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Seismic behavior of end walls in RC tall buildings with torsional irregularity

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Abstract. Many factors affect tall buildings under the influence of earthquake forces. According to the conducted studies, more tensions have been observed in the end wings of shear walls. The end shear wall is used to reduce tensions and to improve the performance of shear walls in tall buildings. In this study, 10-story, 30-story and 50-story concrete buildings with square plans were modeled and two cases of the moment-resisting frame with shear wall and moment-resisting frame with end shear wall, which were under the influence of earthquake and linear static analysis have been investigated. In this analysis, the buildings were torsioned and the results of the analysis showed that the values of the drifts, roof displacement and first period in the structure with the end wall are about 50 % percent less than of that of the building without the end wall, also, On the other hand, with the presence of the end wall in structure the ratio ($\Delta max/\Delta avg$) is more than 1.2, so, the use of the end wall led to a more appropriate behavior of warping in comparison to concrete square frames with no end walls.

1. Introduction

One of the examples that can be mentioned by some researcher about the use of the end wall is the Kingdom tower built in the city of Jeddah, Saudi Arabia, in 2013 which has been used end shear walls to withstand lateral forces; on the other hand, due to severe stresses, the shear walls at the end of the shear walls flanges have been used in the vicinity of the fire escape stairs which have improved the hardness and stability of the system. Also, the layout of the core walls caused torsion strength and hardness for the overall structure system, and the extension of the end wall at the corners has limited the deformation of the floor system [1].

In the case of shear walls, a number of studies have been carried out on different results regarding the effects and behavior of shear walls and related parameters.

Other researcher argued the warping analysis of RC cores and concluded that warping should consider in design, because, longitudinal tensions are very significant [2]. Also, some investigators searched for tall building braced by shear walls and thin-walled under seismic load.at this paper applied Galerkin technique and a generalized method proposed at this aim, and the accuracy of this method controlled by numerical example [3]. A research about seismic behavior of composite shear wall systems and smart structures technology indicated that the design of mentioned shear wall systems could be applied by smart structures technology [4]. Some researcher investigated about RC shear wall in Tall building. One result showed the critical demands occurred in the middle height of the tall building [5]. A study indicated that composite shear wall behavior subjected to cyclic loadings caused slope reduction load-displacement curve [6]. On the other hand, investigators examined size effects in RC flanged shear walls, and they could not find a single relationship about the dimension and behavior of the shear wall [7]. An investigation considered asymmetric shear walls and their vibration analysis by transfer matrix method, and realized the proposed method had acceptable result [8]. Also, other researchers noted to the flange thickness and its behavior in shear walls. The results indicated that while flange is in pressure, the global behavior is more than in tension [9]. Some investigators searched for static analysis in non-planar coupled shear walls and using continues connection method indicated the mentioned method is suitable for pre-design purposes of non-planar coupled shear walls

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[10]. simplified model for the analysis of free plan buildings investigated by researchers and shear wall core modeled by wide column element and finally a model devised by shear wall, energy dissipation system and inelastic behavior of walls [11]. Also, a conceptual design investigated in coupled shear walls and indicated by comparison performance-based seismic design and conventional design based on linear response spectrum, they realized that PBSD significantly improved [12]. Another study about seismic behavior of steel frames with RC shear walls searched by researchers. Analytical results showed that the ductility and the response modification factor depend on the structure height [13]. Some investigators focused on the warping deformation on thin-walled open section shear walls, and after evaluation an experimental test, proposed formulation [14].

On the other hand, some researchers and their colleagues carried out the seismic behavior of narrow RC walls. Some of the conclusion presented that by reduction of wall thickness, 25 % declines the displacement ductility, capacity and energy dissipation [15]. Other investigators discussed about multi-plastic hinges in tall buildings. The elevation indicated a non-elastic energy loss in walls [16]. Also, in a study published by researchers about the seismic damage in prestressed concrete of the wall connection. And it was concluded that the maximum stresses expand on the shear wall and then extend to the wall connection in the first floor [17]. others determined the shear wall position in RC building by Vertical Irregularities and It is observed by using Response Spectrum method and comparison torsional values in structures with and without shear walls realized the mentioned values in structure with shear wall is greater (for EQX) than other one [18]. Also, by consideration shear force in RC walls and showed due to architectural limitations, the optimized support conditions are impossible, some solutions proposed by using late-cast slabs, transfer girders with increased depth, thicker upper shear walls, and using higher grade concrete in critical regions [19]. Other researchers investigated for effect of lintel beams and floor slabs on natural frequencies in tall buildings core and presented by using Vlasov theory and transfer matrix method achieved suitable agreement in the obtained results with FEM and experimental results [20]. An investigation argued energy dissipation and tall RC core-wall buildings by consideration with numerous plastic hinges and using time history analysis. also the performance subjected to near-fault and far-fault compared. One of the result showed inelastic energy dissipation occurring at the part of high, specially, at the base and above the mid-height of the walls [21].

On the other hand, the shear-walls of the high-rise structural system investigated in two type of Open and closed, in this way, the structure modeled as a single equivalent cantilever. So, the method proposed are indicated by a numerical example [22].

Other researches and their colleagues presented shear lag effect shear wall in of T-shaped and short-leg, Research shows that numerical calculation values of results are acceptable, and parameters effect on shear lag coefficient, differently [23].

On the other hand, some investigators extended this work to include the effect of shear wall on seismic behavior of unsymmetrical RC structure, the results showed when shear walls are located at exterior corners, base shear and torsion declined to 28 % to 35 %, 29 % to 35 %, respectively, for earthquake in of X and Y dimensions [24]. Also, others analyzed about seismic performance of slender C-shaped walls under uni-and bi-directional loading by loads, and the results showed in comparison C-shaped to planar walls, there was a more ductile flexural-tension in the C-shaped specimens, specifically, where wall flanges contribute in pressure loads [25]. An investigation demonstrated about boundary element and their detailing in shear walls. also, results indicated that by testing the boundary elements in axial compression just achieving the minimum ACI 318 requirements and strength and strain capacities are, on meaning, 20 % and 10 % more than unconfined concrete, respectively [26]. on the other hand, an evaluation about drift capacity of RC structural walls and in this study considered boundary elements, the study indicates that deformation capacity in wall has a function of some ratios such as 1) wall neutral axis depth-to-compression zone width (c/b), 2) wall length-to-compression zone width (lw/b), 3) wall shear stress ratio ($v_{max}/\sqrt{f_c'}$), and 4) the configuration of boundary transverse reinforcement [27]. Some researchers investigated about the headquarters tower in Turin and Structural analysis subjected horizontal loads. One of the consequence showed the proposed algorithm used at this article led to reliable results [28].

A survey of literature review indicates an investigation is needed about the effect of end wall on behavior of RC tall building. end wall connect end of shear walls in all stories in tall buildings, and some parameters such as maximum displacement, maximum drift and torsional effects play a significant role in the behavior of RC tall buildings under seismic forces. So, this paper present study about the effect of end wall by focus on mentioned parameters in RC tall building with torsional irregularities subjected seismic load.

2. Methods

2.1. Mathematical Formulation

Notations:

Iw is warping moment of inertia;

J_1 is torsion constant;

$B(z)$ is second moment;

$\sigma(c, z)$ is vertical tension of the wall at a distance c from the neutral axis;

$T_w(z)$ is the torsion associated with the warping;

$T_v(z)$ is the torsion associated with the shear currents;

$\sigma(s, z)$ is the distribution of tension in height (z);

$\omega(s)$ is field coordinates;

H is the height of the structure;

A is the area of the plan;

u is poison coefficient;

f_c is concrete comprehensive strength;

ρ is concrete reinforced ratio;

f_y is yield strength of steel.

In the buildings being studied, the shear wall systems were rigid at base of the core and had torsions at the top. Assuming a simple cross section, I, in which the warping effect is observed, these walls are symmetrical in relation to the axes X and Y, and are under the torsion of the eccentrically ratio 0.05 When the torsion T is applied around the axis Z and above the member, this member is rotated around the shear center and the wings will rotate in their plate around the X axis and rotate around the vertical axis. In the moment effect, the slab sections revolve around the X axis in different directions, and the sections of the plate are exited from the plate or warped. The torsion has been noted by researchers [29]; that is tolerated by the spin of the wings equals to:

$$T_v(z) = GJ_1 \frac{d\theta}{dz}(z) \tag{1}$$

Iw is the geometric property of the section and it called the warping moment of inertia or the warping constant. Also, J_1 is the torsion constant and the torsion equation resulting from the warping is as follows:

$$-EI_w \frac{d^3\theta}{dz^3}(z) + GJ_1 \frac{d\theta}{dz}(z) = T \tag{2}$$

On the other hand, $B(z)$ is an action which is called the second moment.

$$B(z) = M(z)L \tag{3}$$

$\sigma(c, z)$ is the vertical tension of the wall at a distance c from the neutral axis.

$$\sigma(\mathrm{c}, z) = \frac{M(z)c}{I} \tag{4}$$

For the rigid warping effect of the uniform cores under the influence of the torsion, we can refer to the theory of Vlasov. In order to study the differential equation, we can assume a core that is rigid at the bottom and free at the top and is under the influence of the extensive torsion $m(z)$. For the analysis of the equation, we can assume that the core has a cross section with uniform dimensions and properties at all altitudes.

The general warping is defined as:

$$T(z) = T_v(z) + T_w(z) \tag{5}$$

The torsion associated with the warping is defined in Eq. (6):

$$T_w(z)=-EI_\omega \frac{d^3\theta}{dz^3}(z) \quad (6)$$

And the torsion associated with the shear currents is as follows:

$$T_v(z)=GJ\frac{d\theta}{dz}(z) \quad (7)$$

The differential equation representing the torsion of the warping of the core is as follows:

$$\frac{d^4\theta}{dz^4}(z)-\alpha^2\frac{d^2\theta}{dz^2}(z)=\frac{m(z)}{EI_\omega} \quad (8)$$

In which:

$$\alpha^2=\frac{GJ}{EI_\omega} \quad (9)$$

In a uniform extensive torsion by applying boundary conditions, we will have:

$$\theta(z)=\frac{mH}{EI_\omega}\left\{\frac{1}{(\alpha H)^4}\left[\frac{\alpha H\sinh\alpha H+1)}{\cosh\alpha H}(\cosh\alpha z-1)-\alpha H\sinh\alpha z+(\alpha H)^2\left[\frac{z}{H}-\frac{1}{2}\left(\frac{z}{H}\right)^2\right]\right]\right\} \quad (10)$$

$$\alpha H=H\sqrt{\frac{GI}{EI_\omega}} \quad (11)$$

$$\alpha z=\ \alpha H(\frac{z}{H}) \quad (12)$$

The above equation consists of two independent parts. The parts inside the brackets represents the distribution of rotation in the height, and it is a function of dimensionless structures parameters of αH and Z/H.

On the other hand, investigators [29] mentioned the warping stresses are calculated as follows with respect to the second moment $B(z)$.

$$B(z)=-EI_\omega\frac{d^2\theta}{dz^2}(z) \quad (13)$$

$$\sigma(s,z)=\frac{B(z)\omega(s)}{I_\omega} \quad (14)$$

As it can be seen in Eq. (14), adding an end wall reduces the stresses and consequently reduces the effect of warping and torsion.

2.2. Specifications of structures and materials

Since the behavior of end walls has less been studied, the purpose of this paper is to investigate the effects of end walls in tall buildings with square plan and moment frames subjected to earthquake forces in relation to the torsion effect using Etabs 2016 software for linear static analysis of frames of 30 and 50 stories in two cases of having an end wall and no end wall.

In order to investigate the effects of end walls on tall buildings with square plan under two-dimensional seismic forces, two concrete frames of 10، 30 and 50 stories with moment frames with and without end walls are used. Eccentrically ratio considered 0.05 for torsional effective in all buildings.

Table 1. Concrete frames models.

Label	Description	Rang	
		Name	Stories
CMF_1	Concrete Moment Frame	High-Rise	50
CMF_2	Concrete Moment Frame With End Wall	High-Rise	50
CMF_3	Concrete Moment Frame	Mid-Rise	30
CMF_4	Concrete Moment Frame With End Wall	Mid-Rise	30
CMF_5	Concrete Moment Frame	Low-Rise	10
CMF_6	Concrete Moment Frame With End Wall	Low-Rise	10

In these models, the location of the site is the same and the frames are considered as three-dimensional concrete of moment type with 7 meters' spans and the height of 4 meters. Table 2 to 4 show the specification of sections and materials.

Table 2. Buildings specifications.

Name	$H\ (m)$	$A\ (m^2)$	Plan Dimensions (m×m)	Story
Building 1	200	61250	35×35	50
Building 2	200	61250	35×35	50
Building 3	120	36750	35×35	30
Building 4	120	36750	35×35	30
Building 5	40	12250	35×35	10
Building 6	40	12250	35×35	10

Also, the sections of beams and columns and specifications of the materials used are as follows:

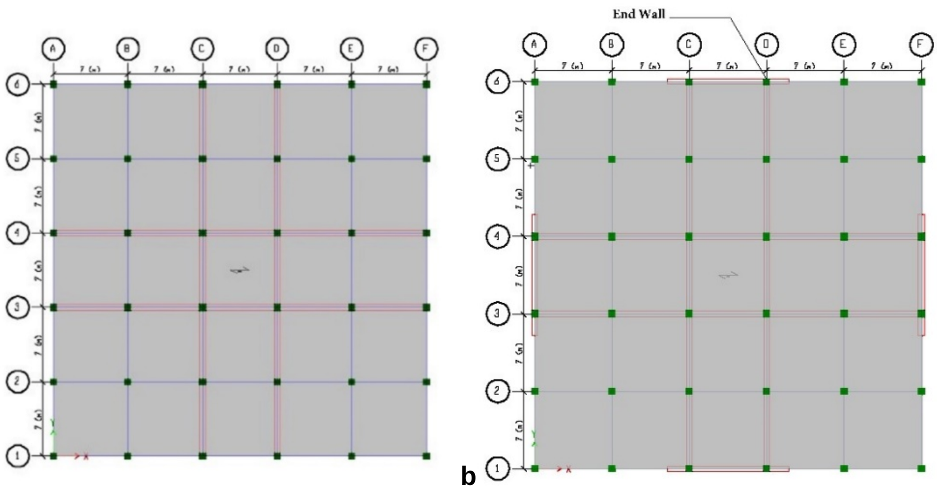
Table 3. Sections specifications.

Label	Dimension
50 Story:	
Beams	(0.6)m wide × (0.8)m deep
Columns	(0.8)m × (0.8)m
Wall	(35)m long × (0.8)m thick
End Walls	(11)m long × (0.8)m thick
Slab	(0.15) m thick
30 Story:	
Beams	(0.4) m wide × (0.5) m deep
Columns	(0.6) m × (0.6) m
Walls	(35) m long × (0.5) m thick
End Walls	(11) m long × (0.5) m thick
Slabs	(0.15) m thick
10 Story:	
Beams	(0.3) m wide × (0.3) m deep
Columns	(0.4) m × (0.4) m
Walls	(35) m long × (0.2) m thick
End Walls	(11) m long × (0.2) m thick
Slabs	(0.15)m thick

Table 4. Materials specifications.

Concrete		Steel	
υ	0.15	Type	A_3
f_c	50 MPa	f_y	400 N/mm^2
ρ	2.5		

In the below plans, the layout of the shear walls has been considered with and without end walls, and on the other hand, the dimensions of opening 1.80×2.40 has been considered in all stories at C and D axesa.



a b

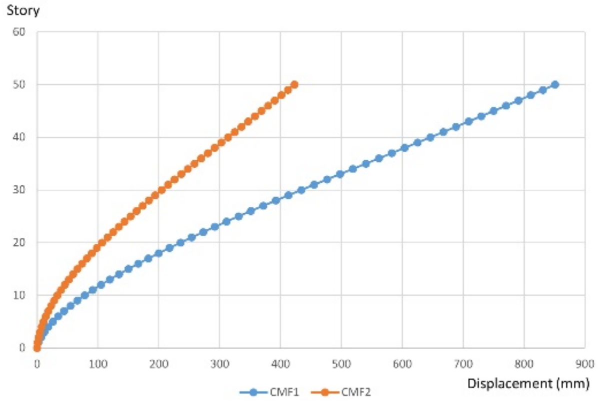
Figure 1. Building plan: (a) Building 1,3,5, (b) Building 2,4,6.

In Fig. 1 (b), the end walls are placed in axes A, F, 1 and 6, and Fig. 1 (a) is a plan without the end wall. CMF1, CMF2 CMF3, CMF4, CMF5 and CMF6 farms are under seismic forces in two directions of x, y.

3. Results and Discussion

In order to investigate the warping effect on CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 structures, EQX and EQY was applied in them.

Also, for more evaluation used displacement results of the 10 stories,30-stories and 50-stories, Fig. 2 (a), (b) and (c) show the displacements graphs based on the stories in the CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 structures under EXN. The maximum displacement of frames mentioned at Table 5. In primarily levels the different of displacements are not very much, but they increase at high levels gradually. Reducing the maximum displacement in structure with end wall is observed.



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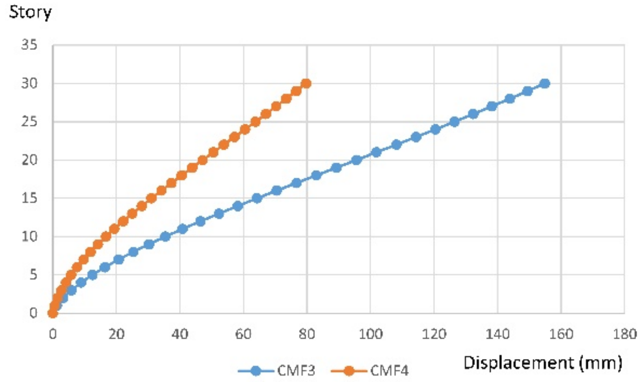

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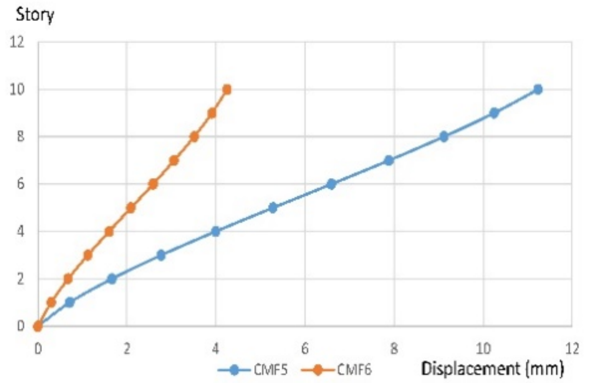


c

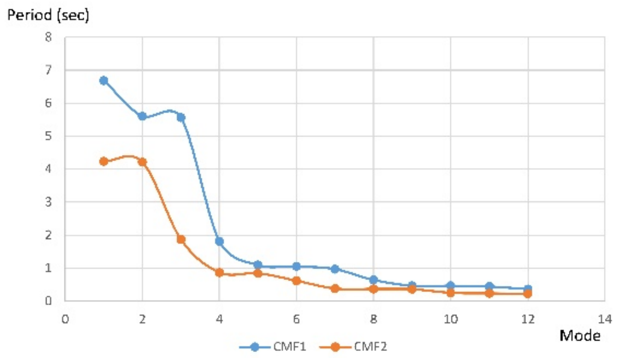
Figure 2. Displacement-Story under EXN (a) CMF1 and CMF2, (b) CMF3 and CMF4, (c) CMF5 and CMF6.

Table 5. Maximum displacement.

Lable	Maximum displacemnet (mm)
CMF1	850
CMF2	422
CMF3	154
CMF4	79
CMF5	11
CMF6	4

Due to the presence of the end wall, a significant reduction from 850 mm, 154 mm, 11 mm to 422 mm, 79 mm, 4 mm in the roof, which indicates the suitable performance of the end wall in all type of structures.

On the other hand, for more comparision,the periods based on modes of CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 indicated in Fig. 3(a), (b) and (c). For example, first modes are 6.69 and 4.24 (sec) in CMF1 and CMF2, respectivley.



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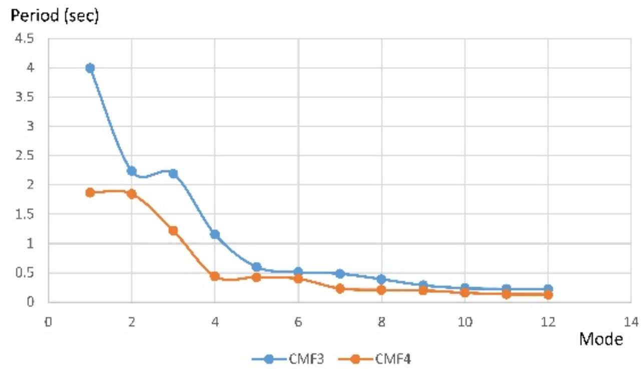

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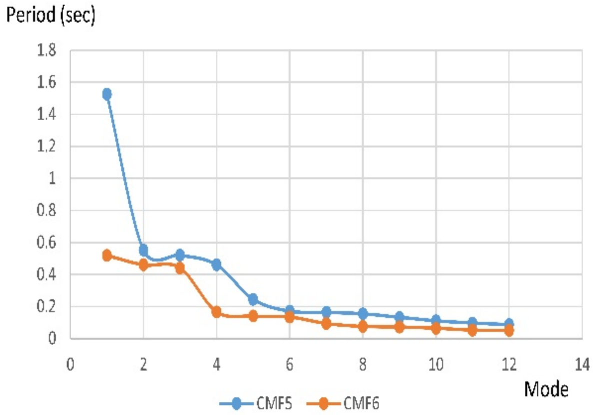

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Figure 3. The Period-Mode under EXN
(a) CMF1 and CMF2, (b) CMF3 and CMF4, (c) CMF5 and CMF6.

Also, in Table 6 listed the first priods of CMF1, CMF2, CMF3, CMF5 and CMF6, so , as it seen.The end wall reduced periods, effectively.

Table 6. Periods.

Label	T_1(sec)
CMF1	6.69
CMF2	4.24
CMF3	3.99
CMF4	1.87
CMF5	1.58
CMF6	0.52

According to Table 6, the end wall effects is observed in the structures in the first mode. On the other hand, as it can be seen, the periods have been decreased in the first mode in CMF2, CMF4, CMF6 apparently. These reductions are 50 %, approximately.

In order to investigate the analytical results, the effects of the torsion on the structures according to the application of the eccentrically ratio in the torsion structure were produced. The effects of this torsion according to ASCE7-2016 code are the conditions and classification for the curvature as follows:

- $\Delta_{\max} / \Delta_{avg} \leq 1.2$ regularities torsion in plan
- Control of torsion regularity many irregularities torsion in plan $1.2 < \Delta_{\max} / \Delta_{avg} \leq 1.4$
- Severe irregularities torsion in plan $\Delta_{\max} / \Delta_{avg} > 1.4$

According to the rules set out in ASCE7-2016 and the output values of the Diaphragm $(\Delta_{max}/\Delta_{avg})$ Drift in CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 structures, the ratios $(\Delta_{max}/\Delta_{avg})$ are included in Table 7. These values are in accordance with the provisions of the code it is mentioned.

Table 7. Torsional Analytical Results.

Type	Story	Ratio ($\Delta_{max}/\Delta_{avg}$)	Type	Story	Ratio ($\Delta_{max}/\Delta_{avg}$)
CMF_1 :			CMF_2 :		
	Story 1-8	$\Delta_{\max} / \Delta_{avg} > 1.4$		Story 1-50	$\Delta_{\max} / \Delta_{avg} \leq 1.2$
	Story 9-23	$1.2 < \Delta_{\max} / \Delta_{avg} \leq 1.4$			
	Story 22-50	$\Delta_{\max} / \Delta_{avg} \leq 1.2$			
	Story 1-20	$\Delta_{\max} / \Delta_{avg} > 1.4$			
CMF_3 :			CMF_4 :		
	Story 1-20	$\Delta_{\max} / \Delta_{avg} > 1.4$		Story 1-30	$\Delta_{\max} / \Delta_{avg} \leq 1.2$
	Story 20-30	$1.2 < \Delta_{\max} / \Delta_{avg} \leq 1.4$			
CMF_5 :			CMF_6 :		
	Story 1-10	$\Delta_{\max} / \Delta_{avg} > 1.4$		Story 1-10	$\Delta_{\max} / \Delta_{avg} \leq 1.2$

As can be seen, in Table 8, eccentrically ratio, in the CMF3 structure, floors 1 through 20 have a severe irregularity torsion and a very irregular torsion 20-30 provided. On the other hand, in CMF4, with the presence of the end wall of the floor 1 to 30 turns into regularity torsion. Also in the CMF1 structure has from 1st to 8th story, the severe irregularity torsion, many irregularity 9 to 23, and regularity torsion 22 to 50, but with the end wall in the CMF2 structure, is tensed from 1st to 50th regular structures. In addition, in the CMF5 indicated severe irregularity at Story 1-10 levels, also, in the CMF6 decreased ratio to 1.2 and it showed regularity torsion.

For comparison and in the form of Fig. 4 (a) Ratio *($\Delta_{max}/\Delta_{avg}$***)** (based on the relative high in CMF1 torsion, CMF2 structures is plotted, and as it seen, the variations in the Ratio *($\Delta_{max}/\Delta_{avg}$***)** to the relative height in CMF1 are greater than CMF2. The effect of the presence of the end wall at the CMF2 has been to control the effects of warping and torsion, as well as the end wall.

However, it reduces the variation in the Ratio *($\Delta_{max}/\Delta_{avg}$***)** at height. In CMF3, CMF4, CMF5, CMF6 is also shown in Fig. 4 (b) and (c) which illustrates the proper function of the end wall in torsion and warping.

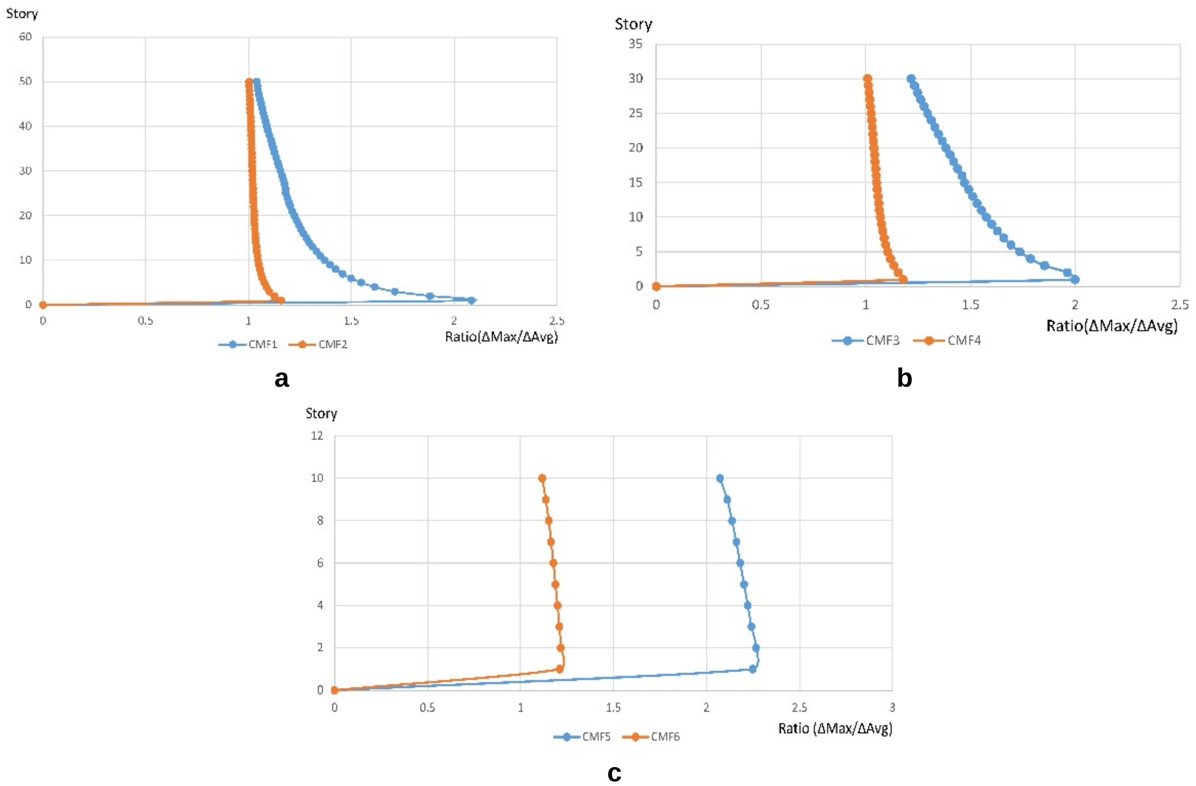
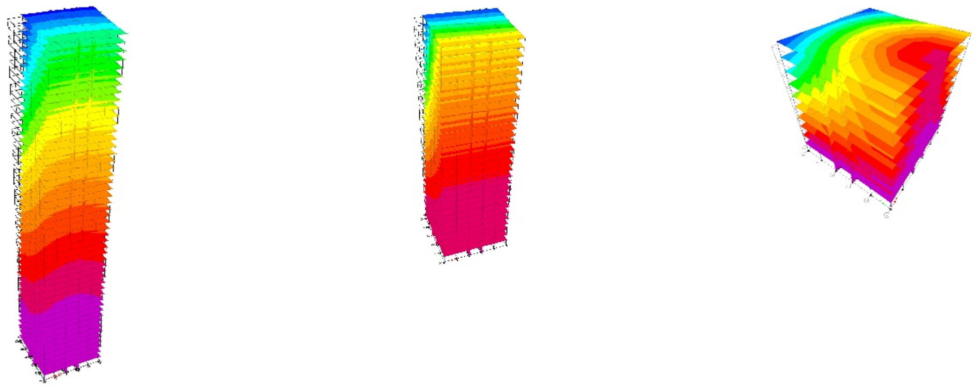


Figure 4. Ratio (ΔMax /ΔAvg) based on Relative Height (a) CMF1 and CMF2, (b) CMF3 and CMF4, (c) CMF5 and CMF6.

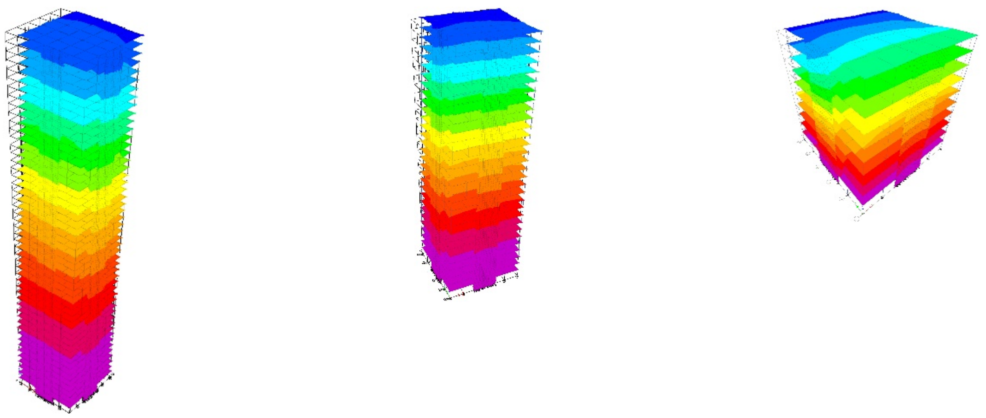
In Fig. 4 (a), (b) and (c), CMF1.CMF3 and CMF5 structures have different the ratios *(*$\Delta_{max}/\Delta_{avg}$**)** from low to high levels, but the results of CMF2, CMF4and CMF6 structures indicate more control on ratios *(*$\Delta_{max}/\Delta_{avg}$**)** at levels and it means that the decreasing of torsion and their variations improve remarkable by end walls.

On the other hand, in order to investigate the structure and the state of tensions in the first mode and in the case of torsion in CMF1, CMF3, CMF5 is considered in Fig. 5 (a), (b) and (c), as is shown by the unbalanced and irregular distribution of stresses in Fig. 5, but with the presence of the end wall in Fig. 6, tensions in the first mode have a regular and classified distribution at height.



a b c

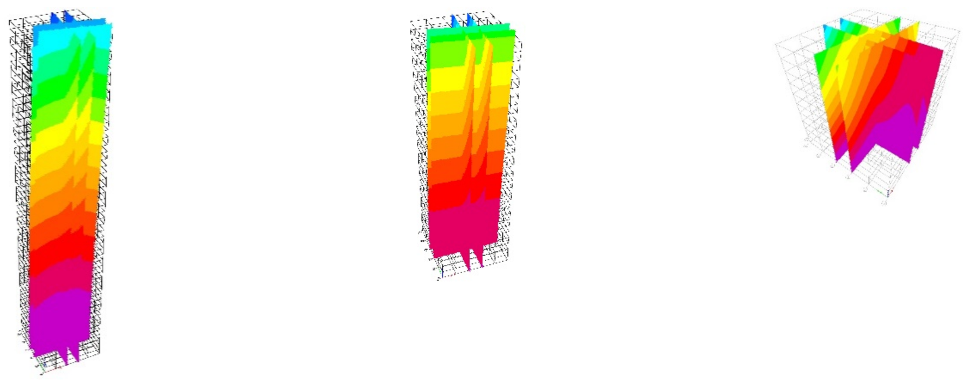
Figure 5. Distribution of structure stress CMF1 (b) CMF3 (c) CMF5.



a b c

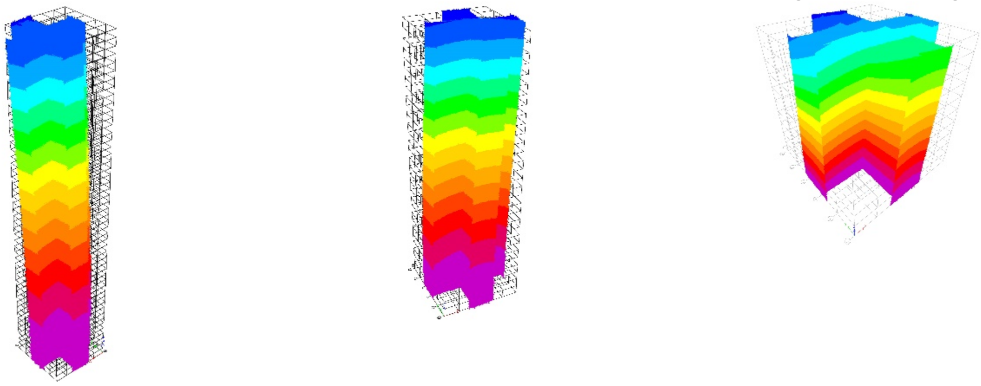
Figure 6. Distribution of structure stress (a) CMF2, (b) CMF4, (c) CMF6.

Also, the Fig. (7) and (8) of the shear wall stresses in CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 structures, as seen in Fig. 7, are unbalanced and irregular distribution in shear walls in the first mode and in the torsion, and in Fig. 8. Shear walls include the end wall, which distributes regular stress. However, this behavior indicates noticeable by end wall utilization.



a b c

Figure 7. Distribution of Shear Wall Stress CMF1 (b) CMF3 (c) CMF5.

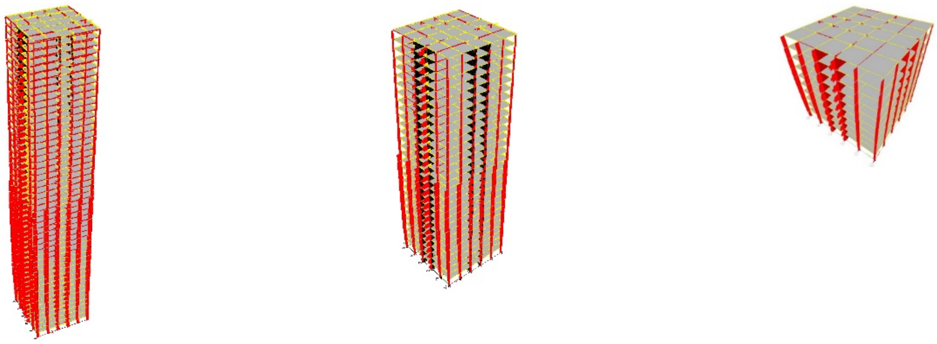


a b c

Figure 8. Distribution of Shear Wall Stresses (a) CMF2 (b) CMF4 (c) CMF6.

Also, the classified tensions cause economical design in structures. so, end walls have effective role for structural engineers.

The torsion contour indicated in Fig. (9) and (10), the torsion Contour of structures in CMF1, CMF3 and CMF5 show that high torsion in shear walls and frames, but in CMF2, CMF4 and CMF6 the contour indicates declining torsion by end wall, so, End walls caused better performance at CMF2, CMF4 and CMF6 in comparison with CMF1, CMF3 and CMF5 structures, respectively.



a b c

Figure 9. The torsion Contour of structure (a) CMF1 (b) CMF3 (c) CMF5.

a b c

Figure 10. The torsion Contour of structure (a) CMF2 (b) CMF4 (c) CMF6.

As can be seen, the end walls had significant role in all structures type (low-rise, mid-rise and high-rise) such as declining at period, displacement, ratio ($\Delta_{max}/\Delta_{avg}$). For more comparison, floor rotation indicated in Fig. 11 for CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6.

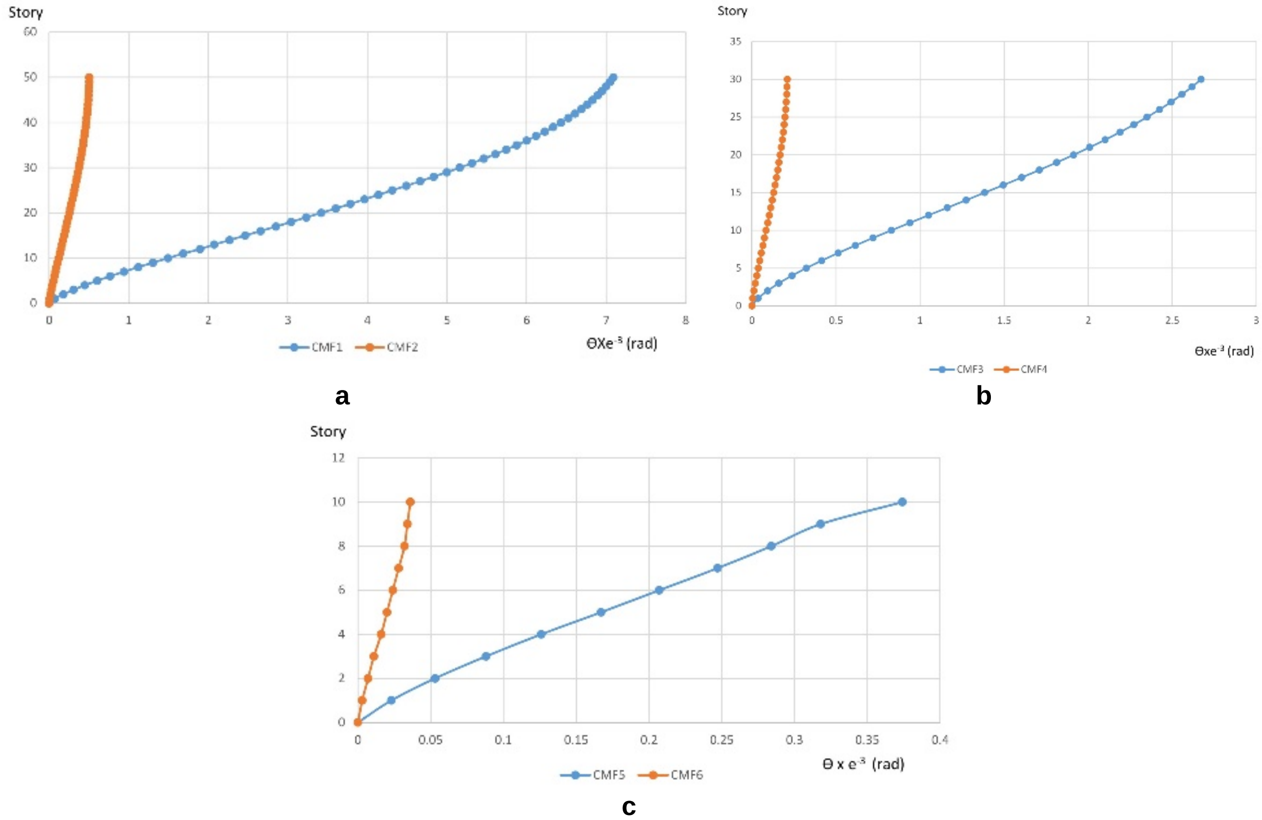


Figure 11. The floor torsion angle-story
(a) CMF1 and CMF2, (b) CMF3 and CMF4, (c) CMF5 and CMF6.

Graph illustrates changes in the amounts of torsions in stories at different type of structures.

In other view, the structures without end wall have with softer curved slope rather than structures end wall. This reason means that, the floor torsion declined at CMF2, CMF4 and CMF6 structures. In Fig. 11 (a), the maximum θ are 0.505*e^{-3} (rad) and 7.089*e^{-3} (rad) in CMF1 and CMF2, respectively. So, this obvious difference derived from presence of end walls in CMF2 Also the maximum θ are 0.211*e^{-3} (rad) and 2.672*e^{-3} (rad) in CMF3, CMF4, and 0.036*e^{-3} (rad), 0.374*e^{-3} (rad) in CMF5 and CMF6, respectively. So, the effective role of end walls observes in Fig. 11.

On the other hand, tensions and forces concentrate in opening zone and link beam, so, for more investigation, their values indicated at first level in Fig. 12 and 13.

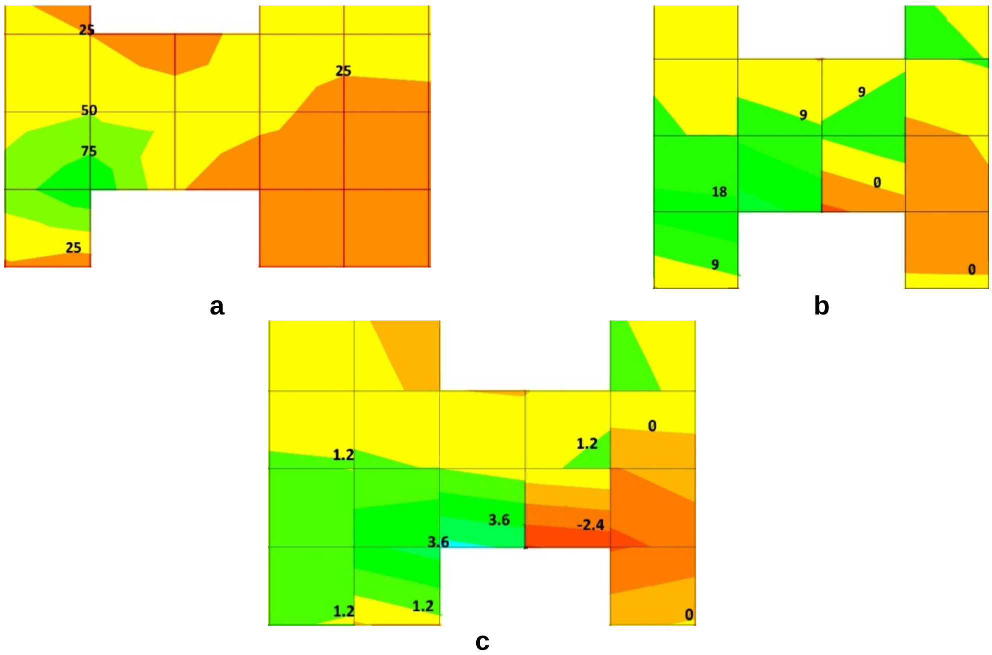
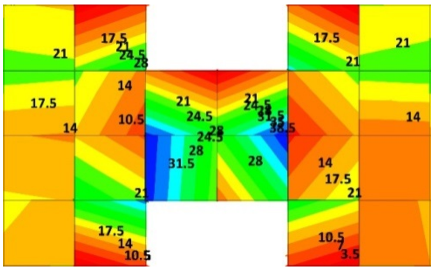
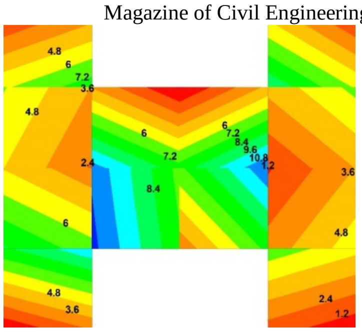


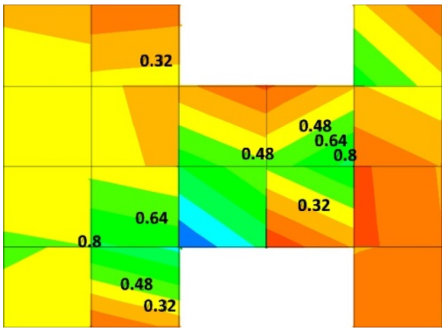
Figure 12. The tension Contour of structure in the opening zone
(a) CMF1 (b) CMF2 (c) CMF3.



a



b



c

Figure 13. The tension Contour of structure in opening zone
(a) CMF2 (b) CMF4 (c) CMF6.

The contour in Fig. 12 (a) express tensions in CMF1, reduction in Fig. 13 (a) is obviously, for example at left the opening zone, tension decreased 50 %, approximately. Also, tension contour in Fig. 13 (b) and 13 (c) is lower than Fig. 13 (b) and 13 (c) dramatically.

However, declining of tensions are remarkable in CMF2, CMF4 and CMF6, it means that the end walls had effective role in the reduction tensions of opening zone.

4. Conclusions

After applying the earthquake force to 10-story, 30-story and 50-story structures with and without end walls and linear static analysis, and investigations carried out on the studied structures, the following results were obtained:

1. Tall buildings with square plan and concrete moment frames under earthquake forces perform better than the same frame without an end wall.

2. Regarding the study of the warping effect on CMF1, CMF2, CMF3, CMF4, CMF5 and CMF6 structures, it was observed that one of the effects of the end wall is the conversion of the torsion mode to the transition mode.

3. In the comparison of CMF1 with CMF2, CMF3 with CMF4 and CMF5 with CMF6 it was concluded that maximum displacement decreases 50 %, approximately.

4. Also, in the comparison of CMF1 with CMF2, CMF3 with CMF4 and CMF5 with CMF6, it was concluded that first period decreases 50 %, roughly.

5. In the comparison of CMF1 with CMF2, CMF3 with CMF4 and CMF5 with CMF6, the periods decreased in different modes by end wall.

6. By attention to the period results in CMF1 with CMF2, CMF3 with CMF4 and CMF5 with CMF6, it was seen, the displacements declined in stories by end wall.

7. The distribution of stress the torsional state in the floors become regular in CMF1, CMF2, CMF3, CMF4 structures with the presence of an end wall.

8. Also, CMF1 is compared with CMF2, CMF3 with CMF4 and CMF5 with CMF6, height where the Ratio $(\Delta_{max}/\Delta_{avg})$ decreases with the presence of the end wall.

9. Due to the fact that CMF1, CMF3, CMF5 in the floors were observed due to the severe irregular torsion of the eccentrically ratio, but with the presence of the end wall in CMF2, CMF4 and CMF6, were change to regularity torsion, and the Ratio $(\Delta_{max}/\Delta_{avg})$ variations reduced in height.

10. The end wall had significant role in opening zone. Approximately, 50 % decreasing of tensions were remarkable in CMF2, CMF4, CMF6.

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