## Effect of Water Tanks Contents on *Changing* the Ball-Loading

Formula for determining how much the Ball-Loading *varies*, depending on whether the water tanks are empty, or completely full:

Note: Dimensions from the centre of the axle-group to the *left* are *positive*… dimensions to the *right* are *negative*.

Filling the water tanks *ahead* of the axle(s) *increases* the Ball-Loading; filling the tanks *behind* of the axle(s) *decreases* the Ball-Loading.
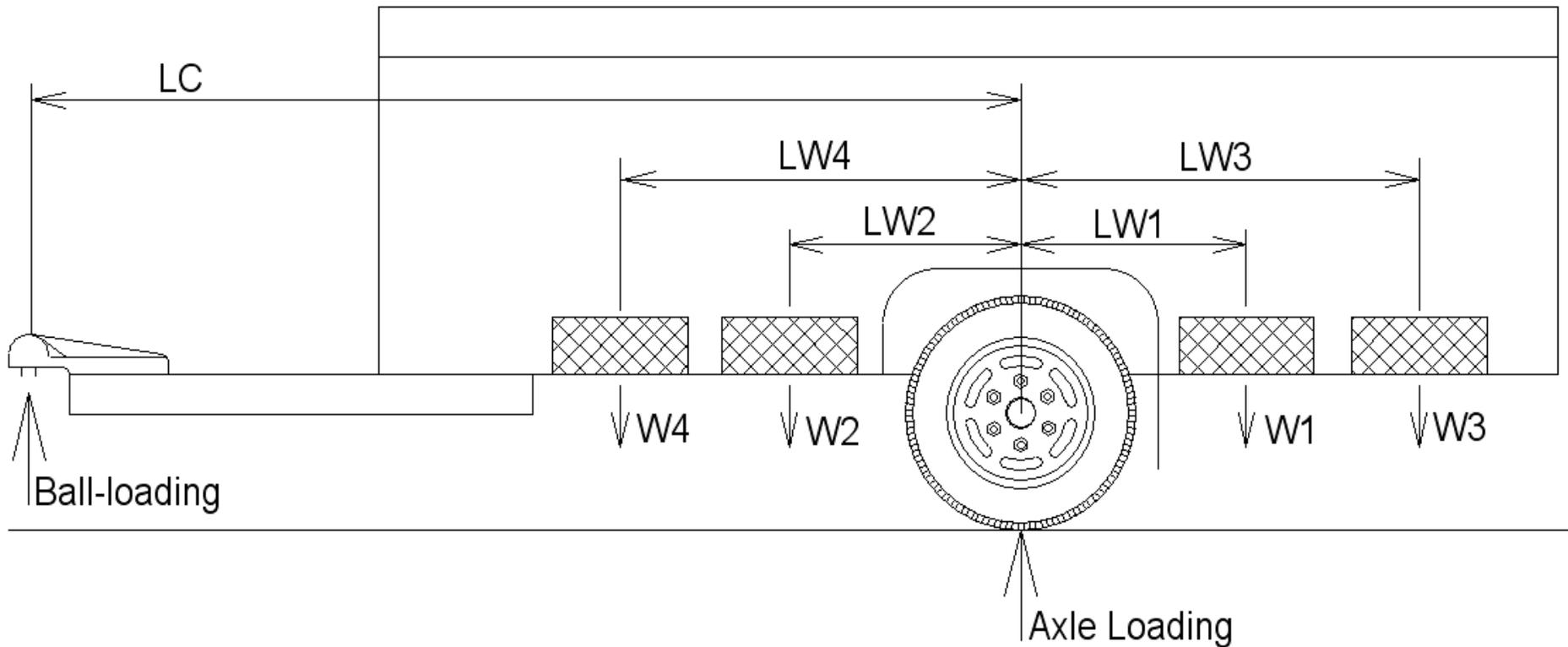
The Actual **Total Mass** of the 'van will *increase* by: W1 + W2 + W3 + W4 when the (empty) tanks are then filled.

The diagram shows *four* tanks are fitted… of course, for any *specific* vehicle, "non-fitted tanks" are simply ignored… W = 0

"W" is the *mass of water* that is *added* to the empty tank.   One (1) litre of water weighs one (1) kg.

Calculate the "Moments" – Mass X Distance – around the *centre* of the axle (or *midway* between tandem axles):

Change in *Ball-Loading* = ((W2 x LW2) + (W4 x LW4) - (W1 x LW1) - (W3 x LW3)) / LC

Example: W1 = 90 kg; W2 = 90 kg; W3 = 70 kg; W4 = 70 kg;   LW1 = 2.0 m; LW2 = 1.5 m; LW3 = 2.5 m; LW4 = 2.5 m;   LC = 3.5 m

Change in Ball-Loading when *all* (empty) tanks are then filled:

Change in Ball-Loading = ((90 x 1.5) + (70 x 2.5) - (90 x 2.0) - (70 x 2.5)) / 3.5

Change in Ball-Loading = ((135) + (175) - (180) - (175)) / 3.5

Change in Ball-Loading = (- 45) / 3.5

Change in Ball-Loading = - 13 kg

Worst Case 1: W1 & W3 empty; W2 & W4 full

Change in Ball-Loading = + 88 kg

Worst Case 2: W1 & W3 full; W2 & W4 empty

Change in Ball-Loading = - 101 kg

Caravans should be designed so that there is the *least* **possible** *change* in the Ball-Loading, regardless of whether each tank is full or empty.

Multiple water tanks should be positioned as *close* as possible to - and *each* side (front / rear) of - the axle(s).