

EN2533 - Robot Design and Competition

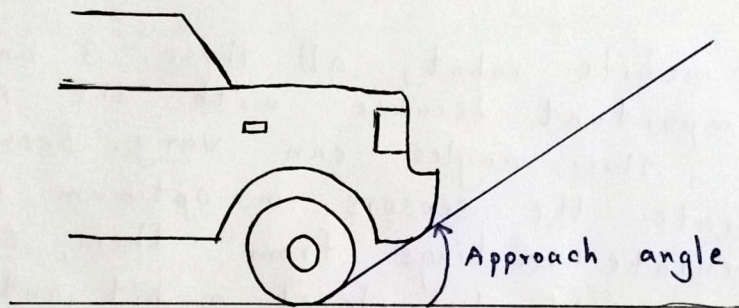
Homework ①

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Index Number: 200733D

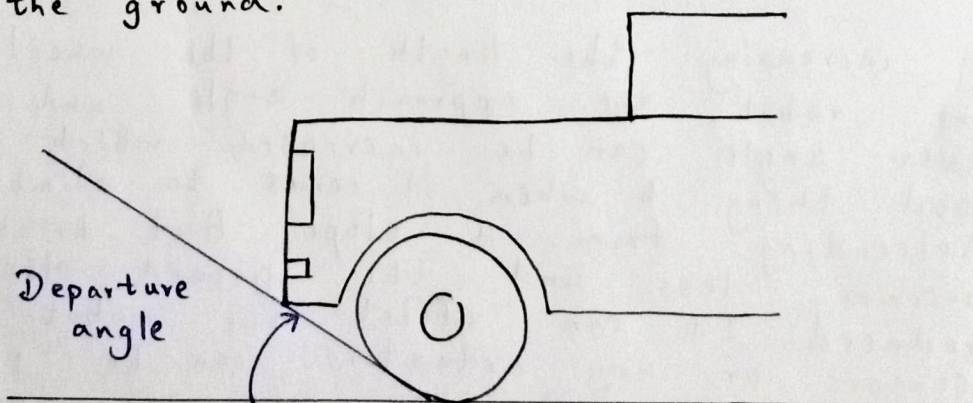
• Approach Angle.

- * Angle between the forward face of the front tire and the furthest forward fixed part of the vehicle.
- * This is also the ^{maximum} angle of a ramp onto which a vehicle can crawled up, without its ~~bumper~~ bumper scraping along it.



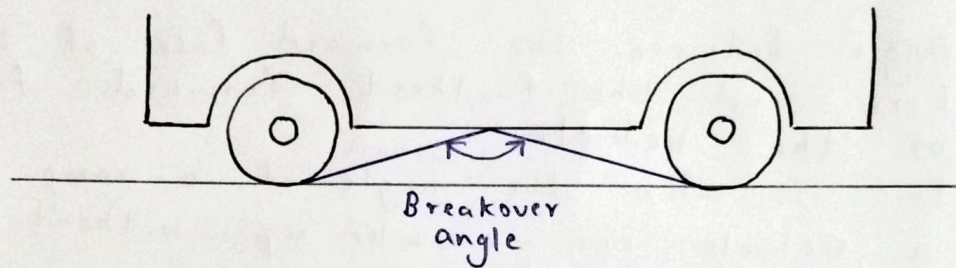
• Departure Angle.

- * Angle between the rear face of the rear tire and the rear most fixed part of the vehicle.
- * This is also the maximum angle a vehicle can descend without its tail bumper dragging on the ground.



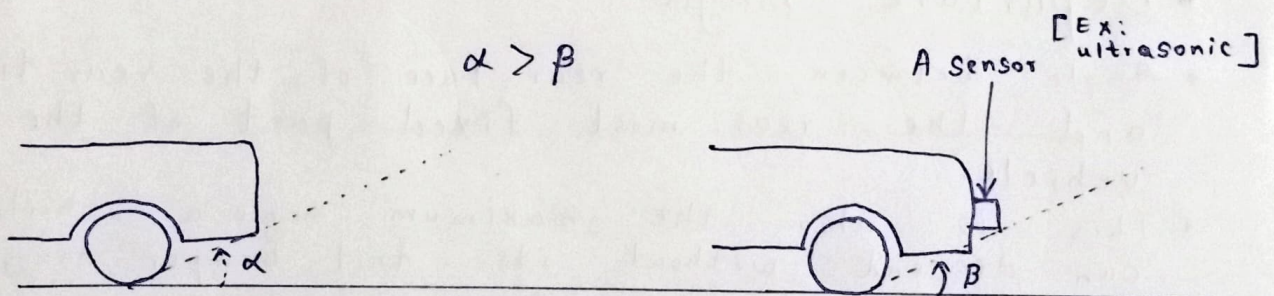
● Breakover Angle

- * The angle between the inner faces of the front and the rear tires and the belly of the vehicle.
- * This has an effect when a vehicle is in transitioning from the upslope the vehicle is driving to the platter of the top.



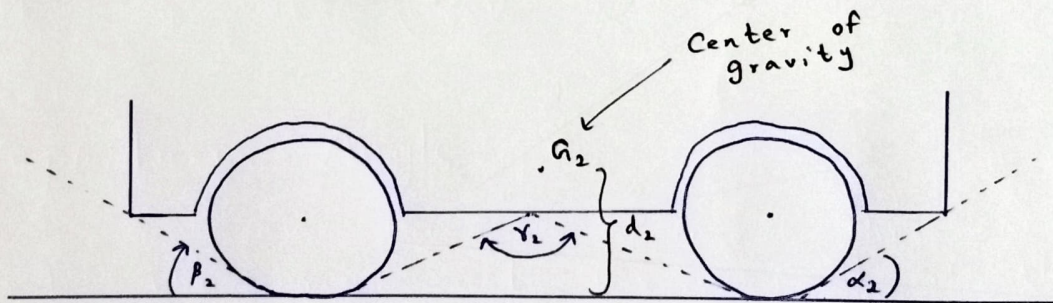
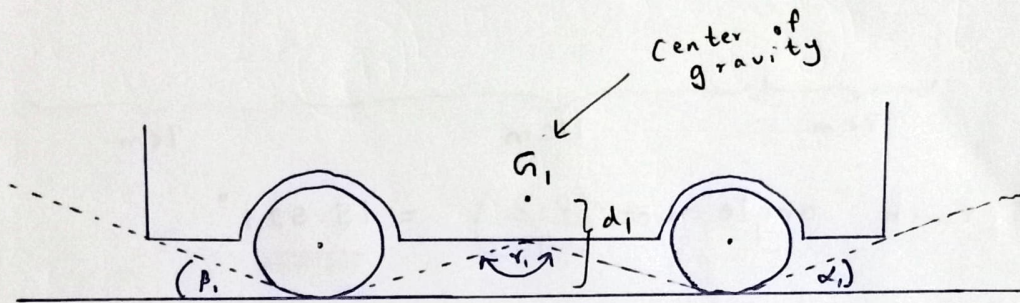
* Notes.

- * For a mobile robot, all these 3 angles are very important because with the placement of sensors, these angles can vary. Because, in order to operate the sensors in optimum condition and get accurate readings from them, sometimes the sensors should be placed a bit outside the chassis.



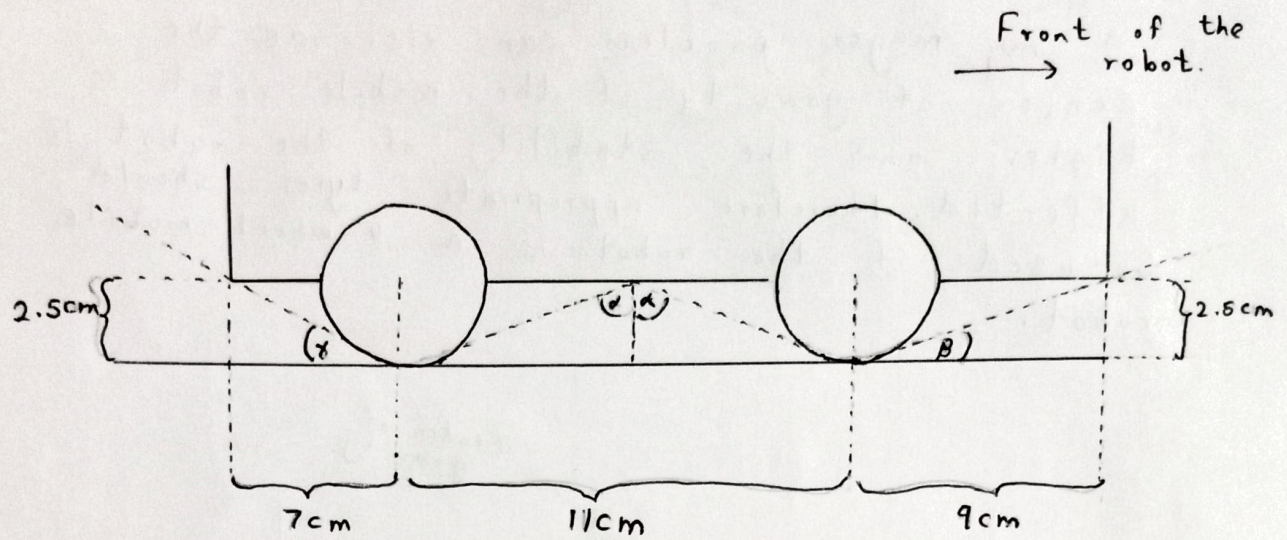
- * By increasing the length of the wheelbase of the robot, the approach angle and the break-over angle can be increased which is a good thing when it comes to climbing and descending from a slope. But breakover angle becomes less and the ground clearance is reduced. It can affect the robot because sensors or any actuators can be placed under the chassis and they may get damaged as the robot comes to the plane after climbing a slope.

* All the 3 angles can be improved in the robot by putting bigger wheels but a ~~major~~ major problem can rise as the center of gravity of the mobile robot is going higher and the stability of the robot is affected. Therefore appropriate tyres should be used if the robot is a 4-wheel mobile robot.



$$d_2 > d_1$$

$$\alpha_2 > \alpha_1, \quad \beta_2 > \beta_1, \quad r_2 > r_1$$



$$\text{Approach angle} = \arctan^{-1}\left(\frac{2.5}{9}\right) = \underline{\underline{15.524^\circ}}$$

$$\text{Departure angle} = \arctan^{-1}\left(\frac{2.5}{7}\right) = \underline{\underline{19.654^\circ}}$$

$$\text{Breakover angle} = \left(\arctan^{-1}\left(\frac{5.5}{2.5}\right)\right) \times 2 = \underline{\underline{131.112^\circ}}$$