

STI SHEARWAL V3.2.1 BR760 Changes to M_u vs. ϕM_n

A change was made in the way *SHEARWAL* reports M_u and ϕM_n for version 3.2.1. In previous versions (V3.1.0 and earlier), ϕM_n represented the capacity of the wall *with the given vertical loads* to resist the moment specified as "Lateral Moment." The new version instead groups moments as the "applied", both lateral and vertical, and the "internal" resulting from the compression and tension couple.

In the new version, any moment about the centroid due to external applied loads, both lateral and vertical, is now reported in the M_u term. Previously, the M_u term included only the moment entered under "Lateral Loads" on the "Lateral & Vertical Loads" page. The moment due to applied vertical loads was included in the ϕM_n term.

The best way to illustrate the change is with an example. We'll use Example 1 from the *SHEARWAL V3.1* Help (with the IBC 2003 code selected), Load Case 1 (1.2D + 0.5L + 1.6W).

The Moment at C.G. entered for Lateral Loads is 2065.0 k-ft making the factored lateral moment, $M_{lat} = (1.6)(2065.0) = 3304.0$ k-ft.

The moment at C.G. for the applied vertical loads is shown in the table below. The moment is calculated by $M_p = lf * P * (C.G. - x)$. The C.G. in our example is at 10.00 ft.

Load type	lf, Load factor	P, Vert. Force (k)	x, Location (ft)	M_p , Moment (k-ft)
Concentrated DL	1.2	78.0	11.00	93.6
Concentrated LL	0.5	30.0	11.00	15.0
Intersecting DL	1.2	95.0	16.00	684.0
			Sum (M_{av}) =	792.6

The moment at C.G. for the internal forces¹ is $M_i = F * (C.G. - x)$.

Component	F, Force (k)	x, Location (ft)	M_i , Moment (k-ft)
Comp. block	-363.19	19.56	-3470.3
Bar 1	26.40	0.50	-250.8
Bar 2	26.40	0.83	-242.0
Bar 3	-9.71	19.17	-89.0
Bar 4	-21.30	19.50	-202.4
		Sum (M_{ni}) =	-4254.4

The previous versions reported M_u and ϕM_n this way:

$$M_u = M_{lat} = 3304.0 \text{ k-ft}$$

$$\phi M_n = \phi(M_{ni} + M_{av}) = 0.9(-4254.4 + 792.6) = -3114.2 \text{ k-ft (reported as pos.)}$$

The new version reports these values this way:

$$M_u = M_{lat} + M_{av} = 3304.0 + 792.6 = 4096.6 \text{ k-ft}$$

$$\phi M_n = \phi M_{ni} = 0.9(-4254.4) = -3828.9 \text{ k-ft (reported as positive to match } M_u)$$

¹ Version 3.1.0 has a bug that reports the numbers for the next-to-last iteration of the neutral axis routine in the Summary of Concrete and Bar Forces... table. We've used the correct values from the last iteration here.