# Current Demand for Reuse of Abandoned Buildings in Yerevan and Possibilities of Applying the Economic Model

Emilia Sargsyan[a], Zara Manvelyan[b]*, Ani Sargsyan[c]

National University of Architecture and Construction of Armenia,
105 Teryan Street, Yerevan, Republic of Armenia

[a] sargsyan.emilia@inbox.ru , [b] zaramanvelian@gmail.com, [c] anisargsyan9701@mail.ru

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**Abstract.** The socio-economic problems caused by the pandemic and the war in the Republic of Armenia require urgent institutional solutions, one of which is providing housing to needy families by the state. Studies show that it can help reduce emigration, restore the demographic balance, and create jobs, especially in the construction sector. The population of Armenia, especially the newly formed families, is in a relatively unstable economic situation; obtaining an apartment is an insurmountable problem for that segment of the society. State sponsorship may be a priority in this situation. To solve the problem, it is proposed to acquire abandoned unusable areas by the state, through the reconstruction of which, with minimal resources, it is possible to have residential areas. Studies show that there are a large number of abandoned industrial structures in the city of Yerevan, which have not been exploited for years, being idle, only harming the existing urban environment [1]. There are many residential buildings that have long been expired, and if they don't have historical values, they can be reconstructed. Many institutions have been left incomplete and abandoned, which have lost funding over time [2]. Based on the studied problems, several proposals were presented - econometric model calculation, which allows comparing the demand for social housing, and the relationship between their criteria. To predict the range of demand fulfillment, the model must be built on a series of primary and secondary factors that can have a positive impact on results. The research can serve as a new applied approach, aiming to reveal socio-economic criteria, solving the existing problems of the given extraterritorial environment. You can take several steps to implement the proposed ideas to reuse unusable abandoned space in a specific environment, which will become a haven for needy families.

## Introduction

Reconstruction in urban development is seen as the demolition of an existing building or constructing a new one. This approach has prevailed in some countries for some time: demolishing, blowing up multi-story residential buildings, industrial buildings, and building new ones instead. However, after making economic calculations, they concluded that the demolition of such buildings and the construction of new ones cost more than their reuse. The Germans found a solution in the concept of "reuse," which they describe as "careful renewal" [3]. The idea of reuse has a deeper problem: it is not the profit due to reuse, but the integration of that lost area or structure into the urban environment, becoming a whole part of the city.

The spread of this idea is beneficial in two ways: on the one hand, the transformation of abandoned buildings into residential areas, and on the other hand, the issue of state intervention in the real estate market. This intervention creates a complex financial and legal situation, which increases the income from real estate. The reuse of abandoned areas is also reflected in the involvement of banks [4].

**Fig 1.** Abandoned Industrial Buildings in Yerevan


**Fig 2.** 4th class emergency buildings to be demolished in Yerevan

## Purpose of the study

The study aims to provide housing to needy families with social assistance free of charge, which can be a stimulus for reducing emigration, restoring the demographic balance, and creating jobs, especially in the construction sector.

## Methodology

The study of the demand for social housing was carried out through the econometric model, in a regressive way, which allows expressing the connection between the provision of social housing and several socio-economic criteria. A multivariate linear equation is considered. Explanatory quantities are the number of marriages ($X_1$) and average salary ($X_2$). And the explained size is the number of social housing (Y) [5]. The following coefficients are defined:

Y - Number of social housing,

$X_1$- number of marriages (%),

$X_2$ - average salary (AMD).

The following analytical tables (Tables 1, 2) were compiled based on statistical data, based on the data of the Statistical Committee.

**Table 1.**

| - | Year | $Y_i$ (%) | $X_{1i}$ (%) | $X_{2i}$ (AMD) |
|---|---|---|---|---|
| 1. | 2016 | 292 | 5,4 | 174 445 |
| 2. | 2017 | 70 | 5,1 | 177 817 |
| 3. | 2018 | 59 | 5,0 | 172 727 |

Based on the data presented in the table, the following average values were calculated to perform the calculations [8]:

**Table 2.**

| $\underline{X_1}$ | $\underline{X_2}$ | $\underline{X_1^2}$ | $\underline{X_2^2}$ | $\underline{X_{1i}X_{2i}}$ | $\underline{X_{1i}Y}$ | $\underline{X_{2i}Y}$ |
|---|---|---|---|---|---|---|
| 5,1 | 174996,3 | 26,72 | 30628186681 | 904168,2 | 742,6 | 24525341 |

The following formula can represent the study of social housing according to the regression equation:

$Y = b_1X_1 + b_2X_2 + a$,
where $b_1, b_2, a$ are unknown settings.

We will use the econometric solution, which is represented by the smallest squares. The best way to determine the parameters $b_1$, $b_2$, $a$ is the method of the smallest squares. According to the real statistical data of that method, the sum of the squares of the deviations of the theoretical data should be as small as possible [6].

$$\sum_{i=1}^{5} b_1X_1 + b_2X_2 + a - Y_{i_{b_1b_2a}}{}^2 \rightarrow min.$$

In the next step we derive the given function according to $b_1$, $b_2$, $a$ unknowns, which we equated to zero. As a result, we get three linear equations:

$$\{b_1\underline{X_1^2} + b_2\underline{X_1X_2} + a\underline{X_1} = \underline{X_1Y}\ b_1\underline{X_1X_2} + b_2\underline{X_2^2} + a\underline{X_2} = \underline{X_2Y}\ b_1\underline{X_1} + b_2\underline{X_2} + a = \underline{Y}$$

To solve this system, it is more expedient to apply Kramer's rule, which will allow to find the unknown parameters: $b_1$ $b_2$ and $a$ [7].

$$a = \frac{\Delta_a}{\Delta}, \quad (1)$$

$$b_1 = \frac{\Delta_{b_1}}{\Delta}, \quad (2)$$

$$b_2 = \frac{\Delta_{b_2}}{\Delta}. \quad (3)$$

According to the calculations we get the following values (calculation in Appendix 1).

$b_1 = -3{,}243$,

$b_2 = 0{,}0025$,

$a = -282{,}97$.

By calculating the correlation coefficients ($r_{X_1Y}$, $r_{X_2Y}$, $r_{X_1X_2}$) one can get some idea of the closeness of the correlation coefficients.

The correlation coefficients can be calculated by the following formulas:

$$r_{X_1Y}=\frac{\underline{X_1Y}-\underline{X_1}\,\underline{Y}}{\sqrt{\underline{X_1^2}-\underline{X_1}^2}\sqrt{\underline{Y^2}-\underline{Y}^2}}=0{,}3\ , \tag{4}$$

$$r_{X_2Y}=\frac{\underline{X_2Y}-\underline{X_2}\,\underline{Y}}{\sqrt{\underline{X_2^2}-\underline{X_2}^2}\sqrt{\underline{Y^2}-\underline{Y}^2}}=-0{,}1\ . \tag{5}$$

The values of the calculated coefficients show the correlation of the indicator. It follows from the mentioned values that we have a closer connection with the $X_1$ index than with the $X_2$ index. The absolute value of the correlation coefficients obtained by the regression method must be less than or equal to 1. When the absolute value is close to 1, the connection is strong, close, when the value is close to 0, the connection is weaker (absolute value is the modulus value). We get the following values from the calculations performed by the authors. $b_1 = -3{,}243$, $b_2 = 0{,}0025$, $a = -282{,}97$.

## Results

The studied model made it possible to identify equations (4,5), which we can apply using a number of factors and to understand their relationship and the impact on social housing demand.

In this model, other criteria can be used, such as population growth, migration flows, etc., which will be presented in the series of factors explained by the *Xs*, respectively.

## Conclusion

The need to reuse abandoned buildings in Yerevan is linked to the development of a social housing fund that can provide viability, improve the quality of life of the population, as well as solve socio-economic and environmental problems. In other words, there are two types of potential public benefits that can be reaped from the urban renaissance and the improvement of socio-economic problems.

The analysis using the implemented econometric model will allow us to understand the connection of a number of socio-economic criteria with the demand for social housing and use it for forecasts.

To date, very little attention has been paid to the functions of creating the necessary spatial conditions for innovation in Armenia. The huge potential of temporarily inactive, abandoned buildings in the city of Yerevan can be used as an area where the majority of vulnerable families can live.

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