Use of Shear Wall Belt at Optimum Height to Increase Lateral Load Handling Capacity in Multistory Building

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Abstract: The improvement of the tall building has been quickly expanding around the world because now a days, people try to live in multistory structures. As per design criteria, the main focus is to resist the structures from lateral loads mainly from severe earthquake. The shear wall came into practice to resist lateral loads. But why complete shear wall is to be used from foundation to top. That’s why shear wall belt criteria came into existence. The study is conducted on a 25-storied high-rise residential building. A standard floor plan with plinth area of 825 m² used in this work. Different cases are created with shear belt at different floors. Response spectrum method with SRSS combinations used to determine various parameters such as base shear, maximum nodal displacement in longitudinal and transverse direction, drift values and load cases that creates maximum drift. With this view, this paper presents the criteria of provision of shear belt at different heights with the use of Staad pro software. Recommendations made to choose optimum location of wall belt position in structure along with the best of all.

Keywords —Drift control, Lateral load handling, Optimum height, Response spectrum, Structural system, Wall belt.

I. INTRODUCTION

The examination of the seismic practice of any structure falsely by means of auxiliary programming uncovers that at whatever point the R.C.C. multistory structure has situated around the zone of epicenter of any shock, the waves makes a destructive impact on it.

Along these lines, to check the parallel powers in the plan of tall structures, the parameters to be kept up are quality, obstruction against sidelong redirection, dependability to stay away from basic and non-auxiliary decimation. For the plan prerequisites, auxiliary inspectors have offered new frameworks to keep up the above parameters are to utilize shear divider, bracket frameworks, minute opposing edges, base confinement frameworks and one of them is outrigger and belt bolstered frameworks. In this framework, when the structure pivots against sidelong impacts experience avoidance and revolution. To check this, firm center is given amidst structure associated by hardened arms that oppose the entire structure and exchange all the sidelong loads around the shaft segment associations. Henceforth the execution of the multistory building relies on the firmness created framework.

IS: 1893, conveys the run of the mill strategy to assess the planning methodology for seismic loads alongside various factors, for example, hazard coefficient, geology factor, territory harshness and stature factor taken from IS 875 Part III from various provisos. The weight acquired for any tallness will be specifically connected to the powerful region of the structure. Since code stays indistinct about how the structure will act on the equivalent processed load when the structure is pivoted along its vertical hub with plan normality and additionally an abnormality.

In this way, it is proposed to perform wind investigation longitudinally and transversely for various expelled plan reached out to a wide region, for example, sporadic L formed multistoried building. Subsequently, the pursuit will finish when the correct area is resolved. Besides, seek additionally expand when the connected breeze strikes the structure and makes the impacts on neighboring structures.

II. OBJECTIVES

This study is based on the use of shear belt at optimum height in multistory building. By exploring many research papers, it is highly recommend increasing lateral load handling capacity when considering tall structures. Response of the building taken in this work leads to fulfill the following objectives:-

- To examine maximum base shear obtained from various location of shear belt of structure.
- To find Maximum displacements in X, Y and Z directions when load and its combinations are applied on the structure.
- To obtain Story drift for different Cases used in this study.
- To determine Load cases that creates maximum drift.
To analyze the optimum height for placing shear wall belt to increase lateral load handling capacity from above objective parameters.

### III. Methodology & Structure Modeling in Seismic Analysis

Method of analysis is done by Staat pro. Since Indian Standard codal provision recommend the seismic effect is more than wind effects and cannot be used as simultaneously. The effects of earthquake in this study are considered as seismic waves are coming from longitudinal along with transverse direction.

Tall structure is analyzed on the basis of how much deflection generated by seismic forces and what is the modal shape it would be adopted.

Seismic Base shear is calculated as:

$$ VB = Ah \times W $$

In eq. 1, W is calculated seismic weight of building. Ah is design horizontal seismic coefficient.

The value of Ah is calculated as:

$$ Ah = \frac{(ZxIySa)}{2Rxg} $$

In eq. 2, Z is Zone factor, I is Importance factor, R is response acceleration factor, Sa/g is average response acceleration coefficient based upon Fundamental time period $Ta$.

$$ Ta = \left(\frac{0.09xh}{d}\right) $$

In eq. 3, h is the height of the structure and d is maximum plan area of a particular side. This equation is used only when brick infill panel is used in the structure.

For modeling in software, the structure made up of a standard plan. Complete details regarding its description for this study consists of various structural element sizes with materials are provided in Table 1. Table 2 provides details of loading used in analysis. The earthquake load consists of various definitions provided in Table 3. Table 4 provides the load combinations as per IS 1893. Different cases assumed are provided in Table 5 from A to B14. Plan of general structure and General Structure with Shear Wall at Corners are shown in figure 1 and 2 respectively. Figure 3 shows Structure with shear strip connected with shear Wall at Corners. 3D view of Multi-story building is shown in Figure 5 and Figure 6 shows 3D view of Structure with shear strip connected to shear wall at 13th floor.

### Table 1: Description of structure taken for this study

| Particulars          | Value          |
|----------------------|----------------|
| Plinth area          | 825 m²         |
| Support              | Fixed          |
| Size of column       | 1200 mm x 900 mm |
| Size of beam         | 700 mm x 450 mm |
| Height of building above ground level | 91.50 m |
| Depth of footing     | 3.66 m deep    |

### Table 2: Details of loading

| Particulars          | Value          |
|----------------------|----------------|
| Floor Finish load    | 2.5 KN/m²      |
| Wall load (External) | 14.27 KN/m     |
| Wall load (Internal) | 8.015 KN/m     |
| Wall load (Roof Parapet) | 2.67 KN/m       |
| Water proofing (including terrace finish) | 3.2 KN/m² |
| Live load for floor and roof | 4.5 KN/m² & 2 KN/m² |

### Table 3: Details of Seismic loading taken for this study

| Particulars          | Value          |
|----------------------|----------------|
| Zone factor          | Z=0.36 (ZONE V) |
| Response reduction factor | R = 4          |
| Importance factor    | I = 1          |
| Fundamental Natural Period for X direction | $Ta_x = 1.4476$ Seconds |
| Fundamental Natural Period for Z direction | $Ta_z = 1.4476$ Seconds |
| Brick infill panels used | Yes           |
| Damping Ratio        | 5 %            |

### Table 4: Particulars of load combinations as per IS 1893

| S. No. | Load Combinations          |
|--------|----------------------------|
| 1      | 1.5 (DL+LL)                |
| 2      | 1.2 (DL+LL+EQ)             |
| 3      | 1.2 (DL+LL+EQ)             |
| 4      | 1.5 (DL+EQ)                |
| 5      | 1.5 (DL-1.5EQ)             |
| 6      | 0.9 (DL+1.5EQ)             |
| 7      | 0.9 (DL-1.5EQ)             |
| 8      | 0.9 (DL-1.5EQ)             |
| 9      | 0.9 (DL-1.5EQ)             |

### Table 5: Details of different cases used in this study

| Case No. | General Structure                |
|----------|----------------------------------|
| A        | General structure without shear wall |
| B        | General structure with shear wall at corners |
| B1       | Structure with shear belt at 0 m |
| B2       | Structure with shear strip at 1st floor |
| B3       | Structure with shear strip at 2nd floor |
| B4       | Structure with shear strip at 3rd floor |
| B5       | Structure with shear strip at 4th floor |
| B6       | Structure with shear strip at 5th floor |
| B7       | Structure with shear strip at 6th floor |
| B8       | Structure with shear strip at 7th floor |
| B9       | Structure with shear strip at 8th floor |
| B10      | Structure with shear strip at 9th floor |
| B11      | Structure with shear strip at 10th floor |
| B12      | Structure with shear strip at 11th floor |
| B13      | Structure with shear strip at 12th floor |
| B14      | Structure with shear strip at 13th floor |
| B15      | Structure with shear strip at 14th floor |
| B16      | Structure with shear strip at 15th floor |
| B17      | Structure with shear strip at 16th floor |
| B18      | Structure with shear strip at 17th floor |
| B19      | Structure with shear strip at 18th floor |
| B20      | Structure with shear strip at 19th floor |
| B21      | Structure with shear strip at 20th floor |
| B22      | Structure with shear strip at 21st floor |

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IV. RESULTS AND DISCUSSIONS

After the applications of various dead loads, live loads and Seismic Load with their combinations on multistory building, comparative results for structure located in seismic
zone V having medium soil condition for various cases are as follows:

**Table 6: Base Shear observed for all 15 cases during seismic ground motions**

| Different Cases | Maximum Base Shear (KN) |
|-----------------|-------------------------|
| CASE A          | 5921.46                 |
| CASE B          | 6506.65                 |
| CASE B1         | 7194.02                 |
| CASE B2         | 7400.52                 |
| CASE B3         | 7867.03                 |
| CASE B4         | 8203.14                 |
| CASE B5         | 8148.27                 |
| CASE B6         | 7919.97                 |
| CASE B7         | 7711.31                 |
| CASE B8         | 7632.42                 |
| CASE B9         | 7573.47                 |
| CASE B10        | 7529.92                 |
| CASE B11        | 7577.15                 |
| CASE B12        | 7609.04                 |
| CASE B13        | 7545.77                 |
| CASE B14        | 7434.07                 |

**Graph 1: Graphical representation of Base Shear observed for all 15 cases during seismic ground motions**

**Table 7: Maximum displacement observed for all 15 cases during seismic ground motions**

| Cases  | Maximum Displacement in X – direction (mm) | Maximum Displacement in Z – direction (mm) | Maximum Displacement (Resultant) (mm) |
|--------|--------------------------------------------|--------------------------------------------|---------------------------------------|
| CASE A | 388.904                                    | 410.963                                    | 412.191                               |
| CASE B | 328.777                                    | 345.503                                    | 348.449                               |
| CASE B1| 317.944                                    | 329.902                                    | 331.686                               |
| CASE B2| 303.872                                    | 315.607                                    | 317.482                               |
| CASE B3| 290.963                                    | 302.409                                    | 304.373                               |
| CASE B4| 280.891                                    | 292.019                                    | 294.057                               |
| CASE B5| 273.763                                    | 284.638                                    | 286.727                               |

**Graph 2: Graphical representation of Maximum displacement observed for all 15 cases during seismic ground motions**

**Table 8: Story drift in X direction observed for cases A to B2 during seismic ground motions**

| Height (m) | Story Drift For X Direction (cm) |
|------------|----------------------------------|
|            | CASE A | CASE B | CASE B1 | CASE B2 |
| 0          | 0      | 0      | 0       | 0       |
| 3.66       | 0.5882 | 0.4912 | 0.1773  | 0.235   |
| 7.32       | 1.2598 | 1.053  | 0.555   | 0.4314  |
| 10.98      | 1.5686 | 1.3126 | 0.8123  | 0.4412  |
| 14.64      | 1.7181 | 1.4393 | 0.9984  | 0.7679  |
| 18.3       | 1.7962 | 1.5062 | 1.1428  | 0.9993  |
| 21.96      | 1.8403 | 1.5445 | 1.2572  | 1.1553  |
| 25.62      | 1.8665 | 1.5675 | 1.3478  | 1.2689  |
| 29.28      | 1.8813 | 1.5804 | 1.4182  | 1.3545  |
| 32.94      | 1.8872 | 1.5854 | 1.4713  | 1.4189  |
| 36.6       | 1.8852 | 1.5831 | 1.5091  | 1.4654  |
| 40.26      | 1.8752 | 1.5736 | 1.5331  | 1.4965  |
| 43.92      | 1.8572 | 1.5565 | 1.5446  | 1.5137  |
| 47.58      | 1.8307 | 1.5314 | 1.5447  | 1.5183  |
| 51.24      | 1.7953 | 1.4981 | 1.5342  | 1.5116  |
| 54.9       | 1.7506 | 1.4561 | 1.5139  | 1.4944  |
| 58.56      | 1.6963 | 1.405  | 1.4845  | 1.4676  |
| 62.22      | 1.6318 | 1.3445 | 1.4469  | 1.432   |
| 65.88      | 1.5568 | 1.2743 | 1.4017  | 1.3886  |
| 69.54      | 1.471  | 1.1944 | 1.35    | 1.3382  |
### Table 9: Story drift in X direction observed for cases B3 to B6 during seismic ground motions

| Height (m) | 0 | 0 | 0 | 0 | 0 |
|------------|---|---|---|---|---|
| 3.66       | 0.2599 | 0.2693 | 0.276 | 0.2811 |
| 7.32       | 0.3521 | 0.3645 | 0.3848 | 0.3996 |
| 10.98      | 0.6565 | 0.7298 | 0.7664 | 0.7918 |
| 14.64      | 0.6664 | 0.8334 | 0.8945 | 0.9324 |
| 18.3       | 0.5617 | 0.8762 | 0.9838 | 1.0381 |
| 21.96      | 0.8876 | 0.8207 | 1.0328 | 1.1125 |
| 25.62      | 1.1063 | 0.6474 | 1.0271 | 1.1561 |
| 29.28      | 1.2404 | 0.9644 | 0.9244 | 1.165 |
| 32.94      | 1.3308 | 1.1676 | 0.7036 | 1.1235 |
| 36.6       | 1.3942 | 1.2817 | 1.0063 | 0.9877 |
| 40.26      | 1.4377 | 1.3515 | 1.1921 | 0.7352 |
| 43.92      | 1.4646 | 1.395 | 1.2867 | 0.1083 |
| 47.58      | 1.477 | 1.4195 | 1.3371 | 1.1843 |
| 51.24      | 1.4765 | 1.4264 | 1.3619 | 1.2593 |
| 54.9       | 1.4644 | 1.4237 | 1.3687 | 1.291 |
| 58.56      | 1.4417 | 1.407 | 1.3608 | 1.2885 |
| 62.22      | 1.4096 | 1.3797 | 1.345 | 0.8885 |
| 65.88      | 1.3689 | 1.3429 | 1.3093 | 1.2655 |
| 69.54      | 1.3208 | 1.298 | 1.2689 | 1.2315 |
| 73.2       | 1.2665 | 1.2463 | 1.2207 | 1.1883 |
| 76.86      | 1.2073 | 1.1891 | 1.1664 | 1.138 |
| 80.52      | 1.1449 | 1.1284 | 1.1079 | 1.0826 |
| 84.18      | 1.0808 | 1.0656 | 1.047 | 1.0241 |
| 87.84      | 1.0149 | 1.0007 | 0.9835 | 0.9626 |
| 91.5       | 0.941 | 0.9278 | 0.9119 | 0.8927 |
| 95.16      | 0.8458 | 0.8339 | 0.8196 | 0.8025 |

### Table 10: Story drift in X direction observed for cases B7 to B10 during seismic ground motions

| Height (m) | 0 | 0 | 0 | 0 | 0 |
|------------|---|---|---|---|---|
| 3.66       | 0.2849 | 0.2863 | 0.2876 | 0.2895 |
| 7.32       | 0.6105 | 0.6147 | 0.6182 | 0.6237 |
| 10.98      | 0.81 | 0.8171 | 0.823 | 0.8321 |
| 14.64      | 0.959 | 0.9692 | 0.9777 | 0.9908 |
| 18.3       | 1.0745 | 1.0883 | 1.0998 | 1.1175 |
| 21.96      | 1.1611 | 1.1791 | 1.1942 | 1.217 |
| 25.62      | 1.221 | 1.2443 | 1.2635 | 1.2925 |
| 29.28      | 1.2558 | 1.2859 | 1.3103 | 1.3466 |
| 32.94      | 1.2651 | 1.3048 | 1.3358 | 1.3813 |
| 36.6       | 1.2439 | 1.3001 | 1.3407 | 1.3978 |

### Table 11: Story drift in X direction observed for cases B11 to B14 during seismic ground motions

| Height (m) | 0 | 0 | 0 | 0 | 0 |
|------------|---|---|---|---|---|
| 3.66       | 0.2908 | 0.2917 | 0.2924 | 0.2929 |
| 7.32       | 0.6275 | 0.6301 | 0.632 | 0.6334 |
| 10.98      | 0.8384 | 0.8428 | 0.8459 | 0.8482 |
| 14.64      | 0.9999 | 1.0062 | 1.0107 | 1.0139 |
| 18.3       | 1.1296 | 1.1381 | 1.144 | 1.1483 |
| 21.96      | 1.2327 | 1.2435 | 1.2511 | 1.2566 |
| 25.62      | 1.3123 | 1.3258 | 1.3353 | 1.3421 |
| 29.28      | 1.3712 | 1.388 | 1.3995 | 1.4078 |
| 32.94      | 1.4116 | 1.4322 | 1.4462 | 1.4562 |
| 36.6       | 1.4352 | 1.4602 | 1.4772 | 1.489 |
| 40.26      | 1.4429 | 1.4733 | 1.4937 | 1.5078 |
| 43.92      | 1.4533 | 1.4723 | 1.4968 | 1.5136 |
| 47.58      | 1.4125 | 1.4478 | 1.4873 | 1.5072 |
| 51.24      | 1.3742 | 1.43 | 1.4656 | 1.4893 |
| 54.9       | 1.3187 | 1.3891 | 1.4322 | 1.4604 |
| 58.56      | 1.2412 | 1.3345 | 1.3873 | 1.421 |
| 62.22      | 1.128 | 1.2648 | 1.3309 | 1.3714 |
| 65.88      | 0.943 | 1.1759 | 1.2627 | 1.312 |
| 69.54      | 0.6686 | 1.056 | 1.1818 | 1.2429 |
| 73.2       | 0.8277 | 0.8739 | 1.0849 | 1.1641 |
| 76.86      | 0.8961 | 0.6148 | 0.9624 | 1.0751 |
| 80.52      | 0.8964 | 0.7367 | 0.7887 | 0.9736 |
| 84.18      | 0.8678 | 0.781 | 0.5517 | 0.8522 |
| 87.84      | 0.8251 | 0.7667 | 0.6356 | 0.6894 |
| 91.5       | 0.77 | 0.7237 | 0.6513 | 0.4729 |
| 95.16      | 0.6964 | 0.6582 | 0.6094 | 0.5018 |

### Table 12: Story drift in Z direction observed for cases A to B2 during seismic ground motions

| Height (m) | 0 | 0 | 0 | 0 | 0 |
|------------|---|---|---|---|---|
| 3.66       | 0.7432 | 0.6219 | 0.1783 | 0.2712 |
| 7.32       | 1.4779 | 1.238 | 0.5838 | 0.4648 |
### Table 13: Story drift in Z direction observed for cases B3 to B6 during seismic ground motions

| Height (m) | CASE B3 | CASE B4 | CASE B5 | CASE B6 |
|------------|---------|---------|---------|---------|
| 0          | 0       | 0       | 0       | 0       |
| 6.36       | 0.2904  | 0.3     | 0.307   | 0.3123  |
| 7.32       | 0.5654  | 0.3956  | 0.6163  | 0.6341  |
| 10.98      | 0.6936  | 0.7587  | 0.7957  | 0.8216  |
| 14.64      | 0.7023  | 0.8692  | 0.9281  | 0.967   |
| 18.3       | 0.5415  | 0.9243  | 1.0223  | 1.0775  |
| 21.96      | 0.9325  | 0.8644  | 1.0772  | 1.155   |
| 25.62      | 1.1614  | 0.6254  | 1.0817  | 1.201   |
| 29.28      | 1.2916  | 1.0135  | 0.9724  | 1.2141  |
| 32.94      | 1.382   | 1.2266  | 0.6806  | 1.1818  |
| 36.6       | 1.4471  | 1.3349  | 1.0575  | 1.038   |
| 40.26      | 1.492   | 1.4036  | 1.2529  | 0.7121  |
| 43.92      | 1.5197  | 1.448   | 1.3404  | 1.07    |
| 47.58      | 1.5325  | 1.4732  | 1.3887  | 1.2449  |
| 51.24      | 1.5318  | 1.4822  | 1.4137  | 1.312   |
| 54.9       | 1.5192  | 1.4772  | 1.4205  | 1.3409  |
| 58.56      | 1.4956  | 1.4598  | 1.4122  | 1.3476  |
| 62.22      | 1.4623  | 1.4314  | 1.3909  | 1.3374  |
| 65.88      | 1.4202  | 1.3393  | 1.3585  | 1.3134  |
| 69.54      | 1.3704  | 1.3468  | 1.3166  | 1.278   |
| 73.2       | 1.3141  | 1.2932  | 1.2667  | 1.2332  |
| 76.86      | 1.2529  | 1.2341  | 1.2105  | 1.181   |
| 80.52      | 1.883   | 1.1712  | 1.1499  | 1.1237  |
| 84.18      | 1.1223  | 1.1065  | 1.0871  | 1.0633  |
| 87.84      | 1.0557  | 1.041   | 1.023   | 1.0012  |
| 91.5       | 0.9815  | 0.9678  | 0.9512  | 0.9311  |
| 95.16      | 0.8716  | 0.8593  | 0.8445  | 0.8268  |

### Table 14: Story drift in Z direction observed for cases B7 to B10 during seismic ground motions

| Height (m) | 0   | 0   | 0   | 0   |
|------------|-----|-----|-----|-----|
| CASE B7    | 3.66 | 0.3162 | 0.3177 | 0.519 | 0.321 |
| CASE B8    | 7.32 | 0.6425 | 0.6469 | 0.6506 | 0.6562 |
| CASE B9    | 10.98 | 0.8402 | 0.8475 | 0.8536 | 0.863 |
| CASE B10   | 14.64 | 0.9942 | 1.0046 | 1.0134 | 1.027 |
| CASE B11   | 18.3  | 1.1148 | 1.2189 | 1.1408 | 1.159 |
| CASE B12   | 21.96 | 1.2049 | 1.2234 | 1.2388 | 1.2623 |
| CASE B13   | 25.62 | 1.2672 | 1.2912 | 1.3109 | 1.3406 |
| CASE B14   | 29.28 | 1.3035 | 1.3344 | 1.3594 | 1.3967 |

### Table 15: Story drift in Z direction observed for cases B11 to B14 during seismic ground motions

| Height (m) | 0   | 0   | 0   | 0   |
|------------|-----|-----|-----|-----|
| CASE B11   | 3.66 | 0.3224 | 0.3234 | 0.324 | 0.3246 |
| CASE B12   | 7.32 | 0.6601 | 0.6629 | 0.6648 | 0.6663 |
| CASE B13   | 10.98 | 0.8695 | 0.8741 | 0.8773 | 0.8797 |
| CASE B14   | 14.64 | 1.0364 | 1.0429 | 1.0475 | 1.0509 |
| CASE B15   | 18.3  | 1.1716 | 1.1803 | 1.1864 | 1.1909 |
| CASE B16   | 21.96 | 1.2786 | 1.2898 | 1.2976 | 1.3033 |
| CASE B17   | 25.62 | 1.361 | 1.3751 | 1.3849 | 1.3919 |
| CASE B18   | 29.28 | 1.4221 | 1.4394 | 1.4514 | 1.4599 |
| CASE B19   | 32.94 | 1.464  | 1.4852 | 1.4998 | 1.5101 |
| CASE B20   | 36.6  | 1.4885 | 1.5143 | 1.5318 | 1.5441 |
| CASE B21   | 40.26 | 1.4966 | 1.5279 | 1.549  | 1.5636 |
| CASE B22   | 43.92 | 1.4888 | 1.5269 | 1.5522 | 1.5695 |
| CASE B23   | 47.58 | 1.4654 | 1.5119 | 1.5423 | 1.5628 |
| CASE B24   | 51.24 | 1.4257 | 1.4832 | 1.5198 | 1.5442 |
| CASE B25   | 54.9  | 1.3688 | 1.4408 | 1.4852 | 1.5142 |
| CASE B26   | 58.56 | 1.2914 | 1.3843 | 1.4386 | 1.4733 |
| CASE B27   | 62.22 | 1.1823 | 1.3125 | 1.3802 | 1.4218 |
| CASE B28   | 65.88 | 0.9879 | 1.2229 | 1.3095 | 1.3602 |
Graph 3: Graphical representation of Story drift in X direction observed for cases A to B6 during seismic ground motions

Graph 4: Graphical representation of Story drift in X direction observed for cases B7 to B14 during seismic ground motions

Graph 5: Graphical representation of Story drift in Z direction observed for cases A to B6

Graph 6: Graphical representation of Story drift in Z direction observed for cases B7 to B14 during seismic ground motions

Table 10: Load Cases that creates Maximum Drift

| LOAD CASES THAT CREATES MAXIMUM DRIFT | For X direction | For Z direction |
|---------------------------------------|----------------|----------------|
| EQ +X                                 | 1.2 (DL+LL+EQ_X) | 1.2 (DL+LL+EQ_Z) |
| EQ -X                                 | 1.2 (DL+LL-EQ_X) | 1.2 (DL+LL-EQ_Z) |
| 1.5 (DL+EQ_X)                         | 1.5 (DL+EQ_Z)    | 1.5 (DL+EQ_Z)    |
| 0.9 DL+1.5EQ_X                        | 0.9 DL+1.5EQ_Z   | 0.9 DL+1.5EQ_Z   |
| 0.9 DL-1.5EQ_X                        | 0.9 DL-1.5EQ_Z   | 0.9 DL-1.5EQ_Z   |

V. CONCLUSIONS

Response spectrum method has applied in the study, from the seismic effects various results obtained and the following conclusion has drawn:-

- Case B7 to Case B9 seems to be minimum parametric values. For efficiency, Case B8 also included and the final result based upon efficient case shown in belt location when Structure with shear strip at 12th floor.
- Maximum Base shear obtained when Structure with shear strip is at 5th floor and minimum at Case A i.e. when General structure without shear wall is considered.
- Maximum nodal displacements observed for X, Z and Resultant as maximum in Case A and when wall belt placed at different locations, the nodal displacement values lowering down up to Case B8 which is a sag point in the graph then from this point value again increasing.
- For different cases, story drift in X direction and in Z direction seems to be least values of all where location of shear belt has applied.
- It is investigated in this study that Load (0.9 DL-1.5EQ_X) for X direction and 0.9 DL+1.5EQ_Z for Z direction creates maximum drift for all the cases.
- Optimum height for placing shear wall belt to increase lateral load handling capacity from above objective parameters will be at 47.58m i.e. structure with shear strip at 12th floor.
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