

BOGIE DESIGN PARAMETERS & FIAT BOGIE

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- Dy. Cme/Shell & Bogie
- Rail coach factory, Kapurthala

BOGIE DESIGN STEPS

- Layout calculations
 - Layout drawing
 - Interface with carbody
 - Gauge, Wheel base and wheel dia (customer)
- Proof layout calculations
 - Frequencies of suspensions
 - Bogie frame
 - Tilting coefficient
 - Derailment coefficient
- Exact calculations for springs, fasteners, brakes

BOGIE DESIGN STEPS

- Construction design on the basis of existing bogie
- FEM as per load case of UIC-515-4
- Refinement of suspension through vehicle dynamics
 - Data of track by user railway

Tilting coefficient

- Tilting coefficient = η / δ
 - » δ = cant angle of track
 - » η = tilting angle of coach body with respect to axle

Derailment coefficient

- Ratio of horizontal force to vertical force acting on rail wheel interaction
- Derailment coefficient = Y / Q

$$\frac{Y}{Q} \text{ not greater than } \frac{\tan \beta - \mu}{1 + \mu \tan \beta}$$

- Y/Q should not be greater than 1.0 ----IR limit
 - Y = Flange force/lateral force for continuous min. 0.05 (1/20) sec.
 - Q = Instantaneous wheel load
 - β = Flange angle (68 degree)
 - μ = Co-efficient of friction between wheel and rail (0.25)
- $Y/Q = 1.4$

CRITERIA FOR DESIGN EVOLUTION

Safety against derailment coefficient	≤ 1.0	To prevent off loading of wheel on curve
Tilting coefficient	$\leq .4$ as per UIC	For max moving dynamic gauge
Separation of carbody bending frequency & bogie frame pitching & bouncing frequencies	By a factor $\geq \sqrt{2}$	To avoid resonance

CRITERIA FOR DESIGN EVOLUTION

Buffer height drop from tare to loaded	<75mm	To ensure safe coupling
Primary stage service deflection	10-15 mm(max)	For maintaing complete overlap of mounted disc brake
Ride quality	Vertical frequency = 1 hz Lateral frequency = .5 hz Roll freq. = .5 Hz Riding comfort ≤ 2.75	For good ride comfort

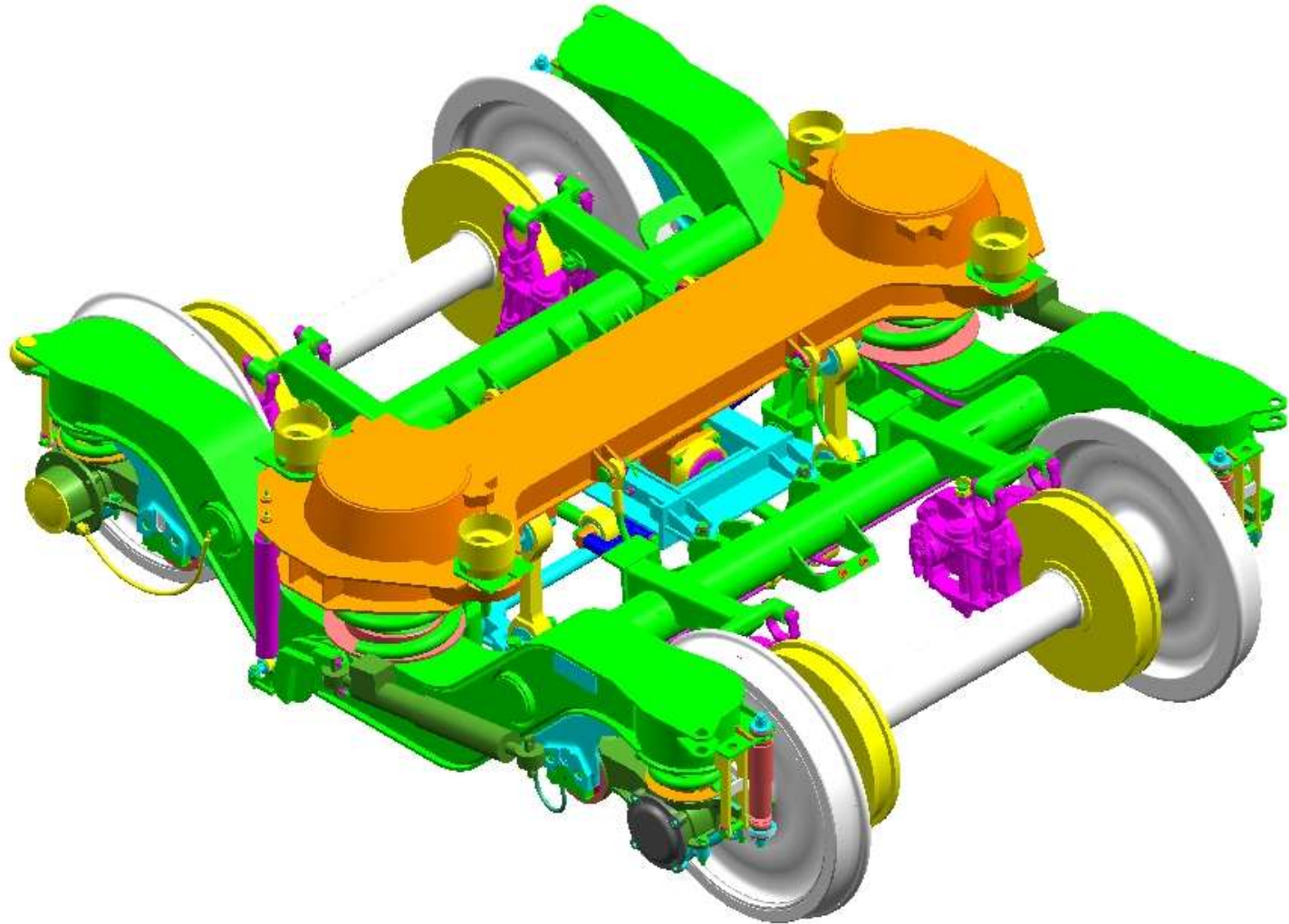
CAR BODY PARAMETERS

- Center of gravity of X, Y & Z coordinates
 - Stability of multi modal system
 - Frequencies of oscillation of car body
 - Most off loaded wheel for safety criteria
 - Tilting coefficient due to lateral imbalance
- Layout drawing and interface drawing to car body
 - Deciding wheel gauge, wheel base and wheel dia
 - Check with max moving gauge
 - Body bogie interface concept

CAR BODY PARAMETERS

- Weight of carbody as per UIC in tare, gross & overloading
 - Calculate deflection of suspension system, buffer drop, interface in bogie components, mmd
 - Stress on bogie parts
 - Brake calculations
 - Vehicle dynamics analysis
- Moment of inertia of car
 - Multibody dynamics
- Interbody car distance
 - Vehicle dynamics and distribution of wheel load
 - Max rotation of bogie on curve

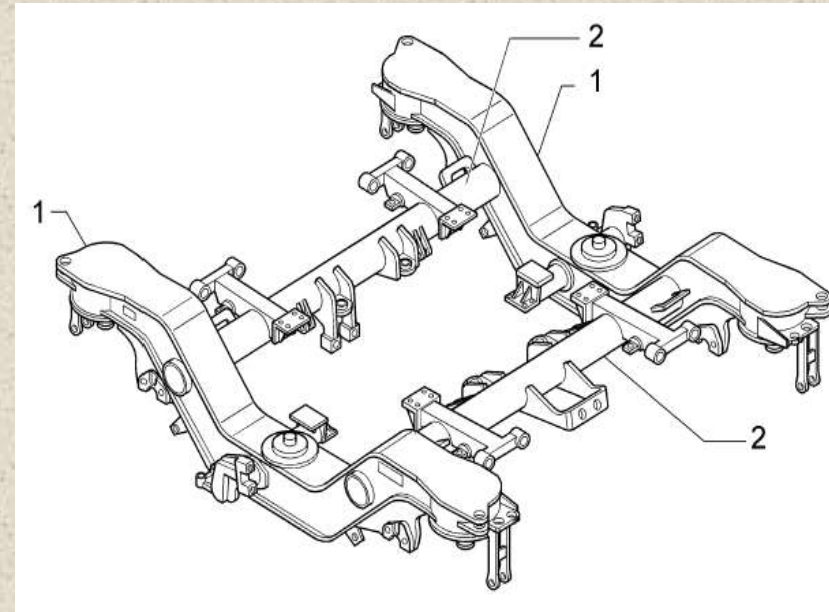
FIAT BOGIE



DESIGN FEATURES

BOGIE FRAME

- Y-FRAME-STEEL SHEETS (St-52)
- TWO SIDE FRAMES CONNECTED BY TWO CROSS BEAMS - SUPPORT BRAKE UNITS.
- BOGIE FRAME ON THE PRIMARY SPRINGS AND SUPPORTS VEHICLE BODY THROUGH BOLSTER.
- BOLSTER-BOGIE FRAME THROUGH SECONDARY SUSPENSION.



MATERIALS USED:

- STEEL CASTINGS (GS20Mn5V; DIN 17182):
 - BRAKE SUPPORT
 - PIN BRACKET
 - SPRING CENTERING IN SECONDARY (1268840)
 - BUMP STOP BRACKET LH/RH
- SGCI CASTINGS (IS:1865)
 - AXLE BOX FRONT COVER
 - CONTROL ARM TOP
 - CONTROL ARM LOWER LEFT/RIGHT
 - PRIMARY SPRING CENTERING LOWER AND UPPER

MATERIALS USED:

- FORGINGS :
 - TRACTION CENTER
 - CENTER PIVOT PIN
 - CONTROL ARM SUPPORT BKT LH/RH
 - ANTI ROLL BAR FORK
 - ANTI ROLL BAR BRACKET

- PLATE/TUBES (S355J2G3;EN10025)
 - BOGIE FRAME
 - BOGIE BOLSTER
 - CROSS SECTION

IMPORTED BOGIE ITEMS

- FORGED WHEEL DISCS
- BRAKE SYSTEM
- PRIMARY SPRINGS(indigenous also)
- SECONDARY SPRINGS
- DAMPERS
- RUBBER-METAL COMPONENTS (06 TYPES)
- MINER PAD

Primary suspension

- Four nos. each per bogie
 - Nested coil springs, primary vertical dampers, control arm, elastic joints-connecting the bearing on wheel-set to bogie frame.
- Flexible guidance.

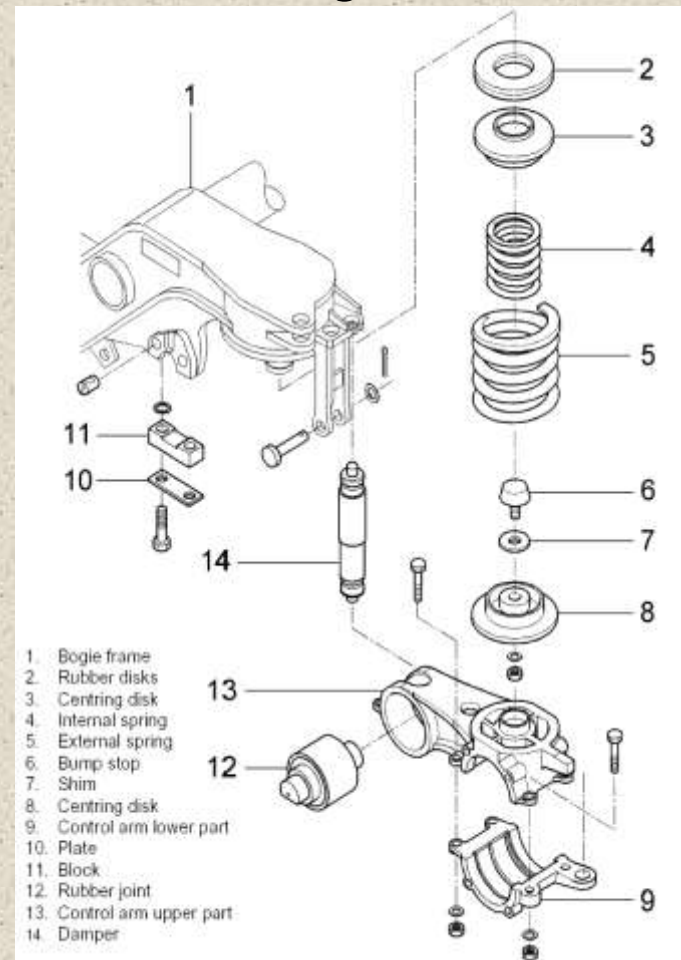
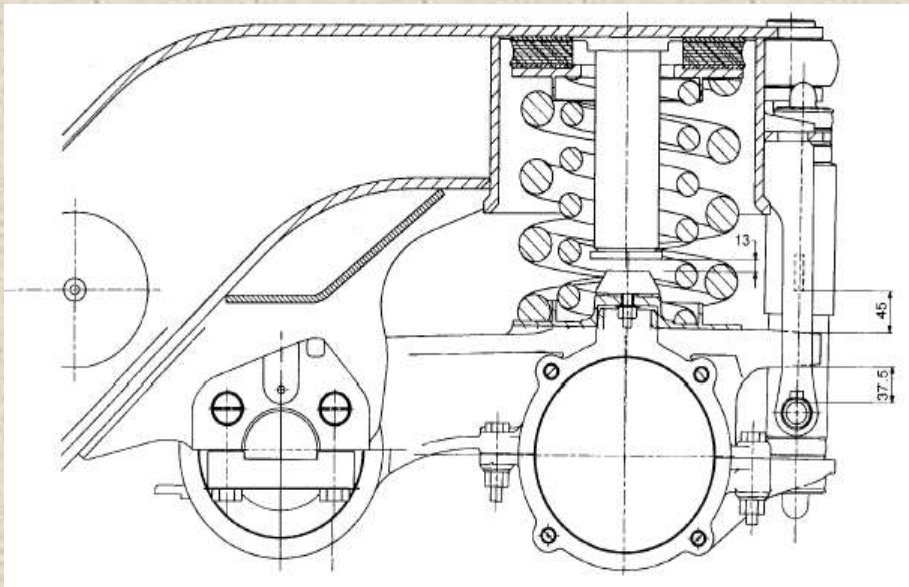
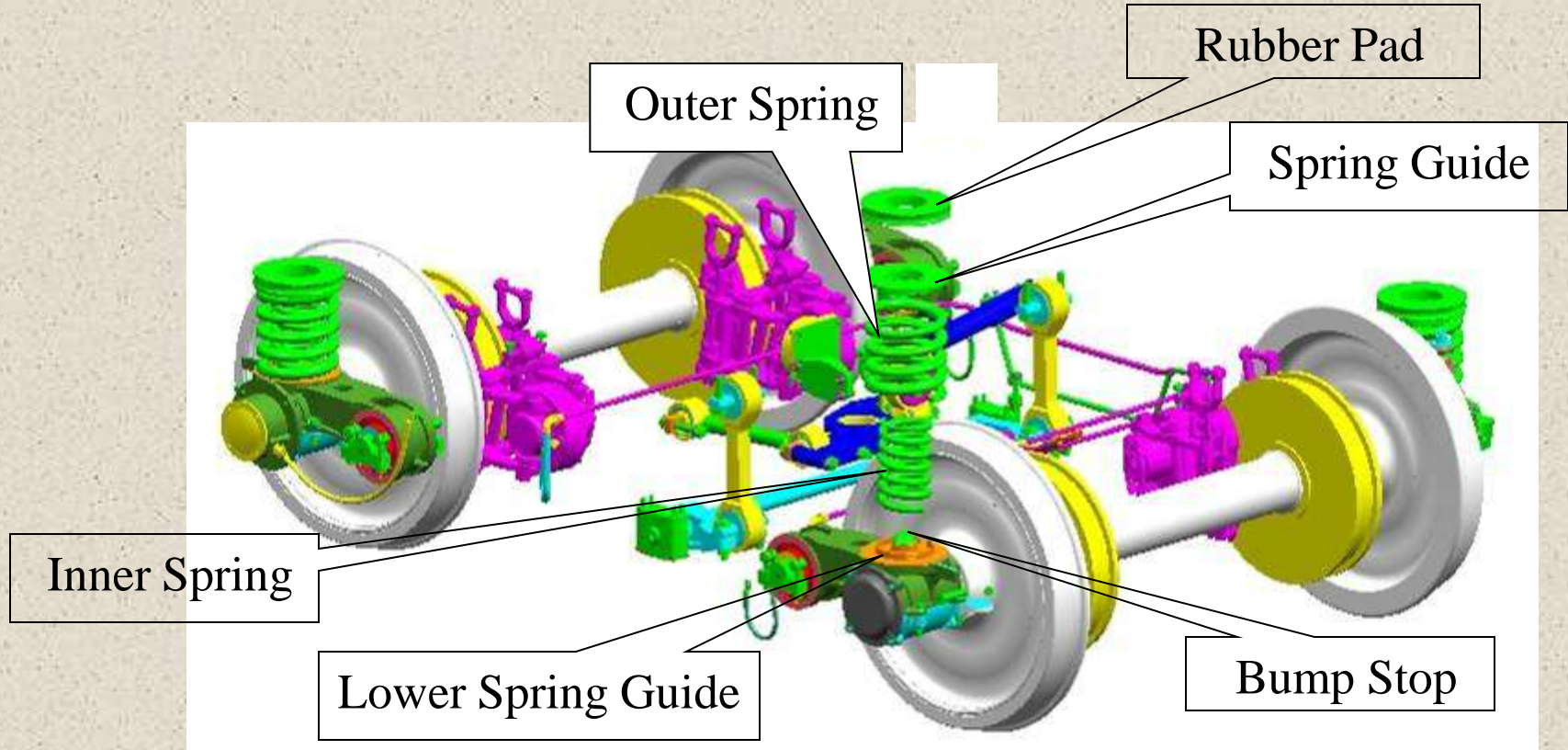
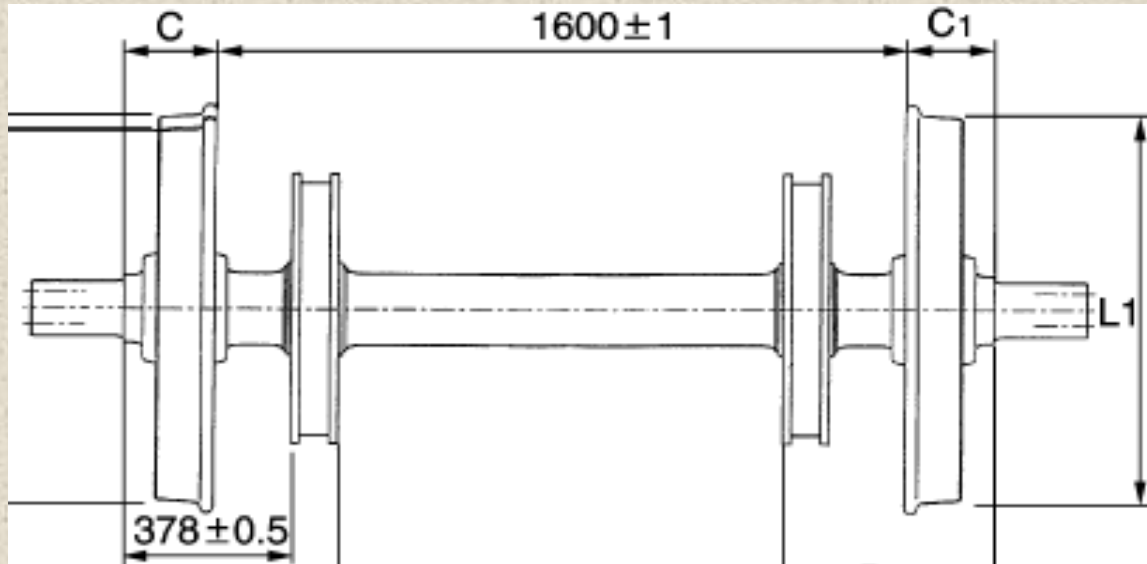


FIG. 1-E PRIMARY SUSPENSION

Primary suspension



WHEEL SET:

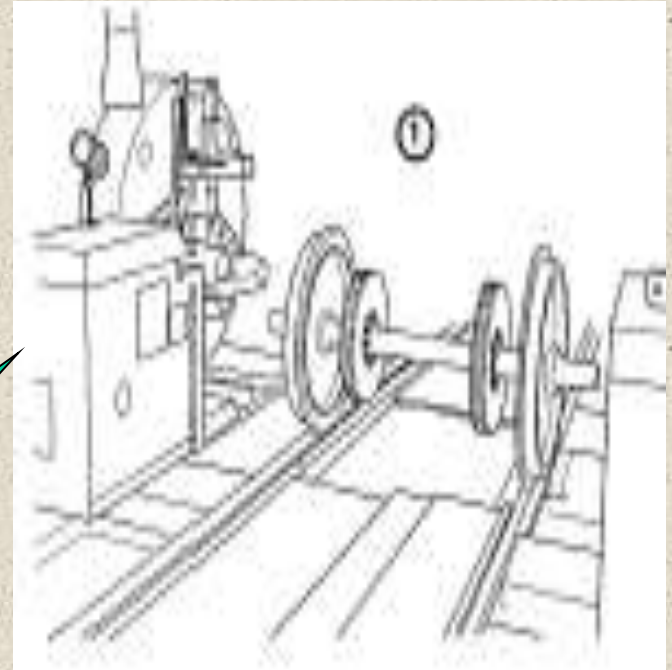


- ⌘ Two brake disks (4), diameter 640 mm and width 110 mm.
- ⌘ Two wheel discs of dia 915 (New), 845 (worn).

Wheel Re-profiling and balancing

- DYNAMIC BALANCING
320 RPM
- PERMITTED
IMBALANCE - LESS
THAN/EQUAL TO 50 gm
- WEIGHTS ARE GLUED
AS REQUIRED

Balancing machine

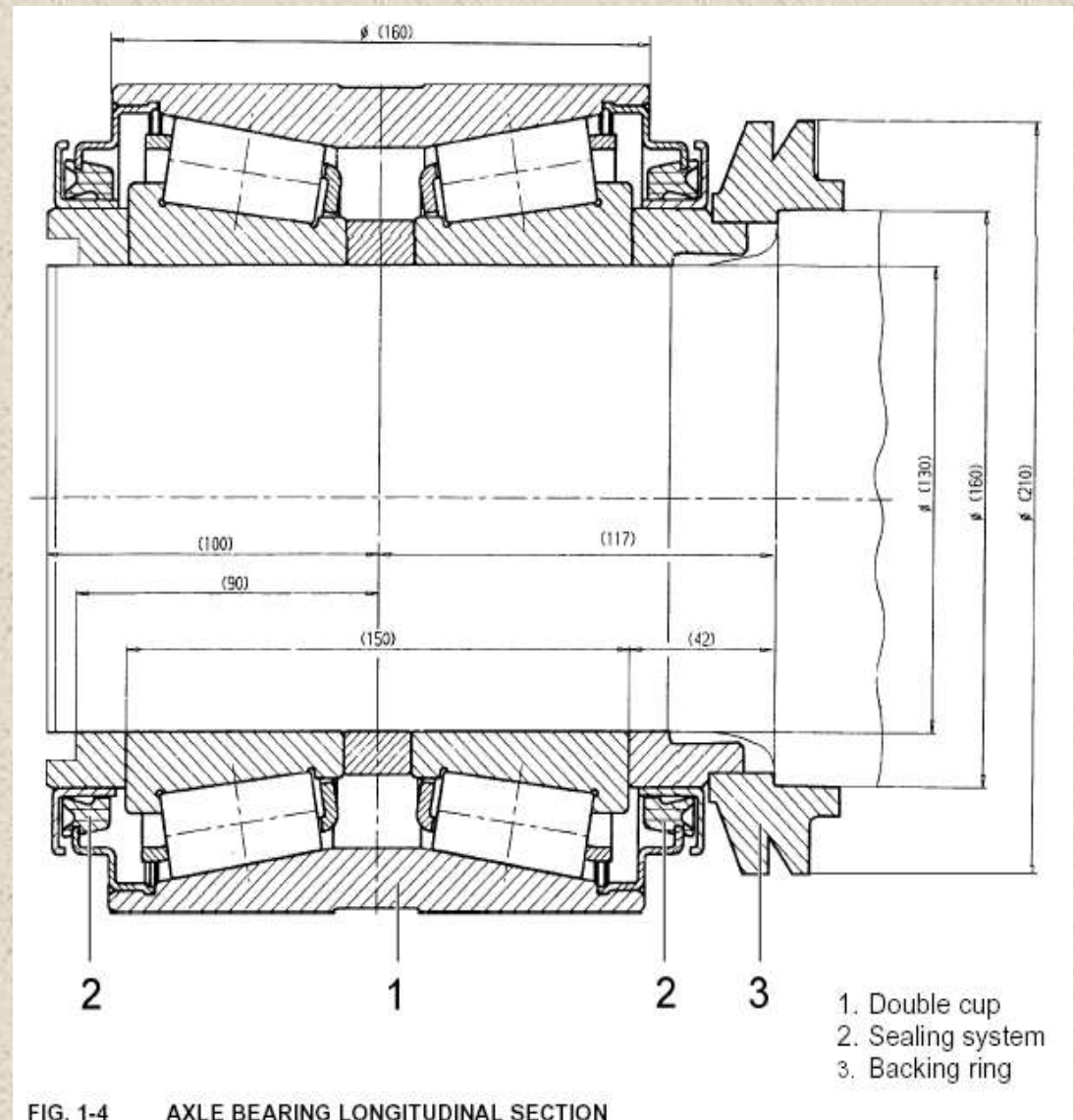


Weights



Axle bearings

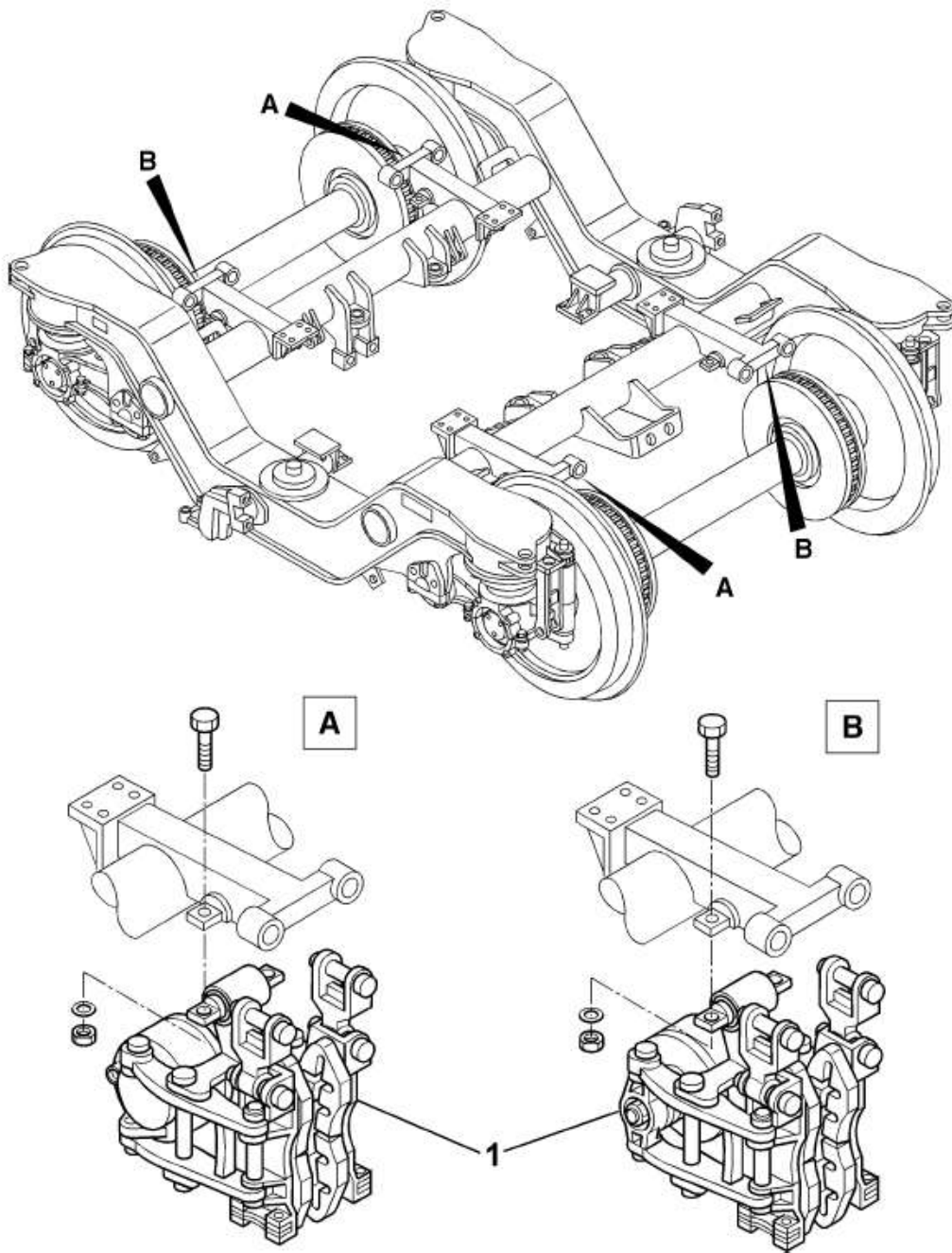
- CARTRIDGE TAPER ROLLER BEARING
- PRE-ASSEMBLED UNIT



BRAKE UNITS

- AXLE MOUNTED DISC BRAKE
- INBUILT SLACK ADJUSTER IN BRAKE CYLINDERS
- CALIPER RATIO 1:2.17 FOR ALL COACHES EXCEPT POWER CAR, WHICH IS 1:2.48
- 35 mm BRAKE PADS
 - JURID 877/BECORIT984

BRAKE CALIPER UNIT



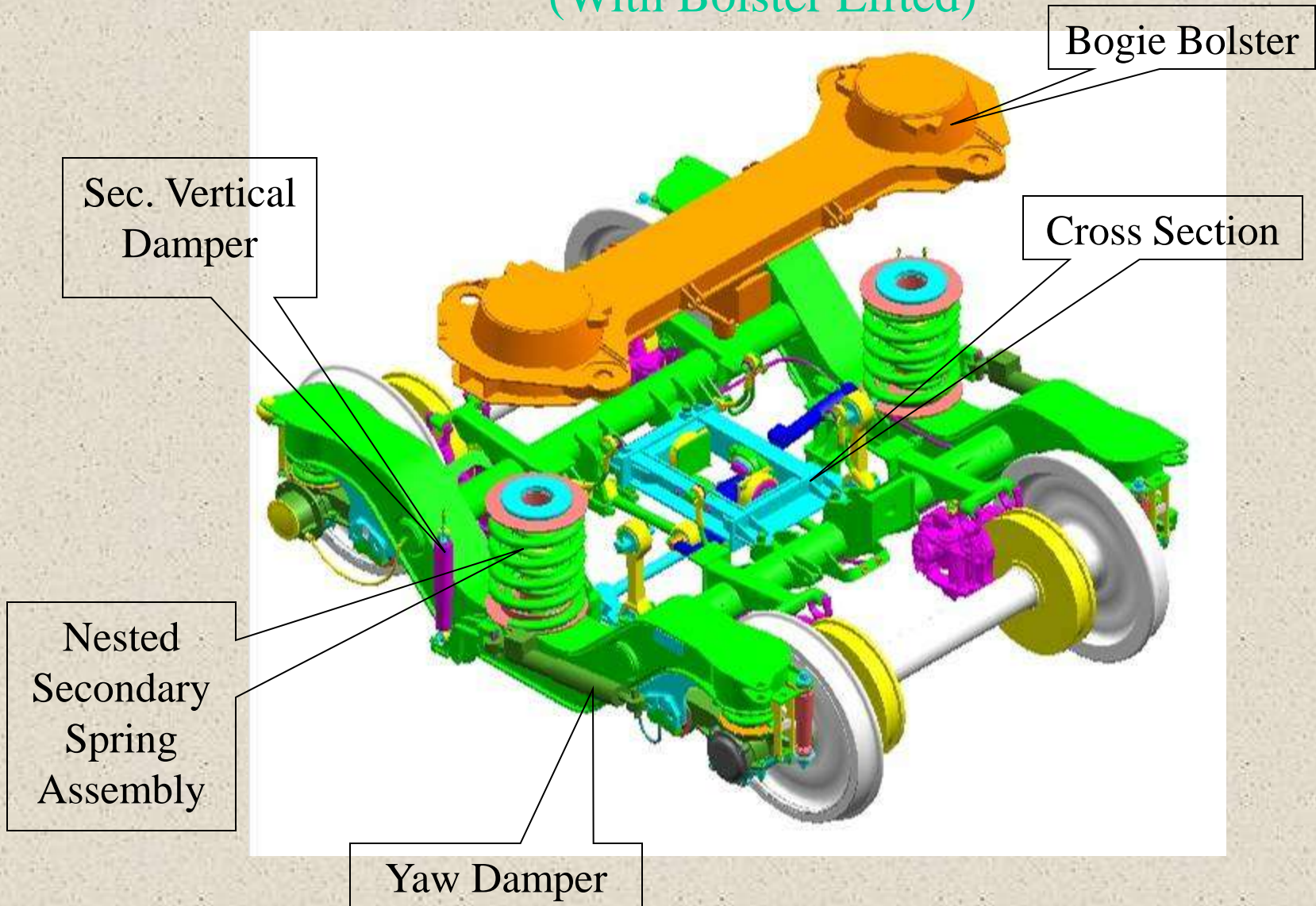
1. Brake unit

SECONDARY SUSPENSION

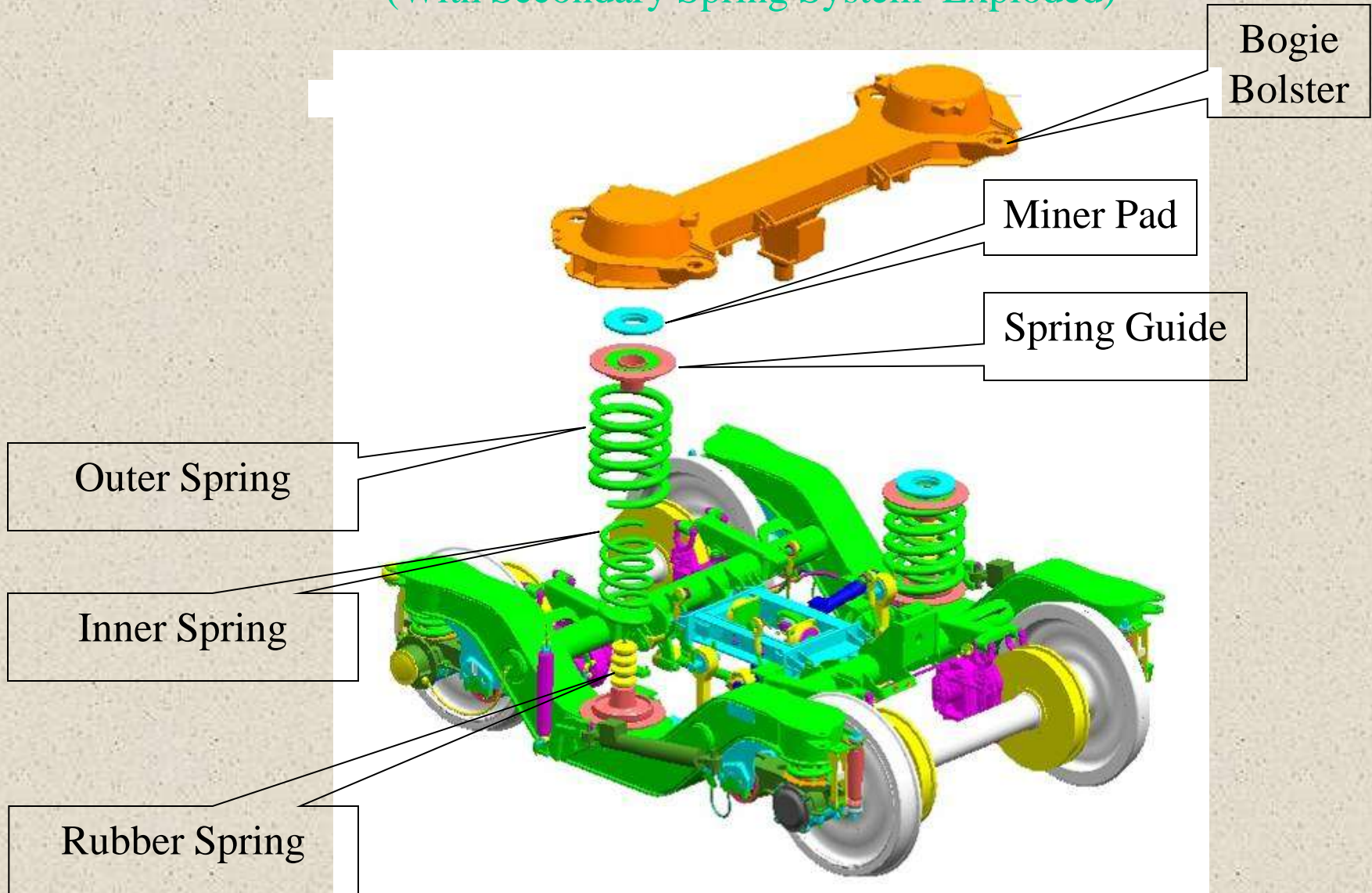
- NEST OF FLEXI-COIL SPRINGS INNER AND OUTER, RUBBER SPRING AND SECONDARY PAD
- VERTICAL DAMPERS
- LATERAL DAMPERS
- YAW DAMPERS
- ANTI-ROLL BAR
- ANCHOR LINKS



(With Bolster Lifted)



(With Secondary Spring System Exploded)

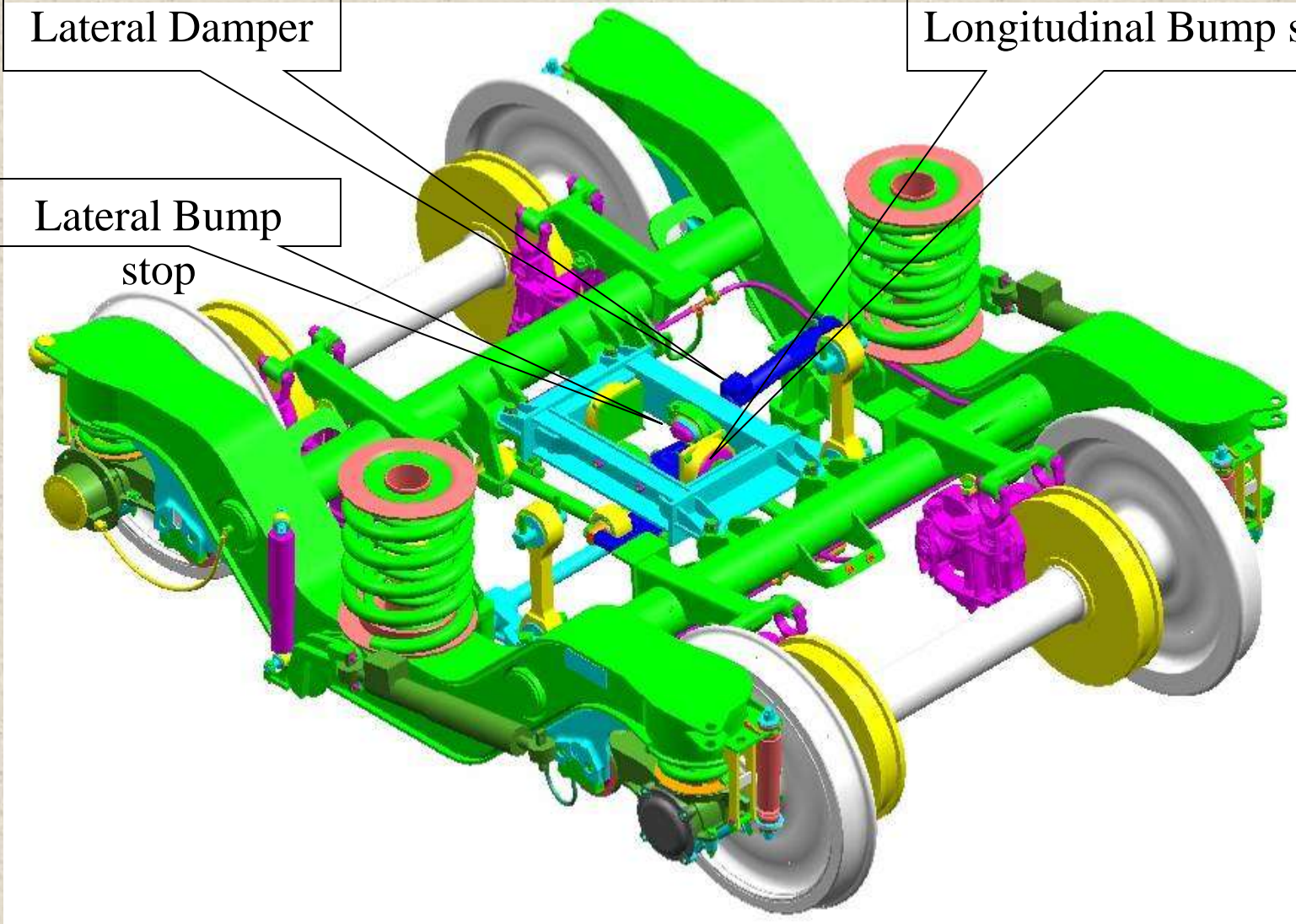


(Bolster removed)

Lateral Damper

Longitudinal Bump stop

Lateral Bump stop



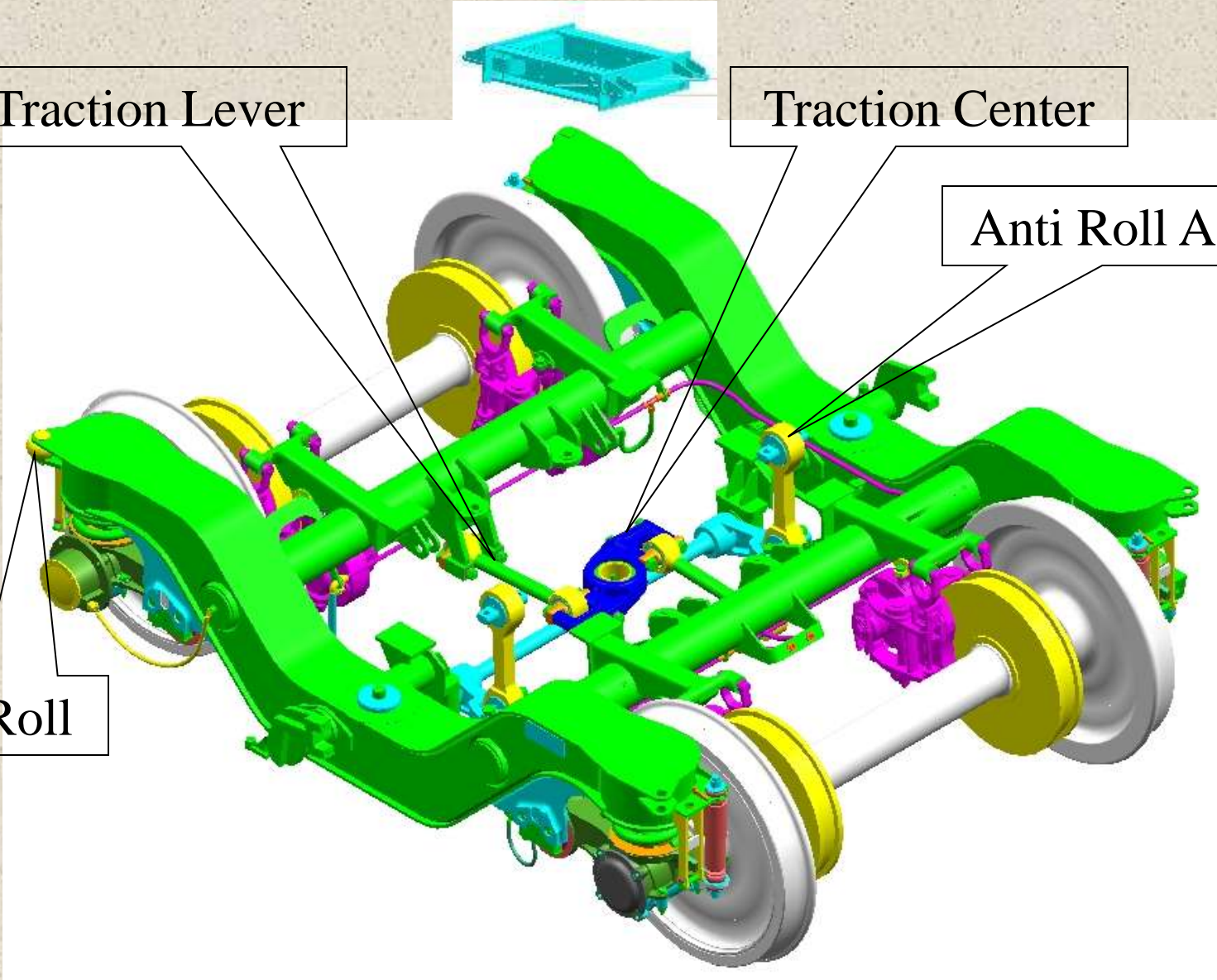
(X-section lifted)

Traction Lever

Traction Center

Anti Roll Assly

Curve Roll



ANTI-ROLL BAR

- A TORSION BAR WITH TWO FORKS - BETWEEN BOGIE FRAME & BOLSTER, CONNECTED BY ROLL LINKS.
- RESISTS ROLLING MOTION OF COACH.

ANTI-ROLL BAR:

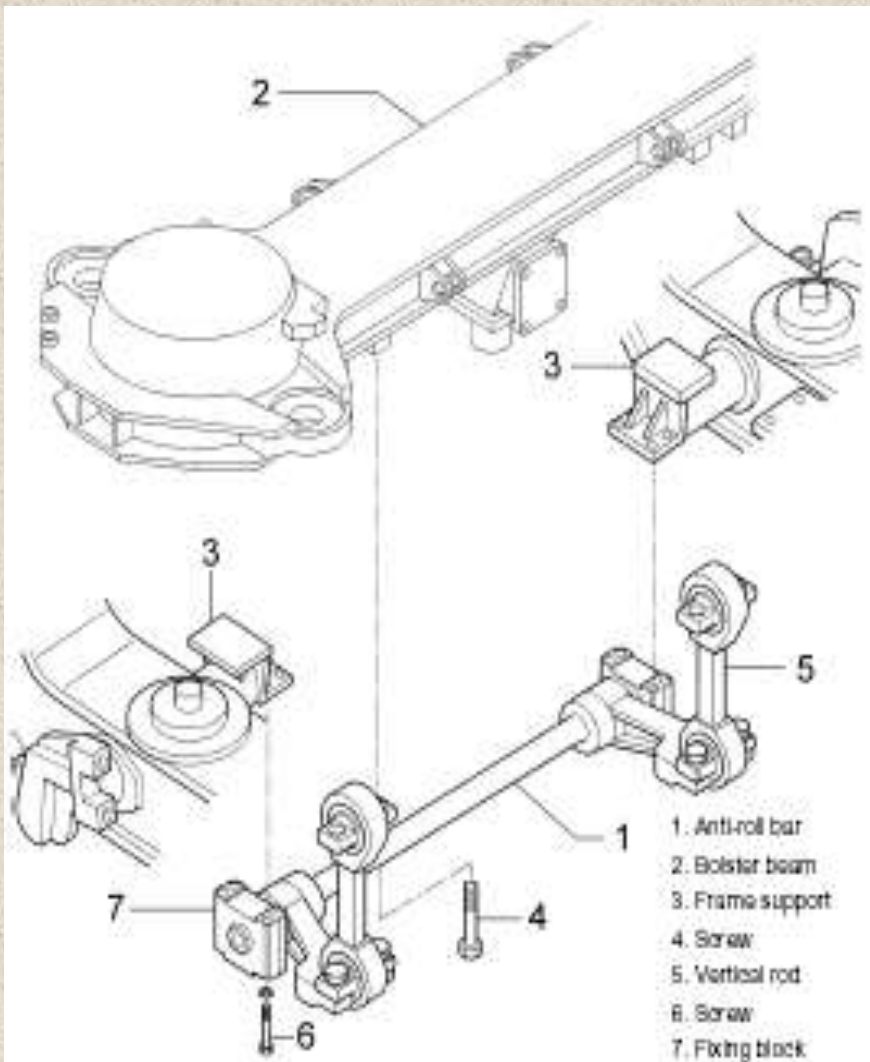
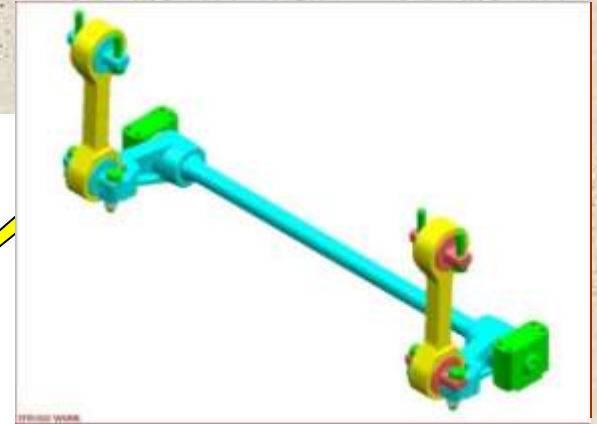
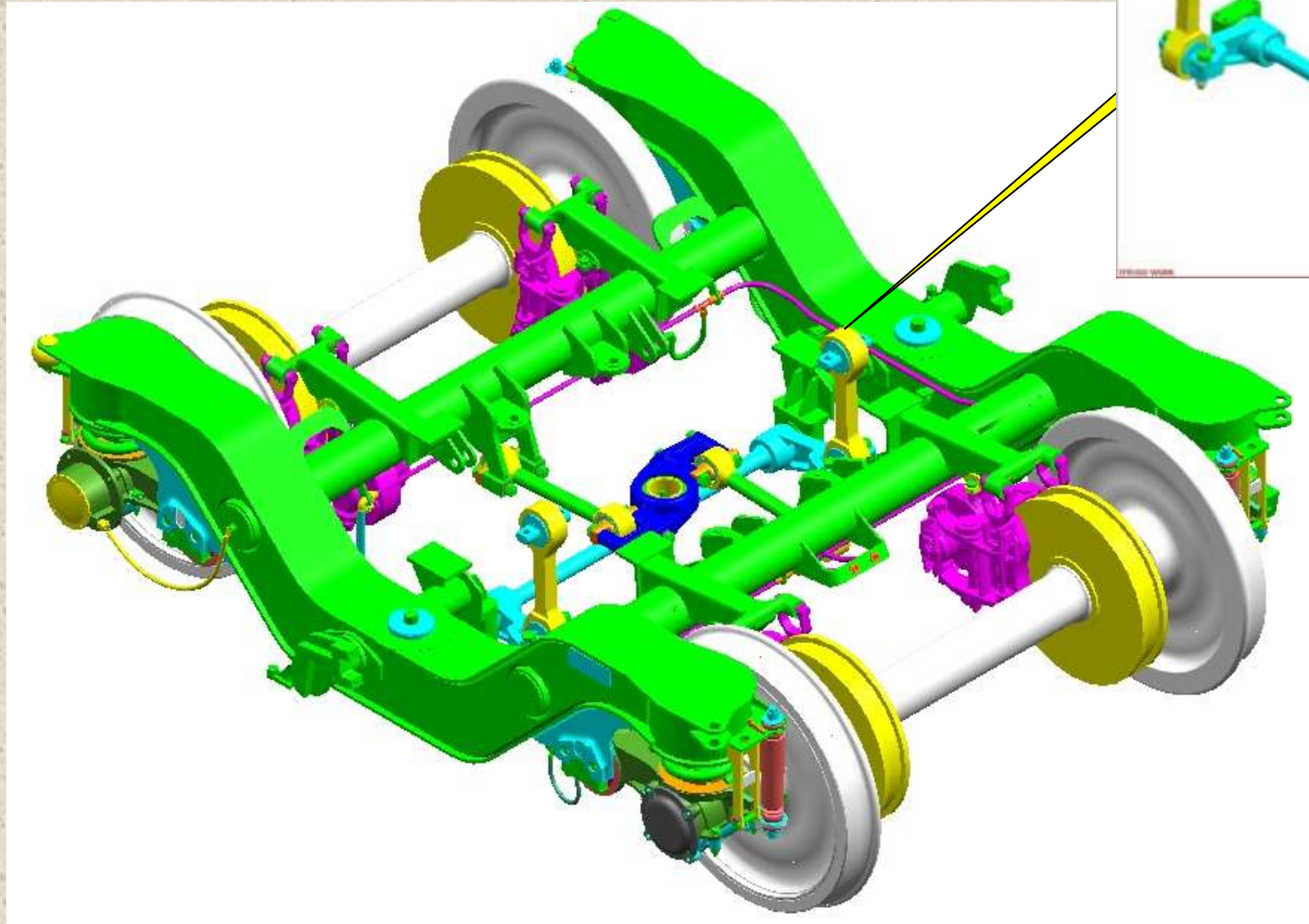


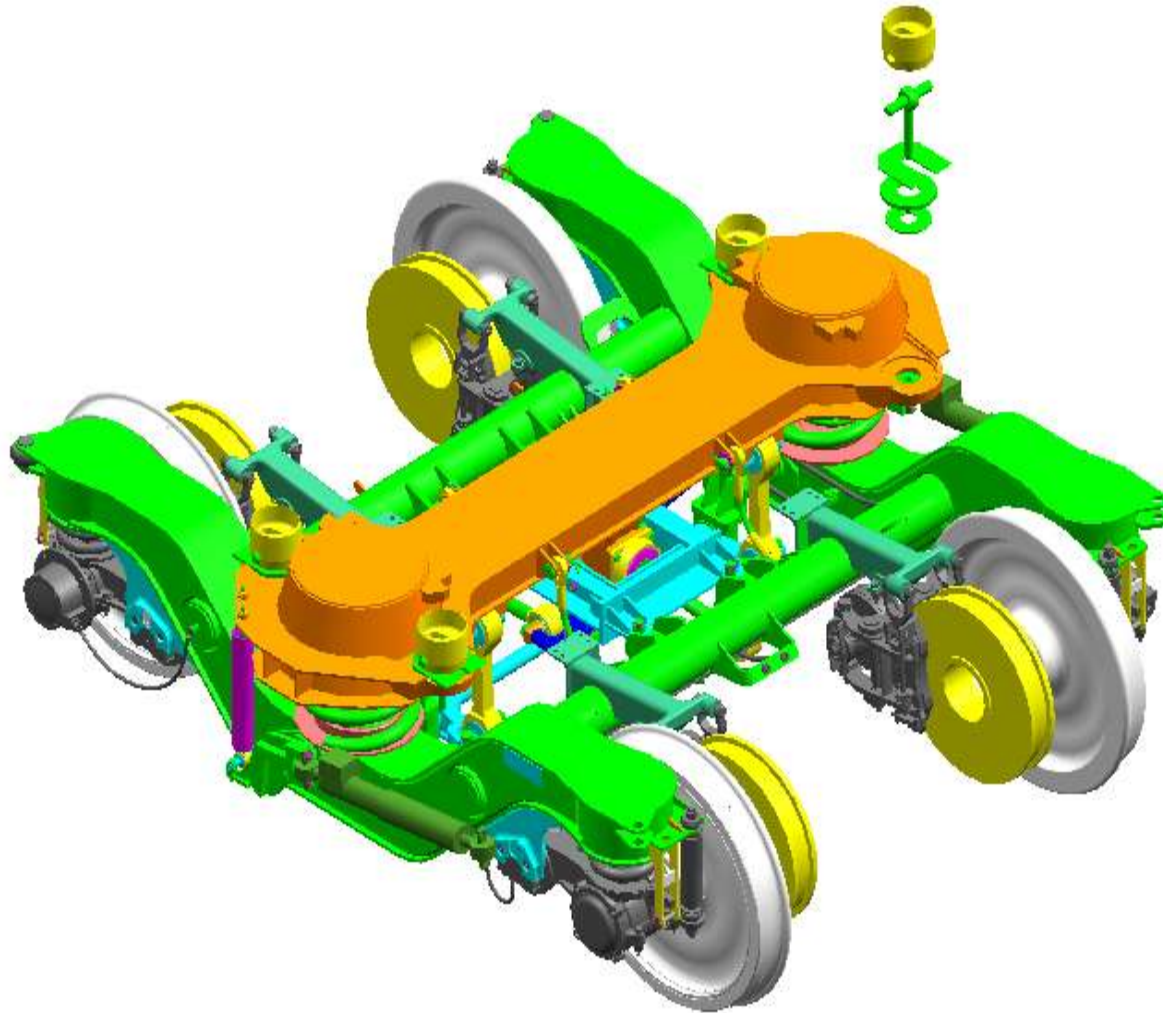
FIG. 3-6 REMOVAL OF THE ANTI-ROLL BAR



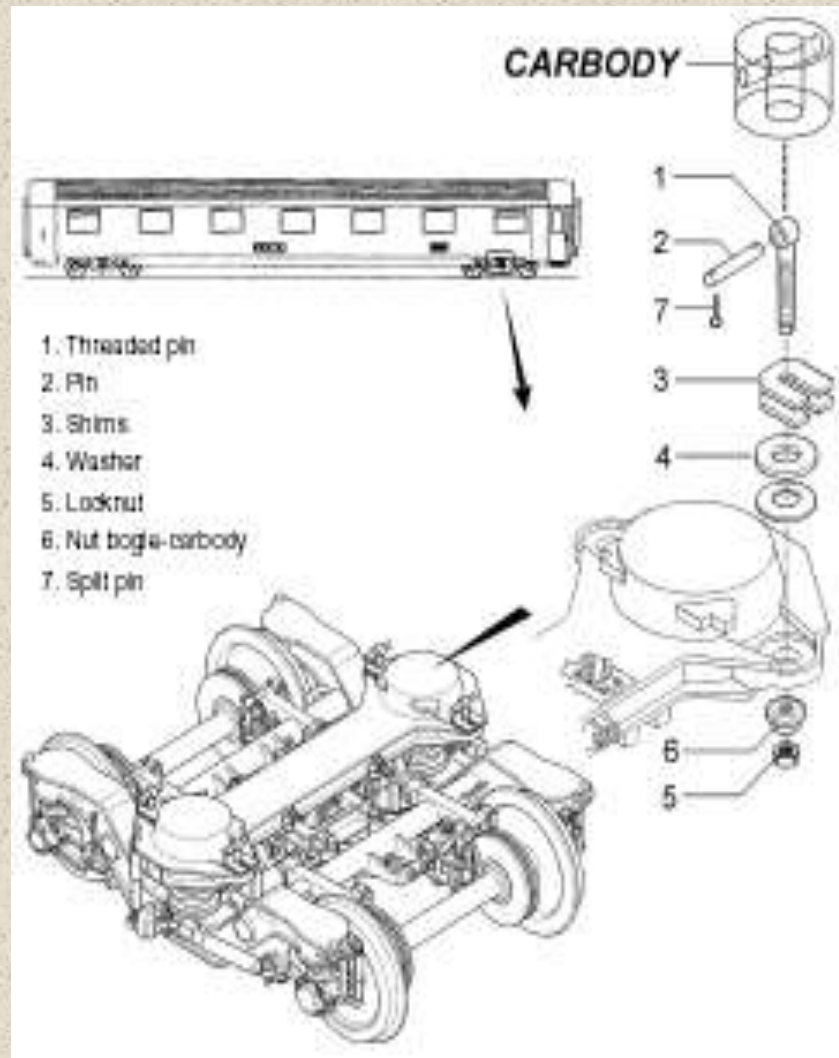


Anti-roll Assly

BODY BOGIE CONNECTION



BOGIE BODY CONNECTION:



Principles of force transmission

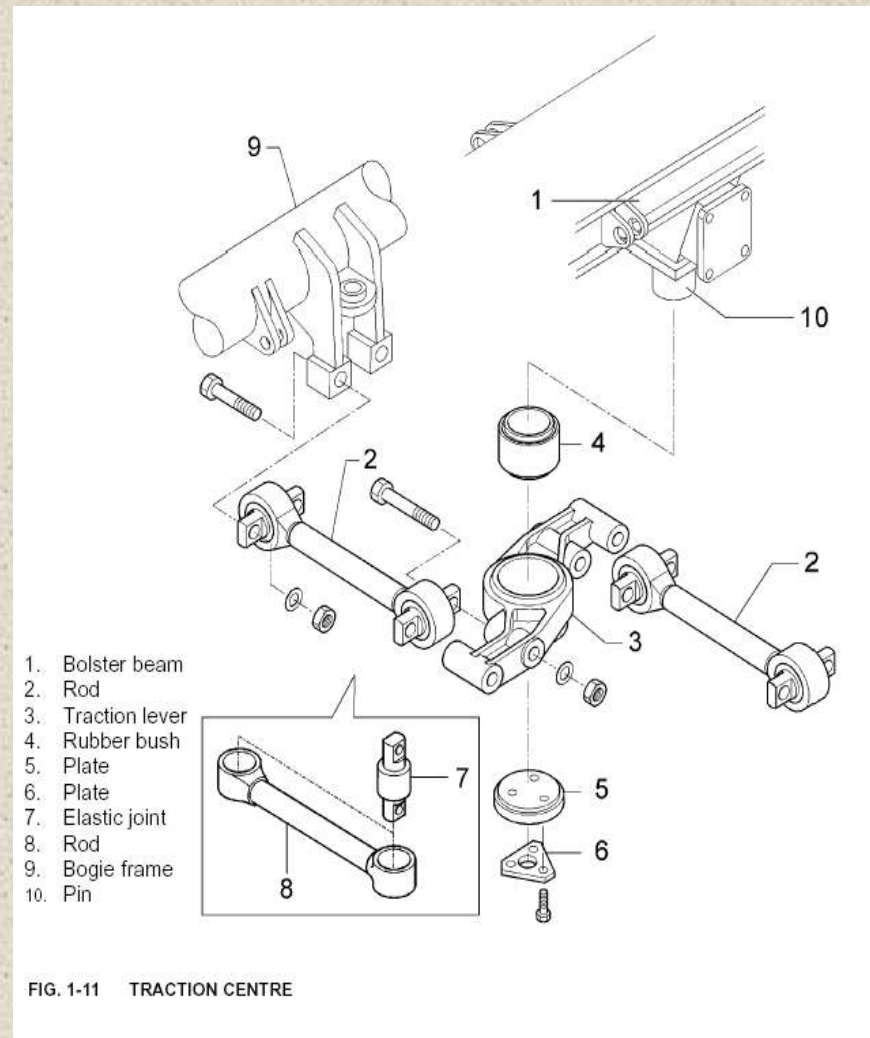
- **Vertical forces:**
- BODY-BOLSTER-MINER PAD-SEC. SUSPENSION-BOGIE FRAME-PRIMARY SPRINGS/BALL JOINT CONTROL ARM-AXLES.

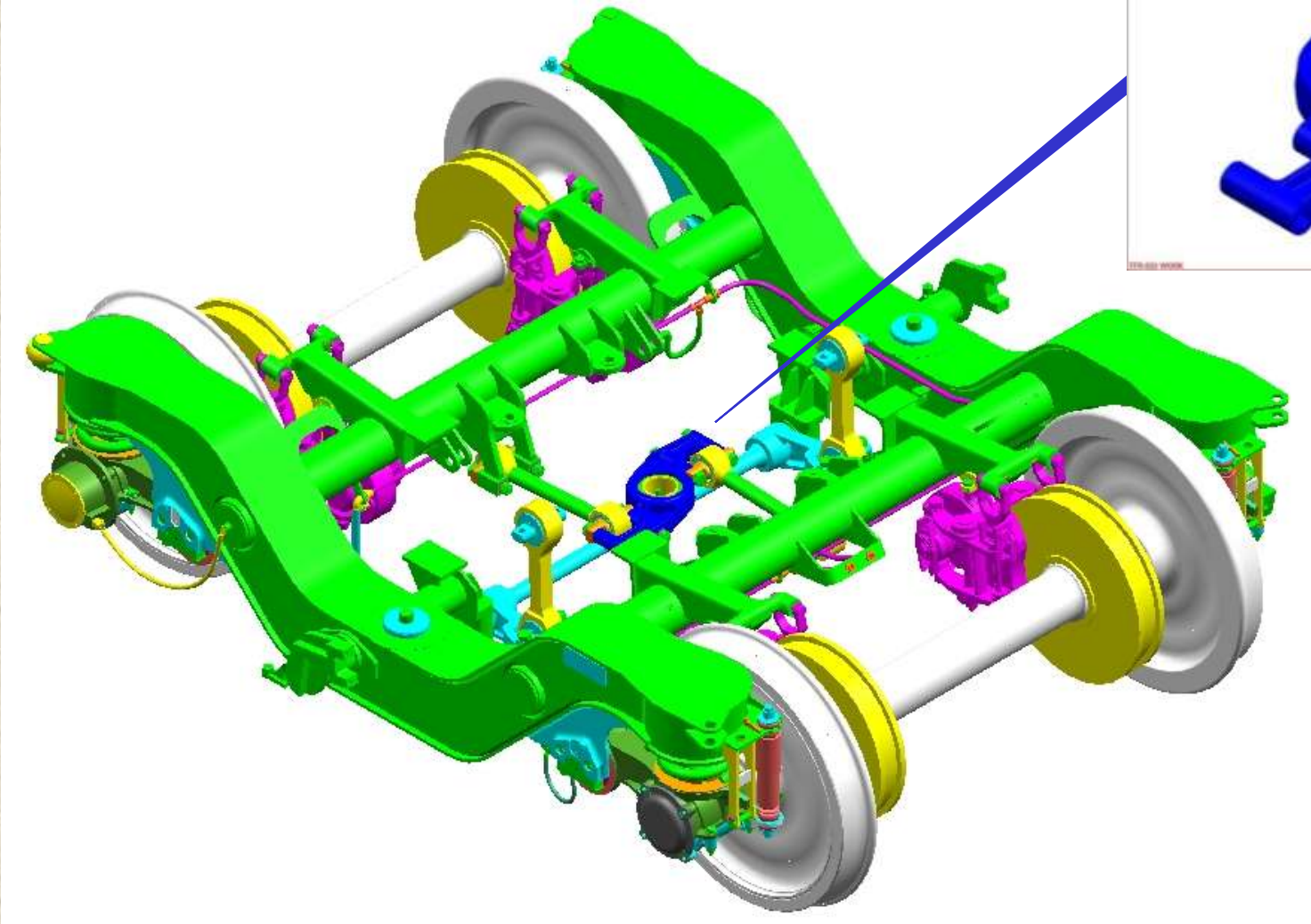
Lateral forces:

- BODY-BOLSTER-MINER PAD/SEC.
SPRINGS/LATERAL BUMP STOP-BOGIE FRAME-
BALL JOINT CONTROL ARM-AXLES.

Traction and braking forces:

- BODY-TRACTION
CENTRE-TRACTION
LEVER/LONGITUDI
NAL BUMP STOP-
BOGIE FRAME-
CONTROL ARM-
AXLES.





Traction Center

CURVE NEGOTIATION:

- CONTROL ARM CONNECTING AXLE BEARING AND SIDE FRAME THROUGH ELASTIC CONNECTION.
- FLEXIBLE GUIDANCE TO WHEEL-SET

Main Data:

Axle distance	mm	2.560
Diameter of new wheels	mm	915
Diameter of max. worn wheel	mm	845
Distance between the wheels	mm	1600
Brake disc diameter	mm	640
Bogie width	mm	3030
Bogie length	mm	3534
Bogie weight	kg	6300

THANK YOU