Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

Dmytro Isaenko Candidate of Public Administration Science, Vice President. ORCID: 0000-0002-6093-3967  
Vitalii Ploskyi Doctor of Science, Professor. ORCID: 0000-0002-2632-8085  
Volodymyr Skochko Ph. D., Associate Professor. ORCID: 0000-0002-1709-2621  

1 Confederation of Builders of Ukraine, Kyiv, Ukraine  
2,3 Kyiv National University of Construction and Architecture, Povitroflotsky Avenue 31, Kyiv, 03037, Ukraine  
*Corresponding author, e-mail: vladimir.and.friends@gmail.com  

ARTICLE INFO  
Article history: Received 02/24/2019; Accepted 03/30/2019; Available online 04/29/2019  
DOI: https://doi.org/10.32557/useful-3-1-2019-0002  
License: Under a creative commons license CC BY-NC-ND 4.0  
Key words: technical regulation parameters, elimination of conflicts, design and construction industry.

ABSTRACT  
The paper proposes an approach to the identification and elimination of conflicts of technical regulation parameters contained in the normative and technical documentation of the design and construction industry. The approach is based on comparing the complexity of the methods of defining the same parameters of technical regulation in various normative documents, followed by an analysis of the validity of only one of the studied methods. It is proposed to apply a quantitative and qualitative analysis of the associated parameters of technical regulation, which are involved in various investigated techniques and regulatory documents, in order to identify the depth of integration of one or another of them in the actual practice of design and construction work. If one or more of the techniques under consideration are less substantiated from a scientific, qualitative and/or quantitative point of view, then it (they) is (are) subject to withdrawal from the relevant normative documents with the provision of appropriate recommendations and references to that normative
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

document, which is accepted as the main one for determining the investigated parameter of technical regulation. After removing unnecessary parameters (duplicated to optimization), all editable regulatory documents should be subjected to expert advice to supplement and provide guidance on the use of other existing normative documents related to the data when determining the specific parameter of technical regulation. In addition, expert opinion will help to avoid possible shortcomings in the narrative of normative documentation, as well as prevent the loss of some important part of descriptive information and simplified approaches to an approximate assessment of the investigated parameters of technical regulation, which can be used for integrated assessment calculations, the execution of project documentation at the stage of sketch design and pre-design works.

1. Introduction.

One of the most acute problems in the field of technical regulation in domestic construction and architecture is a significant number of conflicts in the terminology apparatus, guidelines and principles for determining the parameters of regulation. Such a problem leads to the need to create additional regulations and other documents aimed at clarifying the order of action in case of occurrence of the corresponding conflicts, which complicates the process of using the technical normative documentation as a whole. At the same time, the contradictory nature of additional explanations creates more obstacles and problems than benefits. The solution of this problem is fundamental and extremely relevant in today's conditions, when the technical regulation system is in dire need of a transition from the prescriptive method of forming normative constraints [1] to the parametric method for determining the parameters under investigation, which is based on the use of some target functional assignment of the corresponding parameters, and is more flexible having a scientific, technical and scientific background [2]. However, for the transition from the assignment to the parametric method of designing, it is necessary to eliminate a whole series of conflicts that arise when defining the same parameters of technical regulation in different normative documents as well as to clearly reject all related technical regulation parameters used in the determination of one - investigated - in order to determine their hierarchy in the system of interconnected normative documents and related acts, explanations, instructions and additions.

2. The main part.
Suppose that it is necessary to systematize the normative documentation, which is subject to technical regulation in the design and construction industry, in order to determine the priority of addressing a particular document in the development of project documentation, the implementation of the construction and subsequent operation of buildings and structures throughout the life cycle (including dismantling). In addition, it is necessary to identify all possible conflicts that are present in this documentation and appear in more than one guidance document to identify the same regulatory parameters or the principles of implementing the same procedures and / or operations.

We assign a set of documents intended for the technical regulation of a particular direction of activity in a design and construction business, as a vector \( \{ A \} \), each element of which corresponds to one normative document:

\[
\{ A \}^T = \{ A_1 \ A_2 \ \cdots \ A_n \},
\]

where \( n \) – is the number of relevant regulatory documents.

A set of control parameters is given as a vector \( \{ B \} \), each element of which corresponds to one calculation value, or one rule of technical regulation:

\[
\{ B \}^T = \{ B_1 \ B_2 \ \cdots \ B_m \},
\]

where \( m \) – is the number of corresponding parameters.

Now it is necessary to distribute \( n \) parameters for \( m \) normative documents, which are responsible for determining the first. To do this, it is proposed to construct a table "\( T \)" matching the \( B_i \) parameters, \( A_j \) standard documents, so that each row of the table has one \( B_i \), and each column \( A_j \) includes the set of parameters \( B_i \), which is determined by the relevant regulatory document. The table "\( T \)" will have the following form below (see table 1).

<table>
<thead>
<tr>
<th>&quot;( T )&quot;</th>
<th>( A_1 )</th>
<th>( A_1 )</th>
<th>( \cdots )</th>
<th>( A_n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( B_1 )</td>
<td>( B_1 \lor 0 )</td>
<td>( B_1 \lor 0 )</td>
<td>( \cdots )</td>
<td>( B_1 \lor 0 )</td>
</tr>
<tr>
<td>( B_2 )</td>
<td>( B_2 \lor 0 )</td>
<td>( B_2 \lor 0 )</td>
<td>( \cdots )</td>
<td>( B_2 \lor 0 )</td>
</tr>
<tr>
<td>( \cdots )</td>
<td>( \cdots )</td>
<td>( \cdots )</td>
<td>( \cdots )</td>
<td>( \cdots )</td>
</tr>
<tr>
<td>( B_m )</td>
<td>( B_m \lor 0 )</td>
<td>( B_m \lor 0 )</td>
<td>( \cdots )</td>
<td>( B_m \lor 0 )</td>
</tr>
</tbody>
</table>

Here the "\( \lor \)" symbol means operation "or" (disjunction).
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

Based on the results of the formation of this table, we construct a matrix $[K]$, each element of which must equal or "1" - in the case where the corresponding $(i,j)$ - and cell of the table is $B_i$, or «0» – in the case where the corresponding $(i,j)$ - the cell of table 1 is zero, that is:

$$K_{i,j} = \begin{cases} 1, & \text{ if } T_{i,j} = B_i, \\ 0, & \text{ if } T_{i,j} = 0, \end{cases} \quad (i = 1,2,\cdots m; \ j = 1,2,\cdots n).$$

(3)

Here the symbol "→" is the logical consequence of "if" (implication).

The corresponding matrix will represent an analogue of the incidence matrix of elements of the vector $B$ to the elements of the vector $A$ (except that more than two $B_i$ elements may correspond to one element $A_j$) and will have the following form:

$$[K] = \begin{bmatrix} K_{1,1} & K_{1,2} & \cdots & K_{1,n} \\ K_{2,1} & K_{2,2} & \cdots & K_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ K_{m,1} & K_{m,2} & \cdots & K_{m,n} \end{bmatrix} = \begin{bmatrix} 1 \lor 0 & 1 \lor 0 & \cdots & 1 \lor 0 \\ 1 \lor 0 & 1 \lor 0 & \cdots & 1 \lor 0 \\ \vdots & \vdots & \ddots & \vdots \\ 1 \lor 0 & 1 \lor 0 & \cdots & 1 \lor 0 \end{bmatrix}. \quad (4)$$

Then, in the ideal case, assuming that the normative base responsible for technical regulation is perfect, the following control conditions must be fulfilled:

1) The sum of the elements of each of the rows of the matrix $[K]$ should not exceed 1:

$$a = \sum_{j=1}^{n} K_{i,j} \leq 1, \quad (i = 1,2,\cdots m). \quad (5)$$

2) The sum of the elements of each column of the matrix $[K]$ should not exceed the number of parameters of the technical regulation $m$:

$$b = \sum_{i=1}^{m} K_{i,j} \leq m, \quad (i = 1,2,\cdots m). \quad (6)$$

3) And, consequently, the sum of all elements of the matrix $[K]$ should not exceed the number of parameters of technical regulation $m$:

$$c = \sum_{i=1}^{m} \sum_{j=1}^{n} K_{i,j} \leq m. \quad (7)$$

Obviously, if one of the conditions is not met, then the investigated set of normative documents contains conflicts, which can lead to problems and errors in solving technical and legal problems.

The main indicator of the occurrence of a conflict is the non-fulfillment of the condition (5), which indicates the existence of independent definitions or approaches to the calculation of technical regulation parameters in two or more normative documents. Such a situation requires solving the conflict by extracting
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

from one or more of the $A_j$ documents (included in the set of $a$) the corresponding repeating regulation parameter of the $B_i$. To do this, it is necessary to set the priority (importance) of finding this $B_i$ parameter in $A_j$ documents and instead of setting the principles for determining this parameter, make the following to the document of the document reference to the most priority document from the set $a$.

Establishing the priority of $PA_{ij}$ finding a determination or methodology for calculating a certain parameter of the technical regulation of $B_i$ in documents $A_j$ should be based on the results of the ranking of the corresponding parameters ascending or descending:

$$PA_{i,1} < \cdots < PA_{i,a-1} < PA_{i,a}, \text{a}\,\text{b}\,\text{o} \, PA_{i,1} > PA_{i,2} > \cdots > PA_{i,a}. \quad (8)$$

After that, you should select the most priority document and leave the control parameter $B_i$ exactly in its composition. If the two highest priority documents have the same value (potential), as shown below:

$$PA_{i,1} < \cdots < PA_{i,a-1} = PA_{i,a}, \text{a}\,\text{b}\,\text{o} \, PA_{i,1} = PA_{i,2} > \cdots > PA_{i,a},$$

then in this case, the results of ranking the expert opinion should be subjected.

Appointment of the same priority value while ranking can be performed on the following principle. Specify the contents of the table “$T$” so that if any arbitrary $i$-th parameter of technical regulation $B_i$ is a function of a certain number of $r_{ij}$ preceding or following in a plural of elements of the vector $\{B\}$ parameters, this would be reflected in the record of this parameter in the following form:

$$B_i = f(B_1, B_2, \ldots, B_{j-1}, B_j, B_{j+1}, \ldots, B_t), \quad (j \neq i; \quad j = 1, 2, \ldots, r_{ij}). \quad (10)$$

For clarity, it is possible to show directions of distribution (sequence) of functional connections between the cells, which will contain related parameters of technical regulation in the table "$T$". An example of such a table for five technical regulations and three regulatory documents is shown below (see Table 2).

Table 2. Example of an incidence table of 5 parameters of technical regulation for 3rd normative documents

<table>
<thead>
<tr>
<th>&quot;T&quot;</th>
<th>$A_1$</th>
<th>$A_2$</th>
<th>$A_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B_1$</td>
<td>$B_1=\text{const}_1$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$B_2$</td>
<td>$B_2=f(B_1)$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$B_3$</td>
<td>0</td>
<td>0</td>
<td>$B_3=f(B_1,B_2,B_4)$</td>
</tr>
<tr>
<td>$B_4$</td>
<td>0</td>
<td>$B_4=\text{const}_4$</td>
<td>0</td>
</tr>
<tr>
<td>$B_5$</td>
<td>$B_5=\text{const}_5$</td>
<td>0</td>
<td>$B_5=f(B_1,B_2,B_3,B_4)$</td>
</tr>
</tbody>
</table>

Obviously, in the example above, the last line does not satisfy the condition (5). Therefore, one of the regulatory documents $A_1$ or $A_3$ needs to be corrected by pre-determining which of these documents it is
necessary to remove the method of determination (calculation) of parameter $B_5$. It is logical to proceed from the considerations that the exclusion of parameter $B_5$ should be in document $A_1$, since in document $A_3$ this parameter is determined on the basis of the functional dependence on all four other technical parameters of $B_1, B_2, B_3$ and $B_4$ (which, among other things, are in different normative documents), whereas in document $A_1$ this parameter is determined coercive (though, perhaps also on the basis of objective empirical data), for example, is given in tabular form. However, these arguments are not enough. It is necessary to determine the approach to numerical analysis of the parameters of technical regulation with the possibility of comparing the corresponding parameters by the magnitude of some numerical values. The following approach is proposed. Similarly to constructing a matrix $[K]$, construct a matrix $[L]$ for a specified table "T". In this case, if the parameters of technical regulation will be given in the form of stable empirical quantities, we will accept the elements of the matrix $[L]$ equal to one. If the technical regulation parameters are defined as functions of $r_{ij}$ of the previous or following parameters in a plurality of elements of the vector $\{B\}$, we will accept elements of the matrix $[L]$ equal to the corresponding number of such parameters, increased by one. That is:

$$L_{i,j} = \begin{cases} 1, & \text{→ } "T_{i,j}" = \text{const}, \\ r_{i,j} + 1, & \text{→ } "T_{i,j}" = f(B_1, B_2, \ldots, B_{i-1}, B_k, B_{i+1}, \ldots, B_r), \\ 0, & \text{→ } "T_{i,j}" = 0, \\ \end{cases} \quad \begin{cases} i = 1, 2, \cdots, m; \\ j = 1, 2, \cdots, n; \\ i \neq k, 1, 2, \cdots, r_{i,j}. \end{cases}$$

(11)

The matrix $[L]$ will have the following form:

$$[L] = \begin{bmatrix} L_{1,1} & L_{1,2} & \cdots & L_{1,r} \\ L_{2,1} & L_{2,2} & \cdots & L_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ L_{m,1} & L_{m,2} & \cdots & L_{m,n} \end{bmatrix}$$

(12)

For the example given in Table 2, the number of $r_{i,j}$ parameters, from which functionally dependent individual corresponding parameters of technical regulation are:

1) $r_{1,1} = 1$, as $B_1=\text{const}$;
2) $r_{2,1} = 1 + 1 = 2$, as $B_2=f(B_1)$;
3) $r_{3,1} = 1$, as $B_3=\text{const}$;
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

4) \( r_{4,2} = 1 \), as \( B_4 = \text{const} \);

5) \( r_{3,3} = 3 + 1 = 4 \), as \( B_3 = f(B_1, B_2, B_4) \);

6) \( r_{5,3} = 4 + 1 = 5 \), as \( B_5 = f(B_1, B_2, B_3, B_4) \).

Therefore, the matrix \([L]\) for this example will look like this:

\[
[L] = \begin{bmatrix}
1 & 0 & 0 \\
2 & 0 & 0 \\
0 & 0 & 4 \\
0 & 1 & 0 \\
1 & 0 & 5 \\
\end{bmatrix}.
\]  (13)

It is well seen that \( r_{5,3} > r_{5,1} \).

Removing an extra (conflicting) parameter \( B_5 \) with priority \( r_{5,1} = 1 \) from the matrix (13), we get an adjusted matrix \([L']\):

\[
[L'] = \begin{bmatrix}
1 & 0 & 0 \\
2 & 0 & 0 \\
0 & 0 & 4 \\
0 & 1 & 0 \\
0 & 0 & 5 \\
\end{bmatrix}.
\]  (14)

Each element of \([L']\) will be formed on the following principle:

\[
L'_{i,j} = \begin{cases} 
L_{i,j}, & \text{if } L_{i,j} > L_{j,k}, \ j \neq k = 1, 2, \ldots, j-1, j-1, \ldots, n; \\
0, & \text{if } L_{i,j} < L_{j,k}, \ j \neq k = 1, 2, \ldots, j-1, j-1, \ldots, n;
\end{cases} \quad i = 1, 2, \ldots, m; \quad j = 1, 2, \ldots, n. \)  (15)

And the matrix \([L']\) in its general form will have the form:

\[
[L'] = \begin{bmatrix}
L'_{1,1} & L'_{1,2} & \cdots & L'_{1,n} \\
L'_{2,1} & L'_{2,2} & \cdots & L'_{2,n} \\
\vdots & \vdots & \ddots & \vdots \\
L'_{m,1} & L'_{m,2} & \cdots & L'_{m,n}
\end{bmatrix} = \begin{bmatrix}
L_{1,1} \lor 0 & L_{1,2} \lor 0 & \cdots & L_{1,n} \lor 0 \\
L_{2,1} \lor 0 & L_{2,2} \lor 0 & \cdots & L_{2,n} \lor 0 \\
\vdots & \vdots & \ddots & \vdots \\
L_{m,1} \lor 0 & L_{m,2} \lor 0 & \cdots & L_{m,n} \lor 0
\end{bmatrix}.
\]  (16)

This matrix can be used to determine the global priority of the technical regulation parameters by their mutual functional dependence. To do this, you should calculate the sum of the matrix line \([L']\), and place a new vector of precedence \(\{PB\}^T\) in a cell, the form will be:

\[
\{PB\}^T = \{PB_1, PB_2, \ldots, PB_m\},
\]  (17)

where:

© 2019 The Author(s). Published by SVP4U in USEFUL academy in partnership with Kyiv National University of Construction and Architecture. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Volume 3, Issue 1, 2019 p.12
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.

\[ PB_i = \sum_{j=1}^{n} L'_{i,j}, (i = 1, 2, \cdots m). \]  

(18)

In particular, for the matrix (14), the vector \( \{PB\} \) will have the following form:

\[ \{PB\}^T = \{1 \ 2 \ 4 \ 1 \ 5\}. \]  

(19)

After the formation of the \( \{PB\} \) vector, it is possible to perform a ranging of the technical regulation parameters in descending order or growth, including the sorting of the matrix elements \([K] \) and \([L']\). As a result, we observe a vector \( \{PB^*\} \) and the matrix \([K^*]\) and \([L^*]\):

\[
\begin{align*}
\{PB^*_1\} & < \cdots < \{PB^*_m\} < \{K^*_1\} < \cdots < \{K^*_m\}, \text{ or } \{K^*_1\} > \{K^*_2\} > \cdots > \{K^*_m\}, \\
\{L^*_1\} & < \cdots < \{L^*_m\}.
\end{align*}
\]  

(20)

As a result of the corresponding ranking, we obtain the ordered tables of adjacency of the parameters of technical regulation and regulatory documents. At the same time, in tables "T" there will be no functional "bottom-up" links. For example, for a vector (19) and a matrix (14), the sorting in height will look like:

\[ \{PB^*\}^T = \{1 \ 1 \ 2 \ 4 \ 5\}, \]  

(21)

and

\[
[ L^* ] = \begin{bmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
2 & 0 & 0 \\
0 & 0 & 4 \\
0 & 0 & 5
\end{bmatrix}. \]  

(22)

It should also be added that, in the process of excluding some of the \( i \)-th conflict parameter of technical regulation from one of the normative documents, it is necessary to carefully analyze the conditions and recommendations that were available in the less priority document in order to prevent cases in which, by accidental deletion of previous guidance from moving them to a new (higher priority) document will result in loss of content or accuracy of these instructions. In addition, with negligent correction of both conflicting documents, the probable occurrence of contradictions is in the latter document which is more priority.

One of the examples of conflicts of the same parameters of technical regulation in various regulatory documents can be the value of the resistance of the heat transfer of enclosing structures \( R \) (K-m²/W). Thus, in state building codes for thermal insulation of buildings [8], the minimum value of this value is set as \( R_{q\ min} \) (K-m²/W) a condition binding. These same building codes establish one more, more important
parameter of technical regulation, which determines the specific value of energy consumption per unit area or volume of buildings - specific maximum energy demand $EP_{max}$ (kWh/m$^2$ or kWh/m$^3$).

At the same time, the state standards of Ukraine, for which the above-mentioned norms refer to the subsequent calculations, regulates the procedure for determining such a heat transfer resistance of the enclosing structures $R$ (K$\cdot$m$^2$/W), which satisfies the fulfillment of the condition regarding the maximum specific energy demand of $EP_{max}$, subject to compliance with the normative temperature-humidity regime of premises at certain volumes of transmission and infiltration heat losses.

Therefore, the establishment of the value of the minimum heat transfer resistance of the enclosing structures $R_{q\ min}$ (K$\cdot$m$^2$/W) for state construction is practically meaningless and this indicator can only be used as the first approximation when applying the iterative approach to the calculation of the resulting value $R$ (K$\cdot$m$^2$/W). In certain cases, compliance with the design conditions of the enclosing structure of the minimum heat transfer resistance $R_{q\ min}$ (K$\cdot$m$^2$/W) avoids the failure to comply with the maximum permissible temperature difference between the inner surface of the enclosing structures and air in the respective room. At the same time, the heat transfer resistance $R$ (K$\cdot$m$^2$/W), calculated according to state standards, always satisfies this condition.

Obviously, the values of the minimum heat transfer resistance of the enclosing structures $R_{q\ min}$ (K$\cdot$m$^2$/W), contained in the state building codes, are more declarative and have no practical application, while at the same time causing confusion in the work of engineer-designers who have inertia thinking and guided by outdated building codes, are pushed directly from the values $R_{q\ min}$ (K$\cdot$m$^2$/W) in the process of making design decisions.

Conclusions

Consequently, we can conclude that the proposed approach can allow a significant reduction of labor costs for the analysis of conflicts of technical regulation parameters, repeated in various normative documents, and remove from the latter the least appropriate approaches and methods for determining the appropriate parameters. In addition, the presented approach makes it possible to systematize and define a hierarchy in the set of all parameters of technical regulation used in the process of determining the value of the investigated parameter.

References
Some aspects of setting up the technical regulation system in the design and construction industry in the transition to a design parametric approach.


