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# EFFECT OF CHANGE IN SHEAR WALL LOCATION ON STOREY DRIFT OF MULTISTOREY BUILDING SUBJECTED TO LATERAL LOADS

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## ABSTRACT

Shear wall systems are one of the most commonly used lateral load resisting in high rise building.Shear wall has high in planestiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads.

Incorporation of shear wall has become inevitable in multi-storey building to resist lateral forces .It is very necessary to determine effective ,efficient and ideal location of shear wall.

In this paper, study of 25 storey building in zone V is presented with some preliminary investigation which is analysed by changing various position of shear wall with different shapes for determining parameters like storey drift, axial load and displacement. This analysis is done by using standard package ETAB.

**Keywords:**Shear wall, lateral loading, eccentricity, drift, axial load.

## Introduction

RC multi-storey building are adequate for resisting both the vertical and horizontal load. When such building is designed without shear wall , beam and column sizes are quite heavy and there is lot of congestion at these joint and it is difficulty to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in member. Shear wall may become imperative from the point of view of economy and control of lateral deflection.

In RC multi-storey building lift well or shear wall are usual requirement. Centre of mass and stiffness of the building is ideal for a structure. However, on many occasions the design has to be based on the off centre position of lift and stair case wall with respect to centre of mass which results into an excessive forces in most of the structural members, unwanted torsional moment and deflection.

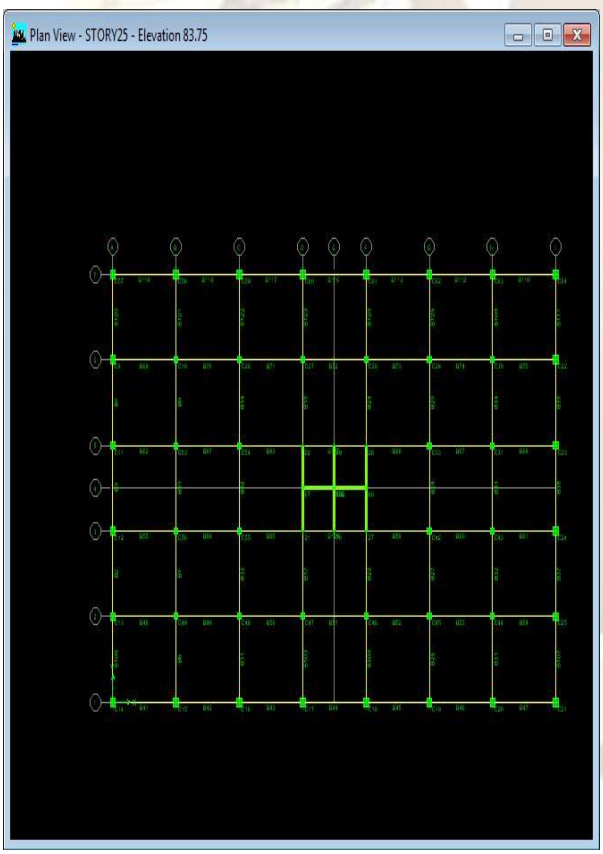
**Structural data:**Building consist of 7 bays of 7.5M in X- direction and 5 bays of 6.5M in Y- direction.

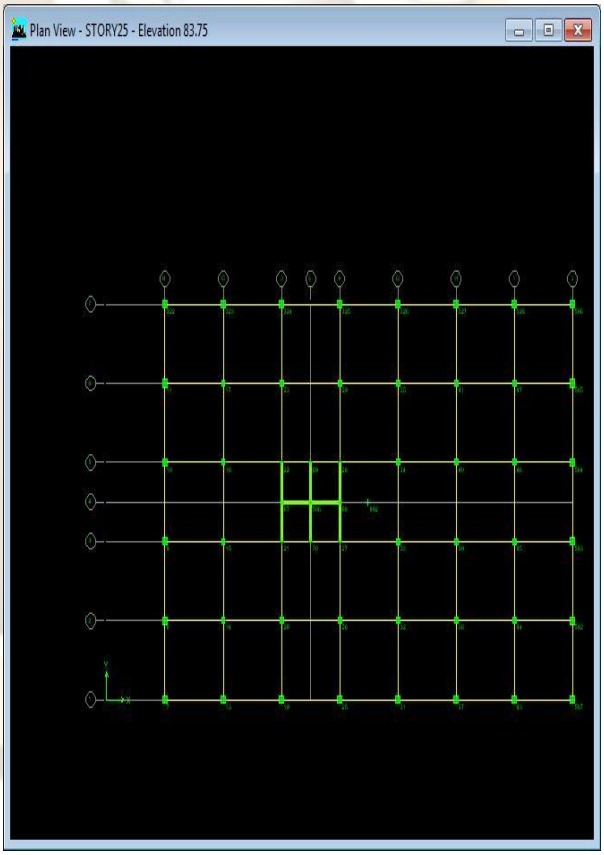
**Table 1: shows the structural data of building**

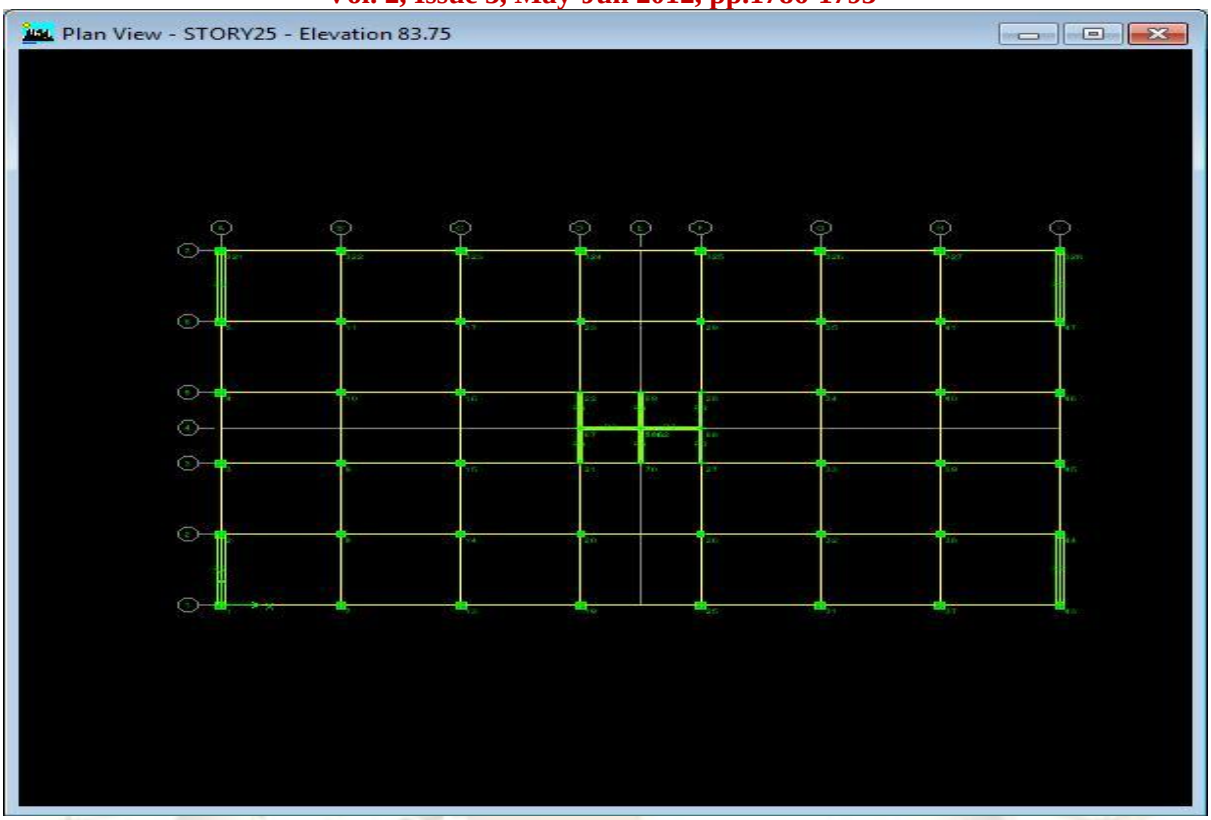
| | |
|---|---|
| Zone | V |
| Height of storey | 3.35 m |
| Number of storeys | 25 |
| Shear wall thickness | • 600mm from base to storey Level 10<br>• 400 mm from storey level 10 to 20<br>• 230 mm from storey level 20 to 25 |
| Grade of concrete and steel | M20 and Fe 415 |
| Depth of slab | 175 mm |
| Size of beam in longitudinal and transverse direction | 400 x 600 mm |
| Size of Column | • 850 x 850 mm From Base to Storey level 13<br>• 750 x 750 mm From Storey level 13 to 16<br>• 650 x 650 mm From Storey level 16 to 19<br>• 550 x 550 mm From Storey level 19 to 22<br>• 450 x 450 mm From Storey Level 22 to 25<br>• Column around periphery 600 x 600 mm |

**Gravity Loading:**
Gravity loading consists of dead load due to structural self-weight.
Live load is considered as 3 KN per Square meter.

**Lateral Loading:**
Lateral loading consist of earthquake loading which has been calculated by program and it has been applied to the mass centre of the building.
**Period Calculation**: Users defined**Response Reduction factor (R)** : 5
**Results and Discussion:**Results obtained from the analysis are recorded in tabular form for the five cases of the building separately for comparison of base shear and displacement.
Case no. 1 without shear wall
Case no. 2 When Shear wall (Lift core) is placed at centre of building
Case no.3 When Shear wall (lift core) placed at centre and four shear wall placed at outer edge symmetrically parallel to Y direction.
Case no. 4 When Shear wall (Lift core) islocated 7.5m from the centroid in X-direction
Case no. 5 When Shear wall (Lift core) islocated 7.5m from the centroid in X-direction and four Shear wall placed at outer edge symmetrically parallel to Y direction.






PLAN SHOWING POSITION OF SHEAR WALL

**Table 2: Case no. 01**
**Displacement and storey drift without Shear wall when force in X direction and Y direction**

| STOREY | DISP-X | DRIFT-X | DISP-Y | DRIFT-Y |
|---|---|---|---|---|
| STOREY25 | 0.142338 | 0.000483 | 0.140327 | 0.000627 |
| STOREY24 | 0.140954 | 0.000756 | 0.138458 | 0.000892 |
| STOREY23 | 0.138871 | 0.001030 | 0.135916 | 0.001155 |
| STOREY22 | 0.136083 | 0.001158 | 0.132701 | 0.001257 |
| STOREY21 | 0.132956 | 0.001362 | 0.129225 | 0.001447 |
| STOREY20 | 0.129277 | 0.001547 | 0.125240 | 0.001617 |
| STOREY19 | 0.125073 | 0.001583 | 0.120782 | 0.001628 |
| STOREY18 | 0.120719 | 0.001708 | 0.116250 | 0.001739 |
| STOREY17 | 0.115956 | 0.001822 | 0.111357 | 0.001839 |
| STOREY16 | 0.110780 | 0.001826 | 0.106103 | 0.001823 |
| STOREY15 | 0.105481 | 0.001904 | 0.100794 | 0.001889 |
| STOREY14 | 0.099837 | 0.001981 | 0.095185 | 0.001953 |
| STOREY13 | 0.093819 | 0.001990 | 0.089255 | 0.001945 |
| STOREY12 | 0.087641 | 0.002057 | 0.083224 | 0.001999 |
| STOREY11 | 0.081140 | 0.002126 | 0.076916 | 0.002055 |
| STOREY10 | 0.074306 | 0.002200 | 0.070322 | 0.002115 |
| STOREY9 | 0.067139 | 0.002276 | 0.063443 | 0.002177 |
| STOREY8 | 0.059648 | 0.002352 | 0.056289 | 0.002238 |
| STOREY7 | 0.051850 | 0.002424 | 0.048876 | 0.002296 |
| STOREY6 | 0.043775 | 0.002486 | 0.041231 | 0.002345 |
| STOREY5 | 0.035470 | 0.002527 | 0.033399 | 0.002377 |
| STOREY4 | 0.027012 | 0.002526 | 0.025447 | 0.002371 |
| STOREY3 | 0.018553 | 0.002426 | 0.017508 | 0.002278 |
| STOREY2 | 0.010426 | 0.002074 | 0.009877 | 0.001957 |
| STOREY1 | 0.003480 | 0.001039 | 0.003322 | 0.000992 |

**Table 3: Case no. 02**

**Displacement and storey drift when Shear wall (lift core) placed at centre and force in X direction and Y direction**

| STOREY | DISP-X | DRIFT-X | DISP-Y | DRIFT-Y |
|---|---|---|---|---|
| STOREY25 | 0.070590 | 0.000887 | 0.098274 | 0.001046 |
| STOREY24 | 0.067875 | 0.000979 | 0.095214 | 0.001115 |
| STOREY23 | 0.064929 | 0.001032 | 0.091992 | 0.001190 |
| STOREY22 | 0.061869 | 0.001049 | 0.088581 | 0.001253 |
| STOREY21 | 0.058780 | 0.001091 | 0.084991 | 0.001329 |
| STOREY20 | 0.055574 | 0.001090 | 0.081161 | 0.001378 |
| STOREY19 | 0.052328 | 0.001083 | 0.077151 | 0.001405 |
| STOREY18 | 0.049092 | 0.001093 | 0.073040 | 0.001435 |
| STOREY17 | 0.045811 | 0.001097 | 0.068799 | 0.001459 |
| STOREY16 | 0.042494 | 0.001078 | 0.064430 | 0.001468 |
| STOREY15 | 0.039196 | 0.001073 | 0.059961 | 0.001483 |
| STOREY14 | 0.035872 | 0.001063 | 0.055371 | 0.001495 |
| STOREY13 | 0.032530 | 0.001038 | 0.050662 | 0.001496 |
| STOREY12 | 0.029221 | 0.001024 | 0.045875 | 0.001502 |
| STOREY11 | 0.025913 | 0.000998 | 0.040999 | 0.001500 |
| STOREY10 | 0.022652 | 0.000949 | 0.036074 | 0.001483 |
| STOREY9 | 0.019531 | 0.000919 | 0.031166 | 0.001463 |
| STOREY8 | 0.016495 | 0.000884 | 0.026306 | 0.001427 |
| STOREY7 | 0.013563 | 0.000838 | 0.021552 | 0.001369 |
| STOREY6 | 0.010774 | 0.000780 | 0.016981 | 0.001285 |
| STOREY5 | 0.008173 | 0.000708 | 0.012684 | 0.001169 |
| STOREY4 | 0.005809 | 0.000619 | 0.008772 | 0.001014 |
| STOREY3 | 0.003739 | 0.000512 | 0.005378 | 0.000812 |
| STOREY2 | 0.002026 | 0.000390 | 0.002660 | 0.000556 |
| STOREY1 | 0.000719 | 0.000215 | 0.000798 | 0.000238 |

**Table 4: Case no. 03**

**Displacement and drift When Shear wall (lift core) placed at centre and four shear wall placed at outer edge symmetrically parallel to Y direction and force in X direction and Y direction.**

| STOREY | DISP-X | DRIFT-X | DISP-Y | DRIFT-Y |
|---|---|---|---|---|
| STOREY25 | 0.072441 | 0.000894 | 0.070572 | 0.000985 |
| STOREY24 | 0.069712 | 0.000981 | 0.067538 | 0.001003 |
| STOREY23 | 0.066771 | 0.001038 | 0.064473 | 0.001022 |
| STOREY22 | 0.063702 | 0.001061 | 0.061374 | 0.001037 |
| STOREY21 | 0.060590 | 0.001104 | 0.058247 | 0.001054 |
| STOREY20 | 0.057350 | 0.001108 | 0.055075 | 0.001065 |
| STOREY19 | 0.054055 | 0.001104 | 0.051869 | 0.001069 |
| STOREY18 | 0.050761 | 0.001116 | 0.048643 | 0.001072 |
| STOREY17 | 0.047415 | 0.001122 | 0.045391 | 0.001071 |
| STOREY16 | 0.044022 | 0.001105 | 0.042116 | 0.001064 |
| STOREY15 | 0.040640 | 0.001102 | 0.038829 | 0.001057 |
| STOREY14 | 0.037224 | 0.001094 | 0.035526 | 0.001048 |
| STOREY13 | 0.033782 | 0.001071 | 0.032212 | 0.001033 |
| STOREY12 | 0.030366 | 0.001058 | 0.028904 | 0.001019 |
| STOREY11 | 0.026946 | 0.001033 | 0.025605 | 0.001000 |
| STOREY10 | 0.023569 | 0.000984 | 0.022335 | 0.000975 |
| STOREY9 | 0.020331 | 0.000953 | 0.019125 | 0.000946 |
| STOREY8 | 0.017178 | 0.000918 | 0.015993 | 0.000907 |
| STOREY7 | 0.014131 | 0.000872 | 0.012976 | 0.000856 |

| | | | | |
|---|---|---|---|---|
| STOREY6 | 0.011230 | 0.000812 | 0.010122 | 0.000790 |
| STOREY5 | 0.008521 | 0.000738 | 0.007482 | 0.000707 |
| STOREY4 | 0.006058 | 0.000646 | 0.005119 | 0.000602 |
| STOREY3 | 0.003899 | 0.000534 | 0.003105 | 0.000474 |
| STOREY2 | 0.002111 | 0.000408 | 0.001519 | 0.000319 |
| STOREY1 | 0.000745 | 0.000222 | 0.000451 | 0.000135 |

**Table 5: Case no. 04**
**Displacement and storey drift When Shear wall (Lift core) is located 7.5m from the centroid in X-direction and force in X direction**

| STOREY | DISP-X | DRIFT-X |
|---|---|---|
| STOREY25 | 0.070631 | 0.000896 |
| STOREY24 | 0.067886 | 0.000978 |
| STOREY23 | 0.064944 | 0.001031 |
| STOREY22 | 0.061884 | 0.001049 |
| STOREY21 | 0.058796 | 0.001091 |
| STOREY20 | 0.055589 | 0.001090 |
| STOREY19 | 0.052342 | 0.001083 |
| STOREY18 | 0.049104 | 0.001094 |
| STOREY17 | 0.045823 | 0.001097 |
| STOREY16 | 0.042504 | 0.001078 |
| STOREY15 | 0.039205 | 0.001074 |
| STOREY14 | 0.035880 | 0.001064 |
| STOREY13 | 0.032537 | 0.001039 |
| STOREY12 | 0.029226 | 0.001024 |
| STOREY11 | 0.025918 | 0.000998 |
| STOREY10 | 0.022656 | 0.000949 |
| STOREY9 | 0.019534 | 0.000919 |
| STOREY8 | 0.016497 | 0.000884 |
| STOREY7 | 0.013565 | 0.000838 |
| STOREY6 | 0.010775 | 0.000780 |
| STOREY5 | 0.008174 | 0.000708 |
| STOREY4 | 0.005809 | 0.000620 |
| STOREY3 | 0.003739 | 0.000512 |
| STOREY2 | 0.002026 | 0.000390 |
| STOREY1 | 0.000719 | 0.000215 |

**Table 6: Case no. 04**
**Displacement and storey drift at left and right edge When Shear wall (Lift core) is located 7.5m from the centroid in X-direction and force in Y direction**

| STOREY | DISP-X | DISP-Y | DRIFT-X | DRIFT-Y | DISP-Y | DRIFT-Y |
|---|---|---|---|---|---|---|
| STOREY25 | 0.053160 | 0.141102 | 0.000261 | 0.001398 | 0.116146 | 0.000774 |
| STOREY24 | 0.052525 | 0.137231 | 0.000326 | 0.001498 | 0.114315 | 0.000892 |
| STOREY23 | 0.051686 | 0.133089 | 0.000403 | 0.001612 | 0.112078 | 0.001030 |
| STOREY22 | 0.050629 | 0.128628 | 0.000474 | 0.001733 | 0.109407 | 0.001115 |
| STOREY21 | 0.049383 | 0.123826 | 0.000544 | 0.001853 | 0.106447 | 0.001244 |
| STOREY20 | 0.047940 | 0.118652 | 0.000601 | 0.001935 | 0.103090 | 0.001353 |
| STOREY19 | 0.046328 | 0.113198 | 0.000639 | 0.001996 | 0.099386 | 0.001391 |
| STOREY18 | 0.044606 | 0.107545 | 0.000680 | 0.002048 | 0.095521 | 0.001470 |
| STOREY17 | 0.042749 | 0.101687 | 0.000716 | 0.002090 | 0.091374 | 0.001541 |

| | | | | | | |
|---|---|---|---|---|---|---|
| STOREY16 | 0.040760 | 0.095630 | 0.000732 | 0.002114 | 0.086948 | 0.001555 |
| STOREY15 | 0.038689 | 0.089403 | 0.000755 | 0.002137 | 0.082391 | 0.001608 |
| STOREY14 | 0.036503 | 0.082992 | 0.000776 | 0.002155 | 0.077587 | 0.001659 |
| STOREY13 | 0.034198 | 0.076402 | 0.000784 | 0.002160 | 0.072530 | 0.001669 |
| STOREY12 | 0.031814 | 0.069672 | 0.00080z | 0.002169 | 0.067346 | 0.001712 |
| STOREY11 | 0.029319 | 0.062798 | 0.000820 | 0.002170 | 0.061940 | 0.001752 |
| STOREY10 | 0.026717 | 0.055819 | 0.000835 | 0.002152 | 0.056326 | 0.001786 |
| STOREY9 | 0.024024 | 0.048826 | 0.000854 | 0.002137 | 0.050535 | 0.001822 |
| STOREY8 | 0.021236 | 0.041843 | 0.000874 | 0.002105 | 0.044573 | 0.001857 |
| STOREY7 | 0.018359 | 0.034933 | 0.000892 | 0.002049 | 0.038455 | 0.001885 |
| STOREY6 | 0.015406 | 0.028184 | 0.000903 | 0.001962 | 0.032212 | 0.001901 |
| STOREY5 | 0.012402 | 0.021705 | 0.000905 | 0.001836 | 0.025892 | 0.001896 |
| STOREY4 | 0.009385 | 0.015629 | 0.000888 | 0.001661 | 0.019568 | 0.001855 |
| STOREY3 | 0.006417 | 0.010118 | 0.000836 | 0.001421 | 0.013368 | 0.001745 |
| STOREY2 | 0.003619 | 0.005385 | 0.000710 | 0.001084 | 0.007531 | 0.001479 |
| STOREY1 | 0.001241 | 0.001760 | 0.000370 | 0.000525 | 0.002576 | 0.000769 |

**Table 7: Case no. 05**
**Displacement and storey drift When Shear wall (Lift core) is located 7.5m from the centroid in X-direction and four shear wall placed at outer edge symmetrically parallel to Y direction and force in X direction.**

| STOREY | DISP-X | DRIFT-X |
|---|---|---|
| STOREY25 | 0.072453 | 0.000894 |
| STOREY24 | 0.069723 | 0.000981 |
| STOREY23 | 0.066782 | 0.001038 |
| STOREY22 | 0.063713 | 0.001061 |
| STOREY21 | 0.060600 | 0.001105 |
| STOREY20 | 0.057359 | 0.001108 |
| STOREY19 | 0.054064 | 0.001104 |
| STOREY18 | 0.050769 | 0.001116 |
| STOREY17 | 0.047422 | 0.001122 |
| STOREY16 | 0.044028 | 0.001105 |
| STOREY15 | 0.040646 | 0.001102 |
| STOREY14 | 0.037229 | 0.001095 |
| STOREY13 | 0.033787 | 0.001071 |
| STOREY12 | 0.030369 | 0.001058 |
| STOREY11 | 0.026949 | 0.001033 |
| STOREY10 | 0.023571 | 0.000984 |
| STOREY9 | 0.020332 | 0.000954 |
| STOREY8 | 0.017179 | 0.000918 |
| STOREY7 | 0.014132 | 0.000872 |
| STOREY6 | 0.011230 | 0.000812 |
| STOREY5 | 0.008522 | 0.000738 |
| STOREY4 | 0.006058 | 0.000646 |
| STOREY3 | 0.003899 | 0.000534 |
| STOREY2 | 0.002111 | 0.000408 |
| STOREY1 | 0.000745 | 0.000222 |

**Table 8: Case no. 05**

**Displacement and storey drift at left and right edge When Shear wall (Lift core) is located 7.5m from the centroid in X-direction and four shear wall placed at outer edge symmetrically parallel to Y direction and force in Y direction.**

| STOREY | DISP-X | DISP-Y | DRIFT-X | DRIFT-Y | DISP-Y | DRIFT-Y |
|---|---|---|---|---|---|---|
| STOREY25 | 0.017890 | 0.062581 | 0.000245 | 0.000877 | 0.091619 | 0.001262 |
| STOREY24 | 0.017145 | 0.059859 | 0.000250 | 0.000893 | 0.087751 | 0.001286 |
| STOREY23 | 0.016393 | 0.057109 | 0.000255 | 0.000909 | 0.083844 | 0.001311 |
| STOREY22 | 0.015634 | 0.054328 | 0.000259 | 0.000923 | 0.079894 | 0.001330 |
| STOREY21 | 0.014869 | 0.051518 | 0.000263 | 0.000938 | 0.075910 | 0.001353 |
| STOREY20 | 0.014094 | 0.048666 | 0.000267 | 0.000947 | 0.071870 | 0.001369 |
| STOREY19 | 0.013310 | 0.045782 | 0.000268 | 0.000951 | 0.067782 | 0.001375 |
| STOREY18 | 0.012520 | 0.042881 | 0.000269 | 0.000954 | 0.063665 | 0.001381 |
| STOREY17 | 0.011721 | 0.039959 | 0.000270 | 0.000953 | 0.059507 | 0.001382 |
| STOREY16 | 0.010914 | 0.037018 | 0.000268 | 0.000947 | 0.055311 | 0.001374 |
| STOREY15 | 0.010101 | 0.034069 | 0.000267 | 0.000940 | 0.051093 | 0.001368 |
| STOREY14 | 0.009281 | 0.031111 | 0.000265 | 0.000931 | 0.046844 | 0.001358 |
| STOREY13 | 0.008454 | 0.028149 | 0.000263 | 0.000917 | 0.042570 | 0.001342 |
| STOREY12 | 0.007624 | 0.025200 | 0.000260 | 0.000902 | 0.038291 | 0.001327 |
| STOREY11 | 0.006790 | 0.022269 | 0.000257 | 0.000882 | 0.034008 | 0.001307 |
| STOREY10 | 0.005957 | 0.019375 | 0.000253 | 0.000857 | 0.029747 | 0.001280 |
| STOREY9 | 0.005130 | 0.016547 | 0.000247 | 0.000829 | 0.025541 | 0.001246 |
| STOREY8 | 0.004315 | 0.013799 | 0.000239 | 0.000792 | 0.021420 | 0.001200 |
| STOREY7 | 0.003524 | 0.011163 | 0.000227 | 0.000745 | 0.017435 | 0.001137 |
| STOREY6 | 0.002769 | 0.008680 | 0.000211 | 0.000684 | 0.013647 | 0.001054 |
| STOREY5 | 0.002063 | 0.006393 | 0.000191 | 0.000609 | 0.010128 | 0.000947 |
| STOREY4 | 0.001426 | 0.004356 | 0.000164 | 0.000516 | 0.006963 | 0.000811 |
| STOREY3 | 0.000876 | 0.002628 | 0.000131 | 0.000404 | 0.004250 | 0.000642 |
| STOREY2 | 0.000438 | 0.001276 | 0.000091 | 0.000269 | 0.002100 | 0.000438 |
| STOREY1 | 0.000135 | 0.000374 | 0.000040 | 0.000112 | 0.000633 | 0.0001 |

**Table no. 9 Axial forces in column Due to only lateral load on building applied in Y Direction.**
**1)Without Shear Wall**

| Axial forces in line D-D | | | Axial forces in line A-A | |
|---|---|---|---|---|
| Line No. | Top row | Bottom row | Top row | Bottom row |
| 1 | 3.83 | 1296.14 | 3.34 | 1231 |
| 2 | 11.22 | 384.92 | 12.02 | 207.31 |
| 3 | 0.49 | 48.40 | 1.33 | 39 |
| 4 | 0.49 | 48.4 | 1.33 | 39 |
| 5 | 11.22 | 384.92 | 12.02 | 207.31 |
| 6 | 3.83 | 1296.14 | 3.34 | 1231 |

**2)Shear wall (lift core) placed at centre**

| Axial forces in line D-D | | | Axial forces in line A-A | |
|---|---|---|---|---|
| Line No. | Top row | Bottom row | Top row | Bottom row |
| 1 | 11.12 | 910.37 | 16.98 | 829.60 |
| 2 | 24.36 | 764.14 | 8.39 | 170.78 |
| 3 | | | 1.11 | 31.39 |
| 4 | | | 1.11 | 31.39 |
| 5 | 24.36 | 764.14 | 8.39 | 170.78 |
| 6 | 111.12 | 910.37 | 16.98 | 829.60 |

**3)Shear wall(lift core) placed at centre and four shear wall located at outer edge**

| Axial forces in line D-D | | | Axial forces in line A-A | |
|---|---|---|---|---|
| Line No. | Top row | Bottom row | Top row | Bottom row |
| 1 | 11.70 | 638.20 | 47.71 | 1814.53 |
| 2 | 22.66 | 539.38 | 58.08 | 1585.92 |
| 3 | | | 12.4 | 198.68 |
| 4 | | | 12.4 | 198.68 |
| 5 | 22.66 | 539.38 | 58.08 | 1585.92 |
| 6 | 11.70 | 638.20 | 47.71 | 1814.53 |

## Conclusion:

From preliminary investigation reveals that the significant effects on deflection in orthogonal direction by The shifting the shear wall location. Placing Shear wall away from centre of gravity resulted in increase in most of the members forces. It may be observed from tables no 2 and table no 3 that displacement of the building floor at storey 25 has been reduced due to presence of shear wall placed at centre From table no 4 placing of shear wall in y direction the displacement reduces but it displacement not reduces in X direction. When the lift core placed eccentric position it develops displacement in both the direction with application of seismic force in Y direction. From above table it is cleared that drift is increased as height of building increased and reduced for top floor. Table no.09 shows that the column which placed at the edge of the building is heavily axially loaded due to seismic forces. Location of shear wall effects on static and dynamic axial load on the column . The displacement of building is uni-directional and uniform for all the grids in the case of Zero eccentricity for seismic loading. With the increase in eccentricity, the building shows non-uniform movement of right and left edges of roof due to torsion and induces excessive moment and forces in member

## References:

1. Ashraf, M.,Siddiqi, Z.A.,andJaved, M.A. (2008).”Configuration of a multi-storey building subjected to lateral forces.” Asian Journal of civil Engineering (Building and Housing), Vol. 9, No.5 Pages 525-537.
2. Anshuman, S.,DipenduBhunia, BhavinRamjiyani (2011),” Solution of shear wall location in Multi-storey building.” International Journal of civil and structural Engineering Vol. 2,No.2 Pages 493-506.
3. ShrikhandeManish,AgrawalPankaj(2010).”Earthquake Resistant Design of Structures.” PHI Learning Private Limited New Delhi.
4. Duggal S.K.(2010).”Earthquake Resistant Design of Structures.” Oxford university press YMCA library building, Jai Singh road, New Delhi.
5. Breau of Indian Standard, IS -1893, Part 1 (2002), “Criteria for Earthquake resistant design of structures.” Part 1 General provision and building, New Delhi, India.
6. Bureau of Indian Standard, IS- 456 (2000),”Plain and Reinforced Concrete ,code of practice.”

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