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NEW METHOD FOR LATERAL STIFFNESS OF SHEAR WALLS WITH OPENINGS

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ABSTRACT

Presently, three methods are employed to estimate the lateral stiffness of shear walls with openings. Existing methods assume fixity at the pier-spandrel junction of the wall piers to estimate their stiffness. In this paper, a new method is presented to determine the lateral stiffness of the shear walls with openings, in which the spandrels are assumed flexible, and can translate and rotate under lateral load. Unlike the lateral stiffness obtained by the older methods, the stiffness obtained by the new method is in good agreement with the results of the linear elastic finite element analyses. It seems that the new method is simple, accurate and reliable alternative over the three known methods for estimating the lateral stiffness of shear walls with openings mainly for the design office use. Based on the new method, design charts have been developed to estimate the lateral stiffness of different piers in a shear wall with openings in terms of their three non-dimensional parameters.

INTRODUCTION

The present concept of modern masonry buildings is to use floors and roofs as diaphragms acting as horizontal flanged girders to distribute the lateral forces to shear walls, which in turn provide the horizontal shear resistance needed, in addition to

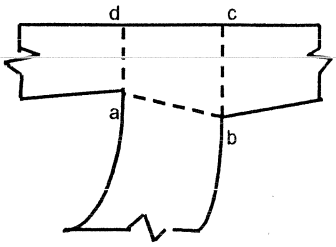

Fig. 1 Deformation at pier-spandrel junction

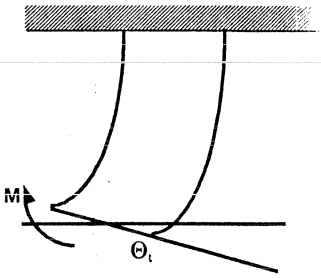

Fig.2 Deformation model

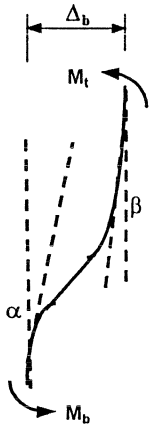

Fig. 3 Bending of beam element

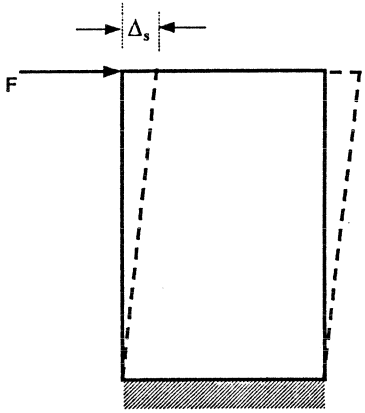

Fig. 4 Shear deformation of beam element

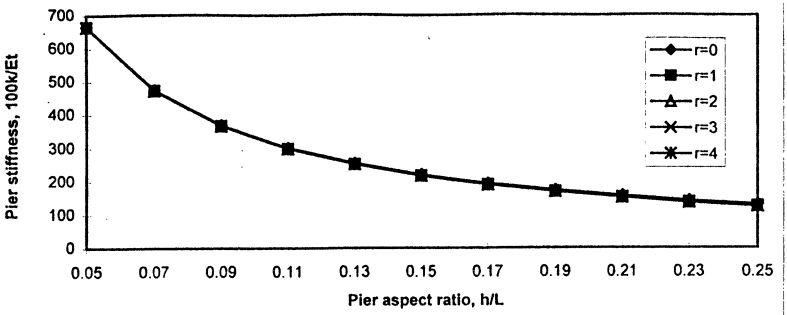

Fig. 5 Stiffness chart for bottom spandrel aspect ratio, $h_b/L = 0$

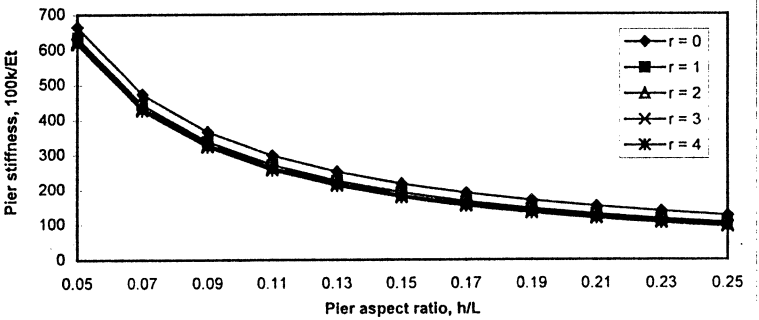

Fig. 6 Stiffness chart for bottom spandrel aspect ratio, $h_b/L = 1$

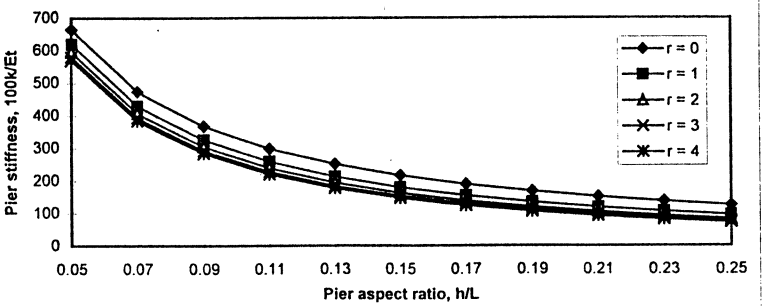

Fig. 7 Stiffness chart for bottom spandrel aspect ratio, $h_b/L = 3$

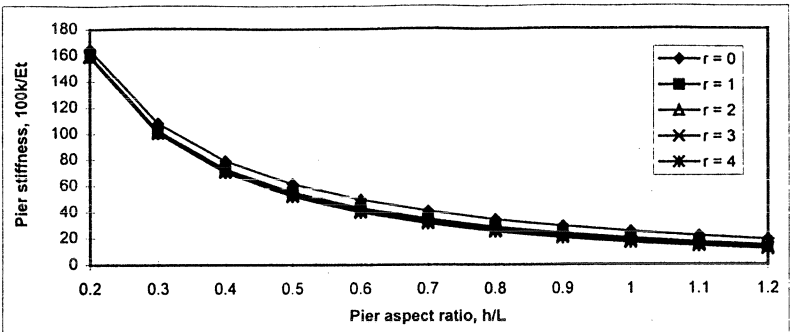

Fig. 8 Stiffness chart for bottom spandrel aspect ratio, $h_b/L=0$

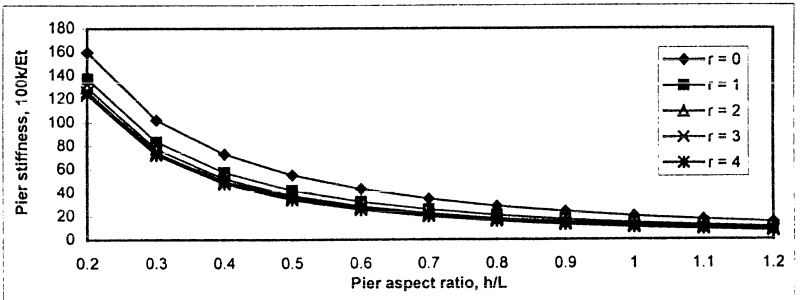

Fig. 9 Stiffness chart for bottom spandrel aspect ratio, $h_b/L = 1$

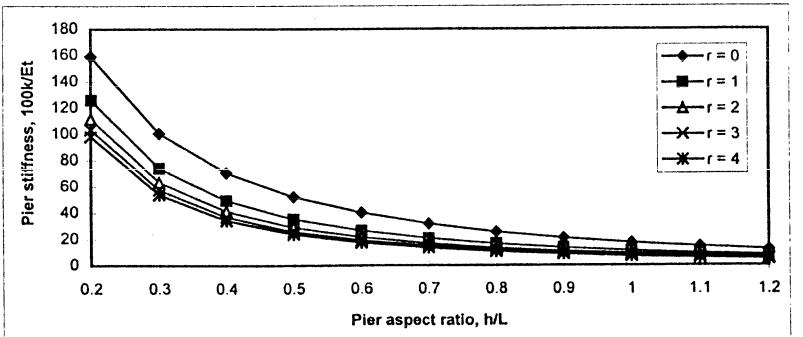

Fig. 10 Stiffness chart for bottom spandrel aspect ratio,$h_b/L=3$

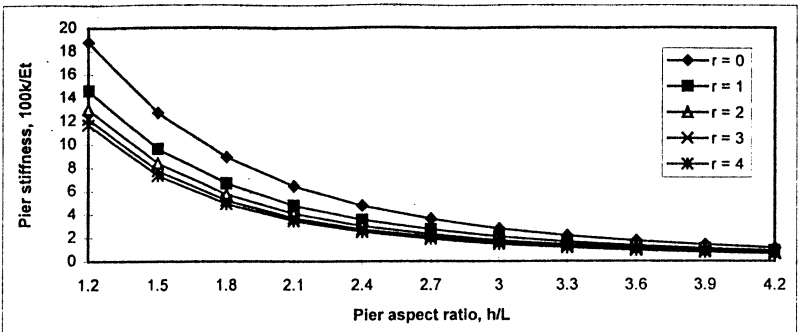

Fig. 11 Stiffness chart for bottom spandrel aspect ratio, $h_b/L=0$

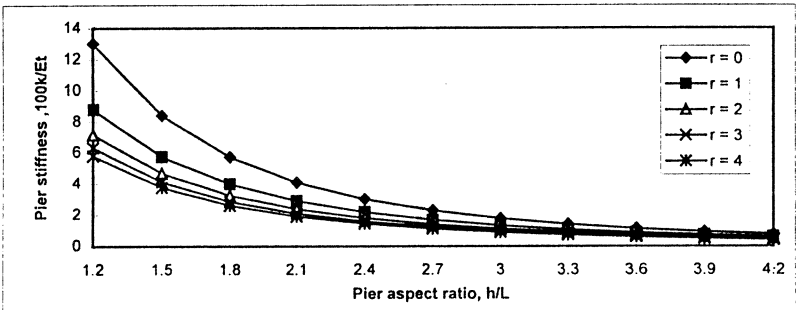

Fig. 12 Stiffness chart for bottom spandrel aspect ratio, $h_b/L=2$

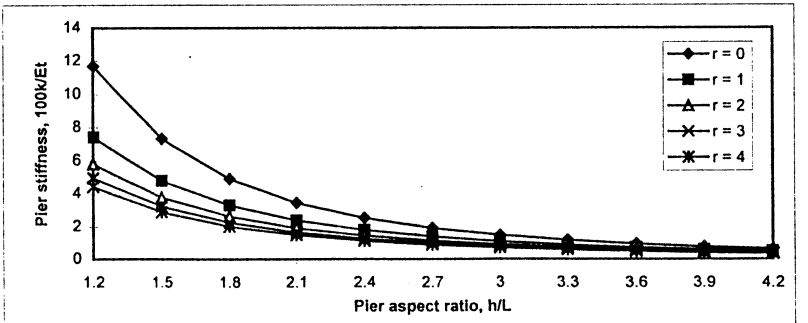

Fig. 13 Stiffness chart for bottom spandrel aspect ratio, $h_b/L=4$

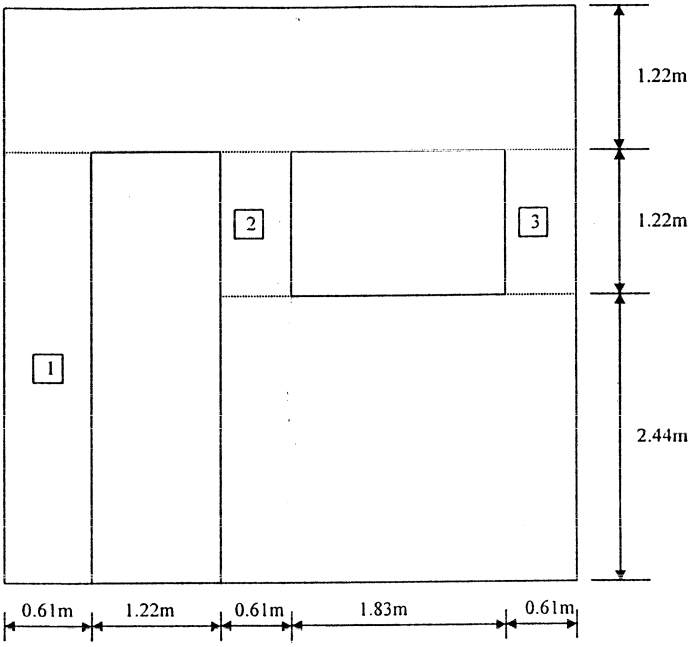

Fig. 20 Example shear wall

Table 1 Dimensions, non-dimensional parameters and stiffness of piers

Pier	L (m)	h (m)	h_t (m)	h_b (m)	q	r	s	k
1	0.61	3.66	1.22	0	6	2	0	0.003Et
2	0.61	1.22	1.22	2.44	2	2	4	0.020Et
3	0.61	1.22	1.22	2.44	2	2	4	0.020Et

$K = \Sigma k = 0.043Et$