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THE RESEARCH ON THE INFLUENCE OF THE AMOUNT OF DEFECTS AND RECLAMATIONS IN THE RANGE OF CIVIL ENGINEERING TO THE GUARANTEE PERIOD

VÝZKUM VLIVU POČTU VAD A REKLAMACÍ V POZEMNÍM STAVITELSTVÍ NA DÉLKU ZÁRUČNÍ DOBY

Abstract

The research was focused on 120 buildings from the range of housing, industrial and public in last 10 years. Stability defects, defects of roofing, technical equipment, water proofing as well as erosion of surfaces have been analysed in accordance to the type of building system (construction). This article adverts to related economical and legal aspects for the proper determination of the guarantee period. An example of statistical and graphical presentation follows. To conclude, there is a statement, that there is no technical reason for prolonging guarantee period within 57 months.

Keywords

Defects, distribution function, histogram, contract of purchase, quantile, legal aspects, median, parametrical division, Histon software, contract, guarantee period, life span.

Abstrakt

Výzkum byl zaměřen na 120 staveb občanské, bytové a průmyslové výstavby za období deseti let. Podle konstrukcí byly analyzovány defekty stability, hydroizolací, střech, technických zařízení budov a povrchy konstrukcí. Publikovaná práce poukazuje na související ekonomické a právní oblasti pro stanovení záruční doby. Na stanovené cíle a metody výzkumu navazuje příklad souhrnného statistického a grafického zpracování dat. Závěr obsahuje tvrzení, že zhruba po 57. měsíci bez rozdílu mezi technickými řešeními a typy objektů prodlužování záruční doby nemá technické opodstatnění.

Klíčová slova

Defekty, distribuční funkce, histogram, kupní smlouva, kvantil, právní aspekty, medián, modus, parametrické rozdělení, program Histon, smlouva o dílo, záruční doba, životnost.

1 INTRODUCTION

The research was focused on the frequency and time of occurence of defects of building parts in the period after the handover of the work from the cotractor to the investor (or user). Further on, on the basic causes of the most frequently occuring defects and time of occurence in time from the termination of the construction itself, i.e. from the handover of the work to the user. In the building construction business practice this is called the guarantee period. However, it does not have any fixed technical or legal rules. From the legal point of view, the guarantee period still has been defined only very generally, especially in the civil and commercial legal code.

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Claim data from the companies Unips Ostrava, a.s. and TCHAS Ostrava, s.r.o. have been used for the research. This data have been collected with the aid of complaint departments of both the companies and matched with single business cases – buildings. An Excel format data file has been made. The charts were the basis for the research along with other documentation (photographs, notifications of the occurence of a defect, records of removing of the defect and other correspondence). The data file and other documentation have been focused on the frequency and time of the occurence of the defects. Single data have been judged and arranged also according to the cathegories of buildings and constructions, where the main causes of the origin of the defects occured and were judged.

The conlusion of the research is the determination of the optimal guarantee period for objects of civil engineering with a recommendation of further technical-legal means aiming to increase the quality of building process.

2 AREAS RELATED TO DETERMINATION OF THE GUARANTEE PERIOD

2.1 Area of economics

Unlike producers of common consumer goods, building companies must solve relatively considerable costs related to eliminating of guarantee defects. Large building enterprises have reclamation departments of various sizes equipped technically and personally at significants costs.

These future costs are very difficult to estimate at the time of creating of the price for the work (offer) and each company includes various values in the price. Accounting rules for the determination of creation of reserves for future costs related to the elimination of future reclamation defects are also very ambiguous, these costs are not tax deductable and companies pay them within their common operation expenses. If there is an increase in the turnover and number of orders, this practice does not cause serious problems. However, if the trend is reverse and the number of orders decreases, serious economical problems related to reclamations also occur. Thus there is no small wonder that, under current economical depresion, some building companies avoid the elimination of reclamation defects to natural major disliking of users and investors. Their natural defense is contractual agreement on bond guarantee within the guarantee period. However this influences the price, and mainly the financial situation in the building industry.

2.2 Area of finance

A large part of the operational credit framework of building companies is limited by the range and size of bank guarantees within the guarantee period. However, this precondition applies only to a part of building enterprises on the market. These companies are enabled to substitute the financial bond, guaranteeing, from the supplier side, immediate eliminations of defects by bank guarantees. Nevertheles, small subsupplier enterprises cannot manage that and a considerable part of their assets is blocked by the financial bond guarantees mainly with the general suppliers, thus large building companies. Then there is a shortage of these resources needed to overcome problems during the crisis period.

It is not necessary to emphasize that investors, users and ordering parties put an enormous effort to determine the guarantee period as long as possible and, contrarily, building enterpreneurs are interested in the shortest possible guarantee. The demanded and thus also offered length of the guarantee period then becomes mercantile goods.

2.2 Area of commerce

It is obvious that the length of the guarantee period is commercial marketing goods. However, it becomes a misused practice, especially if it is a criterion in case of competition assesment. Excessively long guarantee period gets higher evaluation (bigger weight) than e.g. quality and mainly price. In past we have encountered as long as hundred year long guarantee periods in tenders and these offers then won over much cheaper ones with shorter guarantee period. **Still, how to detemine**

an adequate and balanced guarantee period long enough to suit investors, users and ordering parties so that it does not eliminate building enterpreneurs?

Is determination of this „optimal“ guarantee period needed at all?

Having set a recommanded adequate and balanced length of the guarantee period, a whole lot of problems will be eliminated.

A parameter for disigners will definitely occur, defining which products they are supposed to include in the project to make the products maintanance free (guarantee) period entirely clear and when the user must already maintain the building in a standard manner (an example is painting of tinsmith products, various electric equipment etc., but not technology units).

Building enterprise will have a tool at hand to set, legally said, a „usuall“ guarantee period. This reality will be an important fact in cases of legal disputes when, e.g., the length of the guarantee period is not given in the contract and valid laws are not unified.

A unified recommanded guarantee period is also a signal for banks providing financial products for developers, building companies etc., saying whether the guarantee suggested in the contract is legitimate. Determination of a recommanded guarantee period will eliminate the disunity in the commisioning of competitions (it will reduce the space for corruption) as well as the dilemma of what is or is not standard in offers from the commercial point of view. A unified parameter of the guarantee period will also enable better defining of acounting rules for reserve creation, correction sums, cost observation etc.

3 CURRENT LEGAL REGULATIONS AND GUARANTEE PERIODS IN CIVIL ENGINEERING

It is a paradox that there are no unified and inambiguous legal rules for setting of the guarantee period for the production of the civil engineering which is one of the most used products. It is very demanding to determine the guarantee period which would really be the period of time long enough to sufficiently examine whether the building (product) proves the ordered features and will supposedly prove these further on.

Civil code [1] (Act No.40/1964 Coll., valid reading) distinguishes acquirement of a thing according to the sort of contractual arrangements:

- If the product (building) is acquired according to a **purchase contract** (e.g. by the means of a developer) it falls under the section § 620 par. 1), which sets the warranty period for **24 months**. According to par. 5) of the quoted section the seller may provide a warranty exceeding the scope of the warranty stipulated in this Act. The seller shall state the conditions and scope of the warranty in the certificate of warranty.
- If the product (building) is acquired according to a **contract for work** (contract between the „ordering party“ and „supplier“) it falls under the section § 646 par. 3), which sets the warranty period for **36 months**. An implementing regulation may set out that the warranty period applicable to certain parts of the building may be shorter but no less than eighteen months.

Commercial Code [3] (Act No. 513/1991 Coll., valid reading) does not set the length of the guarantee periods. In § 563 (Part IX – Contract for work) in par. 1) it only states that the guarantee period concerning a work starts by handing over of the work. The following paragraph is essentially a reference to regulations §§ 429 – 431, which, in regulations on purchase contract, define guarantees for quality, not the length of the guarantee period.

3.1 LEGAL REGULATIONS in the Czech Republic, Slovak Republic and Poland

Current Czech and Slovak Civil Code as well as Commercial Code have a common initial reading of laws from the period of the federal state arrangement.

Civil Code [2] SR No. 47/1992 Coll. In § 620 it sets the six month guarantee period for the **purchase contract** and in § 646 par. 3 it sets 3 year guarantee period for the **contract fot work.** The amendment of the **Civil Code of SR No. 150/2004 Coll**. unified in § 620 the length of the guarantee period according to the **purchase contract to** 24 months. This makes the Czech and Slovak legislation united when judging the guarantee periods.

Commercial Code SR [4] No. 513/1991 Coll. is identical with the contents of the Czech version of the Commercial Code.

The above mentioned shows that the minimum guarantee period in the civil engineering in the Czech and Slovak Republics is **24 months**, if the ordering party and the contractor proceed according to the **purchase contract** of the civil code, **36 months**, if the ordering party and the contractor proceed according to the **contract for work** of the civil code , **18 months** for some parts of buildings, if the total guarantee period is 36 months according to the contract for work of the civil code.

The original **Building Act No. 50/1976 Coll**., which was valid for 30 years, was, after 16 changes and supplements, completely amended by the Act No**. 183/2006 Coll**., **[5]** valid since 1. 1. 2007. The original version did not include the regulation on the guarantee period in civil engineering. However, in § 100 par. 5), it at least set down the builder's obligation to *„keep the building journal for the period of **ten years** from the time when the final approval comes into force, or from the finishing of the building, if it is not subject to the final approval".*

The amended Act 183/2006 Coll. does not include this regulation (§ 157) although it has been supplemented and changed six times since it came into effect.

The regulation on the guarantee period (warranty period) is not included either in **Building Act of the Slovak Republic No. 608/2003 Coll. [6], or** in the amendment of the Polish Building Act - **Nowelizacja Prawa budowlanego [7].**

4 UTILITY CHARACTERISTICS AND GUARANTEE PERIOD

However, we use buildings 24 hours a day for several decades (even centuries) and acquiring such a product costs the consumer several hundred times more than acquiring other consumers goods. Moreover, we can assume that the consumer will probably acquire this product countlessly less often then other products. Starting from this assumption we suppose that a building is product with relatively high purchase price, comparing to other products, we will use it for the longest time (usually the lifespan of the buildings exceeds the lifetime period of the investor himself several times) and the comfort of the use quality (or the characteristics of the product for the use period) will come as near as possible to the assumed designed characteristics at the time of the acquirement (finishing) of the building.

In the Czech Republic the period in which the product must show the utility characteristics it was acquired for serves for the basic certification of the required characteristics of a product (goods). This period is called the **guarantee period**. With common products (cars, electronica etc.) this period was probably set for two years by various methods (legislative, legal, technical etc.) besides others also determined by the life span of these products or materials they are made of. This period is then extended with various products due to the business strategy of the producers. The producer very likely adapts the selection of semiproducts (rae materials) just to the fact that the product is supposed to (can) evince the purchase parameters for minimum 24 months.

The fact that there are no unified legal rules for determination of the guarantee period for one of the most commonly used products, or its use etc., is paradoxical. It is thus true that even a building may be sold without any user manual with a guarantee period of 24 months – as well as e.g. shoes (although you can find the basic rules for their using, maintanance etc. in the box). If we focus on one basic aspect of the above mentioned facts – determination of the guarantee period – we can find several social points of view to observe these issues.

It is very demanding to set the guarantee period which would really be the period to examine sufficiently that the building (product) shows the demanded, assumed characteristics and will evince these further on.

The length of the guarantee period is thus adapted, unlike the period in the Civil Code, only in the contractual relations where it becomes a „commercial goods“ without technical rules.

5 TARGETS AND METHODS OF THE RESEARCH

5.1 Formulation of the targets of the research

The answer to the above formulated inquiries will be determination of a recommanded adequate and balanced length of the guarantee period for civil engineering based on the findings of the course of the guarantee period with observed buildings. The result is due to be of defensible use in business, economical and civil relations, preventing any misuse of current technically-legal conditions. An example of such misuse is using of the length of the guarantee period as a criterion in tenders in public sphere where e.g. a hundred-year guarantee period enables winning to the offers of the highest price. Legal recovery of such an offer is more than arguable.

We can use a whole lot of views and opinions to determine an optimum guarantee period, e.g.:

- **according to the general lifespan** (from acquiring to demolition)

  We would probably set a relative part of the period;

- **according to the lilespan of the used products**

  it would be difficult to choose from a large amount of products and materials those which supposedly have essential influence on the characteristics of the building during the time of use;

- **according to the commercial rules**

  the basis would have to be statistic observation of several hundreds (thousands) of contracts and determination of the most used length. As the matter of fact, we have recorded examples on the building market of companies trying to get an order whose guarantee period was a decisive factor. With contractors setting the guarantee period for hundred or more years, the results would be rather distorted;

- **according to the custom**

  the problem of determination of the period here is that people’s customs change during the lifespan of the building. Moreover, a question arises, how long the time period in which we can say it becomes a custom is;

- **by technical research**

  by comparing of defect (reclamation) occurence at the time of the initiation of use (handover) up to the time when the faults have been stabilized, there is minimum defect occurence and, contrarily, the maintanance period becomes evident. This solutiuon appears to be the most realistic as it takes account of the characteristics of the products, technological procedures, project assignment regardless of any social, legal or other influences.

5.1 Setting of the solution methods

The base for the research is more than ten year long observation of the guarantee period including defect and reclamation record keeping of finished buildings in the time of commercially given guarantee periods. Just due to this long time of data gathering it is not possible to verify exactly on the spot itself the primal causes of the defects and they can only be assumed from the surviving

correspondence, or notes of the employees of complaint departments. This data have been classified, sumarized and processed so that the arising information was usable for the research conclusion.

There are 1670 usable data available, concerning reclamations of 120 buildings of various sort. They regard residential, civil and industrial buildings. The buildings are found in the whole Czech Republic, however, mainly in the Moravian-Silesian Region. The guarantee period of the observed buildings varied from 3 to 12 and more years. The frequency and character of the guarantee defects of the buildings, their possible repeated occurence, causes of their origin, location of their occurence etc. were examined thoroughly.

The buildings were divided into three technological groups:

civil,

residential,

industrial.

Different sorts of defects with respect of affiliation to a specific building construction of these buildings were observed next:

- defects of static parts and waterproofing;
- defects of roofs;
- defects of technical equipment - TZB;
- defects of perimeter constructions and hole infills,
- defects of surface of the indoor construction.

The frequency of defect occurence and reclamations in the time defined by the guarantee period will be observed in these groups and these types of constructions. The sort of defect and which part of the construction it occurs on was defined for the buildings with the most defects. There is a whole lot of photodocumentation available:

Fig. 1 and 2: Examples of defect implementation of a drain in a roof detail

Fig. 3: A common defect – breaches in the partition construction

6 AN EXAMPLE OF STATISTIC DATA PROCESSING

The available data were processed by statistic methods. On the basis of the statistic assesment it was possible to set the interval in which there are the most defects from the beginning of the guarantee period, interval in which no defects occur independently on the technical solution of the individual objects or their commercially set guarantee period. To fulfil the aim of the research it was necessary to set:

Period of observation:

Time „0“ – in this time, the building was handed over to the investor by an official completion certificate and the guarantee period starts tu run,

Time „93“ – max. number of intervals, in which the observation was executed from the Time „0“, i.e. 93 months (i.e. 7 years and 9 months within a ten-year interval).

Primary data – were processed so that each next month from the Time „0“ is classified with the frequency of defects (number of reclamations) in the given construction cathegory, or group of objects.

Histogram – the primary period is a graphic illustration of the quantity of probability of defect occurence on the vertical axis. The time data are stated on the horizontal axis. The statistic function with the highest correlation (tightness) coefficient towards the given histogram was then assigned to histogram of the primary data by the means of HistAn software (authors doc. Ing. Janas, CSc., doc. Ing. Krejsa and team).

Parametrical division – primary data graph – the histogram was replaced by a graph of the behaviour of a statistic function (parametrical) with the highest correlation.

The essential difference between the graphic illustrations of the primary data – histogram and parametrical division, is that histogram is limited from the left as well as from the right, i.e. it is limited by intervals in which the data were observed. Parametrical division is not limited, i.e. it is possible to make a parametrical function calculation of the probability values from Time „0“ to Time „∞“ (infinity), which enables to make prognosis also for intervals beyond the observed times of the primary research.

Mode (in the graph illustration mode) X is the most frequently occuring value in the statistic file. In the result of the research it concerned the data with the highest frequency in the given period (i.e. the most frequent occurence of defects, their number in the given period per month).

Median (in the graph illustration median) X is the value which divides the arranged statistic file in two same parts, thus a value which lies in the middle of the arranged statistic file.

For further examination it was necessary to set the research area with respect to the primary target, i.e. setting the adequate and balanced length of the guarantee period for civil engineering for individual groups of objects. The research was based on the assumption that the guarantee period is the period in which the contractors are due to eliminate construction defects, faults caused by themselves. That means using of non-compliant construction, material, technology, which later on causes defect of the respective type of construction. However, during the detailed examination of possible causes of the defect occurence, a certain amount of defects was found, which were eliminated by the contractor as reclamations. Yet, they were caused by incorrect use of the construction by the user. These defects were successfully disapproved by the contractor and they were found to account for 5% of the claimed defects.

Therefore, a quantile, which is the range of observation of data valued over 95%, was used for the further statistic observation. The remaining 5% of the total data were considered as the defects caused by incorrect use, insufficient maintenance, etc. (see the 95 % quantile graphics).

Further on, the so-called „basic characteristics“ important for our assessment are found in the „characteristics“ chart:

Mix – the arithmetic average of all found probabilities in the observed data expresses the data centroid in sigma x file, which is the determinative deviation defining the behaviour of the rising of the function.

The following example of statistic data processing is a total of all the reclamations in the residential, civil and industrial building development. The single data were processed by a defined statistic method (Histan software) for individual types of objects, for individual types of construction defects in a detailed examination. The results were analyzed and used to set an optimum guarantee period for single technological groups.

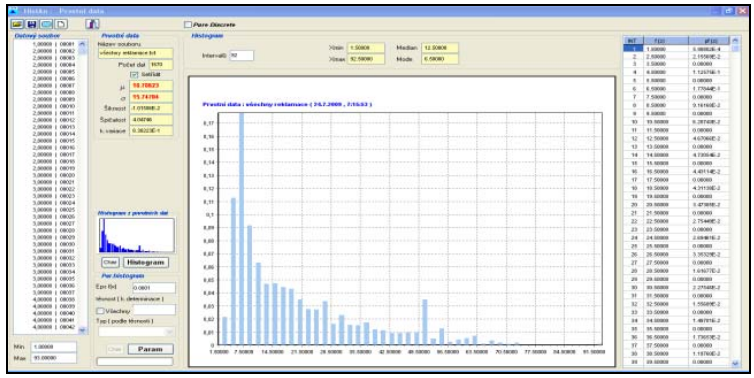

Fig. 4: Primary data

Thorough record keeping of guarantee defects of buildings recorded for the contractor by the means of applied reclamations was the basis for the primary data compilation.

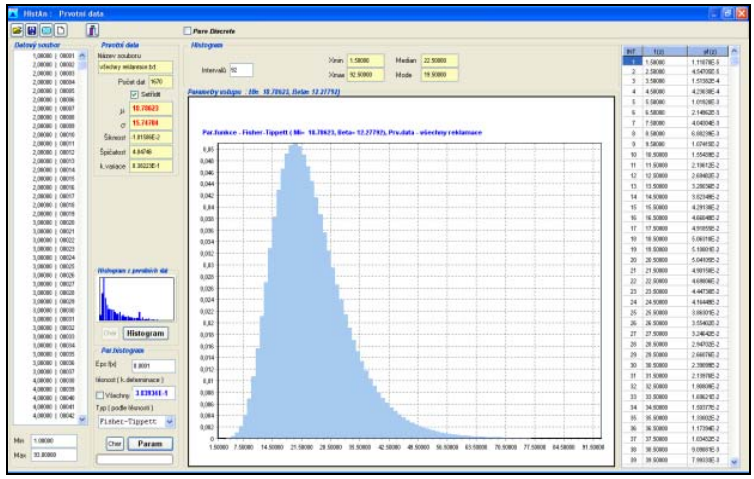

Fig. 5: Parametrical division

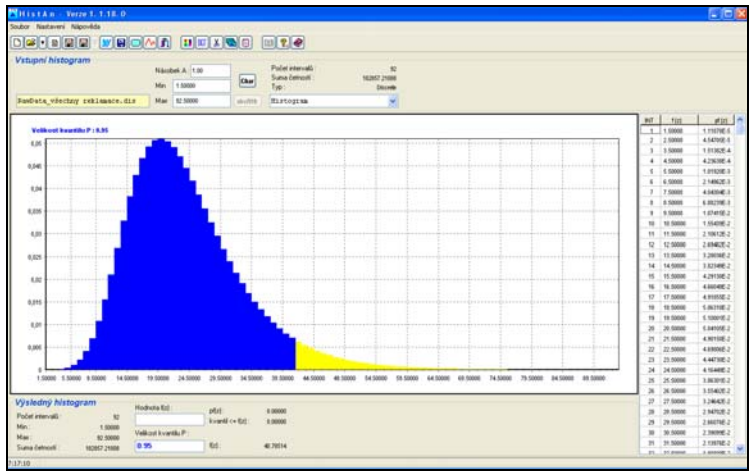

Fig. 6: Parametrical division for **95% quantile – observed time: 40, 78 months**

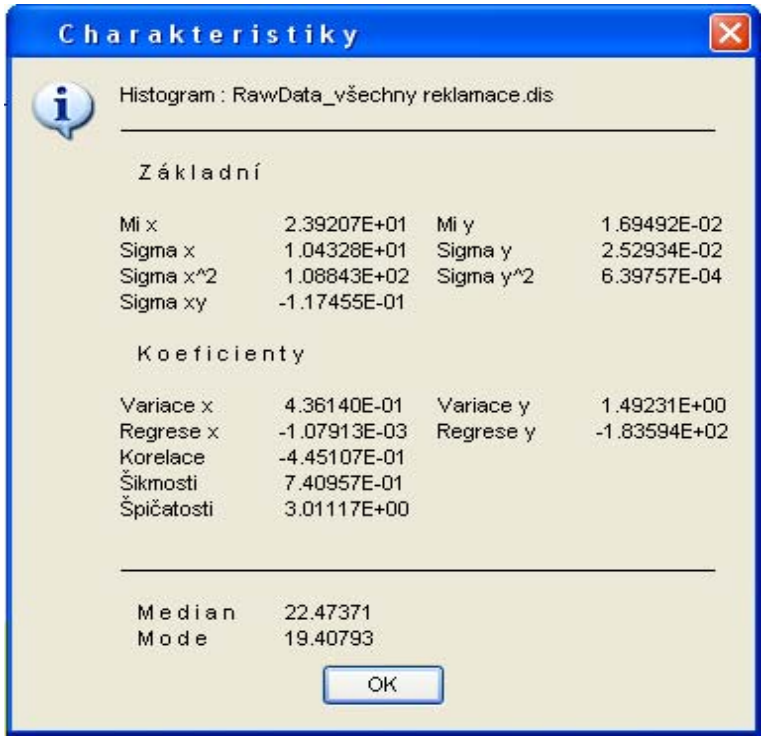

Fig. 7: Histogram of all data

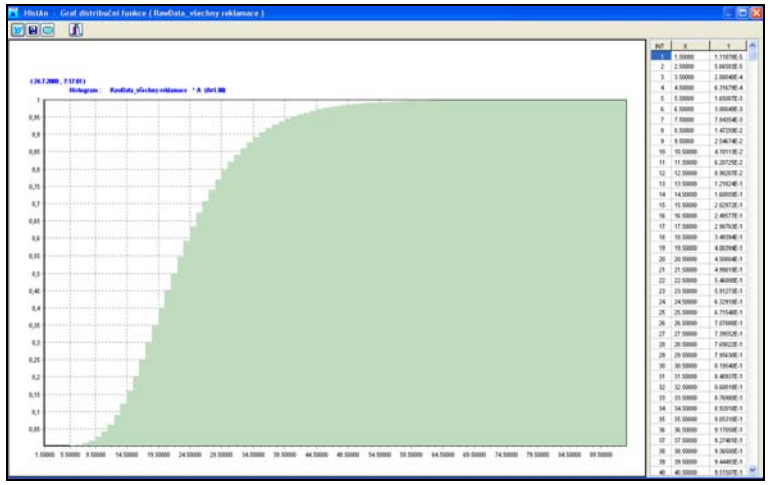

Fig. 8: Distribution function

If we know the time (period) from Time „0“ when there is the highest occurence of defects for the individual types of objects – it is very efficient and needed

1. to perform a complete technical inspection of the building focused on the defects. Most defects occur in the object within this time of the guarantee period, later on the frequency of occurence (% probability of defect occurence) starts to decrease.
2. The inspection is due to be planned for the time when the assumed number of defects is covered with 95 % probability. From this time, a targeted maintenance service activity as well as repair and maintenance work planning should be started.

7 CONCLUSION

The distribution function shows that all defects (max. amount) will be discovered with probability nearing certainty (100 %) roughly in 57th month from the Time „0“, with no difference between technical solutions, types of objects etc. After this period, there is no technical reason to extend the warranty (guarantee period). This fact shows that the building guarantee period longer than 57 months – rounded in years thus 5 years – is ineffective from the technical point of view. Prevention, i.e. correct maintenance and operation of the building on order to keep the longest possible problem-free lifespan of the building should already be running at the time. The processed data will be examined more in detail for individual types of objects, next an analysis of the most often occuring defects will be executed and the contents of single technical inspections will also be defined more in detail. Conclusions gained in this research cannot be applied to traffic constructions, bridges, tunnels, subways, special buildings etc. These certainly deserve their own specific research.

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