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DESIGN CHECK OF *UltraShade* UMBRELLA FRAMES

SUMMARY OF ANALYSES

At your request we have undertaken a design review of standard square and octagonal *UltraShade* CE Series umbrella frames in the 3.0 to 6.0m product range. Attached is our detailed report, however the following summary is provided.

From geometric and materials data provided of the dimensions, sections and profiles used in manufacture, a design check has been completed of the following standard *UltraShade* CE umbrellas:

Square: 3.6m, 4.0m, 4.5m, 4.8m, 5.0m.

Octagonal: 3.5m, 4.0m, 4.5m, 5.0m, 5.5m, 6.0m.

This has involved wind tunnel model testing and engineering analyses of the output, based on umbrella frames as presently constructed and the assumptions noted below.

1. DESIGN ASSUMPTIONS

These umbrellas are considered to be less permanent than a building structure and cannot be considered to provide meaningful shelter in an extreme wind event.

Further, umbrellas can be expected to be in the general proximity of building structures larger than the umbrellas.

Because of the materials used, overstressing and failure of the umbrella frame is expected to be by ductile yielding in the first instance. This would result in bending of radial arms, bending of the main post, or bending of the base spigot, so that the frame will bend but not break. This may be preceded by ripping of the fabric cover, depending on its age and condition, which would also relase wind load, though the fabric pieces remain attached to the frame.

These might be considered to be "safe" modes of failure, in that it is unlikely that a failing umbrella would become a projectile causing damage downwind *(the major cause of damage in Cyclone Tracy, for example)* except by uprooting the entire frame and footing.

Footing options have not been evaluated in this design check due to the variability of footing and soil types possible.

The following table shows wind speed ratings (maximum safe wind speed) for square and octagonal umbrella frames in the open and closed condition, as manufactured. This does not account for degradation of synthetic materials over time, nor for modifications or lack of maintenance that may result in reduced strength over time.

TABLE 1 - FRAME WIND RATING (km/hr)

OCTAGONAL Size		WIND RATINGS Open Km/h	WIND RATINGS Closed Km/h	SQUARE Size		WIND RATINGS Open Km/h	WIND RATINGS Closed Km/h
3.5m	(8.73 sq m)	>200	>200	3.6m	(12.96 sq m)	>200	>200
4.0m	(11.55 sq m)	>200	>200	4.0m	(16.0 sq m)	192	>200
4.5m	(14.4 sq m)	>200	>200	4.5m	(20.25 sq m)	172	>200
5.0m	(17.5 sq m)	>200	>200	4.8m	(23.04 sq m)	143	>200
5.5m	(21.45 sq m)	183	>200				
6.0m	(25.7 sq m)	155	>200				