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**ANSWER 1A:**

The vehicle's CG is at (1.458615 m , 0.685767 m) as measured from the rear axle and left side.

**ANSWER 1B:**

The vehicle's diagonal weight (a.k.a. cross weight or wedge) is 222.410946 N.

**ANSWER 2A:**

The height of CG must be 0.888889 m to cause un-tripped rollover of the vehicle at 0.9g lateral acceleration.

**ANSWER 2B:**

Total load transfer in vehicle when CG height is half of the rollover height will be 5000.00 N.

**ANSWER 2C:**

Since the lateral load transfer is to be evenly distributed between front and rear, and since suspension springs in rear are 25% (1.25 times) stiffer than ones in the front, anti-roll bar needs to be added in the front (to compensate for less stiff springs) with torsional stiffness of **0.32 times front spring stiffness (Kf)**.

**ANSWER 2D:**

The static wheel loads for given vehicle configuration are:

* LF = 6006.25 N
* RF = 5593.75 N
* LR = 4393.75 N
* RR = 4006.25 N

**ANSWER 3A:**

|  |  |  |
| --- | --- | --- |
| Maneuver 1 |  |  |
|  | Chart  Description automatically generated |
| Maneuver 2 |  |  |
|  |  |

**NOTE:** The above plots were generated assuming sprung mass of the vehicle as 100% of the total vehicle mass.

**ANSWER 3B:**

|  |  |  |
| --- | --- | --- |
| Maneuver 1 |  |  |
|  |  |
|  |  |

**NOTE:** The above plots were generated assuming sprung mass of the vehicle as 100% of the total vehicle mass.

|  |  |  |
| --- | --- | --- |
| Maneuver 2 |  |  |
|  |  |
|  |  |

**NOTE:** The above plots were generated assuming sprung mass of the vehicle as 100% of the total vehicle mass.

**ANSWER 3C:**

Major difference between solutions of 3A and 3B is that 3A assumes only steady-state roll (i.e. there are no transients) and its effects on load transfer. On the other hand, 3B uses second order roll dynamics (angular acceleration about the roll axis) at each point in time and uses it to compute the roll angle with numerical integration of the derivative terms, thereby capturing the transients and using them to compute load transfer at each point in time.

Since we are accounting for transient roll dynamics in 3B and not in 3A, we can easily notice a larger peak value of roll angle in 3B plots. Furthermore, we can observe that the roll angle plots display more realistic transient behavior (oscillations) as compared to 3A plots and that there is no sudden increase/decrease in roll angle w.r.t. time in 3B since it gradually changes accounting for the transients (whereas in 3A the roll angle abruptly increases/decreases in a single time step which is clearly observable from 3A plots), which is expected. Finally, this small difference in roll angle update causes minor (the difference could be larger for more aggressive maneuvers and different vehicle parameters) deviation in vehicle trajectory and state propagation.