

Pedestrian Evacuation Planning for Major Events

A new Approach Combining Planning Aspects and Human Factors



Love Parade/ Duisburg, 2010



Source: DPA

Hillsborough Disaster/ Sheffield, 1989



Source: Mirror.uk

Research objectives

- Security of attendees during mass events
- Pedestrian evacuation planning:
Spatially wide-ranging evacuation of mass events
 - Visitors are not expected to be out of danger after they have left the building
- Planning decisions: Combining urban design aspects & human factors
 - Existing escape routes ↔ environmental perception and actual use of the routes
→ to speed up evacuation time and improve people's safety



Source: REPKA project

- Open space evacuation of Fritz-Walter soccer stadium
- Up to 50.000 soccer fans
 - potential dangers (fan riots, attacks, large scaled accidents)
- Located in the inner city of Kaiserslautern
- Difficult topography:
 - High building density (residential neighborhood)
 - Only a few roads → Difficulty of completely free access routes
 - 40 meters height difference to the train station
 - steep slopes including stairs

Socio-psychological analysis

- 328 interviews with soccer fans
 - Human behavior in emergency and flight situation (previous disasters)
 - Observations of visitors going home
 - Experience of local security services
- ➔ Evacuation scenario of the soccer stadium



Source: www.falkenhagener-feld-west.de

Urban spatial inventory-taking and analysis

- General traffic routing as basic grid for escape
- Own characteristics: width, soil conditions, barrier-free design, view-shafts,...

Urban design of escape routes

Urban design aspects	Consequences for pedestrian flow
<i>Path widths</i>	Determinate the pedestrian flow rate
<i>Soil conditions</i>	Potential risk of stumbling
<i>Barrier-free design</i>	Handicapped people can hinder a pedestrian stream
<i>View-shafts</i>	Orientation and perception of the optimal route away from danger (as safe and fast as possible)
<i>Lighting</i>	Orientation and perception of the optimal route away from danger (as safe and fast as possible)
<i>Intended obstacles</i>	Intentionally positioned obstacles to avoid bottlenecks



Human factors

Human factors	Consequences for pedestrian flow
<i>Social groups (members stay together or search for each other)</i>	Time delay and physical obstacles
<i>Herding and familiar routes</i>	Existing route grid is not used effectively + Difficulties in directing people on alternative routes
<i>Environmental perception and orientation</i>	Basic requirement to guide people and to give instruction
<i>Mutual assistance</i>	Evacuation is relatively ordered, panic is rare



Socio-psychological analysis

- 328 interviews with soccer fans
 - Perception of escape routes
 - Knowledge of the stadium and its surroundings
 - Information seeking behavior and preferred contact persons in case of emergency
 - Group size and companions, shared arrival
 - Human behavior in emergency and flight situation (previous disasters)
 - Observations of visitors going home
 - Experience of local security services
- ➔ Evacuation scenario of the soccer stadium



Source: www.falkenhagener-feld-west.de

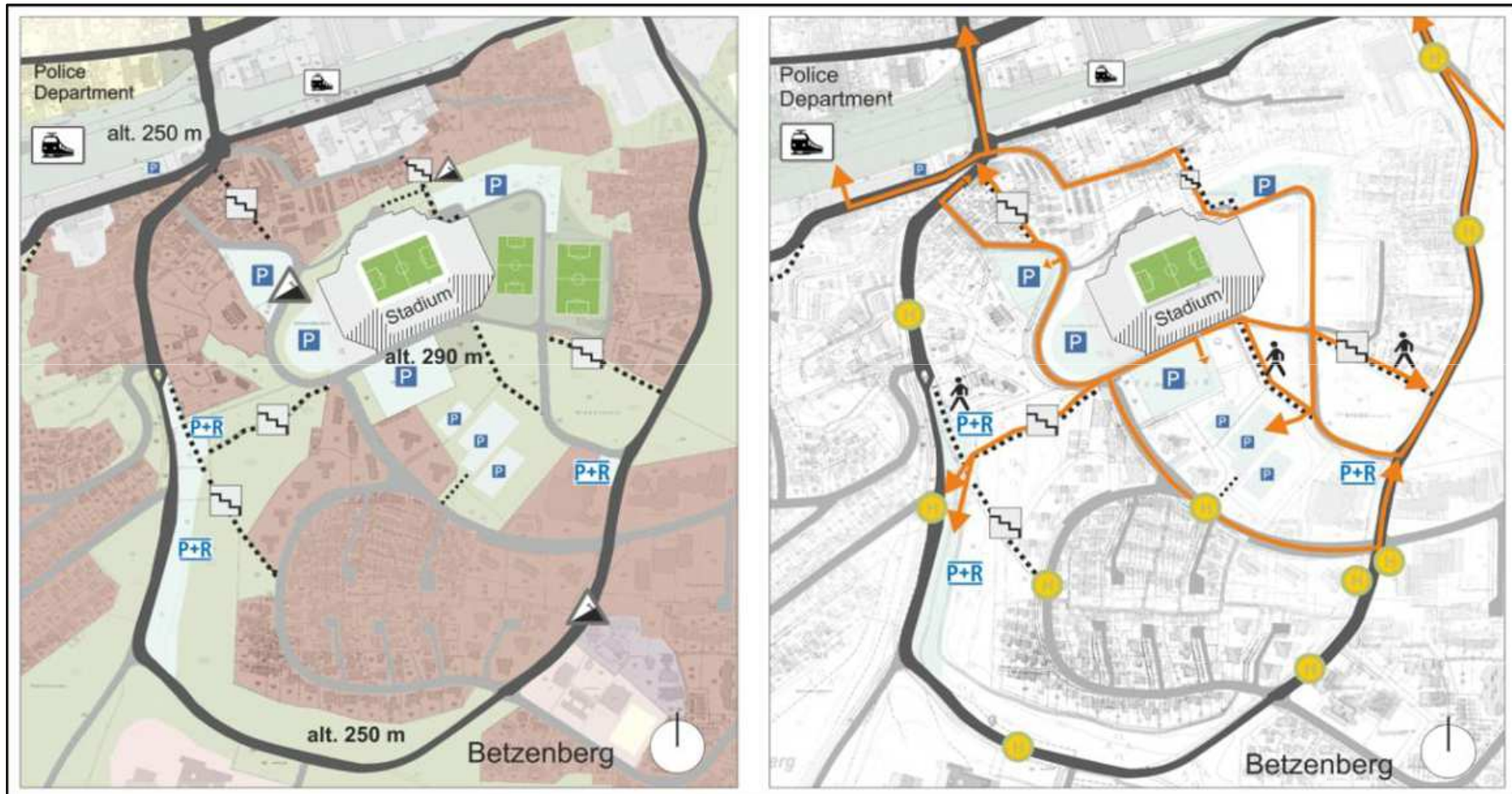
Characteristics and behavior of soccer fans

- Predominance of small (63%) or larger groups (26%)
- Group members have strong ties:
Company of friends (58%), partner (25%) or other relatives (24%)
- Shared arrival (77% travel together)
- High familiarity with the stadium and area around
- Members of the event's security team are preferred contact persons in case of emergency
 - People seek for personal information and focus on other people for orientation

Urban spatial inventory-taking and analysis

- Interdependency of individual perception and behavior of the crowd around
- General traffic routing as basic grid for escape
- Own characteristics: width, soil conditions, barrier-free design, view-shafts,...

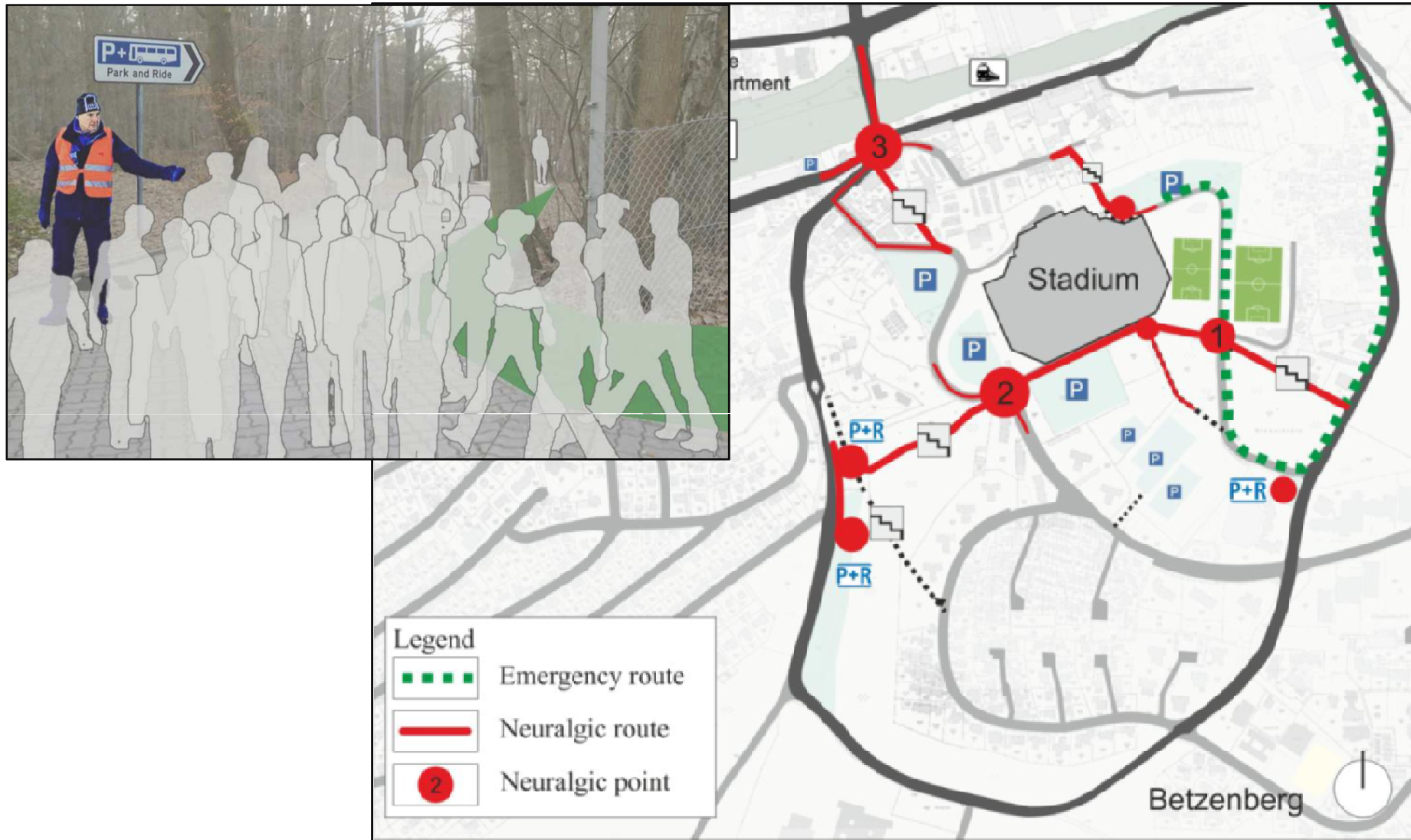
Urban design of the event's surroundings



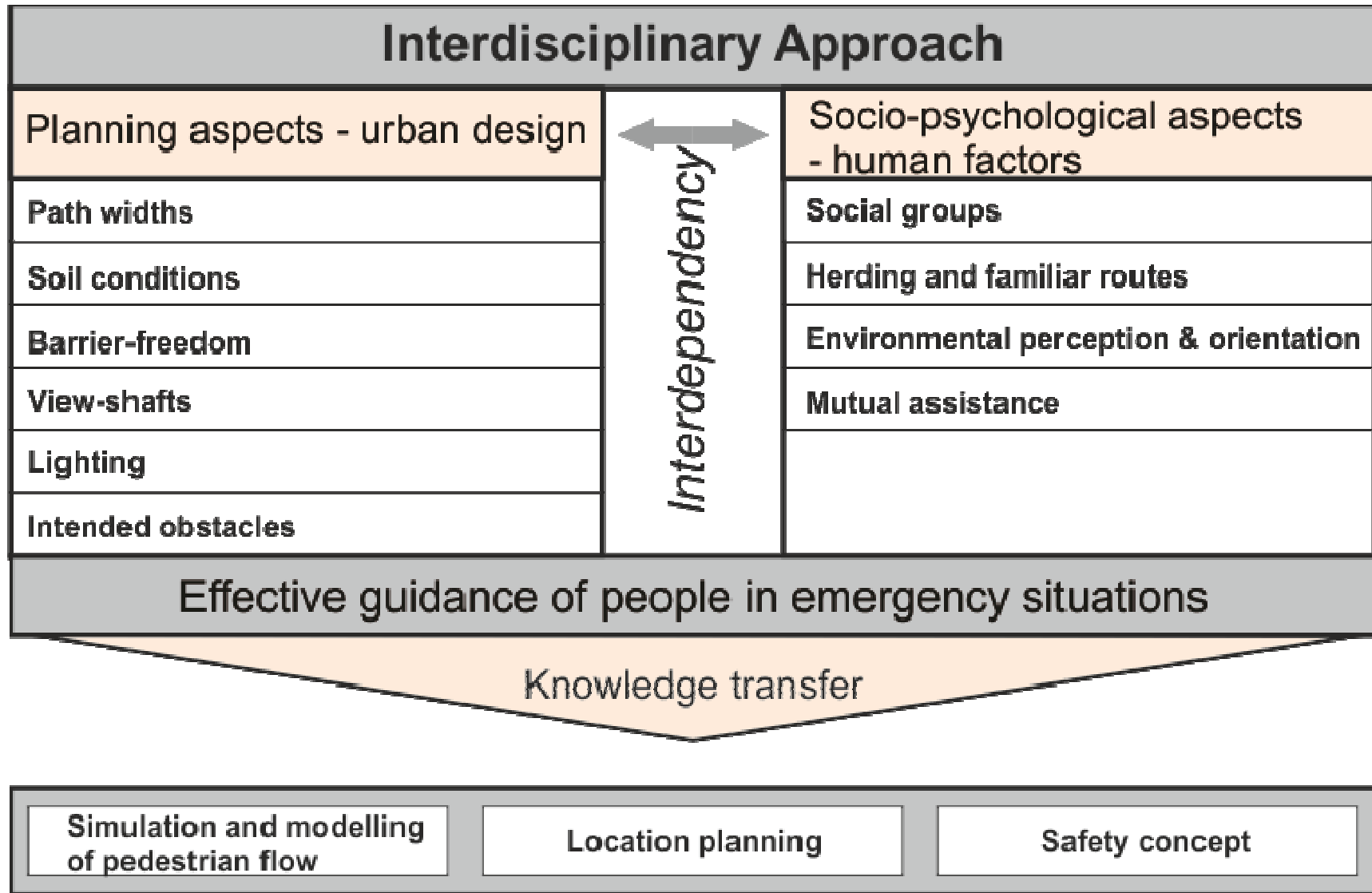
Source: REPKA project

Urban design of the event's surroundings

- Main contents: basic traffic grid, parking, topography, surrounding land-use
- No linear routes leading away from the stadium
- Limited existing view-shafts
- P&R stops are far away (pedestrian flow destination)
- Parking all around the research area



Source: REPKA project



- Combination of urban design and human factors
→ more effective guidance in emergency situations
- Benefits from interdisciplinary approach
- Transfer to simulations models → Helps to identify
neuralgic points
- Further research: behavior of the crowd, behavior in stress
situations, implementation pedestrian evacuation
simulations

Thank you!

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