Urban Transects and Trunk Roads: Observations in Hamburg

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Abstract

The International Hamburg Bauforum, a periodic workshop for several 100 s of architects and town planners, in 2019 focused on “Magistralen”, trunk roads with large traffic volumes that shape the adjacent urban fabric in manifold ways. This study aimed to support the Bauforum with qualitative background about the land use and socioeconomic patterns along the road axis. The longitudinal examination resembles the urban-to-rural—transect school of thought in urban planning and supplies quantitative empirical data to support the corresponding discussions. Our study shows that the transect approach, applied to a radial trunk road, is a helpful systematic approach to analyse a succession urban space along the whole of the road and determine sections that deserve more detailed analysis. Further, we see considerable potential of the approach to illustrate and explain sociodemographic and economic developments of the city as a whole, especially using data and comparing the transect diagrams from different points in time.

Keywords Town planning · Transport planning · Bauforum · New urbanism

Magistralen als urbane Transekten - Beobachtungen aus Hamburg

Zusammenfassung

Das Internationale Hamburger Bauforum, ein regelmäßiger Workshop an dem mehrere 100 Architekten und Stadtplaner teilnehmen, konzentrierte sich 2019 auf die “Magistralen”, verkehrsreiche Fernstraßen, die das angrenzende Stadtgefüge auf vielfältige Weise prägen. Ziel dieser Studie war es, dass Bauforum mit qualitativem Hintergrund über die Flächennutzung und sozioökonomischen Muster entlang der Straßenachsen zu unterstützen. Die Längsschnittuntersuchung ähnelt der urban-ländlich-Transekt Denkschule in der Stadtplanung und liefert quantitative empirische Daten zur Unterstützung der entsprechenden Diskussionen. Unsere Studie zeigt, dass der Transekt-Ansatz, angewandt auf eine radiale Fernstraße, ein hilfreicher systematischer Ansatz ist, um einen städtischen Sukzessionsraum entlang der gesamten Straße zu analysieren und Abschnitte zu bestimmen, die eine detailliertere Analyse verdienen. Darüber hinaus sehen wir ein erhebliches Potenzial des Ansatzes, um die soziodemographische und wirtschaftliche Entwicklung der Stadt als Ganzes zu veranschaulichen und zu erklären, insbesondere durch die Verwendung von Daten und den Vergleich der Transektdiagramme aus verschiedenen Zeitpunkten.

1 Introduction

Transects have been used to describe the variation of geographic features along a section of landscape since Alexander von Humboldt in the late eighteenth century (von

Humboldt et al. 1807). The ‘new urbanism’ movement originating in the USA in the late twentieth century applied them to the study of the urban fabric. An example is the prototypical rural-to-urban transect described in the ‘Smart-Code’ (Center for Applied Transect Studies) that differentiates six transect zones of varying density and recommends corresponding design elements.

Trunk Roads often geometrically represent a transect and have been subject to town planners’ scrutiny in Hamburg, where the ‘Internationales Bauforum 2019’ featured seven selected trunk roads as ‘Magistralen’ with the aim of

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Fig. 1 Axes of the seven trunk roads, resp. ‘Magistralen’ featured in the ‘Internationales Bauforum 2019’ in Hamburg

0 5 10 15 km

Legend

Hamburg (BKG/GDZ 2018)

Water (OpenStreetMap ODbL 2018)

Magistralen / Transects

Amsinckstraße - Holtenklinker Straße (B5)

Buxtehuder Straße - Cuxhavener Straße (B73)

Kieler Straße - Pinneberger Chaussee

Grindelallee - Langenhorner Chaussee

Ring 2

Stresemannstraße - Wedeler Landstraße (B431)

Steindamm - Meiendorfer Straße

improving their contribution to the urban structure (hamburg.de GmbH & Co. KG, 2019; Fig. 1). The radial is the most important type among metropolitan trunk roads, they structure the city and provide orientation, forming the backbone of polycentric structures (Hofmann et al. 2013). Often enough, radial trunk roads, connecting major cities, constituted the *raison d'être* of adjacent towns. Recent studies of the complex interactions between urban fabric and road transportation infrastructure testify to their importance in town planning [e.g. Dutkowski (2012) or Bohmann and Siegmund (2013)].

In this paper, we analysed land use, demographics and traffic volumes along these trunk roads as a quantitative approach to the transect concept and discuss its usefulness.

2 Methodology and Data

The axes of the seven trunk roads were split into segments of 100 m length, which in turn were offset 200 m to each side of the axis to build altogether $400 \times 100 \text{ m}^2$ -sized rectangles. These rectangles were intersected with an array of georeferenced land use, demographic and transport-related data (Table 1).

The ALKIS dataset differentiates 17 actual land use categories, which we classified as traffic, leisure, business or residential space. The resulting values for each transect segment were then exported to a table and visually analysed with a normalized diagram. To improve readability and to more closely represent a pedestrians' perception of the urban space, we also made diagrams representing a moving average of altogether five segments' values.

Table 1 Datasets intersected with trunk road transects

Description [unit]	Source
Composition of land use	
Actual land use, (17 categories) [m ²], Maximum number of storeys above ground [1]	ALKIS: LGV ^a , 2018
Demographic data	
Share of foreign residents [%], Household size [%], share of Households with children [%], share of households on social support [%], motorization [cars/1.000 inhabitants]	Statistical zones: LGV, 2018; Statistisches Amt für Hamburg und Schleswig-Holstein 2018
living space per resident [m ²]	District profiles: FHH, 2018; Statistisches Amt für Hamburg und Schleswig-Holstein 2018
Transport related	
Public transport stops (rail) [1]	HVV ^b
Vehicle kilometers travelled [km]	Transport model of Hamburg (ARGUS)

^aLandesbetrieb Geoinformation und Vermessung (LGV) Hamburg, authority for geoinformation and survey

^bHamburger Verkehrsverbund (Hamburg traffic association)

Fig. 2 Transect of trunk road Steindamm–Meiendorfer Straße

Our moving average is calculated from the two preceding segments, the central segment and the two following segments. Correlation coefficients were calculated for every parameter combination.

3 Results

To illustrate the results, we start with analysing the transect from Steindamm to Meiendorfer Straße with altogether 148 segments, running from the central train station into the suburbs (Fig. 2). The composition of land uses in these segments is displayed in the following Figs. 3 and 4, sorted from town centre (left) to suburb (right).

The moving averages of land uses (Fig. 4) show a rhythmic variation of dominating land use: traffic and business

Fig. 3 Transect diagram for Steindamm–Meiendorfer Straße with share of aggregated land uses, sorted from town centre (number 0, left) to suburb (number 147, right)

in the centre with increasing waves of residential areas and insertions of leisure areas. The latter reflect the Wandse, a creek running parallel in varying distance to the road and before crossing it approximately 10 km from the town centre. Residential dominance appears in aggregations of approximately 0.5–2 kms. Areas of this size can easily be covered with non-motorized transport, given appropriate infrastructure.

The inclusion of socioeconomic parameters in the transect diagram reveals peak percentages of households with migratory background in less favourable sections of the transect with a high share of business- and traffic-related land uses (Fig. 5). Here, the transect diagram effectively reveals ‘arrival city’ (Saunders 2010) or ‘metrozone’ (Hellweg 2010) situations in the urban fabric: “the home of the socially non-homogenous, multicultural societies of the post-modern age” (ibid.). Another obvious pattern along this

Fig. 4 Transect diagram for Steindamm–Meiendorfer Straße with moving averages of aggregated land uses. The black line indicates motorization (right axis), sorted from town centre (number 0, left) to suburb (number 147, right)

Fig. 7 Transect of trunk road Stresemannstraße

Fig. 5 Transect diagram for Steindamm–Meiendorfer Straße with moving averages of aggregated land uses, sorted from town centre (number 0, left) to suburb (number 147, right). The lines display socio-economic data (right axis)

Fig. 8 Transect diagram for Stresemannstraße with moving averages of aggregated land uses, sorted from town centre (number 0, left) to suburb (number 155, right). The lines display socio-economic data (right axis)

Fig. 6 Transect diagram for Steindamm–Meiendorfer Straße with motorization [private cars /1000 residents], left axis, and vehicle kms travelled, right axis

transect is the increase in the percentage of households with children towards the periphery.

A questionable pattern can be demonstrated by plotting motorization vs. vehicle kms travelled (Fig. 6). While vehicle kms travelled peaks around intersections closer to the centre, and display a declining baseline towards the periphery, motorization rises with distance from the centre. This disparity of motorization versus adverse traffic impacts could be a issue that urban transport planners might want to alleviate.

A similar analysis of the transect along Stresemannstraße (Fig. 7) shows that the patterns observed along Steindamm–Meiendorfer Straße can also be found along other trunk roads: the rhythm of residential, leisure and traffic areas, the rising share of households with children towards the periphery, the arrival city situations (Fig. 8). Regarding the latter, the socioeconomic attributes in the section around segments

Table 2 Correlation coefficients for distance from centre and different values, absolute above 0.5, 7 transects

Values	<i>r</i>
% Households with children	+0.521
Motorization	+0.517
Total gross floor area (all buildings)	− 0.544

40–45 will be interesting to watch after the A7 motorway is covered with a park (hamburg.de GmbH & Co. KG, n.d.), presumably in the mid-2020s.

Correlation coefficients between different values are generally low and the underlying causal relations seem trivial, as most of the parameters are either competing in space or mutually reinforcing. Of particular interest is the correlation with distance from town centre as a genuinely locational factor that could support the continuous development of certain features and parameters as suggested by the “Smart Code”. However, the only quantifiable parameters with a noteworthy ($|r| > 0.5$) correlation found for the seven transects analysed in Hamburg were children, motorization and density (Table 2). The negative correlation of total gross floor area corresponds to the density gradient presented by Bertaud (2018).

4 Discussion and Conclusion

Our findings applying the rural-to-urban—transect method to trunk roads in Hamburg confirms common perceptions about urban structure in Europe: the decreasing density and rising motorization of residential areas towards the periphery, and also the rhythmic alteration of predominantly residential versus business-, leisure- and transport-related land uses along the transect. Some of these observations have been stated independently of transects or trunk roads (e.g. Bertaud 2018). As empirical foundations for the ‘rural to urban transect’ school of thought do not seem abundant in the academic literature, our and similar observations may constitute a valuable contribution.

The prototypical rural-to-urban transect, however, appears to lack detail and complex variation along roads or transport infrastructure in general and radial trunk roads in particular. In a similar vein, Tagliaventi (2016) suggests several amendments to the transect concept to use in Europe. He found, for instance, “the need to introduce an intermediate category to the transect classification to identify a common level of European urban settlement with neither the strength, size, nor mixed-use complexity of the neighbourhood” as defined in the Charter of the New Urbanism (Congress for the New Urbanism). Still,

‘neighbourhood’-like structures are clearly visible in our transect diagrams.

Turning towards the practical relevance of the method, we could show that it provides a good overview over the whole length of a trunk road and helps to identify special situations, e.g. ‘metro zones’ or ‘arrival cities’. The observation of transects might thus be helpful to identify all a city’s different spaces, even temporary or transitional ones, and appreciate them in due fashion (Düwel 2010). For instance, the diagrams are useful to identify urban structures resp. ‘neighbourhoods’ with a higher residential density where walk- and bikeability should be dominant design aspects. They also reveal spaces that may require intervention, e.g. strong variation in demographics along the transect and questionable combinations like a high share of residential land use around high traffic volumes. Bohmann and Siegmund (2013) provide a useful influence matrix to identify critical factors for the development of selected sections. Such issues, however, could also be studied on a grid or zoning basis. An advantage of the transect method is that it can be combined with other approaches to analyse road space that frequently use two-dimensional representations (e.g. Dutkowski 2012) to address a huge variety of issues around trunk roads.

In the context of urban mobility, our analysis highlights several issues that link to current issues discussed in urban town and transport planning. Quite prominent is the disparity of motorization and traffic volumes. As natural as this pattern may seem after taking local mobility options etc. into account, it becomes abundantly clear that downtown dwellers bear the fallout of mobility choices made in suburbia. An urban economist might, however, argue that residents along the transect chose this trade-off between adverse traffic effects and benefits of a more or less central location.

Another obvious pattern is the increasing share of households with children towards the periphery, documenting that the downtown areas are not a favoured place for families with children—an observation that warrants political discussions.

Further analysis could, on the one hand, widen the scope of parameters and look at different cities with different historic, economic or topographic backgrounds, incorporate more detailed data or focus on particular aspects—e.g. roadspace allocation, the accessible labour market, real estate prices, patterns in business and retail or local mobility patterns. The transect method has been found useful in other, e.g. anthropological contexts (Krebs and Pilz 2013). As Tagliaventi (2016) suggests to distinguish between different building types within the urban Transect Zones, it might be recommendable from a geographers point of view to analyse the urban morphology along a transect, classified by building, composition and neighbourhood typologies

as documented in Schirmer and Axhausen (2015). Bertaud (2018) suggests a number of indicators to manage developments with relevance to urban planning, such as “rent-to-income ratio, floor consumption per capita, and median commuting time”, the latter corresponding to the accessible labour market.

On the other hand, comparing transect diagrams of the same trunk road for different points in time could be instructive to illustrate and explain the development of the urban fabric, for instance the deterioration or gentrification of certain areas, the relocation of production etc.

We conclude that transect style, two-dimensional analyses of roads and their surroundings in general are compelling where larger stretches of roads and their interaction with the surroundings are examined. They can help to illustrate historic and contemporary developments and to identify spaces worth closer examination. It should be noted that a two-dimensional approach cannot analyse or resolve issues arising from the larger urban environment.

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