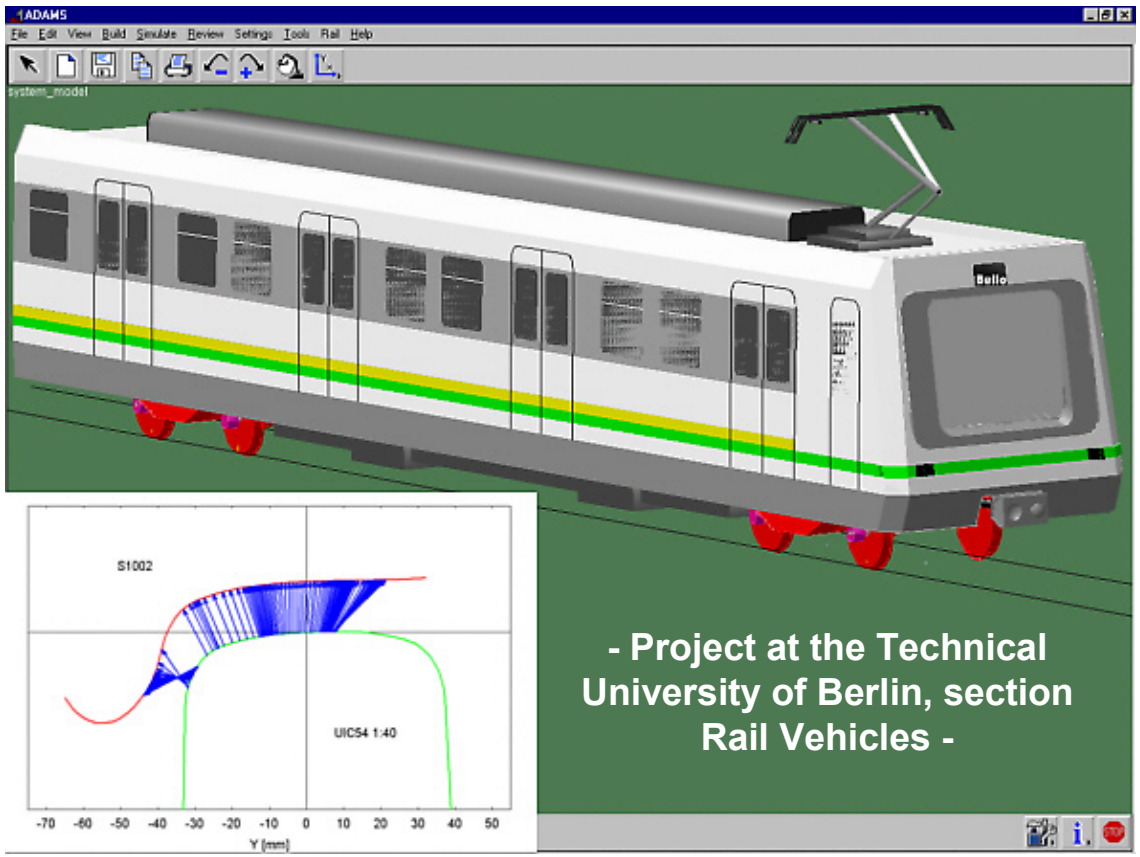
Comparison of the Influence of Standard UIC Profiles and Special Profiles on Wear and Running Behaviour of a Metro System



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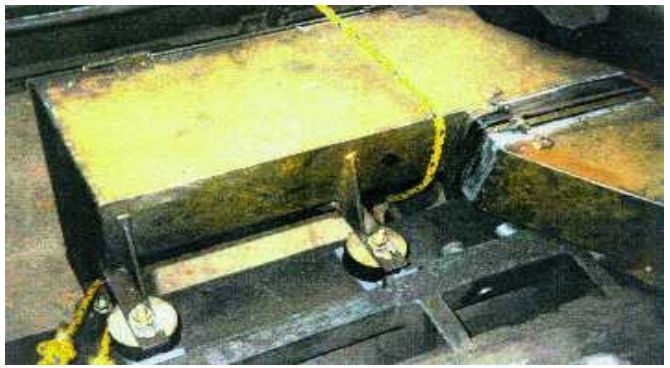
Agenda

1. Problems at the wheel-rail-system
2. Suggestions
3. Task
4. Functions of the profiles and contact points
    - 4.1 tangent track
    - 4.2 curves
5. Calculations with ADAMS/Rail
    - 5.1 Model
    - 5.2 Stability behaviour
    - 5.3 Corneringability
6. Rolling contact fatigue
7. Assessment

Vibration Problems

- Damages to traction bogie components
- Damaged sleepers, loose ballast



Wear Problems

- Corrugation on the low rail of tight curves
- Corrugation on the vehicle wheels

2. Suggestions

Vibrations

Elimination of corrugations on wheel and rail

Corrugations

1. suggestion

Accurate maintenance of standard profiles at rail and wheel for self-steering wheelsets achieved through soft bushing in longitudinal direction of the wheelset guide

2. suggestion

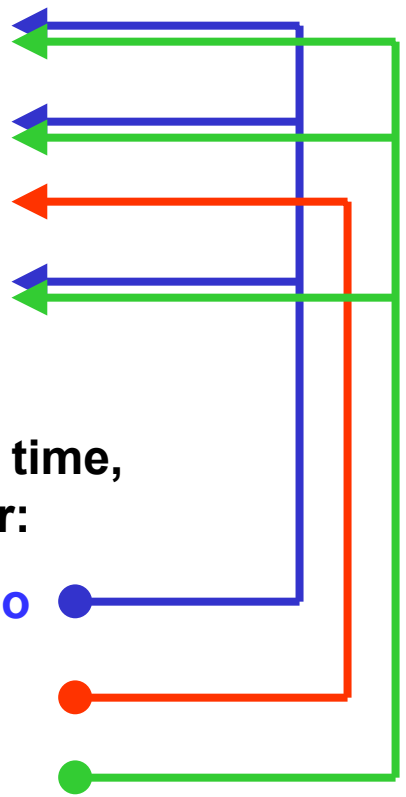
Wheel/rail-profile optimization by creation of special profiles (asymmetric in curves)

→ **Comparisons of these two suggestions with computer simulations:**

1. **UIC profiles with steering wheelsets**
2. **UIC profiles with rigid wheelsets**
3. **Special profiles with steering wheelsets**
4. **Special profiles with rigid wheelsets**

Comparison of UIC profiles with special profiles to improve the dynamical behaviour:

1. Stability (critical speed, conicity)
2. Corneringability (rolling radius difference, angle of attack)
3. Rolling contact fatigue
4. Long time behaviour of the profiles (wear)



Measurements mean high expenditure of costs and time, hence numerical calculations with the computer:

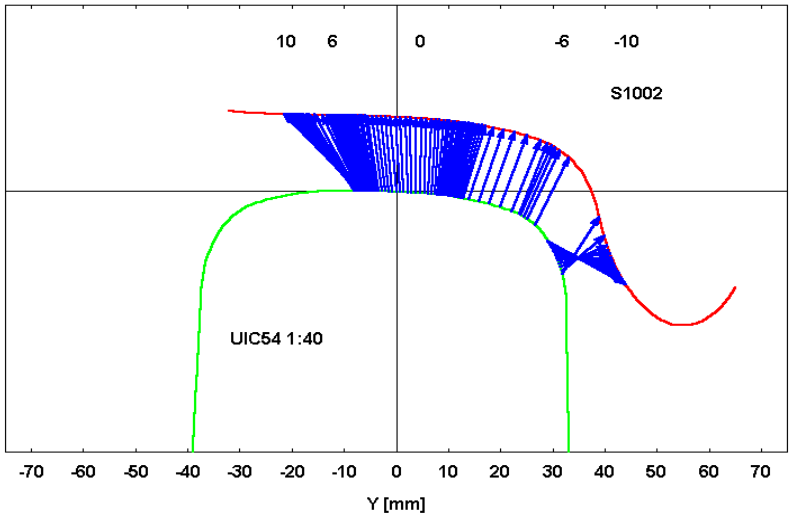
I. Profile functions and contact points with pre-processor **RSGeo**

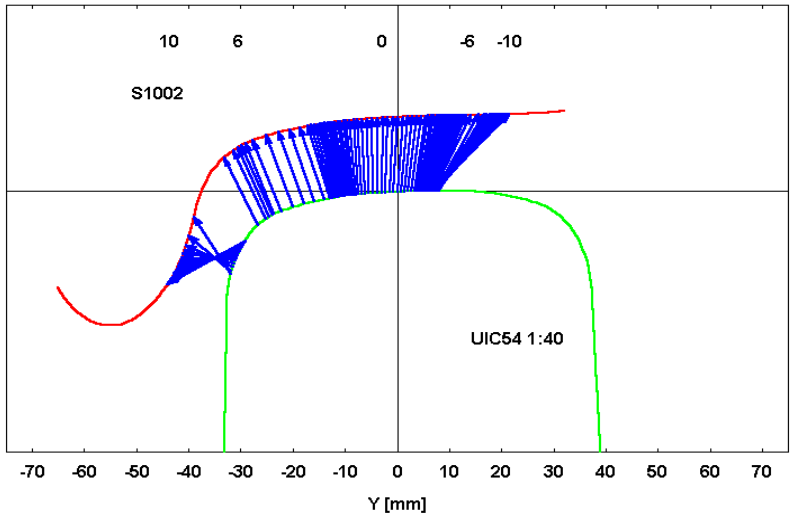
II. Surface pressure with **RSGeo**

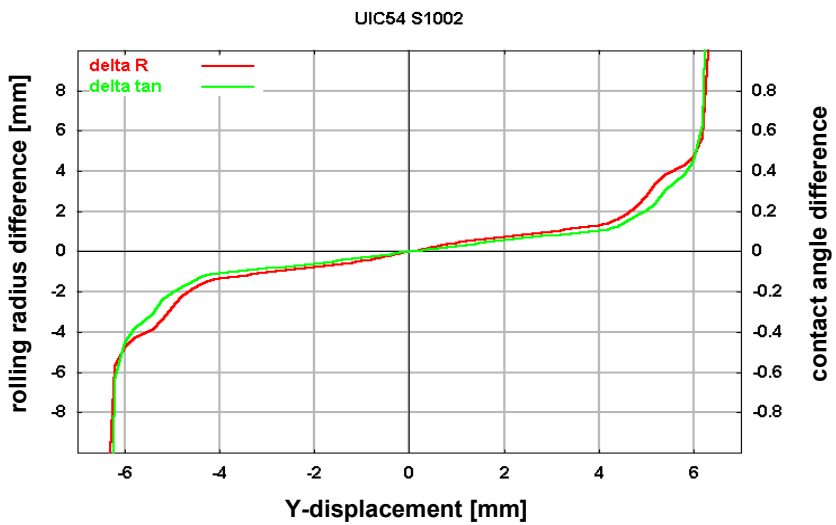
III. Stability and wear index calculations with **ADAMS/Rail**

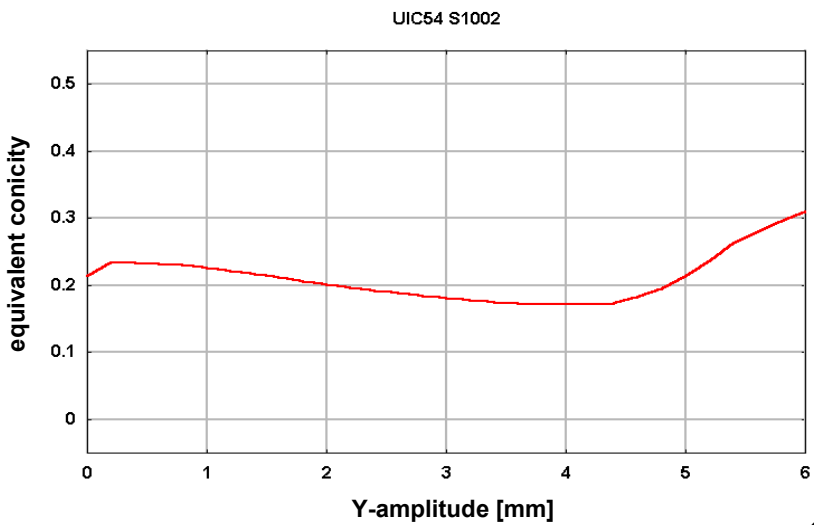
4. Profile Functions

UIC 54 / S1002







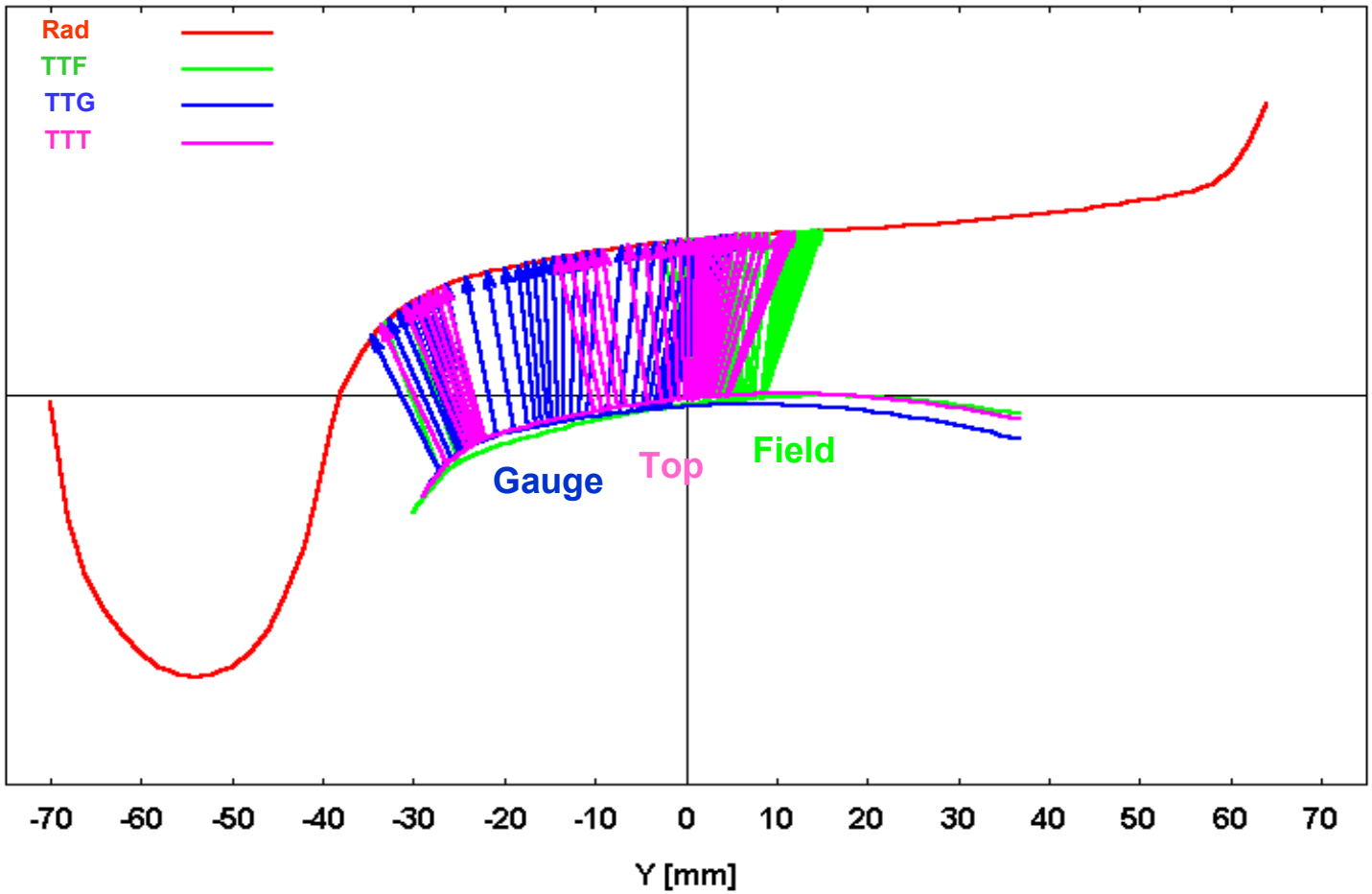


4. Profile Functions

Special profiles in tangent track

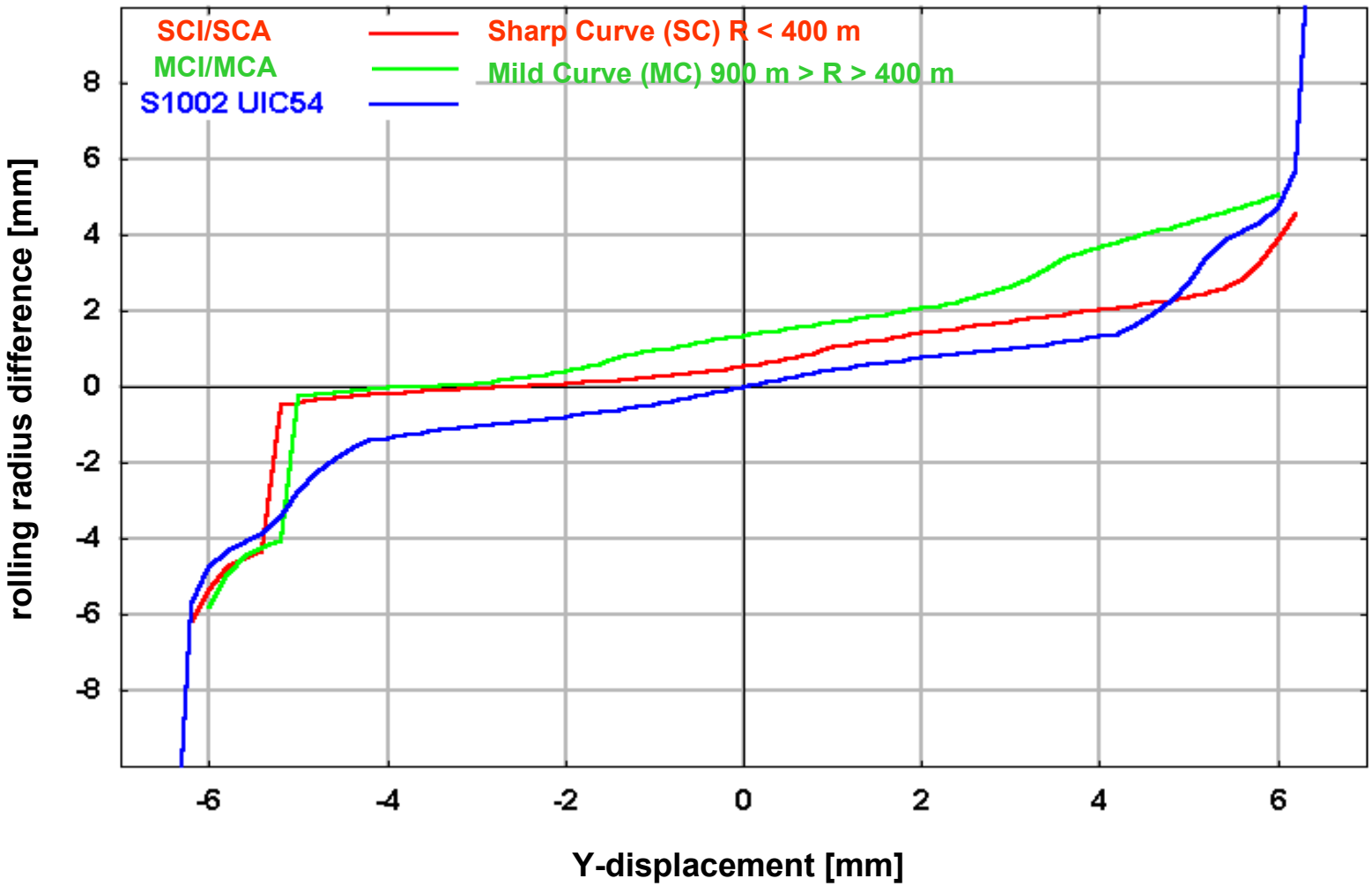
Tangent Track (TT) and curves up to R > 900 m:

Three different rail profiles (each 1/3 of TT) to distribute the contact point on the wheel surface:

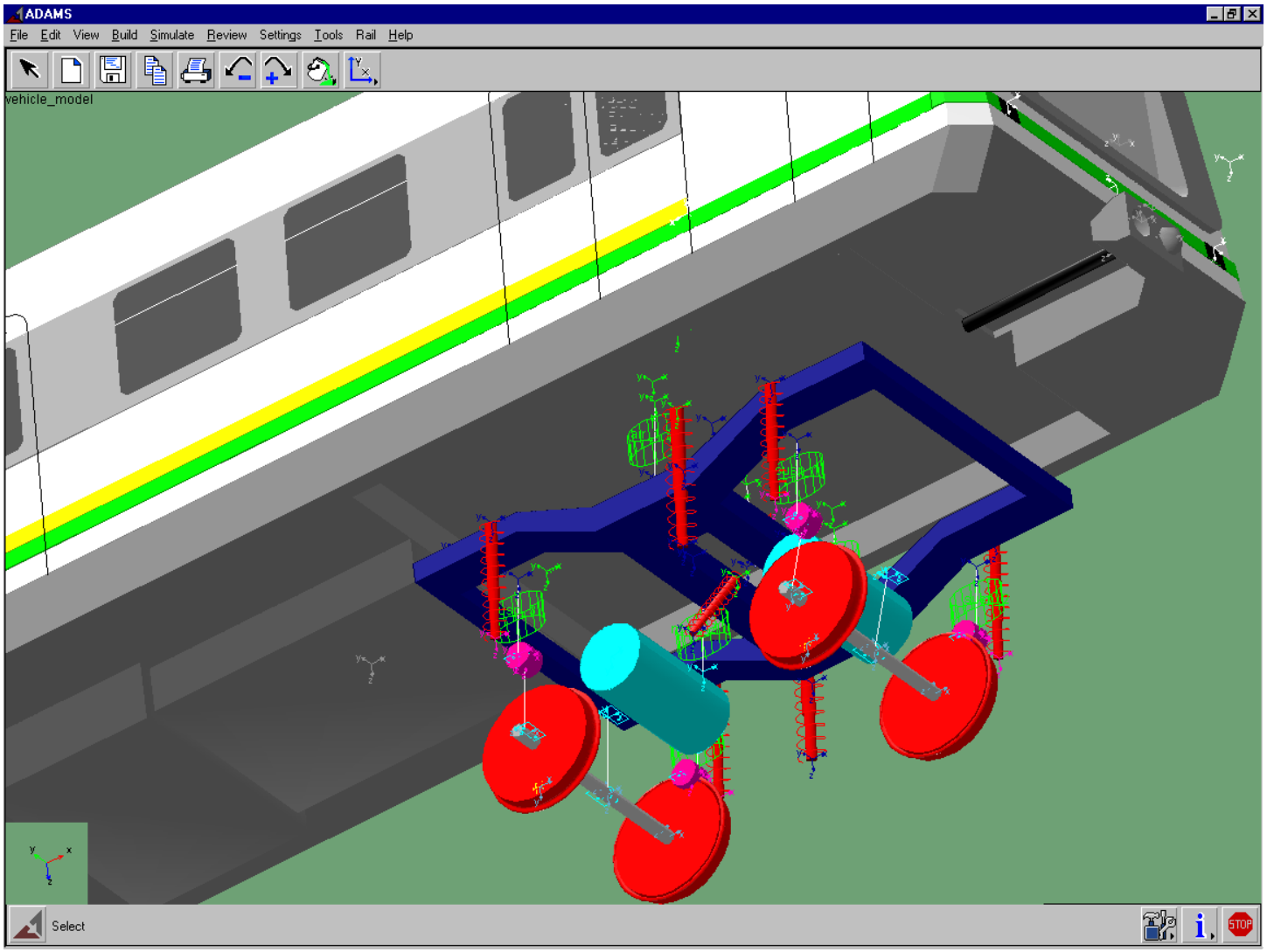


4. Profile Functions

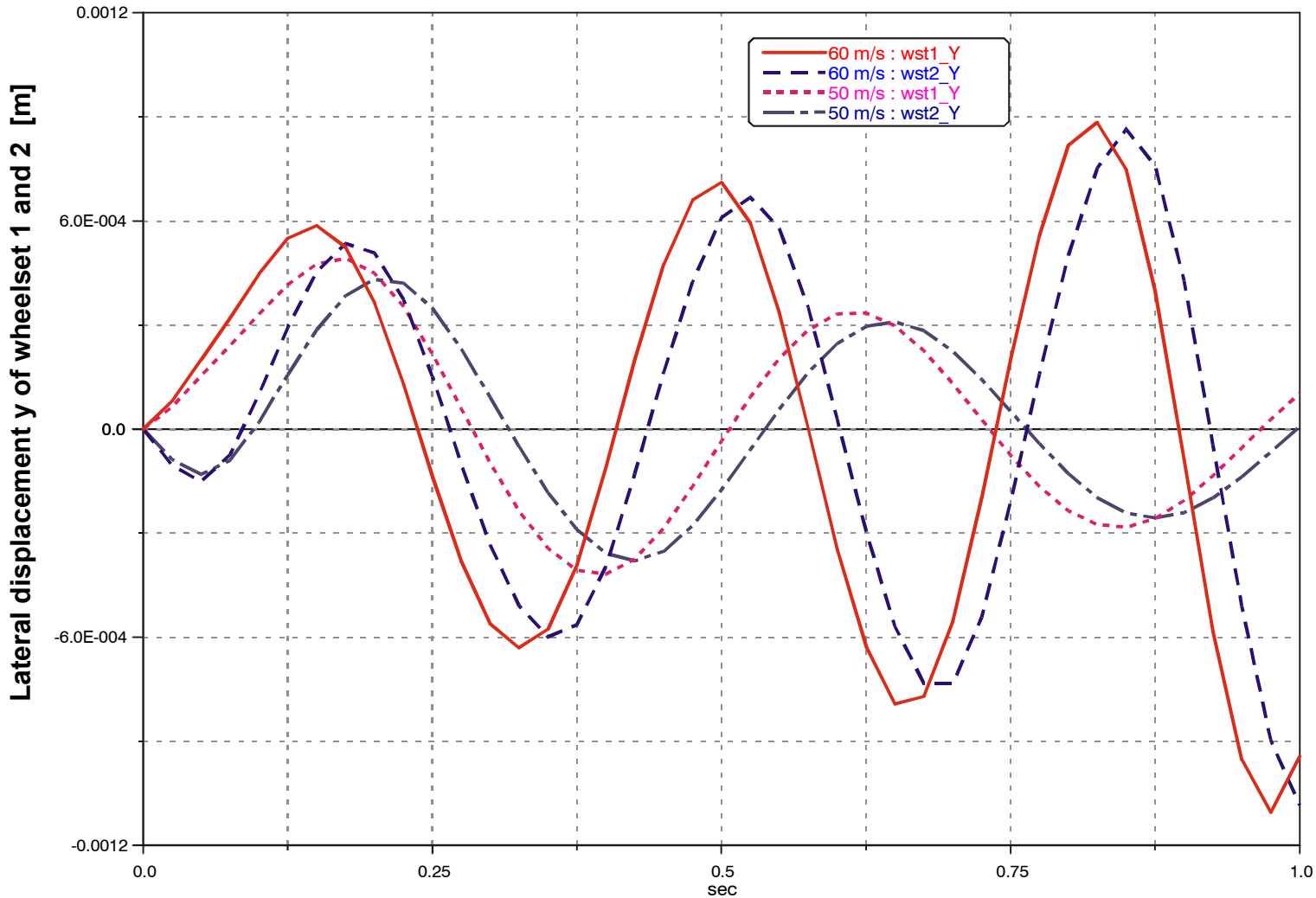
Comparison of the rolling radius differences,
standard and asymmetric rail profiles



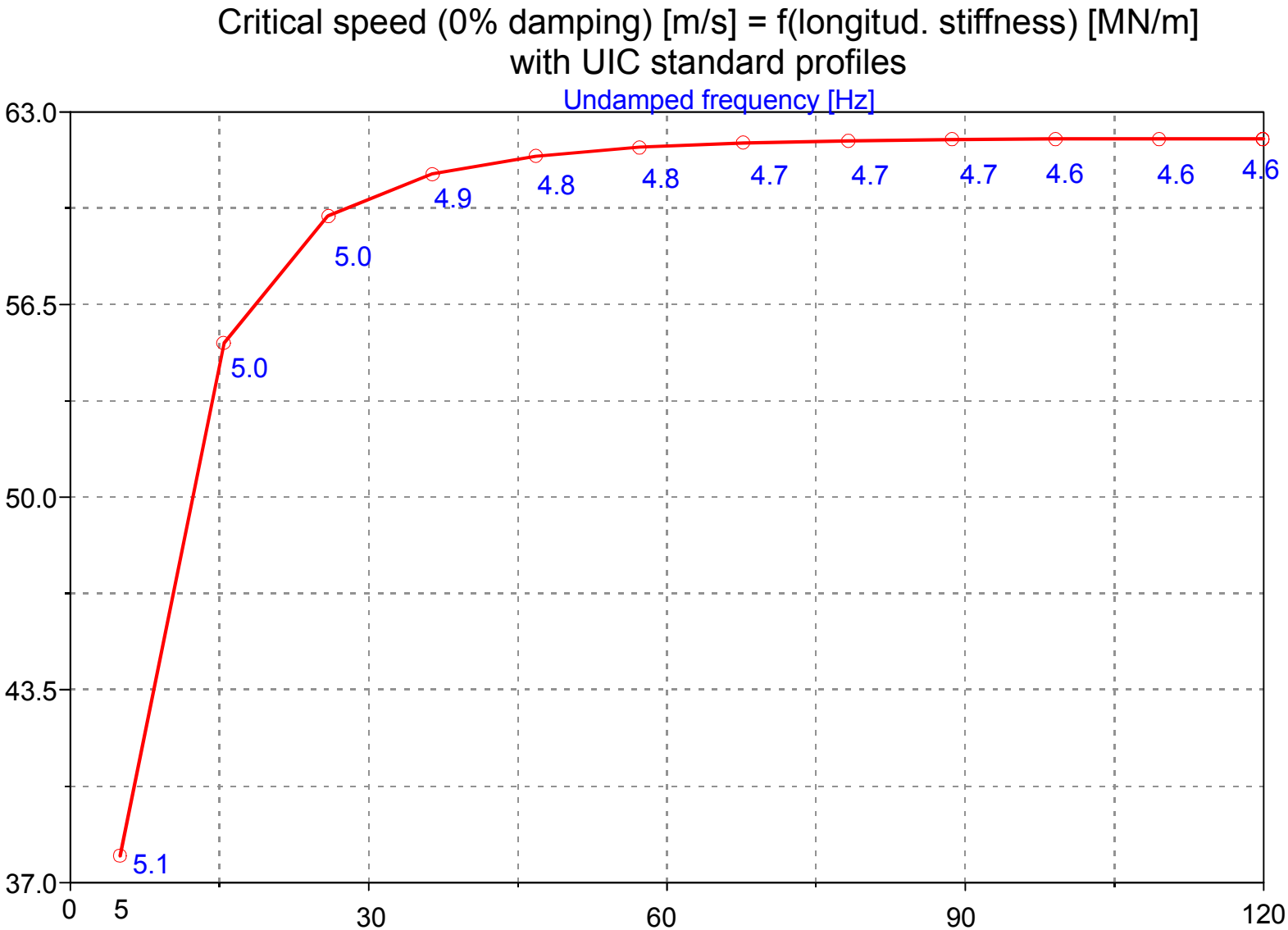
5.1 Model in ADAMS/Rail



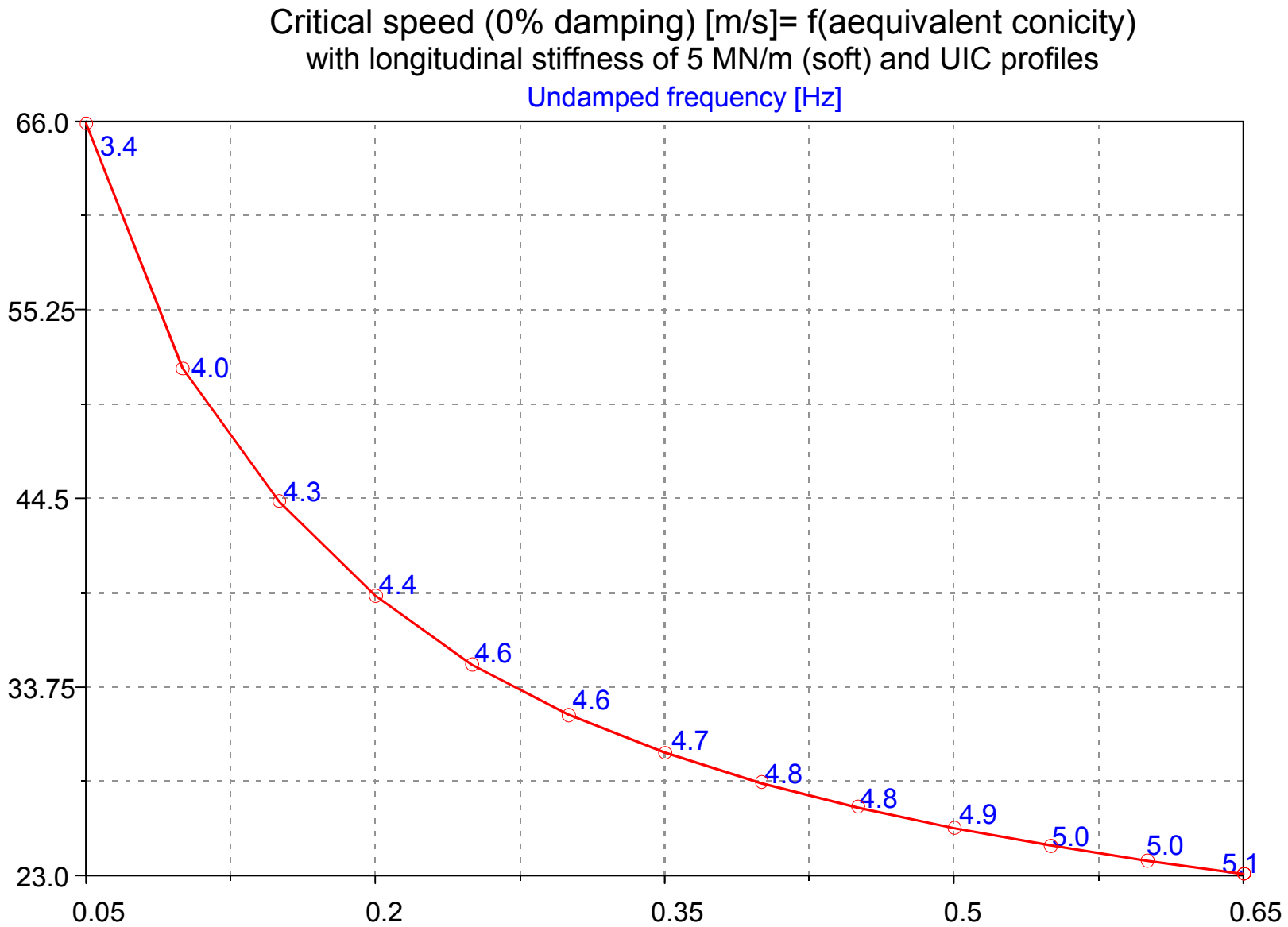
Stability with soft bushings for wheelset guide, special profiles on tangent track



5.2 Stability in Tangent Track



5.2 Stability in Tangent Track

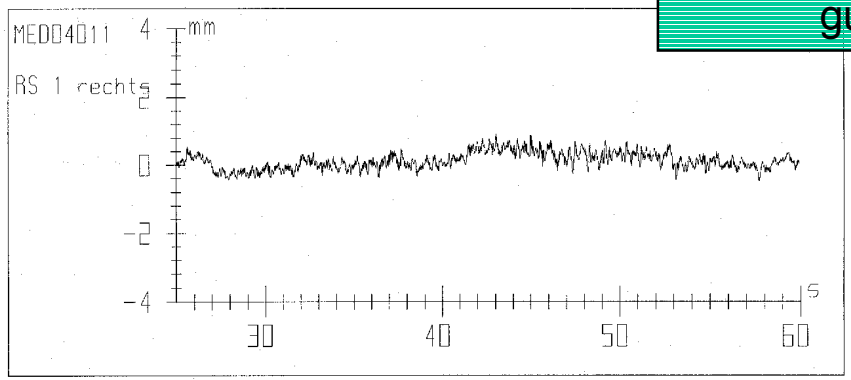


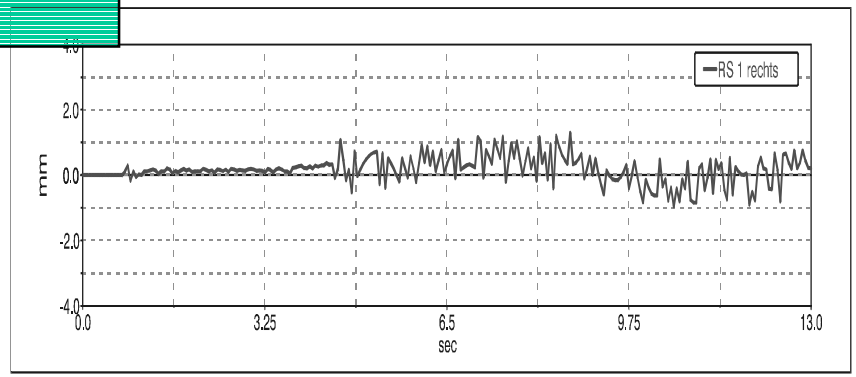
5.3 Corneringability

Measurement

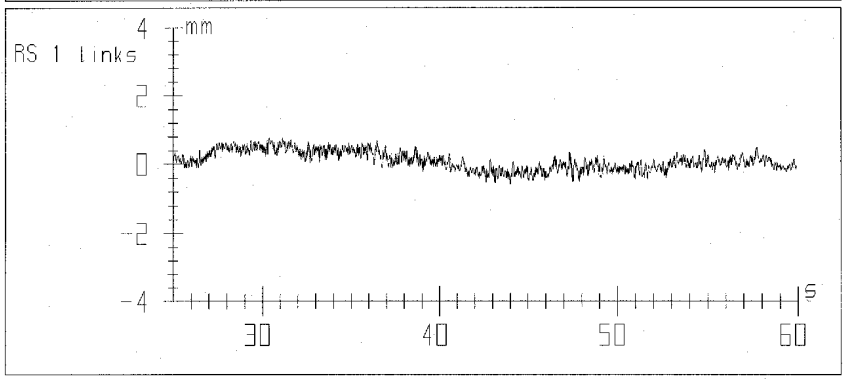
Hard wheelset guide

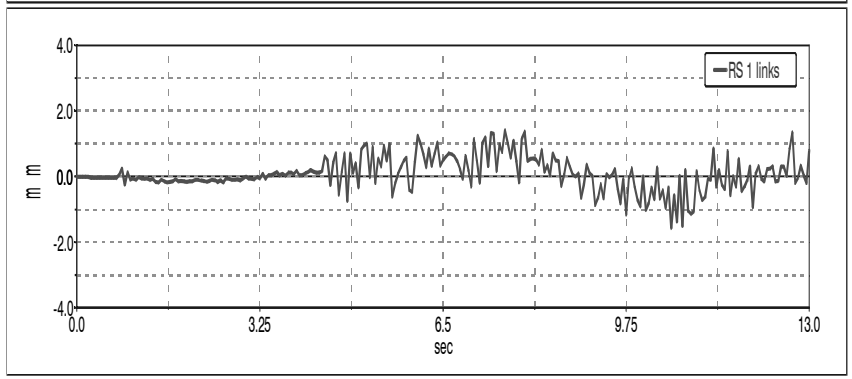
Simulation

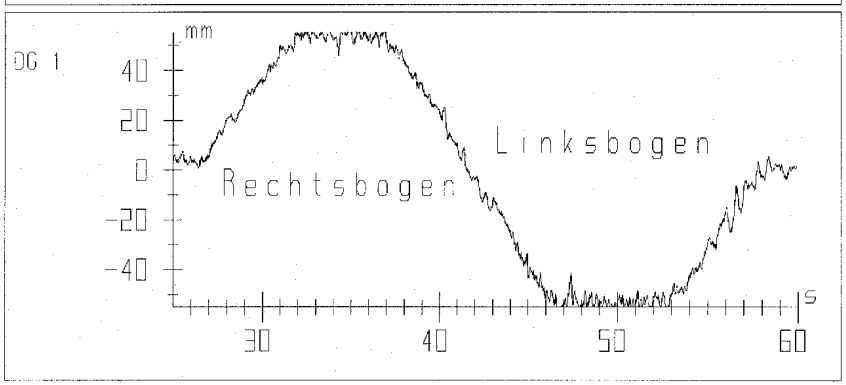




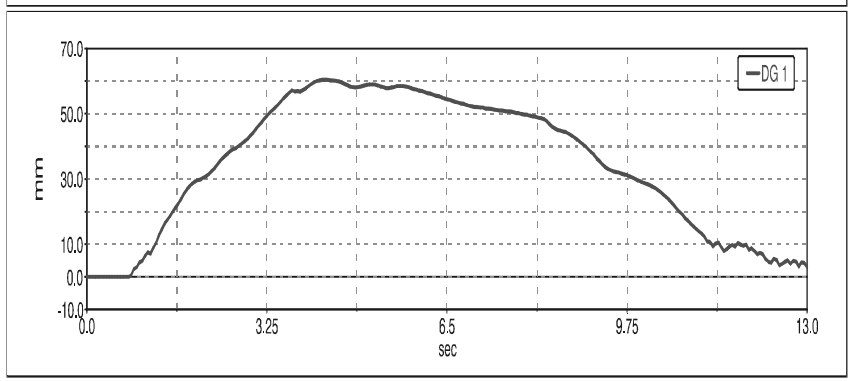
wheelset displacement [mm]







bogie displacement [mm]

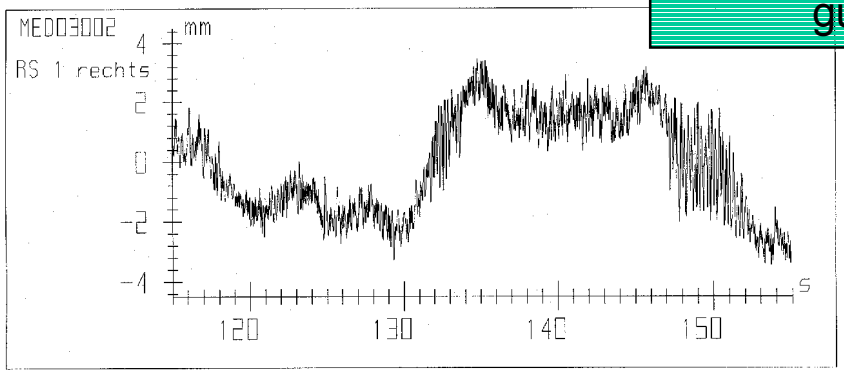


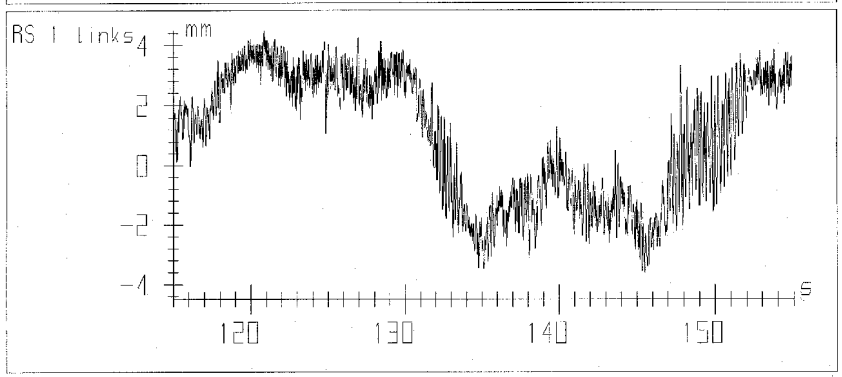
5.3 Corneringability

Measurement

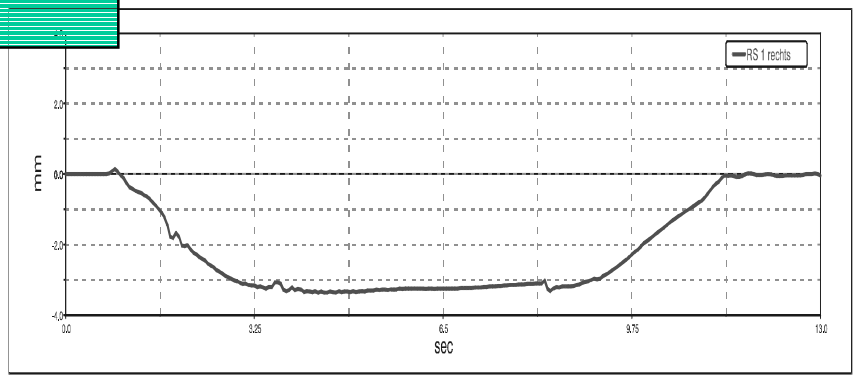
Soft wheelset guide

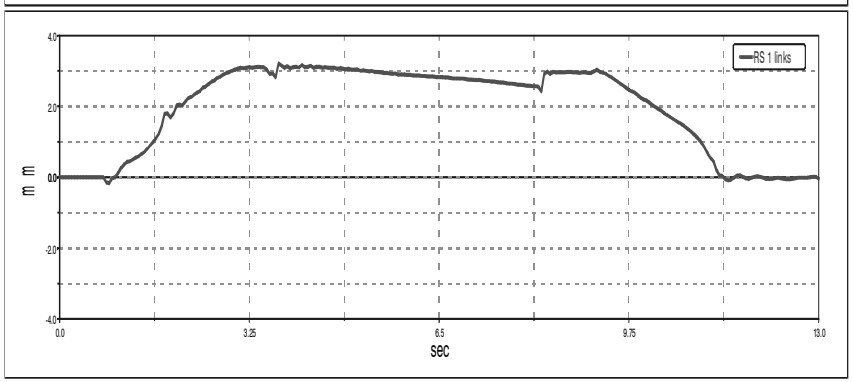
Simulation

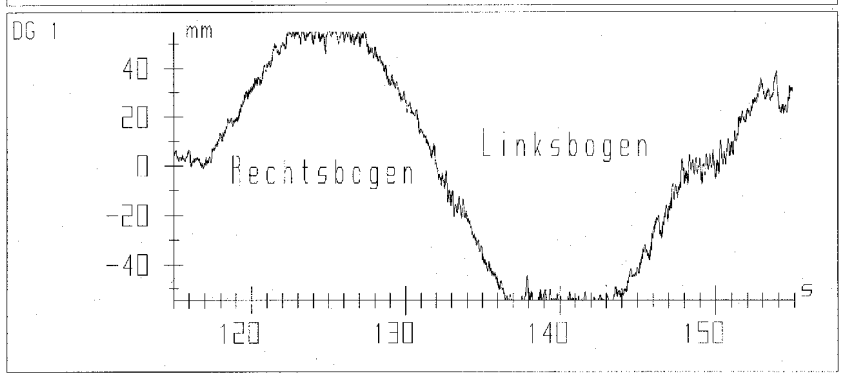




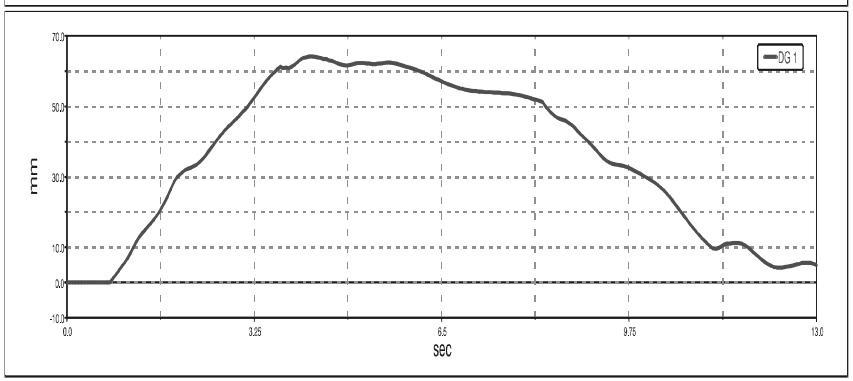
wheelset displacement [mm]





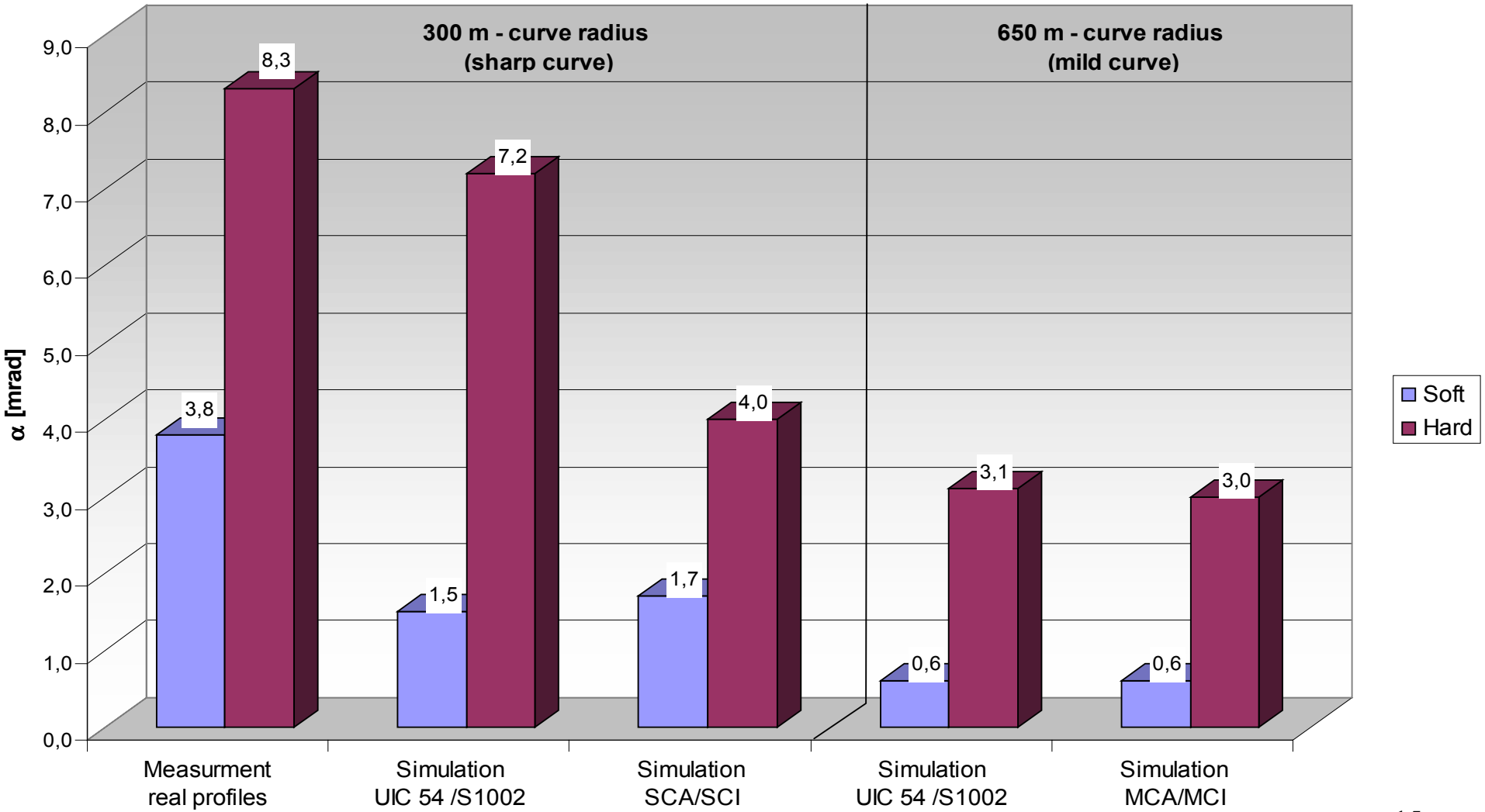


bogie displacement [mm]

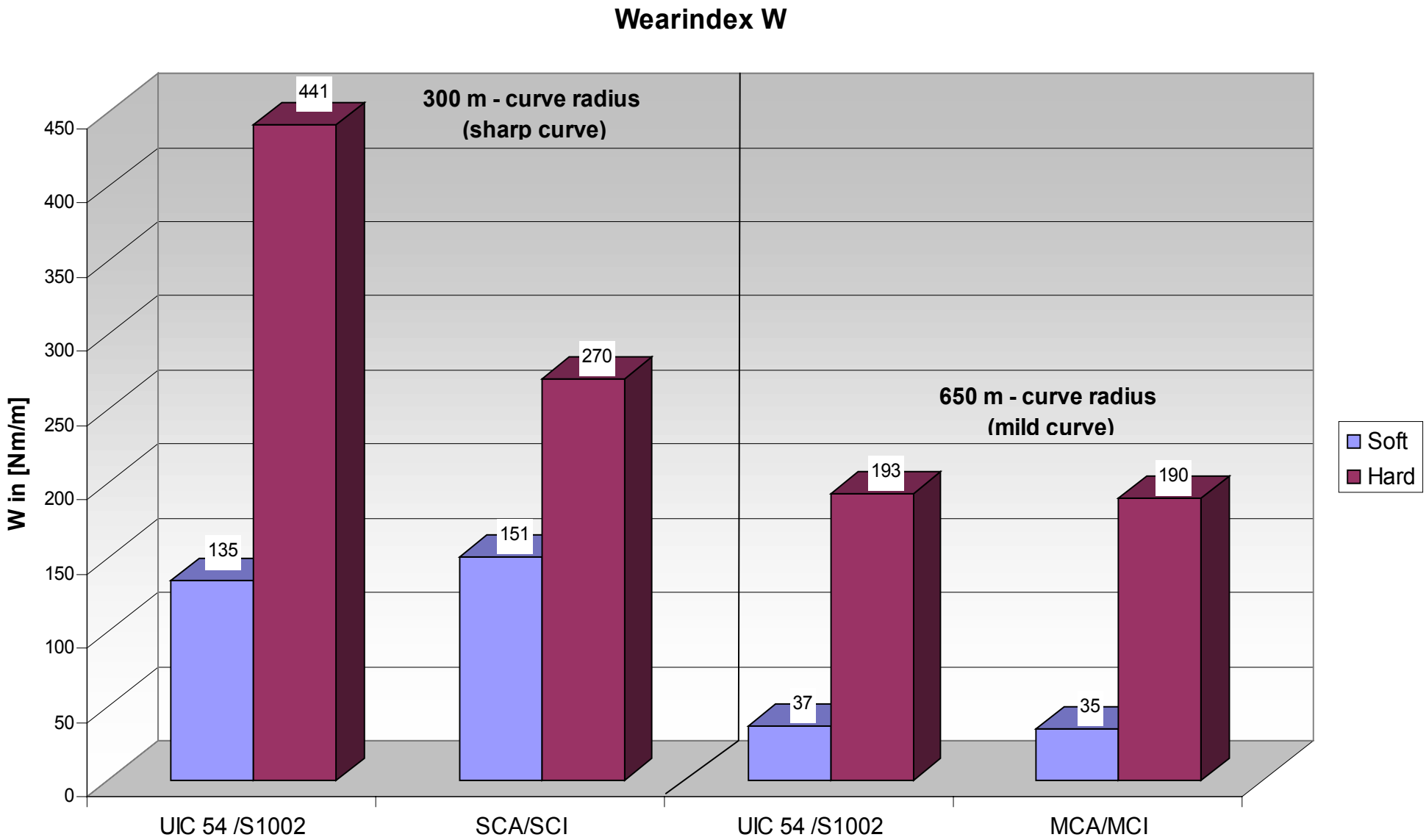


5.3 Corneringability

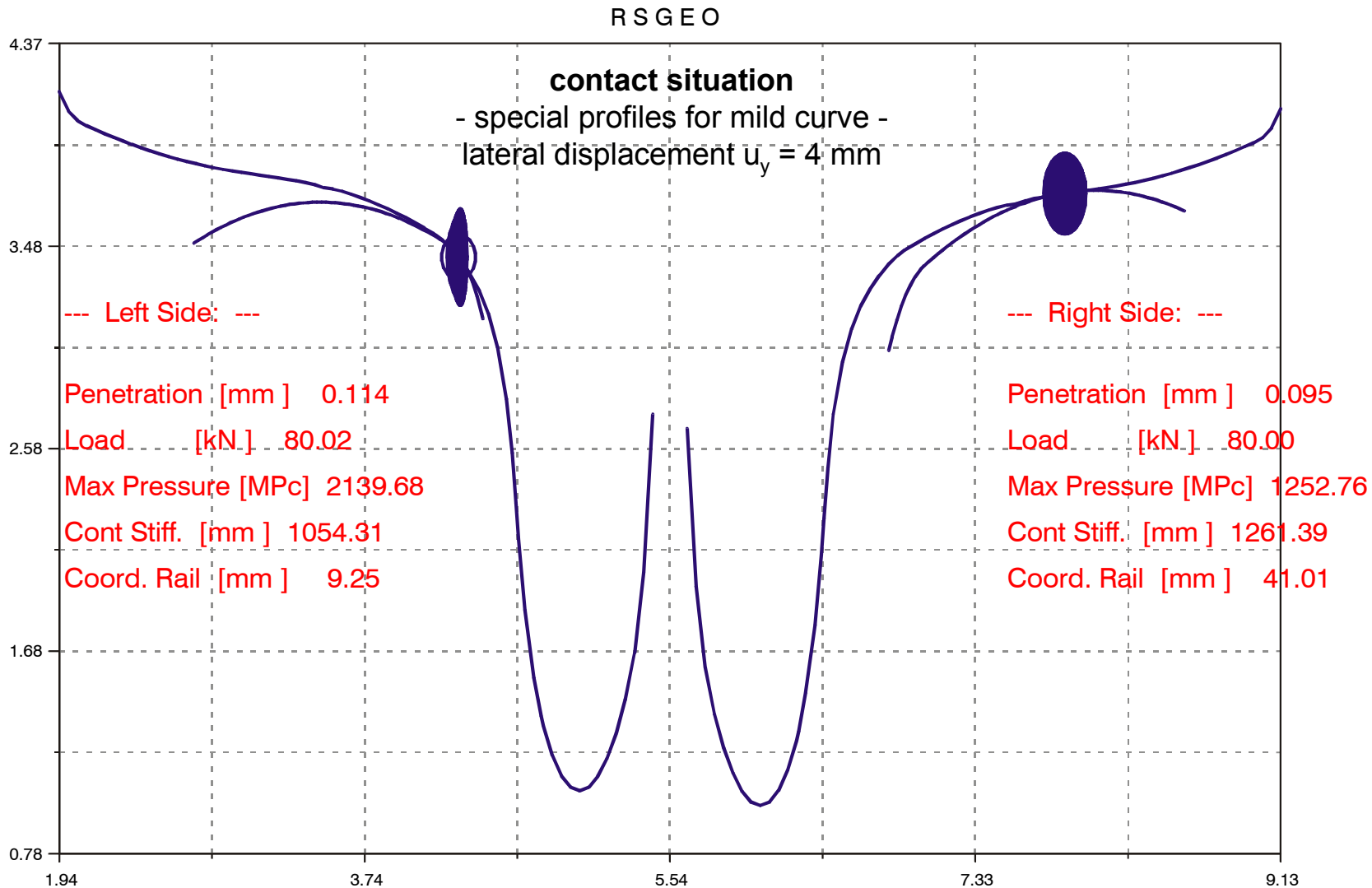
Angle of Attack α



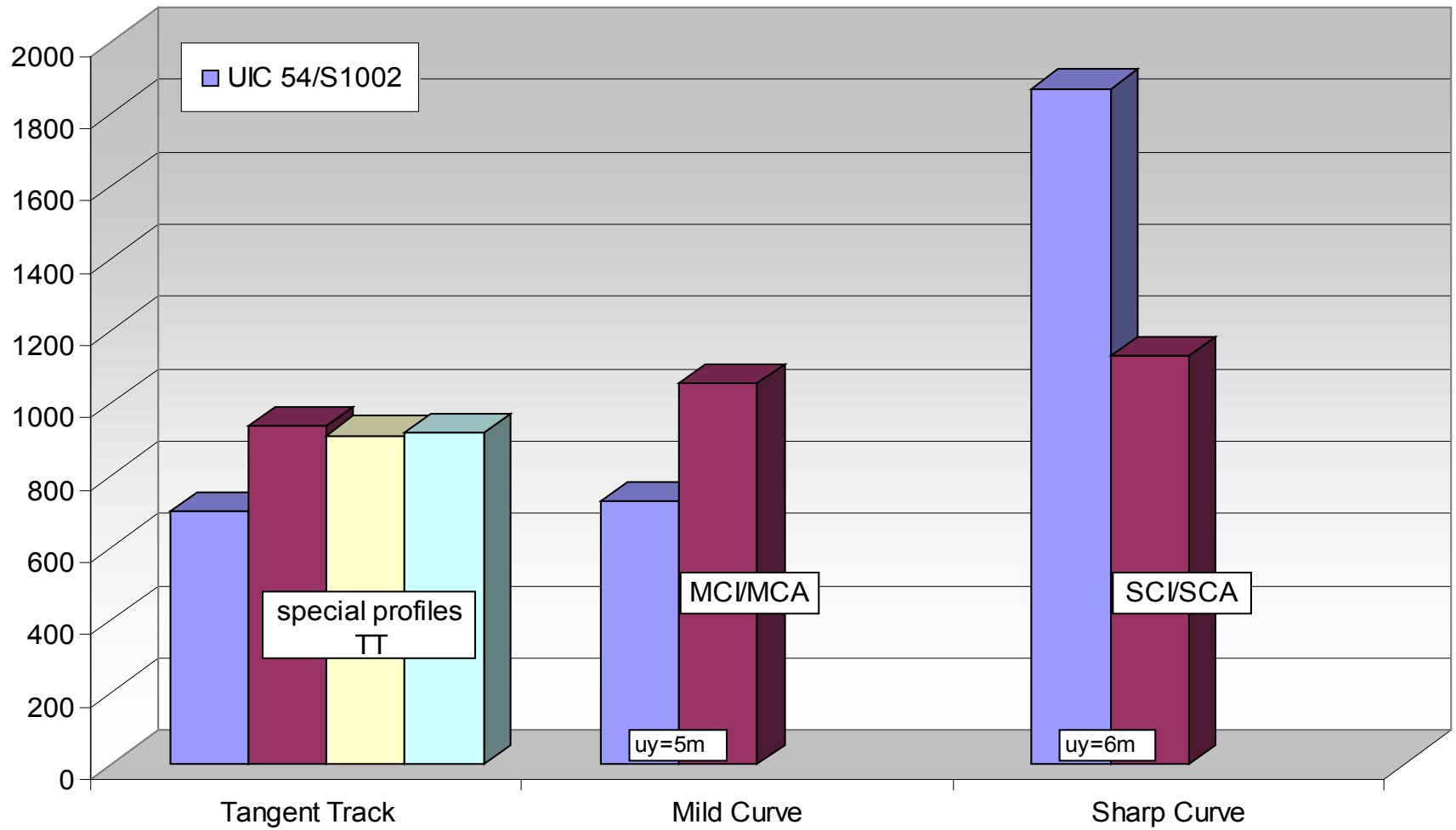
5.3 Corneringability



7. Rolling Contact Fatigue
Surface Pressure



Surface Pressure in MPa
-high rail-



8. Assessment

1. Stability

- All profiles in new state are stable. $v_{krit} > 23$ m/s

2. Corneringability

- Rigid wheelsets: Angle of attack α and wear index W in sharp curves decrease by 50% through special profiles vs. UIC profiles.
- Steering wheelsets: α and W are not improved through special profiles.

3. Rolling Contact Fatigue

- In tangent tracks all profiles are uncritical.
- Special profiles in mild curves are critical (> 2.500 MPa).
- UIC profile in sharp curves are critical (> 1.500 MPa).

4. Long Term Behaviour

- Contact points show a good wear behaviour for all profiles.
- UIC was created as a “wear” profile and is welltried.

5. Practical Use

- 3 profiles in tangent tracks and 2 profiles in curves require a high precision and a lot of experiences in the field of manufacturing and maintenance.
- Transition from one to another profile is problematic.
- Even the exact preservation of the lateral rail profile (UIC) is difficult.

6. Costs

- Manufacturing costs of special profiles increase by 30%, but not with worn profiles.

⟹ **Special Profiles** in general have better riding qualities in tangent tracks and curves but high expenditures.

⟹ **UIC Profiles** with steering wheelsets have the same riding qualities but lower expenditures.

The biggest improvement is not achieved through optimised profiles but through constructive changings at the vehicle (soft bushing for steering wheelsets) and with an accurate condition of the profiles´ property.