

Compressive Stress in Various Orientations

Brick veneer is often laid in the most aesthetically pleasing manner, naturally resulting in the use of various brick orientations in the wall. Although compressive stress is not as much of a factor for veneer, the brick must still be able to support the dead load created by the self-weight of the wall.

A lab test was conducted in accordance with ASTM C67, to determine the compressive strength of lightweight modular brick. ASTM requires testing of half brick units in the stretcher position. Three commonly practiced brick orientations were tested. Thirty modular brick, ten for each group, were Sulfur capped, labeled, and broken to determine compressive strength. The groups and orientations were:

Group 1) Bed-down (Stretcher)

Group 2) Edge (Rowlock)

Group 3) Soldier

Averages from each group are below (complete data sheet on page 2):

Group	Dimensions (in)			Webs (in)				Breaking Load (lbs)	Gross Compressive Stress (psi)	Net Compressive - Minus Cores (psi)	Standard Deviation (based on Net CS)
	Length	Bed Depth	Height	1	2	3	4				
1	7.679	3.528	2.245					271,329	10,019	12,514	4,342
2	7.729	3.540	2.257	0.971	0.619	0.660	0.939	81,803	4,728	11,435	4,761
3	7.723	3.526	2.264	0.847	0.848			25,957	3,246	6,744	2,879

The results corroborated standard industry beliefs and practices. Group 1 produced the highest average compressive strength. Edge and Soldier orientations produced compressive strengths that were less than half of the bed-down orientation.

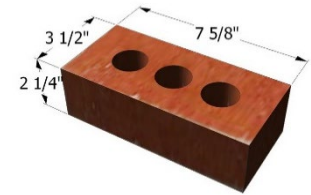
Net compressive strength was calculated in addition to gross compressive strength. The difference being that net compressive strength removes the area of voids on the axis perpendicular to the applied force. This is a more accurate representation of the material strength. Voids being removed from consideration naturally increases compressive strength.

The average compressive strength in each orientation is greater than 3,000 psi. This meets the ASTM C-62 and C-216 standard for building and facing brick. The average compressive strength of five brick must be greater than 3,000 psi to meet the standard for Grade SW.

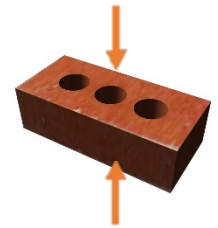
Although the standards established by ASTM are the benchmark, each brick orientation will support the distributed load from the self-weight of a 19' W x 38' H veneer wall. For modular brick at 10 psf per inch of brick depth, the weight of a brick veneer wall amounts to 35 psf. The load (P) from the self-weight of the brick in a wall of these dimensions equates to 25,270 lbs. Assuming load distribution acting through running bond at a 2:1 slope evenly distributes the load across the bottom course of brick, the uniformly distributed load is 1,330 lbs/ft. Breaking this down even further by determining the stress per individual brick results in an axial load of 886.67 lbs/brick in the bed down orientation. This results in a compressive stress placed on the bottom course of 31.67 psi. Comparing this to the allowable stress (F_a) of 2,061 psi, each brick is more than capable of handling the axial stress applied to the wall.

$$F_a = \frac{1}{4} f'_m [1 - (h/140r)^2] = 2061 \text{ psi (TMS 402-13, Equation 8-16)}$$

$$f'_m = 8,250 \text{ psi} \quad h = 456 \text{ in} \quad r = 131 \text{ in}$$

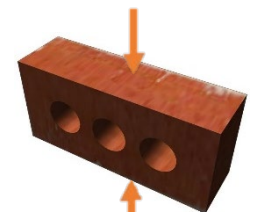


LWM Brick with Dimensions



Group 1) Bed-down (Stretcher)

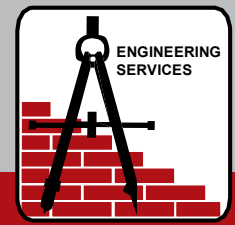
*Arrows represent the direction of force applied to brick.



Group 2) Edge (Rowlock)



Group 3) Soldier



Compressive Stress in Various Orientations

Group 1: Bed-down
 Group 2: Edge
 Group 3: Soldier

Brickhaven #25
 LWM Monticello
 Forney F-401F-DR500
 450,000 lbs. capacity

Group	Dimensions (in)			Webs (in)				Breaking Load (lbs)	Gross Compressive Stress (psi)	Net Compressive - Minus Cores (psi)	Standard Deviation (based on Net CS)
	Length	Bed Depth	Height	1	2	3	4				
1	7.741	3.544	2.256					268,880	9,802	12,204	
1	7.682	3.558	2.238					297,720	10,894	13,575	
1	7.680	3.536	2.247					302,260	11,130	13,891	
1	7.785	3.569	2.236					288,120	10,371	12,872	
1	7.602	3.550	2.255					147,930	5,482	6,852	
1	7.654	3.522	2.231					99,830	3,703	4,631	
1	7.648	3.519	2.239					327,960	12,188	15,247	
1	7.686	3.472	2.251					251,410	9,422	11,811	
1	7.665	3.507	2.254					292,100	10,866	13,596	
1	7.645	3.501	2.247					437,080	16,331	20,457	
AVG	7.679	3.528	2.245					271,329	10,019	12,514	4,342
2	7.644	3.506	2.246	0.992	0.583	0.699	0.925	104,430	6,083	14,537	
2	7.594	3.556	2.264	0.926	0.563	0.684	0.922	104,340	6,069	14,893	
2	7.661	3.516	2.238	0.959	0.696	0.596	0.972	90,650	5,287	12,573	
2	7.687	3.537	2.246	0.938	0.690	0.575	0.986	90,230	5,227	12,602	
2	7.664	3.504	2.233	1.011	0.585	0.663	0.925	116,660	6,818	16,420	
2	7.702	3.493	2.219	0.981	0.609	0.682	0.900	122,930	7,195	17,472	
2	7.854	3.541	2.282	1.015	0.584	0.737	0.940	58,390	3,258	7,812	
2	7.888	3.593	2.285	0.994	0.577	0.684	0.929	28,050	1,556	3,856	
2	7.888	3.595	2.279	0.985	0.644	0.677	0.945	35,790	1,991	4,834	
2	7.714	3.563	2.275	0.914	0.666	0.604	0.947	66,560	3,794	9,349	
AVG	7.729	3.540	2.257	0.971	0.619	0.660	0.939	81,803	4,728	11,435	4,761
3	7.682	3.560	2.254	0.883	0.874			43,280	5,396	10,934	
3	7.709	3.474	2.278	0.841	0.811			21,910	2,769	5,827	
3	7.771	3.639	2.281	0.890	0.866			34,840	4,197	8,701	
3	7.820	3.528	2.267	0.849	0.827			18,540	2,319	4,882	
3	7.730	3.500	2.287	0.846	0.851			30,510	3,812	7,863	
3	7.686	3.534	2.231	0.876	0.857			12,810	1,625	3,315	
3	7.704	3.528	2.244	0.804	0.820			16,420	2,074	4,507	
3	7.727	3.492	2.296	0.832	0.864			11,850	1,478	3,043	
3	7.710	3.483	2.262	0.800	0.840			40,090	5,089	10,807	
3	7.697	3.524	2.247	0.851	0.876			29,320	3,704	7,559	
AVG	7.723	3.526	2.264	0.847	0.848			25,957	3,246	6,744	2,879

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