

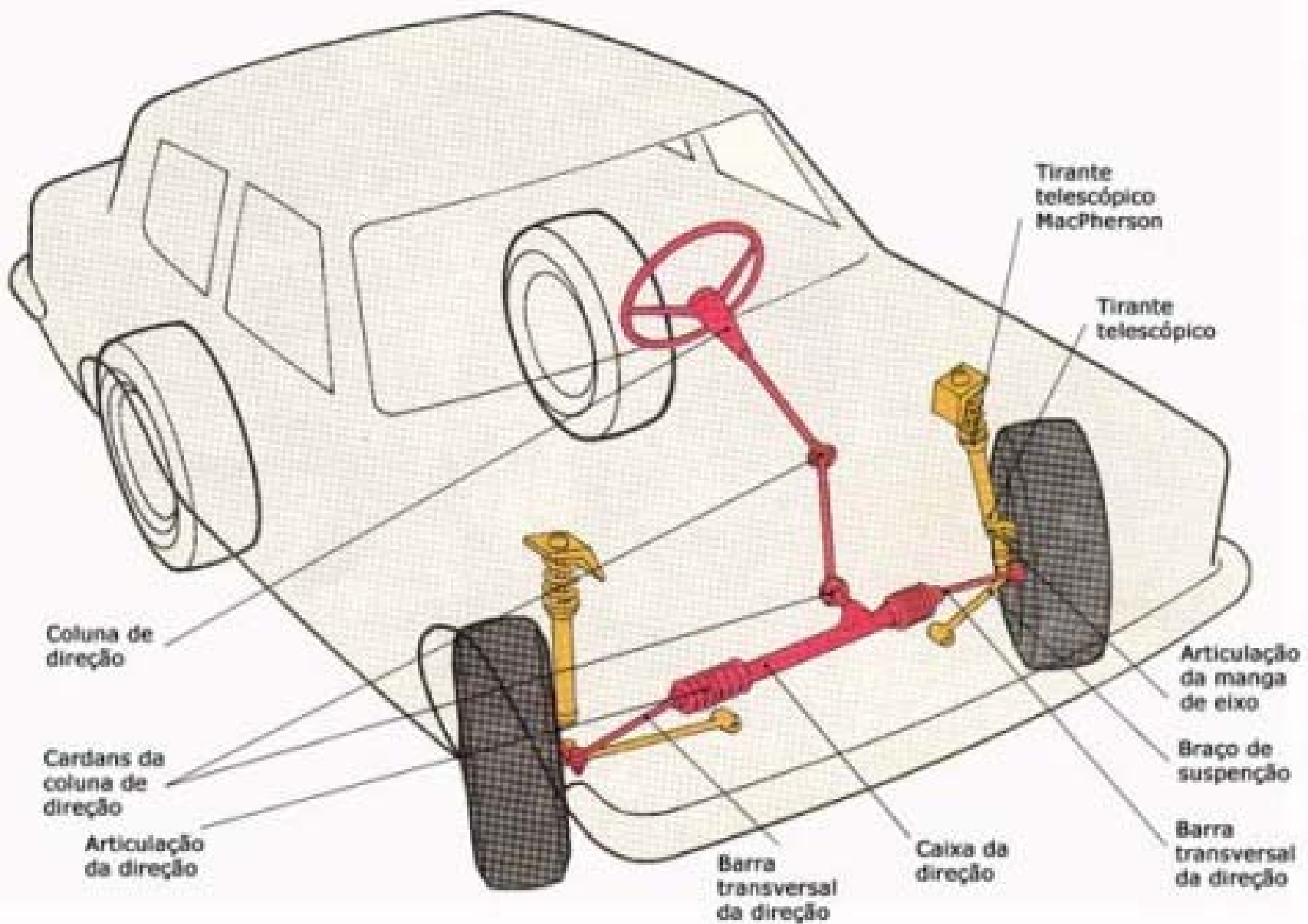
Mecanismos

Prof. Jorge Luiz Erthal

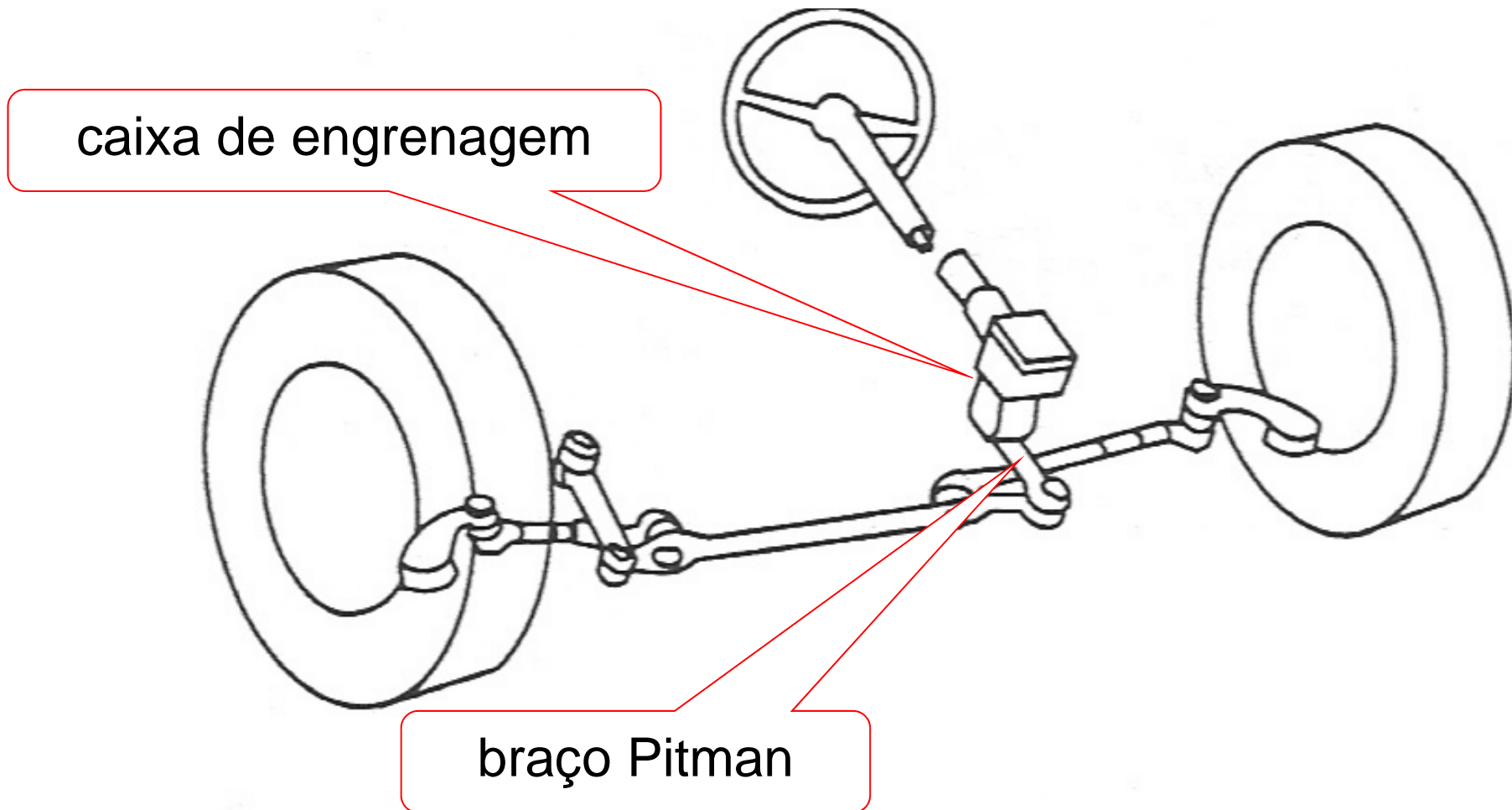
Síntese de Mecanismos

Projeto de um sistema de direção

Sistema de Direção

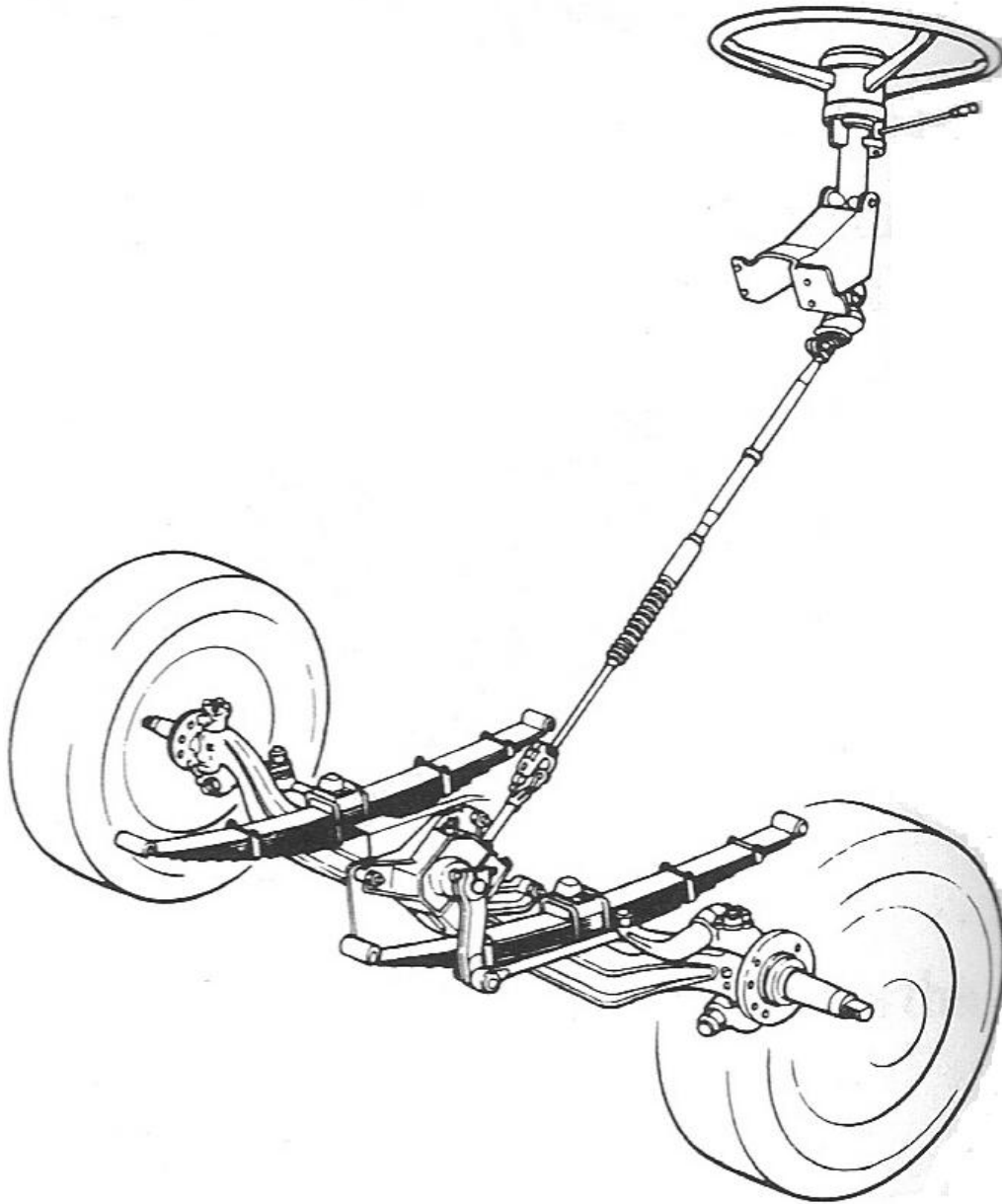


Sistema de direção



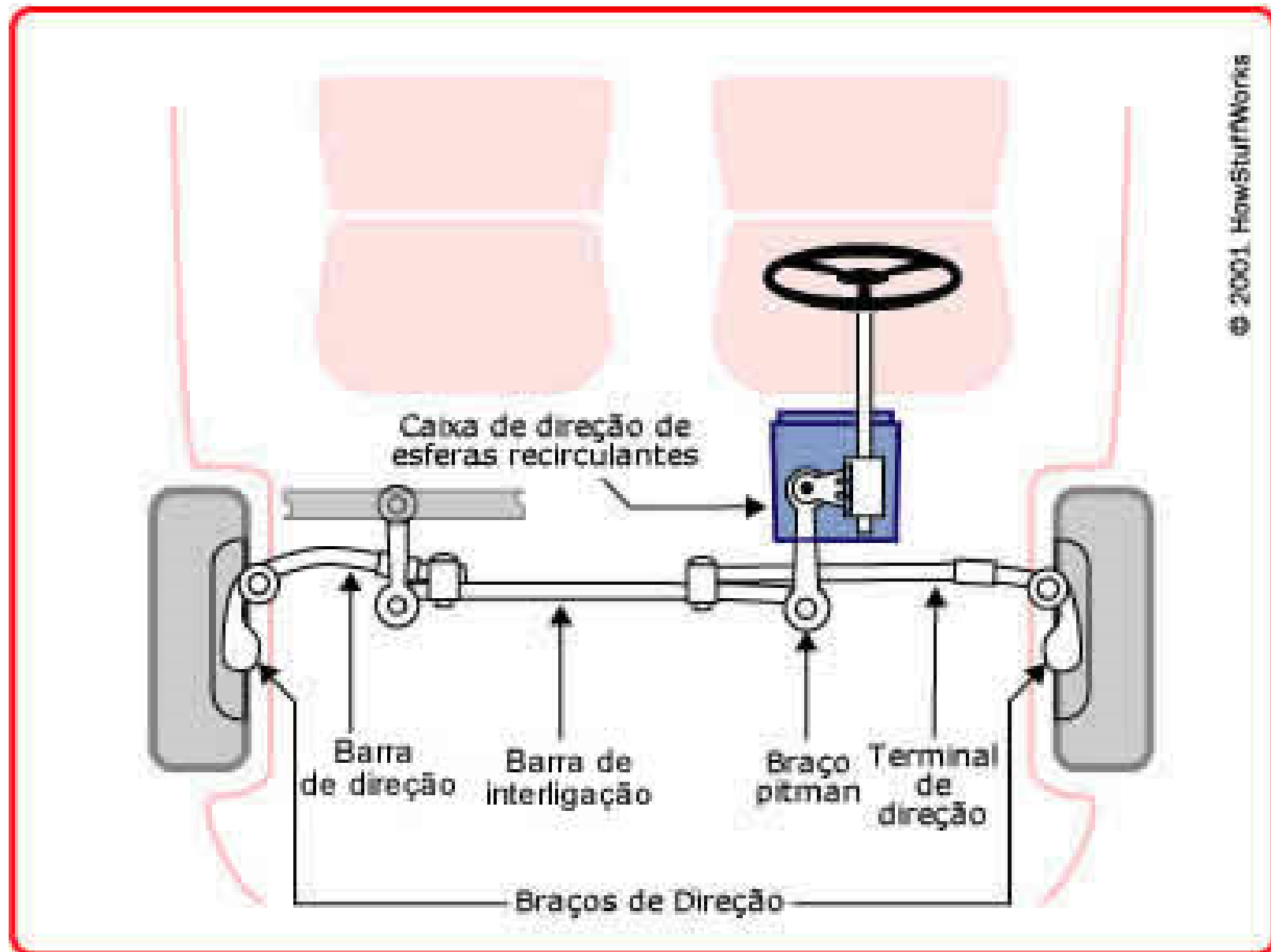
Steering gearbox

Sistema de Direção

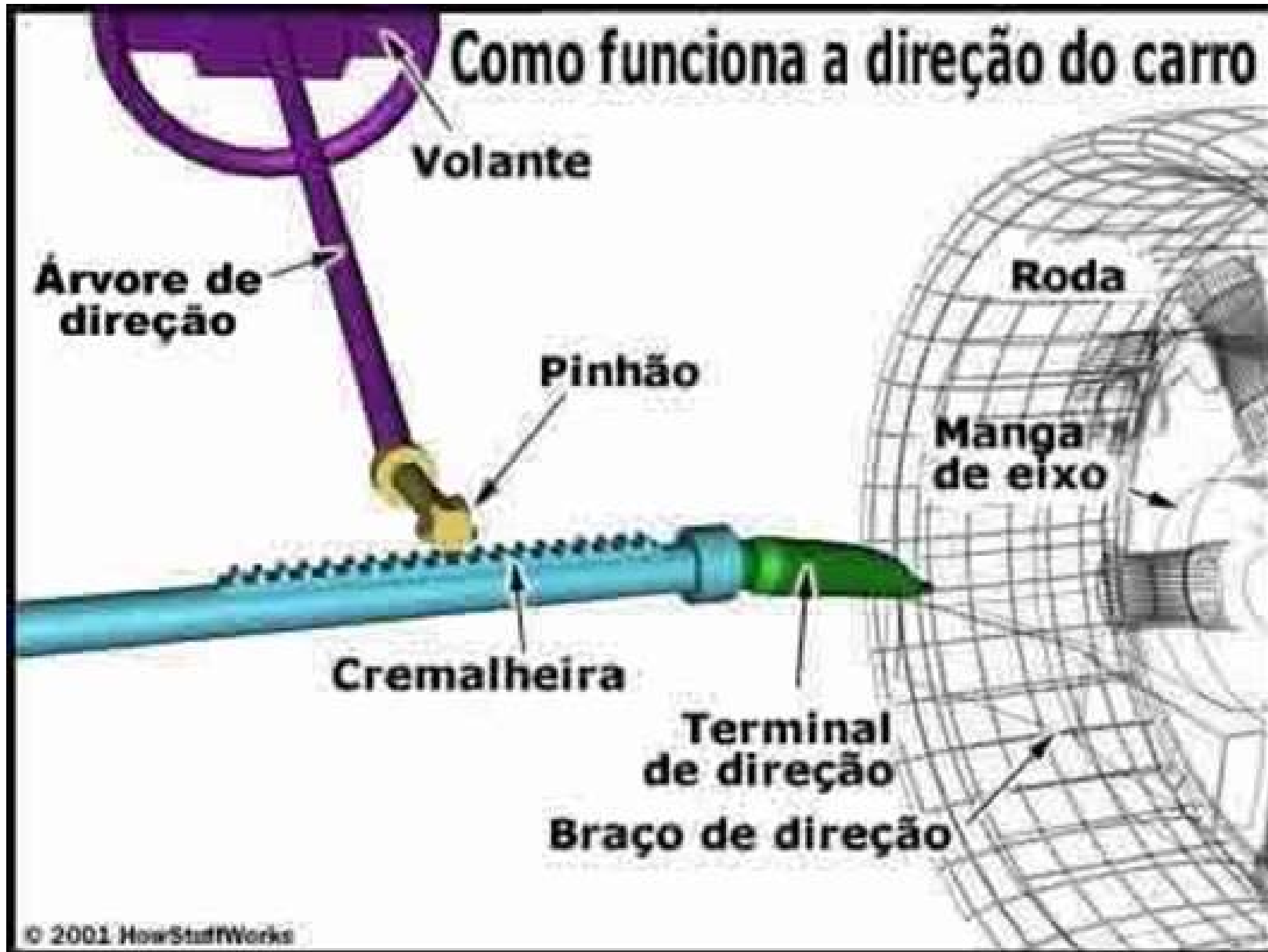


Truck steering system

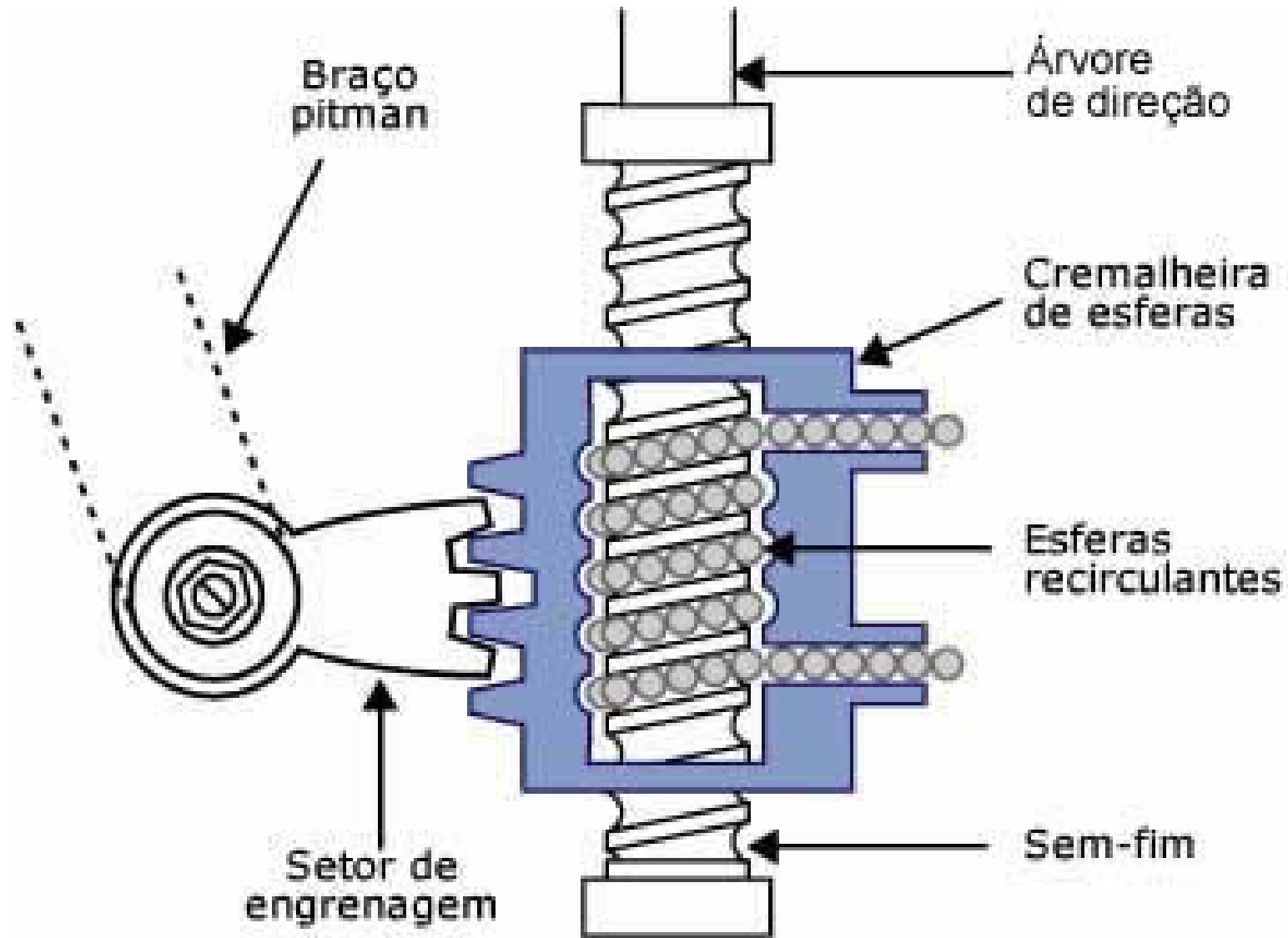
Sistema de Direção



Sistema de Direção

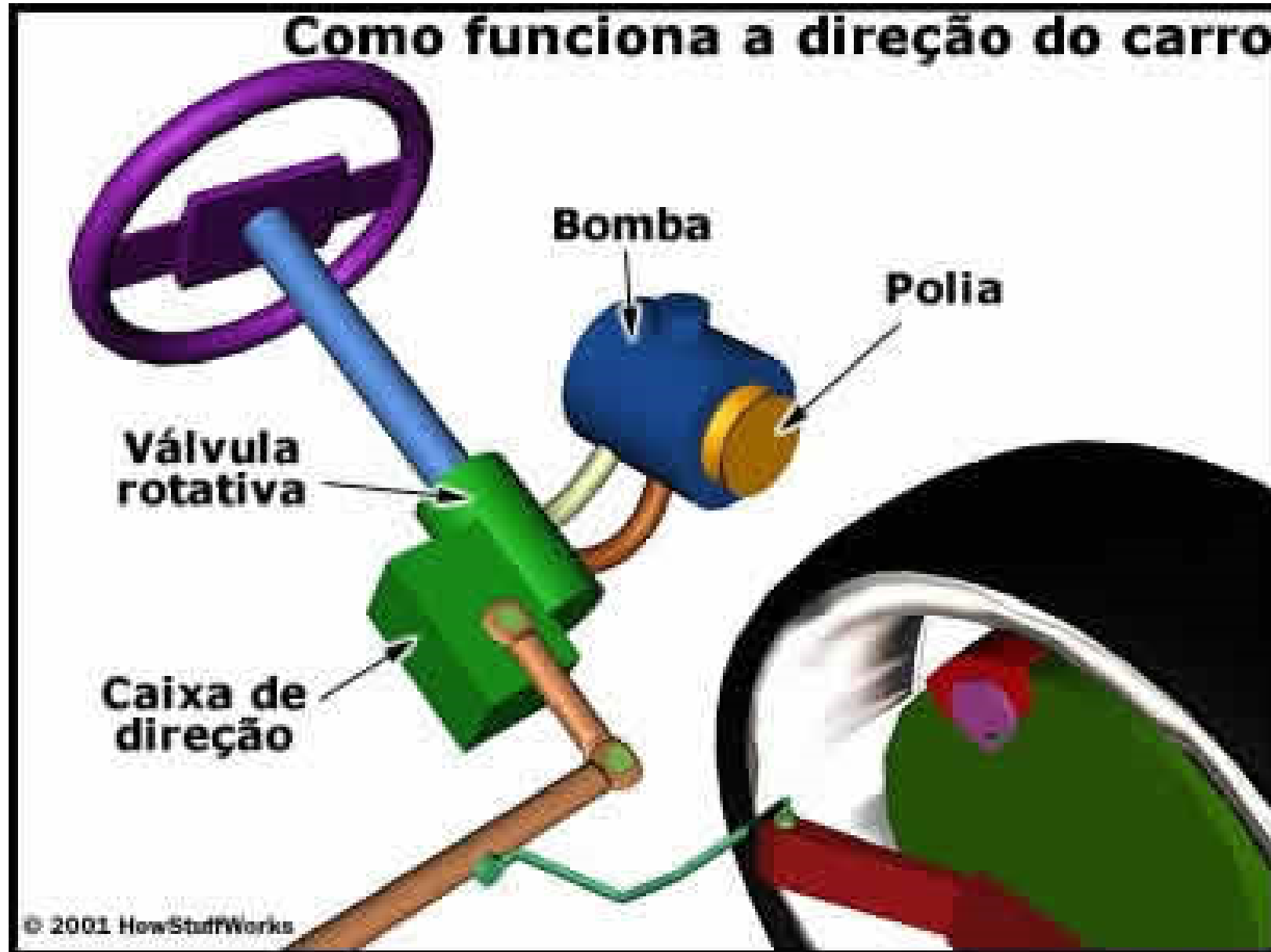


Sistema de Direção

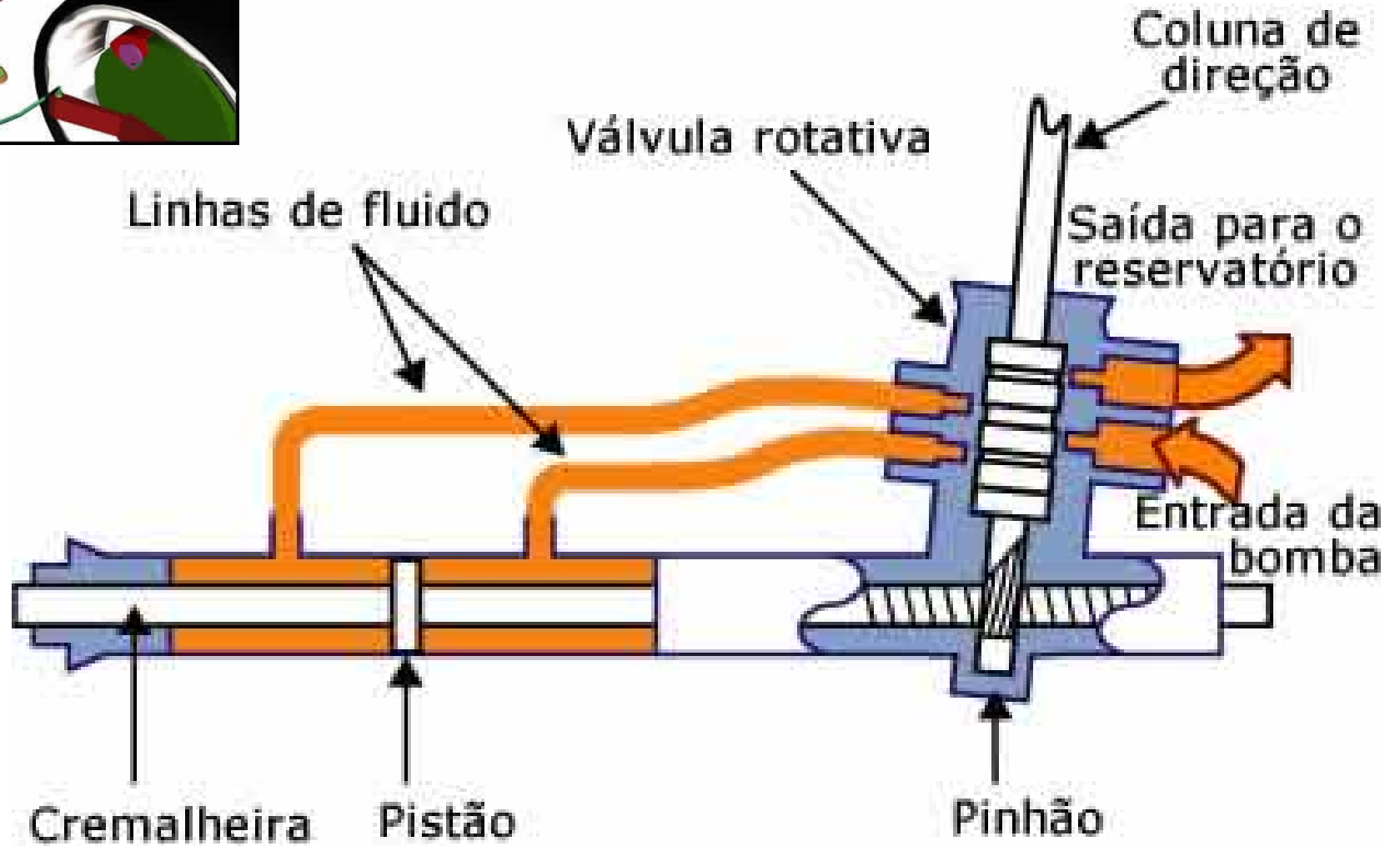
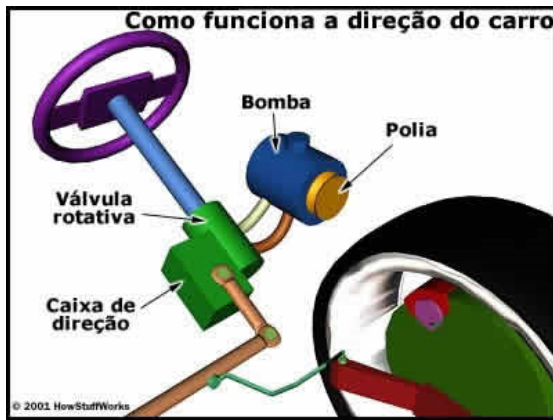


Sistema de Direção

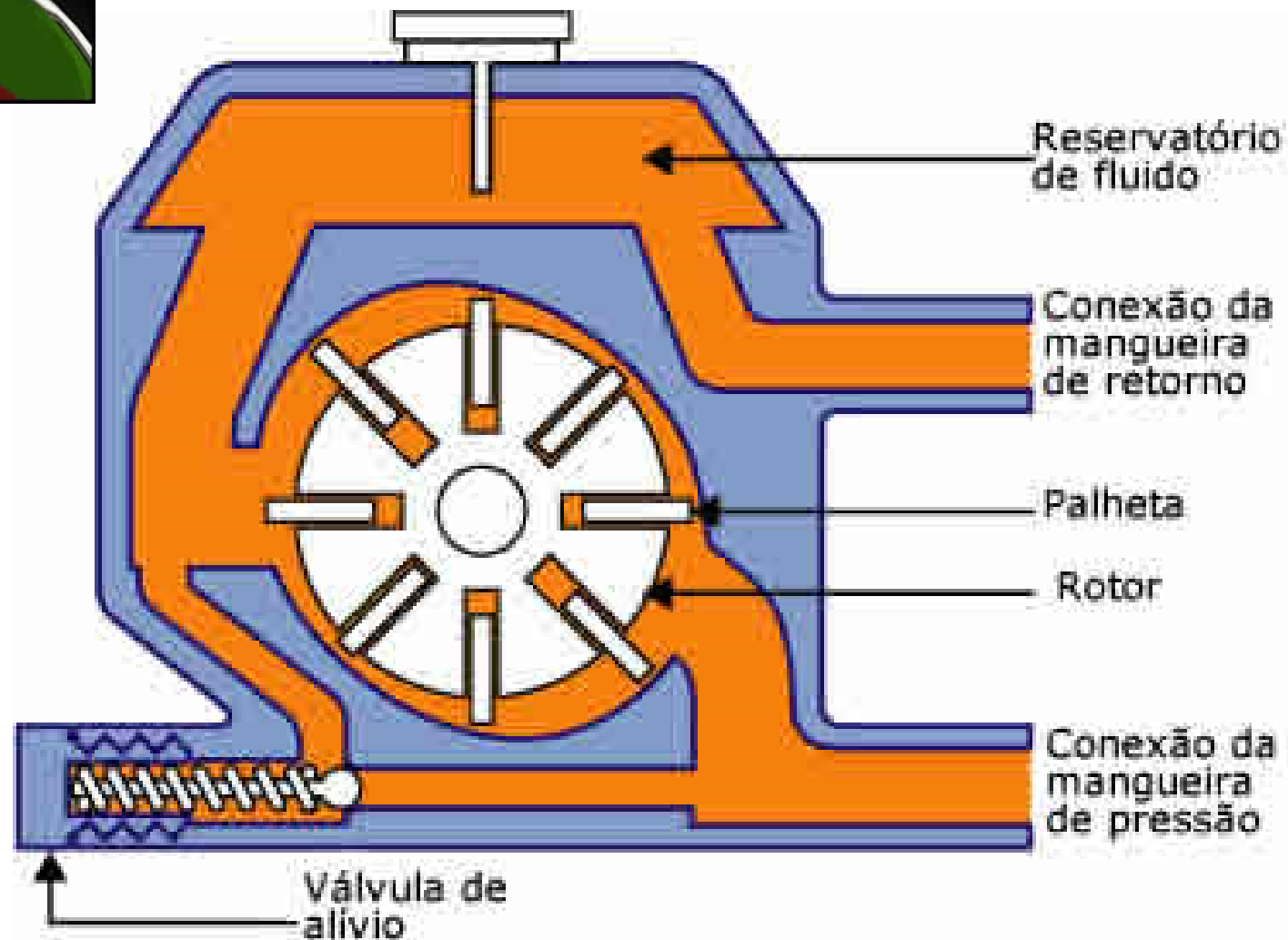
Como funciona a direção do carro



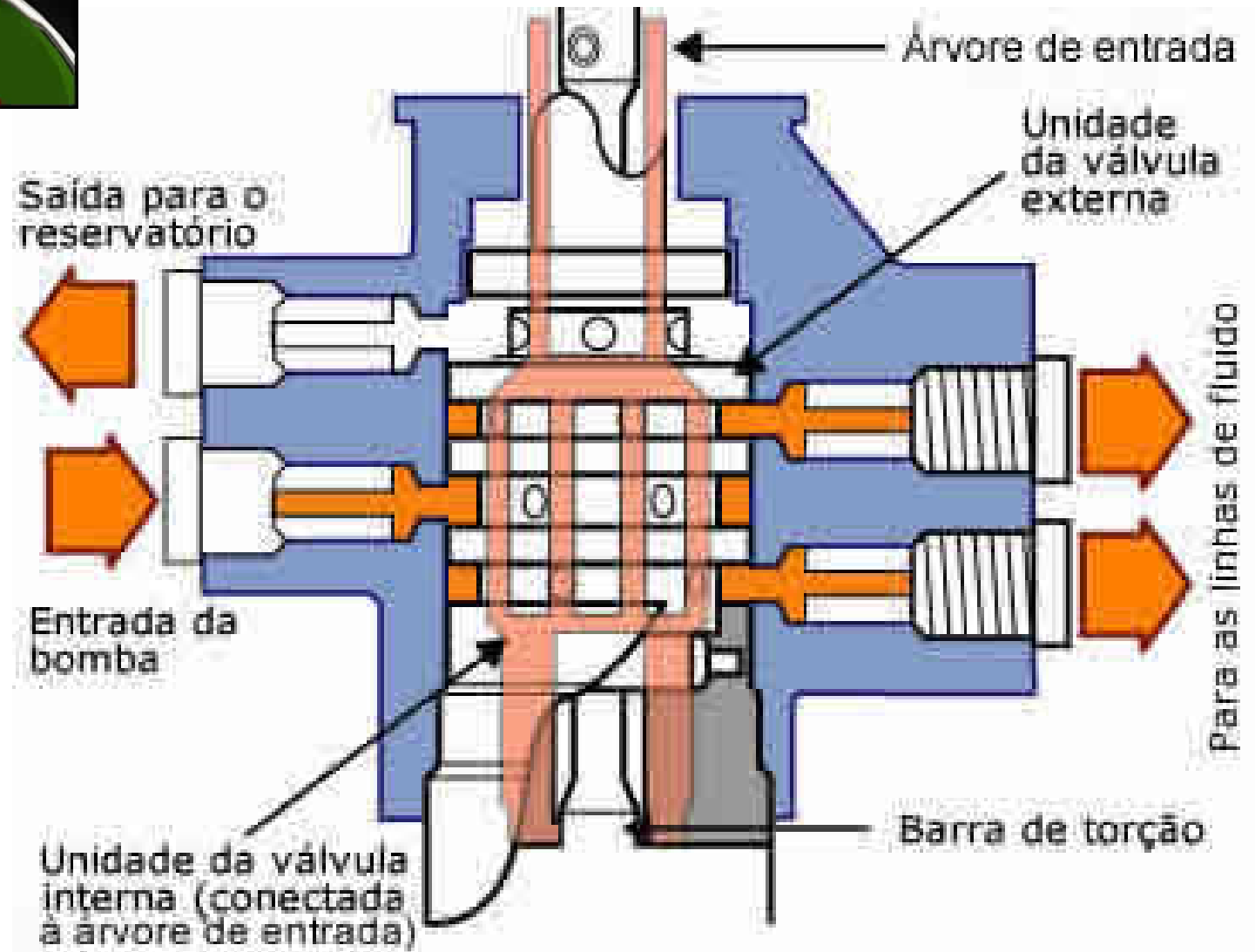
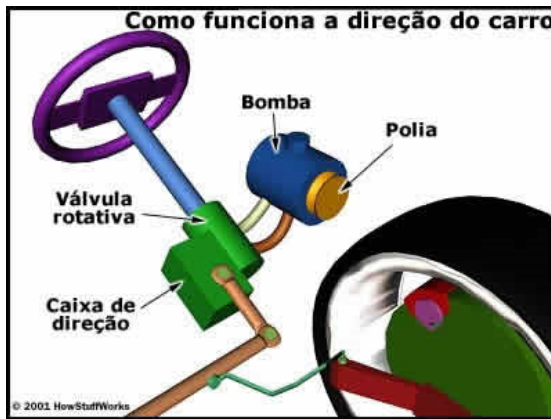
Sistema de Direção



Sistema de Direção



Sistema de Direção



Sistemas de direção

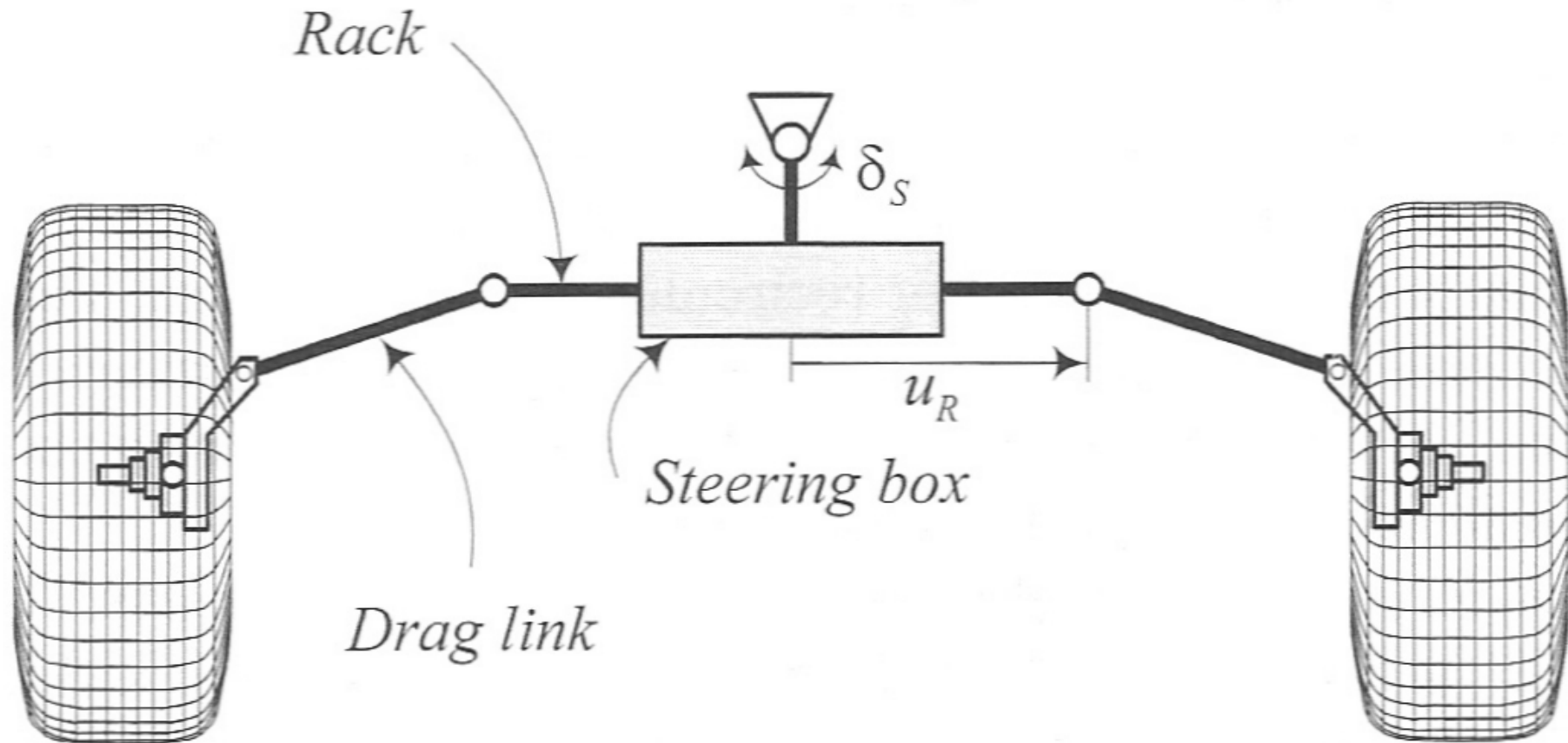


FIGURE 7.24. A rack-and-pinion steering system.

Sistemas de direção

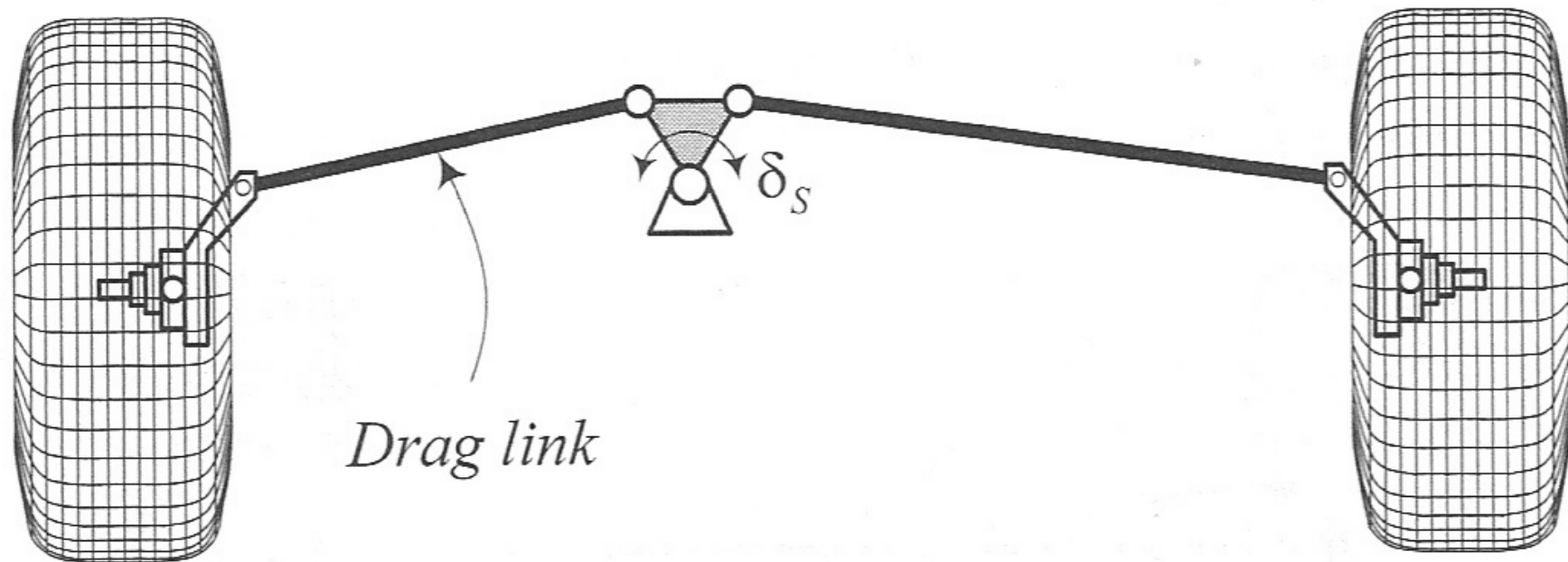


FIGURE 7.25. A lever arm steering system.

Sistemas de direção

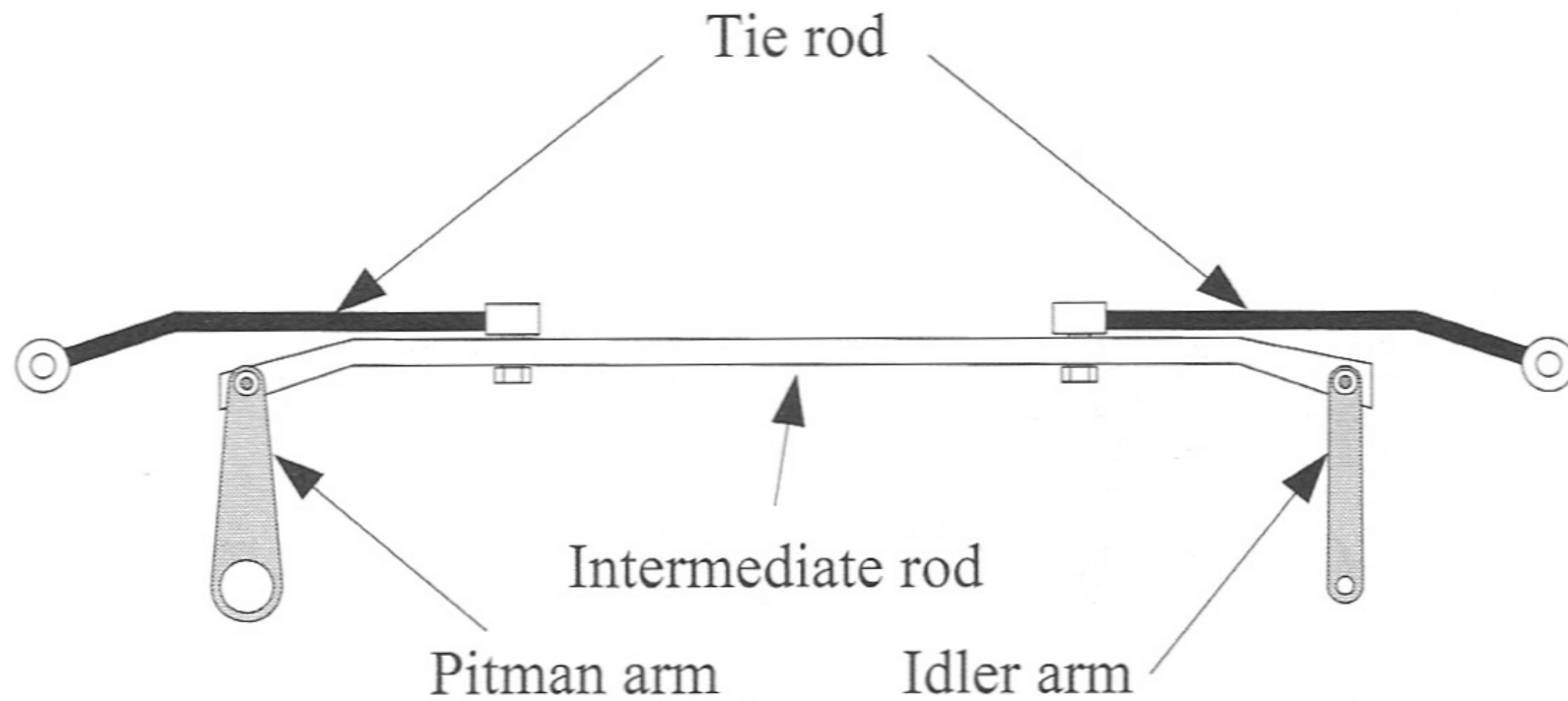


FIGURE 7.23. A sample parallelogram steering linkage and its components.

Sistemas de direção

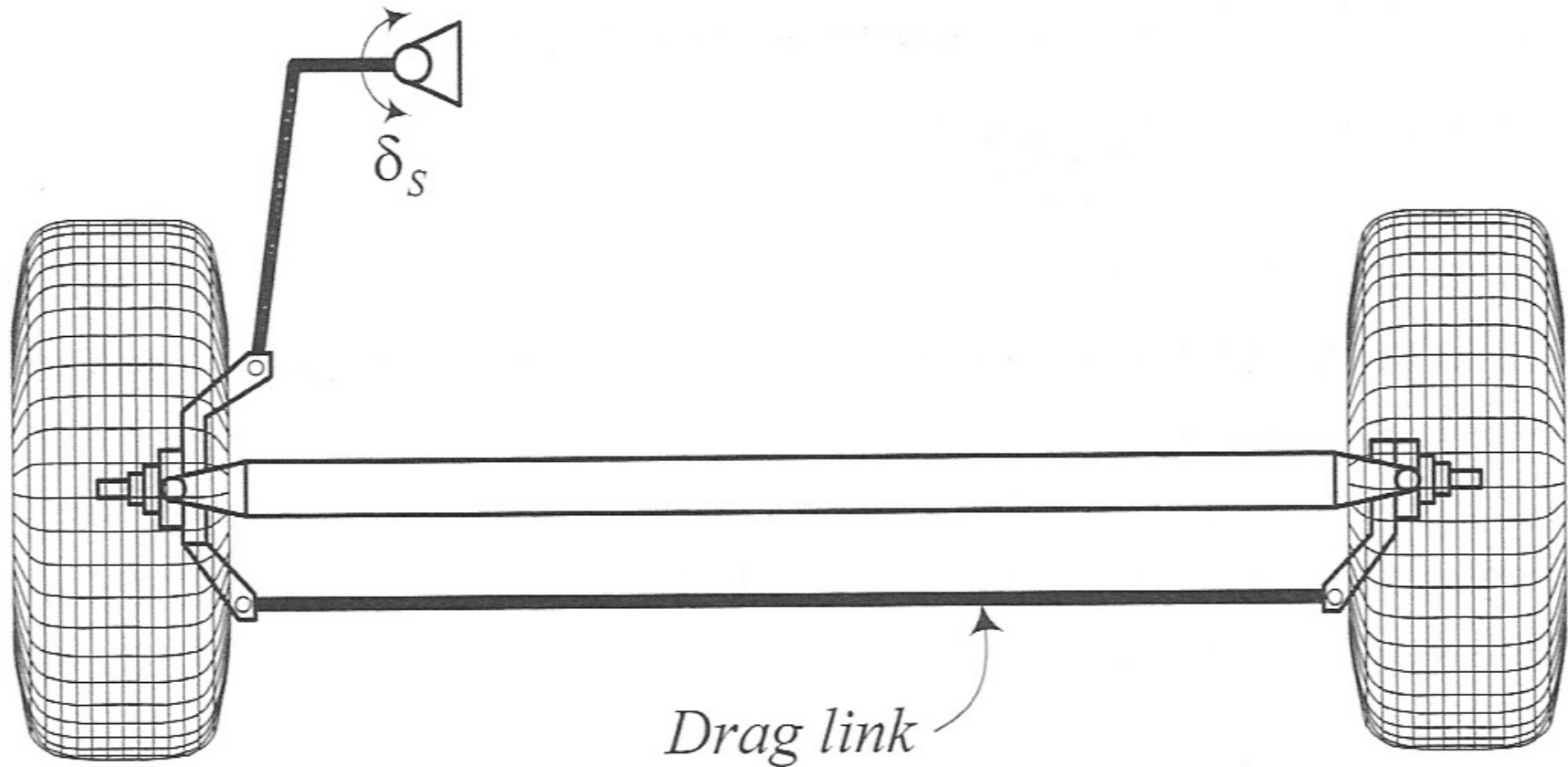


FIGURE 7.26. A drag link steering system.

Sistemas de direção

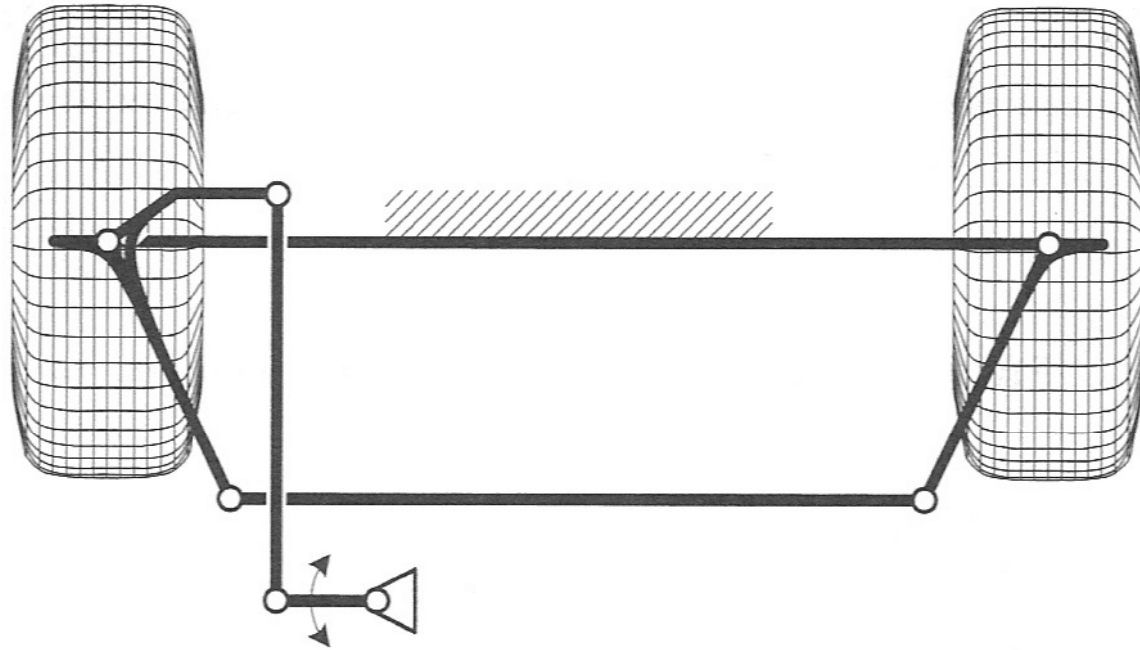


FIGURE 7.27. Connection of the Pitman arm to a trapezoidal steering mechanism.

Dispositivos de segurança

COLUNAS DE DIREÇÃO QUE CEDEM EM CASO DE COLISÃO



Modelo de coluna de direção que pode ser inclinada e dobra-se pelo cardan em caso de colisão.



Neste modelo, a parte inferior da coluna avança, deslizando sobre a parte superior, a fim de absorver a energia do choque.



Em caso de colisão, a rede metálica da coluna telescópica comprime-se para absorver o impacto.

Cinemática do esterçamento

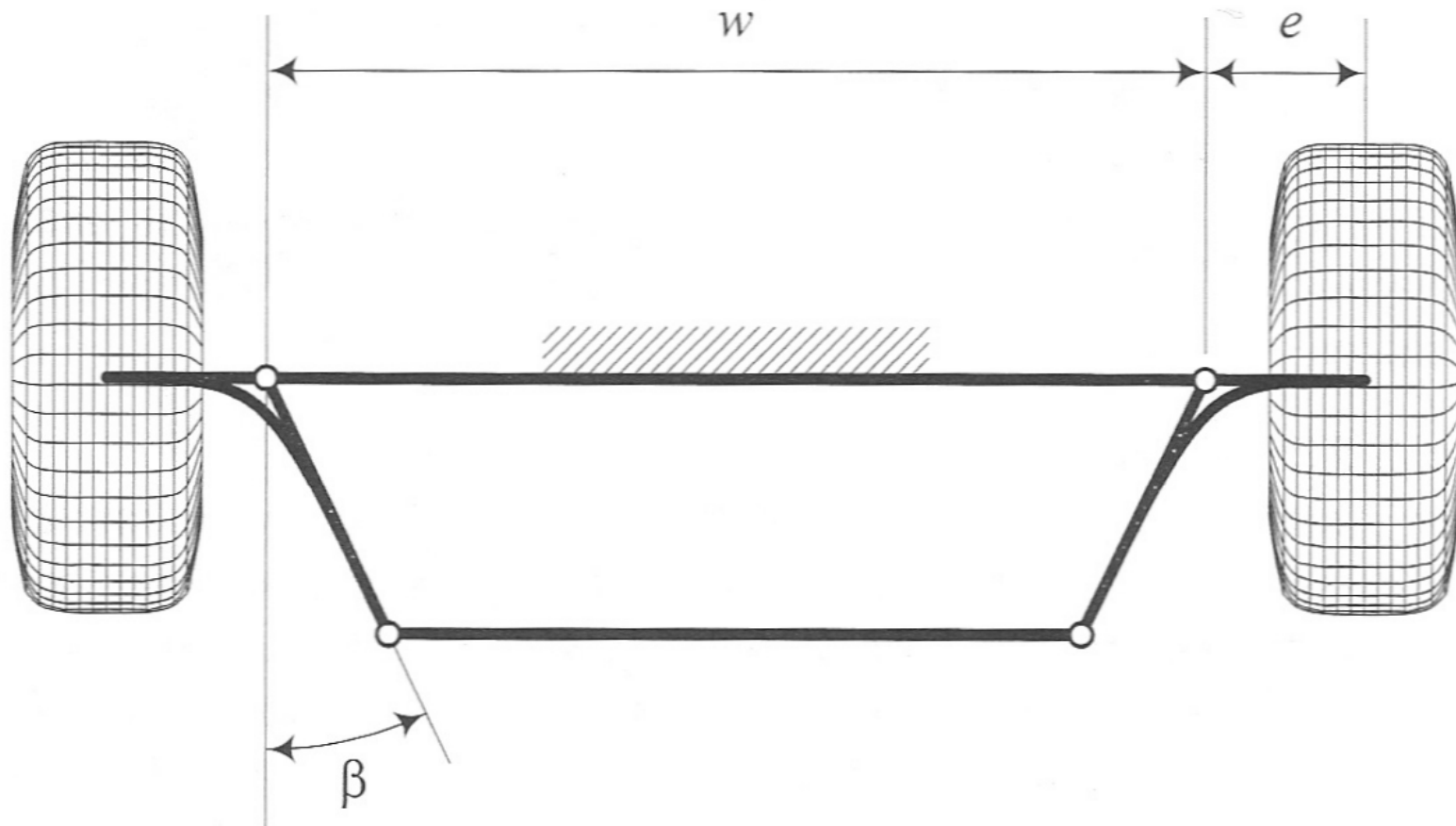


FIGURE 7.29. An offset design for wheel attachment to an steering mechanism.

Cinemática do esterçamento

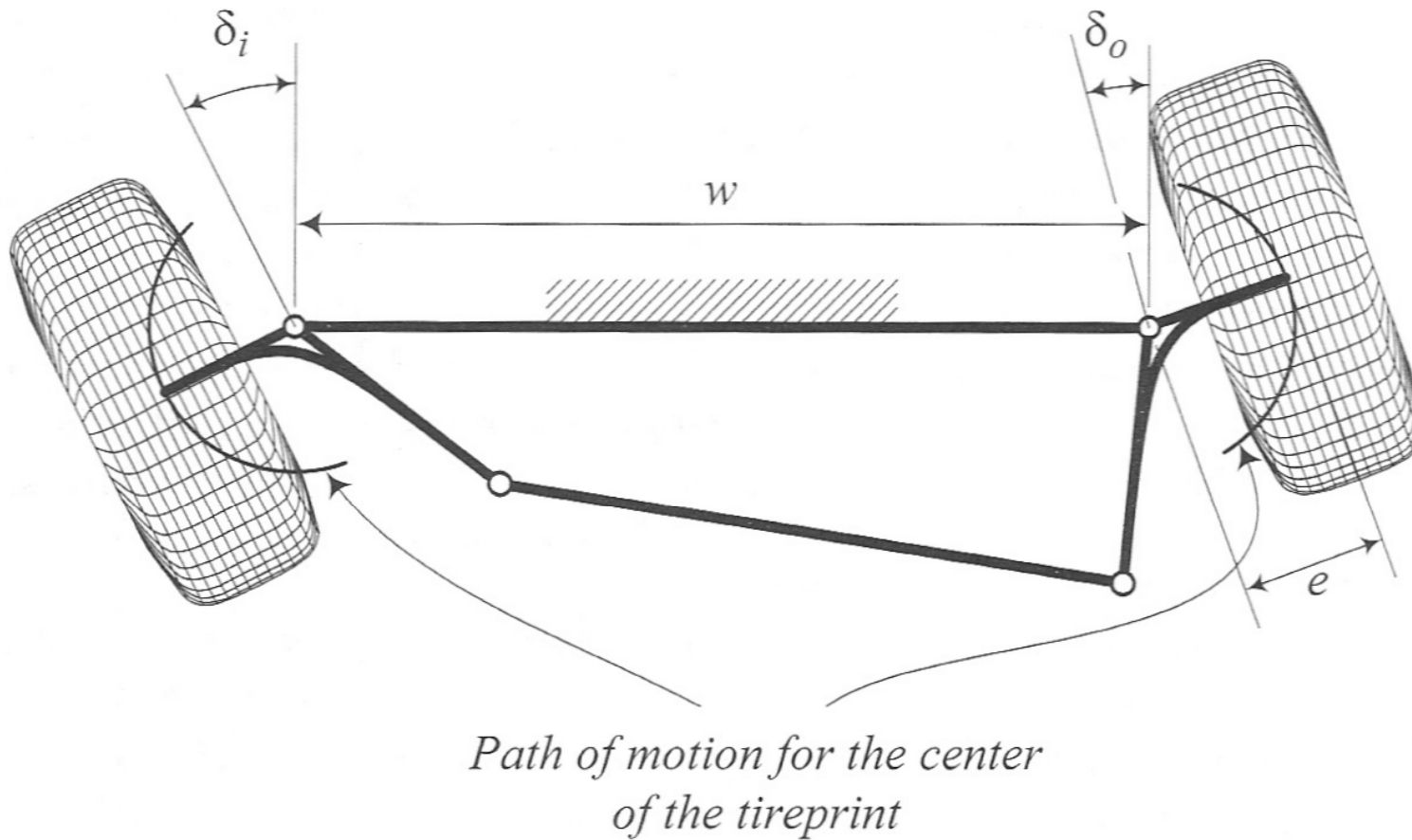
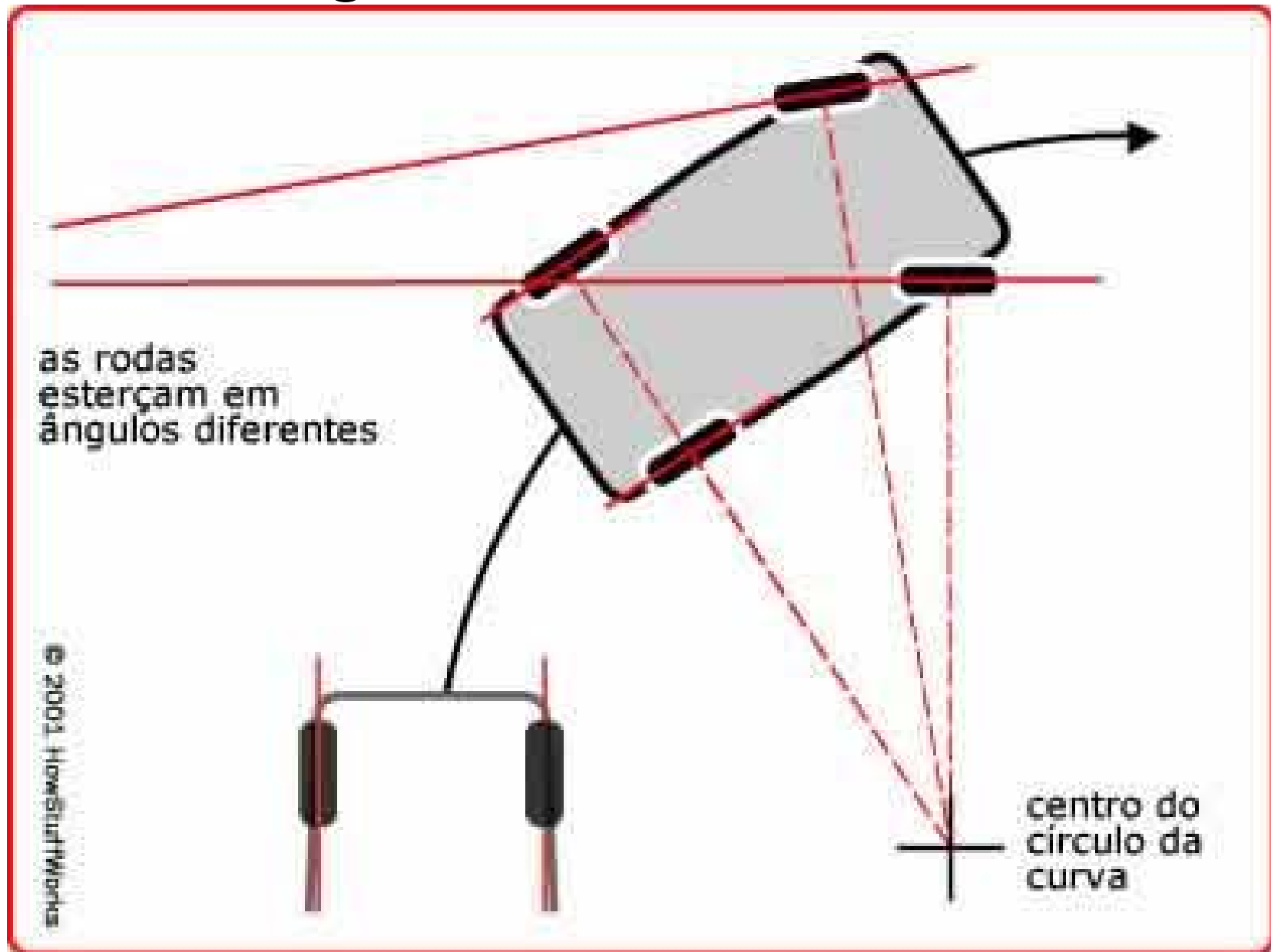


FIGURE 7.30. Offset attachment of steerable wheels to a trapezoidal steering mechanism.

Ângulos de Ackerman

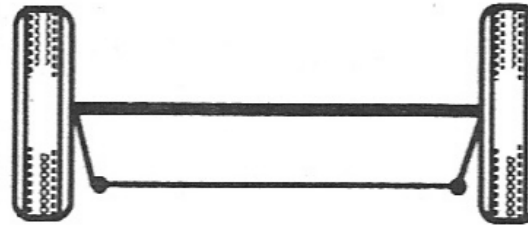


Cinemática do esterçamento

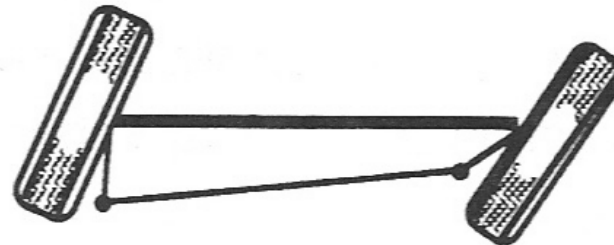
Angulos de Ackerman

$$\tan \delta_o = \frac{L}{R + \frac{t}{2}} \Rightarrow \delta_o \cong \frac{L}{R + \frac{t}{2}}$$

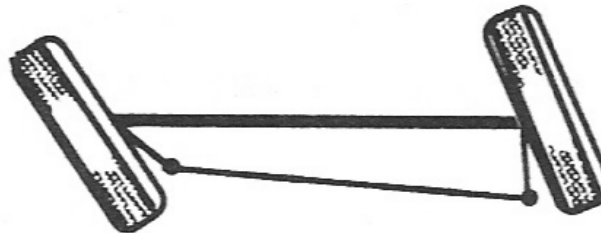
$$\tan \delta_i = \frac{L}{R - \frac{t}{2}} \Rightarrow \delta_i \cong \frac{L}{R - \frac{t}{2}}$$



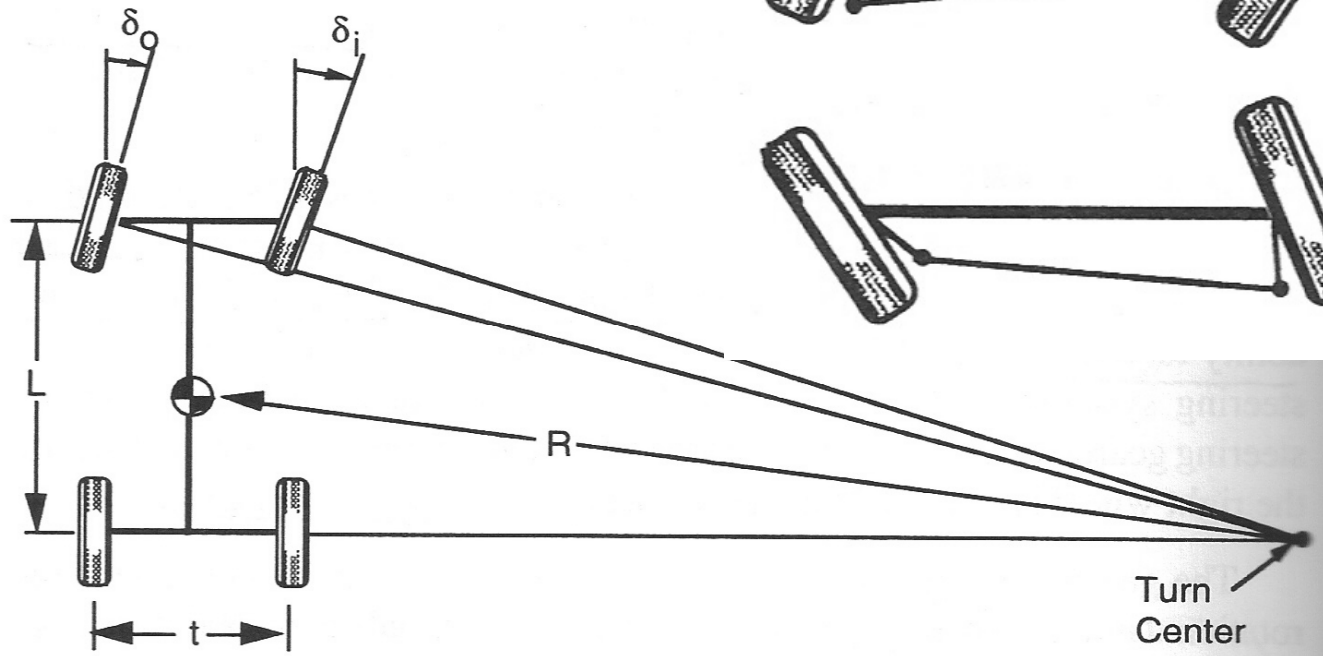
Trapezoidal
Geometry



Right Turn



Left Turn



Cinemática do esterçamento

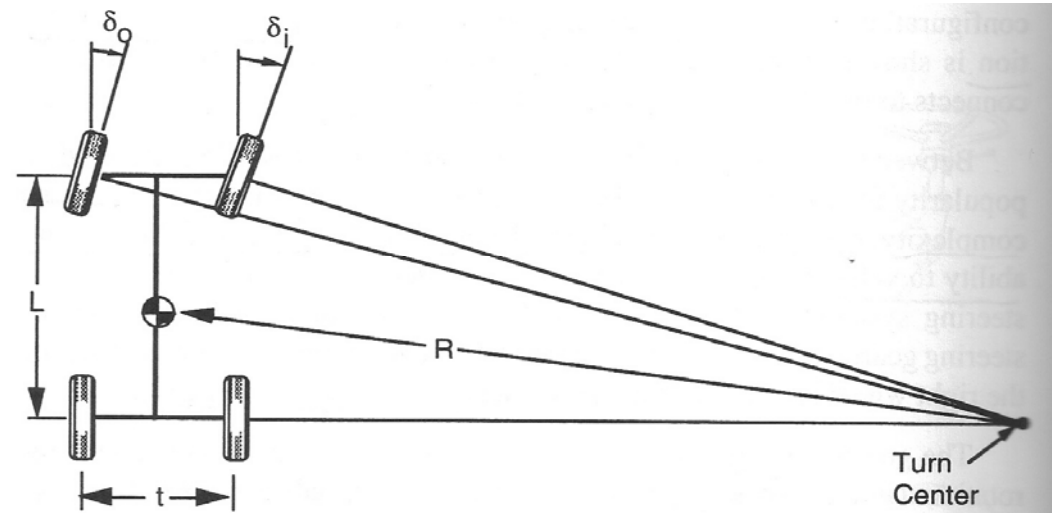
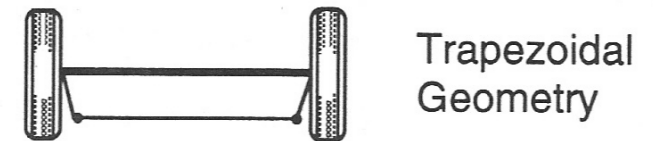
RAZÃO DE ESTERÇAMENTO

Relação entre o ângulo do volante e o ângulo da roda

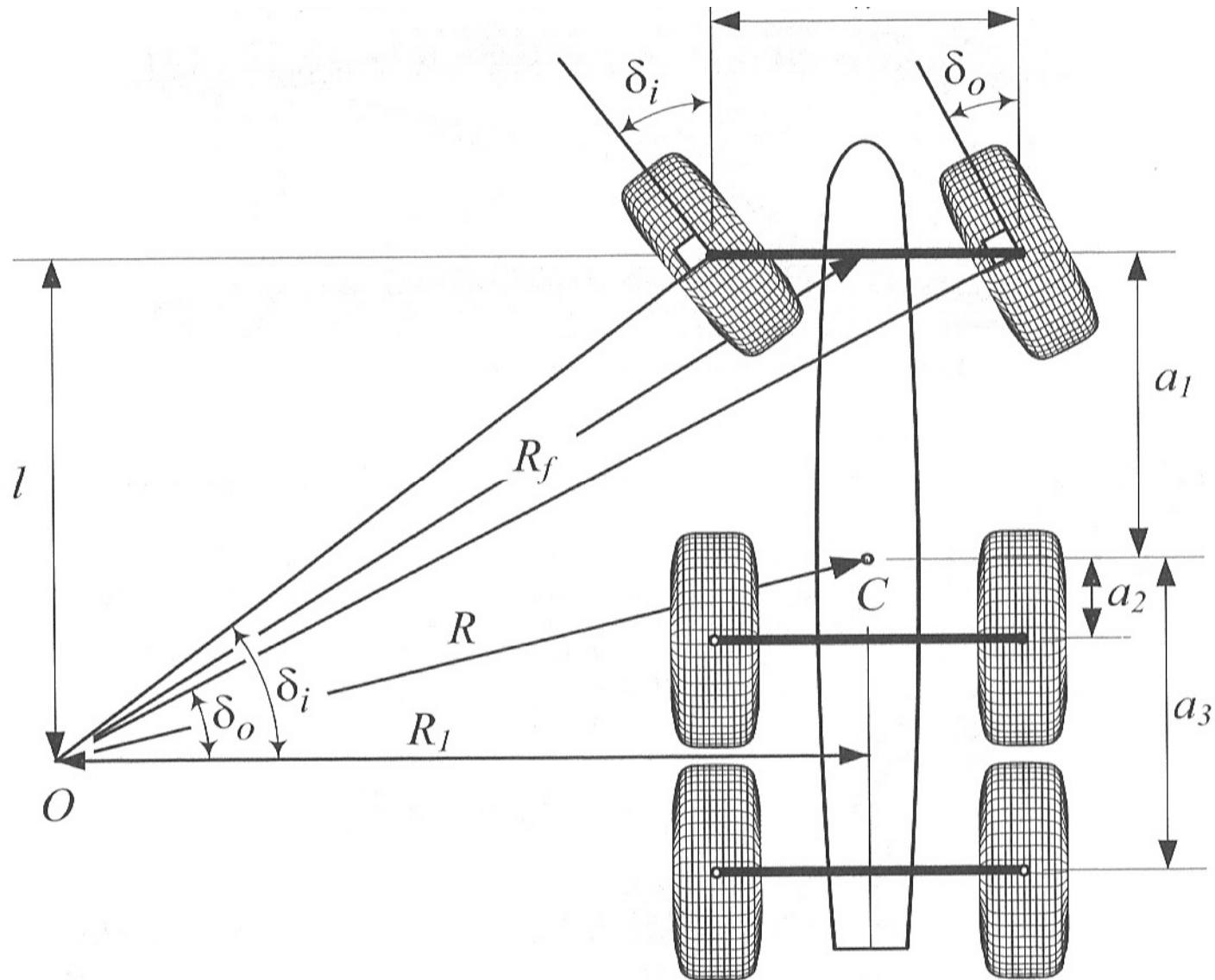
Valores típicos :

veículos de passageiros \Rightarrow 15:1

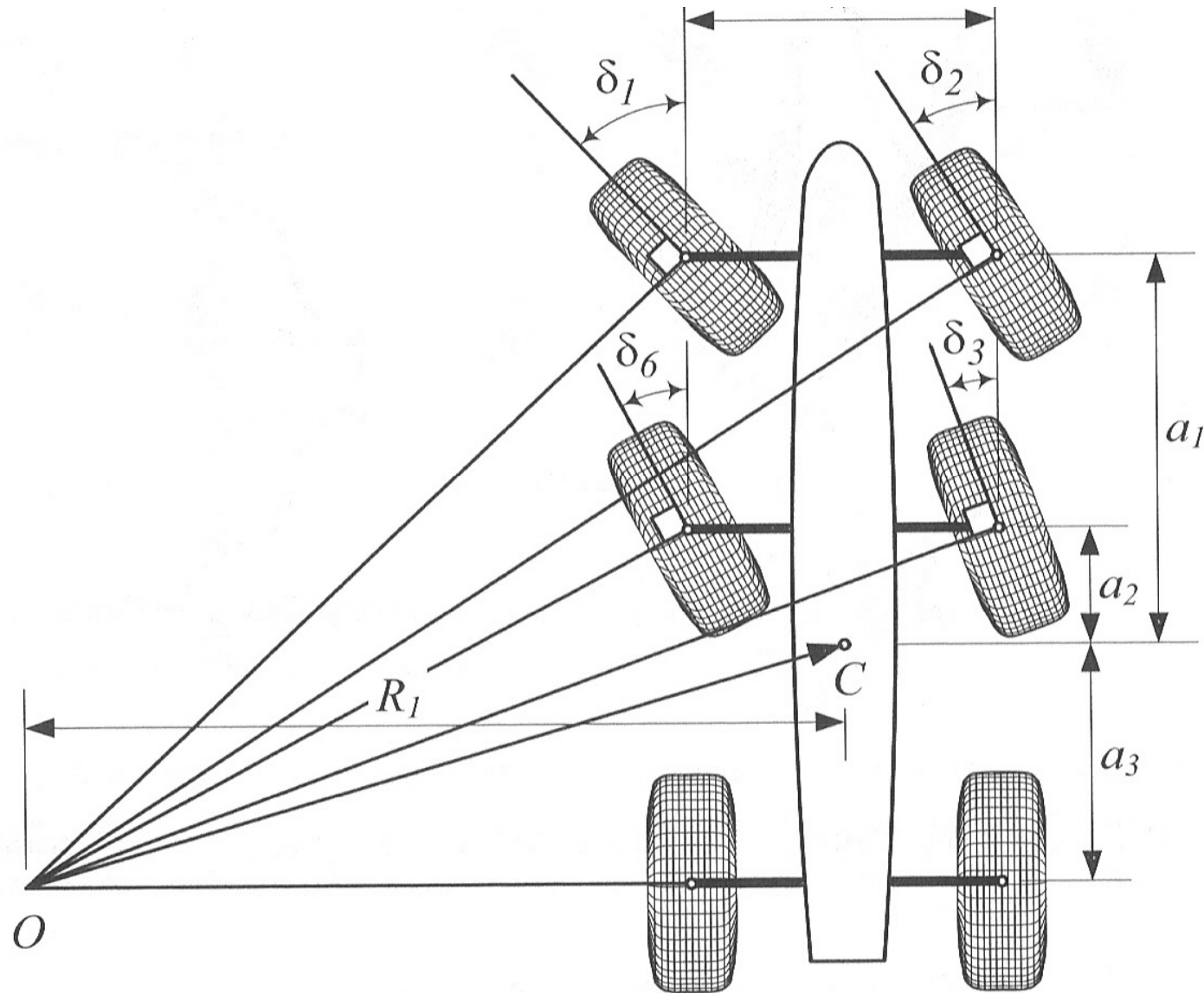
veículos pesados \Rightarrow até 36:1



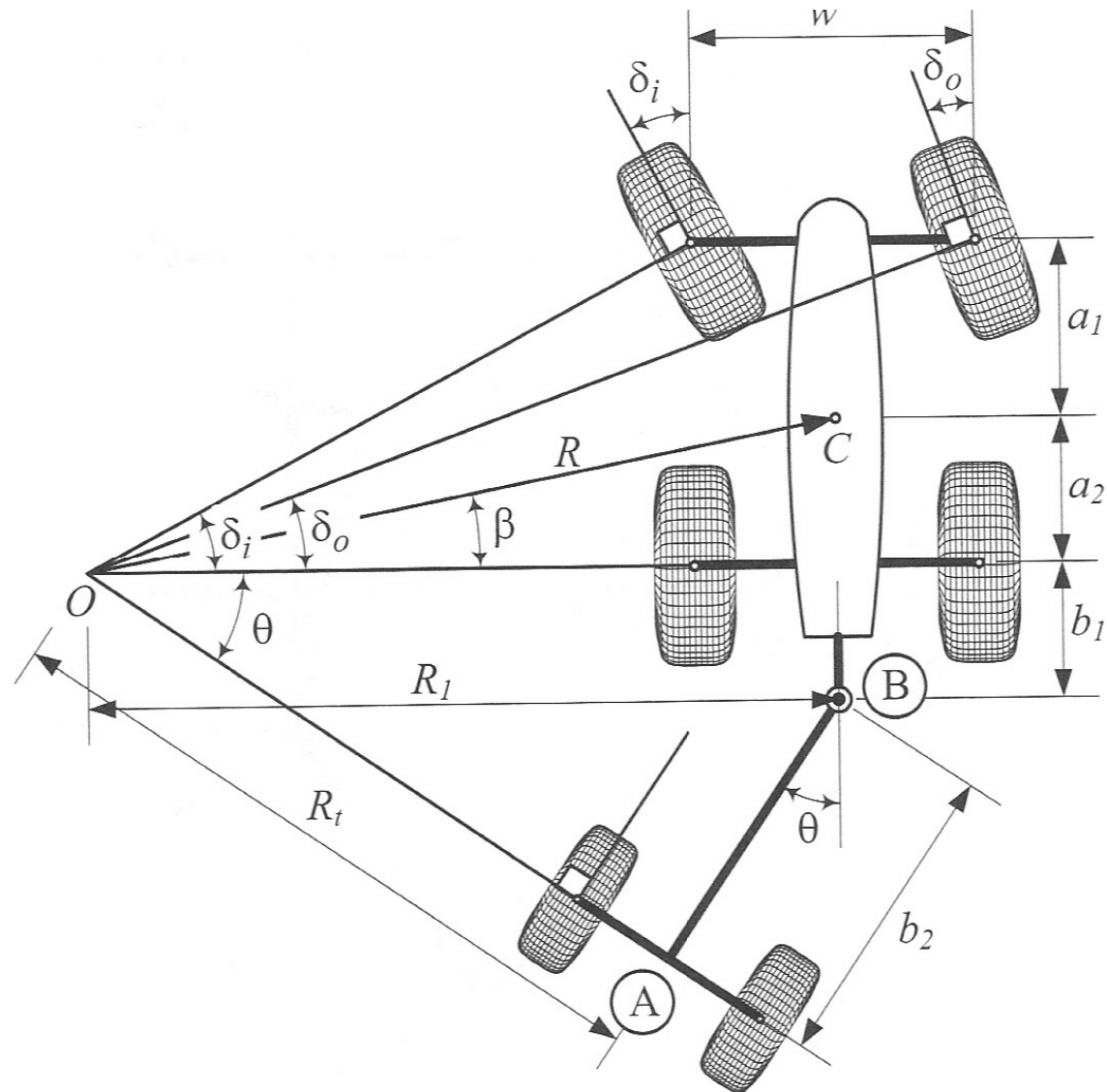
Veículo com três eixos



Veículo com três eixos



Reboque com eixo



Demonstração de sistemas de esterçamento nas 4 rodas

[Animação Técnica - Sistema de Direção do Veículo](#)

<http://www.youtube.com/watch?v=zE13huhOIBc>

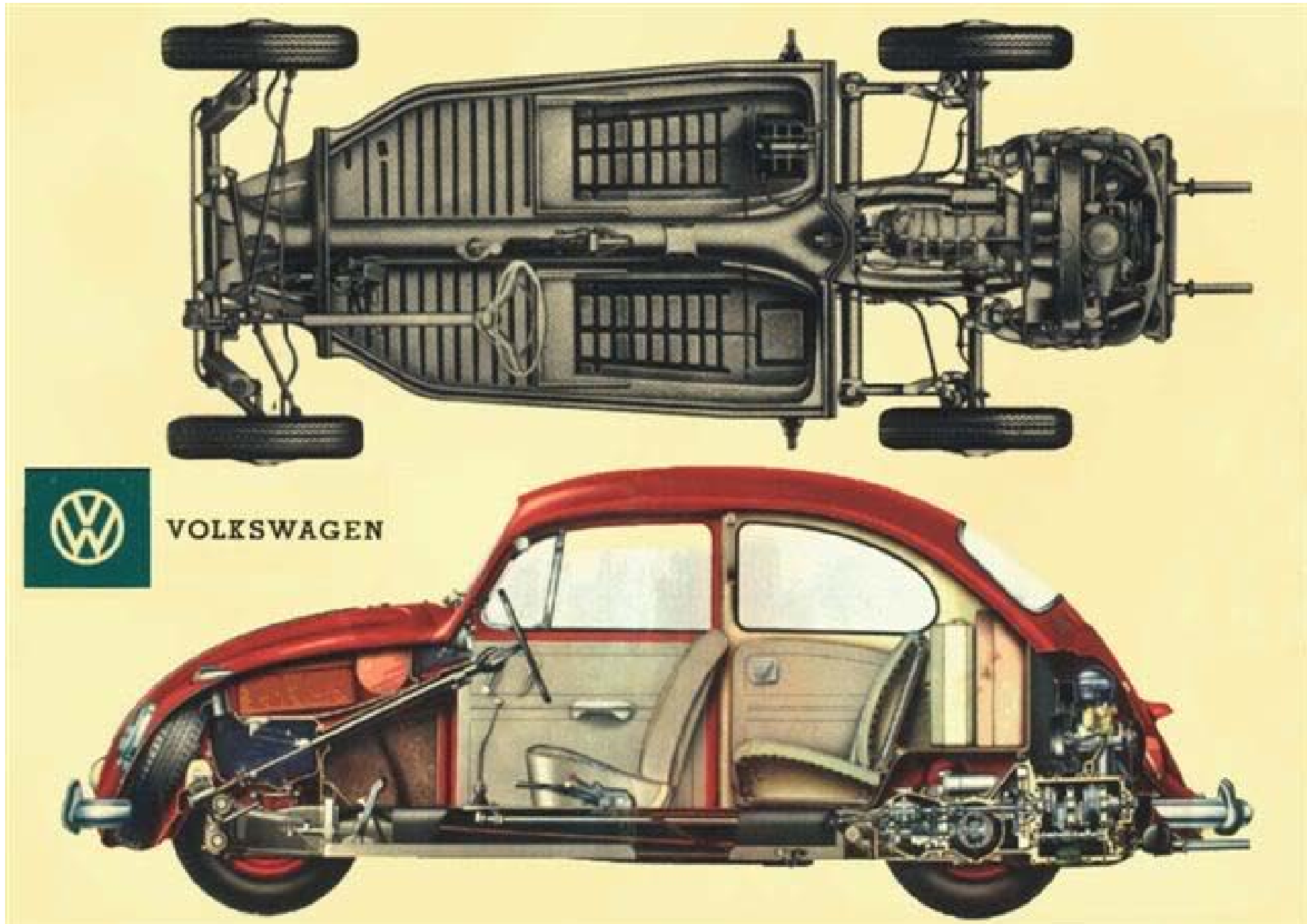
[3000GT VR4 All Wheel Steering demo](#)

<http://www.youtube.com/watch?v=9c9dxEnYh3Y>

[Honda Prelude 4 Wheel Steering](#)

<http://www.youtube.com/watch?v=sldOdWYzW7U>

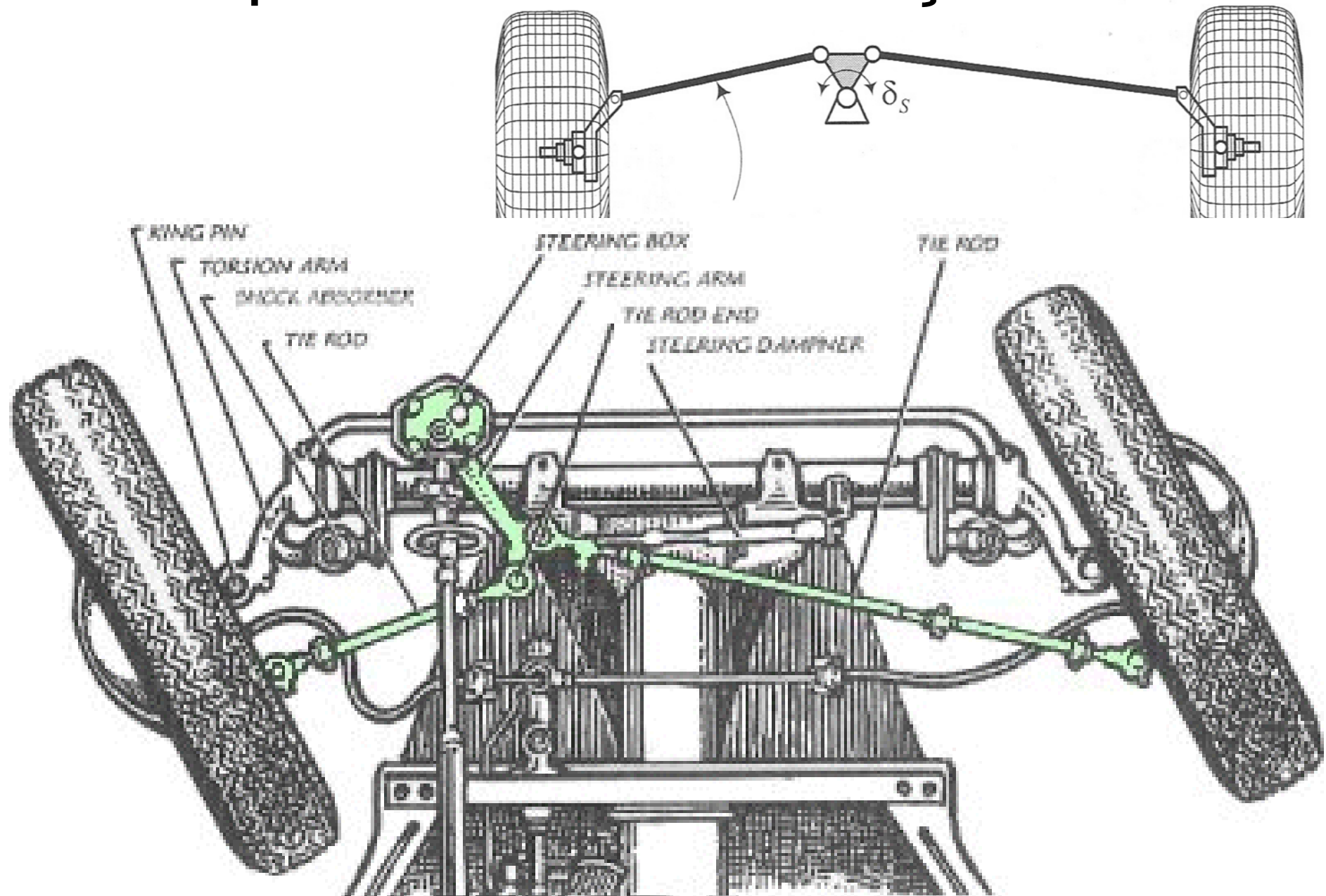
Exemplo: Sistema de direção do VW

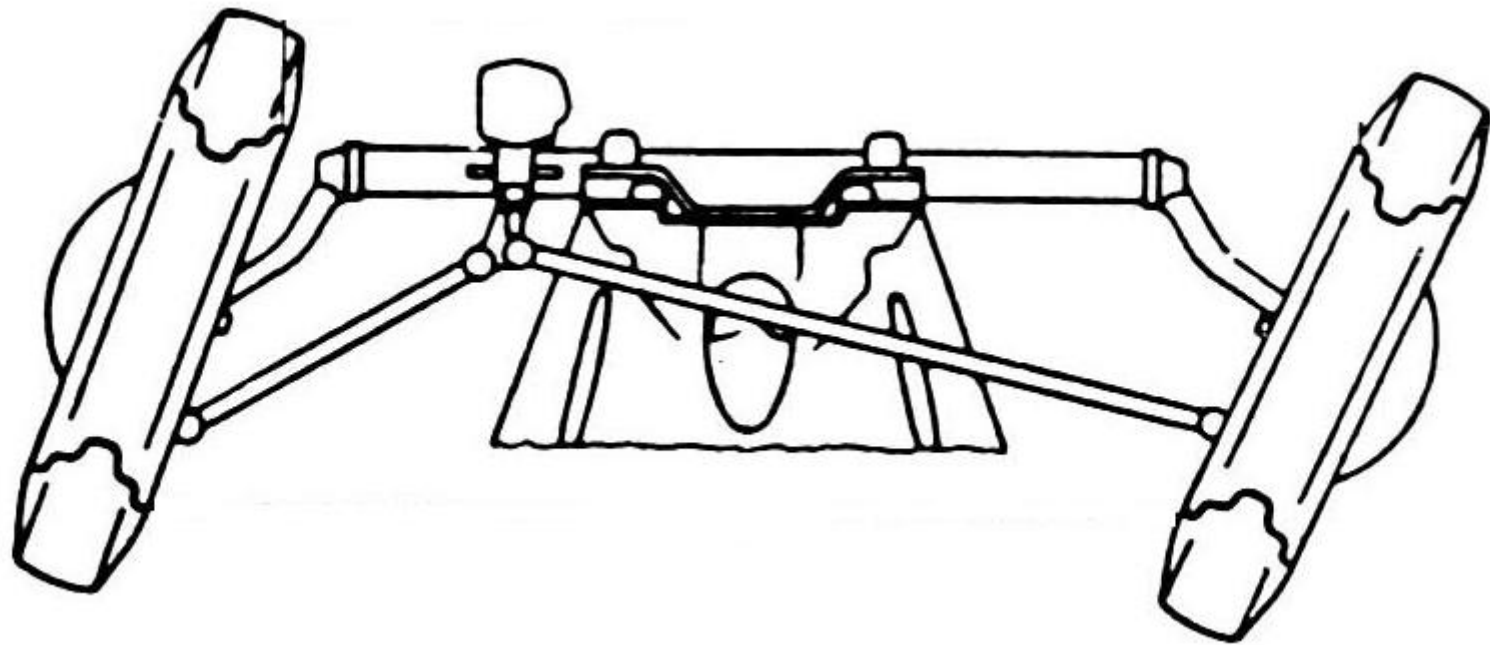
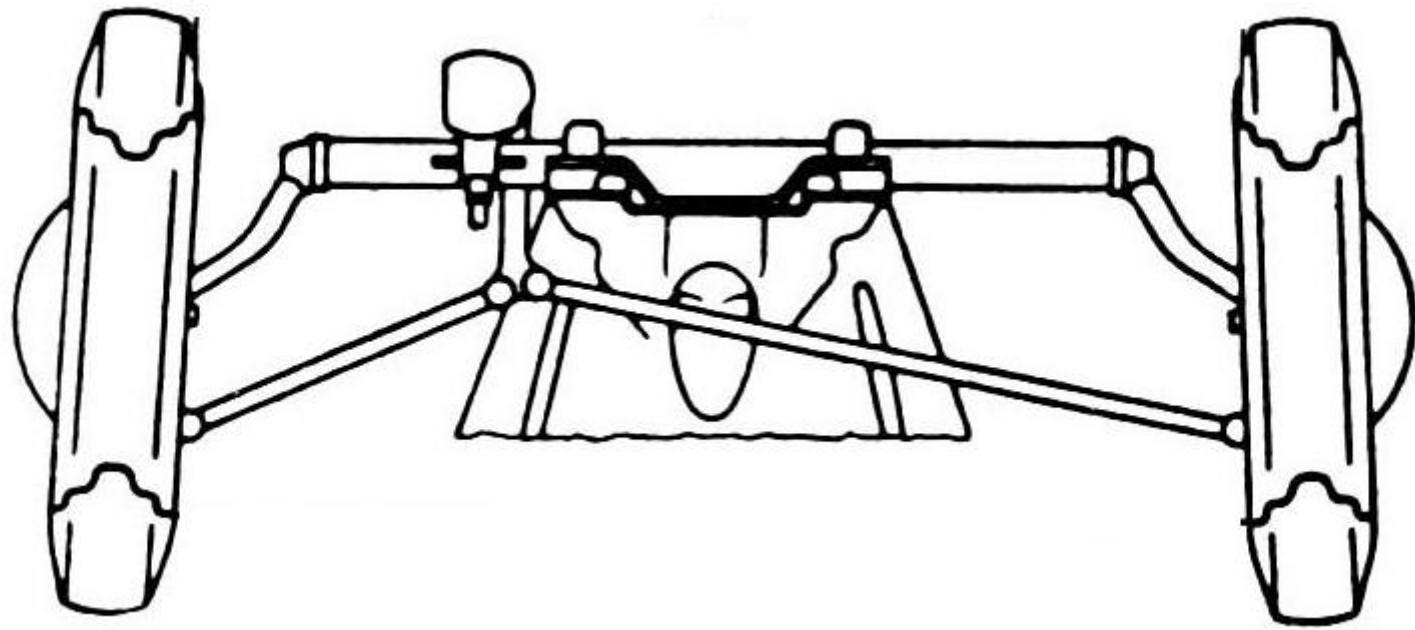


Exemplo: Sistema de direção do VW

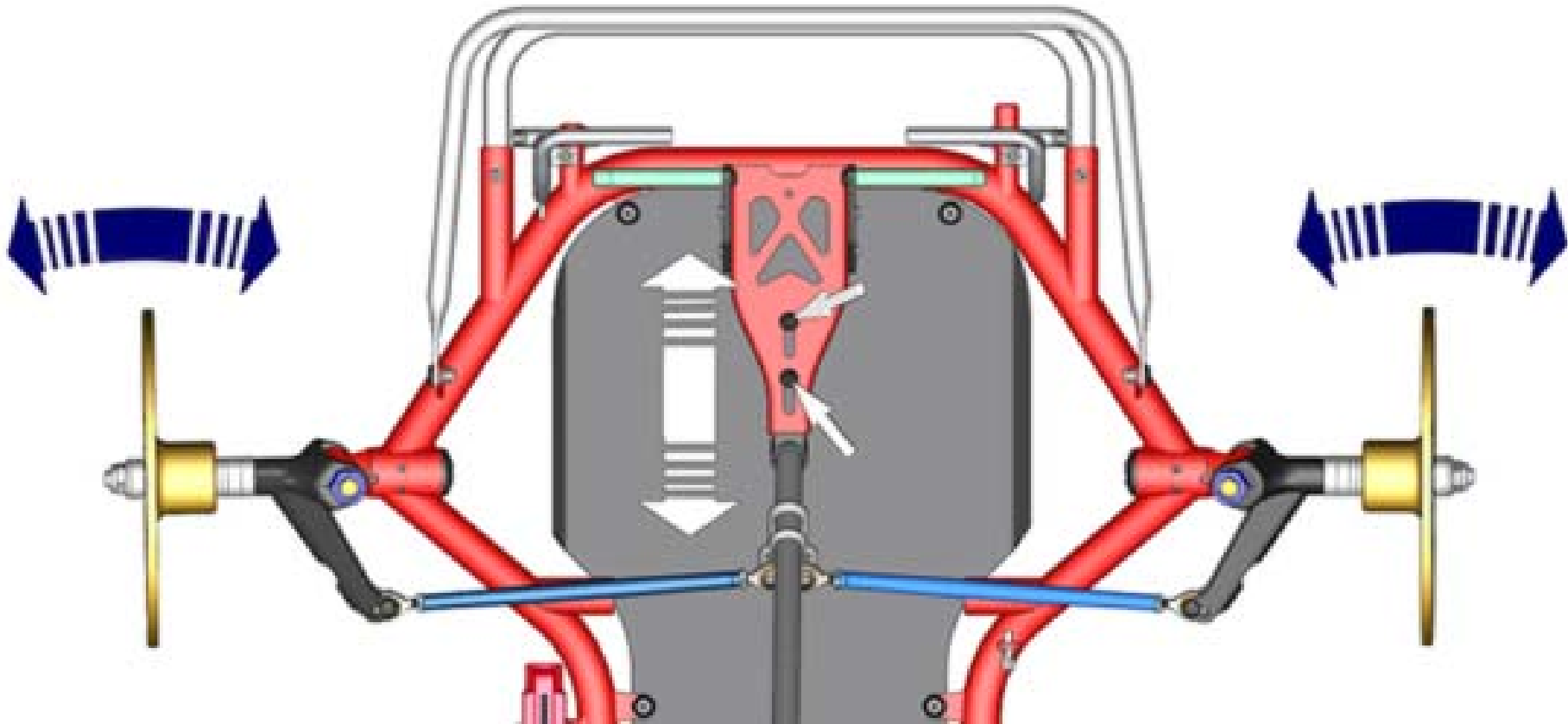


Exemplo: Sistema de direção do VW





Exemplo: Sistema de direção de kart



Exemplo: Sistema de direção de kart

Excel interface showing a spreadsheet for kart steering system calculations. The spreadsheet is titled "kart.xlsx" and is open in the "Planilha1" worksheet. The data is organized into several sections:

Coluna	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Dados iniciais						Ackerman								
2	d	360,00	mm				bitola	720	mm						
3	ang_pittman	10,00	grau	0,1745	rad		entre eixos	1062	mm						
4	ang_braco	90,00	grau	1,5708	rad		delta_i	30,00	graus	0,5236	rad	Raio	2199	mm	
5	ang_dir_1	-70	grau	-1,2217	rad		delta_e	22,54	graus	0,3933	rad		2199	mm	
6	ang_dir_2	0	grau	0,0000	rad		Variáveis intermediárias								
7	ang_dir_3	70	grau	1,2217	rad		w_1	0,993464							
8	Cálculos iniciais						w_2	1,872234							
9	fi_s	25,00	grau	0,4363	rad		w_3	0,5							
10	delta_fi	140	grau	2,4435	rad		w_4	0,883252							
11	psi_s	112,54	grau	1,9641	rad		w_5	-0,17704							
12	delta_psi	52,54	grau	0,9169	rad		w_6	0,209902							
13	Ângulos de precisão						R_1	4,456561							
14	fi_1	25,00	grau	0,4363	rad		R_2	9,208947							
15	fi_2	95,00	grau	1,6581	rad		R_3	1,38461							
16	fi_3	165,00	grau	2,8798	rad		Resultado								
17	psi_1	60,00	grau	1,0472	rad		a	39,0924	mm						
18	psi_2	90,00	grau	1,5708	rad		b	359,0386	mm						
19	psi_3	112,54	grau	1,9641	rad		c	80,7798	mm						
20							d	360,0000	mm						
21															
22															

Summary table on the right side of the spreadsheet:

Dados de entrada
Cálculos
Resultados

The spreadsheet also includes a navigation pane at the bottom showing "Planilha1" and "teste" tabs, and a status bar at the bottom indicating "Pronto" and "100%" zoom.