utilize the most recent calculation using tributary gravity axial loading only.
    - *Envelope of FEM and Tributary:* The program will take a strict maximum envelope of axial loads and moments from the two methods.
    - *FEM Moments and larger of Tributary/FEM Axial:* The program will use moments from the FEM analysis and the larger axial load component from either Tributary or FEM analysis. This feature could be used to exclude minimum moments from use in design.

- *Load Reduction:* Select Yes or No to include or exclude load reduction factors from the design of columns. Yes, will apply the load reductions factors.
- *Max Utilization:* The maximum design utilization the program will use for column design, 1.0 being default.
- *Code:* Select the appropriate design code from the drop-down list. Each code may trigger an extra option, as indicated.

    - ACI 318 & UBC – Adjust N vs M Diagram for Rho < 1%: Select Yes or No
    - BS 8110 & CP 65– Nu (max): Cl 3.8.4.3 or Cl 3.8.4.4.
    - CSA 1994 – Shear Method: Simplified or General

        - *Adjust N vs M Diagram for Rho < 1%: Yes or No.*

- CSA 2004 – Same as 1994 above, plus *Seismic Options* – select from

    - No Additional Checks
    - Clauses 21.4.4 and 21.4.5

        - *Section Location and Region: select Face of Joint (plastic hinge region) or Away from Joint (no plastic hinge)*

    - Cl 21.7.2.2.3 and 21.7.2.2.4 and 21.7.2.2.5

        - *Section Location and Region: select Face of Joint (plastic hinge region) or Away from Joint (no plastic hinge)*

    - Clauses 21.7.2.2.3 and 21.7.2.2.4 only

        - *Section Location and Region: select Face of Joint (plastic hinge region) or Away from Joint (no plastic hinge)*

    - Clauses 21.12.2.6(a) and 21.12.2.6(c)

- *Theta ID (r-r): input value (default = 0.004)*
- *Theta ID (s-s): input value (default = 0.004)*
- *Lw (r-r): input value (default = 240in)*
- *Lw (s-s): input value (default = 240in)*

- EC2

  - Calculate Theta: Yes or No; If No, enter Theta (deg)
  - Maximum Acceptable Utilization of Concrete Without Minimum Shear/Torsion Reinforcement: enter value (default = 0.05)
  - Apply Reduced Maximum Link Spacing Requirement: Yes or No

- *Apply Minimum Moments:* The program will compute the minimum moments according to the specified building code/standard and apply it in the direction of the applied moment, if required.
- *Apply Slenderness Effects:* Select Yes or No. If Yes, enter *BetaD* length ratio factor (default = 0.6)

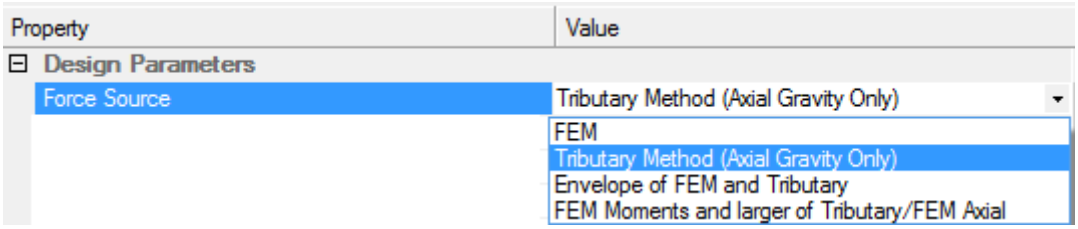


Figure 2-15 Force Source Options

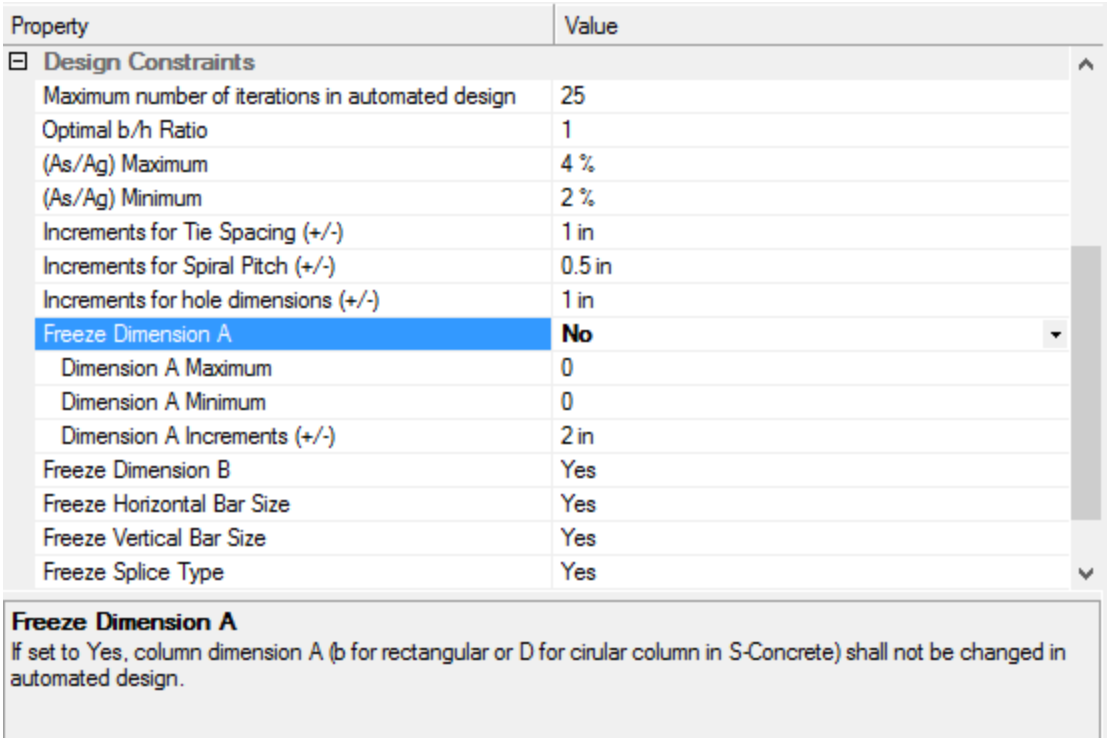


Figure 2-16 Design Constraints under Component Design Options

Design Constraints: See **FIGURE 2-16**.

- *Maximum number of iterations in automated design:* Define the number of iterations the programs will go through in solving for an acceptable design.
- *Optimal b/h Ratio*: If the user wishes to maintain a certain aspect ratio of column dimension for automated/optimized design (i.e. Freeze options described below set to No)
- *(As/Ag) Maximum*: Define the upper limit for reinforcement percentage Rho for automated design.
- *(As/Ag) Minimum:* Define the lower limit for reinforcement percentage Rho for automated design.
- *Increments for Tie Spacing (+/-*): the program will increase or decrease the tie spacing using the basis of the entered value here. If the default value of 1" remains, then spacing may go from 6" to 7", for example. If a value of 0.5" is used here, spacing will go from 6" to 6.5" to 7".
- *Increments for Spiral Pitch (+/-*): like the option above. Default value is 0.5".
- *Increments for hole dimensions (+/-*): If a column Design Section includes a hole within its cross section, the automated design of the program can increase or decrease the size of this hole in increments specified in this field.
- *Freeze Dimension A/B:* Yes or No. Selecting Yes will force the dimension to be kept as specified in the Design Section definition, for instance in the case when checking the capacity of an existing building design that has already been built,

or if column sections can no longer change size. If No, three rows of options will appear, as shown in **FIGURE 2-16**.

- *Dimension A/B Maximum:* enter maximum dimension, which the column cannot be any larger than, in the specified direction.
- *Dimension A/B Minimum:* enter the minimum dimension, which the column cannot be any smaller than, in the specified direction.
- *Dimension A/B Increments (+/-*): specify the increments with which the column size will be increased or decreased.

- *Freeze Horizontal/Vertical Bar Size:* Yes or No. If Yes, bar size will not be changed in automated design. If No, the user can define maximum and minimum size increase and reduction that the program would use in automated design.
- *Freeze Vertical Splice Type:* Yes or No. If No, the program may suggest an alternate splice type than what is defined in Design Section.

Click OK to save all settings. All steps in this section may be done with or without a license of S-CONCRETE.

2.4 Design the Design Groups

A current license of S-CONCRETE is required to complete this step.

The next step in the design process of columns is to perform a Design of the *Design Groups.* Navigate to *Column Design ➔Design Columns*  . A screen will come up as shown in **FIGURE 2-17**. In it, all design groups will be listed as well as the number of columns within each group, in parentheses. The user can select any individual groups to run or can use the *control* key to select multiple groups, if it is not desired to run all groups at once.

When the user clicks OK, Builder will begin transferring data with S-CONCRETE in the background of your system operation. S-CONCRETE will not launch. It may take just a few seconds up to many minutes to run the design of the selected Design Groups, depending on the size of the model, the speed of your processor, and the number of groups selected. The user will know when this process has completed when the Design Summary screen comes up, as shown in **FIGURE 2-18**. This screen shows the results of the design/s which have just completed. This screen can also be invoked later through *Column Design ➔Design ➔Open Column Summary.*

This screen shows a table with columns labeled Update, Design Group, Details, Property, Current Value, and Proposed Value.

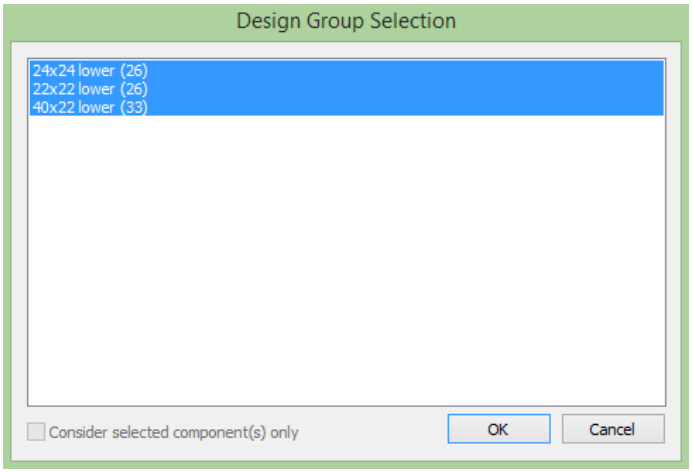


Figure 2-17 Design the Design Groups Selection

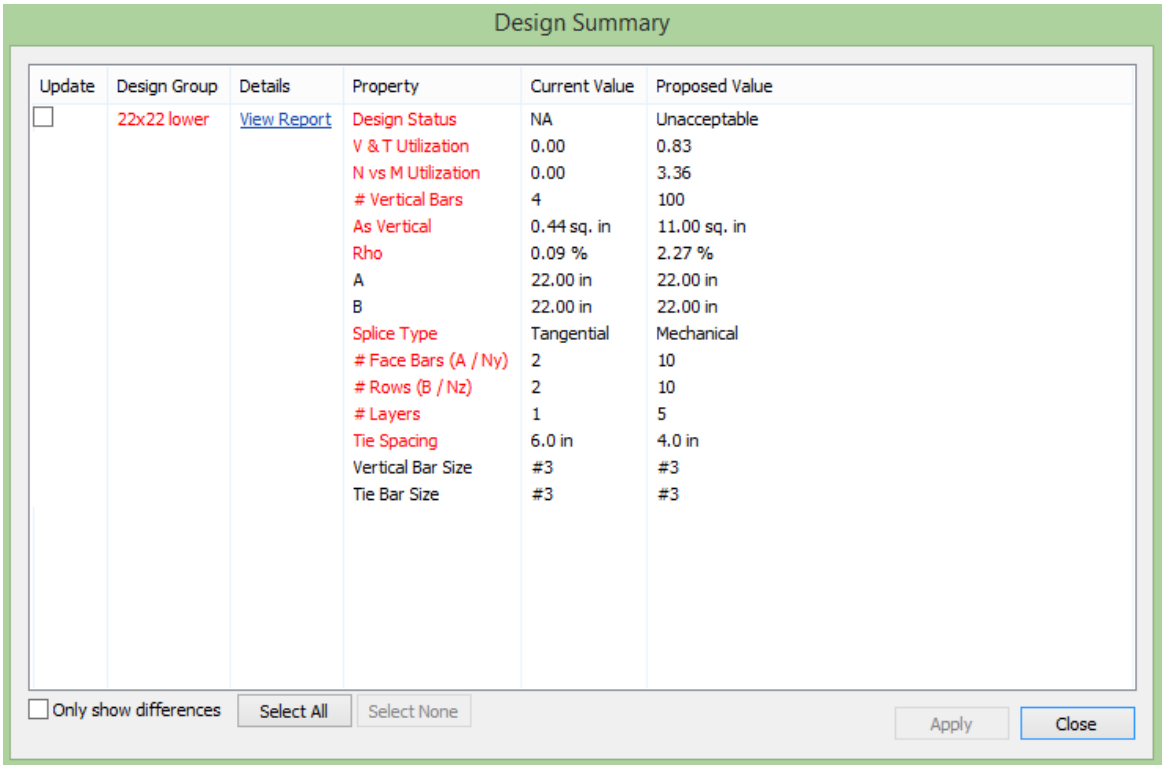


Figure 2-18 Design Summary after Design of Design Groups

Red text in the Design Summary table indicates data which has changed since the last design run of Design Sections. In this example, no prior Design had been done on columns, so many values changed from “Current Value” of 0.00 to a new “Proposed Value”.

This Design Summary table is used to display:

- Design Status

- V & T Utilization (Shear and Torsion)
- N vs M Utilization (Axial and Moment)
- # Vertical Bars
- As Vertical (gross area of steel of vertical bars)
- Rho (Reinforcement Percentage, As/Ag)
- A (Dimension of column in local r direction)
- B (Dimension of column in local s direction)
- Splice Type
- # Face Bars (A/Ny)
- # Rows (B/Nz)
- # Layers
- Tie Spacing
- Vertical Bar Size
- Tie Bar Size

If the user wishes to condense the Design Summary to show only those values which have changed, you may select the checkbox in the bottom left corner of this window, *Only Show Differences,* in which case all text will be black.

Under the Details column of the Design Summary screen, blue html links titled "View Report" are displayed. These links will open in an internet browser and include S-CONCRETE design and loading details. An excerpt of one is shown in **FIGURE 2-19Error! Reference source not found.**. Because it is an HTML link, this can be shared with any other user, who does not have to have a license of S-CONCRETE to view it. **FIGURE 2-19** Design Sections. If the user does nothing in this screen but clicks "Close", the proposed changes will not be updated or reflected in the Design Sections. To accept the proposed changes, the user must check the check box under the *Update* column. To accept all changes, the user may use the *Select All* tool at the bottom of the Design Summary screen; similarly, if all are selected, the user may use *Select None* to de-select all. Once you have selected all the changes to be accepted and incorporated into the Design Groups, click *Apply* and *Close.*

The user may open the Section Type Manager to see how the Design Group section properties have been modified. The Design Status, V & T Utilization, and N vs M Utilization will now be updated within the Design Section properties. See **FIGURE 2-21**, which can be compared to **FIGURE 2-11**.

S-CONCRETE 11.1.06 (c) S-FRAME Software Inc.

File Name: C:\ ... _10CHange_3\CompDesign\24 x 24 Lower.sco

Section Name	Consultant
24 x 24 Lower	ADAPT

Summary	
Status	Acceptable
Maximum	1.000
V & T Util	0.000
N vs M Util	0.370

American Building Standards

ACI 318-11, "Building Code Requirements for Structural Concrete"

ACI 318-11, "Commentary for ACI 318-11"

Design Aids, Manuals, and Handbooks

The Reinforced Concrete Design Manual in Accordance with ACI 318-11

"ACI Detailing Manual - 1994", ACI Committee 315, American Concrete Institute, 1994

"Manual of Standard Practice", Concrete Reinforcing Steel Institute, 2003

Section Dimensions

Rectangular Column

b = 24.0 in

h = 24.0 in

Material Properties

fc' = 6000 psi

fy (vert) = 60.0 ksi

fy (ties) = 60.0 ksi

Wc = 150 pcf

Ws = 500 pcf

Poisson's Ratio = 0.2

hagg = 0.0 in

Es = 29000 ksi

Ec = 4696 ksi

Gc = 1957 ksi

fr = 581 psi

Gross Properties

Zbar = 0.0 in

Ybar = 0.0 in

Ag = 576.0 sq.in.

Ig (y-y) = 27648 in4

Ig (z-z) = 27648 in4

Ashear (Y) = 480.0 sq.in.

Ashear (Z) = 480.0 sq.in.

Jg = 46641 in4

Effective Properties

Ae = 576.0 sq.in.

Ie (y-y) = 27648 in4

Ie (z-z) = 27648 in4

Ase (Y) = 480.0 sq.in.

Ase (Z) = 480.0 sq.in.

Je = 46641 in4

Quantities (approx.)

Concrete = 588 lb/ft

Steel = 48.8 lb/ft

Primary = 41.7 lb/ft

Secondary = 7.1 lb/ft

Vertical Bars

24" x 24" Column

12 - #9 Vert

As = 12.0 sq.in.

Rho = 2.08 %

Tangential Splice

Ties

#4 Ties @ 18.0"

Legs (Z-Direction) = 4

Legs (Y-Direction) = 4

Miscellaneous

Clear Cover = 2.0 in

Factored Input Loads

Load Case/Combo	N (kips)	T (k*ft)	Vz (kips)	My (k*ft)	Vy (kips)	Mz (k*ft)	Comment
1	-430.6	0.0	0.0	0.0	0.0	0.0	Service(Total Load)
2	-514.3	0.0	0.0	0.0	0.0	0.0	Service(Total Load)

Figure 2-19 HTML S-CONCRETE Report from Design Summary

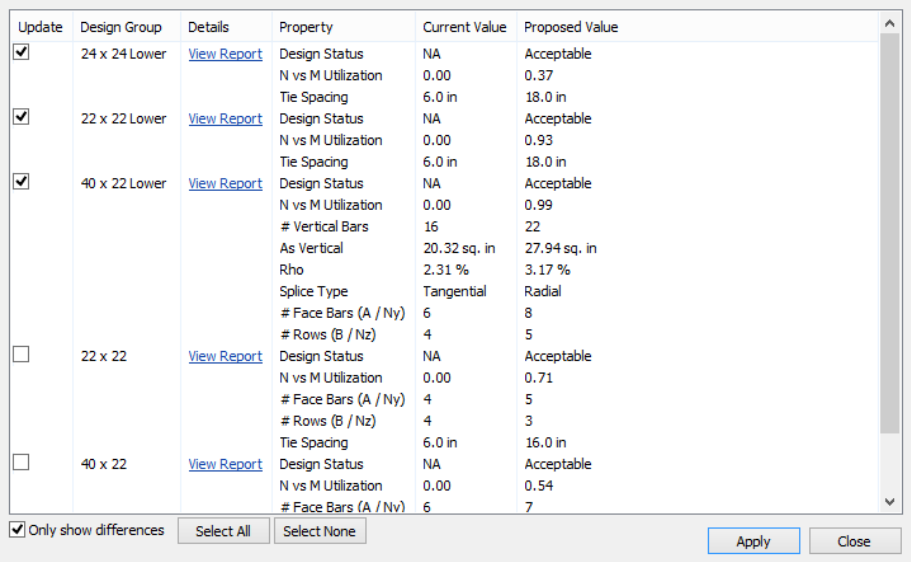


Figure 2-20 Design Summary Selected for Update, Only Differences Shown

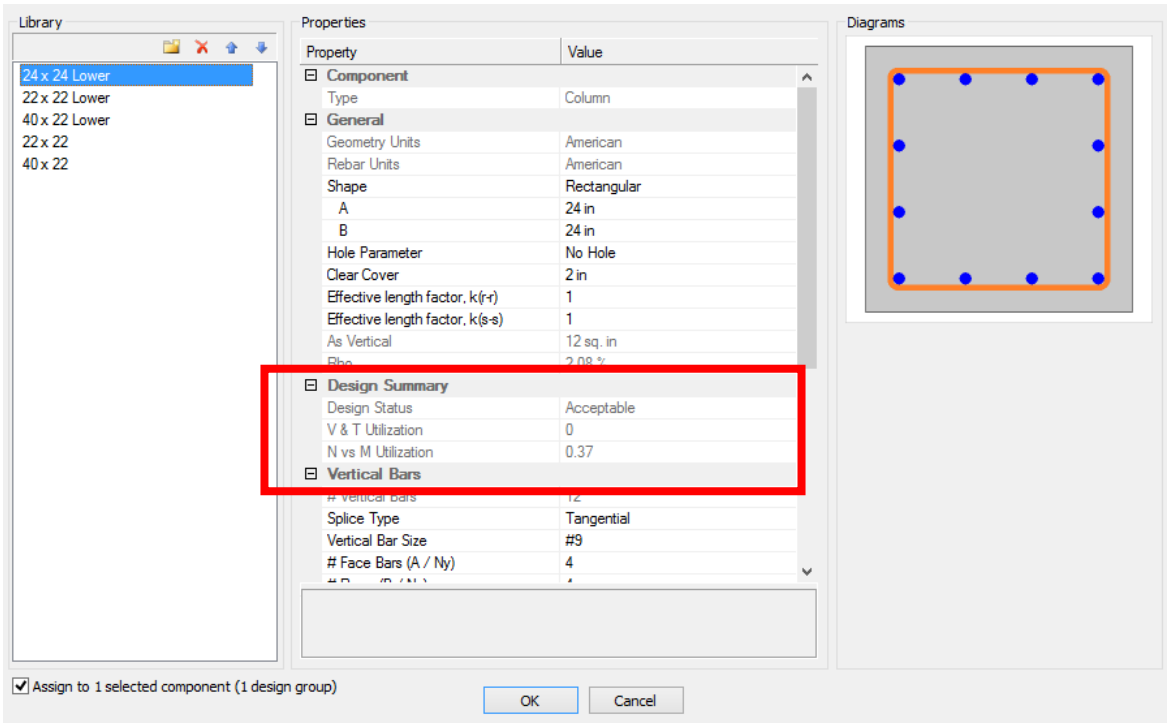


Figure 2-21 Design Group with Updated Design Status

- To view graphical results of designing Design Groups, switch to a *Top-Front-Right view* from the *Visibility* ribbon, and in *Multi-Level* mode. Use the *Select/Set View Items* tool to view only columns.

- From the *Result Display Settings* screen, navigate to *Column – Design Group Results – NvsM Utilization.* Note the status indicated in this screen (OK or NG). The default load combination of Service (Total Load) will be used in this example.
- It is possible to view these results in Pass/Fail mode as well. Select the *Result Display Settings* tab of *Result Display Settings* screen. Change Utilization to *Status* from *Value*, and click Apply. See **FIGURE 2-23**.
- To change the allowable limit for NvsM Utilization display, Select the *Result Display Settings* tab of *Result Display Settings* screen. Change Utilization maximum allowable to 0.85. Click Apply. See **FIGURE 2-24** and **FIGURE 2-25**.
- Other Column Design Group results can be viewed in a similar manner.

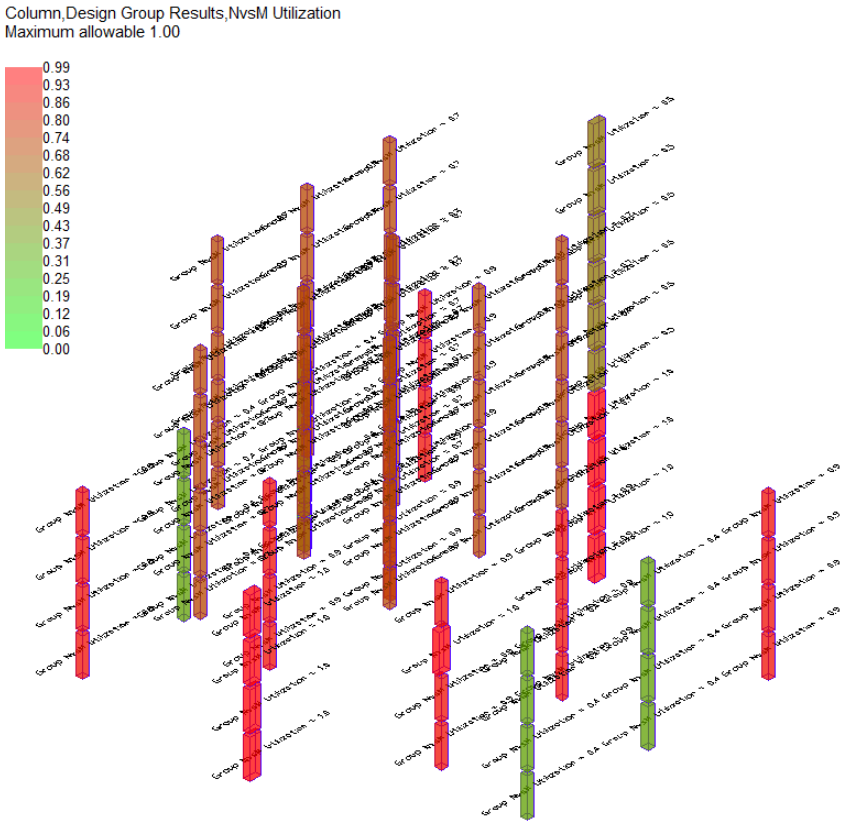


Figure 2-22 Design Group N vs M Utilization

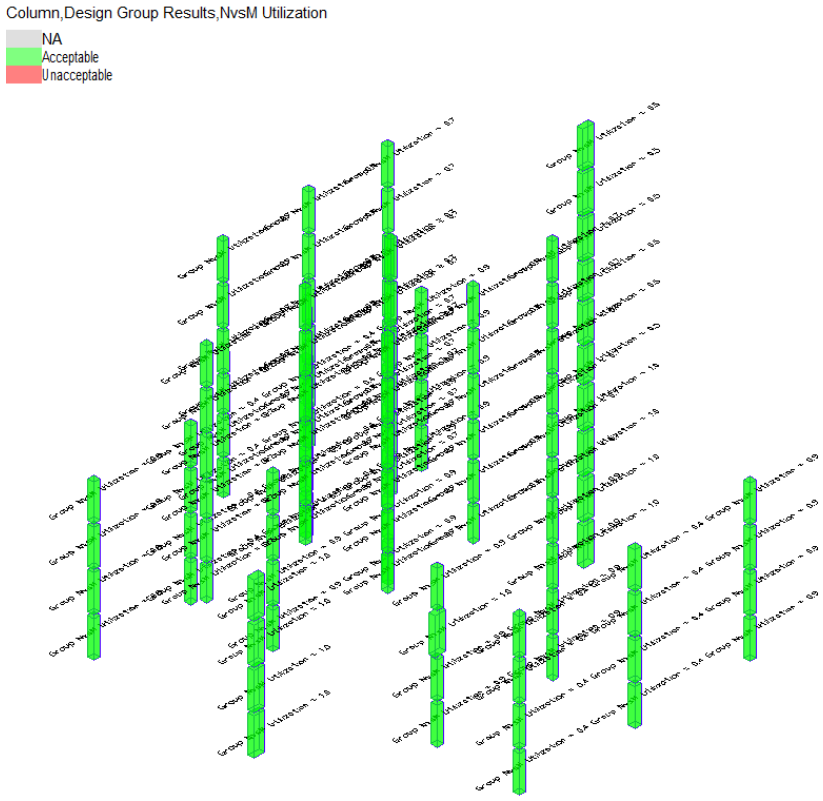


Figure 2-23 Status (Pass/Fail) for Design Group Results with 1.0 Utilization Limit

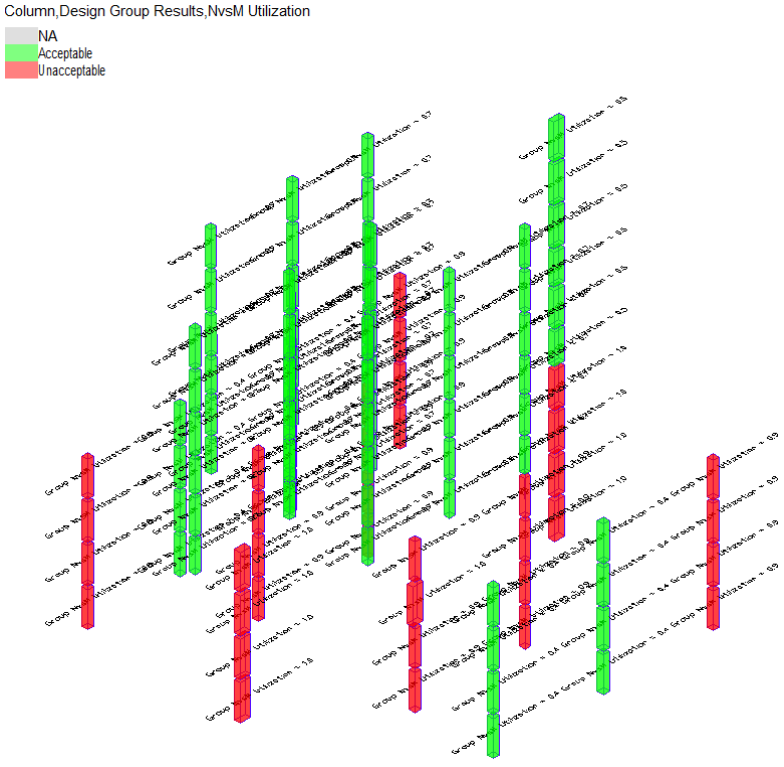


Figure 2-24 Status (Pass/Fail) for Design Group Results with 0.85 Utilization Limit

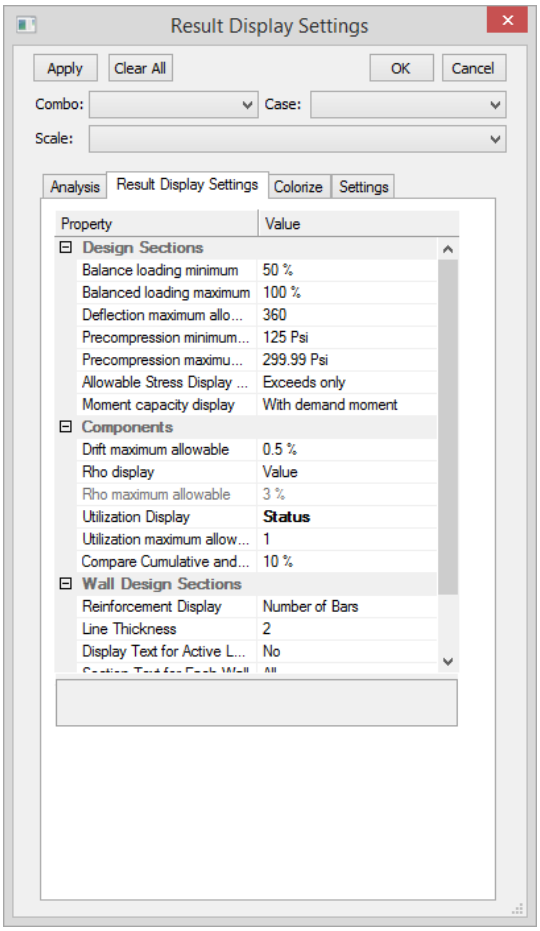


Figure 2-25 Change Utilization Display in Result Display Settings

2.5 Code Check / Design of Individual Columns

A license of S-CONCRETE is required for the steps described in this section.

Once the design of Design Groups has been completed, the user may perform a code check / design of individual columns, which will use the Design Group of that column and compare to the loads which each column will resist in its location of the structure.

Note that this Guide is intended only as a reference for users to learn how to apply ADAPT-Builder and S-CONCRETE software for column design. Detailed information on column design, background, code specifics, etc. is outside the scope of this Guide.

- Go to *Column Design* ➔*Design* ➔*Code Check* . The screen shown in **FIGURE 2-26** will show up and automatically all Design Groups and associated columns will be selected. The user may wish to de-select any particular Design Groups. Additionally, the user may wish to design only certain selected columns, in which case you should select the columns first, then when this window comes

up, retain the checked option in the bottom left corner, *Consider selected component(s) only.*

- You will know when the design of Individual columns is complete when you regain control of the program. Remain patient; it can take several minutes for each column to be individually designed in the background.
- From the *Result Display Settings* screen, navigate to *Column – Individual Design Results – NvsM Utilization.* Note the status indicated in this screen (OK or NG).
- To change the display of results from Pass/Fail mode to display the value, select the *Result Display Settings* tab of *Result Display Settings* screen. Change Utilization to *Value* from *Status*, and click Apply. The column results will appear similar to **FIGURE 2-27**.
- In the *Analysis* tab of the *Result Display Settings* screen, select *Design Loads* and *Axial Capacity.*
- Switch to *Single-level* mode.
- Switch to the left view. Using the mouse and cursor, window/select the top level columns. Click the *Hide Selection* from *Visbility→Selection* to remove these columns from display.
- Switch to top view.
- Now, the user can see color coded utilization values (because N vs M results are still selected) of each column below Level 4, as well as axial capacity of each column and associated Design loads. See **FIGURE 2-29**.
- Other Column Design Group results can be viewed in a similar manner.

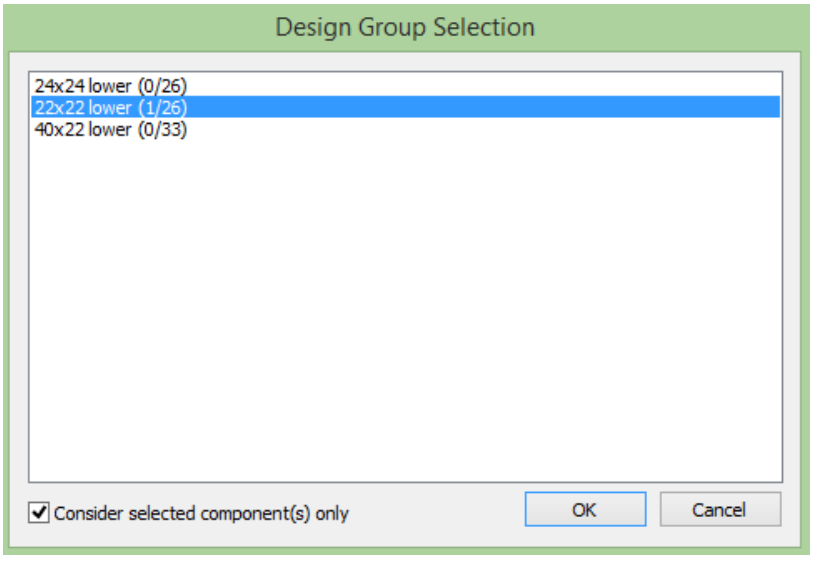


Figure 2-26 Design Group Selection for Code Check

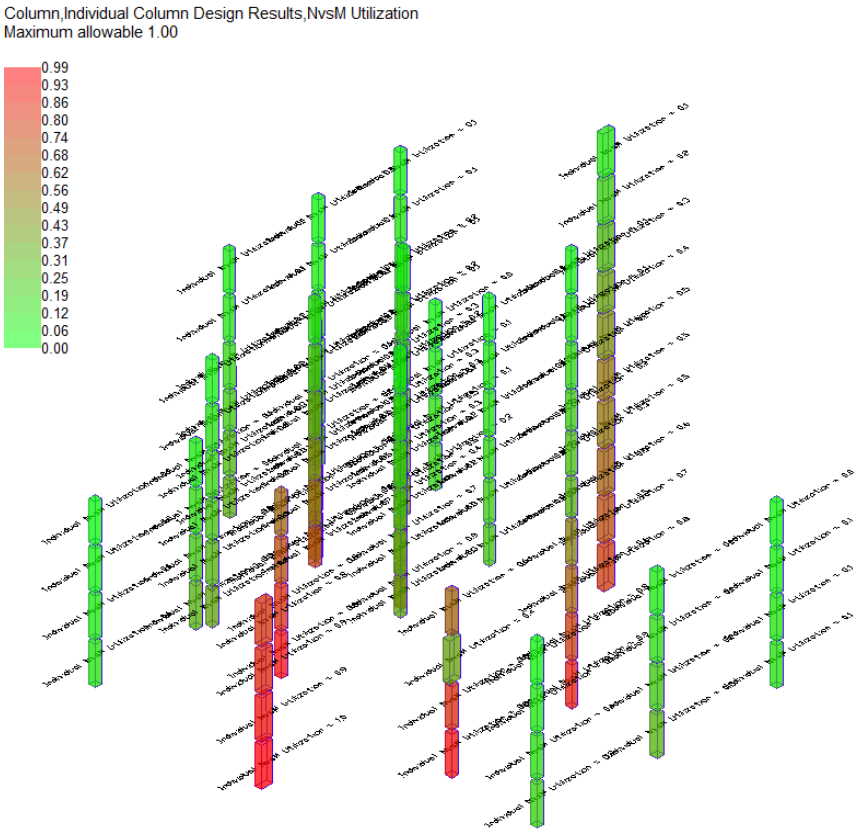


Figure 2-27 Individual Column Design N vs M Results - Value Display

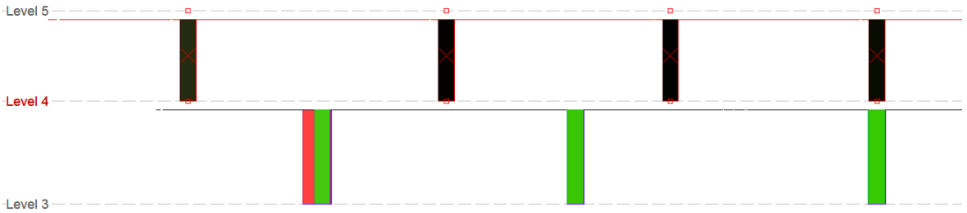


Figure 2-28 Select Top Columns in Single-Level Mode, Elevation View

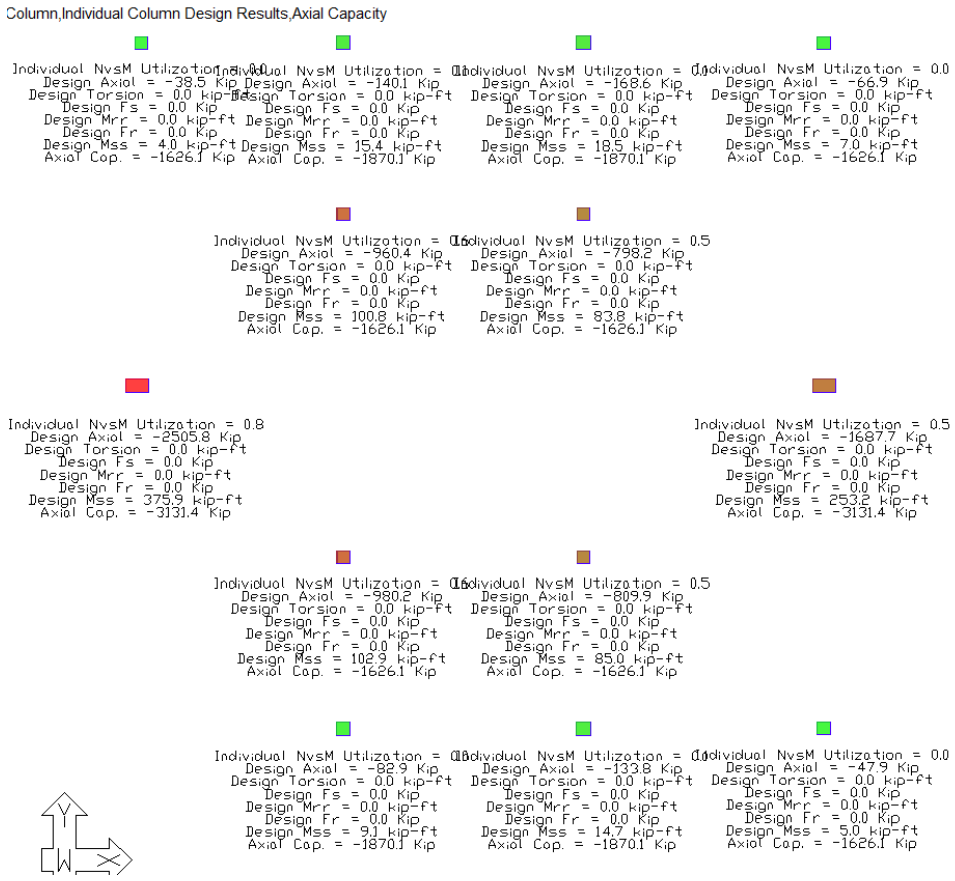


Figure 2-29 Individual Column NvsM utilization, Design Loads, Axial Capacity

2.5.1 Iterating on Individual Column Design

Once results from an Individual Column Design / Code check are completed, it is likely the user will need to revise column reinforcement, size, materials, etc. toward a final optimized design. The steps outlined in the previous section will be followed in addition to utilizing enhanced *Select by Type* tool, as described below.

The user may wish to define new design group/s for column sections which are being too severely utilized, or underutilized. In this Guide, we will run through an example assuming we are optimizing columns design toward N vs M interaction between 0.5 and 0.75.

- Using the same view as the section above, click the *Select by Type* tool on the *Home* ribbon.
- Highlight "Column" in the list on the top left, click the button next to "By design group" and select "24x24 Lower" or equivalent, and select the

checkbox for *NvsM Utilization max* equal to 0.5. This will select all columns within the "24x24 Lower" design group which has a N vs M utilization less than 0.5. See **FIGURE 2-30**. Click OK.

- With these underutilized columns selected, once again open the Section Type Manager. Right-mouse click the "24x24 Lower" Design group and select Clone, which will generate a new Design Group called "24x24 Lower_001". Let's assume we can change the size of the column, so in this case we will reduce the A and B values to 20" each. Reduce reinforcing as desired, perhaps to #8 vertical bars instead of #9s. Be sure the bottom left check box is selected which indicates *Assign to (x) selected components (1 design group).* Click OK. If desired, you could also rename this design group but in this example we will leave it as-is.
- Go to *FEM ➔Design ➔Design Columns.* The newly defined design group should be the only one selected, so only that one will be run. See **FIGURE 2-31**.
- Accept or Ignore any changes proposed in the Design Summary screen. In this example we will select the check box to *Update* and click *Apply*, and Close.
- The same columns should still be selected. Go to *FEM ➔Design ➔Code Check.* See **FIGURE 2-32**. Using steps defined previously, use the *Result Display Settings* to review Design Group and Individual Column Design results for this new group, and iterate again as needed to come to an acceptable design.

Follow similar steps for columns whose N vs M values exceed 0.75 (or any other value which the user prefers). However, *Select by Type* screen would instead have *NvsM Utilization min* selected with a value of 0.75 (or other), as shown in **FIGURE 2-33**.

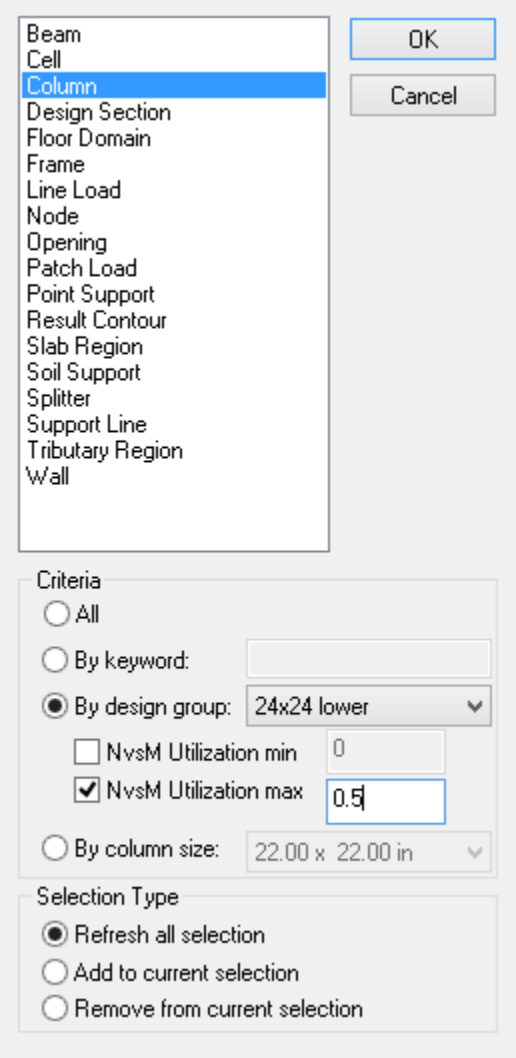


Figure 2-30 Select By Type: Underutilized Columns

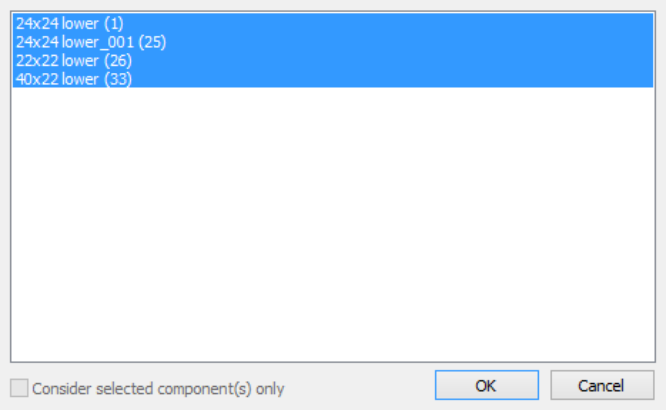


Figure 2-31 Design New Design Group

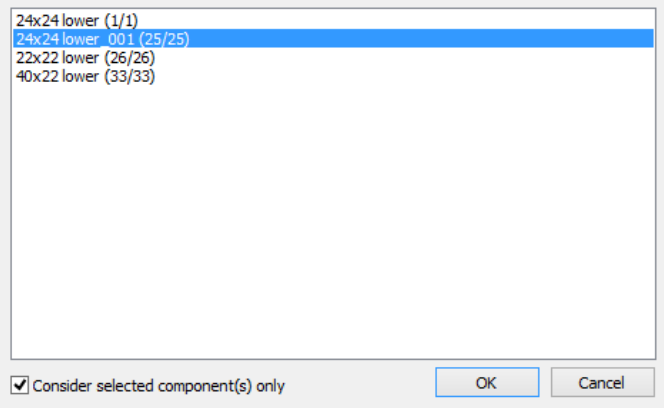


Figure 2-32 Individual Code Check for New Design Group

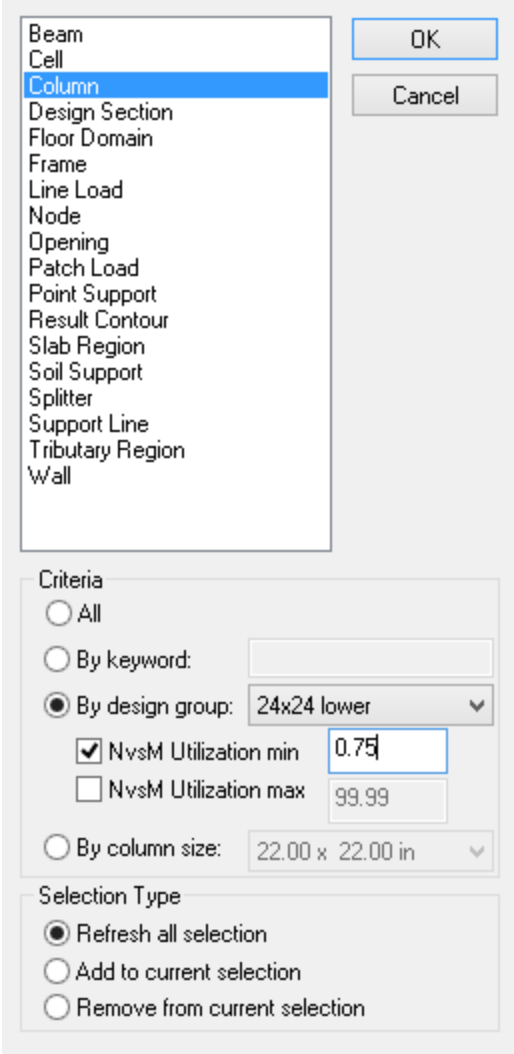


Figure 2-33 Select Columns Exceeding NvsM Allowable Value

3. Wall Piers

Defining wall piers is an essential requirement in the process of performing wall design in **ADAPT-Builder** and provides additional result capabilities for determining reactions and geometrical properties for groups of walls that are physically and analytically interconnected. Wall pier definition is required to produce grouped wall reactions for design objectives like foundation analysis and design, overturning checks, etc.

The ability to create and assign wall piers is available when **ADAPT-Floor Pro** and **ADAPT-MAT** and/or **ADAPT-Edge** is active. When **ADAPT-MAT** is active as a standalone application, the need to define piers is not required. However, if at some point in the design process the same model produced with **ADAPT-MAT** is then opened with **ADAPT-Edge**, the wall piers can be used for wall design from a global solution containing both elevated levels and a foundation system.

The process of designing walls requires wall piers to be defined. The program generates design sections at the top and bottom of each wall that is assigned to a pier. This is essential for processing of walls for design or code checking walls in a model. **FIGURE 3-1** shows an example of wall pier 'P1' having design sections at the top and bottom of each level from L1 through L7. The selected wall section shown in this image carries the standard notation of: Pier Assignment → Level Assignment → Section Location (top or bottom) → Wall ID. Note that the level assignment is made on a sequential basis. Regardless of what the level is called in the model, the assignment for wall sections is from Level 1 to Level N+1.

FIGURE 3-2 shows the top level for the wall stack belonging to wall pier 'P1.' The pier in this example contains two wall legs. These are identified by wall ID's 44 and 45. The program creates top and bottom design sections for each wall that is part of this pier at Level 7. These are listed and reported in **FIGURE 3-1**.

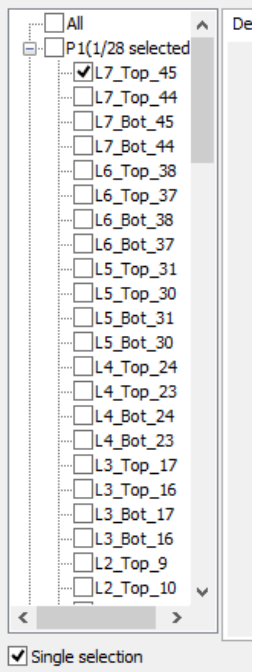


Figure 3-1 Wall Manager Design Section

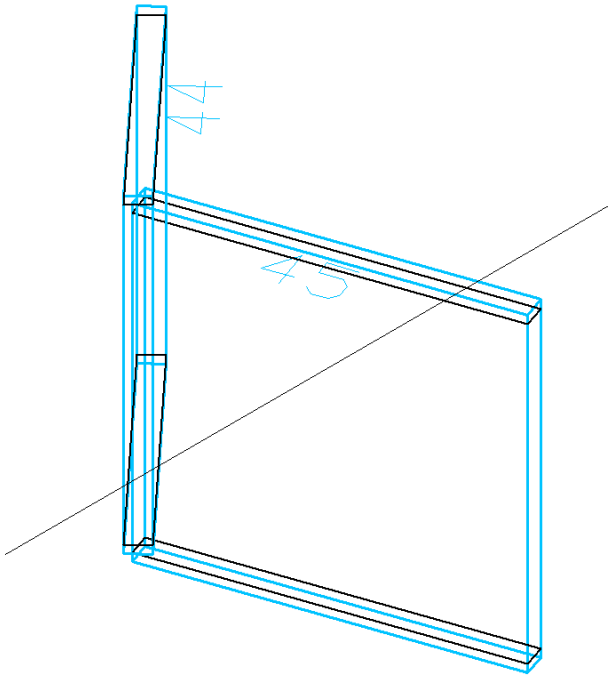


Figure 3-2 Wall Pier 1 - Design Sections at Level 7

3.1 Creating Wall Piers

The most direct way of creating wall piers is to select *Wall Design →Settings →Define Pier Labels*  . This will open the Pier Label dialog window as shown in **FIGURE 3-4**. Additionally, wall piers can be created by selecting any wall that has been modeled and entering the walls property dialog window. You can do this by double-clicking on the wall. In the *General* tab, the entry for *Pier* is made. Note that if no piers have yet been assigned, "NONE" will be shown. Use the *Edit* button to add Pier Labels. See **FIGURE 3-4**. In this menu, the user can add a new label  or delete and existing label  .

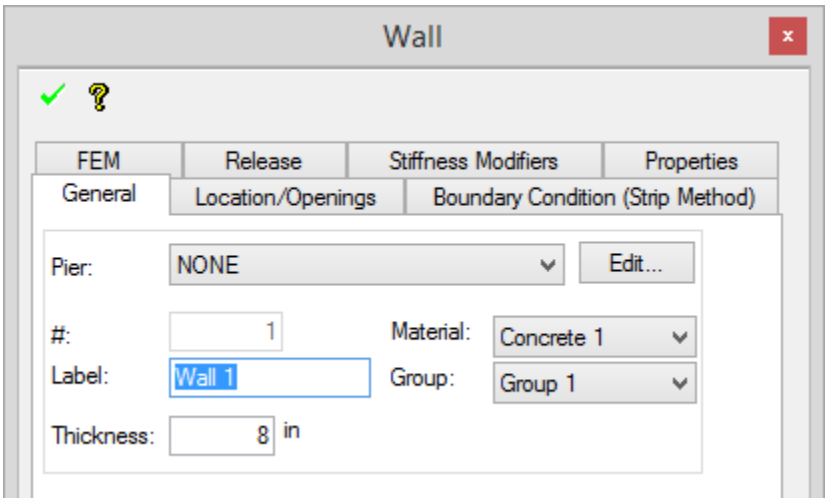


Figure 3-3 Wall Property Dialog Window

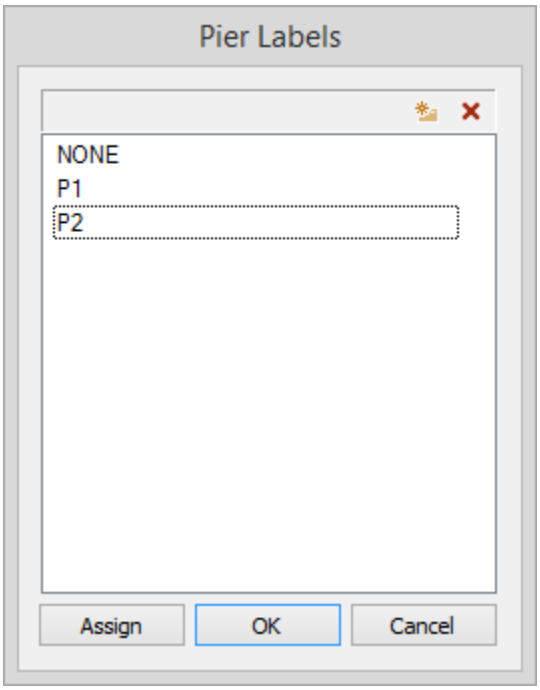


Figure 3-4 Pier Labels

Alternately, after selecting a wall or group of walls, the user can select *Modify→ Properties→Modify Selection→Walls* and use the *Edit* function to create new or delete pier labels. Note this is also the option used when assigning wall piers to multiple, selected walls belonging to the same pier.

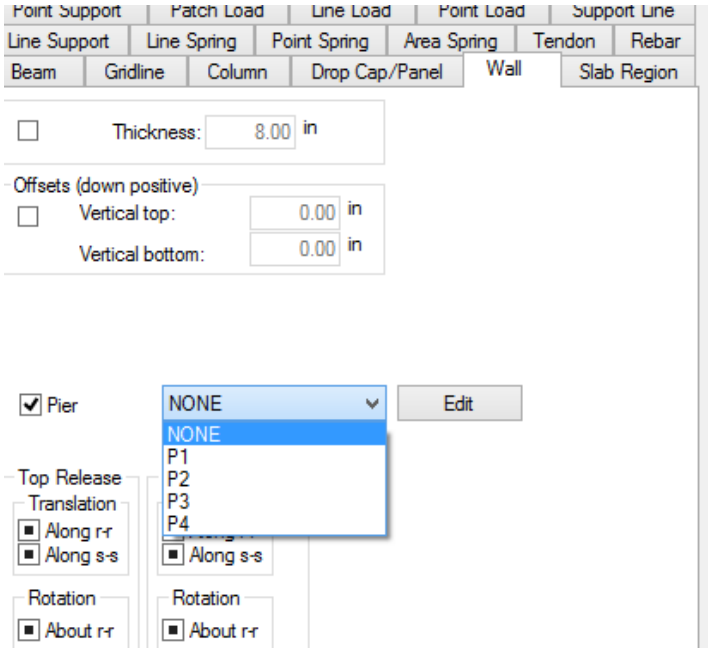


Figure 3-5 Pier Assignment in Modify Item Properties

3.2 Assigning Wall Piers

Wall piers are commonly defined as those walls contained in one composite group for the purpose of acting as a lateral resisting component in the global lateral resisting system. In **FIGURE 3-6**, the example contains 4 wall piers acting as lateral resisting elements and grouped such that all design sections are referenced to the same wall pier.

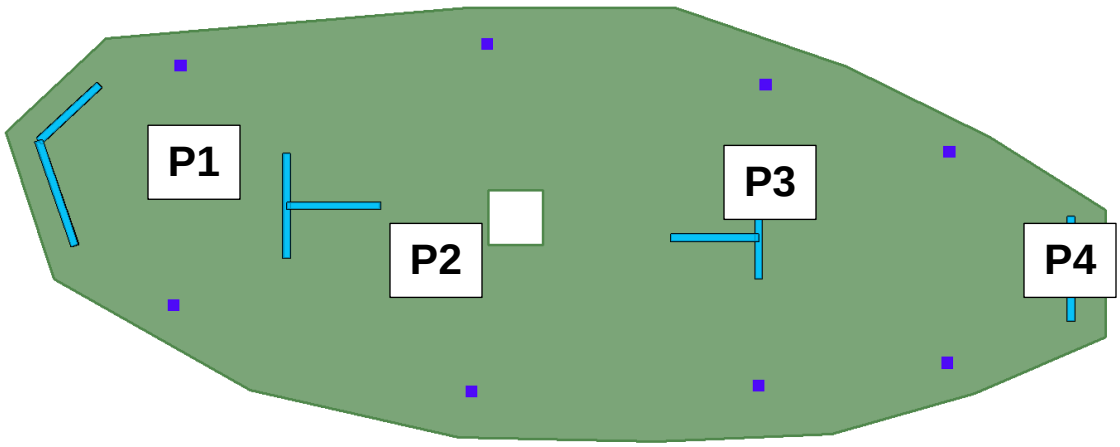


Figure 3-6 Wall Piers in a Two-Way Slab Frame

Two methods can be used to assign wall piers to a group of walls. First, the user can assign an individually selected wall to any defined pier through use of the wall properties menu as shown in **FIGURE 3-5**. Second, the most common way to rapidly assign a pier to a group of walls in a global wall stack is to use the option from *Modify→Properties→Modify Selection→Walls.* See **FIGURE 3-5**. This approach is used for making a modification or assignment to a group of similar components. The steps below can be followed to assign wall piers per the second option.

- Change the model mode to *Multi-Level* . This will allow you to select all walls within the model and the wall stack.
- Change the view to the top view .
- Use the window selection tool by clicking the left mouse button and dragging the cursor to the opposite corner of the wall viewing range.
- Go to *Modify→Properties→Modify Selection→Wall* and assign the proper pier assignment to the selected group of walls.
- Repeat the procedure for as many wall stacks, as necessary in the model. **FIGURE 3-7** shows a model with completed wall pier assignments.

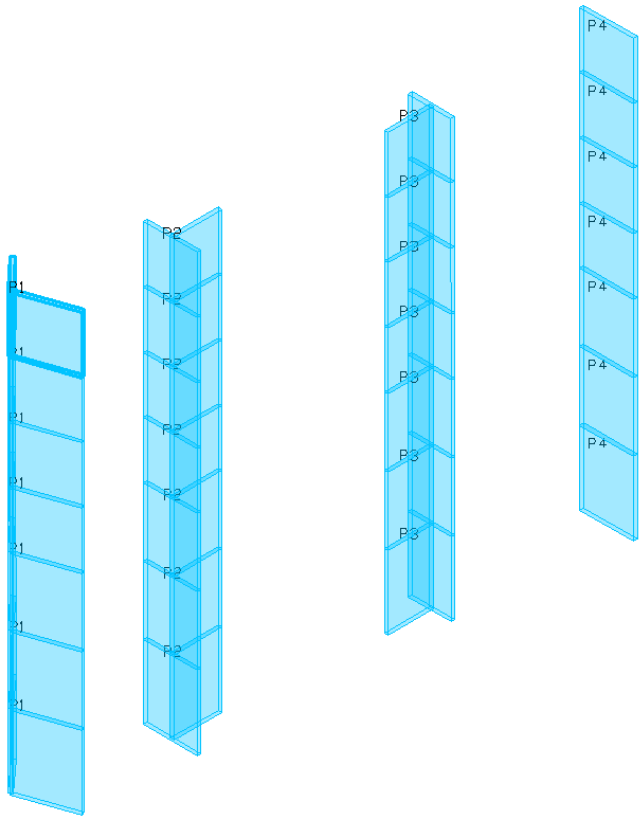
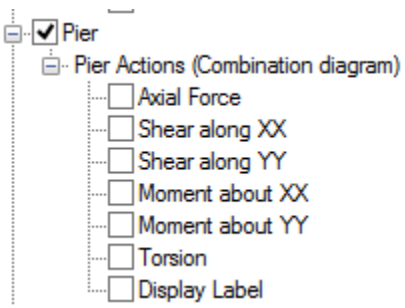


Figure 3-7 Completed Pier Assignments

3.3 Wall Pier Results

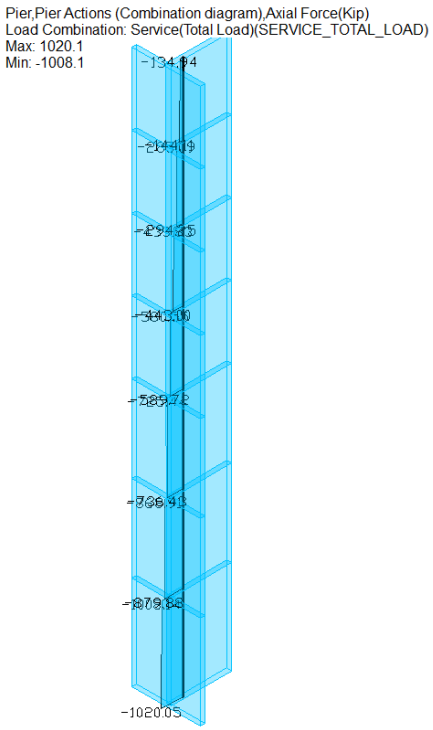
After completion of the analysis of a model, wall pier results can be produced. Note these results are different than those for the design of wall design sections and are primarily the wall pier geometric and physical properties as well as pier reactions for the last run model analysis. Wall pier results can be produced graphically or as a Microsoft Excel® data file in .XLS format.

Graphical pier results are selectable in the *Result Display Settings* selection tree under the *Pier* section.

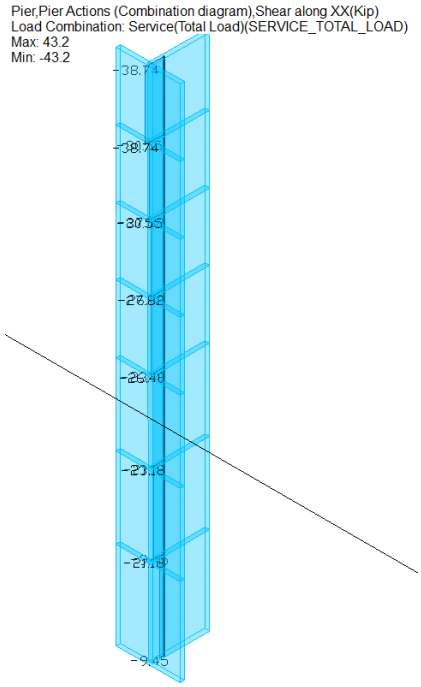


Available options to view graphically are:

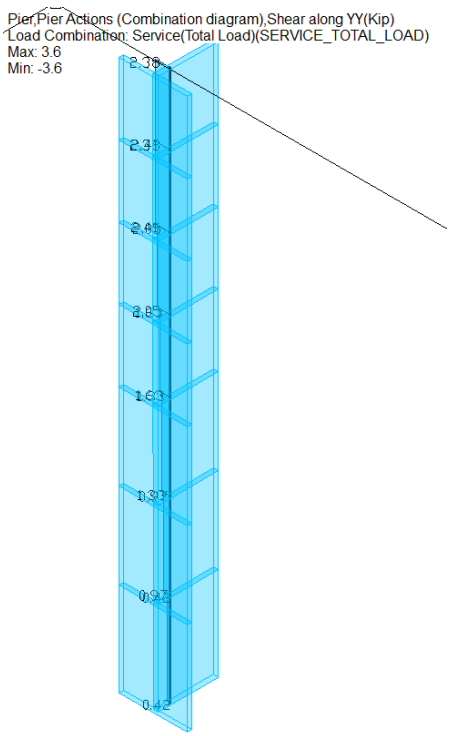
- Axial Force – Reports the axial force for the wall pier at the pier centroid.



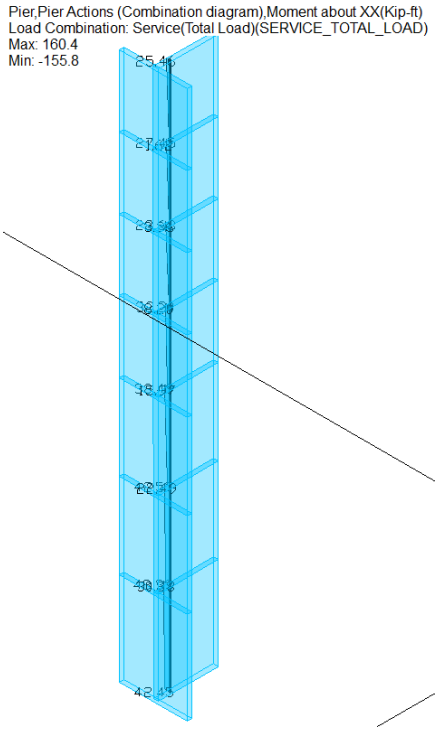
- Shear along XX – Reports the shear in the global X direction for the wall pier at the pier centroid.



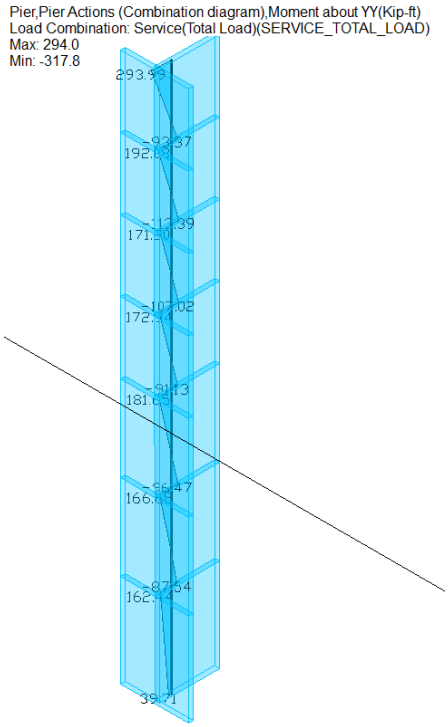
- Shear along YY – Reports the shear in the global Y direction for the wall pier at the pier centroid.



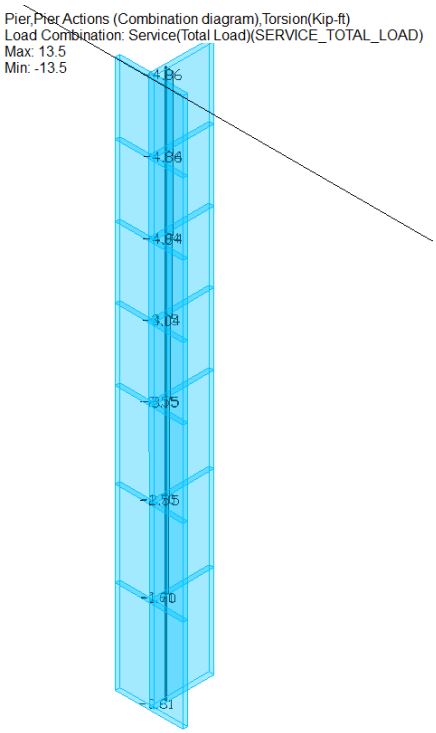
- Moment about XX – Reports the moment about the global X axis for the wall pier at the pier centroid.



- Moment about YY – Reports the moment about the global Y axis for the wall pier at the pier centroid.



- Torsion – Reports the pier torsion for the wall pier at the pier centroid.



- Display Label – Displays the assigned pier wall for each wall in view.

To produce the wall pier reaction report, go to *Wall Design →Wall Reporting →XLS Reports →Pier Reactions.* In the *Report Options* dialog window the combination results to be included in the Pier Reactions reported are selected. You can also choose to produce the reaction report relative to a user-defined orientation angle which transforms the shear and moment values.

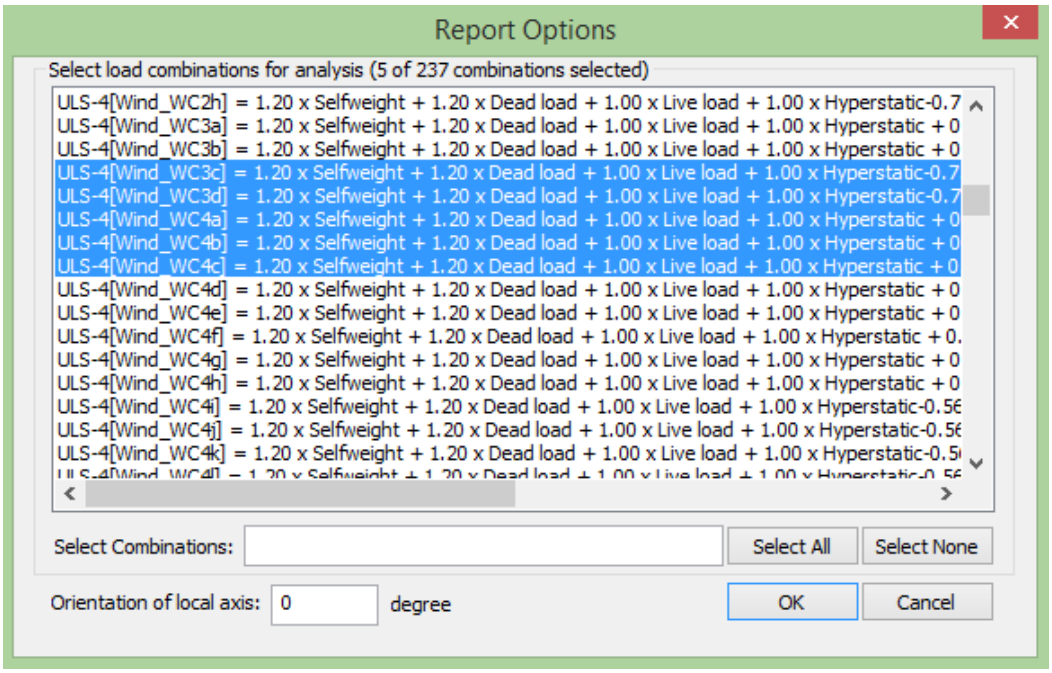


Figure 3-4 Pier Reactions Report Options

After selection *OK* the program will produce a message shown where the XLS file is saved and ask the user to open the file at that time.

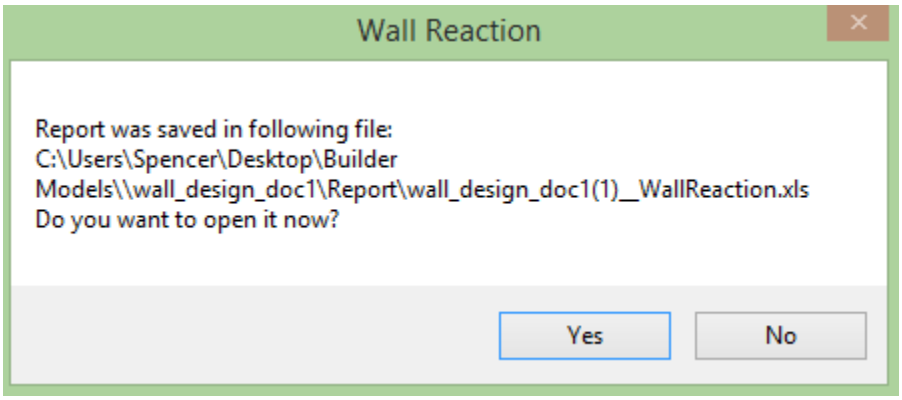
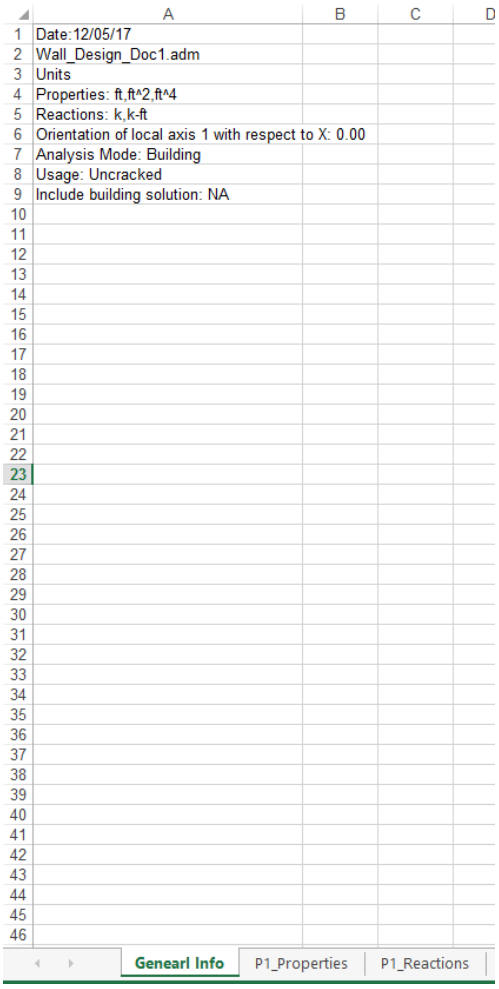


Figure 3-5 Wall Reaction Report Save Open Dialog

The following figures show examples of the pier reaction data report. These include *General Information, Pier Properties, and Pier Reactions.* Each pier defined in a model will have its own set of data.



	A	B	C	D
1	Date:12/05/17			
2	Wall_Design_Doc1.adm			
3	Units			
4	Properties: ft,ft^2,ft^4			
5	Reactions: k,k-ft			
6	Orientation of local axis 1 with respect to X: 0.00			
7	Analysis Mode: Building			
8	Usage: Uncracked			
9	Include building solution: NA			
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46				

Genearl Info | P1_Properties | P1_Reactions

Figure 3-6 General Pier Information - XLS Report

	A	B	C	D	E	F	G	H	I	J
1	Grouped wall properties									
2	Reference Plane	CGx	CGy	CGz top	CGz botto	A	I1	I2	# of walls	Wall IDs
3	Level 7	-2.15348	14.7196	77	67	11.71073	213.9572	22.68835	2	44,45
4	Level 6	-2.15348	14.7196	67	57	11.71073	213.9572	22.68835	2	37,38
5	Level 5	-2.15348	14.7196	57	47	11.71073	213.9572	22.68835	2	30,31
6	Level 4	-2.15348	14.7196	47	37	11.71073	213.9572	22.68835	2	23,24
7	Level 3	-2.15348	14.7196	37	25	11.71073	213.9572	22.68835	2	16,17
8	Level 2	-2.15348	14.7196	25	13	11.71073	213.9572	22.68835	2	9,10
9	Level 1	-2.15348	14.7196	13	0	11.71073	213.9572	22.68835	2	2,3
10	Base									
11	Individual wall properties									
12	Wall ID	CGx	CGy	CGz top	CGz botto	A	Irr	Iss	Material	
13	2	-1.51153	18.89374	13	0	5.011302	0.185604	23.59679	Concrete 1	
14	3	-2.63367	11.59727	13	0	6.699432	0.248127	56.37872	Concrete 1	
15	9	-1.51153	18.89374	25	13	5.011302	0.185604	23.59679	Concrete 1	
16	10	-2.63367	11.59727	25	13	6.699432	0.248127	56.37872	Concrete 1	
17	16	-1.51153	18.89374	37	25	5.011302	0.185604	23.59679	Concrete 1	
18	17	-2.63367	11.59727	37	25	6.699432	0.248127	56.37872	Concrete 1	
19	23	-1.51153	18.89374	47	37	5.011302	0.185604	23.59679	Concrete 1	
20	24	-2.63367	11.59727	47	37	6.699432	0.248127	56.37872	Concrete 1	
21	30	-1.51153	18.89374	57	47	5.011302	0.185604	23.59679	Concrete 1	
22	31	-2.63367	11.59727	57	47	6.699432	0.248127	56.37872	Concrete 1	
23	37	-1.51153	18.89374	67	57	5.011302	0.185604	23.59679	Concrete 1	
24	38	-2.63367	11.59727	67	57	6.699432	0.248127	56.37872	Concrete 1	
25	44	-1.51153	18.89374	77	67	5.011302	0.185604	23.59679	Concrete 1	
26	45	-2.63367	11.59727	77	67	6.699432	0.248127	56.37872	Concrete 1	
27										
28										
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30										
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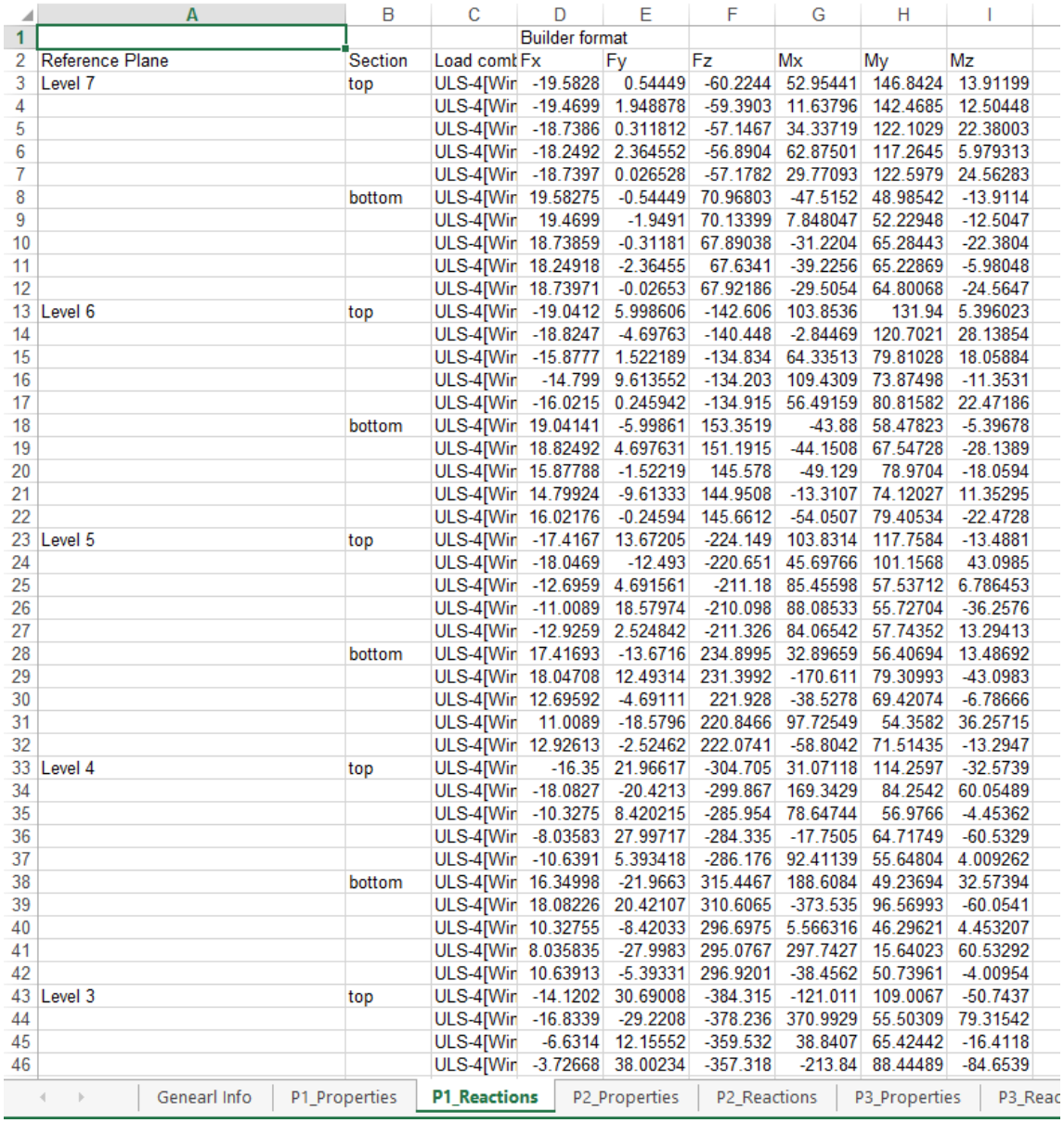
Genearl Info | **P1_Properties** | P1_Reactions | P2_Properties | P2_Reactions | P3_Properties | P3_Reactions

Figure 3-7 Pier Properties - XLS Report



	A	B	C	D	E	F	G	H	I
1				Builder format					
2	Reference Plane	Section	Load comt	Fx	Fy	Fz	Mx	My	Mz
3	Level 7	top	ULS-4[Wir	-19.5828	0.54449	-60.2244	52.95441	146.8424	13.91199
4			ULS-4[Wir	-19.4699	1.948878	-59.3903	11.63796	142.4685	12.50448
5			ULS-4[Wir	-18.7386	0.311812	-57.1467	34.33719	122.1029	22.38003
6			ULS-4[Wir	-18.2492	2.364552	-56.8904	62.87501	117.2645	5.979313
7			ULS-4[Wir	-18.7397	0.026528	-57.1782	29.77093	122.5979	24.56283
8		bottom	ULS-4[Wir	19.58275	-0.54449	70.96803	-47.5152	48.98542	-13.9114
9			ULS-4[Wir	19.4699	-1.9491	70.13399	7.848047	52.22948	-12.5047
10			ULS-4[Wir	18.73859	-0.31181	67.89038	-31.2204	65.28443	-22.3804
11			ULS-4[Wir	18.24918	-2.36455	67.6341	-39.2256	65.22869	-5.98048
12			ULS-4[Wir	18.73971	-0.02653	67.92186	-29.5054	64.80068	-24.5647
13	Level 6	top	ULS-4[Wir	-19.0412	5.998606	-142.606	103.8536	131.94	5.396023
14			ULS-4[Wir	-18.8247	-4.69763	-140.448	-2.84469	120.7021	28.13854
15			ULS-4[Wir	-15.8777	1.522189	-134.834	64.33513	79.81028	18.05884
16			ULS-4[Wir	-14.799	9.613552	-134.203	109.4309	73.87498	-11.3531
17			ULS-4[Wir	-16.0215	0.245942	-134.915	56.49159	80.81582	22.47186
18		bottom	ULS-4[Wir	19.04141	-5.99861	153.3519	-43.88	58.47823	-5.39678
19			ULS-4[Wir	18.82492	4.697631	151.1915	-44.1508	67.54728	-28.1389
20			ULS-4[Wir	15.87788	-1.52219	145.578	-49.129	78.9704	-18.0594
21			ULS-4[Wir	14.79924	-9.61333	144.9508	-13.3107	74.12027	11.35295
22			ULS-4[Wir	16.02176	-0.24594	145.6612	-54.0507	79.40534	-22.4728
23	Level 5	top	ULS-4[Wir	-17.4167	13.67205	-224.149	103.8314	117.7584	-13.4881
24			ULS-4[Wir	-18.0469	-12.493	-220.651	45.69766	101.1568	43.0985
25			ULS-4[Wir	-12.6959	4.691561	-211.18	85.45598	57.53712	6.786453
26			ULS-4[Wir	-11.0089	18.57974	-210.098	88.08533	55.72704	-36.2576
27			ULS-4[Wir	-12.9259	2.524842	-211.326	84.06542	57.74352	13.29413
28		bottom	ULS-4[Wir	17.41693	-13.6716	234.8995	32.89659	56.40694	13.48692
29			ULS-4[Wir	18.04708	12.49314	231.3992	-170.611	79.30993	-43.0983
30			ULS-4[Wir	12.69592	-4.69111	221.928	-38.5278	69.42074	-6.78666
31			ULS-4[Wir	11.0089	-18.5796	220.8466	97.72549	54.3582	36.25715
32			ULS-4[Wir	12.92613	-2.52462	222.0741	-58.8042	71.51435	-13.2947
33	Level 4	top	ULS-4[Wir	-16.35	21.96617	-304.705	31.07118	114.2597	-32.5739
34			ULS-4[Wir	-18.0827	-20.4213	-299.867	169.3429	84.2542	60.05489
35			ULS-4[Wir	-10.3275	8.420215	-285.954	78.64744	56.9766	-4.45362
36			ULS-4[Wir	-8.03583	27.99717	-284.335	-17.7505	64.71749	-60.5329
37			ULS-4[Wir	-10.6391	5.393418	-286.176	92.41139	55.64804	4.009262
38		bottom	ULS-4[Wir	16.34998	-21.9663	315.4467	188.6084	49.23694	32.57394
39			ULS-4[Wir	18.08226	20.42107	310.6065	-373.535	96.56993	-60.0541
40			ULS-4[Wir	10.32755	-8.42033	296.6975	5.566316	46.29621	4.453207
41			ULS-4[Wir	8.035835	-27.9983	295.0767	297.7427	15.64023	60.53292
42			ULS-4[Wir	10.63913	-5.39331	296.9201	-38.4562	50.73961	-4.00954
43	Level 3	top	ULS-4[Wir	-14.1202	30.69008	-384.315	-121.011	109.0067	-50.7437
44			ULS-4[Wir	-16.8339	-29.2208	-378.236	370.9929	55.50309	79.31542
45			ULS-4[Wir	-6.6314	12.15552	-359.532	38.8407	65.42442	-16.4118
46			ULS-4[Wir	-3.72668	38.00234	-357.318	-213.84	88.44489	-84.6539

Genearl Info | P1_Properties | **P1_Reactions** | P2_Properties | P2_Reactions | P3_Properties | P3_Reac

Figure 3-8 Pier Reactions - XLS Report

4. Wall Design Workflow

Fully integrated wall design capabilities are available within **ADAPT-Builder**. The design of concrete shear walls, with or without boundary elements for seismic lateral resisting systems, is available in the program through use of the native ADAPT Wall Designer module or by integration with S-CONCRETE. Both tools are run silently and provide seamless interaction when working in the ADAPT-Builder environment. Note that ADAPT Wall Designer currently supports only prismatic wall sections (rectangular without "dumbbells" boundary elements) and is currently coded for ACI318-11. For the ability to design walls with other design codes and process non-prismatic design sections, S-CONCRETE is required. Separate licensing is required for the enablement of S-CONCRETE with ADAPT-Builder for wall design.

This section is intended to describe the necessary program tools used in the general workflow of designing walls within ADAPT-Builder. For more detailed descriptions of the underlying design tools used (ADAPT Wall Designer and S-CONCRETE), refer to the accompanying manual, "**ADAPT Wall Design Operation and Theory Manual"** and S-CONCRETE documentation found within the HELP menu when opening the application separate from ADAPT-Builder.

Note that ADAPT Wall Designer can be opened as a standalone tool from the default program files installation folder at C:\Program Files (x86)\ADAPT\ADAPT-Builder 2017\walldesign.exe. It is not necessary to use the tool as a standalone application when working within ADAPT-Builder. The user has the option to select the appropriate design tool in the process of setting wall design parameters described further in this section.

4.1 Generating Wall Design Sections

Walls in **ADAPT-Builder** are evaluated based on "wall design sections" cut at the top and bottom of each unique wall that is part of a wall pier. If a wall pier contains more than 1 wall leg, wall design sections will be created for each wall leg that is oriented greater than 10 deg. to the adjoining wall. While each wall leg is part of the same pier, the design sections representing the wall leg are individualized in this way. Wall design sections are generated for each wall at each level assigned to a pier. Walls that are unassigned a wall pier do not have wall design sections generated. **FIGURE 4-1** shows an example of a continuous, adjoined wall having an angle below and above 10 deg. and how design sections are defined for the wall pier.

Prerequisite to being able to automatically generate wall design sections, walls must be grouped and defined as piers. Section 10 of the document describes the process of creating and assigning wall piers.

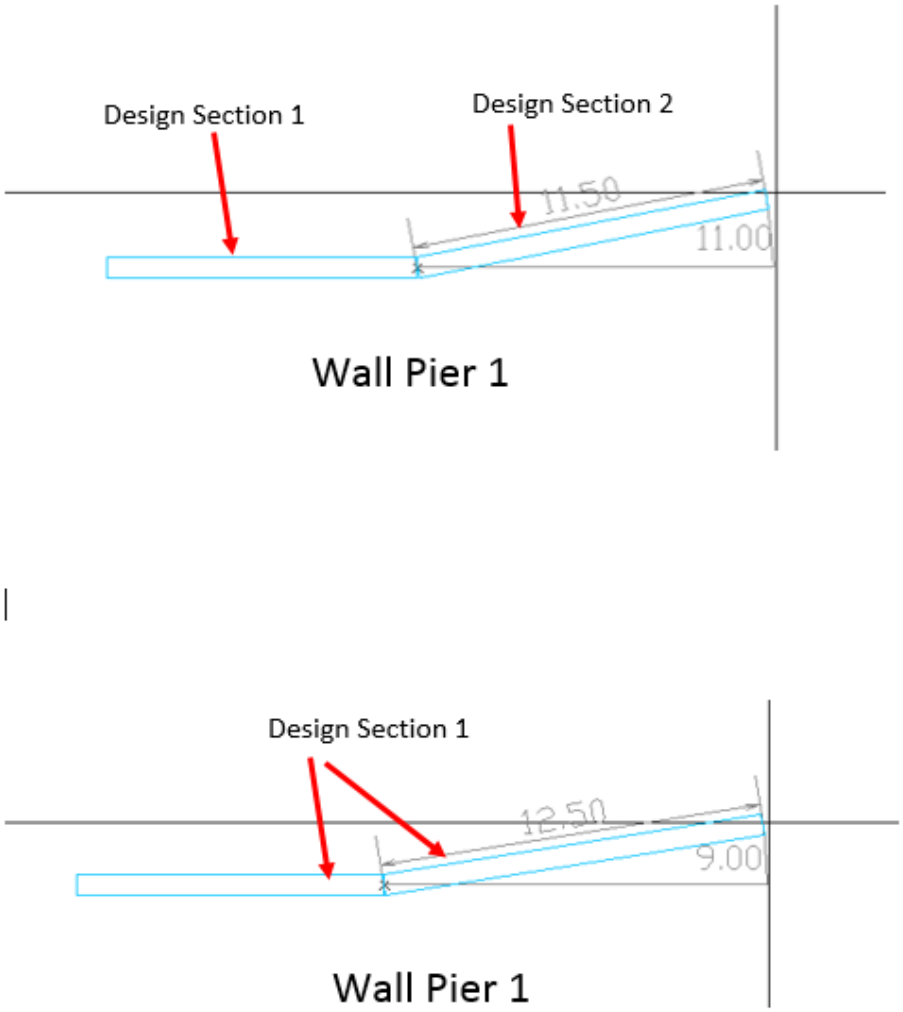
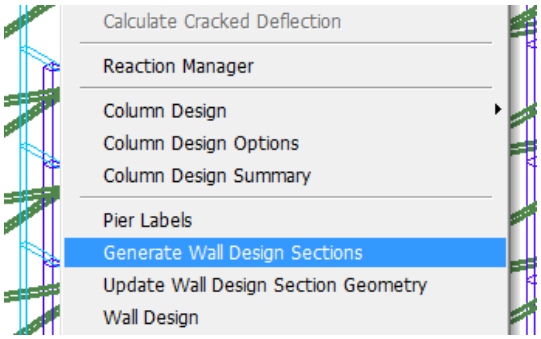


Figure 4-1 Wall Design Section cutoff

After generating wall piers and assigning wall stacks to defined pier labels, go to *Wall Design→Generate Wall Design Sections* . Each wall section that is generated receives its own label, outline and associated reinforcement defined in the *Wall Design Manager* . **FIGURE 4-2** shows generated wall design sections graphically.



In this example, the model contains 4 wall piers (see Section 10). The pier at the far left contains 2 wall legs with unique design sections at the top and bottom of each leg. The same is true for the piers at left-center and right-center. The pier at the far right contains 1 wall leg.

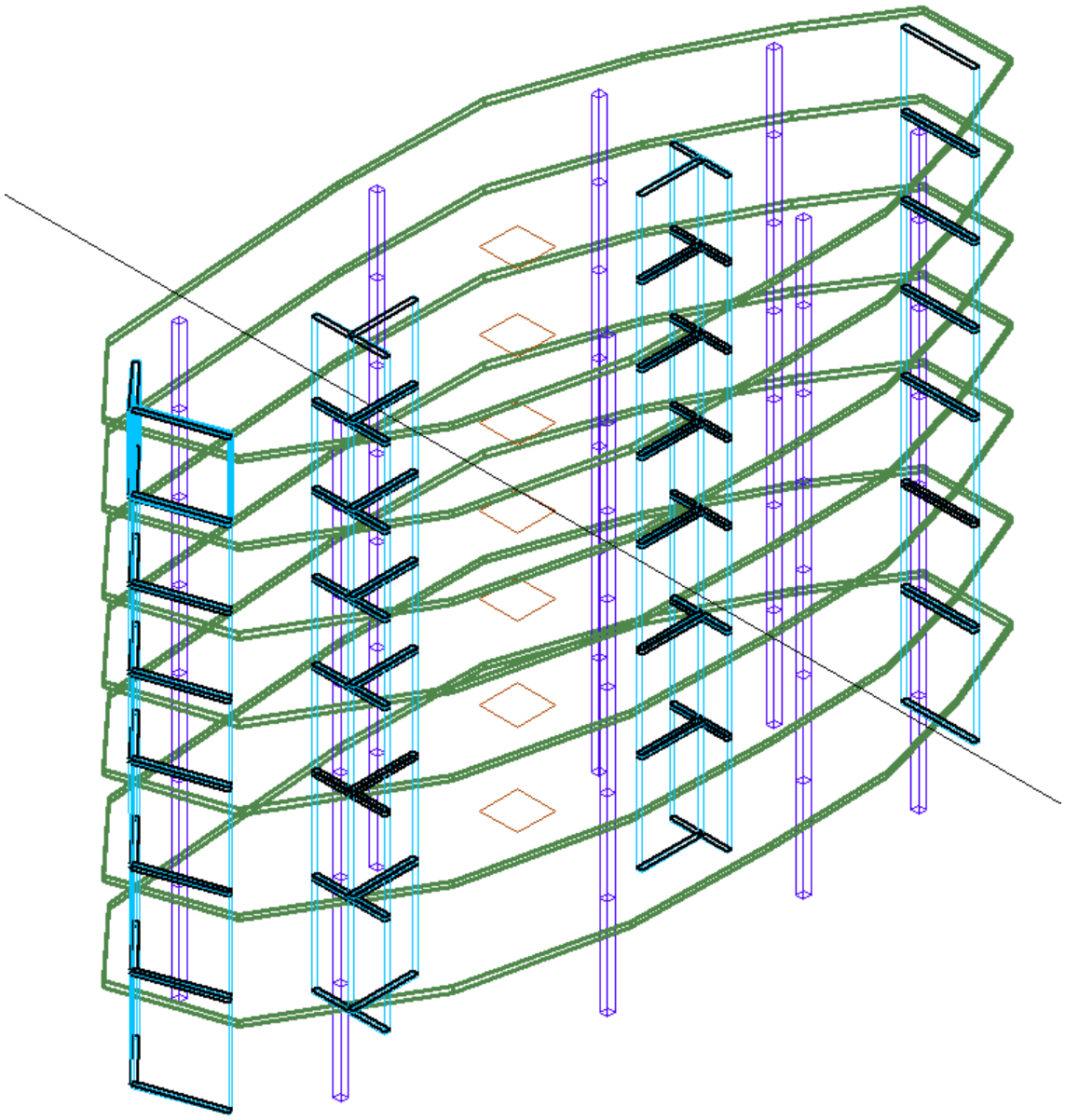
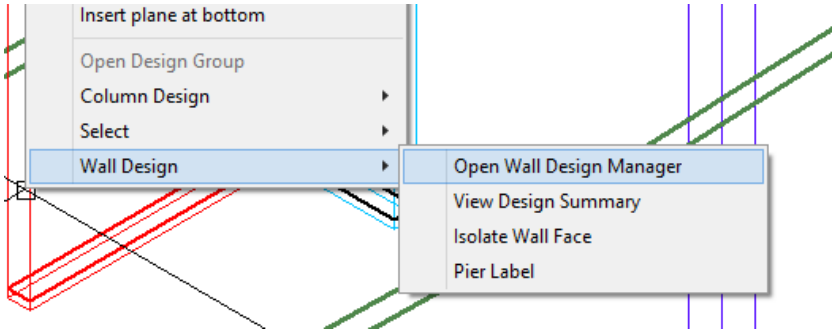


Figure 4-2 Wall Design Sections generated for full model.

4.2 Wall Design Manager

After producing wall design sections, the ADAPT *Wall Design Manager* contains necessary tools and parameters definitions that allow the user to process walls for design or code check. To open the *Wall Design Manager,* go to *Wall Design →Wall Design Manager* or right-click on any wall and select *Wall Design →Open Wall Design Manager.*



The information presented below gives a description of all inputs and selection options in each of the *Wall Design Managers* user interface.

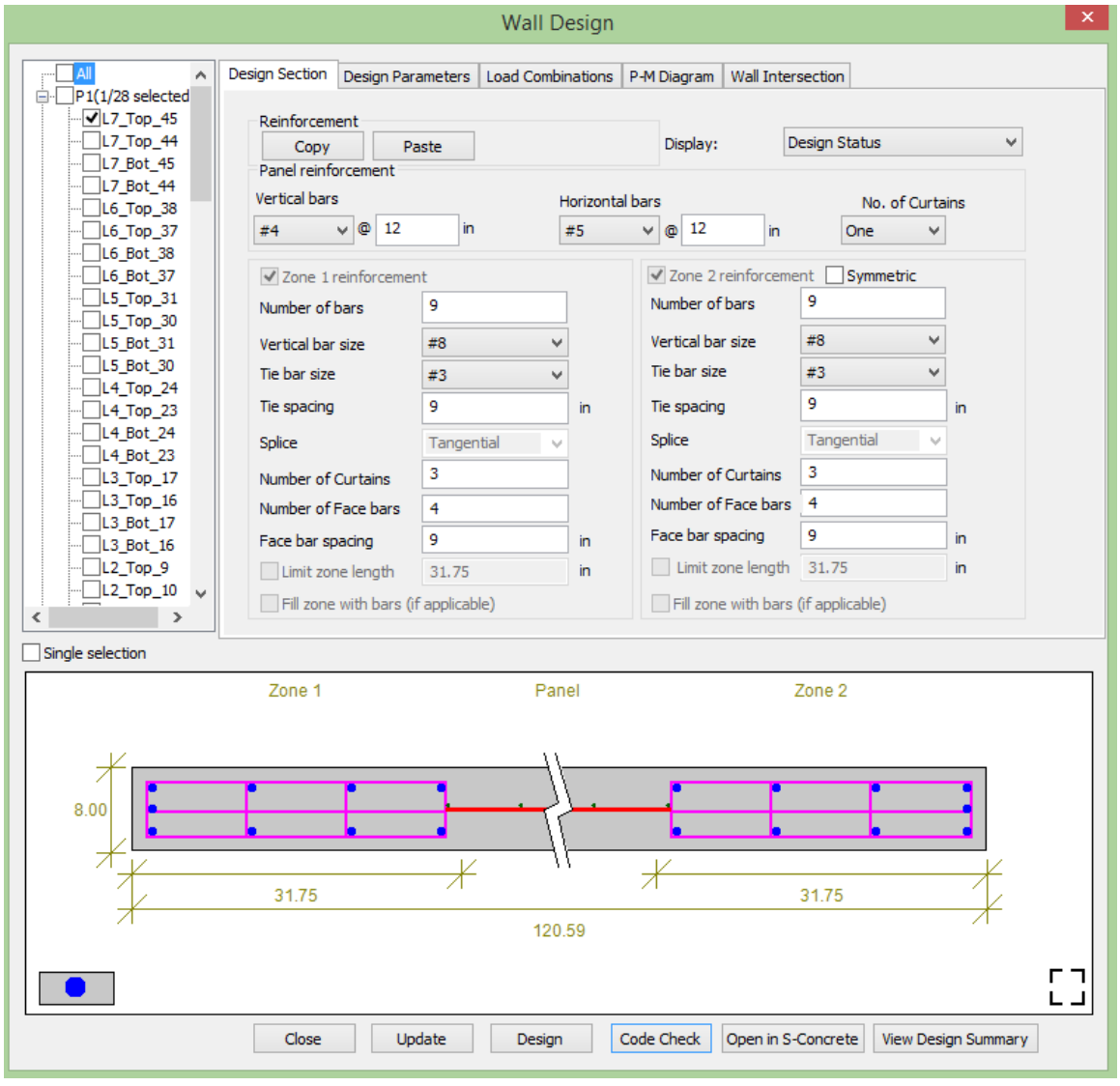
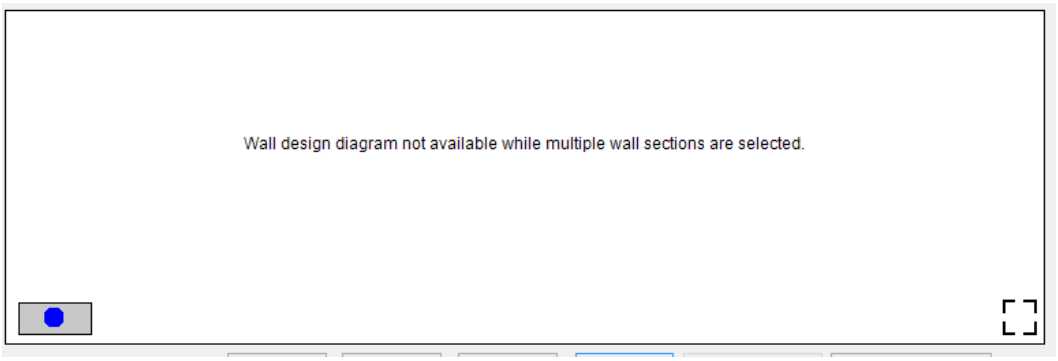


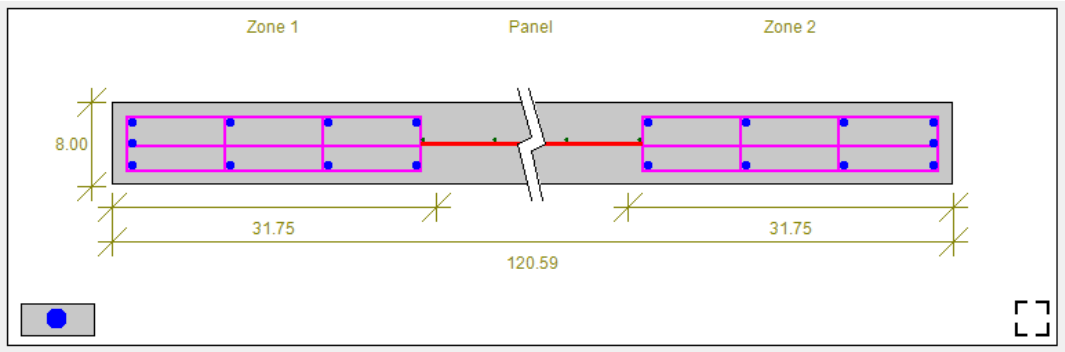
Figure 4-3 ADAPT Wall Design Section Manager

Wall Design Section List - The wall design section list at the left edge of the window identifies each pier and the top and bottom design sections of walls belonging to each pier. Nomenclature for the wall design section names is described in Section 10 of this document.

Single Selection – This checkbox, when selected, limits the user to select only 1 design section at a time. If the box is unchecked, multiple design sections can be selected at the same time. Reinforcement input items that don't contain the same values when multiple sections are selected will show ellipses (…..) until the values of all selected sections are identical. If more than 1 design section is selected, the graphical design section window will not render an image and the warning shown below will appear.



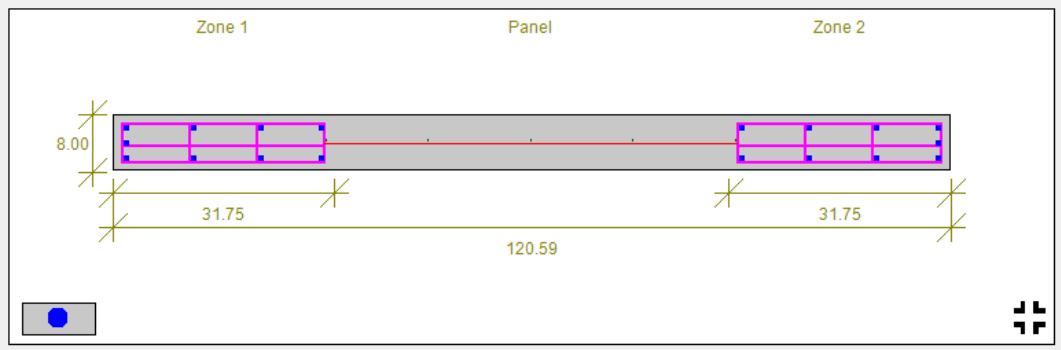
Graphical Design Section Window – This window allows the user to view the selected design section with accompanying zone and panel reinforcement and dimensions. The window can be toggled to different modes as described below.

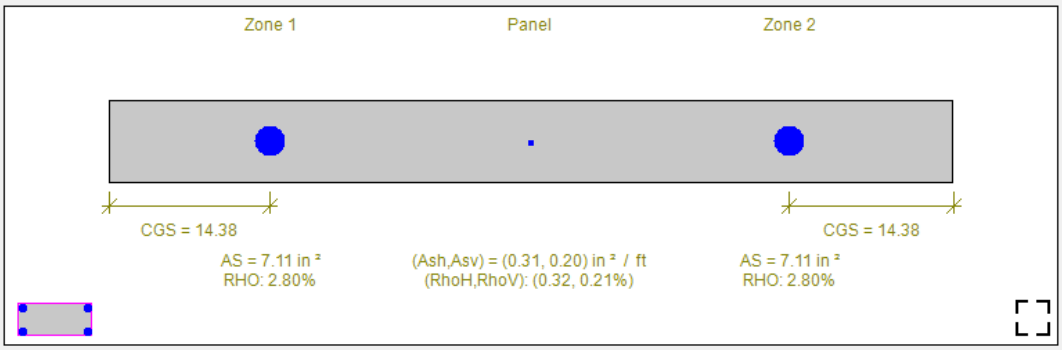


 Reinforcement in the section is shown by bar representation for vertical and horizontal reinforcement and transverse wall ties. Overall wall dimensions and zone dimensions are shown.

 The graphical image shown is a zoomed view showing detailed zone reinforcement while reducing the panel region. As shown above.

The graphical image shown is a full-scale view showing the entire design section. As shown below.





Reinforcement in the section is shown by lump sum approach. The total area of steel and reinforcement ratio in zones and panel and reinforcement are displayed at their individual CGS locations.

Close – Closes the ADAPT Wall Design Manager.

Update – Updates the selected design section/s to the values set in the reinforcement input fields after user modification after a section has been designed.

Design – Designs the selected design section/s. If reinforcement size and/or spacing is not adequate, the program will update the reinforcement fields necessary to meet the selected codes design requirements.

Code Check – Checks the selected design section/s reinforcement and spacing against design provisions for the selected design code.

Open in S-Concrete – This option is only active when the design tool selected in Design Parameters is set to S-CONCRETE. If selected, the design section and data is opened in S-Concrete. An active license of S-CONCRETE is required for this option.

View Design Summary – Opens the HTML summary document for the selected design section/s after a code check or design has been performed.

4.3 Design Section Tab

Figure 4-4 Design Section Input Tab

4.3.1 Reinforcement

Copy – Copies the reinforcement for the selected design section/s.

Paste – Pastes the copied reinforcement to the selected design section/s reinforcement assignments.

4.3.2 Display

Design Status – shows status next to each design section name as “acceptable” or “unacceptable” after the section has been designed or code checked. The status is shown as green or red.

V&T Utilization – shows the status of shear and torsion interaction as “acceptable” or “unacceptable” if the value is less than/equal to or greater than 1.0. The status is shown in green or red.

N&M Utilization – shows the status of axial force and flexure interaction as “acceptable” or “unacceptable” if the value is less than/equal to or greater than 1.0. The status is shown in green or red.

4.3.3 Panel Reinforcement

Vertical bars – Defines the bar size and spacing of vertical reinforcement (parallel to the vertical wall axis) in the wall panel (that portion of the wall between zones.)

Horizontal bars – Defines the bar size and spacing of horizontal reinforcement (perpendicular to the vertical wall axis) in the wall panel.

No. of Curtains – The number of vertical bar layers in the wall local s-s axis direction.

4.3.4 Zone Reinforcement

Checkbox for Zone 1 and Zone 2 – These checkboxes are only active if S-CONCRETE is selected or if the *boundary elements* option is selected when using ADAPT Wall Designer. These are set in the *Design Parameters* input. If the checkboxes are active and selected, the program considers boundary zone design. If de-selected the program considers only the zone that is selected. De-selecting both means the wall is designed as a "zone-less."

Checkbox for Symmetric – If zones are considered for design and symmetric is selected, Zone 2 becomes disabled and takes on the same reinforcement as defined for Zone 1.

Number of bars – Defines the total number of vertical bars in the zone. This box is only active when ADAPT Wall Designer is the selected design tool. In the case where the assigned number of vertical bars does not match the number of bars matching the face bar and curtain input, the program will color this cell pink to alert the user. When S-CONCRETE is selected, the total number of vertical bars is defined by the face bars and curtain assignment for the zone.

Vertical bar size – Defines the bars size for vertical bars.

Tie bar size – Defines the tie (transverse containment) bar size.

Tie spacing – Defines the spacing of the tie bars.

Splice – Active only when S-CONCRETE is the selected design tool and is used for spacing checks of vertical bars in zones. Tangential, bearing, radial or mechanical can be defined. See S-CONCRETE documentation for definitions of each.

Number of Curtains – Defines the number of vertical bar layers in the wall local s-s axis direction.

Number of Face bars – Defines the number of vertical bar layers in the wall local r-r axis direction.

Face bar spacing – Defines the spacing of face bars. The spacing is in the local r-r direction.

Limit zone length – This option is only active when S-CONCRETE is the selected design tool. It is an additional design parameter that limits the length of the boundary zone.

Fill zone with bars (if applicable) – This option is only active when S-CONCRETE is the selected design tool. In DESIGN mode it forces reinforcement to be placed at every possible location where a curtain and face bar location intersect from the outer zone edge to the inner zone edge. Note than when ADAPT Wall Designer is selected as the design tool, vertical bars are always fill-in bars.

4.4 Design Parameters Tab

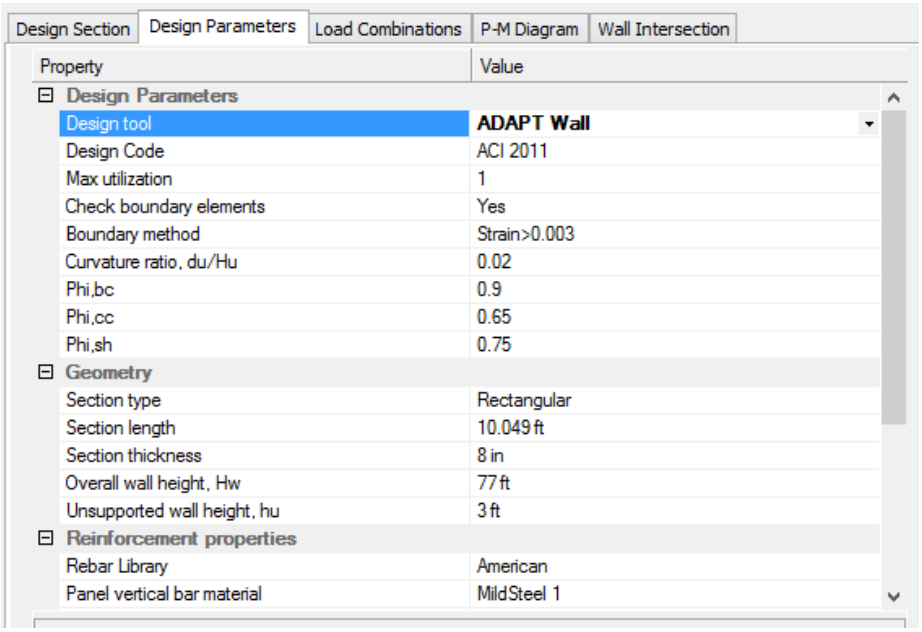


Figure 4-5 Design Parameters Input tab - ADAPT Wall Designer

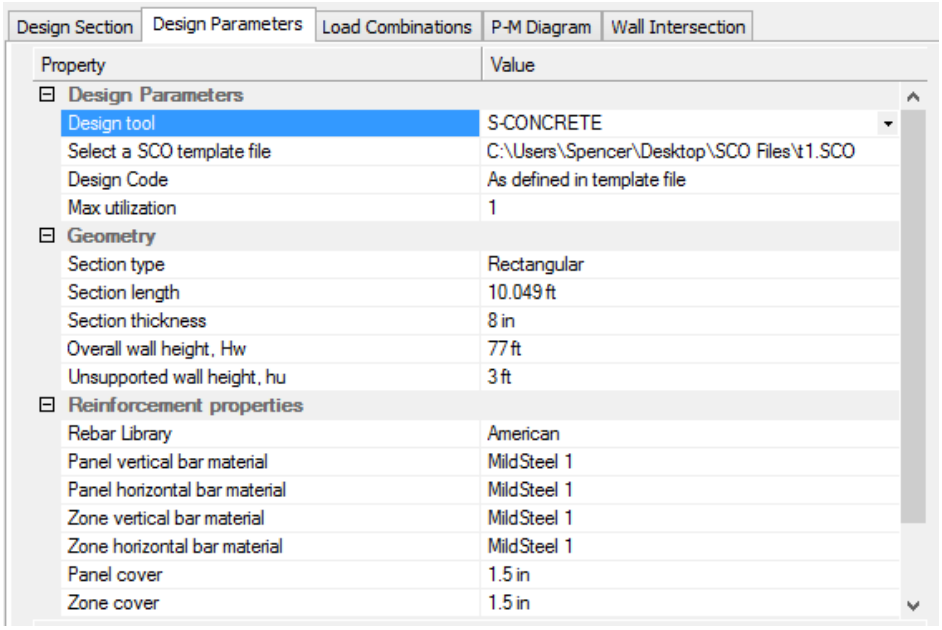


Figure 4-6 Design Parameters Input tab - S-CONCRETE

4.4.1 Design Parameters

Design tool – ADAPT Wall or S-CONCRETE

Select a SCO template file – When S-CONCRETE is selected as the design tool, this additional input parameter is required. A .SCO file needs to be saved from S-CONCRETE in order to define additional design parameters not assigned in ADAPT-Builder. Those parameters and properties defined in ADAPT-Builder which are shared with S-CONCRETE are mapped to S-CONCRETE when the application is run for design or code check OR when the application is launched independently. The additional design parameters are taken from the defined .SCO file. For example, the .SCO file contains parameters assigned the Section assignments. Parameters included in this input that are not defined in ADAPT-Builder are *Seismic Parameters, Slenderness Effects, Effective Section Properties and Design Constraints.*

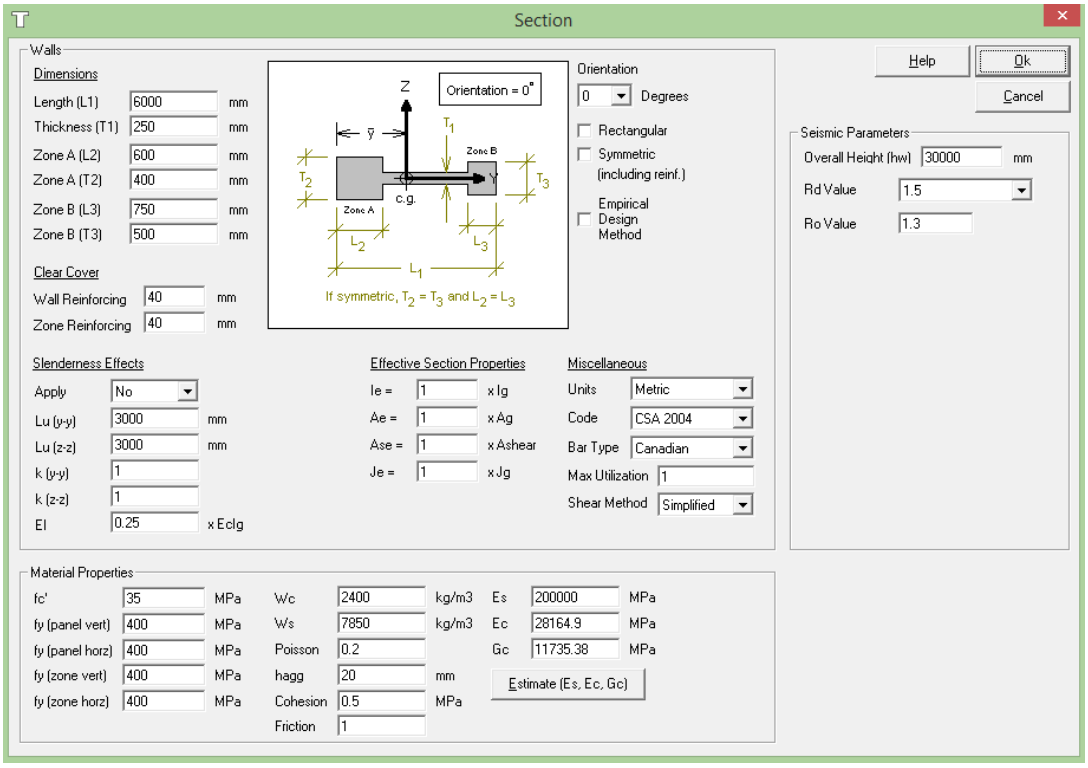


Figure 4-7 S-CONCRETE Section Parameters Input

Design code – When ADAPT Wall is selected, the only design code available is ACI318-2011. When S-CONCRETE is selected the design code used is that set in the .SCO file.

Max Utilization – Sets the maximum demand/capacity interaction ratio for V&T and N&M.

Check boundary elements – Only applies to ADAPT Wall. If set to YES, the program allows for zone reinforcement input and checks boundary reinforcement against code provisions. If set to NO, the program disables the use of zones in the wall design sections.

Boundary Method – Sets the ACI boundary zone method for checking of zones. The method is either strain or stress-controlled method.

Curvature ratio, du/Hu – limits the maximum curvature ratio of the section depth to wall height.

Phi,bc – Flexural strength reduction factor

Phi,cc – Compressive strength reduction factor

Phi,sh – Shear strength reduction factor

4.4.2 Geometry

Section type – Rectangular or I-Section. Rectangular only applies to ADAPT Wall set as the design tool. Both options are available when S-CONCRETE is set as the design tool. The design section graphical view changes according to what is being represented.

Section length – Design section length. Taken as the length of the wall that the design section is assigned to.

Section thickness – Design section thickness. When ADAPT Wall is selected, the section is the same for zones and panel. When S-CONCRETE is selected the value is the panel thickness.

Zone 1 length – When S-CONCRETE is used and I-shape is selected, the boundary elements can be of different length and thickness as the main wall panel. Applies to items e-g below also. Left zone length.

Zone 1 thickness – Left zone thickness.

Zone 2 length – Right zone length.

Zone 2 thickness – Right zone thickness.

Overall wall height, Hw – This is the total height of the wall stack. This is calculated by the program and can be overwritten.

Unsupported wall height, hu – This is defined as the wall segment height between slabs. The default is 3ft (3m). The user must override value to correct unsupported wall height.

4.4.3 Reinforcement Properties

Rebar library – Sets the rebar library from defined in Criteria>Preferred Reinforcement Size and Material. Value can be American, SI or MKS.

Panel vertical bar material – Sets the panel vertical reinforcement material assignment as defined in the Material pull-down menu.

Panel horizontal bar material – Sets the panel horizontal reinforcement material assignment as defined in the Material pull-down menu.

Zone vertical bar material – Sets the zone vertical reinforcement material assignment as defined in the Material pull-down menu.

Zone horizontal bar material – Sets the zone horizontal (ties) reinforcement material assignment as defined in the Material pull-down menu.

Cover – Only applies to ADAPT Wall. Sets the cover dimension for zone and panel.

Panel Cover – Only applies to S-CONCRETE. Sets the panel reinforcement cover dimension.

Zone Cover – Only applies to S-CONCRETE. Sets the Zone Cover dimension.

4.4.4 Design Constraints

These options are only available when ADAPT Wall is selected as the design tool. Design constraints for S-CONCRETE are defined in the .SCO file. If the user selects NO to freeze of zone and panel bars, the minimum and maximum zone and panel reinforcement settings are not active or shown. When YES is selected, the user can set the max and minimum range of bars sizes for the panel and zones. These only apply when design section/s are designed, not code checked.

Design constraints	
Freeze zone bar size	**No**
Zone 1 minimum bar size	#3
Zone 1 maximum bar size	#18
Zone 2 minimum bar size	#3
Zone 2 maximum bar size	#18
Freeze panel bar size	**No**
Panel minimum vertical bar size	#3
Panel minimum horizontal bar size	#3
Panel maximum vertical bar size	#18
Panel maximum horizontal bar size	#18

4.5 Load Combinations Tab

Load combination selection window – This window enables the user to select a custom group of combinations that will be considered for the design or code check process.

Select Combination – This allows the user to filter combination names that are shown in the combination window using entry values. When an entry is made, the options for Select All or Select None can be selected.

Load Case and Solution window – For each load case that is represented in the selected groups of combinations (e.g. dead, live, selfweight, Wind_P0, etc.) the program will list

the load case and applicable solution options. If the model has been globally analyzed for multiple usage cases (uncracked, cracked, etc.) the program will list each solution case to select from. This allows the user to assign reactions for wall design that stem from different usage cases that may represent varying degrees of assumed cracking for a given analysis. The user may also select the option for *Tributary* if the tributary load takedown tool was used to determine gravity loads in walls. This option only applies to gravity load cases. When both FEM and Tributary results exist, the user can envelope the solution reactions to be used for wall design. The 'G' denotes the FEM solution is based on a global analysis and 'L" denotes the FEM solution is based on a single-level analysis.

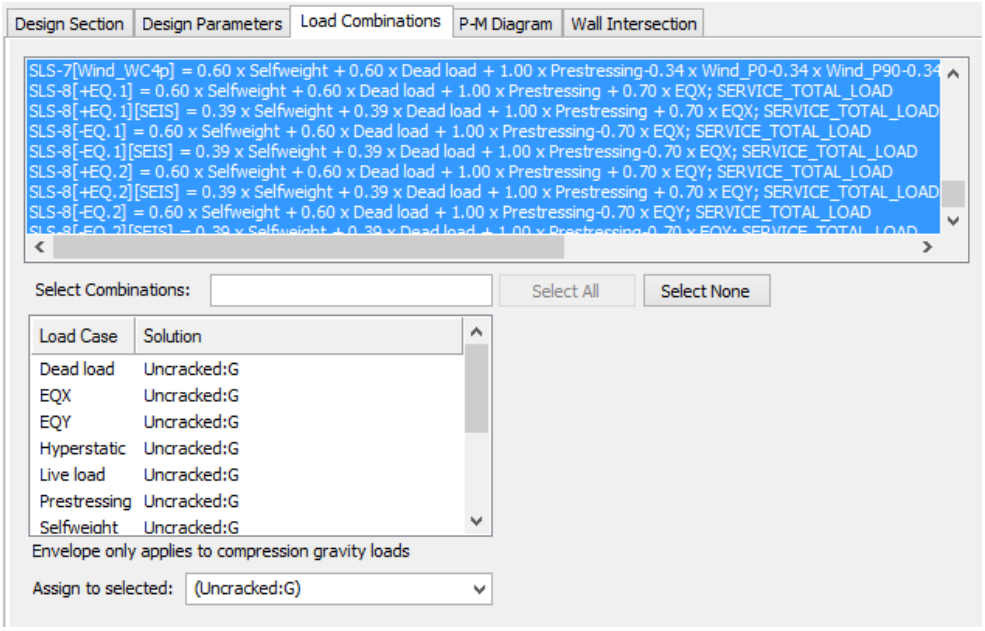


Figure 4-8 Load Combinations Selection tab

4.6 P-M Interaction Tab

Depending on which design tool is used, the program will produce axial-flexure interaction diagrams for the code checked or designed section. When S-CONCRETE is uses as the design tool, the available list of theta angles is comprehensive with multiple options. When ADAPT Wall is used, only the 90, and 270-degree diagrams are produced.

The option for *Nominal & Probable* is available when S-CONCRETE is used and includes additional graphs representing these additional diagrams.

When ADAPT Wall is used, the option for *Show Load Cases* becomes available and when uses will show data points for each processed load combination.

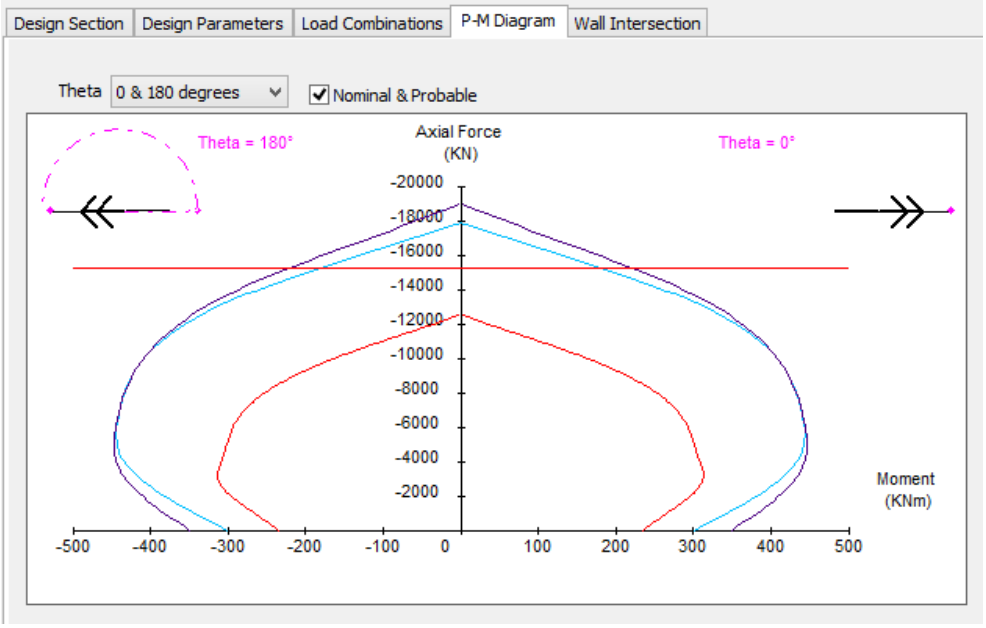


Figure 4-9 P-M Diagram for S-CONCRETE Selection

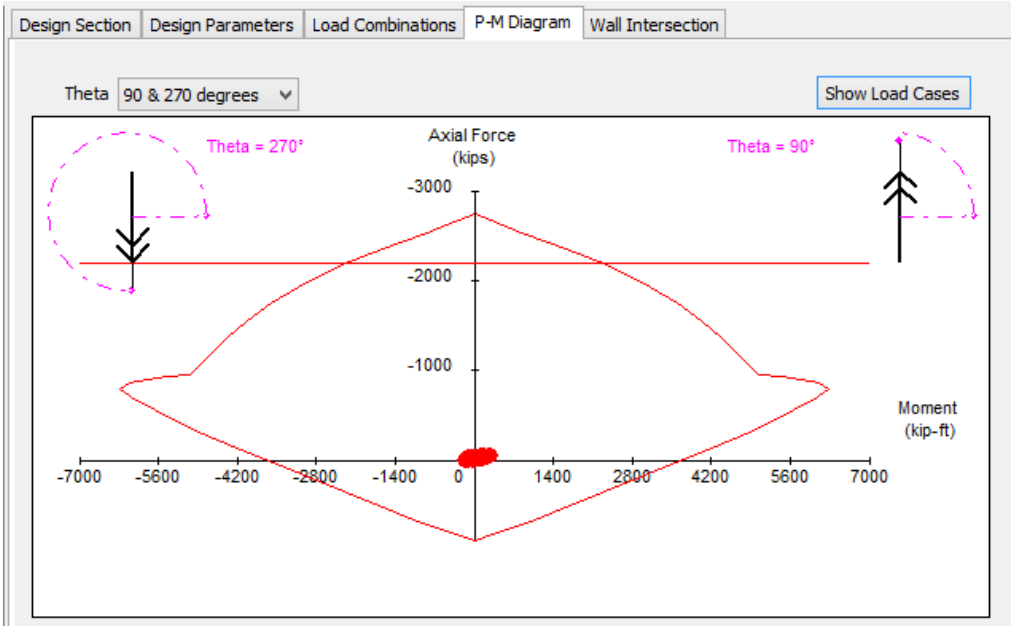


Figure 4-10 P-M Diagram for ADAPT Wall

4.7 Wall Intersection Tab

This feature is unique to ADAPT-Builder. The Wall Intersection feature allows a user to view regions or wall joints where end-zone reinforcement for more than 1 wall is overlapping in the same region. The feature is intended to allow the user to determine how bars are positioned in each zone and can be combined for detailed drawings for the joint.

Main Joint Drawing Window – This window shows a zoomed in view of the selected zone for the selected design section. The program shows representative vertical bars in each zone at the joint location, reference grids in the zone curtain direction and the total quantity, size and area of steel for each zone. The total joint data is summarized in the bottom left of the window.

Key Plan – Shows an overall view of the global wall layout in plan and highlights in red which design section is selected and which joint is shown in the Main Joint Drawing Window.

Design Section List – Depending on the selected design sections in the section list to the far left of the main window, the program populates the Design Section List for available joint locations. The user can select Zone 1 or Zone 2 of the selected section to view in the key plan and main window.

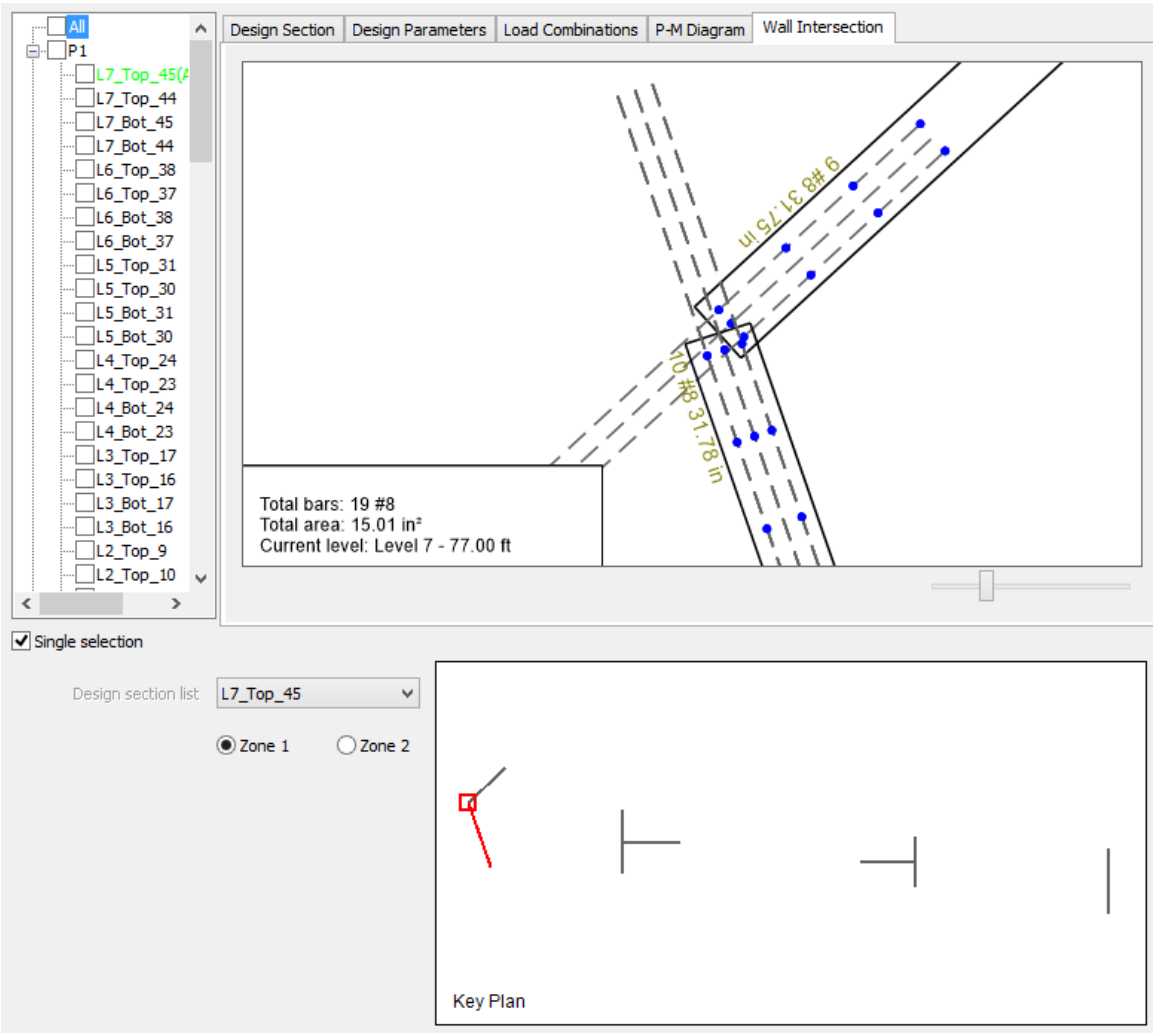
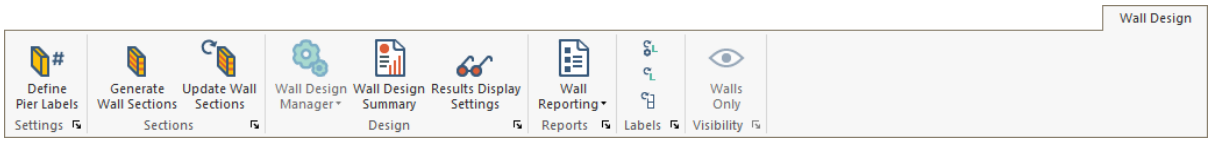


Figure 4-11 Wall Intersection Tab

4.8 Wall Design Options from the Wall Design Ribbon and Right-Click Selection

Additional options are available that pertain to the design of walls and design section results. The *Wall Design* ribbon contains multiple options for wall design as shown below.



Define Pier Labels – Opens the Pier Label dialog window.

Generate Wall Sections – Automatically generates wall design sections for walls assigned a pier label.

Update Wall Sections – After wall sections have been created, if a wall is stretched such that the length of the wall increases or decreases or if the wall thickness changes, this option will update the section data to reflect the latest length and thickness.

Wall Design Manager – Opens the *Wall Design Manager*

Wall Design Summary – Opens the HTML design summary page for the selected design section. Requires that the right-click be made on a design section, not wall.

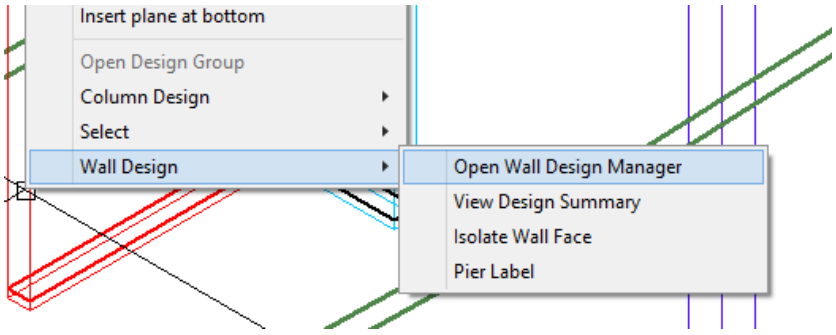
Result Display Settings – Opens the *Result Display Settings* dialog for graphical view selection and settings.

Wall Reporting – Selection of wall tabular, graphical and XLS wall reporting options.

Labels – See Section 2 of this document.

Walls Only – Isolates wall for the graphical view.

When you right-click on a wall, the options shown below are available.



Open Wall Design Manager – Opens the *Wall Design Manager*

Wall Design Summary – Opens the HTML design summary page for the selected design section. Requires that the right-click be made on a design section, not wall.

Isolate Wall Face – Isolates the selected wall stack in view and hides all other walls stacks in the model.

Pier Label - Opens the Pier Label dialog window.

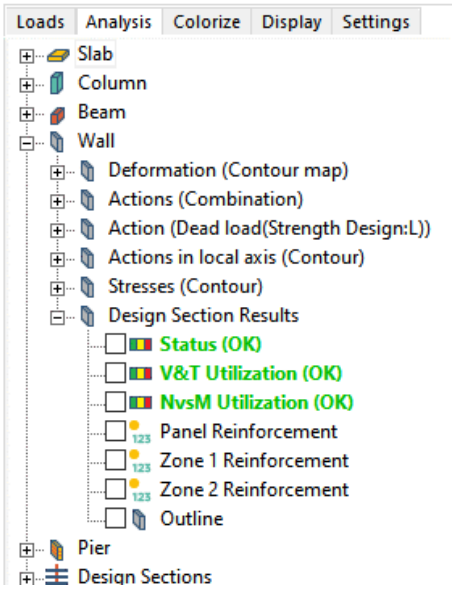
4.9 Wall Design Results

After wall design sections have been processed and updated for either design or code check, both tabular and graphical results are available for review. Some graphical viewing options are available for use prior to design or code check. These are mainly to view reinforcement currently assigned to the wall design sections. Each result option is described below.

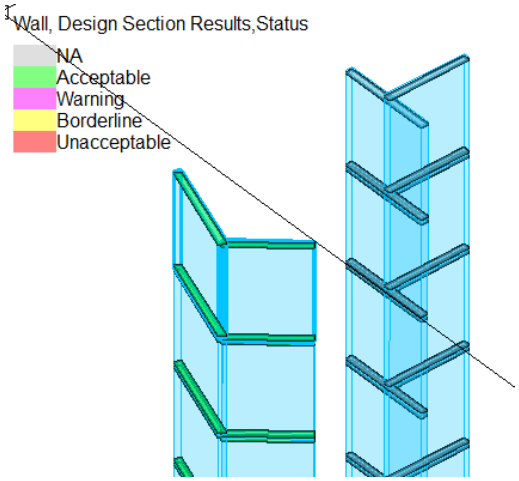
4.9.1 Result Display Settings – Analysis Tab

After wall design sections are generated, each section has default reinforcement designed for the section. If the section is designed or if the user makes modifications through the *Wall Design Manager,* the graphical representation of reinforcement displays the current rebar state for wall sections.

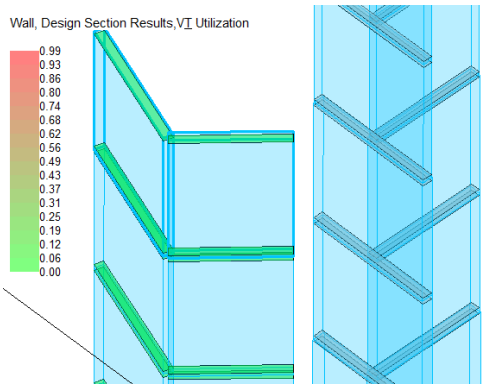
The *Analysis* tab of the *Result Display Settings* window includes new design section options under the *Walls* branch. Each option is defined below. Note that unless the wall design section is designed or code checked, the first 3 options will be reported as *NA.*



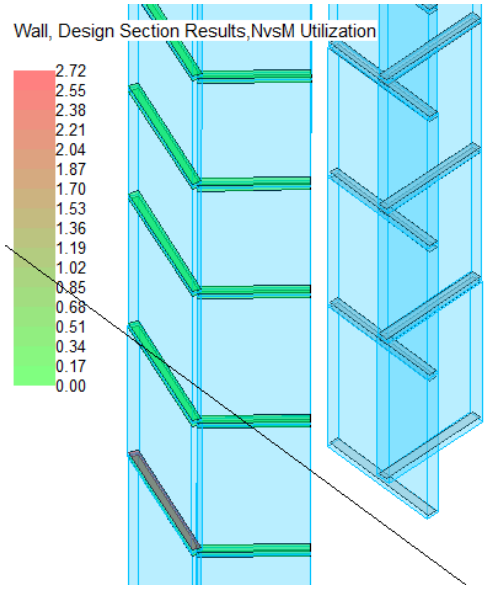
Status – Value can be NA, acceptable, warning, borderline, or unacceptable. *NA* indicates that the design section has not yet been designed. If either utilization check fails to meet the specified utilization setting, *unacceptable* is reported in the form of a red design section. Green represents *acceptable.* When code checked, if the section fails a specific detailing/spacing requirement the *warning* value will be reported with a magenta color. Any section indicated with yellow means that the section is *borderline.* This occurs when the section is within 5% of the maximum utilization factor set by the user.



V&T Utilization – Displays a gradient for utilization values of the sections with results for shear and torsion.



NvsM Utilization – Displays a gradient for utilization values of the sections with results for axial and flexure.



Panel Reinforcement – Displays panel reinforcement.

Zone 1 Reinforcement – Displays Zone 1 reinforcement.

Zone 2 Reinforcement – Displays Zone 2 reinforcement.

Outline – Shows outline of the design sections that have been generated.

The last four options described above do not require that the design section be code checked or designed and can be produced after creation of design sections. **FIGURE 4-12** shows Panel, Zone 1 and Zone 2 reinforcement for the isolated view of Wall Pier 1 – Leg 1. It is recommended to use this graphical tool in combination with front or side viewing and isolated view (described above) for best results.

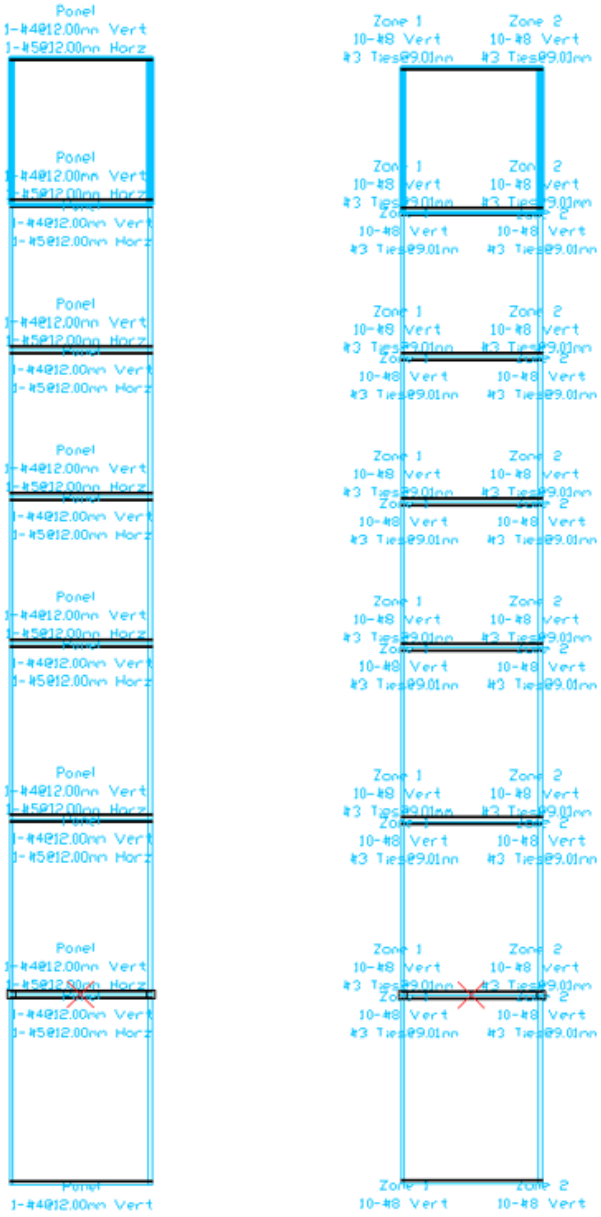


Figure 4-12 Panel and Zone Reinforcing

4.9.2 Result Display Settings – Display Tab

The *Result Display Settings→Result Display Settings* tab includes a new block, *Wall Design Sections* that contains additional options allowing the user to control how the informaton is presented graphically.

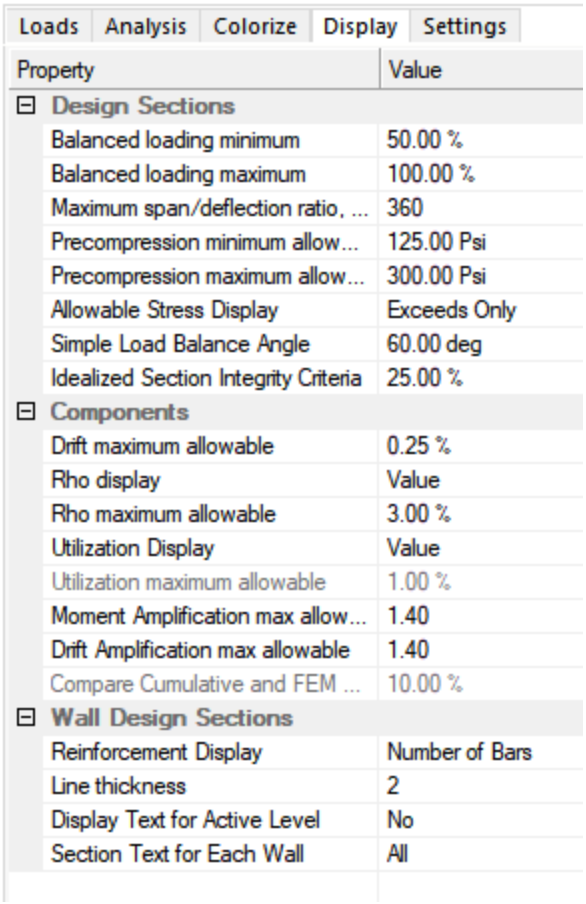


Figure 4-13 Result Display Settings Display Tab - Wall Design Section Options

Reinforcement Display – This value can either be set to *Number of Bars, area, rho, or all.* The application of this value is used for the display of the panel and/or zone reinforcement setting and shown in **FIGURE 4-12**. The value only applies to the walls in view and the location set to be viewed (zone or panel). **FIGURE 4-13** shows the result for 1 wall with *all* selected.

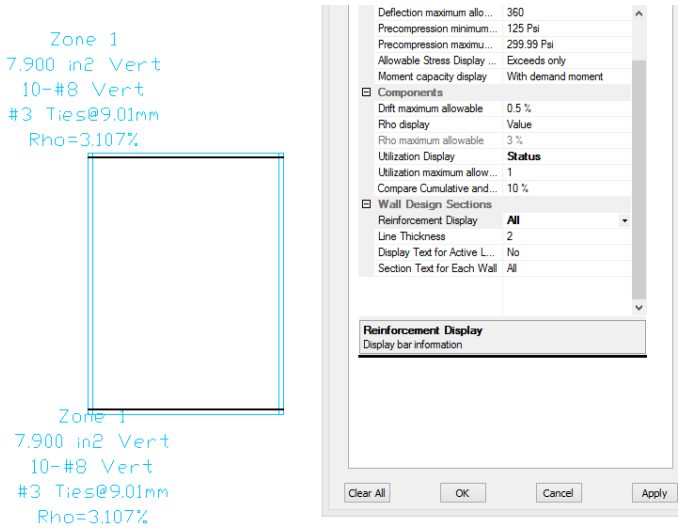


Figure 4-14 Reinforcement Display Selection

Line Thickness – Sets the line thickness for the design section outline.

Display Text for Active Level – The value for this option can be *Yes* or *No.* If *Yes,* is selected the program will display only the reinforcement information for the walls that reference the current active plane for the top of wall. The reinforcement will be shown for all walls in the model that are active in view and referenced from the current plane and for the panel or zones selected in *Result Display Settings.* This selection is useful when needing to view reinforcmeent for 1 plane only in a global top view. For example, **FIGURE 4-15** shows the plan view of Level 1 with panel reinforcement shown by area of steel.

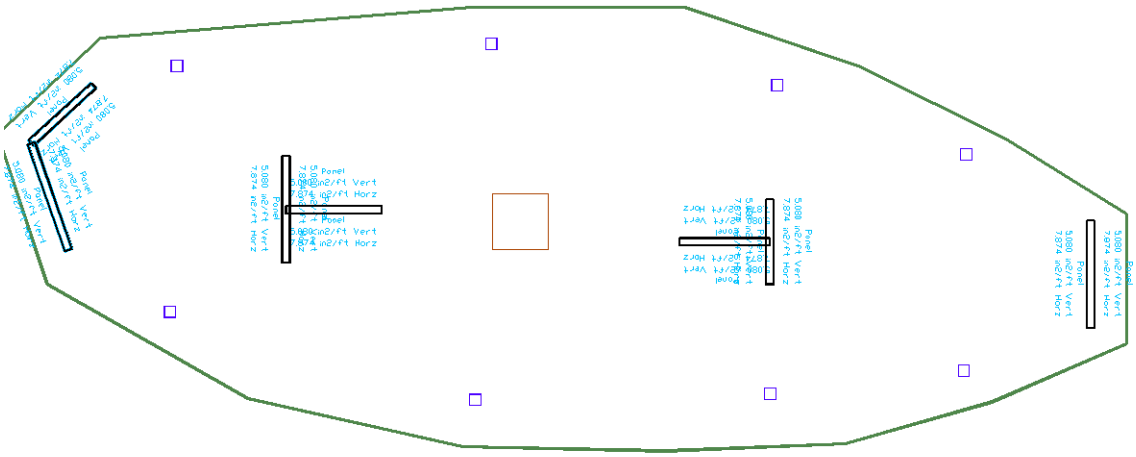


Figure 4-15 Plan View - Level 1 Panel Reinforcement

If *No* is selected, the program will show reinforcement for all walls in view and for the selected zones or panel.

Section Text for Each Wall – This option allows the user to filter which design section for walls in view are shown. The values that can be set are *all, top,* or *bottom.* If *all* is used, top and bottom sections for walls displaying reinforcement will be shown. If *top* is selected, only the top design sections of walls will be displayed. If *bottom* is selected only the bottom design sections of walls will be displayed.

4.9.3 Result Display Settings – Colorize Tab

ADAPT-Builder 2017 introduced a new feature located in *Result Display Settings* described as *Colorize*. This feature has its own tab and selectable checkboxes for application as shown in **FIGURE 4-16**.

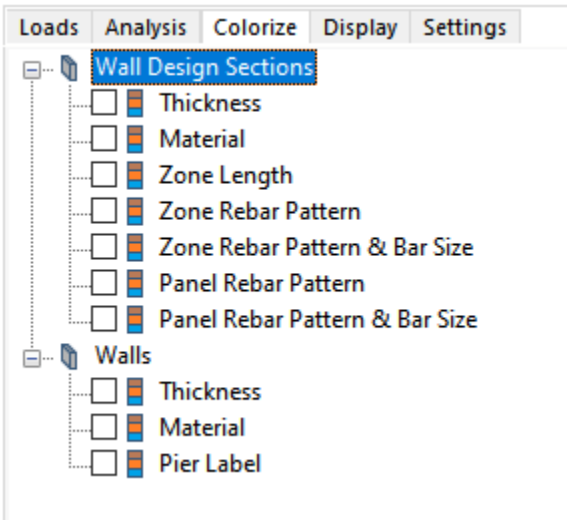
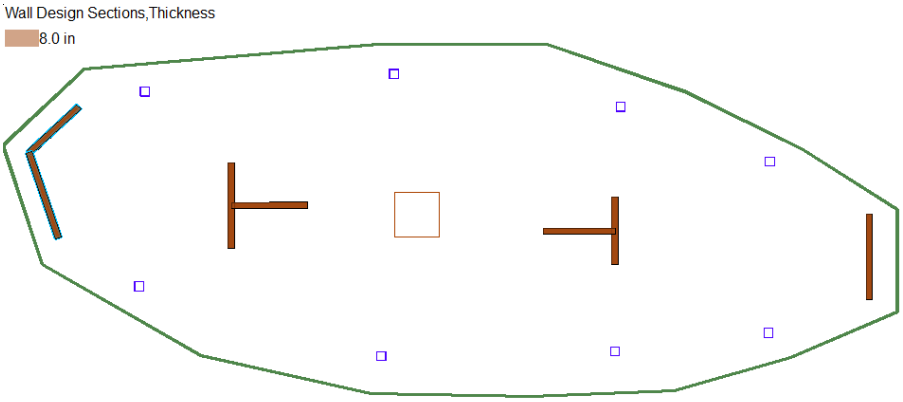


Figure 4-16 Colorize Tab in Result Display Settings

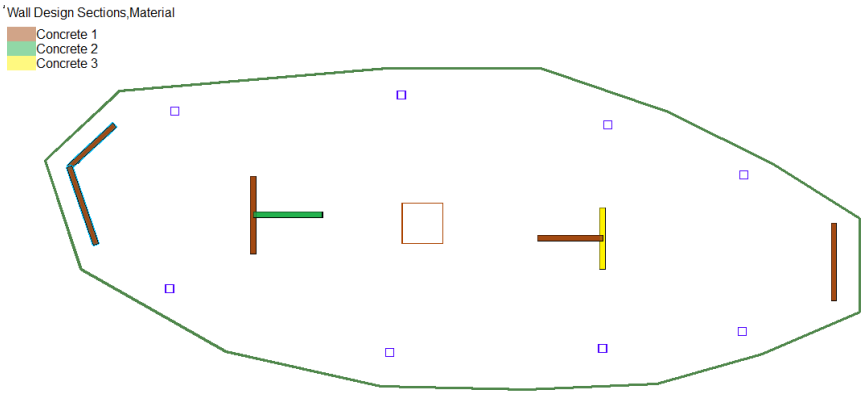
This feature has 2 sections containing predefined selectable properties that can be graphically colorized for quick and efficient comparisons. These sections include *Wall Design Sections* and *Walls.*

Wall Design Sections

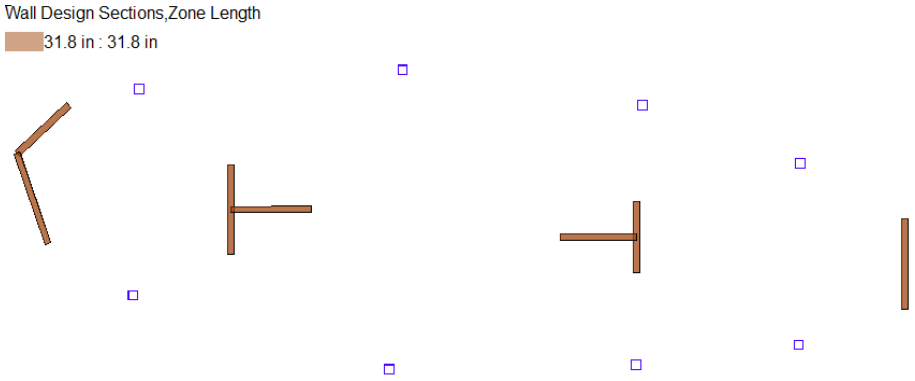
- **Thickness –** The program will identify each wall design section with the same thickness as a unique color.



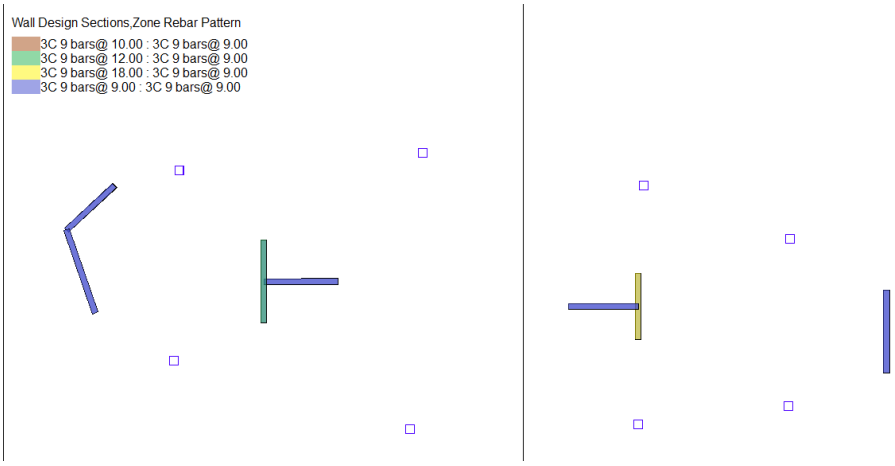
- **Material –** The program will identify each wall design section with the same material concrete material assignment as a unique color.



- **Zone Length –** The program will identify all wall design sections with same zone lengths at Zone 1 and Zone 2 ends and will assign a unique color to the design section. Zone assignment must be identical to be assigned to the same color group. For example, a wall with Zone 1 and Zone 2 having lengths of 30” at both ends would NOT be in the same group as a wall assigned with only Zone 1 having a length of 30” at and nothing assigned for Zone 2.

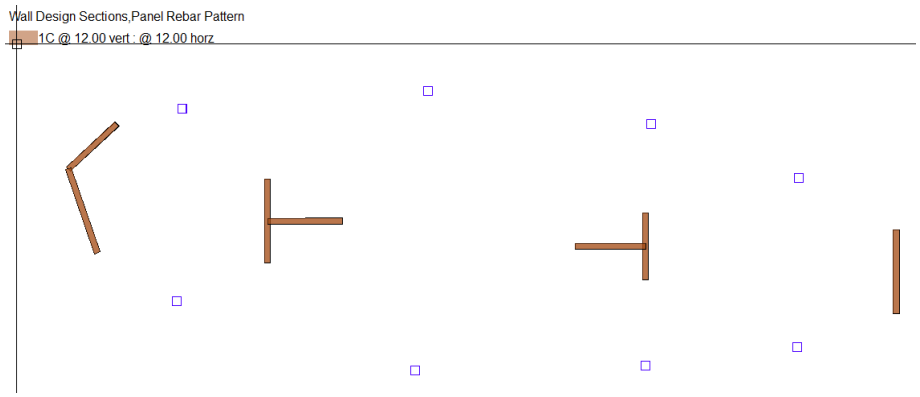


- **Zone Rebar Pattern –** The program will identify all wall design sections that have identical zone reinforcement patterns. This includes identical number of curtains, number of bars and spacing. Similar design sections must have similar number of zones assigned to the section. For example, a section with only 1 zone defined cannot be grouped with a section having 2 zones defined.

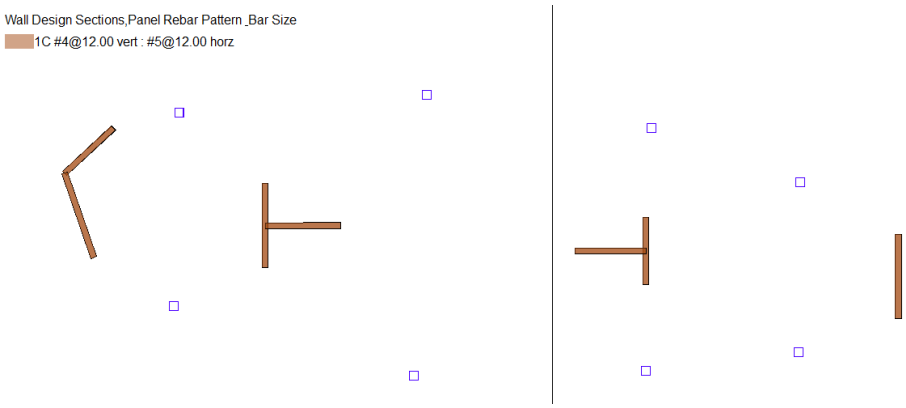


- **Zone Rebar Pattern & Bar Size –** The program will identify all wall design sections that have identical zone reinforcement patterns and bars size. This includes identical number of curtains, number of bars, bar size and spacing. Similar design sections must have similar number of zones assigned to the section. For example, a section with only 1 zone defined cannot be grouped with a section having 2 zones defined.

- **Panel Rebar Pattern –** The program will identify all wall design sections that have identical panel reinforcement patterns. This includes identical number of curtains and spacing for vertical and horizontal reinforcement.

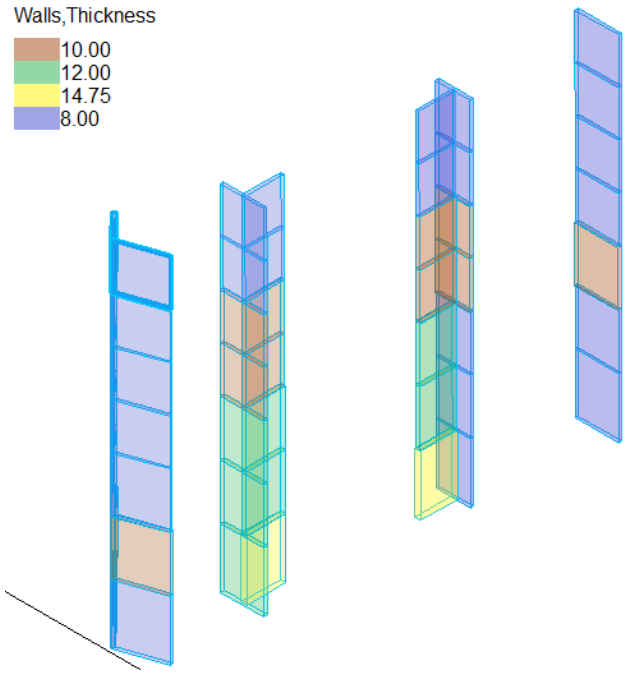


- **Panel Rebar Pattern & Bar Size –** The program will identify all wall design sections that have identical panel reinforcement patterns and bars size. This includes identical number of curtains, bar size and spacing for vertical and horizontal reinforcement.

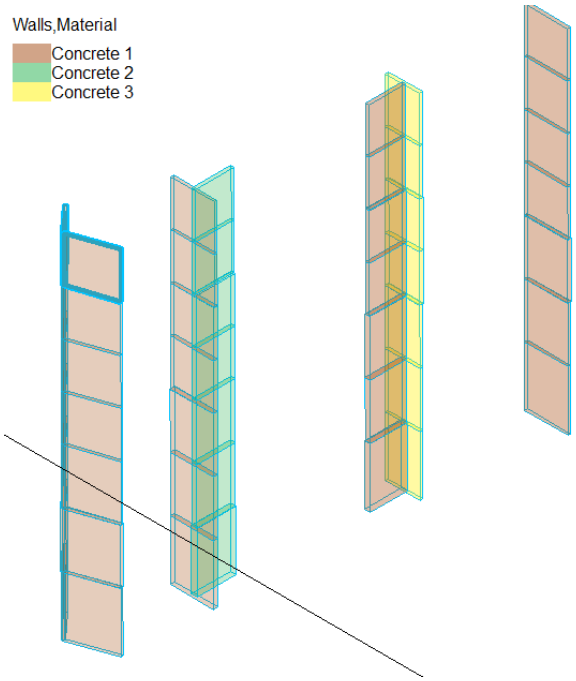


Walls

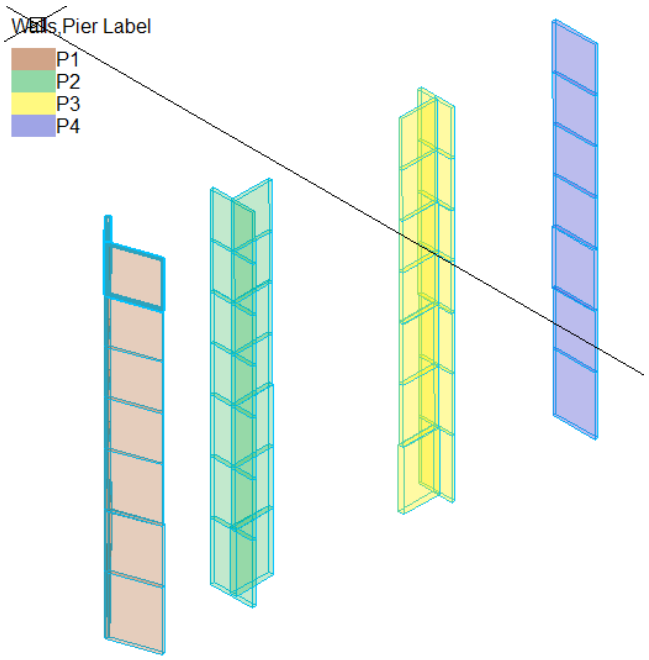
- **Thickness –** The program identifies walls of similar thickness.



- **Material –** The program identifies walls of similar material assignment for the wall concrete.



- **Pier Label –** The program identifies walls with the same Pier Label/Assignment.



4.10 Tabular Results

The program has several options for generating wall design section results. After execution of the design or code check for a single, selected group, or all wall design sections, input and result data are available in HTML format. HTML reports can be produced for a single design section at a time. From the *Wall Design Manager,* select the design section for consideration and select the *View Design Summary* button at the bottom-right of the dialog window. If multiple design sections are selected, only the HTML file for the first section in the list of selected sections will be produced. **FIGURE 4-19** shows an example of an HTLM file for a wall design section code checked using the ADAPT Wall tool. **FIGURE 4-20** shows an example of an HTLM file for a wall design section code checked using the S-CONCRETE tool. Note the files present information in a different way where the former is abbreviated as ADAPT Wall is more limited in information. You can also generate the report by right-clicking on a design section and selecting *Wall Design →View Design Summary.*

Similar wall design section result data can be combined into multi-page PDF report for all sections that have been code checked and/or designed. This is initiated from *Wall Reporting →PDF Reports →Wall Design Summary.* See **FIGURES 4-25** and **4-26**. The PDF format is also applied to a single page report with *Wall Intersection* layouts. This is a one-page report produced only for the active level. See **FIGURE 4-27**.

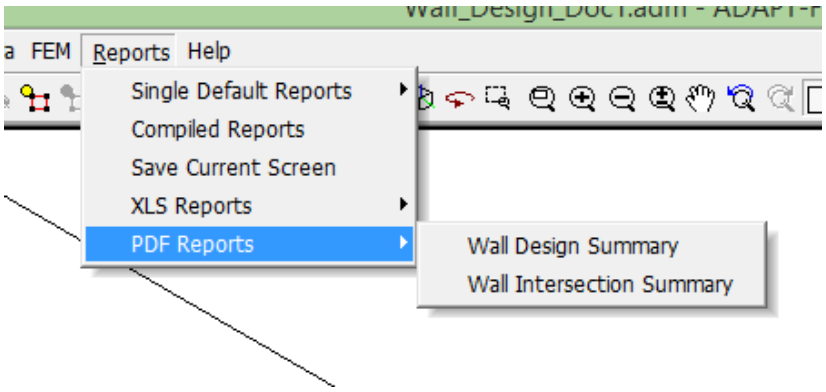


Figure 4-17 PDF Report Generation

The same report data found in the PDF Wall Design Summary Report is generated using the *Wall Reporting →XLS Reports →Wall Design Sections* option. This will launch Microsoft Excel® and open the .XLS report. **FIGURES 11-21** through **11-24** show examples of the *Project Info, Reinforcement, Geometry* and *Governing Loads* excel sheets that are generated with this reporting option.

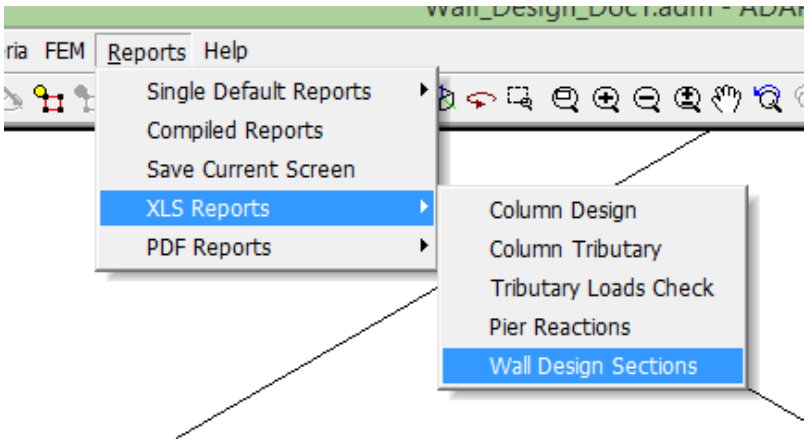


Figure 4-18 XLS Design Section Report Generation

ADAPT Wall Design

		Status:	Acceptable
Model:	wall_design_doc1	N vs M Util:	0.083
Pier Label:	P1		
Design Section:	L7_Top_45 (Level 7 - 77.00ft)	Shear Util:	0.089
		Maximum:	1.000
Design Code:	ACI2011		

Dimension

Length = 10.05 ft
Thickness = 8.00 in
Lu = 10.00 ft
Hw = 77.00 ft

Governing Loads

	Pu (kip)	Vu (kip)	Mu (kip-ft)	Utilization	GLC
Axial	-52.286	6.993	294.490	0.019	"ULS-5[-EQ.1][SEIS]"
Flexure	-52.286	6.993	294.490	0.083	"ULS-5[-EQ.1][SEIS]"
Shear	-44.448	16.502	193.880	0.089	"ULS-5[+EQ.2][SEIS]"

Shear Design

Fys = 60.000 ksi
Fyv = 60.000 ksi
Phi sh = 0.750
Phi Vc = 73.216 kip
Phi Vn = 185.363 kip
Phi Vnmax = 366.079 kip

Panel Bars	Smax (in)	Avmin (in2/ft)	Av req (in2/ft)	Av prov (in2/ft)	Status
#5 @ 12.00 horz	18.00	0.24	0.00	0.31	"O.K."
#4 @ 12.00 vert	18.00	0.12	0.00	0.20	"O.K."

Flexure and Axial Design

F'c = 4000.00 psi
phi b = 0.90
phi c = 0.65
Aused = 0.20 in2
n = 4.00
Aused/Aprov vert = 1.00

Panel bars used:		As in2	As (min) in2	CGS in	Curtains	Spacing in
Zone 1	9 - #8	7.11	0.96	13.23	3	9.00
Zone 2	9 - #8	7.11	0.96	13.23	3	9.00

PM Diagram status: "O.K."

Slenderness check

Lu(ft)	Lu/16	Status
10.00	7.50	"O.K."

Material statistics

Volume(yard3)	Steel ratio(%)	Steel Density
2.481	1.56	0.02

Boundary element check

Method: "Strain>0.003" Du/Hw = 0.02

Confinement 1(Compression @ Zone 1)

Type = Ordinary boundary element per ACI 21.9.6.5(a)
Length req. = 8.58 in
Length prov. = 28.75 in
Development Length vert. = 18.65 in
Development Length horz. = 8.37 in
Status = "O.K."

	Ties	Spacing(horz.) in	Spacing (vert.) in	Spacing(vert.) max in
Transv. (Zone1)	4 - #4	9.00	9.00	8.00
Transv. (Panel)	0 - #4	13.53	0.00	0.00
Transv. (Zone2)	0 - #4	9.00	0.00	0.00
Longitudinal	3 - #4	3.25	9.00	8.00
			Spacing check	"O.K."

Confinement 2(Compression @ Zone 2)

Type = Ordinary boundary element per ACI 21.9.6.5(a)
Length req. = 8.82 in
Length prov. = 28.75 in
Development Length vert. = 18.65 in
Development Length horz. = 8.37 in
Status = "O.K."

	Ties	Spacing(horz.) in	Spacing (vert.) in	Spacing(vert.) max in
Transv. (Zone1)	4 - #4	9.00	9.00	8.00
Transv. (Panel)	0 - #4	13.53	0.00	0.00
Transv. (Zone2)	0 - #4	9.00	0.00	0.00
Longitudinal	3 - #4	3.25	9.00	8.00
			Spacing check	"O.K."

Figure 4-19 ADAPT Wall HTLM Design Section Results

S-CONCRETE 2017.1.4 (c) S-FRAME Software Inc.

File Name: C:\ ... esign_Doc1\WallDesign\Temp\L7_Top_44.sco

Summary

Status	Warning
Maximum	1.000
V (shear) Util	0.765
N vs M Util	0.544

Section Name
Concrete Section

Consultant
ADAPT

Canadian Building Standards

CSA Standard A23.3-04, "Design of Concrete Structures"

CSA Standard A23.1-04, "Concrete Materials and Methods of Concrete Construction"

Design Aids, Manuals, and Handbooks

"Concrete Design Handbook", Cement Association of Canada, 3rd Edition, 2006

"Prestressed Concrete Structures", Collins and Mitchell, Prentice Hall Inc., 1991 (MCFT)

Section Dimensions

I-Shape

L1 = 2292 in

T1 = 203 in

Material Properties

fc' = 28 psi

fy (panel vert) = 413.7 ksi

fy (panel horz) = 413.7 ksi

fy (zone vert) = 413.7 ksi

fy (zone horz) = 413.7 ksi

Wc = 153 pcf

Ws = 7850 pcf

Poisson's Ratio = 0.2

hagg = 1 in

Es = 206844 ksi

Ec = 24821 ksi

Gc = 10342 ksi

fr = 2.36 psi

Gross Properties

Zbar = 0 in

Ybar = 0 in

Ag = 465276 sq.in.

Ig (y-y) = 1597.8xE6 in4

Ig (z-z) = 203685xE6 in4

Ashear (Y) = 387730 sq.in.

Ashear (Z) = 387730 sq.in.

Jg = 6034.5xE6 in4

Effective Properties

Ae = 465276 sq.in.

Ie (y-y) = 1597.8xE6 in4

Ie (z-z) = 203685xE6 in4

Ase (Y) = 387730 sq.in.

Ase (Z) = 387730 sq.in.

Je = 6034.5xE6 in4

Overstrength Factors

Normal (y-y) = 1.5

Normal (z-z) = 1.5

Rd = 1.5, Ro = 1.3

Quantities (approx.)

Concrete = 70 lb/ft

Steel = 105.1 lb/ft

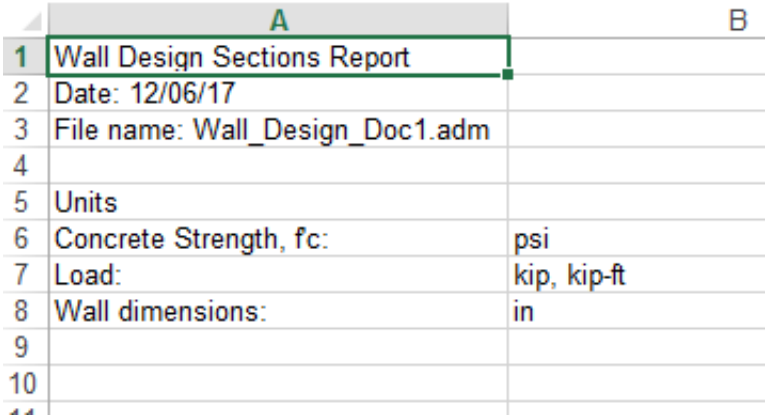
Primary = 82.0 lb/ft

Secondary = 23.0 lb/ft

Factored Design Loads

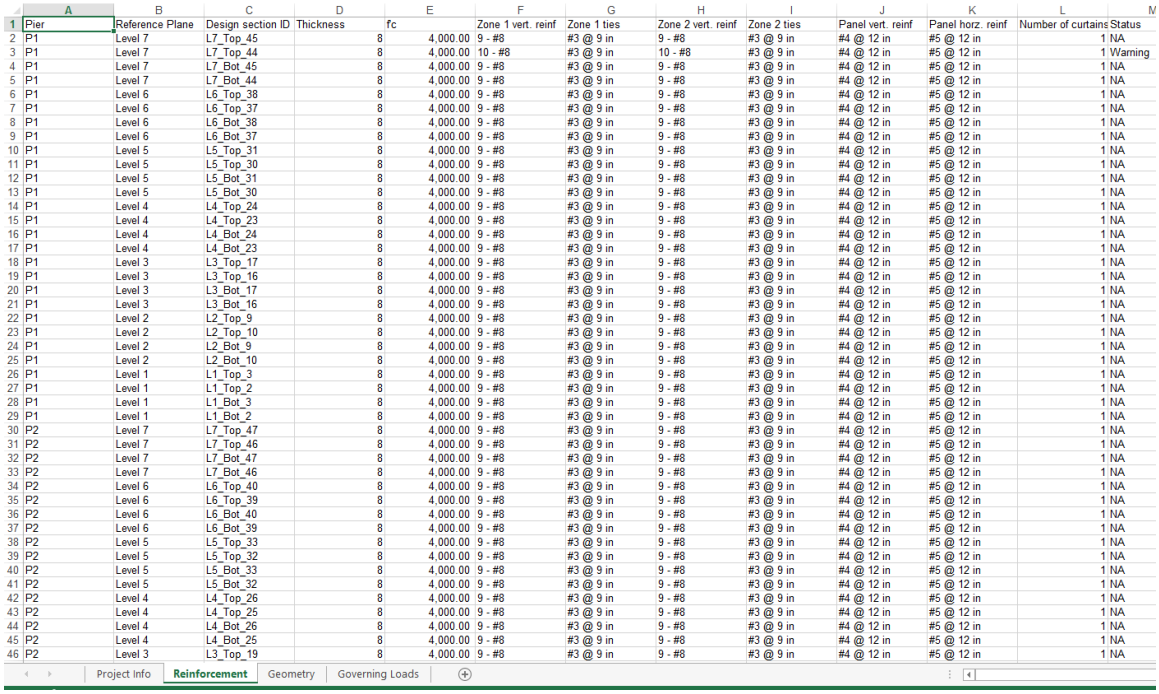
Load Case/Combo	N (kips)	T (k*ft)	Vz (kips)	My (k*ft)	Vy (kips)	Mz (k*ft)	Mres (k*ft)	Theta
1 (O)	-57.2	3.4	7.3	11.2	-26.0	-55.2	56.3	259°
2 (O)	-76.7	4.8	10.2	15.7	-36.3	-77.2	78.7	259°
3 (O)	-100.1	6.5	13.7	21.0	-48.8	-103.5	105.6	259°
4 (O)	-93.4	5.8	12.2	18.7	-43.4	-92.3	94.2	259°
5 (O)	-133.4	8.7	18.4	28.2	-65.6	-139.2	142.0	259°
6 (O)	-17.7	-18.0	-37.5	-58.3	-46.4	114.7	128.7	63°
7 (O)	-37.0	-16.8	-34.9	-54.5	-55.4	95.6	110.0	60°
8 (O)	-101.1	21.9	26.3	40.6	-23.9	-80.4	90.0	243°
9 (O)	-120.5	23.0	28.8	44.4	-32.9	-99.5	109.0	246°
10 (O)	-209.2	32.6	68.4	105.6	-63.5	-348.0	363.7	253°
11 (O)	-228.5	33.8	70.9	109.5	-72.5	-367.1	383.1	253°
12 (O)	-125.7	-7.3	4.7	6.7	-86.0	-152.9	153.1	267°
13 (O)	-145.1	-6.1	7.2	10.6	-95.0	-172.0	172.4	266°
14 (O)	35.7	-21.6	-45.0	-69.9	-19.4	172.1	185.7	68°
15 (O)	55.0	-22.8	-47.6	-73.8	-10.4	191.2	204.9	69°
16 (O)	-47.8	18.3	18.7	29.0	3.1	-23.1	37.0	219°
17 (O)	-28.4	17.1	16.2	25.1	12.1	-3.9	25.4	189°
18 (O)	-155.8	29.0	60.8	94.0	-36.4	-290.7	305.5	252°
19 (O)	-136.5	27.8	58.2	90.1	-27.5	-271.6	286.1	252°
20 (O)	-72.4	-10.9	-2.9	-4.9	-58.9	-95.6	95.7	273°
21 (O)	-53.0	-12.1	-5.5	-8.7	-50.0	-76.5	77.0	277°

Figure 4-20 S-CONCRETE HTLM Wall Design Report



	A	B
1	Wall Design Sections Report	
2	Date: 12/06/17	
3	File name: Wall_Design_Doc1.adm	
4		
5	Units	
6	Concrete Strength, f'c:	psi
7	Load:	kip, kip-ft
8	Wall dimensions:	in
9		
10		

Figure 4-21 Project Information XLS Sheet



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Pier	Reference Plane	Design section ID	Thickness	f'c	Zone 1 vert. reinf	Zone 1 ties	Zone 2 vert. reinf	Zone 2 ties	Panel vert. reinf	Panel horz. reinf	Number of curtains	Status
2	P1	Level 7	L7_Top_45	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
3	P1	Level 7	L7_Top_44	8	4,000.00	10 - #8	#3 @ 9 in	10 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	Warning
4	P1	Level 7	L7_Bot_45	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
5	P1	Level 7	L7_Bot_44	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
6	P1	Level 6	L6_Top_38	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
7	P1	Level 6	L6_Top_37	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
8	P1	Level 6	L6_Bot_38	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
9	P1	Level 6	L6_Bot_37	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
10	P1	Level 5	L5_Top_31	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
11	P1	Level 5	L5_Top_30	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
12	P1	Level 5	L5_Bot_31	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
13	P1	Level 5	L5_Bot_30	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
14	P1	Level 4	L4_Top_24	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
15	P1	Level 4	L4_Top_23	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
16	P1	Level 4	L4_Bot_24	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
17	P1	Level 4	L4_Bot_23	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
18	P1	Level 3	L3_Top_17	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
19	P1	Level 3	L3_Top_16	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
20	P1	Level 3	L3_Bot_17	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
21	P1	Level 3	L3_Bot_16	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
22	P1	Level 2	L2_Top_9	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
23	P1	Level 2	L2_Top_10	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
24	P1	Level 2	L2_Bot_9	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
25	P1	Level 2	L2_Bot_10	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
26	P1	Level 1	L1_Top_3	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
27	P1	Level 1	L1_Top_2	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
28	P1	Level 1	L1_Bot_3	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
29	P1	Level 1	L1_Bot_2	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
30	P2	Level 7	L7_Top_47	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
31	P2	Level 7	L7_Top_46	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
32	P2	Level 7	L7_Bot_47	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
33	P2	Level 7	L7_Bot_46	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
34	P2	Level 6	L6_Top_40	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
35	P2	Level 6	L6_Top_39	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
36	P2	Level 6	L6_Bot_40	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
37	P2	Level 6	L6_Bot_39	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
38	P2	Level 5	L5_Top_33	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
39	P2	Level 5	L5_Top_32	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
40	P2	Level 5	L5_Bot_33	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
41	P2	Level 5	L5_Bot_32	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
42	P2	Level 4	L4_Top_26	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
43	P2	Level 4	L4_Top_25	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
44	P2	Level 4	L4_Bot_26	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
45	P2	Level 4	L4_Bot_25	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA
46	P2	Level 3	L3_Top_19	8	4,000.00	9 - #8	#3 @ 9 in	9 - #8	#3 @ 9 in	#4 @ 12 in	#5 @ 12 in	1	NA

Project Info | Reinforcement | Geometry | Governing Loads

Figure 4-22 Reinforcing XLS Sheet

	A	B	C	D	E	F	G	H	I	J	K
1	Pier	Reference plane	Design Section	Wall ID	Section type	Length	Thickness	Zone 1 length	Zone 1 width	Zone 2 length	Zone 2 width
2	P1	Level 7	L7_Top_45	45	Rectangular	120.5897729	8	NA	NA	NA	NA
3	P1	Level 7	L7_Top_44	44	Rectangular	90.20342776	8	NA	NA	NA	NA
4	P1	Level 7	L7_Bot_45	45	Rectangular	120.5897729	8	NA	NA	NA	NA
5	P1	Level 7	L7_Bot_44	44	Rectangular	90.20342776	8	NA	NA	NA	NA
6	P1	Level 6	L6_Top_38	38	Rectangular	120.5897729	8	NA	NA	NA	NA
7	P1	Level 6	L6_Top_37	37	Rectangular	90.20342776	8	NA	NA	NA	NA
8	P1	Level 6	L6_Bot_38	38	Rectangular	120.5897729	8	NA	NA	NA	NA
9	P1	Level 6	L6_Bot_37	37	Rectangular	90.20342776	8	NA	NA	NA	NA
10	P1	Level 5	L5_Top_31	31	Rectangular	120.5897729	8	NA	NA	NA	NA
11	P1	Level 5	L5_Top_30	30	Rectangular	90.20342776	8	NA	NA	NA	NA
12	P1	Level 5	L5_Bot_31	31	Rectangular	120.5897729	8	NA	NA	NA	NA
13	P1	Level 5	L5_Bot_30	30	Rectangular	90.20342776	8	NA	NA	NA	NA
14	P1	Level 4	L4_Top_24	24	Rectangular	120.5897729	8	NA	NA	NA	NA
15	P1	Level 4	L4_Top_23	23	Rectangular	90.20342776	8	NA	NA	NA	NA
16	P1	Level 4	L4_Bot_24	24	Rectangular	120.5897729	8	NA	NA	NA	NA
17	P1	Level 4	L4_Bot_23	23	Rectangular	90.20342776	8	NA	NA	NA	NA
18	P1	Level 3	L3_Top_17	17	Rectangular	120.5897729	8	NA	NA	NA	NA
19	P1	Level 3	L3_Top_16	16	Rectangular	90.20342776	8	NA	NA	NA	NA
20	P1	Level 3	L3_Bot_17	17	Rectangular	120.5897729	8	NA	NA	NA	NA
21	P1	Level 3	L3_Bot_16	16	Rectangular	90.20342776	8	NA	NA	NA	NA
22	P1	Level 2	L2_Top_9	9	Rectangular	90.20342776	8	NA	NA	NA	NA
23	P1	Level 2	L2_Top_10	10	Rectangular	120.5897729	8	NA	NA	NA	NA
24	P1	Level 2	L2_Bot_9	9	Rectangular	90.20342776	8	NA	NA	NA	NA
25	P1	Level 2	L2_Bot_10	10	Rectangular	120.5897729	8	NA	NA	NA	NA
26	P1	Level 1	L1_Top_3	3	Rectangular	120.5897729	8	NA	NA	NA	NA
27	P1	Level 1	L1_Top_2	2	Rectangular	90.20342776	8	NA	NA	NA	NA
28	P1	Level 1	L1_Bot_3	3	Rectangular	120.5897729	8	NA	NA	NA	NA
29	P1	Level 1	L1_Bot_2	2	Rectangular	90.20342776	8	NA	NA	NA	NA
30	P2	Level 7	L7_Top_47	47	Rectangular	101.7995114	8	NA	NA	NA	NA
31	P2	Level 7	L7_Top_46	46	Rectangular	114.0699492	8	NA	NA	NA	NA
32	P2	Level 7	L7_Bot_47	47	Rectangular	101.7995114	8	NA	NA	NA	NA
33	P2	Level 7	L7_Bot_46	46	Rectangular	114.0699492	8	NA	NA	NA	NA
34	P2	Level 6	L6_Top_40	40	Rectangular	101.7995114	8	NA	NA	NA	NA
35	P2	Level 6	L6_Top_39	39	Rectangular	114.0699492	8	NA	NA	NA	NA
36	P2	Level 6	L6_Bot_40	40	Rectangular	101.7995114	8	NA	NA	NA	NA
37	P2	Level 6	L6_Bot_39	39	Rectangular	114.0699492	8	NA	NA	NA	NA
38	P2	Level 5	L5_Top_33	33	Rectangular	101.7995114	8	NA	NA	NA	NA
39	P2	Level 5	L5_Top_32	32	Rectangular	114.0699492	8	NA	NA	NA	NA
40	P2	Level 5	L5_Bot_33	33	Rectangular	101.7995114	8	NA	NA	NA	NA
41	P2	Level 5	L5_Bot_32	32	Rectangular	114.0699492	8	NA	NA	NA	NA
42	P2	Level 4	L4_Top_26	26	Rectangular	101.7995114	8	NA	NA	NA	NA
43	P2	Level 4	L4_Top_25	25	Rectangular	114.0699492	8	NA	NA	NA	NA
44	P2	Level 4	L4_Bot_26	26	Rectangular	101.7995114	8	NA	NA	NA	NA
45	P2	Level 4	L4_Bot_25	25	Rectangular	114.0699492	8	NA	NA	NA	NA
46	P2	Level 3	L3_Top_19	19	Rectangular	101.7995114	8	NA	NA	NA	NA

Project Info | Reinforcement | **Geometry** | Governing Loads

Figure 4-23 Geometry XLS Report

	A	B	C	D	E	F	G	H	I	J	K	L
1	Pier	Reference Plane	Design section ID	Axial Utilization	GLC	Pu	Mu	Vu	Moment Utilization	GLC	Pu	Mu
2	P1	Level 7	L7_Top_45	0.019476405	"ULS-5[-EQ.1][SEI	-52.286	294.49	6.993	0.082753318	"ULS-5[-EQ.1][SEI	-52.286	294.49
3	P1	Level 7	L7_Top_44	0.024089917	"ULS-5[-EQ.1][SEI	-51.376	-270.79	-16.293	0.112373385	"ULS-5[-EQ.1][SEI	-51.376	-270.79
4	P1	Level 7	L7_Bot_45	0.022173287	"ULS-5[-EQ.1][SEI	-59.526	193.11	-12.679	0.066035936	"ULS-5[+EQ.1][SE	-36.753	-231.07
5	P1	Level 7	L7_Bot_44	0.026950641	"ULS-5[-EQ.1][SEI	-57.477	-72.444	22.039	0.068939039	"ULS-5[+EQ.1][SE	-8.842	158.36
6	P1	Level 6	L6_Top_38	0.047992208	"ULS-5[-EQ.1][SEI	-128.84	542.42	34.141	0.140803972	"ULS-5[-EQ.1][SEI	-128.84	542.42
7	P1	Level 6	L6_Top_37	0.057095391	"ULS-5[-EQ.1][SEI	-121.77	-434.62	-46.047	0.167801584	"ULS-5[-EQ.1][SEI	-121.77	-434.62
8	P1	Level 6	L6_Bot_38	0.054214779	"ULS-5[-EQ.1][SEI	-145.54	158.07	-32.63	0.060612881	"ULS-5[+EQ.1][SE	-65.3	-218.73
9	P1	Level 6	L6_Bot_37	0.055518499	"ULS-5[-EQ.1][SEI	-118.4	-10.012	44.628	0.063100174	"ULS-5[-EQ.2][SEI	-45.949	151.15
10	P1	Level 5	L5_Top_31	0.082177299	"ULS-5[-EQ.1][SEI	-220.4	489.94	46.143	0.118538586	"ULS-7[+EQ.1][SE	21.252	-386.54
11	P1	Level 5	L5_Top_30	0.084406369	"ULS-5[-EQ.1][SEI	-179.94	-406.91	-57.752	0.154221239	"ULS-7[+EQ.1][SE	43.301	332.49
12	P1	Level 5	L5_Bot_31	0.089240795	"ULS-5[-EQ.1][SEI	-239.37	-27.296	-44.849	0.11614957	"ULS-7[+EQ.2][SE	20.45	-379.3
13	P1	Level 5	L5_Bot_30	0.090885476	"ULS-5[+EQ.2][SE	-193.78	-125.24	-24.883	0.09953723	"ULS-5[-EQ.2][SEI	-18.571	231.02
14	P1	Level 4	L4_Top_24	0.11890891	"ULS-5[-EQ.2][SEI	-317.53	99.865	-91.913	0.067535726	"ULS-5[-EQ.1][SEI	-316.72	301.73
15	P1	Level 4	L4_Top_23	0.127737389	"ULS-5[+EQ.2][SE	-271.99	-13.517	42.124	0.105021288	"ULS-7[+EQ.1][SE	51.21	223.17
16	P1	Level 4	L4_Bot_24	0.143619661	"ULS-5[-EQ.2][SEI	-383.59	729.12	92.523	0.253357511	"ULS-7[+EQ.2][SE	98.314	-732.34
17	P1	Level 4	L4_Bot_23	0.18038452	"ULS-7[-EQ.2][SEI	141.67	294.13	56.141	0.156201542	"ULS-7[-EQ.2][SEI	141.67	294.13
18	P1	Level 3	L3_Top_17	0.192128368	"ULS-7[+EQ.2][SE	148.85	-214.22	129.18	0.081574864	"ULS-7[+EQ.2][SE	148.85	-214.22
19	P1	Level 3	L3_Top_16	0.257957038	"ULS-7[-EQ.2][SEI	201.05	-48.378	-68.898	0.041919793	"ULS-5[-EQ.2][SEI	83.354	-84.907
20	P1	Level 3	L3_Bot_17	0.299469752	"ULS-7[+EQ.2][SE	232.19	-1326.6	-128.69	0.577645461	"ULS-7[+EQ.2][SE	232.19	-1326.6
21	P1	Level 3	L3_Bot_16	0.367678662	"ULS-7[-EQ.2][SEI	286.78	446.57	68.854	0.331240205	"ULS-7[+EQ.1][SE	32.382	-716.41
22	P1	Level 2	L2_Top_9	0.475754597	"ULS-7[-EQ.2][SEI	369.99	22.69	-77.102	0.191192697	"ULS-7[+EQ.1][SE	39.687	-408.67
23	P1	Level 2	L2_Top_10	0.400181007	"ULS-7[+EQ.2][SE	307.29	-705.78	147.74	0.359029921	"ULS-7[+EQ.2][SE	307.29	-705.78
24	P1	Level 2	L2_Bot_9	0.604049015	"ULS-7[-EQ.2][SEI	469.59	562.68	76.808	0.583609236	"ULS-7[-EQ.2][SEI	469.59	562.68
25	P1	Level 2	L2_Bot_10	0.527213873	"ULS-7[+EQ.2][SE	404.84	-1970.4	-147.4	1.250993459	"ULS-7[+EQ.2][SE	404.84	-1970.4
26	P1	Level 1	L1_Top_3	0.6442582	"ULS-7[+EQ.2][SE	494.71	-1331	154.95	1.095486754	"ULS-7[+EQ.2][SE	494.71	-1331
27	P1	Level 1	L1_Top_2	0.737560536	"ULS-7[-EQ.2][SEI	566.36	114.33	-76.778	0.448665035	"ULS-7[+EQ.1][SE	6.633	-986.61
28	P1	Level 1	L1_Bot_3	0.781876053	"ULS-7[+EQ.2][SE	600.39	-2795.2	-154.62	3.581404851	"ULS-7[+EQ.2][SE	600.39	-2795.2
29	P1	Level 1	L1_Bot_2	0.876700763	"ULS-7[-EQ.2][SEI	673.2	701.74	77.13	2.069451166	"ULS-7[-EQ.2][SEI	673.2	701.74
30	P2	Level 7	L7_Top_47	0.08290848	"ULS-7[+EQ.1][SE	66.35	-184.84	8.184	0.221680963	"ULS-5[-EQ.1][SEI	-170.35	711.52
31	P2	Level 7	L7_Top_46	0.087887752	"ULS-7[-EQ.1][SEI	71.284	74.93	6.196	0.114274511	"ULS-5[+EQ.2][SE	-24.717	368.58
32	P2	Level 7	L7_Bot_47	0.078746061	"ULS-5[-EQ.1][SEI	-184.66	83.387	-58.682	0.142554469	"ULS-5[+EQ.1][SE	-7.513	-386.77
33	P2	Level 7	L7_Bot_46	0.085622871	"ULS-7[-EQ.1][SEI	69.447	12.992	-6.211	0.04656722	"ULS-7[+EQ.2][SE	-24.981	150.24
34	P2	Level 6	L6_Top_40	0.145982593	"ULS-5[-EQ.1][SEI	-339.1	928.56	127.93	0.287029353	"ULS-7[+EQ.1][SE	92.776	-658.47
35	P2	Level 6	L6_Top_39	0.146700691	"ULS-7[-EQ.1][SEI	118.99	92.818	8.403	0.170688632	"ULS-7[+EQ.2][SE	-49.566	565.82
36	P2	Level 6	L6_Bot_40	0.124896084	"ULS-5[-EQ.1][SEI	-290.12	-117.89	-126.55	0.088741225	"ULS-5[+EQ.1][SE	-95.005	-255.79
37	P2	Level 6	L6_Bot_39	0.125575101	"ULS-5[+EQ.1][SE	-322.65	-2.925	4.321	0.010067721	"ULS-7[-EQ.2][SEI	-69.216	34.087
38	P2	Level 5	L5_Top_33	0.167636494	"ULS-5[-EQ.1][SEI	-389.4	988.68	186.48	0.291789771	"ULS-7[+EQ.1][SE	25.744	-731.16
39	P2	Level 5	L5_Top_32	0.176038296	"ULS-5[+EQ.1][SE	-451.64	-37.885	-5.989	0.119903142	"ULS-7[+EQ.2][SE	-81.2	408.72
40	P2	Level 5	L5_Bot_33	0.129363331	"ULS-5[-EQ.1][SEI	-300.5	-473.51	-184.81	0.135565149	"ULS-5[-EQ.1][SEI	-300.5	-473.51
41	P2	Level 5	L5_Bot_32	0.141106464	"ULS-5[+EQ.1][SE	-361.98	22.334	6.061	0.105726132	"ULS-7[+EQ.2][SE	-85.812	-362
42	P2	Level 4	L4_Top_26	0.164704822	"ULS-5[+EQ.1][SE	-382.59	-418.78	-166.58	0.231732416	"ULS-7[-EQ.1][SEI	-103.36	673.86
43	P2	Level 4	L4_Top_25	0.174978225	"ULS-5[+EQ.1][SE	-448.13	-11.667	-7.294	0.02871782	"ULS-5[+EQ.2][SE	-390.15	127.17
44	P2	Level 4	L4_Bot_26	0.225698222	"ULS-5[+EQ.1][SE	-524.28	677.41	165.28	0.354603851	"ULS-7[-EQ.1][SEI	28.037	-886
45	P2	Level 4	L4_Bot_25	0.191996646	"ULS-5[-EQ.1][SEI	-491.68	-19.893	-11.652	0.222477297	"ULS-7[-EQ.2][SEI	-132.37	793.6
46	P2	Level 3	L3_Top_19	0.29975241	"ULS-5[+EQ.1][SE	-696.3	-121.93	-233.51	0.170444849	"ULS-7[-EQ.1][SEI	90.917	392.02

Project Info | Reinforcement | Geometry | **Governing Loads**

READY

Figure 4-24 Governing Loads XLS Report

ADAPT Wall Design

Model:	wall_design_doc1	Status:	Unacceptable
Pier Label:	P4	N vs MUlt:	2.357
Design Section:	L1_Bot_1 (Level 1 - 13.00ft)	Shear Ult:	1.499
		Maximum	1.000
Design Code:	ACI2011		

Dimension

Length = 9.50 ft
Thickness = 8.00 in
Lu = 13.00 ft
Hw = 77.00 ft

Governing Loads

	Pu (kip)	Vu (kip)	Mu (kip-ft)	Utilization	GLC
Axial	-572.030	-21.449	-685.730	0.220	"ULS-5[+EQ,1][SBS]"
Flexure	-138.500	282.380	8960.700	2.357	"ULS-7[-EQ,2][SBS]"
Shear	-440.550	282.590	9006.000	1.499	"ULS-5[-EQ,2][SBS]"

Shear Design

Fys = 60.000 ksi
Fyv = 60.000 ksi
Phi sh = 0.750
Phi Vc = 69.209 kip
Phi Vn = 175.217 kip
Phi Vnmax = 346.043 kip

Panel Bars	Smax (in)	Avmin (in2/ft)	Av req (in2/ft)	Av prov (in2/ft)	Status
#5 @ 12.00 horz	18.00	0.24	0.57	0.31	"N.G."
#4 @ 12.00 vert	18.00	0.12	0.24	0.20	"N.G."

Flexure and Axial Design

F'c = 4000.00 psi
phi b = 0.90
phi c = 0.65
Aused = 0.00 in2
n = 4.00
Aused/Agrov vert = 0.00

Panel bars used:		As in2	As (min) in2	CGS in	Curtains	Spacing in
Zone 1	10 - #8	7.90	0.91	12.93	3	9.00
Zone 2	10 - #8	7.90	0.91	12.93	3	9.00

FM Diagram status: "N.G."

Slenderness check

Lu(ft)	Lu*18	Status
13.00	9.75	"Slender per UBC 97"

Material statistics

Volume(yard3)	Steel ratio(%)	Steel Density
3.049	1.73	0.02

Boundary element check

Method: "Strain>0.003" Du/Hw = 0.02

Confinement 1(Compression @ Zone 1)

Type = Ordinary boundary element per ACI 21.9.6.5(a)
Length req. = 20.22 in
Length prov. = 26.75 in
Development Length vert. = 18.65 in
Development Length horz. = 8.37 in
Status = "O.K."

	Ties	Spacing(horz.) in	Spacing(vert.) in	Spacing(vert.) max in
Transv. (Zone1)	4 - #4	9.00	9.00	8.00
Transv. (Panel)	0 - #4	12.45	0.00	0.00
Transv. (Zone2)	0 - #4	9.00	0.00	0.00
Longitudinal	3 - #4	3.25	9.00	8.00
			Spacing check	"O.K."

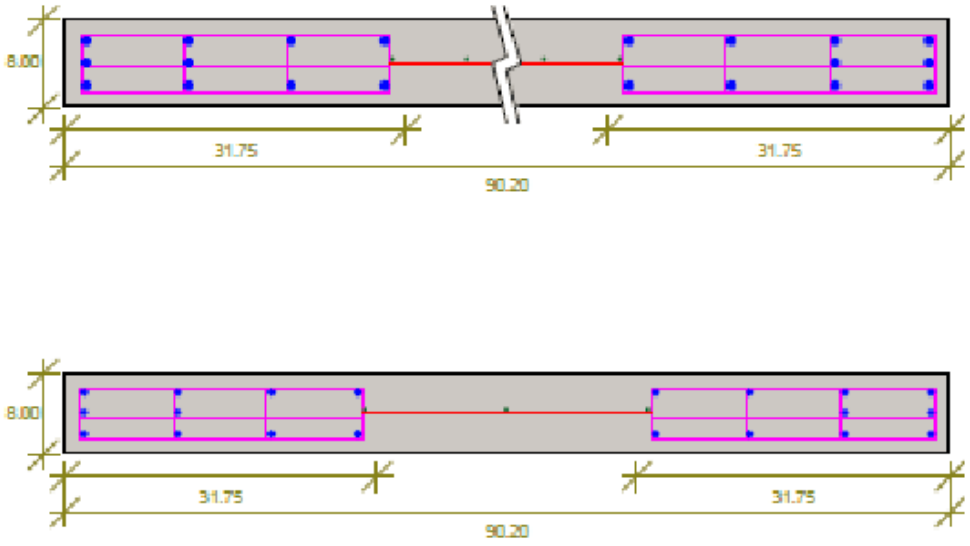
Confinement 2(Compression @ Zone 2)

Type = Ordinary boundary element per ACI 21.9.6.5(a)
Length req. = 20.22 in
Length prov. = 26.75 in
Development Length vert. = 18.65 in
Development Length horz. = 8.37 in
Status = "O.K."

	Ties	Spacing(horz.) in	Spacing(vert.) in	Spacing(vert.) max in
Transv. (Zone1)	4 - #4	9.00	9.00	8.00
Transv. (Panel)	0 - #4	12.45	0.00	0.00
Transv. (Zone2)	0 - #4	9.00	0.00	0.00
Longitudinal	3 - #4	3.25	9.00	8.00
			Spacing check	"O.K."

Figure 4-25 Wall Design Section Report - PDF

Wall Diagram



PM Diagram

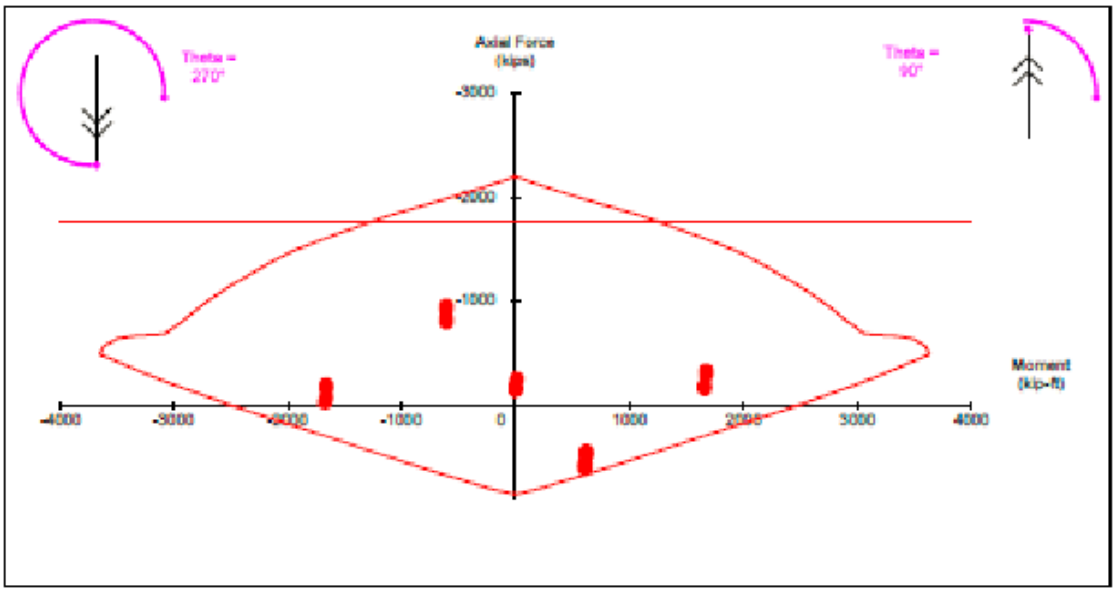


Figure 4-26 Wall Design Section Report – PDF

Level 1 - Top - 13.00 ft

Figure 4-27 Wall Intersection Layout