About the Component's Offcenter in ISSS

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Abstract: In this paper, the problem of component's offcenter, such as shear wall offcenter, beam offcenter, etc., would be discussed in detailbased on the ISSS which is developed by the authors [1-4] to satisfy the engineering requirement for high performance simulation (HPS). The computing results would be presented and compared with offcenter considered and ignored respectively. Finally, the importance of considering component's offcenter in the calculation model of ISSS would be demonstrated through those numerical examples.

Introduction

With the rapid development of high-rise buildings and long-span structures in the recent years, high performance simulation (HPS) is becoming more and more importantfor the structure design and building construction. The traditional design softwares, such as PKPM, ETABS, MIDAS, YJK, and so on, can't match the advanced requirements of HPS. On the other hand, the large scale general finite element analysis (FEA) softwares, such as ABAQUS, ANSYS, etc., although have the powerful computational abilities, but can't be applied directly to the architecturalstructure analysis and design, due to the fact that their preprocessors are inconvenient for building modeling and their postprocessors can't present computational results according to the building structure specifications, say, the civil codes and the custom of engineering. To satisfy the above engineering requirements, the authors have developed an integrated simulation system for structures, or simply ISSS for short, which isanintegration of traditional design softwares and general FEA softwares, together with abundant secondary software developments.For the integrated simulation system, i.e. ISSS, its overview has been presented by the authors in Ref.[1], its FEA model transformation has been discussed in Ref.[2~3], and its parallel FEA computing kernel has been introduced in Ref.[4].

In this paper, the problem of component's offcenter, such as shear wall offcenter, beam offcenter, etc., would be discussed in detail.The computing results would be presented and compared with offcenter considered and ignored respectively. Finally, the importance of considering component's offcenterin the calculation model of ISSS would be demonstrated through those numerical examples.

About the offcenter of shear wall

Figure 1gives an illustration of shear wall's offcenter. The shear walls and end-columns are aligned at their outer-surfaces, leading to the result that the medial surface of the shear walls has a offcenter of 100mm to the central axes of the end-columns. To consider this kind of offcenter in finite element (FE) calculation model, the authors have introduced additional composite cross-sections in ISSS [2]. In order to demonstrate the importance and necessity of the consideration about component's offcenter, the calculation models with offcenter considered and ignored respectively are imported from ISSS into ANSYS [5-6] and the computing results are

presented and compared in Figures 1-4 and Tables 1-2. Observing the results, the following conclusion could be obtained: the offcenter of shear walls have resulted distinctly torsion for the structure, so that this kind of offcenter can't be ignored in the calculation model.

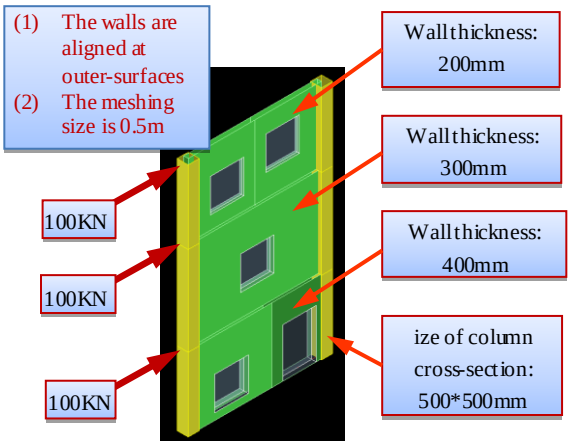


Figure 1Illustration of shear wall's offenter

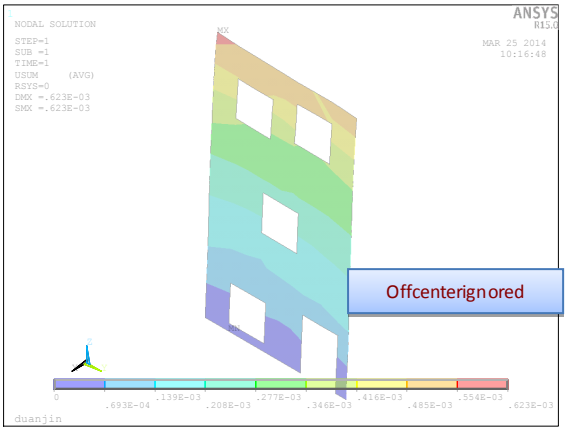
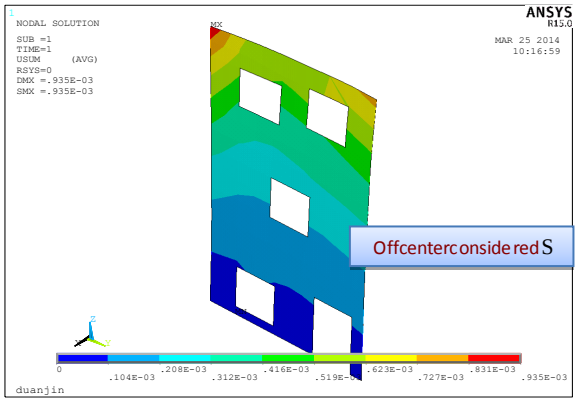
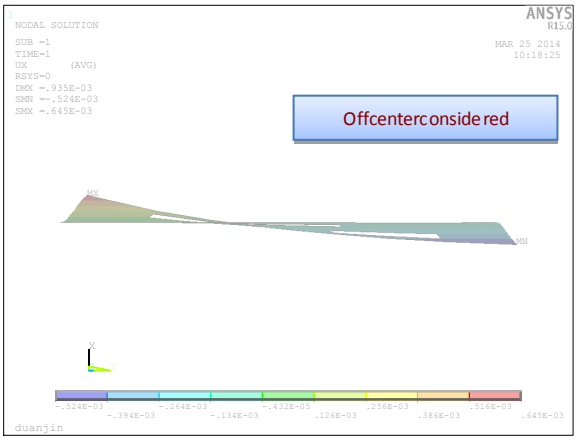


Figure 2The shear wall's displacement contour with offcenter ignored



(a) Isometric view



(b) Topview

Figure 3The shear wall's displacement contour with offcenter considered

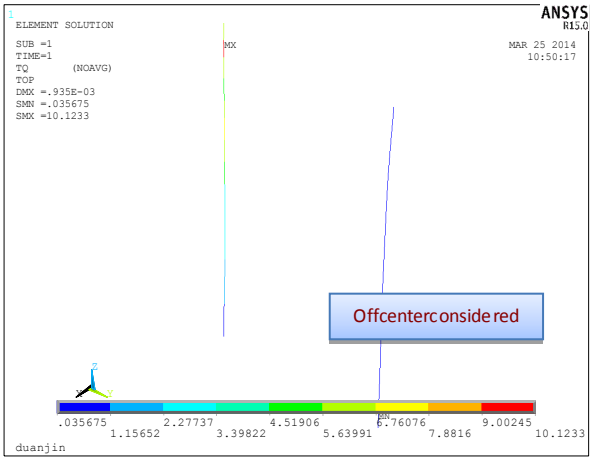


Figure 4The torsion of the columns with offcenter considered

Table 1 The displacement calulation error resulted from the wall's offenter

Maximum displacement	Offcenterignored	Offcenterconsidered	Calculation error
Total displacement	0.623	0.935	33%
Displacement along y axis	0.613	0.667	-8.1%
Displacement along z axis	0.113	0.111	1.8%
Displacement along x axis	0	0.645	100%

Table 2 The internal force calulation error resulted from the wall's offenter

Internal force of columns	Offcenterignored	Offcenterconsidered	Calculation error
Minimum and maximum shear force (F)	-210.3 274.7	-210.2 274.8	0
Minimum and maximum in-plane moment (Mx)	-6.356 15.82	-6.366 15.82	0
Minimum and maximum out-plane moment (My)	0	-3.333 3.468	100%
Minimum and maximum torsion (TQz)	0	0.036 10.12	100%

About the offcenter of beam component

Figure 5 gives an illustration of beam's offcenter. The beam components and shear walls are aligned at the top surfaces, leading to the result that the central axis of the beam has an offcenter of 250mm to the top surface of the corresponding shear wall. This kind of offcenter would be considered by additional composite cross-section in ISSS [2], just the same as shear wall's offcenter mentioned in above sector. To demonstrate the importance and necessity of the consideration about this kind of offcenter, the calculation models with offcenter considered and ignored respectively are imported from ISSS into ANSYS [5-6] and the computing results are presented and compared in Figures 6-7 and Tables 3-4. Observing the results, the following conclusion could be obtained: the offcenter of beam components have resulted distinctly diffirences about the displacements and momentsof the structure, so that this kind of offcenter can't be ignored in the calculation model.

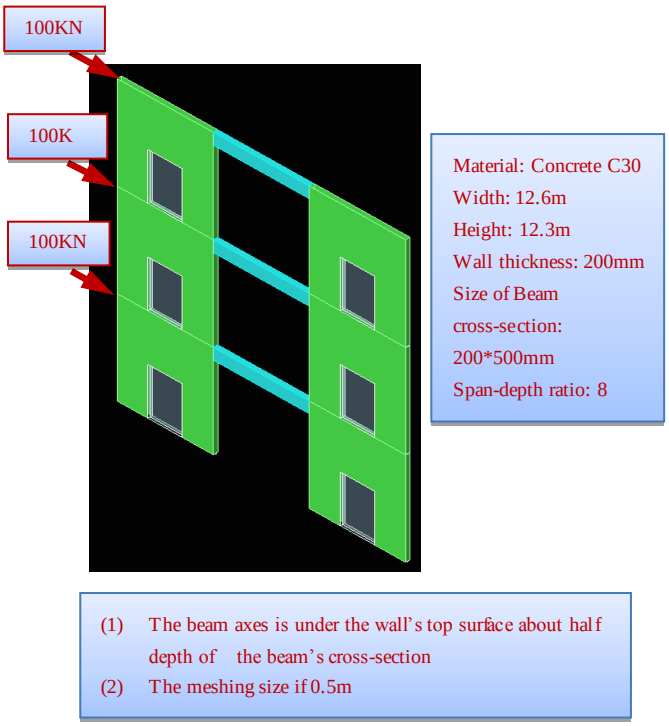
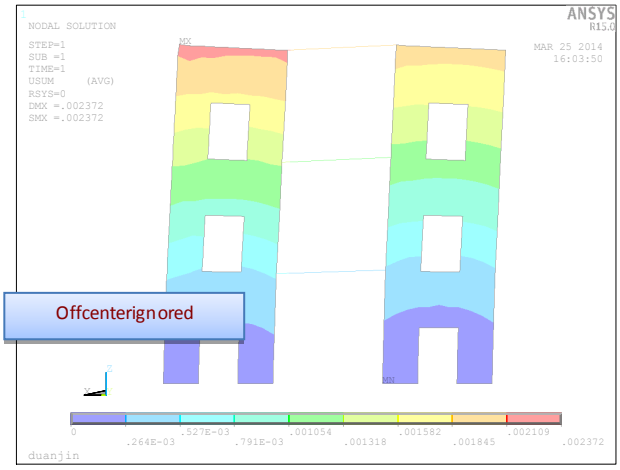
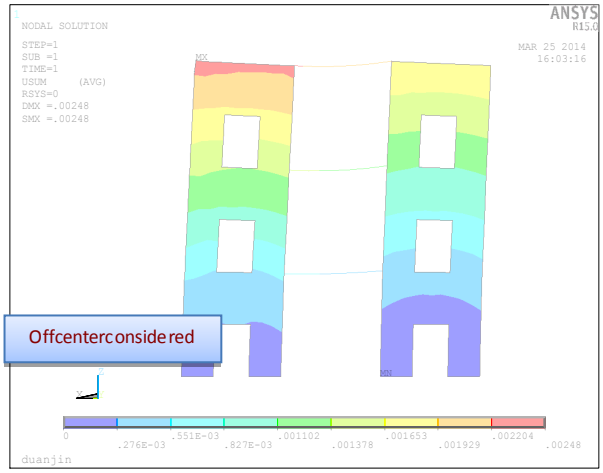


Figure 5Illustration of beam's offcenter

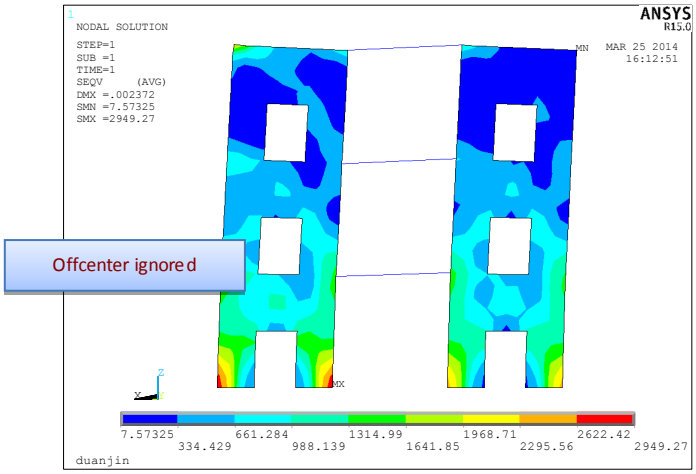


(a) Results with offcenter ignored

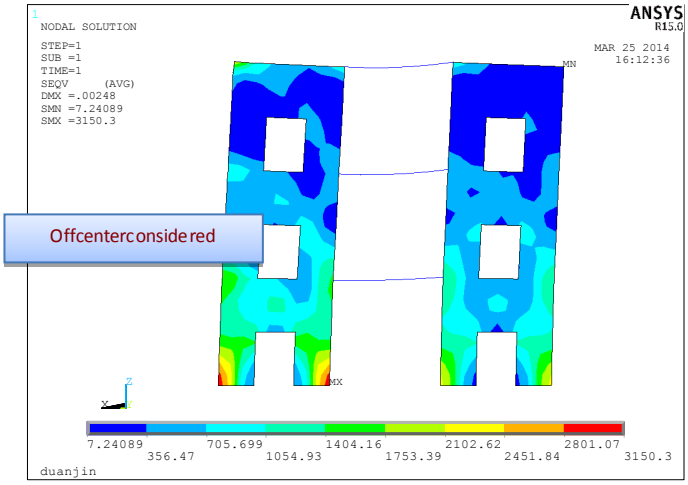


(b) Results with offcenter considered

Figure 6Displacement contour with offcenter ignored and considered respectively



(a) Results with offcenter ignored



(b) Results with offcenter considered

Figure 7 Stress contour with offcenter ignored and considered respectively

Table 3Effects of offcenter on maximum displacement

	Offcenter ignored	Offcenter considered	**Calculation error**
Maximum displacement (mm)	2.372	2.48	4.55%

Table 3.2Effects of offcenter on wall's stress and beam's internal force

	Offcenter ignored	Offcenter considered	**Calculation error**
Maximum stress of walls (MPa)	2.95	3.15	6.35%
Minimum and maximum axial force of beams (KN)	-53.55 -29.19	-49.28 -21.90	8.66%
Minimum and maximum moment of beams (KN.m)	-0.184 0.187	5.23 12.24	98.5%

Conclusions

The problem of component's offcenter, such as shear wall offcenter, beam offcenter, etc., is discussed detailedly in this paper based on the ISSS which is developed by the authors [1-4] to satisfy the engineering requirement for high performance simulation (HPS). The computing results are presented and compared with offcenter considered and ignored respectively. The importance of considering component's offcenter in the calculation model of ISSS is demonstrated through those numerical examples.

Reference

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