



Influence of railway interiors on dwell time and punctuality

Dr. Bernhard Rüger and DI. Doris Tuna
University Assistant

Institute for Railway Engineering, Traffic Economics and Ropeways
Vienna University of Technology

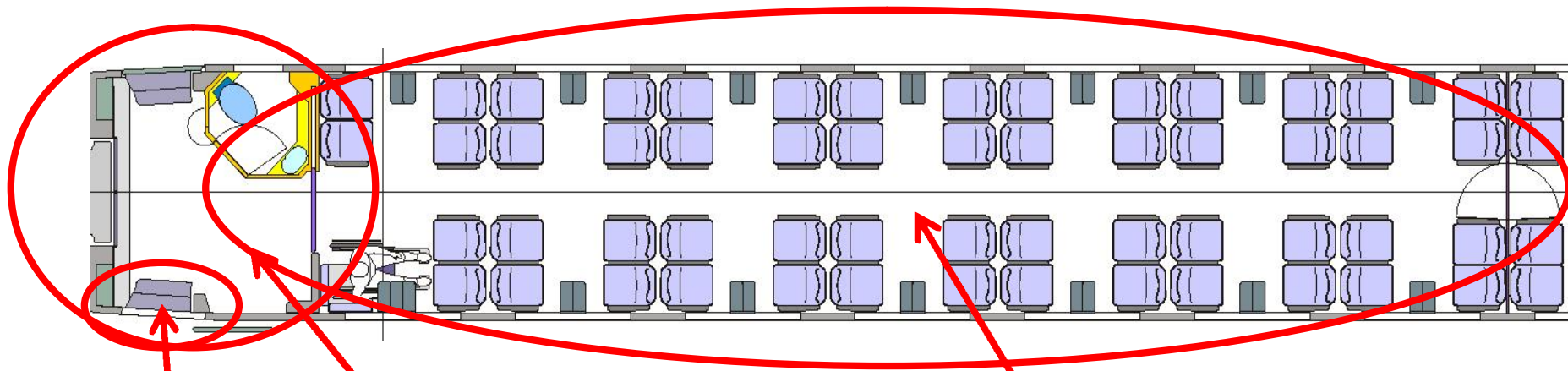
Dr. Bernhard Rüger / bernhard.rueger@tuwien.ac.at
DI. Doris Tuna / doris.tuna@tuwien.ac.at

Why to reduce dwell time?

Trains often run late on main travel days
→ **punctuality**

Without changing schedule (same travel time):
shorter dwell time → longer running time
→ *lower velocity*
→ **potentials for saving energy**

Influence – areas in the vehicle

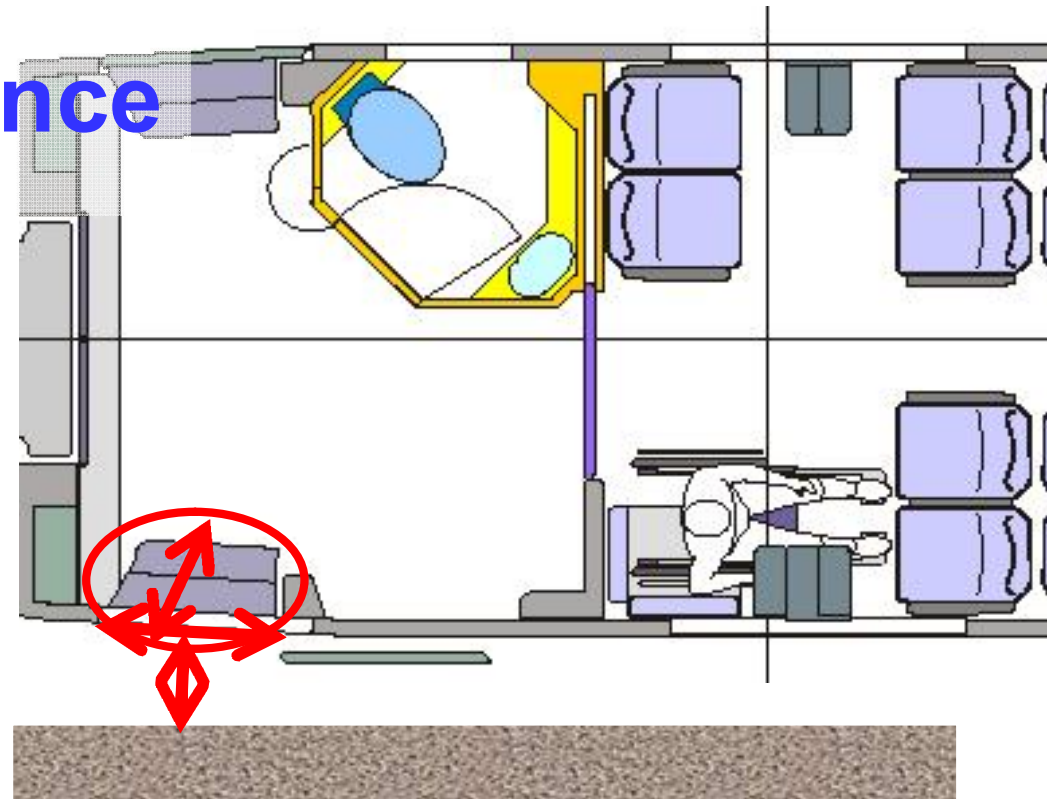
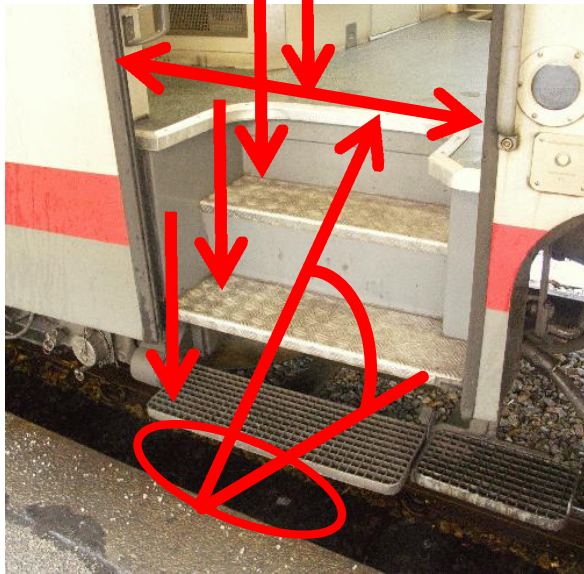


Entrance

**seating area –
vehicle interiors**

**Entrance area –
Retention room**

Influence – entrance



Gap between platform and first step

Number of steps

Door width

Step ratio

Vehicle based

Influence – entrance

handicaps



age

luggage



passenger based

Influence – entrance

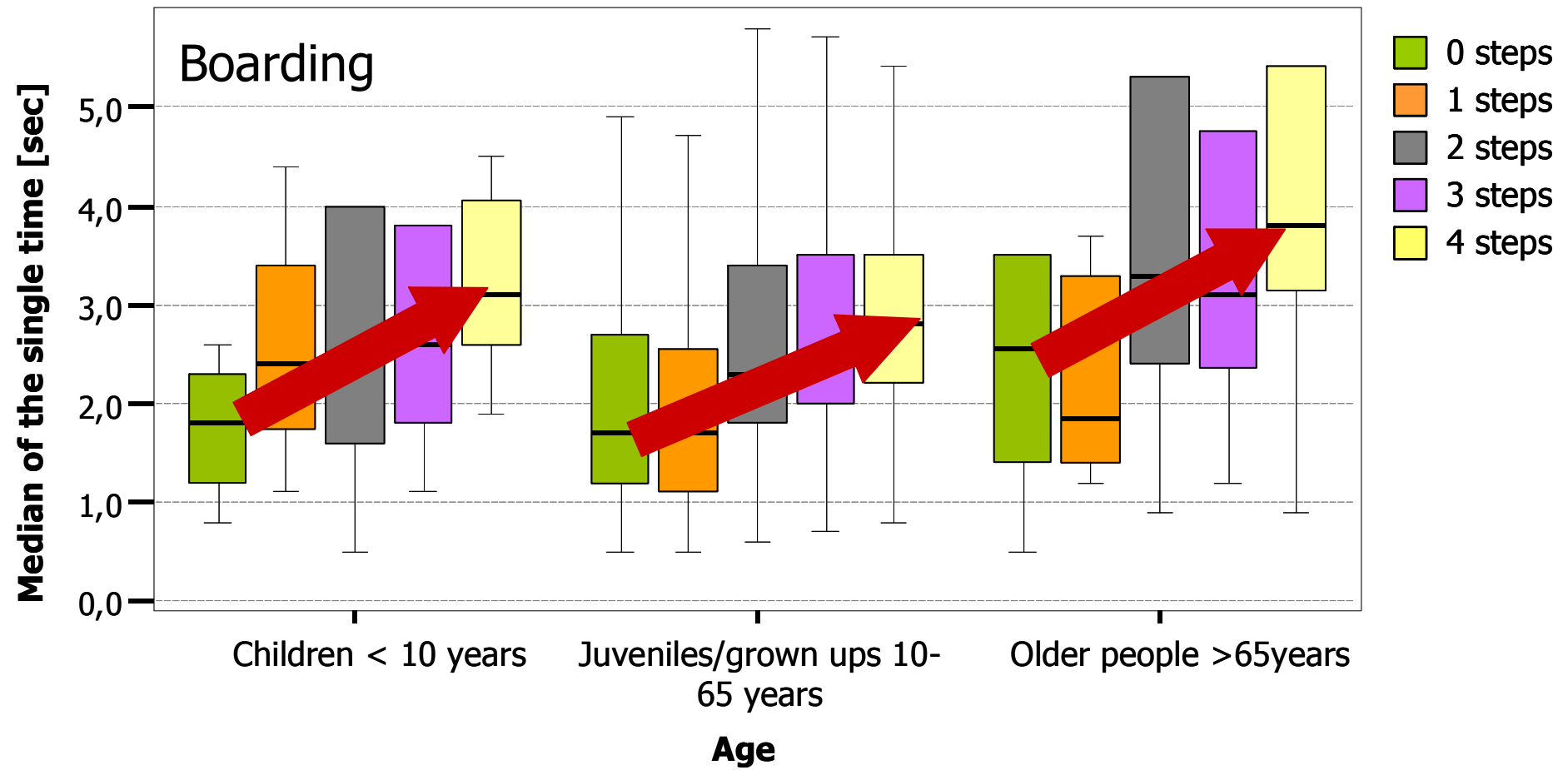


access height
baby carriages



age/handicaps
Combination

Influence – entrance number of steps + age



Influence/ whole boarding process

Main influence: Luggage

causes troubles:

- when **boarding the train**
- **moving along in the train**
 - when **storing**

⇒ **Aftereffect:**

Passengers behave the way, to **reduce** their **own problems**, but enlarge other passengers' or the railway company's difficulties!

Actual passenger behaviour

Passengers want to

- **avoid lifting** their luggage!
- have **visual contact of their own luggage!**

If it is possible somehow:

- Luggage is stored on floor level
- Luggage is stored nearby

Aftereffect:

- Luggage is stored on/ before seats, in the aisle, etc.
 - Comfort restrictions
 - Lower number of actual available seats
 - **Problems when moving along in a train**

Luggage

Average: 1 piece of luggage per passenger
(0.6 one day trip; 1.2 holiday maker)

Trolley ~30-60%

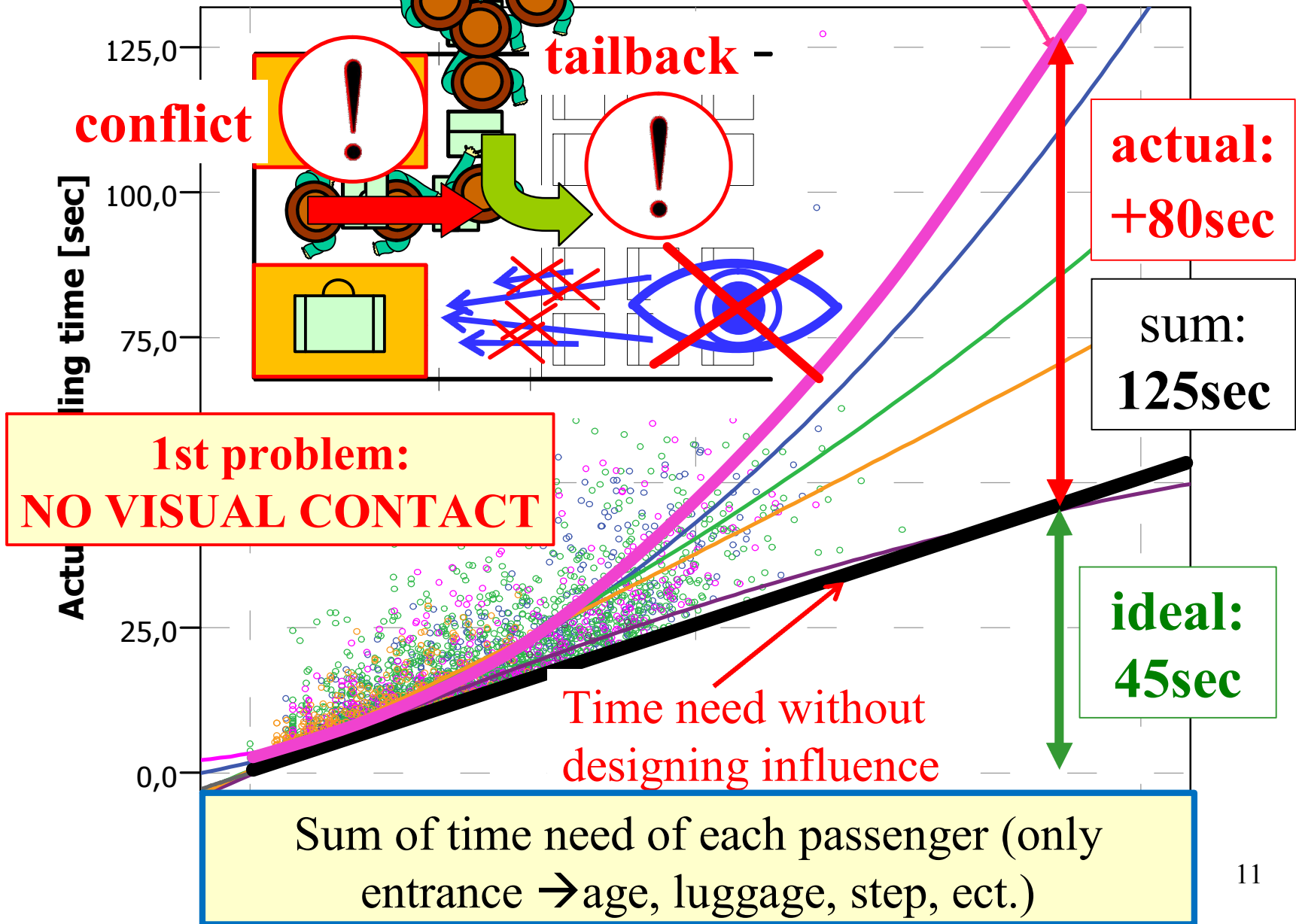
Travel bag ~10-30%

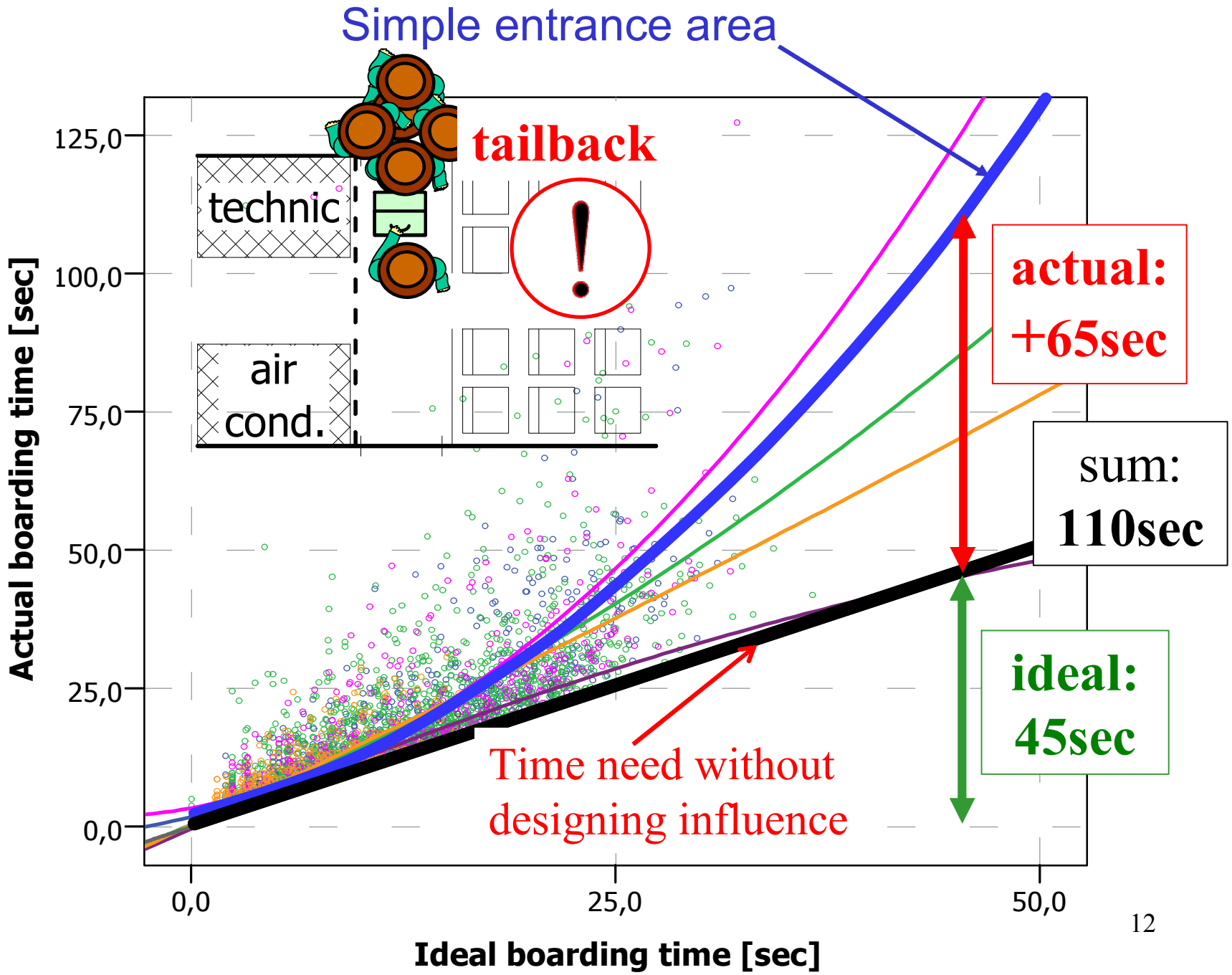
Rucksack ~20-30%

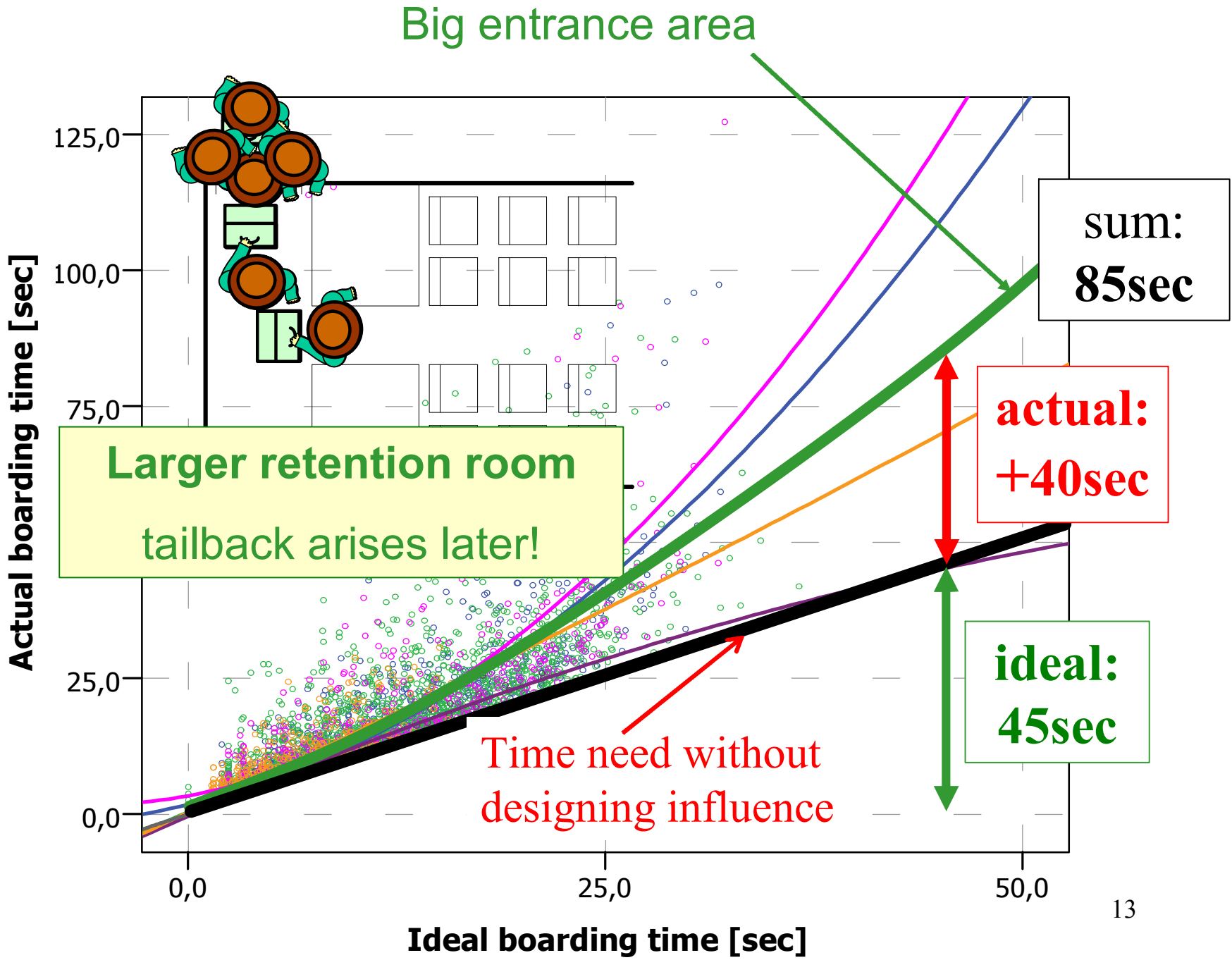


+ ~40% hand luggage

Entrance area with luggage stores



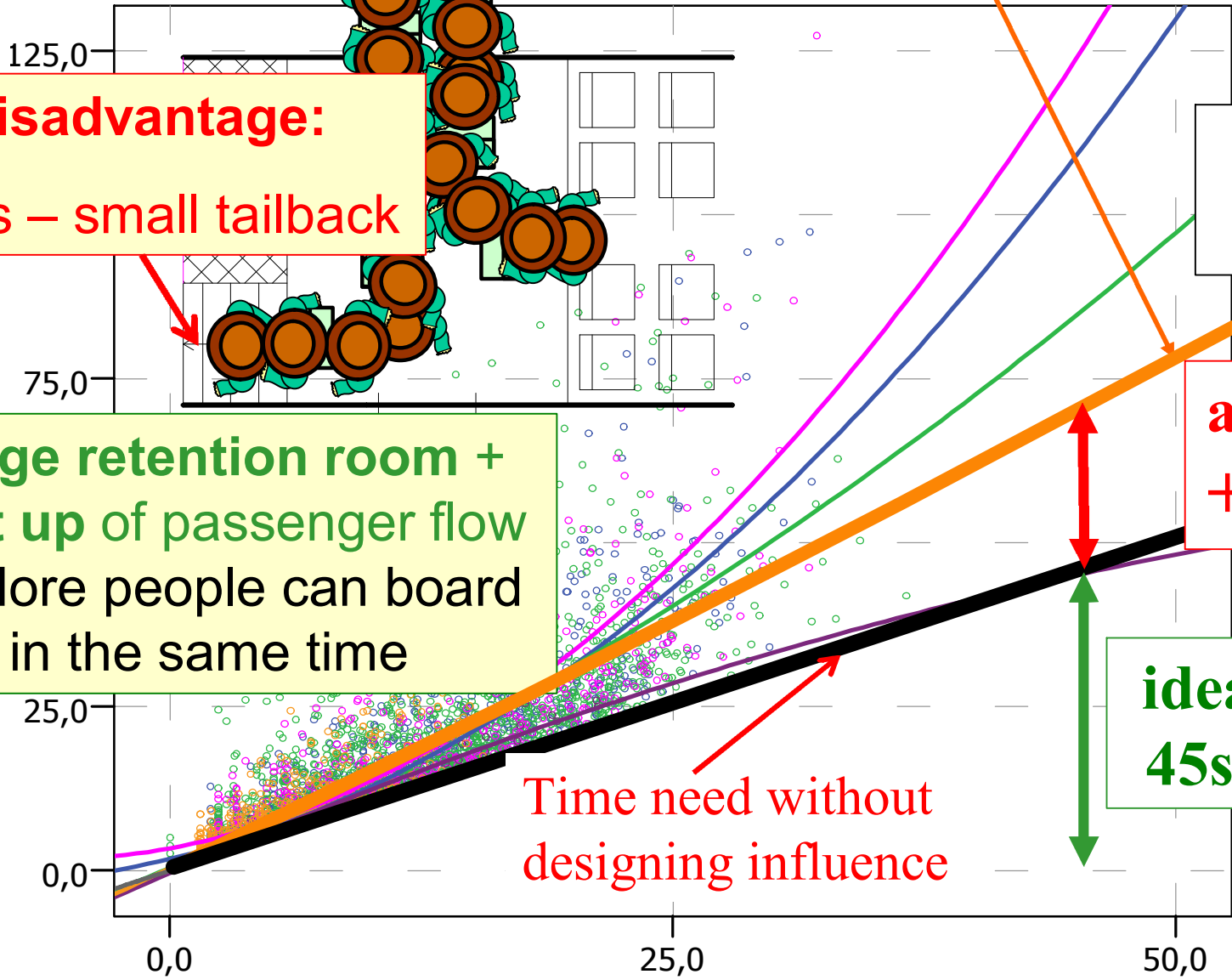




Entrance area of an IC2000

Disadvantage:
steps – small tailback

Large retention room + split up of passenger flow
→ More people can board in the same time



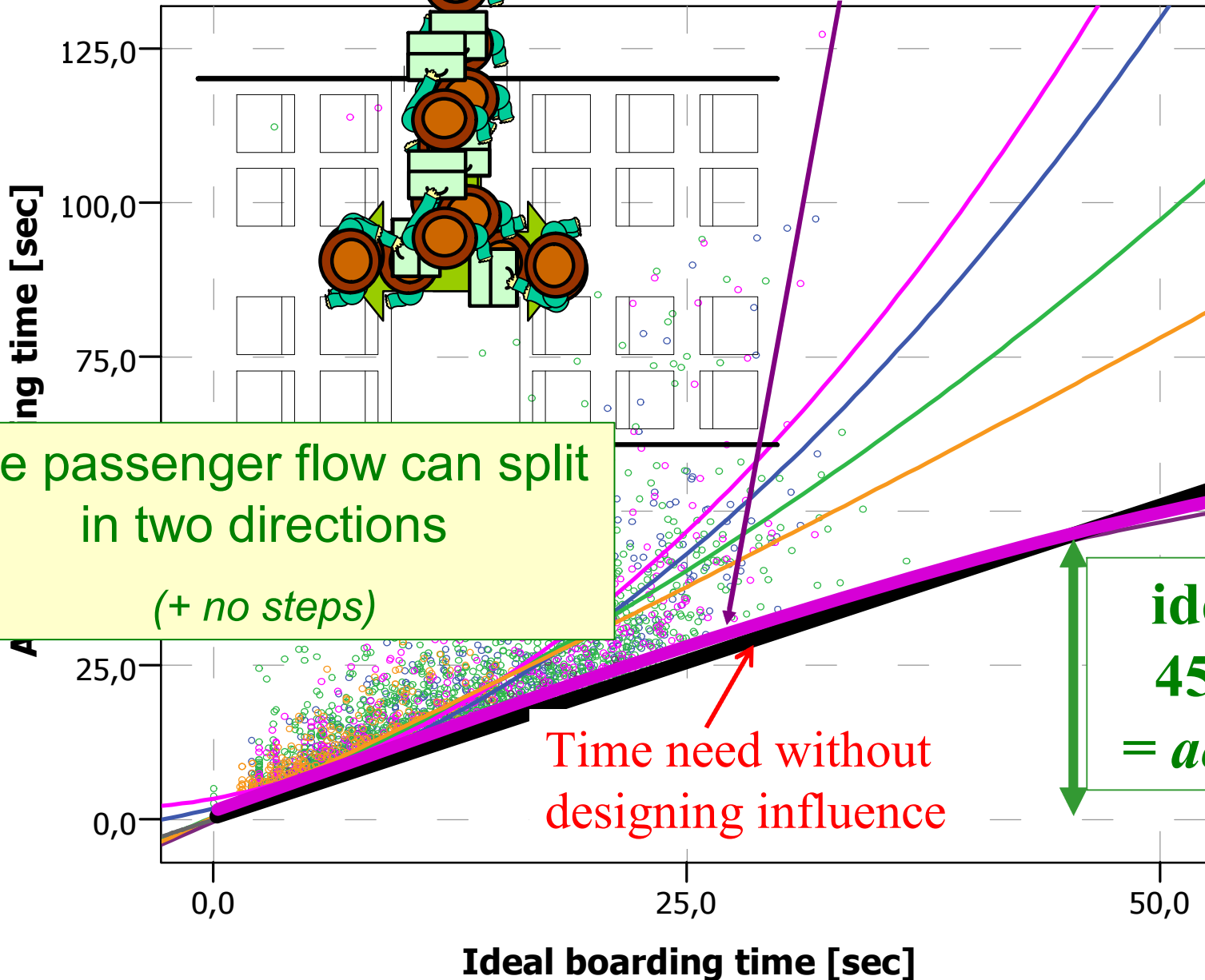
sum:
70sec

actual:
+25sec

ideal:
45sec

Time need without
designing influence

Entrance area with seats on both sides – IC3

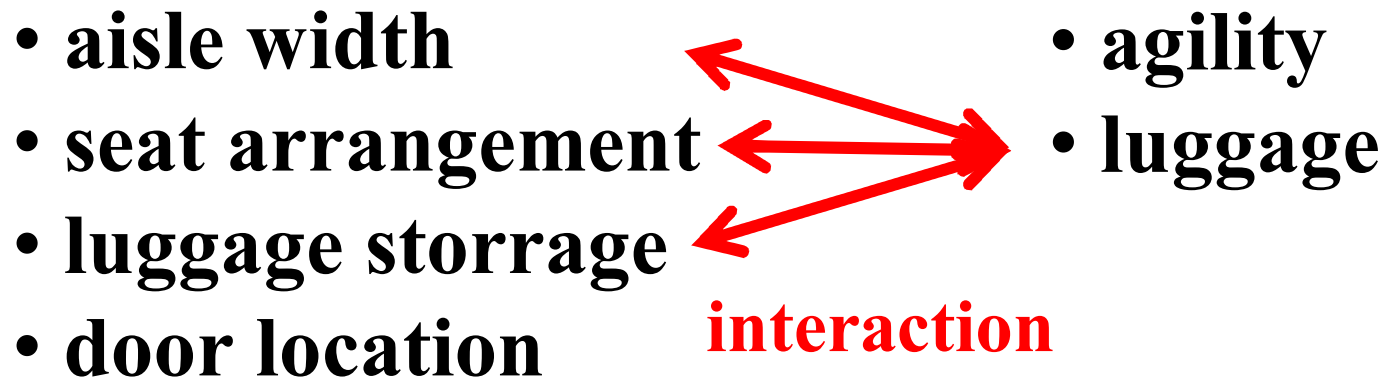
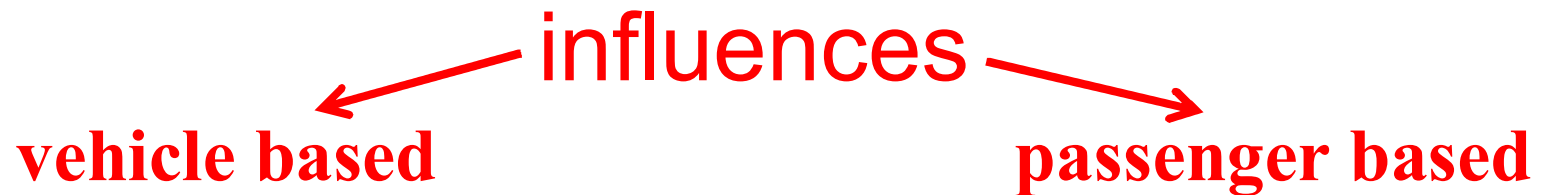


The passenger flow can split in two directions (+ no steps)

ideal: 45sec = actual

Time need without designing influence

Seating area - Coach interiors



Coach interiors – interactions (examples)

- aisle width too small

→ *many difficulties when moving along with luggage*

- seat arrangement

→ *e.g. row seating*

→ *no space for luggage (except overhead bin)*

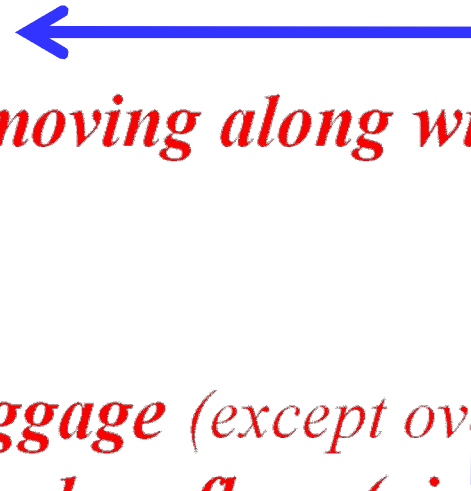
→ *luggage stored on floor (aisle, etc.)*

→ *no passing points (2 way traffic)*

- luggage storage

→ *e.g. too small*

→ *luggage stored on floor (aisle, etc.)*



Coach interiors

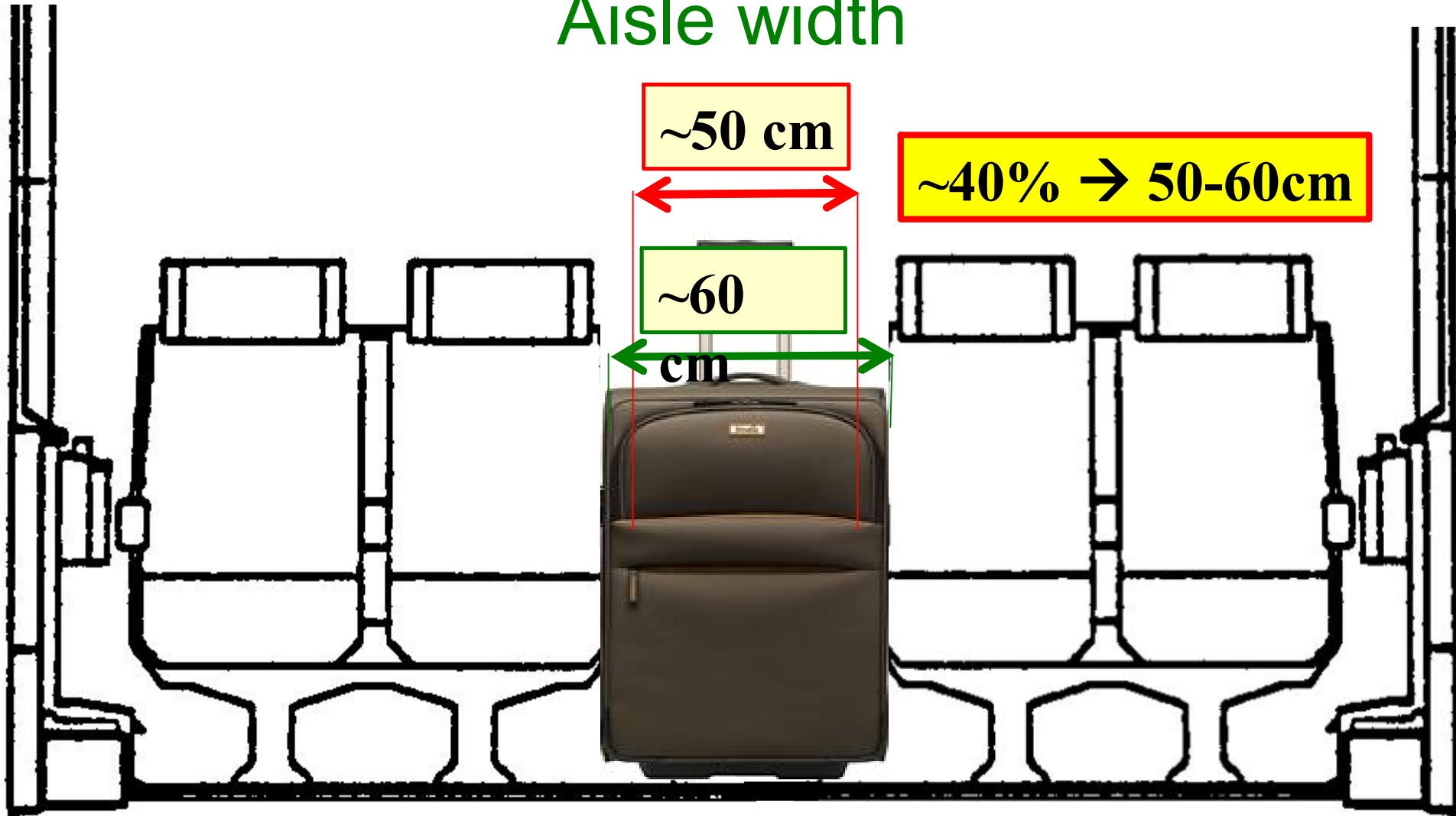
Aisle width

general Problems:

own luggage
luggage in the aisle
Oncomming passengers

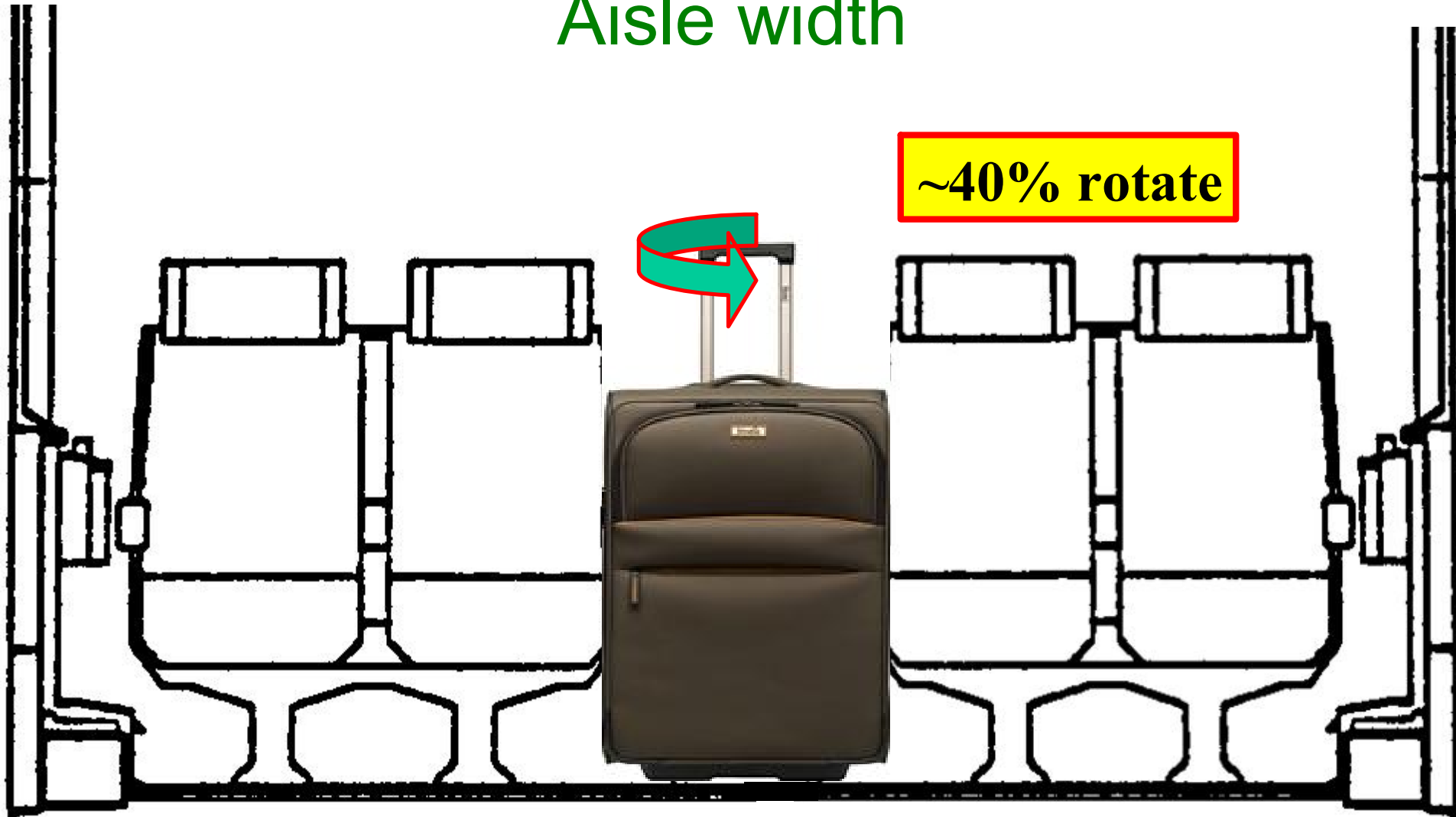
Coach interiors

Aisle width



Coach interiors

Aisle width



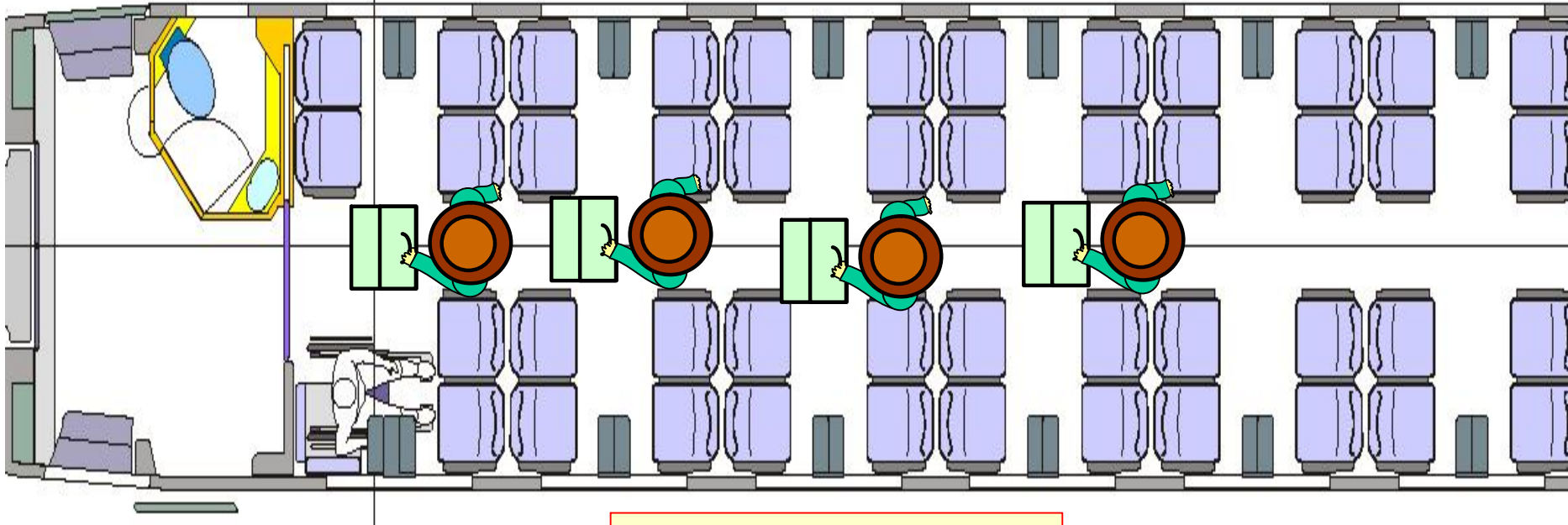
Optimizing passenger exchange

20

Coach interiors

Aisle width

aisle width smaller than 60cm

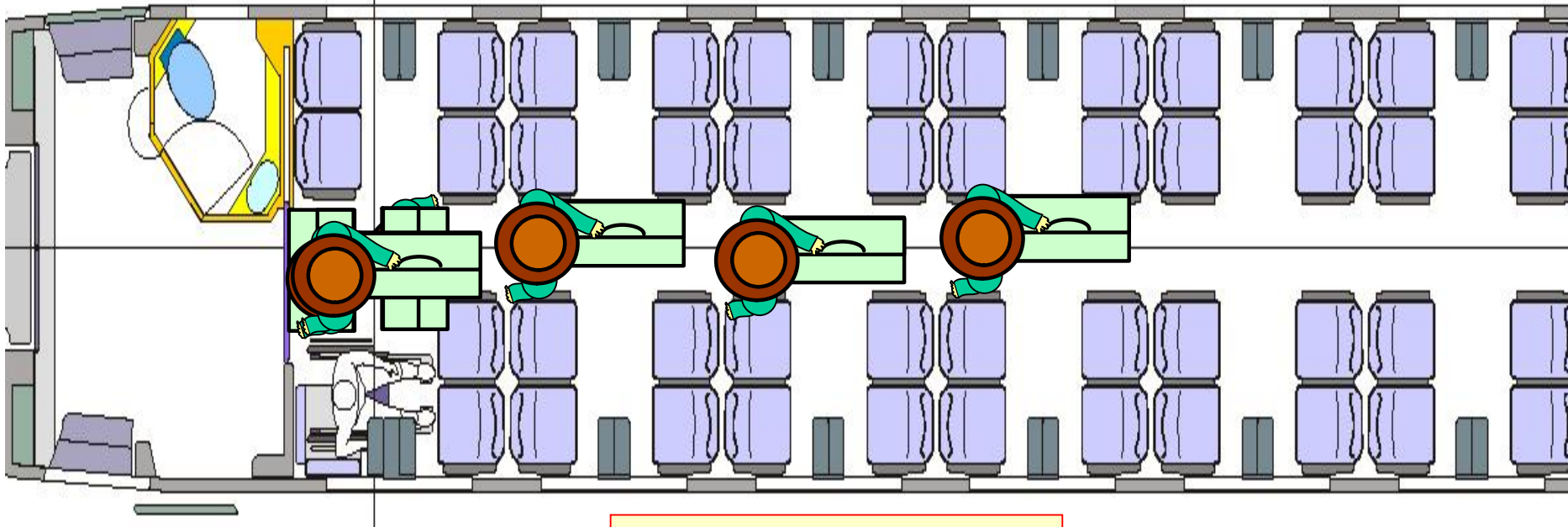


often 50 – 54 cm

Coach interiors

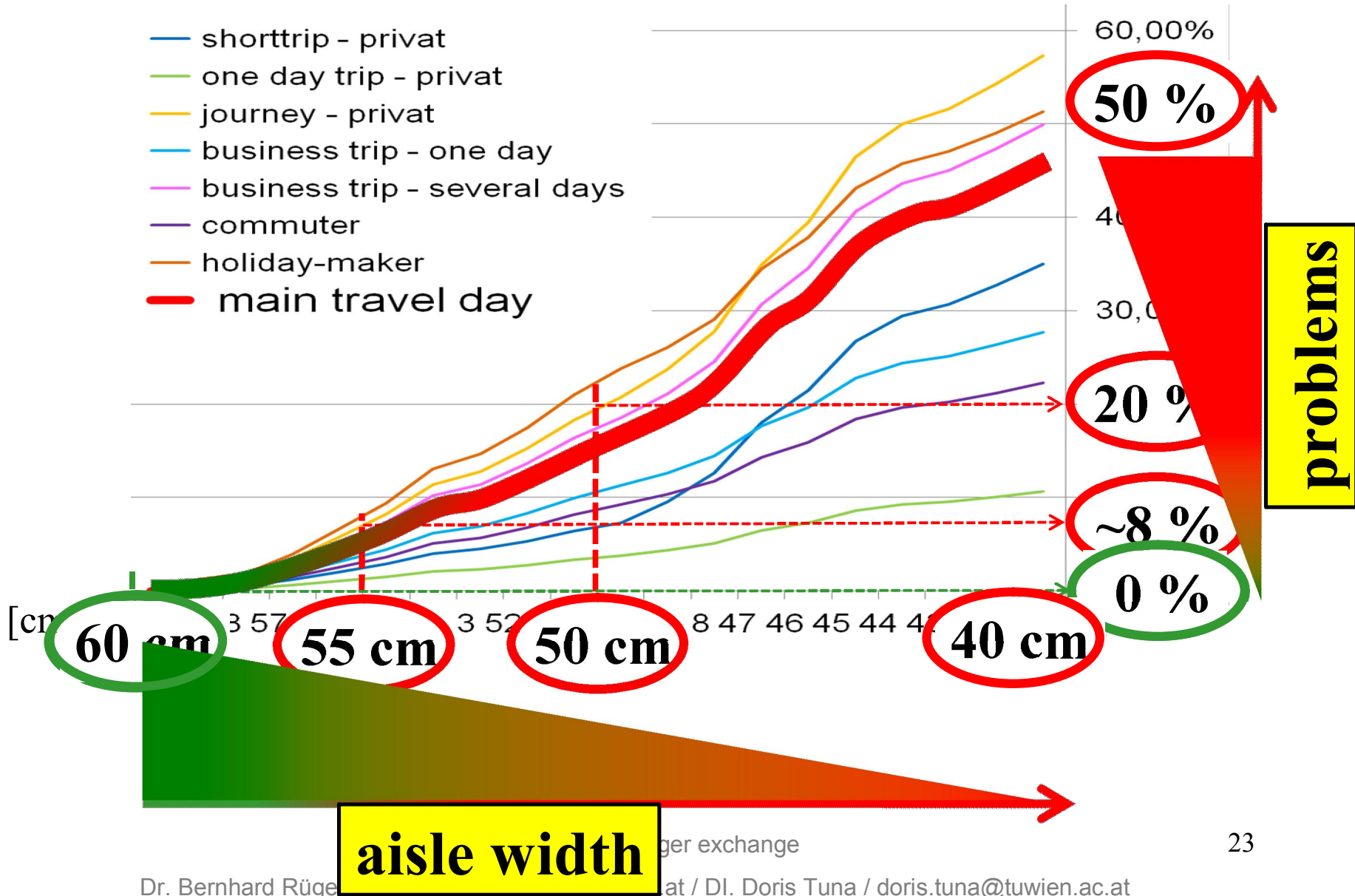
Aisle width

Many trolleys are wider than 50 cm



often 50 – 54 cm

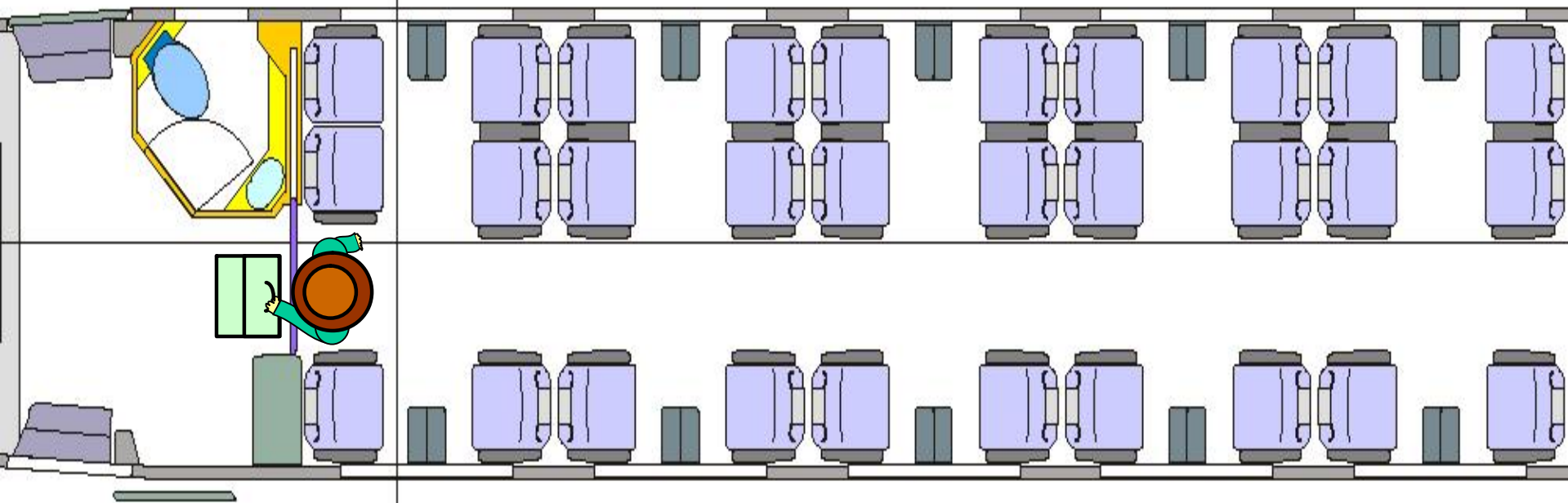
Aisle width - problems



Coach interiors

Aisle width

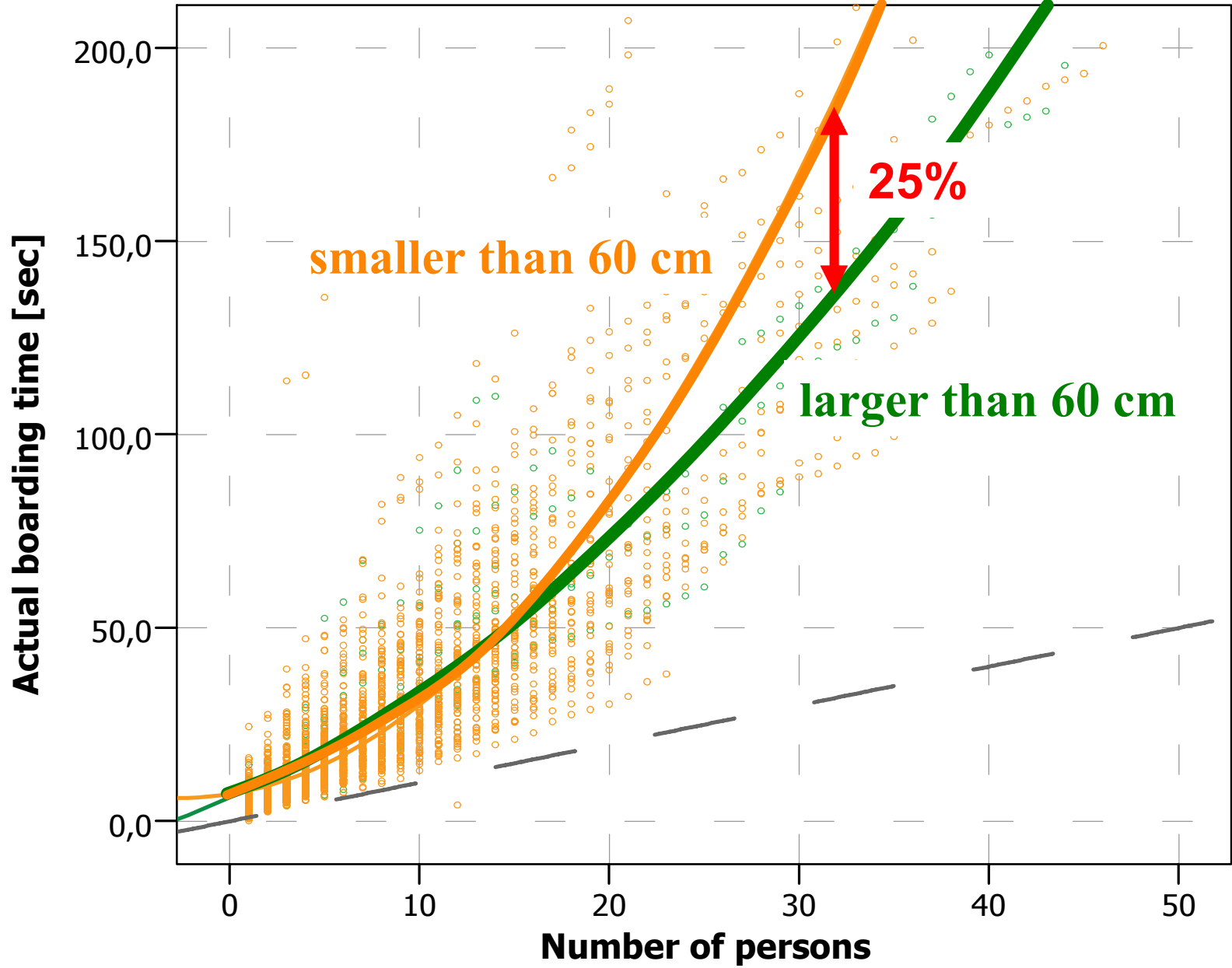
aisle width wider than 60cm



Most trollys are smaller than 60cm

Aisle width >60cm

Aisle width <60cm



Coach interiors

Seat arrangements

Row seating
Vis-a-vis seating
Mixed arrangements
Compartments

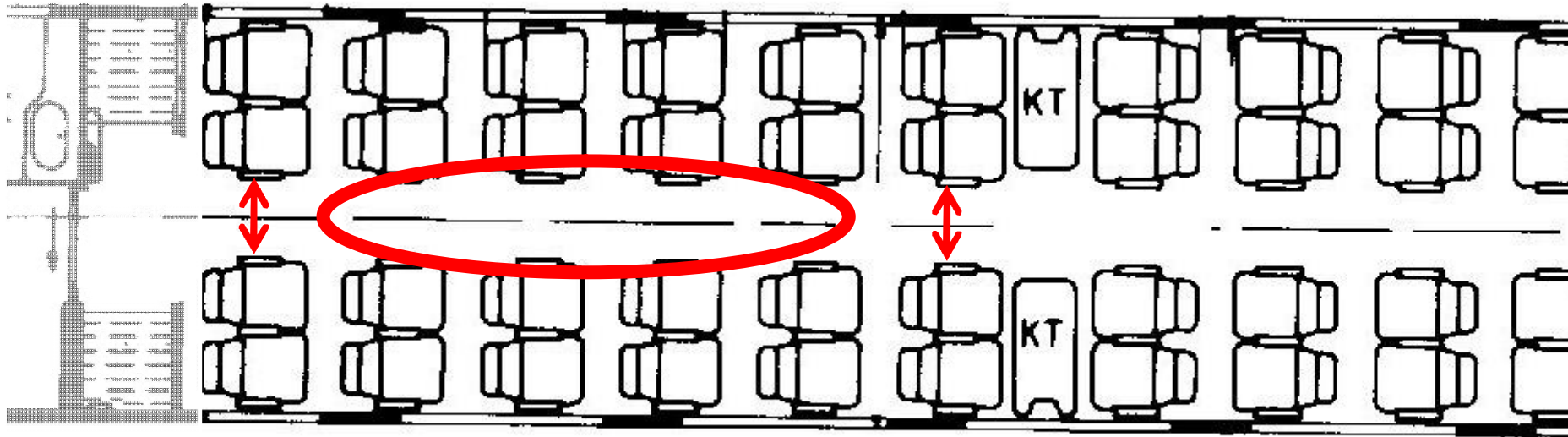


+ several luggage storage concepts

Coach interiors

Row seating

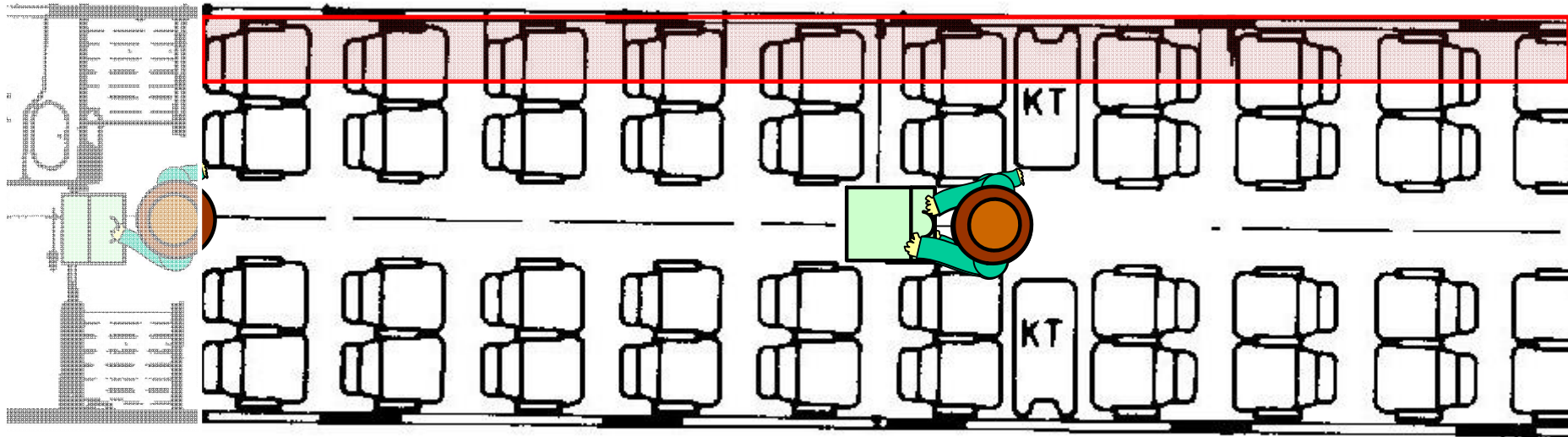
1st problem: aisle width



Coach interiors

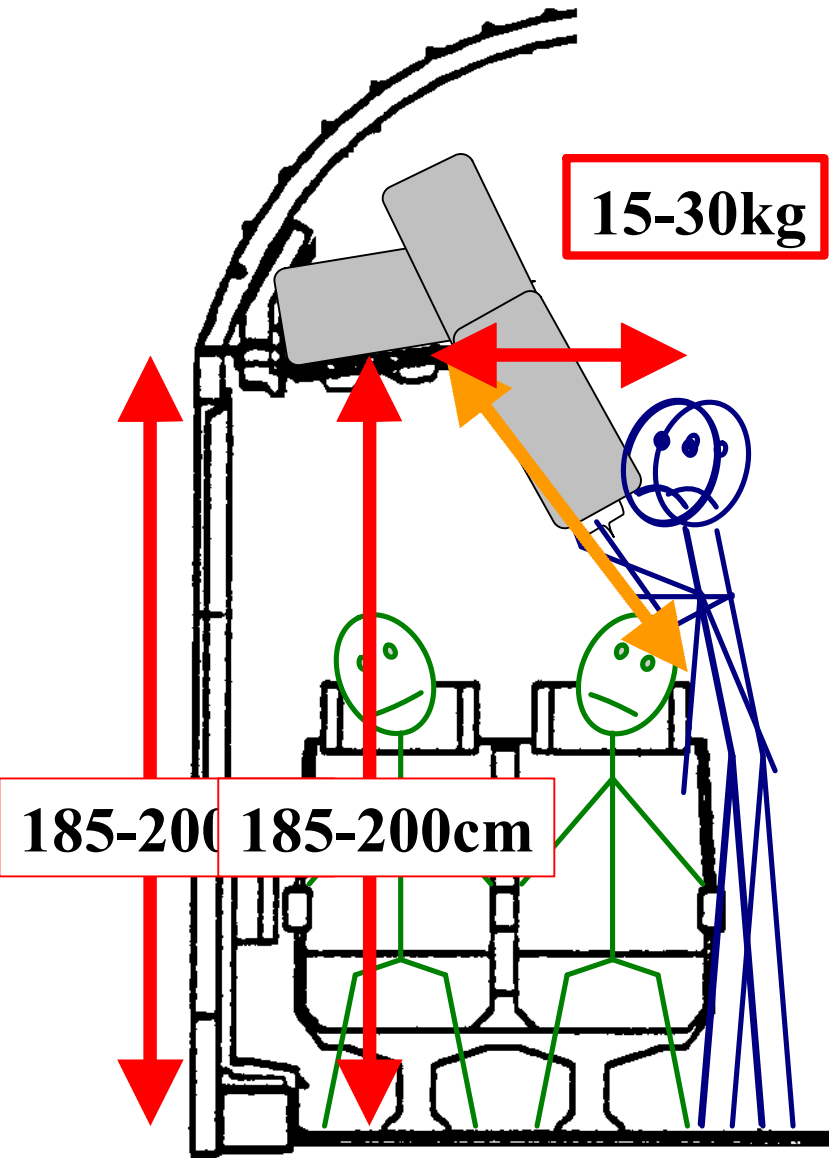
Row seating

2nd problem: only overhead racks
NO SPACE on floor level



needs a LONG TIME!

Storing luggage



Height of overhead rack

Width of seats, large diagonal

Luggage weight

Large torque, large force!

Safety risk for sitting passengers

- Large exertion

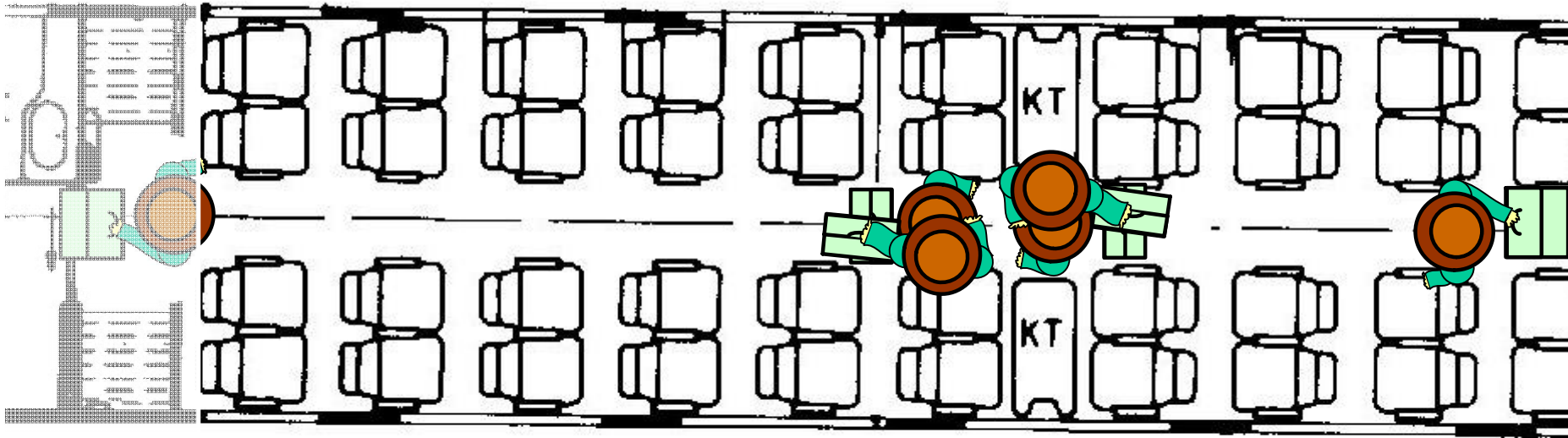
- Safety risks

→ **negativ sensation**

Coach interiors

Row seating

3rd problem: oncoming passengers

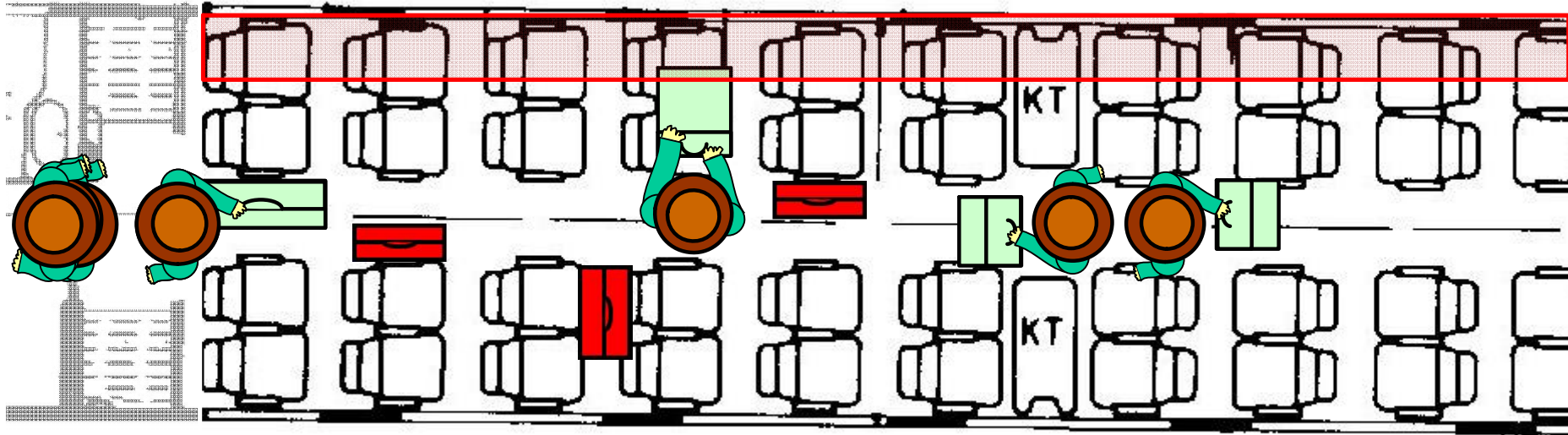


No passing room

Coach interiors

Row seating

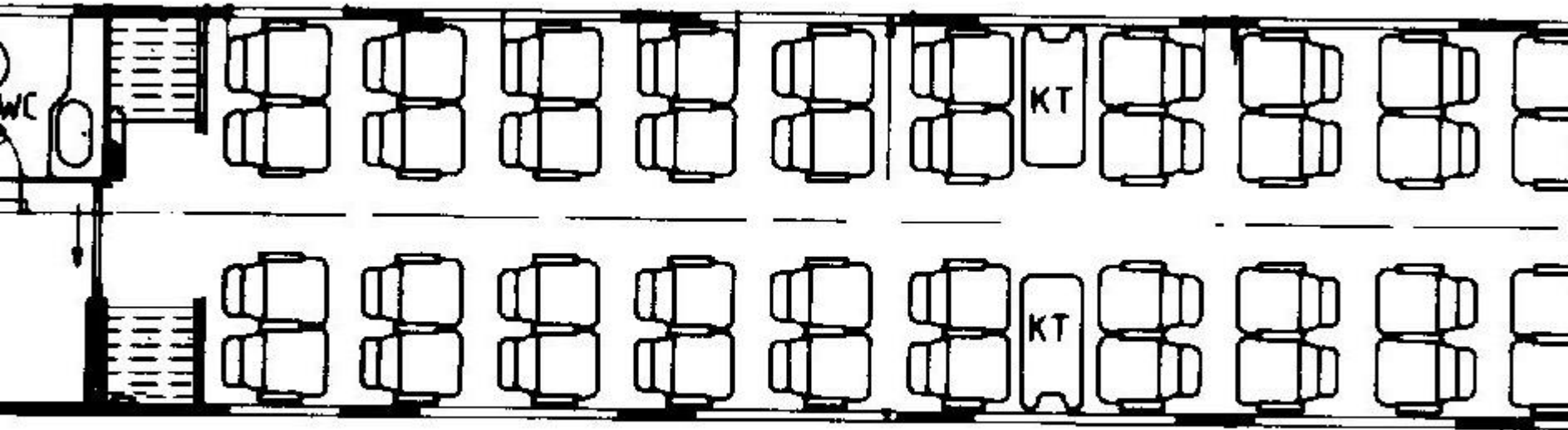
Luggage in aisle, on seats
Oncoming passengers
Overhead luggage storage



Tailback after view passengers, long time need

Coach interiors

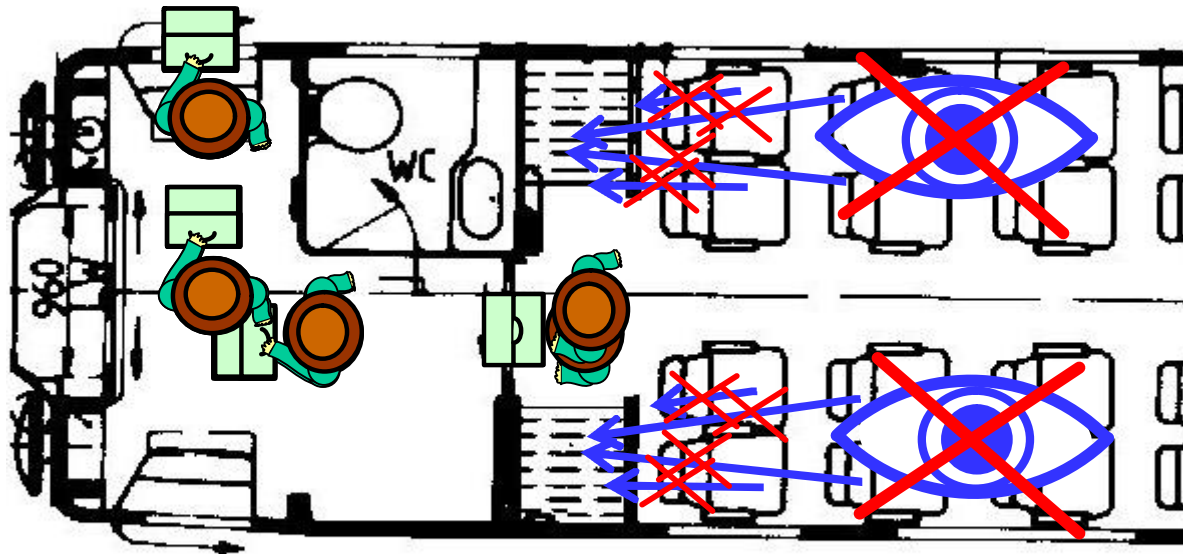
Row seating + luggage rack near entrance



Coach interiors

Row seating + luggage rack near entrance

No visual contact

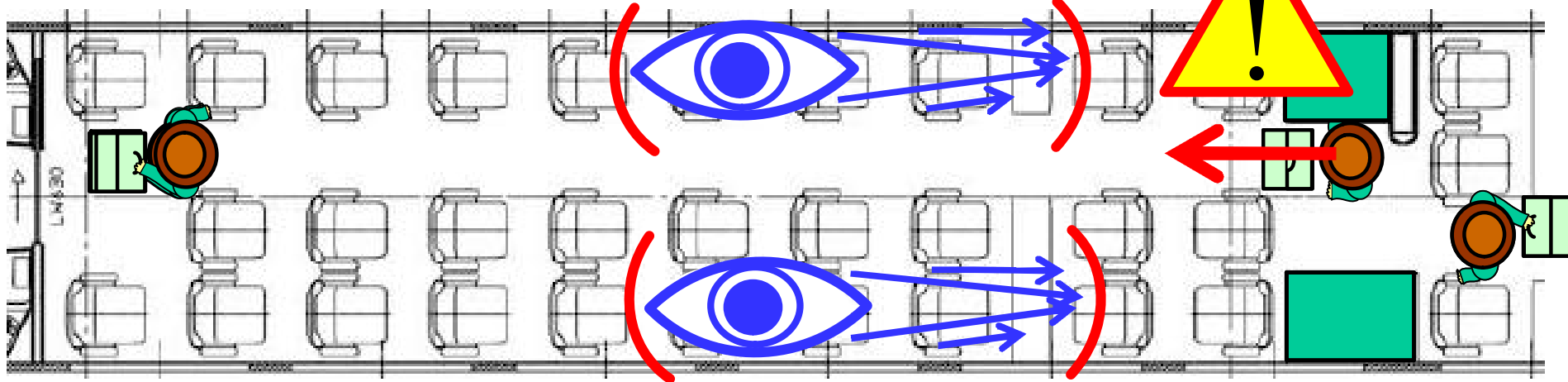


Tailback after view passengers, long time need

Coach interiors

Row seating + luggage rack in the middle

better visual contact but long view distance

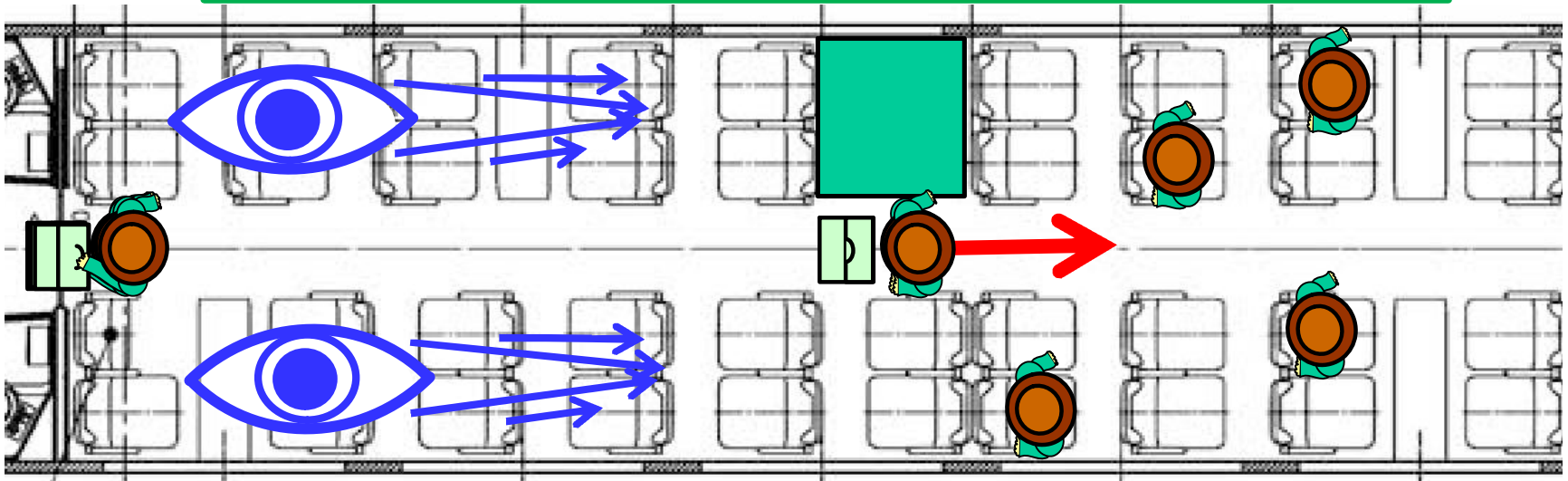


Long way, many hindrances

Coach interiors

luggage rack in the quarter point

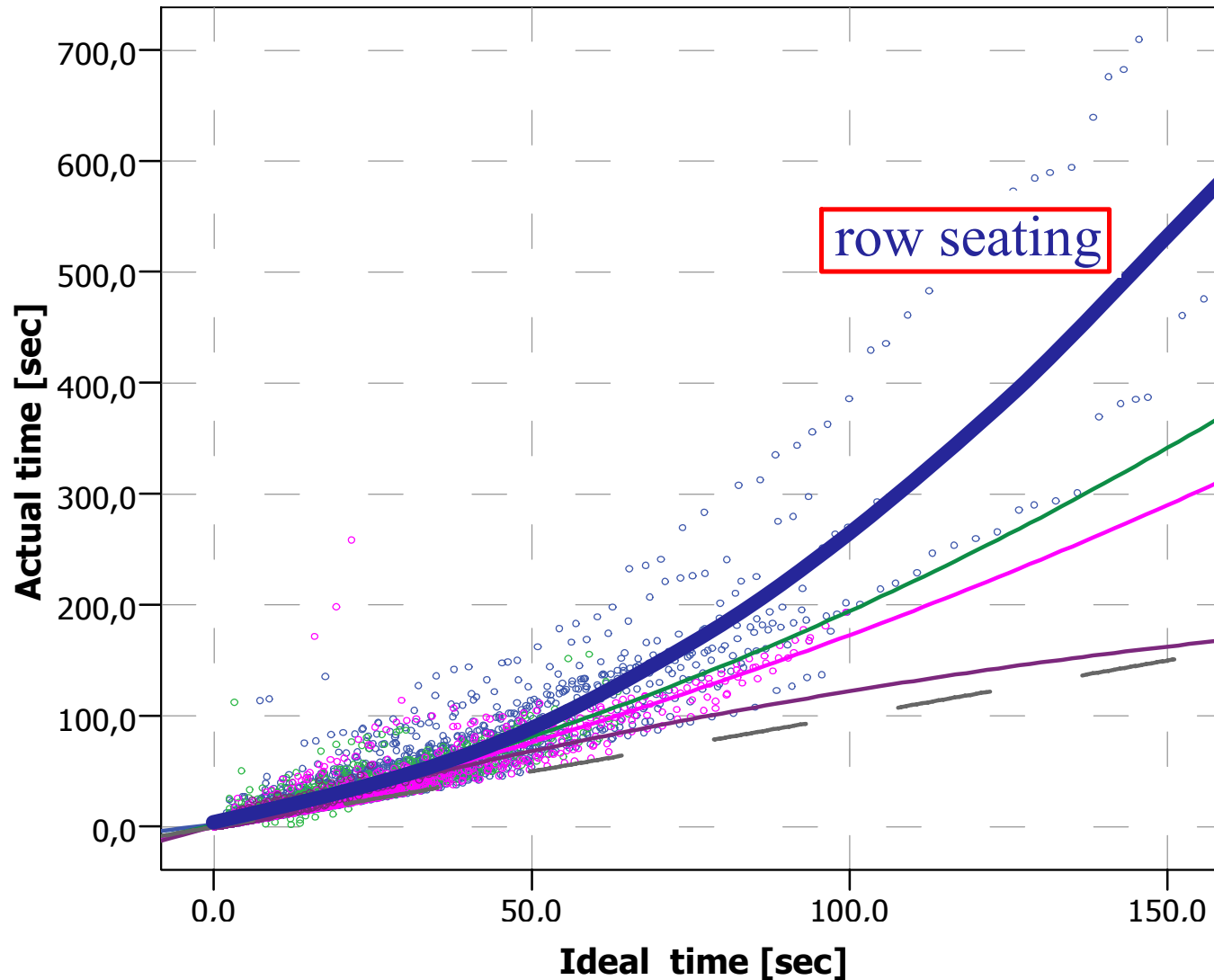
better visual contact but long view distance



Shorter way, less conflicts

row seating– time need

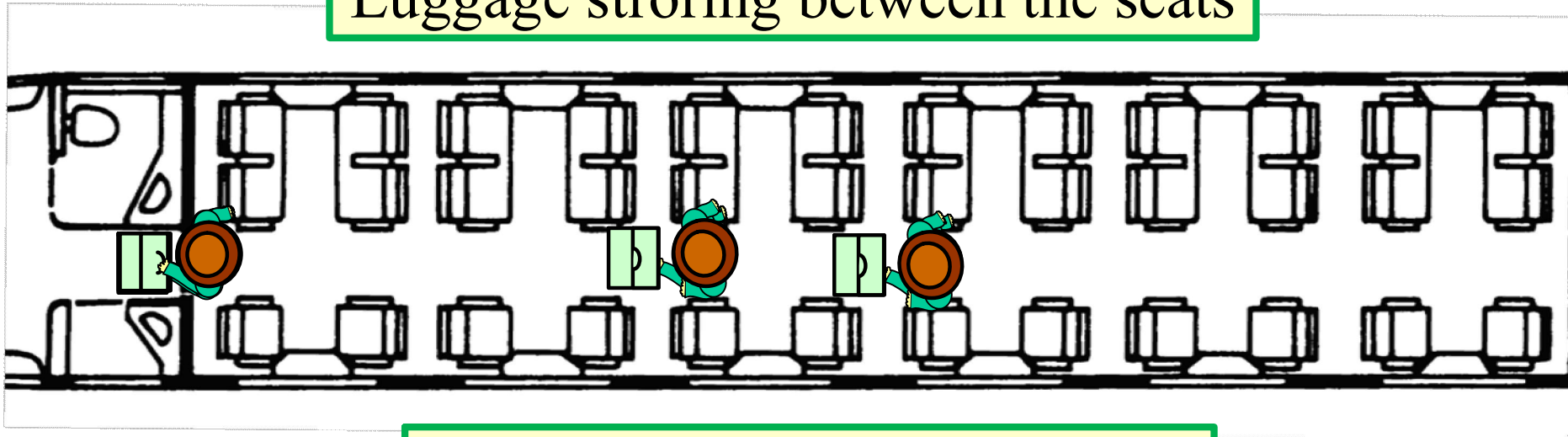
- Seats standing neatly in a row
- Opposite seats
- Compartment coaches
- Opposite seats in an IC2000



Coach interiors

Vis-a-vis seating

Luggage storing between the seats

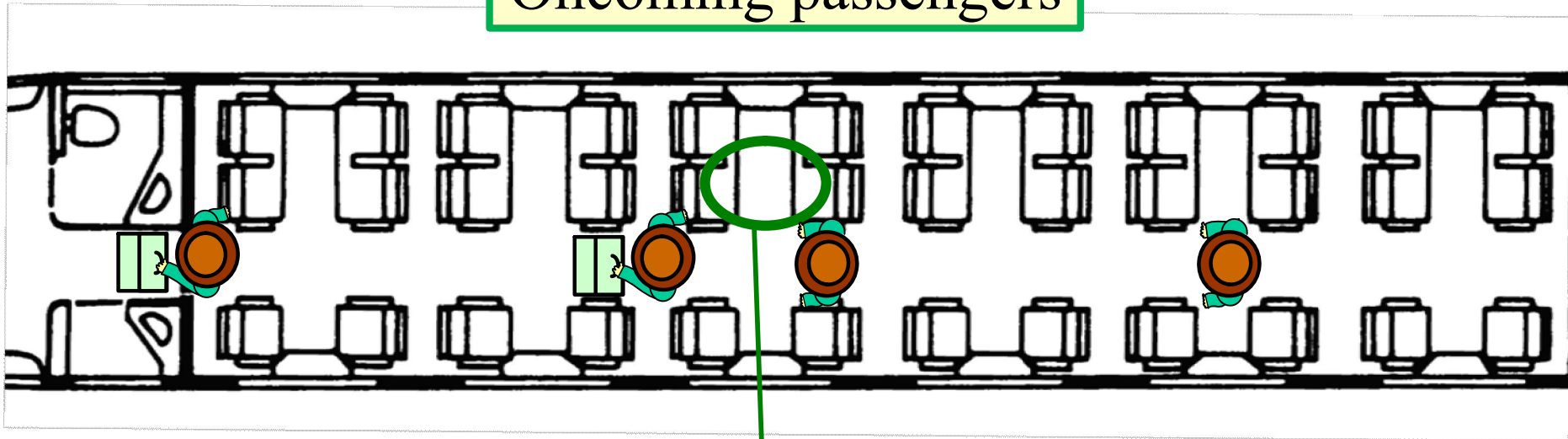


enough space required
→ **Very fast and easy storing**

Coach interiors

Vis-a-vis seating

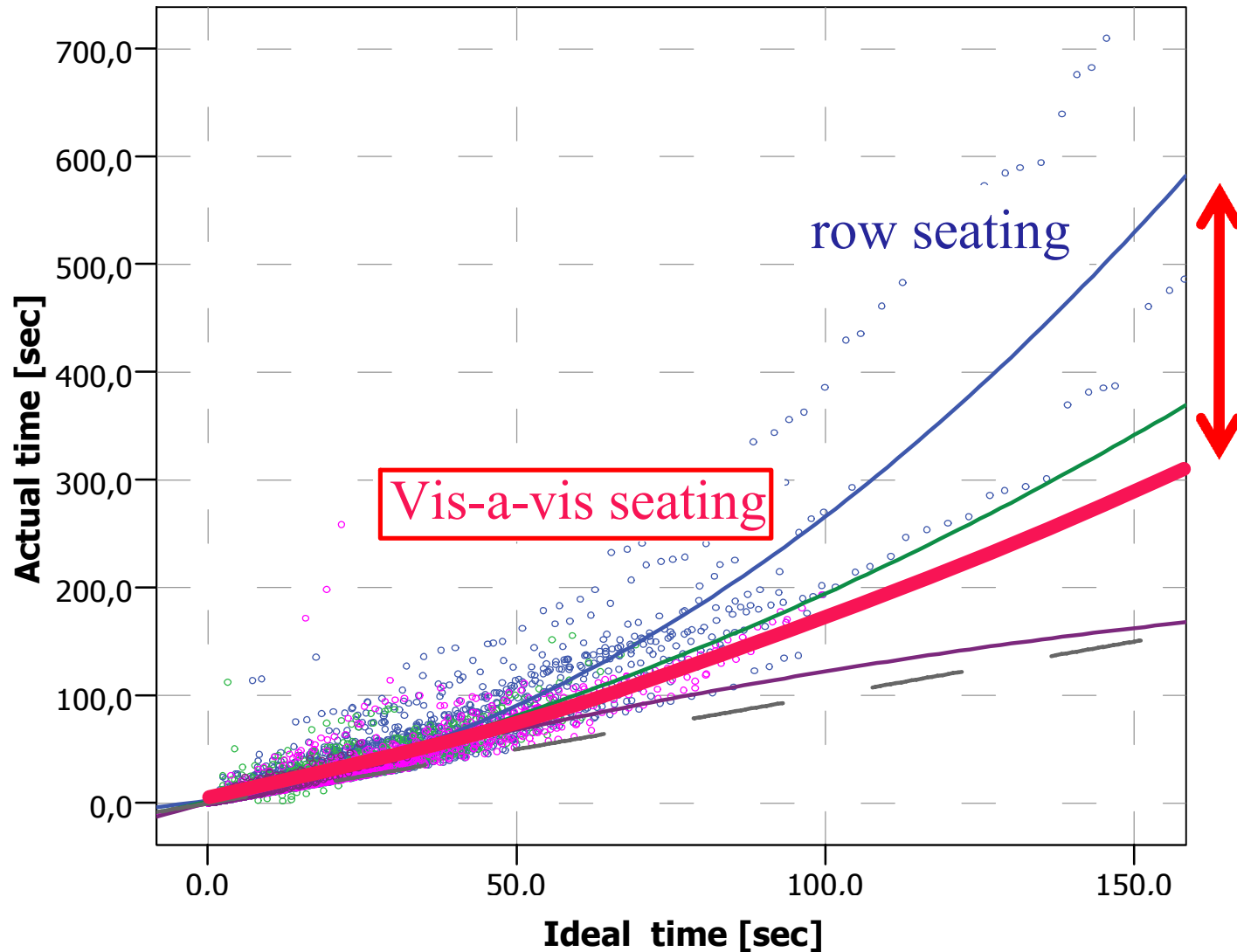
Oncoming passengers



+ Passing points

Seat arrangements

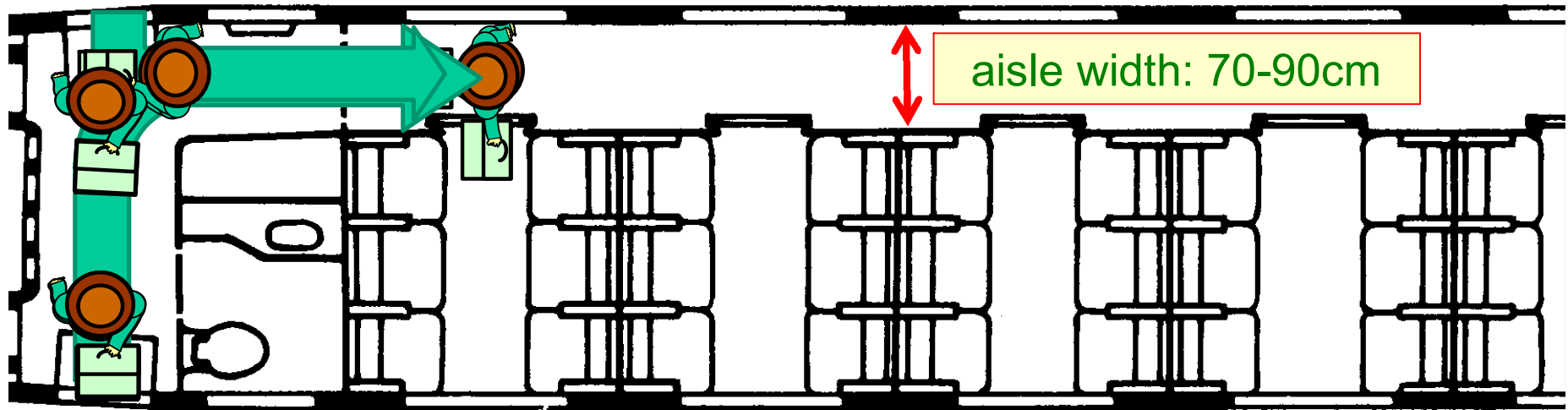
- Seats standing neatly in a row
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Coach interiors

Compartment coach

Longer way → **larger retention area** (until the first compartment)

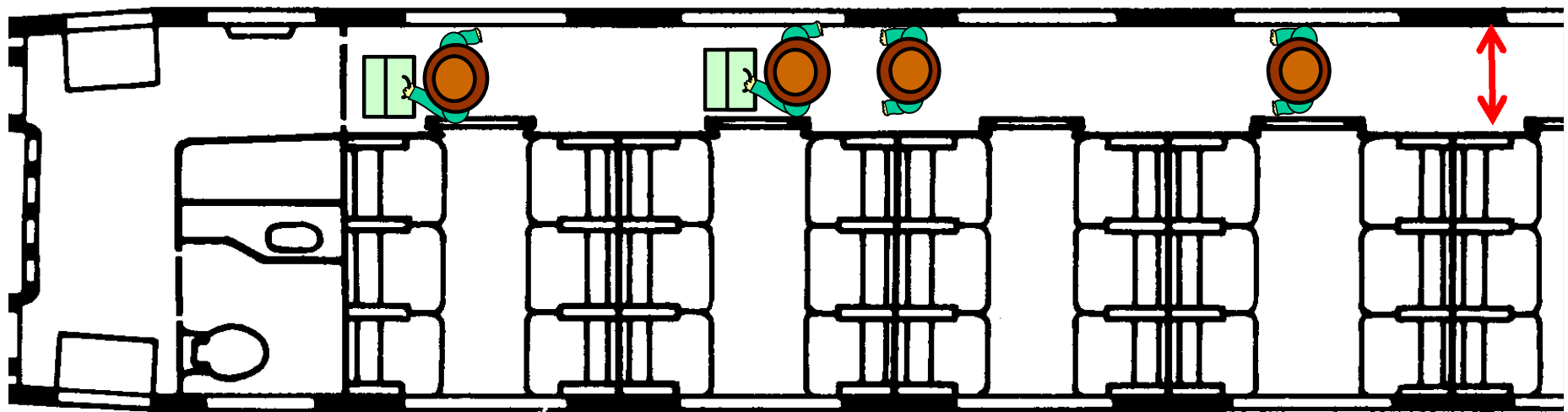


Luggage storing in the compartment →
other passenger can go on

Coach interiors

Compartment coach

aisle width: 70-90cm

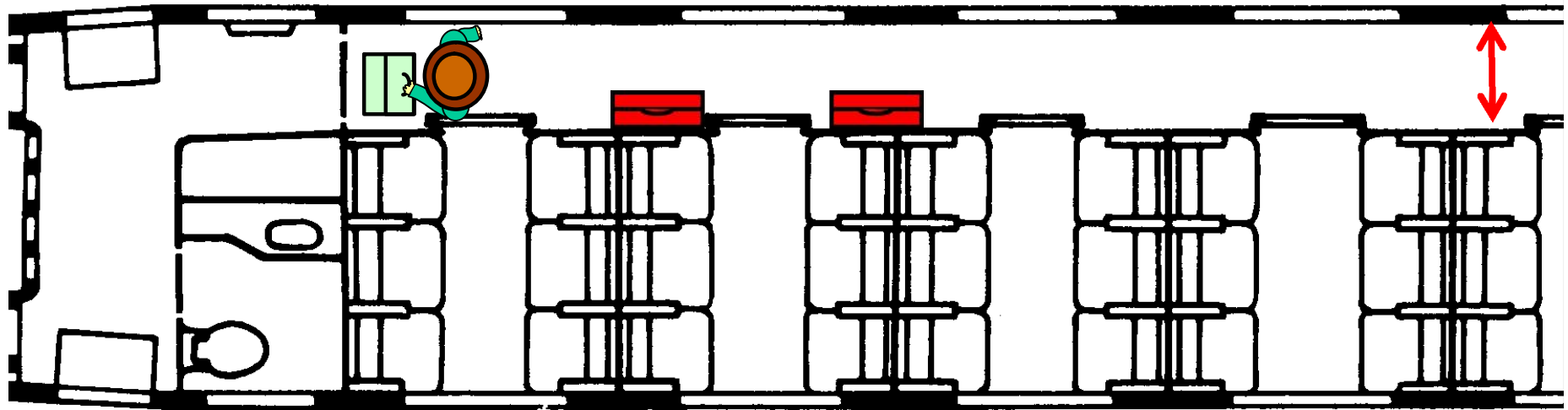


Less conflicts with oncoming passengers
Passing points in compartment + wide aisle

Coach interiors

Compartment coach

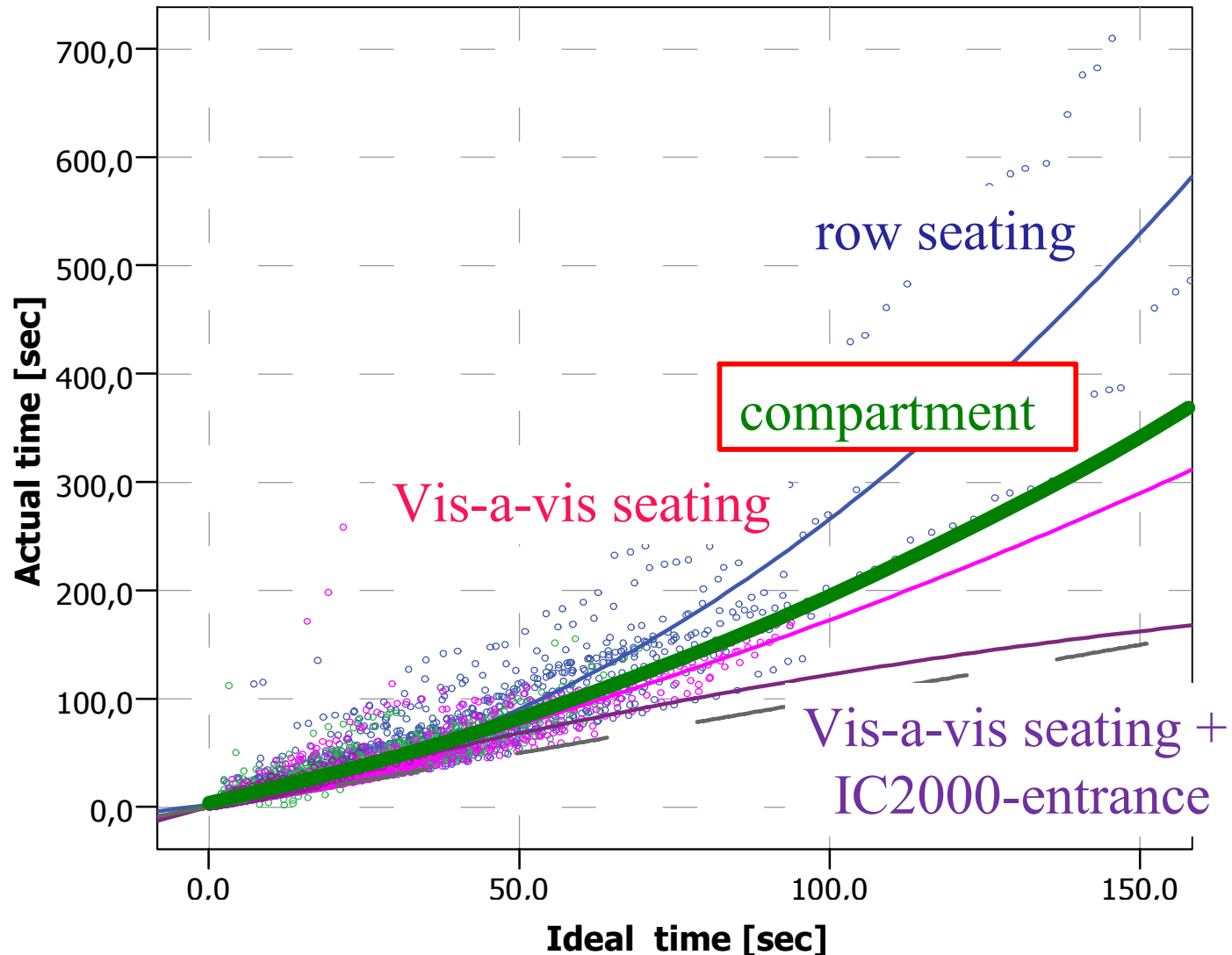
aisle width: 70-90cm



Less conflicts with luggage in the aisle

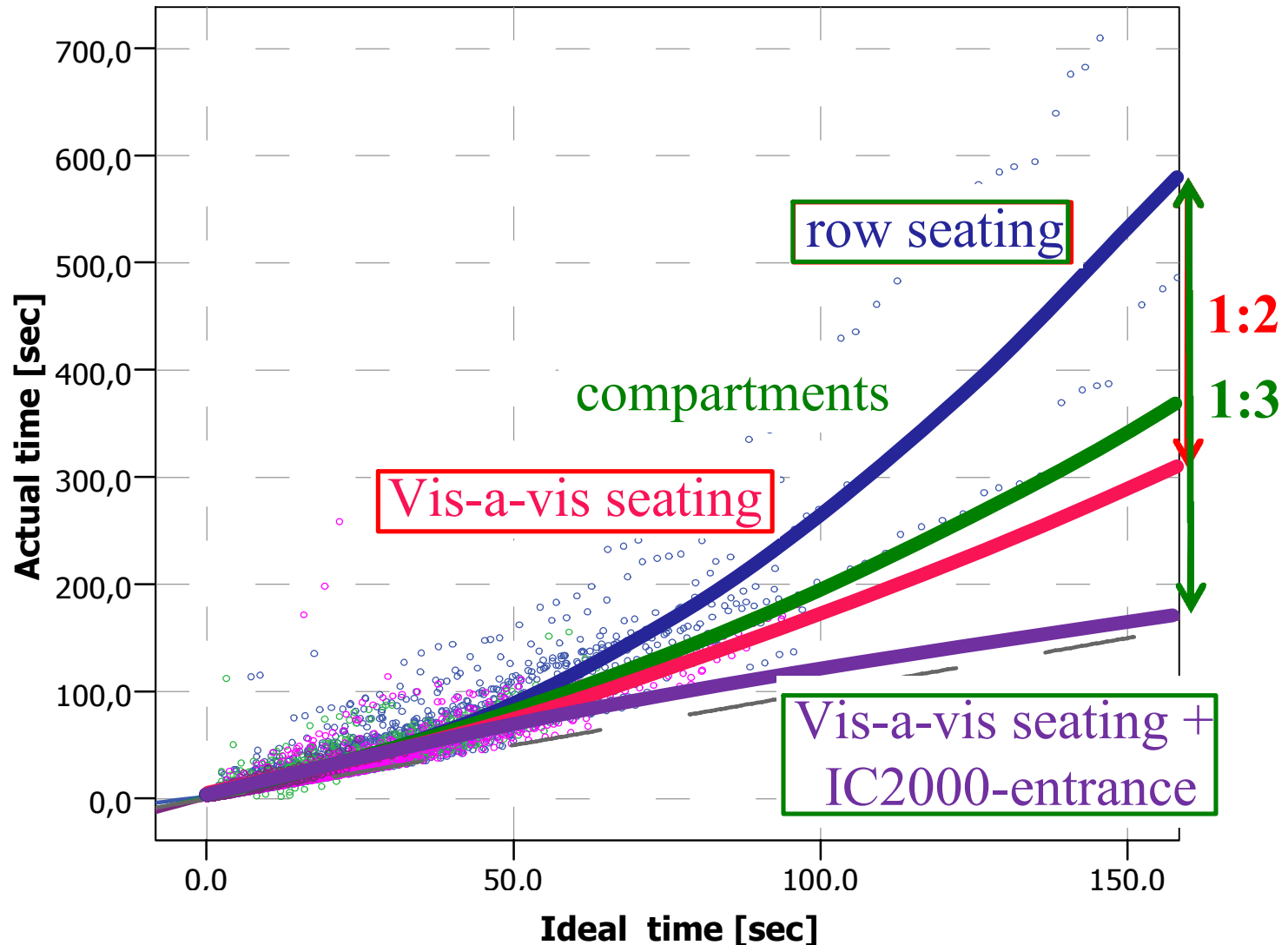
Seat arrangements

- Seats standing neatly in a row
- Opposite seats
- Compartment coaches
- Opposite seats in an IC2000



Seat arrangements - comparison

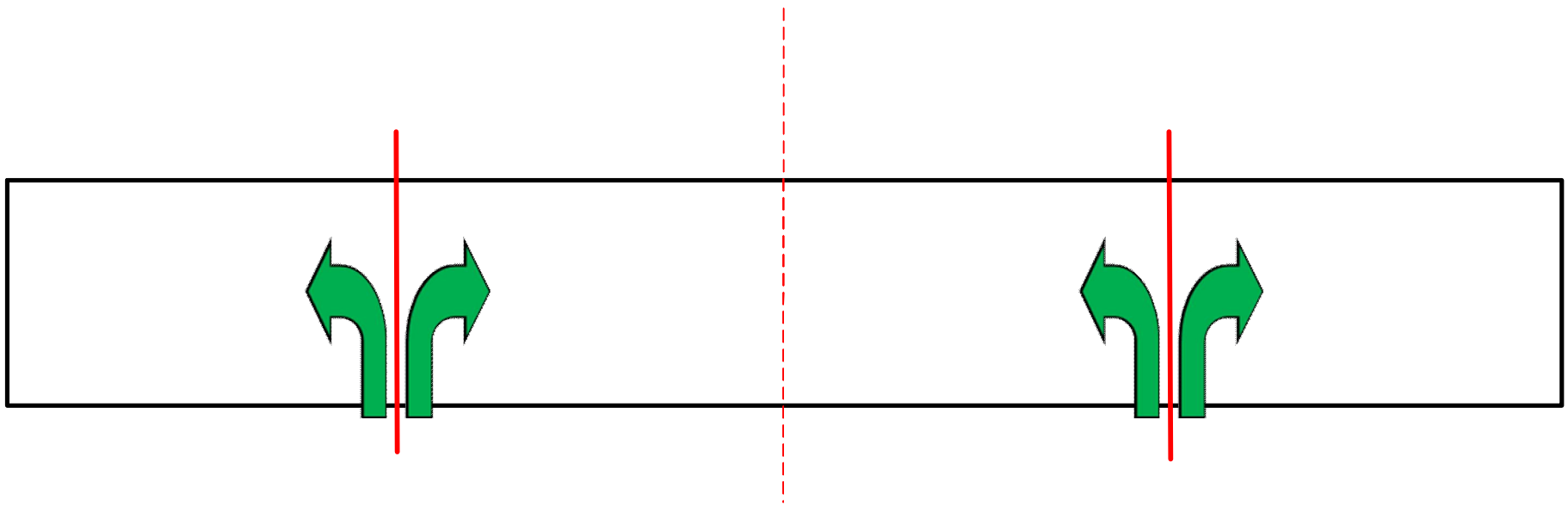
- Seats standing neatly in a row
- Opposite seats
- Compartment coaches
- Opposite seats in an IC2000



time optimised railway interior

conclusion

example for open saloon coach



doors at the **quarter points**

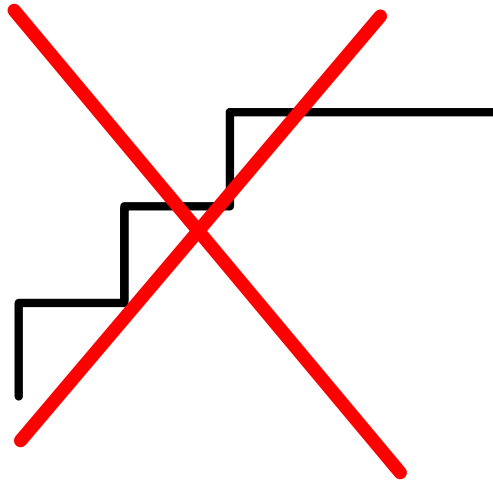
Passenger flow can divide

time optimised railway interior

conclusion

example for open saloon coach

1) doors at the **quarter points**

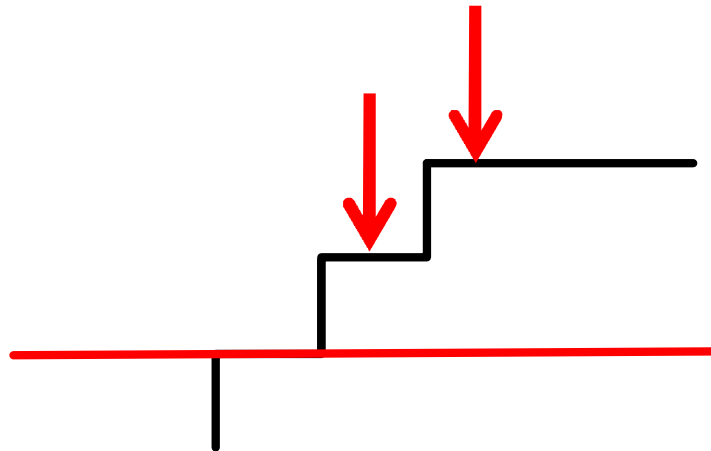


Best: NO steps → level free boarding

time optimised railway interior conclusion

example for open saloon coach

1) doors at the **quarter points**



If steps required: **max 2 steps**

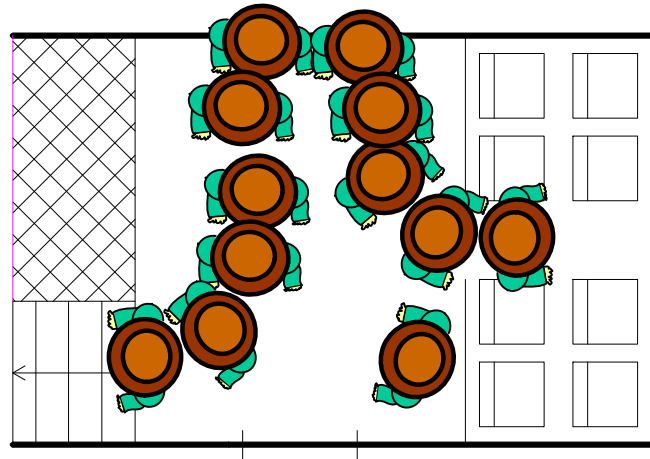
time optimised railway interior

conclusion

example for open saloon coach

- 1) doors at the **quarter points**
- 2) **Level free boarding**, max. 2 steps

Large entrance room

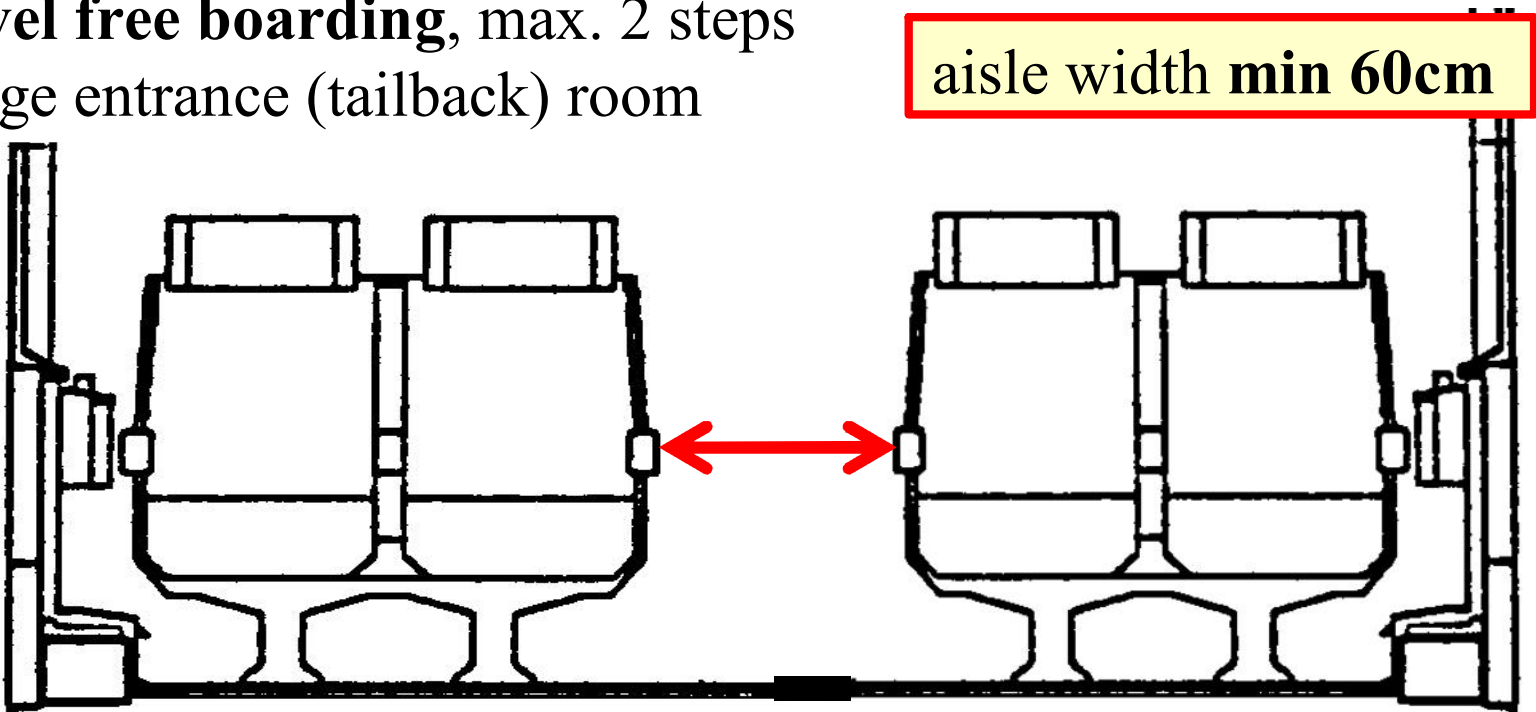


time optimised railway interior

conclusion

example for open saloon coach

- 1) doors at the **quarter points**
- 2) **Level free boarding**, max. 2 steps
- 3) Large entrance (tailback) room



time optimised railway interior

conclusion

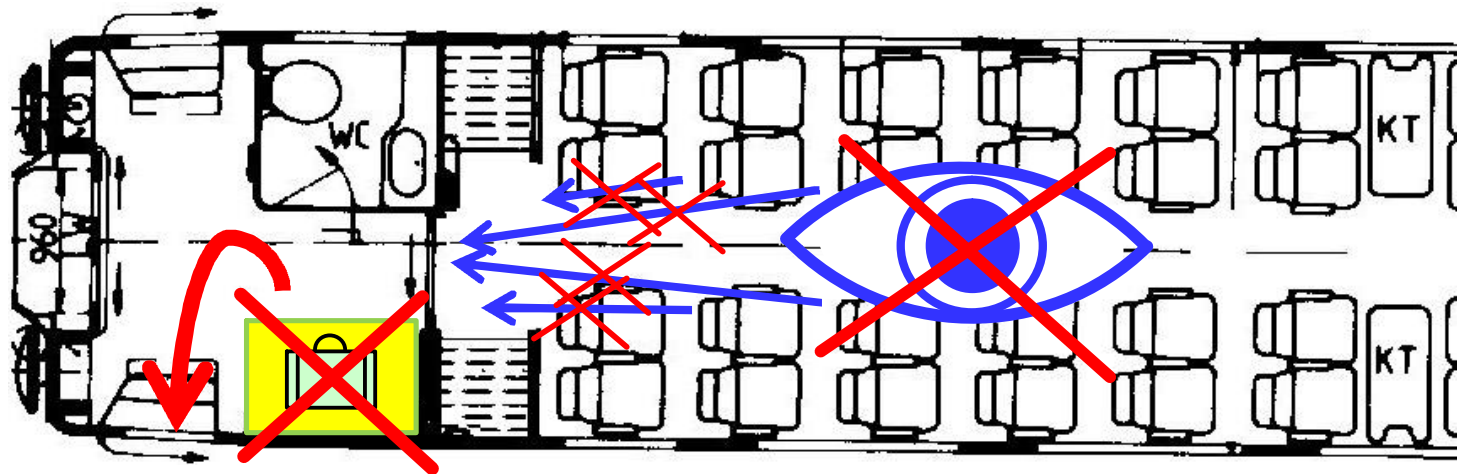
example for open saloon coach

- 1) doors at the **quarter points**
- 2) **Level free boarding**, max. 2 steps
- 3) **Large entrance** (tailback) room
- 4) **Aisle width min. 60 cm**

Luggage rack

NOT in the entrance area

No visual contact, high risk of theft



time optimised railway interior

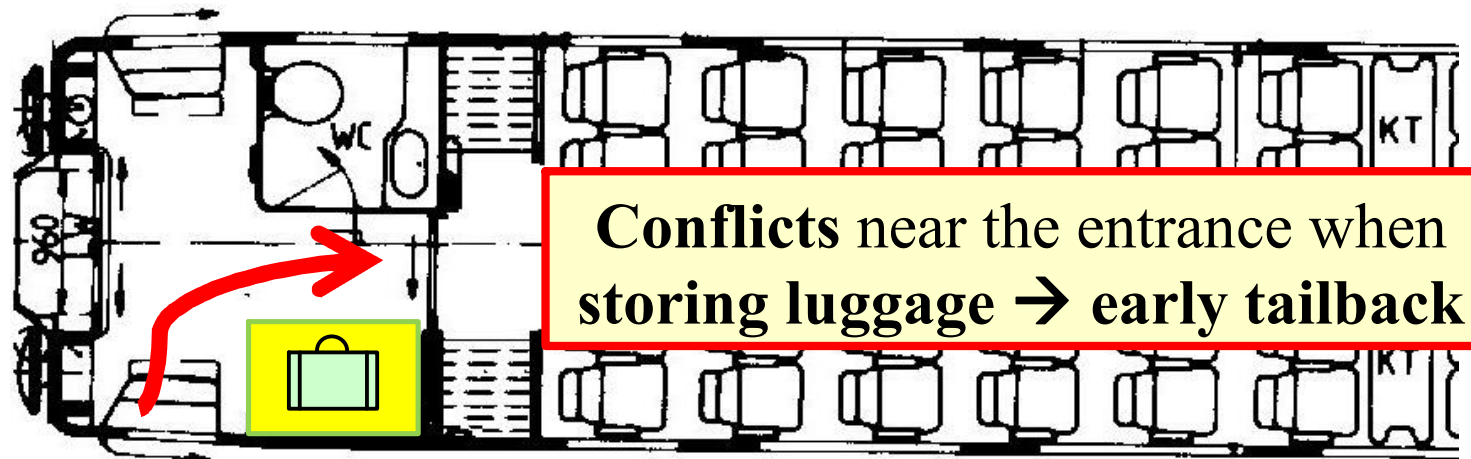
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time optimised railway interior

conclusion

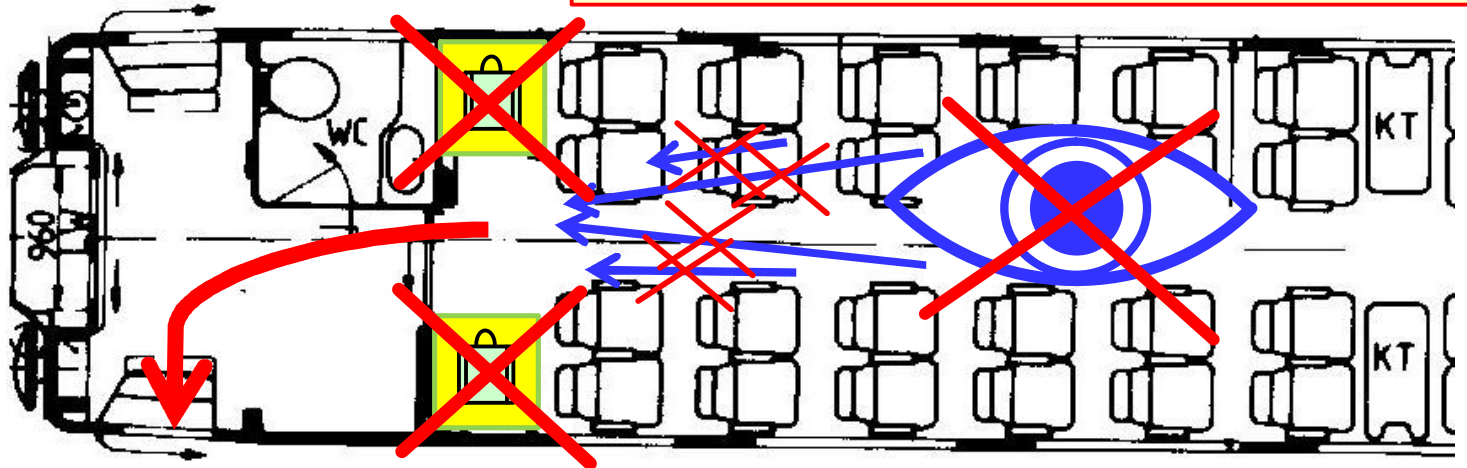
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- 1) doors at the **quarter points**
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Luggage rack

NOT near the entrance area

No visual contact, high risk of theft



time optimised railway interior

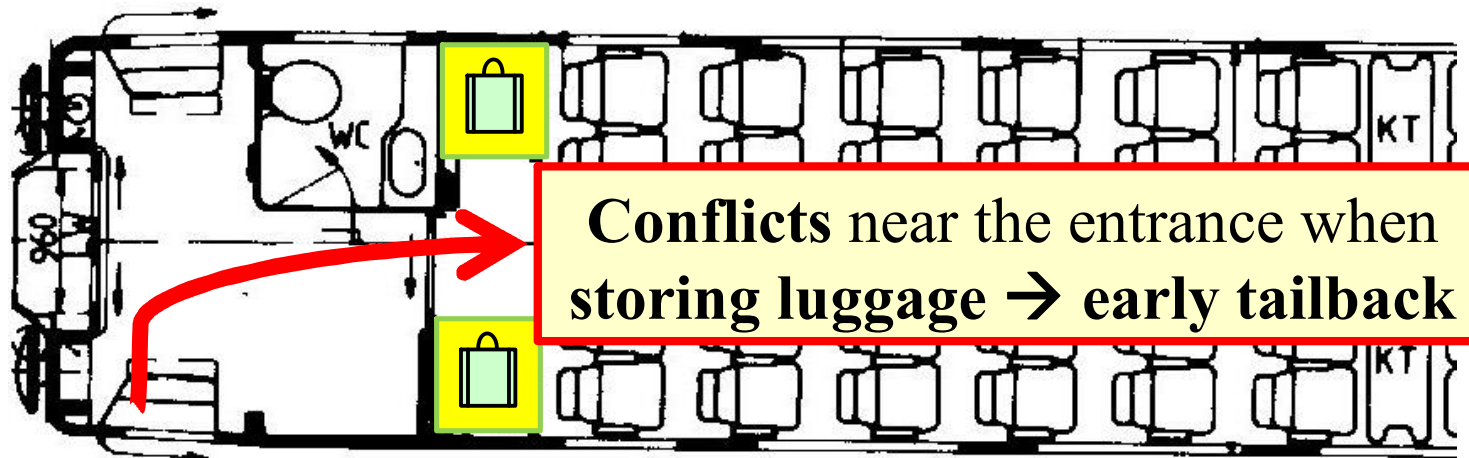
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example for open saloon coach

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Luggage rack

NOT near the entrance area



time optimised railway interior conclusion

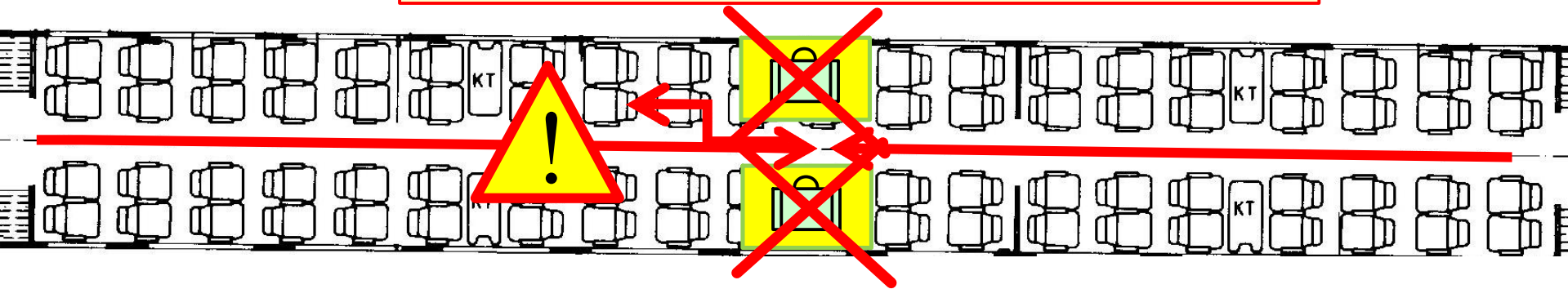
example for open saloon coach

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Luggage rack

NOT in the middle of the saloon

Long way, conflicts with other passengers



time optimised railway interior

conclusion

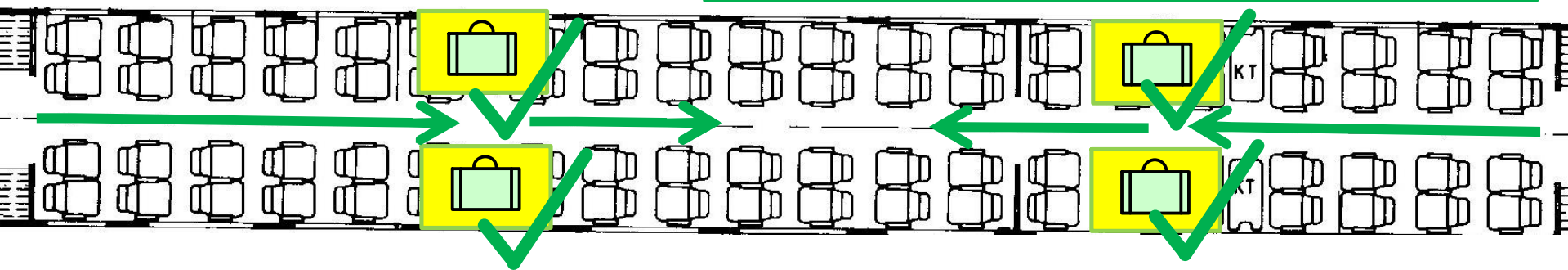
example for open saloon coach

- 1) doors at the **quarter points**
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Luggage rack

In quarter points of the saloon

Shorter way, good visual contact, less conflicts with other passengers



time optimised railway interior

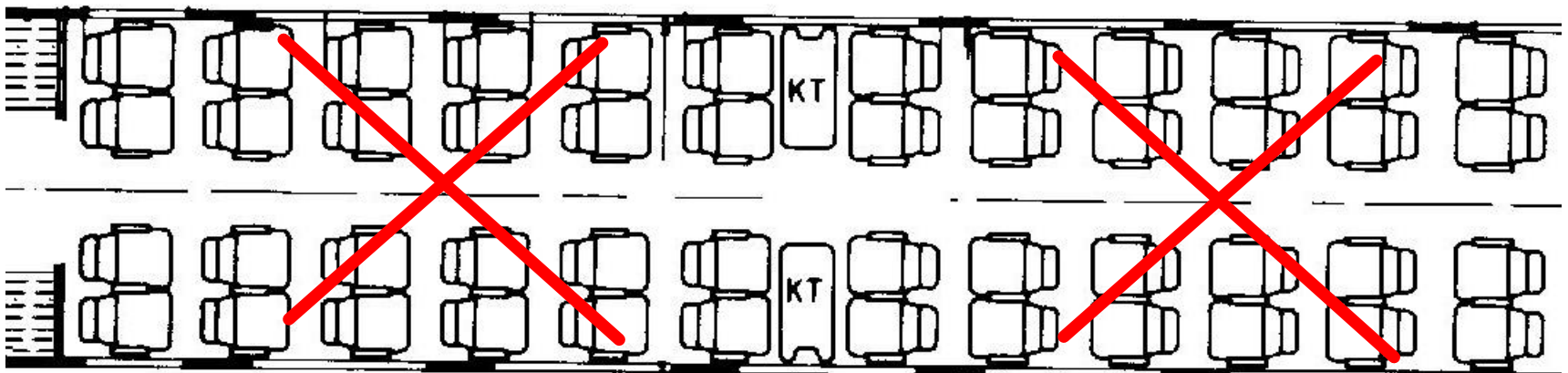
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example for open saloon coach

- 1) doors at the **quarter points**
- 2) **Level free boarding**, max. 2 steps
- 3) **Large entrance** (tailback) room
- 4) **Aisle width min. 60 cm**
- 5) **Luggage racks in quarter points**

Seat arrangement

Not only row seating



time optimised railway interior

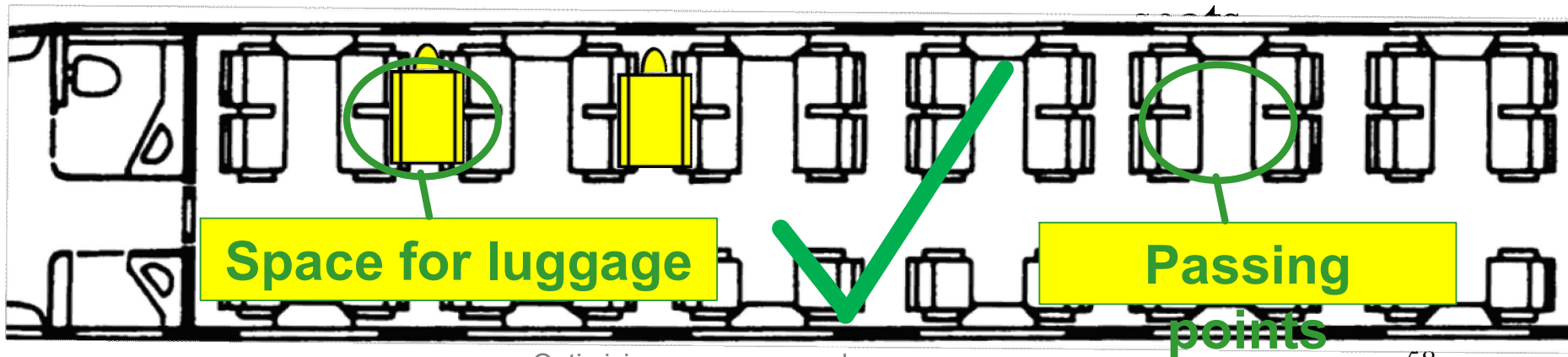
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- 2) **Level free boarding**, max. 2 steps
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- 4) **Aisle width min. 60 cm**
- 5) **Luggage racks in quarter points**

Seat arrangement

Better: more vis-a-vis seats with enough space between



Optimizing passenger exchange

time optimised railway interior

conclusion

example for open saloon coach

- 1) Doors at the **quarter points**
- 2) **Level free boarding**, max. 2 steps
- 3) **Large entrance** (tailback) room
- 4) **Aisle width min. 60 cm**
- 5) **Luggage racks in quarter points**
- 6) **More vis-a-vis seating**



More comfortable boarding

→ **Boarding time reduction** of more than **70%** possible

→ **Rising punctuality**

→ **Potentials for saving energy**

Thank you for your attention

Contact:

Dr. Bernhard Rüger or **DI. Doris Tuna**

Vienna University of Technology

Institute for Railway Engineering,

Karlsplatz 13/232

A-1040 Vienna

Austria

Tel: +43 1 58801 23212 / +43 1 58801 23214

Fax: +43 1 58801 23299

Email: **bernhard.rueger@tuwien.ac.at**

Email: **doris.tuna@tuwien.ac.at**