# Analysis of Space Planning and Design Decisions Modern Cottage

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**Summary.** This article report analysis of the major space planning and design solutions to contemporary cottages. Also considered the land on which built or being built these cottages. Realized statistical processing of the results. Definitely, a line of research of technical parameters of the device bearing structures cottages. Inspected the 68 modern houses and land plots for them in Kiev and Kiev region. Based on these data the histogram parameters most significantly influence the choice of process parameters erection. The results of analysis are a set of body-planning and design parameters that significantly affect the technological solutions.

**Key words:** cottage, parameters, technological solutions, mechanization, statistics.

## INTRODUCTION

Improving the efficiency of the construction of modern cottages is not possible without the constant improvement of technological processes on the device support structures. Analysis, evaluation and synthesis of the features of space-planning and design decisions that have a significant impact on the change in the parameters of technology of construction of buildings allows for more detailed study of the relationship between design decisions and process parameters.

## ANALISYS OF PUBLICATION, MATERIALS AND METHODS

Features space planning and design solutions cottages disclosed in Getun G., Velikovsky L. and other [3, 15]. However, were not present statistical analyzes to address issues of mechanization and organization building processes that relate to modern cottages [8, 11, 18].

## PURPOSE AND STATEMENT OF THE PROBLEM RESEARCH

To conduct the analysis, evaluation and synthesis of space planning and design parameters of modern houses and land plots for them, which act as a factor in determining the organizational and technological parameters of the device monolithic structures [2].

## MAIN SECTION. RESULTS AND THEIR ANALYSIS

To date, in a residential building, there is similarity space planning and design solutions while maintaining and, if necessary, an individual approach to specific conditions and construction requirements [6]. For this, we used the methodology of statistical research presented in the works of Wentzel E [16] Gmurmana V. [4] and other [7, 9, 17].

To accomplish this, inspected the 68 modern houses and land plots for them in Kiev and Kiev region. Based on these data the histogram parameters most significantly influence the choice of process parameters erection [5]. According to the analysis identifies the main space planning and design characteristics (geometry, weight, quantity) of buildings [1, 10, 12]. The characteristics selected for analysis shown in Table 1.

**Table 1.** Characteristics that the affect the parameters of technological process

| Classification of characteristics | | Formalizing |
|---|---|---|
| Groups | Subgroups | |
| Space planning performance of buildings | Built area under the cottage | $S_1$ |
| | Quantity of floors | $n$ |
| | Length of the building | $L$ |
| | Width of the building | $B$ |
| Constructional features of the buildings | Floor height | $H$ |
| | Span length | $l$ |
| Geometric parameters of structures | The thickness of the supporting structure | $t$ |
| | Plinth height | $h$ |
| Geometric parameters of the land plot | Distance from the boundary of the building to the property line | $b$ |
| | Land plot area | $S_2$ |

The histogram shows that the investigated houses with area up to 200 m$^2$, from 200 m$^2$ to 300 m$^2$ and over 300 m$^2$ are in the same range with a standard deviation 63.05 (Fig. 1, *a*).

The number of floor buildings, most in the range one and two floors, is rarely possible to find 3-storey cottages. A substantial share ($\mu$ = 55 %) are the building height of two floors (Fig. 1, *b*). Reducing the frequency of buildings for more than two floors due to lack of demand for such buildings [13, 14].

To date, the Ukrainian family, on average, consists of no more than five people. In addition, for this family enough to the house was a 2-storey.

The length of the vast number of buildings ($\mu$ = 86 %) of 11 m to 20 m (Fig. 1, *c*). Width – from 9 m to 16,5 m (82 %) (Fig. 1, *d*).

The most common buildings with floor height within 2,7...3 m, constituting the bulk of the population (86 %), less common is a group of buildings with a floor height within 3,1...3,5 m (Fig. 2, *a*).

The values of the span of the building are within 4,0...10,5 m with an average of – 6,2 m (Fig. 2, *b*).

As seen in the histogram, the height of the cap ranges from 0,05 m to 2,0 m with an average value of 0,5 m and depends not only on the architecture of the building (Fig. 3, *a*).

In Kiev and region, thickness of the snow cover is 0,84 m. This is one reason why Most of the buildings, namely 87 %, has a height of 1,2 m to the cap.
The distribution of the thicknesses of the bearing members has an average value of 380 mm at a low level of variation indicates the relative homogeneity of this factor.
(Fig. 3, *b*).

The histogram, you can see that the land in Kiev and Kiev region, with an area of up to 8 acres is 41 %, from eight to twelve acres – $\mu$ = 45 % and more than 12 acres only 14 %. House with a large plot of land can be found in extremely rare because of the high cost of land (Fig. 4, *a*).

The second reason for the popularity of small and medium-sized sections depends on the unwillingness to live in extended families with relatives in the big houses.

Respectively, due to not large areas of land, distance from the boundary of the building to the property line, in most cases (83 %), limited to 10 m. More than 10 meters in just 17 % of all study sites (Fig. 4, *b*).

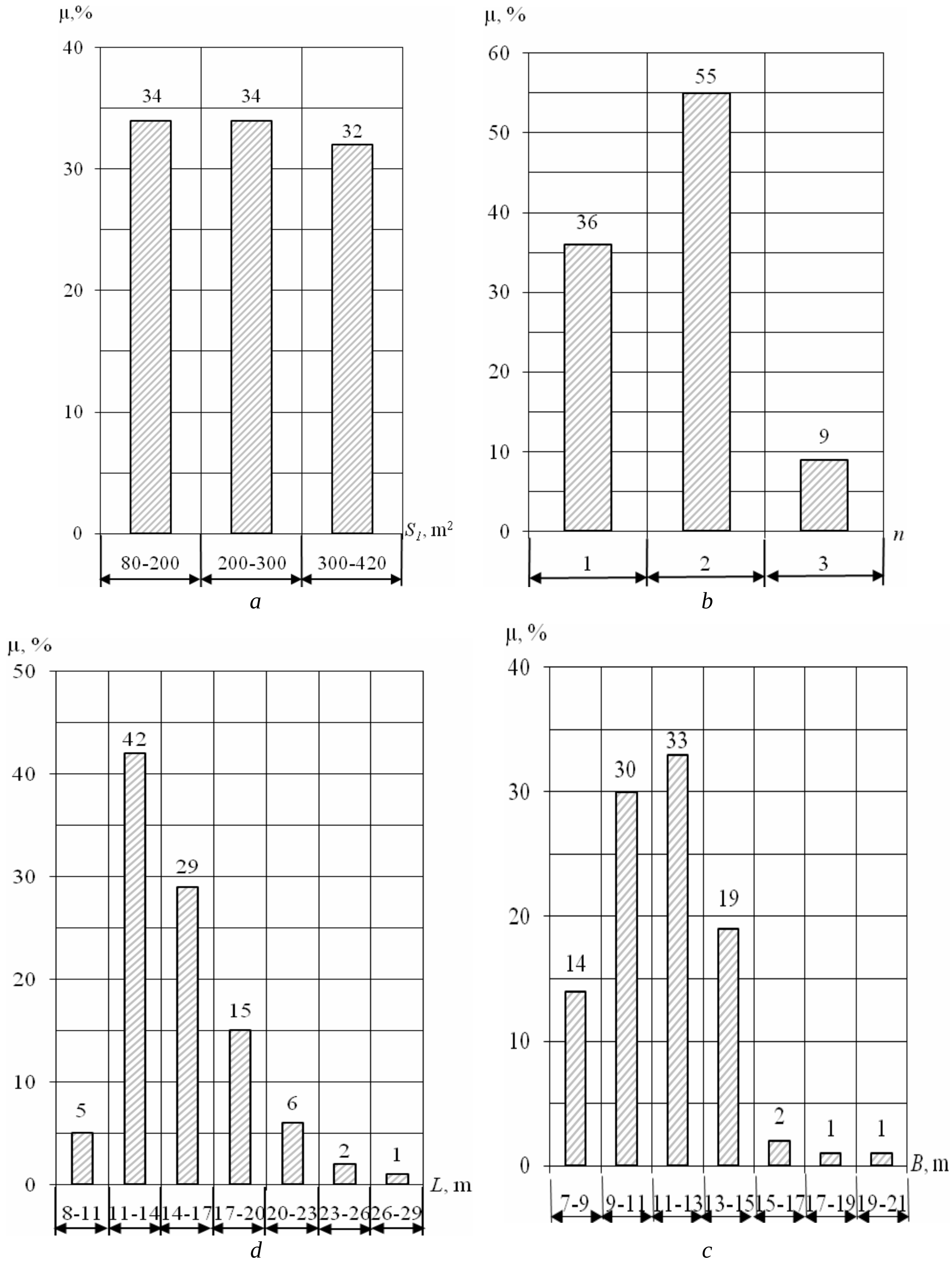



**Fig. 1.** The distribution of space-planning features:
*a* – built area under the cottage, *b* – number of storeys, *c* – length of buildings, m, *d* – width of buildings, m

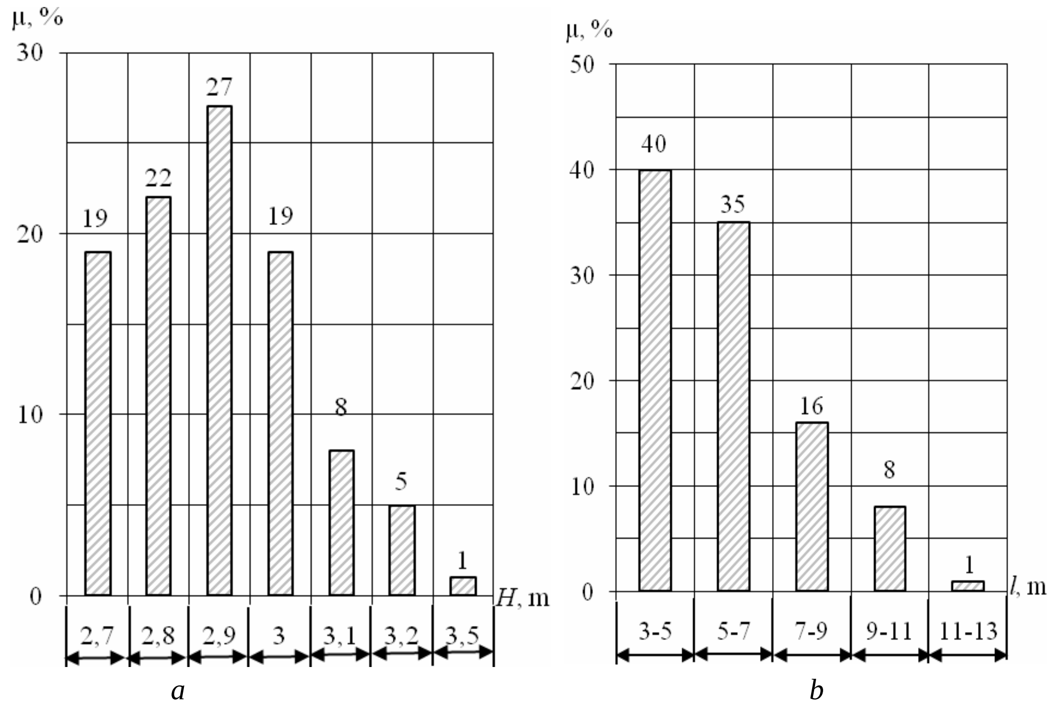



**Fig. 2.** The distribution of design characteristics:
*a* – floor-to-floor height, m, *b* – spen lenght, m

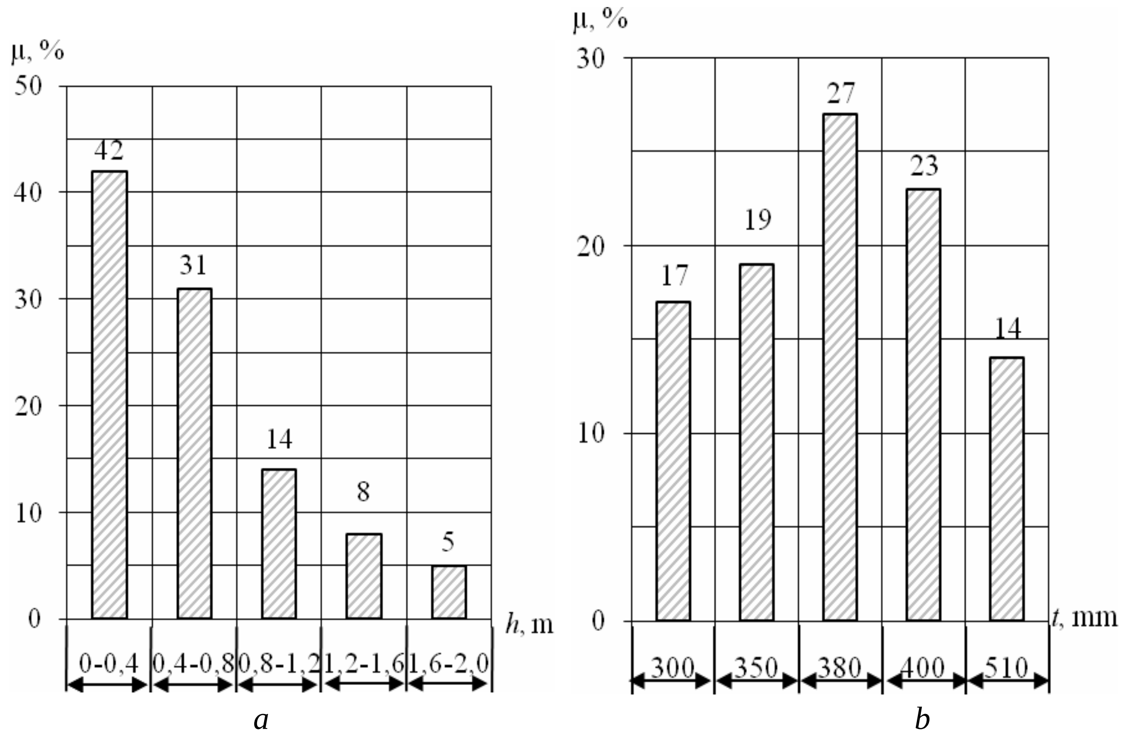
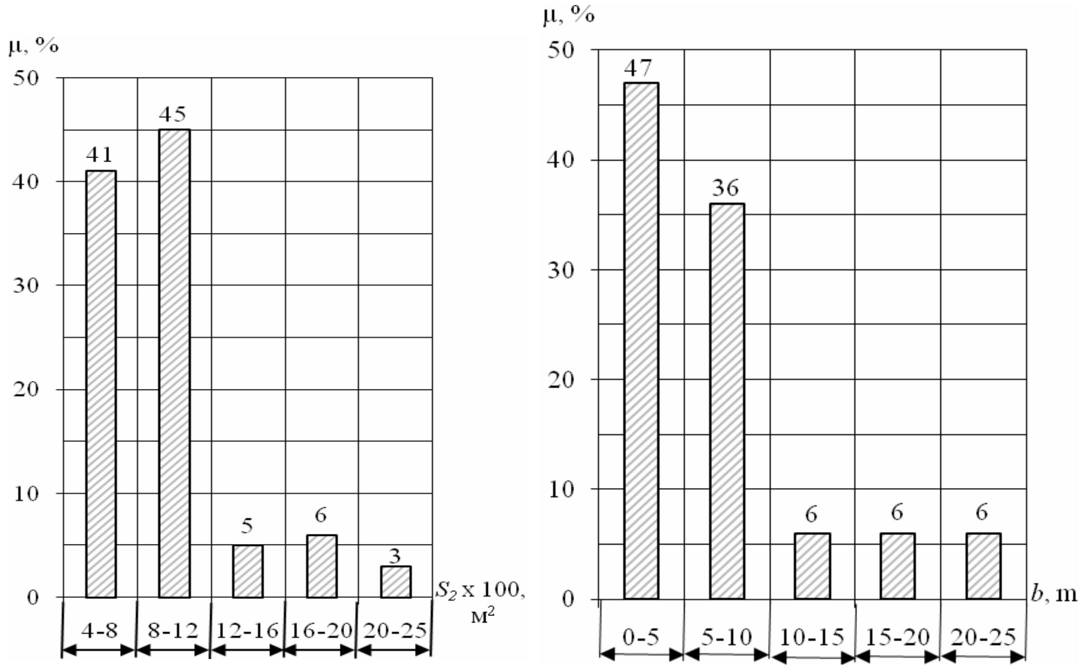



**Fig. 3.** The distribution of geometrical parameters:
*a* – plinth height, m, *b* - thickness of the load-bearing elements, mm




*a* *b*

**Fig. 4.** The distribution of geometrical parameters of land:
*a* – land area, m$^2$, *b* – free place, m

Due to the fact that 47 % of the sites has a distance between the building and the boundary portion to 5 m, such that during construction of the house is very difficult to use a crane. Therefore, it is necessary to choose the larger capacity crane and boom to could work outside the station on the road or neighboring property, which not always permitted, especially in those areas where people living.

In such areas, you need to move away from the use of a crane. It will be safer, solves the problem of transport, transportation, loading and unloading.

Using the methods of probability theory and mathematical statistics performed analysis and evaluation of the data (Table 2). For describing these variables, the following characteristics:

$m^*$ (the arithmetic mean of the sample) - evaluation of the expectation, the most important exponent of the random variable,

$\Delta_x$ (margin of error) - the range of feasible values for the error level is 95 %,

Me (median) - the value of a random variable, separating variation series into two parts of equal number of values,

σ (standard deviation) - evaluation of the scattering has the dimension of the random variable,

ν (variation coefficient) - a dimensionless quantity that is used to compare scattering variational series, the values of which have different dimensions,

$Q_1$ (lower quartile) - separates the 25 % of the population with the lowest values,

$Q_3$ (upper quartile) - separates the 25 % of the population with the highest value.

The variation in economic statistics is rarely used as an independent measure of the deviation. It is part of the expression of the variance and standard deviation. The deviation is used in some sections of statistical physics, in particular in the evaluation of the fluctuations of random thermal motion of the particles as an independent measure of variation.

Result: it computes the average linear deviation of a data set.

The average sampling error gives some representation of the error, i. e. the error with which the sample mean is the actual value of the general average. That it shows what will be the error on the average, if one makes many samples of the same volume out of one and the same population. However, in each actual sample, the error may differ significantly from the average error, i. e. there is no guarantee that the error that really was made in the particular sample study does not exceed the average error.

Therefore, it would be much more useful to know the boundaries within which the actual error in this particular sample is "almost certainly". These boundaries (limits) are specified by limit sampling error (denoted by $\delta_x$). Limiting accuracy of the sample indicates that limit, which the actual error is almost certainly will not exceed. In other words, the maximum error Δ shows really committed error in abundance, with excess (possibly very high) and thus ensures that the actual error is less than $\delta_x$.

Therefore, the required sample size increases as the square of the desired accuracy, which follows directly from the formula. As the squares of the numbers with increasing numbers themselves increase very rapidly, then increasing accuracy requirements can lead to immoderate increase of the sample size. Therefore, it is important that the requirements to accuracy of sampling is always dictated by the objectives and content of the study. In this example, such goal was to justify the meaningful scientific hypothesis.

Median function computes the value of the sample coming into the middle of the ordered sample. If the sample has an even number of the elements, then the value of the function is equal to the average of the two values that are in the middle of the ordered sample.

The median is used instead of the arithmetic mean, when extreme variants of the ranked series (the smallest and the largest variants) compared with the rest are too big or too small [17].

The deviation of the mean square in probability theory and statistics is the most common measure of dispersion of values of a random variable with respect to its mathematical expectation. With limited sample arrays, the arithmetic mean of aggregate samples is used instead of the expectation value.

The standard deviation is measured in units of the random variable and is used in calculation of the standard error of the arithmetic mean, in the construction of confidence intervals, in statistical hypothesis testing, in the measurement of the linear relationship between random variables. It is defined as

**Table 2.** Factors analysis results

| | $S_1, m^2$ | $L, m$ | $B, m$ | $n$ | $H, m$ | $l, m$ | $t, m$ | $h, m$ | $b, m$ | $S_2, m^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $m^*$ | 250,64 | 15,25 | 12,11 | 1,73 | 2,90 | 6,19 | 383,26 | 660,00 | 7,02 | 927,91 |
| $\Delta_x$ | ±13,52 | ±0,77 | ±0,63 | ±0,13 | ±0,03 | ±0,34 | ±13,16 | ±99,09 | ±1,19 | ±91,28 |
| $Me$ | 247,50 | 14,67 | 11,95 | 2,00 | 2,90 | 6,00 | 380,00 | 500,00 | 5,20 | 800,00 |
| $\sigma$ | 63,05 | 3,61 | 2,94 | 0,62 | 0,15 | 1,58 | 61,38 | 462,23 | 5,57 | 425,83 |
| $v$ | 0,25% | 0,24% | 0,24% | 0,36% | 0,05% | 0,25% | 0,16% | 0,70% | 0,79% | 0,46% |
| $Q_1$ | 191,25 | 12,76 | 9,92 | 1,00 | 2,80 | 5,00 | 350,00 | 350,00 | 3,25 | 650,00 |
| $Q_3$ | 316,00 | 16,59 | 13,85 | 2,00 | 3,00 | 7,08 | 400,00 | 1000,00 | 7,60 | 1050,00 |

the square root of variance of the random variable.

Variation coefficient is the relative value that is used to characterize the fluctuations (variability) of the sign. It is the ratio of standard deviation to arithmetic mean and is expressed as in percentage.

The coefficient of variation is used when it is necessary to evaluate the variability of object attributes that are expressed in different units.

The variation is considered weak if ν <10% if ν varies from 11-25%, the average and significant when ν> 25%.

To calculate the quartiles one must divide variation series by into two equal parts, then find the median in each of them. For example, if a sample consists of 6 elements, then the initial point of a sample is the second element and the bottom quartile is the fifth element.

## CONCLUSIONS

1. The results of analysis are a set of body-planning and design parameters that significantly affect the technological solutions.
2. To further investigate the parameters are defined as the main factors.
3. Realized statistical processing of the results. Definitely, a line of research of technical parameters of the device bearing structures cottages.

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## АНАЛИЗ ОБЪЕМНО-ПЛАНИРОВОЧНЫХ И КОНСТРУКТИВНЫХ РЕШЕНИЙ СОВРЕМЕННЫХ КОТТЕДЖЕЙ

**Аннотация.** В статье представлен анализ основных объемно-планировочных и конструктивних решений современных коттеджей, а также рассмотрены земельные участки, на которых построены или достраиваются эти коттеджи. Проведена статистическая обработка результатов. Определенно направление исследования технических параметров устройства несущих конструкций коттеджей.

В результате выполненых объектов представителей 68-ми современных коттеджей и земельных участков под них в Киеве и Киевской области, и на основании полученных данных построены гистограммы распределения параметров,. наиболее существенно влияющих на выбор параметров технологического процесса возведения. По результатам анализа определены основные объемно-планировочные и конструктивные характеристики (геометрические, весовые, количественные) зданий.

Используя методы теории вероятностей и математической статистики выполнены анализ и оценка полученных данных.

Результаты анализа стали совокупность объемно-планировочных и конструктивных параметров, которые существенно влияют на технологические решения.

**Ключевые слова:** коттедж, параметры, технологические решения, механизация, статистика.