



subj.-no.

www.prvkongre
szapatista.mk

contact@p
rvkongreszapat
ista.mk

STANDARDIZATION OF BOQ IN SLOVENIA

Bogomir Troha

univ. dipl. inž. gradb., Axis, d.o.o., Slovenija, mirko.troha@axis.si

Povzetek

Predračun je edini dokument, ki natančno opredeljuje predmet pogodbe in njegovo ceno. V članku ugotavljamo, kdo ima interes za izboljšanje kvalitete popisov del in kdo bi moral biti pobudnik za izboljšanje kvalitete popisov del.

Predstavljene so iniciative in rezultati, ki so v zadnjih desetletjih v Sloveniji delovale v smeri standardizacije popisov del oz. kalkulacije in obračuna. Analizirane so glavne napake pri popisih del in predračunih, ki lahko nepredvideno dvignejo vrednost investicije in podaljšajo projekt in predlagani ukrepi za izboljšanje kvalitete predračunov in popisov del.

Popis del je ključen za vsebinsko določitev predmeta pogodbe. Ključno za izdelavo kvalitetnega popisa del in analiziranje podatkov pa je poenotenje oz. standardizacija strukture in vsebine popisov del. V članku so predstavljena načela za oblikovanje standardiziranega popisa del.

Ključne besede

Standardizacija popisov del, Normativi za gradbeništvo, Projektno vodenje, stroškovni inženiring, Xbase.

Abstract

Bill of quantities (BoQ) is the only document, which in details defines the subject matter of the contract and its price. In this article, we are determining who has an interest in improving the quality of BoQ and who should be the initiator for improving the quality of BoQ.

Presented are initiatives and results that have been executed in Slovenia in the last decades in the direction of standardization of BoQs, construction production rates and construction accounting. The main errors in BoQs which as a result can unexpectedly raise the value of the investment and extend the project deadline are analysed. We propose measures to improve the quality of BoQs.

The BoQ is the crucial document for determination of the subject matter of the contract. The key to prepare a quality BoQ and to analyse data is to unify or standardize the structure and content of BoQ. The article presents the principles for formulating a standardization of BoQ.

Keywords

Standardization of BoQ, construction production rates, project management, cost engineering, Xbase.

1. INTRODUCTION

Priced Bill of Quantities (PBoQ) is the only document that specifies the subject matter of the contract and its price. Only by specifying the object of the contract in the Bill of Quantities (BoQ) can the value of the contract be precisely determined.

BoQ and PBoQ are often synonymous and many do not separate them. The difference is that the BoQ contains only that part of the information describing temporary or permanent results of works or work processes, which are always quantified, without cost data. However, PBoQ also provides a price for each item of BoQ.

Despite the importance of BoQ and PBoQ, we find that the participants' attitude towards BoQ in the project: the client, the designer, the contractor and the supervisor is not good. The BoQ is made by designers for whom the BoQ is only an unnecessary document compared to other project documentation and drawings. Therefore, the designer does not look at the quality of BoQ, but only at the cost of producing the BoQ. The client is often not an expert, so he believes that the BoQ made by the designer is good. The real problem, however, arises when contractor or tenderer evaluates prices for their works based on the BoQ made by designer.

The consequences of ill-prepared BoQ are reflected in unreliable investment estimates, in disputes between the client and the contractor as to what is the subject of the contract. The bidder usually determines the value of the bid by calculating the price of every BoQ item by considering only what is written in the BoQ. Bidding time is getting shorter, so bidders do not have time to examine all the project documentation. If the client wants to get a quality offer, the data that affect the item prices must be presented in the BoQ. If BoQ is incorrect, indeterminate or missing, this is reflected in the financial estimate of the offer.

Due to the mismatch between drawings and BoQ, there are often different interpretations of what is included in the scope of the contract and what is considered as variation and should be paid additionally.

Despite the fact that in recent years we have agreed in Slovenia that the quality of BoQ is poor, no one is prepared to deal with this problem. The key to improving the quality of BoQ is to have an agreement among the project participants which information should be specified in the BoQ and how to describe it. The only way to make the data widely used by everyone is through unification or standardization of data. However, the greatest interest in standardization of BoQ lays on the part of clients and contractors, not designers. Therefore, standardization initiators should be public and private investors and construction contractors.

BoQ in general for buildings and infrastructure cover a broad area of construction, crafts, installation work and equipment. Managing such broad areas requires good organization and experts in those areas who have knowledge and experience in materials and technologies. Such a multidisciplinary approach, however, requires considerable funds that no one wants to provide even though the savings in the organization and reduced prices would be significant.

2. OVERVIEW OF WORK ON THE STANDARDIZATION OF BOQ

2.1 Giposs, GNG, 1979

Until the 1980s, Republics in former Yugoslavia regularly issued policies and extensive documentation for the preparation of Techno-economic Programs [1]. An integral part of the publication was the standardization of BoQ items, materials and resource production rates for construction works. In Slovenia, the Construction Industry Business Community of Slovenia - GIPOSS had issued the book called "GNG" construction production rates [2]. Production rates were in the form of tables containing factors for the consumption of

production resources (material, labour, equipment...) for certain technologies of construction work, subject to certain assumptions. Billing rules have also been described in GNG. It should be emphasized that the GNGs were not intended for making BoQ, but to calculate BoQ's item's price. The difference is that the BoQ item describes a work or work result that often involves multiple technological processes. Whereas production rates relate only to one technological process. In the process of calculating item's price, cost estimator combines usually more resource production rates.

Table 1: Example of resource production rates GIPOSS, GNG

2.360	Mechanical pouring of concrete and comprimation by electrical vibrator	Engine power	Rate	Concrete	Propulsion material	Labour QU	Labour SQ
Item	Description	HP	m ³ / h	m ³		h	h
2.361	Nonreinforced concrete element, crossection over 0'30m ³ /m ² or m ¹	2	6	1	According to GNG 2.320	0,5	0,5
2.362	Reinforced concrete elements, crossection over 0'30m ³ /m ² or m ¹	2	5,5	1		0,55	0,55
2.363	Reinforced concrete elements, crossection over 0'30m ³ /m ² or m ¹ with dense reinforcement	2	4	1		0,7	0,7
2.364	Reinforced concrete elements, crossection from 0'20-0'30m ³ /m ² or m ¹	2	2,5	1		1	1
2.365	Reinforced concrete elements, crossection from 0'12-0'20m ³ /m ² or m ¹	2	2,5	1		1,2	1,2
2.366	Reinforced concrete elements, crossection from 0'08-0'12m ³ /m ² or m ¹	2	2	1		1,5	1,5
2.367	Reinforced concrete elements, crossection from 0'04-0'08m ³ /m ² or m ¹	2	2	1		1,6	1,6
2.368	Reinforced concrete elements, crossection from 0'04m ³ /m ² or m ¹	2	1,5	1		2,4	2,4
2.369	Reinforced concrete elements, crossection from 0'12-0'30m ³ /m ² or m ¹ using tunnel formwork "OUTINORD" including internal transport cost except crane	2	2,5	1		0,4	0,7

Source: GIPOSS, GNG, 1979

2.2 Calculation of construction works, 1964

In addition to the above-mentioned production rates, an older textbook, written by Milan Pajk: Calculations of Construction Works [3], is worth mentioning. The textbook has been reprinted several times since its first edition in 1964 and is even now still relevant in the accounting of building works, despite it has become obsolete. Replacing the textbook of Construction Calculation [3] with the new Building Calculation Manual [4], written by Štefan Žemva in 2006 brought some new chapters, while the contents taken from Pajk's textbook [3] did not undergo major changes. Žemva's manual [4] does not contain modern technologies but relays heavily on the obsolete technologies described in Pajk's textbook.

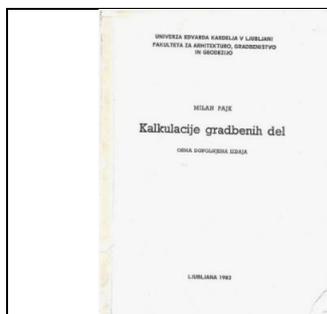


Fig. 1: Textbook of Construction works, 1964 (M. Pajk)



Fig. 2: Handbook Construction calculation, 2006 (Š. Žemva)



Fig. 3: Technical conditions for roads, SZC, 1989

on the bases of new materials and new technology used in construction as well as to use new functionalities enabled by modern information technology.

ZZGS and BEST published on their website over 1000 pages of the list of items, which were rather reminiscent of the production rates prepared six years earlier by the same company for the Chamber of Craft and small business of Slovenia. However, it should be noted that the number of items is not an indication of quality. E.g. compared to Xbase standardized BoQ [8] theoretically almost $7 * 10^{17}$ items can be generated for the concrete slab alone. They have published item's list separately for buildings and for civil engineering, which makes no sense because there are types of works that are common to both areas (excavation, embankments, sewerage, concrete works...). They also used outdated compressive strength markings and unnecessary double marking of the consistency of concrete for concrete works.

Example of the Požar's Initiative is mentioned because it received a lot of interest, but due to the wrong approach, the project has failed. The ZZGS Society website is no longer accessible and there is no information if the Association still exists.

2.5 Austrian standardization of Bill of Quantities

In recent years, some have also advocated for foreign practices to be adopted in Slovenia. In particular, this means that some want Slovenia to adopt the Austrian standardization of BoQ. At the time when the »Green books« were made in Slovenia, standard BoQ for the entire construction industry began to be drawn up in Austria.

The Austrian Standard BoQ covers different areas. List of standard items have been created by public and private institutions, so ownership and access to data are different: from free use to paid use.

Standard items for construction, crafts and installation work are currently published by the Austrian Ministry of Digitalization and the Business Environment, BMDW (ger. Bundesministerium für Digitalisierung und Wirtschaftsstandort). The standard items for building construction are divided into two parts and can be used free of charge:

- Items for construction and craft works LB-HB (ger. Leistungsbeschreibung Hochbau) [9] and to
- Items for installation LB-HT (Leistungsbeschreibung haustechnik) [10].

In addition to the standardization for buildings, the private Research association for roads, railway and traffic (ger. Forschungsgesellschaft Straße - Schiene - Verkehr - FSV) offers a paid BoQ list of standardization for traffic and infrastructure, including roads, bridges, tunnels, railways, sewage, water management [11].

Tabel 2: Austrian standardization LB-HB 19 for concrete slab

<p>070300A Material zu 07.03 n.W.AN Das Verwenden nachstehend angebotener Materialien zu den angegebenen Positionen der ULG 07.03 wird vereinbart: Betrifft Position(en): _____ Material nach Wahl des Auftragnehmers (AN). Angeboten:</p> <p>070300B Material zu 07.03 Beispiel AG Das Verwenden nachstehend angebotener Materialien zu den angegebenen Positionen der ULG 07.03 wird vereinbart: Betrifft Position(en): _____ Beispielhaftes Material: _____ Angeboten ist das beispielhafte oder ein Material gleichwertiger Art. Kriterien der Gleichwertigkeit: _____ Angeboten:</p> <p><i>Decken und Kragplatten (D/Kragpl.) aus Beton mit</i></p>	<p>070300A material k 7:03 n.W.AN Use of materials proposed below at marked items ULG 07.03 Agreed on: Item (-s): _____ Material chosen by contractor (AN) . Offer:</p> <p>070300B material k 7:03 example Use of materials proposed below at marked items ULG 07.03 Agreed on: Item (-s) : _____ Suitable materials : _____ An example material or material of equivalent product characteristics is offered.. Equivalence criterion: _____ Offer :</p> <p><i>Slabs and cantilevers (Sl/Can) made of concrete with a</i></p>
--	---

ebener Untersicht, einschließlich Deckenroste, wenn diese in einem Arbeitsgang mitbetoniert werden können. Im Positionsstichwort sind die Festigkeitsklasse des Betons und die Plattendicke angegeben. Unterstellungshöhe über Null bis 3,2 m.

070301

070301A Beton C20/25 D/Kragpl.b.25cm b.3,2m m³

070301C Beton C25/30 D/Kragpl.b.25cm b.3,2m m³

070301D Beton C30/37 D/Kragpl.b.25cm b.3,2m m³

070301S Schalung D/Kragpl.Untersicht b.3,2m m²

070301T Schalung D/Kragpl.Roste b.3,2m m²

Das Ausmaß der Randschalung wird dem Ausmaß der Deckenschalung hinzugerechnet.

LB-Version: 19 Geändert

Änderung: Das Ausmaß der Randschalung wird dem Ausmaß der Deckenschalung hinzugerechnet.

070301V Bewehrung Stabst.D/Kragpl.b.3,2m kg

070301W Bewehrung Matten D/Kragpl.b.3,2m kg

flat bottom face, including formwork of the edge of the slab, if concreted at the same time.

The item description specifies the compressive strength of the concrete and the thickness of the slab.

Assumed height is up to 3.2 m

070 301

070301A Concrete C20/25 SI/Can to 25cm to 3,2m m³

070301C Concrete C25/30 SI/Can to 25cm to 3,2m m³

070301D Concrete C30/37 SI/Can to 25cm to 3,2m m³

070301S Formwork SI/Can bottom face to 3,2m m²

070301T Formwork SI/Can edge to 3,2m m²

Formwork on slab edge is taken into account in the quantity of horizontal slab formwork.

LB Version: 19 altered

Altered: Slab edge formwork is taken into account in slab formwork

070301V Reinforcing bars SI/Can to 3,2m kg

070301W Reinforcing mesh SI/Can to 3,2m kg

Source: Leistungsbeschreibung Hochbau 19

Austrian standardization has a different structure of works than the one used and unified in the republics of the former Yugoslavia from the 1950s onwards. Also, the data used in the standardization of descriptions are linked to Austrian standards and policies that do not comply with Slovenian standards.

The general comment and disadvantage of all cases of standardization of BoQ from Pajk's textbook, Green Books, OZS standard items to Austrian standardization are that they don't have enough data for contractors to determine the price. As a result, new items are added, hence BoQ item lists are growing, thereby reducing the manageability of the standard item base.

2.6 Xbase, 2019

In 2003, the largest Slovenian construction company SCT in collaboration with company Axis formed a research team working on the development of the Xpert project information system [7] and the creation of databases of production resources and production rates for construction works under the name Xbase [9].

In 2012, we, at Axis, started to work on standardizing BoQ for construction work. We used a different new way of thinking: BoQ is intended to calculate the project price in a precise analytical way and for precise billing according to work performed on the construction project. Hence all the information that influences the price of work and are not ambiguous must be stated in BoQ item's description. We realized that the current concept of standardization needed to be replaced. Instead of the list of standardized items, standardization of parameters should be used.

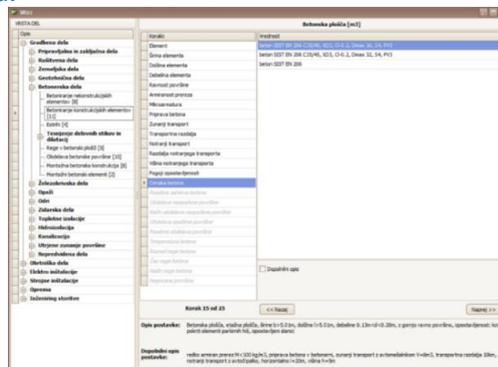


Fig. 6: User interface for making standardized items according to the parameterization concept
Source: Project information system Xpert

3. BOQ ERRORS

No rules, just 60 years old and outdated guidelines are set for the BoQ for construction works in Slovenia. As a result, the quality of BoQ depends on knowledge and experience of individuals who prepare BoQ.

The project design manager is formally responsible for the coordinated project documentation in accordance with the Slovenian Construction Law. Project design manager main responsibility is to coordinate the various designers. The quality and correctness of each drawing is the responsibility of the designer - the drawing maker. But the BoQ for the whole project is compiled from the BoQs of each of the designers by project design manager. Therefore, designers are responsible for individual parts, and the project manager is responsible for the consistency of the entire BoQ so that the items are not duplicated and all the variations during the design phase are properly addressed and accounted.

In reality, the preparation of BoQ is in the domain of high school technicians or young engineers with little or no experience. The first reasons for that are low cost, and the other is unappreciated attitude of design managers to the cost. Problem is that design managers are not aware of the impact the quality of BoQ has on project cost and thus on project as a whole. The main reason for the BoQs being poorly prepared is the lack of quality. The reasons for that are no up-to-date professional literature that would familiarize cost estimators with modern technology, no rules for making BoQs and lack of competence of cost estimators.

Cost estimators often have no contact with the modern construction operations and are not familiar with modern construction technologies and materials and make BoQ for technologies that were used thirty or more years ago.

Designers often give in to the pressure of the client, which requires the BoQ to be made before it is possible in order to make an estimate of the project value sooner. The BoQ is then done in advance and "by heart", assuming quantities for those parts of the project documentation that have not yet been produced. Therefore, the BoQ is then inconsistent with the other documents and give an inaccurate estimate of the investment. Consequently, the requirements of the investors to expedite the BoQ is contrary to their own interests to have a precise cost estimation of the project.

Often, much redundant information is written in the description of BoQ, such as detailed description of work, corresponding standards that product or service must meet, the quality control methods of the material, the accounting rules, ... All this information does not belong to the BoQ but should be a part of specific project documentation called technical specifications, which is not written specifically for the project but is of a general nature for all projects.

Inexperience and low level of knowledge of cost estimators result in improperly prepared items descriptions. Often the item contains a copy of the commercial description rather than parameters based on general technical characteristics. The phrase "or similar" that accompanies such a description is misleading since it does not specify what »similar« actually means. It is not clear what are the requirements for similarity or matching.

The quantities in BoQ are set at a very flat rate, without proof or written calculation. The value of an item is the product of the quantity of the item and the price per unit of the item. Therefore, quantity also significantly affects the value of the item and the value of the project. Inaccurately calculated quantities result in an inaccurate value of the contract. It may happen that actual quantities are bigger than estimated, which can cause a problem for the client if

the project has a tight budget. Also, oversized estimated quantities in the BoQ, combined with the form of a turnkey contract, represent a loss for the client because the client has overpaid the works.

Determining the price of a BoQ item for designers only means entering the number in the dedicated section. Designers have no programs or inf. systems for calculating the price of an item based on production rates. Determining the price of an item is a complex procedure because the item often involves several different work processes that require a number of parameters that affect the consumption of production resources and thus the price of the item. Therefore, an analytical approach and the use of specific programs and databases of production resources and production rates are necessary to determine the price of the item accurately.

Some say that the priced BoQ or design estimate is only a financial estimate that has nothing to do with the actual tender and that the true price of the project is only that set by the market. That only exposes their inexperience and indifference to the investors to determine the value of the project on the analytical basis. Calculated price of the project is a very useful piece of information to prepare the tender and set up the financial structure of the project.

BoQs are usually made today in the MS Xcel. Many designers are involved in the project. Each designer has his own way of making a list of works. Often, BoQ is sent to bidders in multiple tabs and in multiple files, which must first be edited into a meaningful whole. Formulating recapitulative formulas for very large BoQs containing sometimes thousands of items is impossible without errors. Therefore, it is a mistake that the formulas in the recapitulation do not add up all the chapters, so the contract amount is too small.

4. CONCEPT OF BOQ STANDARDIZATION

BoQ standardization is a concept that provides rules for the creation of BoQs and the placement of BoQs in the broader concept of project documentation. BoQs are the part of project documentation that alone specifies in detail the subject matter of the contract and the contract price.

The standardization of BoQs contributes to greater clarity and answers the question of what the client wants and what the contractor offers. If this is not unambiguous, then the costs, which are most often the subject of dispute between the client and the contractor, do not become the reason for the annexes to the contract.

Standardization should be understood in terms of unifying the form, content, rules and substantive interpretation of data and not as a process subject to rules of standardization associations. It is important for investors to require designers to produce BoQs in accordance with the rules for BoQ standardization. In this way, the BoQs will be clearer and more transparent, there will be few discrepancies between the investment estimate and the final investment value, there will be smaller differences in bids, there will be few disputes between clients and contractors, project risks will be reduced, project values will be reduced and projects will finish faster. Once databases of projects BoQs in a standardized format will be gathered, it will be possible to produce various statistical analyses and data processing, which so far could not be done due to unregulated descriptions in BoQ.

The term "BoQ standardization" does not mean merely a "list of standardized items". List of standard items is only part of the notion of "BoQ standardization". List of standard items is only a side product and not the core of the BoQ standardization concept.

To clarify the item description, up to twenty parameters that affect the price of the item must be specified. Typically, up to five parameters are specified for existing standard items. This, however, is not enough data for unambiguous and accurate description of the item and too little data to determine the price of the item.

Since there are many parameters for the unambiguous determination of the item description, there would also be many permutations for an item. This, however, would present a problem of how to find the desired item in the list and maintaining such a large database. Therefore, the correct approach to standardization of BoQs is to standardize the parameters and their values, and not to standardize the item list.

BoQ standardization consists of two parts, both of which are necessary for complete information on the description of works:

- standardized data represented in the form of tables for item description,
- technical specifications for the explanation of table content

Following general rules apply:

- the descriptions should be short, clear and unambiguous,
- the description of the item should only have technical information and not commercial names,
- the description should include all the data that affects the price.

The purpose of the technical specifications specifically for BoQs is to provide users with instructions on how to work with standardized parameters. Materials and working technologies must be explained to the extent that the user knows which value to choose for every parameter in the item's description. The technical specifications of BoQ are intended for those who make BoQs (cost estimators, designers, technologists), as well as those who use them (clients, contractors).

The technical specifications for the BoQ include:

- parameter's description
- parameter's value description
- general explanations of materials and technologies
- list of standards and other relevant documents regarding BoQ works
- measurement rules for quantities

Technical specifications for BoQ should exist as standalone publications and not to be specifically tailored to the specific project. The BoQ should only indicate technical specifications as separate documentation but as a part of the project documentation. A similar principle applies to FIDIC contracts, where the general terms of the contract are in the form of books published, and the specific terms of the contract have additional rules or exceptions made for each project separately. However, both general and specific terms are an integral part of the contract documentation.

5. CONCLUSIONS

BoQs would require systematic and substantive rules. It should be determined in what form and how to produce BoQs so that they can be exchanged between different information tools. The information data necessary to determine the price should be defined. It is essential to standardize BoQs, especially for use in IFC models of the BIM concept, to define a unified database for element attributes.

Axis has been engaged in BoQs standardization since 2012. We plan to produce a standardized database by early 2020, which could enable users to create a standardized BoQ for construction works in a special user interface as part of the XPERT project

information system. In addition to the standardized database, we will prepare technical specifications for the use of standardized data in the preparation of standardized BoQs.

A standardized BoQ should form part of a techno-economic program (TEP). TEP should be a mandatory part of the investment documentation defining the subject of the contract: technical - technological data on the project, data on the timeline of project activity and cost data on the project.

All data collected for the BoQ should be entered into the project information system, which would prevent errors in the summation of the chapters and increase the clarity and transparency of the BoQ. Inputs that are interdependent and influence on each other should be interconnected, for greater accuracy, less time to track changes, and greater analytical capabilities:

- items in the BoQ,
- quantities in the 3D model,
- production resources on BoQ and
- schedule activities.

Considering that the BoQ, priced BoQ or even more extensive documentation collected in TEP is the most important document from a cost point of view, the quality of such technical documentation should also be raised. TEP and BoQ should be produced by a suitably educated and experienced engineer in the field of cost engineering with project management skills, knowledge of present construction technologies and materials and contract law.

6. REFERENCE

- [1] Građevinska knjiga, Normativi i standardi rada u građevinarstvu (knjige 1-7), Beograd: Građevinska knjiga, 1980.
- [2] GIPOSS, GNG gradbene norme, Gradbena industrijska poslovna skupnost Slovenije, 1979.
- [3] M. Pajk, Kalkulacije gradbenih del, Ljubljana: UL FAGG, 1964.
- [4] Š. Žemva, Gradbene kalkulacije in obračun gradbenih objektov, Ljubljana: GZS, CPU, 2006.
- [5] Prometno tehnični inštitut, Popis del in posebni tehnični pogoji (knjige 1-7), Ljubljana: Skupnost za ceste Slovenija, 1989.
- [6] Direkcija Republike Slovenije za ceste, TSC 09.000:2006, Popisi del pri gradnji cest, DRSC, 2006.
- [7] Axis, „Axis produkti,“ 27 09 2019. [Elektronski]. Available: <https://www.axis.si/produkti/>.
- [8] Obrtna zbornica Slovenije, Normativi za gradbena dela (5 zvezkov), Ljubljana: Obrtna zbornica Slovenije, Sekcija gradbincev, 2005.
- [9] Axis, „Xpert - baza znanja,“ 10 07 2019. [Elektronski]. Available: <https://www.axis.si/baza-znanja/>.
- [10] Zvezno ministrstvo za digitalizacijo in poslovno okolje, Avstrija, „Postavke za gradbena in obrtniška dela v visokogradnji,“ 10 07 2019. [Elektronski]. Available: <https://www.bmdw.gv.at/KulturellesErbe/Bauservice/Seiten/Hochbau.aspx>.
- [11] Zvezno ministrstvo za digitalizacijo in poslovno okolje, Avstrija, „Postavke za inštalacije v visokogradnji,“ 10 07 2019. [Elektronski]. Available: <https://www.bmdw.gv.at/KulturellesErbe/Bauservice/Seiten/Haustechnik.aspx>.
- [12] Raziskovalno združenje za ceste, železnice in promet, Avstrija, „Standardne postavke za promet in infrastrukturo,“ 10 07 2019. [Elektronski]. Available: <http://www.fsv.at/cms/default.aspx?ID=422b9d15-5b75-4631-8aab-02be145641fc>.