Ryazanskaya Transit Oriented Development

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Abstract. The Ryazanskaya Transit Oriented Development (TOD) is a large intervention included in Moscow’s 2030 urban planning, realizing a transit hub, commercial / retail spaces, an office tower and two metro/rail terminal buildings, to be built around a public park where ground transportation is also located. Within this master plan, the Terminal 2 integrates an underground transit hall to provide access for three mass transportation lines merging at Ryazanskaya TOD. Such urban-scale complex required international best practice architectural solutions, particularly focused onto the relationship between underground spaces and above-ground structures. The Ryazanskaya project is a case study useful to understand and explain the typical TOD urban design methodology, as a part of a large city-making process originated by the design of underground infrastructures and concluded with the architectural design of a strategic asset for the contemporary metropolis.

1. Introduction: what is a TOD?
In synthesis, a Transit Oriented Development consist into a high-density residential / mixed-use development to be realized in adjacency to a high-capacity transit station (metro / rail / light-rail), as a part of a city-wide planning strategy connecting several TODs onto an existing / planned mass transit system network,[1]. First and foremost, it is key to understand that any TOD project shall be part of a larger strategy, encompassing the overall planning horizon for the whole city / metropolitan area. In this sense we need take a step back to the urban scale, to identify -among the many city development strategies, an urban growth model that better represents the urban support able to “graft” the TODs into the city, metaphorically as a cutting on a tree. Such kind of specific studies start to appear in literature in the last decades of the XX Century, when planners needed a clear definition TOD as the basis for further implementation of proper governmental policies to be structurally applied -as later described- in the next decades.

The theoretical definition of a TOD-oriented urban growth model identifies the capacity of adaptation of the new urban developments to the simultaneous realization of public transportation lines (metro, light rail, urban rail), generating an action-reaction dynamic between mass transit systems and residential / mixed-use urban nuclei. In this sense the model is called “Adaptive City”, as theorized by R.Cervero [2] (figure 1). The Adaptive Cities “are transit-oriented metropolis that have invested in rail systems to guide urban growth for purposes of achieving larger societal objectives such as preserving open space

![Figure 1. Adaptive City diagram by R.Cervero.](image)
and producing affordable housing in rail-served communities. All feature compact, mixed-use suburban communities and new towns concentrated around rail nodes” [2]. Within this representation the real estate value of the new developments exponentially increases as close as they are firstly to the public transportation systems (TODs) and then -in linear way, as close as they are to the city core, either existing, in the case of expansion of historic cities, or planned, in the case of new townships.

As a preliminary introduction to the following discussion of the specific case of Ryazanskaya, it could therefore be concluded that the general planning of any new city expansion intervention - in the perspective of a TOD strategy - must include an underground planning activity to be able to build the foundations and graft any future urban intervention related to public transport nodes.

2. The Ryazanskaya TOD’s planning context and comparative case-studies

The Ryazanskaya TOD, located on the Ryazanskiy Prospekt, is set at the junction between the Kurskaya - Balashikha rail line, the Moscow Central Circle line (MCC) and the new Nekrasovskaya metro line, in the South-Eastern sector of Moscow. The overall master plan includes two terminal buildings, integrating an underground access to the three mass transportation lines (rail, metro and MCC), and a high-rise office building adjacent both to the terminals and to a vast public landscaped space. The TOD project is included in the “Moscow 2030 Horizon” planning scenario (figure 2). This urban planning tool includes simultaneously the design of new metro lines and the provision of many TODs to be built in correspondence of the future metro stations.

It is to be highlighted that the structure of the typical TOD included in this planning presents morphological differences with most common comparative cases - for example belonging to North American market. Muscovite practice tends to circumscribe the boundary of a TOD as much as possible, by unifying transit facilities and mixed-use development into a multifunctional large-size structure, typically with a considerable portion to be built underground. This choice is seemingly related to the need of pursuing an infilling strategy, because most of the new development are to be realized in urbanized or semi-urbanized sectors of Moscow’s vast metropolitan area. Mostly, the TODs included in the 2030 Horizon are meant either to develop vacant lots left over by previous development waves (as per the Ryazanskaya case), either to rehabilitate non-planned areas formerly occupied by spontaneous urbanization (TOD Volzhkaya) or to rehabilitate dismissed non-residential sectors (for example the industrial area of the TOD Electrozavodskaya).

The Volzhkaya TOD (Geodata, 2013, figure 3) can be taken as a milestone to compare with international best practice identifying the characters of the Muscovite TOD. Volzhkaya TOD is planned in a medium density peripheral sector of the city, over a gross area of approx. 12Ha. The intervention includes a single urban-scale multifunctional mat-building, the
“Public Center”, hosting all the required functions (commercial, retail, public facilities), also representing the financial propeller for the requalification of the public spaces associated to the transit function. The transit hub is then constituted by an at-grade transit space, realized around a covered plaza including connections with bus, tram, metro, exchange parking. Contemporary cases from international market show the differences with Russian practice. US TODs designed in the early 2000 years are included into a nation-wide planning policy [3], mostly presenting the characters of urban renewal projects, encouraging “sustainable urban development around public transportation nodes. TODs are compact, mixed use developments that facilitate walking, bicycling and the use of public transport trough urban design” [4].

The characters of a typical American TOD, for example Denver Union Station (Skydmore Owings and Merrill, 2006-2014, figure 4) are different. Similar to the Russian cases per its location in a medium density urban context, the DUS project boundary (approx. 120Ha) is roughly 10 times bigger than Volzkaya, and presents a completely different massing. In lieu of a single mega-structure, the urban fabric is articulated by blocks, each one hosting a specific set of functions, while the public spaces, are given the double duty to connect and provide access to the various transit means.

The Yeni-Sahra TOD in Istanbul, (Geodata, 2015, figure 5) can also be considered as comparative case, because of urban context and planning framework. Although Istanbul isn’t provided of specific TOD urban policy, many interventions are currently in phase of study or realization (for ex. Finanz Merkesi TOD by ARUP), in parallel with new metro lines, foreseen to be extended to 980km (2017 data). Yeni-Sahra TOD shows a comparable size with the Moscow types, although it includes several high-rise buildings, instead of a single structure.

3. The Ryazanskaya TOD’s urban design Agenda

We have seen that in the Ryazanskaya case there is a clear overall planning, that identified a specific type of TOD derived from international practices standards and subsequently adapted to the needs of local urban morphology and investment market. We will now try to explain what are the design implementation that will substantiate the large-scale goals included in the 2030 Horizon, and - in a broader sense- referred to best international practices for TODs, at the scale of a local intervention.
From a design process standpoint, Transit Oriented Design represents the middle ground between urban planning and engineering / functional / urban / architectural design. The urban space defined by transit projects is hence informed both by the nature of the infrastructure through its functional rules and engineering constraints, and by a specific urban design agenda, further discussed.

3.1. **Encourage urban growth planning based on public transportation vs car-driven sprawl**

There is agreement among experts in identifying sprawl, that is the dispersion of housing, industry and production, as the main cause of land consumption. The phenomena of widespread city / continuous urbanization, scarce permeability and heat island effect, concretely constitute the most tangible risk of the urban sprawl, as it is evident in many paradigmatic car-driven metropolises (Los Angeles) or in “continuous” mega-cities that -even if they possess large mass transit networks, developed a seemingly uncontrolled growth structure by incorporating pre-existing urban nuclei once beginning to other towns, often mono-functional residential districts with low density (London).

Regarding this topic, the Adaptive City model might become an effective planning tool to overcome the mentioned risks, also establishing a strategic parallelism with the most diffused sustainable design protocols. Referring for example to the protocol LEED® for Building Design and Construction, the ranking grants approximately the 20% of the total score for “Site Sustainability”, where relevance is given to the credits linked to project physical connection with public transportation. Such topic is further addressed with precision and even analyzed with quantitative studies by dedicated sustainable design literature: "An example of a global approach to the problem of environmental sustainability in urban areas is provided by the studies reported by Kats that link CO₂ emissions not so much and not only to the energy efficiency of the single building, but to several of the parameters examined by LEED® ND [Neighborhood Development, author’s note] [5]. Furthermore, a 2007 study published in "Environmental Building News" [6] shows how energy-efficient buildings in absolute terms are in fact energy-consuming if placed within systems not irrigated by widespread public transport.

What can be deduced from these studies is that a typical TOD possesses by its nature the fundamental characteristics underlying the sustainability of the urban project, that is a zero-kilometer connection to multimodal transport hubs, and from there to the whole extension of the metropolitan mass-transit network. Coherently with the overall planning strategy, car parking is minimized. The masterplan includes proximity parking for staff / authorized visitors only for the high-rise, staff parking and loading bays for both the Terminals, disabled and fire-fighters parking at-grade while no mass parking for generic users nor exchange parking is provided. Once again, such choice meets the design criteria included in the LEED® protocol, confirming the sustainable design nature of the TOD.

3.2. **Create a reasonable urban density concentrated around public / transit spaces.**

A typical TOD project, such as Ryazanskaya, where the mass transit system access happens underground, shall include from the earliest phases an analysis of the final development scenario, and shall implement all necessary design tools in order to coordinate underground facilities with the above ground volumes providing the planned density. More in detail, the urban design agenda included the following design actions, articulated both at the urban and architectural design scale.

At the **urban scale**, the masterplan defined those typical TOD components, i.e. the mixed-use development, the transit facilities and the public / transit space, that both create a reasonable urban density and realize a proper pedestrian spaces network to access the mass transit system. The mixed-use development, directly accessible by the transit hub, is split into two functional volumes, both directly connected with the transit facilities: South of the Terminal 1 the masterplan locates a high-rise office tower, while in the above grade levels of the multi-functional Terminal 2 are realized a retail center and offices floors. The underground portion of Terminal 2 includes an underground transit hall giving access to all transit modes. The public space consists into the empty space between the Terminals and the high-rise building. It is to be noted that the Ryazanskaya TOD concept -once again, highlights proper local Russian characters, by introducing a type of mixed development more focused
onto commercial/office facilities rather than on residential. Finally, the masterplan provided an assembly of public/accessible areas merging into a walkable system of pedestrian paths connected with the neighbourhood and with the near-by heritage complex of the Zhivonachal'noy Troitsy church.

At the architectural scale, the masterplan individuated three specific architectural projects, corresponding to the Terminal 1, Terminal 2 and high-rise building. The theme of coordination between underground and above ground structures becomes paramount in this moment, where the design of Terminal 2 shall be conceived in order to support the future development of the whole functional areas included in the GBA already defined by the masterplan (figure 6).

In other words, this meant to implement key design strategies synthesized as follows: 1) to realize structures that aren’t impacting on potential development of the at-grade surface, leaving the at-grade areas as open as possible to any urban design agenda; 2) to provide an access system coordinated with the texture of the neighborhood, in order to maximize the catchment area of the transit infrastructure below grade; 3) to prevent from the building of any structure that can eventually become a constraint for future urban development; 4) to provide opportunities for expansion or modification of the below grade structures without interference with the existing urban fabric.

3.3. Realize a connection between urban and regional transit with neighbourhood-scale paths
It is key to understand that the connection must be realized by pedestrian paths, because such implementation responds to the same strategy of connection with mass transit systems at the fundament of the urban planning (figure 7).

Academic research and scientific literature agree in highlighting the role of the pedestrian connections, first and foremost in the perspective of a sustainable urban design. The SMARTRAQ report (2007), elaborated by Georgia Tech concludes that "the travel patterns [the typical daily journeys by private vehicle] of the residents of areas with poor pedestrian connections generate CO₂ emissions higher than 20% (per person) compared to areas with widespread pedestrian connections " [7]. In this sense, a TOD realized without an...
extended network of public pedestrian spaces connecting with urban and regional transit would possibly fall out in a situation where the “lack of public transport and pedestrian / cycle connection networks between buildings forces energy-intensive activities that tend to exceed the energy savings potentially obtained thanks to a high classification” [8]. This been said, it is to consider the impact that pedestrian paths assume even at the level of urban quality / real estate value. Furthermore, “Walkability” plays a fundamental role not only in the definition of the efficiency of a TOD, but also - as a consequence- on the acquired real estate value of those properties that can benefit from a pedestrian network, with an average increment estimated to be around 12%, according to 2010 researches [9].

To fulfill these objectives, the Ryazanskaya project implemented an articulated network of public spaces and pedestrian paths, with the double duty of serving both the pedestrian local circulation and to connect with the broader network of the mass transit system. In this sense, at-grade public spaces / pedestrian paths are designed by reprogramming the empty spaces between the buildings, and any other space left available by the right of ways needed to grant internal circulation within the boundary of the TOD. The adopted urban design mixes open spaces and paths without a geometric underlayer, but rather by imitating “spontaneous” pedestrian paths within a landscaped area. This has been facilitated by the fact that all buildings’ footprints are facing a large open space, designed to be public and accessible with no restrictions. Such central open space links the at-grade pedestrian network with the Terminals giving accesso the mass transit system, hence becoming an open transit space.

3.4. Build urban and regional existing and new public transportation systems connections

This point applies to the characteristic of intermodality inherent of a typical TOD. As it is known intermodality consist into the possibility for users to switch from a transit mode to another. Such functionality presents the advantage to extend the users’ reach of a TOD the whole extents of the transit lines merging in that specific location.

In the case of Ryazanskaya, there are three types of railway transport and several local bus lines. The bus lines at-grade, all belonging to local Easter Moscow’s circulation and mostly running on Ryazanskiy Prospekt (a large urban boulevard), are provided with several stops included in the r.o.w.. The connection with these stops is ensured by the at-grade pedestrian path network, as they are in correspondence to the main access to both the Terminals. The new Nekrasovskaya metro line consist into a derivation of the outer metro ring planned in the 2030 Horizon, to reach the Eastern sectors of the metropolitan area of Moscow, in phase of increasing urbanization. The existing Kurskaya – Balashikha rail line lays North of the Ryazanska TOD and connects the central Kursky Railways Station with the Eastern surroundings of Moscow, to reach the town of Balashikha. The Moscow Central Circle line (MCC), also designated Line 14 is a 54-km-long orbital urban/metropolitan rail line that encircles historical Moscow.

Terminal 1 connects directly only to the elevated Ryazanskaya station on the MCC, while most of its interior spaces are dedicated to passengers’ services, retail, and operations, while the true transit hub is realized in the underground levels of Terminal 2 way (figure 8). In this sense, to build the connection between the existing rail system and the designed new metro line, the chosen design solution envisaged the creation of a large subterranean transit hall where all access to different stations are brought to the same underground level. The transit hall is accessible by two surface entrances with mechanized vertical circulation, located one in the south and one in the eastern side of the

![Figure 8. Transit Hall at the underground level.](image-url)
Terminal B, both connected to the at-grade pedestrian paths network. Terminal 2 underground transit hall is hence conceived as an extension of the public space, and in this sense, it is articulated by following the pedestrian flows in the most natural possible, realizing the desired connection between the different transportation modes, existing and in phase of realization.

4. The Terminal 2 Architectural Project
As a result of the discussion carried out so far, it can be considered that the Terminal 2 (project by Geodata, 2019) is the most representative building for the Ryazanskaya TOD, because of its multifunctional nature, its massing articulated below and above ground, and its role as a urban large-scale connector, by realizing the transit hub at the center of the development.

After such an extended urban design process, grounded at the overall city planning scale, it might appear that architectural design can only play a secondary role, like a sort of mere aesthetic exercise, as if the building already set its concept far away from a true architectonical matter. Such consideration couldn’t be more erroneous, as the two following sub-chapters intend to prove.

4.1. The Functional Design
The functional design represents a prominent part of the conception process for transit architectures, and -in the case of Terminal 2, functional design shall be strictly correlated with the structure’s nature of urban connector. Moreover, the broader concept of functionality constitutes a primary parameter of appreciation for public transit structures, as universally recognized by the most competent market research in the sector of transportation studies [10].

In the case of Terminal 2 the functional design needed to organize three different main uses articulated per different levels, according to the following approximated GFA: 5.000sqm of transit/operation spaces underground, 4.000sqm for retail/services at grade, and 6.000sqm for upper levels office floors, over a total GFA of approx. 15.00sqm (figure 9). The underground level, as previously discussed, hosts the transit hall and the access to the different means of transportation, also including retail, technical areas and several vertical circulation’s access directly linked with the office floors above. Included in the underground level is a technical mezzanine associated to a BOH area. The ground floor allocates the space for a medium sized retail gallery organized around an interior patio. At the same ground level is located the direct access to the underground transit hall and the lobby for the office floors above. The last two floors, partially cantilevering on the eastern side, are entirely dedicated to office, taking the name of OZEP building. It is to be noted that the realization of the internal court is functional to bring daylight to the office spaces distributed around the court at the upper levels, given the thickness of the western portion of the footprint. Because of the triangular shape, progressively restricting toward the eastern corner, the rest of the office spaces are placed on the façades, served with double loaded corridors merging at the vertex of the triangle. The central

Figure 9. Functional plans of Terminal 2: ground, second and third floor.
space between these corridors hosts non full-time working spaces such as archives, tech areas, toilets etc. while the meeting and general assembly rooms take place in the most privileged area of the building, i.e. on the East corner, cantilevering on the green open space.

Once assessed the compliance to local standards and regulations as per the sizing of each functional area, the main design theme was the relationship between the three different uses (transit, retail, office). The design approach consisted in individuating those functions that can be paired (transit and retail) and those to remain separated (office). Following this strategy, the design further implemented access and vertical circulation that directly connected the retail spaces and the transit hall, while all office levels have a separated access and vertical circulation, even when stairs and elevators reach the below grade level. This way the retail spaces will benefit from the passenger’s flow directed to the transit hall, and vice versa, the transit space will acquire amenities and services for the transit users.

Pairing retail and transit users informed the necessary Levels of Service study, since the final users load shall include the potential increase originated by the commercial activities. The LOS verification has been carried out on the transit hall and the access gates (escalators, elevators, turnstiles etc.) to ensure the perfect functionality of the Terminal’s driver function, i.e. to provide direct access to the mass transportation system.

4.2. The Architectural Concept
In today’s transportation market it become paramount that architectural quality represents a determinant factor in the choice of a transit mode. Supporting such statement, a 2012 research by experts from Neapolitan universities [11] assesses the value of aesthetics within the public transportation market, by simulating the choice between traditional rail services and the new high aesthetic standards metro line open since 2009, within the framework of the so-called “Art’s Stations” program. Such appreciation for architectural quality establishes an immediate linkage with the Muscovite context, where the public administration currently invests in high architectural standards for metro stations, following a long-time tradition still living from the early soviet era. Within such a fertile context for architecture, the designer’s mission was to elaborate a concept able to connect the building with the city, as a signature representation of the civic sphere of the Ryazanskaya TOD.

The need to provide a continuous façade hosting the gates for the transit hall is at the origin of the curvilinear design of the plan on the southern side, the North and East sides being conceived as rectilinear cuts in order to adapt the footprint to the buildable parcel, and also to represent a change of approach per each side of the building. The curved geometry of southern façade is progressively cantilevering as long as it curves from West to East, to activate an interaction with the adjacent open space, to open the visual towards the Terminal 1 and the high-rise building on the South-West side, and finally to enhance the presence of the access to the transit hall located at the very edge of the building, on the East corner (figure 10).

Figure 10. Job-site progress pictures: South façade (above), North façade (center), Interior of the main meeting room (below).
The volume generated by the footprint is solid, continuous, horizontal. This applies to the tectonic model to which Terminal 2 refers to, i.e. the multifunctional mat-building typical of Muscovite TODs. As an intended consequence, in this compact volume the openings will assume great importance, to enhance the character of connection between at-grade pedestrian paths and underground transit hall. Therefore, there are going to be only two large openings carved into the volume on the southern side, dimensioned to a scale visible from an urban perspective. These carved volumes will contain the access to the transit hall and the main access to the ground floor of the building, hosting the retail gallery. The access to the transit hall happens directly (from at-grade to below grade) at the eastern entrance, while the larger central opening is meant to introduce to the interior court and subsequently, with a secondary access, to the underground transit hall as a consequence of pairing the retail and transit users’ flows. Such large-scale entrance is also meant to activate a visual link with the heritage context on the South (Zhivonachal'noy Troitsy church), following the visual direction of the pedestrian paths crossing the landscaped area facing Terminal 2.

Coherently with these choices, the facades shall conform to the uniformity of the building’s tectonic. In order to avoid the risk of a monotonous design, for facades that can be longer than 100m, the approach per each one is different, even in consideration of sunlight and snow, the two main environmental factors affecting the building skin’s design. The uniformity to the volume will be given by the same choice of a continuous curtain glass wall per the three facades, while the specific character of each one will be given by alternating transparent / opaque glass and by introducing shading devices, such as on the South façade. On the southern side, where in the summer season irradiation might become a problematic factor, the façade’s design included a series of vertical louvers, curving and cantilevering as the volume to which they are applied. The chiaroscuro between the louvers, observed at street level by walking along the South façade, will reveal the plastic nuances of the complex yet uniform tectonic of the building. The North façade is essentially a totally transparent daylight-catch device, to save energy during winter working hours. Stable light from the North is in facts the most suitable kind of daylighting for the office spaces realized in the upper floors of the building.

Inseparable from the architectural concept is the structural concept, because structures are what more applies to overall urban-design theme of coordination between underground and above ground design. At the transit hall level large functional spaces are needed, with as less columns as possible in order not to obstruct the passengers’ flows. At the opposite, the upper levels would need a solidly supportive structure to counterbalance the cantilever on the South façade. The structural solution designed Y-shaped columns, continuous from the lower level to the top, crossing their arms at the upper level and forming a reticular-mass structure to which the cantilevered slabs are suspended. The structure is perceivable from the North transparent façade, showing size and mass of the concrete Y-shaped column and their reticulated composition.

5. Conclusions

The urban city-wide planning strategy in which a TOD is framed shall provide a simultaneous vision for both underground and above-ground development. The case of Ryazanskaya proves that such syncretic kind of planning allows for the realization of multilevel / multifunctional facilities otherwise impossible to build in distinct planning phases. By practical means, this means that together with the provision of new underground metro lines, for example, the city shall simultaneously identify those areas where to develop TODs and identify at least the transit structures hosting mixed-use functions also in their underground portion. Conclusions are synthesized as follows.

1. A TOD can happen in a limited / medium size area (around 10Ha) only if a tendentially high F.A.R. is allowed by local regulations, and -once again- this choice shall be made by the city itself in the very early planning phase. In this sense p.a. shall provide for a mechanism of compensation for developers, for example by allowing to exceed the height limitation, as in the case of the high-rise included in Ryazanskaya TOD or by allowing for the realization of internal courts without which no compact mat-building would be efficient, as in Terminal 2.
2. An efficient masterplan for a TOD shall provide a large public / transit space, from where the connection to the underground transportation layer is accessible and immediately perceivable by the users at the surface level. Minimizing the footprint, compacting the buildings, and providing multi-functional structures appears to be the most efficient urban design concept to realize the needed transit space, also providing pedestrian paths linked to the neighborhood and a large, high-quality green space for the public. In this sense, Ryazanskaya TOD limited the overall massing to mega-buildings only (the high-rise and the Terminal 2), firmly avoiding fractioning in medium size / small volumes.

3. The buildings included int the TOD shall possess the functional character of urban connectors, by providing public circulation patterns that are directly linking the access to the transit mode with the network of pedestrian paths. A functional split per building levels is a recommendable design solution, as in the case of Terminal 2, eventually privileging the choice of the lower levels to access the transit mode by a single, properly dimensioned space. Also, pairing users’ flows with similar agendas and schedules can be beneficial for supporting the economical functioning of the building itself.

4. Architectural quality matters. International best practice architectural design, high-qualitative aesthetic finishing and eventually the integration of artworks within the transit buildings / spaces can be the driver for the users’ choice. Not to forget the accrued R.E. value that a qualitative environment will bring to the properties within and surrounding the TOD. Finally, it remains to say that all the above conclusion postulate that the public transportation layer is located underground. This appears to be the most relevant key of success for a TOD, eventually because it allows for the design implementation of all the strategies of densification, realization connective public spaces and finally urban / architectural quality discussed so far. The Ryazanskaya TOD and the Terminal 2 are hence an example of how such combination of strategic choices has been made possible.

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