



TALLINNA
TEHNIKAÜLIKOOL

Ehituse ja arhitektuuri instituut

HOONEKOMPLEKSI
RAUDBETOONKONSTRUKTSIOONIDE ARVUTUS
JA PROJEKTEERIMINE
THE STRUCTURAL DESIGN OF A REINFORCED CONCRETE BUILDING
COMPLEX
EA 60 LT (inseneriõpe) / EA 70 LT (magister)

Üliõpilane: **Marek Barankov**

Juhendaja: **Aldur Parts**

Tallinn, 2017.a.

Olen koostanud lõputöö iseseisvalt.

KOKKUVÕTTE

Käesolevas projektis on esitatud raudbetoonist hoonekompleksi maa allolevate konstruktsioonide projekteerimine ja arvutus.

Tegemist on kahe hoonega ühe vundamendi peal, ning ühendatud parklaga maa all. Parkla on kahekorruseline ja sees on olemas panipaigad. Esimesel maapealmisel korrusel on büroo-, restoraani-, kaupluste-, äri- ja laopinnad. Alates teisest korrusest ülevale jäävad eluruumid. Viimane korrus on tehniline. Auto parklaga kokku on üheksa korrust.

Hoone katus on oma suures osas sile. Hoonetel esinevad katuserassid, aatriumiosa ja rõdud. On olemas nii trepikojad, kui liftšahtid. Parkla ja esimese korruse vahel on olemas ka üks eskalaator.

Kõik konstruktsioonid on projekteeritud raudbetoonist.

Maapealne osa seisab postide peal, mis ulatuvad rostvärgi pinnast teise maapealse korruseni. Esimese korruse välisseinakonstruktsiooniks on klassfassaad kandvate postide vahel. Vahelaed parklas on projekteeritud monoliit plaatvahelaena punkttoega, kusjuures mõned osad toetuvad kandvate seinte peale. Osa sisesestest toetuvad üksteise peale, osa toetub vahelaed peale. Sissesõit parklasse on projekteeritud ribiplaadi kujuga, kusjuures abitalad on monteeritavad ja plaadiosa monoliitiseeritakse kohapeal. Parkla korruste talad (välja arvatud sissesõiduteed) ja postid on projekteeritud monoliitkonstruktsioonidena. Kõik seinad on projekteeritud monteeritavaks. Treppid ja treppipodestid valatakse kohapeal.

Alaliste koormustena esinevad konstruktsioonide ja mehhanismide omakaalud, pinnasekoormused. Muutuvate koormustena esinevad kasuskoormused, lumekoormused ja koormused mehhanismidest.

Käesolevas projektis on esitatud painutatud elementide arvutused, ekstsentriliselt surutud elementide arvutused, tõmmatud elementide arvutused, läbisurumiskandevõime arvutused jne. On esitatud ka kasutuspiiriseisundite arvutused ja konstruktiivsed nõuded konstruktsioonidele.

Geotehnilised arvutused on ka läbi viidud ja pinnasest tulevad koormused on arvesse võetud.

Arvutustulemuste järgi on projekteeritud ja välja joonestatud tarindi ja elementide tüübid maa alloleva hooneosa ehitamiseks. Esitatud on ka elementide kokkuvõtted liikide järgi, ning materjalide kokkuvõtted.

Parkla ehitamiseks on vaja esialgselt puurida ja valada vaiad ettenähtud kohtades. Vaiad tuleb roostvärgi sisse ankurdada. Üksikvaiade puhul, kuhu toetub post tuleb pikivardad ankurdada niimodi, et nad jääksid posti ristlõike sisse posti rangi taga. Pärast vaiade valamist tuleb valada roostvärgid. Pärast roostvärkide valamist valatakse kõik B korruse postiosad peale ja lastakse pikiarmatuuri jätkud ülesse. Siis paigaldatakse B korruse monteeritavad seinad. Valatakse monoliitseinad. Kui seinad on valmis valatakse põrand. Valatakse treppid ja trepiplaadid. Paigaldatakse monteeritavad talad ja valatakse peale plaadiosa. Seega on kõik valmis B korruse vahelae valamiseks. Vahelae olevad monoliittalad tehakse vahelaeplaadiga samaaegselt. Pärast vahelae valamist on võimalik alustada järgmine korrus.

Korrus A alustatakse postide jätkamisest esimese korruse põranda alumispinnani ja lastakse ülesse pikivarraste jätkud niimodi, et nad jääksid esimese korruse postide rangi taga. Pärast postide valamist paigaldatakse monteeritavad seinad ja valatakse monoliitseinad. Valatakse treppid ja trepiplaadid. Paigaldatakse monteeritavad talad ja valatakse peale plaadiosa. Teljel A5 olevad seinatalad monteeritakse postide peale enne vahelae valamist. Pärast Teljel A5 seinte paigaldamist on kõik valmis vahelae valamiseks. Teljel A5 vahelae lisavardad lähevad läbi seinte avad alumise serva küljes. Vahelae olevad monoliittalad tehakse vahelaeplaadiga samaaegselt. Seega on parkla ehitamine lõpetanud. Lisatehnika paigaldamine (liftid, eskalaator) tuleb eraldi planeerida – käesolevas projektis ehitusjärjekorra planeerimises nad ei esine.

Kõik kasutatavad materjalid ja detailid peavad vastama projektile. Kõik elementide ühendused peavad olema tehtud vastavalt projektile. Töö järjekord, keskkonnatingimused, koormused ja kasutusviis peab vastama projektile. Küsimuse korral konsulteerida projekteerijaga.

SUMMARY

The present thesis comprises the reinforced concrete building complex design.

The current project concerns two buildings on one foundation that share a connected underground parking lot, which has two stories and small storage rooms. First storey above ground level has office, restaurant, shopping, business and storage facilities. Starting from the second and above floor there are residential areas. The last storey is technical. Considering two storeys of parking lot and those above the ground level, the building has nine storeys.

Building has a roof that is mostly flat. Buildings have roof terraces, an atrium and balconies. The complex has stairs as well as elevators. Between the parking lot and the first ground storey there is also an escalator.

All structures are designed from reinforced concrete.

The ground level structures are supported by columns that extend from pile caps to the second storey above the ground level. The first storey outer walls are glass facades between bearing columns. The ceiling slabs in parking lot are designed as cast in place concrete structures on point supports, whereas some areas are supported by walls. Some of the inner walls extend downwards to the foundation, whereas the other are supported by ceiling slabs. The entry to the parking lot is designed as a ribbed concrete slab, whereas ribs are designed as pre-cast elements and a slab part is cast in place. The beams (with the exception of the entry pre-cast beams) and the columns of the parking lots are designed as cast in place structures. All walls are designed as pre-cast products. Stairs and stairway slabs are cast in place.

Dead loads include structural loads of concrete elements and mechanisms, as well as soil loads. Live loads include imposed loads, snow loads and loads from mechanisms.

In the current project are presented: a bent elements design, an eccentrically compressed structures design, a tensed elements design, a control of punching strength of slab structures etc. In addition, a serviceability limit state design is presented, as well as structural requirements for elements.

Furthermore, a geotechnical design is carried out, and loads from soil are also taken into account.

Structure and element types for construction of the complex below ground are designed according to calculation results. Lists of elements are presented by the element type. Tables of required materials are also presented.

Construction of a parking lot begins by boring the pile holes into the ground and casting them in provided places. Piles are anchored into the pile caps. Singular pile foundation reinforcements that support a single column are anchored into the column section behind the stirrups. After the pile casting, pile caps can be casted. After pile caps are cast, it is possible to cast all storey B column parts but leave the main reinforcement extensions above. Then the installation of storey B pre-cast walls begins. After that cast-in-place walls are cast. When walls are cast and set, it is possible to cast floor slabs. Then stairs and staircase slabs are cast. Moreover, pre-cast beams are installed and slab parts of the ribbed slabs are cast above them. Afterwards, the ceiling slabs are ready to be cast. The cast in place beams are cast at the same time with the ceiling slabs. After the ceiling has been cast, the next storey is ready for construction.

Floor A is continued by extending the columns up to the first level floor slab, whereas main reinforcement is extended in such a way, that it is located behind the first level column stirrups. After columns have been cast, pre-cast walls are mounted and cast-in-place walls are cast. Then stairs and staircase slabs are cast. The pre-cast beams are mounted and cast-in-place slab part is cast above. Beam walls of first storey of the A5 axis should be mounted on the columns before ceiling slab is being cast. On the axis A5 additional required reinforcement of the ceiling is installed through the corresponding holes near the lower edge of the walls. Cast-in-place beams are cast at the same time with the ceiling slab. This finishes the construction of parking lot. The installation of additional devices (elevators, escalator) should be planned – the current project does not contain them in the construction order plan.

All provided materials and items should meet the requirements of the current project. All element connections have to be performed according to this project. The sequence of construction, the environmental conditions, loads and conditions of usage have to correlate to current documentation. In case of questions, consult with the designer.