Route Choice Behaviour In A Three Roads Scenario

Dominik Wegerle. Michael Schreckenberg

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Dynamics in Navigation

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EffizienzCluster LogistikRuhr

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Simulation Framework & Global Topology

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- **extended Nagel-Schreckenberg CA model**
  two vehicle classes:
  - cars: length = 1 (7,5 m); max. velocity = 5 cells/sec (135 km/h)
  - trucks: length = 2 (15 m); max. velocity = 3 cells/sec (81 km/h)
- **asymetric lane change rules (for cars only)**
- **three roads, each with 2 lanes**
- **bottleneck (max. Speed = 60 km/h) at 90% road length**
- **desired traffic flow of 6480 vehicles per hour**

10 % hgv => 648 trucks per hour

75 % remaining vehicles => 4374 cars per hour **fixed load**

25 % remaining vehicles => 1458 cars per hour **additional load**

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Simulation: spans 13 hours; started with empty roads; repeated 100 times

„routing“ / distribution strategies:

1. **simulating with no additional load** => determines the freeflow velocities
2. **shortest path** 100% on road A
3. **equal distributed** (1/3, 1/3, 1/3)
4. **alternating road each minute**
5. **alternating road each 3 minutes**
6. **travel time**
7. **travel time of the additional load vehicles**
8. **remaining road capacity**
9. **remaining mean road capacity over 3 minutes**

additional load (1458 cars)

Scenario I

- **Road A:**

  length: 20 km

  bottleneck: 18.0 – 18.2 km (max. velocity = 60 km/h)

- **Road B:**

  length: 22 km (road A + 10%)

  bottleneck: 19.8 – 20.0 km (max. velocity = 60 km/h)

- **Road C:**

  length: 24 km

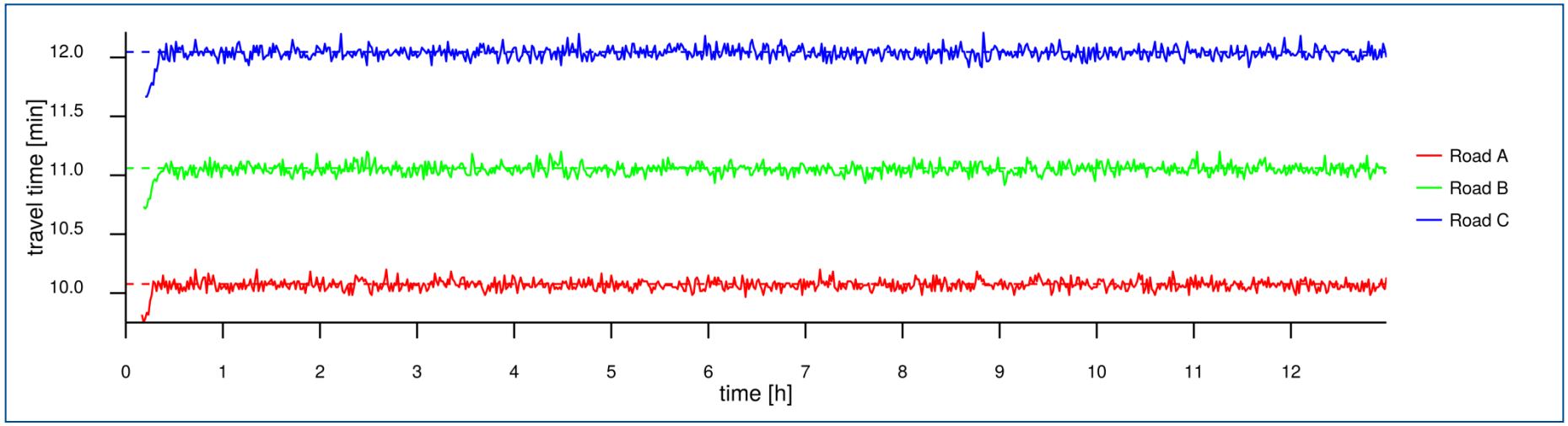
  bottleneck: 21.6– 21.8 km (max. velocity = 60 km/h)

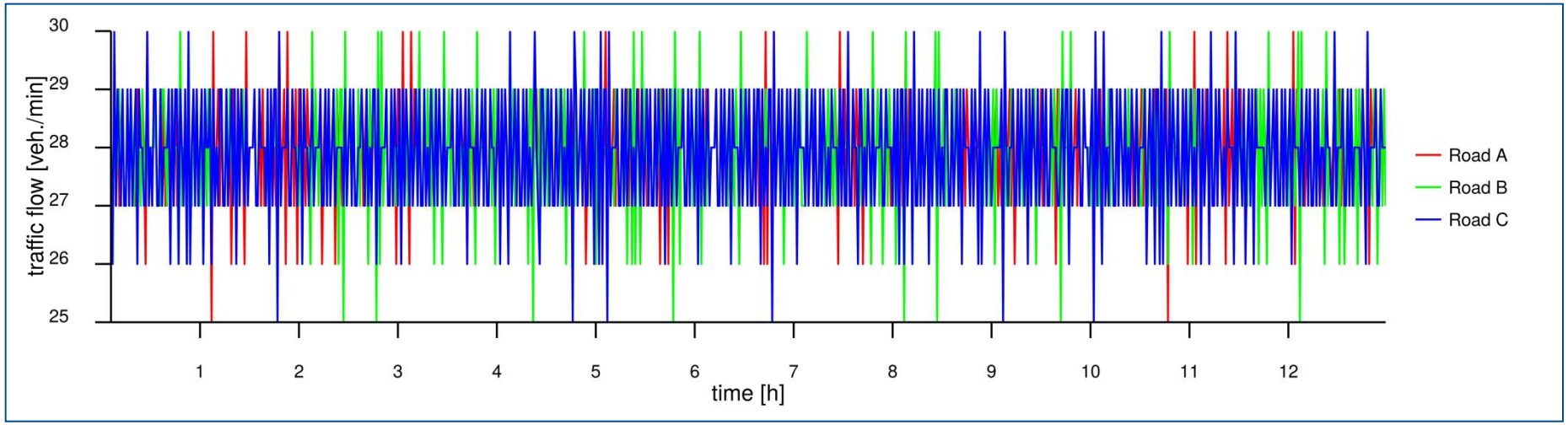
Scenario I

- **fixed load equally distributed:**

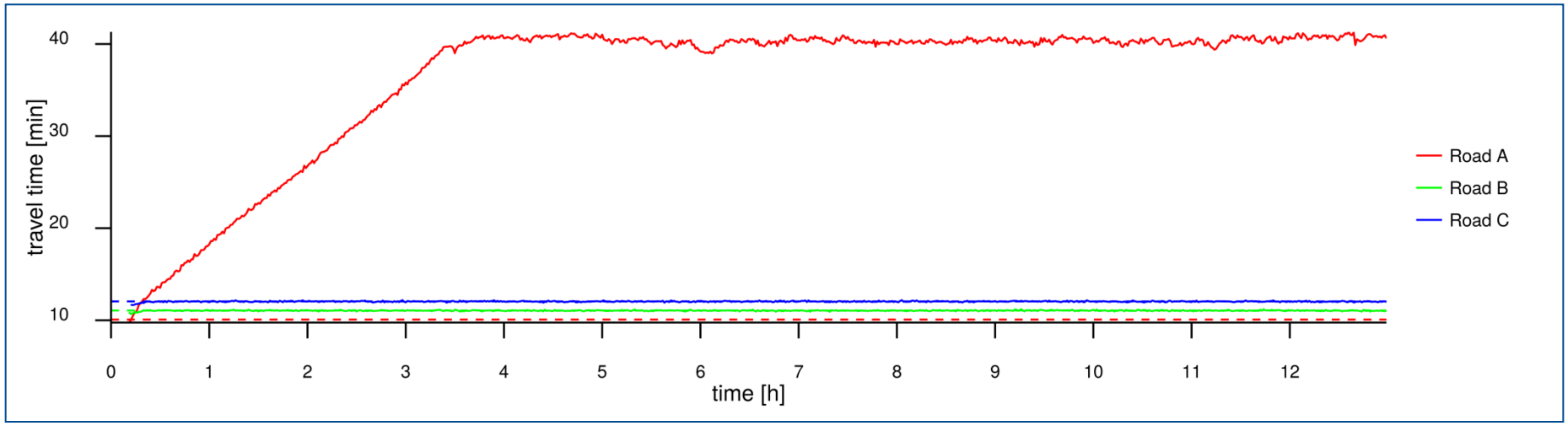
	Road A	Road B	Road C
Trucks / h	216 (on right lane)	216 (on right lane)	216 (on right lane)
Cars / h	1458	1458	1458
	33.33%	33.33 %	33.33 %

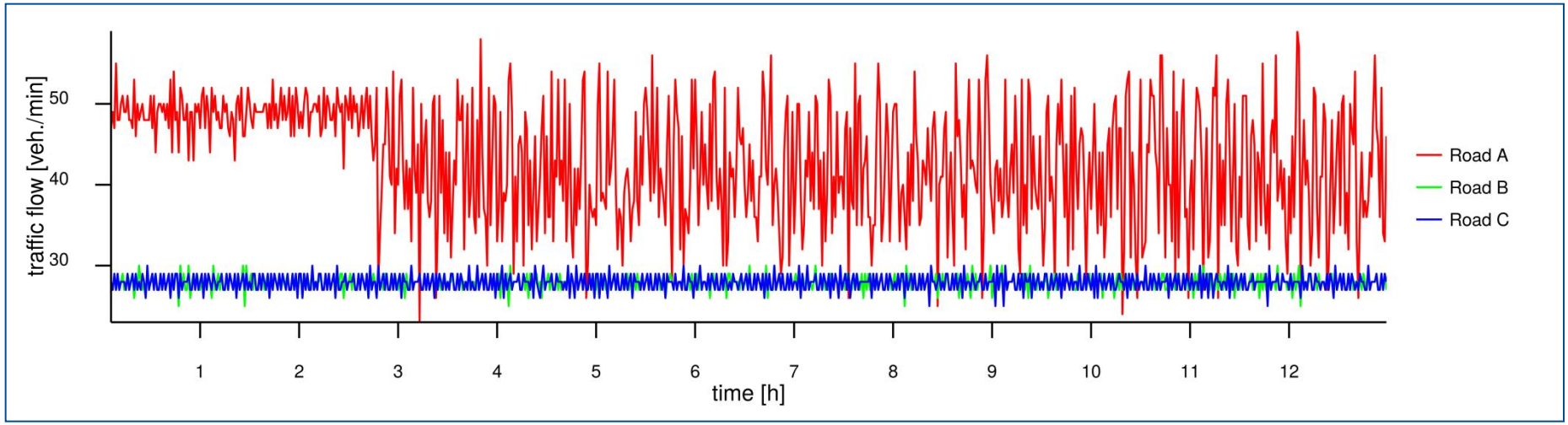
Szenario I, Strategy 1: *no additional load*
Travel Time & Traffic Flow



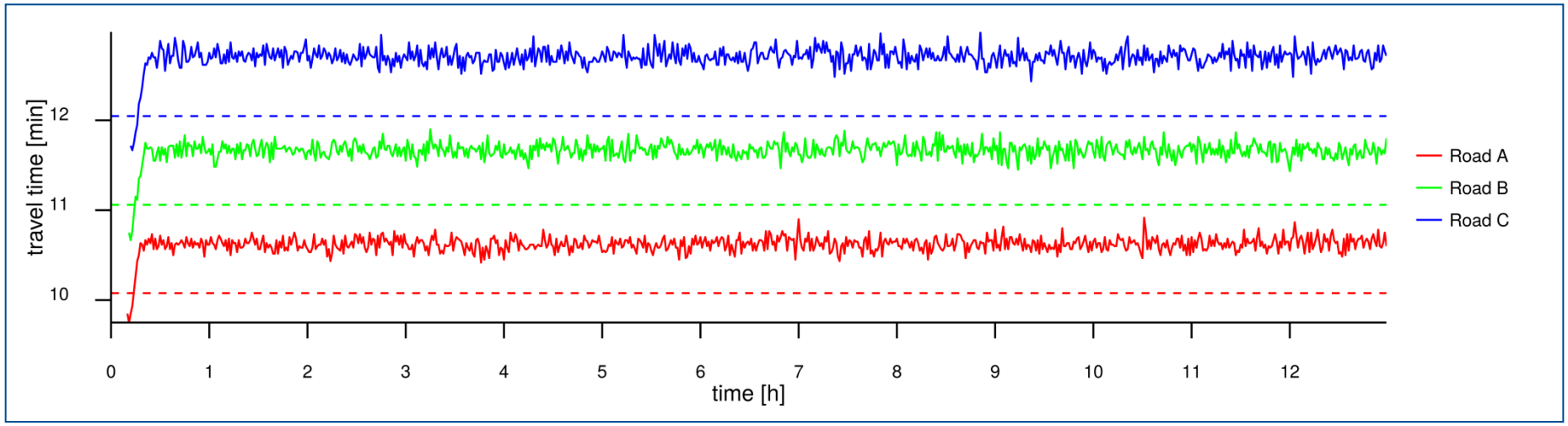


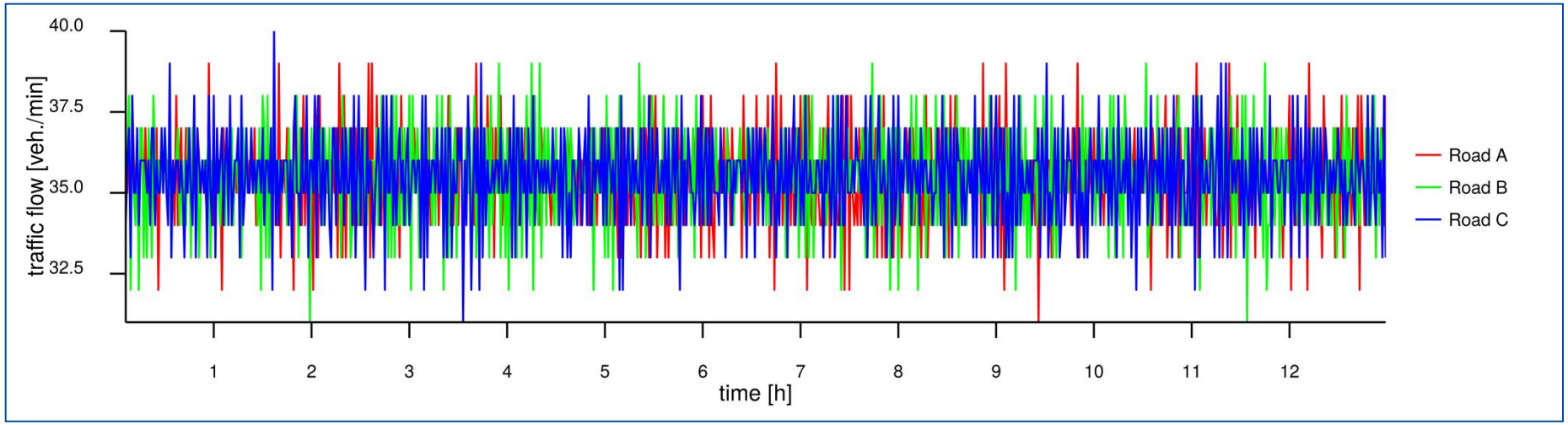
Szenario I, Strategy 2: *shortest path*
Travel Time & Traffic Flow



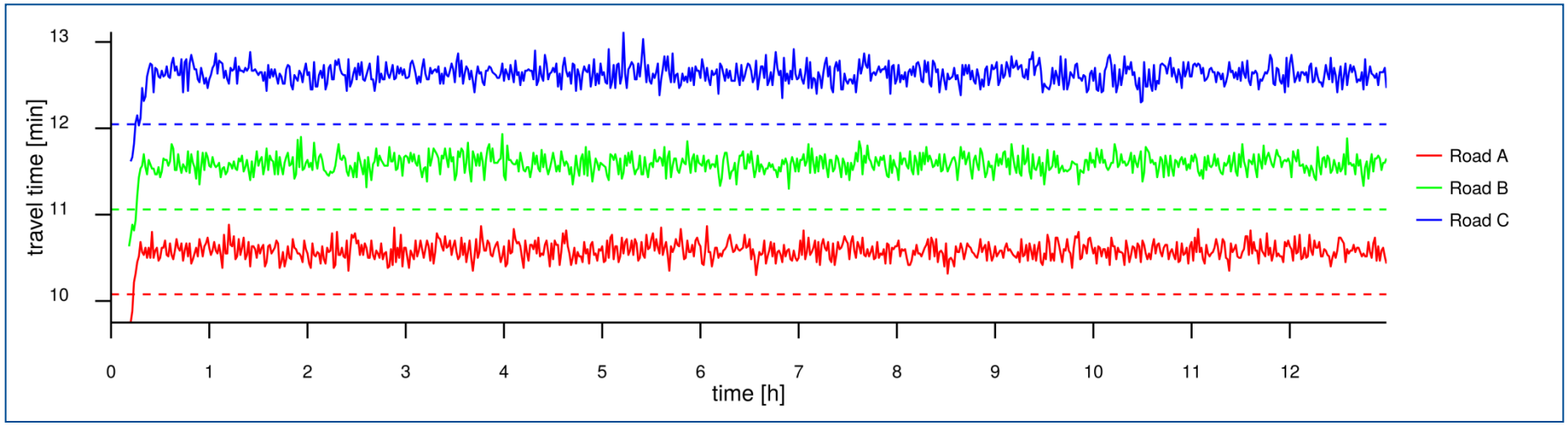


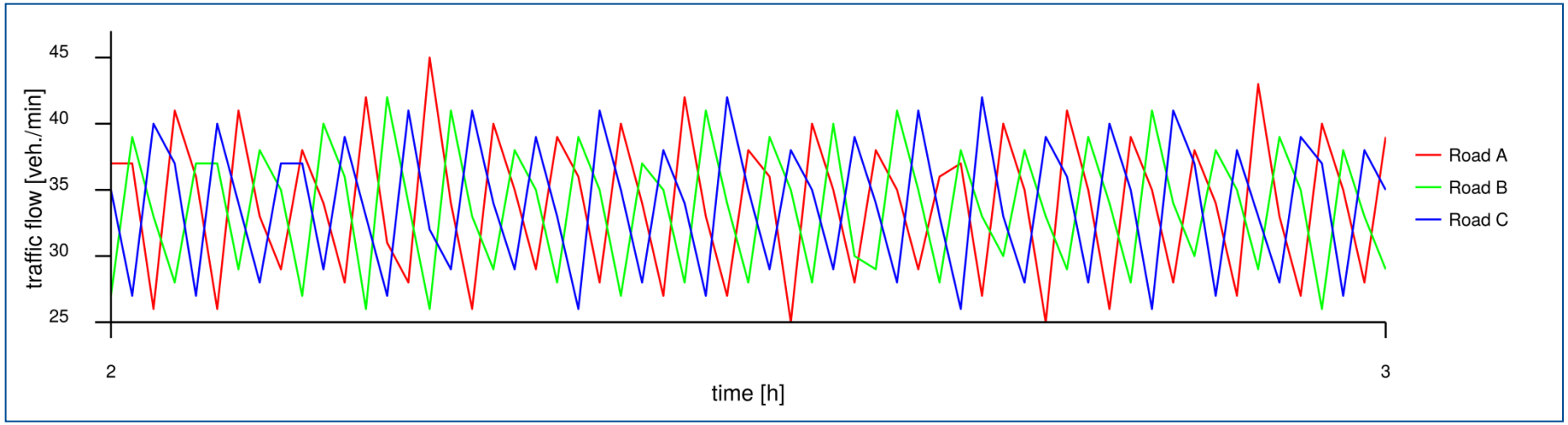
Scenario I, Strategy 3: *equal distributed*
Travel Time & Traffic Flow



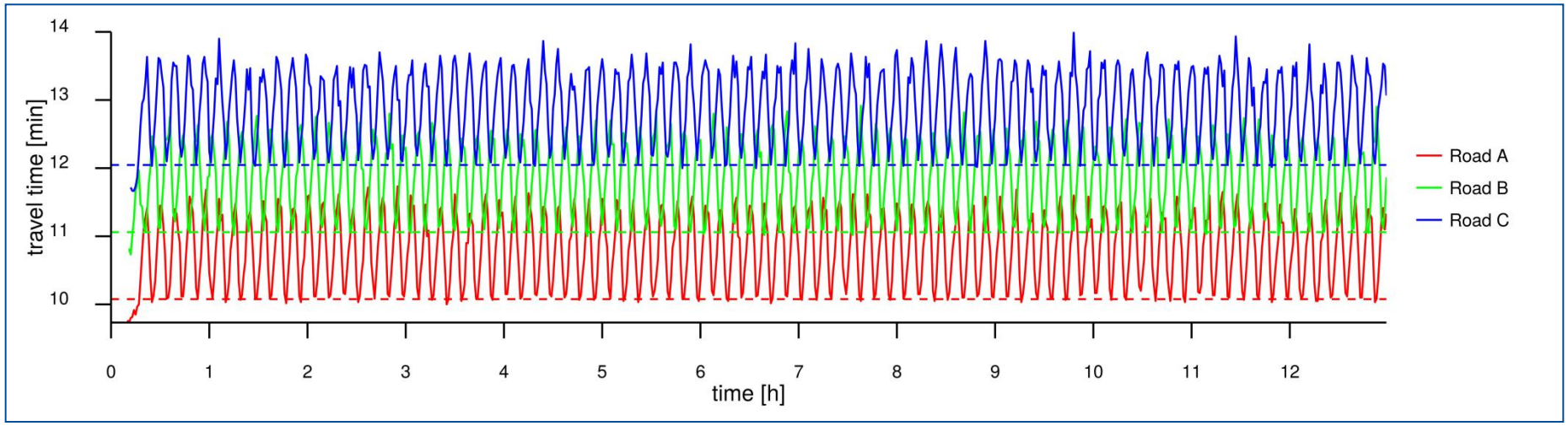


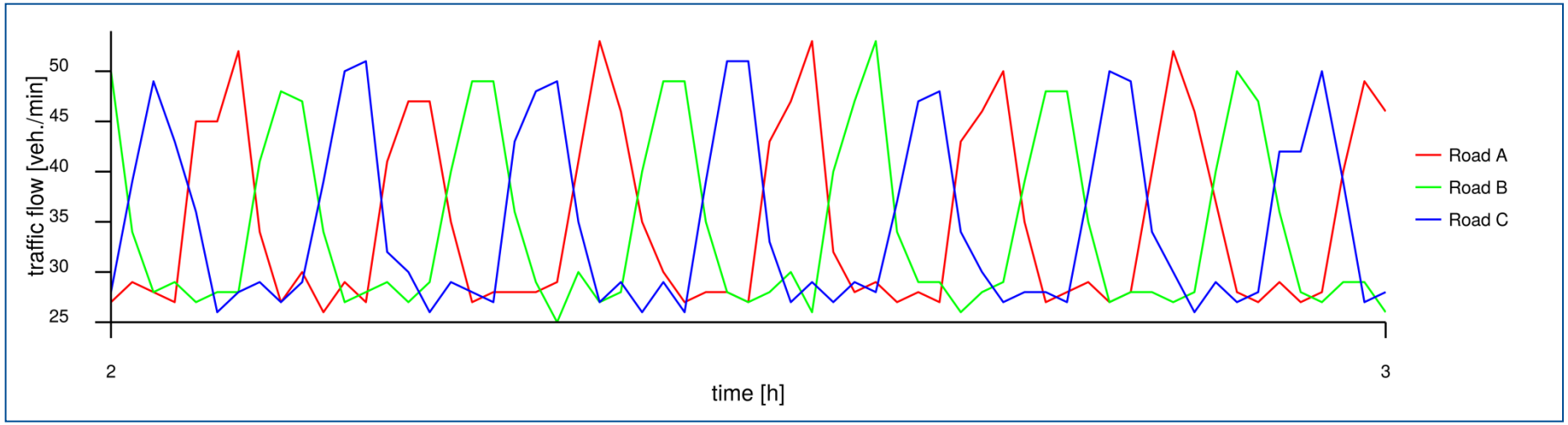
Scenario I, Strategy 4: *alternate 1 minute*
Travel Time & Traffic Flow



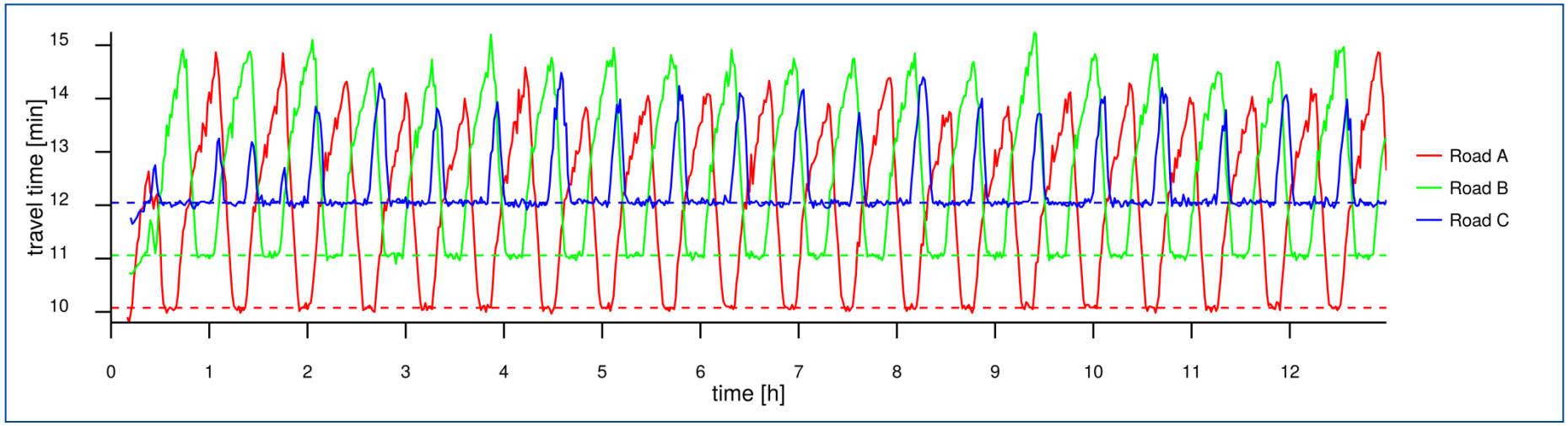


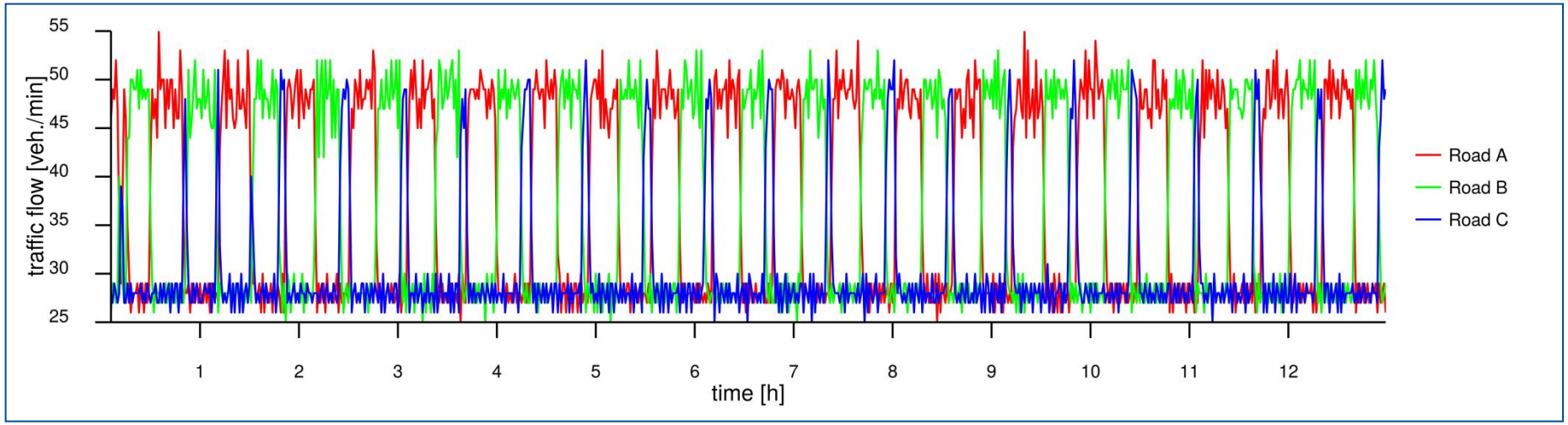
Scenario I, Strategy 5: *alternate 3 minutes*
Travel Time & Traffic Flow





Scenario I, Strategy 6: *travel time*
Travel Time & Traffic Flow





Scenario I, Strategy 7: *travel time of additional load*
Travel Time & Traffic Flow

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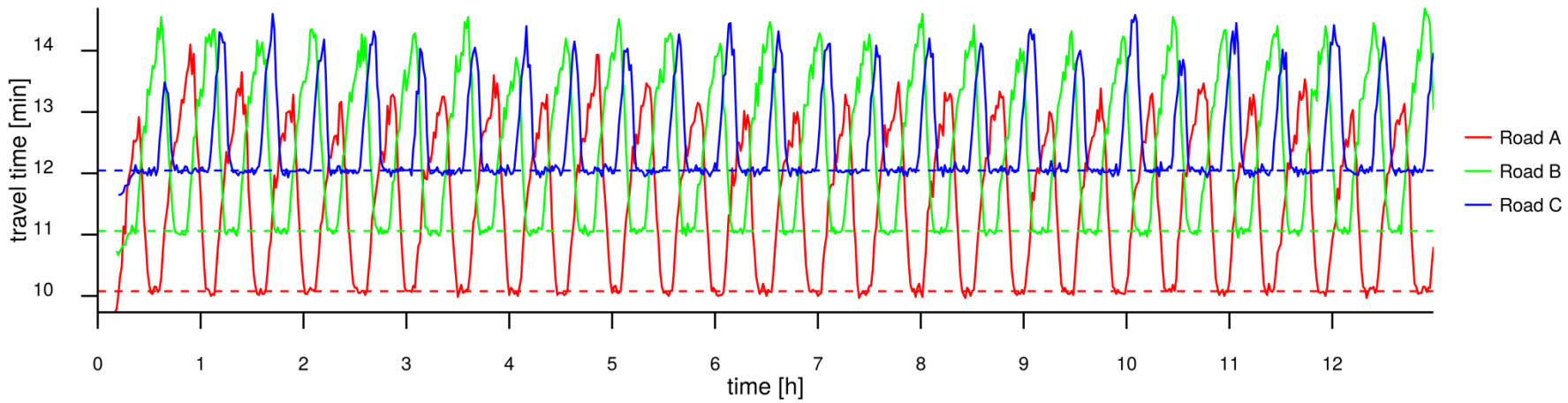
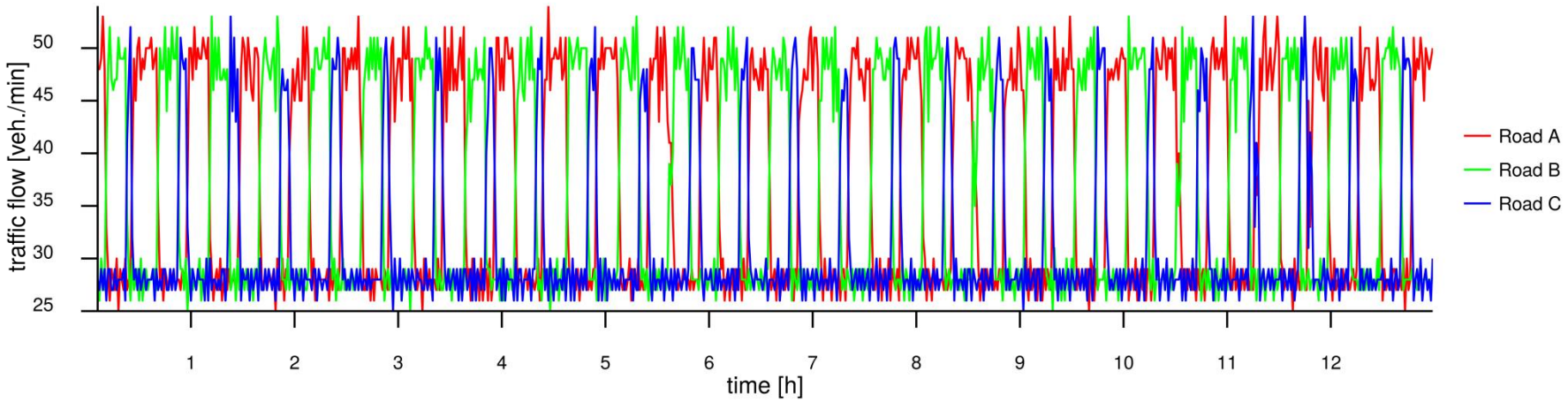
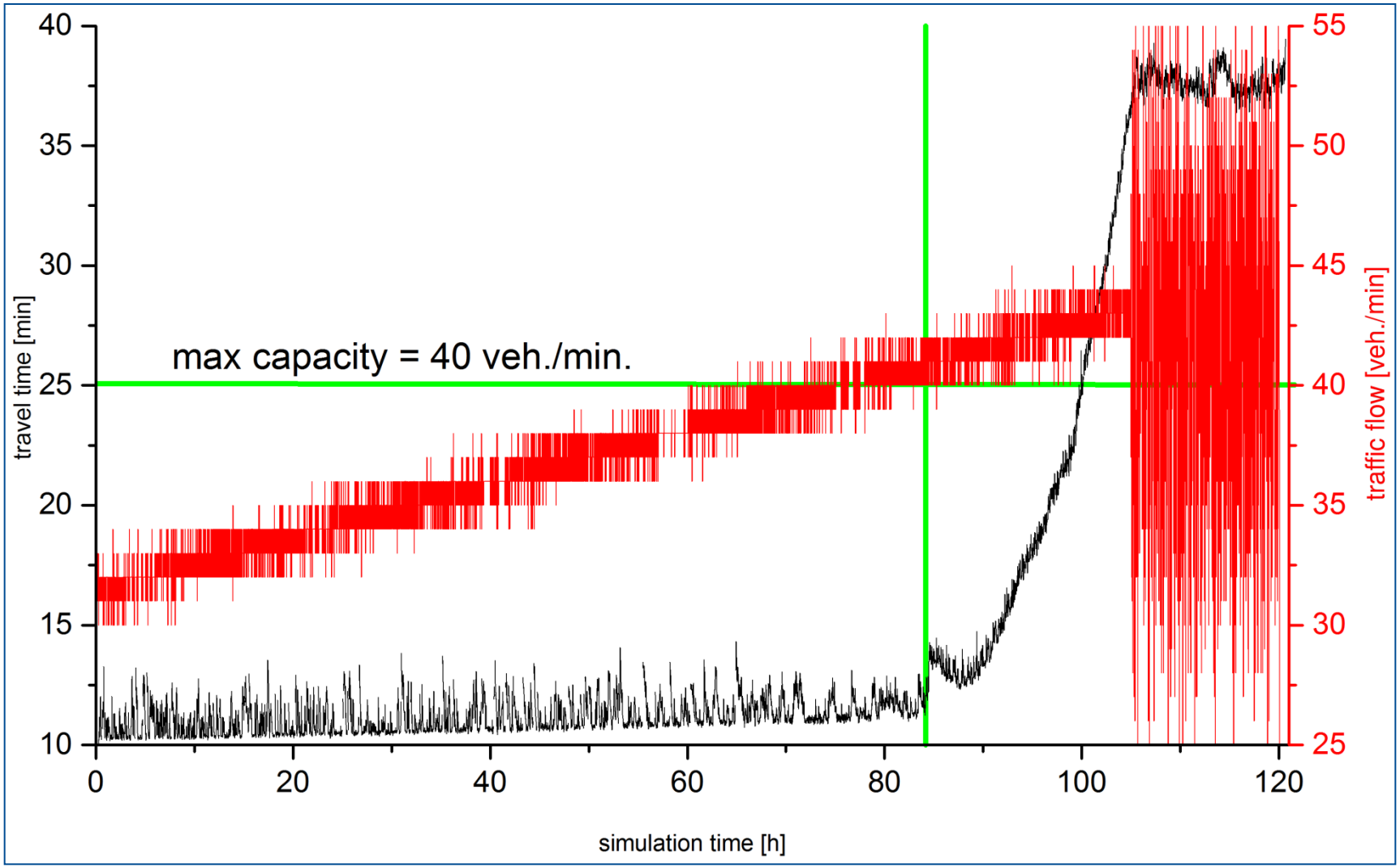
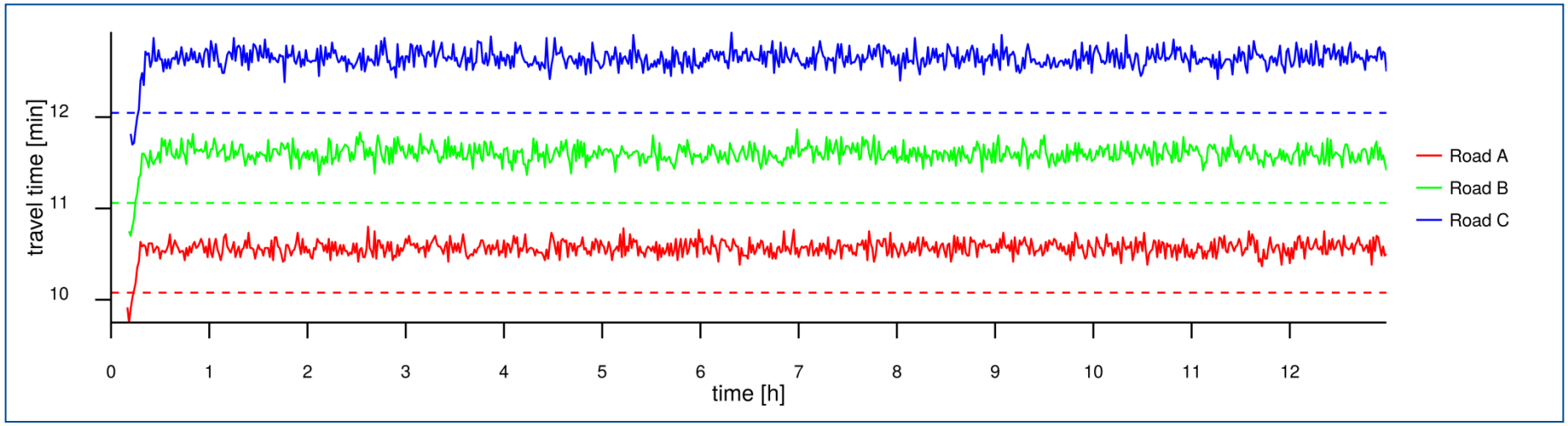


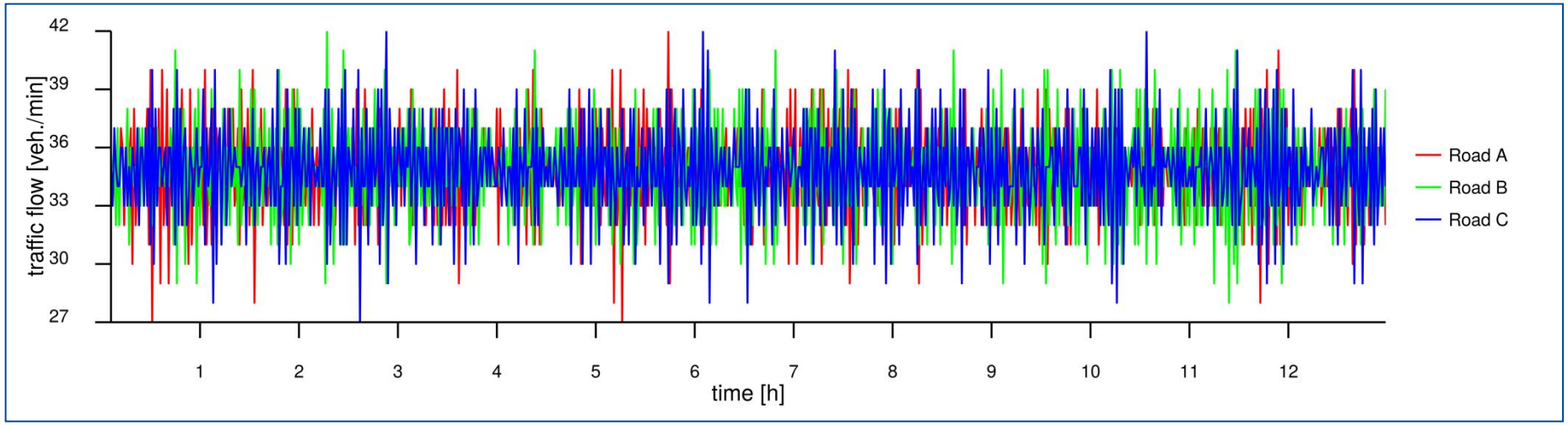


Scenario I, Strategy 8: *remaining road capacity*
Max Road Capacity

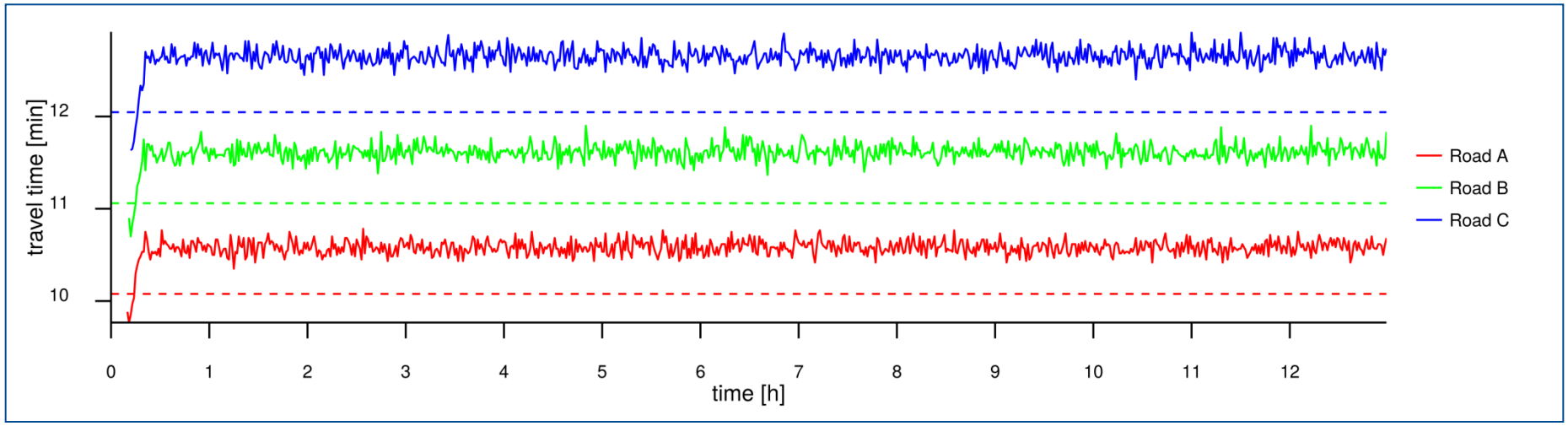


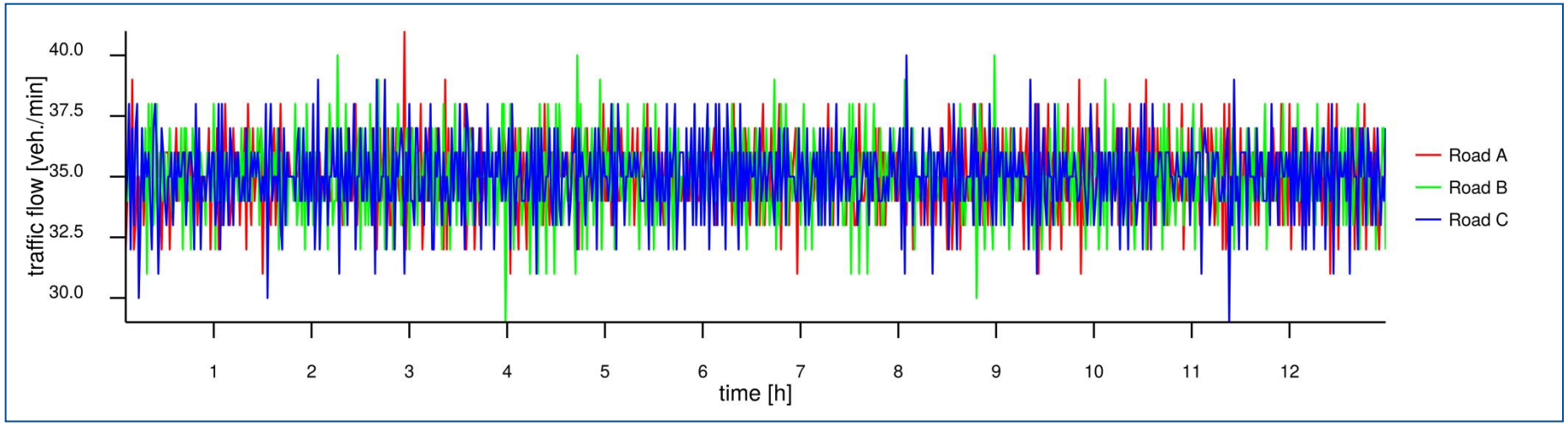
Scenario I, Strategy 8: *remaining road capacity*
Travel Time & Traffic Flow





Scenario I, Strategy 9: *remaining mean road capacity*
Travel Time & Traffic Flow





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mean car travel times for each routing strategy

the first and last half an hour of the simulations were disregarded

	Mean travel time Global [min]	%	Mean travel time additional load [min]	%
No additional load	11,06	100%		
Alternating 1 minute	11,61	105%	11,66	100%
Road capacity	11,61	105%	11,62	100%
Mean road capacity	11,62	105%	11,63	100%
Equal distributed	11,67	106%	11,68	100%
Alternating 3 minutes	11,92	108%	12,12	104%
Travel time additional load	12,34	112%	12,89	111%
Travel time	12,56	114%	13,19	113%
Shortest path	22,78	206%	36,85	317%

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mean filling rates for each routing strategy

	filling rate fixed load	Filling rate trucks	Filling rate additional load
Equal distributed	99.8 %	99.7 %	94.4 %
Mean road capacity	99.7 %	99.6 %	88.6 %
Travel time	99.7 %	99.5 %	86.4 %
Road capacity	99.7 %	99.6 %	86.2 %
Travel time additional load	99.7 %	99.4 %	86.2 %
Alternating 3 minutes	99.7 %	99.5 %	84.5 %
Alternating 1 minute	99.7 %	99.4 %	75.4 %
Shortest path	96.7 %	96.7 %	74.1 %
No additional load	100 %	100 %	0 %

Szenario II

- **equal road length for roads A, B & C:**

  length: 20 km

  bottleneck: 18.0 – 18.2 km (max velocity = 60 km/h)

- **fixed load unequally distributed:**

	Road A	Road B	Road C
Trucks / h	259 (on right lane)	216 (on right lane)	173 (on right lane)
Cars / h	1750	1458	1166
	40 %	33.33 %	26.67 %

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mean car travel times for each routing strategy

the first and last half an hour of the simulations were disregarded

	Mean travel time Global [min]	%	Mean travel time additional load [min]	%
No additional load	10.17	100%		
Alternating 1 minute	10.59	104%	10.59	100%
Road capacity	10.61	104%	10.55	100%
Mean road capacity	10.61	104%	10.55	100%
Equal distributed	10.70	105%	10.65	101%
Alternating 3 minutes	10.77	106%	10.97	104%
Travel time	10,96	108%	11.54	109%
Travel time additional load	11,00	108%	11.59	110%

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mean filling rates for each routing strategy

	filling rate fixed load	filling rate trucks	filling rate additional load
Mean road capacity	99.7 %	99.6 %	89.9 %
Equal distributed	99.7 %	99.6 %	89.2 %
Road capacity	99.8 %	99.7 %	88.4 %
Travel time additional load	99.8 %	99.6 %	77.6 %
Travel time	99.8 %	99.6 %	76.0 %
Alternating 3 minutes	99.8 %	99.6 %	71.9 %
Alternating 1 minute	99.7 %	99.6 %	68.8 %
No additional load	100 %	100 %	/

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- **road length for roads A, B & C:**

	Road A	Road B	Road C
Road length	20 km	22 km	24 km
bottleneck	18.0 – 18.2 km	19.8 – 20.0 km	21.6– 21.8 km

- **fixed load unequally distributed:**

	Road A	Road B	Road C
Trucks / h	259 (on right lane)	216 (on right lane)	173 (on right lane)
Cars / h	1750	1458	1166
	40 %	33.33 %	26.67 %

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mean car travel times for each routing strategy

the first and last half an hour of the simulations were disregarded

	Mean travel time Global [min]	%	Mean travel time additional load [min]	%
No additional load	11.01	100		
Alternating 1 minute	11.52	104.6	11.75	100.6
Road capacity	11.60	105.3	11.89	101.8
Mean road capacity	11.60	105.3	11.88	101.8
Equal distributed	11.61	105.4	11.67	100
Alternating 3 minutes	11.72	106.4	12.18	104.3
Travel time additional load	11.92	108.2	12.64	108.2
Travel time	12.08	109.7	12.80	109.7
Shortest path	19.38	176.0	28.77	246.5

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mean filling rates for each routing strategy

	filling rate fixed load	filling rate trucks	filling rate additional load
Mean road capacity	99.7 %	99.6 %	89.9 %
Equal distributed	99.7 %	99.6 %	89.2 %
Road capacity	99.8 %	99.7 %	88.4 %
Alternating 3 minutes	99.7 %	99.6 %	71.9 %
Alternating 1 minute	99.7 %	99.6 %	68.9 %
Travel time additional load	99.7 %	99.6 %	65.6 %
Travel time	99.7 %	99.6 %	61.0 %
Shortest path	99.3 %	99.3 %	41.0 %
No additional load	100 %	100 %	/

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Thank you, for your attention!