**AEB SYSTEM**

**INPUTS**

Speed of the ego vehicle

Mass of the vehicle

Speed of the leading vehicle

Distance between two vehicles

Time to collision

Brake force

Stopping time, stopping distance

**OUTPUT**

FCW indication

Partial braking

Full braking

**Formulas**

Speed (velocity) of the ego vehicle, the change in distance between the ego vehicle and the leading vehicle  data's are collected as physical values.

* **Relative velocity** = V2 – V1
* **TTC** = Distance / Relative velocity
* **Deceleration** = Mass of the vehicle / Braking Force
* **Braking force** = 0.5\* Mass of the vehicle \* initial speed^2 / Distance to avoid collision
* **Psi of the brake fluid = (**pedal ratio \* pedal force applied) / master cylinder bore size
* **Clamping force**= 2 \*  π \* psi of brake fluid into the callipers
* **Brake force =**2 \* clamping force \* coefficient of friction.
* **Final velocity V** = initial velocity + (deceleration \* time)
* **Distance** = (initial velocity \* time) + **½** (deceleration \* time^2)

**Procedure based on scenario:**

Considering the car of mass 1500kg and a stationary object, the car is moving at speed of 80km/hr(22.22m/sec) and the distance between them is detected as 100 meters. Maximum braking force of the vehicle is 11500N.

Our AEB system will be activated if the speed is less than or equal to 80 km/hr.

We are considering Two threshold values for TTC

* TTCmin
* TTCemerg

Calculating the Time to collision (TTC), according to distance and relative velocity.

TTC (at 100m) = 100 / 22.22 = 4.5 seconds

If (TTC <= TTC min) and (TTC > TTCemerg), the system starts forward collision warning the driver to take immediate action. There will be a threshold time given to the driver for reacting.

The reaction time is 1 second. After 1 second, the stopping distance is 77.78 metres and the TTC will be 3.5 seconds. If the driver has not taken any action, we need to calculate the required braking force.

Required Braking Force = 0.5 \* 1500 \* (22.22)^2 / 76

= 4872 N

Braking deceleration = 4872 / 1500

= 3.24 m/s^2

Stopping time = 22.22 / 3.24

= 6.84 seconds

By using the determined values, we are dividing the braking force for partial braking and full braking(it can be done by using both stopping time and stopping distance).

The maximum braking force that can be applied to avoid slipping is 8000 N. By splitting the stopping time into two equal phase (3.42s \* 2), the first phase is partial braking phase and full braking phase.

The full braking phase uses the maximum braking force 8000N for 3.42 seconds. By comparing the maximum braking force and required braking force, the full braking phase uses 1.64 times of the required braking force.

The braking force during the partial braking phase would be 1754 N. The two phases occur for 3.42 seconds each and the car will be stopped at a distance of 76 meters without collision (1 meter before obstacle).

If the driver had taken the action within reaction time, the system needs to check whether the driver have done enough brake pedal pressure or not.

AEB system will calculate enough brake pedal pressure to avoid the collision or to stop the vehicle. According to time to collision.

The calculated brake pedal pressure is compared with applied brake pedal pressure. If there is a enough brake pedal pressure applied by the driver, AEB will be inactive.

If the applied brake pedal pressure is not enough or the driver fails to respond within the reacting time, AEB will be activated to avoid the collision.