Space-planning Solutions for New Type of Retail and Warehouse Buildings

T Shamaeva

1National Research Moscow State University of Civil Engineering (NRU MGSU), Yaroslavskoye Shosse, 26, Moscow, 129337, Russia

E-mail: ShamaevaTV@yandex.ru

Abstract Modern trade formats require changes to the typology of trade buildings. New titles and space-planning solutions emerge to build new trade and warehouse buildings. This article deals with the analysis and identification of the specific features of space-planning solutions for such buildings. A new type of public trade or warehouse building is characterized by large storage areas (70-85% of the overall area of premises), extensive product ranges, and small retail areas (up to 3-4% of the overall area). Orders and payments are made via the Internet of the digital terminals in the retail area. High (over 5.5 m) shelf and pallet storage practices are used. At warehouses, attics, panels, and built-in structures are used for storing things or as utility rooms, and seldom as office and amenity rooms. The buildings have the frame structure of metal and partially concrete. Simple room architecture and suspended sandwich panel facades make these buildings look like warehouses. The built-up area for the majority of the facilities is over 10,000-15,000 square meters. The overall building floor space is over 15,000 square meters.

1. Introduction
Almost every year on can see new terms and definitions that permeate our lives. This trend also affects the design industry. This article considers the space-planning solutions used in the new types of trade and warehouse buildings. The authors will list the new trade and warehousing facilities and analyze the space-planning solutions used in them. The article also identifies the specific features of space planning solutions.

1.1. Relevance
Due to the rapid development of trade, new formats of it emerge. The typology of trade objects is expanding. In addition to the traditional shops, new types emerge, such as the Cybermarket, Outpost, Online Retail Shop, Distribution Center, Trading Warehouse, etc. It can be confusing for an architect or a designer to navigate through these titles when developing these respective facilities. The regulatory project framework still lacks new definitions and design principles for such objects.

1.2. Research purpose:
- get acquainted with the new concepts associated with trade and warehousing buildings;
- analyze the space-planning solutions used in modern trade and warehousing buildings;
- describe typical planning features of such facilities.
What planning principles should be used in designing new types of trade and warehousing buildings? What functions do these facilities have and what purposes do they serve? Consider these questions in this article. The first thing that unites these facilities is that they are warehouse shops. It means that they serve both functions: trading and storage. The term ‘warehouse shop’ is not represented in designing standards. There is, however, a trading-industry definition for that: a warehouse shop is a trading facility where individuals and/or business entities are served food or non-food items directly from the transport packaging (crates, containers, etc) or in the transport packaging using the self-service practices. This definition does not reflect the planning peculiarities used by the project engineer. Other city planning standards may mention warehouse shops only in the calculation standards for parking bays: Warehouse shops (individual wholesale, retail, or hypermarkets). What is the proportion of the retail and warehouse floor area in a warehouse shop project and what does it depend on? It is known that hypermarkets normally have a larger floor area (over 4,500-5,000 square meters) and use self-service practices. Customers walk around the warehouse that also functions as the retail area [1, 2, 3]. There are, however, other types of warehouse shops that do not have a clear and uniform definition yet. The authors will discuss them in more detail.

Cybermarket, i.e., a digital store. Sales characteristics: customers select products from the digital catalog in the salesroom via a terminal, they do not search shelves or pallets for the products they need, as is the common practice [4]. Shops of this type have no showcases but they feature a large warehouse, self-service checkouts and terminals, and pickup points and checkouts [5]. The notion of cybermarket was introduced by Ulmart in 2010 [5, 6]. The shops of this type reduce salesrooms and replace them with storage areas [4]. This new format combines the advantages of conventional trading and online shops. It stipulates the companies must have large warehouses [7]. Outpost differs from usual pick up points of the majority of online-shops (known to Russian customers as self-collection) in the way that it has terminals that people can use to add products to their order [8]. Online Retail Shop runs sales over the Internet. The order is placed on the retailer’s website, and the vendor delivers the product to the consumer in a certain time. Most commonly, the product is delivered to a pickup point where the customer can get it [9].

1.3. Research significance

This article pursues the following objectives: Getting acquainted with the new concepts associated with trade and warehousing buildings; Identifying specific features of space planning and functionality of facilities based on the analysis of modern next-generation trade and warehousing buildings.

2. Theory

The subject-matter of this article is modern trade and warehousing buildings with floor areas of over 10,000 square meters. The focus of the research is on the space-planning solutions used in such buildings.

2.1. Research methods

The authors conducted the analysis of space-planning solutions for 7 trade and warehousing facilities that are currently being built or have been built over the last 3-5 years (Figure 1). The authors classified the solutions used in them by their function and the percentage ratio of floor areas of different functions. The article considered their facade solutions and structural design, as well as the correlations between the space-planning solutions and the trading type or product range. The research resulted in the following conclusions:

The buildings in question are used as trading and warehousing facilities. Owners and Designers refer to these facilities differently. The titles they use may include Cybermarket, Order Fulfillment

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1 GOST R 51303-2013 Trade. Terms and Definitions (with Update No. 1, with Amendment)
2 SP 42.13330.2016 City Building. Planning and Development of Urban and Rural Settlements. Updated revision of SNiP 2.07.01-89*
Center, Trading Warehouse, Warehouse Shop, Product Distribution Center, etc. Assume that Designers feel the lack of regulatory framework with standardized terms and criteria that would help classify buildings into specific types when they develop such facilities. It happens because these facilities are on the border of warehouses and shops.

Their space-planning solutions and key function resemble those of a warehouse but they also serve the purpose of selling products. The floor area of the warehouse part takes up between 70% and 85% of the overall floor area of the building (in 100% of the facilities examined). Warehousing areas are not very diverse in terms of their location, structure, and storing methods. About 95% of the warehouse units have only one storey. These units always have the following planning elements: attics, panels, and built-in structures that are used as storage areas, workshops, utility or amenity rooms, and rarely as offices. Offices, as well as salesrooms, are most commonly (90% of the cases) located in the administration unit (building) that is adjoined to the warehouse. The single-storey part of warehousing units (95%) features high-shelve storage practices, i.e., the products are stored in racks of over 5.5 meters tall. In practice, the two units serving different functions (office and warehouse) also represent two different fire compartments. This is reflected in space planning: between these compartments, a fire barrier (a wall with specific fire-resisting qualities) is included in the design.

Some of the facilities (Facility 1-3, Figure 1) features an unusual solution for low shelf and pallet storage, the stack-frame. The stack-frame with several levels is located in the center of the room, and its dimensions are 90x108=9,800 square meters, which amounts to 65% of the unit’s floor area. The stack-frame posts are designed as building supports and they are integrated into the entire construction of the unit. This solution is an exception and rarely used because the regular stack-frame is a type of temporary structure. The use of stack-frames does not comply with the definitions from the standards:

The stack frame is a multilevel free-standing and framed structure (without walls) that can be located in the building or outside of it. It is designed for the placement and maintenance of hardware and other equipment.

The author participated in the development of construction documents for Facility 1 (Figure 1) and the designing work for a hypermarket, warehousing, and production facilities. Throughout the author's ten-year-long project work, there were cases when Owners used the term “mezzanine storage” at warehouses. The projects under examination also feature this term. This is wrong. The mezzanine has no relation to warehouses; a mezzanine is a room and/or a utility room in the overstorey on the roof slab panel or the mansard. Actually, this was more about attics where the products were stored. An attic is a platform on the mezzanine floor, whose area is 40% smaller than that of the room in which it is located. Space in buildings examined: simple, rectangular facades, prolonged. Building height between 12 and 16 meters. This value is due to the height of storage units and the placement of additional interior finished ground levels. The buildings (100%) have a frame structure with metal or metal and concrete frames. Suspended sandwich panels are used as exterior walls in 100% of the buildings. Sandwich panels can be installed horizontally or vertically. The architectural style of these buildings is similar to that of warehouses.

| Facility title, options Facility image | Brief description |
|--------------------------------------|-------------------|
| 3 SP 57.13330.2011 Warehouse Buildings Updated revision of SNiP 31-04-2001* | |
| 4 SP 56.13330.2011 Production Buildings Updated revision of SNiP 31-03-2001 | |
| 5 SP 55.13330.2016 Single-Family Residential Homes Updated revision of SNiP 31-02-2001 | |
| 6 SP 118.13330.2012* Public Buildings and Constructions. Updated revision of SNiP 31-06-2009 (03.12.2016) | |
1. YULMART Suburban Order Fulfillment Center. (Online Discounter, Cybermarket).

*Address:* Moskovskaya Oblast, Ostashkovskoye highway.

*Types of trade:* retail, wholesale.

*Main activity:* orders from the terminal room, online trade.

*Functions:* - storage - 80%
- sales - 4%
- office, utility rooms - 16%.

*Number of storeys:* 1-3

*Building dimensions in plan view:* 141 x 108 meters

*Buildup area:* ≈ 15,300 square meters

*The floor area of building:* ≈ 45,000 square meters.

*Building height (maximum):* 16 meters

*Warehouse unit – 80%*

*Office and sales unit – 13%*

*The sales room takes up only 4% of the latter.*

*Product range:* home and gardening equipment, electronics, car parts, health and beauty products, furniture, sport, and tourism.

Same as for Facility 1

2. YULMART Suburban Order Fulfillment Center.

*Address:* Saint Petersburg, Piskarevskiy Prospekt

*Types of trade:* retail, wholesale.

*Main activity:* orders from the terminal room, online trade.

*Number of storeys:* 1-3

*Building dimensions in plan view:* 141 x 108 meters

*Product range:* various, including home and gardening equipment, electronics, car parts, health and beauty products, furniture, sport, and tourism, etc.

Same as for Facility 1

3. YULMART Suburban Order Fulfillment Center.

*Address:* Saint Petersburg, Pulkovskoye highway

*Types of trade:* retail, wholesale.

*Main activity:* orders from the terminal room, online trade.

*Product range:* various, including home and gardening equipment, electronics, car parts, health and beauty products, furniture, sport, and tourism, etc.

Same as for Facility 1
4. ETM Sales and Distribution Center
Address: Russia, Tatarstan, Kazan, M-7 highway

Types of trade: wholesale, online.
Product range: electrical supplies, electric equipment

5. ETM Sales and Distribution Center
Address: St. Petersburg Shushary

6. Kholodilnik.ru Warehouse Shop
Address: Moskovskaya Oblast, Leningradskoye highway, Chernaya Gryaz.

Product range: house appliances, electronics.

7. Katren Multifunctional Wholesale Trading Unit
Trading Warehouse.
Address: St. Petersburg, Shushary

Types of trade: retail, wholesale, online.
Product range: medical supplies (pharmaceuticals and health products).

Functions:
- storage - 85%
- sales - less than 1%
- office and utility rooms, workshops - 15%.
Number of storeys: 1-3
Building dimensions in plan view: 120 x 120 meters + 72 x 72 meter awning = 14,400+5200=19,600 square meters
Buildup area: ≈ 19,800 square meters
The floor area of building: ≈ 22,000 square meters.
Building height (maximum): =15.5 meters
Office and amenity rooms, workshops, sales floors are located in the attic of the OAU (25x30 meters = 3000 square meters).
Same as for Facility 4
The floor area of building: ≈ 22,500 square meters.
Building dimensions in plan view: ≈ 145 x 130-meter warehouse unit + 70 x 50-meter office, amenity, workshop, and sales areas.

Types of trade: wholesale, online.
Product range: electrical supplies, electrical equipment

Functions:
- storage - 85%
- sales - 3 %
- office, utility rooms - 12 %.
Number of storeys: 1-4
Building dimensions in plan view: 225 x 90 meters
Buildup area: ≈ 20,300 square meters
Building height: 12-18 meters
Warehouse unit – 85%
The dimensions of the 4-storey office and sales unit are 24x30 meters in plan view (=720 square meters), which corresponds to 15% of the overall area. The sales floor takes up just 3% of that latter value.

Functions:
- storage - 70%
- sales - 1%
- office, utility - 29%.
Number of storeys: 1-3
Building dimensions in plan view: 96 x 84 meters
Buildup area: ≈ 8100 square meters
The floor area of building: ≈ 10700 square meters.

Figure 1. Trade and warehousing facilities.

The format and the type of trade and the interactions with customers determine the appearance of the office unit that houses the sales-related rooms. Sales floors are very small, and they take up 1-4%
of the overall floor area of the building. The new customer interaction format, i.e., online and terminal orders, is employed in both retail and wholesale. In 100% of the facilities examined, this included various non-food items. The sales area (at 80% of facilities) is designed as a room with terminals for accessing the digital catalog. Facility 6 features a small showroom with a small inventory of products. All of the facilities (100%) enable sales via the Internet, and, in this case, the facility functions as a warehouse and a pickup point. All of the facilities (100%) operate online-sales; and all of them (100%) work in wholesale and 90% in retail as well.

3. Applicability
The design of trade and warehousing buildings depend on the trade format. Orders are fulfilled over the Internet or via digital catalog terminals set up in a small salesroom. The floor area of the salesrooms does not exceed 3-4% of the overall area of the facility. None of the facilities operates large showrooms. Warehouses take up over 70-85% of the total floor area of buildings. All of the facilities feature additional interior space in the form of attics, panels, and built-in structures. Various storage types are employed: high-shelf, pallet. Fire compartments correspond to a functional division. The structure is based on metal or mixed metal-and-concrete frames. Facades feature suspended sandwich panels, with a possible exception of office and sales units.

4. Conclusions
Trade buildings change depending on the format of trades, space-planning solutions used, and architectural or city-building images. The new conditions and principles for designing new types of trade and warehousing facilities have not yet been developed or included in the regulations. This must be accounted for in the future.

5. References
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