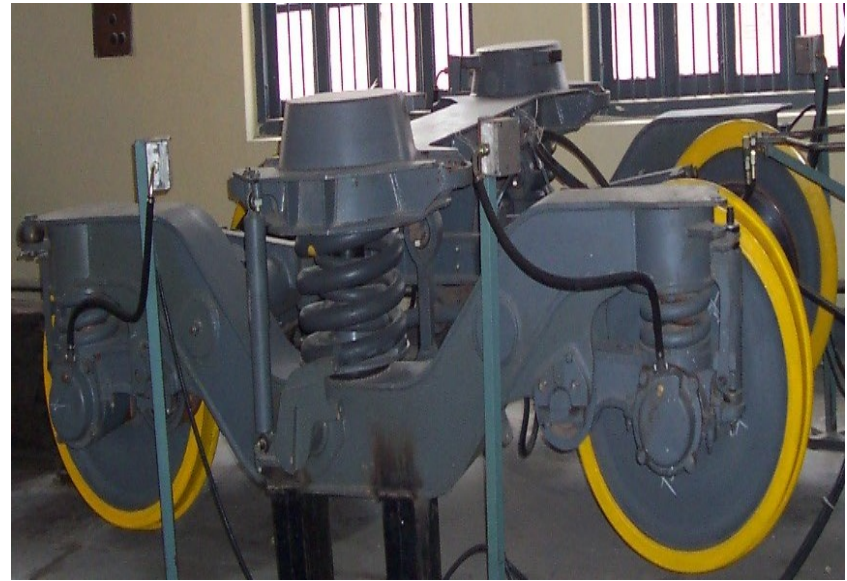
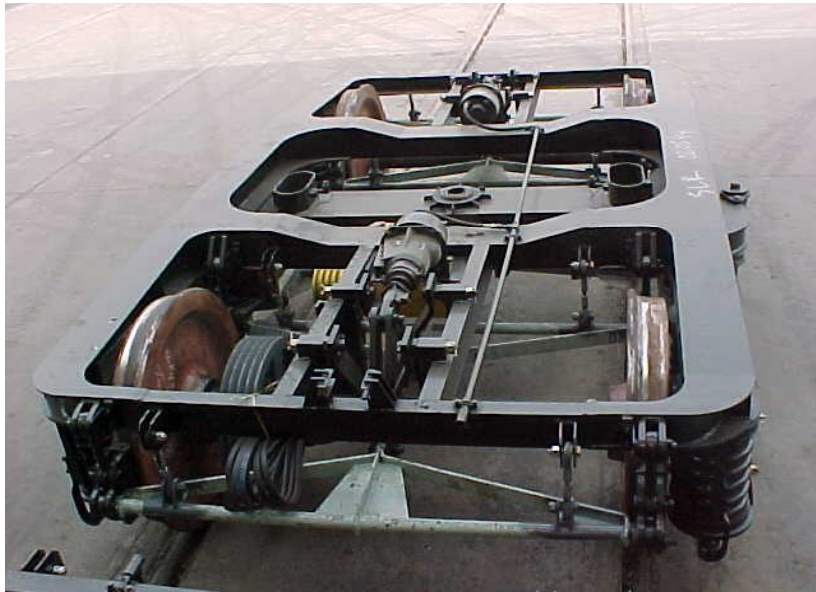


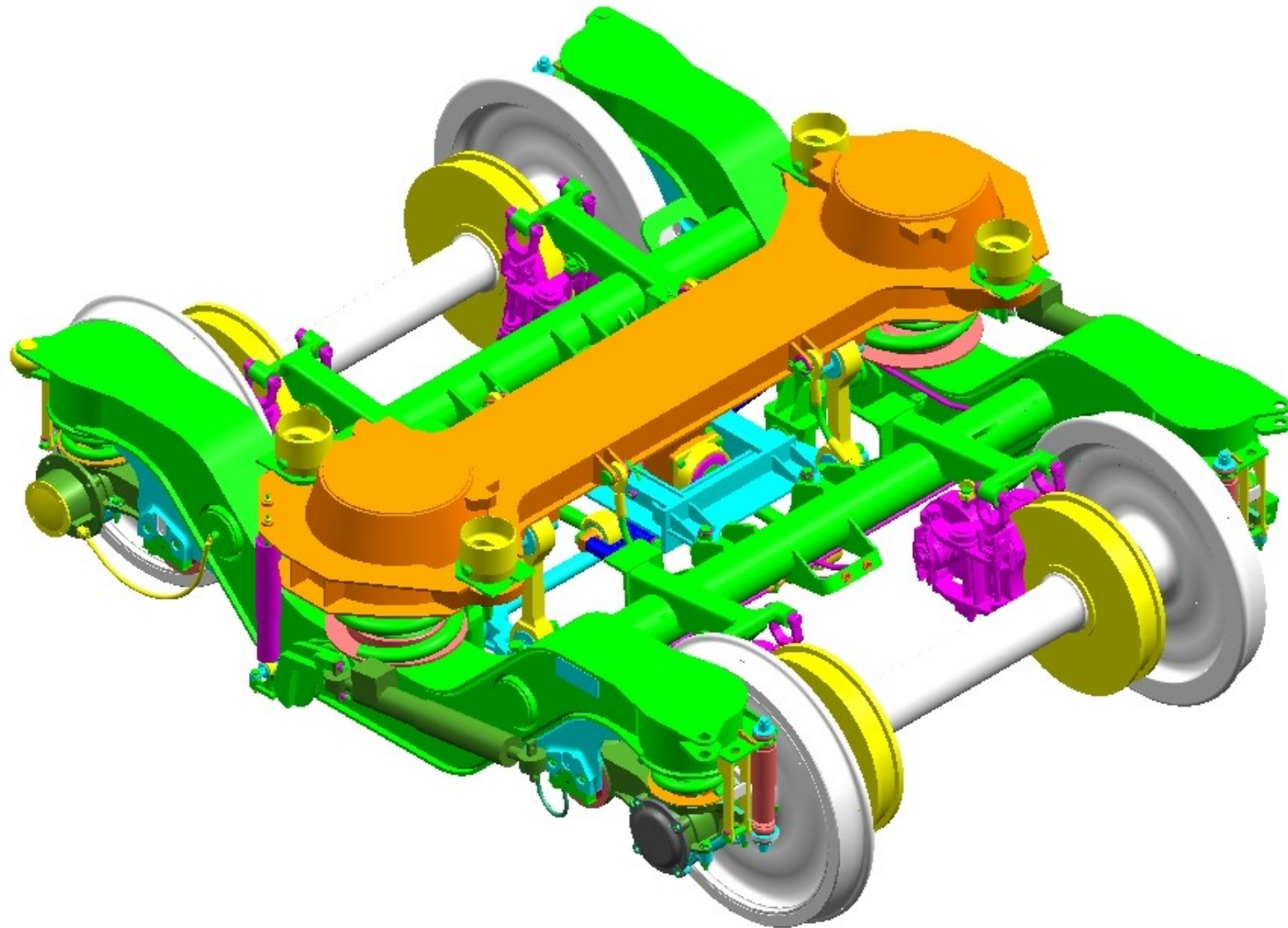
COMPARISON BETWEEN ICF & LHB BOGIE



Limitations of ICF bogie Design

- **Required longitudinal and transverse flexibilities at frame-axle joint can not be obtained.**
- **Vertical space constraints to accommodate longer secondary suspension springs.**
- **Non availability of friction damping in the transverse suspension.**
- **Headstocks increase the yaw inertia of the bogie.**
- **Large wheelbase affects curvability / Wheel flange wear.**

Isometric View of FIAT Bogie



Achievement Through FIAT Bogie

- Better Comfort
- Increased Speed

Ride Index

ICF

- 2.6 at 160 kmph in vertical modes and 3.4 / 3.5 at 160 kmph in lateral mode

FIAT

- Ride index shall be 2.5 but not exceeding 2.75 both in vertical and lateral modes

Economic Advantage

| Speed potential | LHB | ICF |
|---------------------|----------|-----------|
| Test speed | 180 kmph | 160 kmph |
| Service speed | 160 kmph | 140 kmph |
| Oil leakage problem | No | Very high |

Economic Advantage

Higher availability

| Shop Attention | | |
|----------------------|-------------------------------|---------------------------|
| Schedule | ICF | LHB |
| 1 st attn | 9 months/2 lakh kms (ioh) | 18 months / 6 lakh kms |
| 2 nd attn | 18 months/4 lakh kms (poh) | 36 months/ 12lakh kms |

✓ **NO PAINTING REQUIRED FOR 6 YEARS**

Main Units of a Bogie

1. Bogie Frame
2. Wheel and Axle
3. Bearing Arrangement
4. Bogie Frame – Axle Joint
5. Bolster
6. Primary Suspension
7. Secondary Suspension
8. Bogie – Body Joint
9. Brake System

Bogie Frame

ICF

- Box type with headstock

FIAT

- H type boxes construction without headstock

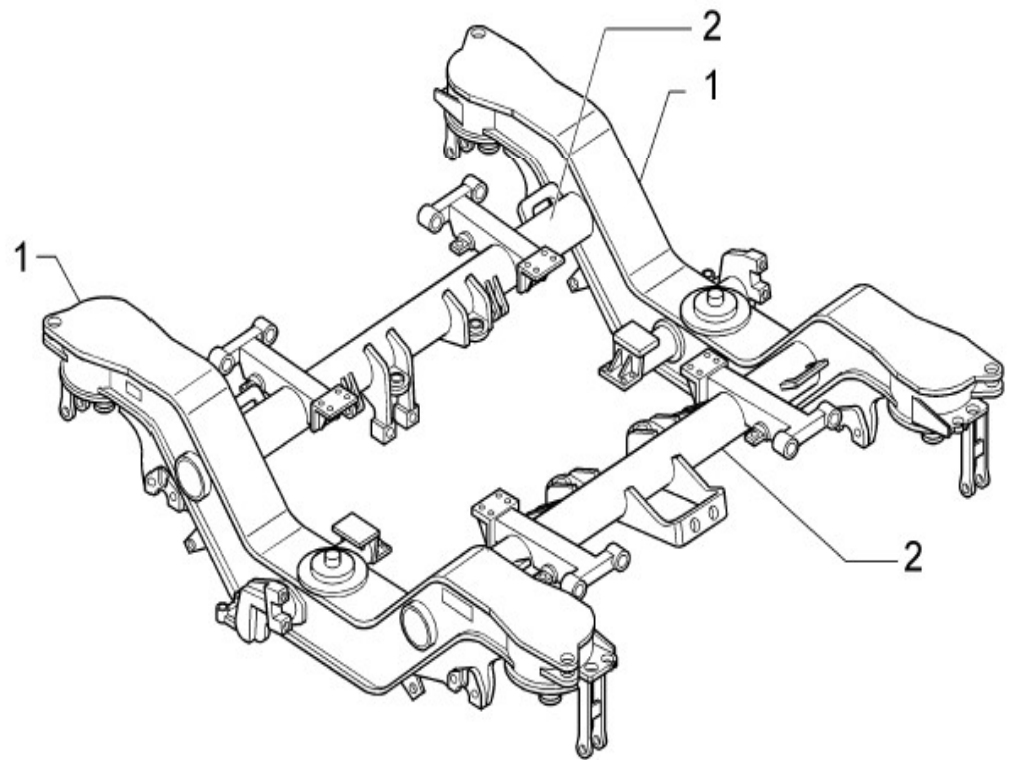
✓ Two side frame of Y Shaped longitudinal beam connected by two tubular steel members

Bogie Frame

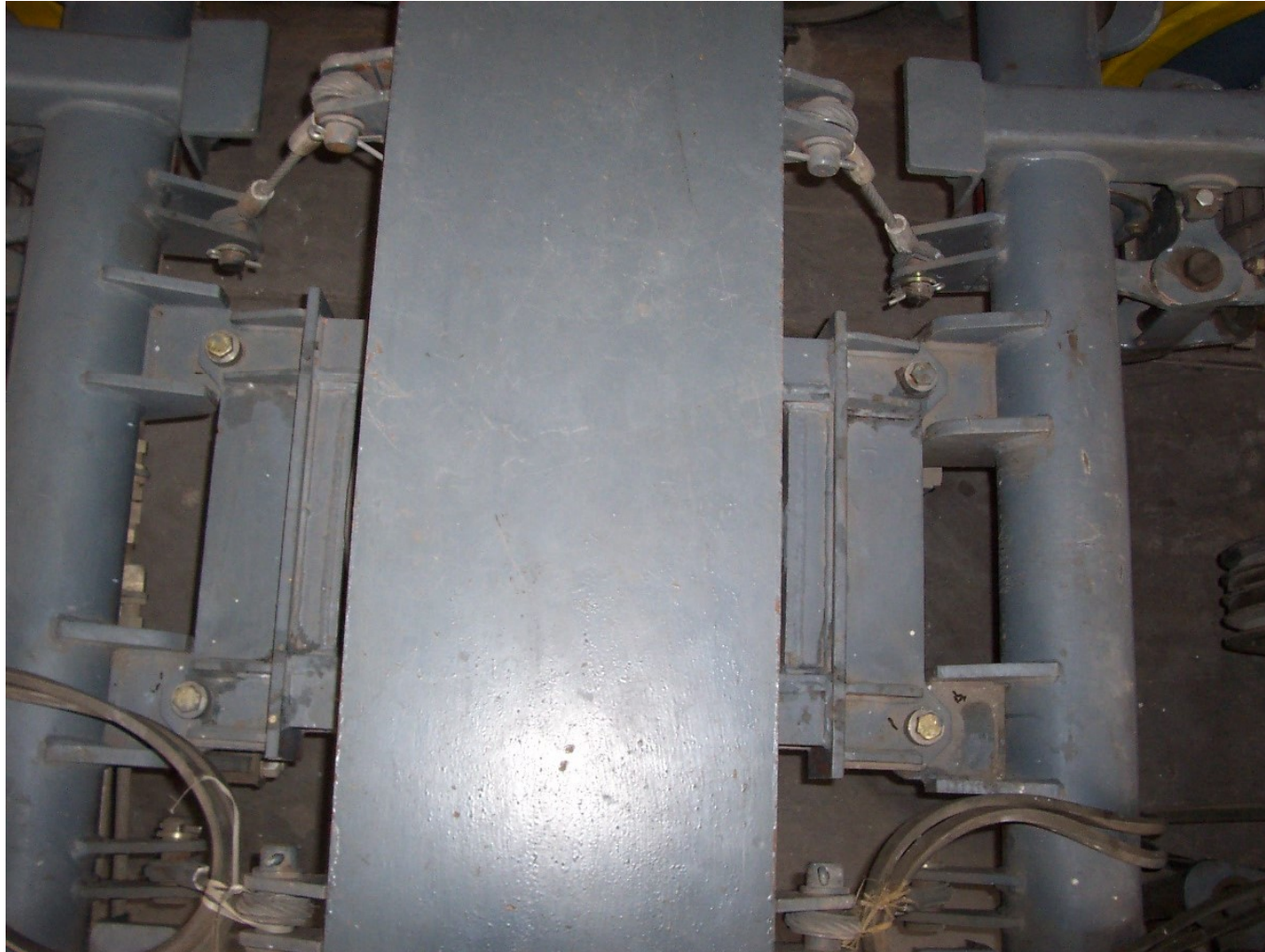
ICF



FIAT



Bogie Frame of FIAT



Wheel and Axle

Wheel Diameter

ICF

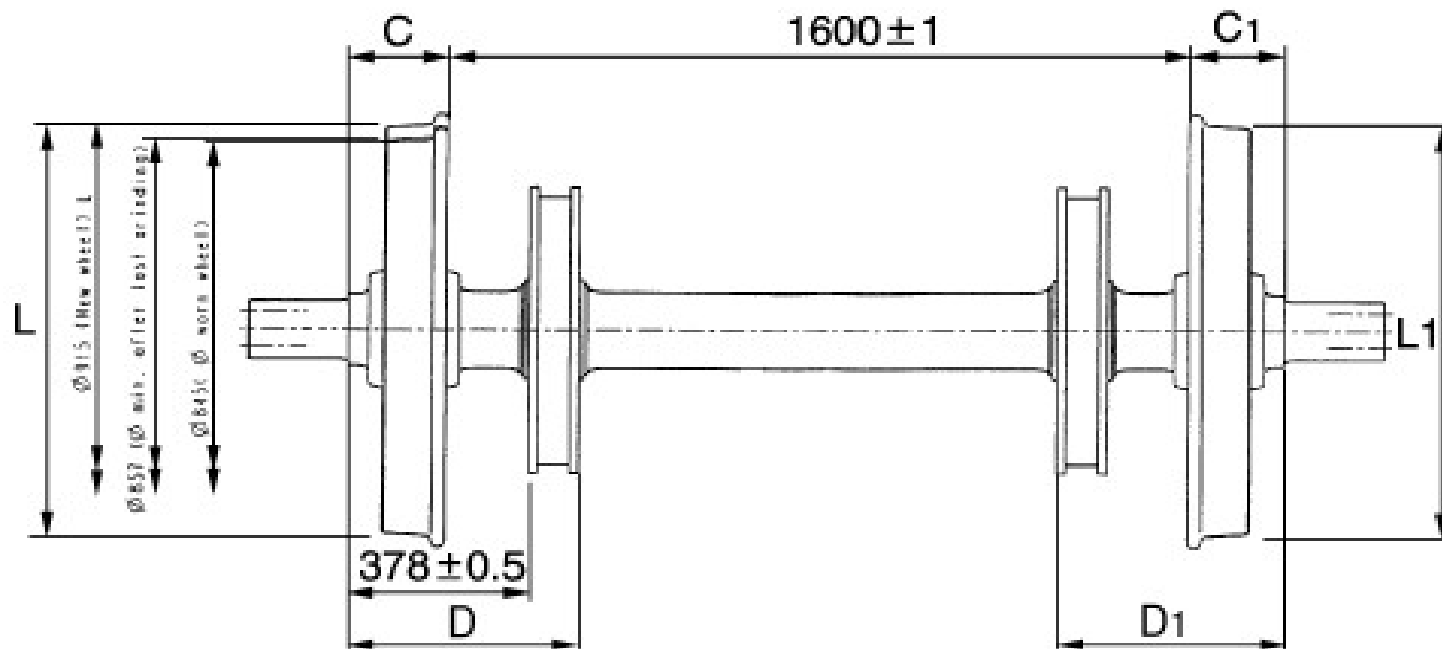
- New: 915 mm
- Condemned: 825 mm

FIAT

- New: 915 mm
- Condemned: 855 mm

Wheel and Axle

Wheel Gauge of LHB



The following differences must be respected:

$$|L - L_1| \leq 0.5 \text{ mm}$$

$$|C - C_1| \leq 0.5 \text{ mm}$$

$$|D - D_1| \leq 0.5 \text{ mm}$$

Wheel and Axle

Wheel Base

ICF

- 2896 mm

FIAT

- 2560 mm

✓ Less Wheel-base improves its ability to negotiate curves

Wheel and Axle

Maximum distance between Inner Wheel

ICF

- 11887 mm

FIAT

- 12345 mm

Bearing Arrangement

ICF

- Spherical roller Bearing

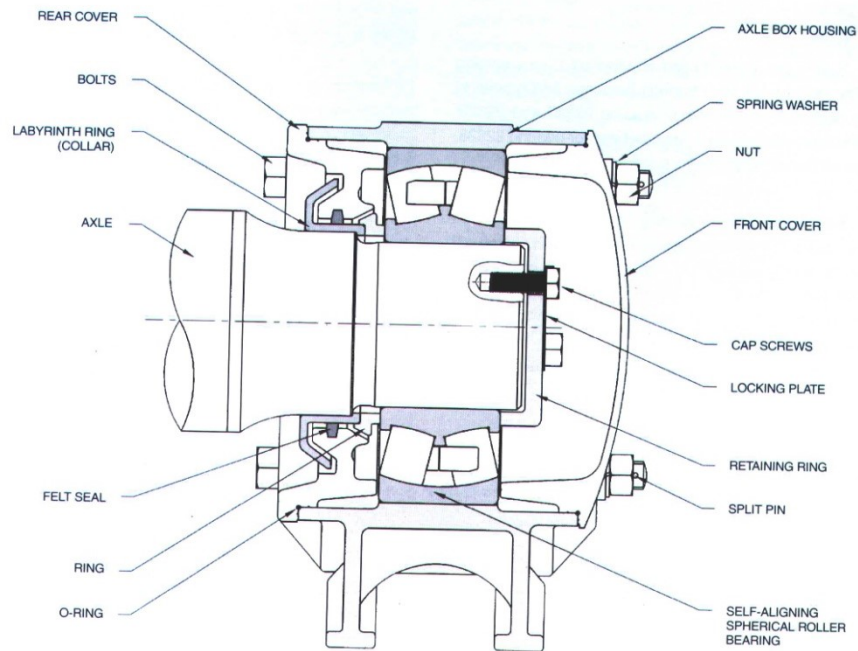
FIAT

- Cartridge tapered roller bearing

✓ Lesser maintenance attention

Bearing Arrangement

ICF



FIAT

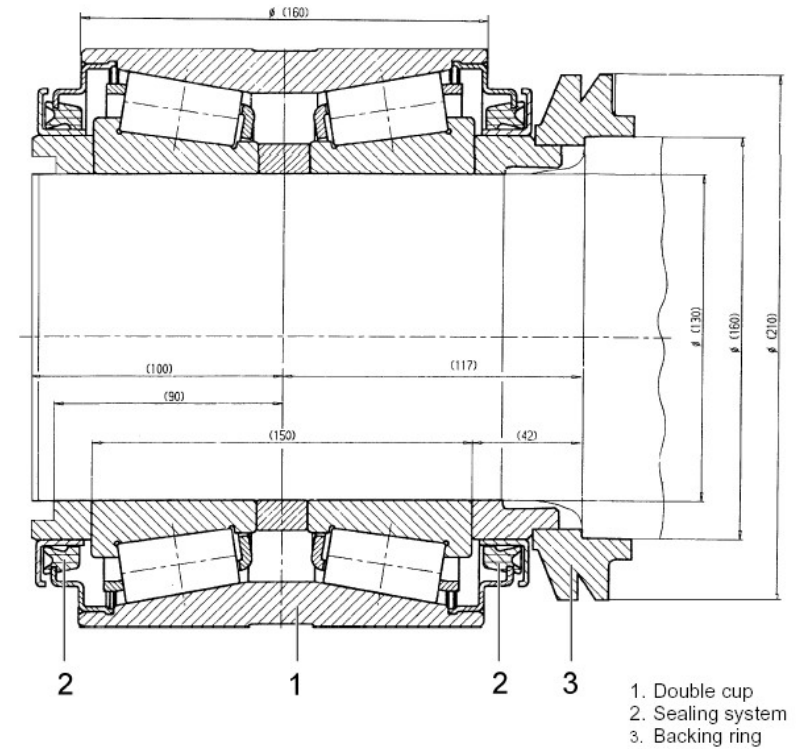


FIG. 1-4 AXLE BEARING LONGITUDINAL SECTION

Bogie Frame – Axle Joint

ICF

- Rigid

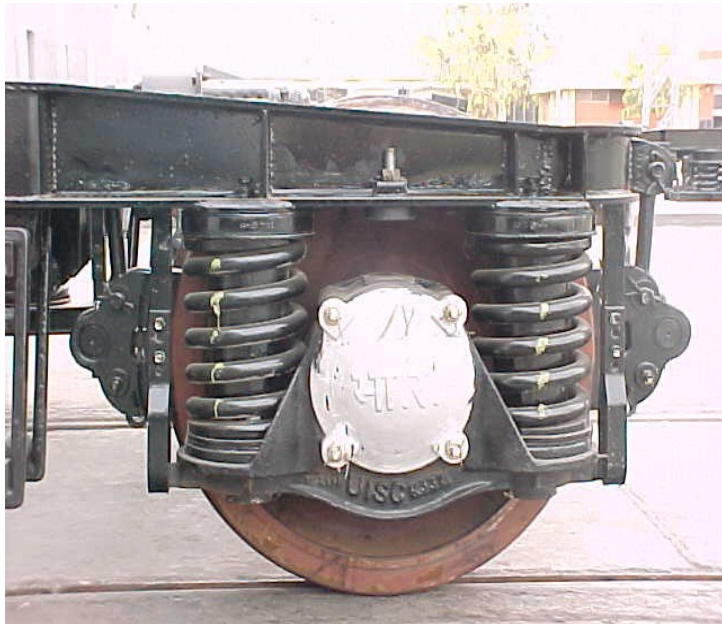
FIAT

- Articulated by control arm

✓ Longitudinal and transverse flexibilities of the axle can be optimised independently.

Bogie Frame – Axle Joint

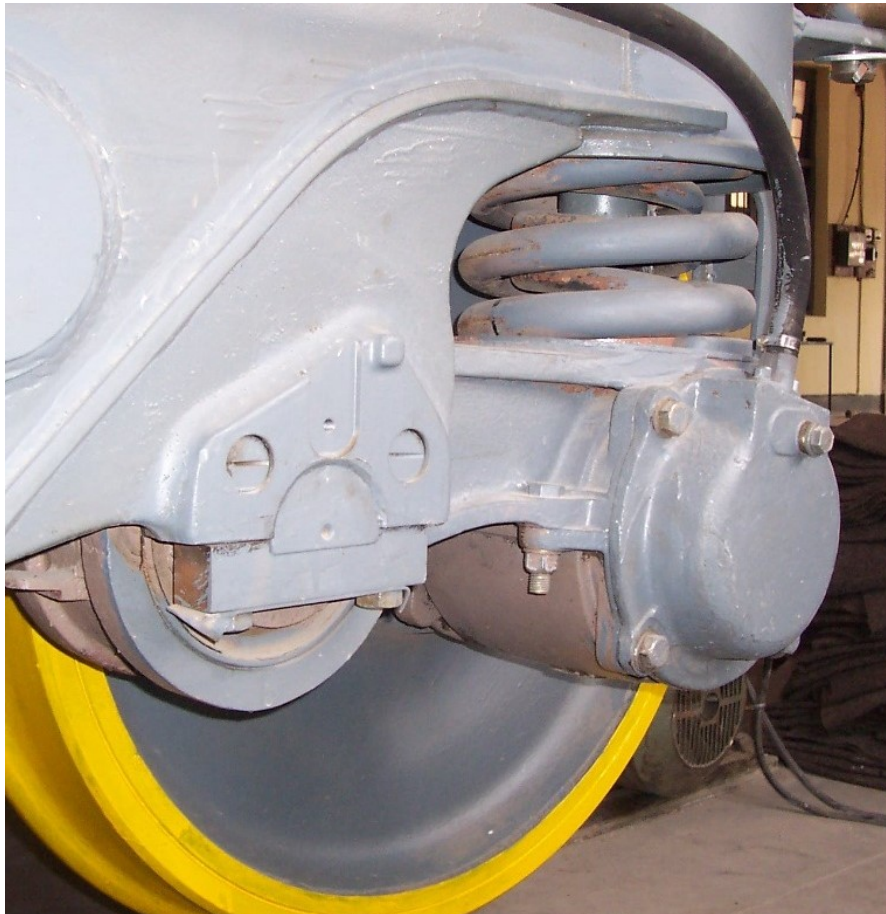
ICF



FIAT

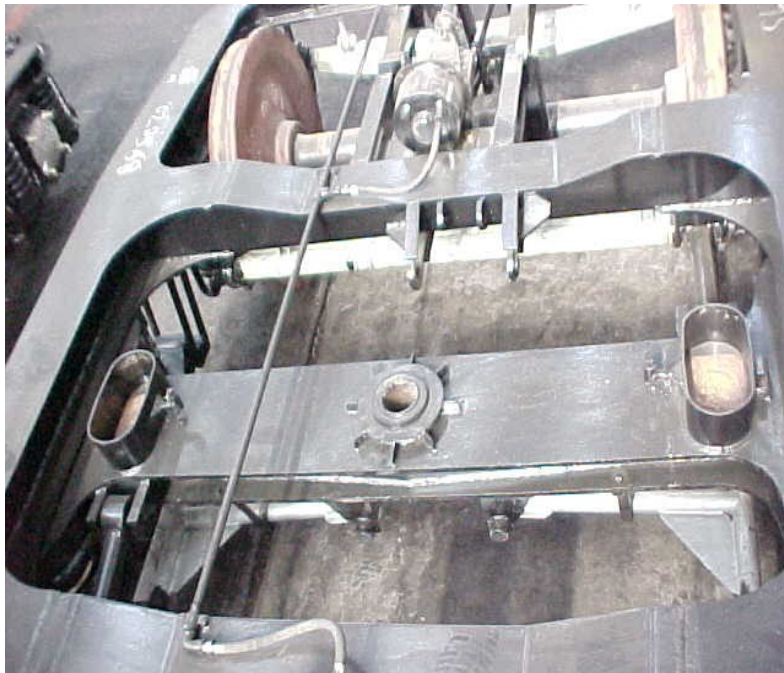


Bogie Frame – Axle Joint of FIAT



Bolster

ICF



FIAT

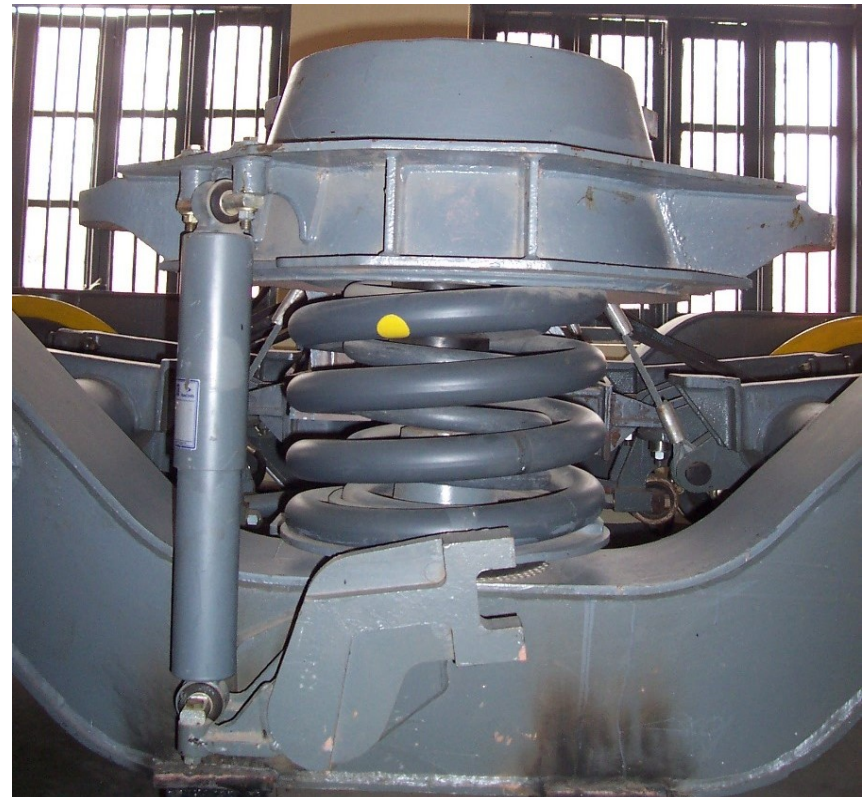


Bolster

ICF



FIAT



Bolster Beam of FIAT



Primary Suspension Unit

ICF

- Coil spring with dashpot level

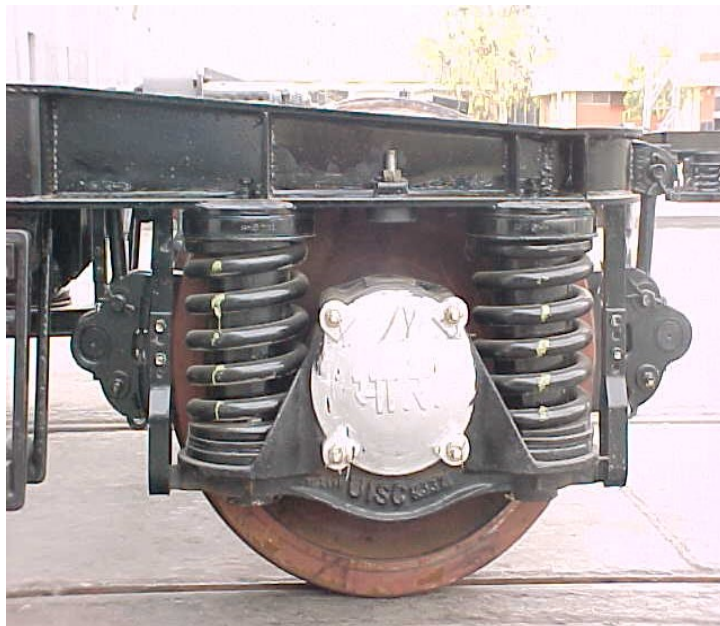
FIAT

- Coil springs are nested with hydraulic damper and control arm

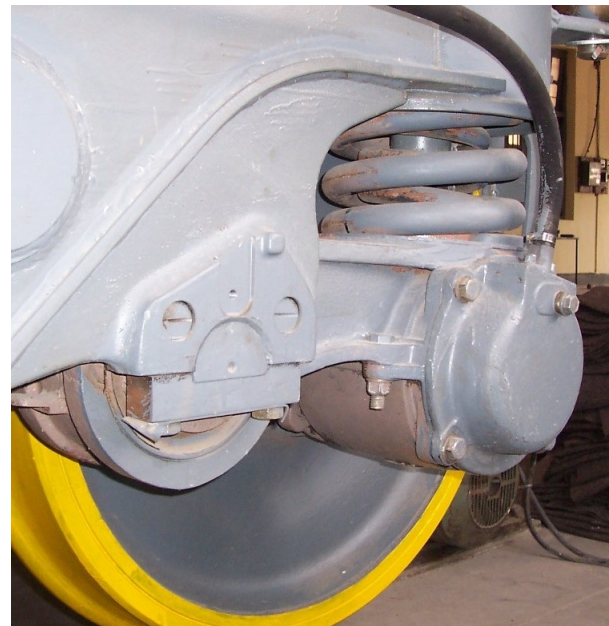
✓ More reliable and maintenance free as compared to dash pot.

Primary Suspension Unit

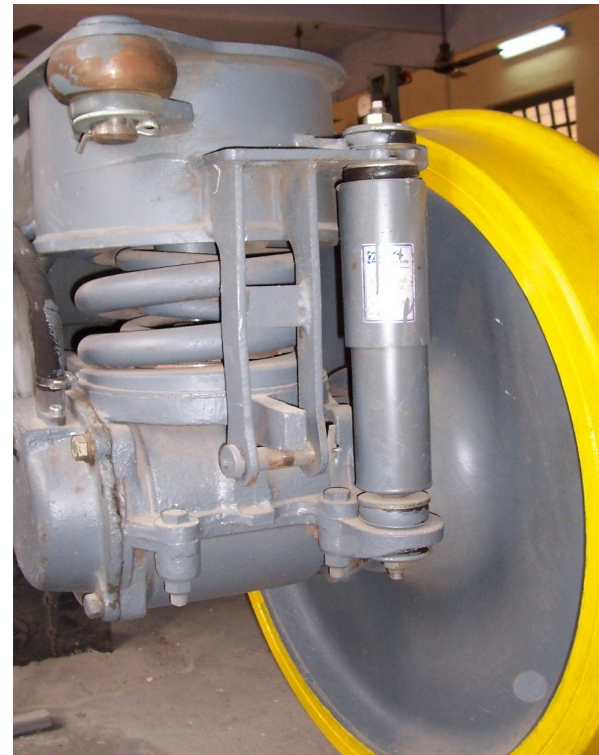
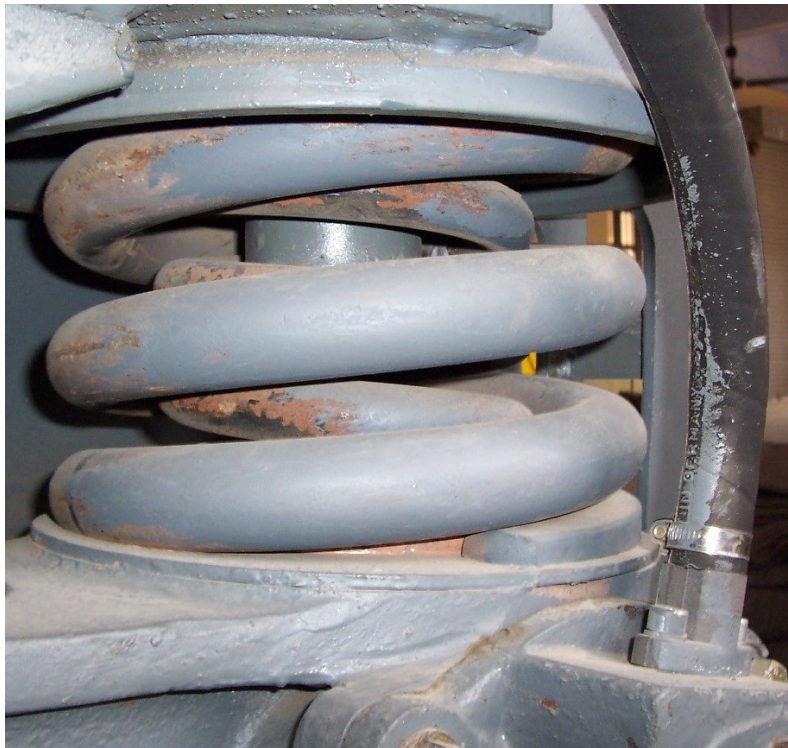
ICF



FIAT



Primary Suspension Unit of FIAT



Primary Suspension Unit of FIAT

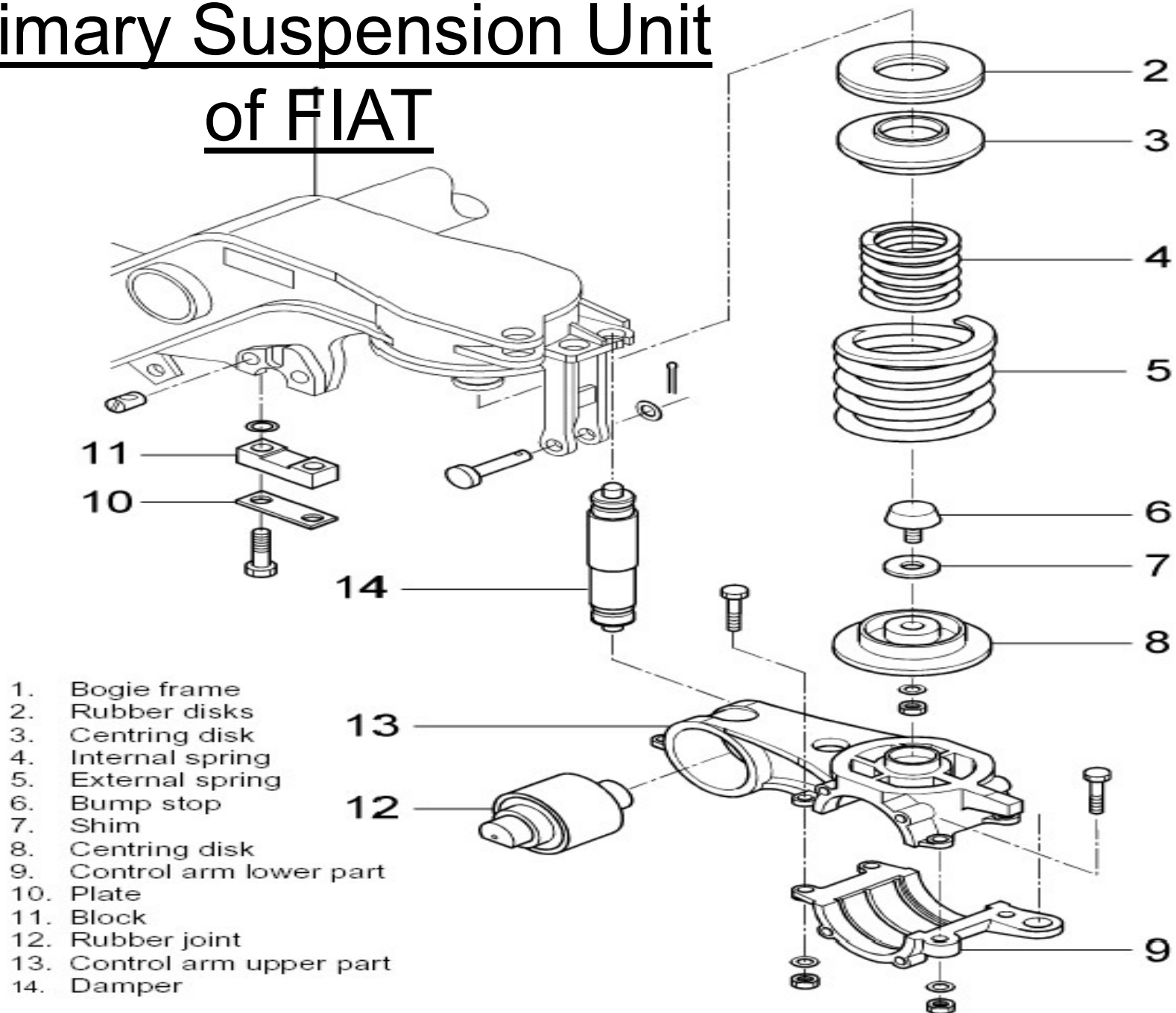


FIG. 1-8 PRIMARY SUSPENSION

Secondary Suspension Unit

ICF

- Secondary spring on lower spring beam through hangers

FIAT

- Secondary spring directly mounted on the side frames

✓ Vertical space constraints to accommodate desirably softer secondary suspension springs.

Secondary Suspension Unit

ICF



FIAT

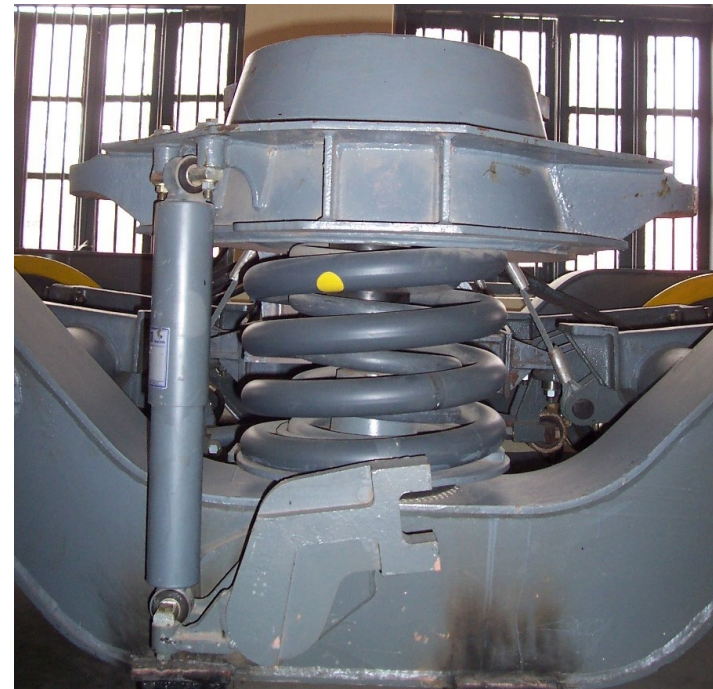
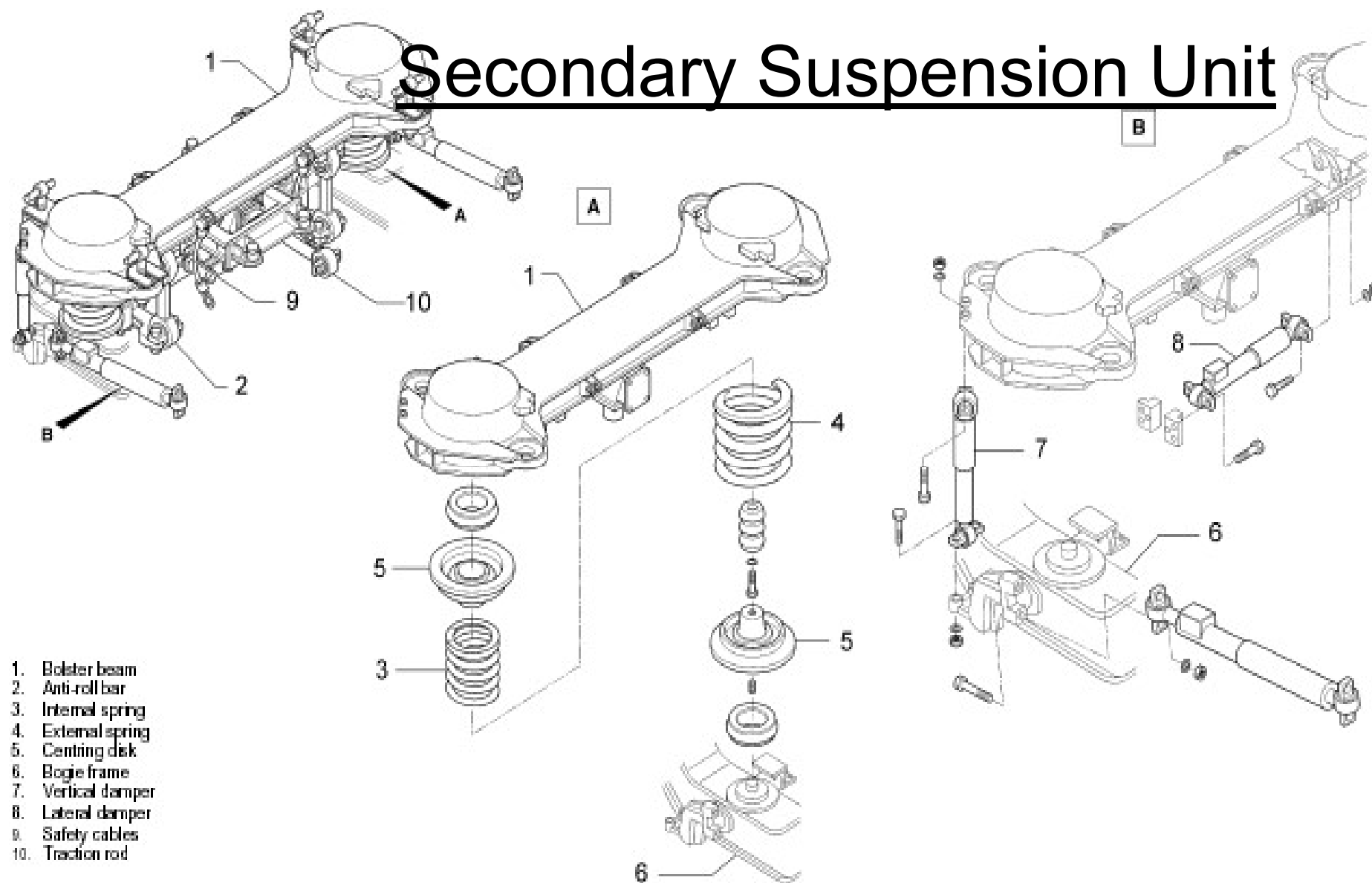


FIG. 1-10 SECONDARY SUSPENSION UNIT

Secondary Suspension Unit



Bogie - Body Joint

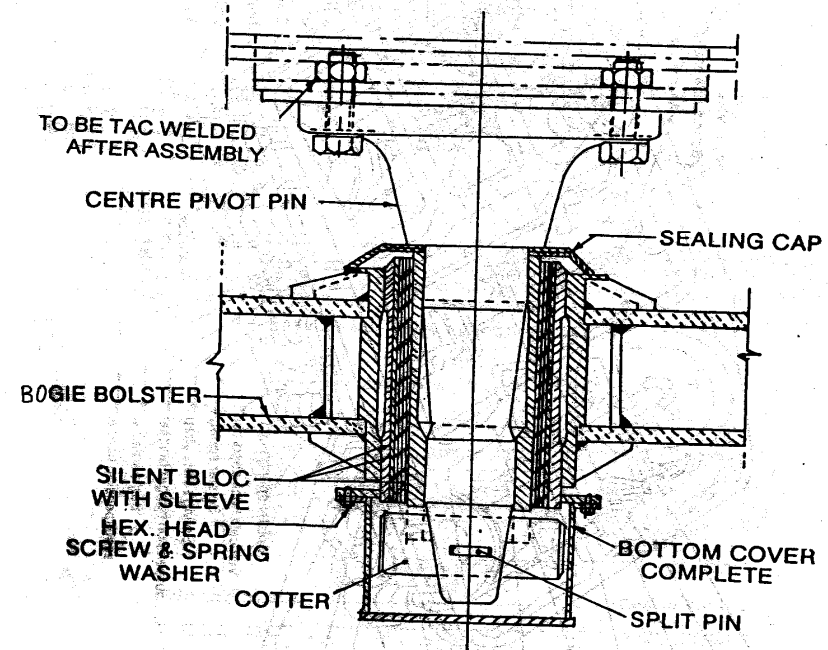
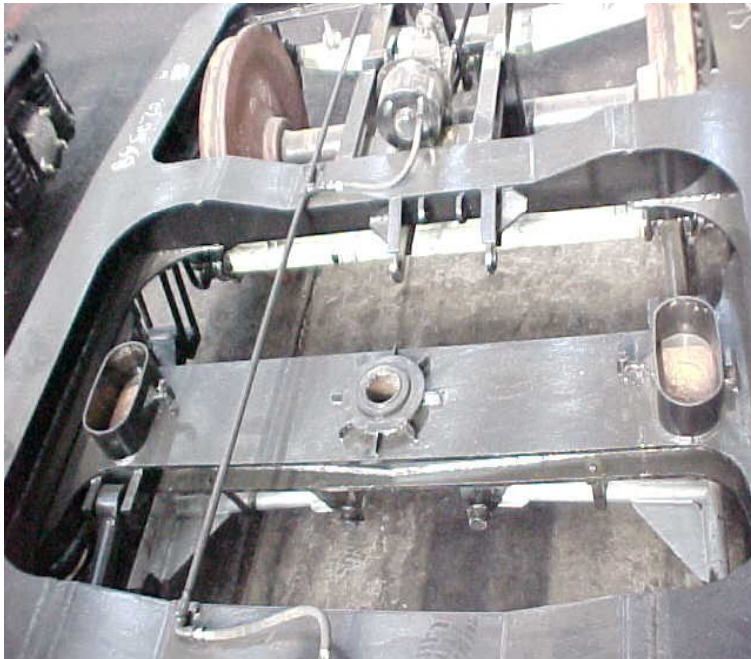
ICF

- Through Centre pivot

FIAT

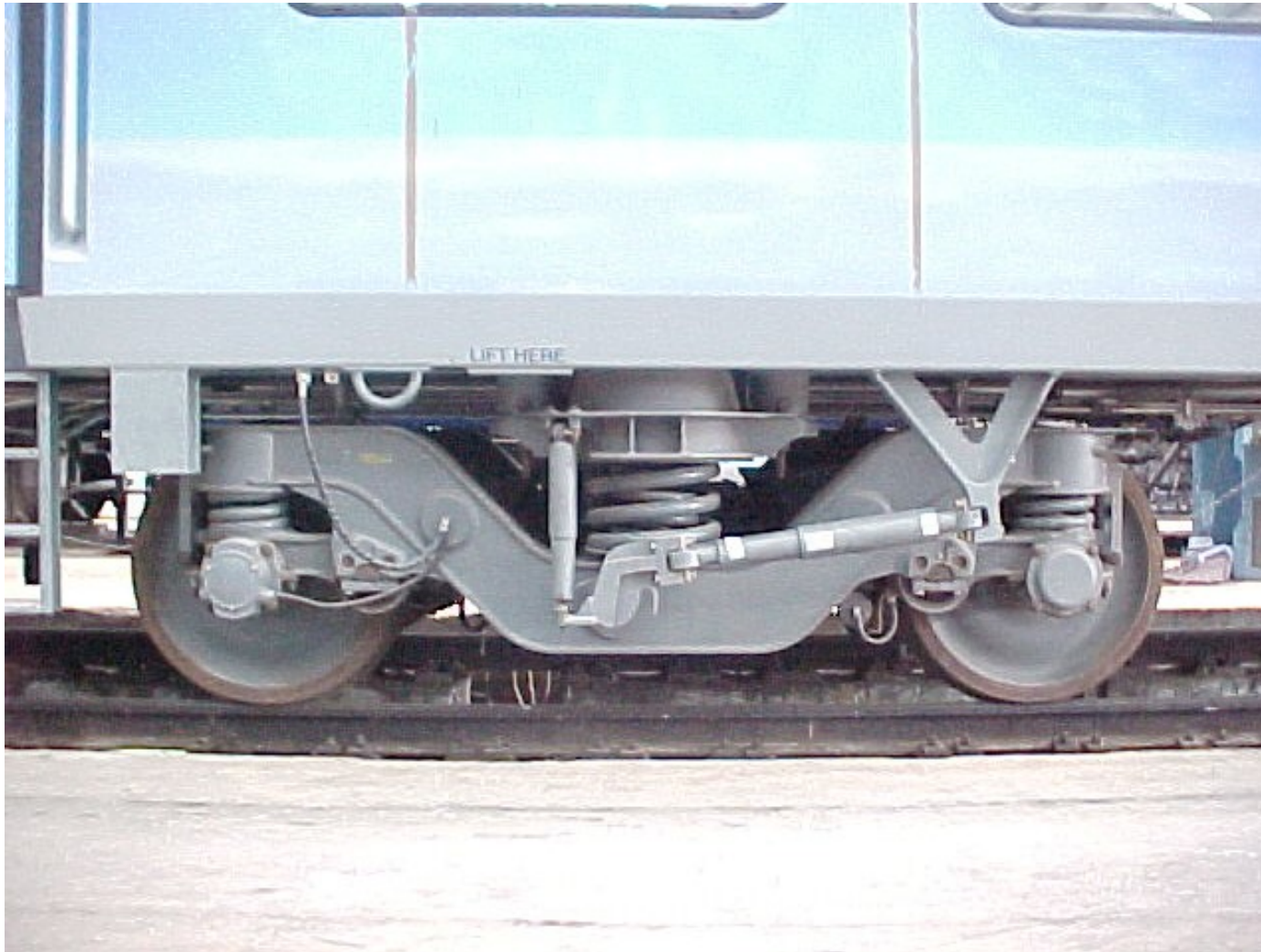
- Through pivot assembly on transverse beam and bracket on doom

Bogie – Body Joint of ICF



Centre Pivot Arrangement (ICF Bogie)

Bogie - Body Joint of FIAT



Bogie - Body Joint of FIAT



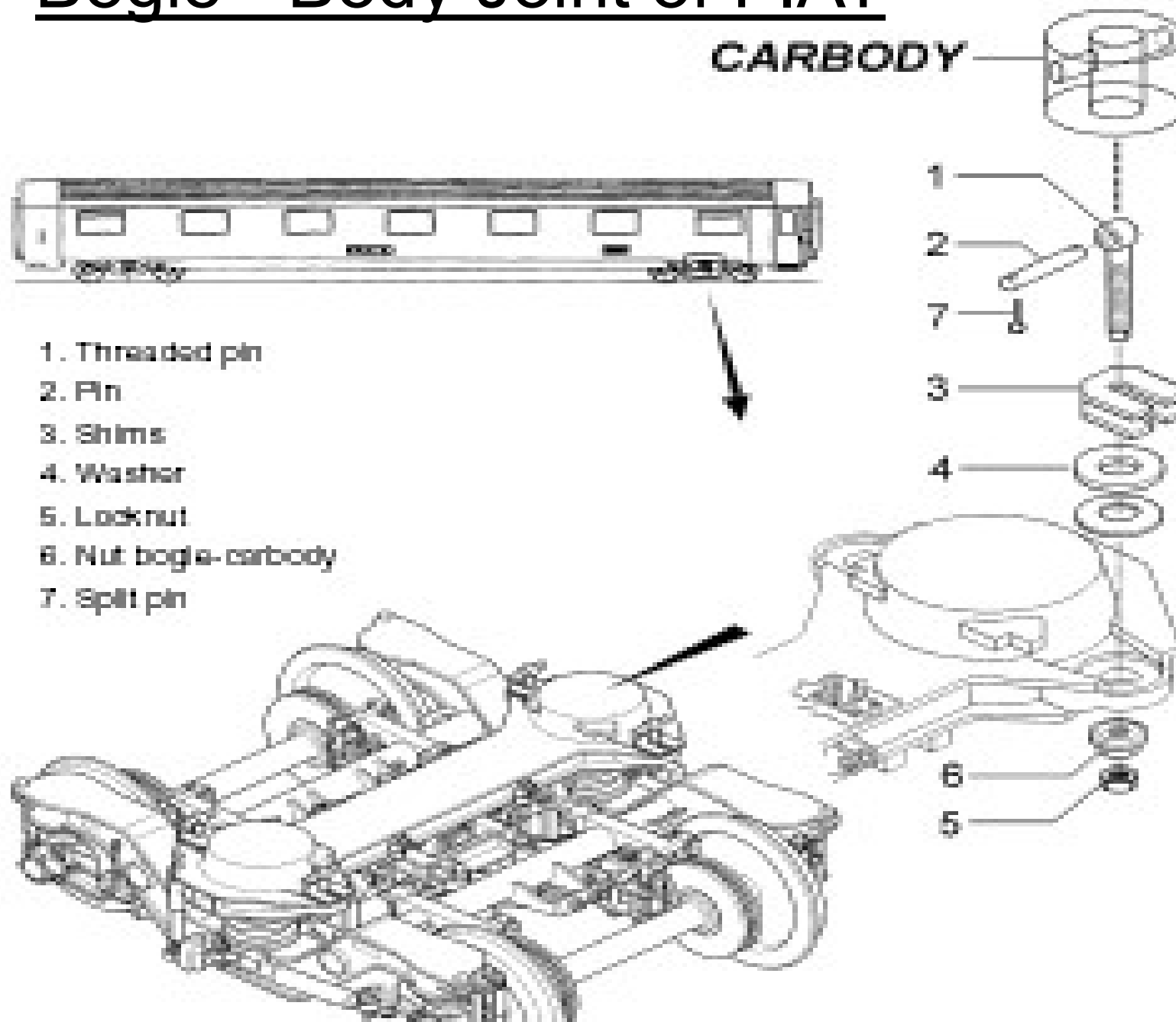
Bogie - Body Joint of FIAT



Bogie - Body Joint of FIAT



Bogie - Body Joint of FIAT



Bogie - Body Joint of FIAT



Brake System

ICF

- Clasp type brake

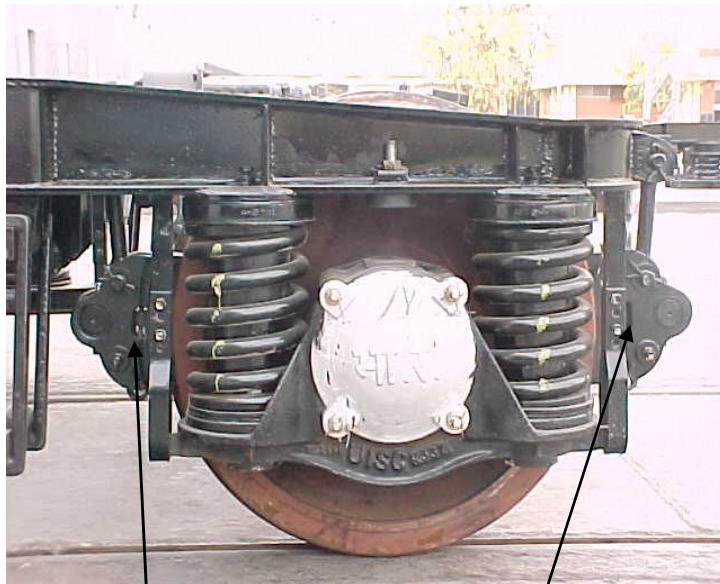
FIAT

- Axle mounted disc brake

- ✓ Reduces wheel tread wear
- ✓ Suitable for offer higher braking force
- ✓ Require lesser maintenance

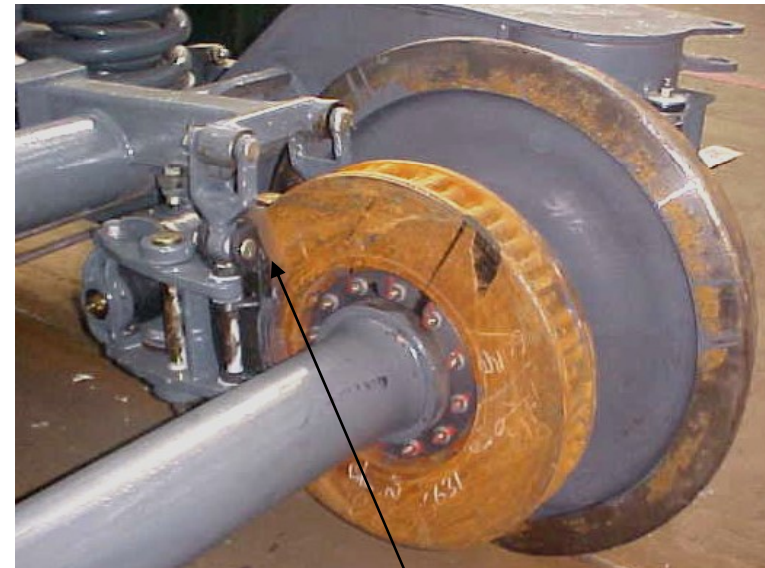
Brake System

ICF



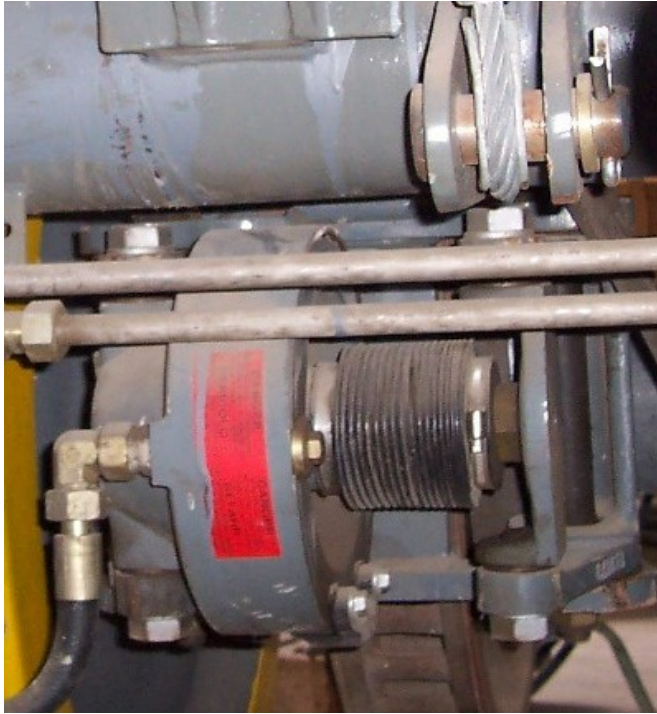
Clasp type brake

FIAT

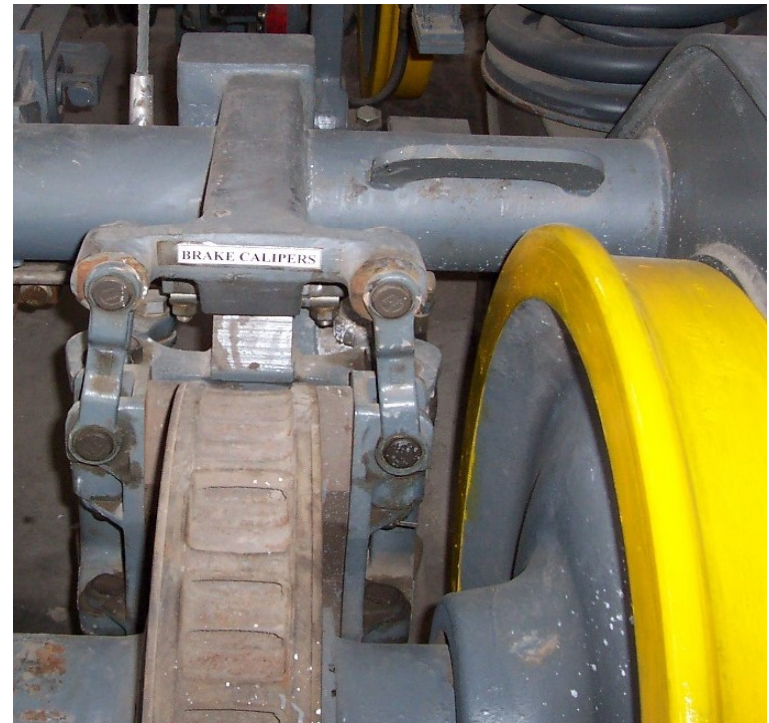


Disc Brake

Brake System of LHB



Brake System of LHB



Brake System of LHB



Maintenance requirement in POH

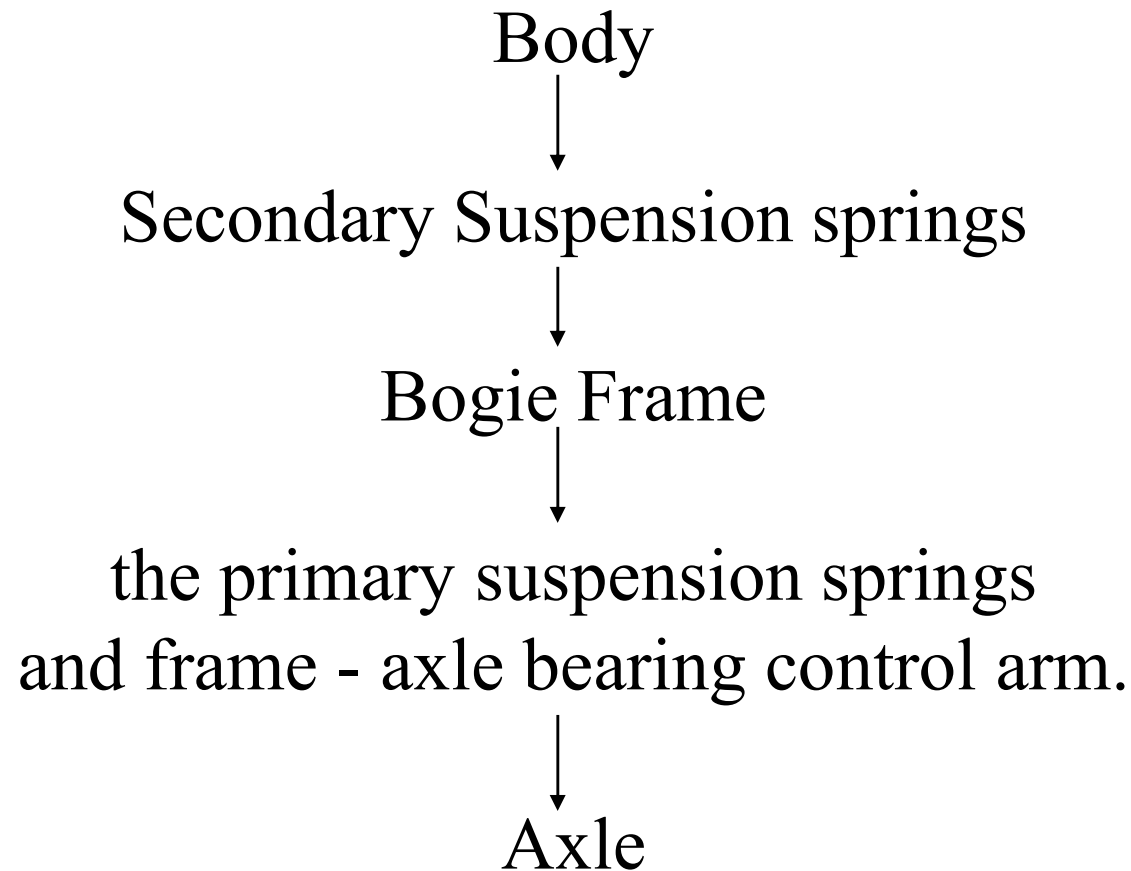
ICF

- More due to
 - Axle guide arrangement
 - Spherical Roller Bearing
 - Clasp brake
 - More pin joints

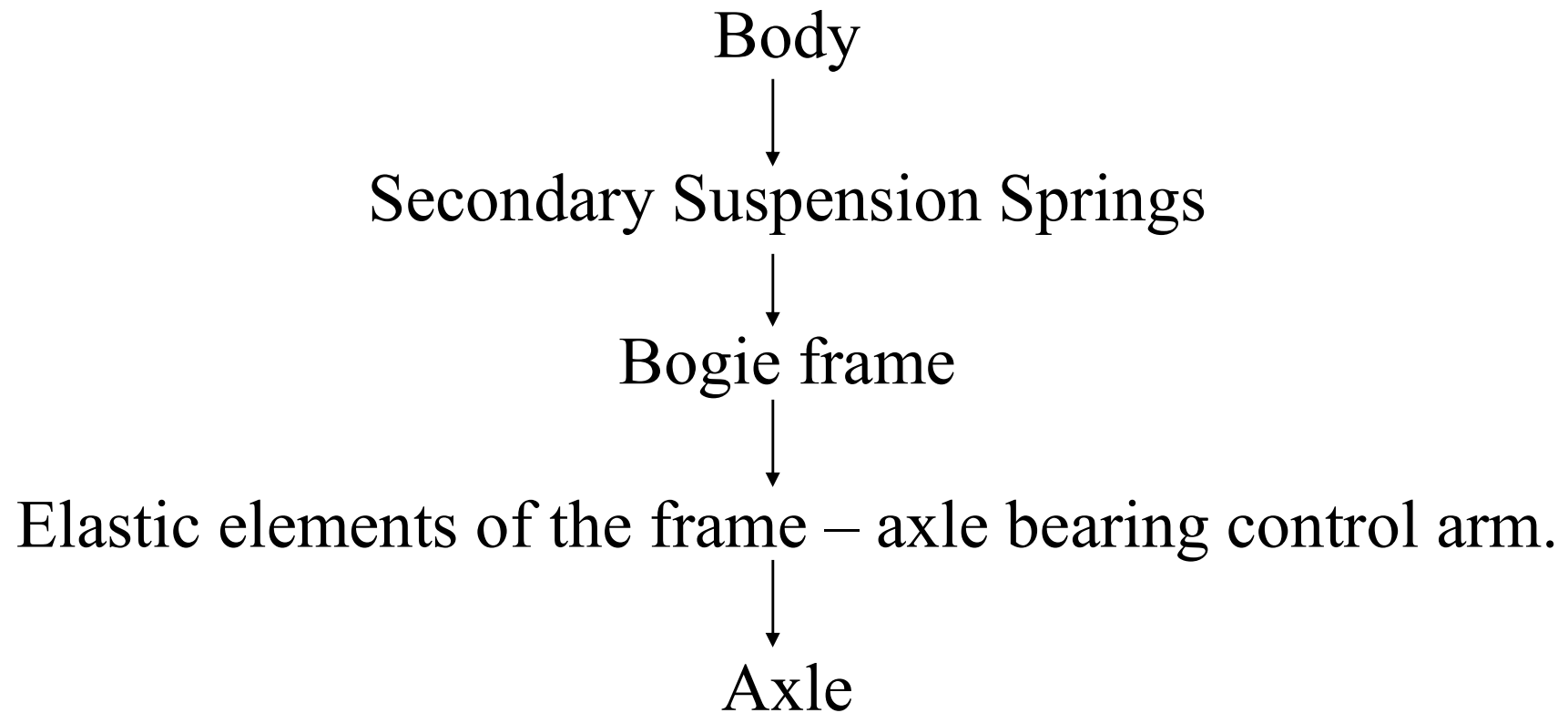
FIAT

- Very little due to
 - Disc Brake
 - CTRB
 - Bogie frame, springs and rubber components.
 - Wheel with improved curving characteristic

VERTICAL FORCES TRANSMISSION

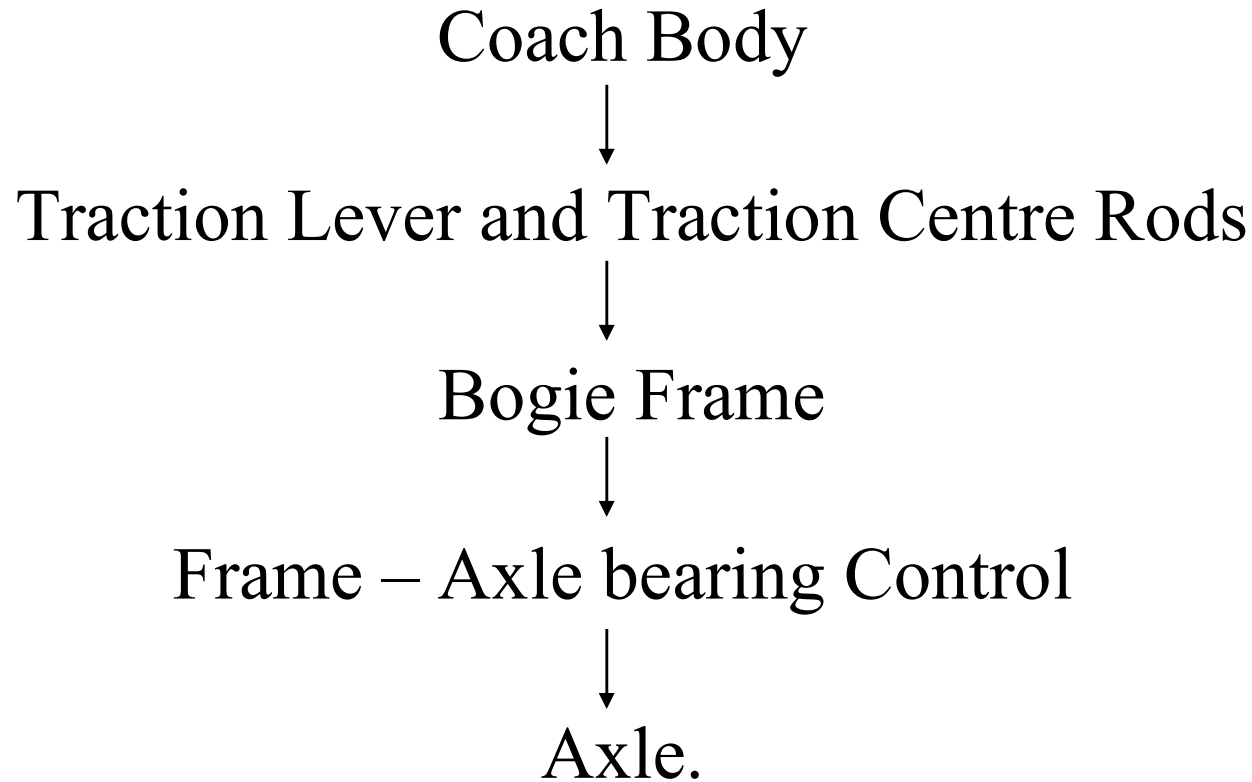


LATERAL FORCES TRANSMISION



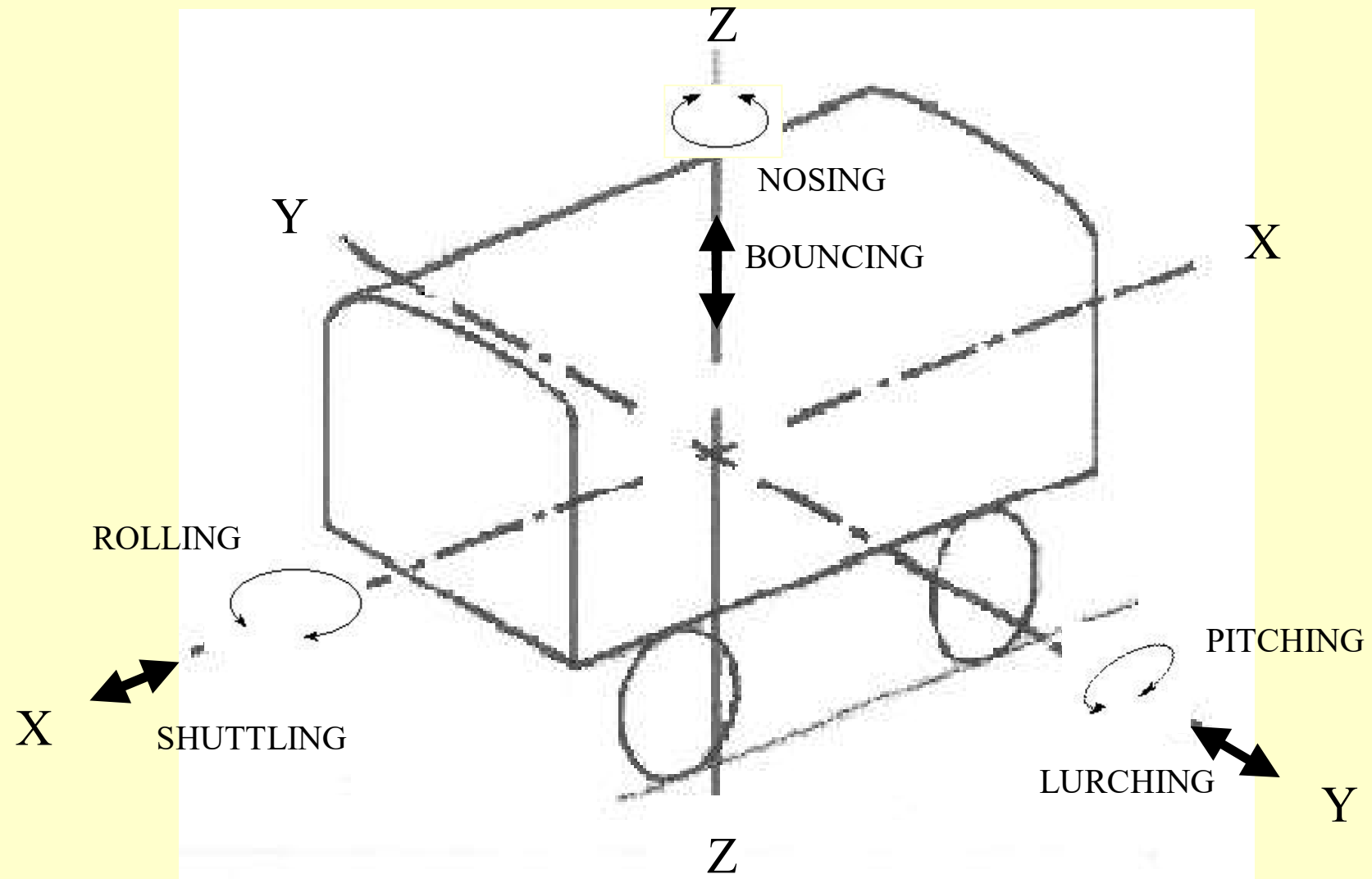
LONGITUDINAL FORCES TRANSMISSION

(TRACTION EFFORTS AND BRAKING POWERS)

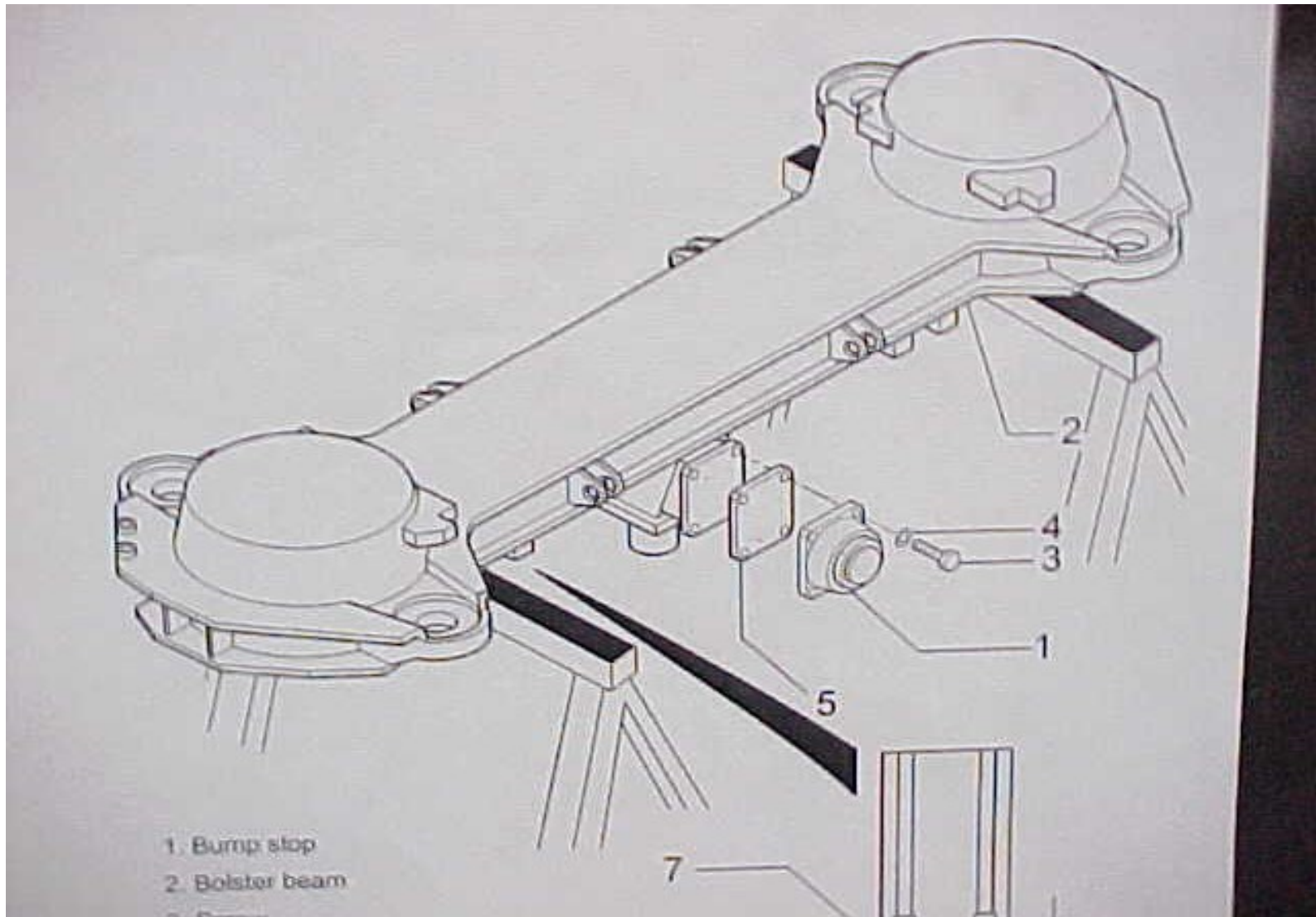


Oscillation modes of vehicles

There are six modes of oscillations:



Shuttling Effect from Body Bolster to Bogie Frame



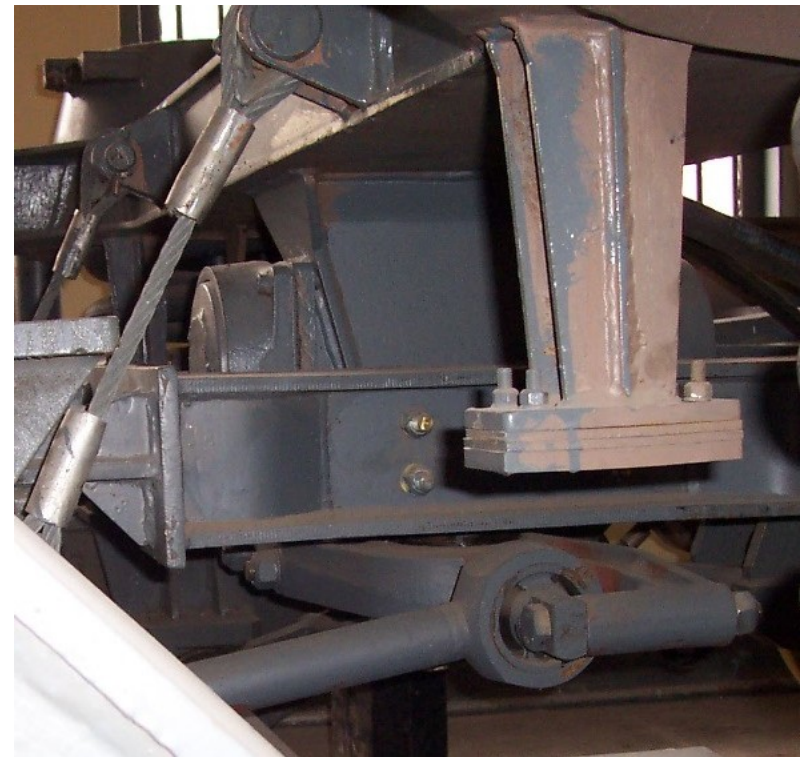
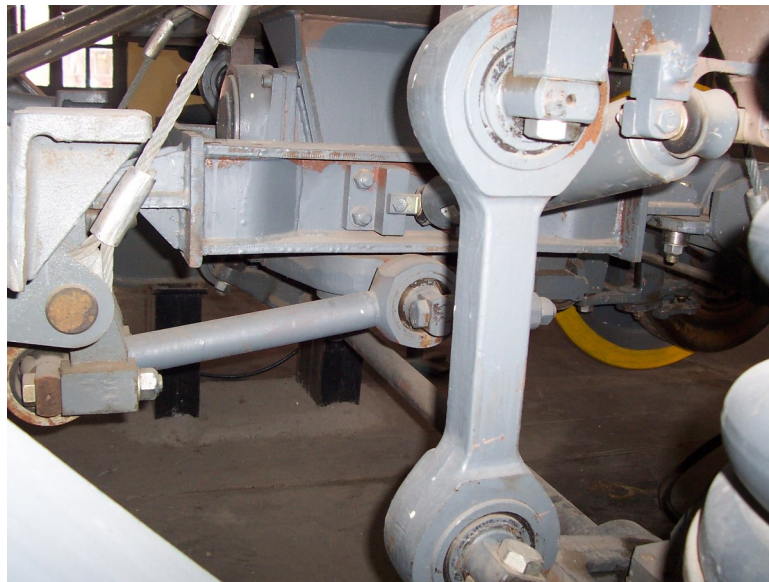
Shuttling Effect from Body Bolster to Bogie Frame



Shuttling Effect from Body Bolster to Bogie Frame



Shuttling Effect from Body Bolster to Bogie Frame



Shuttling Effect from Body Bolster to Bogie Frame



Shuttling Effect from Body Bolster to Bogie Frame

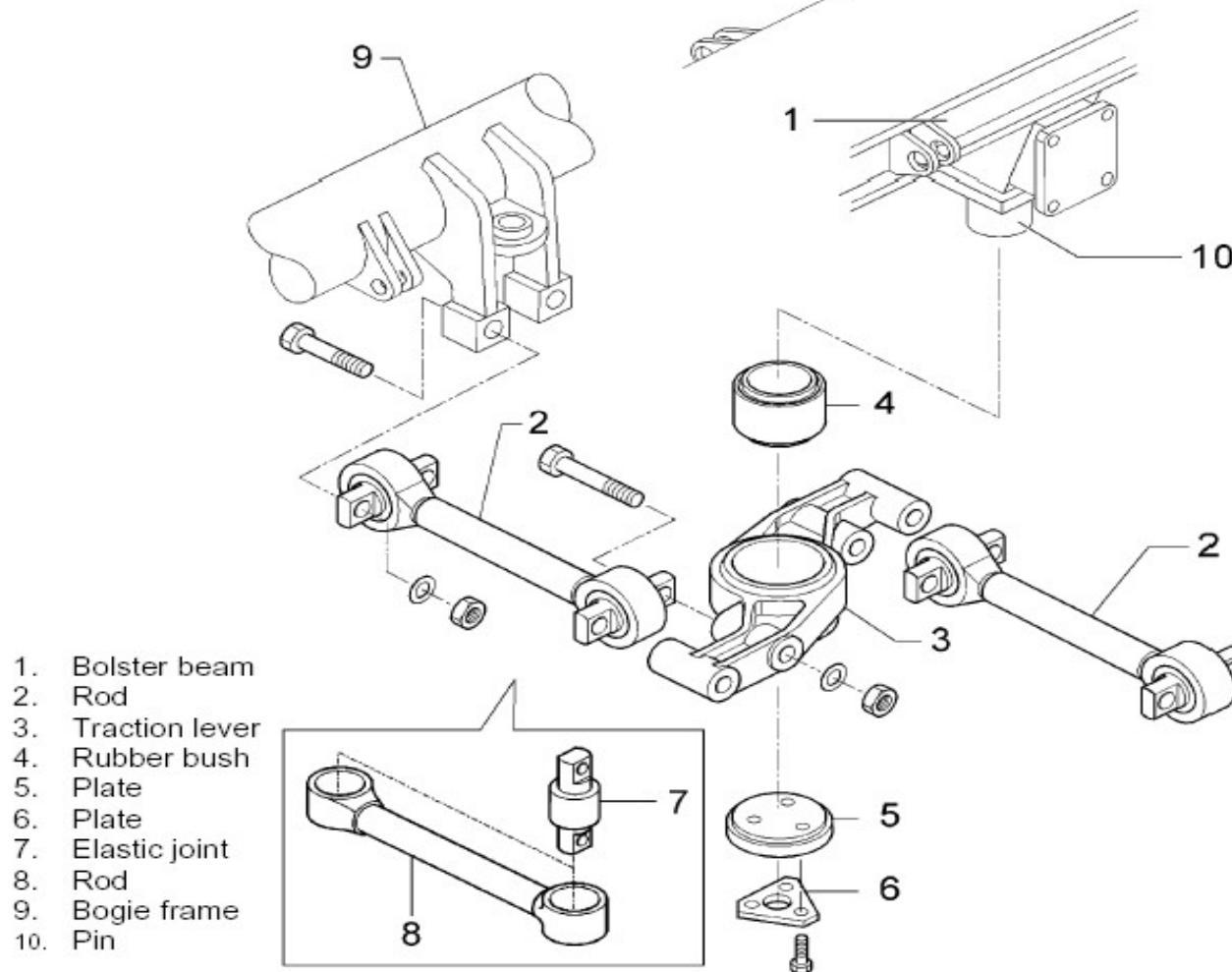
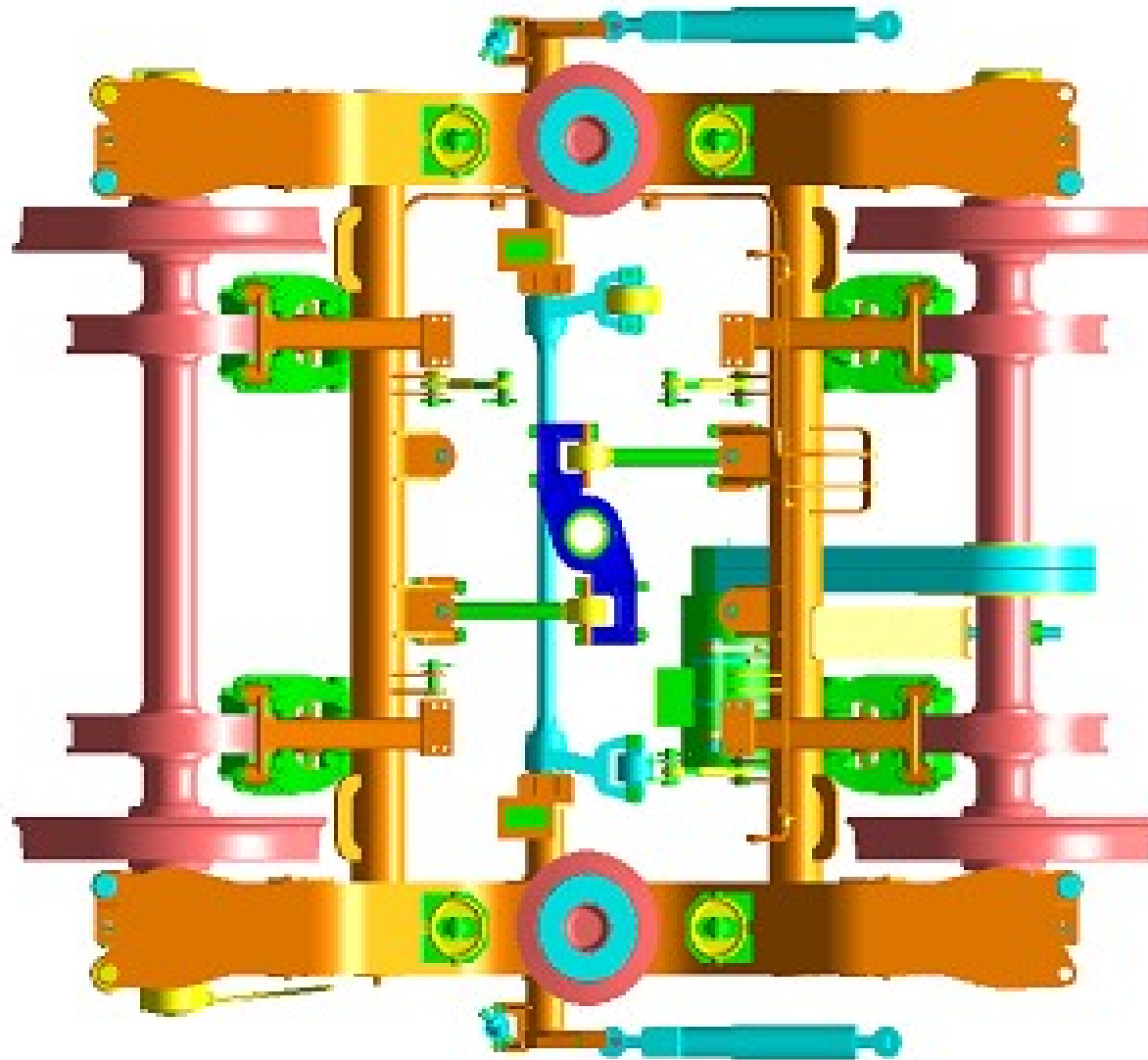


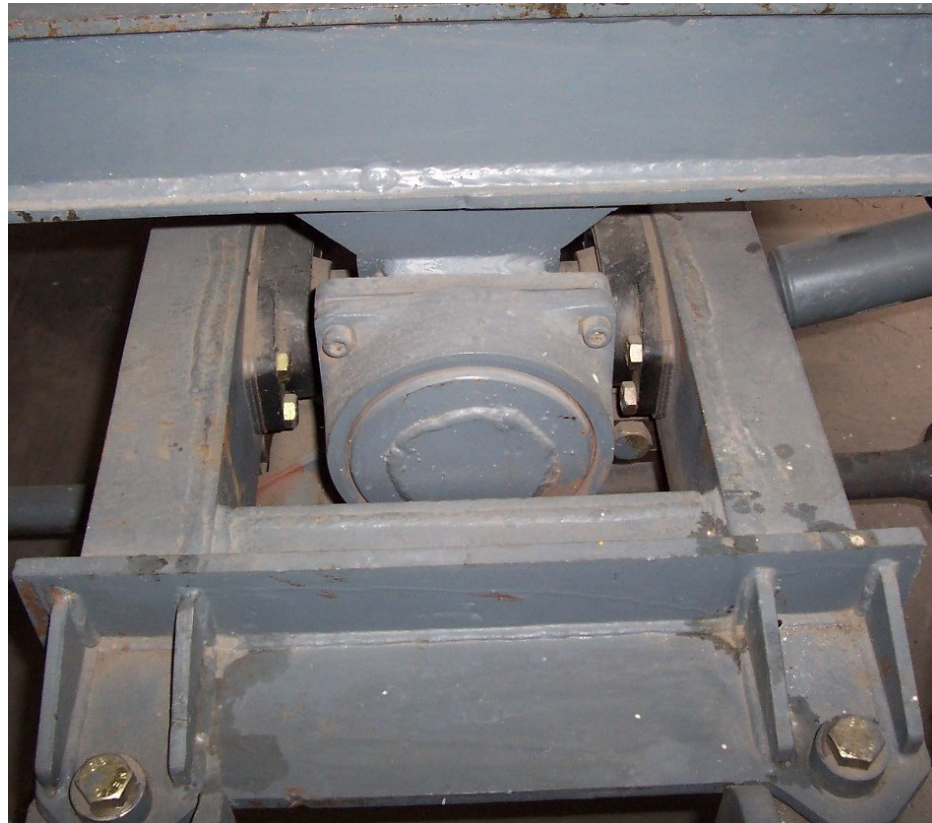
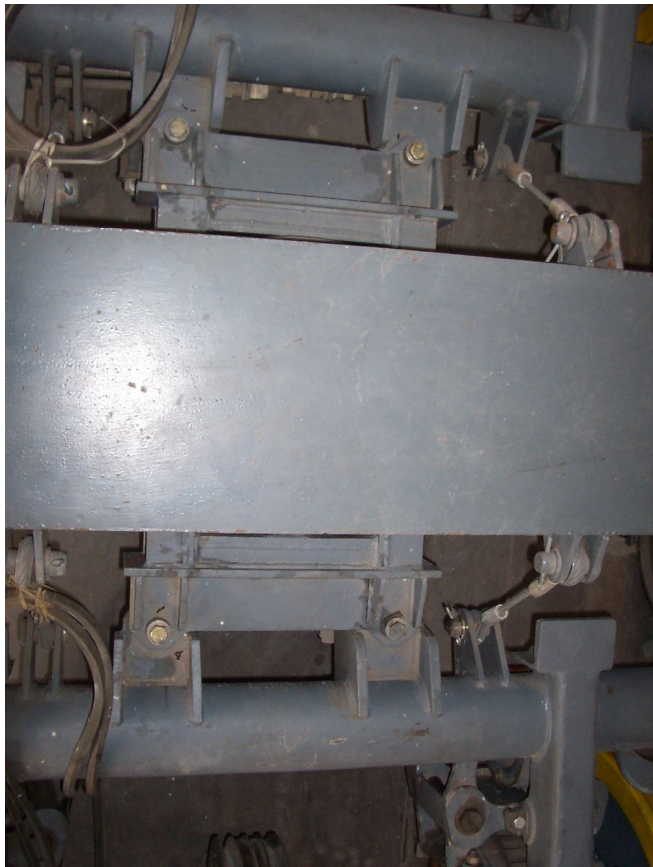
FIG. 1-11 TRACTION CENTRE

Shuttling Effect from Body Bolster to Bogie Frame



Shuttling Effect from Body Bolster to Bogie Frame

Longitudinal Bump

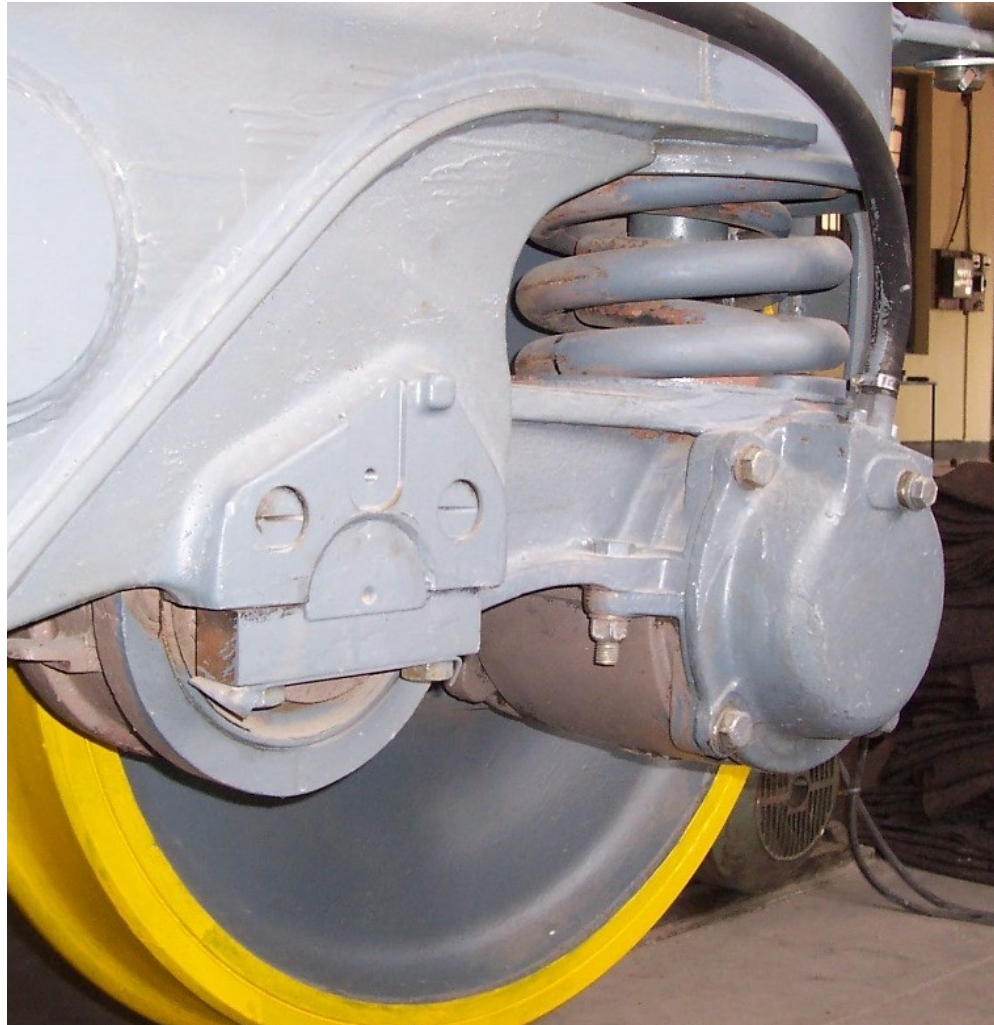


Shuttling Effect from Body Bolster to Bogie Frame

Longitudinal Bump

- 
- This technical diagram illustrates the assembly of a longitudinal bump system. It features a central rectangular support frame (labeled 3) with various mounting points. To the left, a lateral bump stop (labeled 1) is shown with its mounting hardware. To the right, a longitudinal bump stop (labeled 2) is shown with its mounting hardware. The diagram includes numerous bolts, nuts, and washers, with dashed lines indicating their assembly paths onto the frame and bump stops. A separate component, possibly a roller or guide, is shown at the bottom right with its own mounting hardware.
- 1. Lateral bump stop
 - 2. Longitudinal bump stop
 - 3. Support-frame

Shuttling Effect from Bogie Frame to Axle

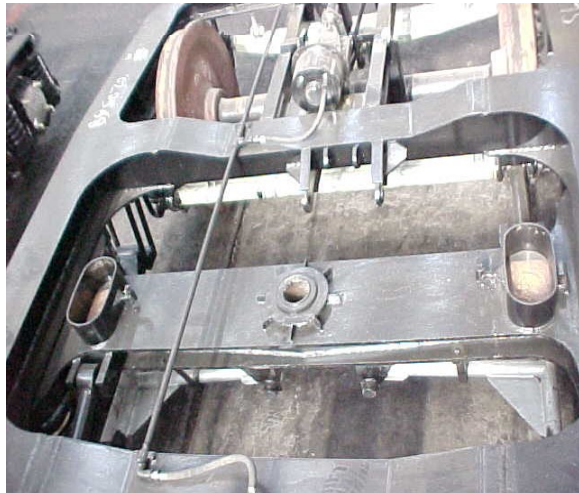


Rolling Effect

Anti Rolling Arrangement

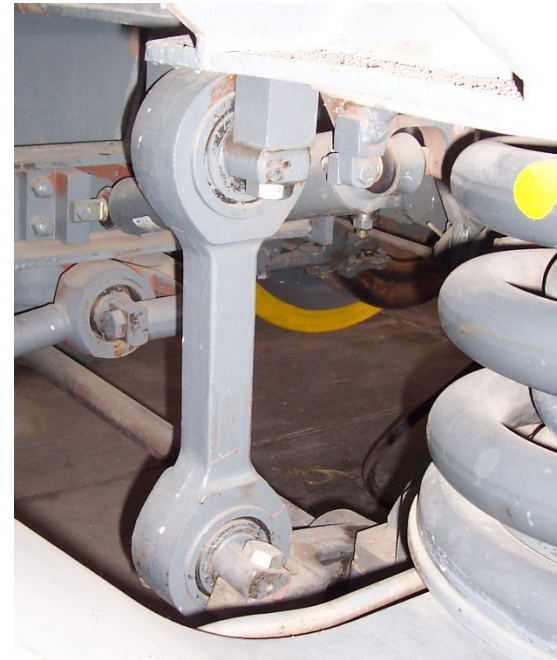
ICF

- Not provided



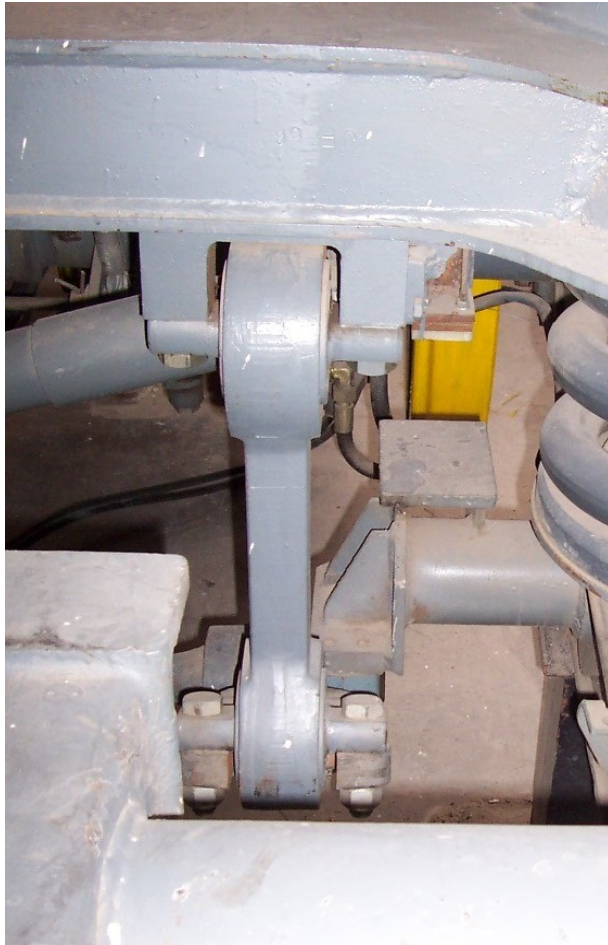
FIAT

- Provided



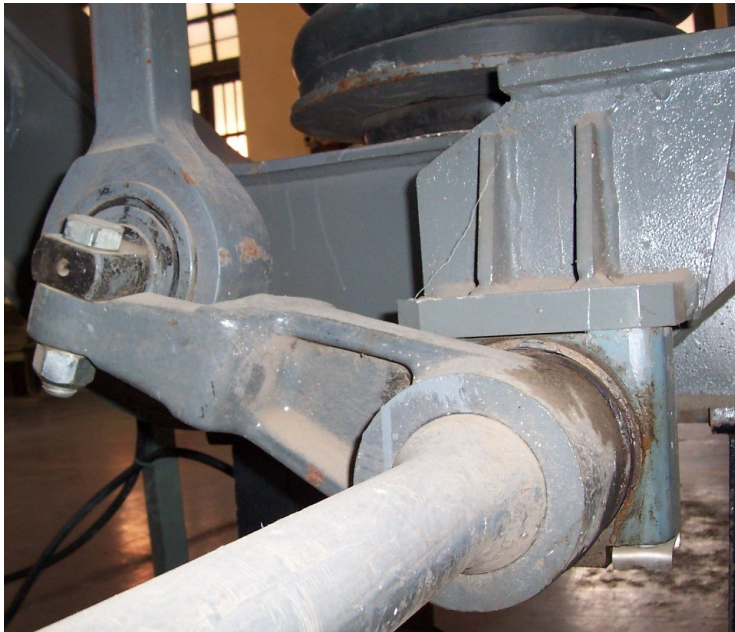
Rolling Effect

Anti Rolling Arrangement of FIAT



Rolling Effect

Anti Rolling Arrangement of FIAT



Rolling Effect

Anti Rolling Arrangement of FIAT

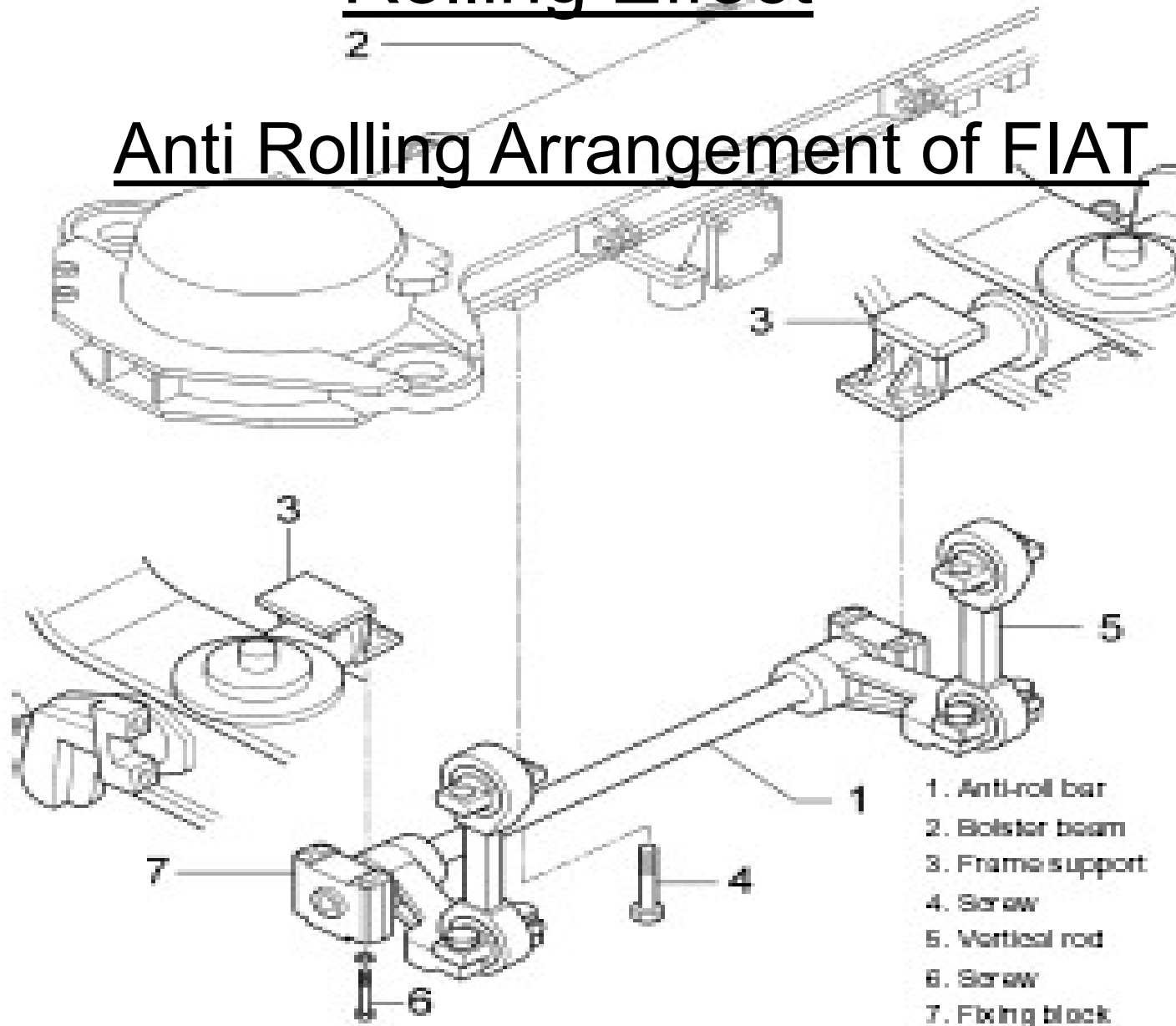
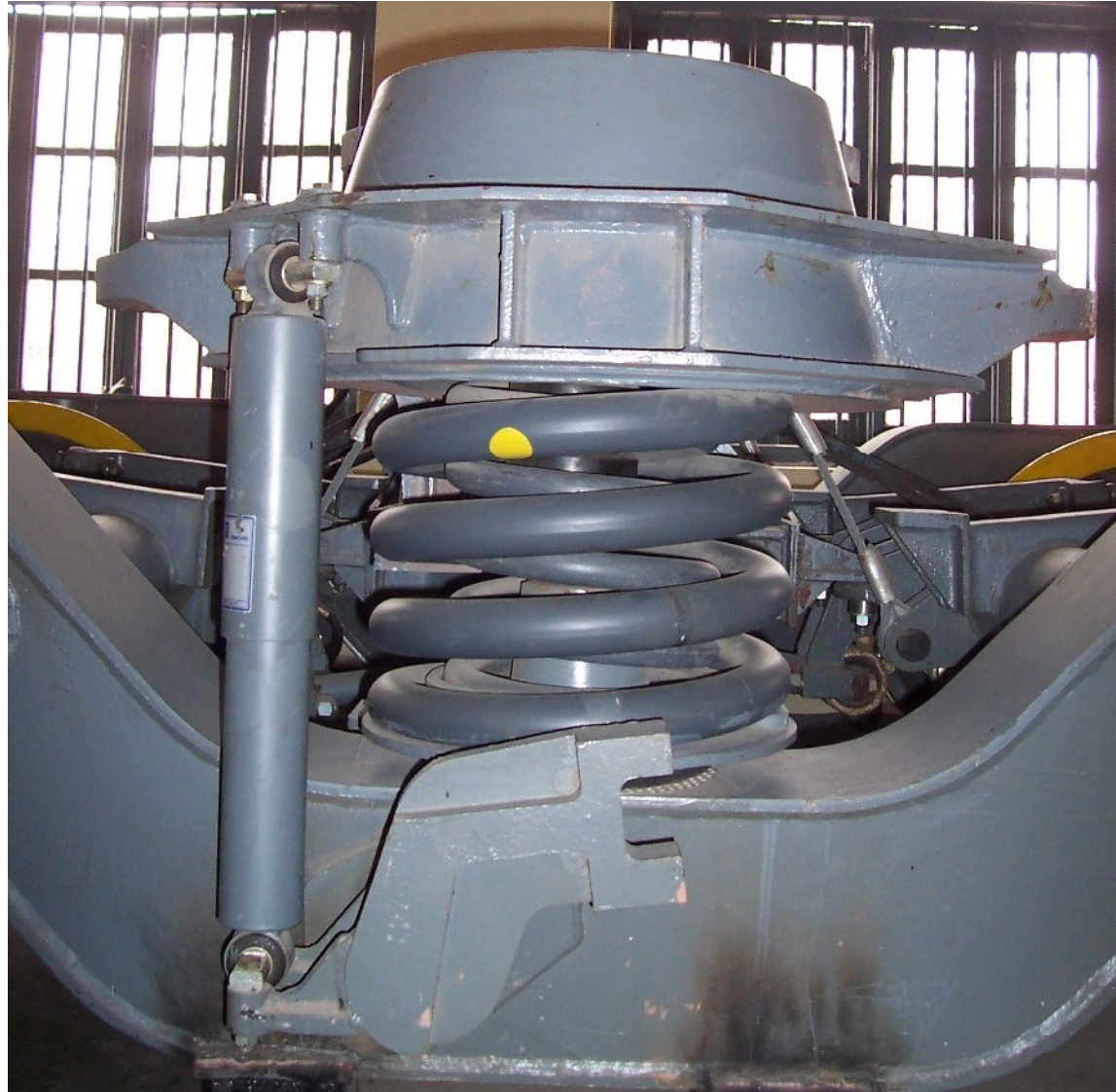
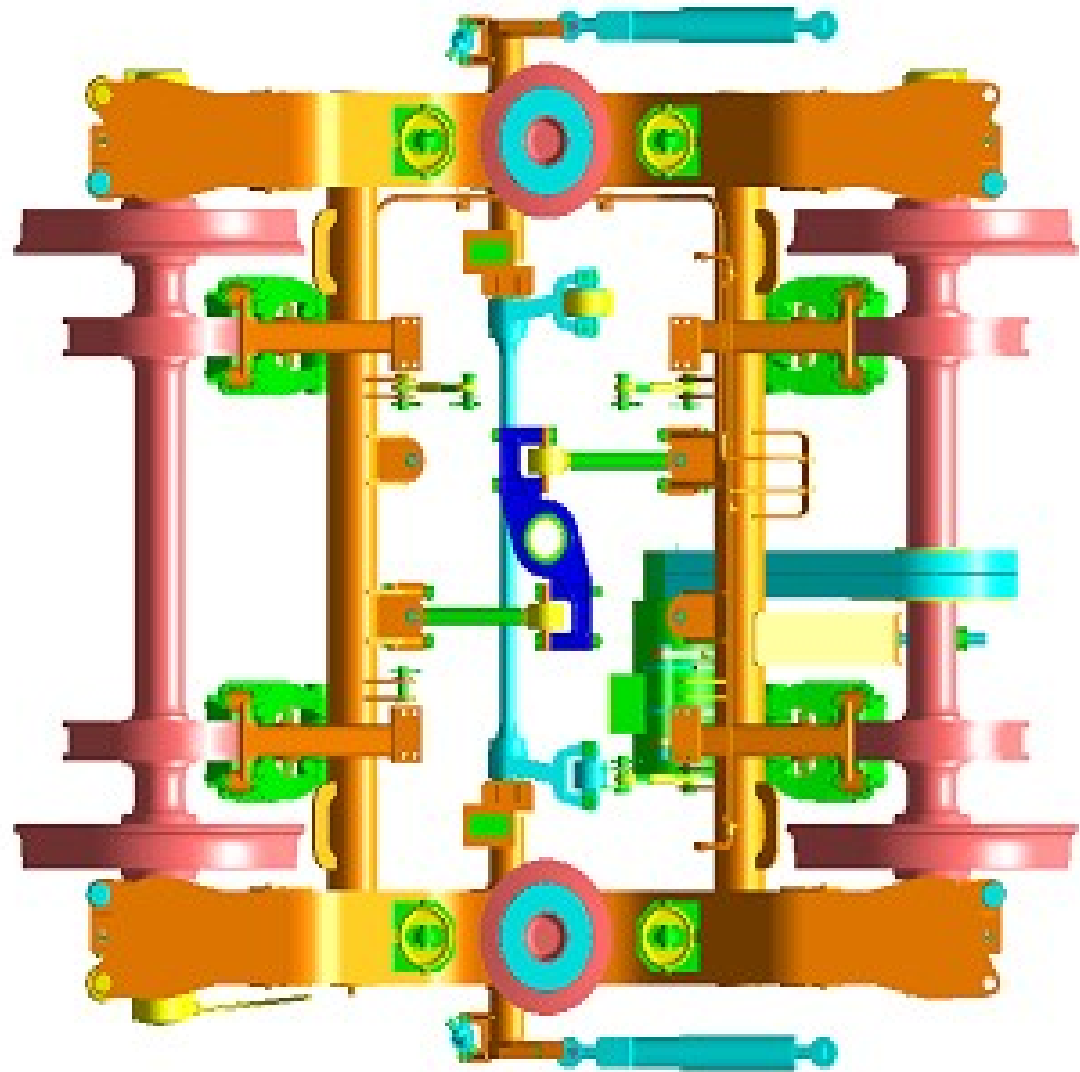


FIG. 3-6 REMOVAL OF THE ANTI-ROLL BAR

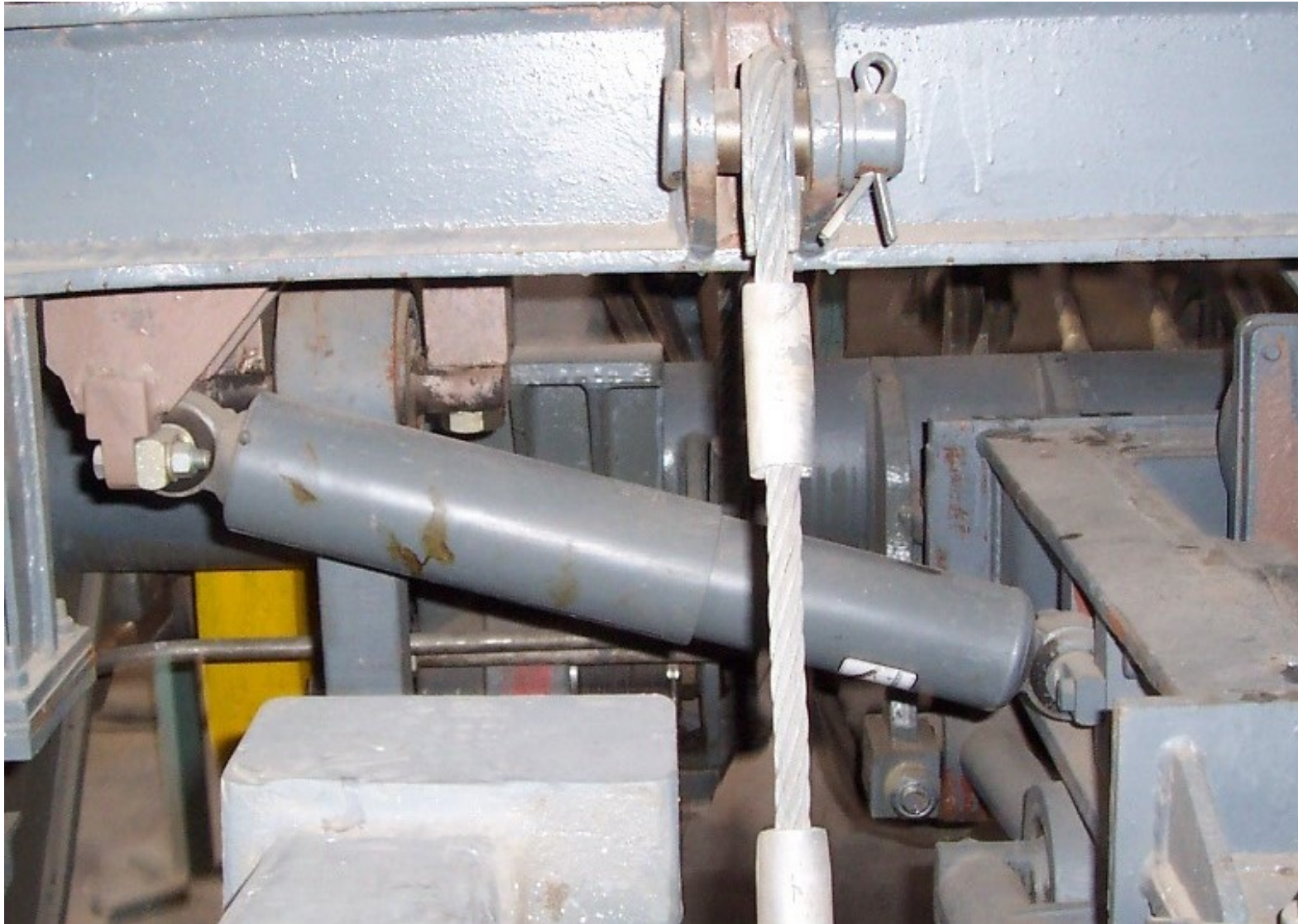
Lurching Effect



Lurching Effect

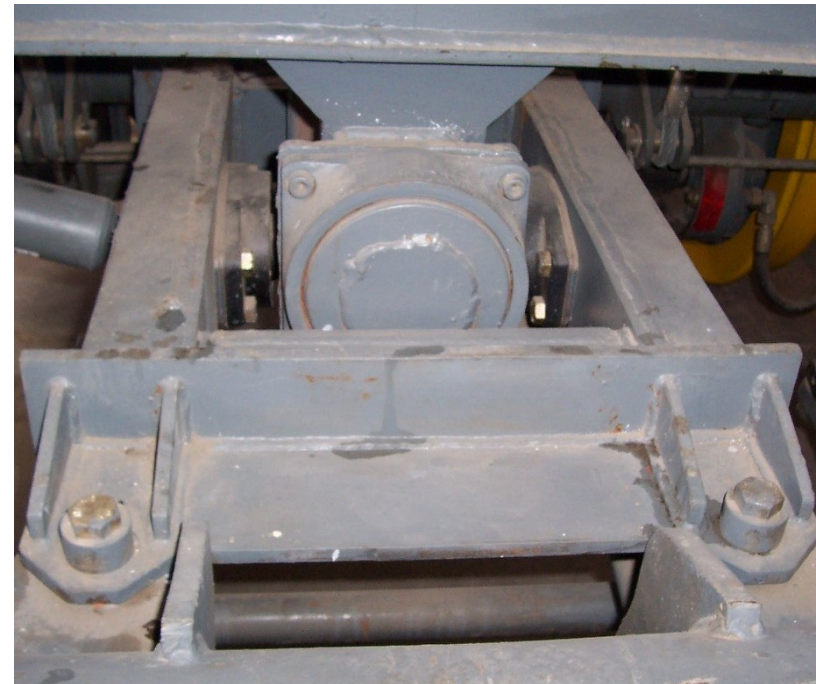
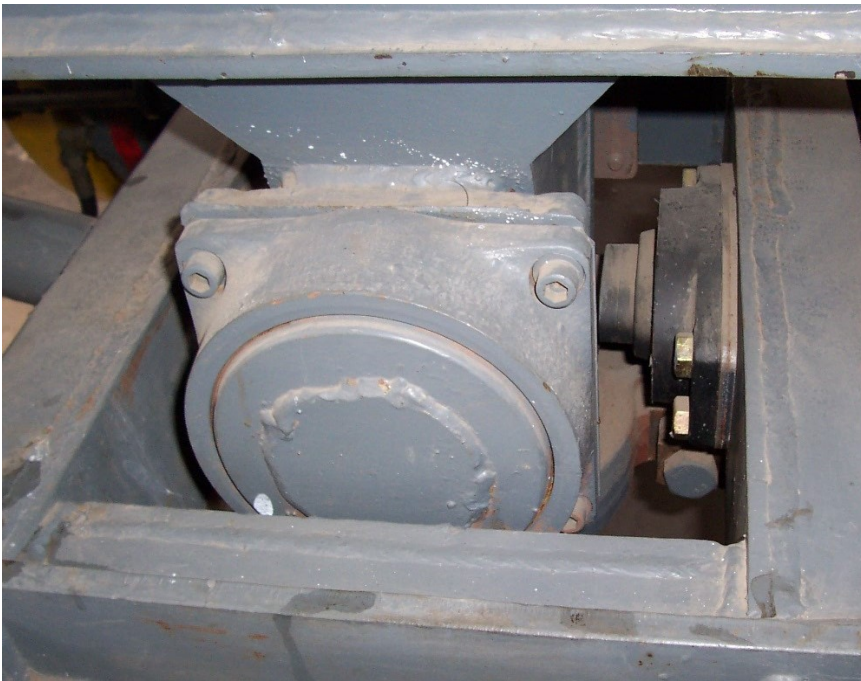


Lurching Effect



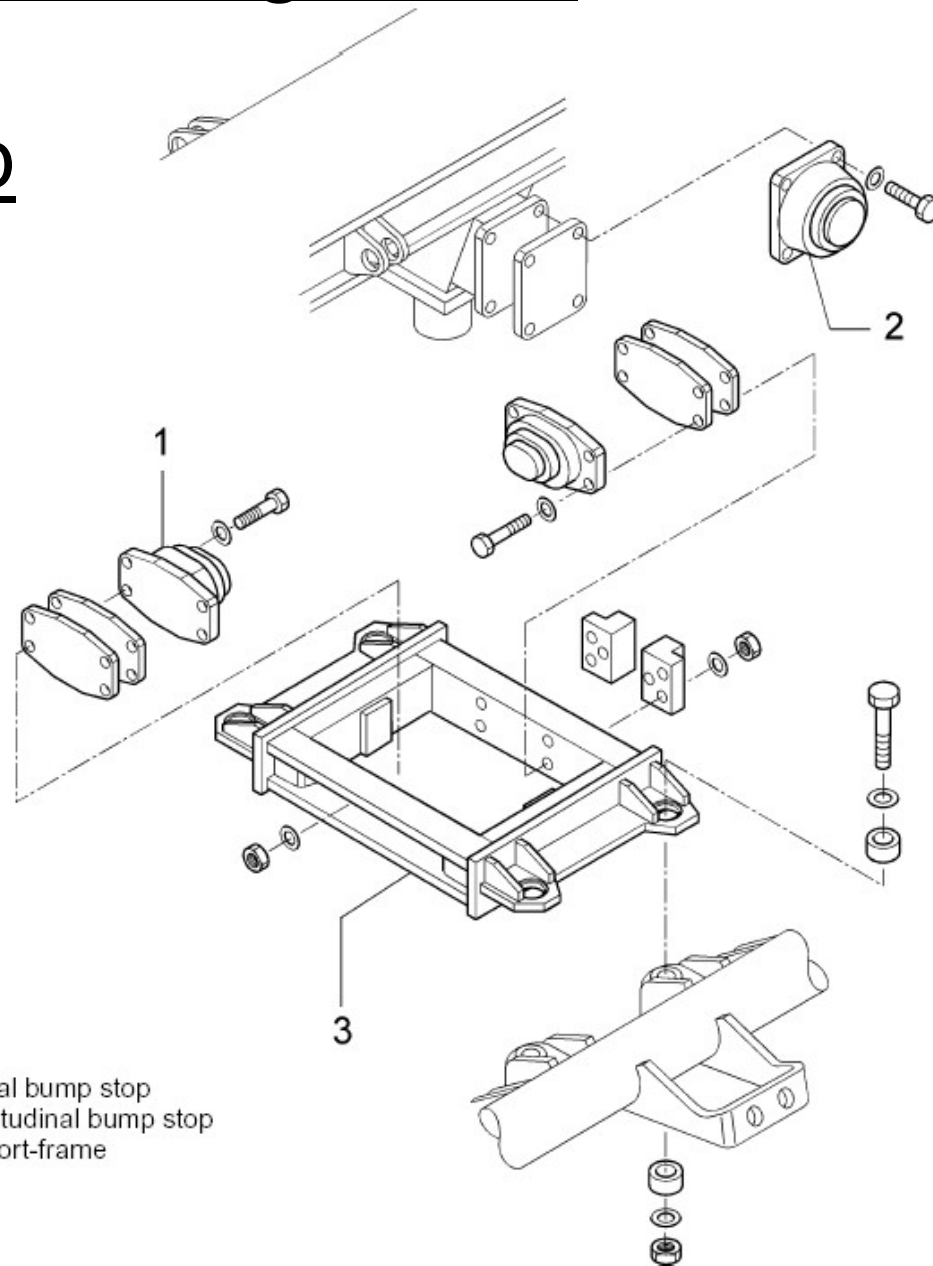
Lurching Effect

Lateral Bump



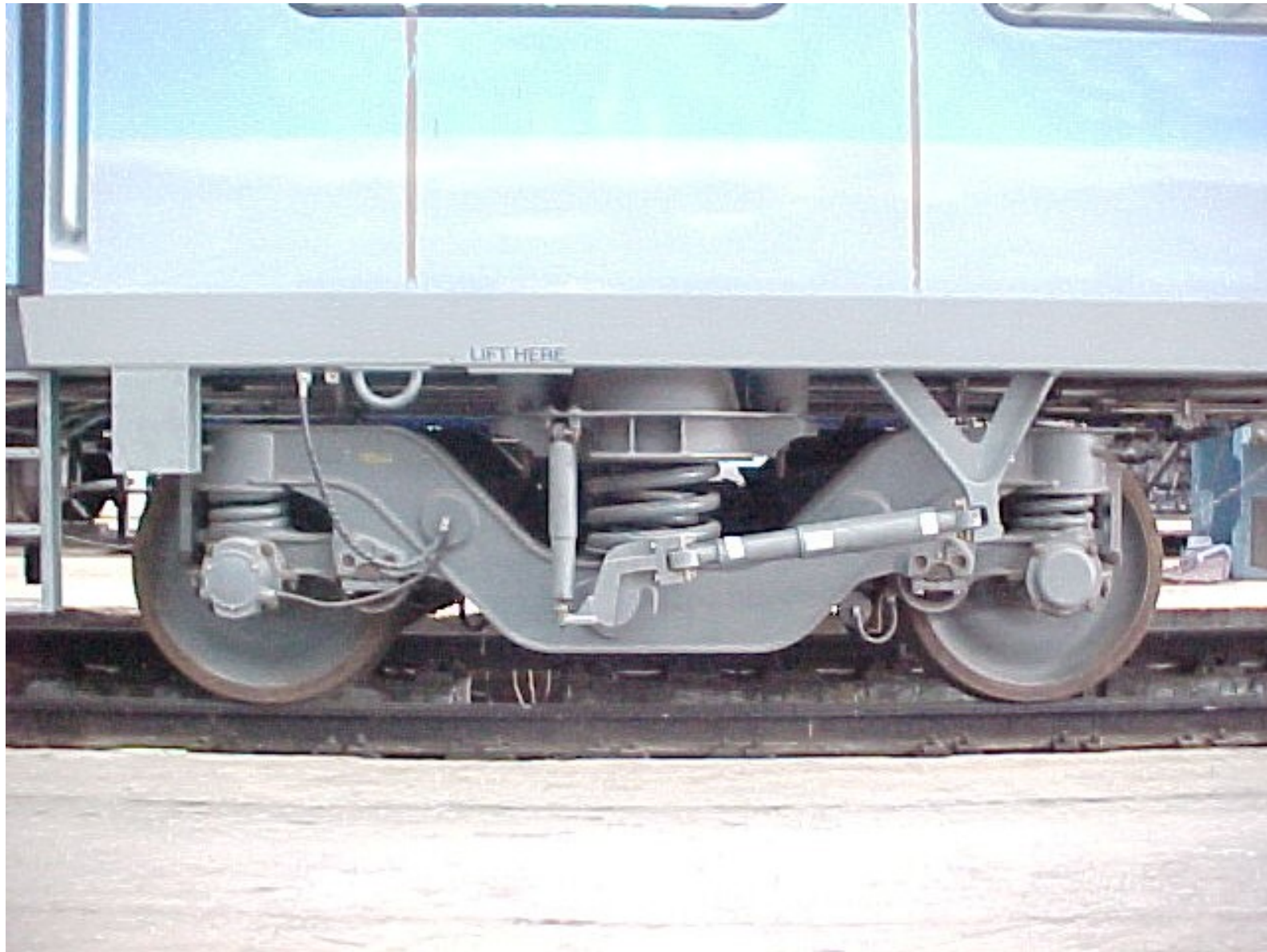
Lurching Effect

Lateral Bump

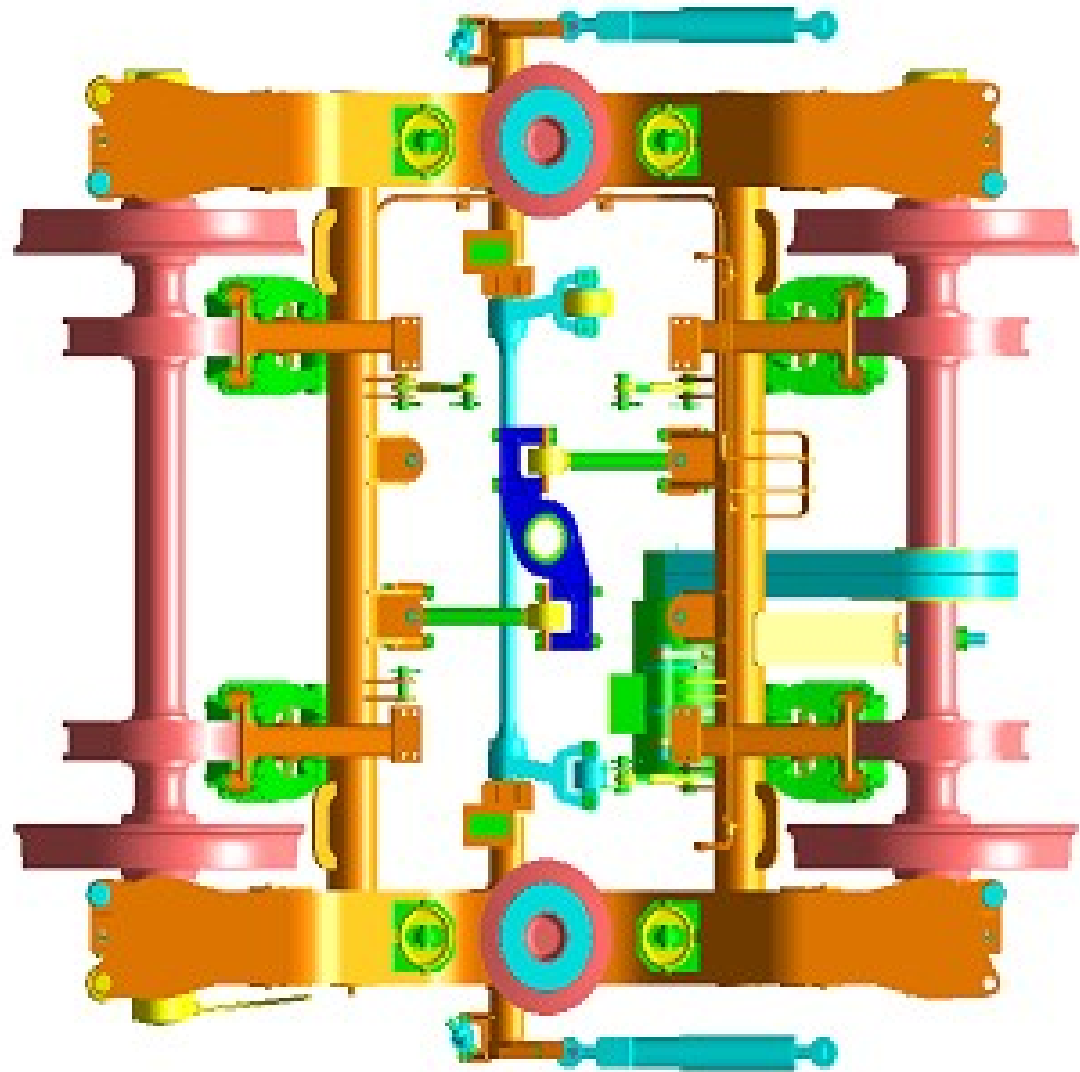


1. Lateral bump stop
2. Longitudinal bump stop
3. Support-frame

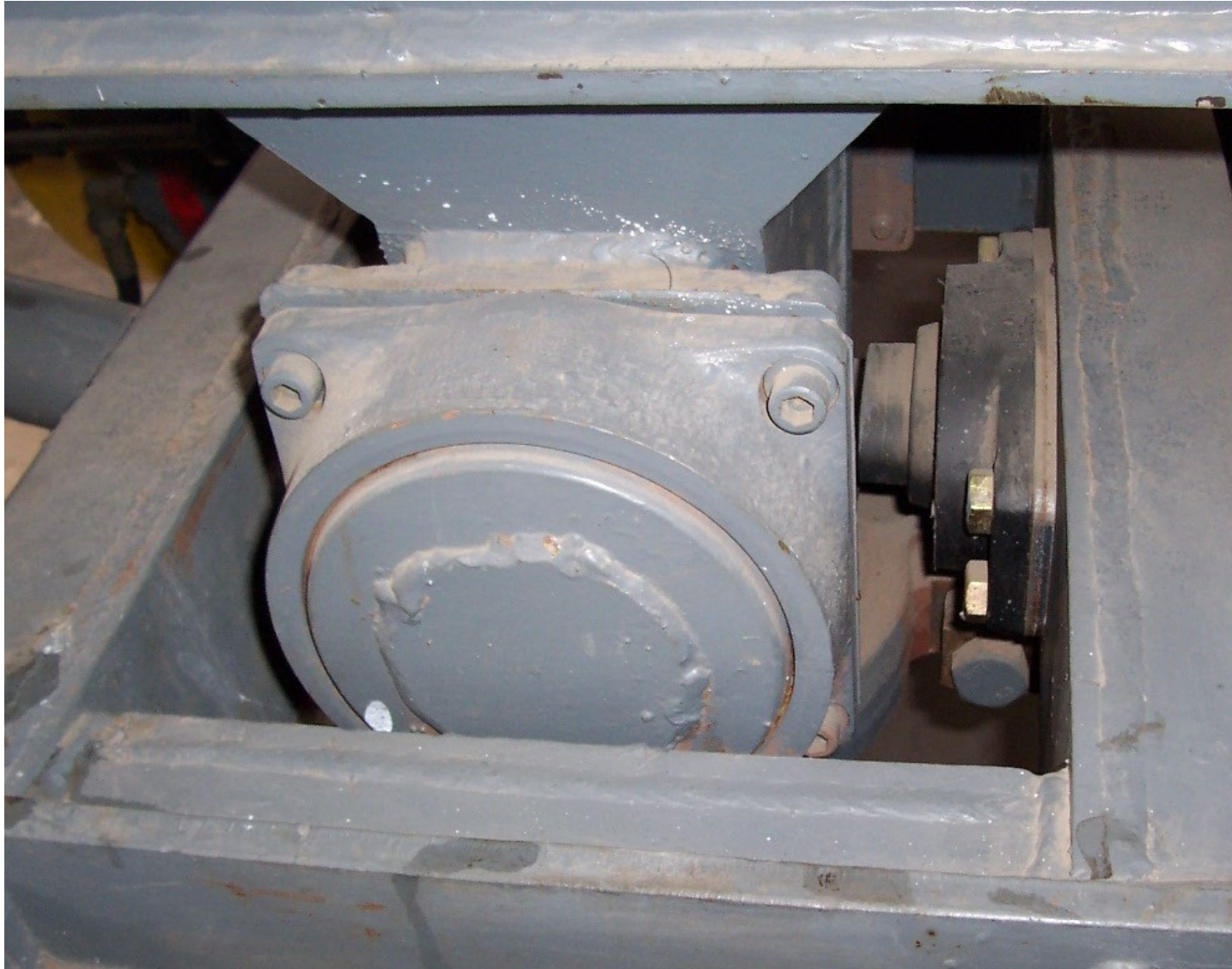
Pitching Effect



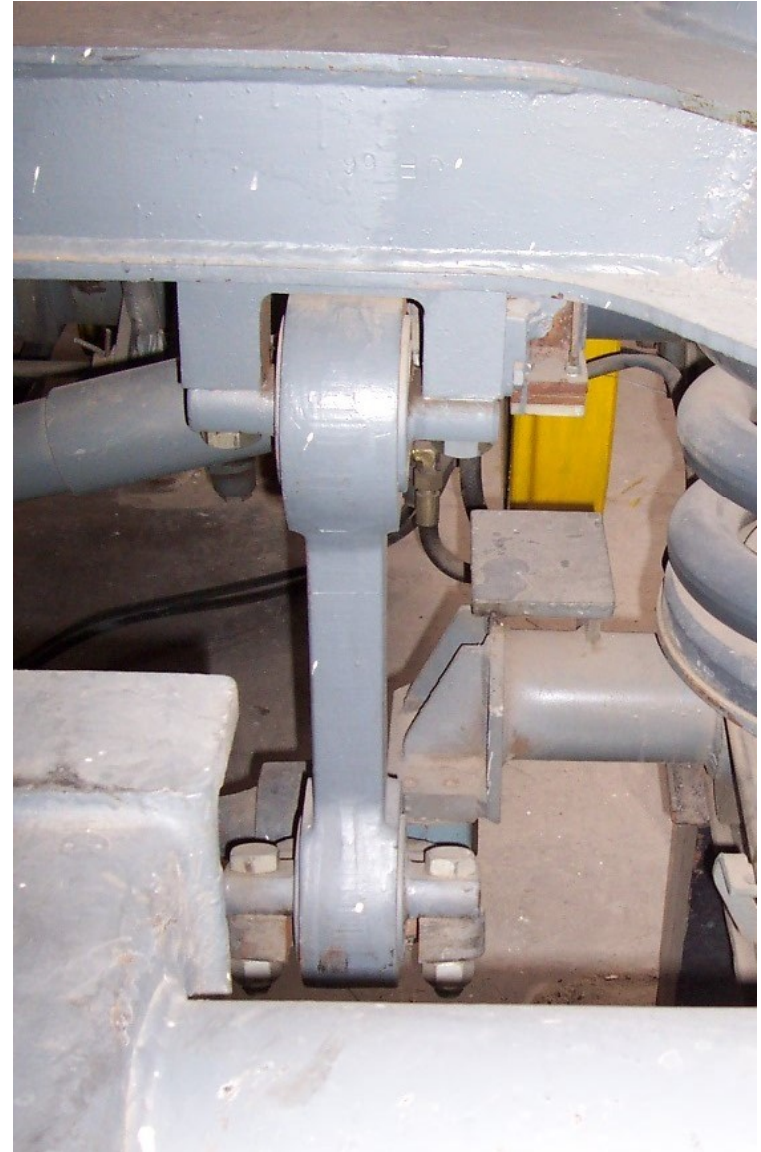
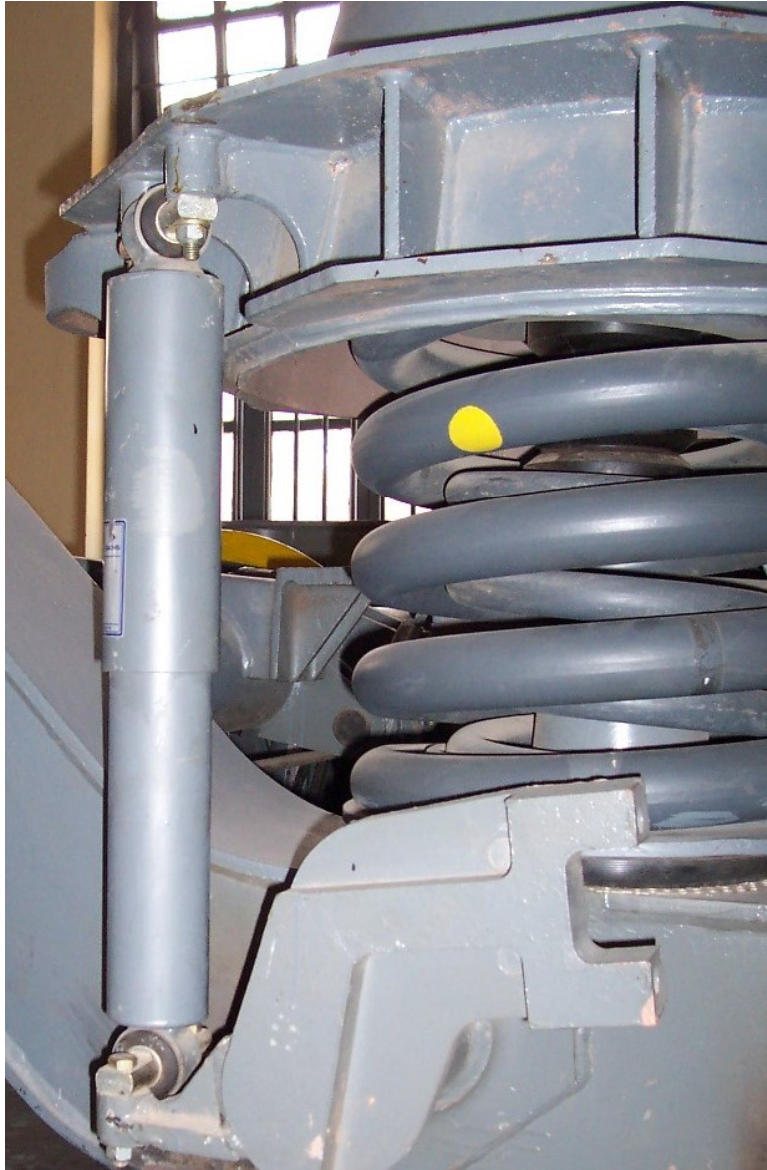
Pitching Effect



Pitching Effect



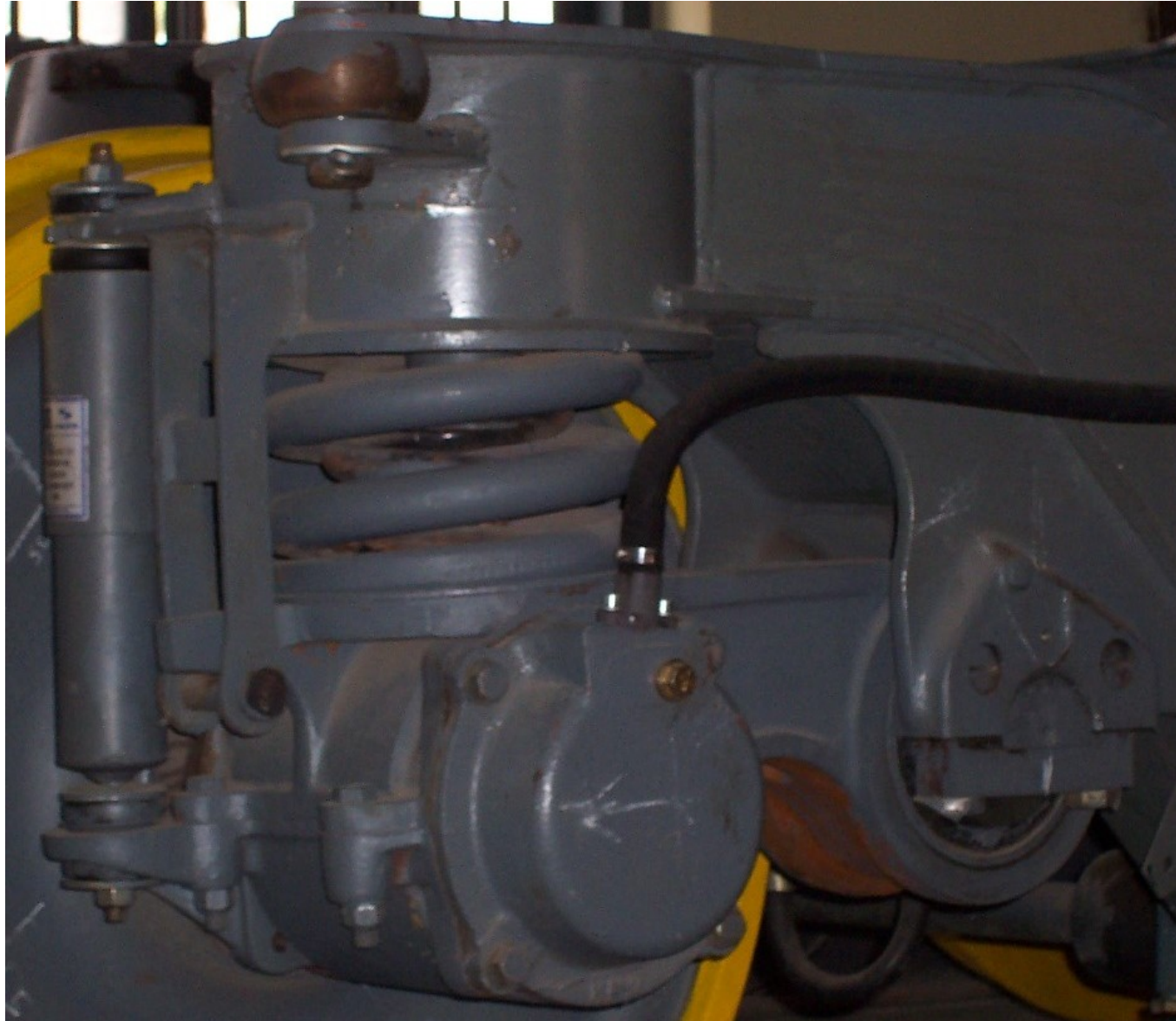
Bouncing Effect



Bouncing Effect



Bouncing Effect



Yaw Effect



Yaw Effect



Thank you