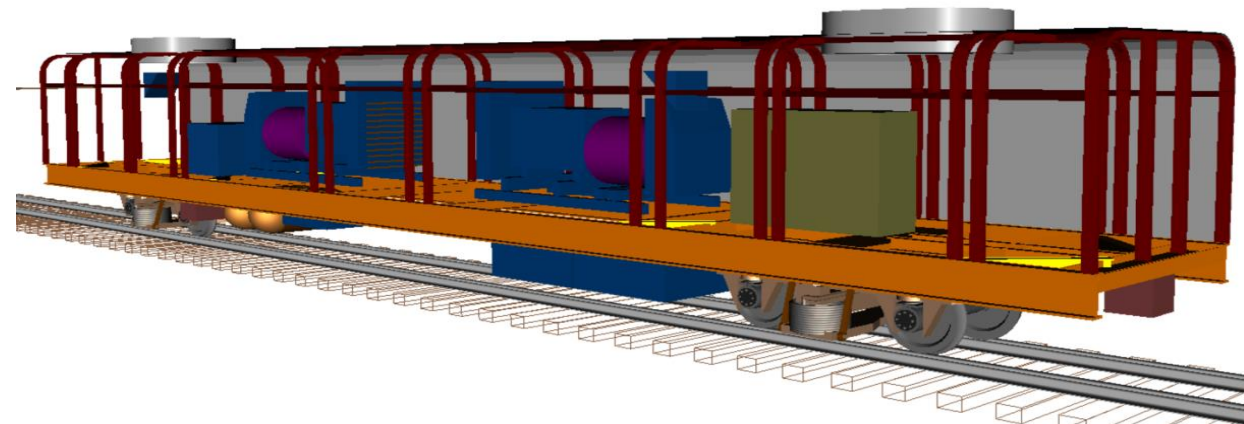


Thailand Customized Power Car



Center of Excellence for Road and Railway
Innovation (NU-RRI)
Faculty of Engineering, Naresuan University

About US

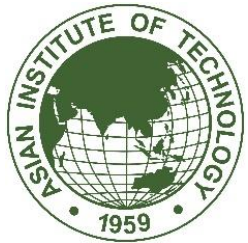
Establish Since 2013 Under University Regulation Aims
to Enhance NU to be a “World Class” University.



OUR ALLIANCE



State Railway of Thailand



Connect to a Better Future

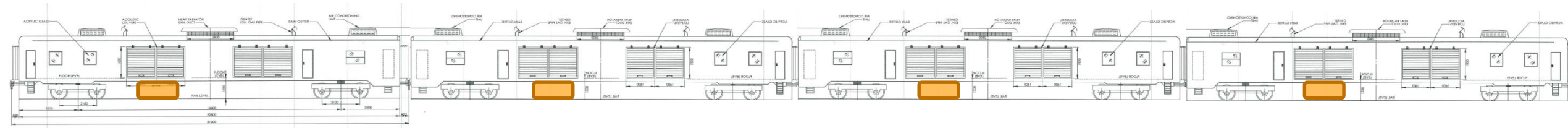
Power Car



Motivation

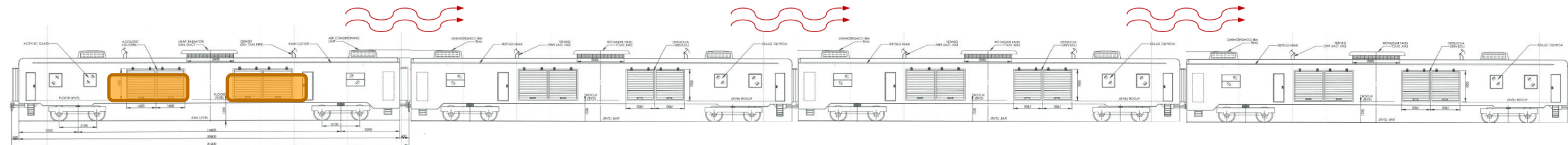
Electrical supply for passenger car

- Supply from locomotive
- Each coach has it own electric generator
- Independent power car

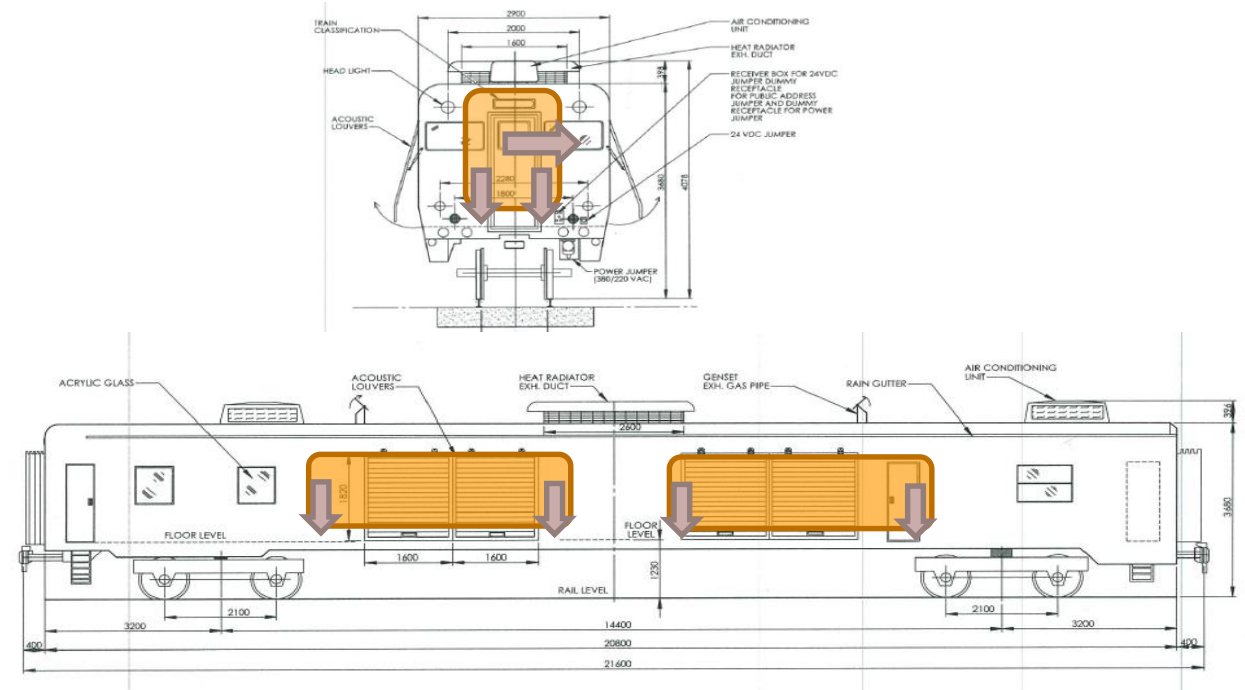


Advantage of independent power car;

- Lower fuel consumption
- Lower maintenance cost
- Reduce maintenance work
- Can be operated with other train set



Challenges



Original Train



Constraint: Old bogie



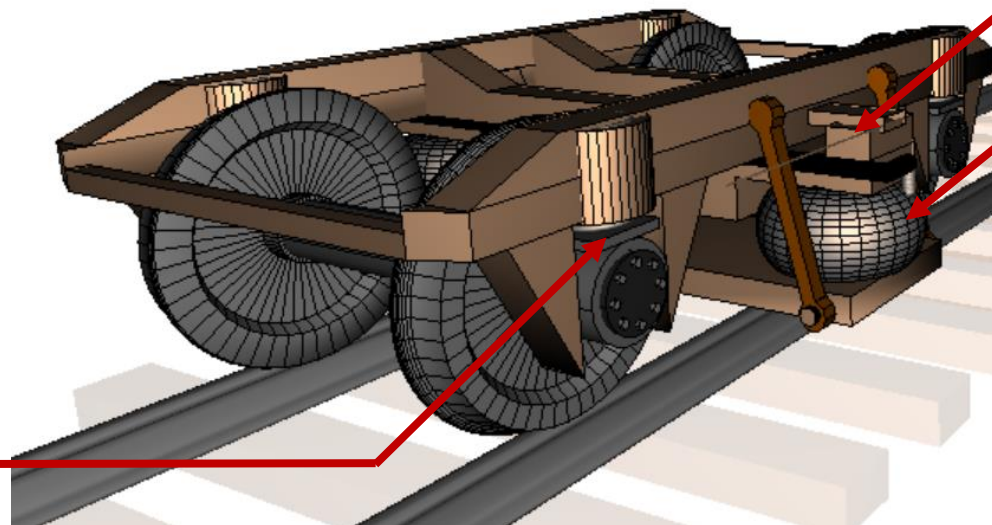
- No information of suspension characteristics
- Limited axle load capacity
- Remaining fatigue life?

Bogie mass 4 tons

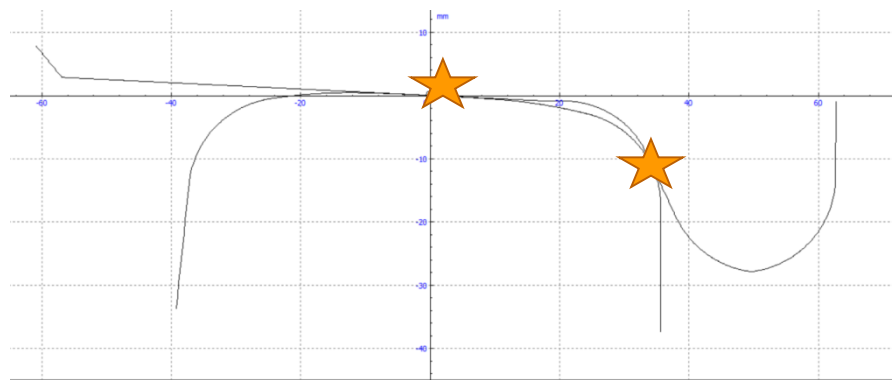
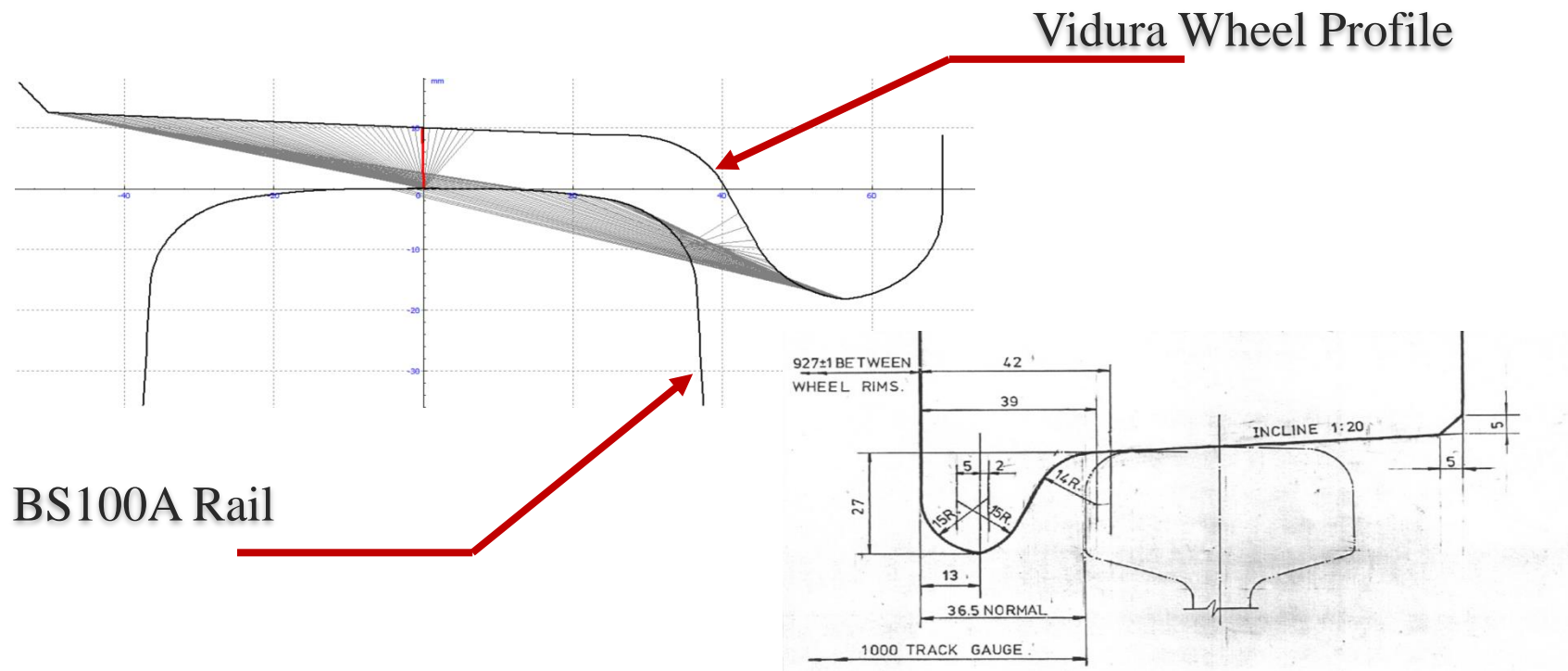
Friction damper
for Yaw Control

Air spring + Viscous damper

Coil spring + Friction damper

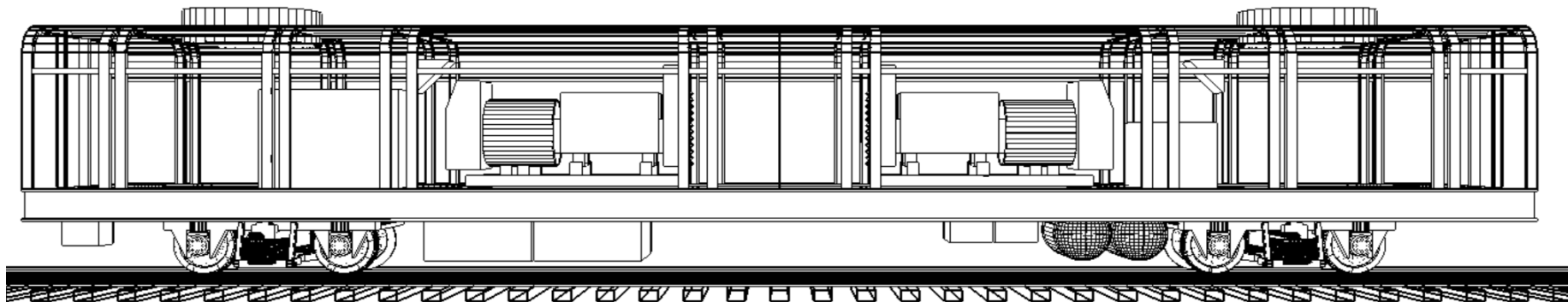
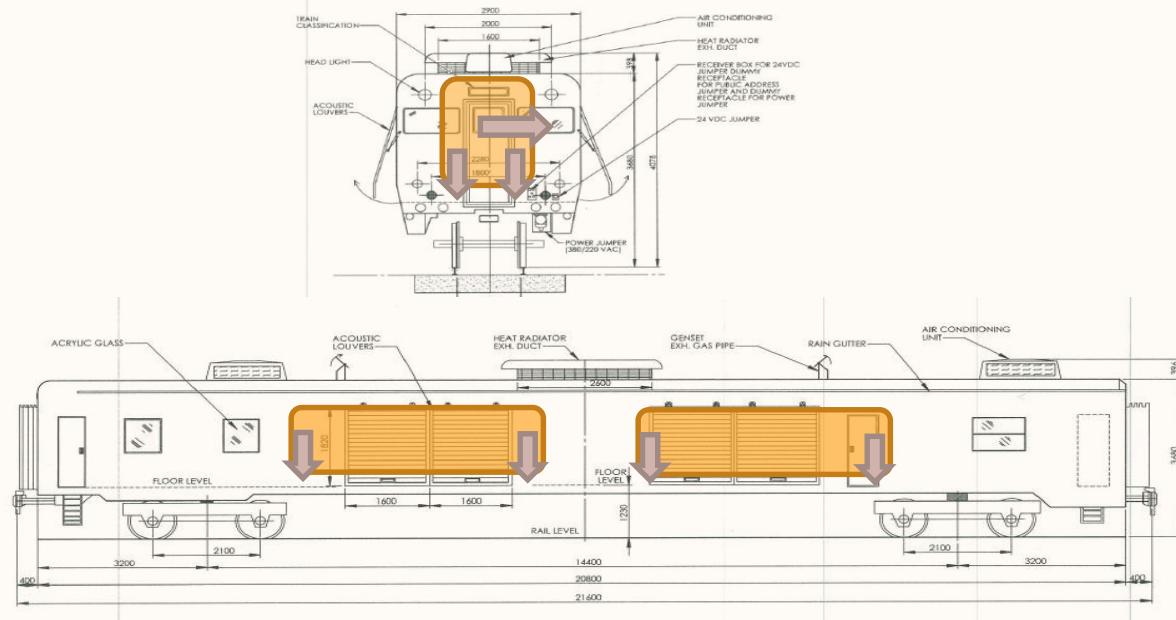


Constraint: Inconsistent Wheel-Rail Profile



Two points contact

Overall Plan

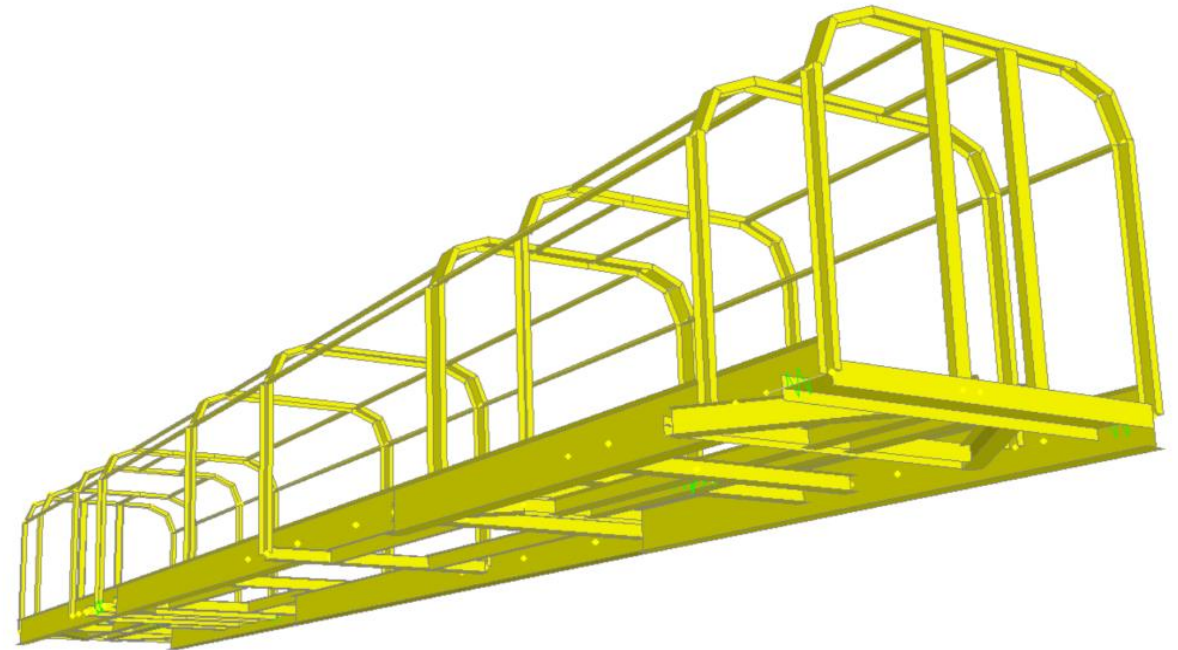
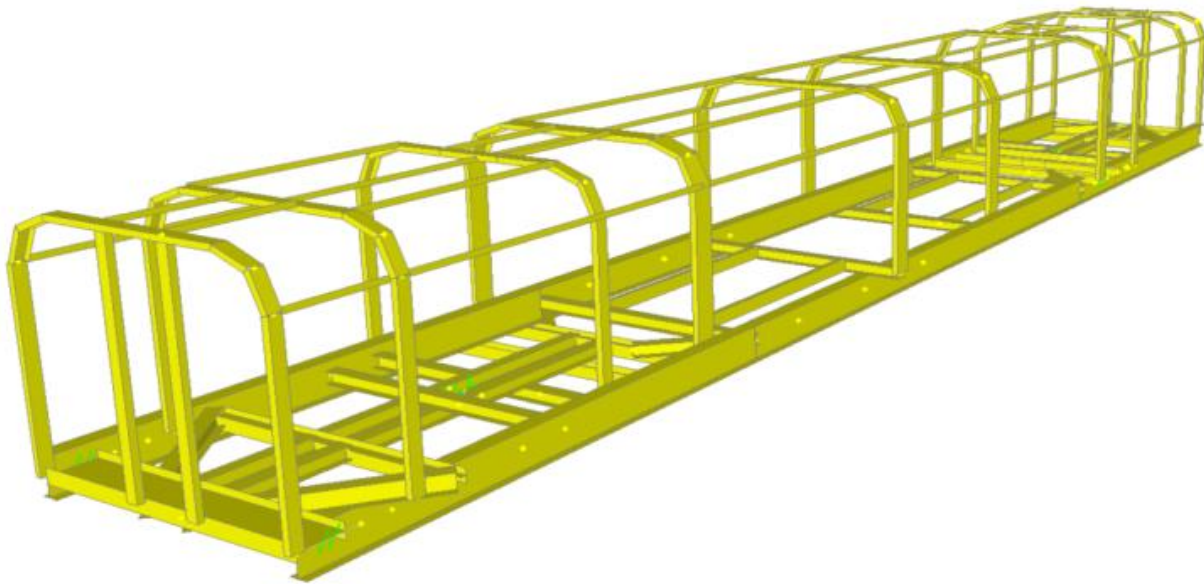


Why we do it



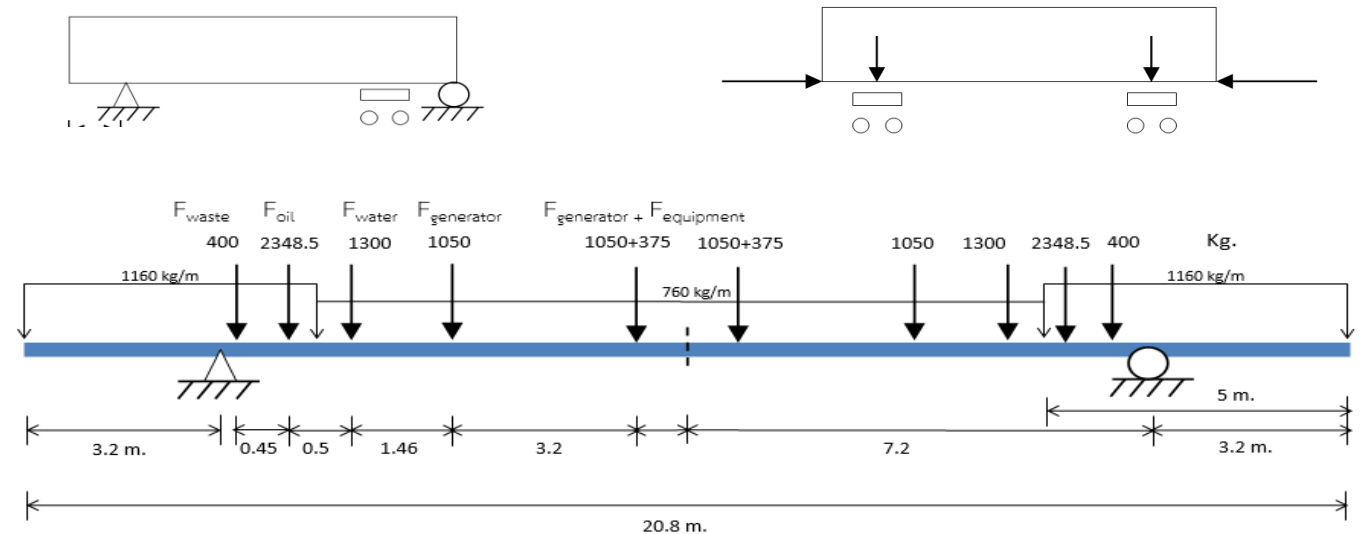
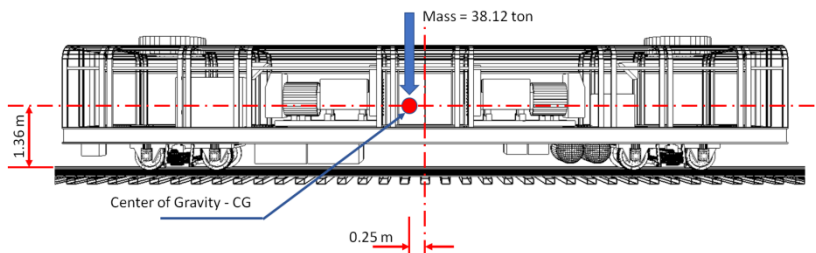
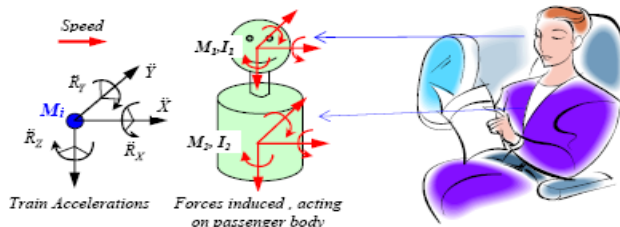
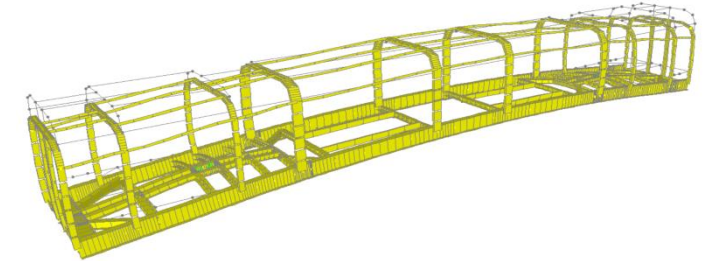
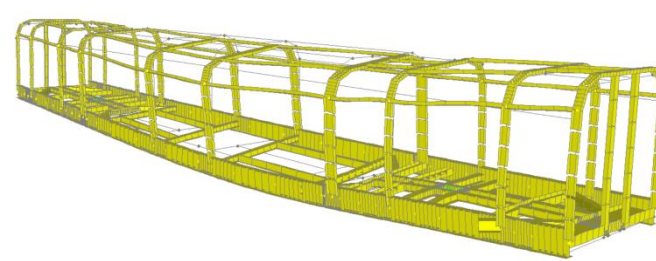
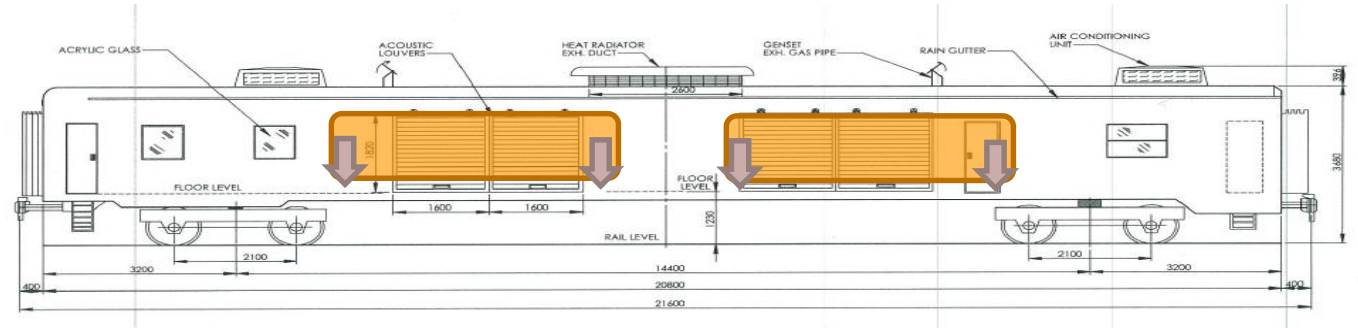
- **First Step for Self Reliance**
- **Only 8 cars with customisation, nobody gonna make it for us**
- **The import one cost more than 2m USD**

Design of Car Body



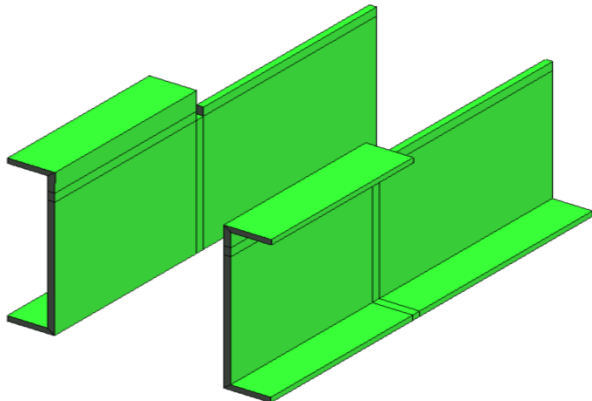
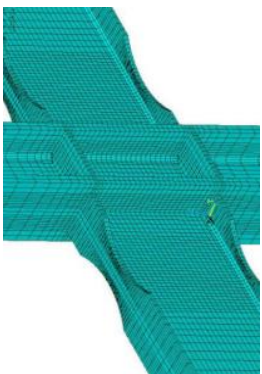
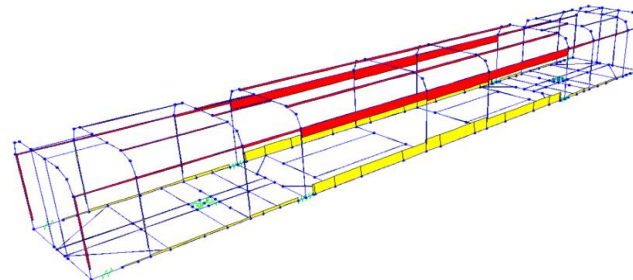
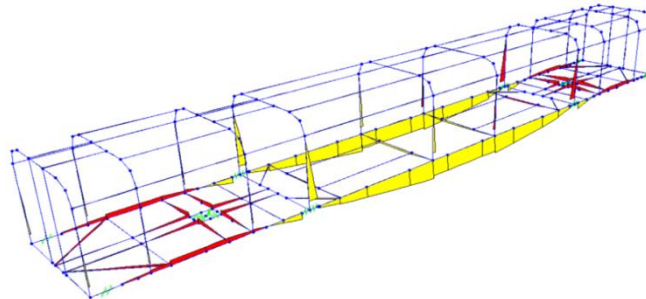
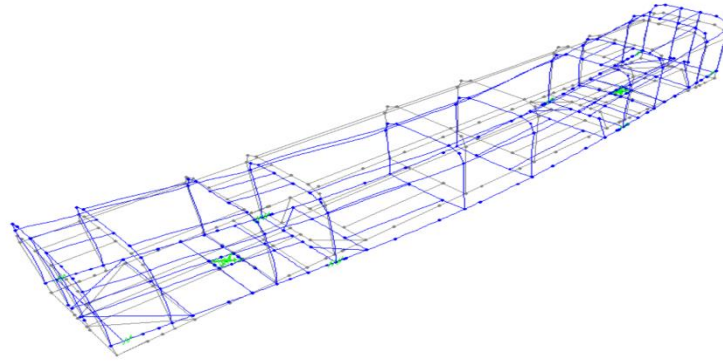
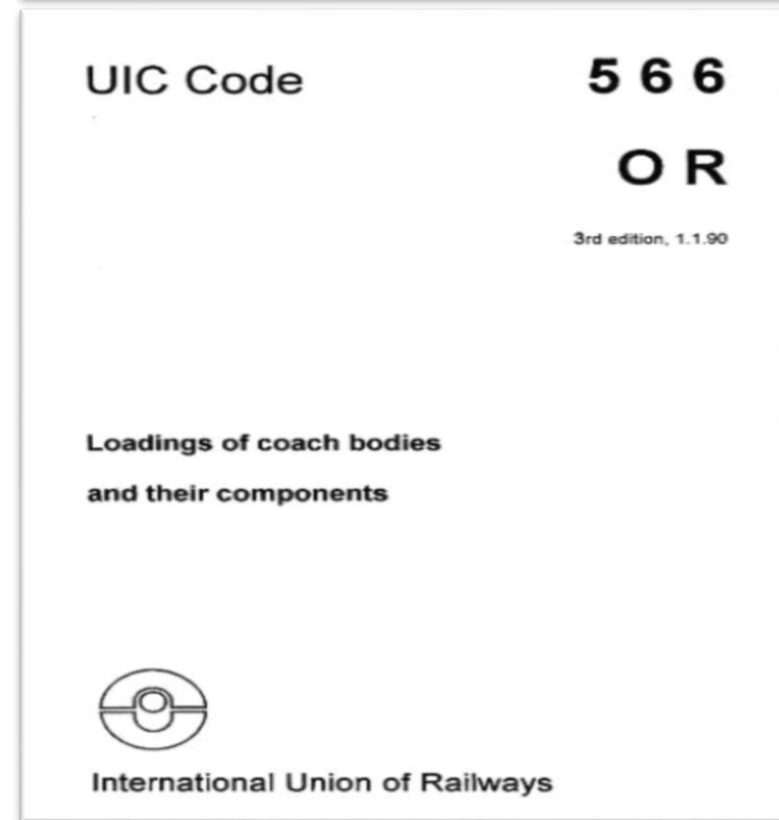
Design consideration of Car body

- Load capacity
- Strength
- Stiffness (bending, torsional, etc.)
- Dynamic response
- Center of Gravity
- Crash worthiness
- Member joint/connection
- Fatigue life
- Door, window & other opening
- Ride comfort
- Construction method
- Maintenance method



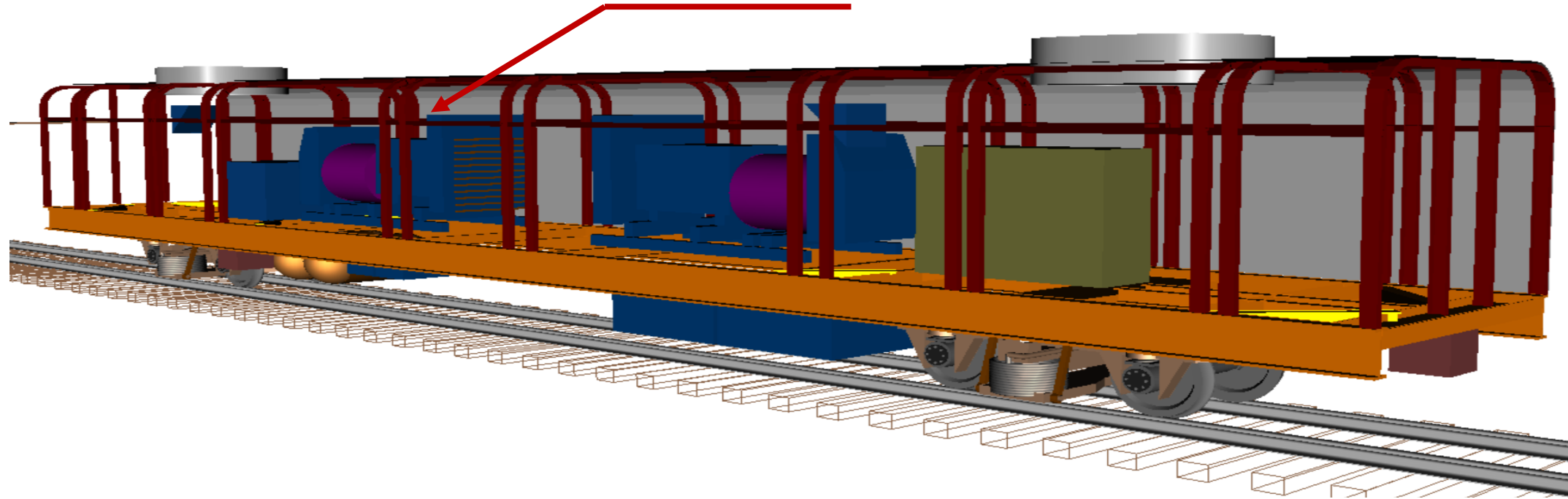
Design standard & Structural Design

- SRT Manual & Guideline
- EN 12663 – European Norm
- UIC 566 – International Union of Railways



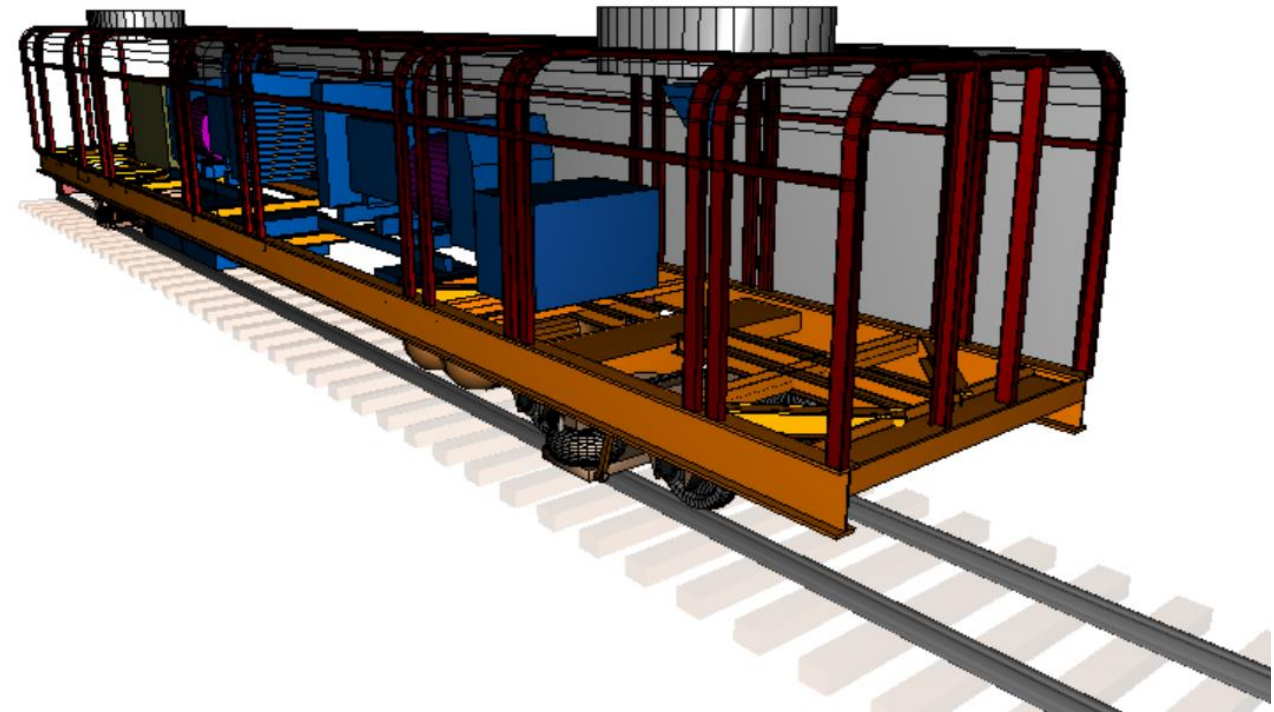
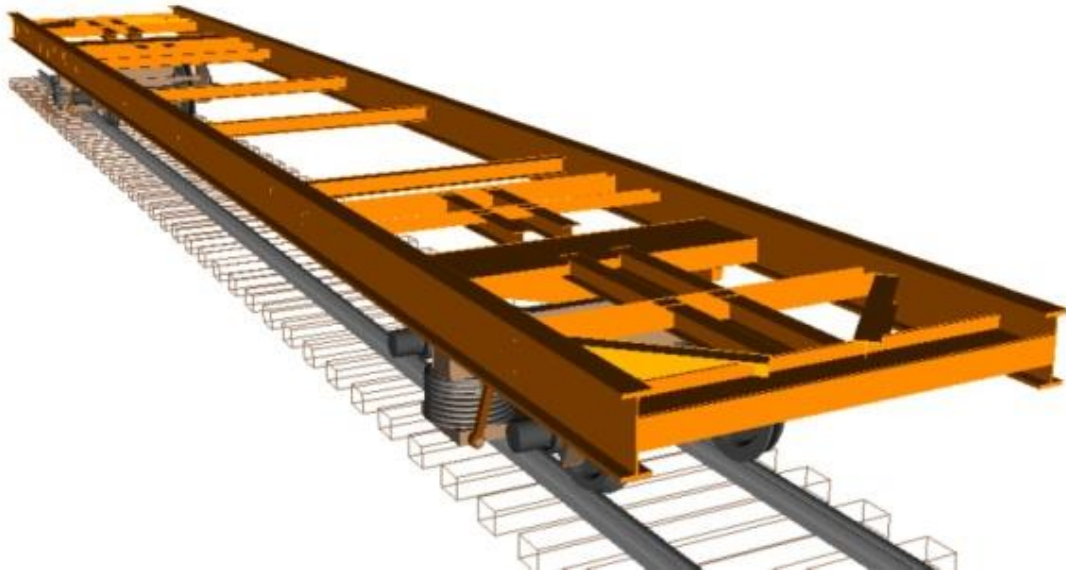
Final Train Layout

3.5 tons electric generator

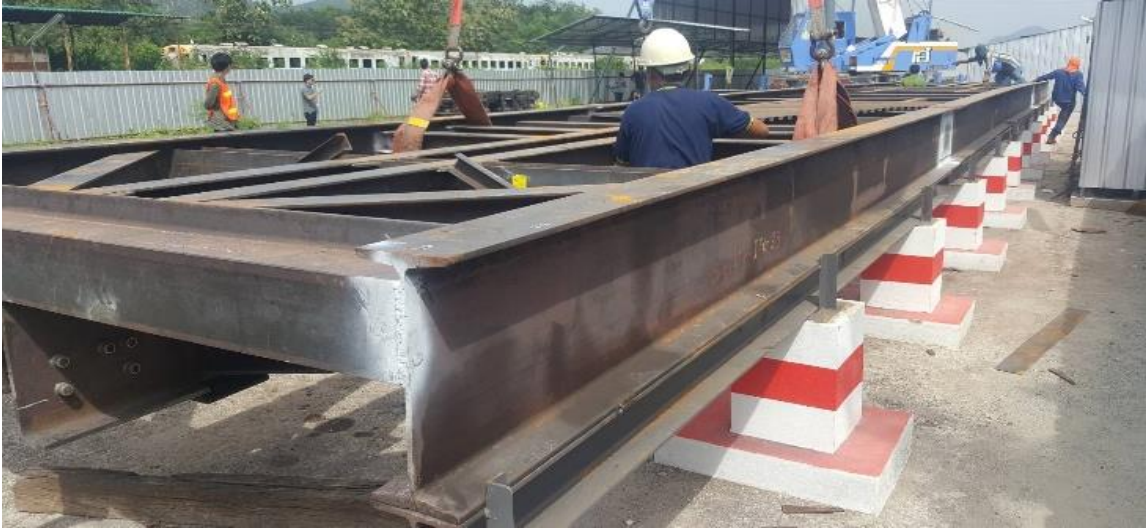


Total train mass 38 ton

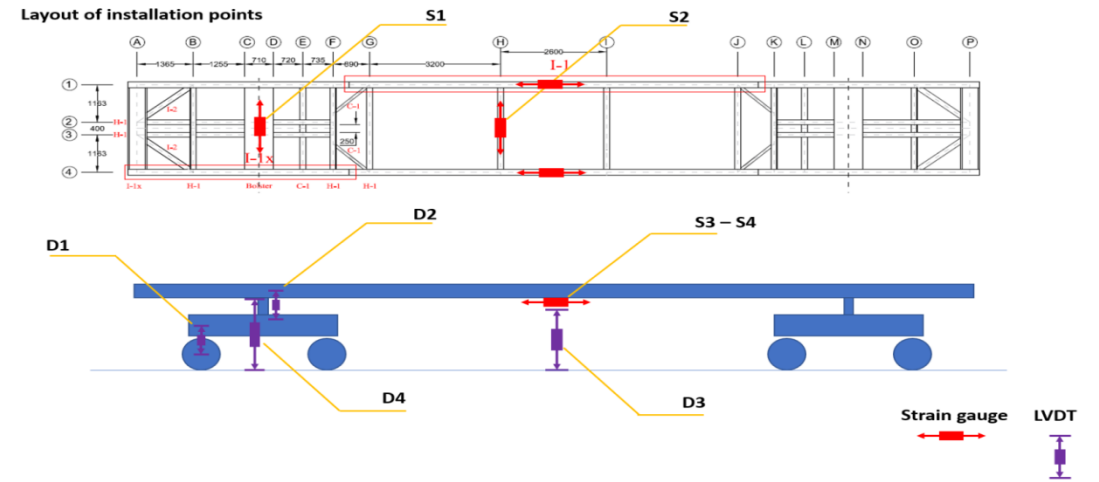
Construction



Construction



Inspection and Testing

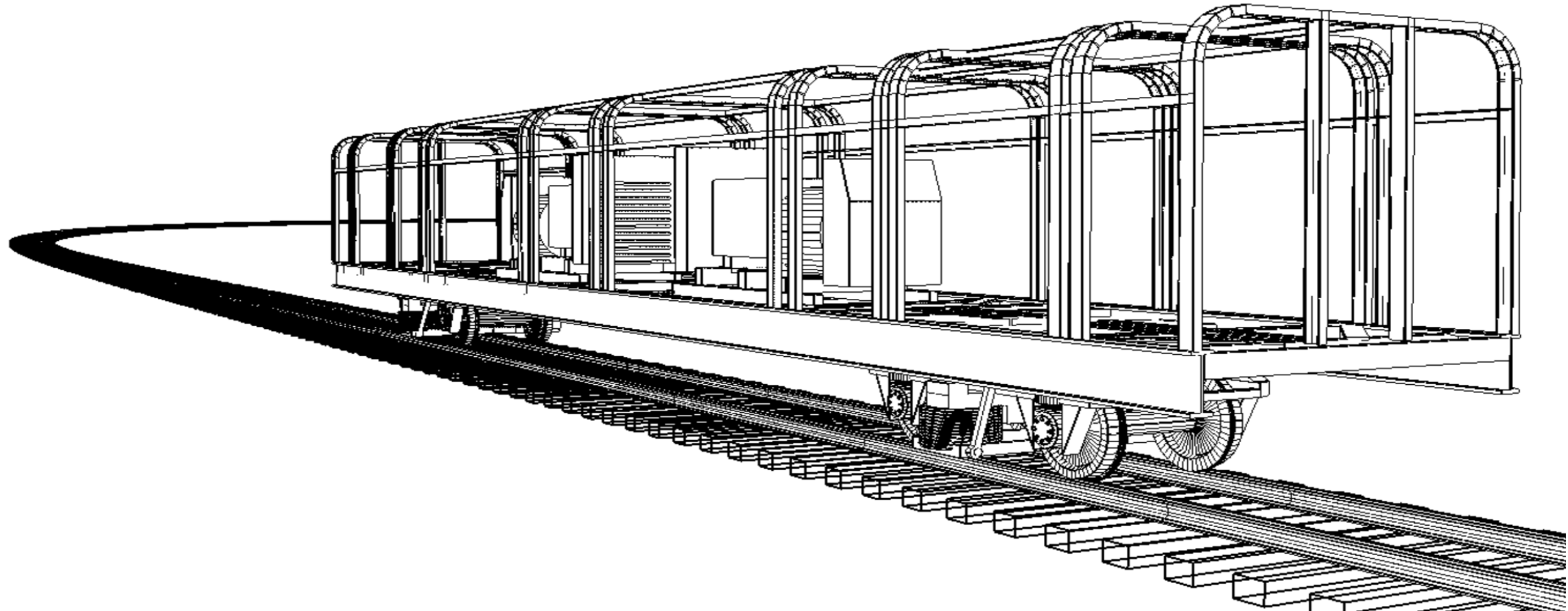


Final Product





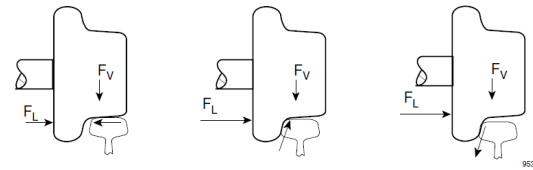
Dynamic Simulation



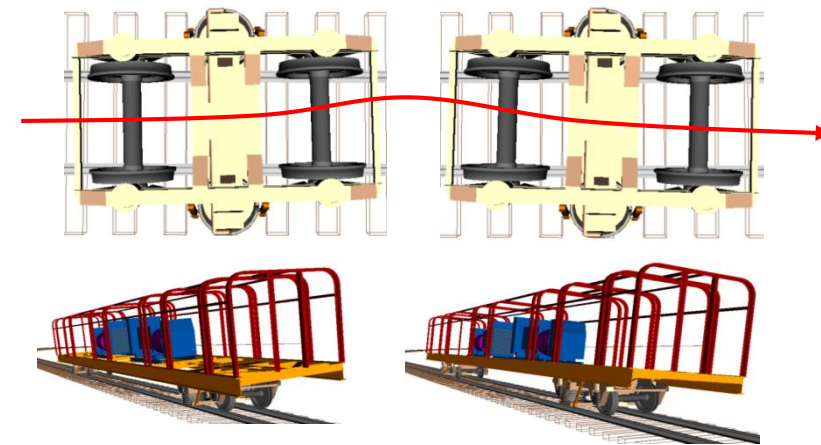
Purpose of Dynamic verification



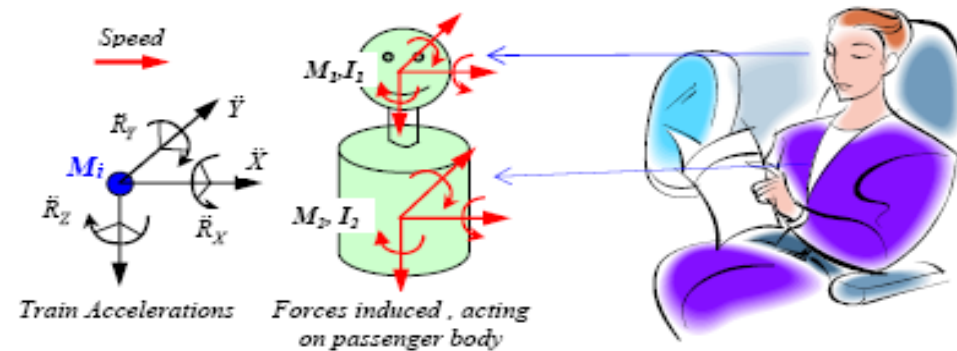
Running Safety



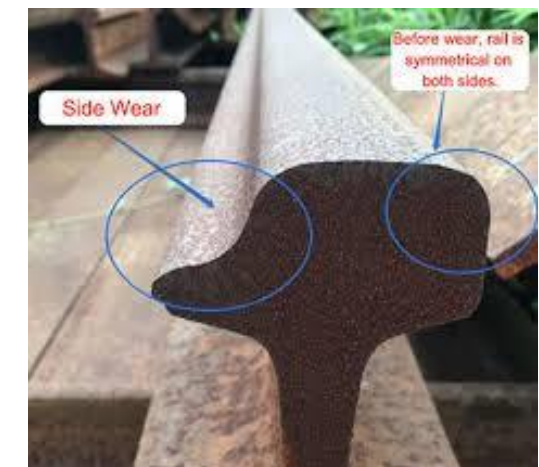
Running Stability



Ride Comfort



Wear & Fatigue

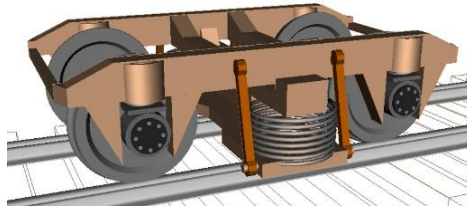


Test Program

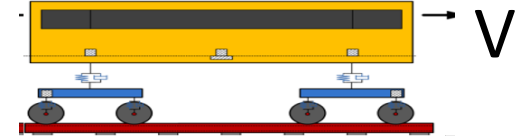
Track Layout



Suspension Variation



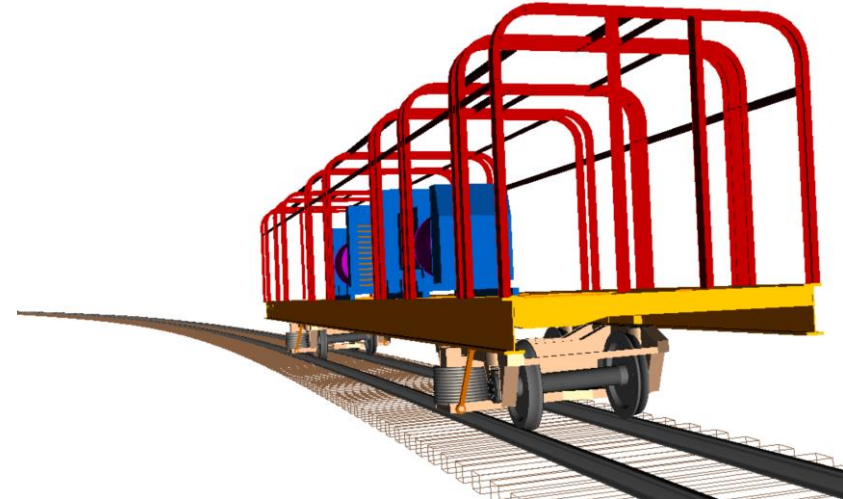
Speed Variation



Tangent Track



Curved Track



Suspension properties

UM Experiment option is Very Useful !



Air spring stiffness ← Calculate from
Car-body bouncing frequency
0.5, 1.0, 1.5, 2.0 Hz

Damping ratio of 2nd suspension
1.0, 1.5

Dynamic Analysis using Universal Mechanism

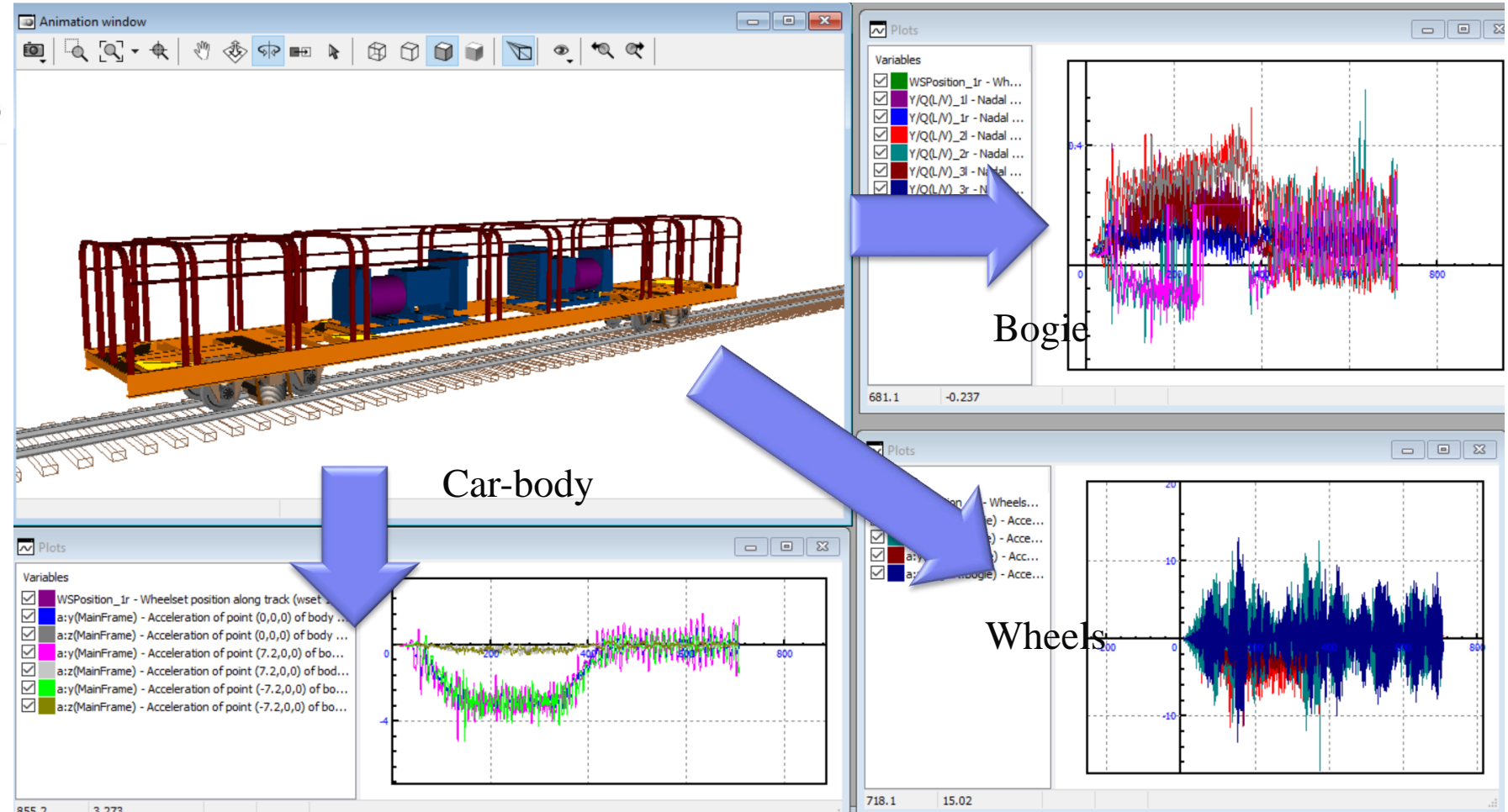


- SRT Manual & Guideline
- EN 14363 – European Norm
- UIC 518 – International Union of Railways

BRITISH STANDARD

BS EN
14363:2005

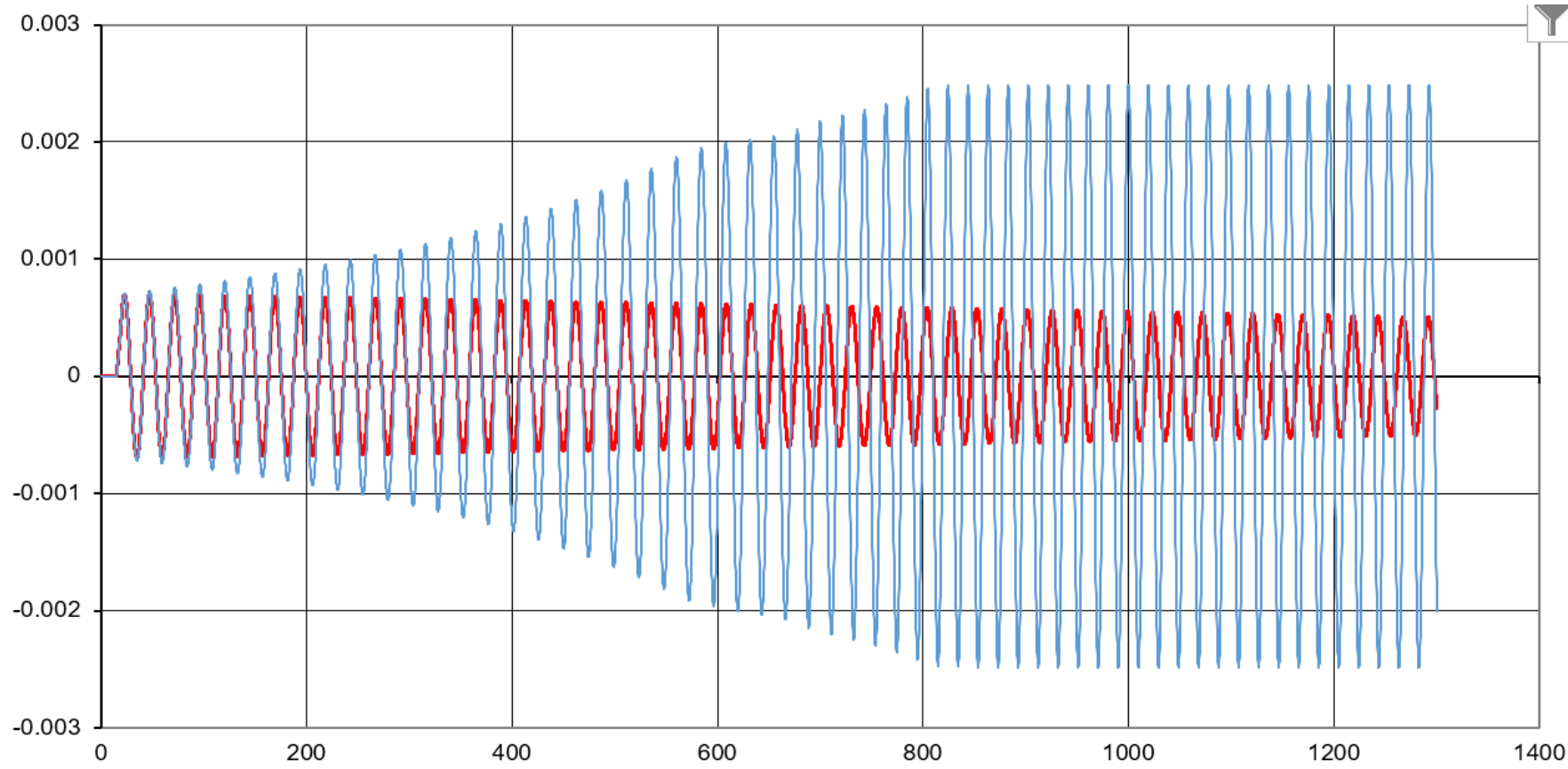
Railway applications —
Testing for the
acceptance of running
characteristics of
railway vehicles —
Testing of running
behaviour and
stationary tests



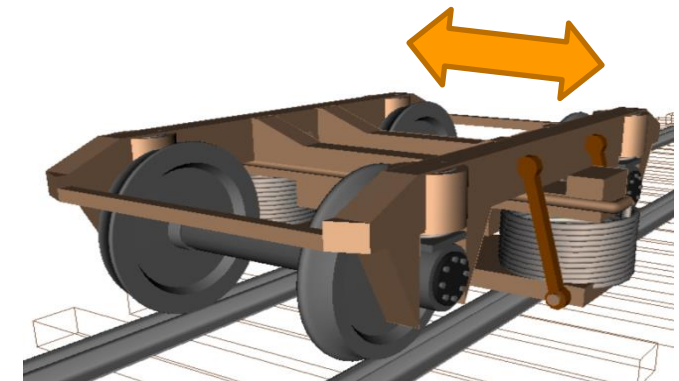
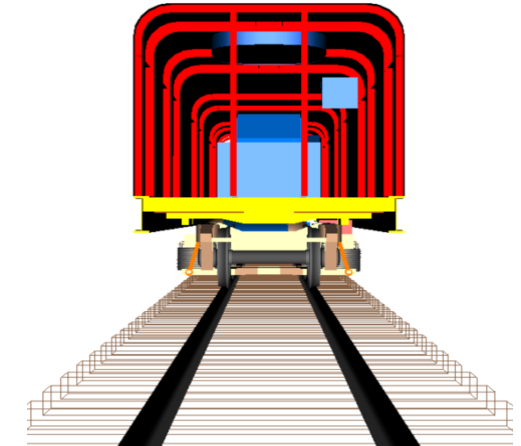
Running Stability



Critical at approx. 100 km/h



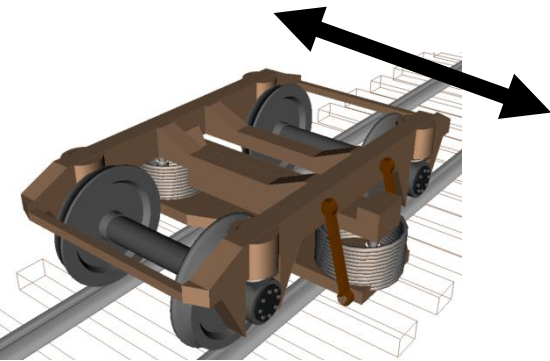
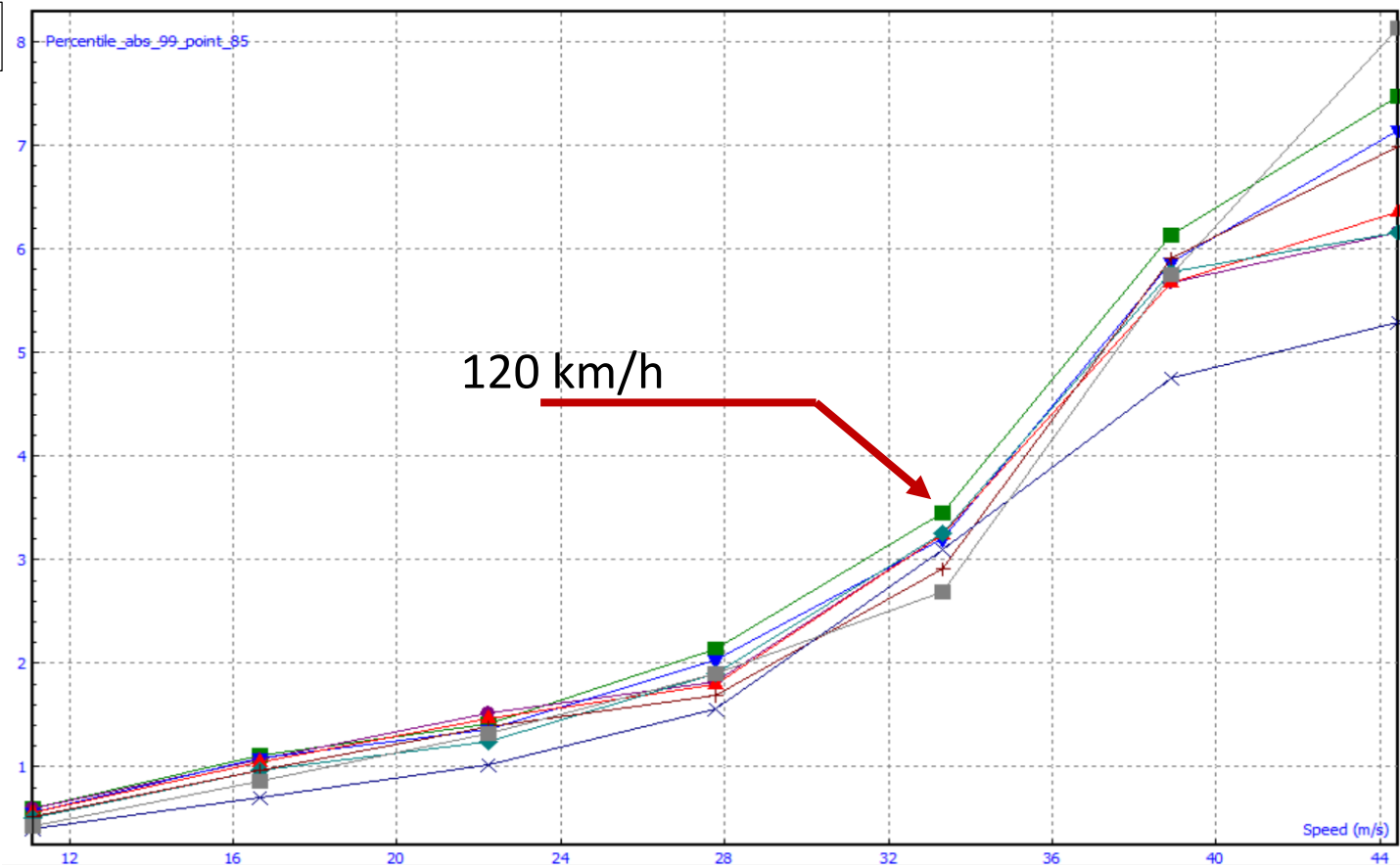
Tangent track



Safety Evaluation (UIC-518)

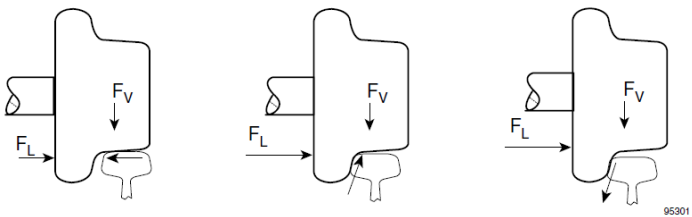
max = 8.2

UIC-518 Limit = 11.2

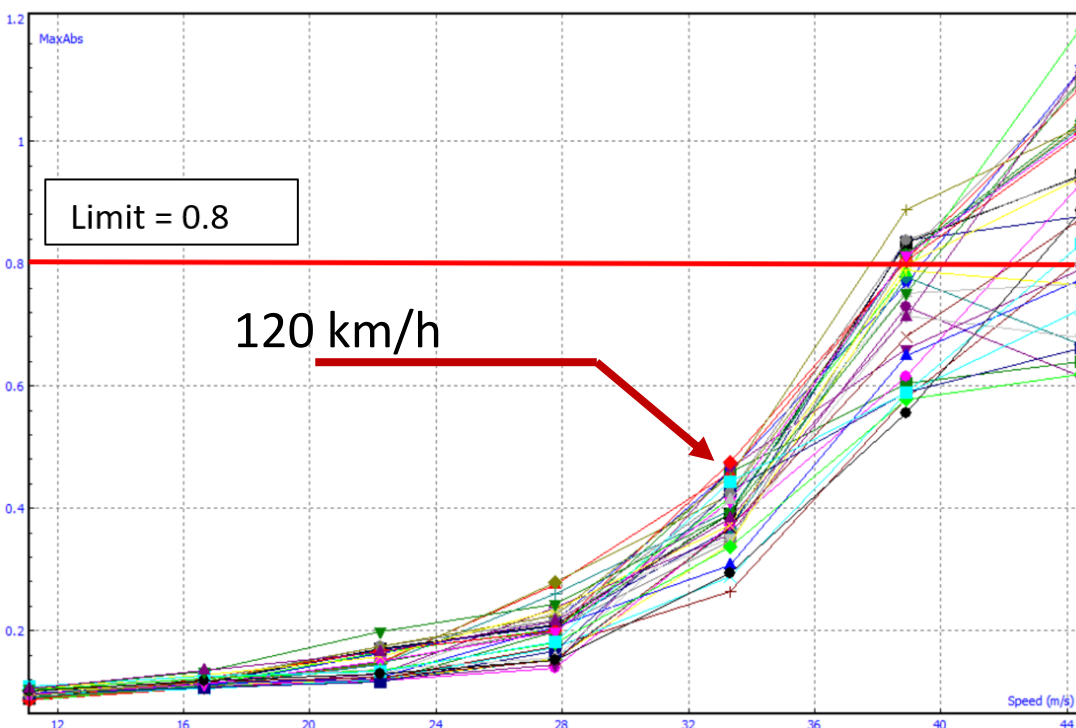


Speed m/s

Derailment ratio of all wheelset (L/V)

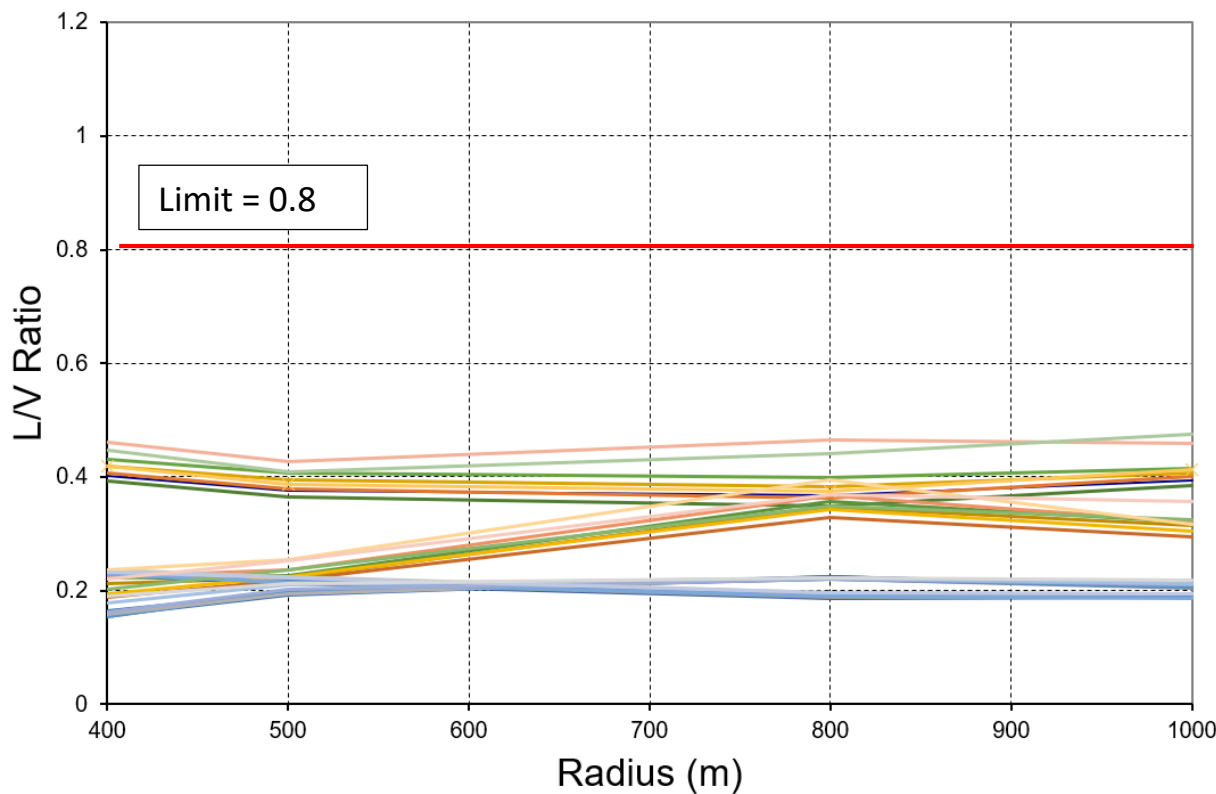


Tangent



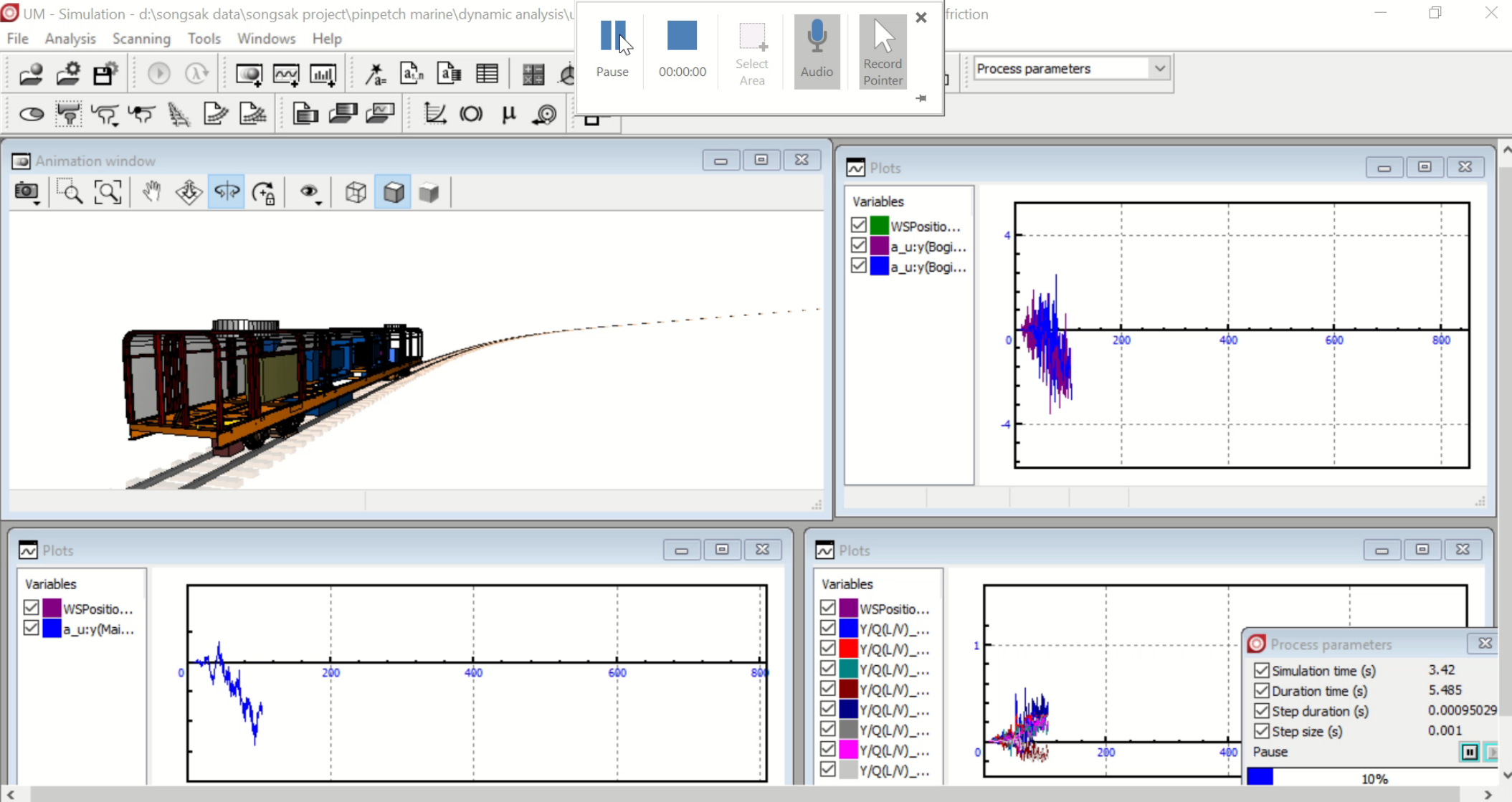
Speed m/s

Curve



Small to large curve

Animation



On-Track Test



Preliminary On-Track Test by SRT



การรถไฟแห่งประเทศไทย

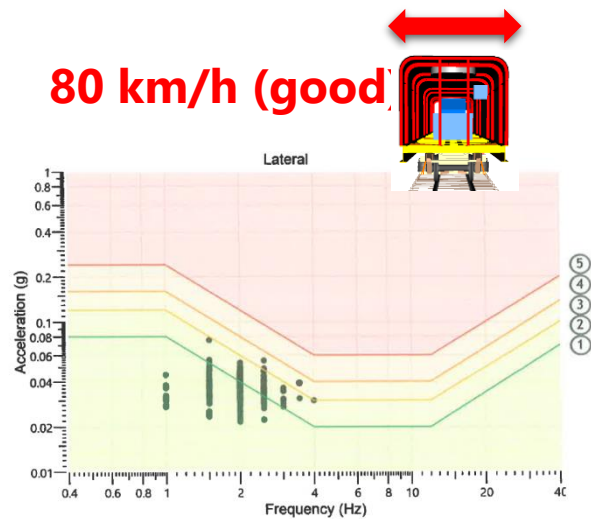


Chiangmai

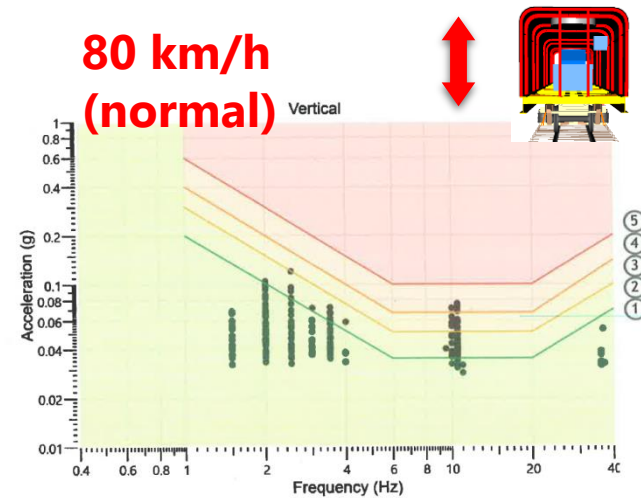


Bangkok

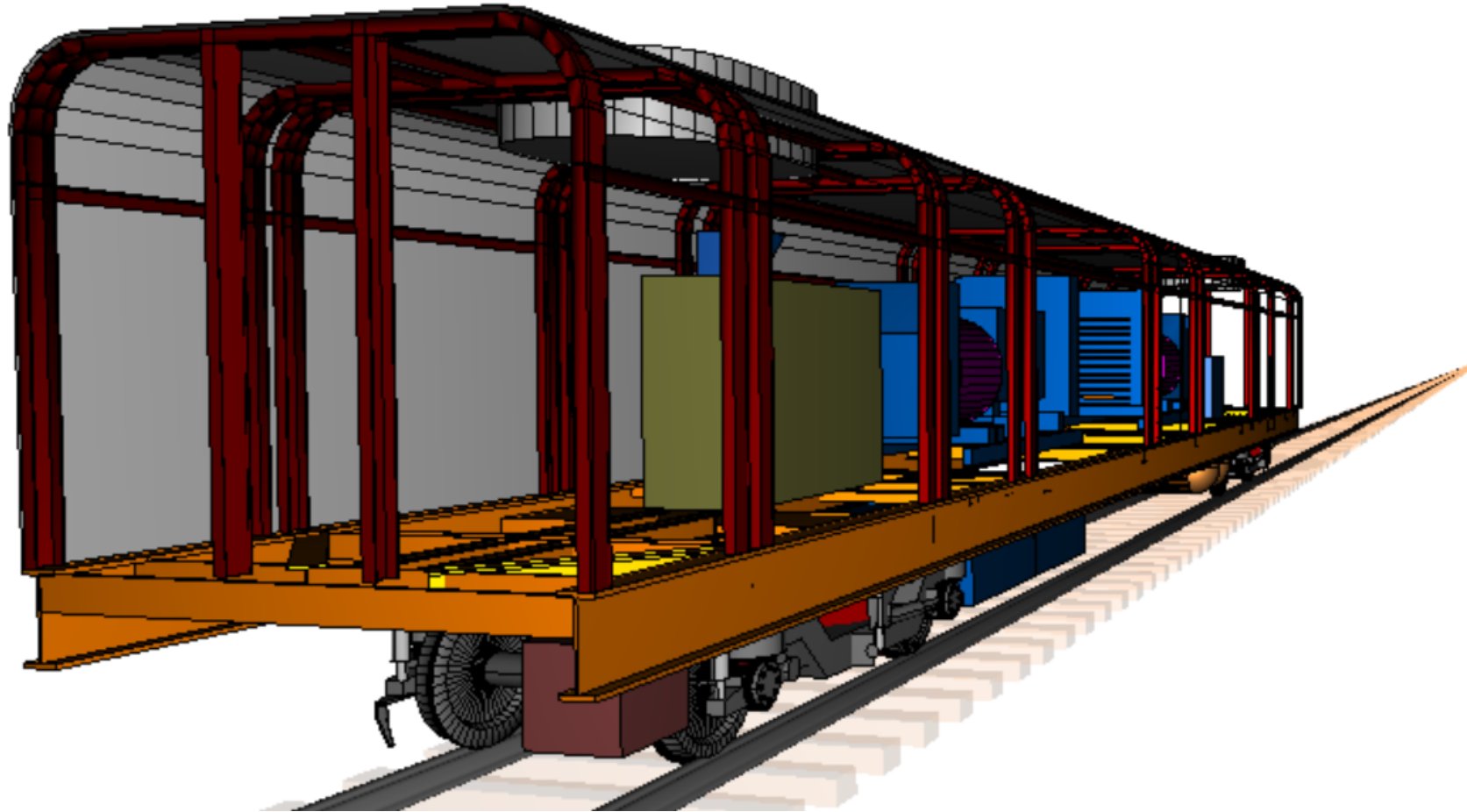
80 km/h (good)



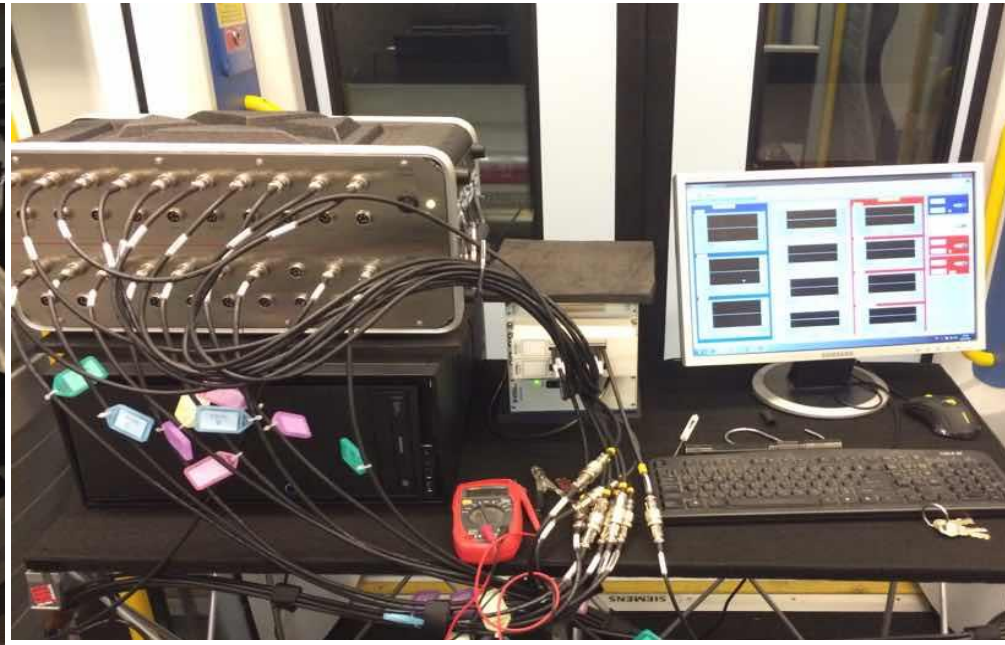
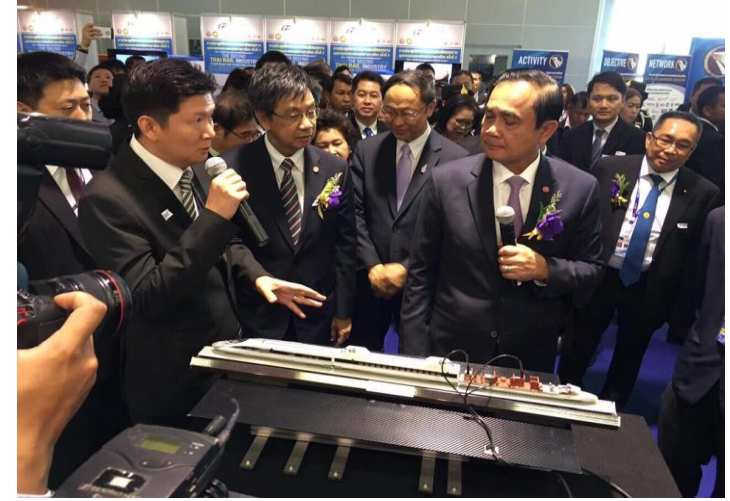
80 km/h
(normal)



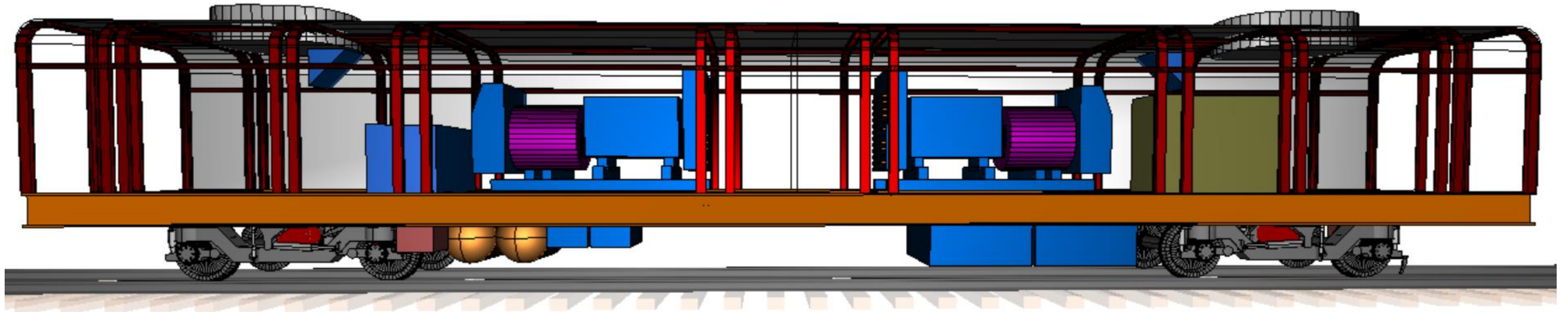
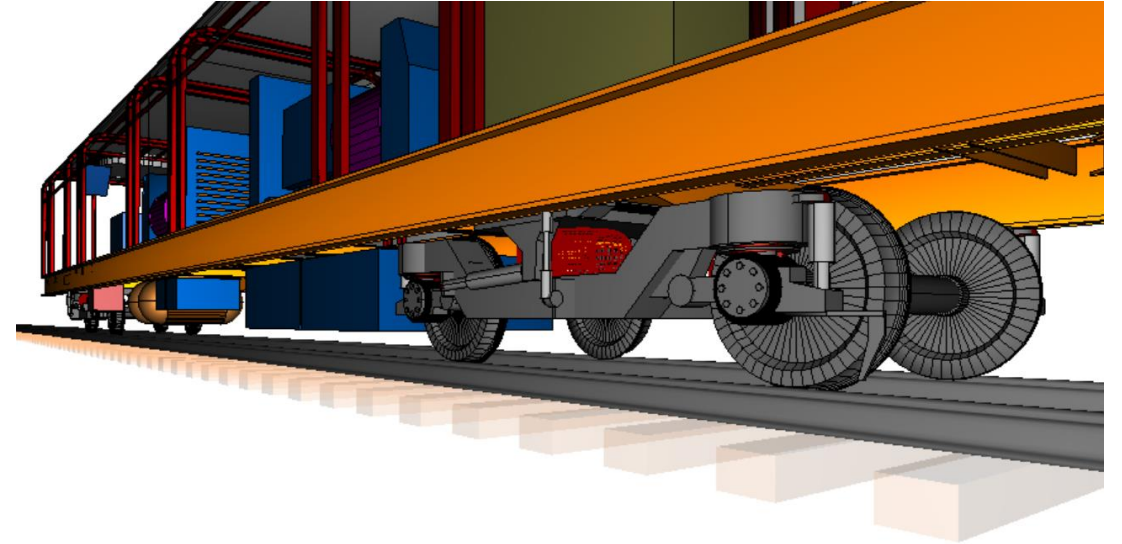
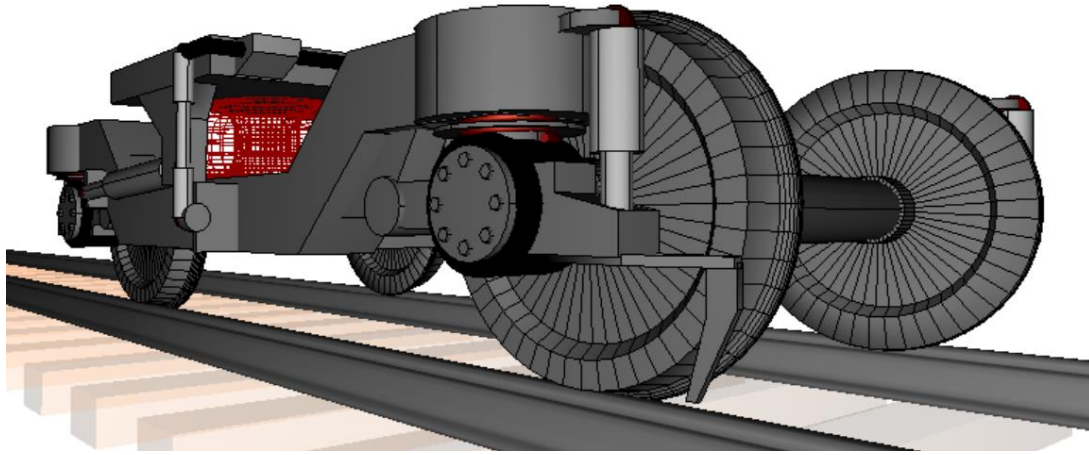
Further Work



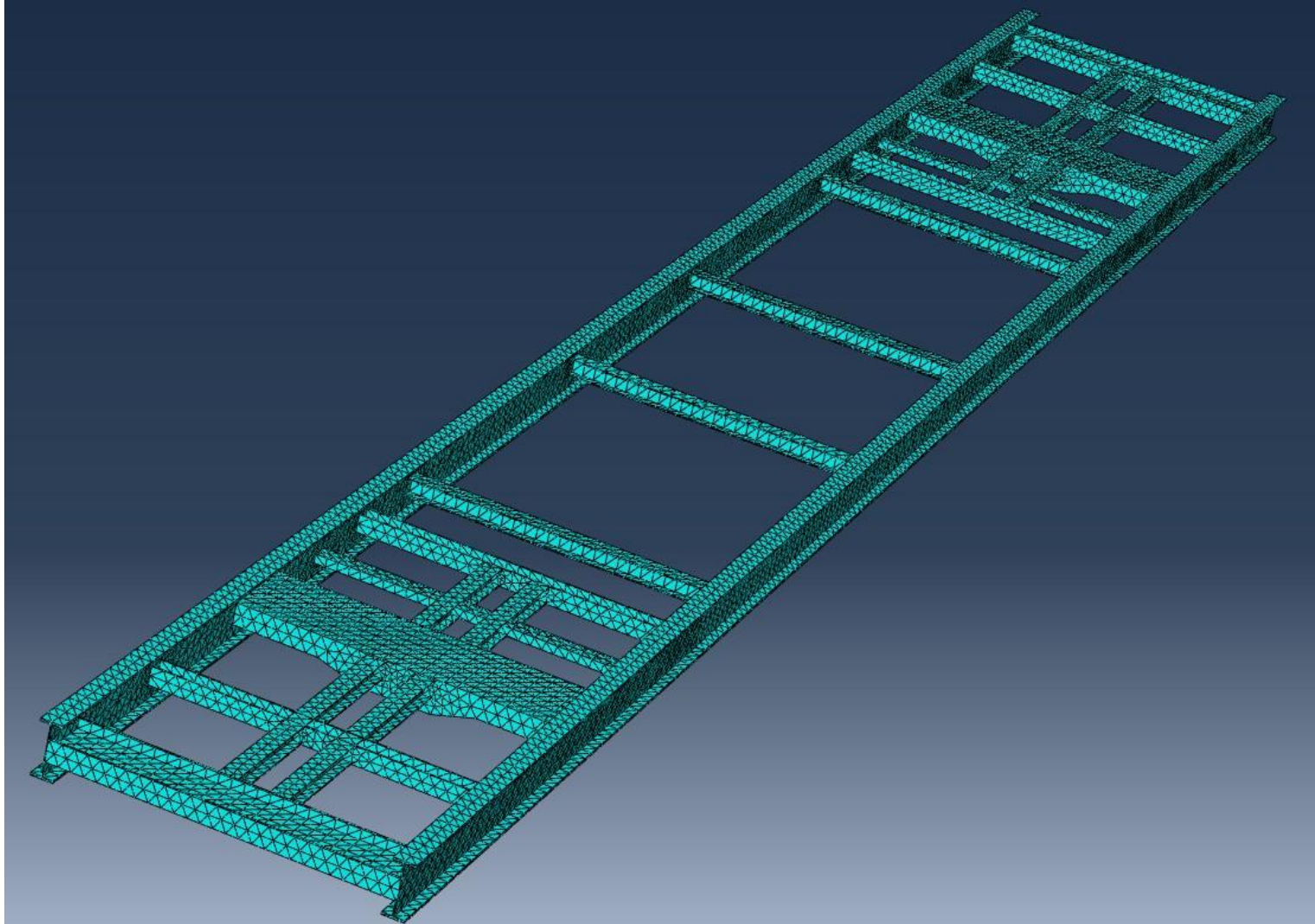
Running Test in Accordance with UIC-518



New Suspension

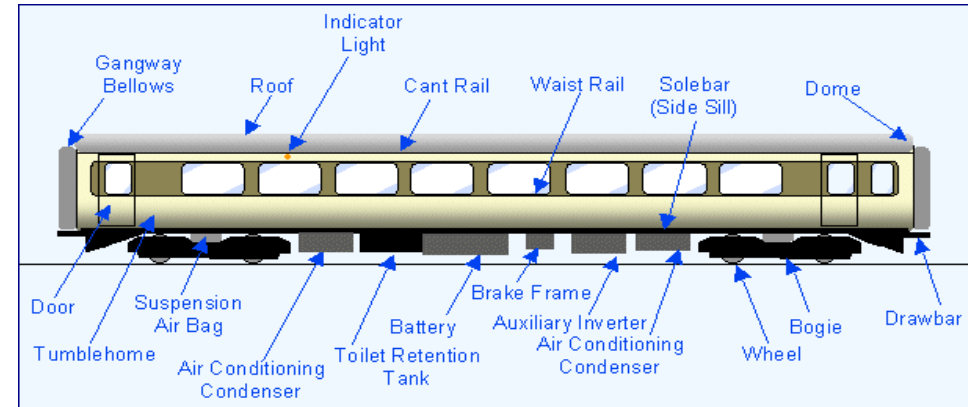
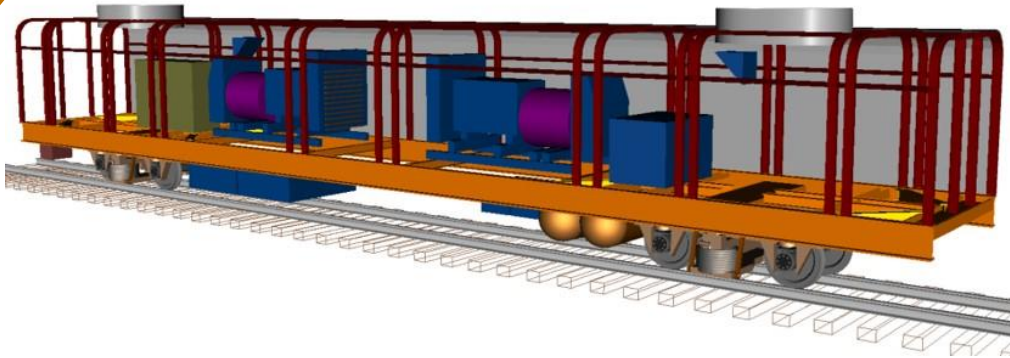


MBS vs Flexible Body Analysis



Development of Thailand Train-Set:

Power Car and 1st Class Passenger Coach Customization

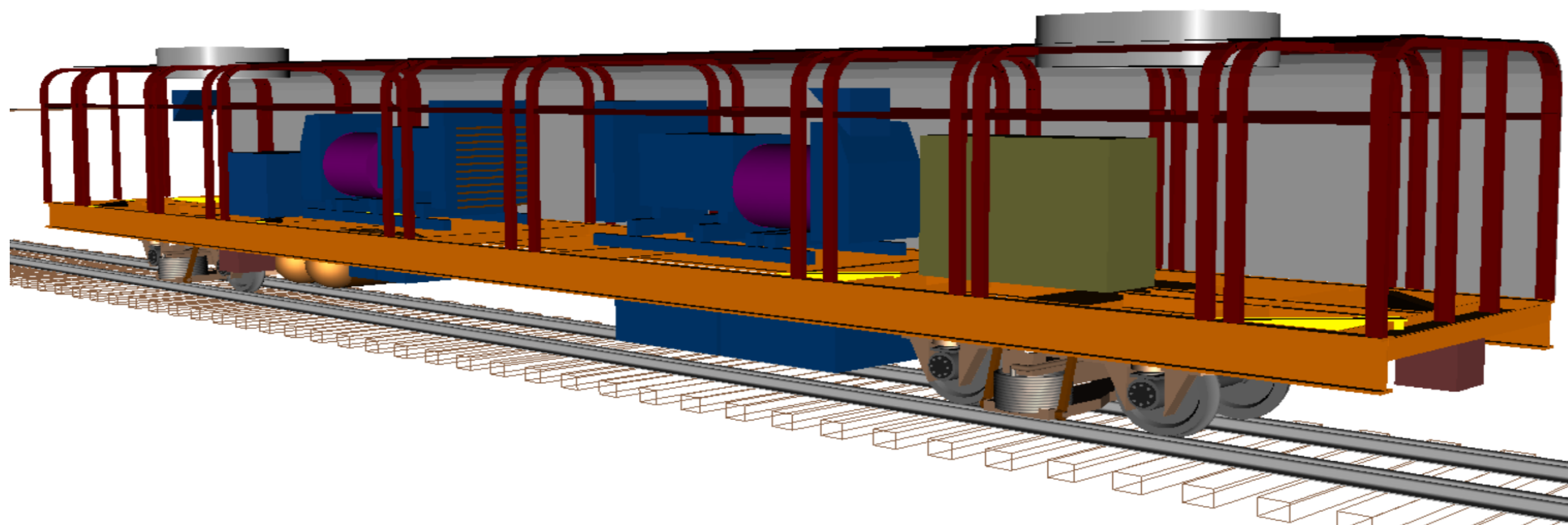




การรถไฟแห่งประเทศไทย



THANK YOU

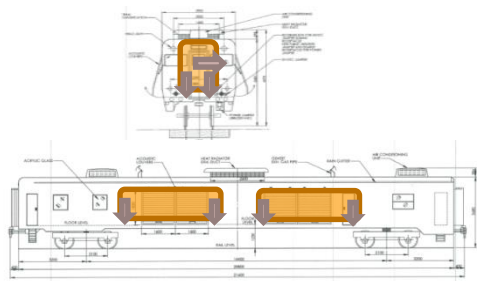


Overall Work Procedure

Design & Construction of Customized Train: Pre-Construction Process

Planning

- List all requirement
- Standard to be used



UIC Code

566

OR

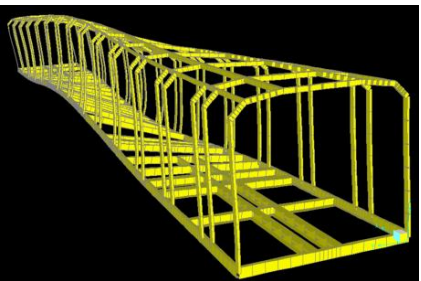
3rd edition, 1.1.90

Loadings of coach bodies
and their components

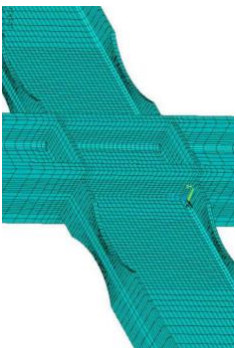
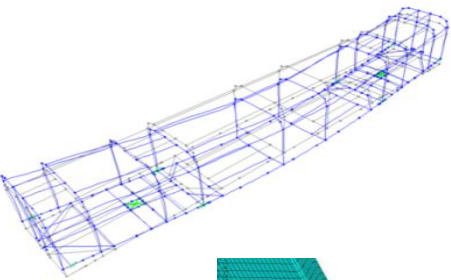
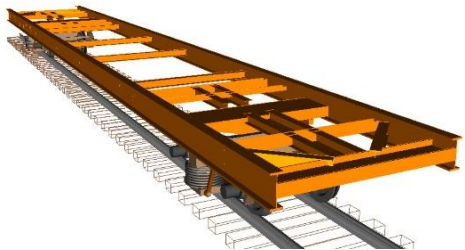
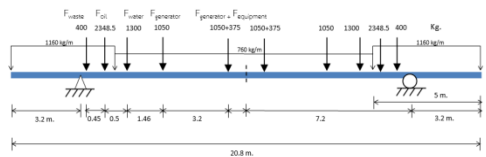


International Union of Railways

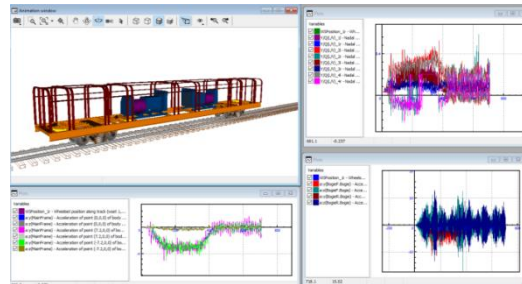
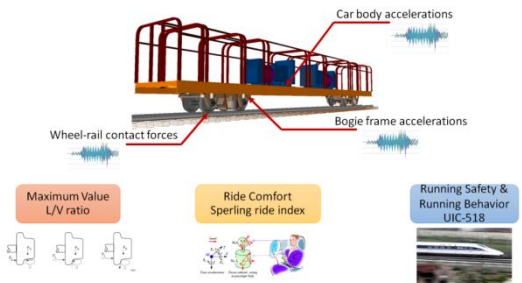
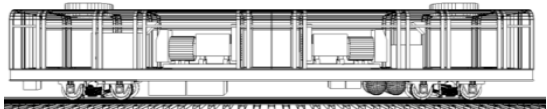
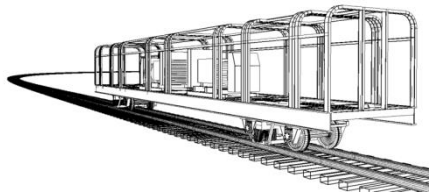
Inspection & Evaluation of Based Train



Car body Analysis & Design



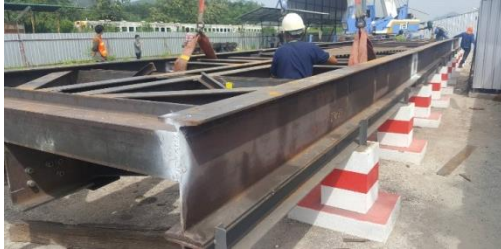
Dynamic Analysis & Safety Evaluation



Design & Construction of Customized Train: **Construction & Testing Process**

Construction

- Alignment
- Member and joint quality



Static Test

- Structural performance



On-track test

- Running safety & comfort
- Running stability

