

## Appendix H

# ESTIMATED DESIGN WIND PRESSURE AND STRENGTHS OF CONNECTIONS OF JOPLIN WALMART BUILDING #59

### H.1 ESTIMATED DESIGN WIND PRESSURE BASED ON IBC 2000

- Basic design wind speed:  $V = 90$  mph (3 s gust)
- Exposure category: C
- Building parameters:
  - Low-rise, 290 ft  $\times$  573 ft in plan, with mean roof height  $h = 21.33$  ft and 2 ft parapet
  - Gust-effect factor:  $G = 0.85$  (rigid building)
  - Partially enclosed<sup>165</sup>. Internal pressure coefficient  $GC_{pi} = \pm 0.55$
- Importance factor:  $I = 1.15$ <sup>166</sup>
- Topographic factor:  $K_{zt} = 1.0$  (flat terrain)

The worst-case net design wind pressure for the Walmart building, based on above parameters and design procedure of IBC 2000, is *wind perpendicular to the building's length* (N-S axis). The computed net internal pressure (with  $+ GC_{pi}$ ) and net internal suction (with  $- GC_{pi}$ ) are shown in Table H-1.

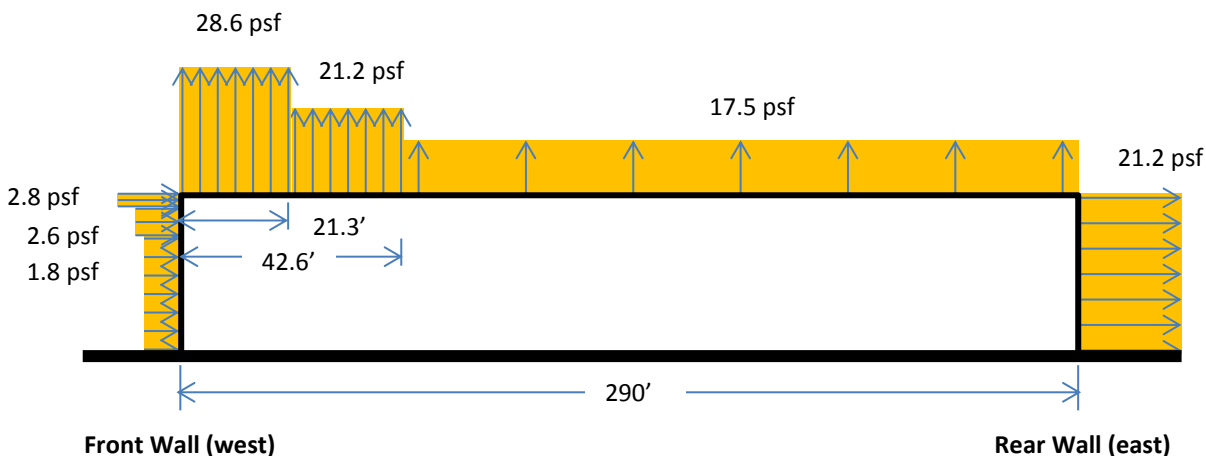
**Table H-1. Net internal pressure and internal suction for the Walmart building.**

Surface	Z (ft)	q (psf)	C <sub>p</sub>	qGC <sub>p</sub> (psf)	Net Pressure (psf) with	
					+ GC <sub>pi</sub>	- GC <sub>pi</sub>
Windward	0 – 15	20.27	0.8	13.78	1.83	25.73
	20	21.47	0.8	14.6	2.65	26.55
	21.3	21.72	0.8	14.77	2.82	26.72
Leeward	All	21.72	-0.5	-9.23	-21.18	2.72
Side wall	All	21.72	-0.7	-12.92	-24.87	-0.97
Roof	0 – 21.3	21.72	-0.9	-16.62	-28.6	-4.67
	21.3 – 42.6	21.72	-0.5	-9.23	-21.2	2.72
	42.6 – 290	21.72	-0.3	-5.54	-17.5	6.4

<sup>165</sup> Assumed based on the conditions where the building envelope was breached during the tornado

<sup>166</sup> Not specified on design drawings obtained by NIST. Assumed based on Occupancy Category III (Buildings and other structures where more than 300 people congregate in one area)

Wind pressure distribution corresponding to the net internal pressure case ( $+GC_{pi}$ ), shown below in Fig. H-1, represents the worst load case for wind uplift, with estimated maximum design (code-level) net uplift pressure of 28.6 lb/ft<sup>2</sup> (psf) on the roof.



Key: psf, pounds per square foot (lb/ft<sup>2</sup>).

**Figure H-1. Wind pressure distribution for the Walmart building.**

## H.2 ESTIMATED UPLIFT STRENGTH OF ROOF JOIST-TO-JOIST GIRDER CONNECTIONS

- Roof joist is welded on each end to joist girder by 2 3/16 in. × 1½ in. (weld leg size  $w$  × weld length  $l$ ) fillet welds, E70 electrode
- Design strength per 1/16 in. of fillet weld leg per inch of weld length:
 
$$= 0.75(0.6F_{EXX})(0.707wl) = 1.392 \text{ kips/in.}$$
- Uplift capacity for 6 in. of total weld length  $l$  (3 in. on each end) and 3/16 in. weld leg size:
 
$$= (1.392 \text{ kips/in.})(3)(6) = 25.05 \text{ kips}$$
- Tributary roof deck area supported by each roof joist: = 39 ft × 5 ft 7½ in. = 219.4 ft<sup>2</sup>
- Estimated uplift strength of joist-to-girder connections: 25,056 lb/219.4 ft<sup>2</sup> = 114 lb/ft<sup>2</sup>