Parallel Session 3A – Station Design 2

Railway Transfer Station Design and Performance

Ingo Hansen
Delft University of Technology
Professor
Railway Transfer Station Design and Performance

Content

1. Aim
2. Typology of railway (transfer) stations
3. Appraisal of station accessibility
4. Estimation of station attractiveness and passenger volume
5. Assessment of railway station performance
6. Conclusions
Aim

Design of railway stations varies a lot as of other buildings depending on its transport & traffic function, urban accommodation and architecture.

The objective of this presentation is introducing
• Parameters for principal design of railway stations, tracks and platforms
• Performance assessment methods for station transport accessibility, attractiveness, capacity and connectivity
Classification of railway stations

I. Network function

II. Route and line network

III. Track number and usage

IV. Platform arrangement
   1. Horizontal
   2. Vertical
   3. Single line
   4. Two lines

➢ Network function
   • Terminal station
   • Intermediate station
   • (No) Line transfer connection
     ▪ At-grade
       - Merging/Diverging
       - Tangent
     ▪ Grade-separated

II. Route and line network

- Dedicated routes and lines
  - High-speed
  - Metro
- Mixed operation
  - Passenger lines
    - High-speed
    - Intercity/Regional (Express)
    - Rail Rapid Transit
    - Suburban
  - Freight lines

III. Track number and usage

- **Single track**
- **Multiple tracks**
  - 2 tracks
  - 4 tracks
  - ≥ 6 tracks

- **Track usage**
  - Train Operation
  - Shunting
  - Stabling

- **Traffic direction**
  - Monodirectional
  - Bi-directional
Classification of railway stations

IV. Platform arrangement

- by lines
- by direction

Lateral and/or Center

Classification of interchange stations

1. Transport modes interconnected
2. Levels of route alignment (At-grade, Elevated, Underground)
3. Kind of line connection and timetable synchronization

4. Transfer mode (Cross-platform, Grade-separated crossing)
5. Escalator and/or elevator availability
6. Synchronization of arrival and departure times
7. Real-time monitoring of delays and transfer connections

Source: Kruse, 1995
Station Accessibility of population and jobs

- Accessibility index within urban rail network commuting time $\leq 30$ min

Source: Papa & Bertolini (2015)
Station Attractiveness and passenger volume

- Station attractiveness measure by regression analysis based on questionnaire survey w.r.t.
  - vicinity of station and attractiveness of commuting destination station
  - presence of facilities within station
  - railway service
  - presence of facilities around station

Source: Ozaki et al. (2017)
Station Performance Assessment

A. Track capacity
   1. Graphical methods (Time-distance diagram, station track occupation diagram)
   2. Analytical methods (Queuing, Mathematical Programming)
   3. Simulation of (scheduled) train operations

B. Network connectivity
   • Variables
   • Benchmark indicators
   • Case Rotterdam CS
Station Connectivity

- Benchmark indicators
  - Number & kind of connected PT modes $M^k_i$
    (Air, HSR, Rail, Metro, Tram, Bus, Ferry)
  - Number & kind of connected railway stations $S^k_i$
    (International, national, regional, urban, suburban)
  - Number & kind of connected (railway) lines $L^k_i$
    (High-speed, Intercity, Regional, Local, Freight)
  - Number & kind of line frequencies/hour $F^k_i$
  - Volume of passengers boarding & alighting/day $P^k_i$
  - Travel time to destination $T^k_i$

Case Rotterdam CS:

- Number of connected PT modes $M^k_i$: 6
- Number of connected railway stations $S^k_i$: >100
- Number of connected railway lines $L^k_i$: 18
- Number of line frequencies/hour $F^k_i$: 20
- Volume of passengers boarding & alighting/day $P^k_i$: 93,000
Railway Transfer Station Design and Performance

• Conclusions

Railway stations are characterised by great variety of architectural design, scope and functions.

Railway stations are classified by their network function, route and line network, track number and usage, and platform arrangement.

Transport & traffic performance of railway stations can be measured by capacity, accessibility, attractiveness, and connectivity.
References

- Kruse, B (1995), Gestaltungsgrundsätze für Verknüpfungspunkte im ÖPNV (in German), Der Nahverkehr 11, 59-62
- Papa, E, Bertolini, L (2015), Accessibility and Transit-Oriented Development in European metropolitan areas, Journal of Transport Geography 47, 70-83 doi
- Vuchic, VR (1981), Urban Public Transportation Systems and Technology, Englewood Cliffs, New Jersey: Prentice-Hall, Section 5.5.3.1, 416-435
- Weigelt, H (1999), Der Personenbahnhof als Verkehrsknoten (in German), Eisenbahntechnische Rundschau ETR 48(7/8, 430-438