

BMA4723 VEHICLE DYNAMICS

Ch3 Tire Mechanics

by

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Chapter Description

- **Aims**
 - Explain the tire ratings and designations.
 - Explain how tire wear can be occurred.
- **Expected Outcomes**
 - Students are able to choose the suitable tire based on the tire ratings.
 - Students are able to determine the factors that can affect tire wear.
- **References**
 - M.Abe, Vehicle Handling Dynamics Theory and Application, Second Edition, Published by Elsevier Ltd, 2015.
 - Thomas D.Gillespie, Fundamental of Vehicle Dynamics, Published by Society of Automotive Engineers.
 - Jack Erjavec, Automotive Technology, A System Approach, 5th Edition, Published by Delmar, Cengage Learning, 2010.

Outlines

- 3.1 Introduction of Tires
- 3.2 Tire Ratings and Designations
- 3.3 Tire Wear

3.1 Introduction of Tires

- In chapter 2, the effect of the dynamic loads on the several conditions have been discussed.
- During accelerating, the load transferred is from the front tire to the rear tire.
- In contrast, for braking, the load is transferred from the rear tire to the front tire.
- Tires is the only component that provide connection between the body of the vehicle to the road.
- Then, it can be said that tires are the major components that can affect the motions and performance of the vehicle.
- Before analysis the forces generated between the tires and road, it is important to know the fundamentals of the tires such as the purpose of the tires, tire ratings and tire wear.

3.1 Introduction of Tires

- Early vehicle tires used solid rubber.
- Nowadays : pneumatic tires (filled with air).
- Two types of pneumatic tires:
 - i. use inner tube (tube tires) and
 - ii. do not use inner tube (tubeless tires)



Figure 1 Inner tube [Image](#)



Figure 2 Tubeless tire [Image](#)

3.1 Introduction of Tires

- The main purpose of the tires:
 - provide traction
 - absorb road shock
 - carry the weight of the vehicle
 - transfer braking and driving torque



Figure 3 Tire and wheel [Image](#)

3.1 Introduction of Tires

- When the driver push the throttle pedal, the driving force from the engine or electric motor will rotates the tire.
- At the same time, the friction force also will be created.
- The direction of the friction force is opposite to the direction of the traction force.
- One of the factor that can affect the amount of friction force is the **friction coefficient** of the road.
- The dry asphalt road will have higher friction coefficient than the wet or snow road.
- In addition, **rolling resistance** also will be created when the tire rolls on the road.
- Too **much traction** means there is **much friction**, and too **much friction** means there is a **lot of rolling resistance**.

3.2 Tire Ratings and Designations



Figure 4 Tire ratings

3.2 Tire Ratings and Designations

From Fig.4:

- 195: Section width (in mm)
- Aspect ratio: The tyre height as a percentage of the width. The 65 refers to 65% of the tire's width of 195mm
- R: Radial construction. It can be a "B" (belted bias) or a "D" (bias ply)
- 15: Rim diameter (The tire diameter)
- 91: Load rating (The tire load capacity)
- V: Speed Rating (The tire speed indicator)

3.3 Tire Wear

- It is normal that the tread of the tires will become shallower.
- There are several factors contribute to the tire wear:
 - **Improper inflation pressure: over/under inflation pressure**
 - **Improper tire alignment: toe and camber**

3.3 Tire Wear

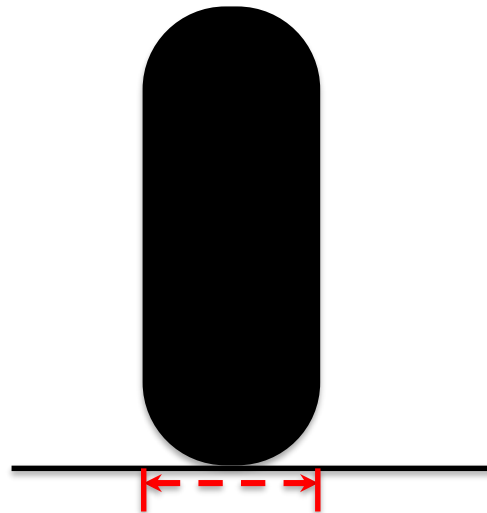


Figure 5 Over inflation

- When a tire is over inflation, the contact surface between the road and tire is small and not optimized.
- The center of the tire will wear faster than at the side area.

3.3 Tire Wear

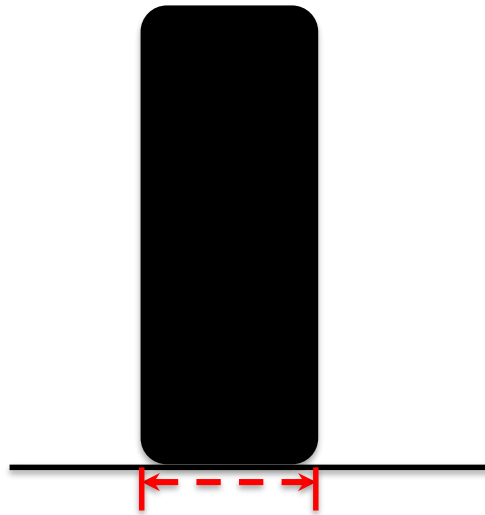


Figure 6 Under inflation

- When a tire is under inflation, the contact surface between the road and tire is large and also not optimized.
- The side part of the tire will wear faster than at the center.

3.3 Tire Wear

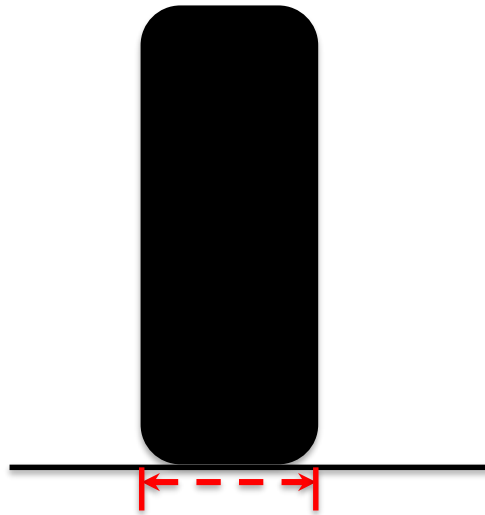


Figure 7 Correct inflation

- When a tire is correct inflation, the load distribution and the forces acting on the thread is optimized.
- This can help to increase the lifespan of the tire.

3.3 Tire Wear

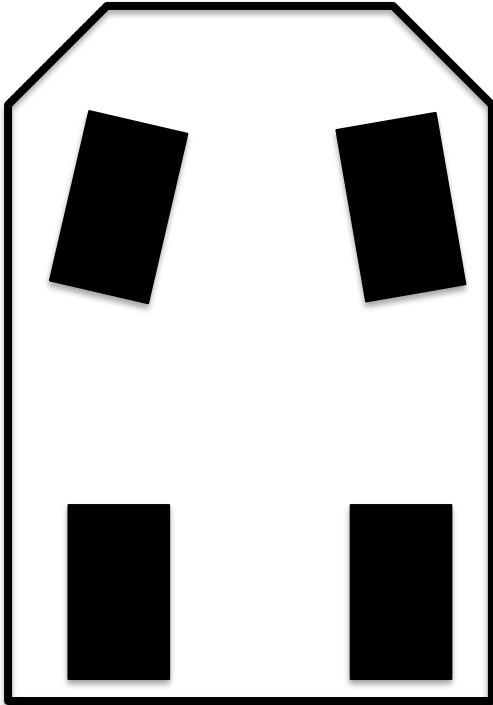


Figure 8 Toe in

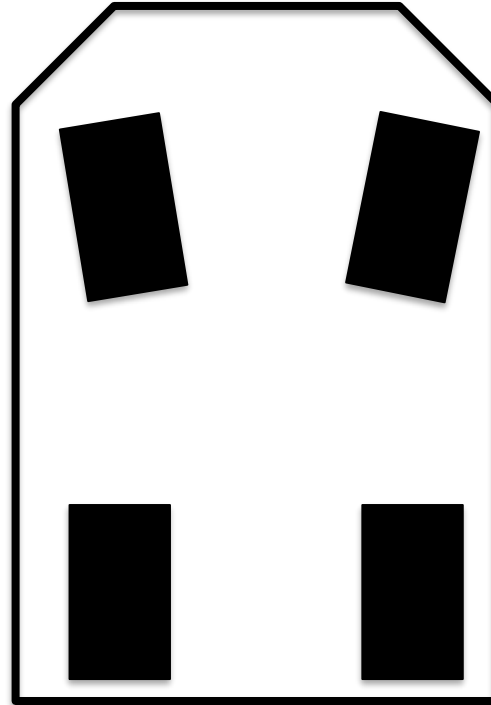


Figure 9 Toe out

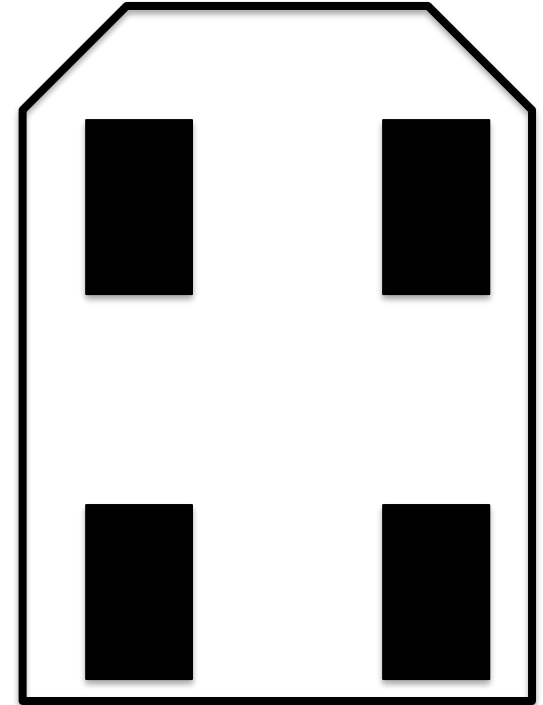


Figure 10 Zero toe

3.3 Tire Wear

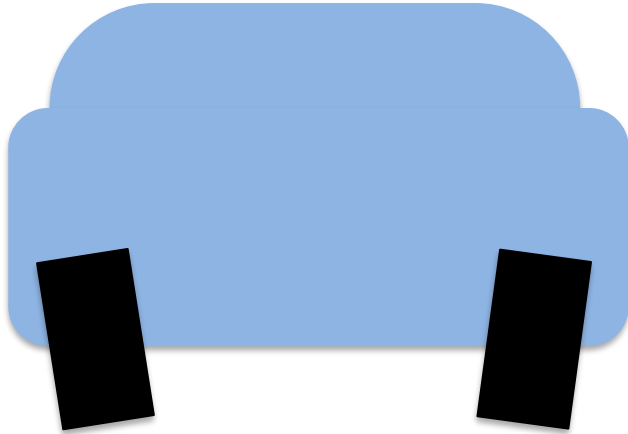


Figure 11 Positive camber

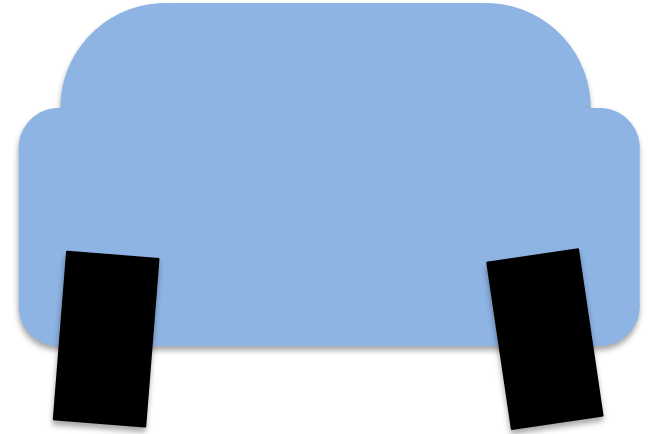


Figure 12 Negative Camber

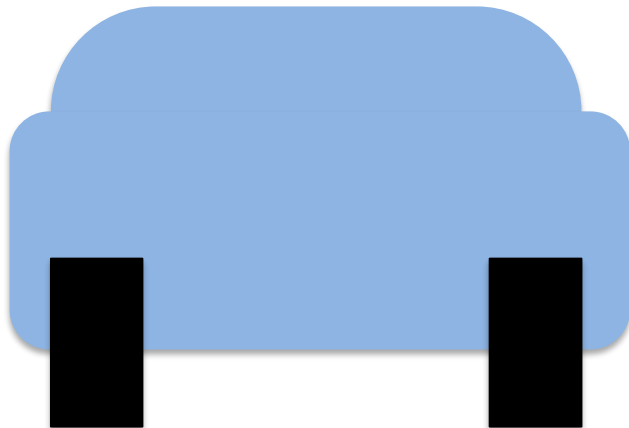


Figure 13 Zero Camber

3.3 Tire Wear

- Tire alignment refers to the vehicle's steering and suspension components.
- Steering and suspension are very important to control the motions of the vehicle.
- Improper tire alignment will cause tire wear unevenly.

Conclusion of The Chapter 1

- **Conclusion #1**
 - Tire can be divided into two groups, tube and tubeless tire
 - Tire ratings can help us to choose the suitable tire.
- **Conclusion #2**
 - Tire wear can be occurred due to the several factors such as improper inflation pressure and improper tire alignment.

Vehicle Dynamics

Chapter 3

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