



**BRNO UNIVERSITY OF TECHNOLOGY**

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

**FACULTY OF CIVIL ENGINEERING**

FAKULTA STAVEBNÍ

**INSTITUTE OF BUILDING STRUCTURES**

ÚSTAV POZEMNÍHO STAVITELSTVÍ

**MULTIFUNCTIONAL BUILDING**

**DIPLOMA THESIS**

DIPLOMOVÁ PRÁCE

**AUTHOR**

AUTOR PRÁCE

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**BRNO 2020**



# VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

## FAKULTA STAVEBNÍ

<b>Studijní program</b>	N3607 Civil Engineering
<b>Typ studijního programu</b>	Navazující magisterský studijní program v anglickém jazyce a prezenční formou studia
<b>Studijní obor</b>	3608T001 Pozemní stavby
<b>Pracoviště</b>	Ústav pozemního stavitelství

## ZADÁNÍ DIPLOMOVÉ PRÁCE

<b>Student</b>	Bc. Alessio Amodio
<b>Název</b>	Multifunctional building
<b>Vedoucí práce</b>	Ing. František Vajkay, Ph.D.
<b>Datum zadání</b>	20. 10. 2019
<b>Datum odevzdání</b>	10. 1. 2020

V Brně dne 20. 10. 2019

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prof. Ing. Miloslav Novotný, CSc.  
Vedoucí ústavu

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prof. Ing. Miroslav Bajer, CSc.  
Děkan Fakulty stavební VUT

## PODKLADY A LITERATURA

(1) Dean's Directive No. 19/2011 as amended and including annexes; (2) Building code, Law No. 183/2006 Coll. as amended; (3) Decree No. 499/2006 Coll. as amended; (4) Decree No. 323/2017 Coll. as amended; (5) Decree No. 268/2009 Coll. as amended; (6) Valid standards ČSN, EN; (7) Catalogues of building materials and elements, structural systems; (8) Professional literature; (9) If applicable own disposition and (10) Architectural design of Building.

## ZÁSADY PRO VYPRACOVÁNÍ

Elaboration of the specified part of the building documentation for construction purposes of assigned building.

**Aims:** The design of structural system and bearing structures based on selected building materials and elements, including the solution of building placement over the plot with respect to its surroundings. The documentation is to be prepared in accordance to Decree No. 499/2006 Coll. as amended and is to include Part A, Part B, Part C, and Part D within the scope of Parts D.1.1 and partially D.1.2. If applicable it should also include the students own concept design of the building and its layouts, and annexes containing preliminary design of foundations and dimensioning of bearing elements of the solved building and spatial visualization of the building (modular building diagram). Documentation should include drawings like: site plans, foundations, floor plans, roof construction, sections, elevations, at least 5 structural details, assembly or formwork drawing of ceiling/slab structures of the selected floors. According to point c) of Part D.1.1. the documentation is to include building-physical assessment of the building and selected details, respectively other specialisations if they were assigned by the supervisor. If applicable the designed building should comply with the requirements stated for buildings with near zero energy consumption. The thesis should also include the concept of ventilation, heating and hot water supply. **Outputs:** The theses will be structured in accordance with the Dean's Directive No. 19/2011 as amended and incl. annexes. The individual parts of the thesis are to be contained in A4-size flaps with a title block on the front and table-of-content on the inside of each folder. All parts of the documentation are to be processed using a PC in a text and graphical CAD editor. The drawings are required to have a title block. The text part is to include items h) "Introduction", i) "Own texts" (which should include the Part A - Accompanying report, Part B - Summary technical report and Technical reports from Parts D.1.1 and D.1.2 which are to be prepared in accordance to Decree No. 499/2006 Coll. as amended), and j) "Conclusion". If applicable it is necessary to use the principles stated for buildings with near zero energy consumption. The electronic version of the thesis should also include a poster on B1 format with basic information about the object and its graphic visualization.

## STRUKTURA DIPLOMOVÉ PRÁCE

VŠKP vypracujte a rozčleňte podle dále uvedené struktury:

1. Textová část závěrečné práce zpracovaná podle platné Směrnice VUT "Úprava, odevzdávání a zveřejňování závěrečných prací" a platné Směrnice děkana "Úprava, odevzdávání a zveřejňování závěrečných prací na FAST VUT" (povinná součást závěrečné práce).
2. Přílohy textové části závěrečné práce zpracované podle platné Směrnice VUT "Úprava, odevzdávání, a zveřejňování závěrečných prací" a platné Směrnice děkana "Úprava, odevzdávání a zveřejňování závěrečných prací na FAST VUT" (nepovinná součást závěrečné práce v případě, že přílohy nejsou součástí textové části závěrečné práce, ale textovou část doplňují).



## **ABSTRACT**

This Master's thesis deals with a designing of a Multifunctional building that servers as an extension hall of a previously existing building. The site is in the Řečkovice part, Brno city.

The thesis aims to interconnect buildings both spatially and visually.

The production hall and the storage will be extended. Last floor will serve as administration part with social facilities and outdoor terrace.

Design proces was support entirely by the use of the BIM technology.

## **KEYWORDS**

Precast concrete, BIM technology, Project documentation, Multifunctional building, Terrace, Building solution, Architectural detail

## **ABSTRAKT**

Tato diplomová práce se zabývá návrhem multifunkční budovy, která slouží jako rozšíření haly dříve existující budovy. Areál se nachází v části Řečkovice v Brně.

Práce si klade za cíl propojit budovy jak prostorově, tak vizuálně.

Výrobní hala a sklad budou rozšířeny. Poslední patro bude sloužit jako administrativní část se sociálním zařízením a venkovní terasou.

Proces návrhu byl plně podporován použitím technologie BIM.

## **KLÍČOVÁ SLOVA**

Prefabrikát, BIM technologie, Projektová dokumentace, Multifunkční budova, Terasa, Stavební řešení, Architektonický detail

## **BIBLIOGRAPHIC CITATION**

**Bc. Alessio Amodio *Multifunctional Building*. Brno, 2020. 56 pp., 102 pp. of appendices Master's Thesis. Brno University of Technology, Faculty of Civil Engineering, Institute of Building Structures. Supervisor Ing. František Vajkay, Ph.D.**

## **DECLARATION OF CONFORMITY OF THE PRINTED AND ELECTRONIC FORM OF THE FINAL THESIS**

I declare that the electronic form of the submitted master's thesis titled *Multifunctional building* is identical to the submitted printed form.

Brno, 6. 1. 2020

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**Bc. Alessio Amodio**  
author

## **DECLARATION OF AUTHORSHIP OF THE FINAL THESIS**

I, Bc. Alessio Amodio declare that this master's thesis titled *Multifunctional building* is my own work and the result of my own original research. I have clearly indicated the presence of quoted or paraphrased material and provided references for all sources.

Brno, 6. 1. 2020

---

**Bc. Alessio Amodio**  
author

## **ACKNOWLEDGEMENT**

First I would like to thank to Ing. František Vajkay, Ph.D., the supervisor of my diploma thesis, who was helpful. Then I would like to give my sincere thanks to my boss who was really nice and release me from work and give me time to work on my thesis. At last I want sincerely thanks my girlfriend to have supported me during the whole time.

Brno, 6. 1. 2020

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**Bc. Alessio Amodio**  
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# 1. Introduction

This master thesis was elaborated as part of project that includes a new construction of a multifunctional building in Brno city.

The multifunctional building consists of a three storey building: warehouse in first floor, production hall in second floor and administration office in third floor.

The new building will be operationally and spatially linked to the existing one. The hall extension reflects the main existing architectural and structural design in order to visually interconnect both elements.

Despite interconnected, both buildings react separately to horizontal forces. The intent is to construct a new column grid spaced enough from the existing structural column line to allow a drilling machine to operate.

In administration and office floor (third floor) there is terrace laying directly of existing precast roof structure that will serve as a support for vertical steel column reactions.

The project documentation includes parts A – Accompanying report, B – Summary technical report, part D made up by part D.1.1. - Architectural solutions and D.1.2. - Structural solutions.

The design process was supported by the use of BIM technology, which helped to achieve the documentation for both structural and architectural part and bills of quantities.

All building parts were modelled using BIM technology.

The main goal is to provide a complete and central information model, in order to monitor the project throughout its life cycle and intervene, if necessary, with further scheduled maintenance.

## **2. Principal text part of diploma thesis**



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## **A ACCOMPANYING REPORT**

**DIPLOMA THESIS**

**AUTHOR**

**Bc. Alessio Amodio**

**SUPERVISOR**

**Ing. FRANTIŠEK VAJKAY, Ph.D.**

**BRNO 2020**

## **A. Accompanying report**

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## **A.1. Identification data**

### **A.1.1. Construction data**

**a) the name of the works**

**MULTIFUNCTIONAL BUILDING**

**b) construction site (address, descriptive numbers, cadastral areas, parcel numbers)**

Address of construction:	Karásek 1J, 621 00 Brno – Řečkovice
Cadastral territory:	Řečkovice (611646)
Parcel numbers of land:	3465/5, 3465/29
Property right:	Dům Řečkovice s.r.o., Běly Pažoutové 742/1, Komín, 624 00 Brno

**c) subject of documentation (new construction or modification of completed construction, permanent or temporary construction, purpose of use of the construction)**

The subject of documentation is the completion of the hall for production and storage, supplemented by administrative and social facilities. Specifically, it is the completion of a new building to the existing hall. The extension of the hall is a new building, which is partially affected by the expansion of production in the 1st floor of the existing building. It is a permanent building.

### **A.1.2. Applicant data**

**a) business name or name, personal identification number, registered address (legal entity)**

Dům Řečkovice s.r.o., Běly Pažoutové 742/1 Komín, 624 00 Brno  
Identifikační číslo: 2334925

### **A.1.3. Information on the draftsman**

**a) name, surname, business name, personal identification number, place of business (natural person doing business) or business name or name, personal identification number, registered address (legal entity),**

INTERPLAN – CZ, s.r.o.,  
Purkyňova 79a, 612 00 Brno  
Identifikační číslo: 60722016

- b) name and surname of the principal designer, including the number under which he is registered in the register of authorized persons kept by the Czech Chamber of Architects or the Czech Chamber of Authorized Engineers and Technicians active in construction,**

Bc. Alessio Amodio

## **A.2. Structure division into buildings and technical and technological equipment**

The building consists of the following building:  
SO 201 – Hall implementation

## **A.3. List of input documents**

The documentation was prepared on the basis of the following documents:

- Investor requirements and site inspection 09/2018
- geological survey (Balun, Česká 13, 664 31; 07/2014)
- assessment of radon index determination (Radontest s.r.o., Na Císařce 3224/32, 150 00 Praha5; 10/2018)
- altimetry and planimetric orientation (THEODAT Brno, s.r.o., Lukovany 215, 664 84 Zastávka; 09/2018)
- photo documentation 09/2018





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## **B SUMMARY TECHNICAL REPORT**

**DIPLOMA THESIS**

**AUTHOR**

**Bc. Alessio Amodio**

**SUPERVISOR**

**Ing. FRANTIŠEK VAJKAY, Ph.D.**

**BRNO 2020**

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## **B. Summary technical report**

### **a) adaptations for barrier-free use by construction of the constructions concerned,**

The construction is without prejudice to any other construction that would require adaptations for wheelchair access.

### **b) determination of special conditions for the execution of construction - execution of construction during operation, measures against the effects of the external environment during construction, etc.,**

The construction will require modifications in the existing production hall. Prior to dismantling the existing cladding on the north side of the building, temporary weather-resistant partition walls, fire resistance and the existing hall must be protected from the effects of the construction until the cladding including the new building fillings is installed.

All work will be performed during operation, possibly with a minimum reduction in operation.

### **c) the principles of occupational safety and health at the construction site**

For construction, the client shall determine in accordance with the wording of Act No. 309/2006 Coll. § 14 (1) of the OSH Coordinator, it is assumed that the work of employees of more than one contractor of the construction.

The contractor is responsible for the fulfillment of his obligations imposed by the legislation regulating the requirements for safety and health at work and for fire protection (ie especially Act No. 365/2011 Coll. - Labor Code, as amended, Act No. 309/2006 Coll. - Act on Provision of Other Conditions at the Construction Site, as amended, Government Decree No. 591/2006 Coll., - on Detailed Minimum Occupational Health and Safety Requirements on Construction Site, as amended, and Government Decree No. 362/2005 Coll. on health and safety requirements with the risk of falling from a height and into the depth, as amended, Government Regulation No. 101/2005 Coll. - on more detailed requirements for the workplace and working environment, as amended, Act No. 133/1985 Coll. , as amended, Government Decree No. 378/2001 Coll. - on detailed requirements for safe operation and use of machines, technical equipment, devices and tools, as amended and others).

When carrying out work on the individual stages of the implementation of the work, especially during the execution of pilots, excavation work, installation of

heavy construction, construction and technological parts and when working at heights, it is necessary to prevent unauthorized persons access to the endangered areas. Endangered area is a defined area where, due to the work being performed, there is a risk of persons or objects falling into or out of the ditch, or in which persons may be endangered by another ongoing activity or threatening condition.

Such a space must always be safely secured according to the impending danger, in particular by eliminating traffic, temporary portable fencing of at least 1.8 m height, construction of protection against falling of persons and objects at the work place at or below the work place at height. two-bar railing at a height of 1.1 m, possibly with portable barriers, or warning foil strips mounted and stretched at a height of 1.1 m at the boundaries of the danger zone. All this must be accompanied by tables with the inscription or the symbol "No entry of unauthorized persons" (for more details on site requirements, see Annex 1 to Government Regulation No. 591/2006 Coll. On minimum requirements for safety and health at work on construction sites and Government Order No. 362/2005 Coll., On the Detailed Requirements for Occupational Safety and Health at Workplaces with the Risk of Fall from Height or in Depth). Every worker involved in the preparation, organization, management and execution of construction work must have the necessary knowledge to ensure safety at work. The contractor is obliged to train all these workers or to ensure their training from the safety regulations.

It is also his duty to verify their knowledge. According to Act 309/2006 Coll. §14 - If employees of more than one contractor work on the construction site, the contracting authority is obliged to determine the required number of OSH coordinators on the construction site, taking into account the scope and complexity of the work and its demanding coordination in preparation and implementation.

The construction site will be properly demarcated/fenced, fitted with lockable gates and marked with appropriate safety signs. The telephone numbers of the nearest fire station, first aid and police will be announced on the building site. Prior to commencing work, all site workers will be instructed on the safety regulations for all work in question. These measures will be properly ensured and controlled. All workers must wear the prescribed protective equipment. At the workplace, order and cleanliness must be maintained. Fire protection must be observed and fire-fighting equipment must be kept alert.

Work on the construction site will be carried out in accordance with the contractor elaborated technological procedures for individual activities. During the construction, only persons competent to perform this activity will perform special work tasks requiring special training.

All products, technologies and materials used in the construction must comply with the relevant binding CSN, be approved for use in the Czech Republic and have the appropriate sanitary and safety attestations. Pursuant to the provisions of the Building Act, the Contractor shall use only those materials and products that have such properties that the required mechanical strength and stability,

fire, safety and hygiene requirements are guaranteed during normal maintenance during the expected existence of the building.

#### **Safety regulations:**

Compliance with the mandatory building safety regulations, in particular the relevant provisions, will also be ensured during the construction period:

- Government Decree No. 591/2006 Coll. on occupational safety and health at construction sites
- Government Decree No. 362/2005 Coll. on more detailed safety and health protection requirements at workplaces with the risk of falling from a height or depth
- Act No. 309/2006 Coll. on ensuring further conditions of occupational health and safety.

The contractor is obliged to organize the work and determine the working procedures so that the principles of safe behavior in the workplace are observed. The requirements for safety and health protection during construction are stipulated by Decree No. 591/2006 Coll., On detailed minimum requirements for safety and health protection at work on construction sites.

Further detailed requirements for ensuring occupational health and safety are laid down in Government Regulation No. 378/2001 Coll. on detailed requirements for safe operation and use of machines, technical equipment of instruments and tools, Government Decree No. 406/2004 Coll. on more detailed requirements for ensuring occupational safety and health at work in potentially explosive atmospheres and Government Decree No. 11/2002 Coll. on the appearance and affixing of labels and the introduction of signals, as amended.

The electrical installation of the construction site equipment will be designed according to valid ČSN standards.

Escape routes and exits - their number, capacity, length and width of existing escape routes will comply with the requirements of special regulations, ie in particular ČSN 73 0804.

Outdoor traffic routes must provide easy, safe and convenient access for pedestrians or vehicles, especially for existing traffic. The roads must be significantly different from other areas of the same level, they must be sufficiently wide and permanently free. Pedestrian routes must be at least 1.1 m wide unless otherwise specified by special regulations. Underpass height must be kept min. 2.1 m and lowered profiles must be provided with a warning black and yellow safety mark. During construction, secure access to existing buildings operated on site must be ensured.

Facilities for cleaning, cleaning and maintenance of the equipment will be provided for operation. First aid equipment must be placed in an accessible place and must be marked with appropriate marks, in accordance with Government Decree No. 11/2002 Coll., as amended by Government Decree No. 405/2004 Coll.

### **Safety of work and technical equipment**

The individual areas of the construction site will be provided with appropriate safety signs. The design and placement of the safety signs will be in accordance with ČSN ISO 3864 and Government Regulation No. 11/2002 Coll., Stipulating the appearance and location of safety signs and the introduction of signals.

In accordance with Government Regulation No. 101/2005 Coll., On more detailed requirements for the workplace and working environment, the Contractor shall ensure before commissioning the workplace:

- Identification of persons whose duties include ensuring the safe operation, use, maintenance, cleaning, cleaning and repair of the workplace,
- Determination of the content and method of keeping operational documentation and records of the workstation equipment,
- Health protection measures for workplaces where substances or preparations harmful to health or use are used,
- Emergency control measures and staff behavior rules to ensure safe evacuation of persons.
- Security of the workplace against the entry of unauthorized persons, even during non-working hours.

### **The Contractor shall also ensure:**

- Setting deadlines, deadlines and scope of inspections, tests, revisions, maintenance, repair,
- Compliance with legal deadlines and deadlines,
- keeping all records of operation and reporting of equipment status in a manner that allows the storage and use of such data for a specified period of time in written or electronic form, to be available to persons working on the installation and to supervisory and control authorities,
- Requirements for the provision of PPE, detergents, cleaning and disinfectants are laid down in Government Regulation No. 495/2001 Coll.
- Description of construction / assembly of the heaviest parts - conditions and limitations, requirements for lifting equipment

Technological procedures will be elaborated in advance for individual activities, including the way of material and construction parts handling. These activities will be carried out on the assumed construction site and coordinated by the responsible construction workers. If the technological procedure determines the endangered area to a greater extent than the site, the construction site will be extended to this endangered area, at least for the duration of their implementation.

## **B.1. Description of the construction site**

### **a) characteristics of the area and building land, built-up area and un-built-up area, compliance of the proposed building with the character of the area, the existing use and built-up area**

The building is designed inside the existing industrial site of the former Lachema, managed by Pharma Park CR. The area is located in the built-up area of the cadastral area Brno-Řečkovice in the area earmarked by the land use plan for industry. The extension to the existing production hall is in accordance with the character and current use of the area. The area is connected to transport infrastructure and there are necessary engineering networks.

The area for the proposed extension is flat. The foundation conditions are complicated, the foundation of the building will be on piles.

The project of building the hall is one of three plans that are proposed in the area. Other projects that are considered in the area - project of production and storage hall and project of multifunctional hall. In terms of permitting procedures and construction, it is expected that the first production and storage hall will be implemented as the first one, followed by the completion of the hall and the construction of the multifunctional hall.

### **b) data on the compliance of the building with land-use planning documentation, with the objectives and tasks of land-use planning, including information on the land-use planning documentation issued**

The proposal of the new building of the extension of the hall and the related paved areas is in accordance with the territorial planning documentation, ie Of the City Plan of the City of Brno, updated ÚPmB, with effect from 14.8.2014. The site is located on the area designated by the land use plan as an area for industry.

### **c) information on decisions taken to grant exemptions from the general land use requirements**

No decision to allow exceptions to general land use requirements has been made and will not be applied for.

### **d) information on whether and in what parts of the dossier the conditions of binding opinions of the authorities concerned are taken into account**

This information will be processed in the dossier after receiving the binding opinions of the authorities concerned.



**e) enumeration and conclusions of conducted surveys and analyzes - geological survey, hydrogeological survey, construction-historical survey, etc.,**

Engineering Geological Survey (Brno-Řečkovice-Lachema-storage hall TRON), Ing. Dan Balun, 07/2014. In the engineering geological survey, within the meaning of Article 20, ČSN 73 1001, b), the foundation conditions are evaluated as complex. This is due to inhomogeneous ground conditions, the occurrence of a relatively high groundwater level, 2.1 meters below the existing terrain and the possible occurrence of landfills.

Design site inspection by designers, 09/2018, to compare the available data with reality and to verify the possibility of connection to existing distribution systems

Altimetry and planimetric orientation, THEODAT Brno, s.r.o., 09/2018. For the purpose of surveying areas for implementation, existing roads, paved areas, existing buildings, shafts, area routes utility lines, etc.

Assessment and determination of radon index, Radontest s.r.o., Na Císaře 3224/32, 150 00 Praha 5, 10/2018 evaluated the radon index of the affected land as medium and it is necessary to take measures against radon penetration from the geological subsoil. At the same time, the waterproofing of the substructure will fulfill the function of the anti-radon insulation and will be delivered with the appropriate certificate. Joints and penetrations will be made with respect to the medium radon risk.

**f) protection of the territory under other legal regulations (conservation area, conservation area, specially protected area, etc.)**

The area is not protected according to other legal regulations, it is not a conservation area, a conservation area, especially a protected or flooded area.

**g) location relative to the flood plain, undermined area, etc.**

Land is not located in flood or undermined areas.

**h) influence of the building on surrounding buildings and land, protection of the surroundings, influence of the building on runoff conditions of the territory**

The new building of the hall building is operationally connected (doors, sectional doors) to the existing production hall and is adjacent to it. Part of the new building on the ground floor is extended by the extension of the production area from the existing hall. In this section, the objects are spatially linked. On the 2nd floor the halls are operationally connected by a door and on the 3rd floor is designed an outdoor terrace, which will be anchored through the roof cladding to the supporting structure of the existing building.

Rainwater from the roof of the hall will be drained by means of vacuum sewerage to the existing areal rainwater sewer, which opens into the existing retention

tank serving for the area. The amount of rainwater drained is 15.74 l/s. The capacity of the existing retention tank is sufficient and the water from it is used for technological needs of the premises. The rainwater of the new paved areas will be partially drained into the existing street gullies and the new parking spaces will be made of concrete drainage paving placed in the crushed aggregate.

**i) requirements for sanitation, demolition, felling of trees**

There are no requirements for sanitation and felling in the area of interest. Before piloting the foundations, it is necessary to check whether the construction of the existing production hall was completely removed from the reservoir located at lot no. 3465/29 and partly on file no. 3456/5 in the column area of the new building on the B, D and 5.6 axes.

**j) requirements for maximum temporary and permanent occupation of the agricultural land fund or land intended for forestry**

The construction does not require temporary or permanent occupation of agricultural land fund or land intended for forest function.

**k) territorial technical conditions - especially the possibility of connection to the existing transport and technical infrastructure, the possibility of barrier-free access to the proposed construction**

The building is located in the former Lachema, which is connected to the public road. Inside the premises there is an existing service road to which the building is connected.

Existing parking spaces in front of the building have sufficient parking capacity for the needs of both existing and new buildings. Two parking places are designed in parameters according to Decree No. 268/2009 Coll., On general technical requirements ensuring barrier-free use of buildings. At the investor's request, 5 parking spaces on the SE side of the building are also designed for the completion of the hall.

The extension of the hall will be connected to the area wiring of the technical infrastructure (electrical, sewage and storm sewer). Connection to the water supply will be from the existing storage hall. The new hall will not be connected to the pipeline. The boiler room in the existing hall, where two new boilers will be connected, serves the needs of heating and hot water. In view of the unsatisfactory capacity of fire hydrants, an underground fire reservoir will be built on the investor's land near the construction.

**l) the material and time constraints of the construction, conditional, induced, related investments**

The construction does not require any material and time links. As a conditional and induced investment, respectively. related, the removal of part of the cladding of an

existing building on the north side can be indicated. The reason is the extension of the production hall of the existing hall into the building of the hall completion and operational interconnection of both halls.

**m) a list of plots by cadastre on which the construction is being carried out**

Location:	Řečkovice (611646)
parcel no.	3465/5
area (m <sup>2</sup> ):	4233
LV No:	10
property rights:	Dům Řečkovice s.r.o., Běly Pažoutové 742/1, Komín, 624 00 Brno
Application:	handling area
type of land:	other area
Location:	Řečkovice (611646)
parcel no.	3465/29
area (m <sup>2</sup> ):	61
LV No:	10
property rights:	Dům Řečkovice s.r.o., Běly Pažoutové 742/1, Komín, 624 00 Brno
Application:	handling area
type of land:	other area

**n) a list of parcels by cadastre on which a protection or security zone is established**

New protection zones will be created for the technical infrastructure networks, to which the construction of the hall will be connected. Protective zones and minimum horizontal distances of technical infrastructure networks according to ČSN 73 6005 - Spatial arrangement of technical equipment networks are observed. The rainwater sewer protection zone, which is owned and administered by PHARMA PARK s.r.o., Karásek 1, 621 33 Brno, is not observed. An exception will be negotiated and allowed with client network administrator.

**Protective zones will arise on land:**

Location:	Řečkovice (611646)
parcel no.	3465/5
area (m <sup>2</sup> ):	4233
LV No:	10
property rights:	Dům Řečkovice s.r.o., Běly Pažoutové 742/1, Komín, 624 00 Brno
Application:	handling area
type of land:	other area

## B.2. General description of constructions

### B.2.1. General characteristics of construction and its use

This is a new building, which is operationally linked to the existing production hall. The production of the existing hall will be partially expanded into the first floor space of the new building. The construction work for the existing interconnection hall concerns the removal of the cladding and the internal partition. Modifications do not affect load-bearing structures.

The first floor will be primarily located warehouse of materials and products. Part of the 1st floor will be spatially connected with the production premises in the existing hall. There will also be an operating block with social facilities and an entrance hall. The 2nd floor is designed to accommodate the production of LED lighting and operating block with sanitary facilities. 3.NP will serve as the administrative workplace of the company with social facilities and outdoor terrace.

Part of the project is the expansion of existing production, which concerns the removal of the inner partition and removal of part of the existing cladding.

#### SO 201 – Hall extention

Build up area .....	954 m <sup>2</sup>
Usable area warehouse .....	646 m <sup>2</sup>
Usable area production .....	807 m <sup>2</sup>
Usable area of administration, social and technological background and commercial.....	1110 m <sup>2</sup>
Enclosed area.....	12857,92 m <sup>3</sup>

Tab.1 Total number of employees sorted by gender and divisions

Division	Men	Woman	Total
Production and storage	8	8	16
Administration and others	20	14	34
Room capacity	Men	Woman	
Social background 1.NP (split lockers)	4	4	8 lockers
Social background 2.NP (split lockers)	4	4	8 lockers
Administration (office with rest room)			3 rooms
Administration (office)			2 rooms
Administration (meeting room)			2 (13 seats each)
Administration (openspace)			24 seats

Source: Company source

## **B.2.2. General urban and architectural design**

### **a) urban planning - territorial regulation, composition of spatial solution.**

The building is situated on an undeveloped area in the southern part of the former industrial area of Lachema, which is located in the built-up area. The extension of the hall is designed on the area according to the approved land use plan intended for industry and is in accordance with the character and previous use of the area.

The spatial solution is based on the required purpose of use and spatial possibilities of the building land. The building is located to the existing production hall and is connected with it operationally and partially spatially.

### **b) architectural design - composition of shape design, material and color design.**

The architectural solution is based on the user and technological requirements of use, and to a large extent also on the investor's effort to give the individual buildings a common architectural concept. It is a three-storey hall for production and storage, supplemented by an administrative social part, but also aesthetic requirements are placed on it. The extension will be architecturally linked to the existing production hall, with similar design solutions and using similar materials. Material solution will be usual for this type of objects - reinforced concrete skeleton sheathed with wall panels filled with thermal insulation with sheet metal finish, roof cladding made of trapezoidal sheets, thermal insulation and waterproofing (PVC foil). The floors will be defined according to the user's needs and the internal partitions will be mainly plasterboard. The color solution will be similar to the existing production hall.

## **B.2.3. General operating and production technology solutions**

The building is designed as a three-storey hall. On the 1st floor there will be a warehouse, on the 2nd floor the production area and on the 3rd floor the administrative part. The floors will be connected by a central staircase and a passenger-lift, which will also meet the parameters for the transport of persons with reduced mobility. The first floor is designed primarily warehouse material and products. The extension of the production premises of the existing hall will be spatially affected by the part of the 1st floor. There will also be an operating block with sanitary facilities, staff changing rooms, a storage lift and an entrance hall with staircase and lift. The 2nd floor is ready for the location of production of LED lighting, which is operationally connected (through the door) to the premises in the existing hall. There will also be an operating block with sanitary facilities, staff changing rooms, a compressor room, a storage elevator and a communication space. The 3rd floor will serve as the administrative workplace of the company with offices, offices

with rest rooms, meeting rooms, social facilities (including barrier-free), day room and outdoor terrace. The production will mainly be fitted and light production:

#### **Fitting**

In the assembly process, LED modules (light sources) for luminaires based on LED technology are produced. The resulting product is created by mounting electronic components (LEDs) on a printed circuit board.

The degreased and cleaned printed circuits are coated with a tin solder paste on the solder pads. After applying the paste, SMD components (mainly LED) are placed on these surfaces. After fitting the components, the printed circuit board goes to a remelting furnace with a fixed temperature profile, where the solder paste is remelted and the electrically conductive connection of the printed circuit board and components is mechanically resistant. After the assembly of the LED module, the output is checked for functionality and packaging. All processes take place in an antistatic environment. The processes can take place both manually and mechanically inside the assembly line.

#### **Light production**

In the light manufacturing process, assemblies and fine mechanical and electrical work on LED-based light sources occur. These are mainly assembling aluminum chassis with LED strips and LED modules, soldering cabling and creating multiple light sources. All technological processes consist of preparation of components (degreasing of aluminum chassis surfaces, shortening of LED strips, etc.), connection of LED light source with aluminum chassis (mechanical, glued), preparation of wiring (shortening, tinning of ends, soldering to light source or connection via connector).

### **B.2.4. Barrier-free use of the building**

**Principles of solving accessibility and use of the building by persons with reduced mobility, including data on conditions for work with disabilities.**

Decree No 398/2009 Coll., On general technical requirements ensuring barrier-free use of buildings.

The construction is designed in such a way that it is possible to consider the possibility of pursuing the profession of persons with limited mobility and orientation in the administrative part of the building completion, in accordance with §12. Work in administration is expected, work in production and warehouse is not suitable for people with limited mobility. The construction is designed to meet the general technical requirements ensuring barrier-free use of buildings, as defined by Decree No. 398/2009 Coll., On general technical requirements ensuring barrier-free use of buildings.

#### **§4 (2) Reserved parking space**

Dedicated parking spaces are designed next to the hall.

Total number of parking spaces: 35

Reserved parking space: 2

#### **§5 – Access to buildings**

Access to the building is designed barrier-free, before the entrance is designed horizontal area greater than 1500 x 1500 mm. The entrance door will open, with a clearance of 1000 mm. The door will be glazed with safety glass, the lower part up to a height of 400 mm will be protected against damage.

#### **§12 – Requirements for construction work**

In the 3rd floor is designed toilet with parameters of Decree No.398/2009 Coll. For transport to the 3rd floor can be used passenger freight elevator, whose cabin size, door width and handling area in front of the door meets the requirements of Decree No.398/009 Coll.

### **B.2.5. Work safety**

Safety during the use of the building will be ensured by the conditions for work and movement within the building as defined in the Operating Rules and their observance.

Employees will be demonstrably acquainted with the operating rules. The Visitors' Rules will be elaborated for visitors, which the visitors will be demonstrably acquainted with when entering the building.

The building will be equipped with safety signs, emergency exit signs, fire signs according to valid legislation.

The main circuit breaker will be accessible and visibly marked.

The requirements of all relevant legislative standards and ČSN standards will be observed.

The construction is designed and will be designed so that it is suitable for the intended use while respecting economy and at the same time it meets the basic requirements, which are:

- mechanical resistance and stability
- protection of health, healthy living conditions and the environment
- noise protection.

### **B.2.6. Basic characteristics of objects (see D.1.1)**

### **B.2.7. Basic characteristics of technical and technological equipment**

The premises of the 2nd floor are ready for production location for LED lighting by TRON company. The production will mainly include automatic assembly lines and light manual production workplaces. Automatic assembly lines will consist mainly of (or similar) devices:

- Automatic Line Loader - feeds printed circuit boards from prepared magazines to the assembly line belt
- Screen printing - applies solder paste to the printed circuit board, printing to PCB format
- SPI - Solder paste inspection - inspection device for screening paste. Captures errors such as sticky screen printing patterns, poor paste position on the printed circuit board, etc.
- Fitting machine - fits SMD components on pasted printed circuit board, fitting speed according to type
- Reflow furnace - ensures reflow of solder paste and thus firm and electrically conductive connection between PCB and SMD components
- AOI - Automatic optical inspection - inspection equipment for final product inspection, checks the position of all mounted components, correct solder paste remelting and more.
- Automatic line unloader - removing and storing final products in prepared magazines

Types of individual technological equipment (including dimensions, functions, features, etc.) will be specified by the investor.

### **B.2.8. Principles of fire safety solution**

Not solved in this project.

### **B.2.9. Energy saving and thermal protection**

SO 201 solution The construction of the hall is in accordance with Act No. 406/2000 Coll., On energy management and implementing Decree 78/2013 Coll., On the energy performance of buildings, as amended.

The building envelope is designed from structures whose heat transfer coefficient ensures that the requirements of the above regulations are met. Thermal technical parameters of structures are designed min. to recommended values ČSN 73 0540 Thermal protection of buildings, part 2 requirements for structures.



Similarly, technical equipment for heating, ventilation, cooling, hot water and lighting is designed in accordance with the requirements of the above regulations.

## **B.2.10. Hygienic requirements for buildings, requirements for work and comunal environment**

### **Ventilation**

Air-conditioning equipment solves the microclimate in the extension of the existing production space and the building SO201 - Completion of the hall, which contains a warehouse, production premises and offices.

The objet of the HVAC project will be:

- Shifting the existing technological airway route
- ensuring the internal microclimate of production premises, office space and changing rooms
- cooling down of office space,
- preparation for future production on the 2nd floor
- ventilation from sanitary facilities.

### **Extension of production from the existing hall**

The existing intake and exhaust elements in the warehouse will be dismantled and moved to the newly created warehouse 101 in the SO 201 building.

### **Offices and sanitary facilities**

The ventilation intensity was designed according to the number of workstations in each room. For each worker is calculated with min. 50 m<sup>3</sup>/h fresh air. The fresh ventilation air will be filtered in the unit and heated as required and is air-conditioning piping transported to ventilated areas, where it is distributed through vortex outlets mounted in suspended ceilings.

### **Hygienic background**

All sanitary facilities are forcedly ventilated by means of duct fans. The facilities are designed according to the Collection of Laws No. 259/2008. Minimum air exchanges (5 - 10 x/h) of air comply with this Government Order and are following:

- 30 m<sup>3</sup>/h per washbasin
- 80 m<sup>3</sup>/h for 1 toilet bowl
- 150 m<sup>3</sup>/h per shower

### **Heating**

The building will be heated from the boiler room in the existing building. The heat source of the building completion will be a pair of condensing boilers with an output of up to 50 kW, which will be connected to the existing cascade of three boil-

ers. The total output of the boiler room is then 230 kW. The boilers will be designed as C-type appliances.

Domestic hot water heating will continue with the existing DHW tank with a capacity of 300 liters. Temperature gradient for radiators 70/55°C with equithermal regulation of heating water. The premises will be heated to standard temperatures corresponding to the type of work.

## **Lighting**

Permanent workplaces will be provided with daylighting through windows and skylights. For offices and day rooms a daylight factor of 1.5 % is ensured in a functionally defined space. In other parts, where visual activity will be performed, there will be combined lighting with a sufficient proportion of the daily component.

The production of LED lighting is carried out mainly by means of automatic lines and the activities required for the operation of lines do not exceed 4 hours a day and according to ČSN 73 0580-1: 2007.

The intensity of artificial lighting will correspond to the class of visual activity according to ČSN EN 12464-1.

For more see Folder 4.

## **Water supply**

The proposed part of the hall construction will be connected to the existing water distribution in the existing Warehouse.

## **Waste**

Waste generated during construction will be treated in accordance with Act No. 185/2001 Coll., On Waste and on Amendments to Certain Acts, as amended. It is assumed that wastes common from construction activities will be generated, no hazardous wastes will be generated. Evidence of the removal of waste from the construction will be part of the documentation submitted for the application for occupancy permit.

The operation of the extension of the hall will result in waste associated with the production of LED lights and common municipal waste. All solid and liquid wastes will be registered, collected, sorted and then handed over for recycling or disposal to contractors according to the Waste Management Program.

The individual wastes will be stored separately in collection containers of metal (plastic) containers and will be handed over to specialized companies that are authorized to handle the waste, to use it or to dispose of it.

Waste management and organization of waste management and work, including the waste management plan, will be processed in accordance with Act No. 185/2001 Coll., On waste and amending some other acts in the hierarchy referred to in Section 9 a., ie waste prevention, preparation for use, recycling, other recovery (eg energy) and finally waste disposal. Material that is not suitable for re-use

shall be transferred to the possession of only the person authorized to take it over pursuant to Section 12 (3) of Act No. 185/2001 Coll.

### **Influence of building on surroundings - vibrations, noise, dustiness, etc.**

Due to their location in an industrial site, outside residential and civic buildings, the impacts of the construction will only concern the site itself. It is not expected to cause vibrations during the construction activity or operation of the construction.

The increase in noise during construction will be temporary and, given the location of the building outside residential and civil construction, will not mean a significant deterioration of the surrounding area outside the premises.

Operation of the noise increase outside the construction will not occur due to the object of activity and the technical construction of the building. Hygiene limits will be met.

Dust increase may occur during construction. The contractor shall take such measures to eliminate as much dust as possible.

## **B.2.11. Protection of the building against the negative effects of the external environment**

### **a) protection against penetration of radon from the ground,**

A survey was carried out in the area under investigation to determine the radon index of the land - RADONtest, s.r.o., 10/2018. Based on the assessment of radon volume activity in the subsoil, soil air and soil gas permeability, the mean radon index was determined. Measures must be taken to prevent radon from penetrating the geological subsoil. At the same time, the waterproofing of the substructure will fulfill the function of anti-radon insulation and will be delivered with the appropriate certificate. Joints and penetrations will be made with respect to the medium radon risk.

### **b) protection against stray currents,**

There are no sources of stray current in the area.

### **c) protection against technical seismicity,**

The object will not be exposed to the effects of the technical seismicity.

### **d) noise protection,**

The working environment will be protected from the outside environment by a cladding including hole fillings, which are designed in accordance with the requirements of ČSN 73 05 32 - Protection against noise in buildings.

**e) flood control measures**

The construction is not located in the flood plain, flood protection measures are not proposed.

**f) Other effects - influence of undermining, occurrence of methane etc.**

No other sources of negative effects, undermining or occurrence of methane have been identified, protection is not proposed.



**BRNO UNIVERSITY OF TECHNOLOGY**

**FACULTY OF CIVIL ENGINEERING**

**INSTITUTE OF BUILDING STRUCTURES**

**D TECHNICAL REPORT**

**DIPLOMA THESIS**

**AUTHOR**

**Bc. Alessio Amodio**

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**Ing. FRANTIŠEK VAJKAY, Ph.D.**

**BRNO 2020**

## **D. Technical report**

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## **D.1.1. Architectural report**

### **a) Purpose of the project**

The purpose of the use of the building is to build a hall for production and storage, complete with the entire floor of the company's administrative workplace. The building develops in three floors, operationally (doors, sectional doors) interconnected with the existing warehouse hall and closely adjacent to it. Part of the new building on the ground floor is extended by the extension of the production area from the existing hall. In this section, the objects are spatially linked.

The first floor will be located mainly warehouse of materials and products. Part of the 1st floor will be spatially connected with the production premises in the existing hall. In the hall will be stored the material of input components needed for the production of LED lighting fixtures. There will also be an operating block with social facilities and an entrance hall. On the 2nd floor will be located the production of LED lighting units (automatic production lines and manual workplaces) and operating block with social facilities. The 3rd floor will serve as the administrative workplace of the company (offices, offices with rest rooms, day room and meeting rooms) with sanitary facilities and outdoor terrace.

### **b) Architectural, constructional, dispositional, operational and artistic design, vegetation modifications around the building, including the solution of access and use of the building by persons with reduced mobility and orientation**

#### **Architectural, constructional and technical solution**

The architectural solution is based on the user and technological requirements of use, and to a large extent also on the investor's effort to give the individual buildings a common architectural concept. It is a three-storey hall for production and storage supplemented by an administrative social part, but it is subject to aesthetic requirements. The extension will be architecturally connected to the existing warehouse hall with similar constructional solutions and using similar materials.

The constructional technical solution will be customary for this type of buildings reinforced concrete three-storey skeleton based on piles, with columns mounted in cast-in place pockets will be clad with wall panels filled with thermal insulation of mineral wool with a surface treatment of sheet metal. The skeleton in the module is about 6.2 x 9.7 m.

The roof cladding consists of trapezoidal sheets, vapor barrier, thermal insulation from MW + EPS and a waterproofing membrane (mPVC foil) anchored through the thermal insulation to the supporting trapezoidal sheet.

The ceilings of the individual floors are designed from reinforced concrete prestressed panels.

Along the perimeter, the hall is lined with reinforced concrete foundation beams.

The floors will be made of reinforced concrete slab (warehouse), concrete reinforced slab (production) and anhydrite (administration) with tread layers according to the purpose of the room (ceramic tiles, marmoleum, shake).

The interior partitions will be plasterboard with parameters meeting the requirements of fire safety solution, partition height, requirements for sound attenuation between the rooms, cladding properties for rooms with wet operation. The ceilings will be cassette and made of solid plasterboard.

Windows are made by multi-chamber plastic profiles with thermal insulating glazing or PUR panels, industrial insulated doors and gates, skylights made of polycarbonate compact panels

Insulation against ground moisture and groundwater will also act as insulation against the penetration of radon from the subsoil.

Surface finishing of walls - painting of gypsum board partitions, ceramic tiles for toilets and washrooms, etc.

The outdoor terrace will consist of a reinforced slab placed on a steel structure anchored to the existing hall.

The exterior staircase will be made of steel, covered with wall panels.

The building is designed for a passenger-lift in the central communication area and a warehouse passenger-freight lift in the warehouse and production area.

### **Art design**

The design will be similar to the existing production hall. The hall has simple geometric shapes with longitudinal openings in the mantle and a shelter above the gate. Wall cladding is designed vertically. The color shades will be specified by the investor.

### **Layout and operational solutions:**

The layout and operational solutions are interrelated. The first floor is designed primarily as a storage area. In the warehouse the material will be stored on pallets and shelves. The extension of the production of the existing hall affects part of the 1st floor. The building is accessible from the main entrance on the SW side of the building. There are two additional entrances and sectional doors for supply. At the main entrance is an entrance hall with reception and access to the elevator, staircase and warehouse. There is also a social background (dressing room, washroom, toilet) for men and women and a utility room.

On the second floor, the main space is a production hall, which is ready for the location of production technology lines. The production is interconnected with the premises in the existing building. There is also a social background (dressing room, washroom, toilet) for men and women, utility room, compressor room and communication space (staircase, hallway, elevator), from which access to the existing building.

The 3rd floor is designed as an administrative workplace of the company. The largest space is an open space office for 24 people. There are two separate offices (each for 2 persons), three offices with rest rooms and sanitary facilities,



two meeting rooms (13 persons each), day room with access to the outdoor terrace, kitchen, communication space (staircase, elevator) and social background for men, women and disabled workers.

From each floor you can get to the outdoor staircase, which opens into the free space next to the building.

### **Vegetation modifications around the object**

After completion of the construction work, the terrain surrounding the building affected by the construction is flat, the topsoil is spread and sown with grass. Due to the limited space available, other landscaping arrangements are not considered.

### **Barrier-free use of the building**

Principles of solving accessibility and use of the building by persons with reduced mobility, including data on conditions for work with disabilities.

Decree No 398/2009 Coll., On general technical requirements ensuring barrier-free use of buildings

The construction is designed in such a way that it is possible to consider the possibility of pursuing the profession of persons with limited mobility and orientation in the administrative part of the building completion, in accordance with § 12. Work in administration is expected, work in production and warehouse is not suitable for people with limited mobility.

The construction is designed to meet the general technical requirements ensuring barrier-free use of buildings, as defined by Decree No. 398/2009 Coll., On general technical requirements ensuring barrier-free use of buildings.

### **§ 4 Reserved parking space**

Dedicated parking spaces are designed next to the hall.

Total number of parking spaces: 35

Reserved parking space: 2

### **§5 - Access to buildings**

Access to the building is designed barrier-free, before the entrance is designed horizontal area greater than 1500 x 1500 mm.

The entrance door will open, with a clearance of 1000 mm. The door will be glazed with safety glass, the lower part up to a height of 400 mm will be protected against damage.

### **§ 12 - Requirements for construction work**

In the 3rd floor is designed toilet with parameters of Decree No.398 / 2009Coll.

For transport to the 3rd floor can be used passenger freight elevator, whose cabin size, door width and handling area in front of the door meets the requirements of Decree No. 398 / 009Coll.

**c) Capacities, utility areas, enclosed spaces, built-up areas, orientation, lighting and sunlight**

**SO 201 – Hall extention**

Build up area .....	954 m <sup>2</sup>
Usable area warehouse .....	646 m <sup>2</sup>
Usable area production .....	807 m <sup>2</sup>
Usable area of administation, social and technological background and commercial.....	1110 m <sup>2</sup>
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Room capacity	Men	Woman	
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Administration (office with rest room)			3 rooms
Administration (office)			2 rooms
Administration (meeting room)			2 (13 seats each)
Administration (openspace)			24 seats

Source: Company source

**Sunlight, lighting**

To minimize heat loss, the building is designed with a minimum of window openings. There will be no permanent workplaces in the warehouse and production premises.

The stored material will be taken as required by production and the material will be stored according to demand in need. This activity shall not exceed 4 hours per day. Designated warehouse workers perform other activities outside the warehouse premises, either in the existing hall or in the secondary warehouse.

Production is carried out mainly by automatic lines. It is necessary to add material to the work lines manually and to collect the resulting products which are put on pallets. These activities are carried out according to the needs of individual assembly lines. These activities shall not exceed 4 hours per day. Daylighting with window strips is partly ensured by production, administrative workstation on the 3rd floor and staircase. Sunlight is irrelevant due to the nature of the object.

Artificial lighting will correspond to the visual activity. Rooms without natural daylight will be provided with artificial lighting.

#### **d) Structural design of the building**

##### **d.1 Building part**

The site is flat. Tree felling is not needed and is not part of this project. At the construction site prepared in this way, rough landscaping will be carried out, creating a working plane of  $-0,600 = 236.90$  m.a.s.l. The upper layers of the construction site form a heterogeneous charge of cl. mining capacity 3 (coarse gravel, sand, clay) in the thickness of about 0.5 to 1 m. The excavation will be transported to the designated dump. The plain will be stabilized with lime and compacted to min.  $E_{def2} = 80$  MPa.

##### **Demolition work**

The cladding on the north side of the existing building will be removed. After the covering has been removed, provision must be made to protect the internal environment of the existing hall against the effects of external influences. The sheathing will be removed according to the schedule of works determined by the contractor of the building completion.

##### **Earthwork**

Excavations for foundation footing will take place mainly in the excavation class 2-3 from the level of the excavation plain just above the groundwater hose, which was found at a depth of approx. 2.8 m and settled at a depth of approx. 2.1 m below the terrain. This water has a non-aggressive chemical composition. If groundwater enters excavations, it will be necessary to pump it. Excavations in clay clays keep perpendicular walls for a short time. arm (shoring is required below groundwater). The excavation will be partly used for backfill, the excess will be transported to a controlled landfill. Under the reinforced concrete floor slab will be made embankment compacted to  $E_{def.} = 100$  MPa with an  $E_{def2} / E_{def1}$  ratio of less than 2.1.

##### **Foundation**

The foundation structures consist of pockets pile head, which will be placed on large-diameter drilled piles due to unsuitable subsoil - more details D.1.2 - structural design. In the corner at the junction of axes 1 and E, the cup will be mounted on the drilled micropiles. The internal staircase will be based on the area. The main supporting columns of the exterior staircase will be based on piles, the rest of the structure will be based on a flat surface. The foundation joint will be at a non-freezing depth above the groundwater level.

### **Vertical load-bearing structures - skeleton**

The construction is designed as a three-storey building with a total dimensions of 31.8 \* 30.0 m and a height of attic +13.30 m. For more details, see D.1.2 Structural design

### **Horizontal structures**

- **Roof construction**  
The roof cladding layers of the building will be laid on a steel trapezoidal sheet placed on the roof beam, which are laid on columns.
- **Ceiling construction**  
On both floors, the ceiling structure will be formed by reinforced concrete panels placed on the reinforced concrete frame elements.
- **Translations, exchanges**  
The openings in the cladding and in the roof will be anchored to steel hollow sections.

### **Construction linking different levels**

The internal staircase is made of prefabricated reinforced concrete products placed on the elements of the supporting skeleton. The external staircase is made of steel, supported by a steel structure, which is based on concrete piles and anchored to the skeleton of the hall. The staircase is covered with wall panels. Access to the roof of the building will be provided by a steel ladder.

### **Roof construction, cladding**

The roof will consist of a load-bearing trapezoidal sheet placed on the roof purlins of the skeleton, a vapor barrier, a layer of thermal insulation in a combination of mineral wool (2 x 30 mm) and expanded polystyrene (60 + 2 x 50 mm). The waterproofing membrane made of softened PVC-P reinforced with an insert laid on the geotextile will be mechanically anchored to the trapezoidal sheet. The roof slope is 3.1 % from the attic towards the center, draining into the roof outlets of the vacuum system. The safety overflow 950 x 150 mm, min 50mm above the valley. Fire resistance of R15 roof cladding with min. Broof (t1).

A roof restraint system will be installed on the roofs to prevent falls during roof maintenance.

### **Cladding - insulation**

The cladding will consist of vertically sandwich panels with hidden anchoring and thermal insulation of mineral wool thickness. 200 mm placed on the insulated foundation threshold. The panels will be anchored to the RC skeleton and to steel structure for hole filling. In the insulated part of the shell the shell will be anchored to the steel structure, which will be anchored to the reinforced concrete shell. This cloak will be complemented by gypsum board in communication areas, social facilities and throughout the 3rd floor to cover the supporting structure of the hole fillings. Part of the cladding will also be the supply of system flashing of attics,

corners, corners and hole fillings. According to PBR is required resistance EW30. This will be proved by a certificate. The steel structures to which the casing will be anchored must be designed to meet the required fire resistance of EW 30.

The external cladding cladding will be anchored to the steel staircase structure. Part of the cladding will also be the supply of system flashing of attics, corners, corners and hole fillings. According to PBR is required resistance EW30. This will be proved by a certificate. The steel structures to which the casing will be anchored must be designed to meet the required fire resistance of EW 30.

### **Partitions and dividing structures**

The inner partitions, the shaft wall of the freight elevator and the walls will consist of steel profiles CW and UW with double gypsum plasterboard with parameters meeting the requirements of the fire safety solution, partition height, sound attenuation between spaces, cladding properties for rooms with wet operation. The shaft of the passenger lift will be made of ceramic blocks 200 mm thick. The partition walls between the warehouse space and the expansion of the existing production will be made of ceramic blocks. 300 mm.

## **d.2 Work construction**

### **Openings**

- doors in the curtain wall
  - In the cladding will be installed steel insulated rolling shutter doors. Sectional with electric drive.
- doors in external cladding
  - The warehouse will be equipped with three insulated escape doors in accordance with the PBR. Entrance and supply doors lead to open space. The door on the east side leads to the outside staircase and then to the open space.
- windows and window in the curtain wall
  - are made of multi-chamber plastic profiles glazed with heat-insulating glass
- shielding technology
  - outdoor blinds are designed on the window strips
- inner door
  - the inner door is smooth, without rebate, fitted in a steel frame.
- skylights
  - 6 skylights with dimensions 1200 x 1200 mm made of polycarbonate compact panels are designed that do not drip or fall off as burning
- fire closures:
  - the building consists of 10 fire sections, which will be separated by doors with resistance to fire protection (EW30DP3C).

**Metalwork**

Locksmith will mainly supply and install steel rails, door and door replacements, exterior staircases, door protective pillars, supporting structures for anchoring the cladding and replacements for air-conditioning installation under the ceiling and on the roof, roof ladder, stair railing and gallery and small locksmith material.

**Joinery work**

They will be mainly associated with delivery and interior doors and window sills.

**Ceilings**

In the corridors, staircases and in the administrative part (3rd floor) are coffered ceilings made of mineral fibers. Clear height 3 000 - 3 300 mm. In the social and technical facilities are designed ceilings of solid plasterboard. Ground clearance 2 800 mm.

**Plumbing work**

Will be included in the delivery of cladding and roof cladding. The downpipes are internal plastic.

**Floors**

In the warehouse area is designed monolithic plate made of concrete. 200 mm mounted on compacted embankment (Edef. 100 MPa), which will be designed for a surface load of 2 000 kg/m<sup>2</sup>, for forklift travel with a load capacity of 2 000 kg and point load shelves.

The following wear layers are designed in the building:

- shake-in shed concrete: storage (1st floor)
- antistatic marmoleum: production hall and compressor room (2nd floor)
- ceramic tiles: social and technical facilities, entrance hall, staircases, corridors
- carpet: office workplace

The composition of the individual floor layers, including the underlying layers, are given in the drawing part. (See D.1.1 – A013)

**Insulations**

- against ground moisture, ground water:
  - Welded PE-HD foil suitable for installation on XPS with geotextile.
- against radon:
  - The PE-HD waterproofing membrane will prevent radon from penetrating the subsoil. Joints and penetrations will be made with the MIDDLE in mind
  - the radon risk that has been determined for the site.

- against surface water
  - The thermal insulation of the foundation threshold below ground level will be protected by a foil.
- against process water
  - on the toilet and in the showers will be provided with a flexible waterproof coating of thickness. 1-2 mm
- roof waterproofing
  - Mechanically anchored foil of softened PVC-P reinforced with liner.
- thermal:
  - roof cladding : EPS 100S th. 120 mm + EPS 150S th. 100 mm
  - cladding: Mineral wool th. 200 mm (part of panel construction)
  - floor: XPS 150 S, th. 100 mm (1st floor)
  - plinth, foundation: Fiber glass 100 mm
- acoustic:
  - Insulating mats in plasterboard partitions ensure min. attenuation 37 dB.
- impact:
  - 1.NP : not proposed
  - 2.NP, 3.NP: 30 mm EPS
  - screed, dihydrate: around the perimeter dilated with PE foam tape thickness 10 mm.

### **Surface treatment and cladding sheeting**

- there are no internal plasters
- wall tiles on the toilet will be ceramic tiles along the entire perimeter up to a height of 2 100 mm, in showers will be at a height of 2 250 mm, ending and corner moldings metal.
  - In the kitchen will be a ceramic tile height of 600 mm and 900 mm
- the plinth in all rooms (except the room with ceramic cladding) will have a 30 mm PVC plinth strip around the perimeter

### **Paints, paintings**

Most products will be provided with a surface treatment from the factory (trapezoidal sheet metal, sandwich panels, flashing, gates, etc.), or. galvanized. Only constructional steel will be painted on the construction site. locksmith products.

Abrasion-resistant white paint will be applied to the plasterboard partitions, and the rooms will be painted down to the ceiling level, even on reinforced concrete columns and foundation sills.

### **d.3 Assembly and special work**

The construction does not include assembly and special works with the exception of the assembly of reinforced concrete skeleton. The supply and installation of the cladding, resp. roof cladding, which should be implemented including a systemic

solution of details and flashing as a whole. On the roof of the hall there will be installed a restraint system at the edge of the roof, which will be realized according to the documentation of a specialized company. The construction of elevators is part of the delivery of a specialized implementation company.

#### e) Building physics

The thermal technical parameters of structures are designed at least to the standard values of ČSN 73 0540 Thermal protection of buildings, Part 2 requirements for structures.

Winter design temperature -15 °C, interior design temperature 20 °C, in washroom 24 °C, in production 18 °C, store 15 °C, elevator shaft and t.m. Low: 12 °C.

Tab. 3 Thermal transmittans sorted by construction types

Construction type	$U_N$ (W/Km <sup>2</sup> ) standard	$U_{rec}$ (W/Km <sup>2</sup> ) recommended	$U_j$ (W/Km <sup>2</sup> ) calculated
cladding	0,30	0,20	0,20
groundfloor	0,45	0,30	0,26
Roof	0,24	0,16	0,16
Openings			
- windows	1,50	1,20	According to producer
- doors	1,70	1,20	According to producer
- gates	1,70	1,20	According to producer

Source: Own calculation

SO 201 solution The building completion is in accordance with Act No. 406/2000 Coll., On energy management and implementing Decree 78/2013 Coll., On the energy performance of the building. For more details go to the Folder 6.

#### f) Compliance with general construction requirements, used standards

The project documentation complies with the general construction requirements and is in accordance with applicable laws, regulations and standards. These are primarily meeting the requirements for mechanical resistance and stability, health protection, healthy living conditions and the environment, protection against noise, safety in use, barrier-free use, energy and heat savings, heating and ventilation requirements, fire safety, etc.

Choice of applicable legislation and standards:

- Act No. 183/2006 Coll. on spatial planning and building regulations
- Act No. 406/2000 Coll. on energy management
- Decree No. 78/2013 Coll. on the energy performance of buildings
- Decree No. 499/2006 Coll. on Documentation of Buildings as amended by Decree no. No. 62/2013 Coll.
- Decree No. 268/2009 Coll. on technical requirements for buildings



- Decree No. 398/2009 Coll. on general technical requirements ensuring barrier-free use of buildings
- Decree No. 23/2008 Coll. on technical requirements for fire safety of buildings
- ČSN 73 0540 Thermal protection of buildings
- ČSN 73 4108 Sanitary facilities and changing rooms
- ČSN 73 0802 Fire safety of buildings - Non-production objects
- ČSN 73 0804 Fire safety of buildings - Production facilities
- ČSN 73 0845 Fire safety of buildings - Warehouses
- Etc.

## **D.1.2. Structural report**

### **a) Technical description**

The subject of the building permit project is the static solution of load-bearing reinforced concrete and steel structures of the building SO 201 - Extension of the hall.

The main supporting structure is made of reinforced concrete prefabricated skeleton - it is a hall building (three floors) based on piles. The hall consists of girders, braces, columns and staircases. The ceilings consist of prefabricated prestressed ceiling panels. The columns stand on cast in place pockets. The pockets are joined to pilots.

Additional steel structures are exterior staircases, brackets for internal staircases, terrace construction, roof construction to support trapezoidal sheet metal and awning above the entrance

The roof is made of trapezoidal sheet metal and folded cladding, on the walls there are vertical facade panels.

The project has been prepared according to ČSN EN to the extent stipulated by the Building Act no. 138/2006 Coll. and Decree No. 499/2006 Coll. as amended by Decree No. 62/2013 Coll.

### **b) Used materials**

Construction part of project documentation (INTERPLAN-CZ, s.r.o. ; 10/2018)

### **c) Standards and literature used**

- ČSN 73 1001 Foundation soil under flat foundations
- CSN EN 206-1 Concrete - Part 1: Specifications, properties, production and conformity EN 1991-1-1 Eurocode 1: Actions on structures
- ČSN EN 1993-1-1 Eurocode 3: Design of steel structures (Part 1-1: General rules and rules for building construction)
- ČSN EN 1993-1-3 Eurocode 3: Design of steel structures Part 1-3: General rules - Supplementary rules for thin-walled cold-formed elements and flat

profiles) EN 1993-1-2 Eurocode 3: Design of steel structures Part 1-2: General rules- Design of structures for fire effects

- ČSN EN 1997-1 Eurocode 7: Design of geotechnical structures - Part 1: General rules
- ČSN EN 1992-1-1 Eurocode 2: Design of concrete structures -general rules and rules for building construction

#### d) Software used

- Robot structural analysis 2018
- Revit 2019
- Microsoft Office

#### e) Used materials

STEEL	S 235	strenght: $f_{yd} = 235 \text{ MPa}$ rigid modulus of elasticity: $E_y = 210 \text{ GPa}$
CONCRETE	C 40/50 – XC1	strenght: $f_{ck} = 40 \text{ MPa}$ modulus of elasticity: $E_c = 35 \text{ GPa}$
REINFORCEMENT	B 500B (10 505 (R))	strenght: $f_{yd} = 434,78 \text{ MPa}$ modulus of elasticity: $E_y = 200 \text{ GPa}$

#### f) Load data

- Snow area II 0,75 kN/m<sup>2</sup>
- Wind area II 25,0 m/s
- Ceiling live load -
- Floor load -

#### g) Main load-bearing reinforced concrete structure

- Primary beam: L, T and three types of rectangular cross-sections are designed, the connection of the beam-column is articulated, bearing on elastomer bearings, thickness 10 mm.
- Bracings: At the level of roof and ceiling are designed bracings of rectangular cross-section, bracing-column joint, articulated bearing on elastomer bearings thickness 10 mm.
- Columns: Square columns are designed. The columns are intermittent in the place of the inserted floor. All columns are fixed to the piles.
- Ceilings: Ceiling structures are designed from prefabricated pre-stressed panels thickness 250 mm. The panels will be stored on the beams.
- Frost beams: Recessed between pillars, mounted on pilots heads, foundation sill-pillar connection by mounting weld-in fittings.

- **Fire resistance:** The precast concrete structure will meet the fire resistance requirement according to the requirements of the fire safety solution. Generally, it can be said that the structure of the building (columns and girders) is designed for fire resistance min. 60 minutes. The pre-stressed prefabricated panels meet the fire resistance requirement of 90 minutes.

#### **h) Steel structure**

- **Outdoor staircase:** The exterior staircase is designed as a separate structure. The main supporting part is made up by a frame which is connected to the skeleton of the building. This frame is attached landing girders and strings, i.e. carries all the load. The main columns of the frame are anchored to separate foundations at the bottom. The cladding construction consists of a steel grid consisting of columns and beams. The grid only transfers the weight of the cladding and the effects of the wind. Under the whole construction there is a base plate into which the grid columns are anchored.
- **Brackets for interior staircases:** These are steel brackets that form supports for ceiling panels. The brackets are welded to the plates in the reinforced concrete elements.
- **Outdoor terrace:** The structure is located on the roof of an existing building. It is a platform consisting of beams and concrete plate for TR sheet. The platform is supported by ten columns for even load transfer.
- **Construction for supporting TR sheet:** Composition of brackets, longitudinal beams and bracing. The brackets are welded to the plates. The longitudinal beam serves as support for the TR sheet as well as for the cladding.
- **Other:** There are included exchanges in the sheath for windows and doors, awning construction.
- **Protection of the structure against corrosion will be done by painting:** The coating system will be sized to meet the following requirements:
  - a) degree of corrosive aggressiveness of the environment (ČSN EN ISO 12 944-2) C3.
  - b) service life (ČSN EN ISO 12 944-1) M - medium.
  - c) specific layers according to the chosen coating system or hot-dip galvanizing
  - d) Cleaning of structures before the application of paints will be done by blasting to the degree of 2.5.
- **Fire resistance:** Steel structures are designed for fire resistance (R15 or R30) according to specific requirements without further modifications (coatings, tiles, etc.)

**i) Geotechnical conditions**

See in Folder 7.

**j) Foundation of the object**

**Foundations:** The foundation structures of the building are designed as deep using large diameter drilled piles. The heads of the pile are formed by chalices of circular ground plan, the columns of the skeleton of the building will subsequently be fixed into the chalice.

The piles are designed with a profile of 900 mm and a length of 10.0 m.

The column in axis 1'-E will be based on an atypical foundation, which will be supported by micropiles with the length of the injected shaft 11.0 m.

The piles will be made of concrete class. C30/37-XC2, XA2 (CZ) with reinforcement class 10 505 (R).

Pile heads will be made of concrete class. C30/37-XC2, XA2 (CZ) with reinforcement class 10 505 (R).

**k) Floor level 0,000**

An wire-reinforced concrete slab with cut shrink joints of 200 mm thickness is designed on the larger part of the surface.

Concrete C 25/30-XC2, 25 kg of wires/m<sup>3</sup>.

Crushed aggregate filler F 0-63 compacted in layers to Edef2 = 80 MPa, Edef2/Edef1 max 2.2.

Ground plane - stabilization with eg lime to Edef2 = 100 MPa.

The rest of the area designed reinforced concrete slab thickness 85 mm.

**l) Conclusion**

The proposed structure is based on the loading data valid for the design in the given area. The proposed solution complies with the regulations and standards applicable in the Czech Republic.

### **3. Conclusion**

The project complies with all the norms and design standards of the Czech Republic.

Designing a multifunctional building that must be interconnected with an existing building has allowed me to design in a wide and varied way looking for solutions and to the various functions of the floors themselves.

Interconnecting two buildings, not only structurally but also architecturally, was very exciting; thanks to this I was able to enrich my wealth of information regarding various design processes.

I paid particular attention to the structural part of the project, trying to reproduce as more similarly as possible the skeleton of the existing building.

The use of BIM technology during the design process played a central role, as all documentation, the list of drawings and the schedule of materials, were reproduced using this technology.

BIM technology is a new way of seeing and understanding the project and, compared to the traditional method, brings several positive features to the process.

In fact, using this new type of process, all the elements of the project can be parameterized and easily replaced and / or modified during the operation that leads to the development of the design

All the disciplines were designed in the same centralized model helping me in better coordination between those and for further facility management intent of model use.

In conclusion, I found too many advantages in various fields not to continue experimenting and adapting this methodology to my needs.

## 4. List of sources

ELLIOTT, Kim S. *Precast concrete structures*. Crc Press, 2016.

KIRBY, Lance, Eddy KRYGIEL a Marcus KIM. *Mastering Autodesk® Revit® 2018*. Indianapolis, Indiana: Sybex, a Wiley brand, [2017].

NEUFERT, Ernst, Peter NEUFERT, Bousmaha BAICHE a Nicholas WALLIMAN. *Architects' data*. 3rd ed. Malden, MA: Blackwell Science, 2000. ISBN 0632057718.

## 5. List of used abbreviations and symbols

Act. – article

°C – celsius degree

Coll. – Collection

ČSN – Česká státní norma (Czech national standard)

DHW – domestic hot water

No. – Number

m.a.s.l – Meters above sea level

m – meter

mm – millimeter

m/s – meter per second

m<sup>2</sup> – square meter

m<sup>3</sup> – cubic meter

m<sup>3</sup>/h – cubic meter per hour

MW – mineral wool

MPa – megapascal

ÚPmB – Územní plán města Brna (Brno city zoning plan)

EPS – expanded polystyrene

EW – radiation reduction

GPa – gigapascal

HVAC – heating ventilation air conditionary

kN/m<sup>2</sup> – kilonewton per square meter

kW – kiloWatt

LED – light emitting diode

LV – List vlastnictví (Owner documentation)

PBŘ – požární bezpečnostní řešení (Fire safety solutions)

PCB – printed circuit board

PE – polyethylene

PE-HD – high dencity polyethylene

PUR – polyurethane

PVC – polyvinyl chloride

SMD – surface mount device

SW – south-west

## **6. List of annexes**

### **Folder 1. Situation drawings**

C001 – SITE PLAN  
C002 – CADASTRAL SITUATION  
C003 – COORDINATION SITUATION

### **Folder 2. D.1.1 Architectural-Structural Solution**

A001 – DOCUMENTATION  
A002 – PROSPECTIVE VIEWS  
A003 – 1<sup>ST</sup> FLOOR – 2<sup>ND</sup> FLOOR  
A004 – 3<sup>RD</sup> FLOOR  
A005 – ROOF PLAN  
A006 – SECTIONS  
A007 – ELEVATIONS  
A008 – ATTIC DETAIL  
A009 – FROST BEAM CONNECTION DETAIL  
A010 – OFFICE WINDOW DETAIL – SECTIONAL DOOR DETAIL  
A011 – TERRACE DOOR DETAIL  
A012 – WINDOW – RAILING LEGENDS  
A013 – DOOR LEGEND  
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### **Folder 3. D.1.2 Building constructional solution**

B001 – DOCUMENTATION LIST  
B002 – PROSPECTIVE VIEWS  
B003 – FOUNDATION PLAN – STRUCTURE PLAN + 0.00  
B004 – STRUCTURE PLAN + 4.00 – STRUCTURE PLAN + 8.00  
B005 – STRUCTURE ROOF PLAN – SECTIONS  
B006 – ELEVATIONS

### **Folder 4. Building physics assessments**

01 – BASIC HYDRO-TERMAL EVALUATION OF BUILDING CONSTRUCTIONS  
02 – DAYLIGHT EVALUATION  
03 – CLADDING AND PARTITION WALL - PRODUCER

### **Folder 5. BIM essay**

01 – BIM ESSAY

### **Folder 6. Building surveys**

01 – EXISTING DRAWINGS (ELECTRONICAL VERSION ONLY)  
02 – GEOTECHNICAL SURVEY