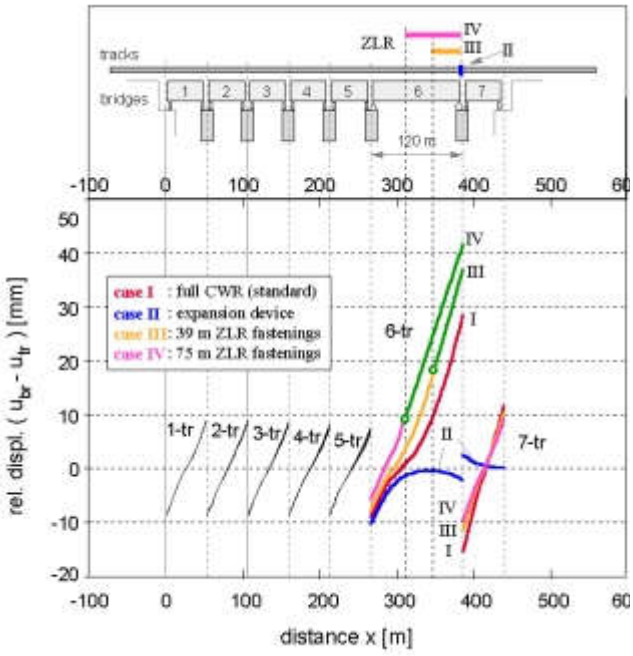
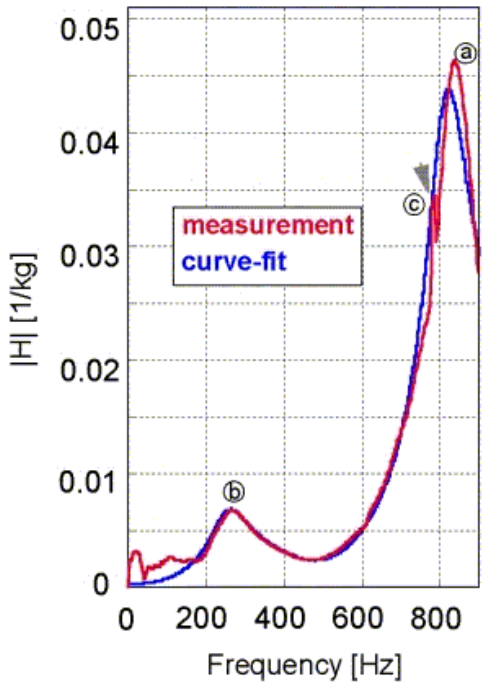
RECENT GRADUATE STUDIES RAILWAY ENGINEERING

Student: **R.C.M. Delhez**
Date:6 October 1995
Subject:
Longitudinal forces and displacements in CWT track on long bridges.
Description:
Due to temperature variations, considerable longitudinal rail forces and displacements may develop in continuous welded rail (CWR) track on long-span bridges or viaducts. Excessive relative displacements between sleepers and ballast bed may disturb the stable position of the track in the ballast which results in a lower frictional resistance. Generally, these problems are solved by installing rail expansion devices in the track. For high-speed track, however, this is not a attractive solution as these devices cause local disturbance of the vertical track stiffness and track geometry which would require intensive maintenance. Initiated by a railway bridge situation near Antoing, Belgium, Delft University of Technology a graduate project was carried out, sponsored by Belgian National Railways (SNCB), to assess the possibility of avoiding expansion joints on long bridges.



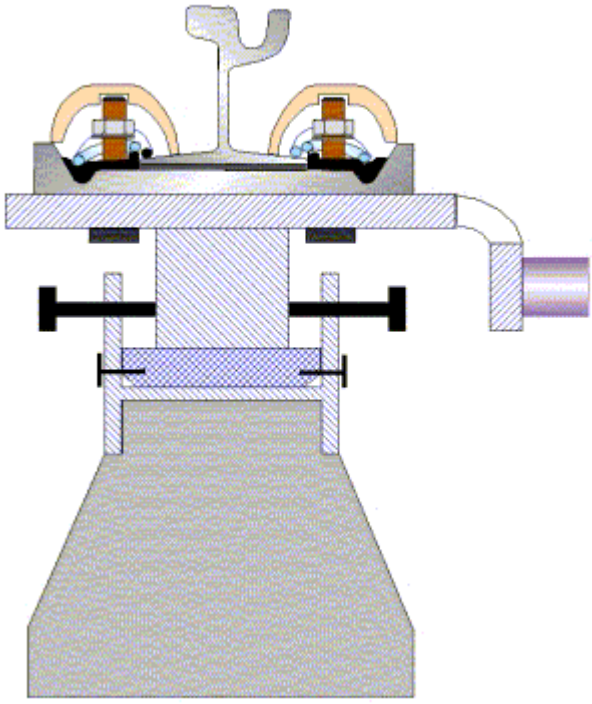
Possible solutions to alleviate longitudinal displacements in CWR track on long bridges (ZLR = zero longitudinal restraint)

Student: **A.P. de Man**
Date:4 October 1996
Subject:
Determination of dynamic properties of railway track using pulse excitation techniques.
Description:
This graduate project concerns the development of an integrated loading, measuring and processing system to obtain dynamic properties of railway track constructions. Existing laboratory equipment was generalised to be used in the real track. Moreover dynamic calculation models and optimalization procedures were enhanced to back-calculate appropriate dynamic track parameters. Laboratory measurements as well as in-situ measurements were carried out with satisfying results. The test system provides for fast determination of quantitative information regarding dynamic track behaviour. As such it is aimed to contribute to the understanding of the dynamic behaviour of railway track constructions, especially regarding the future dense and high speed or high load train transportation systems.



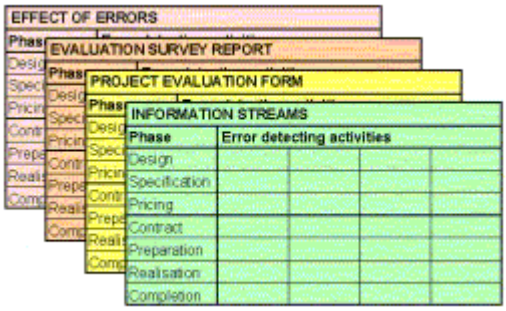
Frequency Response function of measurement and curve-fit result

Student: **A.H. Nolles**
Date:4 October 1996
Subject:
Research of the buttress variant used in open tramway track constructions.
Description:
In this graduate project the problems were examined arising with the so-called buttress construction which is being used in lawn track constructions for tramway lines. Possible failure modes of this construction type were taken into consideration. To this end in-situ observations and measurements were carried out in close co-operation with HTM (The Hague Tramway Company). Based on the acquired knowledge the acting forces were analysed. Calculations were made regarding the strength and deformation mechanisms, including the effect of higher loading in the future. Several constructive solutions were proposed, both for short term (repair actions) and for long term applications (replacement by an alternative construction)



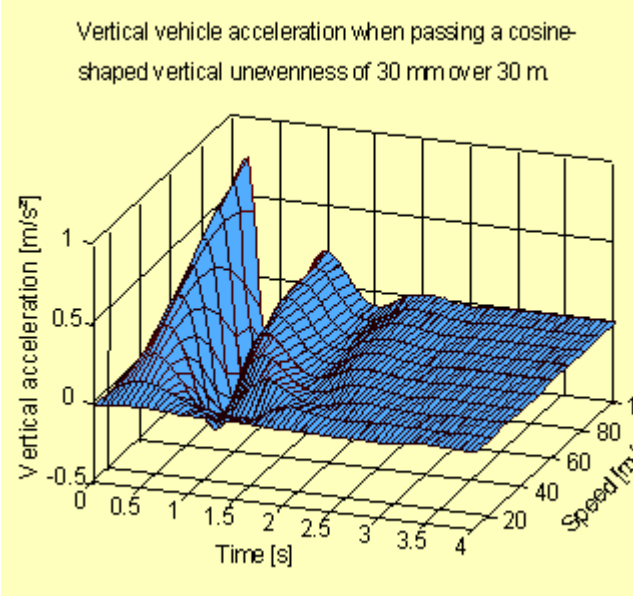
Buttress construction used in lawn track tramways

Student: **M. Reef**
Date:4 October 1996
Subject:
Design of lay-out and verification of railway track geometry using the program INRAIL.
Description:
This graduate research project was concerned with the analysis of the application program INRAIL, which is running under the design software package Microstation. A comparison was made with the 'manual calculation method', currently used in practice. Moreover a conversion program was written based on an extensive programme of technical requirements. Along with the streamlining of the appropriate information this approach resulted in a very useful practical result. The project was mainly carried out in-house at STRUKTON Railinfra Projects.



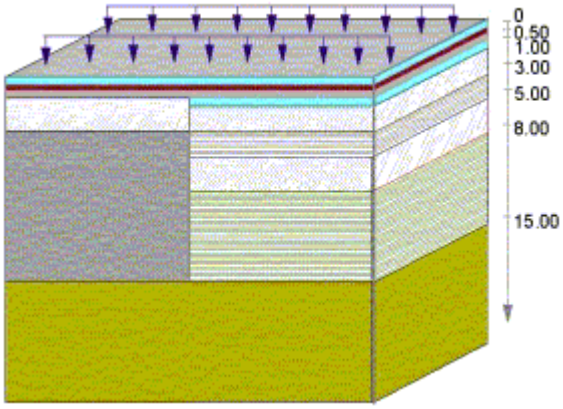
Global view of organisational tables to minimise errors in rail track building activities.

Student: **R.B. Schooleman**
Date:28 February 1997
Subject:
Railway track transition bridge/viaduct to embankment for the high speed line.
Description:
In this graduate project the problems occurring at the transition area of bridge or viaduct to embankment v.v. at high speed are discussed. The discontinuity in the form of a vertical stiffness jump and a permanent settlement difference can results in high vertical accelerations and dynamic wheel-loads. The transition area was modelled using the program TILLY and a parametric investigation was made. Include in the study was also a determination of the critical speed of a high speed track built on a soft subgrade. The checking with various criteria resulted in proposals to increase the stiffness by soil strengthening and adapting the stiffness and geometry course along the longitudinal direction. The results correspond very well with other independent results abroad.



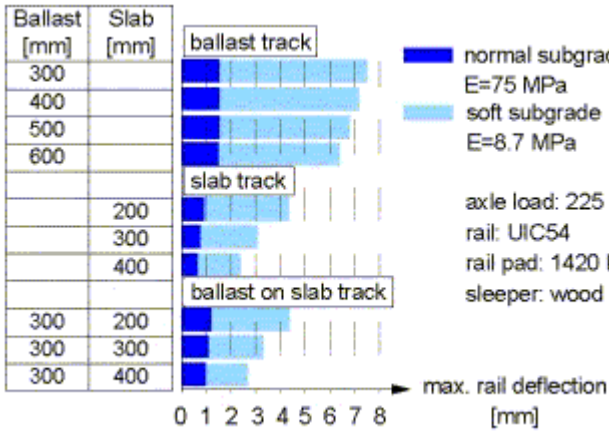
Vertical car body displacements at discontinuity

Student: **Y.H. Norg**
Datum:28 February 1997
Subject:
Unequal settlements under embedded rail constructions.
Description:
The graduate project concerns the settlement behaviour of slab track with embedded rail supported by a multi-layer soil system. After a literature study and exploration of the problem a settlement model was designed using the program PLAXIS, where the track was modelled as a multi-layer system. For two representative soil profiles the increase of the permanent deformation was determined due to a repetitive track loading. Moreover an investigation was carried out regarding the possible occurrence of soil swelling next to the railway track and the effect of possible local lacking support of the track at a settlement jump along the longitudinal direction. The results are of great interest with a view to the intention of building a test track incorporating embedded rail in the near future in the Netherlands.



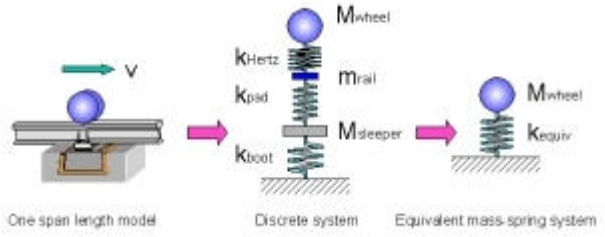
Model of embedded rail construction on two adjacent soil profiles to calculate settlements.

Student: **A. Van Esschoten**
Date:27 June 1997
Subject:
Calculation of railway track superstructure and formation using the program GEOTRACK.
Description:
The graduate project concerned a thorough exploration of the (static) three-dimensional program GEOTRACK, when applied to Dutch railway tracks. First, a well-known analytical solution was checked with the program. Then a comparative investigation was carried out where corresponding rail deflections, support reactions, and soil stresses were determined of a ballasted track (two depths), a slab track (three depths) and a reinforced track (slab track under ballast, two depths). All variants were calculated for two cases of subsoil conditions (normal and soft subsoil). A number of important conclusions could be drawn with respect to quantitative effect of alterations in the constructive design of railway track.



Comparison of maximum rail deflections of several rail track constructions and varying parameters

Student: **J.W. Diels**
Date:26 June 1998
Subject:
Evaluation of existing and alternative track systems for Madrid Metro.
Description:
This graduation project was focused to answer Metro Madrid's question whether the existing track type (block track) should be retained or should be replaced by a possible better alternative. Six track types were selected to investigate their dynamic properties. Experiments were carried out to establish the value of some dynamic parameters. Then the mechanical behaviour of the track types was modelled and simulated using the program RAIL. The results showed no significant differences.



Model simplification with equivalent dynamic behaviour

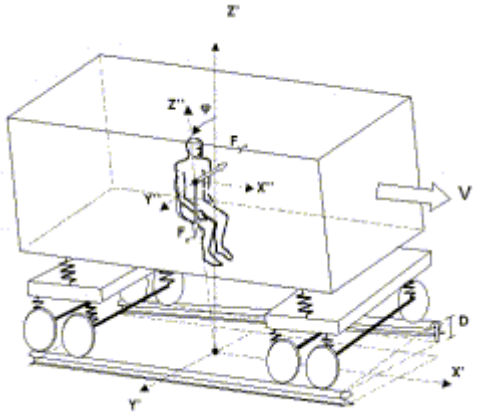
Student: **K.H. Oostermeijer**
Date: 26 juni 1998
Subject:
Dynamic behaviour of embedded rail construction (ERC) for the High Speed Line. (in Dutch)
Description:
In this graduation project a dynamic investigation was made to whether the embedded rail concept might be applied for in a high speed rail track. This ballastless track type is very attractive in terms of availability, durability and lasting track geometry but could develop unexpected dynamic effects at high speed. Based on measurements at embedded rail a number of simulations were carried out using RAIL to check this behaviour. which showed no negative effects at the anticipated speeds.

Hammer excitation testing of embedded rail construction

Student: **A.D. van der Vlugt**
Date: 26 June 1998
Subject:
Development of working regulations for rail track constructions (in Dutch)
Description:
This graduation project was concerned with working regulations used in building new rail infrastructure. This project was initiated following a request of Madrid Metro company to compare the current technique (block track) with alternative rail systems. Also a list of building defects, with their effect on service life, was produced. It was show that quality control during the design, work preparation and building is essential to prevent small and large building errors. The block track system was found to be suitable indefinitely within specific conditions.

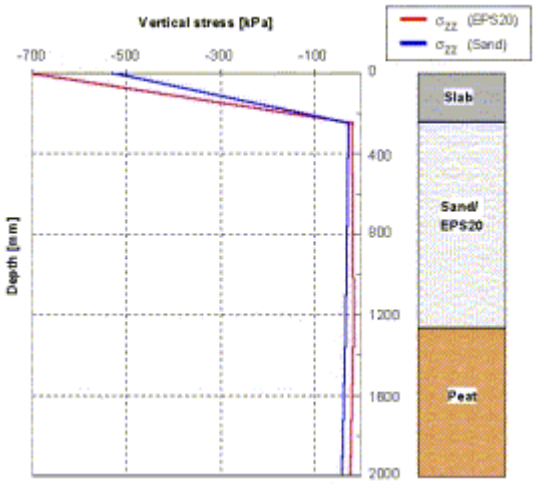
Picture of Metro Madrid's block track (photo AZ)

Student: **D.J. Vermeij**
Date: 28 August 1998
Subject:
Vehicle dynamic and passenger comfort related to track geometry in high speed track (in Dutch);
Description:
The effect of a chosen track geometry, with given vehicle properties and (high) speed, on the comfort experience of passengers, was investigated. First, the notion of passenger comfort was defined followed by a critical review of standards and criteria. Then a suitable geometric spacial model was developed, including vehicle and bogie behaviour (model ICE). To quantify the dynamics a simulation programme was written (SimHSL) to assess a number of typical geometric situations. As a case the route of the future Dutch High Speed Line was chosen.



Vehicle model on curved track to determine passenger comfort

Student: **R.M. Siderius**
Date: 31 August 1998
Subject:
The feasibility of EPS as a subbase material in a rail structure.
Description:
This study looked at the possible use of the lightweight material EPS (Expanded PolyStyrene) in rail track structures, with the aim to prevent large settlements. A mathematical model was made of a slab track with an EPS-layer underneath. The mechanical behaviour was compared to a classical track on a sand base. A static consideration using the program GEOTRACK, revealed the minimal slab depth and the stress and deformation levels. Some basic dynamic properties were determined using the program RAIL A number of applications were indicated. Finally, a global life-cycle cost calculation was made.



Vertical stress development of embedded rail track on either sand or EPS foundation

Student: **H.T. Adema**

Date: 26 February 1999
Subject:

Finite element modelling of embedded rail structures.

Description:

Edilon b.v. – the largest manufacturer of embedded rail systems – asked Railway Engineering to develop a finite element calculation method to predict the results of testing in laboratory. These laboratory tests are essential for approval by railway authorities, but they are quite time and money demanding. Initially, the focus of the project moved from tests on the structure in general to tests to determine component properties. These properties, the designed geometry and (train) loading specifications were input for calculations in ANSYS. Based on the results of experiments of embedded rail structures in laboratory, the general model has been tuned and improved, which finally led to a valuable tool for the both the commissioning company as for Railway Engineering.

The subject of the graduation study was the modelling of an embedded rail structure to enable a fast calculation of alternatives and to support a testing programme of this type of structure.

The present design of embedded rail was modeled and several types of loading were simulated.

Student: **J.M. Zwarthoed** (student of the Section Concrete Structures; Railway Engineering (50%))

Date: 28 September 1999

Subject:

A sleeper of reinforced concrete for light-rail applications

Description:

A fatigue analysis was carried out on a reinforced monoblock concrete sleeper using a suitable variable load pattern. It was shown that crack width is also an important aspect. Since a design regulation for reinforced concrete sleepers is missing, the design procedure was validated using existing sleepers to reach comparable safety margins.

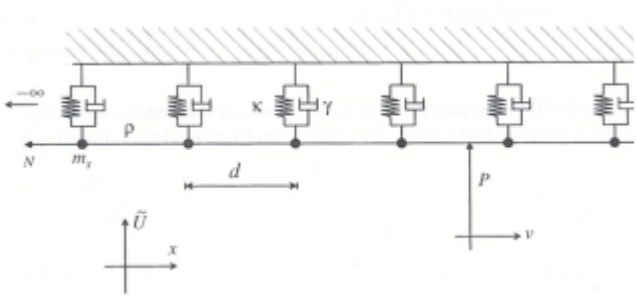
Reinforced sleeper design for light-rail application

Student: **J.J. Velten** (student of the Section Structural Mechanics in cooperation with Railway Engineering)

Date : 16 April 1999

Subject:

Wave generation in overhead contact wires.



Model for overhead contact wire

Student: **Taco Sysling**

Date: March 2000

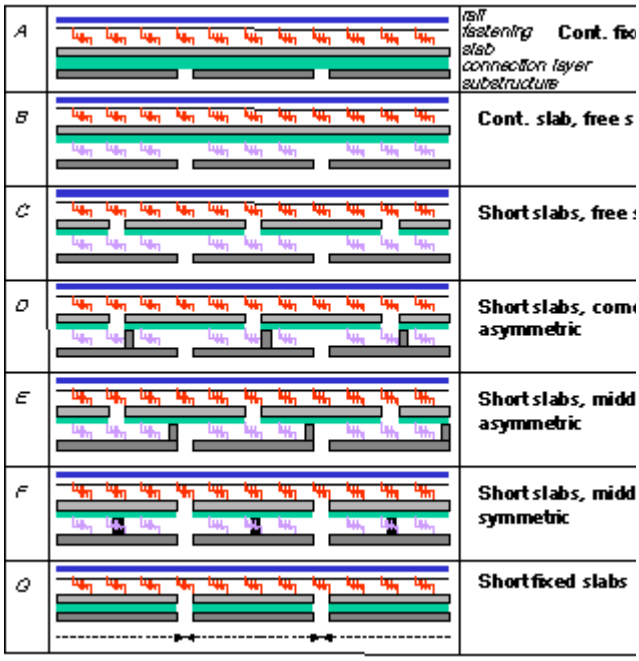
Subject:

Design aspects of the track superstructure on a reduced settlement substructure

Cooperating company: NBM-Rail, Breda

Description:

The MSc research dealt with several design aspects of the track superstructure (slab track) for the High Speed Line South, to be installed on the reduced settlement substructure. Firstly, a review took place on the appropriateness of several rail fastening systems on slab track. The embedded rail system and a direct fastening system (e.g. Rheda 2000) have been considered in the study as promising alternatives. The considered structural systems are listed in the figure. By means of simulations in a finite element program, the behaviour of the structure due to temperature, braking and vehicle loading has been investigated. Also settlements have been considered. At the end of the study, the installation requirements that apply to these track superstructures have been considered.

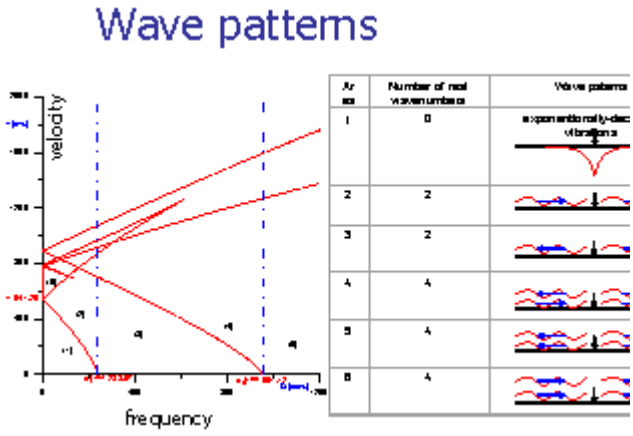


Student: **Manuchehr Shamalta** (student of the Section Structural Mechanics in cooperation with Railway Engineering)

Date : September 2001

Subject:

Dynamic response of an embedded railway track to a moving train.

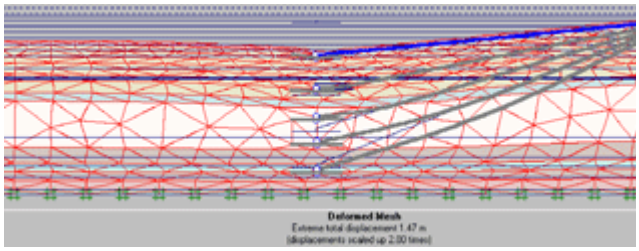


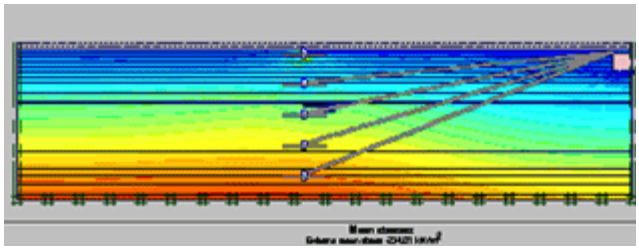
Student: **Henk Hogeweg**

Date: January 2002

Subject:

Design of the transition structure from engineering structure to plain track





Cooperating company: Strukton Railinfra

Description:

Due to differential settlements track maintenance is necessary at regular intervals. To limit this work transition slabs are applied, supported by the engineering structure and following the settlements of the subgrade. The work carried out was focusing on the optimization of this design.

The calculations have been performd with the FEM model PLAXIS, for a characteristic soil profile obtained from the Betuwe Route.

Student: **W.-J. Zwanenburg**

Date: 5 September 2002

Subject:

EcoSwitch: Feasibility Study on a Switches & Crossings Maintenance Management System

This feasibility study was assigned by the International Union of Railways (UIC), and dealt with the setup of a Maintenance Management System for railway switches and crossings (S&C). This decision support system, referred to as EcoSwitch is considered an extension of the already existing EcoTrack system for plain track. The results showed that the system would be financially and technically feasible.

The future project should focus on obtaining information about the actual switch condition for the long term prediction of failures, aiming at increasing reliability and availability of a railway network .

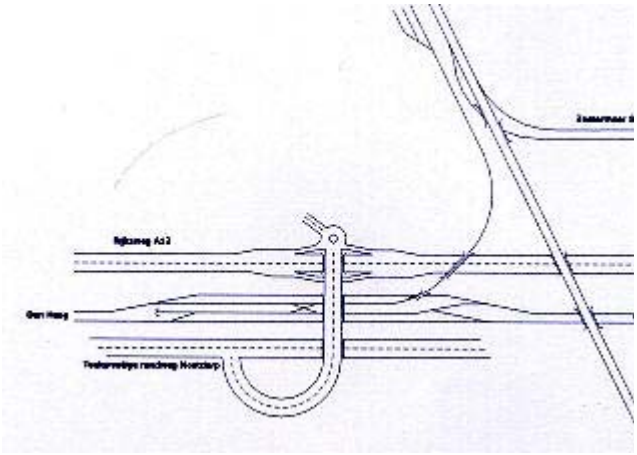
Student: **U. Nooitmeer**

Date: 4 October 2002

Subject:

Impact Railway Bridge on stability and longitudinal forces in the Nootdorp Curve

In this study the longitudinal behaviour of the Nootdorp curve, comprised of a 128 long railway bridge with tight adjacent curves, was investigated. The conditions for CWR were determined with the use of the program CWERRI.



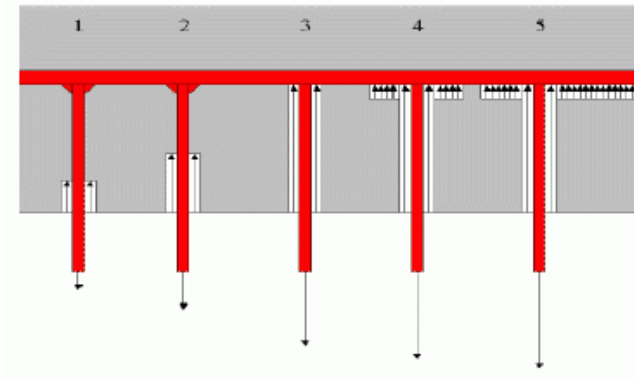
Student: **Pieter Konings**

Date: March 2005

Subject:

A study on the life time effects of the Rheda 2000 track system

The study focused on the strength and the fatigue life of the connection between sleeper and slab of the Rheda 2000 system on the HSL-Zuid . The dynamic force calculations were carried out with the finite element package RAIL, whereas for the fracture mechanics analyses special software was developed in Java. A relationship could be established between the fatigue strength of the sleeper connection and the deviation of the track geometry, from which an admissible value for geometrical track deviations could be derived.



Student: **Arnoud van Rossum**

Student: **Erik Bronsvoort**

Student: **Doesjka Warmerdam**