EDSMAC-IV input	**Value**	**Source Referenced In**
Body overall length	307 in	This Attachment
Body CG to front	158.7 in	This Attachment
Body CG to Rear	-149 in	This Attachment
Body Overall Width	96 in	Field Measurement
Total Weight	22,450 lb	This Attachment
Yaw Inertia	658,984.7in-lb-sec^2	This Attachment
A Stiffness	1000 lb/in	See main body of report
B Stiffness	250 lb/in	See main body of report
Wheel Location X, Front Axle (Left side, pre-collision)	125.7 in	This Attachment
Wheel Location X, Front Axle (Right side, pre-collision)	125.7 in	This Attachment
Wheel Location X, Front Axle (Left side, post -collision)	128.1 in	This Attachment
Wheel Location X, Front Axle (Right side, post-collision)	117.7 in	This Attachment
Wheel Location X, second Axle (left side, pre-collision)	-62.05 in	This Attachment
Wheel Location X, second Axle (Right side, pre-collision)	-62.05 in	This Attachment
Wheel Location X, second Axle (Left side, post -collision)	-62.05 in	This Attachment
Wheel Location X, second Axle (Right side, post-collision)	-62.05 in	This Attachment
Wheel Location X, third Axle (left side, pre-collision)	-112.7 in	This Attachment
Wheel Location X, third Axle (right side, pre -collision)	-112.7 in	This Attachment
Wheel Location X, third Axle (Left side, post -collision)	-112.7 in	This Attachment
Wheel Location X, third Axle (Right side, post -collision)	-112.7 in	This Attachment

Data and sources used for truck calculations

Data from field measurements

W_r = Total weight on rear axle = 6650 +6550 = 13200lb

W_f = Total weight on frontaxle= 9250lb

W_T = Total weight of vehicle = 22,450lb

X_{wb} = The wheel base (distance from the cg to the midpoint between axles 2 and 3)=213"

ROH = Distance from rear axle to rearmost point of truck = 36.5"

Data from manufacturer:

WB2= Distance from first axle to second axle = 187.75"

WB3 = Distance from first axle to third axle = 237.5"

FOH = Distance from front axle to furthest extent of front bumper = 33"

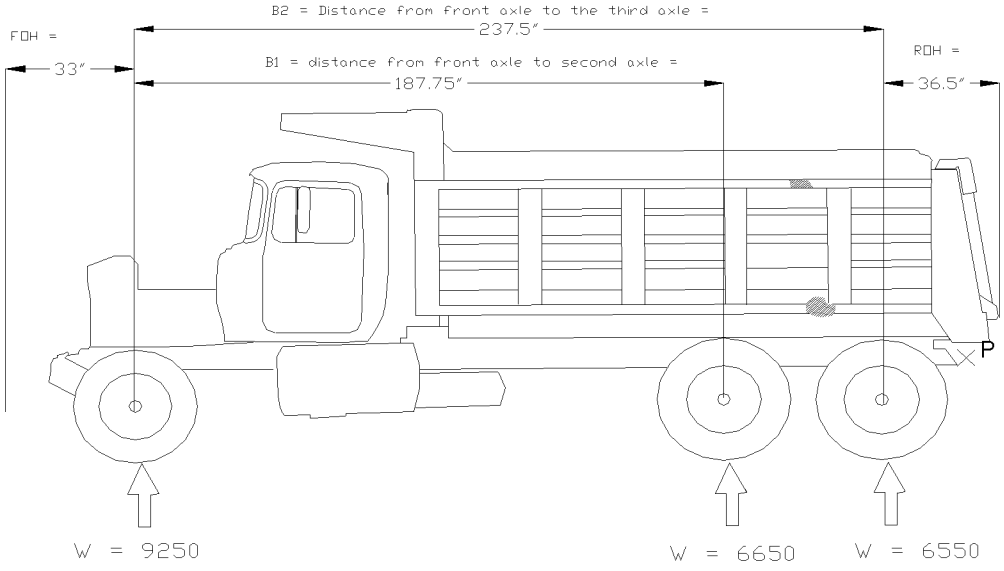
Body Overall Length(see previous section for data)

The Body Overall length is the sum of = FOH + WB3 + ROH

= 33" + 237.5" + 36.5" =307 inches

Figure 1- TRUCK DIMENSION AND WEIGHTS

(All weights are based on NTSB field measurements. Distances between axles and front overhang are based on manufacturer data for undamaged vehilce. ROH is based on NTSB field measurements. All dimensions listed are for undamaged vehicle. Diagram is not to scale.)



Wheel Location X (Pre-collision)

The Wheel Location X is defined as the longitudinal distance from the CG to the wheel location.

This value is calculated in of this attachment entitled "Locating the Center of Gravity" .

Wheel Location X (post collision)

The Wheel Location X (post collision) is based on field measurements made by board

investigators and is measured relative to the undamaged vehicle CG.

Locating the Center of Gravity (cg)
(For data used in the calculations in see section entitled "Data used for truck calculations" in this attachment. Data from that section is summarized in Figure 1.)

Summing the moments about the front axle to calculate A

$$\therefore A = \frac{W_R}{W_T} X_{wb} = \frac{13200}{22450} \cdot 213 = 125.7",$$

Summing the moments about the rear axle to calculate B

$$B = \frac{W_f}{W_T} X_{wb} = \frac{9250}{22450} \bullet 213 = 87.3"$$

$\therefore$ The Wheel Location X, front axle (pre-collision) = A =125.7"

The Wheel Location X, the second axle (pre-collision) B_1 = 62.05"

The Wheel location X, the third axle (pre-collision) B_2 = 62.05" + 50.5" = 112.55"
(Where 50.5" is the distance between the second and third axles)

The data regarding CG location is summarized in Figure 2

Body CG to Front

The body CG to front is equal to the front overhang plus the wheel Location X or:

Body CG to Front = 125.7” (see previous section) + 33”FOH

= 158.7”

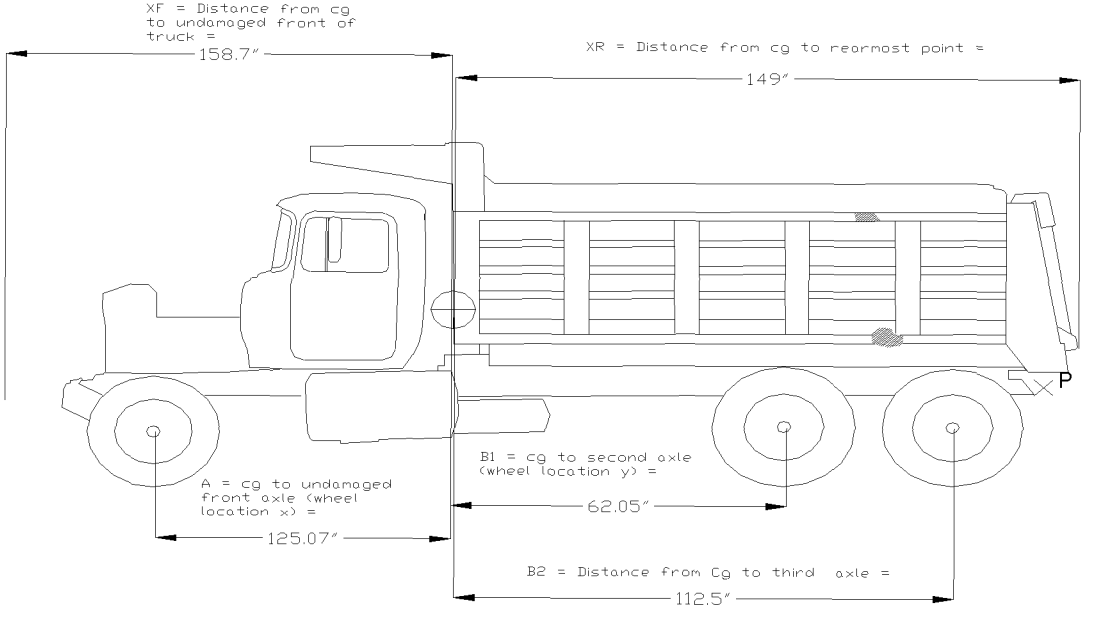
Body CG to Rear

The Body CG to Rear is the distance from the cg of the truck to the rear of the truck. This is equal to the Wheel Location X (pre-collision) of the third axle (see Figure 2) plus the distance from the third axle to the rear of the truck (see Figure 1) or

Body CG to Rear = 112.55” + 36.5” =149.0”

Figure 2 - CG LOCATION

(Diagram not to scale)



YAW INERTIA

The Yaw Inertia in the EDSMAC-IV program is the effective yaw moment of inertia about the cg of the truck.

Methods of calculating: The truck yaw moment of inertia was estimated using a formula for dump truck inertia provided by the University of Michigan Transportation Research Institute (UMTRI). According to researchers at the UMTRI this formula is highly accurate for a 3-axle dump truck. Two other methods of calculating the yaw moment of inertia, the Phase IV formula, and the thin rod approximation are presented in this report for comparison and summarized in the table on the following pages.

TABLE 1 – Summary of yaw moment of inertia estimates, and published data available for school buses and similar vehicles. Calculations listed are given on previous pages

Formula Name	Source	Formula	I
Phase IV formula for tractors	University of Michigan	$I_{zz} = \frac{1}{g}\left\{\left[WF + .4(WR)\right] * A1^2 + (WR)\left[1 - .4\right]A2^2\right\}$	567,158.6 in-lb-sec^2
Formula for 3 wheel dump truck	University of Michigan	$I_{yy} = M * r^2$	658,984.7in-lb-sec^2
Thin Rod approximation		$I_{yy} = \frac{1}{12} \bullet m \bullet (OW^2 + OL^2)$	$496{,}494.8 in * lb \bullet \sec^2$

Formula for dump truck inertia (provided by the University of Michigan) (method used for simulation)

$$I_{yy} = M * r^2$$

Where
M= the mass of the vehicle
R = .5 times the wheel base of the truck (the wheel base is the distance from the front axle to the midpoint between the rear axles see Figure 2 for wheel locations)

Therefore
$I_{yy} = 58.1(213 * .5)^2$
= 658,984.7in-lb-sec^2

Phase IV formula for Tractor

$$I_{zz} = \frac{1}{g}\left\{\left[WF + .4(WR)\right] * A1^2 + (WR)\left[1 - .4\right]A2^2\right\}$$

Where:

A1= Distance from cg to front of vehicle = A =108.9”
A2= the distance from the cg to the midpoint between axles 2 and 3 = B =76.9”
WF = the weight on the front axle =9250lb
WF = combined load on the rear axles =13,200lb

$$= \tfrac{1}{386.4}\left\{\left[9250 + .4 * 13{,}200\right] * 108.9^2 + 13200(.6)76.9^2\right\}$$

$$= \tfrac{1}{386.4}\left[14530(108.9)^2 + 46{,}835{,}791.2\right]$$

$$= 567{,}158.6 \text{ in-lb-sec}^2$$

Thin approximation of rotational inertia

Formula: $I_{yy} = \frac{1}{12} \bullet m \bullet (OW^2 + OL^2)$

Where m = the mass of the truck = 58.1
OW = the overall width of the truck = 96”
OL = the overall length of the truck = 302.5”

$\therefore I_{yy} = \frac{1}{12} \bullet 58.1 \bullet ((96)^2 + 302.5^2) = 496{,}494.8 in * lb \bullet \sec^2$