

DEFINITION OF AREAS IN CITY CENTRES FOR TRANSPORTATION PLANNING PURPOSES

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This paper describes briefly an investigation undertaken by the Department of Transport with the assistance of the National Institute for Transport and Road Research and officials in the Provinces and Local Authorities involved in urban transport planning. Through review of existing methods for defining central business districts it was found that there was no common approach amongst the various metropolitan areas. The study lead to recommended procedures to define a hierarchy of areas in city centres. Land values, which are readily available in local authority records, are used as the main criteria. The procedures should give results which not only are comparable from city to city but also are related to transportation planning.

Hierdie referaat omskryf kortliks 'n ondersoek onderneem deur die Departement van Vervoer met die bystand van die Nasionale Instituut vir Vervoer- en Padnavorsing, en amptenare in Provinsiale en Plaaslike Owerhede betrokke by vervoerbeplanning. 'n Oorsig van bestaande metodes om sentrale sakegebiede te definieer, het verskillende benaderings in die onderskeie metropolitaanse gebiede aangetoon. Die studie het aanleiding gegee tot aanbevole prosedures om 'n hiërargie van gebiede in stadskerne te definieer. Grondwaardes, wat gereedelik beskikbaar is by Plaaslike Owerhede, word in die prosedure gebruik as hoofkriteria. Die prosedure behoort resultate op te lewer wat beide vergelykbaar is tussen stede, en verwant is aan vervoerbeplanning.

Note:

The subject of this paper is described more fully in the Planning Report PR4/84 "Definition of Areas in City Centres for Transportation Planning Purposes", published by the Department of Transport, Pretoria, March 1984. This paper is published with the permission of the Director-General: Transport, Mr. A. B. Eksteen, but does not necessarily reflect the views of the Department of Transport or the National Transport Commission.

An investigation into suitable terms and procedures for establishing boundaries was conducted by the Department of Transport with the assistance of the NITRR and officials in the Provinces and Local Authorities involved in urban transport planning.

This paper, as well as briefly describing the investigation, recommends and defines a hierarchy of areas in city centres and a relatively simple system using land values to establish basic boundaries for the areas which may then be modified slightly for transportation planning purposes.

1. INTRODUCTION

In the Urban Transport Act, (No. 78 of 1977) reference is made to city centres and to key activity areas. In urban planning circles reference is commonly made to Central Business Districts (CBDs), to Central Areas and to Cores such as a Retail Core or an Office Core.

A series of Transport Planning Research Reports (Baxa, Ferreira. et. al., 1978) were prepared by the National Institute for Transport and Road Research (NITRR) in 1978 to set the framework for urban transportation planning called for in the Act. The following definitions were made in relation to areas in city centres,

● Central Business District

"An area within an urban region, usually centrally disposed with very high land valuation and traffic flow and in which the dominant land use is for intensive business activity. A metropolitan area may have more than one area satisfying the definition of Central Business District. If so, one will usually be recognised as the Metropolitan CBD and the others as local CBDs."

● Core of the CBD

"The area within the CBD where the peak land values, tallest buildings and most intensive land-use and pedestrian concentrations are to be found."

● Fringe Area

"That portion of a municipality immediately outside the CBD which is characterized by a variety of business, service and some residential activities."

with the comment,

"The region's transportation system will focus on the CBD (provided it is the only CBD or the metropolitan CBD). It is often not easy to define the boundary of the CBD, since its defining characteristics may diminish steadily from the centre outwards."

With the establishment of Metropolitan Transport Areas (MTAs) in the major urban centres of the Republic and preparation of Transport Plans for these areas it became clear that more definitive descriptions of these city centre areas were required to avoid not only ambiguity but also misleading use of terms.

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2. FIRST STUDY PHASE

In the initial investigation, involving study of documentation submitted to the Department, various factors and problems associated with defining specific areas in city centres were identified.

The procedures used by the various local authorities to define areas in city centres had no common base and even within local authorities a transportation planner might have identified one area as a Central Business District and a town planner might have identified another, neither with sound reasons.

The use of specific terms such as Central Business District or Central Area has quite different interpretations in one local authority as compared to another.

In the Act reference was made to city centres and to key activity areas with the implication that a city centre was a larger area than a key activity area such as a CBD. Some confusion arose from the NITRR definitions as certain sections of the Act were interpreted to apply to CBDs rather than to city centres.

Aside from the problem of whether or not to include high density residential areas in certain definitions, there were also notable differences in functions included in the different city centres. Pretoria, Pietermaritzburg and Bloemfontein are dominantly State function oriented. In certain established definitions of Central Business Districts, government buildings are excluded. This would have a notable effect on comparison between the Central Business Districts of Pretoria and Durban, for example. Similarly, whether or not industry is a function considered to be part of a Central Business District was found to be an important factor. Johannesburg has multi-storey industrial development employing thousands of workers in direct proximity to Office and Retail Cores in the city centre. Durban and Cape Town have only a moderate amount of industrial employment in what they consider to be their Central Areas while Pretoria has virtually no industrial employment in its Central Area.

The most significant factor however which evolved and which guided the later stages of the investigation was the lack of detailed accurate data on land use and employment in many cities. The problem was emphasised by the realistic understanding that time, money and manpower were

just not available to carry out the inventories necessary to gain such data in many cities.

The basic conclusion made was that there had been very little similarity in approach to defining areas in city centres in the initial transport plans of the Metropolitan Transport Areas. In this regard it was decided to conduct an investigation into the city centres of Cape Town, Durban, Johannesburg and Pretoria using information available within the Department or which could be obtained readily from the local authorities or from air photography.

3. SECOND STUDY PHASE

The investigation into the city centres of Cape Town, Durban, Johannesburg and Pretoria was based on identification of the erf in the city centre with the highest land valuation, and then radiating outwards to find a boundary of a Central Business District (CBD) within about 10 minutes walking distance to contain high density retail and office employment. Central Areas, being larger, could include other high density employment areas with recognition for natural and man-made barriers.

Following on discussions with the officials in the four cities and in the Provincial Administrations of the Cape, Natal and Transvaal there was general accord that for transport planning a hierarchy of areas needed to be defined of which a Central Business District (CBD) would be one, with other terms to describe other areas in centres of cities.

It was also recognised that simple definitions were still required to enable different people in different cities to set out comparable areas. In this regard Durban officials provided a Thesis on the Durban CBD prepared by J M van der Heever (1979) which proved to be an important input to the following studies towards developing definitions. Pretoria in its agreement to the principle of having a hierarchy of areas noted that it was ill equipped to perform any extensive detailed studies of land use and employment to aid in the definitions.

In the research of literature which formed part of the second study phase it was apparent that Murphy's and Vance's studies (1954a, 1954b, 1955) conducted in the 1950's in the United States formed the

basis of the studies conducted by a number of the authors of papers reviewed. Herein-after reference to Murphy should be read to include his colleagues.

Murphy considered the following as possible parameters for influencing the boundary of a CBD: building heights, population distribution, traffic and pedestrian flows, valuation data and land use. He considered that none of these could stand on their own but would require further investigation, particularly field surveys of the uses occurring in buildings. He also stated:

"If it were possible to obtain, and to localise on a map, data on the number of persons employed in offices, in retail stores and in service establishments, this might form the basis for a suitable delimitation technique."

The assembly of the data however is an expensive exercise requiring considerable manpower and computer support. It could be unreasonable to require its application to all cities.

Murphy concentrated on the land use approach and his first step was to define what he considered to be central business functions. Briefly these were confined almost entirely to the retailing of goods and services for a profit and the performing of various financial and office functions. He excluded residences, government and public buildings, industries, wholesaling and storage from these central business functions. The studies of nine American cities (1954b) were based on this land use approach which Murphy termed the Central Business Index Method. Except for the intensive floor by floor, block by block, surveys required, the method is basically simple and relies on two indices. The first is the Central Business Height Index (CBHI) which is the total floor area of defined central business uses at all levels in a block divided by the total ground floor area of that block. The second is the Central Business Intensity Index (CBII) which is the percentage of total floor area at all levels in a block that is used for defined central business uses.

To be considered part of a Central Business District a block must-

- (a) have a CBHI of 1 or more
- (b) have a CBII of 50 percent or more

- (c) be part of a contiguous group surrounding the peak land value intersection. (A block may touch only at one corner to others and still be considered contiguous)
- (d) though not itself meeting (a) and/or (b), be surrounded by blocks meeting requirements (a), (b) and (c).

Murphy's CBD boundary is then a line drawn around all blocks meeting the above criteria. In his study of nine American cities Murphy concluded, inter alia, that a line drawn on the boundary of the land valued at 5% or more of the peak value approximated to the CBD boundary. Unfortunately he did not develop this conclusion any further and stressed the need for further information on not only the previously mentioned factors such as traffic and pedestrian flows but also on vertical movements and clustering of activities.

Hywel Davies (1959, 1965) in his study of the CBD of Cape Town in the 1960's used a number of approaches including Murphy's and, like Murphy, he found that a 5% isoval (an isoval being a line drawn around properties with the same land value and expressed as a percentage of peak land value) approximated the boundary of the CBD and that a 30% land isoval approximated the Core. Van der Heever's study (1979) of Durban's CBD for his thesis was intensive and he also looked at the question of land values for defining various components of the CBD. He delineated "Hardcore", "Core" and "Periphery" and examined sectors in terms of Murphy's Central Business Index method and land values. He also found that the 5% of peak land value isoval also approximated the CBD boundary. He adopted without checking Davies' figure of 30% of peak land value as delimiting the Core and also accepted a 50% isoval as defining a "Hardcore" purely on the basis that "it should be worth at least half that of the peak value". He defined the Periphery to the Core by the 15% isoval. Arising from the above information he applied the isoval philosophy to Johannesburg. It was found that the Hardcor and Periphery could be defined by the 50% and 15% isovals respectively and furthermore that the 5% isoval also approximated to the CBD boundary but included several blocks purely industrial in function. In regard to the Core however it was found that

the 40% isoval provided a realistic boundary whilst the 30% isoval included areas that could not be considered as "Core". Van der Heever stated in his report that he would have achieved greater accuracy if he had applied his land valuations to portions of blocks and not taking the mean for a whole block.

In order to check the ease of determining boundaries in terms of land values the 5% isoval for Pretoria was determined. This was done in only two hours. The 5% isoval as shown on Figure 4 corresponds very closely to the CBD boundary defined in 1983 by Pretoria officials using Murphy's Central Business Index method.

It was therefore decided to test the land value philosophy as a means of defining a CBD and its component parts for each of the four cities.

4. APPLICATION OF THE LAND VALUE PHILOSOPHY TO THE FOUR MAJOR CITIES

Durban and Johannesburg land values were available for 1978. Pretoria's values were, as explained above, extracted for 1983, but Cape Town's unfortunately related to 1966. The isovals of 40%, 15% and 5% were taken to represent or approximate the boundaries of the Central Business Core, the Core Periphery and the Central Business District respectively,

these being new terms to describe the hierarchy of areas in city centres. With recognition that a wider area than the 5% isoval might be of interest another broader term was included in the hierarchy, this being a Central Work Complex. The latter term allows the planner to round off the City Centre concept with areas which, though not meeting the land value parameters, have significant employment levels and/or trip generation characteristics common to some industrial areas which fringe on business districts. It may also be used to include areas of planned expansion of the central business activities.

Figures 1, 2, 3 and 4 illustrate the boundaries for Cape Town, Durban, Johannesburg and Pretoria derived from the above stated isovals and principles. Employment levels and densities for the delimited areas in each of the four cities are set out below. The Central Work Complex boundaries are hypothetical and therefore are not included in the comparison. The similarities in the above figures for Cape Town, Durban and Pretoria are remarkable. That the Johannesburg CBD is larger and denser is to be expected given the much larger population of the metropolitan area and also the inclusion of multi-storey industrial development in close proximity to the high density office and retail areas.

	CAPE TOWN (1980)	DURBAN (1981)	JOHANNESBURG (1979)	PRETORIA (1977)
<i>Central Business Core</i>				
Area (Ha)	29	40	60	30
No. of Workers ¹	33 000	42 000	77 000	30 000
Workers/Ha ²	1 150	1 000	1 300	1 000
<i>Core Periphery³</i>				
Area (Ha)	60	66	66	53
No. of Workers	24 000	24 000	56 000	25 000
Workers/Ha	400	350	850	450
<i>Central Business District⁴</i>				
Area (Ha)	178	178	376	173
No. of Workers	73 000	68 000	216 000	73 000
Workers/Ha	400	400	550	400

1 Rounded to nearest 1 000

2 Rounded to nearest 50

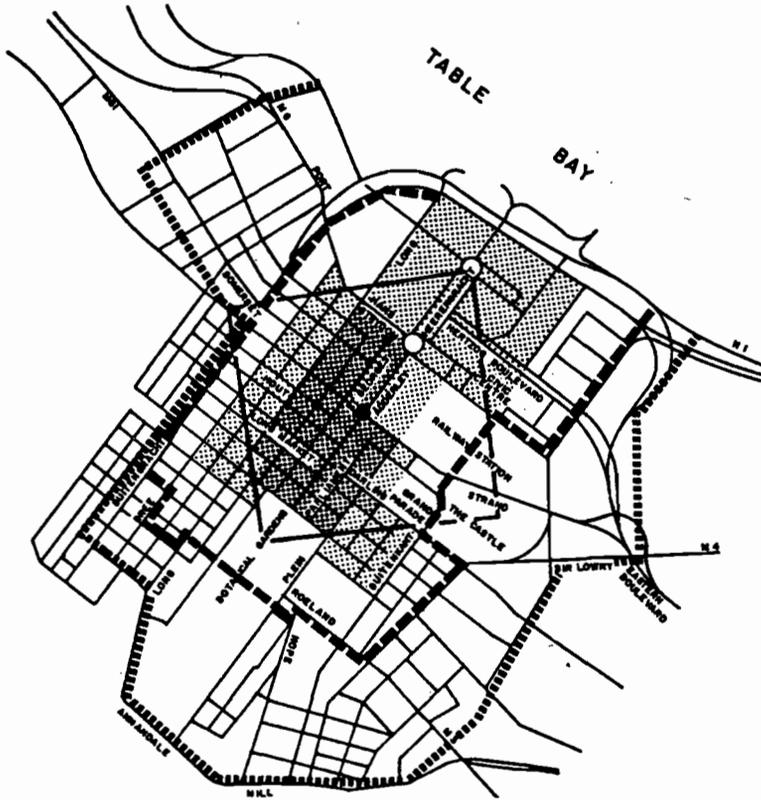
3 Area between 40% and 15% isovals

4 Total within 5% isoval including Core and Periphery

COMPONENTS OF CENTRAL WORK COMPLEX

BOUNDARIES ADJUSTED FOR TRANSPORTATION PLANNING PURPOSES

(BASED ON 1983 LAND VALUES)



LEGEND

- PEAK LAND VALUE INTERSECTION
- ▨ 40% OF PEAK LAND VALUE (1983) CENTRAL BUSINESS CORE
- ▨ 15% OF PEAK LAND VALUE CORE PERIPHERY
- 5% OF PEAK LAND VALUE CENTRAL BUSINESS DISTRICT
- ⋯ CENTRAL WORK COMPLEX
- ◇ 10 MINUTE WALKING DISTANCE

FIGURE 1 CAPE TOWN

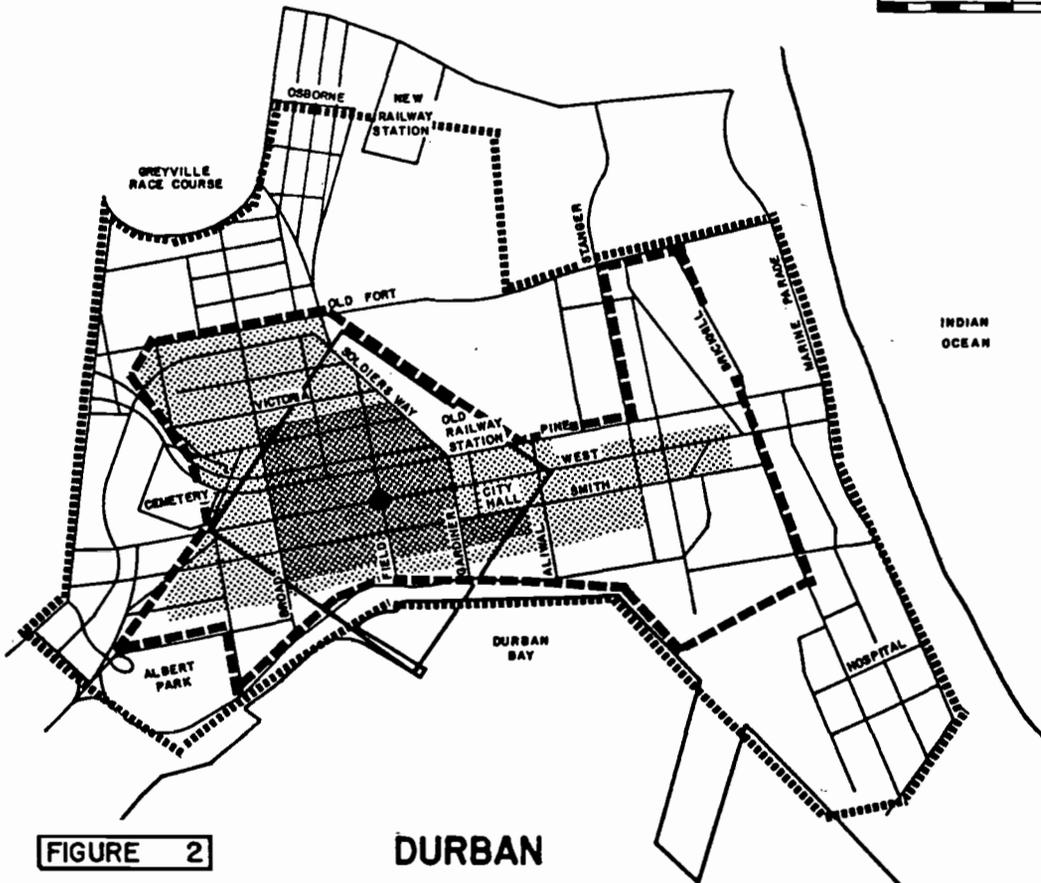
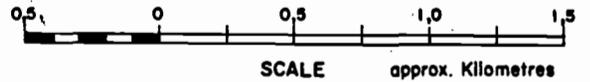


FIGURE 2 DURBAN



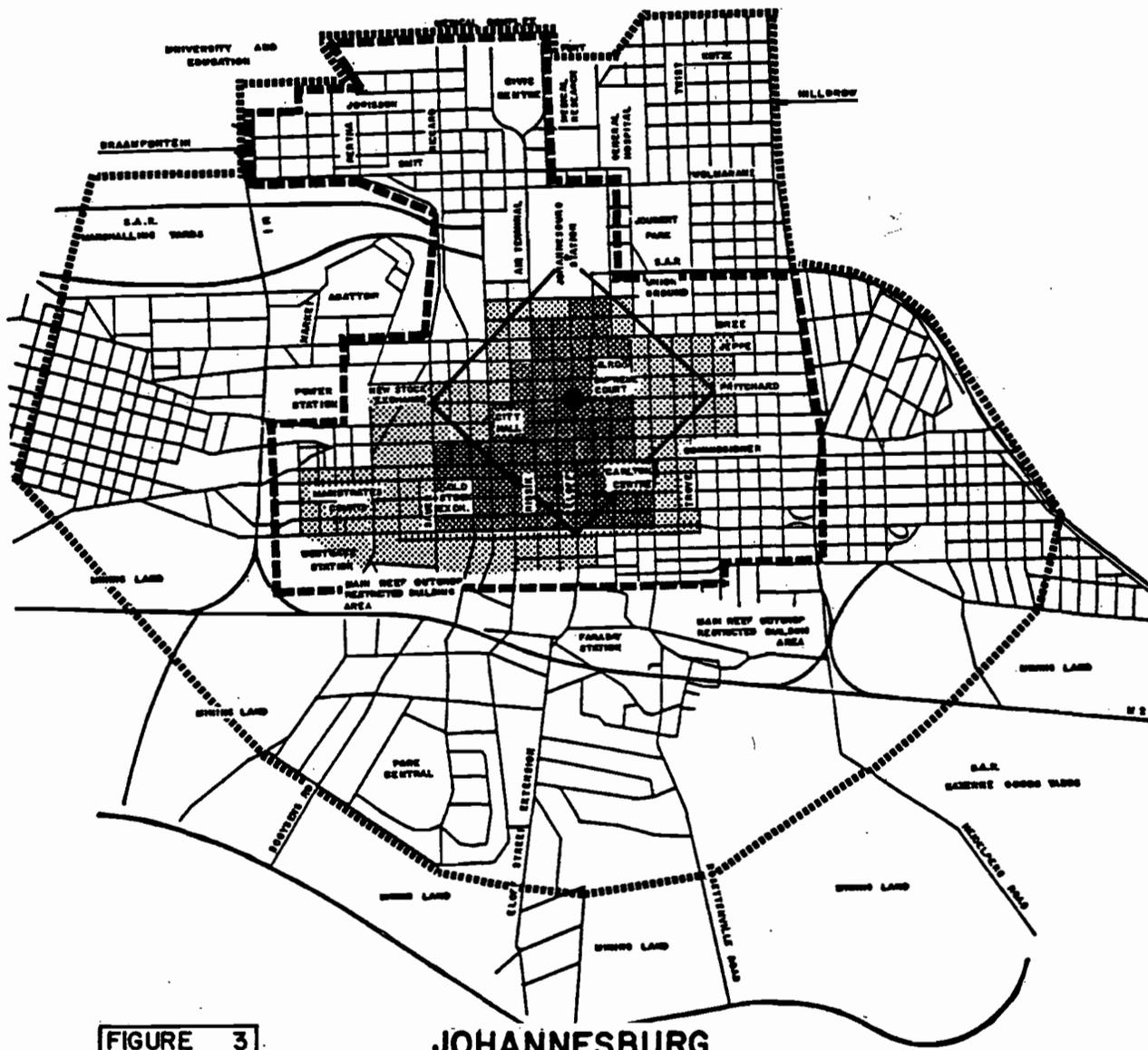


FIGURE 3

JOHANNESBURG

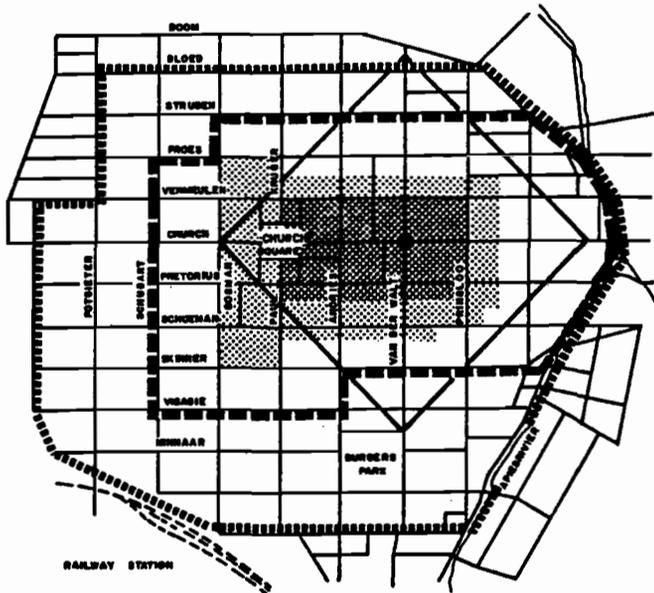


FIGURE 4

PRETORIA

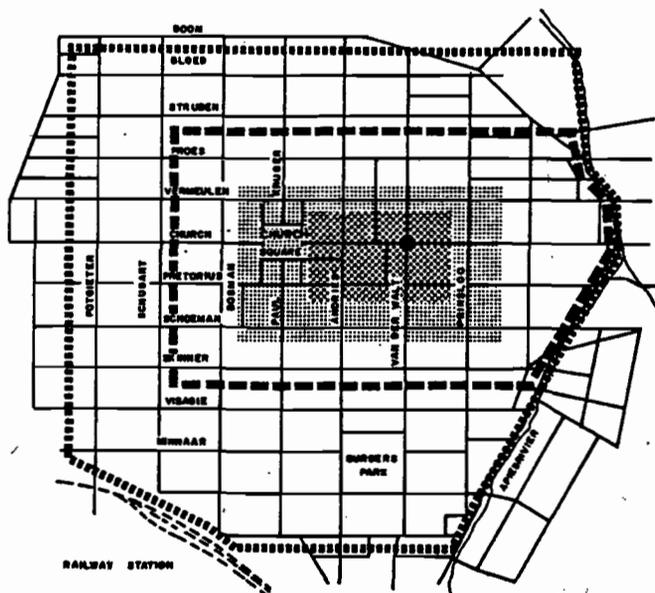


FIGURE 5

5. COMPARISON OF AREAS DEFINED BY LAND VALUE PROCEDURE WITH AREAS DEFINED PREVIOUSLY

5.1 Cape Town

The Central Business Core is similar in size and employment level to the area defined as a CBD in the assessment study but shifted northward to exclude residential properties next to Durban Bay and to include the retail-office development to the north of Pine Street.

Addition of the Core Periphery gives and area in size between the assessed CBD and Central Area.

The Central Business District defined by the 5% isoval approaches in size the assessed Central Area but notably excludes the beach front area.

The Central Work Complex is similar to the assessed Central Area but extends further to the north to include developing employment areas near the new railway station. The Central Area referred to in the Durban Transportation Plan is the same as the assessed Central Area.

5.2 Durban

The Central Business Core as defined by the 40% isoval and shown on Figure 1 is very similar to the area defined as a CBD in the second phase of the study but slightly smaller on the east and west sides.

Addition of the Core Periphery brings in areas beyond that defined in the assessment study as a CBD but still short of that defined as a Central Area.

The Central Business District defined by the 5% isoval is smaller than the previously assessed Central Area having employment of 73 000 instead of 85 000. The 5% isoval did not extend quite so far to the south-west.

The Central Work Complex is bigger than the assessed Central Area and approximates the area that Cape Town officials have called the Central City or the CBD.

5.3 Johannesburg

The Central Business Core as defined by the 40% isoval is about half the size and

employment level of the area defined as a CBD in the assessment study.

Addition of the Core Periphery to the Central Business Core, however, gives an area very similar to that CBD.

The Central Business District defined by the 5% isoval is much larger and approaches in size and employment level the Central Area defined by Johannesburg officials and used in the assessment study.

The Central Work Complex shown is similar to the Central Complex defined by Johannesburg officials.

5.4 Pretoria

The Central Business Core is much smaller than the CBD defined in the assessment study. It is also offset one block eastward.

The 15% isoval defining the Core Periphery, while similar to the assessed CBD boundary on the north, south and west sides, extends further eastwards.

The Central Business District defined by the 5% isoval, while much larger than the CBD defined in the assessment study, is still much smaller than the area called the Central Area in the assessment study and the CBD by Pretoria officials.

The Central Work Complex shown on Figure 4 approximates this latter wide area.

5.5 Conclusion of the comparison

It is apparent that although a wide variety of terms, definitions and procedures have been and could be applied to the problem of defining areas in a city centre the use of land valuations as a percentage of peak land value is relatively simple and will give results that are compatible from city to city. The hierarchy of areas used in the four city study appears to give distinct areas as shown on Figures 1, 2, 3 and 4, which with minor adjustments will be useful in transportation planning and in urban planning as well.

6. RECOMMENDED PROCEDURES

6.1 Definitions

(a) *Peak Land Values (PLV)* is the highest land value expressed in rands per square metre but based on a minimum area of 1 000 m².

(b) *Peak Land Value Intersection (PLVI)* is the intersection of two roads nearest to the 1 000 m² of land having the Peak Land Value.

(c) *Isoval* is a line connecting places of the same value. In this case the value is expressed as a percentage of Peak Land Value.

(d) *City Centre* is a general term referring to a wide area encompassing the main business activities of the city and does not have a specific boundary.

(e) *Central Work Complex (CWC)* is an area encompassing the Central Business District, generally not extending more than about two kilometres from the Peak Land Value Intersection, but including those areas of high employment which are often adjacent to Central Business Districts. The determination of boundaries is based primarily on natural and man-made barriers which separate areas of high density employment from other land uses.

(f) *Central Business District (CBD)* is the area comprising the historic retail and office cores with their high density development and peripheral transitional areas into which the Core uses are expanding. The boundary is based on the 5% isoval which encompasses the area with land values equal to or exceeding 5% of the Peak Land Value.

(g) *Central Business Core (CBC)* is the portion of the Central Business District in which the retail and office cores are sited and the highest density of employment usually occurs. The boundary is based on the 40% isoval.

(h) *Core Periphery (CP)* is the area adjacent to the Central Business Core within the Central Business District into which retail and office development is expanding and consequently is an area of transition. Its outer boundary is based on the 15% isoval and its inner boundary is the Central Business Core boundary.

6.2 Setting boundaries

(a) *Computing and plotting isovals.*

On a cadastral map of the city centre plot the Peak Land Value Intersection. Compute the Land Value related to 40%, 15% and 5% of Peak Land Value. From cadastral plans and the valuation role, compute land values in rands per m² for sites of 1 000 m² or more. For smaller sites group with adjacent sites to make up sites of at least a 1 000 m² and average

the valuation. Where there are many smaller sites in a city centre a sampling system, averaging the four block corner sites and a mid-block site, may be used to determine an average land value for a block. Plot on the map the land values of sites near the 40%, 15% and 5% levels. Isovals can be drawn between the sites of nearly equal value. It is not necessary to be too exact in this process as the area is to be adjusted to establish logical boundaries for transportation planning purposes.

Adjusting for boundary conditions.

In transportation planning it is more important that a boundary be set on a line that is suitable for the measurement of movements across it than it is to identify one area from the next. In this context a cordon or boundary around a given area should run mid-block rather than mid-road and if sites with land values of less than 5% of the Peak Land Values are included in the Central Business District it is inconsequential.

Where a boundary is a river it can be located in the centre. But where the boundary is a transport facility such as a freeway or a railway the boundary should

be located on one side or the other, usually on the side farthest from the centre. Consideration must also be given to access points to parking garages, to railway and bus stations and to freeway interchange ramp terminal locations. All these adjustments should tend to straighten and move outward the initial line taken from the basic isovals.

In Figures 1, 2, 3 and 4 a certain amount of adjustment was made from the isovals in marking the boundaries of the hierarchy of areas. No detailed adjustments were made however for transportation planning purposes. For example, in Figure 4, Pretoria, the Central Business District boundary in the north-west jogs to exclude the block bounded by Struben, Bosman, Proes and Schubart Streets, a school site. With adjustments for transportation planning considerations, Schubart Street being part of a one-way couple with Potgieter Street and Struben Street being part of a one-way couple with Bloed Street, the boundary would probably run just to the east of Schubart Street and just to the south of Struben Street. Figure 5 shows the boundary adjustments made for transportation planning purposes.

7. CONCLUSIONS AND RECOMMENDATION

The initial understanding of terms relating to city centres by those involved in urban transport planning in the Republic was inadequate.

It was found that initial review of data submitted on employment, comment received on the problems involved in carrying out proper inventories, the attempt to define common areas for each of four cities using the assessment method based on employment and development intensities and also, the review of literature, particularly that of Murphy, all led to the conclusion that a simpler method was required.

The use of land value isovals relative to a peak land value appears to be a reasonable, simple method of indicating approximate locations of boundaries of specific areas in City Centres. The boundaries can be adjusted for transportation planning considerations. The hierarchy of areas and related isovals selected appear to approximate reasonable areas for transportation planning purposes.



CAPE TOWN (The Argus)

8. REFERENCES

- BAXA, J. V., FERREIRA, L. J., RATHBONE, D. B., ROYCE, N. D., VAN ZYL, N. J. W. 1978. Definitions of Urban Transport Planning Terms, *Transport Planning Research Report, TPRR2*, National Institute for Transport and Road Research, CSIR, Pretoria, October.
- DAVIES, D. HYWEL. 1959. Boundary Study as a Tool in CBD Analysis: An Interpretation of Certain Aspects of the Boundary of Cape Town's Central Business District, *Economic Geography*, Vol. 35, pp. 322-325.
- DAVIES, D. HYWEL., 1965. *Land Use in Central Cape Town*, Longmans, Cape Town.
- MURPHY, RAYMOND E., AND VANCE, J. E. JNR. 1954a. Delimiting the CBD *Economic Geography*, Vol. 30, pp. 189-222.
- MURPHY, RAYMOND E., AND VANCE, J. E. JNR. 1954b. A Comparative Study of Nine Central Business Districts, *Economic Geography*, Vol. 31, pp. 301-336.
- MURPHY, RAYMOND E., AND VANCE, J. E. JNR. AND EPSTEIN, BANT, J. 1955. Internal Structure of the CBD, *Economic Geography*, Vol. 31, pp. 21-46.
- URBAN TRANSPORT ACT (Act 78 of 1977) June 1977: *Government Gazette No. 5593*, Government Printer, Pretoria.
- VAN DER HEEVER, J. M. 1979. *The Durban Central Business District*, Thesis Natal University.
- DAVIES J. AND RAJAH D. S. 1965. The Durban CBD Boundary Delimitation and Racial Dualism. *The South African Geographical Journal*, Vol. 47, pages 45-58.
- DEWAR N. 1972. Delimiting The Zone In Transition An Assessment. *South African Geographical Journal*, Vol. 54, pages 95-104.
- GODDARD J. B. 1975. *Office Location in Urban and Regional Development*. Oxford University Press.
- HOLFORD W. & KANTOROWITCH R., 1968. *Durban 1985*. Durban City Council.
- LOFFELL B. L. 1967. *Central Area Johannesburg*. Johannesburg City Council.
- LOFFELL B. L. 1973. *Johannesburg City Centre*. Johannesburg City Council.
- MACKETT R. L. 1980. The Relationship between Transport and the Viability of Central and Inner Urban Areas. *Institute for Urban Studies*, University of Leeds Working paper 129, April.
- MARSH H. M. 1982. *Greater Johannesburg Present and Future*. Johannesburg CBD Association.
- MARSH H. M. AND SMITH R. W. 1984. *Definition of Areas in City Centres for Transportation Planning Purposes*. Department of Transport, Pretoria, March.
- MORRIS S. S. 1975. *Cape Town City for the People*. Cape Town City Council, March.
- MOSES L. & WILLIAMSON H. F. 1967. The location of Economic Activity in Cities. *American Economic Review* Vol. 57, pages 211-222.
- NESS M. P., MORRAL J. F. AND HUTCHINSON B. G. 1969. An Analysis of CBD Pedestrian Circulation Patterns. *Highway Research Record* 283, Highway Research Board, pages 11-18.
- PRESTON R. E. 1966. The Zone in Transition: A Study of Urban Land Use Patterns. *Economic Geography*, Vol. 42, pages 236-260.
- PUSHKANEV B. AND ZUPAN J. M., 1971. Pedestrian Travel Demand. *Highway Research Record* 355, Highway Research Board, pages 37-53.
- ROBERTSON K. A. 1980. The Impact of Transportation on the Central Business District. *Traffic Quarterly*, Vol. 34, No. 4, October, pages 523-537.
- RUTHERFORD G. SCOTT, AND SCHOFFER J. L. 1976. Analysis of Some Characteristics of Pedestrian Travel. *Transportation Research Record* 605, Transportation Research Board, Washington, D.C., pages 29-34.

9. SELECTED READING

- BEAVON K. S. O., BUTTERWORTH D. S. AND DEWAR N. 1970. A Procedure for Estimating Cut-Off Points for Bivariate Data. *S A Geographer*, Vol. 3, No. 6, pages 559-567.
- BENHAM J. AND PATEL B. G. 1977. Method of Estimating Pedestrian Volume in a Central Business District. *Transportation Research Record* 629, Transportation Research Board Washington D.C. pages 22-26.
- BOHNERT J. E. AND MATTINGH P. F., 1964. Delimitation of the CBD Through Time. *Economic Geography*, Vol. 40, October, pages 338-347.
- BOURNE L. S, 1968. Comments on the Transitions Zone Concept. *The Professional Geographer*, Vol, XX, number 5, September, pages 313-316.
- CAMERON J. G. C. 1973. The British Conurbation Centres. *Regional Studies*, Vol. 7, Permagon Press, pages 47-55.
- CHAN YUPO & ELLIS R. H. 1978. An Analysis of Internal Transit Systems Requirements for Central Cities. *Transportation Planning & Technology*, pages 1-11.