

CHAPTER 2. EVALUATION OF ROAD NETWORK DEVELOPMENT IN ASTRAKHAN REGION

Condition of public road network

To-date the network of roads in Astrakhan Region functioning as public roads has a total length of 6,357 km. Not all public roads of both federal and territorial importance are paved. Out of the total length of paved roads, 72.9% (2,800.9 km) have major pavement (Table 2.1).

According to jurisdiction, the road network of Astrakhan Region is divided by federal, territorial (regional), municipal and departmental roads. Roads of federal importance are 570.6 km long, and 3.2% of their length have no major pavement. These roads are placed over territory of more than half districts in the Region (map 1).

Territorial roads have the length of 2,236.2 km, of which 92.9% are paved (1,510.6 km – with major, 113.6 km – with simplified and 449.3 km – with transitional pavement, and 158.6 km are unpaved).

Table 2.2 shows dynamics of territorial road network development in Astrakhan Region. It is observed that specific weight of paved roads is growing. But the rate of increase in paved roads for the last 4 years was steadily reducing. The length of unpaved roads reduced more than by 22%.

Specific weight of departmental and municipal roads in the structure of the network makes 46.2% which is higher than the average value for the Russian Federation (37%), see table 2.2. Out of 1,917.3 km of departmental roads, 187 km (9.8%) are paved – according to this parameter Astrakhan Region is in a bad position among other regions of Russia. Unpaved municipal roads comprise 84.7%. Unlike the network of regional roads, municipal roads were not improving for the recent years, their summarized length is also stable.



Table 2.1

Condition of the road network in Astrakhan Region as of 1 May 2006 (km)

Description	Total length of roads	Including		
		federal	territorial	departmental* (municipal)
All roads	6,357.0	570.6	2,232.2	3,554.3
<i>Of them paved roads</i>	3,844.6	570.6	2,073.5	1,200.5
Including those: with major pavement	2,800.9	552.1	1,510.6	738.1
with simplified pavement	146.2	18.4	113.6	14.1
with transitional pavement	579.1	0	449.3	129.8
Unpaved roads	2,512.4	0	158.6	2,353.8

* - the length of roads functioning as public is shown. According to the data from the Ministry of Construction and Road Sector in Astrakhan Region.

Distribution of roads in the region by categories is also unfavorable for transport infrastructure users (see Table 2.3). Thus, roads of category 4 and roads with low traffic volume together make 62.8% of total length. Even in the structure of the length of federal roads about 4% - are roads of category 4. The length (and specific weight) of roads of category 1, which is 11.2 km, may also be an indicator of current condition of road infrastructure development.

Table 2.2

Development of the regional road network in Astrakhan Region

Parameters	As of 01.01 of respective year				
	2002	2003	2004	2005	2006*
Length of public roads, thousand km					
Total	4,218.73	4,197.55	4,211.93	4,149.46	4,139.9
Regional road network	2,301.43	2,280.25	2,294.63	2,232.16	
including paved roads	2,097.1	2,111.59	2,131.47	2,073.53	
of them with major pavement	1,505.91	1,537.61	1,561.82	1,510.62	
with simplified pavement	157.94	128.26	118.84	113.63	
with transitional pavement	433.25	445.73	450.81	449.29	
unpaved roads	204.33	168.66	163.16	158.63	
Municipal road network	1,917.3	1,917.3	1,917.3	1,917.3	
paved roads	187.0	187.0	187.0	187.0	
with transitional pavement	106.0	106.0	106.0	106.0	
unpaved roads	1,624.3	1,624.3	1,624.3	1,624.3	
Portion of regional roads in the total length of roads, %					
Paved roads	91.1	92.6	92.9	92.9	

As per the data of the Ministry of Construction and Road Sector in Astrakhan Region.

* - data as of 1.05.2006 (as per the data of NF «Geogracom»)

Table 2.3

Distribution of roads in Astrakhan Region per categories (as of 1.06.06)

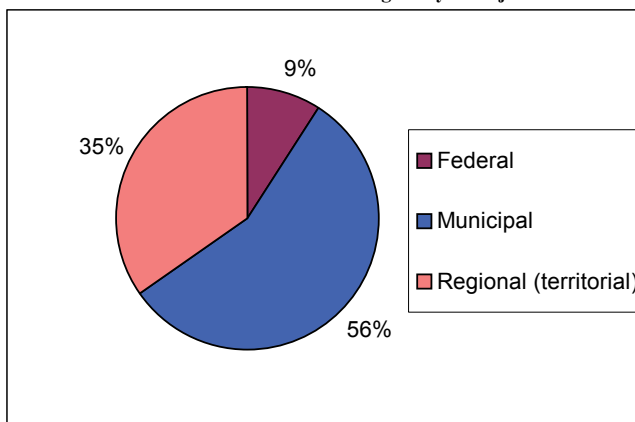
Category	Departmental	Municipal	Territorial	Federal	TOTAL
Category 1	0	0	11.2	0	11.2
Category 2	0	6.0	97.5	265.2	368.6
Category 3	51.6	52.4	761.6	295.7	1,161.3
Category 4	96.8	142.9	791.7	24.0	1,055.4
Roads with low traffic volume	416.3	569.4	557.8	0	1,543.5
TOTAL:	564.7	770.6	2,219.8	584.8	4,139.9

As per the data of NF «Geogracom»

All accounted in the process of investigation road network is shown on Figure 2.1.

Figure 2.1

Distribution of roads within the network of Astrakhan Region by their jurisdiction

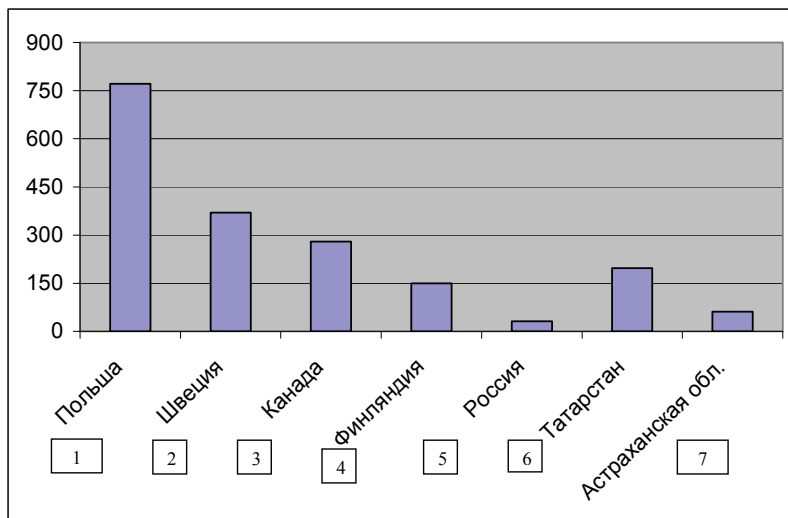


Thus, as of 1 January 2004, density of public paved roads was 61 km per 1000 km² of the territory and 2.82 km per 1000 residents.

For comparison Table 2.4 and Figure 2.2 show parameters of provision with roads per regions of Russia.

Figure 2.2

Provision with rural paved roads (km) per 1000 sq. km of territory



1 - Poland; 2 - Sweden; 3 - Canada; 4 - Finland; 5 - Russia; 6 - Tatarstan; 7 - Astrakhan Region

Table 2.4

Provision with public roads per regions of Russia

Parameters, for 2005	Russia	Astrakhan Region	Krasnodar Territory	Orenburg Region
Paved roads, km				
per 1000 km ²	32.16	61	145	107
per 1000 men	3.7	2.82	2.15	5.84
Portion of inhabited areas not provided with paved roads	33.6	30.0	24.7**	4.20*

* Data for 2000; ** Data for 2004.

According to experts' evaluation made by international companies, minimum density of roads for provision with economic and passenger links of inhabited territories should be 200 - 300 km per 1000 sq. km. Astrakhan Region is only striving to these criteria. And Russia as a whole essentially yields to the countries with well-developed market economies (in density per area unit of the territory - by 5-30 times, per 1000 residents - by 3-10 times) (diagram 2.2). This indicator by density is not adequate and can't serve as a basis for comparison. In particular, according to this parameter calculated per 1000 residents, provision with roads in Evenk Okrug is four times higher than in Astrakhan Region. As minimum, the length of networks should be compared not to the total area of the territory, but only to inhabited. However, it does not solve in principle a matter of parameter provision with roads. We developed and tested a consistent parameter - integral transport accessibility (ITA) (Chapter 4).

Attention should be paid to the last parameter in Table 2.4. In general, the population in the Region is settling in enlarged settlements, at the same time majority of little rural settlements (less than 10 residents) faced unfavorable transport conditions, though by the number of population their portion is only less than 0.02%.

Length of public road network in Astrakhan Region per types of pavement

Existing road network of Astrakhan Region has comparable to average Russian transport operating parameters. Characteristics of road technical condition per types of pavement is given in table 2.5. As we can see from the Table, the portion of unpaved roads in the Region is relatively big and comprises 27.8% of the total length of roads (for comparison, the portion of unpaved roads in the Russian Federation as a whole is about 9%. The most portion of unpaved roads is typical for Akhtubinsky (54.1%), Krasnoyarsky (36.8%) and Volodarsky (35.9%) districts.

Table 2.5 represents also a degree of inconsistency between the existing road network and that required per types of pavement. In general, Astrakhan Region suffers deficiency of roads. The demand in roads is satisfied only by 96.9%. It refers mainly to roads with major pavement, Region's demand in them is satisfied only by 62.0%, and for the roads with simplified pavement the degree of satisfaction is even lower - it is 51.4%. On the contrary, networks of roads with transitional pavement and unpaved roads is excessive, their length exceeds that of required respectively by 5.2 and 11.4 times. The least values of degree of satisfying the demand in roads with major pavement are in Limansky (33.7%), Volodarsky (38.0%) and Akhtubinsky (48.4) districts. Contrasts in inconsistency between existing and required structure of roads are typical for Astrakhan Region. None of the districts in the Region is fully provided with roads with major pavement. At the same time, in the majority of districts there is excess of roads with transitional pavement and unpaved roads (the degree of satisfying the demand comprises 100%). Part of these roads, performing important transportation functions, should be transformed into those with major pavement.

Table 2.5

Existing and prospective length of public roads in Astrakhan Region per types of pavement (as of 01.01.2007)

Nos.	District	Length of roads, km				
		Total	Paved roads			Unpaved roads
			Major	Simplified	Transitional	
1	Akhtubinsky	646.7	232.4	-	64.6	349.7
2	Volodarsky	376.8	126.8	25.8	88.9	135.4
3	Enotaevsky	295.0	239.4	9.2	26.0	20.3
4	Ikryaninsky	250.1	170.9	11.9	41.7	25.6
5	Kamyzyaksky	417.5	207.4	28.7	48.7	132.7
6	Krasnoyarsky	382.0	223.5	4.8	13.3	140.5
7	Limansky	379.5	124.3	93.1	107.5	54.7
8	Narimanovsky	522.5	317.5	5.1	36.6	163.3
9	Privolzhsky	380.3	301.4	6.9	14.9	57.0
10	Kharabalinsky	253.2	179.6	-	33.9	39.7
11	Chernoyarsky	236.5	165.4	0.8	39.4	30.9
Total		4139.9	2288.7	186.2	515.5	1149.6

Table 2.5. Continued

Minimum required length of roads, km						Degree of satisfying the demand in roads with a respective type of pavement, %				
District	Total	Per types of pavement				Per types of pavement				
		Major	Simplified	Transitional	Unpaved	Total	Major	Simplified	Transitional	Unpaved
Akhtubinsky	693.8	480.0	140.6	2.3	70.9	93.2	48.41	0	100.0	100.0
Volodarsky	377.7	333.7	10.5	4.0	29.5	99.8	38.01	100.0	100.0	100.0
Enotaevsky	296.7	276.9	18.4	0.5	0.9	99.4	86.48	47.85	100.0	0
Ikryaninsky	262.8	243.1	13.2	3.4	3.1	95.2	70.29	90.25	100.0	100.0
Kamyzyaksky	421.9	356.4	63.2	0.6	1.7	99.0	58.19	45.34	100.0	100.0
Krasnoyarsky	391.4	330.0	8.7	0.3	52.4	97.6	67.73	54.47	100.0	100.0
Limansky	380.2	368.5	10.6	1.1	0	99.8	33.73	100.0	100.0	0
Narimanovsky	537.9	492.7	37.4	0.8	7.0	97.1	64.45	13.63	100.0	100.0
Privolzhsky	392.7	353.3	32.5	6.9	0	96.8	85.33	21.26	100.0	0
Kharabalinsky	271.7	249.4	17.8	4.0	0.5	93.2	72.00	0	100.0	100.0
Chernoyarsky	243.7	209.4	9.1	18.5	6.7	97.0	79.01	8.75	100.0	100.0
Total	4,270.5	3,693.4	362.0	42.4	172.7	96.9	62.0	51.4	1,215.8	665.7

Links between inhabited areas

Table 2.6 describes characteristics of provision with the links between inhabited areas. Special attention should be paid to two relative parameters: level of road permeability of borders (80.0%) and level of spatial integrity of the Region (70.0%). These parameters characterize a degree of road isolation of districts one from another (the first parameter) and degree of interconnection of inhabited areas with paved roads within a district (the second parameter). For comparison, in majority of regions in the Russian Federation values of these parameters are within the limits of 70 to 80%.

For Astrakhan Region in general the level of road permeability is satisfactory. 4 out of 11 districts are linked by paved roads to all adjacent districts, and 7 more – are not linked to only one adjacent district. At the same time, in some districts there are “bottlenecks” requiring consistent actions. With respect to the level of road permeability of borders, the worst situation is in Akhtubinsky (33%), Chernoyarsky (50%) districts, i.e. half of these districts’ connections with their neighbors are not realized due to the lack of paved roads, therefore, the lack of comfortable roads becomes a hindrance in establishment of economical connections between the districts. Low level of road permeability of borders in the Region to much extent is related to separation of the region territory by large rivers (Volga, Akhtuba) and their tributaries.

At inter-district level, characterized by a parameter «level of spatial integrity», the situation in the Region as a whole is a little worse (70.0%). Only in Ikryaninsky, Limansky, Privolzhsky districts over 85% of inhabited areas are provided with paved roads. In general, by the level of spatial integrity, districts in the Region do not vary much. Only in Volodarsky district the level of spatial integrity of the district is less than 50% (49.3%).

One of results of proposed program for road network development in Astrakhan Region will be provision of all major districts of the Region with guaranteed links, by paved roads, to both regional and district centers.

Table 2.6

Provision of links between inhabited areas of Astrakhan Region by paved roads

Nos.	District	Direct links between administrative districts		Level of road permeability of borders, %	Direct links between habitation areas		Level of spatial integrity of the district, %
		Total number of adjacent districts	Links by paved roads (m)		Total number of inhabited areas	Including those not linked by paved roads	
1	Akhtubinsky	3	1	33	45	22	51.1
2	Volodarsky	3	3	100	73	37	49.3
3	Enotaevsky	4	3	78	26	5	80.8
4	Ikryaninsky	4	3	78	38	4	89.5
5	Kamyzyaksky	3	2	67	47	15	68.1
6	Krasnoyarsky	4	4	100	51	15	70.6
7	Limansky	2	2	100	30	3	90.0
8	Narimanovsky	6	5	83	45	16	64.4
9	Privolzhsky	5	5	100	39	4	89.7
10	Kharabalinsky	4	3	75	19	3	84.2
11	Chernoyarsky	2	1	50	17	5	70.6
Region as a whole (without Znamensk and Astrakhan)		3.64	2.91	80.0	430	129	70.0

Structure of vehicle fleet in Astrakhan Region

A fleet of vehicles in Astrakhan Region as of 01.01.2006 per types of vehicles is shown in Table 2.7. As the table demonstrates, the biggest number of trucks (without accounting towns of regional administration) is at the disposal in districts Akhtubinsky (16,577 units), Krasnoyarsky (9,777 units), Ikryaninsky (9,191 units).

In the structure of trucks fleet the trucks of carrying capacity up to 9 t dominate which makes 97.1%. The biggest portion of vehicles with higher carrying capacity (over 9 t) is observed in Krasnoyarsky district (18.3%).

Analysis of dynamics of vehicle fleet variation in the Region shows a steady increase in the number of all types of vehicles. It refers, first of all, to the fleet of trucks, especially heavier than usual trucks with carrying capacity over 9 t. Increased axle loads can result in intensive deterioration of road pavement. As a result of numerous experiments, it was found that doubling of vehicle axle load, compared to these of standard values, leads to 16-time increase in deterioration affect.

Compared to the year of 2000, the fleet of cars increased by 82.2% (Figure 2.3), fleet of trucks – by 29.0% (since 2001), buses – by 30.0% (since 2001). Hence, the number of vehicles in Astrakhan Region increases significantly faster than its road sector develops.

Figure 2.3

Increase in the fleet of cars in Astrakhan Region

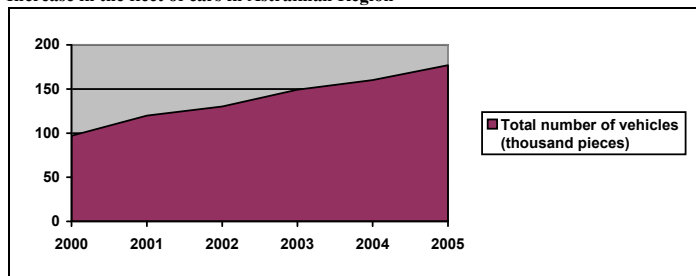


Table 2.7

Structure of the fleet of vehicles in Astrakhan Region (possessed by residents, as well as major and medium companies) as of 1.01.06

District	Total number of trucks, units	Including trucks with carrying capacity over 9 t, % (units)	Total number of cars, units	Total number of buses, units	Total number of motor transport
Akhtubinsky	1,590	41	14,715	272	16,577
Volodarsky	735	6	4,350	208	5,293
Enotaevsky	677	2	4,229	73	4,979
Ikryaninsky	1,163	23	8,012	161	9,191
Kamyzyaksky	1,307	11	6,511	146	7,964
Krasnoyarsky	1,703	312	7,354	720	9,777
Limansky	1,094	16	6,281	102	7,477
Narimanovsky	1,890	34	5,808	371	8,069
Privolzhsky	1,422	16	6,452	124	7,998
Kharabalinsky	1,340	13	6,730	115	8,185
Chernoyarsky	1,296	11	4,187	56	5,539
Total in the Region (together with the data on towns Astrakhan and Znamensky)	27,232	786	181,219	6,118	214,569

Traffic safety in Astrakhan Region

One of the most important trends in development of transport system in Astrakhan Region is elimination of potentially dangerous sections capable in some cases to cause significant damage to social and economic interests of the Region.

It should be pointed out that dangerous sections are understood here in wider sense than it is used to. This includes not only those sections where characteristics of accident rate exceed standard values and, therefore, a risk of getting into traffic accidents and, therefore, a risk of getting into traffic accidents is higher, and, respectively, social and economic losses (which is customary), but also those which have important topological significance. Under importance of topological significance a value of economic damages is understood which a district (or a region as a whole) could suffer in case of a given road section breakdown (even if there are no above listed prerequisites for traffic accidents on these sections). Thus, by their potential social and economic consequences, dangerous sections are divided into two groups: 1 - technical, 2 - topological.

Factors stipulating the first group of dangerous sections are railway crossings at grade, presence of bridges in dangerous condition, as well as sections of traffic accident concentration and sections suffering regular natural disasters (such as floods and flooding of a road, as it happens, for example, with access to the village Soultanovka in Volodarsky district).

Russia essentially stands out among economically developed countries by the level of accident rate on roads. Especially adverse situation exists with grave consequences of traffic accidents, the rate of which is 3 to 15 times higher than in economically developed countries.

Table 2.8

Basic parameters of traffic accident rate on roads of Astrakhan Region

Parameters of traffic accident rate	2001	2002	2003	2004	2005
Number of traffic accidents	1,106	1,126	1,245	1,292	1,290
Number of killed	164	178	202	209	194
Number of injured	1,269	1,260	1,411	1,466	1,486

Table 2.9

Number of traffic accidents with injured and killed in Astrakhan Region, units

District	On rural roads			On urban roads		
	2003	2004	2005	2003	2004	2005
Akhtubinsky	95	105	91	34	36	34
Volodarsky	47	43	37	0	0	0
Enotaevsky	35	26	31	0	0	0
Ikryaninsky	61	58	59	0	0	0
Kamyzyaksky	54	36	43	23	13	13
Krasnoyarsky	54	45	42	0	0	0
Limansky	52	51	35	0	0	0
Narimanovsky	68	60	72	31	22	21
Privolzhsky	98	99	83	0	0	0
Kharabalinsky	34	38	45	10	11	17
Chernoyarsky	32	29	38	0	0	0
Total in the Region (together with the data on towns Astrakhan and Znamensk)	1,712	1,379	1,414	1,180	870	917

In Astrakhan Region, same as in Russia as a whole, traffic accident rate is still high enough. For the last years a number of traffic accidents increased (Table 2.8), and, though some reduction of growth rate was observed, in general it is still very high. Compared to other regions of Russia, Astrakhan Region holds 54th place by specific number of traffic accidents (129.2 traffic accidents/100,000 men in 2004) and 62nd place by specific number of killed (20.9 men/100,000 men in 2004). The portion of traffic accidents caused by unsatisfactory road condition comprises 57% (for the roads outside habitation areas, as per the data from GIBDD) and about 20% of all traffic accidents (in Tatarstan – 24.5%).

Within Astrakhan Region a significant contrast is observed in the number of traffic accidents, injured and killed in them. Districts with big population and high traffic rate are distinguished (Privolzhsky and Akhtubinsky). And over 35% of traffic accidents occurs in Astrakhan (see Tables 2.9, 2.10). Most dangerous with respect to traffic safety are largest roads of the Region – Federal Road «Moscow-Astrakhan» and Volgograd-Astrakhan. The most concentration of traffic accidents is observed in the vicinity of Astrakhan (first of all, on roads Astrakhan-Zelenga and Astrakhan-Kamyzyak).

Table 2.10

Roads of Astrakhan Region with the highest rate of traffic accidents with injured and killed in 2003-2005

Road description	Number of traffic accidents with injured and killed in 2003-2005, units
1. Federal Road «Moscow-Astrakhan»	689
2. Volgograd-Astrakhan	679
3. Federal Road «Astrakhan-Makhachkala»	386
4. Astrakhan-Zelenga	173
5. Astrakhan-Kamyzyak	141
6. Astrakhan-Evpraksino	116
7. Astrakhan-Krasny Yar	90
8. Access to receiving point Nachalovo	74
9. Astrakhan-Krasnye Barrikady	61
10. Seitovka-Vantazhnoye-border with Kazakhstan	59

In accordance with the Federal Special Program "Enhancement of traffic safety in Russia" for the years of 2000-2003, one of the basic tasks is elimination and prevention of dangerous sections originating.

In Tables 2.11 and 2.12 the data is given characterizing a number and condition of bridges on public roads of Astrakhan Region as of 01.07.06. As we can see from Table 2.8, there are 177 bridges altogether on public roads of Astrakhan Region. Nearly all bridges are permanent (except for three), including 140 – reinforced concrete and 34 metal and steel and concrete. The portion of metal and steel and concrete bridges is bigger by the length (37.8%) rather than by the quantity (19.2%). Table 2.12 in fact sums up successful results of implementation of a regional program on development of bridges in Astrakhan Region.

Table 2.11

Existing bridges on public roads of Astrakhan Region and their length as of 01.07.06*

Characteristics of bridges and viaducts	Quantity		Length		Average length, m
	шт.	%	l. m	%	
1. Permanent	174	98.3	16,152.22	99.4	92.8
including:					
- reinforced concrete	140	79.1	10,010.0	61.6	71.5
- metal and steel and concrete	34	19.2	6,142.215	37.8	180.7
2. Wooden	3	1.7	99.50	0.6	33.2
3. Total	177	100.0	16,251.72	100	91.8

* - without account of federal roads,

The data given in table 2.11 shows that there are no bridges in dangerous condition in the existing system of roads, however there is big enough percent of bridges in unsatisfactory condition (18.1% of the total number and 6.5% of the total length).

Topological characteristics of the road network are related to the damage resulting from breakdown of one of road sections in case if there is no reliable alternative way (so called "Shteyner's bridges"). Specific reasons and measures for elimination of dangerous sections are to be considered in each case separately in the process of design and operation.

Classical example of «Shteyner's bridges» is observed on the road network in Enotaevsky district where between two parts of the district separated by Volga only one ferry crossing exists. And even construction of an additional bridge in the area of village Vladimirovka in principle will not change low reliability of the road networks.

The data on distribution of bridges over the territory of Astrakhan Region are given in Table 2.13. Due to big natural difference of districts' territories, their number vary significantly. E.g., 41 bridges out of 177 are in Krasnoyarsky district, whereas in Enotaevsky and Chernoyarsky districts there are no bridges on territorial roads. In addition to Krasnoyarsky district, the most number of bridges in both satisfactory and unsatisfactory condition is in Volodarsky district (32 out of 36 pcs.).

Table 2.12

Evaluation of bridge condition on public roads of Astrakhan Region as of 01.07.06*.

Evaluation of the condition	Length, l. m	Quantity, units	%	
			of total length	of total quantity
Total, including	16,251.72	177	100	100
- unsatisfactory	1,050.36	32	6.46	18.1
- satisfactory	11,573.039	102	71.21	57.6
- good	3,628.321	43	22.23	24.3

* Without account of federal roads. As per the data of the Ministry of Construction and Road Sector in Astrakhan Region.

Table 2.13

Distribution of bridges on public roads per districts of Astrakhan Region*

District	Total	Number of bridges						
		as per material			Condition**			
		Permanent			wooden	1	2	3
		reinforced concrete	steel and concrete and metal					
Akhtubinsky	4	4	0	0	1	3	0	
Volodarsky	32	26	8	2	4	25	7	
Enotaevsky	0	No						
Ikryaninsky	20	17	2	1	8	8	4	
Kamyzyaksky	27	19	8	0	10	15	2	
Krasnoyarsky	41	34	7	0	7	27	7	
Limansky	10	10	0	0	3	5	2	
Narimanivsky	7	5	2	0	0	4	3	
Privolzhsky	26	20	5	0	10	11	4	
Kharabalinsky	6	4	2	0	0	5	1	
Chernoyarsky	0	No						
Total	177	140	34	3	43	102	32	

* Without account of federal roads. ** 1 - good, 2 - satisfactory, 3 – unsatisfactory.

Table 2.14 lists the results of calculation of *potential* financial damage caused by breakdown of some, most dangerous, sections of roads with daily damage over 0.6 mln. rubles per districts of Astrakhan Region. As shown in the Table, maximum damage within one district is reached in Kharabalinsky district (each day of «downtime» of the section «22.junction. Volgograd-Astrakhan - Kharabali-Biriuchij - 36.Kochkovatka (Vostok)» costs 5.36 mln. rub.). In Astrakhan Region most significant losses will occur in case of breakdown of sections on Road «Volgograd-Astrakhan» and Federal Road «Moscow-Astrakhan».

Table 2.14

Potential damage caused by disorganization of life in the districts due to breakdown of most topologically dangerous road sections (at daily damage of more than 600 thousand rubles, but not less than one section in each district)

Nos.	Road section (numbers of section end points)	Integral transport availability, h		Daily financial damage (thousand rub.)
		prior to breakdown	after breakdown	
District: Akhtubinsky				
1	23.Korochin -- 51.junction. access road to Lopin - Kapoustin Yar-Sadovoye	1.795	2.434	249.8
District: Volodarsky				
2	141. characteristics variation. access road to road Astrakhan-Marfino -- 65.Dianovka	1.301	3.312	1132.2
3	118. junction. Volodarsky-Koshevanka - access road to Novinka -- 117. junction. Volodarsky-Koshevanka - access road to Toulouganovka	1.301	2.931	917.7
4	105. junction. access road to Koshevanka - Volodarsky-Koshevanka -- 116.junction. Volodarsky-Koshevanka - access road to monument to Kourmangazy	1.301	2.462	653.6
District: Enotaevsky				
5	61. junction. Federal Road Moscow-Astrakhan - access road to village Vetlyanka -- 62. characteristics variation. access road to Federal Road Moscow-Astrakhan	1.763	8.317	2582.3
6	36.junction. access road to Enotaevka - Federal Road Moscow-Astrakhan -- 68.junction. access road to Fedorovka - Federal Road Moscow-Astrakhan	1.763	6.294	1785.2
7	55.junction. Federal Road Moscow-Astrakhan - access road to Vladimirovka -- 36.junction. access road to Enotaevka - Federal Road Moscow-Astrakhan	1.763	5.885	1624.1
8	69.junction. Federal Road Moscow-Astrakhan - access to Kosika -- 5.Vostok	1.763	5.334	1407.0
9	68.junction. access road to Fedorovka - Federal Road Moscow-Astrakhan -- 66.junction. Federal Road Moscow-Astrakhan - access road to Mikhailovka	1.763	5.292	1390.4
District: Ikryaninsky				
10	108. characteristics variation. access road to Federal Road Astrakhan-Makhachkala -- 22.Anatoly Zverev	1.076	4.511	1861.8
11	7.Bakhtemir -- 21.Algaza	1.076	2.516	780.5
District: Kamyzyaksky				
12	130.junction. Kamyzyak-Kirovsky - Kamyzyak-Travino -- 65.junction. Kamyzyak-Karatat - Kamyzyak-Kirovsky	0.783	4.696	1807.8
13	64.junction. Kamyzyak-Karatat - access road to Chapaevov -- 74.intersection [1] access road to battery farm [2] access to Brick Plant №2 [3] Kamyzyak-Karatat	0.783	3.496	1253.4
14	23.Zastenka -- 96.characteristics variation access road to road Kamyzyak-Touzoukley	0.783	2.626	851.5



Table 2.14. Continued

Nos.	Road section (numbers of section end points)	Integral transport availability, h		Daily financial damage (thousand rub.)
		prior to breakdown	after breakdown	
District: Krasnoyarsky				
15	91.junction. Seitovka-Vatazhnoye - access road to Krivoy Bouzan -- 60.junction. access road to n. Kondakovka - Seitovka- Vatazhnoye	0.972	2.088	1478.7
16	109.junction. Seitovka- Vatazhnoye - access road to Baranovka -- 65.junction. Seitovka-Vatazhnoye - access road to stitl. Per-vomaisky	0.972	2.022	1391.3
17	4.Verkhny Bouzan -- 103.junction. Volgograd-Astrakhan - Novourousovka-Bely Ilmen	0.972	1.851	1164.7
District: Limansky				
18	6.Olya -- 16.Lesnoye	0.873	2.524	571.2
District: Narimanovsky				
19	76. characteristics variation. access road to Federal Road Astrakhan-Elista -- 155.junction. Federal Road Astrakhan-Elista - access road to Soleny	1.772	3.057	686.2
District: Privolzhsky				
20	180.intersection [1] embankment of Astrakhan [2] Trousovo-Solyanka [3] Federal Road Moscow-Astrakhan [4] Astrakhan-Makhachkala-Astrakhan-Evpraksino - 3.Trusovsky district of Astrakhan	0.550	1.196	496.8
District: Kharabalinsky				
21	22.junction. Volgograd-Astrakhan - Kharabali-Biriuchij -- 36.Kochkovatka (Vostok)	1.385	7.589	5360.2
22	7.Zavolzhskey -- 39.junction. Volnoye-Zam'yany - Volgograd-Astrakhan	1.385	6.435	4363.2
23	34.Syskoli (Zapad) -- 13.Bougor	1.385	2.219	720.6
District: Chernoyarsky				
24	33.junction. access road to Stoupino - Federal Road Moscow-Astrakhan -- 60.junction. Federal Road Moscow-Astrakhan - access road to Kalnovka	1.150	6.454	2301.9
25	6.Zoubovka -- 14.MTФ Collective Farm named after Kalinin	1.150	3.423	986.5
26	28.junction Federal Road Moscow-Astrakhan - access road to Baranovka -- 18.junction. access road to Chernoyarsky Brick Plant - Federal Road Moscow-Astrakhan	1.150	3.359	958.7

Network characteristics of provision Astrakhan Region with roads

In order to enhance validity of decisions on investment policy and with the account of Minimum Transport Standard requirements, evaluation was carried out of acuteness of transport problems in each administrative/territorial unit. For this, a method was used based on a number of parameters informally considering system-defined character of consuming road services, presence of other types of transport, specifics of the network outline and a number of other factors.

Analysis of condition of the transport system in Astrakhan Region is given in Table 2.15.

Integral transport availability, measured by average weighted spending of time required for getting one point to any other point of the district. It is calculated separately for freight and passenger

transportation and includes specifics of outline and technical condition of not only road network, but also all existing transportation links. ITA is used instead of non-adequate «density» parameters of road network of the type as Engel coefficient, Goltz coefficient, etc.

Table 2.15

Network characteristics of roads in Astrakhan Region

District	Coefficient of technical reliability of road network (standard =1)		Average technical speed on roads, km/h		Coefficient of probability of links (standard – 0,999)	
			For freight transportation		Freight transport	Passenger transport
	for freight transportation	for passenger transportation	Standard	Actual		
Standard						
Akhtubinsky	0.35	0.21	83.79	28.02	0.78	0.44
Volodarsky	0.32	0.20	82.38	25.56	0.69	0.45
Enotaevsky	0.40	0.36	94.97	35.72	0.80	0.64
Ikryaninsky	0.32	0.28	87.11	28.13	0.71	0.59
Kamyzyaksky	0.44	0.27	82.15	38.17	0.80	0.50
Krasnoyarsky	0.43	0.30	89.62	37.79	0.79	0.54
Limansky	0.43	0.32	84.60	38.69	0.86	0.65
Narimanovsky	0.37	0.24	92.05	33.20	0.79	0.52
Privolzhsky	0.41	0.41	90.74	38.05	0.84	0.71
Kharabalinsky	0.36	0.27	95.27	29.54	0.76	0.55
Chernoyarsky	0.44	0.33	93.44	37.82	0.83	0.58
Region as a whole	0.38	0.28	88.56	33.39	0.80	0.56

ITA is an analogue of the parameter of road network functioning reliability and, to this respect, it represents a special interest for road users, as for them it is advantageous to pay not for kilometers of newly built or reconstructed roads (cost characteristics of used resources), but for real decrease in time spending for freight or passenger transportation.

There is no unified standard of ITA for a regional road network - it is designed for each particular region (district, kraj). For the lowest level of administrative unit, like a rural administration district, the standard is close to constant: 2.4 h (net time of traffic without stops and waiting) for freight transportation and variable (depending on existing system of settling and a set of services in settlements) – for passenger transportation (it varies around 1.8 hour).

The standard for freight transportation was defined based on ability of a driver to get within one district within one work day (7 h) to the most remote point of a district and come back. Thus, for one way he can spend not more than 3.5 h, and without stops and time spent for loading/unloading operations – 2.4 h.

The standard for freight transportation per districts of Astrakhan Region is not much and varies from 0.47 (Privolzhsky) to 1.58 h (Akhtubinsky), due to inclination of majority of settlements to arterial transport system.

General condition of transport environment for freight transportation is reflected on Map 3.

Table 2.15. Continued

Parameter	Integral transport availability per all types of communications, h				Percentage of network provision with all types of transport	Portion of roads in united transport system	
	freight transportation		passenger transportation			freight transportation	passenger transportation
	Norm	Actual	Norm	Actual			
Akhtubinsky	1.55	1.63	1.46	2.08	95,01	84.16	87.24
Volodarsky	0.97	1.30	1.57	1.49	74.85	100.00	100.00
Enotaevsky	1.43	1.76	1.59	1.27	81.23	100.00	100.00
Ikryaninsky	0.81	1.08	1.37	1.00	75.57	100.00	100.00
Kamyzyaksky	0.82	0.78	1.11	1.75	104.28	100.00	100.00
Krasnoyarsky	1.01	0.97	1.53	1.01	104.21	66.09	89.07
Limansky	1.00	0.87	0.88	1.00	114.50	88.00	89.83
Narimanovsky	1.57	1.77	1.78	2.47	88.84	84.89	88.62
Privolzhsky	0.47	0.55	0.51	0.45	84.56	89.71	89.93
Kharabalinsky	1,11	1,75	1,18	1,38	63,67	78,71	84,96
Chernoyarsky	1.06	1.15	1.21	1.28	92.45	100.00	100.00
Region as a whole	3.23	3.80	2.89	2.91	85.05	83.93	86.53

On the map (№2) of integral transport availability with respect to passenger transportation within each district we can clearly see standard zones (pale blue color). Visually, the more they cover inhabited territory (spots are habitation areas), the better is transport and road environment of vital activities. And, on the contrary, the more a district is covered with dark paint – the worse. A good example is west of Narimanovsky district where availability exceeds 12 hours. But this should not be a matter of concern, as these are not inhabited territories, whereas similar situation at the southern and northern borders of Akhtubinsky district is a matter of making decisions.

In overwhelming majority of districts, both for freight transportation, and passenger transportation, actual value of ITA is more than standard (i.e. worse). The exception is only 3 districts (Kamyzyaksky, Krasnoyarsky, Limansky) for freight and 5 districts (Volodarsky, Enotaevsky, Ikryaninsky, Krasnoyarsky, Privolzhsky) for passenger transportation. Hence, only Krasnoyarsky district is in conformity with standard values of both freight, and passenger integral availability.

For freight transportation, the difference between actual and standard values of ITA is much less than for passenger one. For freight transportation it comprises not more than 58% (except for Kharabalinsky district).

Regarding standard of ITA for passenger transportation, here the problem district is still Akhtubinsky where actual value is worse than standard by 42%.

Percentage of territory provision with all transport system or just road network – it is a basic characteristic of the quality of region road network which is defined as a ratio between actual average weighted spending of time for transportation (freight and passenger) and that of standard.

A network of communications (roads) is considered to be standard if it is of such technical reliability and configuration with which spending of time in traffic (without stops and waiting) from one point to any other, as already stated above, in the low level administrative unit do not exceed variable standard.

Floating standards are related to high specific weight of regular connections, i.e. no matter how large is the territory of a low-level administrative area, all its residents need more or less regu-

lar consuming of services of guaranteed minimum (specialized medical care, cultural and social-service institutions, repairs of complicated domestic equipment, etc.).

However, it is possible to get these services only in some habitation areas. For the region as a whole, where regular social and transport connections are replaced with special and occasional, the standard is even more so variable.

The network is considered to be a 100-% network if, on each section of it, it is possible to drive with average standard technical speed, depending on the status of settlement which this section adjoins. Maximum possible speed for passenger transportation is 130 km/h, for freight transportation - 88.56 km/h (on sections adjacent to major habitation areas). In this case the network has an ideal structure (outline) which, once again, depends on the system of settling, as well as the status of settlement.

The network of all types of transport in the Region is provided to full extent only in 3 districts (Kamyzyaksky – 104%, Krasnoyarsky – 104% and Limansky – 115%), where actual percentage of provision with the network exceeds the standard. In the rest of districts this parameter is lower and comprises from 76% to 100% of the standard. As a standard for Astrakhan Region, recommended value of Minimum Transport Standard could be chosen (Table 1.1), i.e. over 100%. As we can see from the Table, actual level of transport availability (79%) is an obvious deficiency of road provision in the Region as a whole. Map 3 shows integral transport availability for freight transportation over the Region as a whole. From the map we can see that standard zone is displaced from the centre of the Region to the north, and its size leaves much to be desired.

The rest parameters of transport provision have intermediate character and represent interest from the viewpoint of analysis of the reasons for insufficient reliability of the transport system, including its technical and configuration part.

Portion of roads in transport system (with respect to the input into ITA). Analysis of road portion in the transport system showed that in the majority of districts in Astrakhan Region the portion of roads in the network measured by the input into ITA vary from 70% to 100% (except for Krasnoyarsky (66%)), and in 5 out of 11 districts there are no other types of transport, i.e. the role of roads in formation of normal transportation conditions is determinant (river ways were excluded from analysis for the reason of their seasonality and, in general, minor role in formation of transport environment, i.e. decrease of integral transport availability).

Figure 2.4. for the first time represents input of roads of various jurisdiction into the quality of transport environment. If with respect to conditions for freight transportation the portions of federal and territorial roads are nearly equal, then by conditions for passenger transportation territorial roads dominate (79%).

Similar to that, using system «Geogracom 5W+», it is possible to define a rating of individual roads in the existing network, including rating by their input into the quality of transport environment under condition of their standard maintenance and rehabilitation. Below, in table 2.16, a list of roads is given in the sequence of their role in the life of the Region lessening.

From the Table one can clearly see how much the roads differ from one another by their role, and how much their input into establishment of comfortable economic and social environment does not coincide. E.g., the first three roads provide over 50% of the quality of transport environment for freight transportation and only 20% for passenger transportation (the numbers are given in the Table cumulative). The last three columns eloquently demonstrate priorities of investments into certain roads. E.g., roads Volgograd-Astrakhan and Astrakhan-Makhachkala at 7.5% costs for maintenance and rehabilitation provide over 33% of total economic effect and only less than 10% of social effect. Road Akhtoubinsk-Nizhny Baskouchak at the costs of about 1% (51.62-50.67) provides also about 1% of total economic effect (34.99- 29.41).



Figure 2.4

Current input of roads of various jurisdiction into the quality of transport environment (by social (saving of spare time) and economic (ITA for freight) criteria).

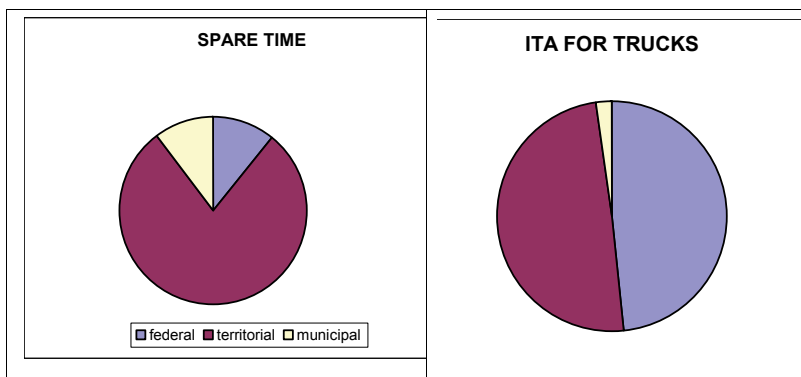


Table 2.16

Financial rating of roads in the existing network by maintenance and rehabilitation (fragment)

№	Description of roads	Portion in formation of existing road network of districts		Portion of effects growth at standard maintenance and rehabilitation		Average yearly costs, %
		per freight transportation, %	per passenger transportation, %	economic effect, %	social effect, %	
1	Volgograd-Astrakhan	7.05	3.01	17.11	5.65	17.95
2	Astrakhan-Makhachkala	20.00	8.84	33.04	10.19	17.53
3	Moscow-Astrakhan	50.17	20.40	48.42	15.22	34.59
4	B.Seitovka-Vatazhnoye-border with Kazakhstan	56.34	24.03	54.82	18.09	35.97
5	Astrakhan-Krasnyi Yar	56.62	24.15	57.58	18.67	37.15
6	Astrakhan-Marfino	58.67	25.01	59.96	19.45	38.43
7	Astrakhan-Zelenga	60.08	25.91	62.24	21.72	41.40
8	Astrakhan-Elista-Stavropol	65.19	27.79	64.25	22.94	45.14
9	Astrakhan-Travino	67.48	28.84	66.05	24.14	47.07
10	Astrakhan-Kamyzyak	67.93	29.02	67.82	25.19	48.57
11	Alcha-Maly Aral	68.35	30.65	69.37	26.48	48.91
12	Novourousovka-Bely Ilmen	68.75	31.19	70.67	26.91	49.60
13	Access from Road B.Seitovka-border with Kazakhstan to village Krivoy Bouzan	68.95	32.53	71.85	27.96	49.62
14	Volnoye-Zamiany	69.08	34.19	72.94	29.19	50.57
15	Henrie Barbousse Str. (town Astrakhan)	69.22	34.21	74.00	29.41	50.67
16	Akhtoubinsk-N.Baskouchak	71.12	37.00	74.99	34.94	51.62
17	Kamyzyak-Touzoukley	73.67	39.59	75.92	36.85	52.37
18	Astrakhan-Stavropol (70 km)- Bourouny-Kizlyar	74.85	42.50	76.69	38.77	55.36

Coefficient of technical reliability represents a ratio between average weighted by sections traffic speeds of transport (actual and standard). Coefficient of technical reliability per districts of Astrakhan Region varies from 0.31 (Volodarsky district) to 0.47 (Kamyzyaksky district) for freight transportation and Akhtubinsky (0.20) and Volodarsky (0.20) districts for passenger transportation. This average coefficient for Astrakhan Region equals 0.38 (for freight) and only 0.28 for passenger transportation. Such low value of this coefficient for roads is explained by really low consumer's qualities of paved roads due to their chronic insufficient rehabilitation.

The fact that technical reliability of freight transportation is higher than reliability of passenger transportation within one and the same network speaks about insufficient utilization of even normal road conditions by public passenger transportation.

Coefficient of probability of links shows ability of the network to perform its functions to full extent in case of its individual sections breakdown. The more there are cycled network sections-links and the higher their coefficient of reliability, the better this parameter. The value of this parameter for Astrakhan Region as a whole is 0.80 which is lower than standard. None of the districts in Astrakhan Region has this coefficient value close to that of standard (0.999 both for freight and passenger transportation), i.e. outline of public road network in the Region is not sufficiently reliable.

Actual value of coefficient of probable links for passenger transportation is much lower than standard. Except for Privolzhsky district (0.71) in all districts of the Region the value of coefficient is less than 0.7. In general, in Astrakhan Region the value of this coefficient of probability of links for passenger transportation equals 0.56.

SUMMARY:

1. To-date the network of public roads in Astrakhan Region includes 6,357 km, the biggest portion of them (46%) is departmental and municipal roads.
2. Minimum required length of public roads of federal, territorial and municipal jurisdiction makes 4,270.5 km. Whereas at present their length does not exceed 2,803 km. Hence, to-date Region's demand in roads with major pavement is satisfied by 62%, simplified – by 51.4%, whereas there are several times more roads with transitional pavement, compared to the required quantity.
3. Currently the problem of available links between habitation areas by way of paved roads is still not solved in all districts of the Region (there are 129 such habitation areas), which drastically limits the quality of life of the population.
4. Forward increase in the fleet of vehicles in Astrakhan Region compared to the growth of road financing results in significant traffic accident rate the most number of which occur on Federal Road «Moscow-Astrakhan» and road Volgograd-Astrakhan. Maximum potential daily financial damage, which can arise in case of one of the network sections breakdown, exceeds 5 mln rub. (in Kharabalinsky district).
5. In the majority of districts in the Region a value of integral transport availability – one of the most important indicators of the quality of transport environment – is worse than standard values. As a result, existing network, with regard to opportunities of speed modes, is 2.5 times behind the standard, and reliability of the network outline is one of the most critical in the European part of the Russian Federation.

