International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 03 – Issue 04 || April 2018 || PP. 87-91

Comparative Study of Precast Concrete Rectangular and Circular Hollow core Wall panel by Handling Capacity Analysis

Henna Salam[1], Lekshmi Priya R.[2]
[1]Mtech Student
Sree Narayana Institute of Technology, Adoor, Kerala
[2]Assistant Professor
Sree Narayana Institute of Technology, Adoor, Kerala

Abstract: This paper summarizes the research work on the Handling analysis of the precast concrete hollow core wall panels to find out the effects of loads as the panel is transported to the site and erected with crane. Handling Stress Analysis and creation of handling diagrams are critical for safe handling of panels in both yard and job site and for choosing the lifting point of panel. In this paper Modelling and Handling analysis are done by LECwall software

Keywords: Precast Wall panels, Hollow core wall panel, Handling Capacity Analysis, LECwall

1. Introduction

Precast concrete wall panels gained popularity due to its speed of erection, design flexibility, thermal efficiency, competitive cost etc. Precast Concrete Wall Panels are cast in the yard, then cured in a controlled environment, then transported to the construction site and lifted with crane.

A hollow core wall panel is a precast, pre-stressed concrete member with continuous voids provided to reduce weight and, therefore, cost. As a side benefit, voids can be used to conceal electrical or mechanical runs. The hollow core can be of either rectangular or circular shape.

Handling analysis of wall panels is crucial since the handling of wall panels during stripping from formwork; trucking and erecting induce stresses in the wall panel. These stresses should be considered while designing a precast wall panel. The calculation of ultimate capacity, crack resistance, handling stresses and moments in the wall panels are also important while designing the wall panel. The wall panels can be handled either by standard two point picking or standard four point picking. Strain compatibility is used to determine the member's ultimate capacity in the horizontal position for both positive and negative moment.

2. Software Used

2.1 LECwall

LECwall is a product of Losch software having hyper-specialized software tools to analyze precast wall panels.

3. Modelling of wall panel (As per PCI handbook [6])

3.1 Defining section properties

Thickness of wall panel	=	8in
Outer layer	=	3in
Inner layer	=	3in
Insulation layer	=	2in
Width of the panel	=	96in
Length of the panel	=	360in
Size of opening	=	30x30in

Panel with rectangular hollow core

Size of hollow core	=	4.75 x 5.25 in²
No. of hollow cores	=	15

Figure 1shows the cross section of precast concrete wall panel with rectangular hollow cores.

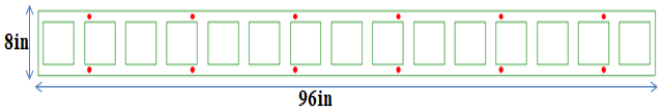

Figure 1: Precast concrete wall panel with rectangular hollow cores

Panel with circular hollow core

Size of hollow core =5.63in dia.

No. of hollow cores =15

Figure 2shows the cross section of precast concrete wall panel with circular hollow cores.

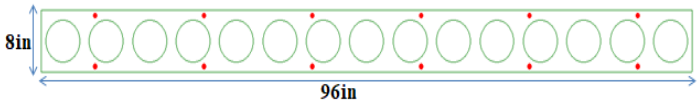

Figure 2: Precast concrete wall panel with circular hollow cores

3.2 Defining material properties

Grade of concrete = 5000 psi
Grade of pre-stressing strands = 60 ksi
Cracking stress coefficient = 7.5 (ACI 318-9.5.2.3)

3.3 Defining pre-stressing strands

Diameter of pre-stressing Stand = 0.375
Number of pre-stressing Strand = 12

3.4 Defining loads

Wind load = 160 plf
Roof dead load = 4 kip
Roof live load = 4 kip

3.5 Defining static load multipliers

Table 1: Static load multiplier

Condition	Multiplier on static load
Stripping	1.3
Trucking	1.5
Erection	1.2

4. Handling analysis

4.1 Shear force of wall panel

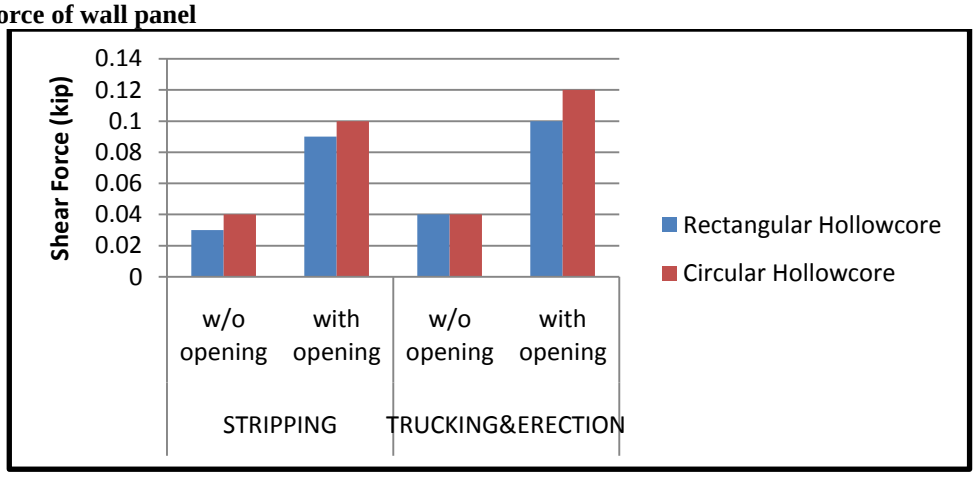

Figure 4: Shear force during Handling

Figure 4 depicts the shear force induced in the hollow core wall panel during its handling. The bar diagram shows comparison of shear force of circular and rectangular hollow core wall panels with and without opening during stripping and trucking respectively. From the diagram it is clear that panel with circular hollow core have more shear force. With opening shear force increases.

4.2 Bending moment of wall panel

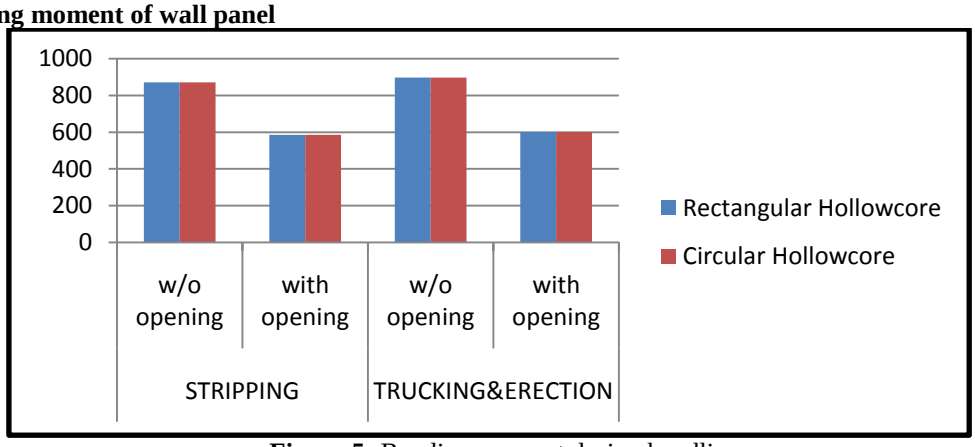

Figure 5: Bending moment during handling

Figure 5 depicts the bending moment induced in the hollow core wall panel during its handling. The bar diagram shows comparison of bending moment of circular and rectangular hollow core wall panels with and without opening during stripping and trucking respectively. From the diagram it is clear that with opening bending moment gets reduced. The both hollow core panels have same bending moment.

4.3 Ultimate capacity of wall panels during handling

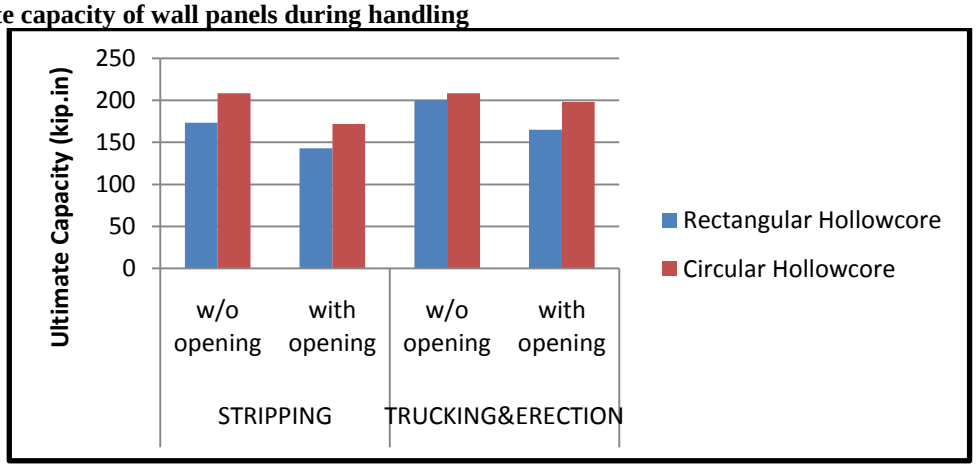

Figure 6: Ultimate capacity during handling

Figure 6 depicts the ultimate capacity of the hollow core wall panel during its handling. The bar diagram shows comparison of ultimate capacity of circular and rectangular hollow core wall panels with and without opening during stripping and trucking respectively. From the diagram it is clear that panel with circular hollow core have more ultimate capacity. With opening bending moment reduced

4.4 Crack resistance of wall panels during handling

Figure 7 depicts the crack resistance of the hollow core wall panel during its handling. The bar diagram shows comparison of crack resistance of circular and rectangular hollow core wall panels with and without opening during stripping and trucking respectively. From the diagram it is clear that panel with circular hollow core have more crack resistance. With opening crack resistance reduced

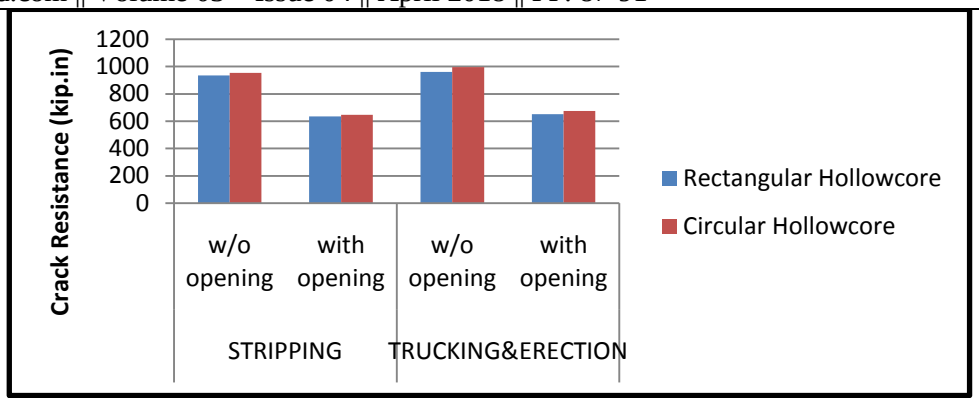

Figure 7: Crack resistanceduring handling

4.5 Handling stress of wall panels

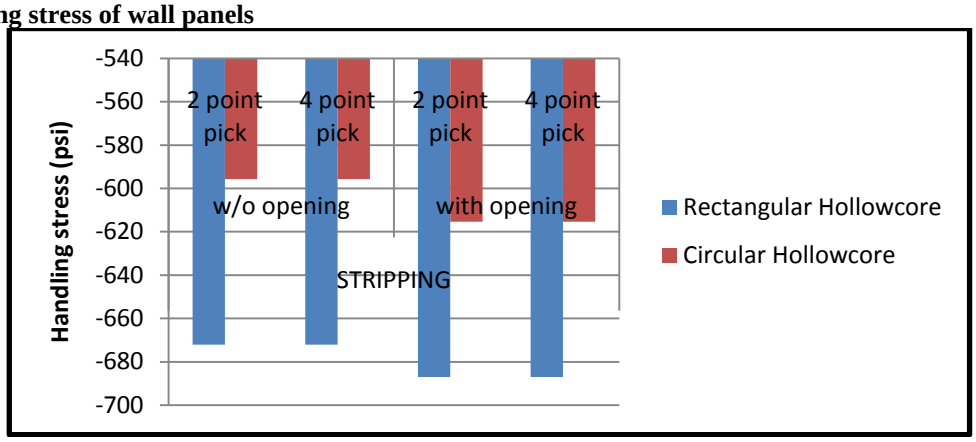

Figure 8: Handling stress during stripping

Figure 8 depicts the handling stress during stripping from formwork of the hollow core wall panels. The bar diagram shows comparison of handling stress of circular and rectangular hollow core wall panels with and without opening during stripping. From the diagram it is clear that panel with rectangular hollow core have more handling stress. With opening handling stressincreased. Handling stress is almost equal for standard two points and standard four points picking of panel.

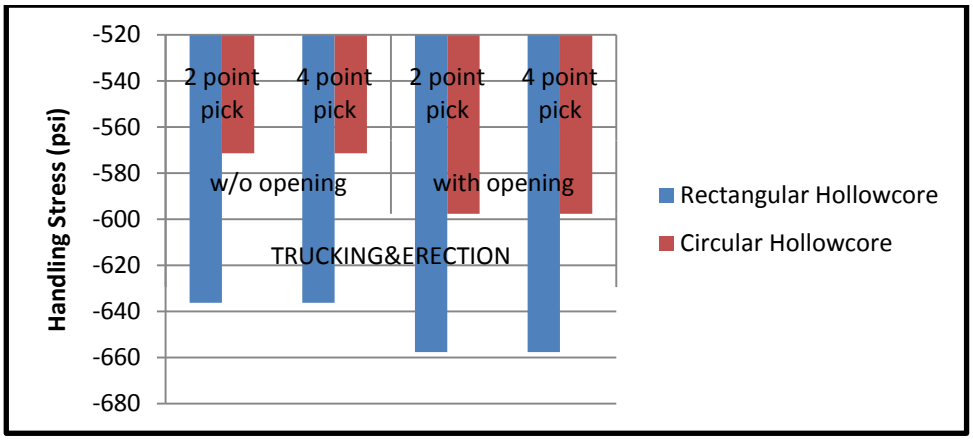

Figure 9: Handling stress during trucking or erection

Figure 9 depicts the handling stress during trucking or erection of the hollow core wall panels. From the bar diagram it is clear that the wall panel behaves in a similar fashion as that of stripping.

4.6 Allowable stresses in the wall panel

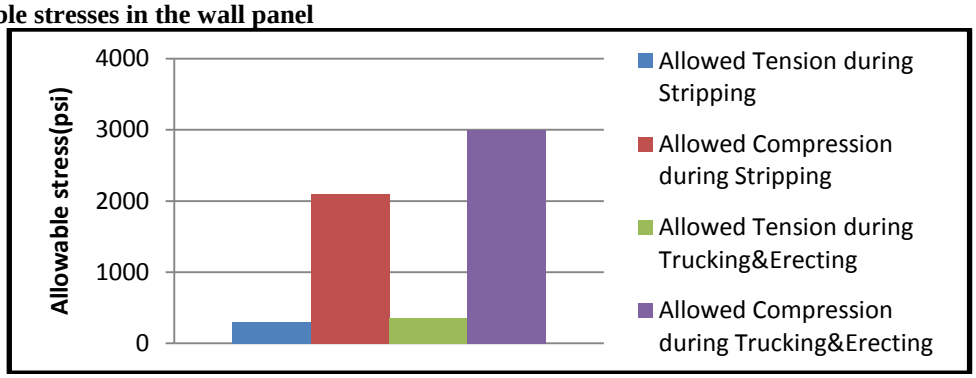

Figure 10: Allowable stresses in wall panels during stripping and trucking or erection

Figure 10 shows variation of tensile stress and compressive stress for both stripping and trucking or erecting operations respectively.

5. Conclusion

Panel with circular hollow core have more shear force and when opening is provided shear force increases. Shear force is more at the time of trucking/erection due to the lifting action.

Both hollow core panels have same bending moment but with opening bending moment get reduced. Bending moment is equal during stripping, trucking and erection.

Ultimate capacity is most for wall panel with circular hollow core. When opening provided ultimate capacity get reduced. Also ultimate capacity of wall panel is more at trucking(erection) than stripping. When opening provided axial strength ratio decreases due to increase in slenderness ratio of the panel

Since edges of the panels are restrained, when a handling load applies on it the panel tends to crack. From the analysis it is clear that the panel with circular hollow core have more crack resistance. When opening provided crack resistance get reduced due to the reduction of stiffness in the panel. Also crack resistance of wall panel is more at trucking (erection) than stripping.

Handling stress of wall panel is maximum for rectangular hollow core wall panel with opening. Also handling stress is more at the time of stripping than trucking (erection). While handling the panel, it may subject to bending that causes both compressive and tensile stresses that must be resisted by the concrete and reinforcing steel.

Allowable tensile and compressive stress of panel during trucking or erecting is more than that during stripping of panel. Also the allowable compressive stress is more than allowable tensile stress since pre-stressed strands are used.

Acknowledgments

The Author(s) wish to express their special gratitude to **Dr. P. G. Bhaskaran Nair**, PG Dean, Sree Narayana Institute of Technology, Adoor, **Dr. K. A. Abubaker**, Chairman of Baker Associates Group, Edappally and **Er. Khayiz Ibin Subair,** Tekla Engineer (Precast), Advenser Engineering services pvt. Ltd., Kochi for their valuable suggestions, encouragement and motivation. Above all the author(s) thank **God** Almighty for His grace throughout the work

References

[1] EhabHamed 2016 “Modeling, Analysis, and Behavior of Load-Carrying Precast Concrete Sandwich Panels” ASCE Journal of Structural Engineering Volume 142, Issue 7

[2] LoeiBadreddine et al. 2015 “PCI Manual for the Design of Hollow Core Slabs and Walls” PCI Committee Report 3rd Edition

[3] Mahmoud E. Kamara& Lawrence C. Novak 2013 “Notes on ACI 318-11 Building Code Requirements for Structural Concrete with Design Applications” *Portland cement Association Report*

[4] Donald F. Meinheit et al. 2012 “Guide for Precast Concrete Wall Panels” *Reported by ACI Committee 533*

[5] Building Code Requirements for Structural Concrete (ACI 318-11), American Concrete Institute, Detroit, MI, 2011

[6] Edward D. Losch et al. 2010 “State-of-the-Art of Precast/Prestressed Sandwich Wall Panels” *PCI Precast Sandwich panel Committee Report 2nd Edition*

[7] Edward D. Losch 2003 “Bowing of Insulated Precast Concrete Wall Panels” *PCI Journal*