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Urban Zones

Note by the Secretary

Following the completion of task by WG/4 the present document is published as reference for the description of Urban Zones in addition to STANAG 4536.

(signed) H. BRICHE

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URBAN ZONES

1. Introduction.

The purpose of this document is to build a generic model of a city in the context of combat.

A city is described in terms of zones, buildings and streets. However, even though the underground may be very important in terms of combat, it is not described in detail in this document.

We focus on an European city.

But in R.A. Ellefsen's « Urban Terrain Zone Characteristics », it can be found that :

« Though many conditions vary widely for cities around the world, a positive sense of order and replication exists for the urban terrain zones of these cities. »¹

Four major regions are represented by :

- Helsinki, Finland, Braunschweig and Stuttgart, Germany, Vienna, Austria (for Europe) ;
- Athens-Piraeus, Greece, Beirut, Lebanon, Tel-Aviv-Yafo, Israel, Tunis, Tunisia (for the Mediterranean Area) ;
- Kuala Lumpur, Malaysia, Colombo, Sri Lanka (For Asia) ;
- San Jose, Costa Rica, Panama City-Balboa, Panama, Caracas, Venezuela (for Latin America).²

However, this report lacks in North American cities.

2. Description of the zones.

Each town can be cut in several zones, where a zone intends to signify an area of homogeneous type of urban terrain. These zones are related to the functional and the architectural aspects of the buildings.

The classification of the cities delineated 5 broad classes : open space, residential (63,8% of the area of a city), commercial (2,5%), industrial (14,1%) and freeway.

A first level of cutting leads to the difference between a zone with attached buildings (« A » zone) and a zone with detached buildings (« D » zone). In the latter one, there is the possibility for the buildings to remain close to each other (« Dc » zone) or not (« Do » zone, with « o » meaning open). It seems that 69,6% of the area of all urban terrain has buildings detached from one another.

In fact, occurrences of each class found in A, Dc or Do zone share such features as being a similar distance away from the center of the city (the center itself for the A1 zone), the relation to railroads and with quite a uniform spatial distribution.

« A » zone :

In this zone, the terrain is high-valued.

¹ Ellefsen, R.A., « Urban Terrain Zone Characteristics », San Jose State University, AMCMS Code 612716.H700011, September 1987.

² Ellefsen, R.A.

A1 : Core area :

- Densest concentration of multistory buildings,
- Brick buildings in the oldest part ; framed, heavy-clad structures in the next to the oldest part ; framed, light-clad buildings in the newest part,
- Headquarters for commercial/financial activity.

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A2 : Apartments/hotels, core periphery :

- Medium to tall apartment buildings (four stories and over),
- Types of construction identical to the A1 ones.

A3 : Apartments/row houses :

- Buildings with four stories or less,
- Courtyards behind the building, on the other side of the street.

A4 : Industrial/storage, full urban form :

- Brick or frame heavy-clad buildings,
- Uniform height of this building (5 stories ?)
- Large and unpartitioned interior.

A5 : Old commercial ribbons .

A9 : Old core, vestigial.

- With narrow and twisting streets,
- Low-rise buildings,
- Open space around public buildings (like a church),
- LOS (line of sight) extremely short in all directions,
- Mass buildings (Stone and brick).

Dc :

Though in this zone, the buildings are no more attached, the distance between them is still reduced from a few meters to tens of meters.

Dc1 : Urban redevelopped core area :

(A more modern core area to extend it)

- Light-clad high buildings,
- Open space : small courts and parks.

Dc2 : Apartments/row houses, >75% ground coverage/frontage :

- Buildings like for A3,
- Opening between buildings around 4m.

Dc3 : Houses, >75% ground coverage/frontage :

- Lightweight construction,

Dc4 : Industrial/storage, railroad or dock-related :

- Long and narrow buildings,
- Space between buildings marked by the structure,
- Open space near the end of buildings (where LOS are reasonably long).

Dc5 : Outer city :

- Physical characteristics of zone Dc1,
- Different from neighbouring buildings,
- At the edge of large cities.

Dc7 : Engulfed agricultural village :

- Narrow and twisting streets, in contrast with broader streets of the suburbs around them.

Dc8 : Shanty towns :

- Underdeveloped countries,
- Irregularity in building placements and the connecting path.

Do :

The structures are more separated than in the previous group, with separations ranging from 200 to 300m. « o » stands for open-set.

Do1 : Shopping centers :

- Easy access for cars from streets and highways with large, open parking areas,
- Mass construction and concrete-framed parking garages,
- Long LOS.

Do2 : Apartments/row houses, <75% ground coverage/frontage :

- Different from Dc2 because of their uniform pattern,
- Different from Dc2 because of the large openings between them : from 5 to 75m or more (one quarter of the frontage of the buildings),
- Equally in light-clad framed structure and in brick construction.

Do3 : Houses, <75% ground coverage/frontage :

- 5m or more separations between houses,
- Brick buildings (but small walls) or wood structures.

Do4 : Industrial/storage, truck related :

- Widely separated buildings,
- Wide streets and parking lots,
- Concrete buildings.

Do5 : New commercial ribbons :

- Large, one or two-story buildings,
- Major arterial streets,
- Open space in between and large parking lots..

Do6 : Administrative/cultural :

- Clusters of buildings largely separated from each other : class-styled government buildings, college campus, military reservation,
- Mass construction

ON : Open space, not built on.

OW : Open space, wooded, not built on.

Do31 : A level III classification for leased garden areas (with small structures), in German and Austrian cities.

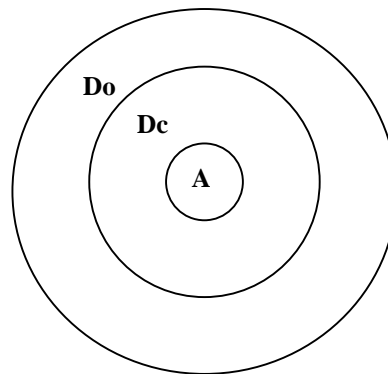
Remark on the underground zone :

This can be roughly modeled by using a point of entrance, a point of way out and a length to run underground.

3. Situation of the zones.

The zones are situated in rough circles, with the core area in the physical center of the city, though small in area.

Actually, the « A » zone is in the center. It is encircled by the « Dc » zone. Then, at the periphery of the city, there is the « Do » zone.



Open spaces can be in each of these zones but the largest, and above all the wooded ones, are preferably in « Dc » and « Do » zones. The administrative and cultural class is usually distributed evenly throughout each city (and the presence of this class is universal in cities throughout the world, not like shanty towns or other).

The way these circles are drawn depends on the way the city has developed and on the geography/topography of the site (port or mountain city, river...).

Roughly, it can be estimated that, compared to the total area of the city and for all the cities studied :

- 42,3% is occupied by the detached buildings, Dc,
- 27,3% by the detached buildings, Do,
- 21% by the attached buildings, A,
- 9,4% by the open space.

Going to the subclasses, it can be estimated, for Europe :

In the « A » zone (17,4%) :

- 1,5% for the core area,
- 1,4% for the apartments/hotels,
- 12,7% for apartments/row houses,
- 1,3% for industrial/storage, full urban form,
- 0,5% for old commercial ribbons,
- 0% for old core vestigial,

In the « Dc » zone (27,6%) :

- 0,1% urban redeveloped core area,
- 7,2% apartments > 75% ground coverage,
- 7,3% houses > 75% ground coverage,
- 11,9% industrial/storage, railroad or dock-related,
- 0% outer city,
- 1,1% engulfed agricultural villages,
- 0% shanty town,

In the « Do » zone (36,7%) :

- 0,1% shopping centers,
- 13,3% apartments < 75% ground coverage,
- 11,1% houses < 75% ground coverage,
- 4,6% industrial/storage, truck-related,
- 0,3% new commercial ribbons,
- 7,3% administrative/cultural,

Others (18,3%) :

- 3,8% leased garden areas (German and Austrian cities),
- 6,9% open space, not built upon, wooded,
- 7,6% open space, not built upon.

(The sum equals 100%.)

In each zone, except the core area unique in the center of the city, the subclasses consist of distinct and separate areas within the zone. The process of generation for a city could be a random process to place each of the subclasses in a city of which a total area has been determined. However, common sense should be a good counselor when deciding the number of different zones into which a subclass can be subdivided.

Building types.

Most of the zones in cities are largely homogeneous with respect to the types of buildings.

The construction are first parted in mass, framed heavy-clad and framed light-clad, with the number of stories attached.

On the one side, for mass construction, 5 stories is a practical limit. On the other side, there are few framed structures lower than 3 stories.

There are a lot of differences among the cities studied, because of the history of the city. With regard to the number of stories, Europe has the least number of stories. In the other cities, buildings can be as high as 30 stories.

Each of the buildings of the zone is described by the type of construction (mass or framed, heavy-clad or light-clad for A1), the number of stories, the surface structure for A1. A proposal for the type of building according to the Draft Edition 1 STANAG 4536³ follows.

« A » zone :

³ AC/22F(LG/3)D/14, Draft Edition 1 of STANAG 4536 : Representative Buildings Targets, Unfortified and Fortified, 29/07/1997.

A1 : Core area :

- 47,7% mass, 9% framed heavy-clad, 43,3% framed light-clad, (average for all the cities : 39,7% mass, 10% framed heavy-clad, 50,3% framed light-clad)
- Stories : 3 : 8,4% ; 4 : 24,4% ; 5 : 28,3% ; 6 : 26,8% ; 7 : 5,1% ; 8 : 6,9% ,
- Surface structure : brick : 5,4% ; stone : 6,7% ; glass : 9,4% ; composite : 16,2% ; plaster : 62,2%.
- Municipal building.

A2 : Apartments/hotels, core periphery :

- 80% mass, 20% framed, (average : 41% mass, 59% framed because of the more recently developed cities),
- Stories : 82% 1-5 (most 5), 18% 5-15 (most 7-8).
- Municipal building.

A3 : Apartments/row houses :

- 94% mass, 6% framed (average : 61% mass, 39% framed) : an old zone with old and low-rise buildings,
- Stories : 97% 1-5 (most 4), 3% 5-15 (most 8).
- Municipal building.

A4 : Industrial/storage, full urban form :

- 55% mass, 45% framed (average : 43% mass, 57% framed because of the more recently developed cities) ,
- Stories : 95% 1-5 (most 4), 5% 5-15 (most 8).
- Municipal building.

A5 : Old commercial ribbons .

- 100% mass,
- Stories : 100% 1-5 (most 3,5).
- Municipal building.

A9 : Old core, vestigial :

- 100% mass,
- Stories : 100% 1.
- Small domestic building.

Dc :

Dc1 : Urban redevelopped core area :

- 100% framed (light-clad),
- Stories : 100% 5-15 (most 10).
- Municipal building.

Dc2 : Apartments/row houses, >75% ground coverage/frontage :

- 89% mass, 11% framed (average : 56% mass, 44% framed because of Mediterranean cities)
- Stories : 96% 1-5 (most 4,5), 4% 5-15 (most 7).
- Municipal building.

Dc3 : Houses, >75% ground coverage/frontage :

- 100% mass (average : 59% mass, 41% framed because of Mediterranean cities),
- Stories : 100% 1-5 (most 2).
- Small, Standard, Substantial domestic building.

Dc4 : Industrial/storage, railroad or dock-related :

- 51% mass, 49% framed (35% mass, 65% framed),
- Stories : 92% 1-5 (most 2), 8% 5-15 (most 6).
- Adobe building.

Dc7 : Engulfed agricultural village :

- 75% mass , 25% framed (average : 69% mass, 31% framed) : old and low-rise,
- Stories : 100% 1-5 (most 2,3).
- Small, Standard, Substantial domestic building.

Do :

Do1 : Shopping centers :

- 100% mass,
- Stories : 100% 1-5 (most 1).
- Light industrial building.

Do2 : Apartements/row houses, <75% ground coverage/frontage :

- 56% mass, 44% framed (light-clad) (average : 23% mass, 77% framed) : because of the multiple stories, 5 and over,
- Stories : 72% 1-5 (most 4,5), 287% 5-15 (most 8, 9, 10).
- Municipal building.

Do3 : Houses, <75% ground coverage/frontage :

- 100% mass (average : 56% mass, 44% framed) : traditionally in mass construction, this trend has been inversed because of the newest cities,
- Stories : 100% 1-5 (most 2).
- Small, Standard, Substantial domestic building.

Do4 : Industrial/storage, truck related :

- 48% mass, 52% framed (average : 15% mass, 85% framed) : recent and framed buildings with thin walls are cost-beneficial,
- Stories : 100% 1-5 (most 2).
- Light industrial building and Adobe building.

Do5 : New commercial ribbons :

- 100% framed : only one or two stories but recent and commercial,
- 100% 1-5 (most 2).
- Light industrial building and Adobe building.

Do6 : Administrative/cultural :

- 61% mass, 39% framed (average : 46% mass, 54% framed) : longevity of the institutional buildings,
- Stories : 92% 1-5 (most 3, 4, 5), 8% 5-15 (most 6, 7).
- Municipal building.

- (Do31 : Leased garden areas
 - Stories : 100% 1-5 (most 1).)

After this list, STANAG 4536 on the representative building targets doesn't seem sufficient to describe all the buildings. For example, only municipal buildings can be multi-storied. The others can be only single or double storied.

As a rehearsal, here are the 6 buildings listed in the STANAG :

- Adobe building,
- Small domestic building,
- Standard domestic building,
- Substantial domestic building,
- Municipal building,
- Light industrial building.⁴

Description of the streets.

The streets remain the most important way of displacement for the soldiers outside the buildings, above all in the A and Dc zones.

They should be well described. However, it is difficult to find raw information about lengths and widths of the streets in the different parts of a city.

However, we have underlined some characteristics of the streets, depending on the zones where they were sited.

What is used sometimes is the LOS or Line Of Sight.

What can be used to make a description of the streets and to complete the urban area description is the Space Syntax, a technique used by the Space Syntax Laboratory.⁵

The method deals with the layout of the buildings and street patterns. It was first used to predict patterns of pedestrian movement in towns (now also for pattern of crime, vehicle pollution patterns and land value).

Thus, the LOS for a soldier can be limited in practice at 200 m, and three stages can be distinguished : the same room (3-7 m), the same building (7-15 m) and the street (over 15 m).

The utilities of a building.

In a thorough modelization of a city, the utilities of the buildings (for example gas, fuel, electricity) should be also represented because it can affect military actions. This representation should be added in another layer of modelization.

⁴AC/22F(LG/3)D/14, Draft Edition 1 of STANAG 4536 : Representative Buildings Targets, Unfortified and Fortified, 29/07/1997.

⁵University College of London Worldwide Web Home Page, Bartlett Faculty of the Build Environment, Space Syntax Laboratory, <http://www.bartlett.ucl.ac.uk/spacesyntax/>, 20 April 2000.

Conclusion.

In this paper inspired from Ellefsen, a cutting of a city in circular zones with areas of these zones and buildings associated, especially for an European city is proposed (annex for Mediterranean and Asian).⁶ The exact description of the streets (width, length) is not discussed.

But, the Ellefsen paper was written in 1987. Therefore, the repartition of the zones may have changed. Furthermore, this document merely alludes to underground even though it is in fact very important in the context of war.

Finally, the concept of layers is presented in the last paragraph (for the utilities of the buildings). This concept could be extended to obtain a more generic city, for example for the effects of the arms on the structures (from the small caliber to air-launched munitions).

Finally, satellite imagery and aerial photography can provide accurate, precise, and current information regarding land use. These sources should be considered.

⁶ Ellefsen, R.A.

ANNEX

Mediterranean and Asian cities

Even if it is not the purpose of the document, this annex enlarges the percentages to the Mediterranean and Asian cities.

Indeed, African and Asian cities can be good places to model for conflict purpose.

The percentages are based on the study of the following cities :

- Athens-Piraeus, Greece, Beirut, Lebanon, Tel-Aviv-Yafo, Israel, Tunis, Tunisia (for the Mediterranean Area) ;
- Kuala Lumpur, Malaysia, Colombo, Sri Lanka (For Asia).

Percentages of the representation of the different zones (in area).

In the « A » zone (17,4%) :

- core area (0,5% for Mediterranean and 1,3% for Asian)
- apartments/hotels, (7,0% for Mediterranean and 0,5% for Asian)
- apartments/row houses, (19,1% for Mediterranean and 3,2% for Asian)
- industrial/storage, full urban form, (1,1% for Mediterranean and 0,9% for Asian)
- old commercial ribbons, (0% for Mediterranean and 1,6% for Asian)
- old core vestigial, (0,5% for Mediterranean and 0% for Asian)

In the « Dc » zone (27,6%) :

- urban redeveloped core area, (0,1% for Mediterranean and 0,9% for Asian)
- apartments > 75% ground civerage, (20,4% for Mediterranean and 7,7% for Asian)
- houses > 75% ground coverage, (18,1% for Mediterranean and 25,5% for Asian)
- industrial/storage, railroad or dock-related, (8,2% for Mediterranean and 9,0% for Asian)
- outer city, (0,3% for Mediterranean and 0,5% for Asian)
- engulfed agricultural villages, (0,1% for Mediterranean and 0% for Asian))
- shanty town, (1,2% for Mediterranean and 0,1% for Asian)

In the « Do » zone (36,7%) :

- shopping centers,(0,1% for Mediterranean and 0% for Asian)
- apartments < 75% ground coverage, (4,3% for Mediterranean and 5,2% for Asian)
- houses < 75% ground coverage, (3,2% for Mediterranean and 26,9% for Asian)
- industrial/storage, truck-related, (3,7% for Mediterranean and 2,4% for Asian)
- new commercial ribbons, (0,5% for Mediterranean and 0,5% for Asian)
- administrative/cultural, (5% for Mediterranean and 6,6% for Asian)

Others (18,3%) :

- leased garden areas (German and Austrian cities), (0% for both Mediterranean and Asian)
- open space, not built upon, wooded, (2,9% for Mediterranean and 1,6% for Asian)
- open space, not built upon (3,6% for Mediterranean and 5,9% for Asian).

Building types.

« A » zone :

A1 : Core area :

- 36,9% - 52,3% mass, 13,6% - 8,0% framed heavy-clad, 49,5% - 39,7% framed light-clad
- Stories : 3 : 19,6% - 42,3% ; 4 : 20,6% - 13,3% ; 5 : 15,4% - 10,2% ; 6 : 7,9% - 6,6% ; 7 : 5,1% - 2,6% ; 8 : 31,3% - 25,0% ,

A2 : Apartments/hotels, core periphery :

- 12% - 47% mass, 88% - 53% framed,

A3 : Apartments/row houses :

- 25% - 89% mass, 75% - 11% framed : an old zone with old and low-rise buildings,

A4 : Industrial/storage, full urban form :

- 27% - 54% mass, 73% - 46% framed,

Dc :

Dc2 : Apartments/row houses, >75% ground coverage/frontage :

- 9% - 61% mass, 91% - 39% framed,

Dc3 : Houses, >75% ground coverage/frontage :

- 15% - 77% mass, 85% - 23% framed,

Dc4 : Industrial/storage, railroad or dock-related :

- 8% - 45% mass, 92% - 55% framed,

Dc5 : outer city :

- 25% - 0% mass, 75% - 100% framed,

Dc7 : Engulfed agricultural village :

- 50% - 0% mass , 50% - 0% ,

Do :

Do2 : Apartements/row houses, <75% ground coverage/frontage :

- 1% - 38% mass, 99% - 62% framed (light-clad),

Do3 : Houses, <75% ground coverage/frontage :

- 21% - 42% mass, 79% - 58% framed,

Do4 : Industrial/storage, truck related :

- 0% - 2% mass, 100% - 98% framed,

Do6 : Administrative/cultural :

- 20% - 59% mass, 80% - 41% framed,