SOME PROBLEMS OF COEXISTENCE OF PORT'S AND URBAN FUNCTIONS

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ABSTRACT

The paper discusses the functional and spatial relations occurring in the transition zone, existing between a port and a city area. In order to identify and organize these issues, the determinants of the spatial development of port cities were discussed briefly, including inter alia: natural and historical conditions, spectrum of port's transshipment, port's transportation system, the ownership of a port and a port management model, the economic importance of a port for the city and region. The rest of the work describes a typical functional structures of coastal and sea-river port cities on the background of the concentric distribution of functions in a typical modern inland city. In the short resume some examples of the "good practice" in spatial management of port cities are given.

Keywords: seaports, sea-river ports, port cities, port-city relationship, spatial planning, urban planning

1. CONDITIONS FOR DEVELOPMENT OF PORT CITIES

Functional and spatial structure of port cities, in addition to typical factors for the development of each agglomeration, is formed by factors related to the existence, operation and development of the port, including:

- **natural factors**

The spatial character of the port depends on the characteristics of water areas, over which it is located (e.g., sea, river, bay). Emerging on the reservoirs, port cities are stretching along the port area, so their form refers to the shape and configuration of the basin and the coastal zone. Hence one can distinguish port city situated:
– in lagoons, or coastal lakes (e.g. Venice, Kaliningrad),
– along rivers, far away from the estuary (e.g., Hamburg, Bremen, Szczecin),
– in estuaries (e.g. Rotterdam, Bremerhaven, Gdańsk – Inner Port),
– by the open sea (e.g., Trieste, Gdynia, Gdańsk – North Port).

Mostly, the shape of water areas determines the form of the port city. Also the urban structure of maritime forum[1] is usually defined by configuration of shoreline.

- **historical background**

As a result of technological development the process of spatial development of ports and industrial areas has a discrete (quantified) character. Therefore, ports normally operate in a dual system – there are two ports, a new and an old one, which are working simultaneously. Each generation of ports represents a distinctly different spatial characteristics and level of technical equipment. Post-port areas in turn, undergo the phenomenon of urban recycling[2].

- **port's activity**

Transshipment profile and port's annual turnover significantly affect the functional and spatial structure of the port city. These factors allow to distinguish three basic situations, where:

– a town is developing next to highly specialized bulk terminals, handling several or tens millions of tons per year of dry or liquid bulk (such as coal, iron ore, chemicals, petroleum, fuel, gas). Most of the cargo is passing through the terminal in only one direction – import or export;
– urban center is developing next to passenger or ferry terminals;
– a city is developing next to a universal port consisting of multi-purpose terminals, suitable for handling general cargo (including conventional general cargo, ro-ro and containerized cargo), and conventional bulk cargo handled in all relations.

The most spatially developed and economically stable are port cities accompanying universal ports. In their functional structure one could find highly diversified and developed port related industry, services and logistics, which are located mostly on the city' fringe (in a metropolitan area).

Profile of the port operational activities affects also the labor market in a port city. One could notice, that the more goods are processed in the city, the greater are the indirect benefits received by the city. Thus, for example, containers and ro-ro cargos, which require developed logistics facilities and services, generate a series of jobs and have clearly city-creative character. At the same time the more diverse port in terms of cargo, the greater the diversification of the industrial and service facilities, and the more developed peri-port activities making the port-city relationship stable.

[1] "A maritime forum is an open public space, which is a place for official and informal contacts and events. At least one of the façade of maritime forum is open to the sea or the port. Architecturally, functionally, and symbolically it is linked to the maritime economy and education. Functionally three types of forums could be distinguished: the administrative-economical, transport-economical, and cultural-recreational". According to: Krośnicka K. [1].
[2] See also: Bird J. [2], Rodrigue J-P., Comtois C., Slack B. [3], Rodrigue J-P. [4], Krośnicka K. [5].

- **port transport system**

Paradoxically there is nothing that divides urban space so much as transportation network. According to this statement port cities are often cut off from the water and from the port by a wide belt dedicated to rail and road transportation. So, very often, cities have no chances to create an attractive access to the water for pedestrians, and to form public spaces such as maritime forums.

Road network, and to a lesser extent rail network, is jointly used by the city and the harbor. This fact leads to overlapping of heavy traffic and passenger traffic on certain routes and sometimes to the formation of functional conflict, or at least restrictions on the traffic flow fluency. In this case, the authorities of the both structures (the port and the city) should be interested in shaping of the appropriate course of roads, their proper operation, as well as their co-financing.

- **the economic importance of the port for the city**

Intuitively, according to the importance of the port function for the city, one can distinguish three situations in which:
- port's functions dominate the urban functions; in this case the port's functions influence strongly many areas of the city life, while other functions have much lesser impact on city specificity (e.g. Rotterdam, Hamburg, Gdynia),
- port's and urban functions are of an equivalent importance - the port exists in the city as a one of many activities (e.g. Amsterdam, Gdańsk),
- urban functions dominate the port functions; in this situation, typical for big cities (e.g. New York) and the capitals of countries (e.g. Stockholm), the port holds a secondary role in city life.

Quantifying the economic impact of ports on cities (usually by a multiplier effect) is rather complicated due to the difficulty of obtaining relevant data. Much more detailed classification concerning port cities, which are basing on container's trans-shipment could be found at Sung-Woo et al. [6].

- **ownership of the port and port management model**

The ownership of port's land and resulting from this fact port's management model affects significantly the land use form of port's and in a consequence also near-port areas, as well as the port – city interface.

In terms of ownership the four following types of ports could be distinguished: state owned, municipal, autonomous, private. In case of municipal port, at least by the definition, the interests of the port and city should be balanced by the city authorities. In fact, there is often a contradiction between short-term benefits of inhabitants and prospective needs of the individual terminals and port industry. When the port is an autonomous unit, or the state owned property, a clear competition of functions and objectives appears, and conflicts between the port and city are exacerbating. Solving these problems requires both parties to understand the interaction, mutual interest, and

unconditional cooperation, particularly with regard to land management. Otherwise, the two structures (the port and the city), through their administrative and legal capacity, can effectively inhibit the mutual development. Port's investments, planned as part of a port development strategy, are directly subordinated to the national policy, and take precedence over the local ones. On the other hand the development of the port is somewhat limited by the planning powers of the city authority (in Poland: "Local Development Plan[3]", "Study on Conditions and Directions of Spatial Development"[4]). These two levels of planning system are competed by the regional level, which, together with spatial and demographic growth of cities and the formation of metropolitan areas, is becoming a more important.

- **port regulation**

Some authors add to the list above port regulation. According to Wiegmans et al. [7] "(…) port regulation is increasingly harming the port development, because the port regulation is influenced by the 'sharpened' societal regulation (environmental- but also labour regulations). It appears that port regulation is slowly starting to influence port form and port function in a limiting way."

2. THE SPATIAL DISTRIBUTION OF FUNCTIONS IN PORT CITIES

Functional and spatial structure of modern cities has been widely described in literature. Therefore, as a background for further consideration, a simplified scheme of the land use structure in a typical inland city is presented underneath (Fig. 1). Such an idealized city (not taking under consideration local physiographic conditions) is normally built with concentric rings, which are separated from each other by the peripheral roads. Within the individual rings one can distinguish different functional zones (residential, industrial, services and large-surface services such as shopping malls, transport and logistics). Communication routes (road and rail) and sometimes also ecological corridors (such as green areas along rivers, forests, agricultural areas, parks) spread radially from the city center, linking the city with the region. The farther from the city center, the land is less intensively used, the lesser the built-up surface, and larger the surface of agriculture and forests. It should be noted that due to the urban growth, the urban and rural centers situated around the city are often functionally merged with central city, what causes the emergence of so-called metropolitan areas. Functional and spatial structure of metropolitan areas are correspondingly more complicated and strongly dependent on the shape of the transport network and physiographic conditions.

[3] In Polish: Miejscowy Plan Zagospodarowania Przestrzennego.
[4] In Polish: Studium Uwarunkowań i Kierunków Zagospodarowania Przestrzennego.

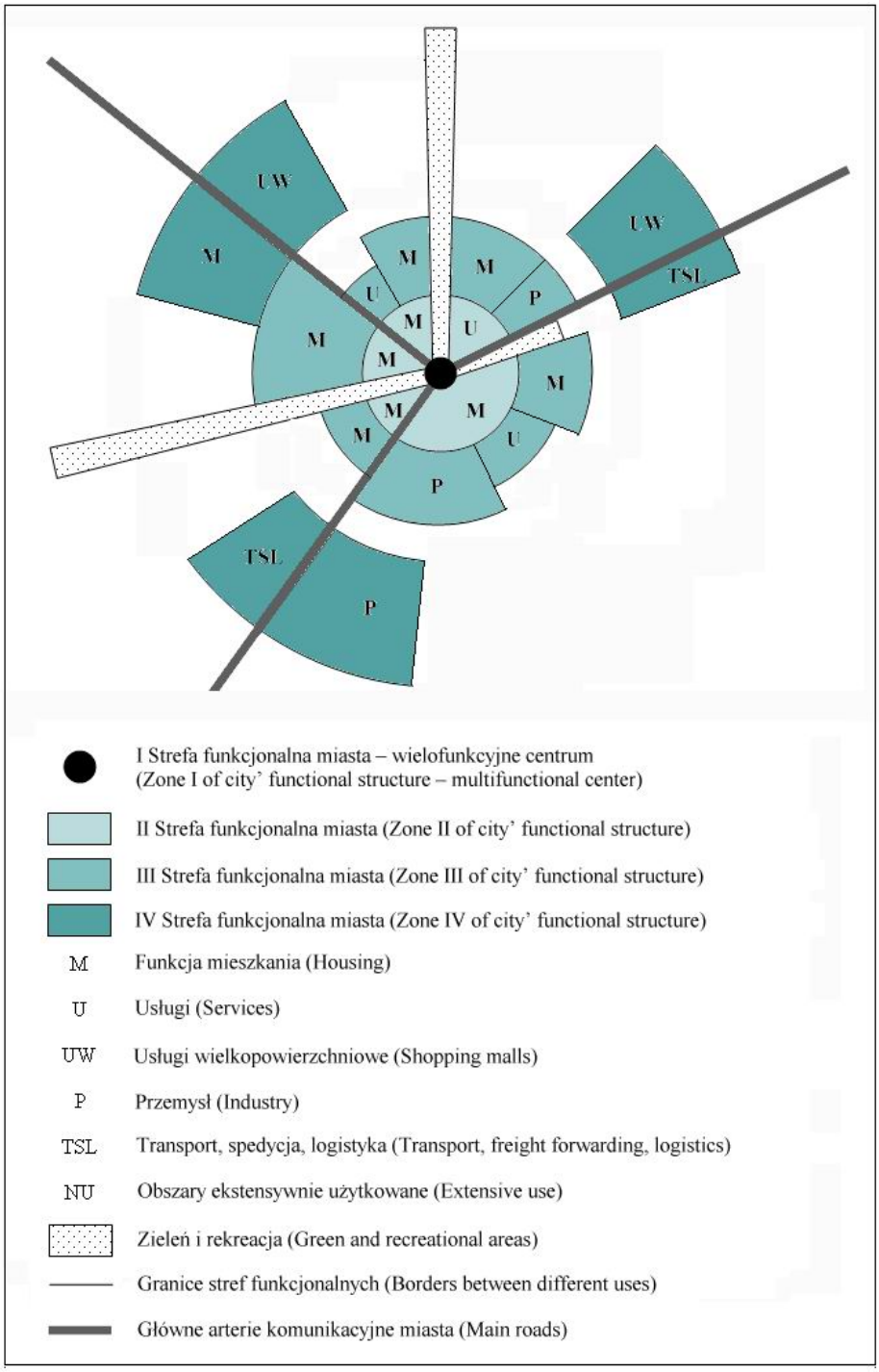

Fig. 1. A typical inland city' functional structure

Analyzing the spatial distribution of functions in the port cities one should begin with the characteristics of the spatial structure of the ports themselves. In the area of sea ports (see Fig. 2) one can see clearly the three major functional zones, which extend approximately parallel to the berthing line, and are characterized by fairly different thickness. These zones are the result of the land value and technical opportunities. One could distinguish in turn:

- **Zone I** consists of terminals, having different spectrum of cargo and a diverse organization of work. Within this area one can notice two further functional stripes:
  - a zone of operations, where discharging operations and short-term storage are taking place,
  - a zone of direct hinterland, where terminal's auxiliary facilities (such as workshops, garages, etc.) are situated, and where the long-term storage is realized.
- **Zone II** ensures infrastructure, logistic facilities and industrial for the zone I. Within infrastructure one could distinguish such port's objects as: oil base, wastewater treatment, water intake points, power plants, electricity facilities, equipment base. Logistics objects serving the port's zone II are for example: distribution centers, warehouses, railway terminals, parking for lorries, container depots, companies providing services for cargo (such as packing, sorting, processing and confectioning). Industrial facilities are for instance factories, whose production is based on port's cargo. Zone II is not fully continuous – it is crossed by routes leading to terminals' gates, and by insulation belts.
- **Zone III** consists of port's services, such as: centers providing services to vessels (port's agents, ship's technical service, companies supplying vessels in food, water, fuel), maritime trade companies, seats of transport and freight forwarding companies, maritime administration, port's security services (port fire brigade, port's guards, customs services), centers ensuring safety of navigation (e.g. meteorological services, radio stations, marine rescue centers), medical services (e.g. port health clinics, specialist hospitals, vaccination points), services for sailor, commercial buildings (commodity exchanges, banks, insurance offices, maritime education centers.

The first two zones (I and II) are closed areas having no public access. Exception are cruise and ferry terminals, activity of which is based on handling of passengers and their cars, and for this reason they are partially available for pedestrians. However, in this case people and cars should be treated as cargo. The third zone is usually functionally merged with the urban fabric, and is available to city dwellers.

At the zonal arrangement of the port overlays a division onto port's regions, which consist of terminals operating similar types of cargo, having comparable turnovers, and characterized by similar methods of operating. This allows to maintain appropriate distances between areas having different methods of cargo handling. Because of the reasons mentioned above, general cargo terminals (such as conventional, container and ro-ro terminals) are grouped together. Due to historical

conditions and the similar volume of the turnover in the neighborhood of general cargo regions often appear conventional bulk terminals and grain terminals. A separate group is formed by modern, specialized bulk terminals, including dry (coal, crude, chemicals, etc.) and liquid bulk (fuel, LPG, LNG, chemicals, etc.).

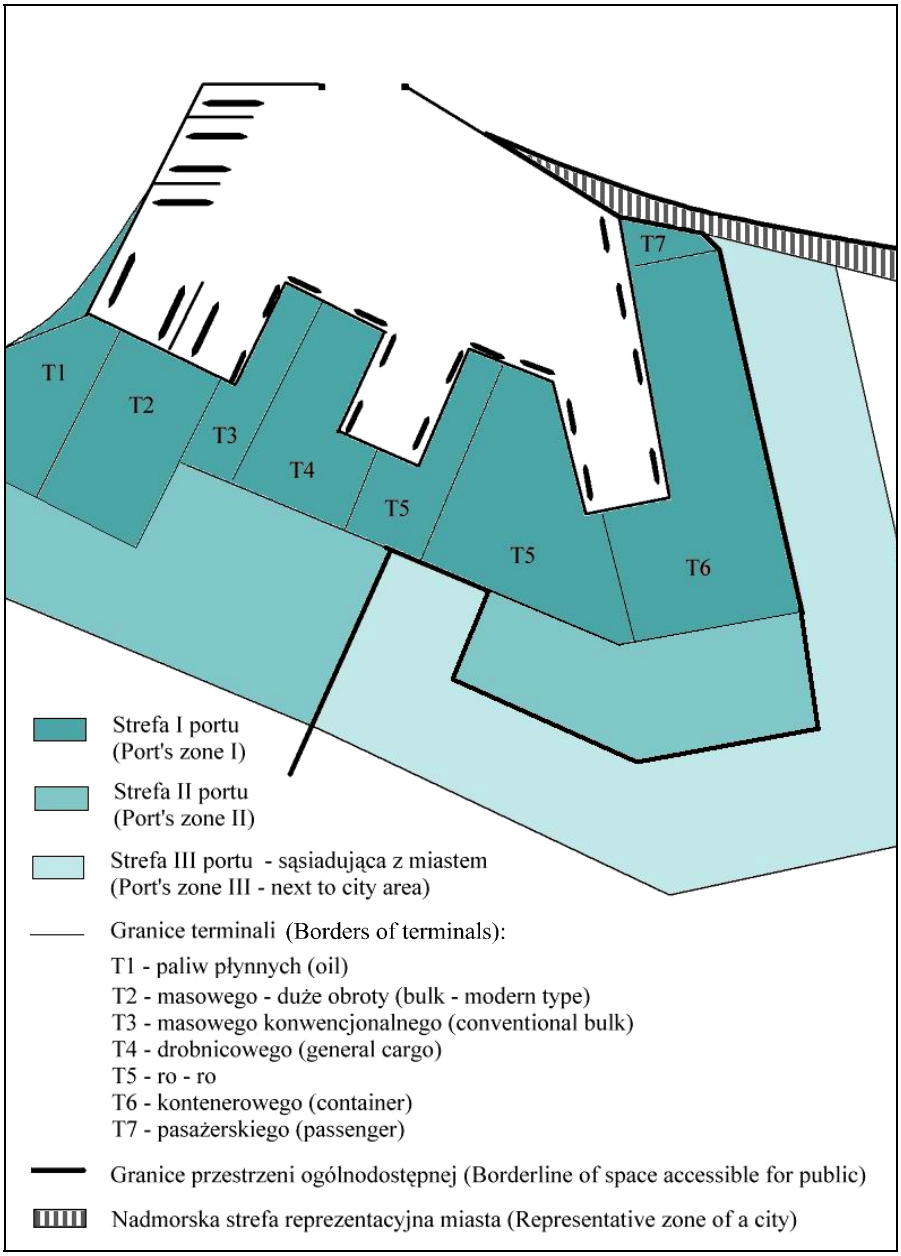

Fig. 2. A typical seaport's spatial and functional structure

Long-term ports' development, which takes place in a historical scale, and existing physiographic conditions, makes maintaining the "pure" regionalization of ports difficult. A common situation now is separation of conventional cargo terminals, which are usually located in the old parts of the ports, from modern bulk cargo terminals, which most often are newly-built on the sea surface, allowing for operation of vessels of greater draft (so-called deep-water terminals). The division of the port into two spatially independent centers (conventional one and a modern one) breaks through also the zonal arrangement of functional zones (Fig. 3). A part of the second zone (II) is usually relocated to the area in vicinity of deep-sea terminals, while the rest of the objects, which are located in the II and III zone in general remain in the vicinity of the old conventional port. Some of these objects are functionally merged with the urban space, some are becoming a subject to urban recycling [4].

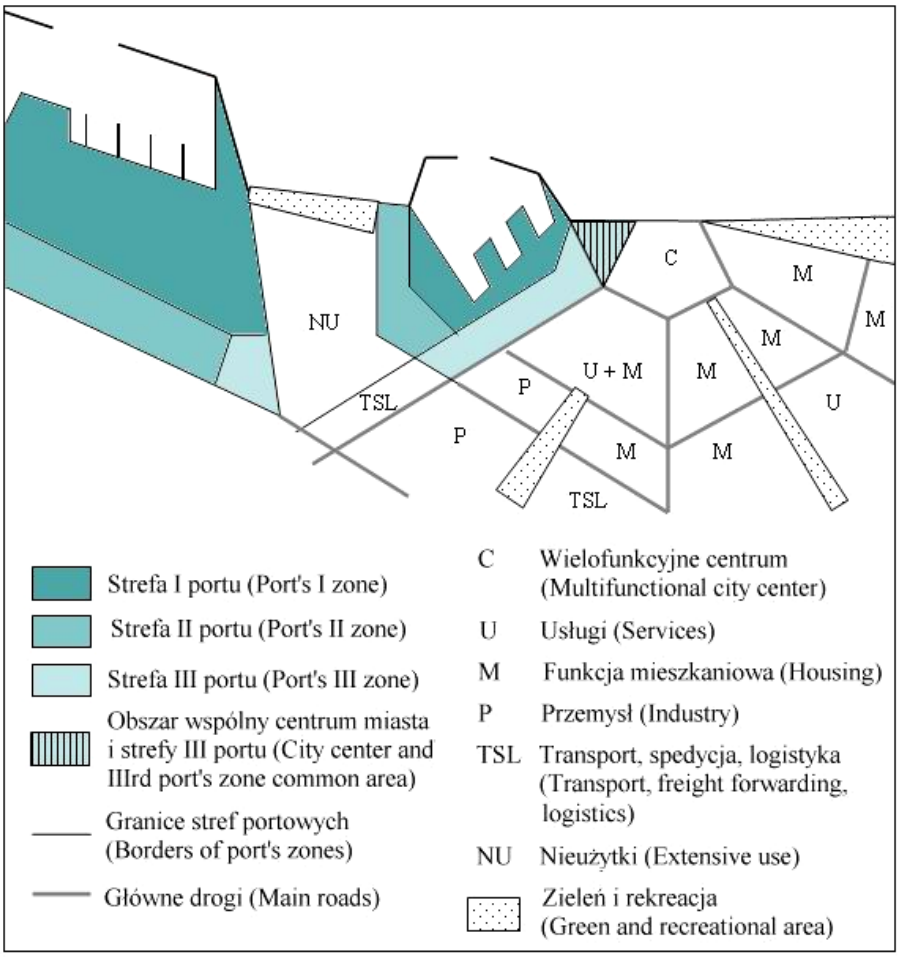

Fig. 3. Functional structure of a port city. The case of a bi-center port, located at the seashore

The functional and spatial structure of port cities bordering the sea is physically limited by the seashore and the sea. As a result, the spatial development of these towns is only possible on the plan close to a semicircle (not a full circle like in case of inland cities). Downtown area is usually located at the coastline, near the center of a semicircle. The main public space of coastal port cities has often a form of maritime forum, which is a place of organizing of the official and unofficial maritime events, it is visually opened into direction of sea or the port, and is functionally, architecturally and symbolically connected with the maritime economy and education. Therefore, somewhere in the middle of coastal port cities, close to the downtown area, the zone of port services (III) is located. Objects belonging to zone II and port terminals are situated in a bit greater distance from the city center (as far as in a result of technological development, the port has not been relocated outside the city to the deep-water port). Further rings of functional and spatial structure of coastal port cities are characterized by a mosaic of features, similar to those typical of inland cities. The difference is clearly greater participation of transport, logistics and fright forwarding, as well as industries than in inland cities. A port city is functionally a base and a backup for the activities and facilities of the development of the port, industrial and logistics investments.

More analysis is devoted to the riverside port cities (Zaremba, 1962 [8]; Bird, 1963 [2]; Siemiński, 1973 [9], Krośnicka 2010 [10], Ducruet 2005 [11]). In the plan of riverside port cities (Fig. 4) one can clearly notice, that the structure of the riverside port has a linear character, and consists of the I, II and sometimes also the III, port's functional zones. Often, due to the fact, that the two first zones of the port (I, II) are closed for pedestrian movement, at the considerable length of the river, the city has no access to the water.

The total width of the port's zones (I, II, III), which are extending along the river, may vary, but it is usually comparatively small near the city center and significantly increases with moving towards the estuary. The next generations of ports (new ports), in accordance with the Bird's "downstream" rule [2], are constructed on the area situated down the riverbank (below the city centre). Hence, one can observe the breakdown of the port's structure onto two simultaneously existing centers (the new and the old one).

It happens that the port's activity occurs only on one of river banks. In this case, it is possible to eliminate functional conflicts, which usually appear between neighboring residential and port's areas, what gives a chance for creation an interesting visual connections between the port and the city.

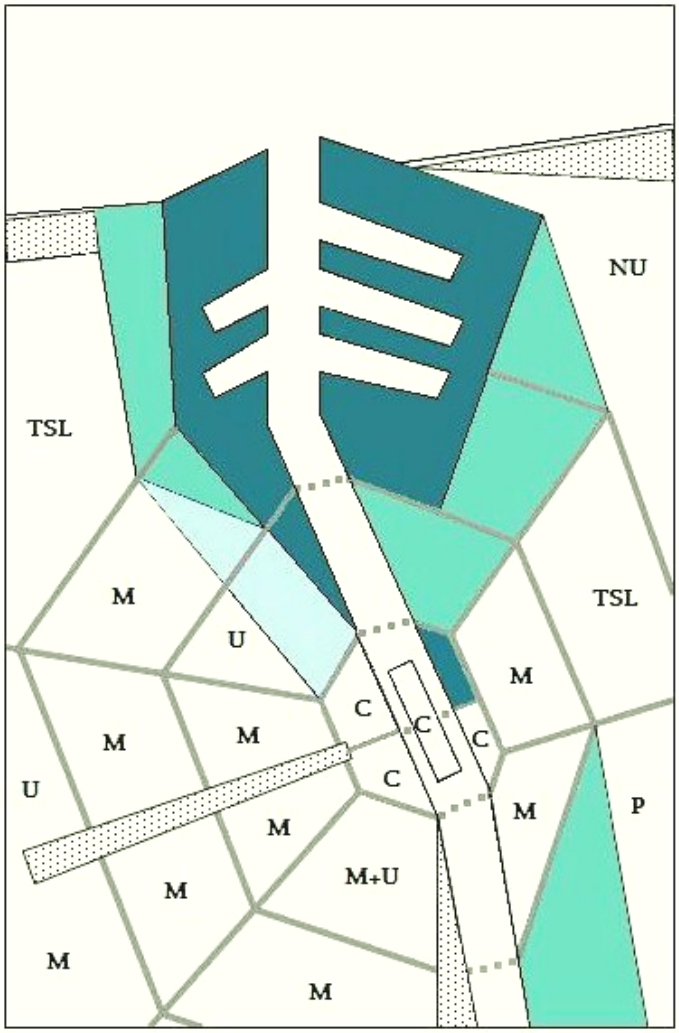

Fig. 4. Sea-river-port's spatial and functional structure. Abbreviations like in Fig. 3

3. MANAGEMENT OF THE AREAS LOCATED ON THE BORDER OF THE PORT AND THE CITIES

Depending on functions realized on the areas situated along the boundary of a port and a city, one can distinguish the existence of at least two different types of spatial borders:

– fuzzy, where services of a port (zone III) and a city permeate each other (e.g. offices representing both sides are creating one district or, logistic facilities

of a city and a port are adjoined to each other, etc); another possibility is the situation, where a green protection zone of the port bordering with recreational areas,

– sharp, when next to residential areas or recreational areas of a city occurs zone I or II of the port.

Residential areas rarely are located directly adjacent to the port terminals (zone I). This follows from the fact that the handling and storage of cargo may cause inconvenience such as: bad smell, noise and vibration, dust, air and soil pollution, water pollution, danger of fire or explosion (connected with storage of dangerous goods, including fuels and chemicals). It should be borne in mind that different port terminals have a different influence on the environment. Currently, ones of "the loudest" are the container terminals, which generate a cacophony of sound having relatively high frequencies. It is mostly connected with vehicles movement on the terminal, as well as with the road traffic (depending on the size of the terminal, on average from 1 to 5 entries of trucks could be recorded per minute). Simultaneously, container and ro-ro terminals are considered to be relatively clean, because they do not "produce" dust, smell or pollution of land, what is quite often in bulk terminals, for example. In container and ro-ro terminals dangerous goods might be stored, although in an incomparably smaller quantity than in terminals operating liquid fuels or chemicals. Depending on a type of cargo operated at the terminal, and the function of area adjacent to a terminal, protection (insulation) zones of an adequate width (e.g. 50, 100, 300, 500, 1000 m.) should therefore be individually designated, and the various possibilities of their use should be considered. The greatest width of the insulation belt, and simultaneously the smallest possibilities of land use (mostly agricultural functions), is observed in case of terminals handling hazardous cargo. Protection zones of other terminals (such as conventional bulk cargo, general cargo, ro-ro and container terminals) give much more options of optimization of their land use - usually the insulation zone becomes an infrastructural and logistic hinterland of the port (zone II). Often, passenger terminals do not need any protection zones, which separates them from residential areas and city services.

In port's services zone (III) port's and city's functions usually permeate each other, creating a district of business and administration. In this case, the spatial border between a port and a city practically does not exist.

Zone II could generate nuisance for the residential functions. Therefore, it is usually accompanied by city's industrial objects (especially clean industry connected with port's activities), as well as transport and logistics areas of the city, and back-up transport facilities (car parks, bus' depots), by shopping malls, or recreational areas (e.g. parks).

Sometimes, between the IInd port area and the city, belts so called "no man's land" are appearing. They are usually administered by a port authority, but are not fully valuable for the port due to significant restrictions on the possibilities of their development. For example in case of Amsterdam, according to Wiegmens et al. [7]

“the current housing plans of the City of Amsterdam will lead to shorter rental periods for land, which is causing companies to rethink their investment plans and may also lead (if executed) to an actual reduction of land available to port activities”.

The so called "gray zone", which occurs between the city and the port is an empty space between two strong, well defined spatial structures. Therefore, when the density of development and the multifunctionality of a city in the area adjacent to the port increases, the city puts more pressure on constructing new buildings within the port's area.

4. SOME PRINCIPLES OF GOOD NEIGHBORHOOD OF THE CITY AND THE PORT

Based on the above considerations concerning the problem of coexistence of residential areas and port's land one can draw a number of principles of proper land use and planning in the port-city transition zones, including but not limited to:

- both the long- and the short-term development plans of the port and the city should be closely correlated;
- the city should have a physical access to water and a port, and the landscape of the port should be treated as a valuable element of the city identity;
- due to nuisances, which may occur during operation of port terminals such as noise, vibration, dust or smells, residential areas should be located windward with respect to the port;
- the width and functions of port's protection zones should be carefully matched to the type of activity on both sides (a port's and a city's). In order to avoid the problem of "no-man's land" the insulation zones should be used for interim functions (such as recreation) or for transition functions (for example: logistics, storage transportation);
- main access routes to the port should not run through the city centre or residential districts. In this case, heavy traffic generated by the port is further strengthened by the city traffic, what contributes to appearance of functional conflicts for both sides;
- urban recycling of post-port areas, and realization of waterfront-type projects, is a long-term task, requiring many-year's social involvement of port city residents.

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