Structural Design in Russia for a company operating from Finland

Tekla Structures Russian Environment

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Bachelor's thesis

Hämeenlinna, Degree Programme in Construction Engineering

2nd Semester, 2020

Kirill Zhdanov

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Degree Programme in Construction Engineering
Hämeenlinna University Centre

Author	Kirill Zhdanov	**Year** 2020
Subject	Structural Design in Russia for a company operating from Finland. Tekla Structures Russian Environment.	
Supervisor(s)	Ahmad Shagerdi (HAMK), Alexey Krishtalevich (AFRY)	

ABSTRACT

This Bachelor's thesis was commissioned by AFRY Finland Oy (former Pöyry Finland Oy). AFRY, as a big player in the engineering market, intends to participate in Russian projects in the near future. Therefore, the company requires to be capable to implement a project using the advanced design software, such as Tekla Structures and have deep knowledge about the Russian design system in order to provide high-quality solutions.

The purpose of the thesis was to conduct research on the structural design processes and project management systems used in Russia and provide the reference guidelines about it in order for the design team, working on a Russian project to read the guidelines and get essential knowledge without sourcing the material in the Russian language. The other target was to analyze, edit and develop Tekla Structures Russian Environment in order to make it possible to produce project documentation according to GOST standards. In addition, the aim was to guide the potential user through the processes of using Tekla Russian Environment, show practical features and explain the software insights.

The thesis is divided into two main parts. The first part summarizes the information about project design and management system in Russia, gives an introduction to the Russian norms and standards and describes the processes of design documentation development. In the second part, the BIM technology was introduced. The development processes of TS Russian Environment were displayed, guidelines about the use were given. As a result, AFRY has successfully launched the first project in Russia using Tekla. The designers of the project used parts of the thesis as a reference and TS with Russian Environment as the main tool.

Keywords Tekla Structures, Russian Environment, BIM, GOST, Structural Design

Pages 69 pages + appendices 24 pages

CONTENTS

Appendices

FIGURES

1 INTRODUCTION

This Bachelor's thesis including all the materials, databases, metadata, accompanying texts and files, prepared and developed during the research and practical tasks are directed to the needs of AFRY Finland Oy.

Some of the textual data is presented in bilingual format, containing Russian language words in the Cyrillic alphabet.

AFRY Finland Oy (globally - AFRY) is an international engineering and consulting company, providing services in energy, industry and infrastructure sectors, with offices in more than 40 countries across the world and with more than 16,000 employees. Behind the brand AFRY stand two international companies ÅF-Consult and Pöyry which joined forces in 2019 and formed a new company AFRY.

AFRY is one of the leading companies in structural design and innovative building solutions in Nordic countries. Due to the wide area of expertise, efficient, high-quality solutions and experience in implementation of projects in Russia, AFRY considers to have big involvement in the Russian engineering market in the near future, and, as a result, the launch of new projects. Knowing this fact, the company is required to be capable to develop and implement any project according to the Russian norms of construction and standards of design documentation.

The following work covers general and structural design sections of project activities. As the main tool in structural design, AFRY uses Tekla Structures software to produce a BIM-based model, accompanying the building during its life cycle.

In terms of software, the main problem of using Tekla Structures is that the design documentation, produced using it, should comply with GOSTs and its strict rules on project documentation formats. This problem leads to the development of Tekla Structures Russian environment. The other reason why implementing projects in Russia is difficult is that as an international company, AFRY has a multinational team, and the project organization should be made so that speaking different languages is not a barrier for reaching high-quality engineering solutions.

Summing up these two problems, the decision was made to conduct a research and then develop reference guidelines about how to implement projects on the basis of engineering in Finland, project location in Russia; how to organize the structural design documentation to comply with GOSTs. Consider the problems regarding Tekla Structures Russian Environment, edit and develop the necessary program attributes to be able to execute the project in Russia using Tekla as the main tool.

2 STRUCTURAL DESIGN IN RUSSIA

2.1 General information

The implementation of a project in Russia differs to a great extent from the projects executed in the European Union countries. However, the basic design processes, e.g. making drawings, structural calculations and other technical tasks naturally remain very similar, a variety of different design norms and standards, invented in the USSR, adopted by ISO and used in Russian Federation and the Commonwealth of Independent States (CIS) countries, apply very strict rules on all the design stages of the project. These norms and standards will be considered in the further sections of the thesis.

According to the requirements of the Town Planning Code of the Russian Federation, mandatory design documentation is required for the implementation of new construction, reconstruction and some types of major repairs of buildings and structures. This documentation consists of textual and graphical materials that define the architectural, technological, functional and engineering parameters of the future building or construction object.

The design technology, depending on the type and purpose of the object, may differ, but the staging and the order of work, in most cases, are preserved. The design process consists of the following steps:

- Collection of initial permits
- Performing engineering surveys at the site of the construction
- Development of project documentation for obtaining approvals from the State Construction Supervision and Expertise Department
- Technical expertise appraisal of project documentation
- Development of working documentation
- General Designer's site supervision

The further sections of the thesis describe mostly the subjects related to the project's structural design objectives.

2.2 Structural design stages

GOST 2.103-2013 determines the main divisions (stages) of the structural design procedures to which the Customer of the project, General Designer, Main Contractor and all involved parties are referring during the agreement signing, project execution, technical expertise and reporting. These stages are shown in Table 1.

Table 1. Structural design stages

Technical assignment	Техническое задание (ТЗ)
Technical proposal	Техническое предложение (ПТ)
Conceptual design	Эскизный проект (ЭП)
Basic (project) design (P)	Технический проект (ТП)
Technical expertise	Техническая экспертиза
Detailed (working) design (W)	Рабочий проект (РП)

- **Technical assignment.** In this task, the customer establishes the basic conceptual, technical and functional characteristics of the construction object, general and specific technical and financial tasks, terms of compliance with the requirements at various stages of the project and the general scope of work. The task should be accompanied by the documents that prove the rationale for the investment to the project, duties of General Designer (GD) and basic architectural plans. The agreement between the customer and GD is usually signed at this stage.

- **Technical proposal.** It is a set of documents that contain the feasibility study and technical justification of the project. The conclusion about the feasibility is given after analyzing the technical assignment of the customer, project-related risks and consideration of alternative solutions by comparing them with each other.

- **Conceptual design.** At this stage, a package of documents which contain general ideas about the principles of operation, structural plans (low level of detailing), including structural types, overall dimensions and other parameters, as well as the information about the set of fundamental decisions chosen for this building. In case of designing particularly complex structures, additional pre-design studies (advance design) can be carried out, the results of which become the rationale for the possibility of creating the conceived building (or structure).

- **Basic design.** The technical documentation contains final decisions of the structure (medium level of detailing) and the initial data of project disciplines e.g. HVAC design drawings, complete set of architectural plans, design of sewage and water communications, building-specific design drawings, etc. Basic design documentation forms the main set of documents of the project. According to GOST 21.1101-2013, basic design documentation should be sectioned as shown in Table 2.

Table 2. Design documentation sections

Section/ Раздел		
1	**Project summary**	**Пояснительная записка (ПЗ)**
2	Construction site layout	Схема планировочной организации земельного участка (ПЗУ)
3	Architectural design	Архитектурные решения (АР)
4	**Structural design and space planning (ST)**	**Конструктивные и объемно-планировочные решения (КР)**
5	Mechanical equipment, engineering networks, engineering and technical communications, process design	Сведения об инженерном оборудовании, о сетях инженерно-технического обеспечения, перечень инженерно-технических мероприятий, содержание технологических решений (ИОС)
6	Construction management plan	Проект организации строительства (ПОС)
7	Demolition or disassembling of existing structures	Проект организации работ по сносу или демонтажу объектов капитального строительства (ПОД)
8	Environment protection actions	Перечень мероприятий по охране окружающей среды (ООС)
9	**Fire safety actions**	**Мероприятия по обеспечению пожарной безопасности (ПБ)**
10	Actions on providing an access to physically challenged persons	Мероприятия по обеспечению доступа инвалидов (ОДИ)
10.1	Safety requirements to the object of the construction	Требования к обеспечению безопасной эксплуатации объекта капитального строительства (ТБЭ)
11	Cost estimation documents	Смета на строительство объектов капитального строительства (СМ)
11.1	Actions to ensure compliance with energy efficiency and consumption requirements. Requirements for buildings and structures to be equipped with energy	Мероприятия по обеспечению соблюдения требований энергетической эффективности и требований оснащенности зданий, строений и сооружений

	metering devices	приборами учета используемых энергетических ресурсов (ЭЭ)
12	Other documentation in cases, covered in federal laws	Иная документация в случаях, предусмотренных федеральными законами

According to these sections, the design documentation is systemized by an assignment or action determined in each section and then formed into the document sets. The information about structural design documentation (Section 4) can be found in Chapter 3 (Design documentation).

- **Technical expertise.** Basic design documents set, as a rule, passes the examination. In a vast majority of cases, the customer announces a tender for the examination of large and complex structures. In the process of examination, the examination company (or authority) checks the compliance of the developed project with the issued technical assignment, analyzes the technical level of progressiveness and novelty of design solutions, checks the correctness of the assessment of the financial efficiency of investments, compares the decisions with the best domestic and foreign projects. Particular attention is drawn to the solution of issues related to the safety of structures.

After completion of the examination, expert opinion is transmitted to the GD. If the design documentation gets the status “accepted”, GD and the Customer, after checking comments, decide together on the finalization of the project and making any changes to it. After that, the project is fully approved, and the customer decides to announce the tender for the construction (in some cases, this part may include one more set of project documentation called “Tender documentation” which is defined by the customer). When the main contractor is determined, they start to prepare the construction management assignments: site set-up plans, execution timetables, working cycles with labour timing, site safety and logistics plans, etc.

Note: According to the “Regulations on the procedure for the examination of design documentation 145/2007”, those parts of the design documentation, in which changes that were made affect the structural safety and reliability of the structure, should be subjected to re-examination.

- **Detailed design.** At this stage, the detailed documentation (working drawings) is developed based on the previous stage. The stage starts when the main contractor is defined. The content of detailed design documentation is listed in GOST 21.1101-2013. It is quite the same as

in basic design set. Working documents include local estimates, volumes, areas and requirements for building materials, equipment specifications, requirements for the production and structure performance, etc.

Note: When drafting working drawings, it is prohibited to accept deteriorating technical and economic solutions, previously agreed in basic design, that adversely affect working conditions on the construction site or reduce the amount or quality of safety facilities.

2.3 **Engineering standards**

2.3.1 Technical calculations and design according to SP

"SP" (СП – in Russian) is a set of rules officially used in Russian Federation for design and construction as a regulatory document that provides recommendations for technical solutions and engineering survey procedures for construction, design, installation works and manufacture processes of construction products, as well as for the implementation of construction and defining ways of achieving the design compliance with the mandatory requirements of building codes and standards.

SP norms are setting the main values, principles and formulas to be used when making technical calculations of buildings, structures and objects of the construction. Equivalently, as in the EU, the Eurocode must be used as a basis for technical calculations and design of the structures. From the technical side, the design of structures should always be made according to SP rules. It is very important that they are clearly displayed in calculation reports with references, as they later will be examined by the state technical expertise.

Below is the list of active SP codes related to structural design (the list contains only the major codes, not all of the available ones):

- *СП 16.13330.2017* Steel structures. This set of rules establishes the requirements for the design and technical calculations of steel structures for buildings of different purpose, being executed under the range of temperatures no more than 100°C and not less than -60°C. (The content is equal to Eurocode 3, Design of steel structures)
- *СП 20.13330.2016* Loads and actions. This set of rules establishes requirements for the assignment of loads, impacts and their combinations, taken into account when calculating buildings and structures for the limiting conditions of the first and second groups, in accordance with the provisions of GOST 27751. (The content is equal to Eurocode 1, Actions on structures)

- *СП 22.13330.2016* Soil bases of buildings and structures. This set of rules applies to the design of soil bases of newly constructed and renovated buildings and structures in trenches and open spaces.
- *СП 24.13330.2011* Pile foundations. This set of rules establishes requirements for the design of foundations with different types of piles in different engineering and geological conditions and in all types of structures.
- *СП 26.13330.2012* Foundations for machines with dynamic loads.
- *СП 28.13330.2017* Protection of structures against corrosion.
- *СП 41.13330.2012* Concrete and reinforced concrete hydraulic structures.
- *СП 45.13330.2017* Earthworks, grounds and footings. This set of rules contains instructions on the execution and conformity assessment of earthworks, construction of bases and foundations for new and renovated structures.
- *СП 50.13330.2012* Thermal performance of the buildings. This set of rules applies to the design of thermal protection of residential, public, industrial, agricultural and storage buildings under construction with a total area of more than 50 m^2, in which a certain temperature and humidity conditions must be created.
- *СП 51.13330.2011* Sound protection. This set of rules establishes the requirements for the design, construction and operation of buildings for various purposes, urban and rural area planning, in order to protect against noise and provide regulatory parameters of the acoustic environment in industrial, residential and public buildings, adjacent to the territories and recreational areas.
- *СП 54.13330.2016* Residential buildings. This set of rules applies to the design and construction of new and renovated multi-apartment residential buildings up to 75 m high, including apartment-type dormitories, as well as residential premises constituting buildings of other functional purposes.
- *СП 56.13330.2011* Production buildings.
- *СП 58.13330.2012* Hydraulic structures. Basic statements.
- *СП 63.13330.2018* Concrete and reinforced concrete structures. This set of rules applies to the design of concrete and reinforced concrete structures of buildings for various purposes, operated in the climatic conditions of Russia (with systematic exposure to temperatures not higher than 50 °C and not less than -70 °C) in an environment with a non-aggressive degree of impact. The set of rules establishes requirements for the design of concrete and reinforced concrete structures manufactured from heavy, fine-grained, lightweight, cellular and pre-stressed concrete, and contains recommendations for the design and calculation of structures with composite polymer reinforcement. (The content is equal to Eurocode 2, Design of reinforced concrete structures)
- *СП 64.13330.2017* Timber structures. This set of rules on the methods of designing and calculating structures made of solid and glue-laminated timber, used in public, residential, industrial and

other constructions, in new and operating buildings and structures and objects of renovation. (The content is equal to Eurocode 5, Design of timber structures)

- *СП 70.13330.2012* Load-bearing and separating structures. This set of rules applies to the design of load-bearing and separating structures of industrial, agricultural, residential and municipal buildings. The set of rules applies during the construction of monolithic concrete and reinforced concrete structures made of heavy concrete, heat-resistant and alkali-resistant concrete, during the application of shotcrete and underwater concreting; in the design and manufacture of precast concrete and reinforced concrete structures on the construction site; when installing precast reinforced concrete, steel, timber structures and structures made of lightweight materials; when welding assembly connections of steel and reinforced concrete structures, reinforcement joints and embedded products of reinforced concrete structures; in the construction of masonry and reinforced masonry structures made of ceramic and silicate bricks, ceramic, silicate, natural and concrete stones, brick and ceramic panels and blocks, concrete blocks. The requirements of this code should be considered when designing the structures of buildings and individual structures.
- СП 113.13330.2016 Parking places.
- СП 118.13330.2012 Public buildings.
- СП 128.13330.2016 Aluminium structures. (The content is equal to Eurocode 9, Design of aluminium structures)

Below, as a reference, are the examples extracted from *СП 20.13330.2016* Loads and actions. Figures 1, 2 display the map of snow load distribution across the Russian Federation municipal districts and load values in kPa, accordingly. Figures 3, 4 display the wind pressure map across the Russian Federation municipal districts and load values in kPa, accordingly.

Figure 1. Snow load distribution map

Снеговые районы (принимаются по карте 1 приложения Е)	I	II	III	IV	V	VI	VII	VIII
S_g , кПа	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0

Figure 2. Snow load values, kPa

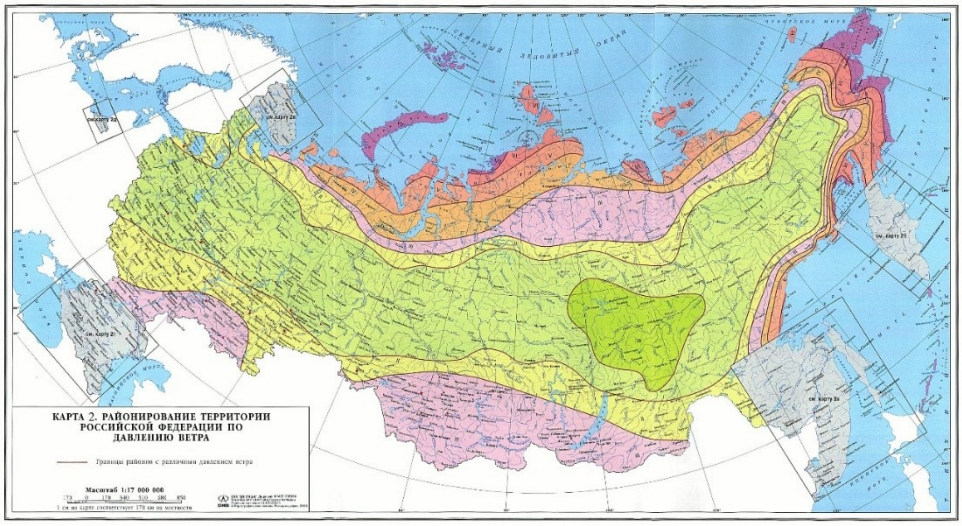


Figure 3. Wind pressure distribution map

Ветровые районы (принимаются по карте 2 приложения Е)	Ia	I	II	III	IV	V	VI	VII
w_0 , кПа	0,17	0,23	0,30	0,38	0,48	0,60	0,73	0,85

Figure 4. Wind load values, kPa

Comparing SP and Eurocode standards, fundamentally, the design and calculation processes are very similar. However, there are quite many differences in design values and coefficients used due to the fact that these standards were developed at different times, independently, by various nations, to meet the specific criteria. In the Russian Federation, SP norms are mandatory to use in structural design.

As an example of a comparison between SP and Eurocode, the table was created (see Table 3) showing characteristic equally distributed imposed loads on floors, in buildings of different purpose. The information was extracted from Eurocode 1, Actions on structures (EN1991-1-1:2002, 6.3.1.2) and SP 20, Loads and actions (*СП 20.13330.2016, 8.3).* The load values are given in a range to cover the difference specified in Eurocode national annexes.

Table 3. Eurocode to SP comparison, imposed loads on floors

Eurocode 1, Part 1-1			*СП 20.13330.2016*		
Category	Specific use	qk [kN/m^2]	Category		qk [kN/m^2]
A	**Domestic and residential areas:**				
	-floors	1,5-2,0	1		1,5
	-stairs	2,0-4,0	10		3,0-4,0
	-balconies	2,5-4,0	12		2,0-4,0
B	**Office areas**	2,0-3,0	2		2,0
C	**Congregation areas:**				
	-areas with tables	2,0-3,0	4(а)		2,0
	-areas with fixed seats	3,0-4,0	4(б)		3,0
	-public access areas	3,0-5,0	9(а)		4,0
	-areas with possible physical activities	4,5-5,0	4(в)		4,0
	-areas susceptible to large crowds	5,0-7,0	7(а)		4,0-5,0
D	**Shopping areas**	4,0-5,0	4 (г)		4,0
E	**Storage areas**	7,5	-		>5,0

As seen in Table 3, SP norms give slightly lower values for imposed load actions. As Russian norms are mandatory to use in structural design, in some cases, when the project is implemented in Russia, but engineering and design is done in one of the European Union countries, it is allowed to take into account Eurocode values and use the middle (average) number to be on the safe side, but only if the average value will be greater than the basic given by SP norms.

Consequence/reliability classes for buildings and structures are given in Figure 5 (GOST 27751-2014, 10.1). The difference between SP and Eurocode (EN1990-1-1) is only in class 1 and is 0,8 and 0,9 accordingly.

Класс сооружений	Уровень ответственности	Минимальные значения коэффициента надежности по ответственности γ_n
КС-3	Повышенный	1,1
КС-2	Нормальный	1,0
КС-1	Пониженный	0,8
Примечание - Для зданий высотой более 250 м и большепролетных сооружений (без промежуточных опор) с пролетом более 120 м коэффициент надежности по ответственности следует принимать не менее 1,2 ($\gamma_n = 1,2$).		

Figure 5. Consequence/reliability classes, GOST 27751-2014

2.3.2 Design documentation according to GOST

GOST is a set of technical standards maintained by the Euro-Asian Council for Standardization, Metrology and Certification (EASC), a regional standards organization operating under the auspices of the Commonwealth of Independent States. GOST standards are used in the Russian Federation and other 11 countries of the CIS union: Belarus, Ukraine, Moldova, Kazakhstan, Azerbaijan, Armenia, Kyrgyzstan, Uzbekistan, Tajikistan, Georgia, Turkmenistan.

At present, the collection of GOST standards includes over 20,000 titles. Serving as the regulatory basis for government and private-sector certification programs throughout the Commonwealth of Independent States, the GOST standards cover energy, oil and gas, environmental protection, construction, transportation, telecommunications, mining, food processing, and other industries. Since the EASC, the organization responsible for the development and maintenance of the GOST standards, is recognized by ISO as a regional standards organization, the GOST standards are classified as the regional standards. The national standards of Russia are the GOST R standards.

In the structural design section of project documentation, two main subdivisions of GOST standard are used: (SPDS) and (ESKD). These norms establish uniform rules for the implementation of project documentation for construction. In detail:

- unification of the content, rules of registration and circulation of documentation, taking into account the designation of project documents
- completeness of the documentation, taking into account the contractor's specialization, type and purpose of the object of the construction
- the maximum necessary amount of documentation for the construction and installation works
- general rules for the implementation of drawings and text documents, regardless of the intended purpose of the object and type of design solutions
- unification of project documents and graphic images with the exception of information not required by the consumer
- unification of terms and concepts used
- the use of project documentation in computer-aided design and construction management systems
- the possibility of implementation high-quality production of design products and its reprography

The abbreviation SPDS (transliteration from Russian) or SPDC (translation) stands for the System of Project Documentation for Construction. It is a set of regulatory organizational and methodological

documents that establish the general technical requirements necessary for the development, accounting, storage and use of project documentation for the construction of various facilities. SPDS standards are used in the development of building's and structure's project documentation and they regulate how the design documentation looks.

The abbreviation ESKD (transliteration from Russian) or USCD (translation) stands for the Uniform System of Constructor Documentation. It is a set of state standards that establish interrelated rules, requirements and norms for the development, design and handling of design documentation, developed and applied at all stages of the product life cycle (in the design, development, manufacture, control, acceptance, operation, repair, recycling).

To put it simply, all the structural design documentation, its content, numbering, formats, sectioning and development procedures must comply with SPDS standards. It is usually applied to the documentation of the Basic Project stage. ESKD norms are focused on a detailed level design attributes and give rules on how technical drawings, textual files, images, stamps, templates are supposed to look like. ESKD give requirements for certain attributes, such as fonts, scales, dimensions, annotations, lines, tables, lists, images, stamps, etc.

GOST standards may be advisable or obligatory. Obligatory are the ones, dealing with safety, environmental impacts, inter-changeability, conformity and risks.

Detailed information about the application of these standards can be found in Chapter 3, Design Documentation.

GOSTs related to structural design documentation are given below:

General

- *ГОСТ Р 21.1101-2013* SPDS. Main requirements for the design and working documents. The standard is obligatory to use.
- *ГОСТ 21.501-2018* SPDS. Rules for execution of working documentation of architectural and construction solutions. The standard is obligatory to use.
- *ГОСТ 21.201-2011* SPDS. Symbol graphics elements of buildings, works and structures. The standard is obligatory to use.
- *ГОСТ 21.110-2013* SPDS. Specification of equipment, products and materials. The standard is obligatory to use.
- *ГОСТ Р 2.901-99* ESKD. Documentation to be sent abroad. General requirements.
- *ГОСТ 2.102-2013* ESKD. Types and sets of design documentation.

Steel Structures

- *ГОСТ 2.410-68* ESKD. Rules for making drawings of metal structures.
- *ГОСТ 21.502-2016* SPDS. Execution rules of working documents for metal structures. The standard is obligatory to use.

Concrete Structures

- *ГОСТ 23009-2016*. Prefabricated concrete and reinforced concrete constructions and products. Symbols (marks).

Timber Structures

- *ГОСТ 21.504-2016* SPDS. Rules for execution of working documentation for wooden structures. The standard is obligatory to use.

All GOST and SP standards are in public access and can be downloaded from the official sources:

- http://docs.cntd.ru/ (Electronic Database of Law and Normative-Technical documentation, Official) Contains a complete database of GOST and SP standards with information on validity.
- https://www.gost.ru/portal/gost/ (Federal Agency for Technical Regulation and Metrology, Official) Main state regulating agency.
- https://runorm.com/ (Russian Standards and Technical regulations) GOST and SP standards in the English language can be purchased from here.

3 DESIGN DOCUMENTATION

3.1 General information

Technical documentation for the project has to follow the rules of sectioning as it was mentioned earlier in Chapter 2, Table 2. In the following chapter, we will touch upon the Section 4 (Structural design and space planning) of design documentation. This section forms the main set of documents providing solutions and working drawings for the construction of the building (or structure).

Basically, the design documentation (its major scope) is divided into two parts: **Basic Design Documentation** or **Project Documentation** (abbreviation: PD or P) and **Working Documentation** (abbreviation: WD or W). It is also called stage “P” and stage “W” documentation. Both Project Documentation and Working Documentation relate to the following design stages (see Table 1) accordingly. GOST R 21.1101-2013 SPDS defines the main rules for the content, completeness, sectioning,

development, formatting, as well as rules for revising of Project and Working Documentation.

Depending on the project's size, one-stage or two-stage design systems could be implemented. The one-stage system implies that the development of Working Documentation can go along with the Project Documentation. In that case, if the main technical solutions of the object are already agreed between the project participants, then, while simultaneously developing two stages, the construction of the object can begin immediately after receiving a positive expert opinion (meaning technical expertise) and a construction permit. The essence of the two-stage system is that the documentation is developed in stages: at the first stage, the Project Documentation is developed, the main design decisions are made, the documentation for construction is approved and only after that the "W" stage begins.

3.2 **Stage "P" documentation**

The stage "P" documentation must pass the examination process. The set of documents sent for the technical expertise does not include detailed information about all the building's structures, but it should show the fundamental and principal solutions that were made. The content of Project Documentation includes:

- Explanatory note or a description of the building (in Finnish - rakenteiden suunnittelun perusteet) including general information about the building, consequence class, lifetime, fire resistance class, location of the building, geotechnical data, design loads, design standards, etc.
- Technical calculation reports of the building's overall stability, stiffening diaphragm, foundation support reactions, etc.
- Document register ((list of applied documents) see Appendix 2)
- Structural types
- Typical joints
- Typical connections
- Foundation loads plan
- Typical floor plan level: +0.000…
- Layout of load-bearing structures
- Drawings of typical elements:
    - Column
    - Beam
    - Stairs
    - Wall panel
    - Hollow-core slab
- Reinforcement drawings of typical elements
- Other project-specific drawings

Having passed the technical expertise, the set of documents prepared on the “P” stage will change its status to “W” as soon as it is finalized and completely detailed. Then, this set becomes construction working documents.

According to GOST R 21.1101-2013 SPDS, Project documentation should be divided into volumes (*Том* – in Russian) following the sections of project documentation (see Table 2). An example of the stage “P” document set for the structural design can be found in Table 4.

Table 4. Example of stage “P” document set

№ Тома/ Volume	**Обозначение/ Code number**	**Наименование/Name**	**Примечание/Note**	**Исполнитель/ Performer**
1	2	3	4	5
Раздел 4. Конструктивные и объемно-планировочные решения Section 4. Structural Design and Space Planning				
Том 4.1	5720-02-П-КР.1	Конструкции железобетонные. Concrete structures	-	Company A
Том 4.2	5720-02-П-КР.2	Конструкции железобетонные. Concrete structures	-	AFRY Finland Oy
Том 4.3	5720-02-П-КР.3	Конструкции металлические. Steel structures	-	AFRY Finland Oy
Том 4.4	5720-02-П-КР.4	Технические расчеты. Technical calculations	-	Company B

*Each volume of stage “P” documentation must start with the title page (see Appendix 3 for the example). Title pages are not numbered.

[5720-02]-[П]-[КР.1] – is the code number of structural design documentation, where:

[5720-02] – is the number of the project, established by the customer or General Designer
[П] – is the abbreviation of Project (*Проект* – in Russian) Documentation
[КР.1] – is the volume 1 of the set

Each volume of Project Documentation must be formed as follows:

1. Cover page (*ГОСТ Р 21.1101-2013, приложение Н*), (see app. 3)
2. Title Page (*ГОСТ Р 21.1101-2013, приложение П*) , (see app. 3)
3. The content of the volume (*ГОСТ Р 21.1101-2013, приложение Г*)
4. Document register (*ГОСТ Р 21.1101-2013, приложение Г*) Document register is allowed not to include to each volume separately but add it as an independent document to the whole set.
5. Textual part
6. Graphical part (drawings and schemas)

The number of sheets included in each volume must not exceed 300 pages of A4 format or equivalently of other formats.

Each document of the volume must have a running number if the set consists of separate documents or, if there is an assembly of documents, each page should be numbered. Depending on the Customer's requirements, there is a possibility to number documents using Latin letters and English abbreviations, e.g. if the Customer is an international company building in Russia or a Finnish Contractor. In AFRY, the major number of projects implemented in Russia were done for Finnish building companies like SRV Development LLC and YIT Construction.

Document numeration:

Page system:

5720-02-П-КР.1 – would be the number of all documents in assembly, following the code of the volume, where each page has a running number. For example, the volume consists of 100 pages (cover and title pages are not numbered), pages 1-5 are the volume's content, pages 6-15 are textual documents and pages 16-100 are drawings. Therefore, the first drawing must have a start page number 16. In electronic format, these documents can be created as separate files and then merged into one file when finished.

Running number system:

[5720-02-П-КР]-[А-01-01-1001] – would be the number of an individual document, where [5720-02-П-КР] is general part, the same for all documents and [А-01-01-1001] is specific designer's system, which can include e.g. the block number (А), floor elevation (01), specific drawing type code (01) and running number (1001). Page numbers are added post factum.

If numbering is done in Latin letters and English abbreviations, then the document number could be:

5720-02-P-ST-A-01-01-1001 – where "P" displays the Project Documentation, "ST" – structural design section.

Page system is not possible because the documentation volumes which go for the technical expertise must be named in Cyrillic letters, and therefore the listed documents, too.

The system for assigning numbers for documents could be done as shown in Table 5.

Table 5. Document numbering system

Project number	Design stage	Section	Block	Elevation	Type code	Running number
[5720-02]	[P]	[ST]	[A]	[01]	[01]	[1001]

Building's blocks: [A], [B], [C], [D], …

Elevations:
[00] - +0.000
[03] - +3.500
[07] - +7.500
[11] - +11.500
…

Type codes:
[01] – Textual
[02] – General
[03] – Sections
[04] – Dimensional
[05] – Reinforcement
[06] – Element
[07] – Steel
[08] – Geo
…

Running numbers:
[0001] – Drawing list
[0100] – Specifications, list of bid items and quantities, cost estimation
[1000] – Cast-in-place structures
[3000] – Precast elements
[5000] – Steel structures
[7000] – Recess drawings
…

3.3 **Stage "W" documentation**

Working documentation, in practice, is a package of basic sets of working drawings in which different types and directions of construction work are presented. There are presented text documents, drawings and specification lists, according to the SPDS standards. In the Decree on the composition of the sections related to Working Documentation (*Минстрой РФ, ПП No. 87*) in Paragraph 4 of the general provisions, it is determined that the Working Documentation is developed for the implementation of various architectural, technical and technological solutions during the construction process. Working documents are made

for each construction object in the form of working drawings, textual documents, product specifications and/or equipment catalogues. There are rules and standards for the development of each Main Set of Working Documentation which will be described below.

The Main Sets of such documents are combined by code marks - letter abbreviations, in which one or another type of construction and installation activity is encrypted (for example, GP - General Plan, AR - Architectural Solutions, etc.). A complete list of such marks is a list of several dozen items, among which there are combined ones. For example, when combining the general plan (GP) and transport facilities (TR) under one brand into a consolidated section, it receives the “code” GT. The choice of the appropriate mark at a particular construction site is carried out by the design organization, but in most cases they represent the following areas of work:

- Architectural design
- Structural design
- Power supply
- Water supply and drainage
- Heat and cold supply
- Ventilation
- Gas supply
- Protection systems
- Telecommunication systems, etc.

GOST R-21.1101-2013 SPDS says that the working documentation transferred to the customer includes working drawings of the Main Set and documents attached to them, which, in turn, include:

- Working documentation related to building products
- Dimensional and reinforcement drawings
- General plans
- General data for the whole building/separate structure/concrete/steel, depending on the project (see Appendix 4 for General Data Sheet template example)
- General drawings of non-standard products
- Dimensional drawings developed on the basis of manufacturers' data
- Equipment specification
- Material specification
- Product specification
- Local estimate and other documents in accordance with SPDS and Customer’s technical assignment

The specification lists must be performed according to the requirements of GOST-21.110, and the outline drawings - according to the requirements of GOST-21.114

Document numeration:

Typically, in Russia, each of the Main Sets of Working Documents is marked according to the recommendations set in Appendix B, Table B.1 of GOST R-21.1101-2013 SPDS. The code marks are assigned by the purpose of the structures or object of the construction, it could be e.g. reinforced concrete structures (code mark "RC"), steel structures (code mark "S"), etc. These code marks are presented in Table 6.

Table 6. Code marks of Main Sets of Working Documents

Name of the Main Set of Working Documents	Code mark (Rus)	Code mark (Eng)	Note
General Plan	ГП	GP	General Plan meaning the layout of building surroundings, external facilities, transportation, etc.
Architectural and Structural solutions	АС	AS	When architectural and structural solutions are combined (except steel structures)
Architectural solutions	АР	AR	-
Reinforced Concrete structures	КЖ	RC	-
Steel structures	КМ	S	-
Steel structures detailed	КМД	SD	-
Timber structures	КД	ST	-
*The complete list of available code marks is given in GOST R-21.1101-2013 SPDS, Appendix B, Table B.1. **Code marks are translated to Latin letters according to their meaning and ISO standards containing similar abbreviations. Transliteration is not used.			

Working drawings are numbered in accordance with the code mark of the Main Set. This is the traditional system. For example, there are four main Sets of Working Documents: *КЖ1, КЖ2, КЖ3* and *КМ1.*

Drawing numbers would be then:

[5720-02]-[КЖ1]-[1] – where [5720-02] is the number of the project, set by the Customer or GD, [КЖ1] is the code mark of the Main Set and [1] – running number of the drawing

5720-02-[КЖ1.И]-1 – [КЖ1.И] is the code mark of the Main Set and postfix *И* is showing that the drawing refers to “for fabrication”

5720-02-КЖ1.С-1 – the same way postfix *С* refers to the “specifications”

The drawback of this system is that all the documents of each set become pages of that set. For example, the set *КЖ1* consists of 30 pages (lists), 5 of which are textual documents, and the rest are drawings. Once the number of pages in the textual part is increased to 7, then the start number of the first drawing in that set changes from 6 to 8, and the whole set should be renumbered. So the system works in the same way as in the Project Documentation.

Another way of numbering is assigning a number to each individual document in a set. This system is usually used by AFRY when implementing projects. It works the following way:

- There are no divisions on different sets of working documents, the Main Set is single
- The Main Set is usually marked the same way as for the Project Documentation – *“КР”* (rus) or “ST” (eng) – meaning structural solutions
- The design stage then changes from “P” to “W”
- The numbering system is the same as presented in Table 5 (Table 5, document numbering system)

In most cases, General Designer or the Customer establishes the rules for the document numeration, specifically, for each individual project.

3.4 **Revisions**

Rules for revising technical documents are presented in GOST R-21.1101-2013 SPDS, section 7. A revision of a document previously submitted to the Customer means any correction, deletion or addition of any data to it without changing the designation of this document. The designation of the document is allowed to be changed only in case when different documents are mistakenly assigned with the same designation, or an error is made in the number or name of the document. Changes to the calculation reports are not allowed.

Any modification made in the document, causing any changes in other documents, should be simultaneously accompanied by the introduction of appropriate changes in all related documents.

The revision registry table is required to be developed either as an individual document, where all changes in technical documents are listed or as a content embedded in the document register table. The revision

table is shown in drawings above the main stamp. In Russia, revisions are reported numerically, starting from number 1.

3.5 **Bilingual System**

As we are talking about internationally or transnationally executed projects, with its location in Russia and Structural Design being developed in Finland (and possibly in other EU countries), the bilingual system for project's documentation is required.

There are no mandatory requirements about how the documents are formed and their outlook. Basically, when the creation of bilingual documentation is required, all textual content of technical drawings, layouts, schemes, title and cover pages, stamps and other are being presented in two languages at the same time.

The primary language in our case will be the Russian language, and English is the accompanying language.

Two languages must be presented in all technical documents and their appendices, textual and graphical.

Regarding drawings, both languages are presented in the following parts:

- All the side texts
- Specification lists
- Main stamp
- View names
- Section names (except if the name of the section is numerical)
- Part marks (not the position number of the element)
- Annotations and explanations
- Detail register
- Other drawing-specific textual content

GOST R 21.1101-2013 SPDS sets the requirements on the outlook of drawing's stamps (GOST R 21.1101-2013, Appendix G). General principles of the bilingual system are set in GOST R 2.901-99 ESKD. The example of drawing's main stamp is shown in Figure 6.

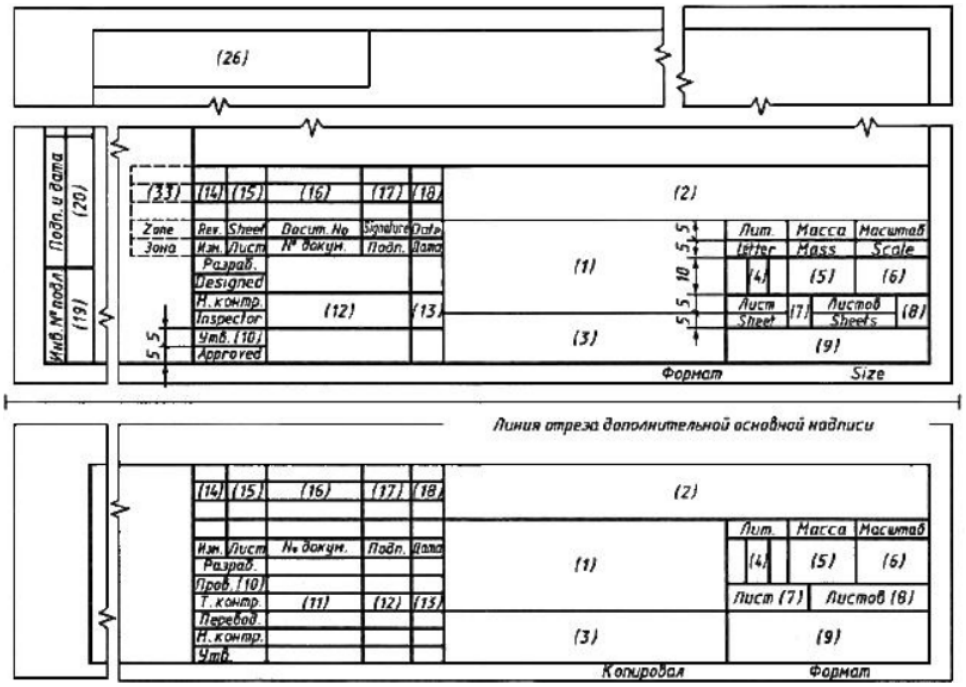


Figure 6. Main stamp on drawings (GOST R 21.1101-2013, app. G)

3.6 **Adaptation company**

Big projects are always accompanied by a significant amount of data. If the project implemented in Russia is one of the complex ones and a lot of technical documentation is required to be shortly translated, the adaptation companies can help with it. Usually, these kinds of issues are solved by the GD or the Customer but sometimes engineering companies utilize the services of adaptation companies directly.

Adaptation companies provide services on technical documentation translations in a range of languages required for the project. They work with both graphical and textual data. In AFRY's experience, such services were used multiple times for complex projects in Saint-Petersburg and Moscow. An adaptation company acts as a sub-contractor between the engineering company and the client. Depending on the language used initially in documents, they translate documentation to Russian or English and then send back to the Designer.

3.7 **Document transfer**

The transfer of technical documentation to the Customer depends greatly on the Customer's requirements. Typically, the stage "P" documentation is transferred in a printed version with all accompanying documents and appendices. Project documentation must be assembled by volumes including cover and title pages of each volume, textual content, registry tables and drawings. All documents of big formats must be folded to A4 or A3 format. The rules of creating formalized

documentation sets are described in GOST R-21.1101-2013 SPDS, section 8. The Project documentation is usually printed in three to four copies; one copy is stored in the designer's archive, other copies are transferred to the Customer and technical expertise company.

Regarding the stage "W" documentation, as its volume is much bigger than in stage "P", documentation with status "for construction" is transferred to the Customer in one of the following ways:

If printed documentation transfer is required, the way of transfer is decided with the client.

For electronic transfer:

- The use of physical data carrier (e.g. a memory stick). Nowadays, this way is very outdated but in Russia, it is still in use.
- OneDrive folder. The good way of electronic transfer and the most common.
- Use of Digital Project Bank systems. This way of document transfer is the most popular in Finland nowadays and the safest because all the data is encrypted by the service provider security protocols. Project Bank systems allow to store, modify, download and check the validity of all project documentation from all disciplines in one place. Such systems could be SokoPro.com and BuilderCom.fi

The systems BuilderCom.fi and SokoPro.com are localized in Russia.

4 BIM

4.1 General information

BIM (Building Information Modeling) is a digital approach to the construction, equipping, maintenance and repair of a building (lifecycle management of an object), which involves the collection and complex processing of all architectural, technological, economic and other information about the building with all its interconnections and dependencies, when a building and everything related to it are considered as a single object (see Figure 7). Building information modeling in construction is a set of tools that allow designers and workers to develop, maintain and manage the building during its lifecycle.

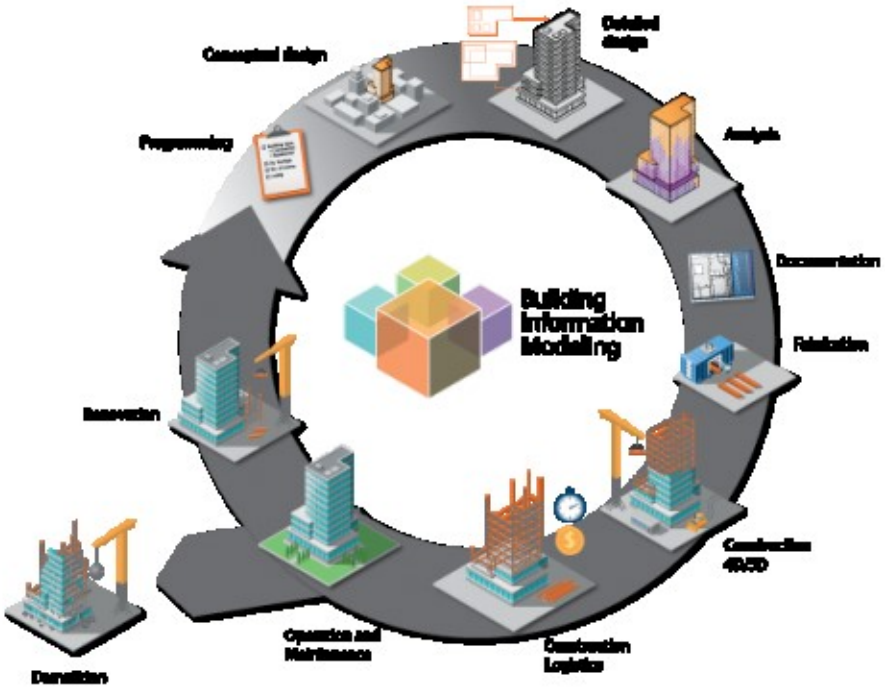


Figure 7. BIM segments. (www.reuters.com)

BIM is introduced in design and construction as a three-dimensional model of a building or other construction object associated with an information database, in which additional attributes can be assigned to each element of the model. The peculiarity of this approach is that the construction object is actually designed as a whole, and the change of any of its parameters entails an automatic change of the other parameters and objects connected with it, up to the drawings, visualizations, specifications, schedule of work, etc.

The term “BIM” (in the sense in which it is used today) was first used in works in the mid-1980s: in an article by Simon Raffle in 1985, published in 1986, and then in an article by Robert Aish - a developer of software RUCAPS, which the author referred to in describing the use of software at London Heathrow Airport. However, the system of design (including the abbreviation “BIM”) has become widely used only since 2002, when Autodesk released an information document called “Building Information Modeling” and soon other software developers also began to announce their involvement in this area. The first innovator in this field was the company Graphisoft with its application ArchiCad. It was the first application for personal computers allowing to create 2D and 3D geometry.

Nowadays, BIM is being considered as the new generation in design technologies. It is being developed by an enormous number of independent companies and specialists during the past 20 years, and now

it exists as an inherent tool in the creation of any project with a variety of different application purposes. Experts say that with BIM, it is possible to build anything from small family houses to the biggest nuclear power plants and spaceships, and actually, they are right. The technology has become so complicated and smart, with the introduction of AI (artificial intelligence) technologies and two decades of development. At present, the designers, architects, contractors, workers and scientists use it to solve a vast amount of different problems.

Similarly, as drafting shifted from paper to the screen of computer 40 years ago, BIM shifted from its 3D nature to 4D (time), 5D (cost), 6D (environment and sustainability) and even 7D (lifecycle management).

In AFRY, BIM technologies were first introduced in 1992 and have been widely applied since 2005.

4.2 **BIM technologies in Russia**

In Russia, BIM technologies have faced a “slow launch” due to the fact that on the time, when BIM was already in use in several countries, a post-soviet economy, philosophy of work and outdated standards did not let the technology to break through all these aspects at the beginning. But nowadays, the government of the Russian Federation has officially admitted that the Ministry of Construction must develop, organize and apply BIM in the construction and design process of all new buildings. They have started to create new norms and standards and update the old ones so that BIM would be applied as one of the main parts in the process. Nowadays, regulatory authorities are fully occupied with the development of these standards and the creation of a normative database covering all of the information modelling - related processes.

4.2.1 BIM standards

There are not many standards about working with the BIM model at present. Working with BIM is mostly company dependent. Talking about the design, the lack of standards affects only the internal market but not the internationally implemented projects.

Below is the list of all standards regarding BIM, available at the moment:

- *ГОСТ Р 10.0.03-2019/ИСО 29481-1:2016* System of standards on information modeling of buildings and structures. Building information models. Information delivery manual. Part 1. Methodology and format
- *ГОСТ Р 57311—2016* Building information modelling. Requirements for the operational documentation of completed construction.

- *ГОСТ Р 57309—2016 (ИСО 16354:2013)* Guiding principles for the libraries of knowledge and library facilities.
- *ГОСТ Р 57563—2017/ISO/TS 12911:*2012 Building information modelling. The main provisions for the development of standards for information modelling of buildings and structures.
- *ГОСТ Р ИСО 12006—2—*2017 Construction. Model of the organization of data for construction works. Part 2. Basics of information classification.
- *ГОСТ Р ИСО 12006—3—*2017 Construction. Model of the organization of data for construction works. Part 3. Basics of the exchange of object-oriented information.
- *ГОСТ Р ИСО 22263—*2017 Model of the organization of data on construction works. Structure of project information management.
- ГОСТ Р 57295—2016 Design - Management Systems. Guidance on the design - management in construction.
- *СП 301.1325800.*2017 Building information modelling. Rules for the organization of works of production and technical departments.
- *СП 328.1325800.*2017 Building information modelling. Rules for the description of the components of the information model.
- *СП 331.1325800.*2017 Building information modelling. Modelling guidelines and requirements of exchange data between building information models and application package models.
- *СП 333.1325800.2017* Building information modelling. Modelling guidelines for various project life cycle stages.

4.2.2 Perspectives of development

To investigate at what stage the Russian BIM market is now and what the perspectives are, the author of the thesis participated in the “First International Conference. BIM in Construction & Architecture” organized by the Saint Petersburg State University of Architecture and Civil Engineering in May 2018. The conference included reports and lectures conducted by the representatives of the Ministry of Construction of the Russian Federation, representatives of the main educational institutions of Russia, as well as employers and students.

The conference was held in two days and the number of participants was over 300 people. The conference aimed to provide an ideal interdisciplinary platform to share current developments in BIM technologies in relation to the tasks of the construction profile, design and operation of buildings, as well as education, regulatory framework and economic aspects of the issue.

Moreover, participating in the conference included writing an article about BIM technologies. To show our knowledge of BIM utilization in Finland, the author and thesis supervisor Alexey Krishtalevich, presented and published the work “BIM Technologies in Finland. Tekla Structures as

a main tool in Structural Design". The work was published in the book of the conference (*BIM-моделирование в задачах строительства и архитектуры: материалы Всероссийской научно-практической конференции; СПБГАСУ. – СПБ., 2018, p.107).*

During the conference, many opinions were heard and reports about the current and future development of BIM technologies in Russia were obtained. This data (the issues of introduction of BIM) was statistically analyzed from the actions, speeches and reports (51 reports in total of 234 pages) presented in the conference and is displayed in a chart below in Figure 8.

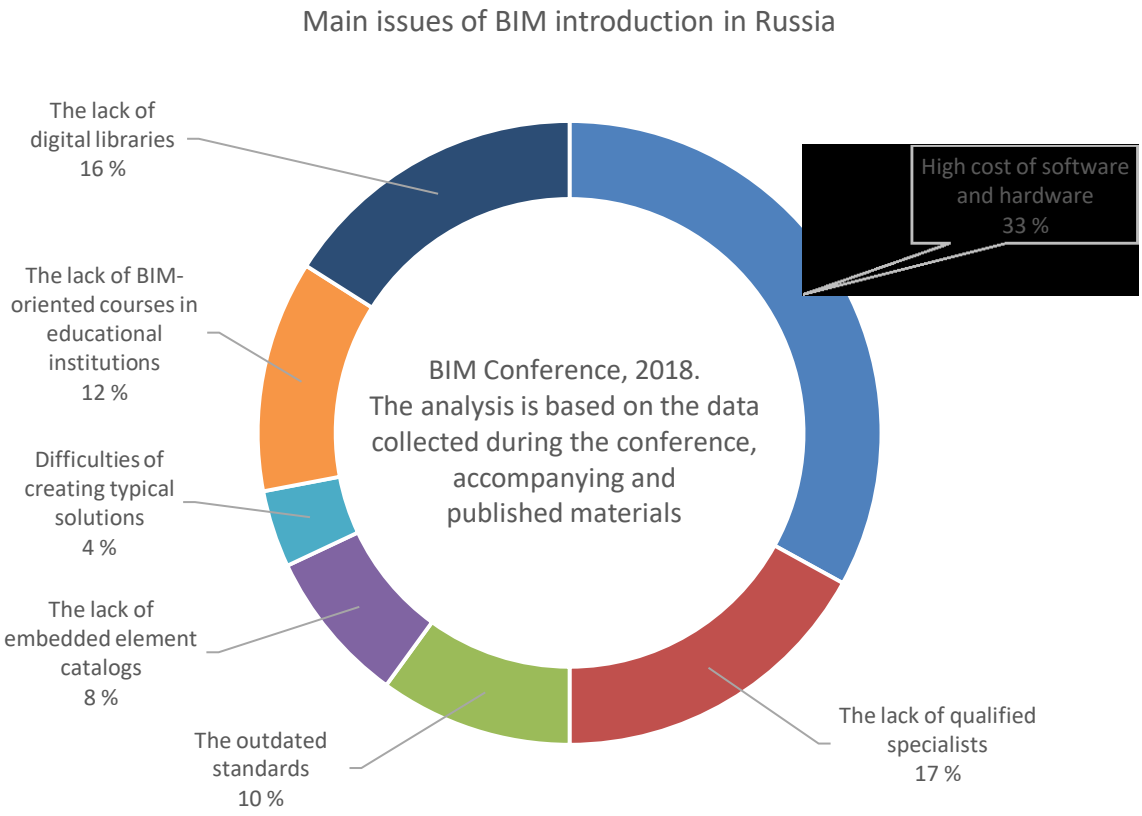


Figure 8. Chart of the main issues of BIM introduction in Russia

There are several resulting factors that are always mentioned talking about the introduction of BIM: high expenses, lack of qualified specialists and digital libraries. The speeches of the representatives of the educational community and the Ministry of Construction of Russian Federation give very precise and promising information that these problems will be solved by the engineering society very soon and for Russia, the introduction of BIM is the first priority issue. It can be concluded that the development and introduction of BIM in Russia are stepping forward, as we could see, the new standards as well as modern educational programs are developed and launched.

The representatives of engineering companies say that high expenses regarding the introduction of BIM-based applications are worthy due to the fact that the expenses of design and construction, both for the Customer and engineering companies, are reduced by 30% using BIM. Therefore, the utilization of BIM decreases the cost of the project from a long-term perspective. Also, BIM's main advantages are:

- Higher quality of design and construction
- Reduction of mistakes
- Reduction of time and labour
- Investments security (which is a very sharp issue in Russia)
- Higher accuracy
- Coordinated teamwork and clear project tasks

However, the rate of utilization of BIM in Russia at present is less than 50% (according to the Ministry of Construction of Russian Federation), the government, as well as educational and commercial sectors, are making big steps in the development and introduction of BIM. The perspectives of its popularization seem very promising and most likely we will be able to see the increase of its distribution even by the end of the current year.

To conclude, the perspectives of the implementation of international projects in Russia, from the technological side, are very comprehensive. The contracting and engineering companies appreciate the use of BIM and are ready to communicate and support the project, made using BIM.

5 TEKLA STRUCTURES

5.1 General information

Tekla Structures is a BIM family application that allows the creation of 3D structural models of buildings, structures or single objects, as well as detailing, material management and drafting, regardless of the complexity. The output material consists of digital model in TS format, working drawings, drafts, bills of material, digital libraries, reports, calculation material; possibly model to use in augmented, virtual or mixed reality software e.g. Trimble Connect with Hololens 2.

Tekla is an abbreviation from Finnish meaning technical computations (Tek:la - *teknillinen laskenta*). The company was established in 1966 in Espoo, Finland. Nowadays, it is a world-famous company, a part of Trimble Group, that provides solutions for structural engineers and designers. Tekla has a partner network in more than 80 counties.

In Finland, Tekla is used as the main tool in structural engineering.

Tekla BIM software supports interoperability with other software through the open programming platform Tekla Open API. It is based on Microsoft .NET Framework technology. Examples of supported formats: IFC, 3D DWG/DXF, FEM, SKP, DGN.

5.2 **Tekla Structures Environments**

Tekla Structures Environment is a set of region or company-specific settings and information that are predefined by Tekla Structures or defined by the user. In general, the environment consists of profile catalogues, part property files, model and drawing settings, attributes, region or company-specific templates and annotation objects. In total, TS is localized in 30 environments.

For projects in Russia, therefore, TS Russian environment is used.

6 USE AND DEVELOPMENT OF TS RUSSIAN ENVIRONMENT

6.1 **Introduction**

Since AFRY uses Tekla Structures as the main tool in structural design, the company has its own TS environments adapted for specific needs, for example, the common environment for Finland is POY Finland, for Sweden is POY Sweden and for Russia is Russia respectively (see Figure 9). Finnish environment is the most developed out of all and has several subdivisions: bridge&road construction, structural, management. The Russian environment is the least developed one and is usable only by around 65% (an estimation only indicates AFRY's Russian environment readiness). The question of its development rose when the company announced a won tender for an upcoming project in Saint-Petersburg – an 8-floor Parking Building for an existing shopping mall. At that time, the target issues for the development of the Russian environment were assigned and the work started. Therefore, in further sections of the thesis the processes of development, setups, work principles of TS Russian environment will be described.

The environment was developed for TS2017. The test project is commercial parking building in Saint-Petersburg (structure – mainly precast elements, cast-in-place concrete and some steel frames), height is 27 meters, length - 212 meters. The main principle was to develop the environment according to the current needs and along with the project timeline. It means that the work covered not all of the aspects, e.g. tables and templates for parking building can differ from the ones used for residential buildings or steel frame buildings.

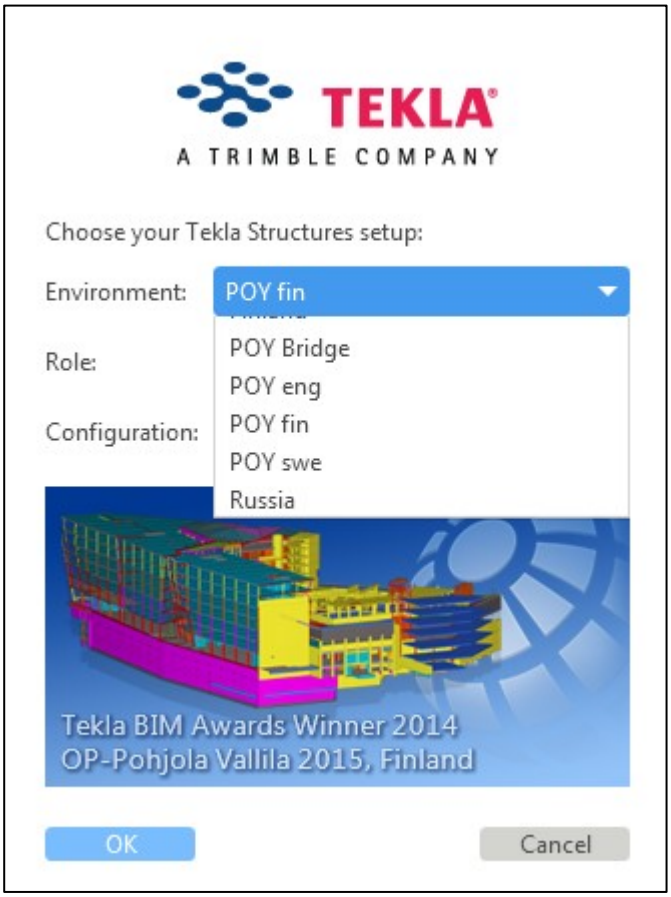


Figure 9. Example of TS startup menu with different environments

Used software:

- Operation system: Microsoft Windows 10
- TS: Tekla Structures 2017 Service pack 12
- Default language: English
- Project output language: Russian, English
- IFC Model viewer: Solibri Anywhere, Trimble Connect
- DWG/DXF format viewer: Autodesk AutoCAD 2018
- SKP format viewer: Autodesk 3DsMax
- Coding: Notepad++

6.2 File and folder structure

The environment is stored under the following path: *C:\ProgramData\Tekla Structures\2017\Environments* on user's local computer.

If the project in Tekla (TS model and work files) is implemented as a multi-user model, it is usually stored on a local network drive or server and, therefore, all the users use the same model. If the project in TS is done using a model sharing service (cloud-based storage) then each user of the model has their own copy of it on a local computer and every time

a change in the model happens, the user writes out changes from the local model to the model in the cloud where these changes are merged with the cloud model and changes from other users and, respectively, changes from the cloud come to the local computer of each user (see Figure 10). Model sharing service is used more often now than multi-user model because the data stored in the cloud is safer and the chances of data loss are much smaller.

As a rule, each environment is updated once Tekla Structures is started. It works so that general TS environment is stored somewhere on a local network server and if there is a need to change it, for example, add a new template, the administrator adds a template to the folder on server and then, after the user starts Tekla, an update program (usually called update.bat – is a windows-based installer) replaces changed or added files from the server folder to the local folder so that they are identical. The following method is used for two reasons: make environment updates automatically available for all users and protect files from accidental changes, as the updater rewrites all the local files each time.

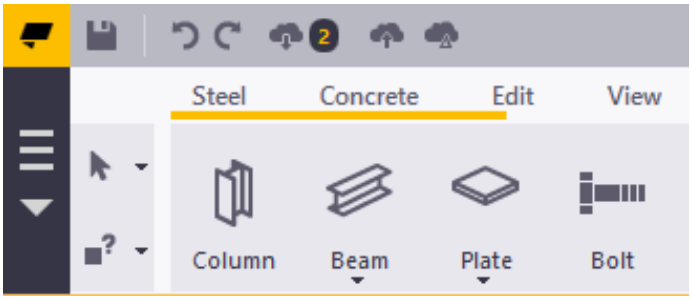


Figure 10. TS2017 common menu. Model sharing read in and write out buttons (cloud in/cloud out)

By default, the environment has the following folder structure (see Figure 11).

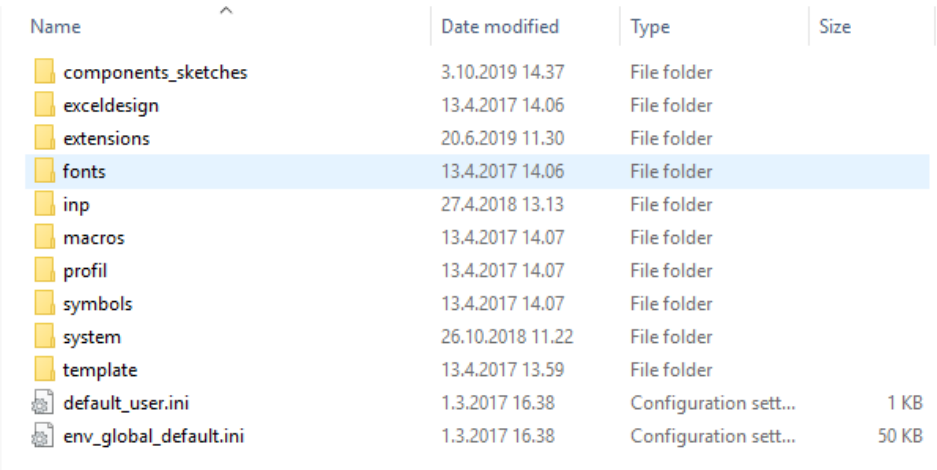


Figure 11. Default environment folder structure

Main folders here are:

- **extensions** – includes applications and components for modelling and drawing views
- **fonts** – includes windows font files .fon
- **inp** – includes property sets and user-defined attribute settings
- **macros** – includes macros
- **symbols** – includes .sym files for symbols used in annotation objects and lines
- **system** – main folder. includes system-specific settings, standard files and databases
- **template** – includes template and report files
- Additionally, the folder structure can include other company-specific folders e.g. TS-PROJECT, TS-FIRM, TS-SYSTEM and other.

Trimble has published many supporting materials for Tekla users and administrators to help with the maintenance and development of the environment. It can be found from Trimble web pages or Tekla User Assistance web page.

6.3 Before entering the model

Any user must do several steps before starting to use a TS Russian environment. These steps are described below.

Tekla Structures is a non-Unicode program and therefore, Cyrillic letters can't be displayed until the location is switched to the appropriate. The use of the Russian environment is only possible if Windows locale is switched to Russia. The necessary steps are shown below:

Step 1: Go to Start menu> Control Panel> Clock and region

Go to the administrative tab. Change the locale as shown in Figure 12.

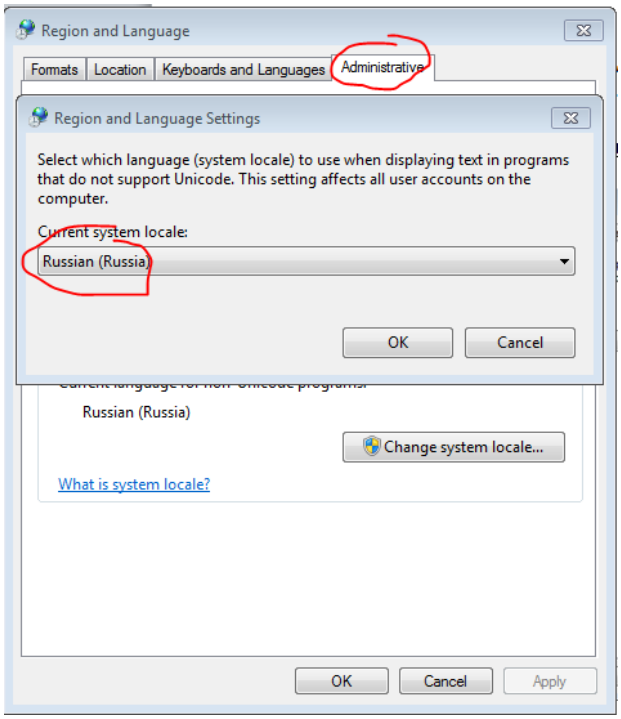


Figure 12. Windows localization

Step 2: After this, press Ok button. The computer will ask to restart, press Yes.

Step 3: Check if GOST fonts are installed in windows. Go to Start Menu> type Fonts> Open the folder

Check that *GOST type A* and *GOST type B* fonts are installed. Otherwise, in Tekla drawings and templates there will be no GOST fonts and they will switch to standard.

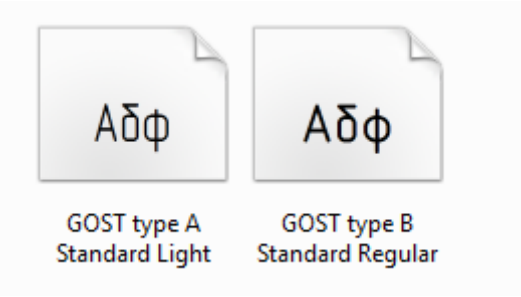


Figure 13. GOST fonts in window

Fonts can be downloaded from the internet (from trusted sources only).

6.4 Tekla advanced options, material and profile catalogues, applications

First steps which were done in the environment include: checking of profile and material catalogues, validity according to GOST standards (see Figures 14 and 15). It is very important because property sets assigned for each individual profile or material will be displayed in bills of material and reports.

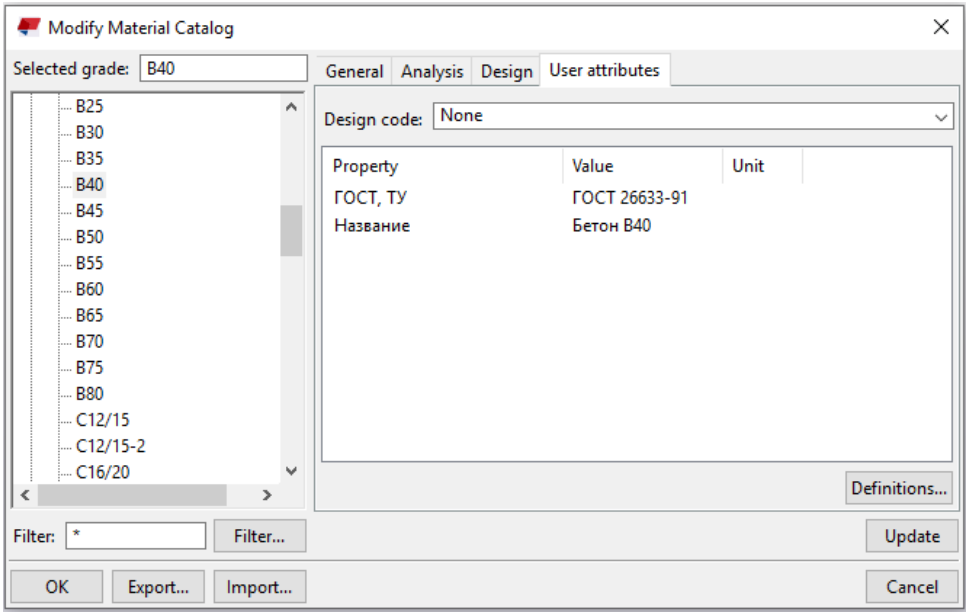


Figure 14. Material catalogue. Example of concretes

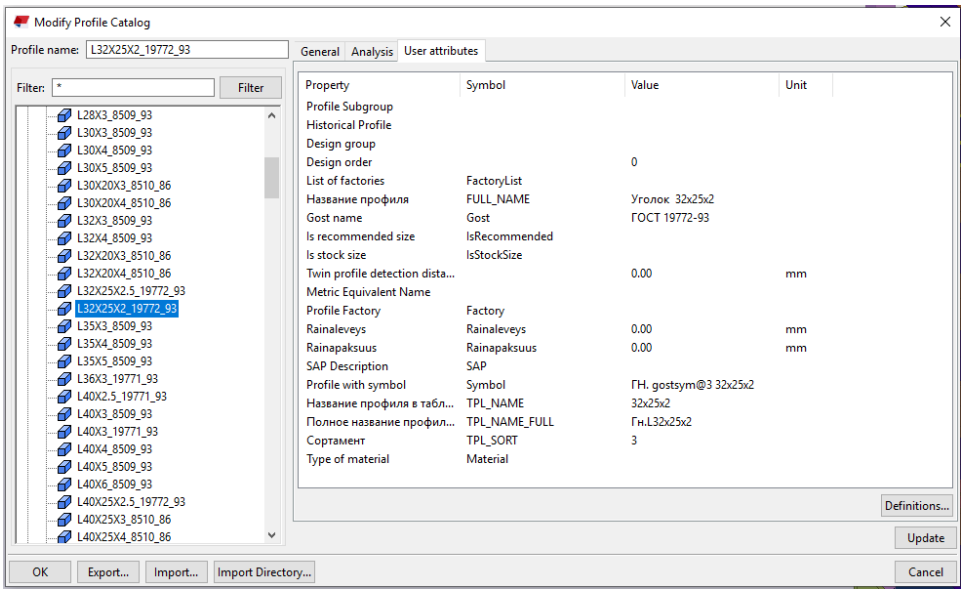


Figure 15. Profile catalogue. Example of L-profiles

Outdated materials and profiles after checking were modified, replaced or added.

The second step was to check the availability of applications and components in TS Russian environment (see Figure 16). Applications and components section consist of a big amount of embeds and useful tools that noticeably shorten the time of modeling and drafting processes. All the default applications were working properly, some Russia-specific were downloaded from Tekla Warehouse:

- Drawing welding plugin
- Model welding plugin
- Bill of steel plugin (for reports)
- RUS Bolt standards (database)
- A500C Rebar grades (database)
- Foundation bolts (embeds)

AFRY uses more than a thousand different components and applications in TS Finnish environment but they were not present in Russian. That was a problem because many engineers are used to working with familiar apps. The decision was the following: according to the Parking Building project needs, some of the applications, embeds and components were transferred to the Russian environment from the Finnish one. The task was hard to implement due to the fact that after import, some apps didn't work because of wrong file locations. Finally, it was solved.

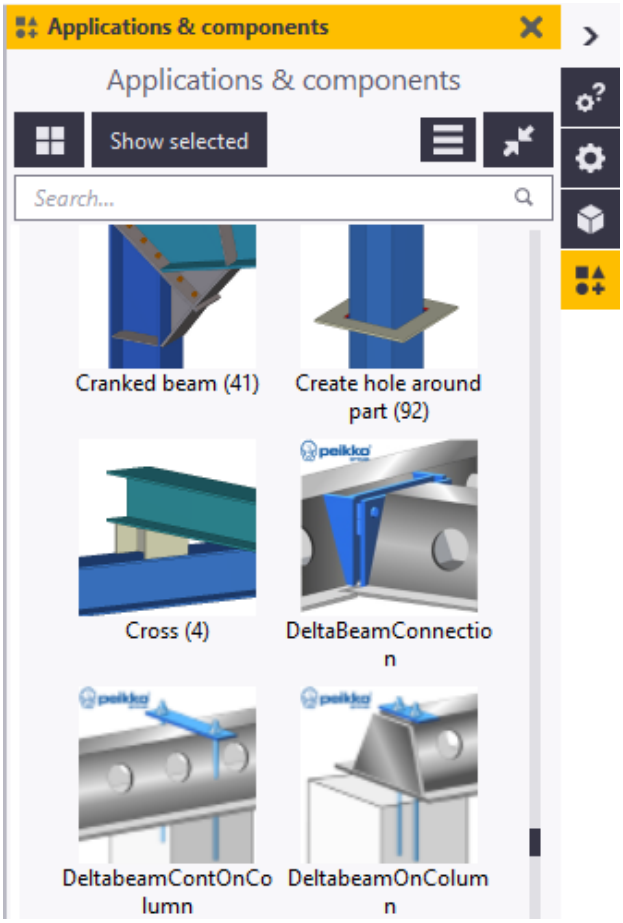


Figure 16. TS Applications & components tab

The third step was to check Tekla advanced options attributes. Advanced options tab (see Figure 17) is responsible for setting project, model, drawing and system-specific settings which have an effect on both UI (User Interface) and Input-Output communications.

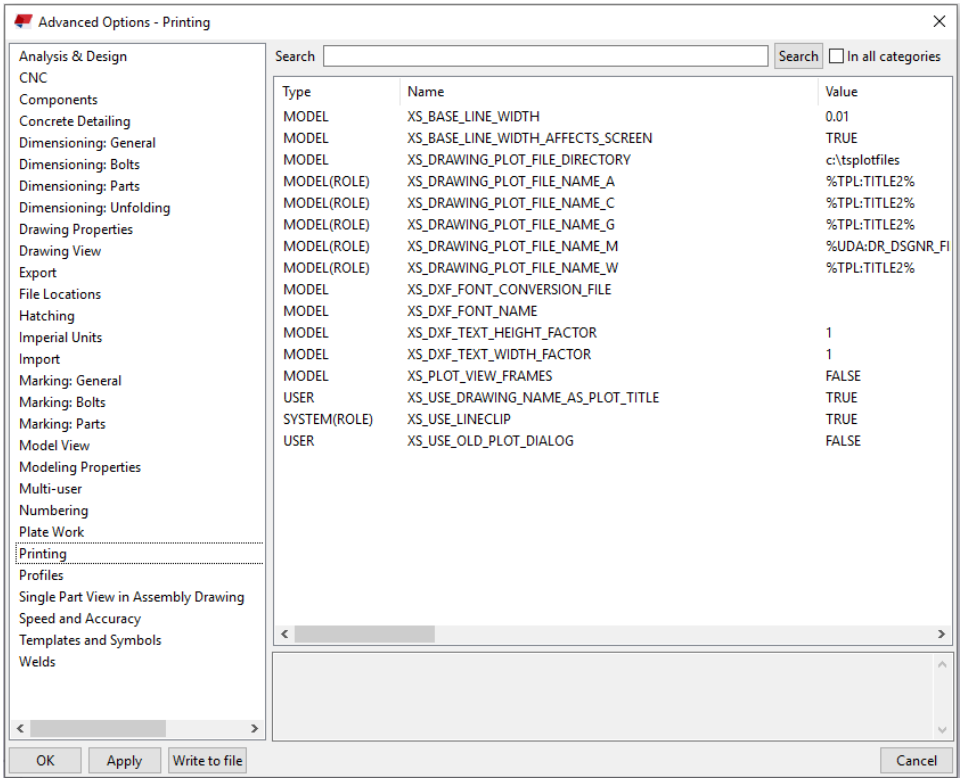


Figure 17. Tekla Advanced options tab

Several attributes to pay attention to in advanced options are:

a) XS_DRAW_HORIZONTAL_VIEW_SHORTENING_SYMBOLS_TO_PARTS: TRUE
b) XS_DRAW_VERTICAL_VIEW_SHORTENING_SYMBOLS_TO_PARTS: TRUE
c) XS_SHORTENING_SYMBOL_WITH_ZIGZAG: TRUE
d) XS_ENABLE_POUR_MANAGEMENT: FALSE
e) XS_USE_CROSS_FOR_OPENING_SYMBOL: FALSE
f) XS_USE_RECESS_SYMBOL_FOR_BORDER_AND_CORNER_RECESSES: TRUE
g) XS_PLOT_VIEW_FRAMES: FALSE

Also, all attributes with a target to set FONT need to be GOST Type A. All these attributes are set according to the requirements of GOST 21.1101-2013. Attributes a, b and c are responsible for how automatic part cut lines look in drawings. Attribute d disables the use of pour breaks in the model and drawings. Attributes e and f are responsible for how recesses and openings in the drawing are displayed (if *show openings/recess*

symbol feature is turned on in the drawing view); see Figure 18. Attribute g removes drawing frames from printouts.

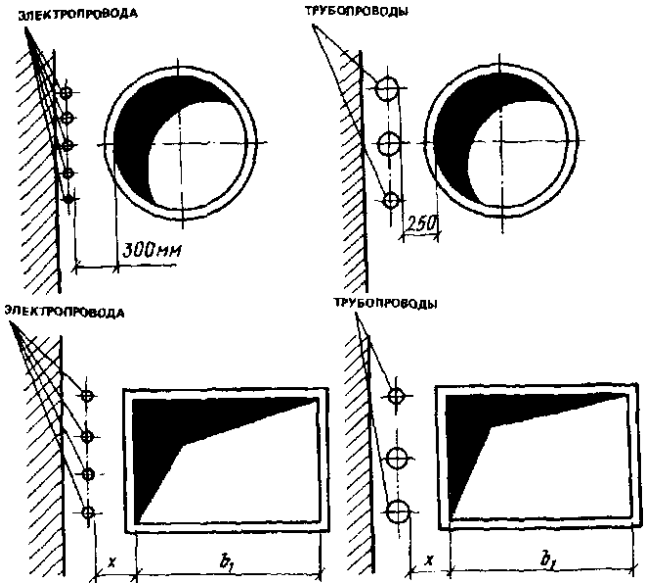


Figure 18. Opening symbols. Extract from GOST 21.201-2011. Symbol graphics elements of buildings, works and structures.

The advanced options include many attributes which must be set as well as the ones listed above, but the others are mostly company-specific e.g. file locations, print properties, print file names, etc.

6.5 **Numbering**

One of the main parts of using Tekla is setting the correct numbering settings. Numbering settings affect how parts, assemblies and cast-units are numbered and how numbers are assigned. In the Options tab, numbering section, position number separator needs to be "-" for parts and rebars as displayed in Figure 19. Also, in the advanced options tab, in section numbering, attributes for start numbers shall be set to 1.

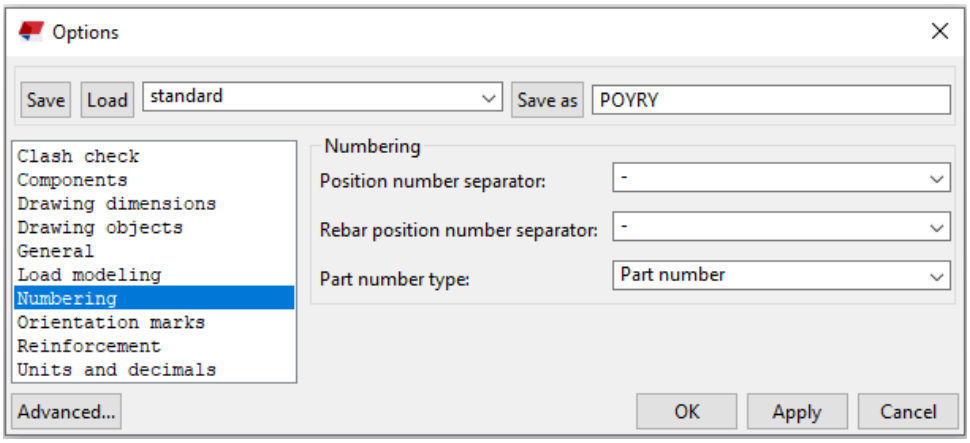


Figure 19. Tekla options tab. Numbering

Standard settings for numbering were divided into three sets:

- **Standard** – for general modelling, no drawing production (see Figure 20)
- **Drawing issue** – for drawing production (no tick on re-use old numbers)
- **Revisions** – for revisions (no tick on re-use old numbers, modified objects are set to keep number if possible)

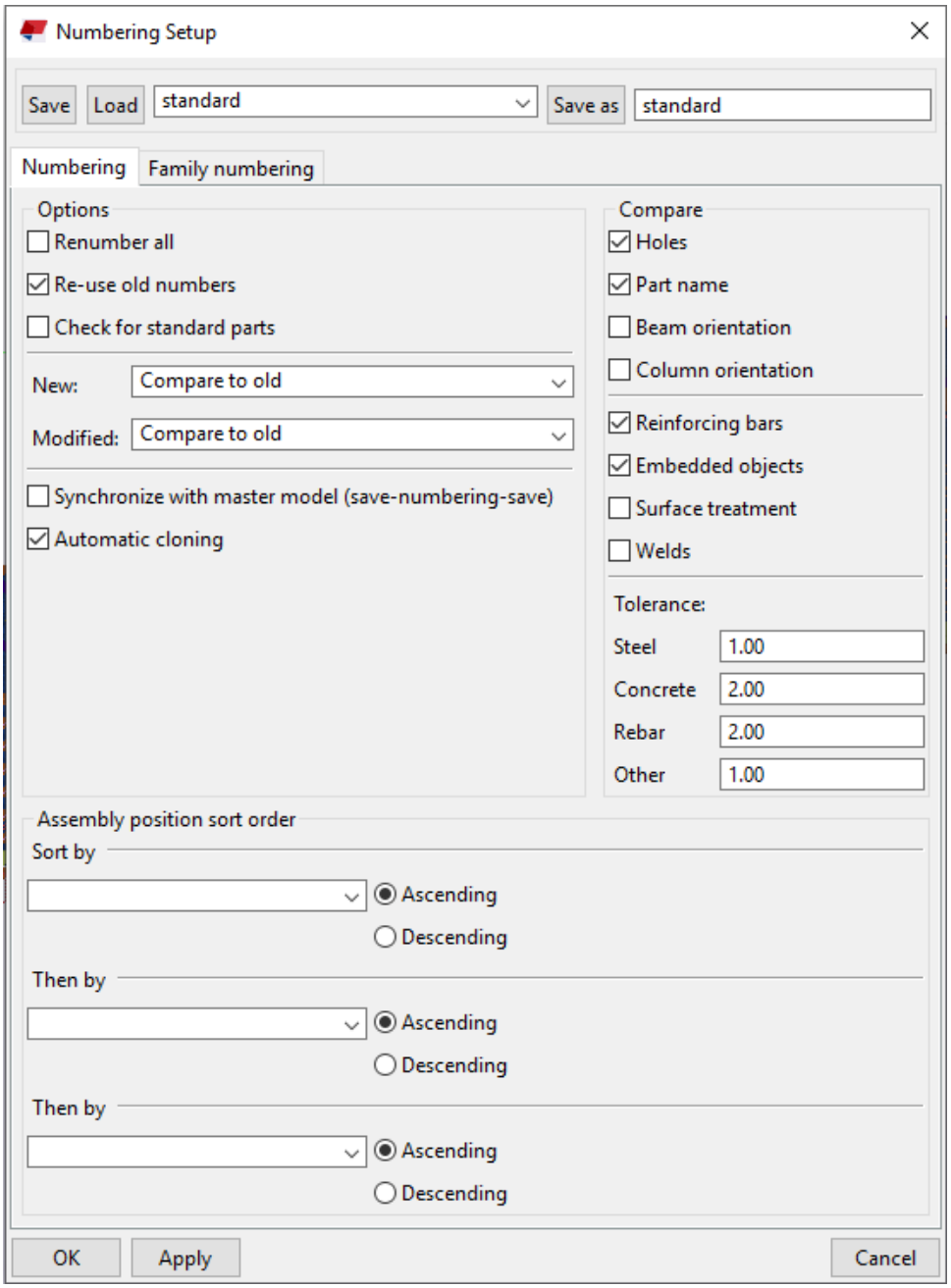


Figure 20. TS numbering settings

Family numbering is not in use. Similar objects are compared by shape, holes, name and prefix, reinforcing bars and embeds.

For this setup, Tekla numbers objects the following way: it takes prefix of the main part of the assembly or cast-unit, adds "-" and then start number, which is 1. After that, it compares similar assemblies or cast-units and numbers identical with the same position number and different with numbers in an ascending order. Let's say we have 10 columns with prefix K and start number 1. Eight columns are identical and 2 are different. Tekla will give numbers like this: K-1 (8 pc.), K-2 (1 pc.), K-3 (1 pc.). If drawings for these columns are ready and *revisions* setting for numbering is used and one column from series K-1 is changed, Tekla will give the next number to it comparing it with the whole series. The number will be K-4. Then if we change this column back as it was in series K-1 and number again, Tekla will not change the number and leave K-4. In this case, we would need to use *standard* setting to return the number back to K-1. This method helps to avoid gaps in the numbering of any objects.

The other method, which is used only during the modeling stage (if the previous one did not work) is to use *clear part and assembly numbers* from *change number* tab or, similarly, *clear reinforcing bar numbers* for reinforcement. After that, *standard* numbering is done, and no gaps appear in series.

Depending on the project, the numbering system can vary, as an example, adding special characters to prefixes for depicting levels or sections of the building to group elements. The position number of a column then would be 4K4-1, as shown in Figure 21.

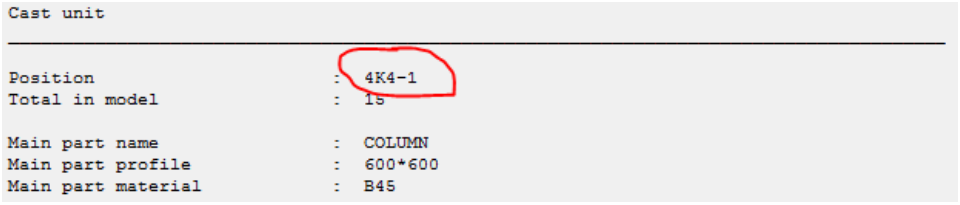


Figure 21. Example of column position number. Tekla inquiry tool

Table 7 shows how this position number is built.

Table 7. Position number of column with additional characters

Building block	Element prefix	Level	Tekla running number
4	K	4	-1

The building has 5 blocks in total and 6 levels, columns can be grouped by block only, then all columns in each block would have pre-prefix 1..5+K-1, by levels only, then on each level we add level postfix K+1..6-1, or both as shown in Figure 21.

6.6 **The model**

6.6.1 Standard property sets

There is not much specific in the modelling process using TS Russian environment in comparison with the Finnish one. It uses the same principles in objects, catalogues, parts, assemblies or cast-units, but of course, all the property sets are region-oriented and therefore, *standard* property set needs to be assigned. The work was done so that all the *standard* property set were checked and changed, if needed, to comply with Russian norms. Figure 22 shows how the property set was changed for a steel column, where the standard set includes:

- the part prefix was removed (acc. to norms for detailed steel structures all single parts in the building (or sub-structure) need to be numbered using a single numbering series)
- assembly prefix (see Appendix 1)
- start numbers equal to 1
- name in Russian (see Appendix 1)
- common profile from GOST catalogue
- GOST steel grade
- part class (see Appendix 1)

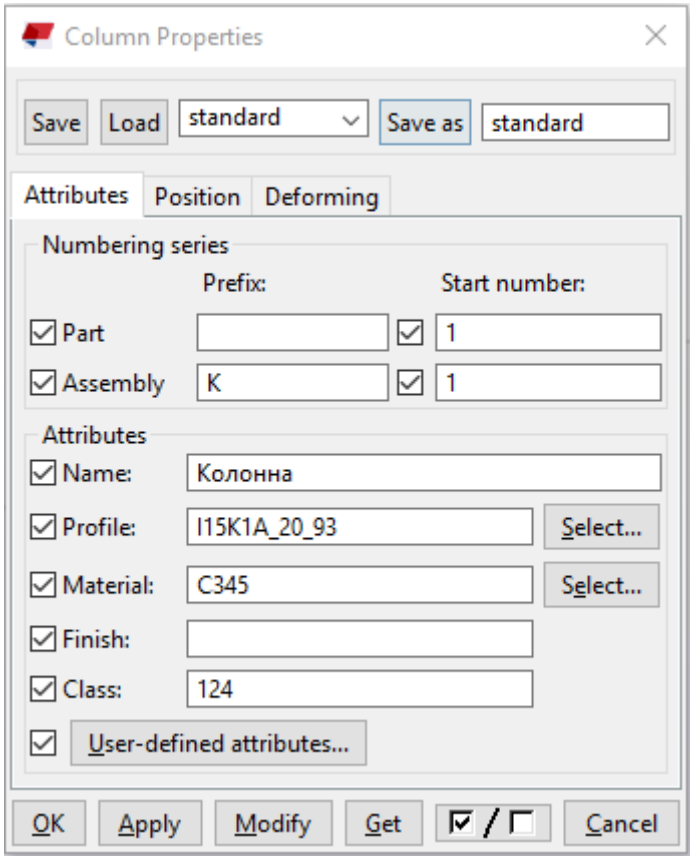


Figure 22. Steel column property set

Standard property set files are saved either in the model or environment folder. This operation was implemented for all the objects of modeling, including:

- steel section
- concrete section
- rebar section
- display settings
- object group – view filter
- selection filter
- representation settings
- phase manager
- numbering settings
- drawing creation settings

The main objective of setting correct standard property sets is to decrease the time of finding the correct attributes for new model objects and reduce the number of typing mistakes.

6.6.2 Object names, classes and prefixes

A brief explanation of what are classes, prefixes and names in Tekla:

- **class** attribute is responsible for which colour an object has in the model, it allows filtering by class in both model and drawing views and setting special output properties for certain classes. For example, class 100 is assigned to all embeds and displayed attributes in drawings are: PRODUCT_CODE and PRODUCT_DESCRIPTION. The number of classes is not limited but there are only 14 colours available which repeat in sequential order.
- **prefix**, as it was already mentioned in section 6.5, affects the numbering of objects and usually, in Russia, Prefix + running number is called the factory Mark or the Element. Prefix allows to group and sort objects.
- **name** appears in drawing's title block as the name of the final element, in reports, bills of material and templates. Name in Tekla also allows filtering, sorting and grouping.

These three simple attributes form one of the fundamental principles of BIM.

Each project is unique but they all have something in common. The common property here is how objects are named. The way they are named in Tekla usually comes from three sources: Client requirements, regional standards and design company own rules. The difficulty in case of the Russian environment and doing projects from Finland is that AFRY uses its own system and most employees are used to it. On the one hand,

the system could be just transferred to the Russian environment from the Finnish one, but on the other hand, it must comply with GOST standards and pure transfer sounds not possible.

The following solution was implemented: a set of instructions in pdf format was created called “TS Eng-Rus name and prefix instructions” (see Appendix 1). This set is based on the system used in former Pöyry in TS Finnish environment (but oriented on the system used in Russia), including its main features like embed class 100-104, view filter by class, detailed object-level settings for drawings, etc. The document includes the main set of attributes to assign to objects in different model situations: name in Russian and English (language may differ depending on the project), prefix in Russian and English, part class, alternative field.

The following document was successfully used in the Parking Building project.

6.6.3 User-defined attributes and objects.inp

User-defined attributes are attributes set in Tekla dialogue boxes, templates in Template Editor, drawing properties or embed dialogue boxes which contain variables, information or product data about the object. The example below (see Figure 23) shows a steel assembly dialog box containing default (Assembly, IFC export) and custom (Grade specification, Element specification) tabs. Element specification tab is used to assign forces to the assembly. Each attribute contains a string where the desired numbers are typed. Any string of user-defined attributes has its own code e.g. string for *linear force compression, kN* has a code *usilie_N.*

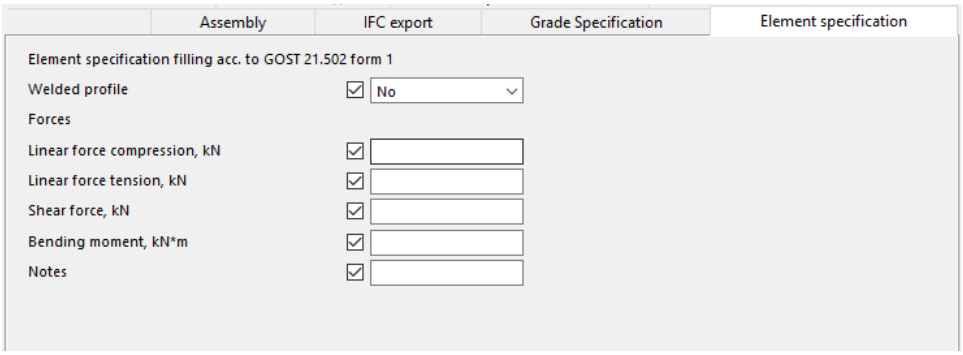


Figure 23. Steel assembly dialogue box

Each code word is used to link attributes assigned in the model to the ones, displayed in drawing tables, bills of material or IFC-export models, reports and model organizer.

The main file for formatting and coding attribute properties is objects.inp file. The file is stored in the environment, model, project or firm folders.

If there are multiple files, they are merged in the following order: firstly, file from the model folder is read, then project folder, firm folder and then environment folder. Note, that to see the changes in the model after editing objects.inp Tekla model needs to be reopened.

For the Russian environment, it was decided not to use the original objects.inp coming from Trimble but to use the one, developed in AFRY for the Finnish environment, as it is complete and covers all fields, change its language to English and supplement it with necessary attributes from Russian objects.inp. During that work, a lot of coding was required. As the environment is still under development, in the near future all attributes will be fully integrated according to Russian standards.

Tabs for steel assembly properties dialogue box as were shown in Figure 23 as a source code in objects.inp look as shown below (see Figure 24).

objects.inp

```
/*****************************************************************************/
/* Assembly attributes */
/*****************************************************************************/

steelassembly(0, "jd_SteelAssembly")
{


  tab_page("","Grade Specification", 8)
  {
    attribute("", "Elements of structures for grade specification acc. to GOST 21.502 form 2", label, "%s", no, none, "0.0", "0.0")
    attribute("kategoriya_TSS", "Category", option,"%s", no, none,"0.0", "0.0")
    {
      value("", 2)
      value("Columns", 0)
      value("Beams", 0)
      value("Braces", 0)
      value("Column braces", 0)
      value("Surface braces", 0)
      value("Girders", 0)
      value("Secondary trusses", 0)
      value("Main trusses", 0)
      value("Crane beams", 0)
      value("Staircases. Stairs. Railings", 0)
      value("Other", 0)
    }
  }
  tab_page("","Element specification", 9)
  {
    attribute("", "Element specification filling acc. to GOST 21.502 form 1", label, "%s", no, none, "0.0", "0.0")
    attribute("svarnoi_profil", "Welded profile", option,"%s", no, none,"0.0", "0.0")
    {
      value("j_No", 1)
      value("j_Yes", 0)
    }
    attribute("", "Forces", label, "%s", no, none, "0.0", "0.0")
    attribute("usilie_N", "Linear force compression, kN", float, "%s", no, none, "0.0", "0.0")
    {
        value("", 0)
    }
    attribute("usilie_N_otr", "Linear force tension, kN", float,"%s", no, none, "0.0", "0.0")
    {
        value("", 0)
    }
    attribute("reakciya_A", "Shear force, kN", float, "%s", no, none, "0.0", "0.0")
    {
        value("", 0)
    }
    attribute("moment_M", "Bending moment, kN*m", float, "%s", no, none, "0.0", "0.0")
    {
        value("", 0)
    }
    attribute("prim_vedomost", "Notes", string, "%s", no, none, "0.0", "0.0")
    {
        value("", 0)
    }
  }
  modify(1)
}
```

Figure 24. Objects.inp steel assembly dialogue box tabs example.

In the output, in the example of layout drawing of steel brace support structure (see Figure 25), we can see how force attributes look in the specification (see Figure 26).

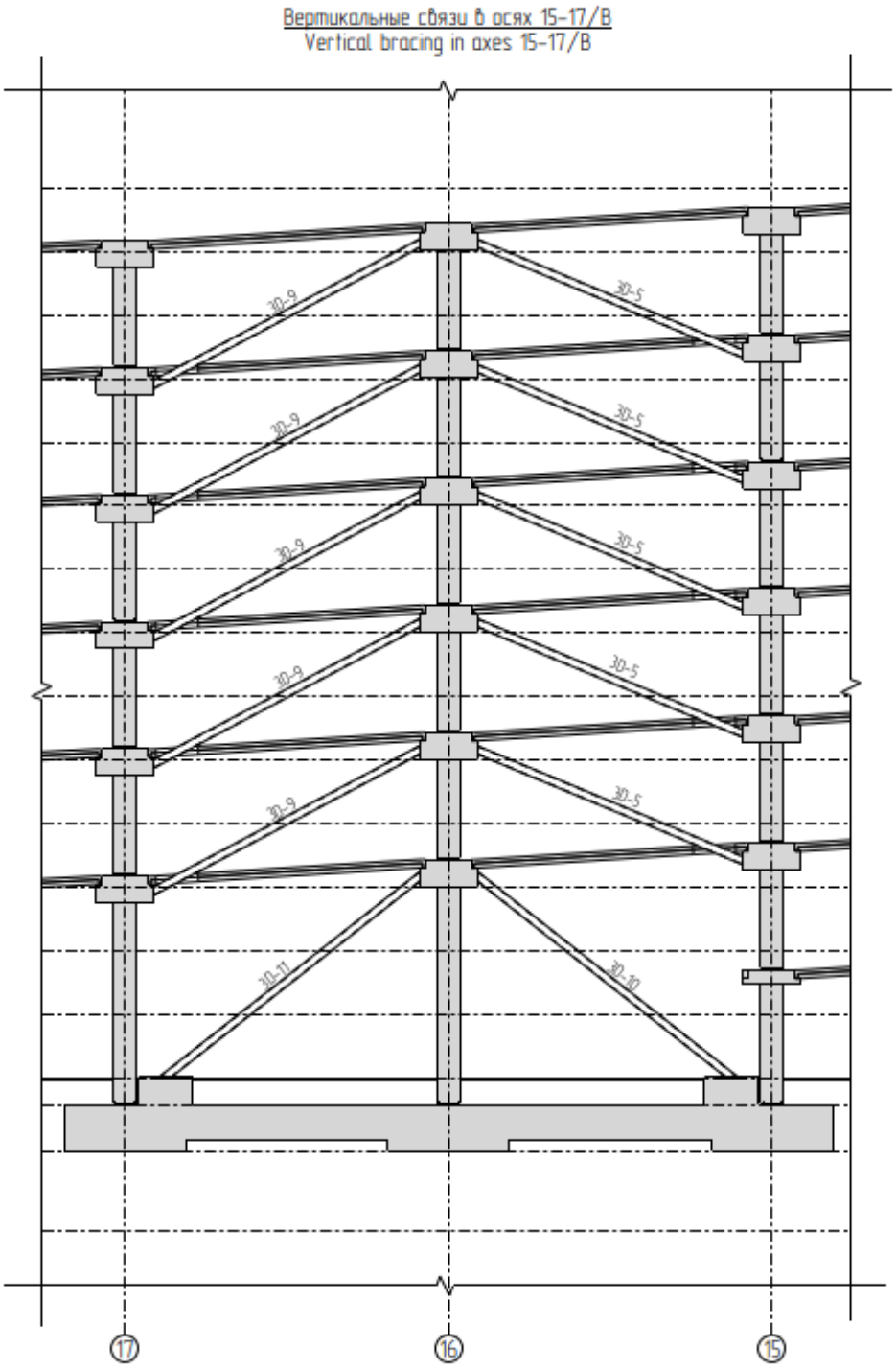


Figure 25. Extract from the layout drawing of steel brace support structure (Retrieved by KZh). Main view

Ведомость элементов Element list								
Марка элемента Element mark	Сечение Cross-section			Усилие для прикрепления Forces			Марка металла Steel grade	Примечание Notes
	эскиз draft	поз. pos.	состав profile	A, kN	N, kN	M, kNm		
3D-1	☐		☐ ПК200x10.0		383 /-176		C345	
3D-2	☐		☐ ПК200x10.0		383 /-176		C345	
3D-3	☐		☐ ПК200x10.0		383 /-176		C345	
3D-4	☐		☐ ПК200x10.0		383 /-176		C345	
3D-5	☐		☐ ПК200x10.0		383 /-176		C345	
3D-6	☐		☐ ПК200x10.0		383 /-176		C345	
3D-9	☐		☐ ПК200x10.0		383 /-176		C345	
3D-10	☐		☐ ПК200x10.0		383 /-176		C345	
3D-11	☐		☐ ПК200x10.0		383 /-176		C345	

Figure 26. Specification of structural forces. Extract from the steel brace support layout drawing

Another example of user-defined attributes which was originally created from scratch is UDA dialogue box tab for filling in drawing title blocks. It is called **RUS-Drawing Name**. The tab was created for each drawing type:

- GA Drawing
- Assembly drawing
- Single-part drawing
- CU drawing

The tab allows to fill in drawing title block, assign designer and other specialists names, add date, scale, drawing number, etc. Tab outlook is shown in Figure 27.

There are two options for the scale attribute. The scale is either automatically detected from the main drawing's view or it can be switched to manual scale assignment in which the scale is taken from the string MAIN SCALE in user-defined attributes dialogue box.

As a rule, the main drawing view has the biggest scale. The formula for detecting the biggest scale used in drawing looks as follows:

```
"1:"+ max(int(mid(GetValue("SCALE1"),2,3)),
int(mid(GetValue("SCALE2"),2,3)),
int(mid(GetValue("SCALE3"),2,3)),
int(mid(GetValue("SCALE4"),2,3)),
int(mid(GetValue("SCALE5"),2,3)))
```

(1)

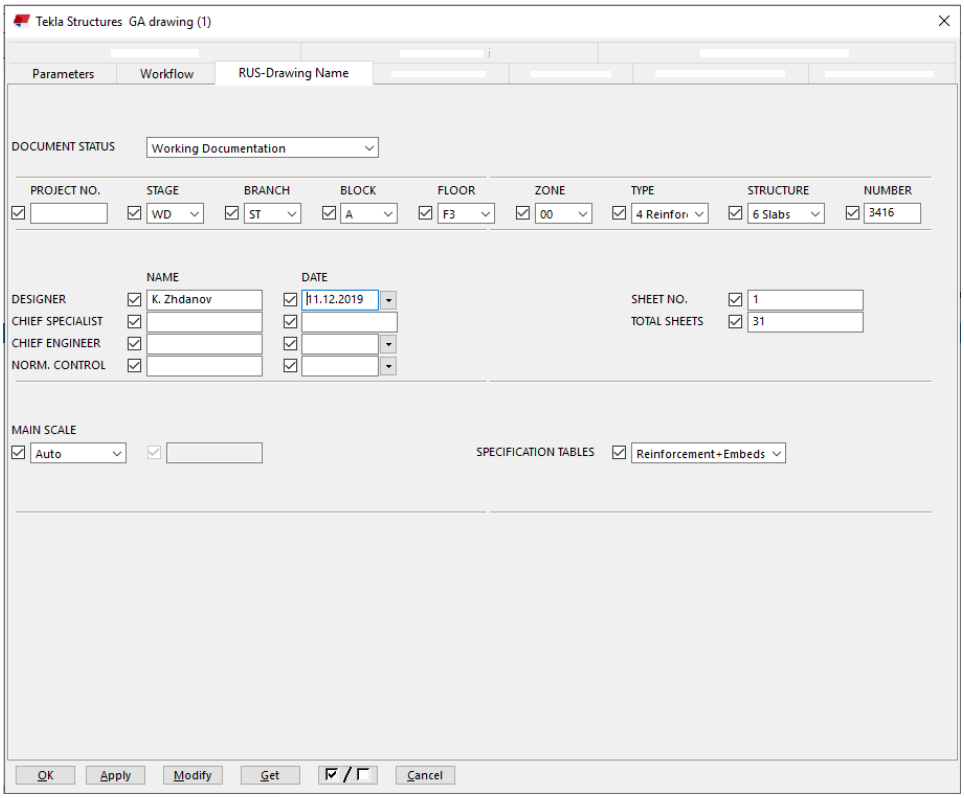


Figure 27. Tab for filling in drawing's title block

Below is shown how it looks in the drawing (see Figure 28):

Figure 28. Drawing's title block

The title block was designed particularly for the project and includes the Client's title block on top of the general, done according to GOST 21.1101-2013 (in Russian – ГОСТ Р 21.1101-2013б приложение Ж). The source code is long but the next is a part of it (see Figure 29):

objects.inp

```
91
92  /*************************************************************************/
93  /* Drawing attributes - GA                                               */
94  /*************************************************************************/
95
96  gadrawing(0,"GA drawing")
97  {
98   tab_page("RUS_DRAWING_TITLE","RUS-Drawing Name",9)
99    {
100     attribute("label", "DOCUMENT STATUS", label,"%s", no, none, "0.0", "0.0",0,50,50)
101
102     attribute("RUS_DOCUMENT_STATUS", "", option,"%s", no, none, "0.0", "0.0",175,50,300)
103     {
104       value("", 0)
105       value("Tender Documentation", 0)
106       value("Project Documentation", 0)
107       value("Working Documentation", 0)
108     }
109
110     picture("line", 0, 0, 0, 90)
111     picture("line", 0, 0, 575, 90)
112
113     attribute("RUS_PROJ_NO", "", string,"%s", no, none, "0.0", "0.0",25,125,100)
114     {
115       value("", 0)
116     }
117     attribute("RUS_STAGE", "", option,"%s", no, none, "0.0", "0.0",175,125,75)
118     {
119       value("", 0)
120       value("TD", 0)
121       value("PD", 0)
122       value("WD", 0)
123     }
124     attribute("RUS_BRANCH", "", option,"%s", no, none, "0.0", "0.0",300,125,75)
125     {
126       value("", 0)
127       value("ST", 0)
128     }
129     attribute("RUS_BLOCKS", "", option,"%s", no, none, "0.0", "0.0",425,125,75)
130     {
131       value("", 0)
132       value("A", 0)
133       value("B", 0)
134       value("C", 0)
135       value("AB", 0)
136       value("BC", 0)
137       value("ABC", 0)
138       value("0", 0)
139     }
```

Figure 29. RUS-Drawing Name tab source code (not full)

And the last is how the title block template looks in template editor (see Figure 30).

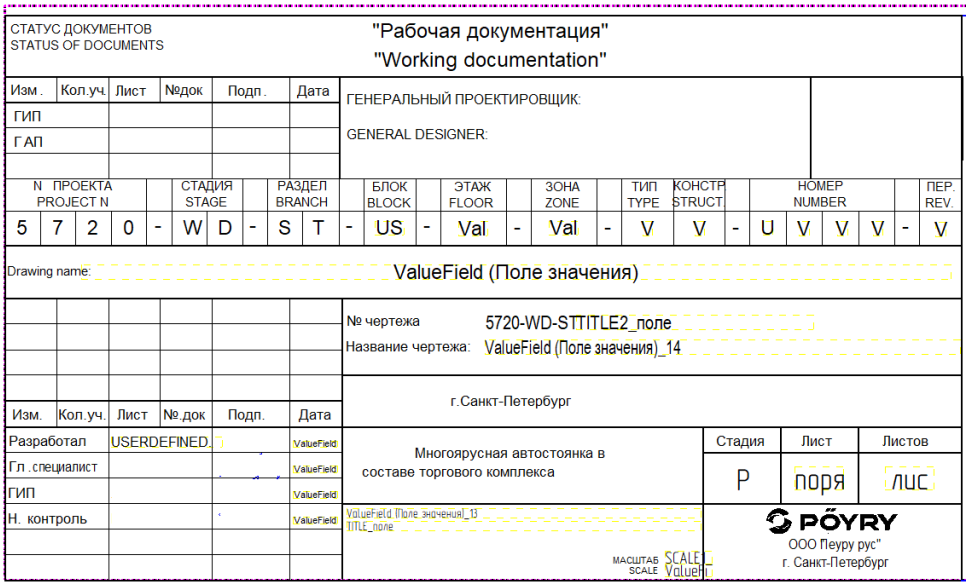


Figure 30. Title block template in the template editor

Some fields are covered with white boxes due to the Copyright reasons.
The development of user-defined attributes together with templates took around 80% of the whole work. It is a complicated and time-consuming but necessary task. Once created, these attributes will be reusable and will save time and budget during the design, modeling and drafting processes.

6.6.4 IFC export

Exporting the .ifc format models require additional pre-sets and settings. In case of the development project, according to client's requirements, objects in the IFC model should be sorted by floor & section and structural type: assembly. For this task, Tekla model organizer was used (see Figure 31).

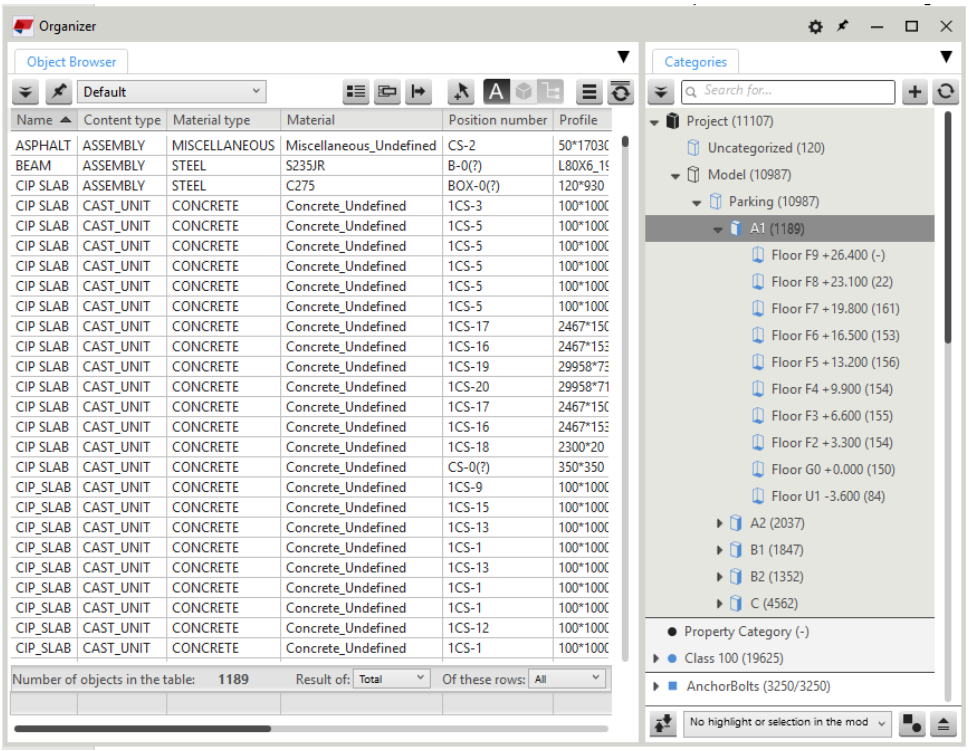


Figure 31. Tekla model organizer

Firstly, the model was split by blocks and floors using sectioning tool in the organizer (see Figure 32). After that, each element of the model has got a special attribute of location by building's block and floor. These locations can be seen using the inquiry tool.

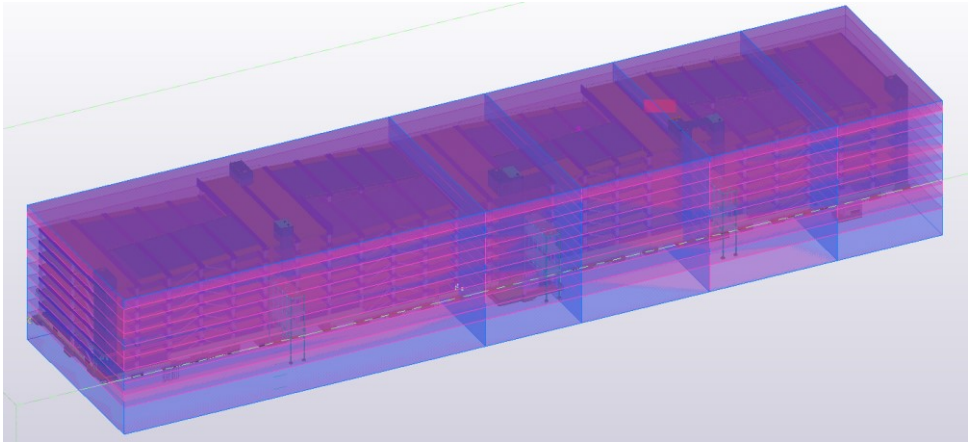


Figure 32. Model sectioned by blocks (blue) and floors (magenta) using Tekla organizer tool

Then the model is synchronized and saved. In IFC export settings, property set rules and attributes were taken from TS Finnish environment general property sets in English (property set is called **All materials**, see Figure 33). Depending on the client's requirements for IFC models, the export can be done for all objects as in Figure 33 or for selected objects, if for example, a client wants only concrete structures at a time. Then using the selection filter, it is possible to select only objects that are needed and make an export.

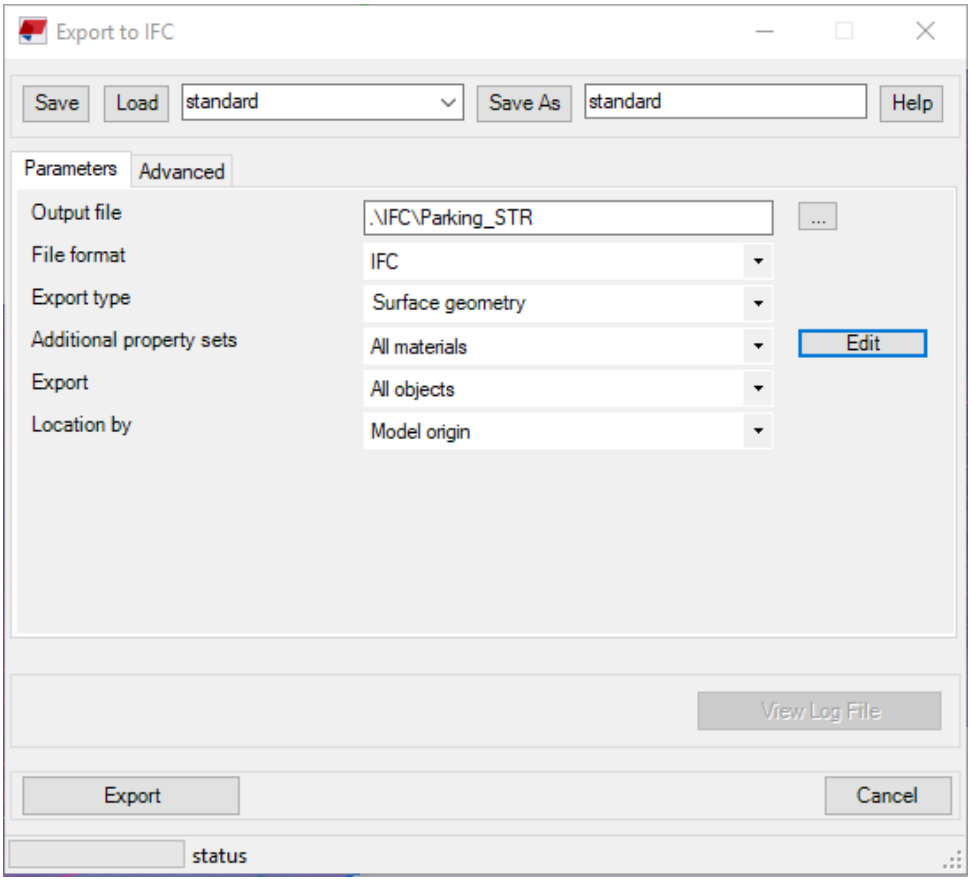


Figure 33. Export to IFC main dialogue configuration. Parameters tab

To get the locations from the organizer in the main configuration window, in section **advanced**, the tick must be set in **Locations from the organizer** (see Figure 34).

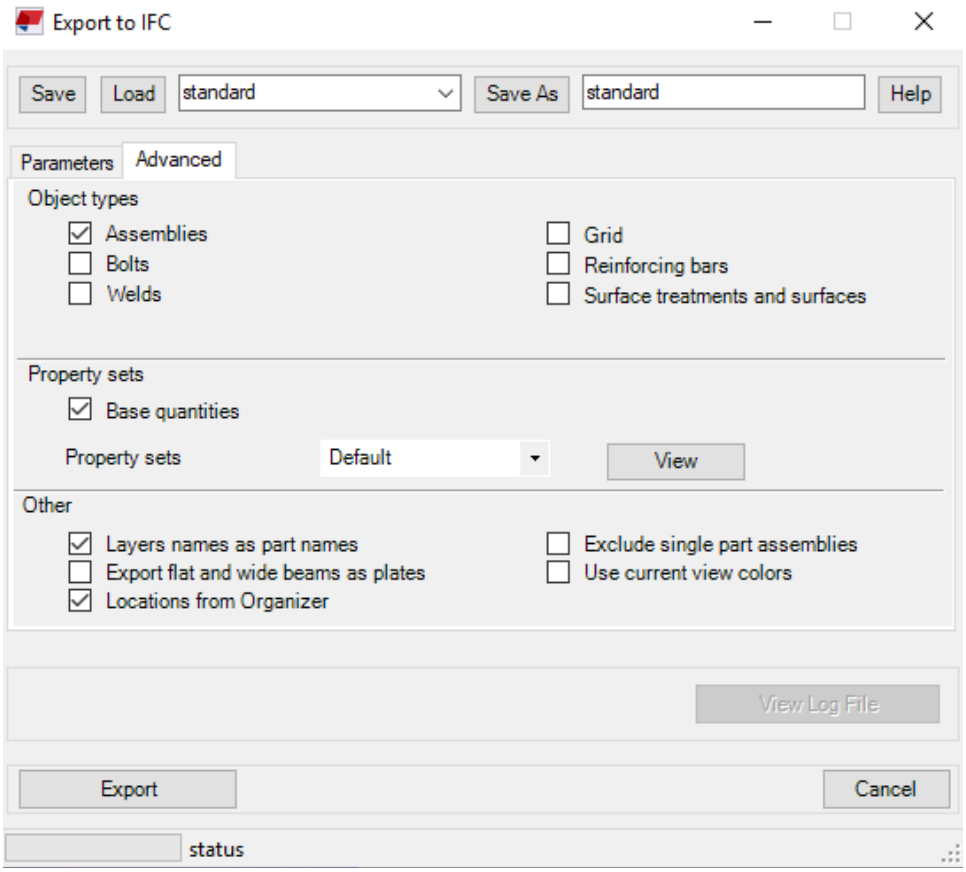


Figure 34. Export to IFC main dialogue configuration. Advanced tab

After all the steps mentioned above, the model is exported and then can be transferred to the client.

6.7 **Drawings**

Structural drawing is an output product that goes to the Client of the project, element manufacturers, other design companies and to the construction site. Any building is constructed using drawings as a basis which define orientations, locations, specifications, elements and building's properties.

Drawings in Tekla are created from the model using 3D to 2D technology. Drawings are automatically updated when the model is changed. Both the model and the drawing are digitally linked together.

There are several types of drawings in Tekla Structures:

- **General arrangement drawings (G**) – are used for plans and layouts of a building or separate structures

- **Cast-unit drawings (C)** – are used for concrete structures in cast-in-place construction or prefabricated elements
- **Assembly drawings (A)** – are used for steel assemblies to be sent to factory
- **Single-part drawings (W)** – are used for single parts of steel assembly for manufacturing
- **Multi-drawings (M)** – combines multiple drawing sheets on one sheet of a big size

Each drawing type has its own features, but they all consist of the following elements:

The model ->

- **Master drawing catalogue ->**
  - **Drawing type (G, C, A, W, M) ->**
    - **Drawing property set:** (all the properties below are filed)
      - titles
      - detailed object-level settings
      - layout (is filed)
        - tables (templates)
        - size
      - views
        - …
      - dimensions
        - …
      - marks
        - …
      - objects
        - …
      - other
        - drawing's UDA
        - filter
        - neighbour part filter
        - protection

The development of the Russian environment required to design the properties from the hierarchy tree above. The property sets are stored in the master drawing catalogue (see Figure 35) as pre-sets for the creation of drawings for different structures e.g. prefabricated concrete column, the layout of anchor bolts, assembly drawing and other. Each preset is mastered to provide the best result in output as an automatically created drawing containing almost all necessary views, marks and dimensions. The start was to pass through all the existing pre-sets and investigate what the situation is.

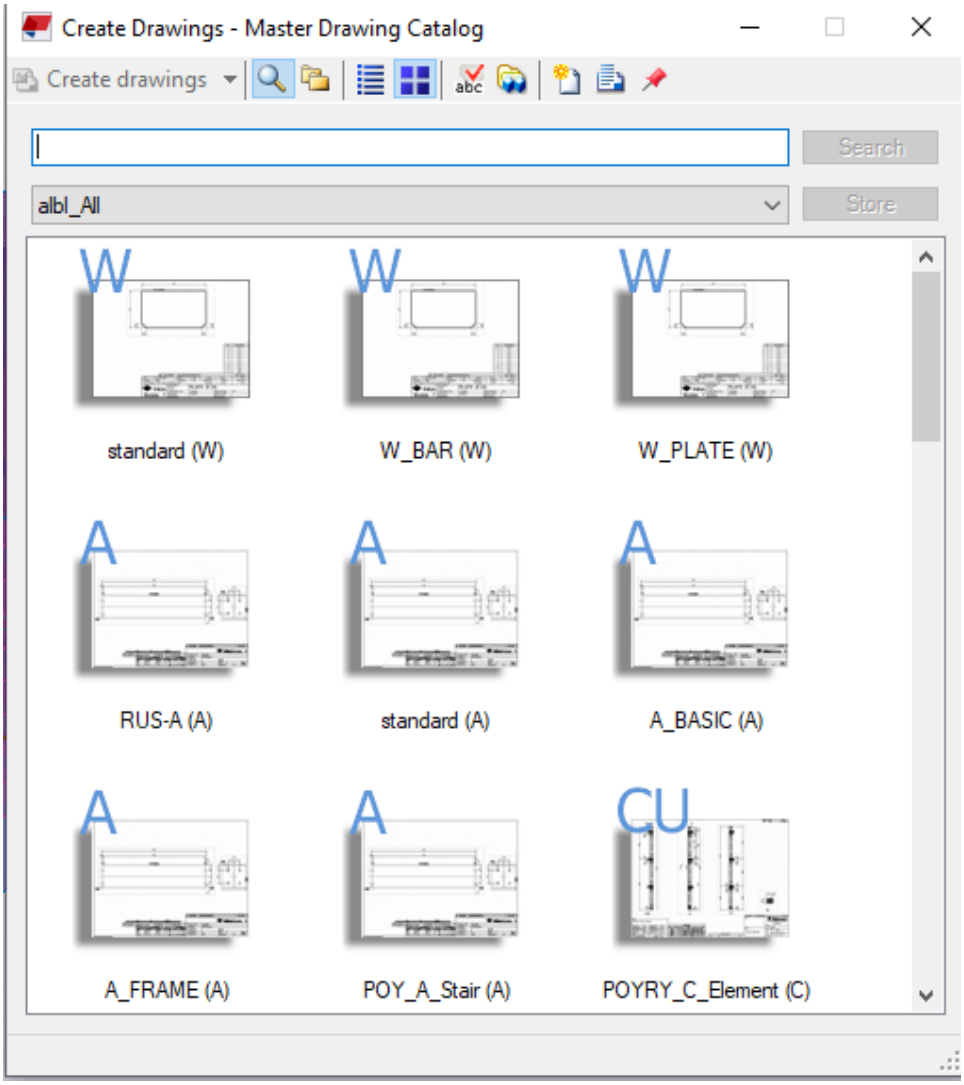


Figure 35. Master drawing catalogue

Working pre-sets were listed and examined. On their basis the following work was done: necessary layouts, templates, user-defined attributes and tables were created. In further sections of the thesis, the mentioned objectives will be described.

6.7.1 Layouts

Layouts in Tekla include the set of templates like drawing frame, specification tables, bill of material, title block, revision block and other. Layouts are created using the drawing layout tool from menu->editors->drawing layout (see Figure 36). Each layout has several or one table layout (sub-layout). All layouts are stored in the environment folder in .lay format. Main layouts which were created for the environment are:

- **RUS-A** – for assembly drawings (see Appendix 5 for drawing examples)
    - tables: specification, specification A3

- **RUS-C** – for cast-unit drawings and precast elements (see Appendix 5 for drawing examples)
    - tables: specification
- **RUS-G** – for GA drawings (see Appendix 5 for drawing examples)
    - tables: general (empty), concrete formwork, concrete reinforcement, bill of material (steel grades), assemblies
- **RUS-G-Bolt_Plan** – for foundation bolts layout (see appendix 5 for drawing examples)
    - tables: specification
- **RUS-G-Element** – For precast element layouts with a bill of material (see Appendix 5 for drawing examples)
    - tables: specification
- **RUS-HC** – same as for cast-units but especially for hollow-core slabs
    - tables: specification
- **RUS-PCap** – for pile cap drawings and foundations
    - tables: specification
- **RUS-W** – for single part drawings (see Appendix 5 for drawing examples)
    - tables: specification first page, specification next pages

Other layouts are from the default environment.

Each layout is mastered to provide the complete set of information and product data for the specific type of structure or drawing. However, layouts are exchangeable and can be used in any drawing type and for any structure. The easiest way to plan the number of layout types is by type of the drawing e.g. G, C, A. For the Russian environment the same system was used but some special layouts were added in addition. Then, table layouts can be categorized by type of the structure (frame, foundation, wall, etc.), drawing purpose (for construction, for manufacturing) and building material (concrete, steel, timber).

It is preferred to build lesser layouts by combining different tasks and adding switching attributes to tables and templates in UDA as it is easier to work with for Tekla users.

Another great advantage is having the set of instructions in a form of a word or pdf document, accompanying the project in Tekla. Instructions can give an introduction to the company-specific settings in Tekla, the use of templates and layouts, how to create drawings, how to do numbering and other important topics regarding the use of Tekla Structures. The user can find the support material easily and therefore, the number of mistakes can be substantially decreased.

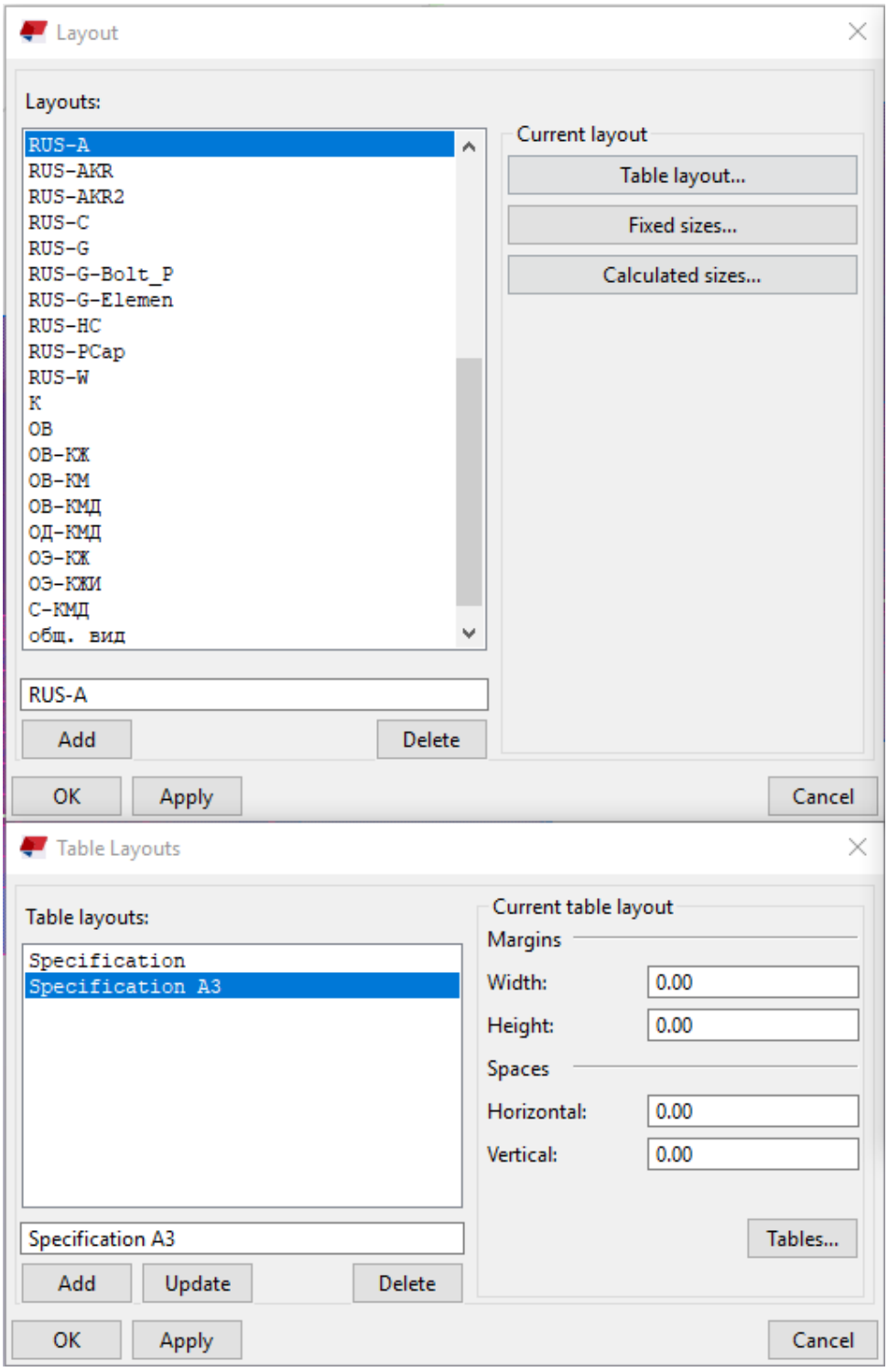


Figure 36. Drawing layout tool

Templates in layouts are placed using the layout editor tool (see Figure 37). They are linked to the corners of the drawing frame and then moved to the correct position.

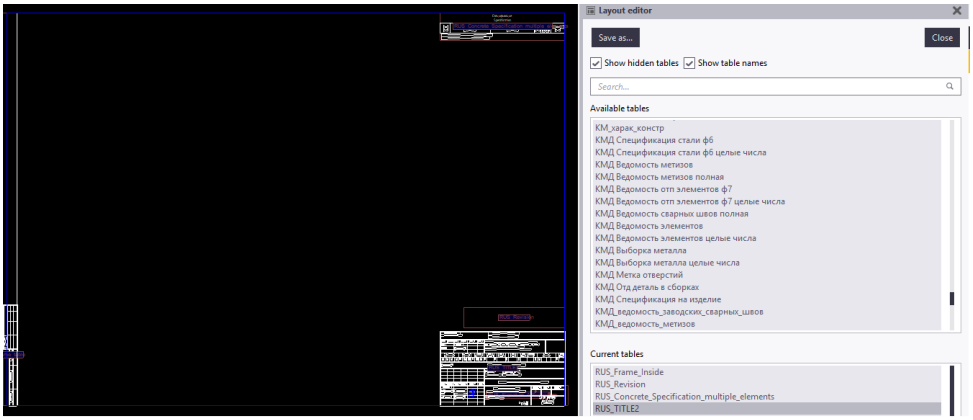


Figure 37. Layout editor tool

6.7.2 Templates

As it is said in Template Editor User's Guide: "Templates are descriptions of forms and tables that can be included in your products. Templates are either graphical or textual. The contents of the template fields are filled in by the product at run time. Templates are used for a variety of different purposes, for example, to print a list of parts used in a construction assembly, to denote the legend on an electrical network map, or to provide statistics on the contents of the map such as city area, scale or date" (Template Editor User's guide, Trimble Solutions Corporation, 2017).

Templates in Tekla are divided into two types: textual templates (see section 6.7.3, Reports) and graphical templates. Graphical templates are the ones used in Tekla drawings as a set of embedded graphical contents that display properties of the BIM model in paper space.

Templates are stored either in environment, model or project folder with the file extension .tpl. Templates in TS is based on C-family programming language with common logical operators and Tekla-based user-defined parameters.

The goal here was to check default Russian environment templates in compliance with GOST requirements, adjust them to company-specific tasks and outlook, and develop new ones that were necessary to have.

After examination of default templates, they were edited and adjusted according to the following criteria:

- Default template colours must be in harmony with printing settings (see section 6.7.6, Printing), line thickness settings and colour scheme that was developed (the blue colour is not in use in templates or drawings, it is reserved for signature images)
- Fonts – GOST Type A, 4.0 for headings, 3.5 for body text

- Line thicknesses acc. to GOST's, typically 2mm for outer frame and 1mm for inner frames
- Template attributes must be linked to the ones used in the model and UDA's
- Content in rows must be either centred or left-sided
- Table outlook and column & row layout acc. to GOST's
- All content and column headings in bilingual format (Russian first, English second) according to GOST R 2.901-99
- Template's file name must be in English
- Common properties values must be checked for if they depict real values e.g weights, dimensions, areas calculation.

In total, after the following procedures and development of new templates 30 templates are in use for general, concrete and steel (see Figure 38), 12 templates for additional marks.

Name	Status	Type	Size
RUS_Additional_frame_stamp.tpl	✓	TPL File	5 KB
RUS_Concrete_Reinforcement_register.tpl	✓	TPL File	14 KB
RUS_Concrete_Specification_for_element_layouts.tpl	✓	TPL File	7 KB
RUS_Concrete_Specification_multiple_elements.tpl	✓	TPL File	167 KB
RUS_Concrete_Specification_Slab_layout.tpl	✓	TPL File	50 KB
RUS_Concrete_Specification_Wall_layout.tpl	✓	TPL File	50 KB
RUS_Concrete_Steel_expense_register.tpl	✓	TPL File	50 KB
RUS_Designer_Signatures.tpl	✓	TPL File	33 KB
RUS_Detail_register_for_bolts.tpl	✓	TPL File	19 KB
RUS_Drawing_Frames.tpl	✓	TPL File	137 KB
RUS_Frame_Inside.tpl	✓	TPL File	20 KB
RUS_Loads_on_foundations.tpl	✓	TPL File	50 KB
RUS_Revision.tpl	✓	TPL File	14 KB
RUS_Steel_Assemblies_to_send.tpl	✓	TPL File	32 KB
RUS_Steel_Bolt_Specification.tpl	✓	TPL File	60 KB
RUS_Steel_Elelement_List.tpl	✓	TPL File	139 KB
RUS_Steel_Grade_Specification.tpl	✓	TPL File	112 KB
RUS_Steel_Grade_Specification_full.tpl	✓	TPL File	248 KB
RUS_Steel_Parts_in_Assemblies.tpl	✓	TPL File	9 KB
RUS_Steel_Specification_Assembly.tpl	✓	TPL File	45 KB
RUS_Steel_Specification_for_Parts.tpl	✓	TPL File	113 KB
RUS_Steel_Specification_grades_full.tpl	✓	TPL File	113 KB
RUS_Steel_Specification_Single_Part.tpl	✓	TPL File	32 KB
RUS_Steel_Specification_welds.tpl	✓	TPL File	28 KB
RUS_Title_Block_Main.tpl	✓	TPL File	582 KB
RUS_Title_First_Page.tpl	✓	TPL File	439 KB
RUS_Title_Second_Page.tpl	✓	TPL File	17 KB
Steel_expense_register_1.tpl	✓	TPL File	12 KB
Steel_expense_register_2.tpl	✓	TPL File	2 KB
Steel_expense_register_3.tpl	✓	TPL File	4 KB

Figure 38. Russian environment main templates

The most difficult part was to develop a template for reinforcement weight specification table (see Figure 39) used to calculate the amount of reinforcing bars of each diameter in cast-unit drawings.

Ведомость расхода стали, кг
Reinforcement weight specification, kg

Марка элемента Element mark	Изделия арматурные Reinforcing parts						Всего Total	Сетки арматурные Reinforcing meshes							Всего Total
	Арматура класса Reinforcement of class							Арматура класса Reinforcement of class							
	A500C ГОСТ 34028-2016							A500C ГОСТ 34028-2016							
	Ø8	Ø10	Ø12	Ø20	Ø25	Итого Total		Ø6	Ø6	Ø8	Ø8	Ø10	Ø10	Итого Total	
5ПС4-1	34.7	48.8	64.8	3.0	46.2	197.5	197.5	0.6	0.5	8.6	8.3	149.1	143.2	310.4	310.4

Figure 39. Reinforcement weight specification table

By default, the table's orientation was vertical with vertical distribution, but according to GOST 21.501-93, form 5 – it must be horizontal with horizontal distribution and include reinforcing meshes, too.

In Tekla 2017 this is not possible to do but there is one solution: to divide one template into two or three separate templates. The first one is the main table for bars and meshes but in template editor, it is rotated by 90° as shown in Figure 40. After placing the template in layout Tekla allows to rotate it back by 90° but now table will distribute from right to left.

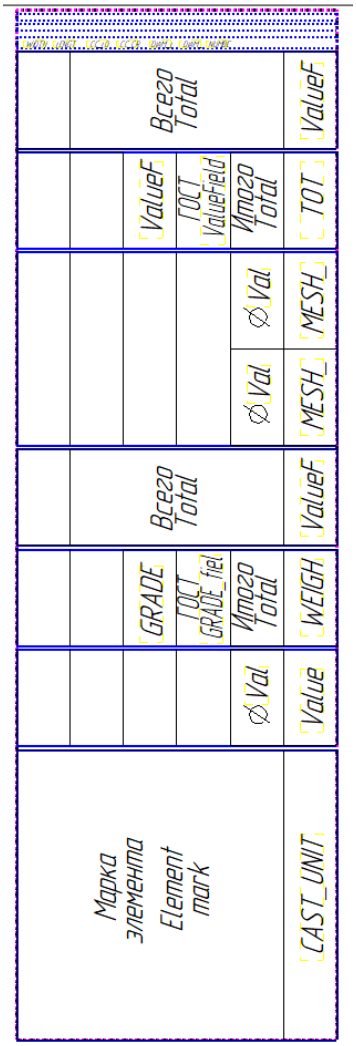


Figure 40. Reinforcement weight specification table template in tplEd

The second template includes headings on top and inside the table (see Figure 41). The template is horizontal and snapped in the layout editor to the top left corner of the main table.

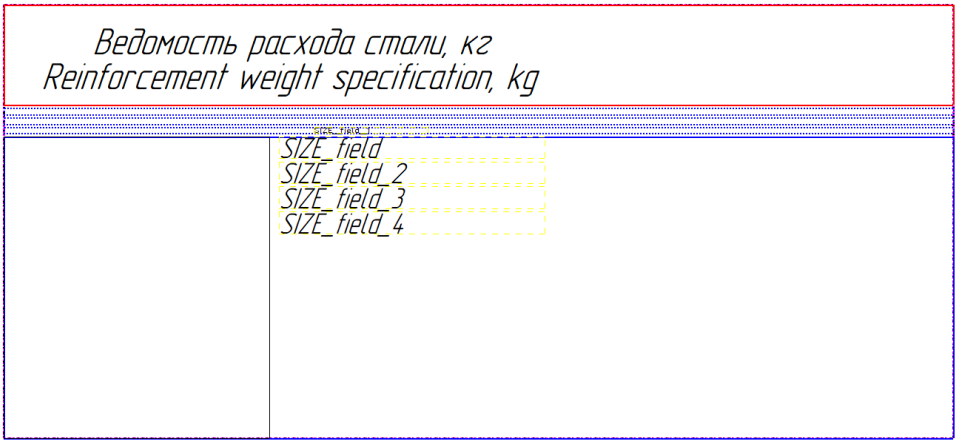


Figure 41. Reinforcement weight specification template with headings in tplEd

In case of code, the most complicated formula here is for calculating weights of meshes separately for longitudinal bars and cross bars (as the mesh can consist of two different diameters e.g. 10/12-150/150-A500C.

The formula looks as follows (see Figure 42):

```
3.1416
* (GetFieldFormula("DIAM_LONG") * GetFieldFormula("DIAM_LONG"))
* GetFieldFormula("LENGTH_FIELD")
* round((GetFieldFormula("WIDTH_FIELD")/GetFieldFormula("CC_LONG_FIELD")), 1)
* 7850
* GetFieldFormula("NUMBER_FIELD")
* 0.000000001
- (GetValue("WEIGHT_GROSS") - GetValue("WEIGHT_NET"))
```

Figure 42. Formula for calculating longitudinal rebar weights of each diameter

Parameters:
DIAM_LONG refers to formula: GetValue("CC_DIAMETER_LONG")/2
LENGTH_FIELD refers to GetValue("LENGTH”)
WIDTH_FIELD refers to GetValue("WIDTH”)
CC_LONG_FIELD refers to GetValue("CC_LONG”)
NUMBER_FIELD refers to GetValue(“NUMBER”)

The same formula is used for calculating cross rebars but with different diameter and c/c parameters.

Working with templates is not effortless work and takes time to get used to the program’s logic but correctly working templates, especially bill of material tables is one of the most important parts to develop. Wrong

formulas or missing constants can have n impact on the budget of the whole structural design part of the project. It can cause mistakes in ordering procurement packages and construction management on site. Therefore, these templates must always be double-checked.
For template examples see example drawings in Appendix 5.

Moreover, according to GOST, it is required that documents from the main set of working drawings are signed. To make it faster and easier, for the development project, all the involved designers and supervisors had to create their digital signatures in .dwg format. After that, a special template was created in Tekla and all the signatures were embedded into it. The formula reads the name of the designer from UDA and according to it chooses which signature to display. All signatures must be in blue colour.

6.7.3 Reports

The report is another type of template typically used to quickly create bills of material or specifications. Reports, generally, are created to be used by the construction management team or procurement specialists.

The report can be created for any type of structural element, assembly, cast-unit or embedded element. The basic cast-unit report is presented in Figure 43.

```
-------------------------------------------------------------------------------------
CAST UNIT            PROJECT NUMBER:                          Page: 1
BILL OF MATERIAL       PROJECT NAME:         Parking           Date:
-------------------------------------------------------------------------------------
=====================================================================================
Cast Unit             Pcs     Material    Volume (mi)     Weight (kg)
-------------------------------------------------------------------------------------
  Pм-29                 1       B35         9.50            23752.7
  ---------------------------------------------------------------------------------
  Embeds              Pcs     Material                    Weight (kg)         kg/tot
  ---------------------------------------------------------------------------------
     HPM30L           4         Steel_U                       1.1              4.6
                                                            ----------------------
                                                            Total:             4.6
  ---------------------------------------------------------------------------------
  Reinforcements:
  Typ Pos  Pcs  Grade  Size L     a    b    c    d    e    u   v   D   kg/pcs kg/tot
  ---------------------------------------------------------------------------------
  A   PAR   18  A500C    16 5740  5740                                    9.1    163.0
  B   PAR    8  A500C    16 1560  600  1000               90      80   2.5     19.7
  C   PAR    8  A500C    16 3130  1520 1620               38      80   4.9     39.6
  D   PAR   76  A500C    16 4180  600  3060 600                        80   6.6    764.3
  E   PAR    4  A500C    16 2370  600  1200 600            52  52  80   3.7     15.0
  U   PAR   11  A500C    12 2700  155  780  490  780  490          60   2.4     28.2
                                   155
                                                            ----------------------
                                                            Total:          1029.8
-------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------
                                              Cast Unit Total:        24787.0   kg
=====================================================================================
```

Figure 43. Example of a report in Tekla

Reports can be exported to Excel for further editing. Report templates with file extension .rpt are stored under the environment, project or model folder. Report templates are created the same way as graphical templates (see section 6.7.2, Templates) via the Template editor.

For the Russian environment, it was decided not to use Tekla Reports tool in order not to create additional template files and save time, but to use the Organizer tool.

Tekla model organizer, as it was mentioned earlier in section 6.6.4 allows organizing model objects by floor, section and building (if a building is split into parts). Moreover, the Organizer tool is used to create reports, but unlike the Reports tool, it doesn't need pre-defined templates. Organizer combines the features of a digital interactive model catalogue and the reporting tool (see Figure 44).

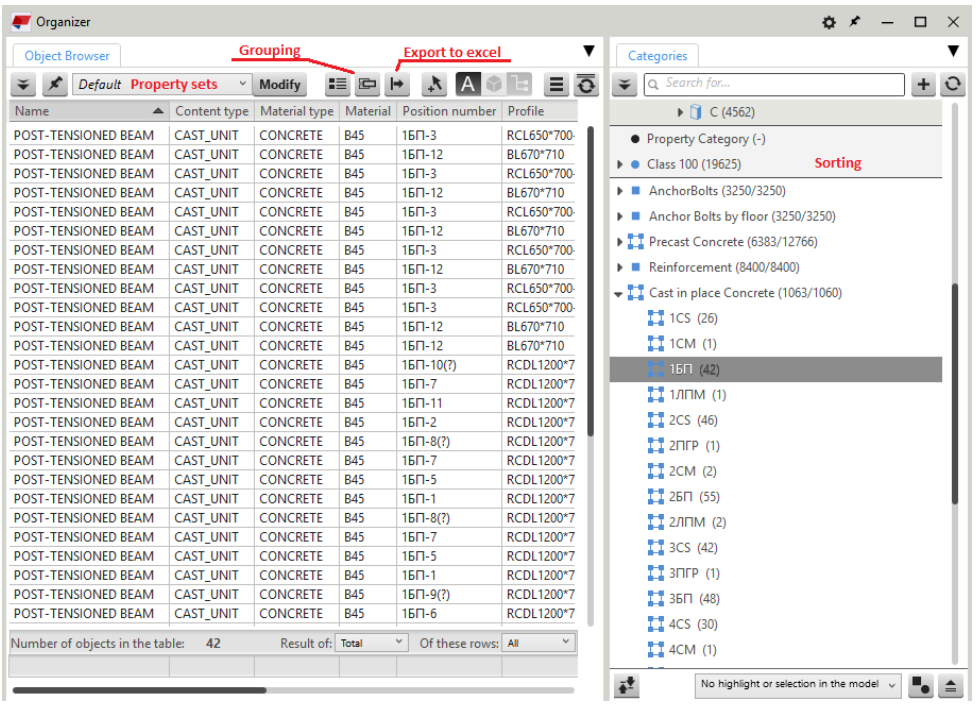


Figure 44. Tekla Organizer tool

In the organizer, the creation of property sets is fast and simple and so it doesn't need preparation of all possible cases in advance, but made "as issued". Necessary property sets can be firstly discussed with the Client and then easily adjusted using UDA attributes.

Editing of property sets in the Organizer (see Figure 45) is done through the settings tab in the top right corner.

All property sets are saved under the model folder and can be reused in other projects. BEC library settings were loaded from the Finnish environment because they contain many useful custom-designed attributes.

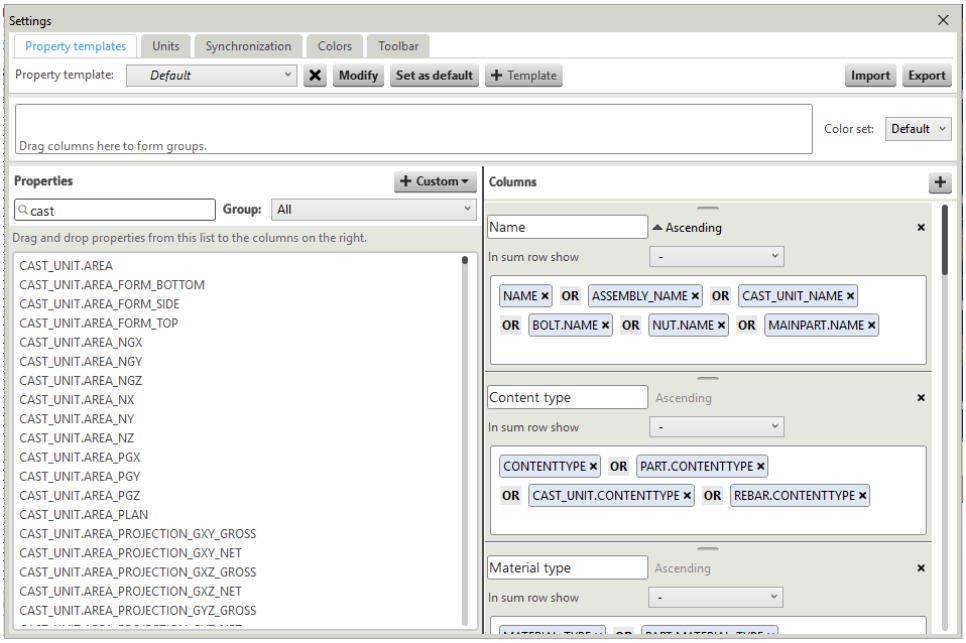


Figure 45. Property sets editing in Organizer tool

In the output, the data is exported to excel (excel style templates can be created) and then can be transferred to the Client. Organizer allows automatic grouping, too.

ФУНДАМЕНТЫ / FOOTINGS						
			Project number:			
			List date:			Revision, date:
Кол-во / Count	Имя/Name	Материал /Material	Марка/Position number	Профиль/Profile	Отметка верха/Top level / mm	Высота/Height / mm
1	Foundation beam	B35	Рмб-1	600*1400	-220	2 530
1	Foundation beam	B35	Рмб-2	600*6430	20	600
2	Foundation beam	B35	Рмб-3	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-3	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-3	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-4	600*6430	20	600
2	Foundation beam	B35	Рмб-5	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-5	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-6	600*5260	-700	600
2	Foundation beam	B35	Рмб-6	600*5260	-700	600
6	Foundation beam	B35	Рмб-6	600*5260	-700	600
3	Foundation beam	B35	Рмб-6	600*5260	-700	600
2	Foundation beam	B35	Рмб-7	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-7	600*1400	-220	1 080
1	Foundation beam	B35	Рмб-7	600*1400	-220	1 080
2	Foundation beam	B35	Рмб-8	600*5260	20	600

STAGE: WD						
		Author:	KZH			
		List number:				
Длина/Length / mm	Ширина/Width / mm	Объем/Volume / m3	Масса/Weight / t	Секция/Section	Этаж/Floor	Масса армирования/Reinforcement weight / kg
5 930	1 400	6	15,072	B1	Floor U1 -3.600	474
1 620	6 430	4,1	10,432	B1	Floor U1 -3.600	439
3 910	1 400	3,3	8,218	C	Floor U1 -3.600	496
3 910	1 400	3,3	8,218	A2	Floor U1 -3.600	248
3 910	1 400	3,3	8,218	B1	Floor U1 -3.600	248
1 620	6 430	4,1	10,285	A1	Floor U1 -3.600	427
4 460	1 400	3,7	9,372	C	Floor U1 -3.600	577
4 460	1 400	3,7	9,372	A2	Floor U1 -3.600	288
900	5 260	2,8	7,101	A1	Floor U1 -3.600	240
900	5 260	2,8	7,101	A2	Floor U1 -3.600	479
900	5 260	2,8	7,101	C	Floor U1 -3.600	1 438
900	5 260	2,8	7,101	B1	Floor U1 -3.600	719
4 460	1 400	3,7	9,373	C	Floor U1 -3.600	577
4 460	1 400	3,7	9,373	A2	Floor U1 -3.600	288
4 460	1 400	3,7	9,373	B1	Floor U1 -3.600	288
1 620	6 480	3,9	9,987	C	Floor U1 -3.600	871

Figure 46. Example of report exported from Organizer to Excel. Split into two parts (read order: first-left side, second-right side)

6.7.4 Scales

Scales used in drawings are taken according to GOST 2.302-68 ESKD and are presented in Table 8.

Table 8. General drawing scales. Extract from GOST 2.302-68

Scale down	1:2; 1:2,5; 1:4; 1:5; 1:10; 1:15; 1:20; 1:25; 1:40; 1:50; 1:75; 1:100; 1:200; 1:400; 1:500; 1:800; 1:1000
Life-size	1:1
Scale up	2:1; 2,5:1; 4:1; 5:1; 10:1; 20:1; 40:1; 50:1; 100:1

The main scale for drawing's title block must be the same as used for the main drawing's view; the same method when exporting to DWG.

6.7.5 Texts, marks and dimensions

According to GOST 2.304-81 ESKD, two **font types** are in use in working drawings: GOST Type A (regular or italic) and GOST Type B (regular or italic).

Font sizes are: 1,8; 2,5; 3,5; 5; 7; 10; 14; 20; 28; 40

In templates, font size 5 used for headings was changed to 4,5, as headings in two languages are required and font size 5 does not fit in one line.

It is always better to use one font and font size in one drawing.

All specifications, side texts, marks and notes are doubled in the English language. If there is no possibility or necessity in translation, text can be left in Russian only.

The line thickness of main contour lines, according to 2.303-68 ESKD, must be in a range from 0,5mm to 1,4mm. In the development project, 0,5mm is used. Neighbour lines, reference lines and dimensions can vary from 0,15mm to 0,45 mm (see section 6.7.6, Printing).

Dimension mark properties (see Figure 47).

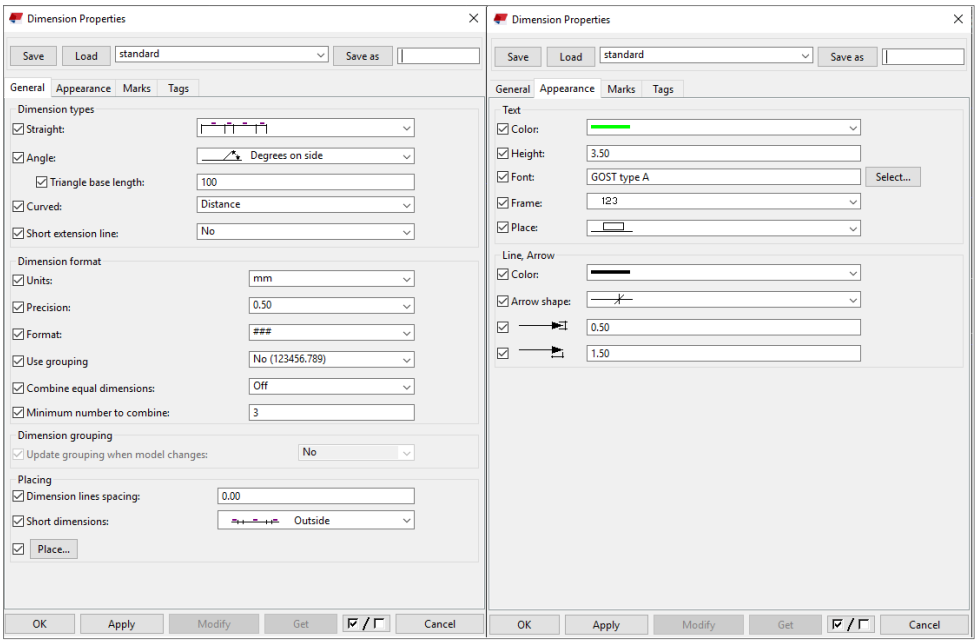


Figure 47. Dimension mark properties

Section mark properties (see Figure 48). Sections are named using digits 1-1, 2-2, etc. Elevations are named using letters in capitals, details using either digits or letters.

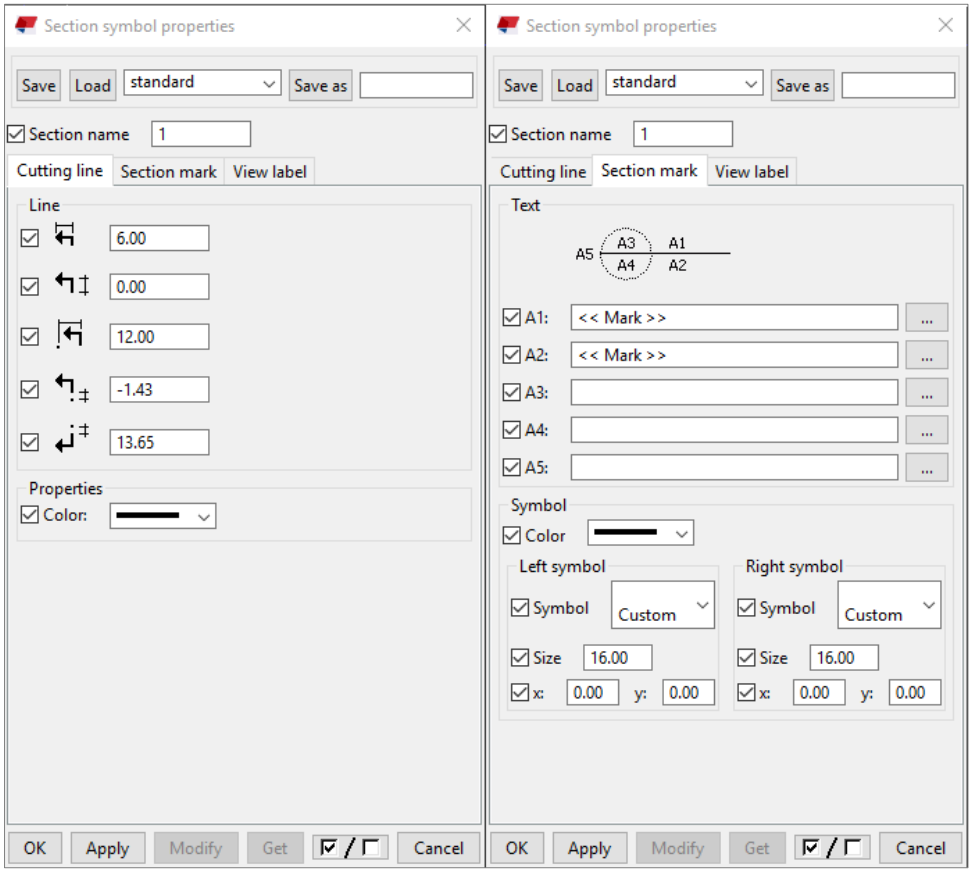


Figure 48. Section mark properties

Level mark properties (see Figure 49).

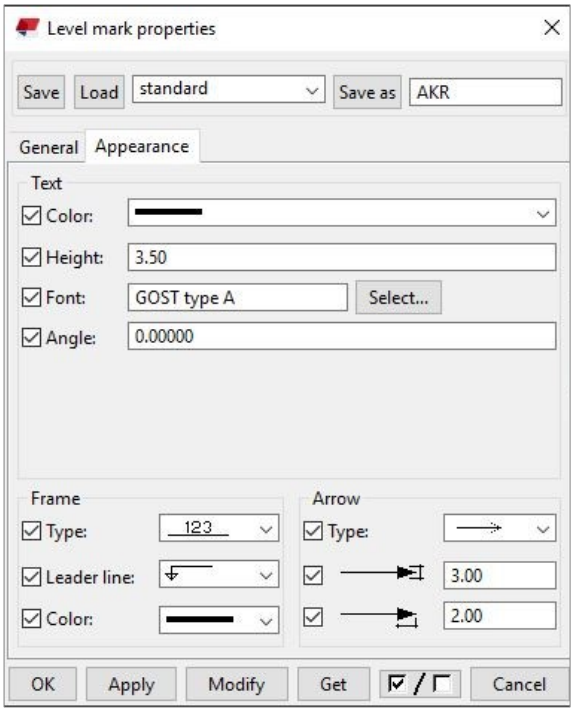


Figure 49. Level mark properties

Weld marks are mostly the same as in the Finnish environment, the font is GOST Type A. Welds as objects from the model are shown in the drawing with a light outline. To show welds according to GOST (GOST 2.312-72) pattern lines Tee visible/hidden for factory welding and Seam visible/hidden for site welding must be used. Pattern lines are drawn manually (or using drawing welding plugin) all-around welded parts.

Revision marks are shown with a cloud and aligned revision mark as shown in Figure 50. The number of changes in a single revision is marked in the revision table.

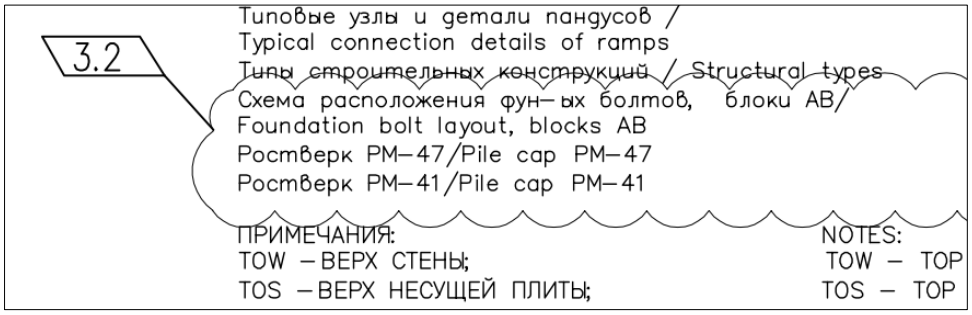


Figure 50. Revision marking

Gridlines: font size 5, circular frame, line thickness as for reference lines. In the model, vertical gridlines (axis lines) are named with Cyrillic letters, from down to up direction, and horizontal gridlines with digits from left to right (acc. to GOST R 21.1101-2013).

All necessary standard files for annotation objects were created and saved in TS Russian environment.

6.7.6 Printing

Printing in the Russian environment is done in colour mode, due to the requirements of coloured signatures and the Client's logo. Print settings and colour scheme are displayed in Figure 51.

All colours are black in output except blue, yellow and shades of grey. The blue colour is used for signatures, yellow – for the Client's logo and shades of grey for solid hatches on sections.

The file name is taken from drawing's title 2. Output print file names can be edited through the advanced options.

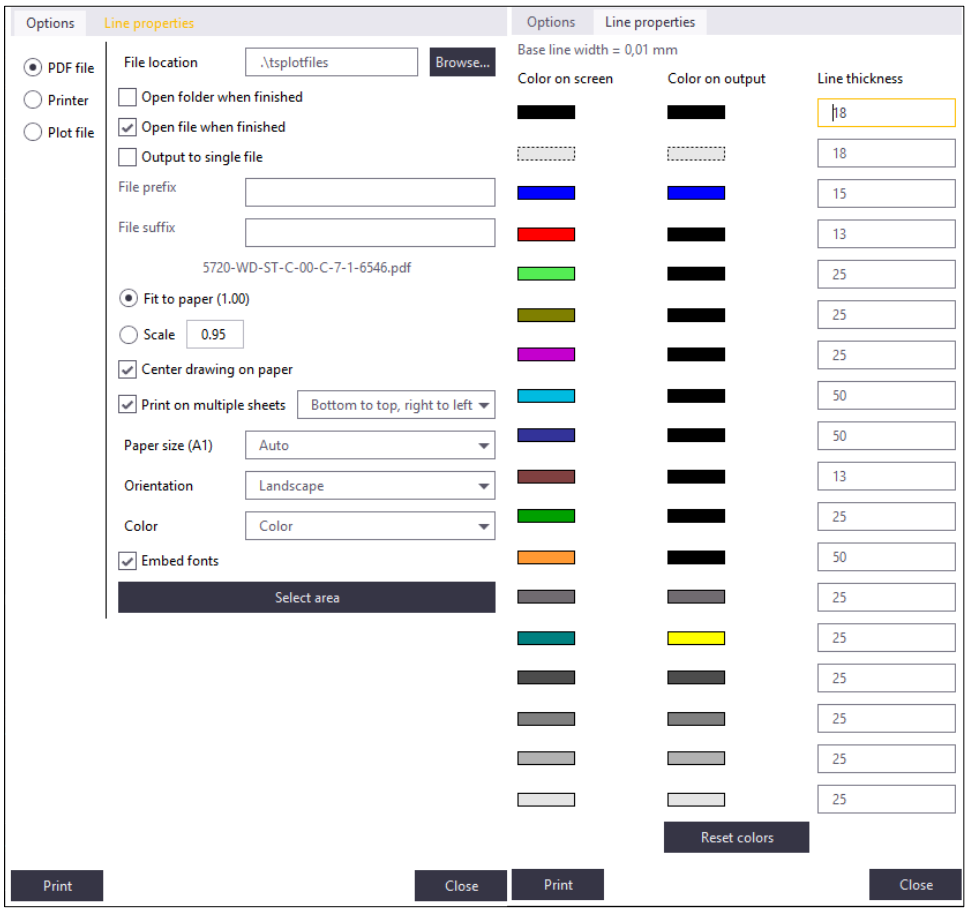


Figure 51. TS printing colours and settings

By default, the drawing frame is in the same blue colour as used for signatures and it will be seen on the printout. This problem can be fixed using the old plot dialogue option from the advanced options tab. In the old print settings tab, in sub-tab frames either colours need to be switched from blue to black, or ticks unchosen as shown in Figure 52.

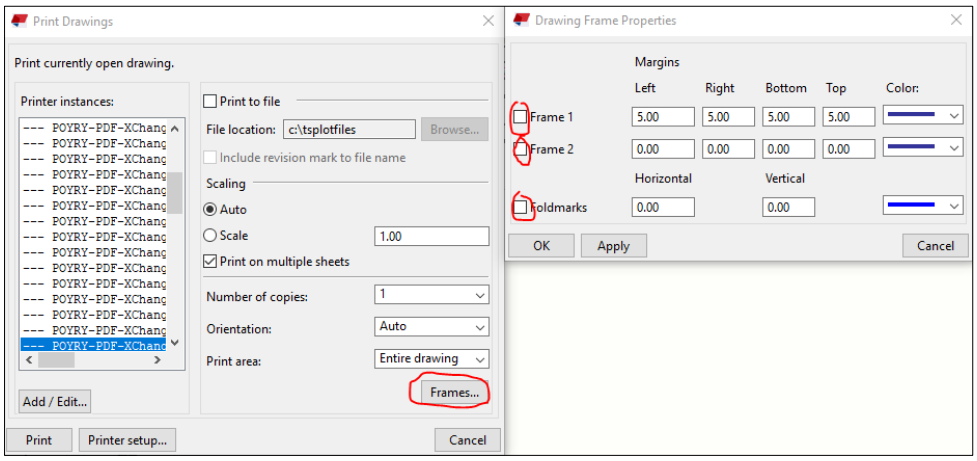


Figure 52. Old print settings dialogue. Switching off drawing frames

7 CONCLUSION

Project implementation in Russia requires a deep knowledge of the Russian norms of construction and design systems in order to compete in the Russian engineering market and provide high-quality solutions. A total of two chapters in the thesis describe the main principles of Russian normative system and design standards, cover the aspects of sectioning, management and creation of design documentation following GOST standards, and explain the strategy used when engineering is performed internationally. Chapters 4-6 report the use of BIM technologies in Russia, the perspectives of its development and provide a comparison to the BIM management system used in Finland. Moreover, the information presented in these chapters provide general knowledge about Tekla Structures and its role in the design process, as well as give the understanding of how Tekla Structures environments work.

Chapter 6 describes the procedures of Tekla Structures Russian Environment development, gives recommendations and advice about its use, directs and specifies the internal processes. The steps of development were shown in a practical way to provide a better insight into how the program works. In prospect, the described development methods may be used for further improvements, localizing and learning of TS Russian Environment.

In conclusion, the materials designed and developed within this thesis allowed AFRY to successfully launch and make progress in the first project in Russia executed using the Tekla Structures software as the main tool. The assigned targets are achieved as this document can serve as a reference guideline to engineers, project managers and Tekla users planning or being involved in Russian projects.

At the present time, both Russian engineering companies and State Construction authorities are in the process of developing new and reorganizing old standards and norms to follow the high levels of construction and design. Although now Russian and Finnish systems are different, in the near future, we can possibly see more in common. Trimble Russia also improves Tekla Russian Environment every year which leads to a more convenient and reliable program environment.

REFERENCES

AO KODEX. (2019). Digital library of law and technical documentation. Extracts: System for Project Documentation in Construction (SPDS), Uniform System of Constructor Documentation (ESKD), Design rules (SP). Retrieved 01-09 2019 from http://docs.cntd.ru/

Draycott T., Bullman P. (2009). *Structural Elements Design Manual: Working with Eurocodes*. UK: Oxford.

KB Konstruktor. (n.d.). Structural drawings. Documentation according to GOST. Retrieved September 2019 from http://www.kb-konstruktor.ru/

Sborshikov S. B. (2015). *Basics of Design, Construction, Operation of Buildings and Structures.* Moscow: MSUC.

SFS -EN 1990 (2002). Eurocode - Basics of Structural Design, with Finnish National annex. Helsinki: Finnish Standards Association SFS. The document was provided by Pöyry Finland Oy.

SFS -EN 1991 (2002). Eurocode – Actions on Structures, with Finnish National annex. Part 1-3, General Actions – Snow Loads. Part 1-4, General Actions – Wind Loads. Helsinki: Finnish Standards Association SFS. The document was provided by Pöyry Finland Oy.

SPSUACE. (2018). BIM Modeling in terms of Construction and Architecture: materials of All-Russian scientific and practical conference, Saint-Petersburgh State University of Architecture and Civil Engineering. Saint-Petersburg: SPSUACE.

SPSUACE. (2018). BIM Modeling in terms of Construction and Architecture: materials of All-Russian scientific and practical conference, Saint-Petersburgh State University of Architecture and Civil Engineering. K. Zhdanov & A. Krishtalevich (Ed.) *BIM Technologies in Finland. Tekla Structures as the main tool in Structural Design.* Saint-Petersburg: SPSUACE, pp. 107-113.

Topengineer.ru (Tekla Structures distributor in Russia). (n.d.). Examples of Concrete and Steel fabrication drawings. Retrieved July 2019 from https://topengineer.ru/

Trimble Solutions Corporation. (2019). Tekla Structures 2019. Manage Tekla Structures. Retrieved August 2019 from https://teklastructures.support.tekla.com/tekla-structures-2019-pdf-documentation

Trimble Solutions Corporation. (2017). Tekla Structures 2017. Tekla Structures System. Retrieved August 2019 from https://teklastructures.support.tekla.com/tekla-structures-2017-pdf-documentation

Trimble Solutions Corporation. (2017). Tekla Structures 2017. Template Attributes Reference. Retrieved October 2019 from https://teklastructures.support.tekla.com/tekla-structures-2017-pdf-documentation

Trimble Solutions Corporation. (2017). Tekla Structures 2017. Templates and Reports. Retrieved October 2019 from https://teklastructures.support.tekla.com/tekla-structures-2017-pdf-documentation

Trimble Solutions Corporation. (2017). Template editor user's guide. Retrieved July 2019 from https://teklastructures.support.tekla.com/tekla-structures-2017-pdf-documentation

Tekla Warehouse (Trimble Solutions Corporation). (n.d.). Plugins and components for Tekla Structures 2017. Retrieved September 2019 from https://warehouse.tekla.com/

Trimble Russia LLC. (2017). Tekla Structures 2017. Russian environment release notes. Retrieved October 2019 from https://teklastructures.support.tekla.com/ru/2017/ru/envrn_%D0%B7%D0%B0%D0%BC%D0%B5%D1%87%D0%B0%D0%BD%D0%B8%D1%8F-%D0%BA-%D0%B2%D1%8B%D0%BF%D1%83%D1%81%D0%BA%D1%83-%D0%BF%D0%BE-%D0%BB%D0%BE%D0%BA%D0%B0%D0%BB%D0%B8%D0%B7%D0%B0%D1%86%D0%B8%D0%B8-tekla-structures-2017

Appendix 1

TEKLA STRUCTURES CLASS AND PREFIX INSTRUCTIONS

PÖYRY	TEKLA STRUCTURES - РЕКОМЕНДАЦИИ ПО ПРЕФИКСАМ И КЛАССАМ TEKLA STRUCTURES CLASS AND PREFIX INSTRUCTIONS	Poyry Finland Oy (ENG-RUS Edition) Kirill Zhdanov 02.2019			
Имя/Name		Класс/ Class	Alternative	Сборка/Assembly	
				Prefix Rus	Prefix Eng
STEEL STRUCTURES	**СТАЛЬНЫЕ КОНСТРУКЦИИ**	**2****			
Vertical Members	**Вертикальные элементы**	**21***			
Column	Колонна	212		К	C
Vertical Brace	Связь вертикальная	213		СВ	BV
Frame	Рама	214		Р	F
Skylight Frame	Рама фонаря	214		РФ	FSK
Bracing Strut	Раскос	215		РК	BST
Vertical Post (Stand)	Стойка	217		СТ	VP
Additional element	Дополнительный элемент				
Horizontal Members	**Горизонтальные элементы**	**22*-23***			
Beam	Балка	220		Б	B
Secondary Beam	Балка второстепенная	221		БВ	BS
Deck Beam	Балка настила	222		БН	BD
Tying Beam (Or eave strut)	Балка обвязочная	221		БО	BT
Rafter (Secondary)	Балка подстропильная	224		БП	RS
Rafter (Main)	Балка стропильная	224		БС	R
Crane Girder	Балка подкрановая	230		БК	BC
Horizontal Brace	Связь горизонтальная	227		СГ	BH
Column Brace	Связь по колоннам	235		СК	BCL
Deck	Настил	238		Н	DK
Deck Joist	Прогон настила	237		ПН	DJ
Delta-Beam	Delta балка	209		ДБ	DB
Additional element	Дополнительный элемент				
Trusses	**Фермы**	**24***			
Truss	Ферма	241		Ф	T
Truss (Secondary)	Ферма (Подстропильная)	242		ФП	TS
Truss (Main)	Ферма (Стропильная)	241		ФС	TM
Truss (Skilight)	Ферма (Фонарная)	241		ФФ	TSK
Truss (Wind)	Ферма (Ветровая)	242		ФВ	TW
Mounting Elements	**Монтажные элементы**	**9***			
Plate	Пластина	99		П	P
Mounting Plate	Пластина монтажная			ПМ	PM
Bent Plate	Пластина гнутая			ПГ	PB
Mounting Element	Монтажный элемент			МЕ	ME
Stairways	**Лестницы и площадки**	**25***			
Stairway	Лестница	250		Л	S
Stair (Single)	Ступень	253		ЛС	ST
Fence	Ограждение	255		ОГ	F
Railing	Ограждение лестницы	255		ОГЛ	RL
Fire Emergency Ladder	Пожарная лестница	256		ПЖЛ	FEL
Stringer	Косоур	257		КС	STR
Vertical Post (Stand)	Стойка лестницы	259		СТЛ	SVP
Shell&Facade Structures	**Фасадные конструкции**	**26***			
Corrugated Sheet	Лист гофрированный	263		ЛГ	CSH
Coffer	Кассета	264		КА	COF
Sandwich Panel	Сэндвич панель	265		СПА	SP
Girt	Прогон	269		ПР	GR
Sheet (General)	Лист	262		ЛИ	SH
Profiled Sheet (Bearing)	Профлист несущий	263		ПФ	PSH
Lantern	Фонарь световой			ФОС	LT
Gate Frame	Каркас ворот	267		КВ	FR
Door Frame	Каркас двери	267		КВ	FR
Gate	Ворота	268		В	G
Door	Дверь	268		Д	D
Arc	Арка	268		АРК	ARC
PRECAST ELEMENTS	**СБОРНЫЕ ЭЛЕМЕНТЫ И КОНСТРУКЦИИ**	**3****			
Frame Members	**Элементы каркаса (линейные объекты)**	**32***			
Column	Колонна	320		К	CP
Prestressed Beam	Балка преднапряжённая	321		БР	BPP
Beam	Балка сборная	322		Б	BP
Prestressed Longitudinal Girder	Ригель преднапряжённый	321		Р	GPP
Longitudinal Girder	Ригель	322		Р	GP
Socle Beam	Балка цокольная	327		БЦ	BSL
Window Lintel	Перемычка	329		ПРЧ	WL
Slabs	**Плиты (плоскостные элементы)**	**33*-34***			
Reinforced Slab	Плита армированная	341		ПА	RSL
Solid Flat Slab	Плита сплошная	344		ПСП	SFS
Hollow-Core Slab	Плита пустотная	340		ПП	HCS

	TT-Slab	Плита ТТ	342		ПКТ	TTS
	Strip Footing Element	Фундамент ленточный	337		ФЛ	FES
	Pad Footing Element	Фундамент столбчатый	337		Ф	FEP
	Walls	**Стены (плоскостные элементы)**	**35*-36***			
	Precast Sandwich Panel (Not Bearing)	Сэндвич-панель ненесущая	361-104-354		СПН	PSN
	Precast Sandwich Panel (Bearing)	Сэндвич-панель несущая	367-104-354		СП	PS
	Socle Panel (Not Bearing)	Цокольная панель ненесущая	361-104-362		ЦПН	SPN
	Socle Panel (Bearing)	Цокольная панель несущая	367-104-357		ЦП	SP
	Socle Panel (One layer)	Цокольная панель (Один слой бетона)	351			
	Precast Insulated Panel (Not Bearing, External)	Панель наружная ненесущая	361-104		ПНН	PIN
	Precast Insulated Panel (Bearing, External)	Панель наружная несущая	367-104		ПН	PI
	Precast Panel	Панель стеновая	351		ПС	PP
	Intermediate Panel	Панель внутренняя	368		ПВ	PIM
	Elevator Shaft Wall	Стена шахты лифта	363		СШЛ	SW
	Retaining Wall	Стена подпорная	364		СТП	RW
	Balcony Elements	**Элементы балкона**	**37***			
	Balcony Slab	Плита балконная	379		ПБ	BSL
	Balcony Column	Колонна балконная	378		КБ	BCN
	Balcony Wall	Стена балконная	376		СБ	BWA
	Balcony Fence Panel	Ограждение балконное	376		ОБ	BFP
	Other	**Другие элементы**	**38*-39***			
	Reinforced Concrete Pile	Свая	385		СВ	RCP
	Precast Stairway	Лестничный марш	380		ЛМ	PST
	Precast Stairway Case	Лестничная площадка	391		ЛП	PSC
	CIP Area (Between Precast Elements)	Монолитный участок	383		МУ	CIP
	Sandwich Panel Outer-Core	Наружный слой (сендвич панели)			НСП	SOC
	Sandwich Panel Insulation	Изоляционный слой (сендвич панели)			ИЗС	INS
	Sandwich Panel Inner-Core	Внутренний слой (сендвич панели)			ВСП	SIC
	CAST-IN-PLACE STRUCTURES	**МОНОЛИТНЫЕ ЭЛЕМЕНТЫ И КОНСТР.**	**4****			
	Foundations	**Фундаменты**	**41*-42***			
	Foundation	Фундамент	414		ФПМ	CF
	CIP Socket	Приямок монолитный	414		ПРМ	CST
	Pile Footing	Фундамент свайный	414		ФС	FPL
	Pad Footing	Фундамент столбчатый	414		ФПМ	CF
	Strip Footing	Фундамент ленточный	414		ФПМ	CF
	CIP Socle	Цоколь монолитный	423		ЦМ	CSL
	Equipment Plinth	Фундамент оборудования	417		ФОМ	FE
	CIP Pile	Свая монолитная	421		СВМ	CPL
	Capping Beam	Ростверк монолитный	411		РМ	CPM
	Frame Members	**Элементы каркаса (линейные объекты)**	**43*-44***			
	CIP Column	Колонна монолитная	434		КМ	CC
	(Column) Corbel	Консоль колонны	434		КМ	CC
	CIP Beam	Балка монолитная	435		БМ	CB
	CIP Slab	Плита перекрытия	442		ППМ	CS
	CIP Slab (Top)	Плита покрытия	442		ППМ	CS
	CIP Stairway	Лестница монолитная	432		ЛМТ	CST
	CIP Stairway Case	Лестничная площадка	432		ЛПМ	CSC
	Ground Slab	Плита по грунту	443		ПГР	CG
	CIP Wall	Стена монолитная	437		СМ	CW
	Wall Console	Консоль стены	437		СМ	CW
	CIP Parapet	Парапет монолитный	437		ПТМ	CW
	CIP Retaining Wall	Стена подпорная монолитная	437		СТМ	CWR
	Waffel Slab	Кесонная Плита	439		КСП	WS
	CIP Ramp	Пандус монолитный	441		ПНМ	CR
	COMPOSITE STRUCTURES	**КОМПОЗИТНЫЕ КОНСТРУКЦИИ**	**5****			
	Composite Column	Композитная колонна	506		КМК	CMC
	Composite Beam	Композитная балка	506		КМБ	CMB
	Composite Slab	Композитная плита	506		КМП	CMS
	MISCELLANEOUS STRUCTURES	**ДРУГИЕ КОНСТРУКЦИИ**	**6****			
	Masonry Wall	Кирпичная стена	601		КС	MW
	Block Wall	Блочная стена	603		БЛ	BW
	Insulation	Утепление	608/104		И	I
	CIP Strip (e.g. belt in masonry walls)	Монолитный пояс	605		МУ	CIP
	Lean Concrete	Бетонная подготовка	609		БПОД	LCON
	Surface Cast (e.g. 80mm on hollow-cores)	Стяжка	602		СТЖ	SC
	Backfill	Засыпка	612		ЗС	BF
	EXISTING STRUCTURES	**СУЩЕСТВУЮЩИЕ КОНСТРУКЦИИ**	**0-9**			
	Existing Structure	Существующий элемент	1		СУЩ	EX
	Demountable Structure	Сносимый элемент	2		ДЕМ	DEM
	Reference Structure	Внешний (XREF)	3		ВНШ	REF
	EMBEDS	**ЗАКЛАДНЫЕ ДЕТАЛИ**	**10***			
	Not reported to drawing templates	Не отображается в чертежах	0			
	Name + Material + UDA: Product Description	Имя + Материал + Пользовательские атрибуты	100		(Pcs)	

	Name + Profile + Length + Material + UDA	Имя + Профиль + Длина + Материал + ПА	101		(Pcs)	
	Name + Width + Height + Length + Material + UDA	Имя + Ширина + Высота + Длина + Материал+ПА	102		(Pcs)	
	Name + Profile + Material + UDA	Имя + Профиль + Материал + ПА	103		(M)	
	Name + Material + Width + UDA	Имя + Материал + Ширина + ПА	104		(M^2)	
	REINFORCEMENT	**АРМИРОВАНИЕ**	**110-199**			
	Anchor	Анкер	100/11*		A	A
	Main Rebar	Главный стержень			(Ass. Prfx.)	
	Secondary Rebar	Вторичный стержень			(Ass. Prfx.)	
	Stirrup	Хомут			(Ass. Prfx.)	
	U-Bar/Edge Rebar	Скоба			(Ass. Prfx.)	
	L-Bar/Hook	Г-образный			(Ass. Prfx.)	
	Mesh	Сетка	100/11*		C	M
	TIMBER STRUCTURES	**ДЕРЕВЯННЫЕ КОНСТРУКЦИИ**	7**			

1. Названия указанные в скобках (_) не вписываются в имя элемента Tekla и несут справочный характер
1. Part descriptions given in brackets (_) should not be pasted into Tekla object name

2. Префикс арматуры задается в соответствии с префиксом армируемого объекта
2. Reinforcement prefix to be considered the same as the prefix of native object

3. Сборные стеновые панели из двух или трех слоев задаются по классам начиная от главного ядра (ядро внутр. - изоляция - ядро внешн.)
3. Classes for precast wall panels with two or three layers are given in direction from inside to outside (inner core - insulation - outer core)

Appendix 2

DRAWING REGISTER TEMPLATE EXAMPLE

Ведомость рабочих чертежей комплекта ST
Register of working drawings for set ST

Лист Sheet	Обозначение Designation	Масшт. Scale	Дата Date	Изм. Rev.	Дата изм. Rev. date	Наименование Name	Примечание Remark
1.1	5720-WD-ST-00-0-00-1-0-0001		10.05.2019			Ведомость рабочих чертежей ST Register of working drawings ST	
1.2	5720-WD-ST-00-0-00-1-0-0001		10.05.2019			Ведомость рабочих чертежей ST (продолжение) Register of working drawings ST (continuation)	
2	5720-WD-ST-00-0-00-1-0-0002					Общие данные General data	

Ведомость основных комплектов рабочих чертежей марки ST
List of main sets of working drawings of mark ST

Обозначение Designation	Наименование Name	Примечание Remark
ST-.....-000*	Ведомости, спецификации, расчеты Lists, bills of material, calculation reports	
ST-.....-100*	Конструкции железобетонные нулевого цикла Reinforced concrete structures, foundations	
ST-.....-200*	Конструкции железобетонные (монолит) Reinforced concrete structures (cast-in-situ)	
ST-.....-300*	Конструкции железобетонные (сборочные элементы) Reinforced concrete structures (precast elements)	
ST-.....-400*	Конструкции металлические Steel structures	
ST-.....-500*	Конструкции металлические деталировочные Detailed steel structures	
ST-.....-600*	Конструкции деревянные Timber structures	

Согласовано

Взам. инв. №

Подп. и дата

Инв. № подл.

Rev.	Quant.	Sheet	Doc.No	Signature	Date
Изм.	Кол.уч.	Лист	№док.	Подпись	Дата
Разработал Designed		К. Жданов			10.05.19
Н. контроль Inspector		А. Егоров			
Утвердил Approved		В. Иванов			

5720-WD-ST-00-0-00-1-0-0001

Многоярусная автостоянка в составе торгового комплекса по адресу г. Санкт-Петербург, улица Ленина, 28

Многоярусная автостоянка	Стадия Stage	Лист Sheet	Листов Sheets
	P	1.1	n..

Ведомость рабочих чертежей ST
Register of working drawings ST

PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

Формат/size A3

Ведомость рабочих чертежей комплекта ST (продолжение)
Register of working drawings for set ST (continuation)

Лист Sheet	Обозначение Designation	Масшт. Scale	Дата Date	Изм. Rev.	Дата изм. Rev. date	Наименование Name	Примечание Remark

Инв. № подл. | Подп. и дата | Взам. инв. №

Rev.	Quant.	Sheet	Doc.No	Signature	Date
Изм.	Кол.уч.	Лист	№док.	Подпись	Дата

5720-WD-ST-00-0-00-1-0-0001

Лист Sheet 1.2

Формат/size A3

Appendix 3

COVER AND TITLE PAGE TEMPLATE EXAMPLE

ООО «ПЕУРУ РУС»
г. Санкт-Петербург
СРО-П-044-09112009

МНОГОЯРУСНАЯ АВТОСТОЯНКА В СОСТАВЕ ТОРОГОВОГО КОМПЛЕКСА

Санкт-Петербург, ул. Ленина, 28

MULTI-STOREY PARKING BUILDING AS A PART OF SHOPPING MALL

Saint-Petersburg, Lenina st. 28

РАБОЧАЯ ДОКУМЕНТАЦИЯ
WORKING DOCUMENTATION

Конструктивные и объемно-планировочные решения
Structural design and space planning

Конструкции железобетонные (сборочные элементы)
Reinforced concrete structures (precast elements)

5720-WD-ST-3000

Руководитель проектной организации И.О. Фамилия

Главный инженер проекта И.О. Фамилия

Санкт-Петербург
2019 г.

Взам. инв. №

Подп. и дата

Инв. № подл.

Appendix 4

GENERAL DATA SHEET TEMPLATE EXAMPLE

						5720-WD-ST-00-0-00-1-0-0002
						Многоярусная автостоянка в составе торгового комплекса
Rev.	Quant.	Sheet	Doc.No	Signature	Date	
Изм.	Кол.	Лист	№док	Подпись	Дата	
Разработал		К. Жданов				г. Санкт-Петербург, улица Ленина, 28
Designed						
Н. контроль		А. Егоров				
Inspector						
Утвердил		В. Иванов				Общие данные General data
Approved		.				

Стадия	Лист	Листов
Stage	Sheet	Sheets
Р	2	П.

PÖYRY
ООО "Пеуру Рус"
г. Санкт-Петербург

Взам. инв. №

Подпись и дата

Инв. № подл.

Appendix 5

DRAWING EXAMPLES:

- Foundation bolts plan (General arrangement drawing)
- The layout of hollow-core and pre-tensioned shell slabs (General arrangement drawing)
- Layout drawing for pipe support hangers (General arrangement drawing)
- Wall panel 5ПС4-1 (Cast-unit drawing)
- Column 1К1М-1 (Cast-unit drawing)
- Steel brace 3D-5 (Assembly drawing, single assembly)
- Pedestrian bridge frame I gridlines A/14-15, Mark SC-B-13 (Assembly drawing, full specification, no weld marks)
- Pipe support hanger ОП-2 (Assembly drawing, weld outline)
- Pedestrian bridge in gridlines A/14-15 (single-part drawing):
    - Item 1008
    - Item 1003
    - Item 1001
    - Item 5

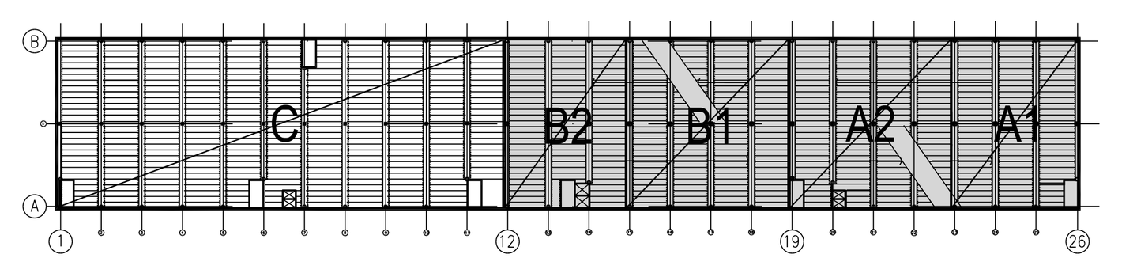
План фундаментных болтов, блоки АВ
Foundation bolts plan, blocks AB

Спецификация элементов
Specification for elements

Поз. Item	Обозначение Designation	Наименование Description	Кол. Num.	Масса ед., кг Weight	Примечание Note
101	Анкерный болт/Anchor bolt	Peikko PPM39L+AL39	2	15.0	
102	Анкерный болт/Anchor bolt	Peikko PPM39P+AL39	19	25.3	
103	Анкерный болт/Anchor bolt	Peikko HPM30P+AL30	10	10.5	
104	Анкерный болт/Anchor bolt	Peikko HPM30P+AL30	8	10.5	
201	Анкерный болт/Anchor bolt	Peikko HPM30P	54	11.1	
202*	Анкерный болт/Anchor bolt	Peikko HPM30P	119	11.5	
203	Анкерный болт/Anchor bolt	Peikko HPM30L	100	4.5	
204	Анкерный болт/Anchor bolt	Peikko HPM39P	16	21.9	
205	Анкерный болт/Anchor bolt	Peikko HPM39L	44	9.8	
209	Анкерный болт/Anchor bolt	Peikko HPM24L	98	2.3	

*См. деталь (DET-13 (5720-WD-ST-00-0-00-1-0-0902)
*See detail (DET-13 (5720-WD-ST-00-0-00-1-0-0902)

СИТУАЦИОННЫЙ ПЛАН / SITE PLAN



ИЗМ. REV.	КОЛ.УЧ NR.REV.	ПОЯСНЕНИЕ EXPLANATION	ПОДПИСЬ SIGNATURE	ДАТА DATE
1	3	Изменения в осях А-В/25-26 Changes in gridlines A-B/25-26	К. Жданов	21.10.2019

СТАТУС ДОКУМЕНТОВ / STATUS OF DOCUMENTS: "Рабочая документация" "Working documentation"

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
ГИП					
ГАП					

ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК: / GENERAL DESIGNER:

LOGO

N ПРОЕКТА PROJECT N					СТАДИЯ STAGE			РАЗДЕЛ BRANCH			БЛОК BLOCK		ЭТАЖ FLOOR		ЗОНА ZONE		ТИП TYPE	КОНСТР. STRUCT.		НОМЕР NUMBER					ПЕР. REV.
5	7	2	0	-	W	D	-	S	T	-	AB	-	00	-	00	-	3	8	-	3	1	1	0	-	1

Drawing name: Foundation bolts plan, blocks AB

№ чертежа 5720-WD-ST-AB-00-00-3-8-3110
Название чертежа: План фундаментных болтов, блоки АВ

г.Санкт-Петербург, ул. Ленина, 28

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал		К. Жданов		Zhdanov	10.10.2019
Гл.спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
Р		

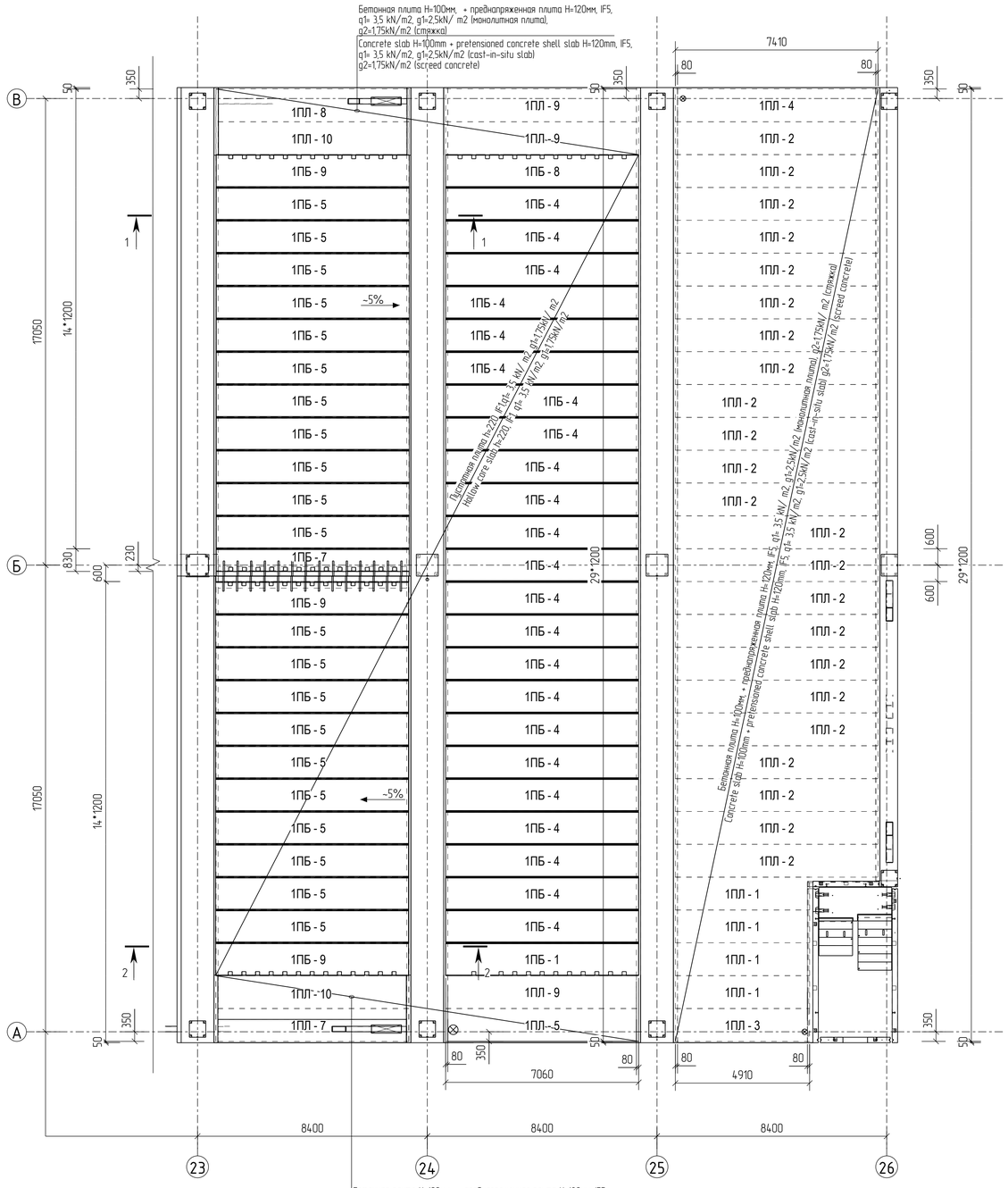
План фундаментных болтов, блоки АВ
Foundation bolts plan, blocks AB

МАСШТАБ 1:100
SCALE 1:100

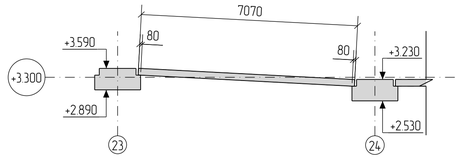
PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

Формат: А1+

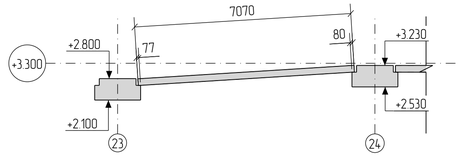
План на отметках +3.300
Plan view at level +3.300



Разрез 1–1
Section 1–1

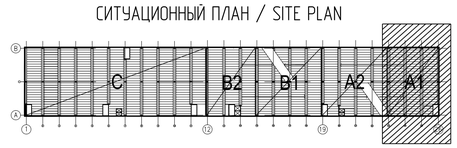


Разрез 2–2
Section 2–2



ПОЛЕЗНЫЕ НАГРУЗКИ :		LIVE LOADS:	
ПЕРЕКРЫТИЯ	3.5 кН/ м2	SLABS	3.5 kN/m2
ВЕТРОВАЯ НАГРУЗКА	0.64 кН/ м2	WIND LOAD	0.64 kN/m2
СНЕГОВАЯ НОРМАТИВНАЯ	1.5 кН/ м2	SNOW CHARACTERISTIC LOAD	1.5 kN/m2
ПОСТОЯННЫЕ НАГРУЗКИ :		DEAD LOADS:	
СТЯЖКА	1.75 кН/ м2(70мм)	SCREED	1.75 kN/m2 (70mm)
МОНОЛИТНАЯ ПЛИТА	2.5 кН/ м2(100мм)	CAST-IN-SITU SLAB	2.5 kN/m2 (100mm)
МАТЕРИАЛЫ		MATERIALS	
БЕТОН :		CONCRETE :	
ПУСТОТНЫЕ ПЛИТЫ	B40, F200, W6	HOLLOW-CORE SLABS	B40, F200, W6
ПРЕДНАПРЯЖЕННАЯ ПЛИТА	B50, F200, W6	PRETENSIONED CONCRETE SHELL SLAB	B50, F200, W6
ОГНЕСТОЙКОСТЬ		FIRE PROTECTION	
СТЕПЕНЬ ОГНЕСТОЙКОСТИ ЗДАНИЯ II ПРЕДЕЛ ОГНЕСТОЙКОСТИ: ПРЕДНАПРЯЖЕННЫЕ И ПУСТОТНЫЕ ПЛИТЫ В ОСЯХ 7–8, 13–14 И 19–20 REI150, ОСТАЛЬНЫЕ REI120		BUILDING FIRE PROTECTION CLASS II FIRE RESISTANCE: HOLLOW-CORE AND PRETENSIONED CONCRETE SHELL SLABS BETWEEN LINES 7–8, 13–14 AND 19–20 REI150, OTHER PLACES REI120	

СИТУАЦИОННЫЙ ПЛАН / SITE PLAN



FOR CONSTRUCTION __.__.____
ДЛЯ ПРОИЗВОДСТВА РАБОТ __.__.____

СТАТУС ДОКУМЕНТОВ STATUS OF DOCUMENTS						"Рабочая документация" "Working documentation"	
Изм.	Кол.уч.	Лист	№док	Подп.	Дата	ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК: GENERAL DESIGNER:	LOGO
ГИП							
ГАП							

N ПРОЕКТА PROJECT N				СТАДИЯ STAGE		РАЗДЕЛ BRANCH		БЛОК BLOCK		ЭТАЖ FLOOR		ЗОНА ZONE		ТИП TYPE	КОНСТР. STRUCT.	НОМЕР NUMBER			ПЕР. REV.
5	7	2	0	W	D	S	T	AB		F1		A1		2	1	3	2	1	3

Drawing name: Layout of hollow core and pretensioned shell slabs at level +3.300, A, A1

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал		К. Жданов			10.10.2019
Гл.спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

№ чертежа: 5720-WD-ST-AB-F1-A1-2-1-3213
Название чертежа: Схема расположения пустотных и преднапряж. плит на отм. +3.300, A, A1

г.Санкт-Петербург, ул. Ленина, 28

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
P		

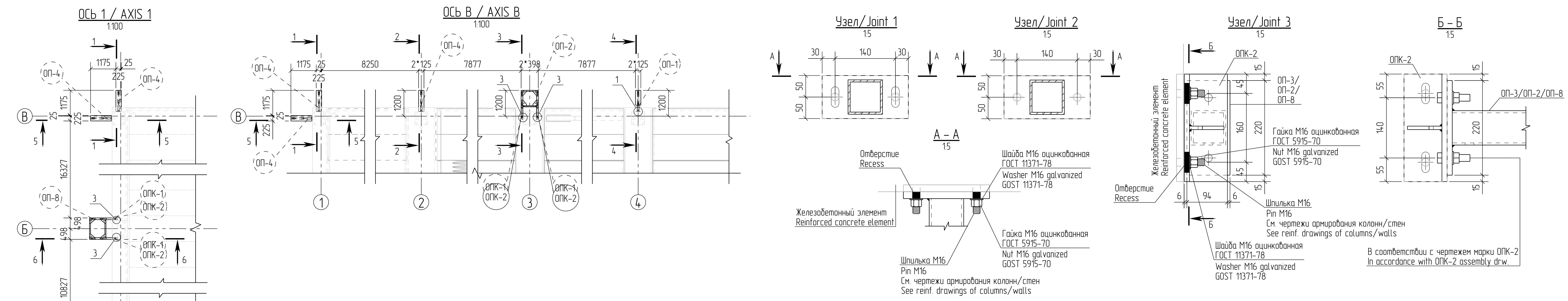
Схема расположения пустотных и преднапряж. плит на отм. +3.300, A, A1
Layout of hollow core and pretensioned shell slabs at level +3.300, A, A1

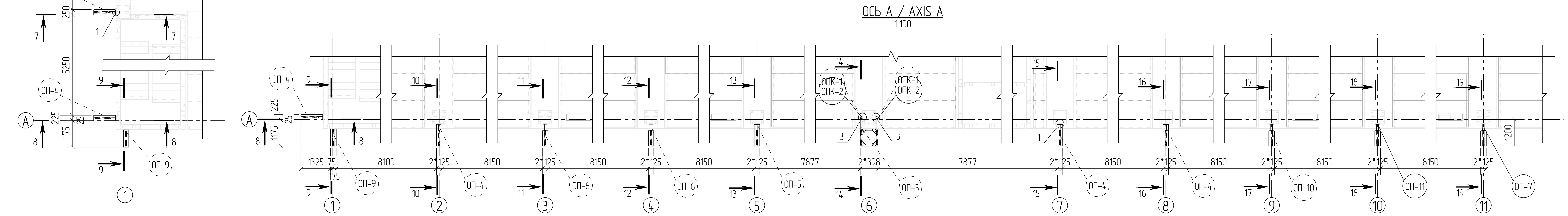
МАСШТАБ 1:100
SCALE 1:100

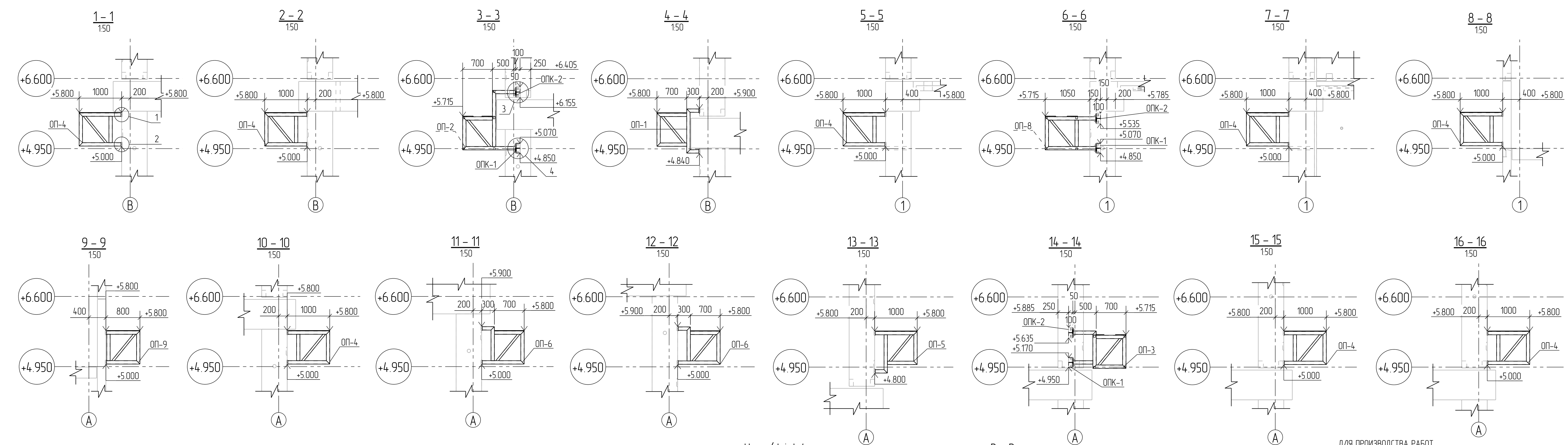
PÖYRY
ООО "Пёуру рус"
г. Санкт-Петербург

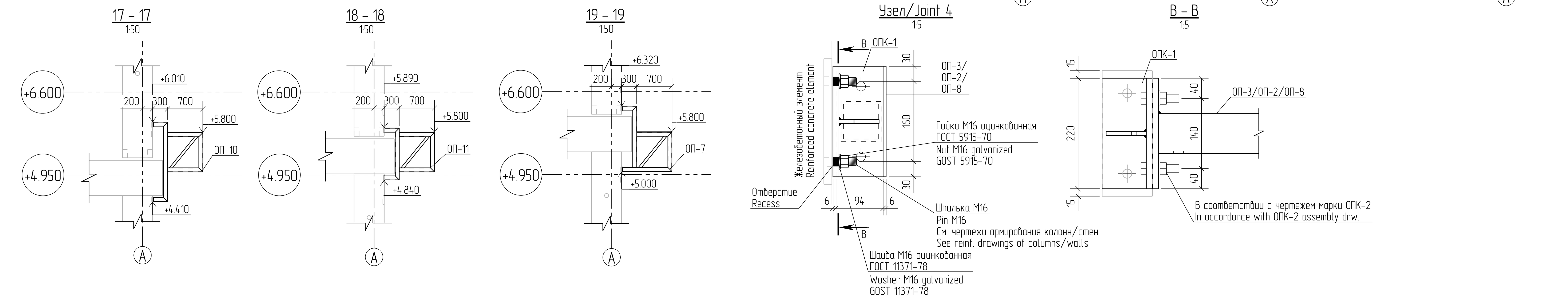
Формат: A1

Согласовано
Взам. инв. №
Подп. и дата
Инв. № подл.









Ведомость отправочных элементов
List of assemblies

Марка эл-та Element mark	Кол-во, шт. Number, pc.	Масса, кг / Weight, kg: марки / of mark	Масса, кг / Weight, kg: всех / total
ОП-1	1	65	65
ОП-2	1	163	163
ОП-3	1	143	143
ОП-4	8	67	537
ОП-5	1	69	69
ОП-6	2	63	125
ОП-7	1	68	68
ОП-8	1	144	144
ОП-9	1	58	58
ОП-10	1	71	71
ОП-11	1	64	64
ОПК-1	6	4	26
ОПК-2	6	5	29
		Всего Total	1562

ПРИМЕЧАНИЯ:
Покрытие конструкций: горячая оцинковка 120мкм

Сварные швы и прилегающие к ним участки защитных покрытий, нарушенные при монтаже и сварке, покрыть цинкосодержащей краской толщиной 120 мкм по грунтовке

Чертежи отправочных марок см. 5720-WD-ST-C-F2-C-8-0-4007
Чертежи деталей см. 5720-WD-ST-C-F2-C-8-0-4008
Чертеж общих данных см. 5720-WD-ST-00-0-00-1-0-0101

NOTES:
Covering: hot galvanization (120 micrometers thick)

Welded joints and neighbouring parts of protective covering, damaged during the installation or welding must be covered with primer and zink-rich paint 120 micrometers thick

Assembly drawings: 5720-WD-ST-C-F2-C-8-0-4007
Single-part drawings: 5720-WD-ST-C-F2-C-8-0-4008
General data sheet: 5720-WD-ST-00-0-00-1-0-0101

ДЛЯ ПРОИЗВОДСТВА РАБОТ
FOR CONSTRUCTION

СТАТУС ДОКУМЕНТОВ / STATUS OF DOCUMENTS: "Рабочая документация" / "Working documentation"

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
ГИП					
ГАП					

ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК:
GENERAL DESIGNER:
LOGO

N ПРОЕКТА / PROJECT N					СТАДИЯ / STAGE			РАЗДЕЛ / BRANCH			БЛОК / BLOCK		ЭТАЖ / FLOOR		ЗОНА / ZONE		ТИП / TYPE	КОНСТР. / STRUCT.		НОМЕР / NUMBER					ПЕР. / REV.
5	7	2	0	-	W	D	-	S	T	-	C	-	F2	-	C	-	8	0	-	4	0	0	6	-	

Drawing name: Layout drawing for pipe support hangers

№ чертежа: 5720-WD-ST-C-F2-C-8-0-4006
Название чертежа: Схема расположения опор для монтажа труб

г.Санкт-Петербург, ул. Ленина, 28

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал	К. Жданов			Zhdanov	10.10.2019
Гл.специалист	Т. Коркеамяки				
ГИП	В. Иванов				
Н. контроль	А. Егоров				

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
Р		

Схема расположения опор для монтажа труб
Layout drawing for pipe support hangers

МАСШТАБ 1:100
SCALE 1:100

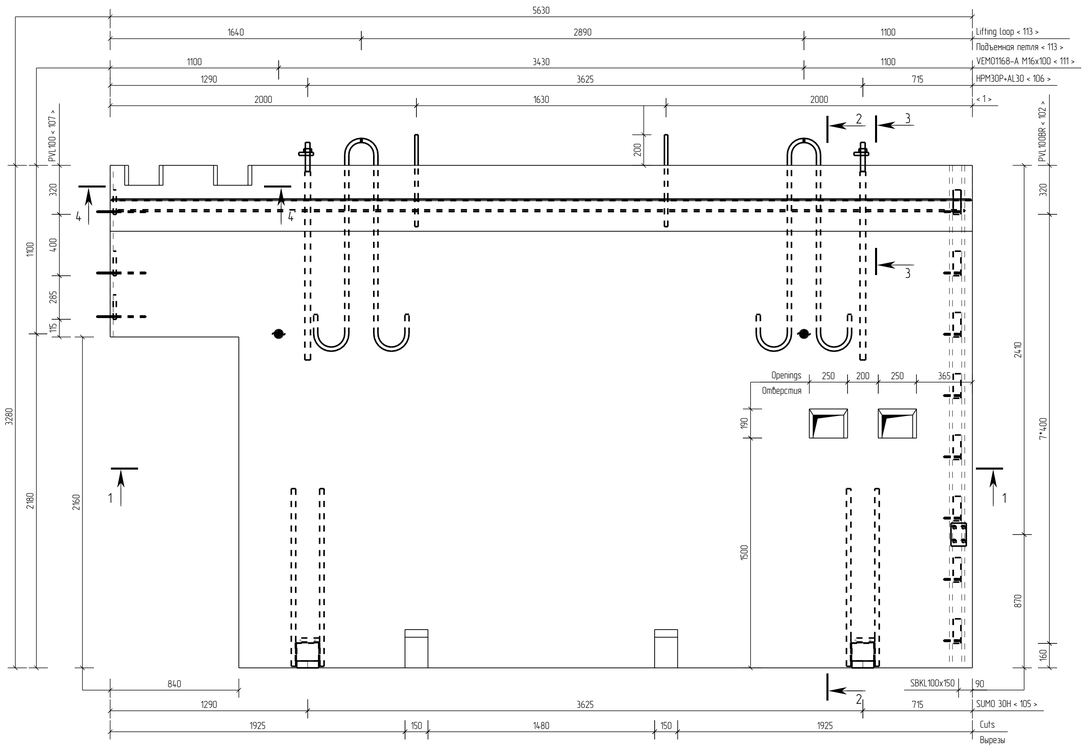
PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

Формат: А1

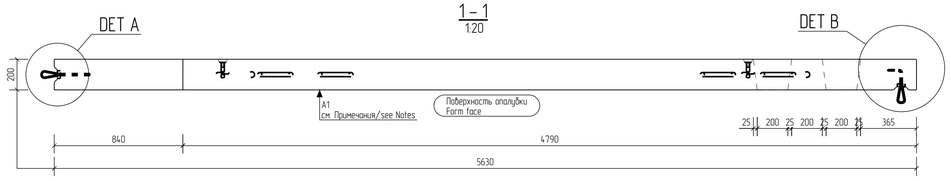
Согласовано
Взам. инв. №
Подп. и дата
Инв. № подл.

Стеновая панель ПС. Опалубочный чертеж
Wall panel ПС. Formwork drawing

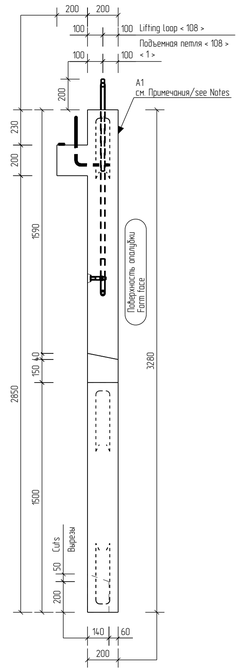
1:20



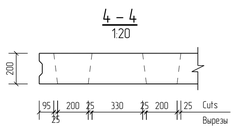
1 – 1
1:20



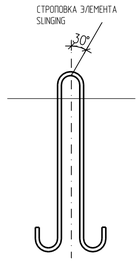
2 – 2
1:20



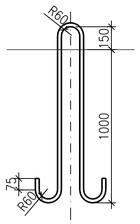
4 – 4
1:20



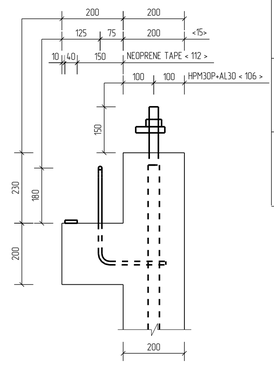
СТРОПОВКА ЭЛЕМЕНТА
SLINGING



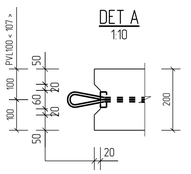
ПОДЪЕМНАЯ ПЕТЛЯ
LIFTING LOOP



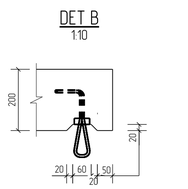
3 – 3
1:10



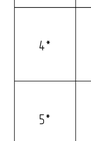
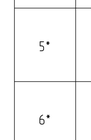
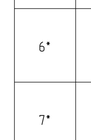
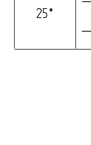
DET A
1:10



DET B
1:10



Ведомость деталей
Details register

Поз. Item	Эскиз Draft
4*	
5*	
6*	
7*	
11*	
12*	
18*	
19*	
23*	
24*	
25*	

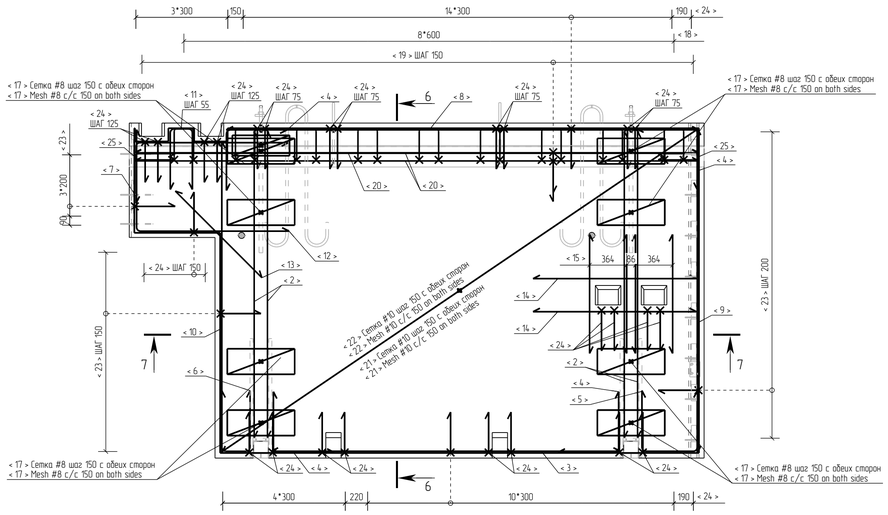
Спецификация железобетонных конструкций
Specification for element

Поз. Item	Обозначение Designation	Наименование Description	Кол. Number	Масса ед., кг Unit weight	Примечание Note
		Сборочные единицы / Embedded parts			
102		Трассовая петля / PVL Connecting Loop PEIKKO PVL100BR Peikko PVL100BR	8	1.4	11.2
105		Башмак стены/Wall shoe,Peikko SUMO 30H Peikko SUMO 30H	2	16.8	35.8
106		Анкерный болт/Anchor bolt HPM30P+AL30 Peikko HPM30P+AL30	2	10.5	21.0
107		Трассовая петля / PVL Connecting Loop PEIKKO PVL100 Peikko PVL100	3	1.4	4.2
110		Крепежные планы / Fastening plate Peikko SBKL100x150	1	1.5	1.5
111		Анкеры/Fixing anchors VEMO M16x100	2	0.3	0.5
113		Подъемные петли ⌀25A300 Lifting loops ⌀25A300	2	13.6	27.2
112		Неопреновая лента/ Neoprene tape, 40*10, 60 shore A, L=5610	1	3.1	3.1
		Сборочные единицы / Mesh			
16	ГОСТ 23279-2012	Сетка 4С 6 A500C – 100 / 6 A500C – 100 56 x 20 50/25	2	0.5	1.0
17	ГОСТ 23279-2012	Сетка 4С 8 A500C – 150 / 8 A500C – 150 66 x 25 50/25	16	1.0	16.3
21	ГОСТ 23279-2012	Сетка 4С 10 A500C – 150 / 10 A500C – 150 553 x 318 25/25	1	131.1	131.1
22	ГОСТ 23279-2012	Сетка 4С 10 A500C – 150 / 10 A500C – 150 553 x 318 25/25	1	131.1	131.1
		Детали / Details			
1	ГОСТ 34028-2016	⌀ 20 A500C L= 600	2	1.5	3.0
2	ГОСТ 34028-2016	⌀ 25 A500C L= 3000	4	11.6	46.2
3	ГОСТ 34028-2016	⌀ 12 A500C L= 3420	2	3.0	6.1
4*	ГОСТ 34028-2016	⌀ 12 A500C L= 1170	8	1.0	8.3
5*	ГОСТ 34028-2016	⌀ 12 A500C L= 1690	2	1.5	3.0
6*	ГОСТ 34028-2016	⌀ 12 A500C L= 1430	2	1.3	2.5
7*	ГОСТ 34028-2016	⌀ 12 A500C L= 2070	2	1.8	3.7
8	ГОСТ 34028-2016	⌀ 12 A500C L= 4630	2	4.1	8.2
9	ГОСТ 34028-2016	⌀ 12 A500C L= 3180	2	2.8	5.6
10	ГОСТ 34028-2016	⌀ 12 A500C L= 3050	2	2.7	5.4
11*	ГОСТ 34028-2016	⌀ 12 A500C L= 1370	2	1.2	2.4
12*	ГОСТ 34028-2016	⌀ 12 A500C L= 2470	2	2.2	4.4
13	ГОСТ 34028-2016	⌀ 12 A500C L= 1200	1	1.1	1.1
14	ГОСТ 34028-2016	⌀ 12 A500C L= 1600	4	1.4	5.7
15	ГОСТ 34028-2016	⌀ 12 A500C L= 1160	8	1.0	8.3
18*	ГОСТ 34028-2016	⌀ 10 A500C L= 1180	9	0.7	6.6
19*	ГОСТ 34028-2016	⌀ 10 A500C L= 1400	37	0.9	32.0
20	ГОСТ 34028-2016	⌀ 10 A500C L= 5530	3	3.4	10.2
23*	ГОСТ 34028-2016	⌀ 8 A500C L= 840	35	0.3	11.6
24*	ГОСТ 34028-2016	⌀ 8 A500C L= 860	66	0.3	22.4
25*	ГОСТ 34028-2016	⌀ 8 A500C L= 830	2	0.3	0.7
		Материал / Material			
	ГОСТ 7473-2010	Бетон кл. B40			3.5 м³

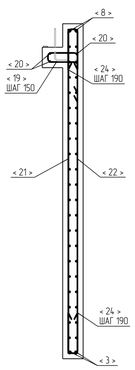
Поз обозначенные * – см. ведомость деталей
Items marked by * – see the details register

Стеновая панель ПС. Схема армирования
Wall panel ПС. Reinforcement drawing

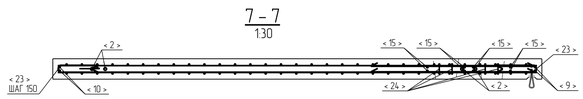
1:30



6 – 6
1:30



7 – 7
1:30



Ведомость расхода стали, кг
Reinforcement weight specification, kg

Марка элемента Element mark	Изделия арматурные Reinforcing parts						Всего Total	Сетки арматурные Reinforcing meshes						Всего Total
	Арматура класса Reinforcement of class							Арматура класса Reinforcement of class						
	A500C ГОСТ 34028-2016							A500C ГОСТ 34028-2016						
	⌀8	⌀10	⌀12	⌀20	⌀25	Итого Total		⌀6	⌀6	⌀8	⌀8	⌀10	⌀10	Итого Total	
5ПС4-1	34.7	48.8	64.8	3.0	46.2	197.5	197.5	0.6	0.5	8.6	8.3	149.1	143.2	310.4	310.4

Масса элемента
Element weight

Марка элемента	Масса	Кол-во
5ПС4-1	8.8 т	1

ПРИМЕЧАНИЯ/NOTES

МАТЕРИАЛЫ:

БЕТОН:	B45 F200 W8
МАКС. РАЗМЕР ФР. ЗАПОЛНИТЕЛЯ:	20мм
АРМАТУРА:	A500C
МИН. ЗАЩИТНЫЙ СЛОЙ БЕТОНА:	50мм
ПРЕДЕЛ ОГНЕСТОЙКОСТИ:	R150
КЛАСС ОТДЕЛКИ ПОВЕРХНОСТИ:	A1 по ГОСТ 13015-2012
КЛАСС МОРОЗОСТОЙКОСТИ:	F200
ФАСКА 10x10 НА ВСЕХ ГРАНЯХ	

Рассматривать совместно с чертежами:
Схема расположения колонн, блок C, оси 6–12
5720-WD-ST-C-00-C-7-0-3281

MATERIALS:

CONCRETE:	B45 F200 W8
FILLER MAX. FRACTION SIZE:	20mm
REINFORCEMENT:	A500C
MIN CONCRETE COVER:	50mm
FIRE RESISTANCE:	R150
SURFACE TREATMENT CLASS:	A1 by GOST 13015-2012
FROST RESISTANCE CLASS:	F200
CHAMFER 10x10 ON ALL CORNERS	

See together with drawings:
Layout of columns, block C, lines 6–12
5720-WD-ST-C-00-C-7-0-3281

FOR CONSTRUCTION _____
ДЛЯ ПРОИЗВОДСТВА РАБОТ _____

СТАТУС ДОКУМЕНТОВ / STATUS OF DOCUMENTS	"Рабочая документация" / "Working documentation"
ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК: / GENERAL DESIGNER:	LOGO
N ПРОЕКТА / PROJECT N	5 7 2 0 - W D - S T - C - 00 - C - 7 1 - 5 4 0 4 -
СТАДИЯ / STAGE	
РАЗДЕЛ / BRANCH	
БЛОК / BLOCK	
ЭТАЖ / FLOOR	
ЗОНА / ZONE	
ТИП / TYPE	
КОНСТР. / STRUCT.	
НОМЕР / NUMBER	
ПЕР. / REV.	
Drawing name:	Wall panel 5ПС4-1
№ чертежа	5720-WD-ST-C-00-C-7-1-5404
Название чертежа:	Стеновая панель 5ПС4-1

г.Санкт-Петербург, ул. Ленина, 28

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
Разработал	К. Жданов				10.10.2019
Гл.спец.	Т. Коркеамяки				
ГИП	В. Иванов				
Н. контроль	А. Егоров				

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
P		

Стеновая панель 5ПС4-1
Wall panel 5ПС4-1

МАСШТАБ / SCALE 1:30

ООО "Пёури рус"
г. Санкт-Петербург

Согласовано

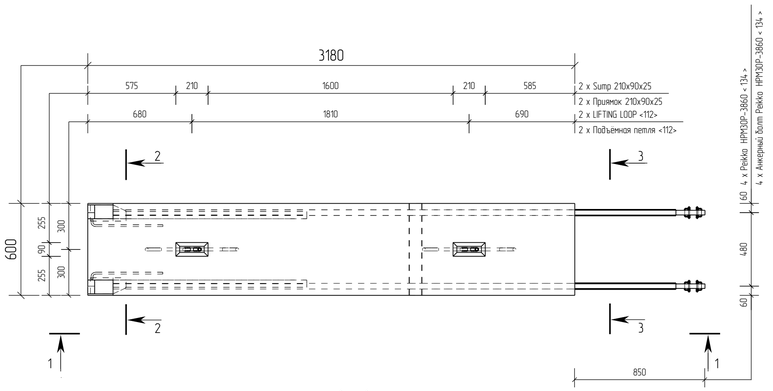
Взам. инв. №

Подп. и дата

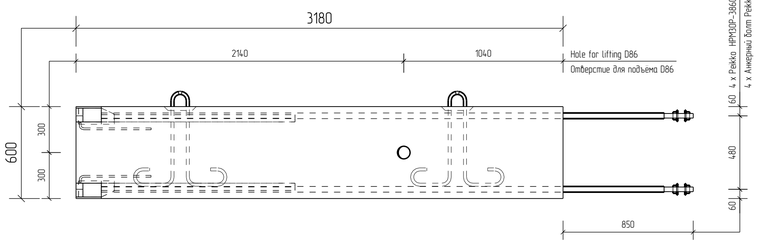
Инв. № подл.

Формат: A1

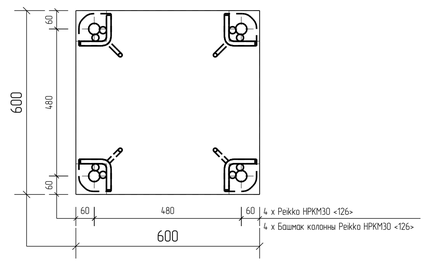
Колонна. Опалубочный чертеж
Column. Formwork drawing
1:20



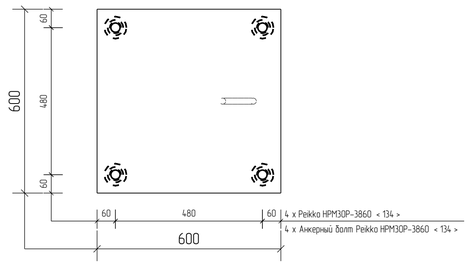
1 – 1
1:20



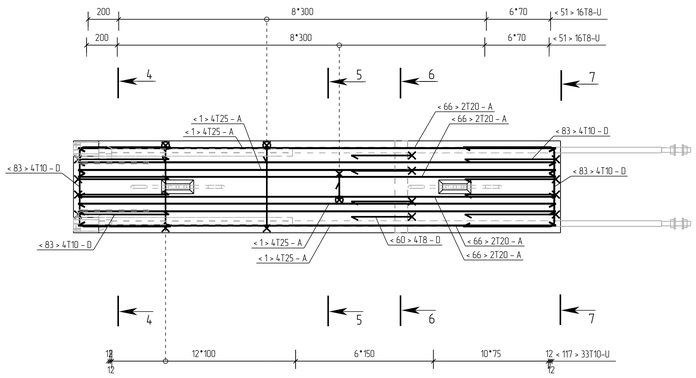
2 – 2
1:10



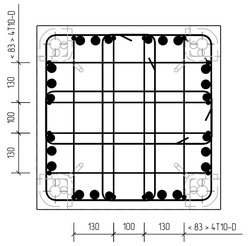
3 – 3
1:10



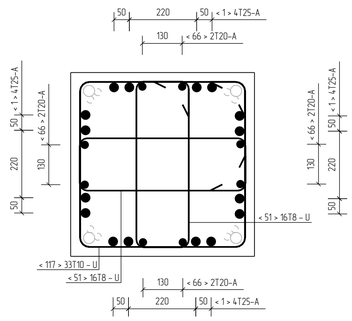
Колонна. Схема армирования
Column. Reinforcement drawing
1:20



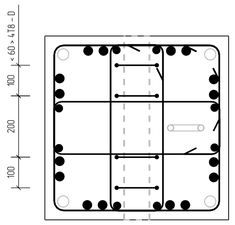
4 – 4
1:10



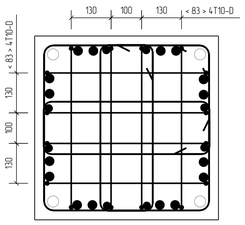
5 – 5
1:10



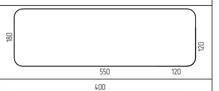
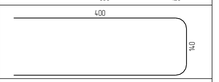
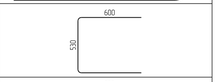
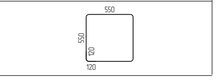
6 – 6
1:10



7 – 7
1:10

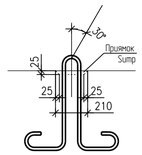


Ведомость деталей
Details register

Поз. Item	Эскиз Draft
51*	
60*	
83*	
117*	

Размеры всех хомутов указаны по внешним граням
Dimensions of all closed stirrups are specified from the outer side

СТРОПОВКА ЭЛЕМЕНТА
SLINGING



ПОДЪЕМНАЯ ПЕТЛЯ
LIFTING LOOP

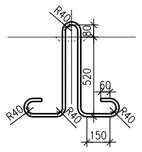
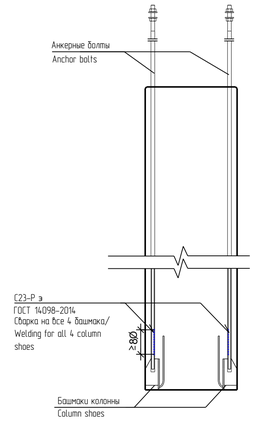


СХЕМА ВЫПОЛНЕНИЯ МОЛНИЕЗАЩИТЫ
LIGHTING PROTECTION ROD SCHEME



Спецификация железобетонных конструкций
Specification for element

Поз. Item	Обозначение Designation	Наименование Description	Кол. Number	Масса ед., кг Unit weight	Примечание Note
		Сборочные единицы / Embedded parts			
112		Подъемная петля/Lifting loop d20 A300 П2.1	2	5.0	10.0
126		Башмак колонны/Column shoe; Peikko HPKM30	4	13.9	55.5
134		Анкерный болт/Anchor bolt Peikko HPM30P-3860	4	25.2	100.9
123		Пластиковая трубка/Plastic tube D86x3	1	0.0	0.0
		Детали / Details			
1	ГОСТ 34028-2016	∅ 25 A500C L= 3120	16	12.0	192.3
51*	ГОСТ 34028-2016	∅ 8 A500C L= 1600	32	0.6	20.2
60*	ГОСТ 34028-2016	∅ 8 A500C L= 900	4	0.4	1.4
66	ГОСТ 34028-2016	∅ 20 A500C L= 3120	8	7.7	61.6
83*	ГОСТ 34028-2016	∅ 10 A500C L= 1680	16	1.0	16.6
117*	ГОСТ 34028-2016	∅ 10 A500C L= 2310	33	1.4	47.2
		Материал / Material			
	ГОСТ 7473-2010	Бетон кл. B45			1.1 м^3

Поз. обозначенные * – см. ведомость деталей
Items marked by * – see the details register

ПРИМЕЧАНИЯ/NOTES

МАТЕРИАЛЫ

БЕТОН:	B45 F200 W8
МАКС. РАЗМЕР ФРАКЦИИ ЗАПОЛНИТЕЛЯ:	20мм
АРМАТУРА:	A500C
МИН. ЗАЩИТНЫЙ СЛОЙ БЕТОНА:	40 мм
ПРЕДЕЛ ОГНЕСТОЙКОСТИ:	R120
КЛАСС ОТДЕЛКИ ПОВЕРХНОСТИ:	A1 по ГОСТ13015-2012
КЛАСС МОРОЗОСТОЙКОСТИ:	F200
ФАСКА 15x15 НА ВСЕХ ГРАНЯХ	

MATERIALS:

CONCRETE:	B45 F200 W8
FILLER MAX. FRACTION SIZE:	20mm
REINFORCEMENT:	A500C
MIN CONCRETE COVER:	40 mm
FIRE RESISTANCE:	R120
SURFACE TREATMENT CLASS:	A1 acc. to ГОСТ13015-2012
FROST RESISTANCE CLASS:	F200
CHAMFER 15x15 ON ALL CORNERS	

Рассматривать совместно с чертежами:
See together with drawings:

Схема расположения колонн, блок A, зона A1 Layout of columns, block A, area A1	5720-WD-ST-A-00-A1-7-0-3201
Схема расположения колонн, блок A, зона A2 Layout of columns, block A, area A2	5720-WD-ST-A-00-A2-7-0-3221
Схема расположения колонн, блок B, зона B1 Layout of columns, block B, area B1	5720-WD-ST-B-00-B1-7-0-3250
Схема расположения колонн, блок B, зона B2 Layout of columns, block B, area B2	5720-WD-ST-B-00-B2-7-0-3261
Схема расположения колонн, блок C, оси 1-6 Layout of columns, block C, lines 1-6	5720-WD-ST-C-00-C-7-0-3280
Схема расположения колонн, блок C, оси 6-12 Layout of columns, block C, lines 6-12	5720-WD-ST-C-00-C-7-0-3281

Ведомость расхода стали, кг
Reinforcement weight specification, kg

Марка элемента / Element mark	Изделия арматурные / Reinforcing parts					
	Арматура класса / Reinforcement of class					Всего Total
	A500C ГОСТ 34028-2016					
	∅8	∅10	∅20	∅25	Итого Total	
1K1M-1	21.7	63.8	61.6	192.3	339.4	339.4

Масса элемента
Element weight

Марка элемента	Масса	Кол-во
1K1M-1	2.8 т	1

FOR CONSTRUCTION: _____
ДЛЯ ПРОИЗВОДСТВА РАБОТ: _____

СТАТУС ДОКУМЕНТОВ STATUS OF DOCUMENTS	"Рабочая документация" "Working documentation"

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
ГИП					
ГАП					

ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК:
GENERAL DESIGNER:

LOGO

N ПРОЕКТА PROJECT N			СТАДИЯ STAGE		РАЗДЕЛ BRANCH		БЛОК BLOCK		ЭТАЖ FLOOR		ЗОНА ZONE		ТИП TYPE	КОНСТР. STRUCT.	НОМЕР NUMBER			ПЕР. REV.
5 7 2 0	-		W	D	-	S T	-	A	-	00	-	A1	-	7	2	-	5 1 7 8	-

Drawing name: Column 1K1M-1

№ чертежа	5720-WD-ST-A-00-A1-7-2-5178
Название чертежа:	Колонна 1K1M-1

г.Санкт-Петербург, ул. Ленина, 28

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал		К. Жданов			10.10.2019
Гл.спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
Р		

Колонна 1K1M-1
Column 1K1M-1

МАСШТАБ SCALE 1:20

PÖYRY
ООО "Пеури рус"
г. Санкт-Петербург

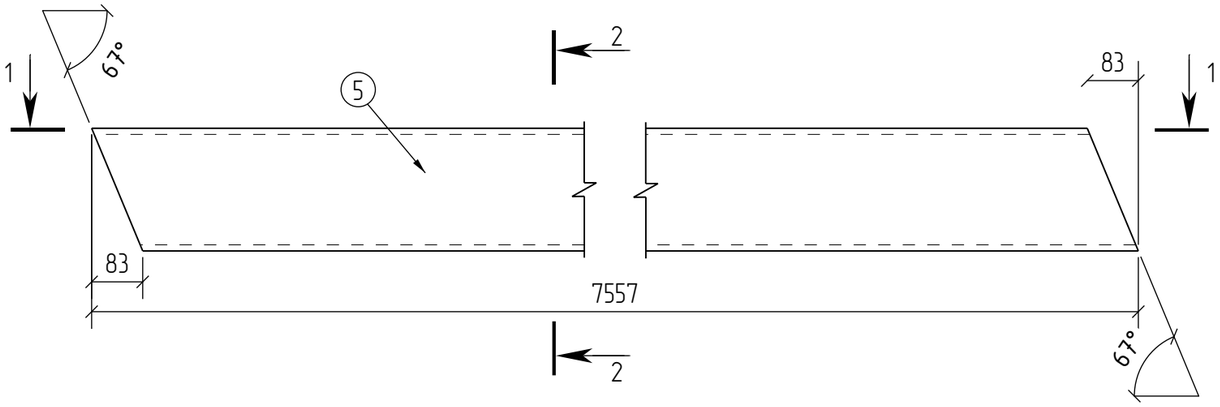
Согласовано

Взам. инв. №

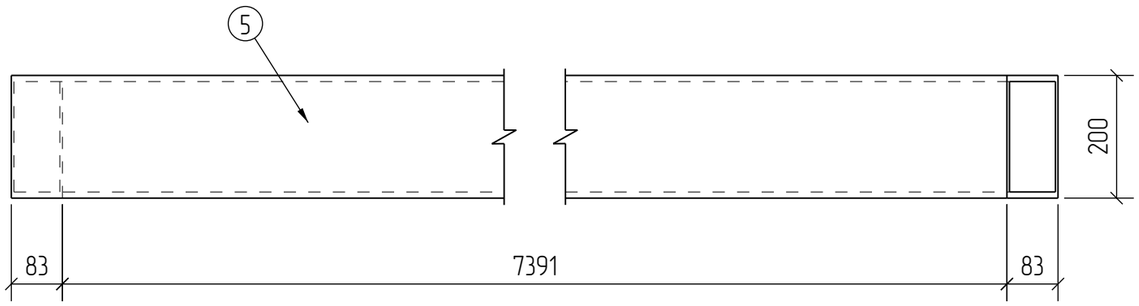
Подп. и дата

Инв. № подл.

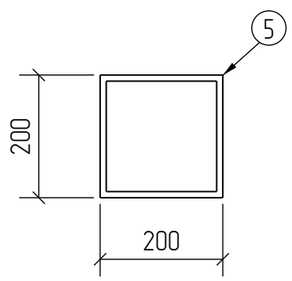
Формат: A1



1 – 1



2 – 2



Спецификация
Specification

Марка эл-та Element mark	Дет. № Item No.	Кол. шт. Num. pc.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg			Марка стали Steel grade	Примечание Notes
					шт. pc.	общ. tot.	марки of mark		
3D-5	5	1	ПК200x10.0	7558	445.9	445.9		С345	
							446		

Ведомость отправочных элементов
List of assemblies

Марка эл-та Element mark	Кол-во, шт. Number, pc.	Масса, кг Weight, kg	
		марки of mark	всех total
3D-5	10	446	4460
		Всего Total	4460

Выборка металла на все сборки
Steel specification for all assemblies

Профиль Profile	ГОСТ, ТУ GOST	Марка стали Steel grade	Масса, кг. Weight, kg
▢ 200x10.0	ГОСТ Р 54157-2010	С345	4459.0
*Наплавка и раскрой не учитываются *Chamfers and welds are not counted		Всего Total	4459

Примечание/Note:

Предельное отклонение от геометрических размеров в соответствии с СП53-101-98
по горизонтали ± 8.8, по вертикали ± 0.20
Maximum deviation from geometrical dimensions according to SP53-101-98
horizontally ± 8.8, vertically ± 0.20

СТАТУС ДОКУМЕНТОВ
STATUS OF DOCUMENTS

"Рабочая документация"
"Working documentation"

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
ГИП					
ГАП					

ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК:
GENERAL DESIGNER:

LOGO

N ПРОЕКТА PROJECT N					СТАДИЯ STAGE			РАЗДЕЛ BRANCH			БЛОК BLOCK		ЭТАЖ FLOOR		ЗОНА ZONE		ТИП TYPE	КОНСТР. STRUCT.		НОМЕР NUMBER					ПЕР. REV.
5	7	2	0	-	W	D	-	S	T	-	A	-	F1	-	A1	-	5	3	-	5	1	4	3	-	

Drawing name: Steel brace 3D-5

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал		К. Жданов		Zhdanov	10.10.2019
Гл.спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

№ чертежа 5720-WD-ST-A-F1-A1-5-3-5143
Название чертежа: Связь стальная 3D-5

г.Санкт-Петербург, ул. Ленина, 28

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
P		

Связь стальная 3D-5
Steel brace 3D-5

МАСШТАБ SCALE 1:10

PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

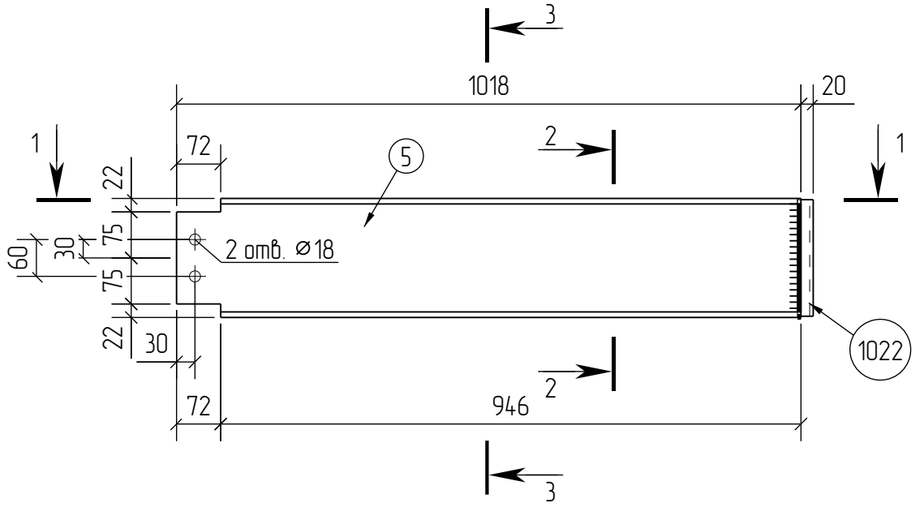
Формат: А3

Согласовано

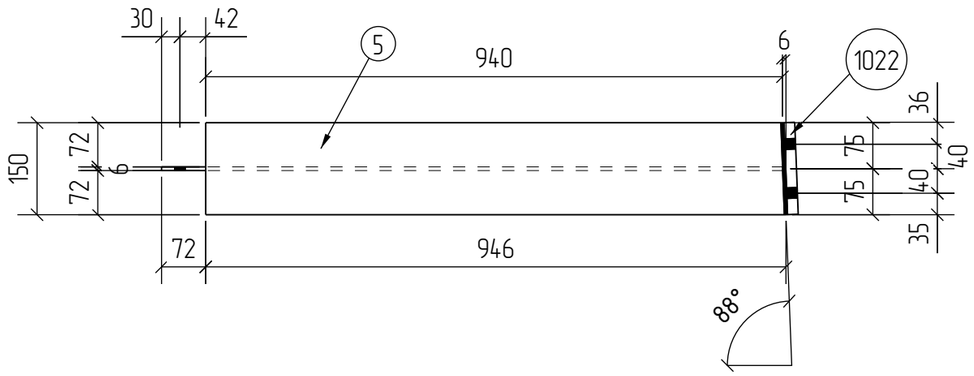
Взам. инв. №

Подп. и дата

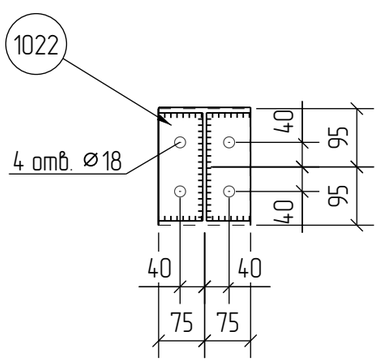
Инв. № подл.



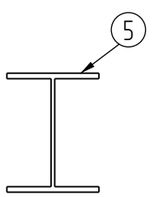
1 – 1



2 – 2
1:10



3 – 3
1:10



Спецификация
Specification

Марка эл-та Element mark	Дет. № Item No.	Кол. шт. Num. pc.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg			Марка стали Steel grade	Примечание Notes
					шт. pc.	общ. tot.	марки of mark		
SC-B-13	5	1	I20Ш1	1018	31.2	31.2		C345	
	1022	1	Лист 20x190	150	4.5	4.5		C345	
Масса напл. металла / Weld weight: 0.4							36		

Ведомость отправочных элементов
List of assemblies

Марка эл-та Element mark	Кол-во, шт. Number, pc.	Масса, кг Weight, kg	
		марки of mark	всех total
SC-B-13	2	36	72
Всего Total			72

Выборка металла на все сборки
Steel specification for all assemblies

Профиль Profile	ГОСТ, ТУ GOST	Марка стали Steel grade	Масса, кг. Weight, kg
I 20Ш1	СТО АСЧМ 20-93	C345	62.4
– 20	ГОСТ 103-2006	C345	9.0
*Наплавка и раскрой не учитываются *Chamfers and welds are not counted		Всего Total	71

Ведомость метизов
Fasteners list

Наименование Name	ГОСТ, ТУ. GOST	Кол. шт. Num. pc.	Масса, кг. Weight, kg	Примечание Notes
Болт M16 x60	ГОСТ Р Т22	2	0.24	
Гайка M16	ГОСТ ISO 4032	2	0.07	
Шайба 16	ГОСТ DIN 7989	2	0.06	
Всего Total			0.37	

Изм.	Кол.уч.	Лист	№док.	Подпись	Дата
Разработал		К. Жданов		Zhdanov	10.10.2019
Гл. спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

5720-WD-ST-A-F2-00-8-3-1232

Многоярусная автостоянка в составе торгового комплекса

Каркас пешеходного моста в осях А/14-15
Pedestrian bridge frame in gridlines A/14-15

Стадия	Лист	Листов
Р		

Марка SC-B-13

PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

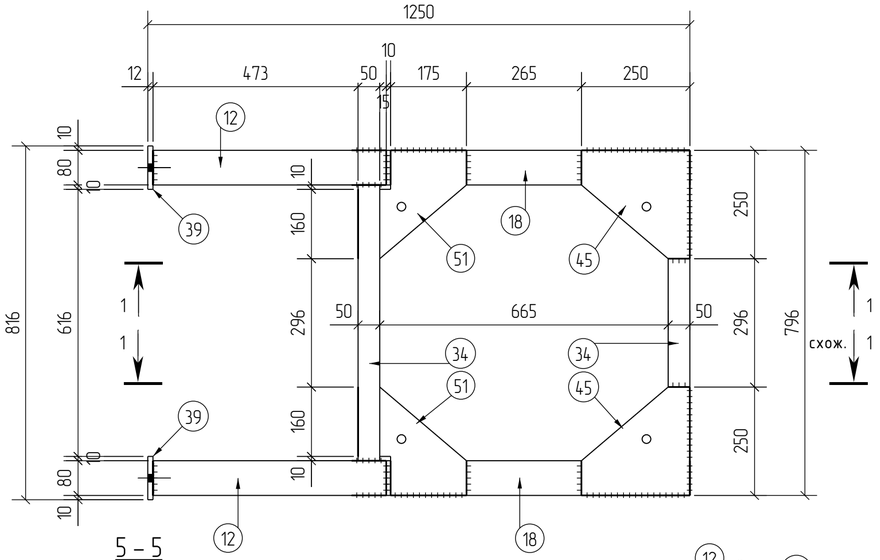
Согласовано

Взам. инв. №

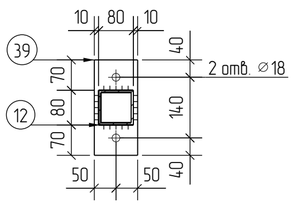
Подп. и дата

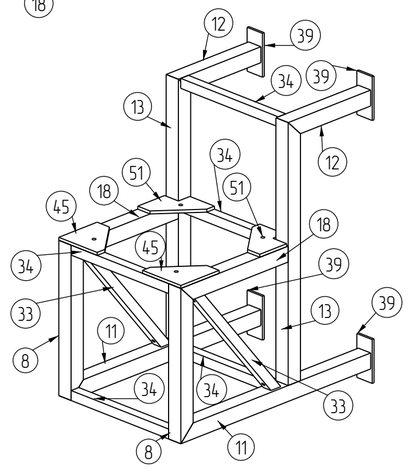
Инв. № подл.

Формат: А3

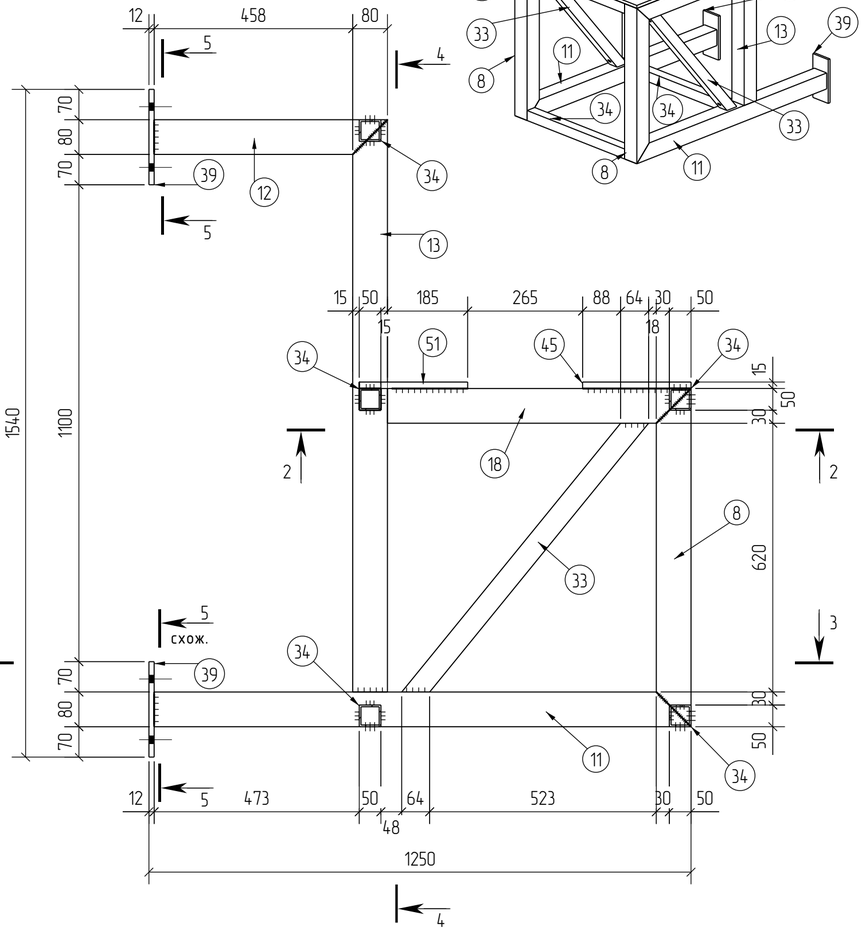


5 – 5
1:10

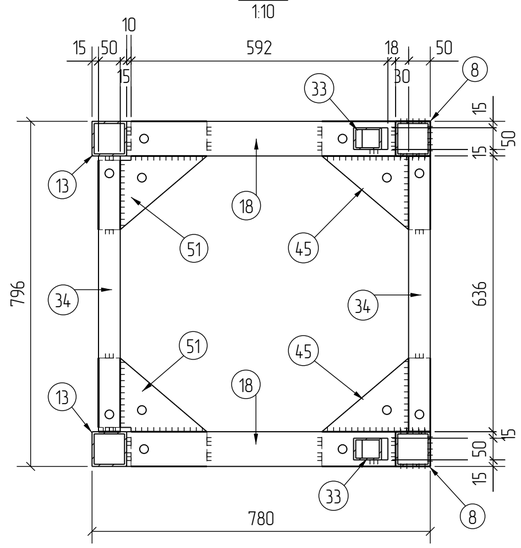




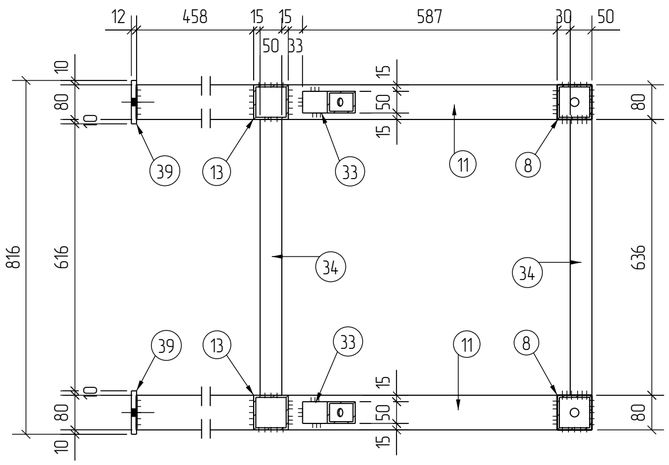
1 – 1
1:10



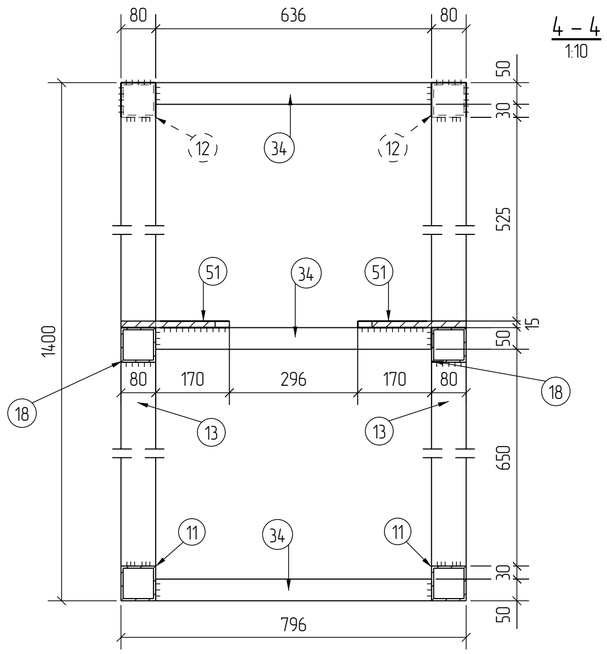
2 – 2
1:10



3 – 3
1:10



4 – 4
1:10



Спецификация
Specification

Марка эл-та Element mark	Дет. № Item No.	Кол. шт. Num. pc.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg: шт. pc.	Масса, кг Weight, kg: общ. tot.	Масса, кг Weight, kg: марки of mark	Марка стали Steel grade	Примечание Notes
ОП-2	8	2	ПК80х5.0	780	8.2	16.4		С345	
	11	2	ПК80х5.0	1238	14.1	28.2		С345	
	12	2	ПК80х5.0	538	5.8	11.6		С345	
	13	2	ПК80х5.0	1320	15.0	30.0		С345	
	18	2	ПК80х5.0	700	7.7	15.4		С345	
	33	2	ПК50х4.0	840	4.6	9.2		С345	
	34	5	ПК50х4.0	636	3.7	18.5		С345	
	39	4	Лист 12х100	220	2.1	8.4		С345	
	45	2	Лист 15х250	250	5.3	10.6		С345	
	51	2	Лист 15х250	250	4.5	9.0		С345	
Масса напл. металла / Weld weight: 1.6							159		

Ведомость отправочных элементов
List of assemblies

Марка эл-та Element mark	Кол-во, шт. Number, pc.	Масса, кг Weight, kg: марки of mark	Масса, кг Weight, kg: всех total
ОП-2	1	159	159
		Всего Total	159

Выборка металла на все сборки
Steel specification for all assemblies

Профиль Profile	ГОСТ, ТУ GOST	Марка стали Steel grade	Масса, кг. Weight, kg
▬ 12	ГОСТ 103-2006	С345	8.4
▬ 15	ГОСТ 103-2006	С345	19.6
▭ 50х4.0	ГОСТ Р 54157-2010	С345	27.7
▭ 80х5.0	ГОСТ Р 54157-2010	С345	101.6
*Наплавка и раскрой не учитываются *Chamfers and welds are not counted		Всего Total	157

ПРИМЕЧАНИЯ:
1. Катеты сварных швов принимать по наименьшей толщине свариваемых элементов
2. В размерах деталей не учтены пропуски на механическую обработку и усадку после сварки
3. Контроль швов по СП53-101-98
4. Покрытие конструкций: горячая оцинковка 120мкм
5. Предельные отклонения от геометрических размеров в соответствии с СП53-101-98: расцентровка относительно вертикальной оси +- 2.8мм

Схема расположения конструкций см. 5720-WD-ST-C-F2-C-8-0-4006
Чертежи деталей см. 5720-WD-ST-C-F2-C-8-0-4008
Чертеж общих данных см. 5720-WD-ST-00-0-00-1-0-0101

NOTES:
1. Cathets of welds to be equal to the thinner side of welded elements
2. The dimesions of parts do not include gaps/chamfers for machining and shrinkage after welding
3. Quality control of joints acc. to SP53-101-98
4. Covering: galvanizing (120 micrometers)
5. Geometrical imprefections acc. to SP53-101-98: alignment relative to the vertical axis +-2.8mm

Layout drawing: 5720-WD-ST-C-F2-C-8-0-4006
Single-part drawings: 5720-WD-ST-C-F2-C-8-0-4008
General data sheet: 5720-WD-ST-00-0-00-1-0-0101

СТАТУС ДОКУМЕНТОВ
STATUS OF DOCUMENTS

"Рабочая документация"
"Working documentation"

Изм.	Кол.уч.	Лист	№док	Подп.	Дата
ГИП					
ГАП					

ГЕНЕРАЛЬНЫЙ ПРОЕКТИРОВЩИК:
GENERAL DESIGNER:

LOGO

N ПРОЕКТА PROJECT N				СТАДИЯ STAGE		РАЗДЕЛ BRANCH			БЛОК BLOCK		ЭТАЖ FLOOR		ЗОНА ZONE		ТИП TYPE	КОНСТР STRUCT	НОМЕР NUMBER				ПЕР. REV.
5	7	2	0	W	D	S	T	-	C	-	F2	-	C	-	8	0	4	0	0	7	-

Drawing name: Pipe Support Hangers

№ чертежа: 5720-WD-ST-C-F2-C-8-0-4007
Название чертежа: Опора для монтажа труб

Изм.	Кол.уч.	Лист	№.док	Подп.	Дата
Разработал		К. Жданов		Ждanov	10.10.2019
Гл.специалист		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

г.Санкт-Петербург, ул. Ленина, 28

Многоярусная автостоянка в составе торгового комплекса

Стадия	Лист	Листов
Р		

Опора для монтажа труб
Pipe Support Hangers

МАСШТАБ SCALE 1:10 1:10

PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

Согласовано

Взам. инв. №

Подп. и дата

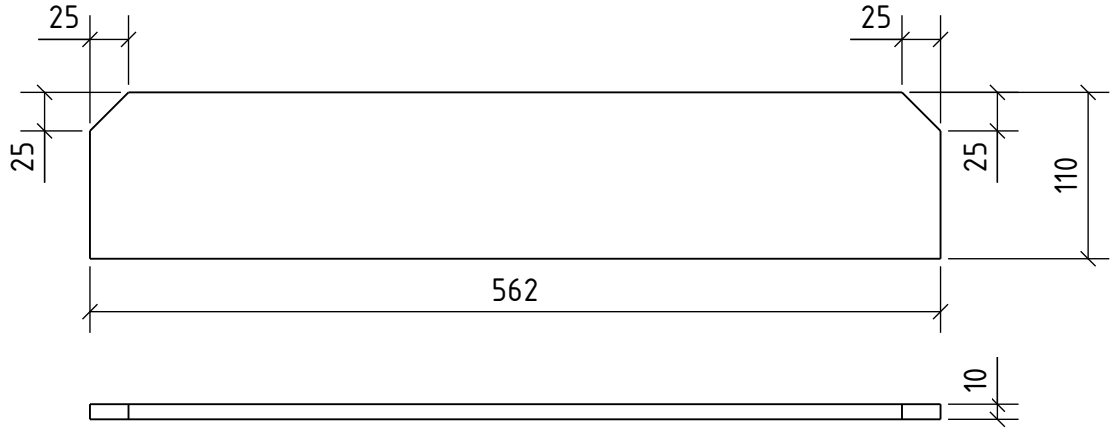
Инв. № подл.

Формат: А2

Дет. № Item No.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg		Кол. шт. Num. pc.	Марка стали Steel grade	Примечание Notes
			шт. pc.	общ. tot.			
1008	Лист 10x110	562	4.8	4.8	32	C345	

Кол-во Number	В сборках In assemblies
16	SB-B-1
16	SB-B-2

Деталь 1008
Item 1008



1	5	Детали обновлены Details updated	K. Zhdanov	15.10.2019
ИЗМ. REV.	КОЛ.УЧ NR.REV.	ПОЯСНЕНИЕ EXPLANATION	ПОДПИСЬ SIGNATURE	ДАТА DATE

Согласовано

Взам. инв. №

Подп. и дата

Инв. № подл.

Изм.	Кол.уч.	Лист	№док.	Подпись	Дата
Разработал		К. Жданов		Zhdanov	10.10.2019
Гл. спец.		Т. Коркеамяки			
ГИП		В. Иванов			
Н. контроль		А. Егоров			

5720-WD-ST-ABC-F2-B1-1-4-5234

Многоярусная автостоянка в составе торгового комплекса

Каркас пешеходного моста в осях A/14-15
Pedestrian bridge frame in gridlines A/14-15

Стадия	Лист	Листов
P	1	32

Деталь 1008

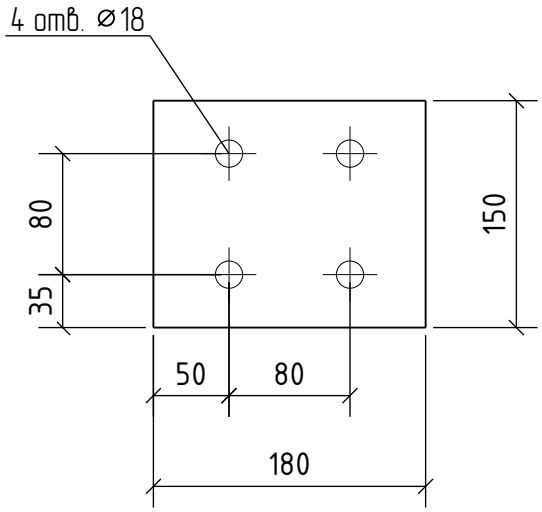
PÖYRY
ООО "Пеуру рус"
г. Санкт-Петербург

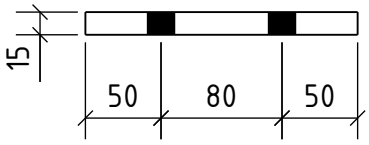
Формат: A4

Дет. № Item No.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg		Кол. шт. Num. pc.	Марка стали Steel grade	Примечание Notes
			шт. pc.	общ. tot.			
1003	Лист 15х150	180	3.2	3.2	12	С345	

Кол-во Number	В сборках In assemblies
4	SB-A-5(?)
4	SB-B-5
4	SB-C-0(?)

Деталь 1003
Item 1003





Взам. инв. №

Подп. и дата

Инв. № подл.

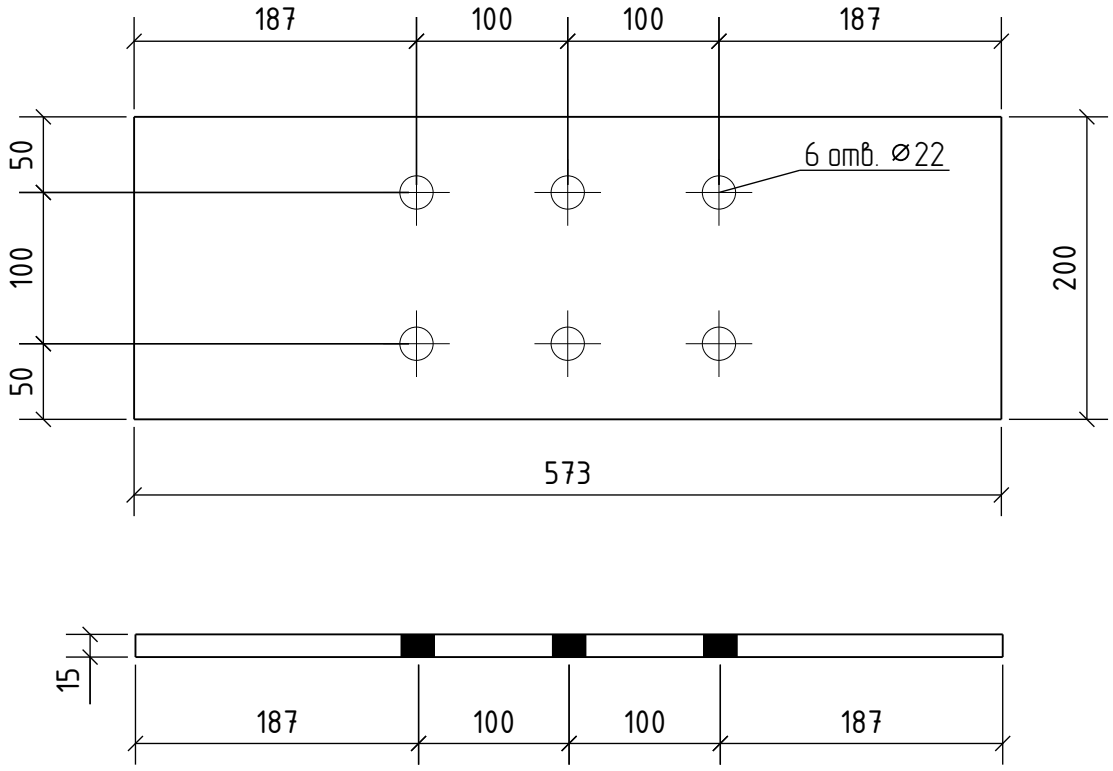
Изм.	Кол.уч.	Лист	№ док.	Подпись	Дата	Деталь 1003	Лист 2

Формат: А4

Дет. № Item No.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg		Кол. шт. Num. pc.	Марка стали Steel grade	Примечание Notes
			шт. pc.	общ. tot.			
1001	Лист 15х200	573	13.5	13.5	8	С345	

Кол-во Number	В сборках In assemblies
4	SB-B-1
4	SB-B-2

Деталь 1001
Item 1001



Изм.	Кол.уч.	Лист	№ док.	Подпись	Дата	Деталь 1001	Лист 3

Взам. инв. №

Подп. и дата

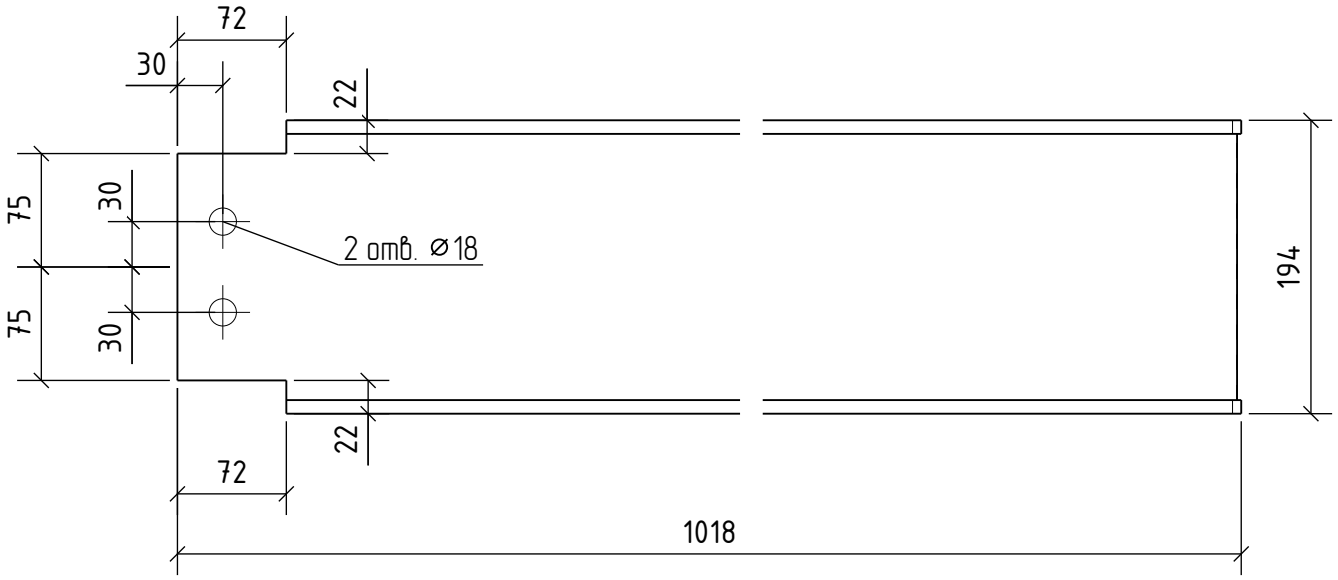
Инв. № подл.

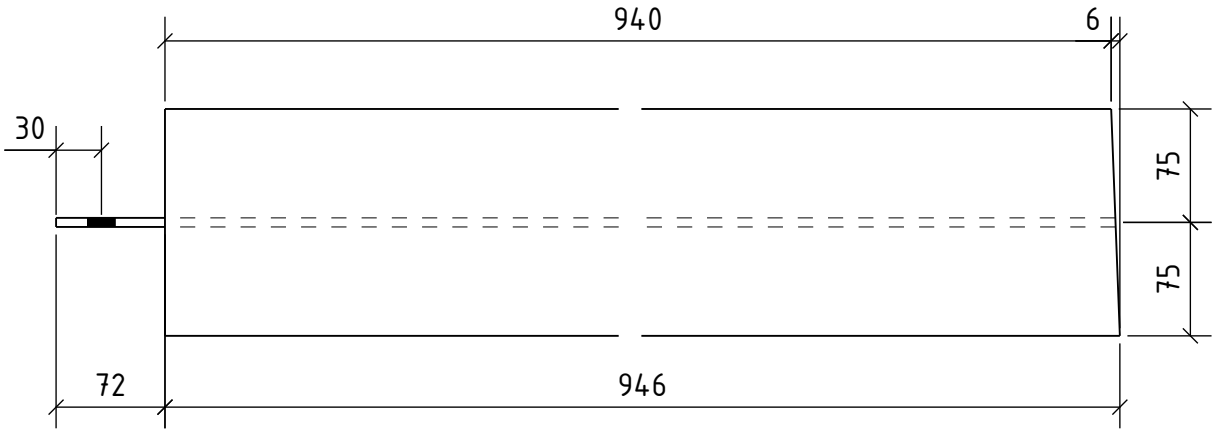
Формат: А4

Дет. № Item No.	Профиль Profile	Длина, мм Length, mm	Масса, кг Weight, kg		Кол. шт. Num. pc.	Марка стали Steel grade	Примечание Notes
			шт. pc.	общ. tot.			
5	I20Ш1	1018	31.2	31.2	2	C345	

Кол-во Number	В сборках In assemblies
2	SC-B-13

Деталь 5
Item 5





Взам. инв. №

Подп. и дата

Инв. № подл.

Изм.	Кол.уч.	Лист	№ док.	Подпись	Дата	Деталь 5	Лист 4

Формат: A4