

Written Exam Rail Transport

Written Exam	Rail Transport
Teacher	Van Zuilekom
Course code	201100013
Date and time	26-6-2012, 13:45 – 17:15 hour
Location	OH 114
Remarks	Closed book, calculator allowed Formulas and tables are, when necessary, are part of the question.

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Calculation of the marks:

- The maximum number of points, P_{max} , is 100
- The marks for the written exam, C , is calculated by the sum of points, P , times ten divided by the maximum number of points:

$$C = 10 \cdot \frac{P}{P_{max}}$$

- Available time is 210 minutes.
- The points per question roughly reflect the time needed for answering the question.

Question 1 [10 points] Travel time ratio

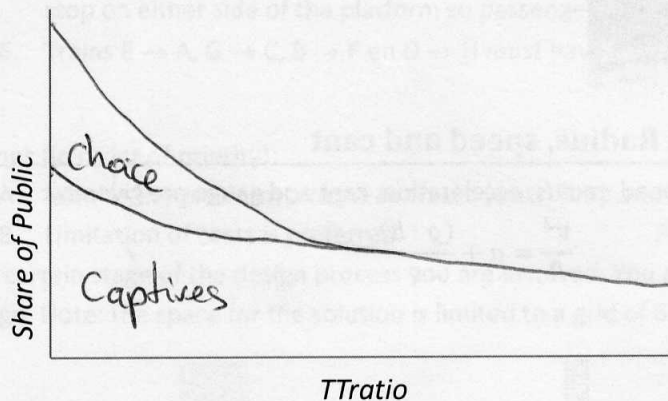
On a journey from A to B the travel time ratio ($TTratio$) is defined as the ratio of travel time by public transport ($TT_{publictransport}$) and the travel time by car (TT_{car}):

$$TTratio = \frac{TT_{publictransport}}{TT_{car}}$$

Give comment on the following statements:

- a) [3 points] The $TTratio$ is of limited relevance for the choice passenger.
- b) [3 points] The $TTratio$ is of limited relevance for the captive passenger.
- c) [4 points] The $TTratio$ is of large importance for the public transport operator especially in specific situation.

Illustrate the answers with a graph.



Question 2 [5 points] Goods transport characteristics

In goods transport we distinguish three categories of transport: (1) full train load, (2) unit cargo and (3) intermodal transport. Give an overview of the logistic principle for these three categories.

Question 3 [5 points] Axle configuration

Rolling stock can be classified by the axle configuration: (1) fixed axles, (2) bogies and (3) articulated bogies.

What are the consequences of axle configuration on:

- a) [2 point] minimum radius in curves
- b) [2 point] interior layout for passenger trains
- c) [1 point] loading capacity for goods trains?

Question 4 [5 points] Monorail versus tram

Siemens developed in the past a monorail system (named SIPEM, Siemens People Mover). It has been applied in Dortmund and Dusseldorf. Several years ago Siemens stopped further development and decided to focus on tram technique for urban public transport.

- a) [4 points] Give an overview of similarities and differences between monorail and tram in terms of: infrastructure and quality of service.
- b) [1 point] What are your arguments in favor of a tram?



Question 5 [10 points] Radius, speed and cant

The relationship between speed, radius, acceleration, cant and gauge are given by:

$$\frac{v^2}{R} = a + \frac{(g \cdot h)}{s}$$

Where:

v = speed [m/s]

R = radius [m]

a = acceleration [m/s²]

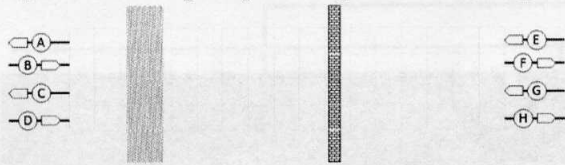
g = gravity constant [9.81 m/s²]

h = cant [m]

s = gauge [m]

- a) [4 points] Explain why cant is of influence on the forces felt by the passenger. Use a drawing of the forces working on a passenger to support the arguments.
- b) [2 points] Explain why at very low speeds the minimum radius in a curve is not determined with the formula above.
- c) [2 points] In practice cant is limited. Why is this the case?
- d) [2 points] What is the function of the transition curve? Which variables will change in the transition curve?

Question 6 [15 points] Track design



For a new situation (picture above) infrastructure has to be designed.

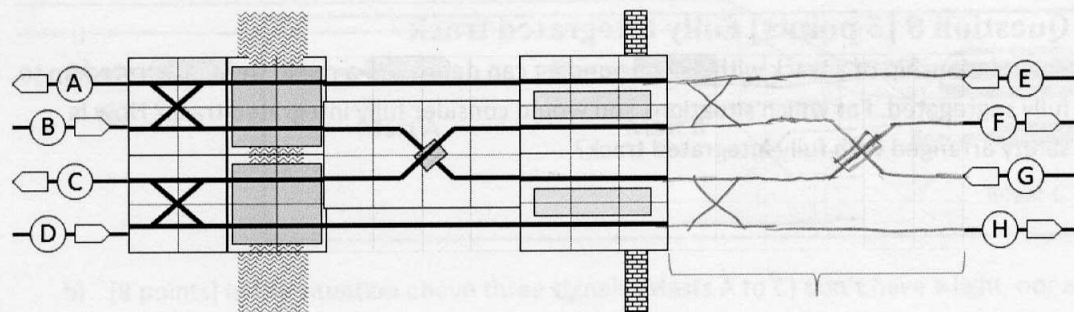
The demands for this new situation are:

1. The new station must be connected to Main street (the platform must overlap Main street at some point).
2. Use a bridge to cross the river.
3. Only use standard elements.
4. Train movements from E to A and from G to C must have independent routes and stop on either side of the platform so passengers can change trains "cross platform".
5. Train movements from B to F and from D to H must have independent routes and stop on either side of the platform so passengers can change trains "cross platform".
6. Trains $E \rightarrow A$, $G \rightarrow C$, $B \rightarrow F$ en $D \rightarrow H$ must have independent routes.

Wishes (in order of priority):

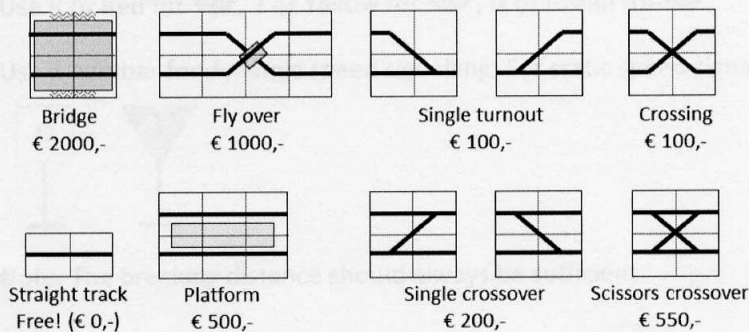
- A. From every platform a route to tracks (exits) A up and including H is possible.
- B. Limitation of costs is preferred.

At a certain stage of the design process you are involved. You are asked to complete the design. Note: the space for the solution is limited to a grid of 6×4 units.

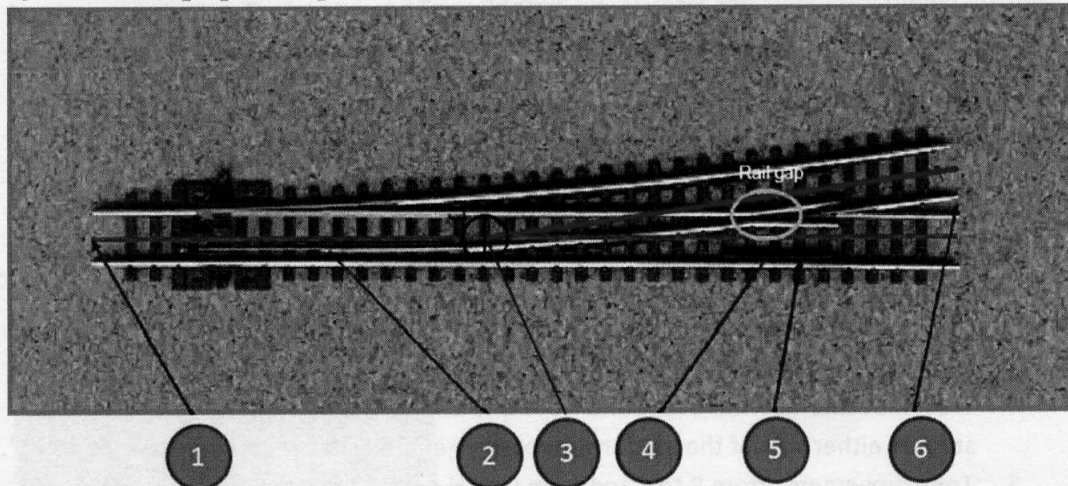


To be completed

Standard elements to be used:



Question 7 [5 points] The turnout



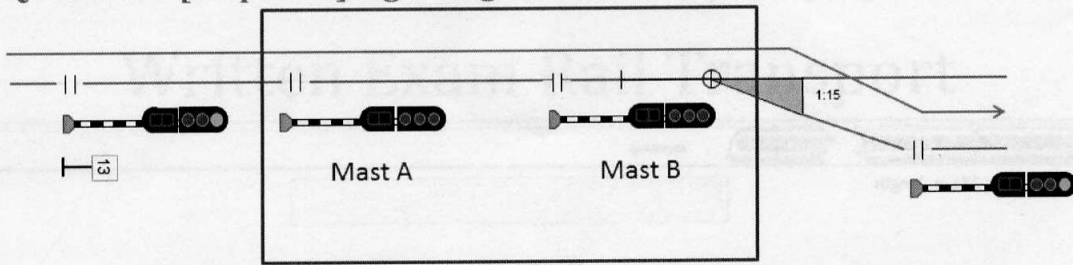
Which element of a standard turnout (see picture above) is the:

- a) frog (1..6)
- b) tongue (1..6)
- c) check rail (1..6)
- d) mathematical or intersection point (1..6)
- e) rear (1..6)

Question 8 [5 points] Fully integrated track

The relationship of a track with its surrounding can be defined in a range from integrated up to fully segregated. For which situations you would consider fully integrated track? How is safety arranged with fully integrated track?

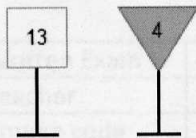
Question 9 [15 points] Signaling



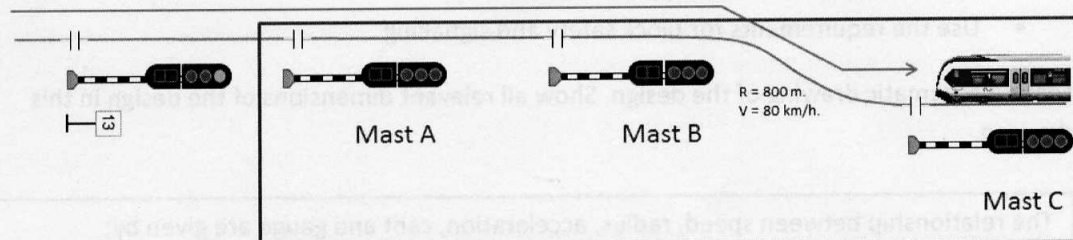
- a) [7 points] In the situation above two signals (Mast A and Mast B) don't have a light, nor a speed indication. What are the appropriate lights for each of these two signal masts? And what is the speed indication, if applicable?

Use R or Red for , Y or Yellow for , G or Green for .

Use a number for dynamic speed signalling. For static speed signalling use signs such as:



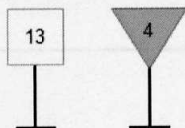
Note: The breaking distance should always be sufficient.



- b) [8 points] In the situation above three signals (Masts A to C) don't have a light, nor a speed indication. What are the appropriate lights for each of these signal masts? And what is the speed indication, if applicable?

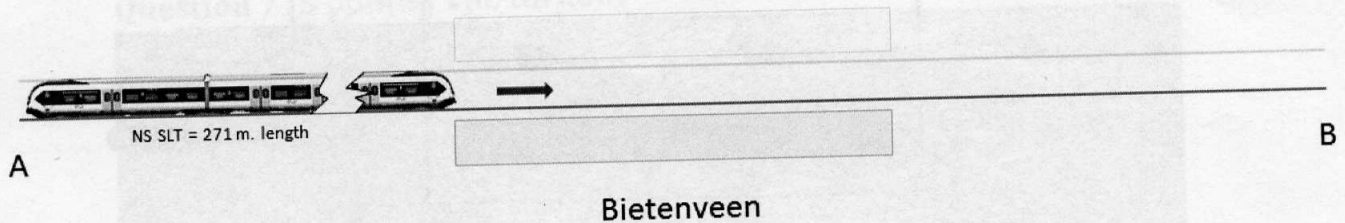
Use R or Red for , Y or Yellow for , G or Green for .

Use a number for dynamic speed signalling. For static speed signalling use signs such as:



Note: The breaking distance should always be sufficient.

Question 10 [25 points] Bietenveen



Between the cities A and B lies the place Bietenveen. In 2016 the rail traffic on the line A to B will increase from 4 trains per hour to 6 trains per hour per direction. To make this possible the Sprinter (stop train) needs to be overtaken by an intercity train at station Bietenveen.

Question:

Design an overtake track for train stop Bietenveen. A design for one direction is sufficient as the situation for the other direction is identical.

The requirements for the design are:

- the design speed for through trains is 140 km/h
- for the diverging traffic the design speed is 80 km/h
- no cant in track or curves
- Bietenveen is a Sprinter station. The intercity train won't stop here.
- At the track SLT Sprinters rolling stock with a maximum length of 271 meter is used
- Use the requirements for platform dimensions
- Use the requirements for block safety and signalling

Make a schematic drawing of the design. Show all relevant dimensions of the design in this drawing.

The relationship between speed, radius, acceleration, cant and gauge are given by:

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