

A System of Comprehensive Technical and Economic Evaluation of Standardized Design Documentation

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Abstract. One of the most important tasks of Russia's Ministry of Construction is the compilation of the registry of building designs approved for repeat use in public facilities construction. When completed, this registry will facilitate the design process and reduce building-related costs and construction timeframes. The existing guidelines, standards and regulations applicable to repeat designs are analyzed. Challenges hampering the broader use of repeat designs are assessed and possible solutions are suggested. The article presents a set of criteria for the selection of the most efficient designs recommended for repeat use (technical and technological evaluation, investment attractiveness, operation and maintenance costs estimate).

1 Introduction

One of the ways to encourage permanent construction of public facilities is the use of standardized designs (designs approved for repeat use, repeat designs). Russia's Ministry of Construction, Housing and Utilities is currently working on the Registry of Standardized Designs. So far, more than 200 designs have been added to the Registry. The following types of facilities are represented: residential, administrative, educational, healthcare, sports facilities and venues, cultural facilities, miscellaneous [8].

2 Comprehensive Technical and Economic Evaluation of Standardized Designs

To be added to the Registry, the design must fulfill the following requirement:

- The structure and the contents of the design documentation must be in compliance with the Russian legislation.
- The design must have a state expertise approval issued no more than 7 years ago;
- The design documentation must be in compliance with by-law land use and development regulations for the site where the design is to be repeated (including dimensional limits for permanent construction, e.g. the height of the building).

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- Its repeat use must be in compliance with the intellectual property rights in accordance with the civil legislation of the Russian Federation, i.e. if the design is to be repeated by anyone other than the owner of the rights, there must be a legal basis for it (e.g. a license agreement, a contract of uncompensated use etc.).
- The repetition on a new site must be possible and appropriate with regard to topography [2,8].
- Such designs must have the best performance in terms of:
 - Building-related costs and service life estimate;
 - The ratio of net floor area to gross floor area;
 - Energy performance (resources consumption per unit of power necessary for the operation of the building);
 - Innovative architectural, engineering, technical, technological and/or organizational solutions.

All designs added to the Register must have a portfolio containing sufficient information to help investors and developers get a full picture of the design and its main technical and economic parameters [1,8].

However, the analysis of the design portfolios published by the Ministry of Construction raises some questions and ambiguities that need to be addressed. Table 1 shows part of the Registry.

Table 1. Registry of Standardized Designs.

No (type, section, design no)	Section	Design
1	2	3
1.1	Section 1. Low-rise residential buildings (manors) and townhouses-	
1.2.1	Section 2. Mid-rise residential buildings (3-5 storeys)	A 24-flat residential building for orphans in the town of Nikolaevsk, Volgograd region
1.2.2	Section 2. Mid-rise residential buildings (3-5 storeys)	A 24-flat residential building in Iglino, Iglinsky administrative and municipal district, Republic of Bashkortostan
1.2.3	Section 2. Mid-rise residential buildings (3-5 storeys)	A residential building for the disabled, orphans and families with disabled children in the city of Khabarovsk
1.3.1	Section 3. Multi-storey residential buildings (6-10 storeys)	A residential building at 15a Montclair St, 112th district of the city of Cherepovets, Vologda region
1.3.2	Section 3. Multi-storey residential buildings (6-10 storeys)	A 108-flat residential building in Levitana St
1.3.3	Section 3. Multi-storey residential buildings (6-10 storeys)	An apartment building at 1 Vishnevaya St, in the Central district of Sochi
1.3.4	Section 3. Multi-storey residential buildings (6-10 storeys)	An apartment building at 2 Vishnevaya St, in the Central district of Sochi
1.3.5	Section 3. Multi-storey residential buildings (6-10 storeys)	A residential building in Kirpichnaya St, in the city of Murmansk
1.4.1	Section 4. High-rise residential buildings (11-16 storeys)	An 88-flat residential building
1.4.2	Section 4. High-rise residential buildings (11-16 storeys)	A residential building for the artistic personnel of regional theatres and other entertainment establishments in the city of Krasnoyarsk

1.5.1	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS1-R type (a 84-flat central section with a 1-1-1-3-3 floor plan)
1.5.2	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS2-R type (a 84- flat central section with a 1-2-2-3 floor plan)
1.5.3	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS3-Tl type 1 (a 67-flat left-end section with a 2-2-2-2 floor plan)
1.5.4	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS3-Tp Type (a 67-flat right-end section with a 2-2-2-2 floor plan)
1.5.5	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS4-Tp type (a 84-flat bend section with a 1-1-1-3-3 floor plan)
1.5.6	Section 5. High-rise residential buildings (>16 storeys)	A 17-storey large panel residential building, BS7-R type (a 84-flat bend section with a 1-1-1-1-2-2 floor plan)

Table 2. General design information.

No (type, section, design no)	Region	Gross floor area, sq. m.	Net floor area, sq. m.	Designed in	State expertise approval issued in
1	2	3	4	5	6
1.1	Section 1. Low-rise residential buildings (manors) and townhouses				
1.2.1	Volgograd region	223.50	832.20	2014	2014
1.2.2	Republic of Bashkortostan	1492.20	1 143.36	2011	2012
1.2.3	Khabarovsk region	4260.00	2 905.20	2013	2014
1.3.1	Vologda region	4894.60	3 510.36	2014	2014
1.3.2	Kaliningrad region	8813.11	n/a	2012	2012
1.3.3	Krasnodar region	6771.80	4 923.00	2013	2014
1.3.4	Krasnodar region	6771.80	4 923.00	2013	2014
1.3.5	Murmansk region	6720.00	n/a	2012	2012
1.4.1	Kaliningrad region	6090.88	n/a	2012	2012
1.4.2	Krasnoyarsk region	10753.21	7 494.23	2014	2014
1.5.1		n/a	n/a	2011	n/a
1.5.2		n/a	n/a	2011	n/a
1.5.3		n/a	n/a	2011	n/a
1.5.4		n/a	n/a	2011	n/a
1.5.5		n/a	n/a	2011	n/a
1.5.6		n/a	n/a	2011	n/a

Table 3. Estimated construction costs.

No (type, section, design no)	Year of commissioning	Estimated construction costs at basic prices in 2001, in thousand roubles	Construction costs at the time of expertise, in thousand roubles	Owner of the rights
1	2	3	4	5
1.1	Section 1. Low-rise residential buildings (manors) and townhouses			
1.2.1	n/a	3729.39	26605.64	EPROM Ltd, TIN (tax identification number) 3446012489 TRRC (tax registration reason code) 344601001 19/2 Raboche-Krestyanskaya St, 400074, Volgograd, tel. 78-11-85
1.2.2	n/a	5687.96	82270.41	State unitary enterprise Bashagroprom proekt 59 Kommunisticheskaya St, Ufa, Republic of Bashkortostan
1.2.3	n/a	24003.18	155365.09	Municipal unitary enterprise Komsomolskgor proekt project institute 41 Kirova St, 681000, Komsomolsk-on-Amur, Khabarovsk region
1.3.1	2014	13858.96	119699.71	ArkhiTEZHE Ltd TIN (tax identification number) 3528093520 TRRC (tax registration reason code) 352501001 23 Arkhangelskaya St, 162600, Cherepovets
1.3.2	n/a	29027.46	187526.39	Stroyproekt project institute Ltd, 1 Kirova St, 236022, Kaliningrad
1.3.3	n/a	26453.57	81822.26	Terem Ltd, 128B Psekupskaya St, 353290, Goryachy Klyuch, Krasnodar region
1.3.4	n/a	26453.57	81822.26	Terem Ltd, 128B Psekupskaya St, 353290, Goryachy Klyuch, Krasnodar region
1.3.5	n/a	34824.12	219268.92	JSC Murmansk promproekt, 43 Lenina St, 183038, Murmansk
1.4.1	n/a	20030.59	132694.10	SIGMA-R Ltd, 3-1 Kolkhoznaya St, 236009, Kaliningrad
1.4.2	n/a	55815.81	346821.99	JSC Krasnoyarskgrazhdan proekt town planning institute, 126 imenigazety Krasnoyarskiy Robochiy, 660095, Krasnoyarsk
1.5.1	n/a	20566.57	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow
1.5.2	n/a	18377.24	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow

1.5.3	n/a	18904.63	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow
1.5.4	n/a	18994.80	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow
1.5.5	n/a	21681.24	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow
1.5.6	n/a	20429.95	n/a	JSC Bureau of Architectural and Construction Systems and New Technologies named after A. Yakushev, 5 Mashinostroyeniya Pervaya St, 109088, Moscow

Table 4. Design specifications.

No (type, section, design no)	Portfolio link	Ministry of Construction order no, issued	Construction information
1	2	3	4
1.1	Section 1. Low-rise residential buildings (manors) and townhouses		
1.2.1	http://www.minstroyrf.ru/docs/10485/	№ 13/pr issued on 19/01/2016	Basement: 400-500 mm foundation concrete blocks. Exterior walls: 9.3 or 10.7 NF ceramic porous blocks, M100 grade concrete
1.2.2	http://www.minstroyrf.ru/docs/10486/	№ 13/ pr issued on 19/01/2016	Exterior walls: silicate brick masonry with heat-insulation and a thin layer of decorative plastering
1.2.3	http://www.minstroyrf.ru/docs/10487/	№ 13/ pr issued on 19/01/2016	Exterior walls: three-layered inner brick masonry (380 mm heavy dense clay bricks), a 270 mm layer of foam concrete (insulation), a 120 mm layer of facing masonry
1.3.1	http://www.minstroyrf.ru/docs/9102/	№ 483/ pr issued on 03/07/2015	Exterior walls: silicate brick masonry. Floors and Ceilings: pre-fabricated reinforced concrete panels. Tongue-and-groove partition walls. Prefabricated reinforced concrete stairs. Technoelast™ welding roofing material. Windows: PVC panels with double glazing. Insulated metal entrance doors, metal front doors, wooden interior doors
1.3.2	http://www.minstroyrf.ru/docs/10488/	№ 13/ pr issued on 19/01/2016	Exterior walls: pre-fabricated reinforced concrete panels. Pre-fabricated reinforced concrete floors and ceilings
1.3.3	http://www.minstroyrf.ru/docs/10489/	№ 13/ pr issued on 19/01/2016	Exterior walls: non-load-bearing two-layered masonry (120 mm standard bricks)

1.3.4	http://www.minstroyrf.ru/docs/10489/	№ 13/ pr issued on 19/01/2016	Exterior walls: non-load-bearing, two-layered masonry (120 mm standard bricks)
1.3.5	http://www.minstroyrf.ru/docs/10490/	№ 13/ pr issued on 19/01/2016	Exterior walls: concrete columns and beams with brick walls and facing masonry
1.4.1	http://www.minstroyrf.ru/docs/10491/	№ 13/np issued on 19/01/2016	Exterior walls: pre-fabricated reinforced concrete panels. Pre-fabricated reinforced concrete floors and ceilings
1.4.2	http://www.minstroyrf.ru/docs/10492/	№ 13/pr issued on 19/01/2016	Exterior walls: non-load-bearing masonry (250x120x65 heavy dense bricks, KR-r brand), a 150 mm layer of Technoroof™ insulation material. The outer layer: Kraspan™ ventilated facade system with steel composite panels Floors and Ceilings: 200 mm thick reinforced concrete panels
1.5.1	http://www.minregion.ru/upload/documents/reestr_1_7/reestr_2/30102013_r_5_1_1.pdf	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.
1.5.2	-	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.
1.5.3	http://www.minregion.ru/upload/documents/reestr_1_7/reestr_2/30102013_r_5_1_2.pdf	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.
1.5.4	-	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.

1.5.5	http://www.minregion.ru/upload/documents/reestr_1_7/reestr_2/30102013_r_5_1_3.pdf	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.
1.5.6	-	№ 457 issued on 28/10/2013	The design of the section: longitudinal and transverse large panel load-bearing walls with exterior brick walls bearing on the floor below. Interior walls: pre-fabricated reinforced heavy weight concrete panels. Floors and ceilings: solid reinforced heavy weight concrete panels. Pre-fabricated reinforced concrete balconies. The roof with the heated attic floor and an interior drainage system.

In order to analyze the data for each design, all construction costs need to be adjusted to a single price level. This article uses the adjustment indices of estimated construction costs issued by the Ministry of Construction of the Russian Federation [3].

Table 5. Estimated construction costs adjusted to 2016 prices.

No	Design	Price of 1 sq. m. in 2001, in roubles	Adjustment index	Price of 1 sq. m in 2016, in roubles	Average market price of 1 sq. m of housing accommodation in the regions of the Russian Federation in the 1st quarter of 2016, in roubles [5,6]
1	2	3	4	5	6
1	A 24-flat residential building for orphans in the town of Nikolaevsk, Volgograd region	3048	8.551	26065	31100.00
2	A residential building at 15a Montclair St, 112th district of the city of Cherepovets, Vologda region	2831	9.596	27171	35375.00
3	A 108-flat residential building in Levitana St, Kaliningrad region	3294	11.888	39155	32915.00
4	An 88-flat residential building, Kaliningrad region	3289	11.888	39095	32915.00

5	An apartment building at no1 Vishnevaya St, in the Central district of Sochi	3906	9.308	36361	34835.00
6	An apartment building at no2 Vishnevaya St, in the Central district of Sochi	3906	9.308	36361	34835.00
7	A residential building for the artistic personnel of regional theatres and other entertainment establishments in the city of Krasnoyarsk	5191	9.872	51242	39238.00
8	A residential building in Kirpichnaya St, in the city of Murmansk	5182	13.623	70597	37202.00
9	A 24-flat residential building in Iglino, Iglinsky administrative and municipal district, Republic of Bashkortostan	3812	9.076	34596	34586.00
10	A residential building for the disabled, orphans and families with disabled children in the city of Khabarovsk	5635	12.429	70032	46018.00

The analysis of the adjusted construction costs raises questions about whether it is appropriate to re-use these designs. Seven designs out of ten exceed the average market prices of housing accommodation. Note that we intentionally chose to analyze residential buildings, as the market for housing accommodation is open, active and does not allow for much correction in terms of construction costs estimation and operation requirements [7].

The compilation of the Registry of Standardized Design has the aim of reducing budget expenditures. However, the share of government budget that goes to residential construction is minimal. The main budget spendings are associated with the construction of public facilities, i.e. schools, nurseries, sports venues [4]. The analysis of the data currently published in the Registry of Standardized Designs revealed numerous inconsistencies where the designs added to the Registry fail to comply with the requirements for designs approved for repeat use as stipulated in the legislation of the Russian Federation.

3 Conclusion

It can be concluded that now there exist numerous issues regarding the contents of the Registry and the viability of the designs added to it. Below is the summary of the issues:

- ambiguity of the criteria for the selection of a design by the investor (developer);
- poor quality of the contents that stems from insufficient requirements for the portfolio of standardized designs;
- lack of legislation regulating repeat design siting, expertise and operation;

- ambiguity in terms of respecting intellectual property rights for the repeat design documentation.

Yet, standardized designs remain a powerful tool the principal benefits of which are time and cost savings. We suggest that new information be added to the Registry to reflect the following: maintenance and operations experience; design drawbacks; procedures for routine and major repairs for specific designs, construction and finishing materials. Local features, such as climate, material resources and workforce market, also need to be taken into consideration.

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