International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 23 (2015) pp 43450-43455

New principles of codification of material resources and works in construction

Karakozova Irina Victorovna

Associate professor Institute of Economics, Management and Information System in Construction and Real Estate, National Research University "Moscow State University of Civil Engineering", 26 Yaroslavskoye shosse, Moscow, Russian Federation, 129337 i.kar@inbox.ru

Pavlov Alexander Sergeevich

Professor, All-Russian Research Institute for Nuclear Power Plants Operation (VNIIAES) Ferganskaya st. 25, Moscow, Russian Federation, 109507 a.s.pavlov@inbox.ru

Abstract
The purpose of this article is the carrying out the short analysis of earlier and current systems of classification and coding of material resources and works, the development of some suggestions for its improvement. The tasks and problems connected with the creation of the system of classification and codification of projects and resources within the subject domain of construction are considered. The unified approaches to codification of material resources and works which can be used for the creation of information model of a building are suggested. The conclusion about the need of creation of several systems of codification, connected with transitional modules, is made.

Keywords: construction, material resources, classification, codification, hierarchical system, facet method

Introduction

Plenty of various types of resources including information, financial, labor, natural, material, technical as well as organizational-and-technological resources is widely used in construction. The special place has been always occupied by the material resources uniting designs, semi-finished products, products, accessories, etc. as they usually make up nearly a half of expenses in the general cost of construction, and in many cases-even more, then a half. Construction machines, construction mechanisms, equipment, tools and stock belong to the technical resources participating in the construction production. Separate qualifiers refer to equipment, tools, furniture, production and economic stock, with which a building or a construction is equipped, as technical resources.

Within the resource management in construction classification and the system of coding based the principles meeting the requirements of future users are used.

In 1970-1980ths code dictionaries in which the basic concepts, objects, constructions were coded were created for the needs of the automated systems in construction. In the field of classification of objects and complexes in construction great work was completed within the creation of All-union qualifier of fixed assets which was accepted by the resolution of Gosstandart of the USSR #182, enacted since18.09.1987, and then the All-Russian qualifier of fixed assets of OKOF (OK 013-94) enacted since 01.01.1996. However the last document has become invalid since 01.01.2016, the OK qualifier 013-2014 was enacted instead (SNS 2008). The qualifier of fixed assets approved by the resolution of the Government of the Russian Federation #1 01.01.2002 is used generally for accounting.

Nowadays the fullest and the most detailed classification of material resources with the obligatory coding of each element is presented in the budget regulatory bases, in particular, in the collections of the budget prices [1, 15-17]. The collections of the budget prices of materials, products and designs consist of parts, sections or subsections being united according to certain signs, such as an origin, appointment, geometrical sizes, physical characteristics, etc. The collections of the budget prices of the maintenance of the construction machinery and mechanisms are also structured taking into account their appointment and technical parameters. Nowadays the approaches to coding of the material resources used in the construction branch differ, but their main appointment consists in the information transfer during the automated data processing.

Thus, the creation of the effective material resources management system which is based on the modern approaches to the system of coding of resources will promote effective functioning of the project management system. Besides, the classification and coding of information is one of the most important prerequisites for the modern approach to logistics, to drawing up budget documentation, to information support of the life cycle of construction project. It should be noted that despite of the great work which is being carried out in this direction, the unified approach satisfying all the participants of construction does not exist at the moment.

Technique

Domestic experience.

The main areas in construction and construction design which need the classification and the system of coding as well as of the applied concepts, are:

- the classification of construction facilities (complexes) of different function;
- classification of components of facilities, chambers and designs;

- classification of construction and other works, results of the specified works;
- classification of the applied resources, mainly presented by material and technical resources.

We shall note that concept of the project site as the complex of buildings and constructions built within one project exists only in statistics [7] and in budgeting [8].

Classification of separate facilities within industrial complexes (shops, cases, warehouses, etc.), and also processing equipment was carried out as OKOF, however no one distinguish complexes, facilities and elements that is still a weak point of existing documents on classification.

Within the budget standards for material resources the code based on All-Russian qualifier of production OK 005-93 (OKP), approved by the Resolution of Gosstandart of the Russian Federation on 30.12.1993, #301 with the subsequent changes [10] is appropriated now. OKP represents the systematized set of codes and names of the groups of products, based on the hierarchical system of classification. Five-step hierarchical classification with the digital decimal system of coding is provided in OKP. At each stage of classification the division is carried out according the most significant economic and technical classification signs. Each position of OKP contains the six-digit digital code, the unambiguous control number and the name of group of products.

The bases of intersectoral classification of the processing equipment were developed in the USSR in 1979 within the Uniform System of Design Documentation (USDD), however they did not get any further application.

Types of construction, commissioning, design and exploration work were listed in All-Russian qualifier of types of economic activity OKVED (OK 029-2007) created on the basis of harmonization with Statistical qualifier of types of economic activity of the European Union. However the attempt of its application, for example, for the list of types of works which influence safety of the construction projects, failed because of the considerable difference from the concepts and terms accepted in construction in Russia: the relevant order of the Ministry of Regional Development of the Russian Federation #274 was cancelled in a year (on 09.12.2008).

For the creation of the structured lists of types of works (in project management the term WBS-Work Breakdown System is applied) the uniform approach does not exist. In particular, the industry's own list of some types of works is developed for highways [9]. There is also the industry's classification of works on capital repairs and maintenance of highways. Own lists of types of works exist in budgeting: in federal budget regulatory base FSNB-2001 and in the similar Moscow base TSN-2001.

For the development of codification of resources the facet-and-hierarchical method offered in [13] can be assumed as a basis. According to this method the code of a resource consists of the sequence of facets, each of them designates a classification sign. The classification signs correspond to the main characteristics of the subject and are divided into the groups presenting appointment, origin, structure and properties of subjects (in this case resources).

Facet consists of alphabetic and digital parts which are divided by a semicolon. Lowercase Latin letters designate a classification sign of a certain level of hierarchy. During the allocation of subtotals of hierarchy they are designated by the second letter, etc. The quantity of subtotals isn't limited. The digital decimal part following the designation of a sign specifies the serial number of the listed classification sign at the level of hierarchy. Such an approach to coding of resources, allowing continuous lengthening of codes without changing the earlier appropriated ones, provides the fuller information on the used resources.

Foreign experience

Systems of coding are widely used and in the foreign practice. In the power industry the system of codification for power plants KKS (Kraftwerk-Kennzeichensystem-German), originally developed in Germany, is in broad application. This system includes both buildings and constructions of a power plant, and the power equipment. Basing on this system the international RDS-PP system is developed. However the experience of application of KKS on thermal and nuclear power plants proved, what even for the similar power plants it is difficult (if it is possible) to create a unified system: the codifications were approved individually for each project.

The attempt to unite classifications of chambers, constructions, resources and other construction concepts was undertaken in the USA [18, 20, 21]. In 1973 the system of coding of elements of expenses under named Mastercost was developed. Later Institutes of construction specifications of the USA and Canada reconsidered it and published in 2010 under the UniFormatTM trademark, as the standard for classification of specifications, estimating and the analysis of cost in construction of the USA and Canada. The elements of classification include the main components, general for the majority of buildings and constructions. UniFormat is often used for the preliminary descriptions of the project and for the estimates. The classification of MasterFormat which is used for the organization of the project at later stages has similar tasks.

The newer strategy of classification in the subject domain of construction was called OmniClass. It includes classification of construction elements (UniFormat) as Table # 21 "Elements", and MasterFormat as Table # 22 "Results of Work". Besides, the system includes classification of construction facilities, chambers, stages of work and other elements. The specified systems are the three main systems of classifications allowing to structure data on construction for the purposes of mathematical modeling.

At the same time the structure of the OmniClass system regarding materials and other construction products looks to be alien for the domestic constructor. In particular, few positions are taken away under combined ferroconcrete structures, steel structures, industrial construction. But wooden designs, including joiner's elements, medical and laboratory equipment, furniture, etc. are considered in details. The classification practically does not affect standard sizes and other quantitative characteristics of materials and structures.

The use of qualifiers of different destination in Finland's construction industry also proves the gained experience of

optimization of the process of information transfer between the participants of investment-and-construction process. Nowadays the House 90 Qualifier, developed in the early 1990ths and covering all the field of housing and considering modern methods of project and production management, works. Besides the qualifier of chambers, types of works, parts of facilities, construction complexes and facilities as whole its structure includes the qualifier of equipment, construction equipment and material resources [5].

Somewhat the attempt of classification of concepts has been executed in the international ISO 6707-1:2014 [19] standard. However only some hundreds of concepts from various spheres of construction are described there; the classification of material resources is developed insufficiently. The structure of the participating enterprises of the project (EPS-Enterprise Project Structure) and the organizational structure of the project (OBS-Organizational Breakdown Structure) can be also used in project management for the description of productions. Any approaches to such classifications have not been developed yet.

CIS countries' experience

In the CIS countries the work on development and the subsequent use of qualifiers and codifiers in construction is also conducted. For example, in Belarus the information block of data on a construction project, which allows to solve issues of planning, management and logistics by the means of the use of software of the system of preparation of construction production, is formed. This block includes information on a construction project, types of works and the material resources used, i.e. the design-and-technological module is formed and on its basis there is the coding of elements with the subsequent grouping them according to the technology of performance of work and taking into account all the conditions of their performance. During coding an element the first two groups of digits of the code indicate the facility signs-its parts (underground part, elevated part, on-site networks and communications, etc.) constructive elements (ladders, air shafts, etc.) and the integrated types of works (preparation of the territory, drainage, etc.). Then information on types of works and expenses, for example, recultivation, soil transport, laying of pipes, etc. is given in the form of three-digit group of digits. Then the subsequent two figures in the group take their place, indicating the material used, for example, monolith, brick, precast concrete, timber, metal, linoleum, etc. It should be noted that the development of design-and-technological models belongs to the duties of design organizations [2, 6].

The system of classification of material resources and the principles of their coding in the Kazakhstan partly repeat those in Russia as in the structure resources are grouped depending on their appointment or origin. However all the resources as the part of budget standards have only a branch code which indicates its place in the general system of budget standards.

Results

The revision of the acting All-Russian qualifiers presented in [9-12] is the part of "Plan of measures on the formation of methodology of systematization and coding of information, as well as improvement and updating of All-Russian qualifiers, registers and information resources", developed by the Interdepartmental Working Group on the development and application of unified registers and All-Russian qualifiers at the Ministry of Finance of the Russian Federation. Transition to the new system of the classification harmonized with the European system is inevitable in view of Russia's membership in the World Trade Organization (WTO) and the Customs Union. Besides the transition is necessary in view of the urgent issue of import substitution of resources in the national economy's industries, including also construction industry.

As a result of works and events held according to this plan the new All-Russian system of classification of production according to the requirements to the order of work for the development, appliance and use of the all-Russian qualifiers according to [14] is to be created. One of the elements of the system was All-Russian qualifier of production according to types of economic activity OK 034-2014 [12], or OKPD 2 which replaces the qualifiers of production and services which existed earlier (OKDP, OKPD, OKP, OKUN). OKPD 2 is based on the decimal hierarchy with 9-digit codes. According to the hierarchical method of classification and the consecutive method of coding the structure of the code in OKPD 2 includes information on the class and the subclass of a product, its group, subgroup, appearance, category and a subcategory.

Unfortunately, the its harmonization with the classification of the European economic community (as well as in the case of Product range of foreign economic activity TNVED) resulted in that the description of products, perhaps, satisfactory from the point of view of wholesale trade, in some cases is inconvenient from the point of view of designer, estimator, or manager at the construction enterprise. For example, buildings, constructions, design documents and construction works are united according to OKPD 2 into the same Class 41. At the same time railroads, highways, bridges, tunnels, power plants and main pipelines are united into the class of civil engineering-Class 42 (obviously, it is the wrong interpretation of the English term "civil engineering" which currently means "construction of facilities" [19]).

Then works on construction of hydraulic engineering structures, constructions of the mining industry and even blast furnaces are referred to as "other civil constructions" though there are vacant positions of an appropriate level in Class 42. Class 43 "Specialized construction works" includes, besides wiring and insulating, grading, plaster, facing, painting and joiner's works which would not be refer to the specialized works by any constructor. Besides, pile, concrete and ferroconcrete works are referred to as the class of "other works".

Thus, the classifications which are available nowadays do not help the experts in construction to perform their professional activity but on the contrary they shade the essence of terms and do not allow to organize project management and construction properly.

Discussion

Coding of material resources

In this article we will consider the suggestions concerning only one aspect of the subject domain-material resources. We will note that in OKPD 2 they can be found in different classes, in some cases-according to the material they are made of, in other cases-according to their destination.

The authors repeatedly addressed in the works to the problem specified [3, 4, 13]. It was underlined that, in spite of the known convenience of hierarchical classification, it cannot quite reflect the property of the resources necessary for their use in practice of design and construction, budget and resource calculations. In this regard the use of the facet method of codification of concepts (first of all for the material and technical resources applied in construction) was offered.

Within this method the digital code is divided into some separate independent parts (facets) consisting of decimal figures divided by a special sign (usually a point). It is reasonable to limit the quantity of digits in a facet to two or three just because of convenience of reading and record: the quantity of signs doesn't matter for a computer. Nevertheless the majority of indicators can be coded in two or three digits.

If necessary it is possible to introduce additional facets, however the experience of the development proves that in most cases 3-4 facets are enough. For the admission of a facet the dividing signs follow one after another. For the increase of informational content it is possible to make complicated facets with a divider of the second level, for example, a colon or a dash. Then it is possible to connect (for example) some standard sizes in a single facet.

Without applying for a final decision, the authors suggest the preliminary structure of coding of material resources according to a number of positions brought to the level close to the production requirement. For example, the first facet can mean the field of application (type of works, facilities, structures) for material resources. For the classification of construction materials, elements and structures it is possible to use as the first facet the basic purpose on the following groups:

1- materials and products for the foundations and a roadwork;
2- construction materials and products;
3- architectural products;
4- functional materials for layers of coverings;
5- materials and products for technical systems;
6- materials and products for wirings and information systems;
7- materials and products for the improvement and “green” construction;
8- processing equipment;
9- other material resources.

The remained two digits of the first facet can be used for the specification of the purpose of materials, details and designs according to their appearance, type, industry of application. For example, the first facet can include natural soil (101), nonmetallic materials (102), materials for the road covering (103), elements and designs for the arrangement of roads (104), etc. The second facet can present the material origin (natural raw materials, semi-finished products, chemical compositions), the way of production or processing. The third facet can define certain properties of the product, characteristic for this position of classification: class on durability, type of isolation of the cable, plant grade, etc. The fourth facet can mean the main standard size of the detail, design (diameter, length, section, etc.).

Coding of material resources is possible on the basis of the OKPD2 code. The information on their design features and various properties is provided for the submission of fuller information on the used material resources in the OKPD 2 code (physical mechanical, ecological, ergonomic, etc.). In this regard the OKPD 2 code can be expanded to 15 digits which will contain the following information (for example, for reinforcing steel):

- class of production 24-Main metals
- subclass 24.1-Iron, cast iron, ferroalloys
- group 24.10-Iron, cast iron ferroalloys
- subgroup 24.10.6-bar and steel hot-rolled wire
- type 24.10.62-bar and other steel iron rolled wire, forged, hot-rolled, hot-drawn or extruded, without additional processing, including winded after rolling, from not alloyed steel
- category 24.10.62.210-reinforcing steel
- subcategory 24.10.62.211-reinforcing steel, hot-rolled for ferroconcrete structures
- type of fittings 24.10.62.211.XX-smooth/periodic profile in accordance with GOST 5781-82
- diameter of fittings 24.10.62.211.XX.XX-from 6 mm and more in accordance with GOST 5781-82
- class of fittings 24.10.62.211.XX.XX.XX-from A-I and more in accordance with GOST 5781-82

When forming a code it is necessary to specify addition information on standard, technical and other documentation which was the base for the development of a code for a specific material resource.

Coding of technical resources

The machinery used in construction, mechanisms and equipment can be classified according type of work, power, type of the transmission, running equipment, universality, form management etc. However from the position of budget rationing, first of all it is more reasonable to group according the technological sign taking into account those types or complexes of works in which they participate.

For the classification of technical resources according their destination it is possible to use the following groups for machines, mechanisms and construction equipment:

1- for a preparatory work, gardening and grading;
2- for pile and concrete works;
3- for road-building works;
4- for vertical transport;
5- for horizontal transport and charging (discharging);
6- for special works and installation of equipment;
7- for finishing, insulating and auxiliary works;
8- mechanized tool;
9- other technical resources.

Each of the specified groups contains, as a rule, no more than 100 versions that allows to create the first facet of 3 digits.

The second and third facets can present the main technical characteristics of the machinery: type of the propulsion unit, running gear and working unit, industry and technological features of the machine. At last, the fourth facet can be used for the record of the main production characteristic of the machine: loading capacity, productivity, volume of a ladle, draft, etc. Thus, 10-12 digits of the code contain the exhaustive characteristic of the construction machine sufficient for the application for the calculation of a project cost, planning of installation and construction works, organization of construction.

When coding the construction machinery and mechanisms on the basis of OKPD2 the structure of the code depending on the type of the used resource includes information on its loading capacity, power, etc. Below the process of formation of a code on the example of a construction tower crane is given:

- class of production 28-the Machinery and equipment which are not included into other groups
- subclass 28.2-Other m Machinery and equipment of general purpose
- group 28.22-Hoisting-and-transport equipment
- subgroup 28.22.1-Hoisting-and-transport equipment and its parts
- type 28.22.14-Derrick cranes; cranes; mobile lifting farms; portal cranes; the self-propelled or not self-propelled machines equipped with the crane
- category 28.22.14.120-Load-lifting cranes
- subcategory 28.22.14.126-Construction tower cranes
- type of the tower 28.22.14.126.XX-Rotary/not rotary type in accordance with GOST 13556-91
- cargo moment 28.22.14.126.XX.XX-from 25 t.m. and more in accordance with GOST 13556-91
- loading capacity 28.22.14.126.XX.XX.XX-to 5 t. and more in accordance with GOST 13556-91

Within drawing up sheets and estimates in construction it is admissible to specify additionally the name of material, design, construction machine and any additional technical characteristics as a text. Nevertheless the specified way of coding allows to facilitate considerably the automated data transmission between information systems, preparation for the project and technological documents for the needs of construction.

Coding of results of works

The hierarchical structure of works (WBS) is not widely spread, as it is impossible to cover all works and constructive elements of all buildings it is impossible with one structure. However the facet method of classification allows to overcome that. For example, the code of work or result of work may contain several facets. One of them (about 5 digits) designates a constructive element or a design. In the facet the hierarchy is kept. So, the first digit of a code designates the division of constructive elements of the first level into the systems:

1- foundations of buildings and constructions
2- the bearing structures of buildings and constructions
3- architectural details
4- coverings
5- technical systems
6- electric systems
7- processing equipment.

The second figure designates the class of designs:

12- groung constructions,
13- hydraulic engineering and underwater ground constructions, etc. At the same time works which will not result in any construction can be completed: for example, 11-preparatory work.

The third digit designates the type of constructive elements, etc. For example, the code 12532 can mean "Slopes of a road bed of the railroads". Totally the existence of about 5-7 thousand constructive elements is assumed.

The second facet indicates the main material the constructive element is erected of. For example, for ground constructions this code indicates the category of soil. It is expedient that this facet was similar by structure to the code of a material resource (see item 4.1).

The third facet (about 4 digits) indicates the applied technology. The technology is often reduced to the use of a definite equipment for the creation of a construction element. In this case the facet can be coordinated with the code of a technical resource (see item 4.2).

The fourth facet means various stage of life cycle for the same design, for example:

4- construction
5- installation of equipment
6- commissioning
7- repair and reconstruction
8- operation
9- dismantle.

The considered four facets can provide exhaustive information about the result of works, i.e. to prove what is created, from what it is created, how it is created and at which stage of life cycle it exists. In certain cases the code can be added with the building (construction) image and the image of the construction site, however in most cases it is considered to excessive.

Conclusion

Hypothetical uniform classification of all concepts is too difficult for the needs of construction to be used for any practical purposes. In this regard it is offered to develop the classification of material resources, and subsequently elements of designs and installation and construction works as the first step. It is proved that for such classifications the facet method of coding with the use of four main facets can be used. The specified codes can be used for managing the project in general, in budgeting, during scheduling and rationing expenditures of resources, during the creation of information model of the building. As it is also necessary to follow All-Russian standards, it is necessary to create in parallel some dictionaries for the code conversion into OKPD 2 [12].

The codification of resources and works is obviously the important classification element as it provides unambiguous perception of the code by computer and thus promotes the

improvement of its interaction with the human during the realization of information technologies.

The offered system of classification and codification of material resources and works will promote the solution of various tasks, such as: ensuring the exchange of information about material resources used between all the participants of the investment-and-construction process; the use of information in the course of the organization of the statistical account and reporting; provision of the conditions for the formation of the whole information space, including the sphere of pricing and budget rationing in construction. Besides, there will be an opportunity to provide harmonization with All-Russian qualifier of production according to types of economic activity OK 034-2014 (KPES 2008) under the condition of the use of the principles of coding of material resources and works described in this article.

References

[1] State budget standards. The federal budget prices of the materials, products and designs applied in construction (in 5 parts). accepted and enacted by the Orders of the Ministry of Construction, Architecture and Housing of Russia on January 30, 2014 #31PR, on October 17, 2014 #634 PR, on November 12, 2014 #703PR.

[2] Instruction on the order of definition of estimated cost of construction and drawing up budget documentation on the basis of standards of expenditure of resources in kind. Enacted by the resolution of the Ministry of architecture and construction of Belarus on 18.11.2011 #51.

[3] Karakozova I.V. Methods of material resources management and rationing of their expenditure at the construction enterprises: abstract from the Candidate of Technical Sciences thesis : 05.02.22.-Moscow, MSUCE, 2007.-22 p.

[4] Karakozova I.V., Pavlov A.S. Classification of material resources in construction. Collection of the reports of the XIV seminar "Theoretical principles of construction". Warsaw: Polytechnical institute, 2005.

[5] Kiiras Yu, Tauriaynen M. Calculation of costs in construction: Finnish practice//Bulletin of price management and budget rationing, 2004.-#1 (38), page 37-56; #3 (40), pp. 51-55.

[6] The methodical instructions on the determination of cost of construction of enterprises, buildings and constructions and drawing up budget documentation with the application of resource and budget standards (RDS 8.01.105-03) approved by the Order of the Ministry of architecture and construction of Belarus on 29.04.2003 г. #91

[7] Methodological provisions on the statistic indicators system developed in the statistics of construction and investments into fixed capital. Approved by the order of Rosstat on 11.03.2009 #37.

[8] MDS 81-35.2004 "Technique of determination of cost of construction products in the territory of the Russian Federation".-/ State Committee for Construction of Russia / Moscow, 2004

[9] ODM 218.9.001-2013. Application of the structured lists of works on the maintenance of public highways of federal value and road constructions in the automated navigation systems of dispatching control. Approved by the order of Federal Highway Agency of the Ministry of transport of the Russian Federation on 28.06.2013, #879-r.

[10] OK 005-93 (OKP). All-Russian qualifier of production. Approved and enacted by the Resolution of Gosstandart of the Russian Federation on 30.12.1993 # 301

[11] OK 029-2014 (KDES 2). All-Russian qualifier of types of economic activity. Approved by the order of Rostechregulirovanie on 31.01.2014, #14-st

[12] OK 034-2014 (KPES 2008). All-Russian qualifier of production by types of economic activity. Approved and enacted into operation by the Order of Federal Agency for Technical Regulation and Metrology on January 31, 2014, # 14-st

[13] Pavlov A.S. Information transfer and recognition of projects in systems of construction design. Moscow: New Millennium Fund, 2003.-272 p.

[14] PR 50.1.024-2005 Standardization regulations "Basic provisions and the order of work on development, maintaining and application of the all-Russian qualifiers". Approved and enacted by the Order of Federal Agency for Technical Regulation and Metrology on 14.12.2005 #311-st.

[15] TCH-2001.1. Average budget prices of materials, products and designs (with the enacted additions from 1 to 34). Approved and enacted by the Resolution of the Government of Moscow on 14.11.2006 #900-PP.

[16] TCH-2001.2. The budget prices of the maintenance of construction machinery (with the enacted additions from 1 to 34). Approved and enacted by the Resolution of the government of Moscow of 14.11.2006 No. 900-PP.

[17] TCH-2001.13-2. Collection of the average budget prices of the equipment, furniture, stock and accessories ((with 2 enacted additions). Approved and enacted by the Order of Moskomekspertiza on 14.12.2013, #87.

[18] Gelder J. Classification. Manchester, 2012. URL = http://www.cpic.org.uk/wp-content/uploads/2013/06/classification_v1.2.pdf.

[19] ISO 6707-1:2014 Building and civil engineering works-Vocabulary. Part 1: General terms.

[20] MasterFormat Number & Titles. URL = http://www.generalinsulation.com/wp-content/uploads/2014/11/MasterFormat-2014-Divs.-147222340-Sales-Opportunities.pdf.

[21] OmniClass. A Strategy for Classifying the Built Environment. URL = http://omniclass.org.