S A D S

What's New

Version 19.0

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1 Database Replacement

SADS has a database for managing all input data and result data. SADS v7 to SADS v18 are using Paradox database application and Borland Database Engine (BDE) as a management of the paradox database.
In recent years, we have heard some rumors that Windows may discard BDE without any notice. If this event happen, SADS will stop working immediately.
For the safety of our users, we decide to find out one replacement database and implement to SADS v19 and later version. We found Absolute Database (ABS) is a good solution.

- No BDE; no DLLs;
- Single-file database;
- Compatible with standard and third-party database controls that SADS currently used;
- Works great on all versions of Windows.
- All operation are exactly the same as BDE database, no any new learning curve is needed.

Before BDE is discarded, we can support BDE version of SADS. If our users prefer using BDE, they can select BDE version until they like the new ABS version. We will provide 2 ways conversion utility between BDE and ABS database. Using this utility, you can convert BDE database to ABS database any time, also you can convert ABS database back to BDE database.

2 Beam-Column Joint

This is the most important change in SADS v19. We follow the Amendments to the Code of Practice for Structural Use of Concrete 2013 ("Amendments") to make these changes.

2.1 The Design Moment of BC Joint

In SADS previous version, the design moments of BC joint are taken from moment envelop of beam design program. There are defects using this envelop. The moments in moment envelop is calculated for designing sections of beams. There is no problem for this purpose. The main feature of this moment envelop is generated using multiple load patterns (Clause 5.1.3.2):

1. all spans loaded with the maximum design load (1.4xDead Load + 1.6xLive Load);
2. alternate spans loaded with the maximum design load (1.4xDead Load + 1.6xLive Load) and all other spans loaded with the minimum design load (1.0xDead Load);
3. any two adjacent spans loaded with the maximum design load (1.4xDead Load + 1.6xLive Load) and all other spans loaded with the minimum design load (1.0xDead Load).

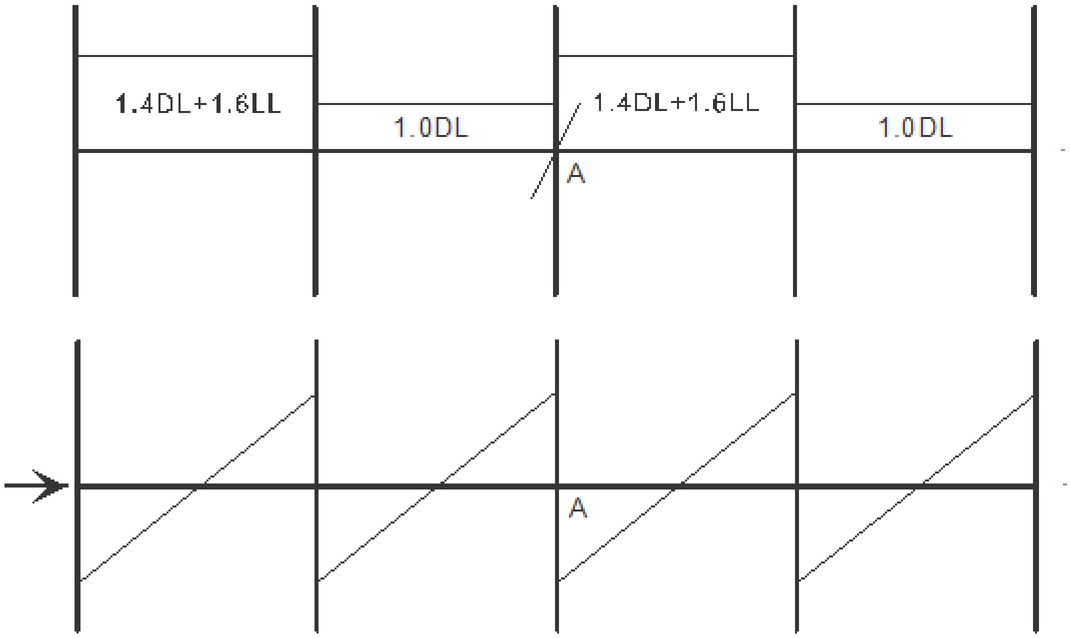
The major design forces T of BC joints are calculated based on 2 moments on the both sides of joint. These 2 moments are dependent and should be calculated from the same load pattern.

If we take the maximum hogging moment from moment envelop for one side of joint and take minimum hogging moment or maximum sagging moment on another side, the first moment is in 3rd load pattern and the second moment is in 2nd load pattern.The case is never happen in real world and it is over design.

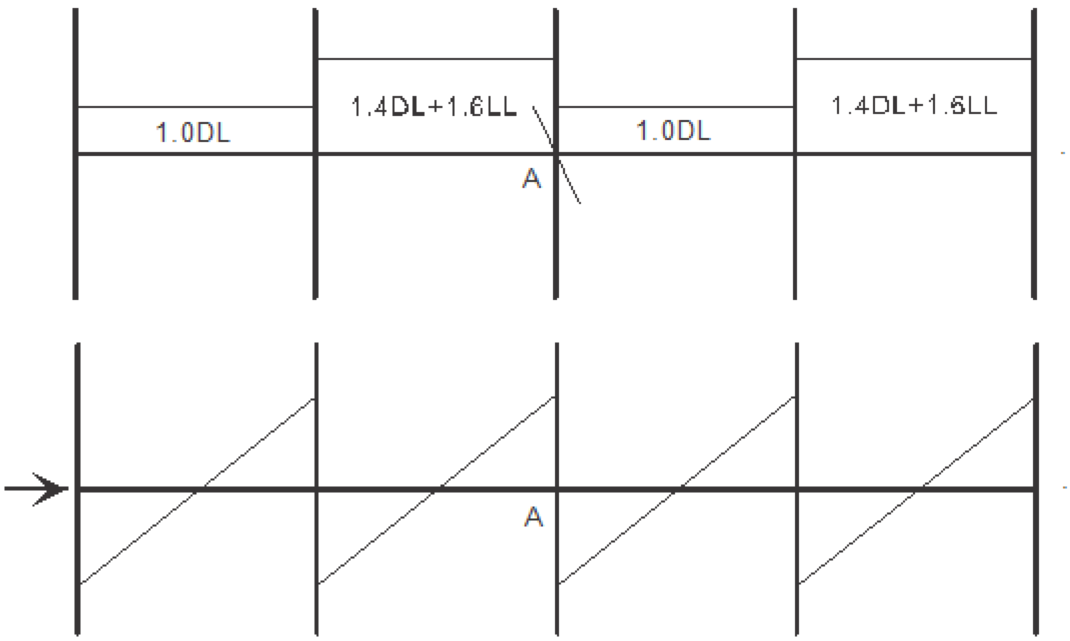
According the "Amendments" Clause 6.8.1.2, "The design forces for beam-column joint of lateral load resisting frames, ..., should be calculated by taking the most adverse combined net moments and forces at the joint under the load combinations at ultimate limit state as specified in Table 2.1, with the joint in equilibrium."

SADS v19 uses the following 2 load patterns (2nd load pattern) to get the design force T. We can prove these 2 load patterns can cover the most adverse combination and all moments and shears of joint are in equilibrium.

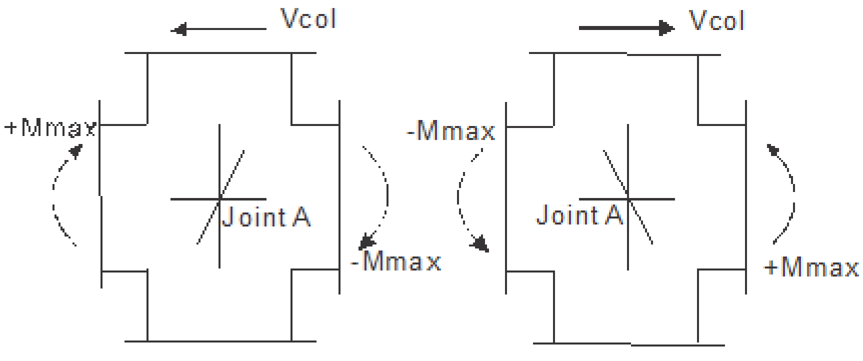
Pattern 1: Odd spans are fully loaded (1.4DL+1.6LL) and even spans are loaded 1.0DL only.



Pattern 2: Odd spans are loaded 1.0DL only and even spans are fully loaded (1.4DL+1.6LL).



If we look at joint A, we can find the point A get the maximum rotation in anti-clockwise in pattern 1. The maximum hogging moment -Mmax, maximum sagging moment +Mmax and shear Vcol are shown as below. The same figures of pattern 2 are shown below also.



Obviously, the +Mmax, -Mmax and Vcol are calculated in the same pattern and in equilibrium.

2.2 Calculate Design Shear of Joint

When the design moment is maximum hogging moment or sagging moment on opposite side, the design shear force can be calculated as below.

$T = f_y A_{st}$

For other case, the shear force can be calculated as below.

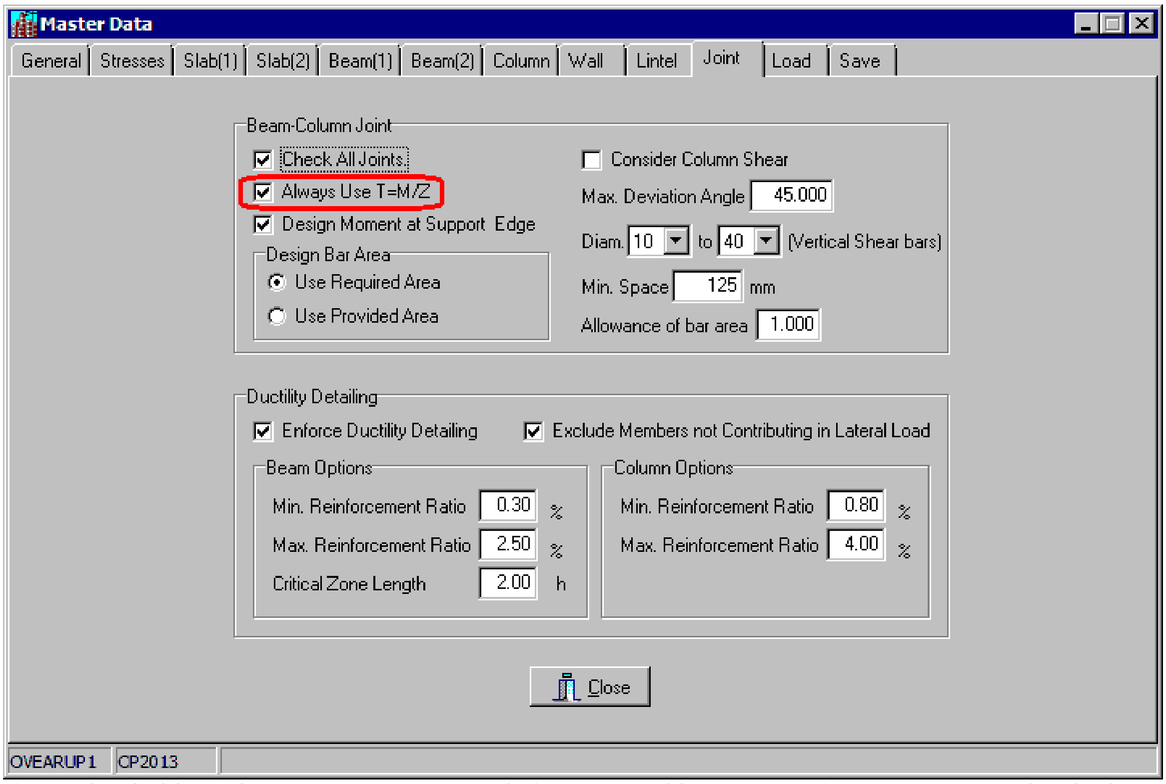
$T = M/z$

In SADS previous version, the A_{st} is the provided area of longitudinal bar of beam. In "Amentmends" this area is changed to required area. This change usually decreases the value of shear force T. It is a good news for BC joint design. SADS v19 follows this requirement to change the provided area to required area.

2.3 Option of Shear Force Calculation

But, we can see this required area is applied to longitudinal reinforcement of beam section design, i.e. the required area is calculated based on maximum hogging moment in 3rd load pattern. This moment is much larger then design moment of BC joint design. It still is over design.

We provide an Always Use T=M/Z option in SADS v19 Master Data.



If you check this option, SADS uses T = M/z formula and ignores $T = f_s A_{st}$ to calculate the design shear forces. You may see the value of shear force T decreased further.

2.4 Consider Shear in Column above BC Joint

In SADS previous version, the shear of column is ignored. According with the requirement of "Amendments', the effect of all forces on the beam-column joints including beneficial column shear forces should be considered in deriving the total horizontal design joint shear force Vjh. SADS v19 includes the column force in calculation of joint shear force. This shear decreases the design shear force Vjh.

3 Shear Reinforcement for Circular Column

In SADS previous version, there is no function to calculate and design circular section of column. We can only to create an equivalent rectangular section to design the reinforcement of the section.
In SADS v19, we can use new Clause 6.2.1.4 (e) (iii) in the Amendments to design the circular section directly.

4 Column Shear Checking

In SADS previous version, there is a brief output of column shear checking and can't checks the circular section of column. According with "Amendments" Clause 6.2.1.4 (e), we add a detail output of the calculation of column shears.

Screen Viewer

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* C6 *            2ND. FLOOR TO 1ST. FLOOR                  X-X : Unbraced
                                                            Y-Y : Unbraced
                Mark     Type  Span   Section    Ang        F.E.M.
     Top Beam: 2BX6        1  6.000  300x550  180.0  110.261( 42.188,   0.000)
               2BX7        1  6.000  300x550    0.0  110.261( 42.188,   0.000)
               2BY11       1  6.000  300x450  270.0   52.470( 22.500,   0.000)
               2BY12       1  6.000  300x450   90.0   52.470( 22.500,   0.000)
     Bot.Beam: 1BX6        1  6.000  400x550  180.0  113.966( 46.286,   0.000)
               1BX7        1  6.000  400x550    0.0  110.286( 44.550,   0.000)
               1BY13       1  6.000  400x600  270.0   58.680( 27.000,   0.000)
               1BY14       1  6.000  400x600   90.0   58.680( 27.000,   0.000)

     Colm.Pro.:  Hux   Huy   Section   Hcx   Hcy   Section   Hlx   Hly   Section
               3.200 3.200  550x550 4.000 4.000  550x550 5.000 5.000  650x650

     Slender  : Lex= 6.418   Lamx= 11.67 > 10 Ley= 7.380   Lamy= 13.42 > 10

     Vert.Load: D.L.= 4225.092(29.040)          L.L.= 921.818[0.000]
          Top :+Mdx = 42.187   -Mdx = -42.187  +Mdy = 21.424   -Mdy = -21.424
               +Mlxn= 16.141   -Mlxn= -16.141  +Mlyn= 9.187    -Mlyn= -9.187
               +Mlxp= 0.000    -Mlxp= 0.000    +Mlyp= 0.000    -Mlyp= 0.000
          Bot.:+Mdx = 37.422   -Mdx = -36.213  +Mdy = 18.395   -Mdy = -18.395
               +Mlxn= 15.198   -Mlxn= -14.628  +Mlyn= 8.464    -Mlyn= -8.464
               +Mlxp= -0.000   -Mlxp= -0.000   +Mlyp= -0.000   -Mlyp= -0.000
     Vert.Shears:
           D+L:Vxmax= 19.846   Vxmin= -20.799  +Vymax= 11.042   Vymin= -11.042
       D+L (W):Vxmax= 12.849   Vxmin= -13.684  +Vymax= 7.286    Vymin= -7.286
        D ONLY:Vxmax= 7.538    Vxmin= -8.263   +Vymax= 3.982    Vymin= -3.982
      D+L(FLS):Vxmax= 5.852    Vxmin= -6.570   +Vymax= 3.530    Vymin= -3.530
     D ONLY(F):Vxmax= 5.852    Vxmin= -6.570   +Vymax= 3.530    Vymin= -3.530

     Soil Load:      Mstx      Msty      Msbx      Msby      Vsx      Vsy       Ps
           ---     -0.398     0.040     0.618    -0.023    0.275   -0.017   -0.198

     Wind Load:      Mwtx      Mwty      Mwbx      Mwby      Vwx      Vwy       Pw
           X-X    -27.632     8.395   110.503   -20.985   37.334   -7.941   -7.053
           Y-Y      7.595    -8.068   -28.070    31.690   -9.639   10.745  -35.886
           U-U     19.054    -9.267   -71.847    31.397  -24.568   10.990  -25.892
           V-V     -5.724    -5.384    21.022    25.380    7.229    8.314  -34.313

     Dyna.Load:      Mntx      Mnty      Mnbx      Mnby      Vnx      Vny       Pn
           X-X    -26.318     9.658   148.333   -25.071   47.203   -9.386  -11.185
           Y-Y      6.338    -6.473   -31.938    37.715  -10.345   11.943  -55.474
           U-U     23.088   -11.405  -127.451    44.390  -40.686   15.080  -31.312
           V-V    -14.126     2.252    82.292     8.940   26.059    1.808  -47.128
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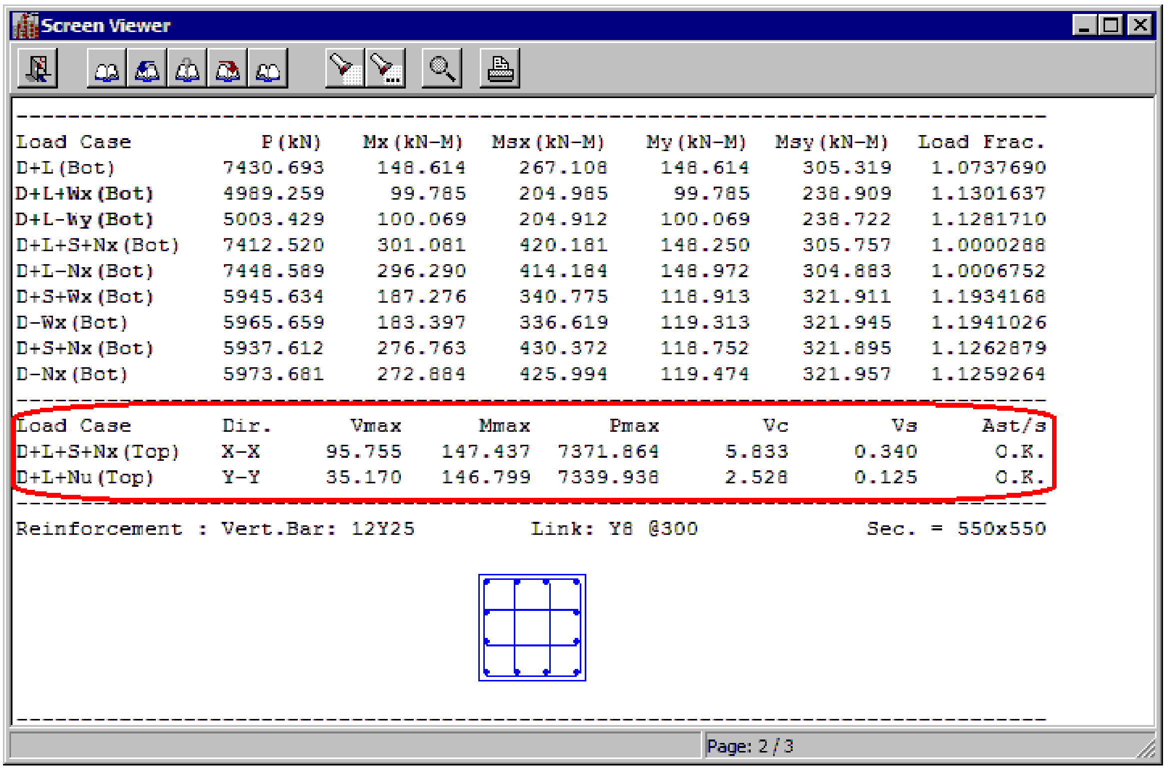
1. We add the output of Vertical Shears. These shears are calculated from moments of vertical load. These shears have multiplied by load combination factors.
2. We add the shear output of lateral loads. The design shears can be calculated by summing the vertical shear and factored lateral shear. We can easily trace these design shears any time.

The shear checking output is shown as below.



Load Case	P(kN)	Mx(kN-M)	Msx(kN-M)	My(kN-M)	Msy(kN-M)	Load Frac.
D+L(Bot)	7430.693	148.614	267.108	148.614	305.319	1.0737690
D+L+Wx(Bot)	4989.259	99.785	204.985	99.785	238.909	1.1301637
D+L-Wy(Bot)	5003.429	100.069	204.912	100.069	238.722	1.1281710
D+L+S+Nx(Bot)	7412.520	301.081	420.181	148.250	305.757	1.0000288
D+L-Nx(Bot)	7448.589	296.290	414.184	148.972	304.883	1.0006752
D+S+Wx(Bot)	5945.634	187.276	340.775	118.913	321.911	1.1934168
D-Wx(Bot)	5965.659	183.397	336.619	119.313	321.945	1.1941026
D+S+Nx(Bot)	5937.612	276.763	430.372	118.752	321.895	1.1262879
D-Nx(Bot)	5973.681	272.884	425.994	119.474	321.957	1.1259264

Load Case	Dir.	Vmax	Mmax	Pmax	Vc	Vs	Ast/s
D+L+S+Nx(Top)	X-X	95.755	147.437	7371.864	5.833	0.340	O.K.
D+L+Nu(Top)	Y-Y	35.170	146.799	7339.938	2.528	0.125	O.K.

Reinforcement : Vert.Bar: 12Y25 Link: Y8 @300 Sec. = 550x550

If the reinforcement is not necessary, the Ast/S is marked as O.K. otherwise the required reinforcement area is shown.

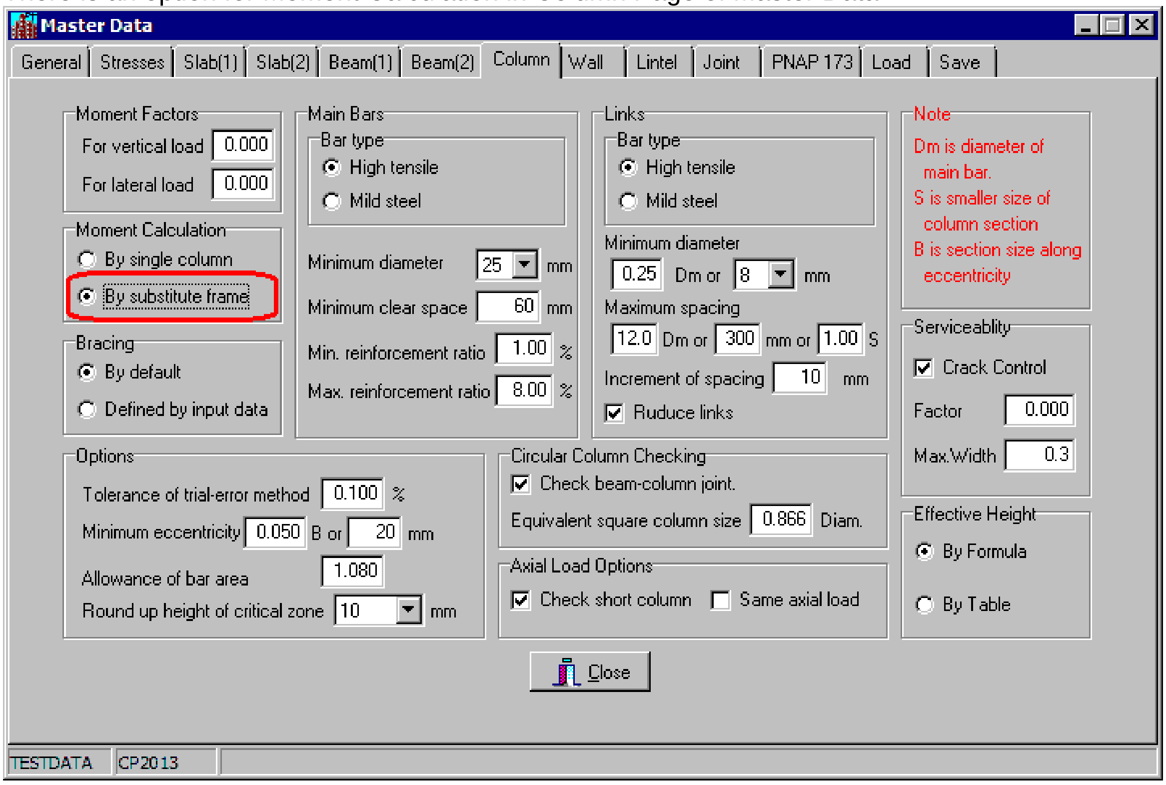
For circular column, the reinforcement is calculated according with "Amendments Clause 6.2.1.4 (e) (iii), equation 6.58a, 6.58b and 6.58c,

5 Change Crack Width Calculation

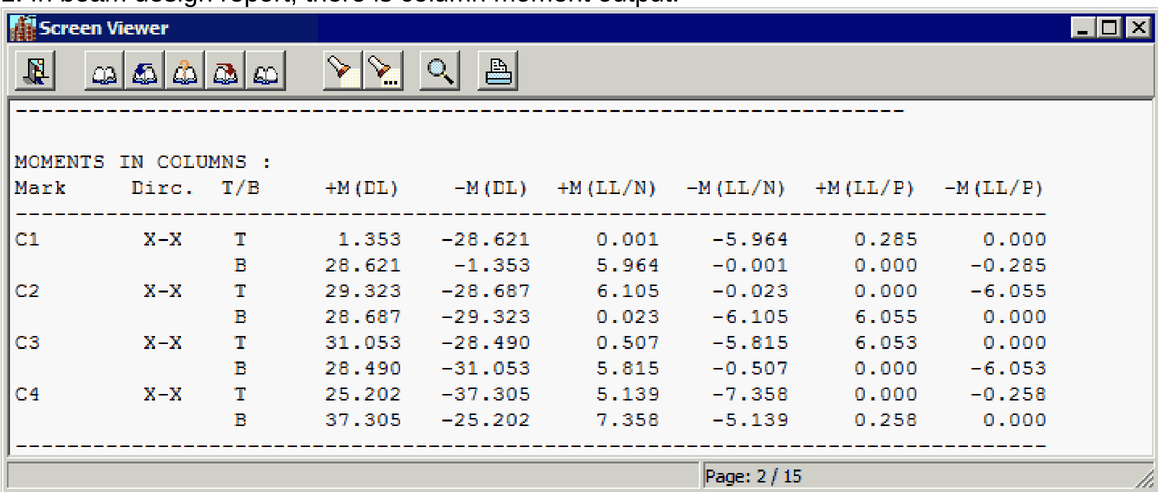
When we need to check the surface crack width that limiting the design crack width of 0.1 mm, we follow the requirement of "Amendments" Clause 7.2.3. We use equation 7.2(a) instead of equation 7.2. The equation for the determination of average strain e m for a limiting crack width of 0.1mm to facilitate the assessment of crack widths for structures with design crack widths limited to 0.1mm is added.

6 Substitute Frame Option

There is an option for Moment Calculation in Column Page of Master Data.



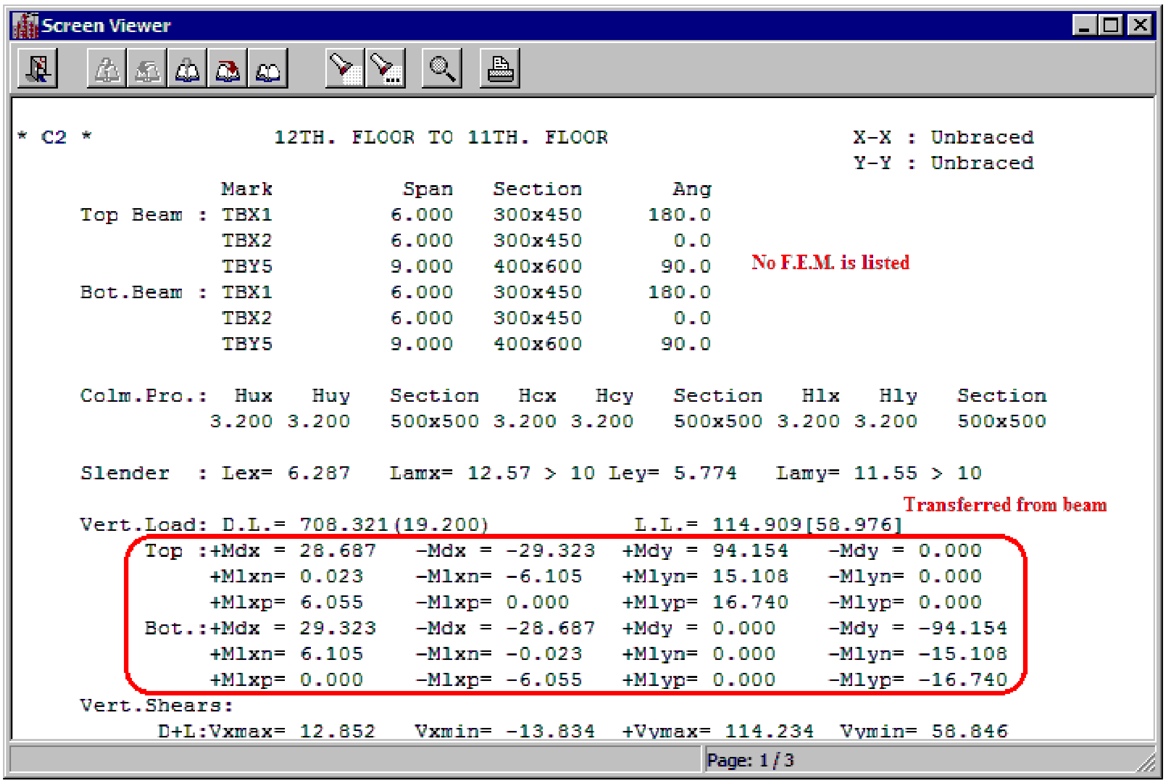
If we select By substitute frame option, there are 2 changes in SADS.
1. In beam design report, there is column moment output.



MOMENTS IN COLUMNS :

Mark	Dirc.	T/B	+M(DL)	-M(DL)	+M(LL/N)	-M(LL/N)	+M(LL/P)	-M(LL/P)
C1	X-X	T	1.353	-28.621	0.001	-5.964	0.285	0.000
		B	28.621	-1.353	5.964	-0.001	0.000	-0.285
C2	X-X	T	29.323	-28.687	6.105	-0.023	0.000	-6.055
		B	28.687	-29.323	0.023	-6.105	6.055	0.000
C3	X-X	T	31.053	-28.490	0.507	-5.815	6.053	0.000
		B	28.490	-31.053	5.815	-0.507	0.000	-6.053
C4	X-X	T	25.202	-37.305	5.139	-7.358	0.000	-0.258
		B	37.305	-25.202	7.358	-5.139	0.258	0.000

These moments are calculated from beam analysis and will be transferred to column design sub-command as design moments.
2. In column design report, the design moments is not taken from distribution method of single column. These moments is transferred from beam design sub-command.



Screen Viewer

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* C2 *            12TH. FLOOR TO 11TH. FLOOR                  X-X : Unbraced
                                                              Y-Y : Unbraced
                 Mark          Span    Section      Ang
     Top Beam :  TBX1          6.000   300x450     180.0
                 TBX2          6.000   300x450       0.0
                 TBY5          9.000   400x600      90.0   No F.E.M. is listed
     Bot.Beam :  TBX1          6.000   300x450     180.0
                 TBX2          6.000   300x450       0.0
                 TBY5          9.000   400x600      90.0

     Colm.Pro.:   Hux   Huy    Section   Hcx   Hcy    Section   H1x   H1y    Section
                3.200 3.200   500x500 3.200 3.200   500x500 3.200 3.200   500x500

     Slender   : Lex= 6.287   Lamx= 12.57 > 10 Ley= 5.774   Lamy= 11.55 > 10
                                                                 Transferred from beam
     Vert.Load: D.L.= 708.321(19.200)          L.L.= 114.909[58.976]
          Top :+Mdx = 28.687   -Mdx = -29.323  +Mdy = 94.154   -Mdy = 0.000
               +M1xn= 0.023    -M1xn= -6.105   +M1yn= 15.108   -M1yn= 0.000
               +M1xp= 6.055    -M1xp= 0.000    +M1yp= 16.740   -M1yp= 0.000
          Bot.:+Mdx = 29.323   -Mdx = -28.687  +Mdy = 0.000    -Mdy = -94.154
               +M1xn= 6.105    -M1xn= -0.023   +M1yn= 0.000    -M1yn= -15.108
               +M1xp= 0.000    -M1xp= -6.055   +M1yp= 0.000    -M1yp= -16.740
     Vert.Shears:
           D+L:Vxmax= 12.852   Vxmin= -13.834  +Vymax= 114.234  Vymin= 58.846
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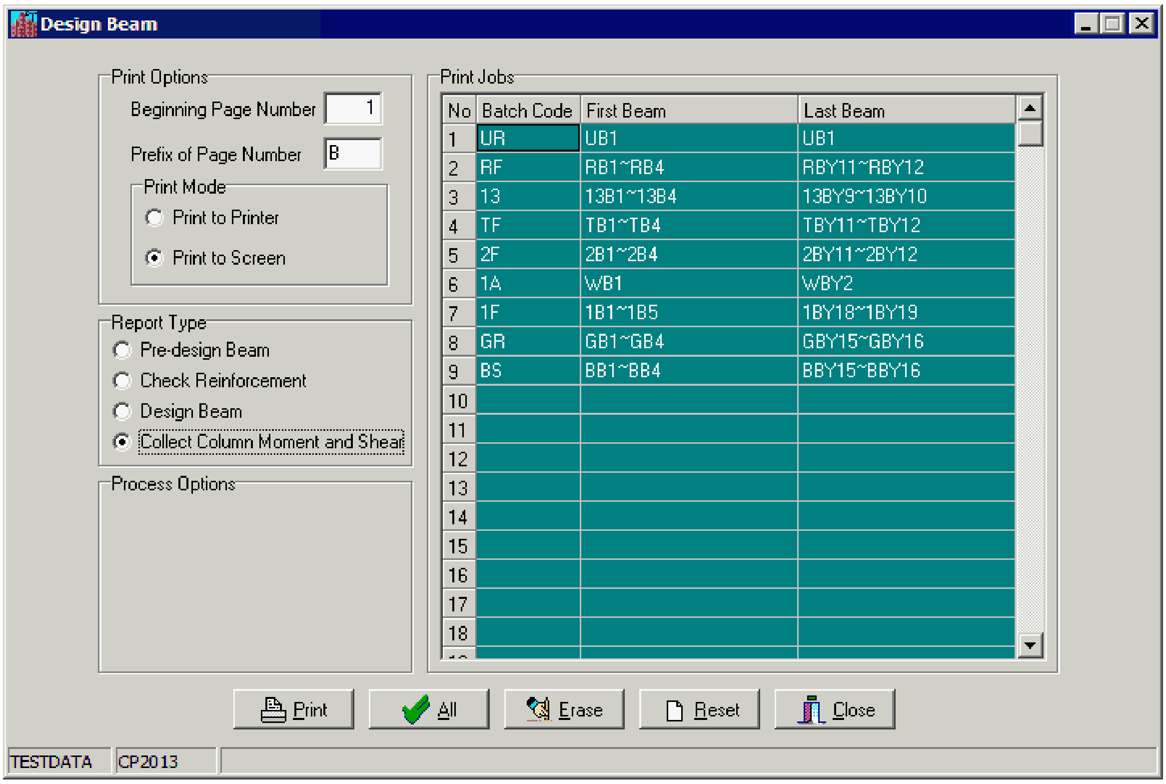
This option was implemented in previous SADS versions. But, it is not working smother. There are 2 things we need to take account to solve this problem.

1. This option is working when the beams are arranged along X-X and Y-Y only. Beam in diagonal direction may not work properly.
2. When collecting these column moments, we must collect all moments in all columns at the same processing. Partly collecting will not get correct results.

The first thing, users can decide which option you can take for your building structure.
The second thing, SADS collect these moments in Collect Column Moment and Shear Sub-command instead of Beam Pre-design Sub-command.

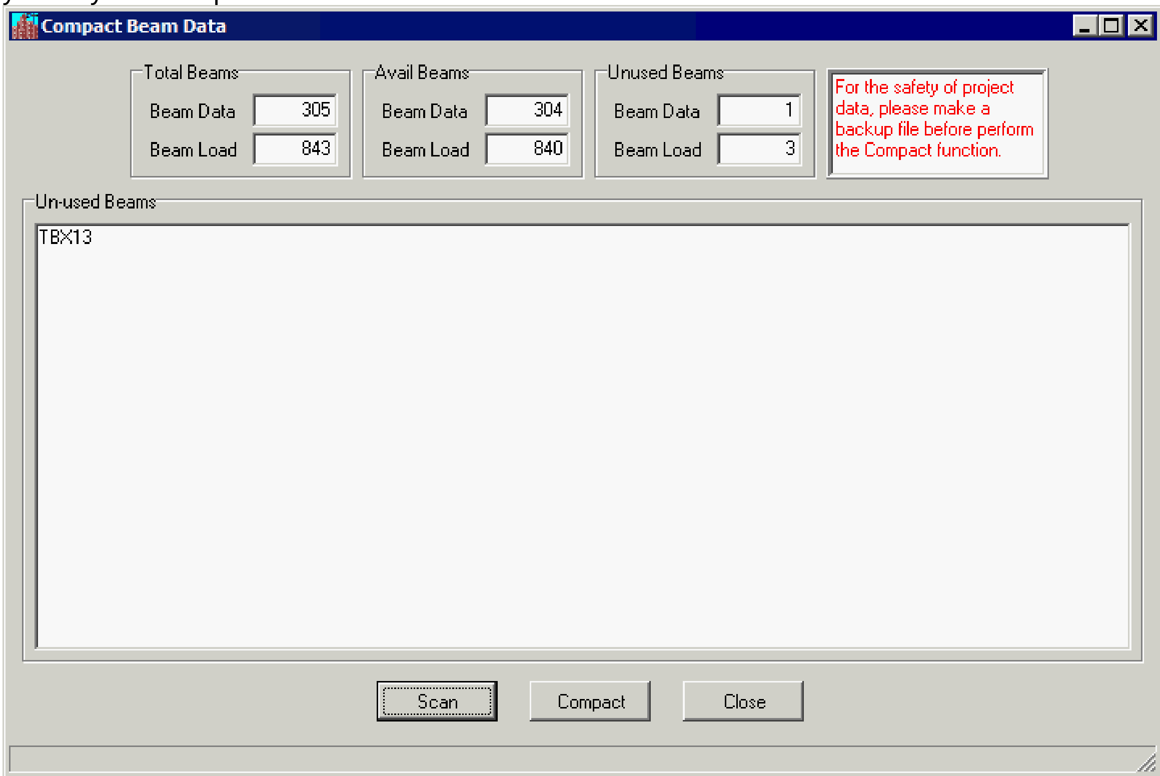


7 Collect Moments and Shears of BC Joints

In SADS previous version, we are collecting these moments and shears using Beam Pre-design Sub-command. It is a problem if you have edited your reinforcement using Edit Beam Sketch Sub-command. These edited sketches will be restored to the original shapes if you run Beam Pre-design Sub-command. In SADS 19, we use the Collect Column Moments and Shears Sub-command to get the moments and shears for BC Joint design. This sub-command is described in previous topic.

8 Compact Beam Data

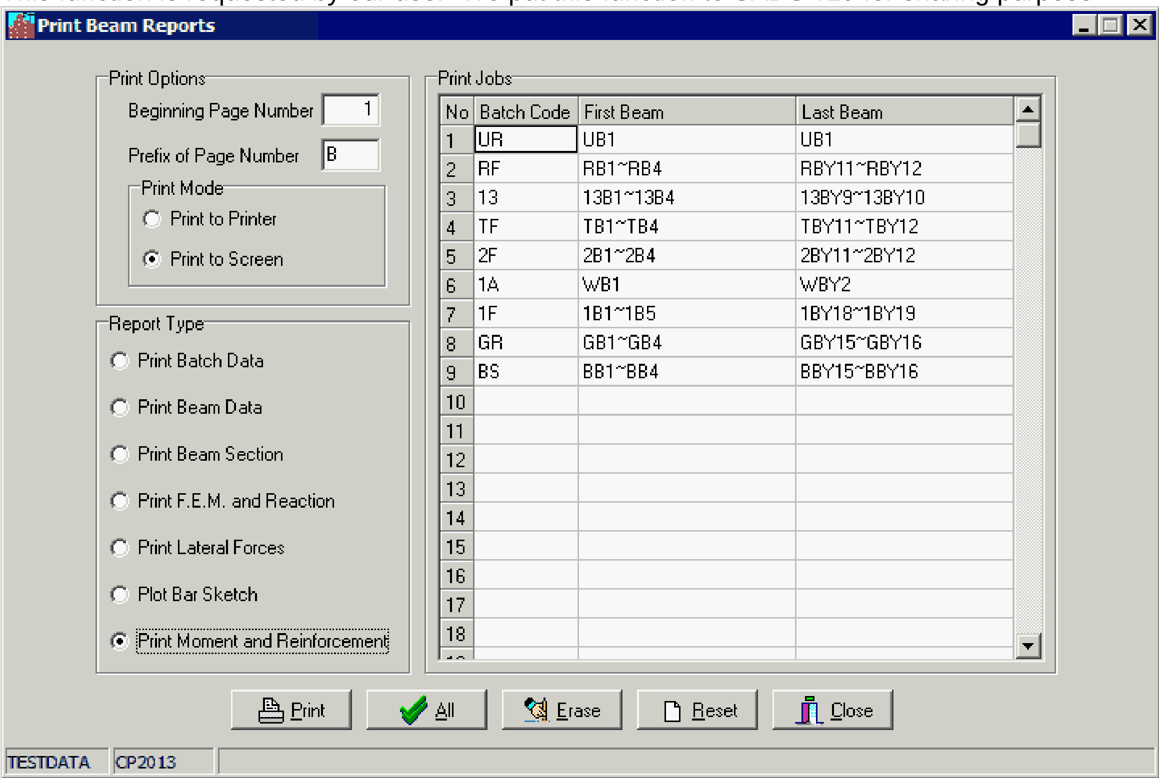
If you have a huge project and you add, edit and delete batch data, beam data and beam load repeatedly, your project may contain many unused data. If you want to remove these unused data you may run Compact Beam Data sub-command.



You may click the Scan button to show the numbers of beams and load. If the number of Unused Beams is large enough, you can click the Compact button to remove the unused data from your harddisk. For the safety of your data, please make a backup before you perform this operation.

9 Output Extra Beam Data

This function is requested by our user. We put this function to SADS v19 for sharing purpose.



The output extra data is save to User Access Folder. The file format is TAB delimiter TEXT file. You can easily import to MS Excel for further processing.

10 Compare SADS versions

	SADS v12	SADS v15	SADS v16	SADS v17	SADS v18	SADS v19
CoP 2004	OK	OK	OK	OK	OK	OK
CoP 2011	NO	OK	OK	OK	OK	OK
CoP 2013 w/o FLS	NO	NO	OK	OK	OK	OK
CoP 2013 Full	NO	NO	NO	OK	OK	OK
CoP 2013 Amentmends	NO	NO	NO	NO	NO	OK
Online Link to ETABS	NO	NO	NO	NO	OK	OK
Advanced Joint Analysis	NO	NO	NO	NO	NO	OK
Deflection by Curveture	NO	NO	NO	NO	OK	OK
Alternative Database	NO	NO	NO	NO	NO	OK