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| TÖÖPROJEKT  truup CU037082. SELETUSKIRI    Ainuvastutus käesoleva väljaande eest lasub autoril.  Euroopa Liit ei vastuta selles sisalduva teabe mistahes kasutamise eest. | DETAILED TECHNICAL DESIGN  culvert CU037082. EXPLANATORY LETTER    The sole responsibility of this publication lies with the author.  The European Union is not responsible for any use that may be made of the information contained therein. |

**Projekti nimi:** Rail Baltica Harjumaa põhitrassi raudteetaristu I etapi ehitustööd

**Projekteerimisteenused:** Tööprojekt. Truup CU037082 (DP pikett 4+063). Seletuskiri

**Dokumendi pealkiri:** RBDTD-EE-DS2-DPS1\_TRE\_CU037082-ZZ\_0005\_RP\_STR-EK\_DTD\_000002

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| 001 | 19.07.2024 | Esitatud | Nadezda Tervo | Liisa Karu | Liisa Karu | Ats Pildre |  |
| 002 | 02.10.2024 | Täiendatud | Nadezda Tervo | Liisa Karu | Liisa Karu | Ats Pildre |  |
| 003 | 02.12.2024 | Täiendatud | Nadezda Tervo | Liisa Karu | Liisa Karu | Ats Pildre |  |
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**Project title:** Rail Baltica Harjumaa main route railway I stage construction works

**Design Service:** Detailed technical design. Culvert CU037082 (DP Station 4+063).Explanatory letter

**Document title:** RBDTD-EE-DS2-DPS1\_TRE\_CU037082-ZZ\_0005\_RP\_STR-EK\_DTD\_000002

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| 005 | 16.06.2025 | Updated | Nadezda Tervo | Liisa Karu | Liisa Karu | Ats Pildre |  |
|  | Signatures |  |  |  |  |  | |  |

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| SISUKORD  [1. SISSEJUHATUS 4](#_Toc174618893)  [1.1. LÄHTEÜLESANNE 4](#_Toc174618894)  [1.2. PROJEKTEERIMISE ALUSED 4](#_Toc174618895)  [1.3. NORMATIIVID, STANDARDID JA JUHENDMATERJALID 4](#_Toc174618896)  [1.4. NÕUDED KASUTATAVATELE MATERJALIDELE JA EHITUSTÖÖDELE 5](#_Toc174618897)  [1.5. PROJEKTI MUUDATUSED 5](#_Toc174618898)  [1.6. EHITUSGEOTEHNILISED TINGIMUSED 5](#_Toc174618899)  [1.7. KOORMUSED 6](#_Toc174618900)  [1.8 TRUUBI ARVUTUSED 9](#_Toc174618901)  [2. TRUUBI KONSTRUKTSIOONID 9](#_Toc174618902)  [2.1. TRUUBI ÜLDKIRJELDUS 9](#_Toc174618903)  [2.2. EHITUSE TEHNOLOOGILINE JÄRJESTUS 11](#_Toc174618904)  [2.3. MATERJALIDE OMADUSED 11](#_Toc174618905)  [2.4. HÜDROISOLATSIOON 12](#_Toc174618906)  [2.5. MAANDUS 12](#_Toc174618907)  [3. KESKKONNAKAITSE 13](#_Toc174618908)   1. SISSEJUHATUS    1. lähteülesanne   Tööprojekti esemeks on Truup CU037082 (DP pikett 4+063, OR0070 pakett)  Käesoleva töö koostamise aluseks on:   * „ Rail Baltica Harjumaa põhitrassi raudteetaristu I etapi ehitustööd“ Töövõtulepingu lisa „Tehniline kirjeldus 01112023“ ja selle Lisa 1 – „Projekteerimise LÜ 27102023” * IDOM, Consulting, Engineering, Architecture S.A.U. töö DPS1 Ülemiste Kangru, Tallinn -Lagedi Riste (OR0070), põhiprojekt.   1. projekteerimise alused   Kandekonstruktsioonid projekteeritakse vastavalt Eurokoodeksi sarja standarditele EVS-EN 1990…EVS-EN 1999.  Kandekonstruktsioonid projekteeritakse piirseisundite meetodil kasutades arvutusolukordi, milles konstruktsioon peab oma otstarvet täitma. Tugevus- ja stabiilsusarvutused tehakse osavarutegurite meetodil.   |  |  |  | | --- | --- | --- | | Projekteeritud kasutusea kategooria | 5 | EVS-EN 1990 tabel 2.1 | | Projekteeritud kasutusiga | 100 aastat | EVS-EN 1990 tabel 2.1 | | Tagajärgede klass | CC2 | EVS-EN 1990 tabel B.1 | | Töökindlusklass | RC2 | EVS-EN 1990 tabel B.2 | | Koormuste tegur KFI | 1,0 | EVS-EN 1990 tabel B.2 | | Projekteerimise järelevalve tase | DSL2 | EVS-EN 1990 tabel B.4 | | Ehitusaegne järelevalve tase | IL2 | EVS-EN 1990 tabel B.5 |  * 1. Normatiivid, standardid ja juhendmaterjalid   Töö koostamisel kasutatud normatiivid, standardid ja juhendmaterjalid:   * EVS-EN 1990:2002 EUROKOODEKS Ehituskonstruktsioonide projekteerimise alused; * EVS-EN 1990:2002 EUROKOODEKS Ehituskonstruktsioonide projekteerimise alused. Lisa A2: Rakendamine sildade puhul; * EVS-EN 1991-1-1:2002 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 1-1:   Üldkoormused. Mahukaalud, omakaalud, hoonete kasuskoormused;   * EVS-EN 1991-1-3:2006 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 1-3:   Üldkoormused. Lumekoormus;   * EVS-EN 1991-1-4:2007 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 1-4:   Üldkoormused. Tuulekoormus;   * EVS-EN 1991-1-5:2007 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 1-5:   Üldkoormused. Temperatuurikoormus;   * EVS-EN 1991-1-7:2006 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 1-7:   Üldkoormused. Erakorralised koormused;   * EVS-EN 1991-2:2007 EUROKOODEKS 1: Ehituskonstruktsioonide koormused. Osa 2:   Sildade liikluskoormused;   * EVS-EN 1992-1-1:2007 EUROKOODEKS 2: Betoonkonstruktsioonide projekteerimine. Osa   1-1: Üldreeglid ja reeglid hoonetetele;   * EVS-EN 1992-2:2005 EUROKOODEKS 2: Betoonkonstruktsioonide projekteerimine. Osa 2:   Betoonsillad. Arvutus ja detailiseerimisreeglid;   * EVS-EN 1997-1:2006 EUROKOODEKS 7: Geotehniline projekteerimine. Osa 1: Üldeeskirjad; * RT I, 22.11.2023, 9 Tee projekteerimise normid (17.11.2023 nr 71); * „Teetööde tehniline kirjeldus“, kinnitatud Transpordiameti peadirektori käskkirjaga nr 1-2/19/096.   1. nõuded kasutatavatele materjalidele ja ehitustöödele   Nõuded kasutatavatele materjalidele ja ehitustöödele on esitatud järgmistes juhendistes:   * Rail Baltica tehniline juhend RBDTD-EE-DS1-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_SP\_GP-AA\_MD\_00001;   Vastuolude ilmnemisel eelnimetatud dokumentide ja käesoleva seletuskirja vahel lähtutakse käesolevast seletuskirjast.  Projektis nimetatud tooteid ja materjale on lubatud vahetada analoogsete vastu. Võimalikud vahetused tuleb eelnevalt kooskõlastada projekteerija ja järelevalvega.   * 1. projekti muudatused   Truubi ehituskonstruktsioonide tööprojekti koostamisel on võrreldes põhiprojekti lahendusega tehtud järgmised muudatused:   * Maantee all olev osa pikendati 3m võrra (uus pikkus 16.5m), et ehitada ajutine liiklustee. Truubi kogu pikkus jäi samaks * Truubis olevate avade asukohat täpsustati vastavalt uuendatud drenaazi ja kraavi lahendusele.   1. ehitusgeotehnilised tingimused   Truubi aluste pinnaste detailsem kirjeldus on esitatud põhiprojekti geotehnilise projekti aruandes  RBDTD-EE-DS2-DPS1\_IDO\_RW0400-ZZ\_0001\_RP\_GEO-AA\_MD\_00002.  Geotehniline kirjeldus põhineb uuritud alal leitud geotehnilistel üksustel, kus esinevad valdavalt moreenisetted ja aluspõhi.  Ehitise CU037082 piirkonnas tehtud väliuuringute kohaselt koosneb ülemine 0,6 m kasvupinnase materjalidest, mis ehitustööde käigus eemaldatakse. Lisaks sellele, vastavalt löökpuurimistele puuraugus DPS1-401, mis asub projekteeritud ehitise asukohas, koosneb pinnas moreenisetetest, mis vastavad kesktihedatele kuni väga tihedatele möllise liiva-kruusa setetele.  Aluspõhi asub moreenisetete all. Aluspõhi koosneb murenevast lubjakivist. Allpool paikneb eeldatavalt murenemata aluspõhi.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Kihi tähis | Kirjeldus | Mahukaal kN/m3 | Deformatsioonimoodul MPa | Sise-hõõrdenurk | Dreenimata nihketugevus kPa | Efektiivnidusus c kPa | | III\_a | Kesktihe liiv-kruus | 21.5 | 40 | 34 | 0 | 0 | | III\_bc | Tihe liiv-kruus | 22.0 | 125 | 38 | 0 | 0 | | IV\_w | Murenenud lubjakivi | 24.0 | 500 | 34 | 0 | 50 | | IV\_un | Murenemata lubjakivi | 25.0 | 2250 | 47 | 0 | 200 |   *Geotehniliste parameetrite normatiivsete väärtuste kokkuvõte*  Ehitise lähedal läbi viidud geotehnilistes uuringutes (DPS1-401) tuvastati pinnaveetase sügavusel 0,55 m (absoluutne kõrgus 38,70 m).   * 1. koormused      1. Konstantsete väärtustega püsikoormused         1. Omakaal   Vastavalt projekti alusdokumendile „Teesildade projekteerimisalus. Põhiprojekt  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  Ehitise omakaalu arvestatakse igas mudelis. Projekteerimisaluste näidete järgi on raudbetooni tiheduse väärtus 25 kN/m3.   * + - 1. Lisatud omakaal   Vastavalt projekti alusdokumendile „Teesildade projekteerimisalus. Põhiprojekt  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  Selle konstruktsiooni jaoks arvestatakse järgmiste väärtustega.   * Katend: omakaaluga 25 kN/m3 * Kõnnitee: omakaaluga 25 kN/m3 * Sillakarniis: omakaaluga 25 kN/m3 * Liiklustõke: 5 kN/m kummalgi küljel * Kontaktvõrgu paneel: 2,5 kN/m mõlemal serval * Piire: 0,7 kN/m mõlemal serval   + 1. Muutuvate väärtustega püsikoormused        1. Eelpingekoormused   Ei kohaldata, sest tegemist on raudbetoonist ehitisega.   * + - 1. Roome ja mahukahanemine   Selle ehitise korral ei kohaldata. Pole seda tüüpi ehitise puhul asjakohane.   * + - 1. Geotehnilised mõjud          1. Horisontaalne mullakoormus   Vastavalt projekti alusdokumendile „Teesildade projekteerimisalus. Põhiprojekt  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  Selles rajatises on mulla- ja aluspinna surve korral võetud arvesse kõige ebasoodsamaid puhkeseisundi ja aktiivse surve näitajaid.  Täitematerjali korral on arvesse võetud järgnevaid omadusi:   * ɣ = 20 kN/m³ (ühikukaal); * ɸ = 35° (sisehõõrdenurk); * c = null (nidususe väärtus).   + - * 1. Ebaühtlane vajum   Selle ehitise korral ei kohaldata.   * + 1. Hõõrdejõud pott-tugiosadel   Ei kohaldata, sest ehitisel pole pott-tugiosi.   * + 1. Muutuvad mõjud        1. Vertikaalne koormus maanteeliikluse tõttu   Ligipääsuteede truupidel rakenduvad need 6 m laiuse käigutee ulatuses. Vastavalt tehnilistele tingimustele kohaldatakse täiendavalt alljärgnevaid reguleerimistegureid ja erisõidukeid.   * Koormusmudel LM1: αQ1 = 0,8; αq1 = 0,8; αQ2 = αQ3 = αqi = αqri = 0,8 * Koormusmudel LM2: βQ = αQ1 * Koormusmudel LM3: ei rakendata, sest seda ei nõua kohalik omavalitsus   + - 1. maanteeliikluse horisontaalsed mõjud   1.7.4.2.1 Karptruupidele on rakendatud pidurdus- ja veojõud.  Vastavalt projekti alusdokumendile „Teesildade projekteerimisalus. Põhiprojekt  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“   * + - * 1. Tsentrifugaaljõud   Selle ehitise korral ei kohaldata.   * + - * 1. Võnkumisjõud   Selle ehitise korral ei kohaldata.   * + - * 1. Aerodünaamilised mõjud   Aerodünaamilised mõjud pole truupide projekteerimisel asjakohased.   * + - * 1. Muud   Selle ehitise korral ei kohaldata.   * + - 1. Maanteesildade liikluskoormuste rühmad (EN 1991-2:2003 Tabel 4.4.a)   Selle ehitise korral ei kohaldata.   * + - 1. Mitteavalike jalgradade mõju   Selle ehitise korral ei kohaldata.   * + - 1. Temperatuur   Selle ehitise korral ei kohaldata. Pole seda tüüpi ehitise puhul asjakohane.   * + 1. Erakordsed koormused        1. Raudteeliikluse erakordsed koormused (EN 1991-2:2003 Punkt 6.7)   Selle ehitise korral ei kohaldata.   * + - 1. Maanteeliikluse erakordsed koormused (EN 1991-1-7:2006 Punkt 4.3)   Selle ehitise korral ei kohaldata.   * 1. truubi arvutused   Truubi arvutused on toodud põhiprojektis. Dokumendi nr RBDTD-EE-DS2-DPS1\_IDO\_BR0070-ZZ\_0005\_RP\_STR-TS\_MD\_00001   1. TRUUBI KONSTRUKTSIOONID    1. Truubi üldkirjeldus   Praegune drenaažisüsteem piirkonnas sisaldab järgmisi elemente ülesvoolust allavooluni:   * Olemasolev karptruup 1520 rööbastee all. * Kanal 1520 rööbastee ja 11290 riigimaantee vahel voolu kogumiseks 1520 rööbastee ja 11290 riigimaantee pikisuunalistest kraavidest. * 800 mm läbimõõduga torutruup 11290 riigimaantee all. * 800 mm läbimõõduga torutruup jalakäijate tee all. * Maaparandusvõrk jalakäijate teest allavoolu.     Voolu edastuse säilitamiseks projekti ehitustööde ajal on kaalutud kahte faasi pakutud CU0370 truubi ehitamiseks.  Faas 1 (CU037082) sisaldub OR0070 paketis. See faas sisaldab järgmisi elemente.   * Allavoolu kiviplokikaitse. * Allavoolu truubi ots. * Truup jalakäijate tee all. * Kanal 11290 riigimaantee ja jalakäijatete tee vahel. * Truup 11290 riigimaantee all. * 4 meetri pikkune kanal truubist ülesvoolu 11290 riigimaantee all. * Pealesõiduplaadid truubi mõlemalt poolt   Faas 2 (CU037081) sisaldub RW400 paketis. See sisaldab ülejäänud truubi elemente.  Truup koosneb monteeritavast raudbetoonist karpkonstruktsioonist, millel on ühtlase paksusega ülemine plaat, alumine plaat ja seinad.  Konstruktsioon on kaetud täitekihi ja katendiga. Maastikukate mõõdetuna kuni katendi tasemeni on iga konstruktsiooni jaoks selline, nagu on näidatud allpool toodud tabelis:   |  |  |  |  | | --- | --- | --- | --- | | **KOOD MD** | **DP pikett** | **Kirjeldus** | **Pinnakate [m]** | | CU037082 | 4+063 | TRUUP+LOOMADE ÜLEKÄIGUKOHT | 0,5 |   Maastikukate monteeritava betoonkarbi peal.  Karkassi liitekoht lahendatakse nii, nagu kirjeldatud dokumendis UNE-EN 14844:2007+A2. “2.A liitekohta” kasutatakse vastavalt iga karkassi paksusele, nagu näidatud allolevas tabelis:     |  |  |  | | --- | --- | --- | | **Truubi paksus** [m] | **a** [m] | **b** [m] | | 0.2 | 0.075 | 0.1 | | 0.25 | 0.1 | 0.1 | | 0.35 | 0.15 | 0.1 | | 0.45 | 0.2 | 0.1 |   Kanalid riigimaantee ja jalakäijate tee vahel ning maantee ja raudtee vahelisel alal koosnevad monteeritavatest elementidest, sama ristlõikega mis truubi karp, ilma ülemise plaadita.  Maantee all oleva truubi mõlemalt poolt valatakse pealesõiduplaadid paksusega 250mm, laius 5,0m, pikkus11,5m. Elastsusmoodul tihendatud killustikaluse pinnal peab olema ≥180MPa, sõiduplaatide all ≥80MPa.  Jalakäijate truubi otsa on paigaldatud täitematerjali hoidmiseks tiibsein. Monteeritava karptruubi ja kohapeal valatud tiibseina vaheline liitekoht on kaitstud polüuretaanist elastse tihendiga sisepinnal ja bituumentihendiga välispinnal. Tiibsein koosneb kahest seinast, mis on joondatud truubi teljega 30º kaldenurga all ja ühendatud plaatvundamendiga. Allavoolu truubi otsa käiguradade täitematerjali kinnipidamiseks on lisatud ka tugiseinad. Need valatakse kohapeal, kasutatav materjal on sama mis tiibseinas.   * 1. ehituse tehnoloogiline järjestus   Truubikarbid on monteeritavad elemendid, mis tarnitakse ettenähtud kohtadesse vastavalt konkreetsele ehitusprotsessile. Karbi alla rajatakse 3 cm liivapõhi, et tagada koormuste ühtlane jaotumine maapinnale. Karbi peale valatakse lahja betooni kiht kerge kallega 1%, et tagada vee äravoolu. Truubi ehitusprotsess on jagatud kolmeks osaks, et tagada ajutine liikluskorraldus. Iga etappi kuluvad järgmised tööd:  väljakaeve, tööbetoon, elementide montaaž, hüdroisolatsioon, tagasitäide.  Tiibseinad ehitatakse siis, kui karp on juba paigaldatud ja enne muldkeha rajamist.   * 1. materjalide omadused      1. betoonkonstruktsioonid   Nõuded betoonkonstruktsioonidele on toodud alusdokumendil „Teesildade projekteerimisalus. Põhiprojekt“ RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002.  Järgnevates tabelites on määratletud erinevate elementide betoon ja betoonkatted vastavalt keskkonnatingimustele. Tugiseinte keskkonnaklass on sama mis tiibseintel, sest neid elemente loetakse tiibseinte pikenduseks.   | **BETOONI SPETSIFIKATSIOON VASTAVALT STANDARDITELE EN-1992-1-1, EN 206, EVS-814 ja EVS-EN 206** | | | | | | | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Elemendi tüüp** | | **Keskkonnaklass** | | **fck** | | **Min tsement** | | **Max vee-sisaldus** | | **max osakeste suurus** | | | **(MPa)** | | **(kg/m3)** | | **(mm)** | | | Lahja betoon | Ei kohaldata | | Ei kohaldata | | C16/20 | | Ei kohaldata | | Ei kohaldata | | 20 | | |  | Tiibseinad | | XC4/XD1/XF3 | | C35/45 | | 340 | | 0,45 | | 20 | | |  | Monteeritav truup | | XC4/XD1/XF3 | | C35/45 | | 340 | | 0,45 | | 20 | | | **BETOONI SPETSIFIKATSIOON VASTAVALT STANDARDITELE EN-1992-1-1, EN 206, EVS-814 ja EVS-EN 206** | | | | | | | | | | | | |  | **Elemendi tüüp** | **Külma-kindluse klass** | | **Struktuuri-klass** | | **K.kiht cv**  **(mm)** | | **Min õhu-sisaldus** | | **Muud nõuded** | | | **(%)** | | | Lahja betoon | Ei kohaldata | Ei kohaldata | | Ei kohaldata | | Ei kohaldata | | - | | - | | |  | Tiibseinad | KK3-100 | | S5 | | 55 | | - | | - | | |  | Monteeritav truup | KK3-100 | | S4 | | 50 | |  | |  | |   Betooni spetsifikatsioon  Minimaalne kaitsekiht ettevalmistatud pinnasele valatud betoonil (koos tasanduskilega) on 50 mm ja otse pinnasele valatud betoonil 75 mm.  Tagada tuleb betooni tootmise spetsiaalne kvaliteedikontroll vastavalt standarditele EN 1992-1-1 ja EN 206-2013, näiteks tootmise sertifitseerimisega vastavalt standardile EN 206-2013, lisa C. Betooni tootmise spetsiaalset kvaliteedikontrolli on kaalutud pealisehitises struktuurse klassifikatsiooni jaoks.   * + 1. sarrusteras   Ehitustöödel kasutatav sarrusteras vastavalt standardile EVS-EN 10080:   * sarruse tüüp – profileeritud terasvardad; * normatiivne voolavustugevus fyk=500 MPa; * venivusklass B või C.   1. hüdroisolatsioon   Hüdroisolatsiooniks plaadi peal ja pealesõiduplaatide peal kasutada Süstem 2 lahendust - bituumen-rullmaterjaliga sildade hüdroisolatsioon EVS-EN14695 järgi.  Seinad kaetakse võõphüdroisolatsiooniga Asol-FE ning kaetakse geotekstiiliga GXP Drain geokomposiit.   * 1. maandus   Maandust truubile ei paigaldata.   1. keskkonnakaitse   Ehitaja lähtub oma tegevuses heast ehitustavast, järgib keskkonnaalaseid seadusi, standardeid, norme ja juhiseid, mis on seotud antud tegevusega.  Tööprojekti koostamisel on arvestatud kliimamuutuse mõjuga vastavalt tööprojekti koostamisele eelnenud projekteerimisstaadiumites esitatud meetmetele.  Kaeve- ja ehitustööde ajal reostustunnustega pinnase või pinnasevee ilmnemisel selgitada pinnase- ja veeproovidega reostuse suurus ja koostada edasine tegevuse kava. Juhtumist teavitada koheselt Tallinna Keskkonna- ja Kommunaalametit ning Tellijat. Peatada koheselt reostuse levikut soodustavad tegevused. | TABLE OF CONTENTS  [1. 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ENVIRONMENTAL PROTECTION 13](#_Toc174618928)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 1. INTRODUCTION    1. initial data   The object of the detailed technical design is Culvert CU037082 (DP Station 4+063, OR0070 Package).  Basis of the work:   * Rail Baltica Harjumaa põhitrassi raudteetaristu I etapi ehitustööd“ Addendum to the contract „Tehniline kirjeldus 01112023“ and Addendum 1 – „Projekteerimise LÜ 27102023” * IDOM, Consulting, Engineering, Architecture S.A.U. order DPS1 Ülemiste Kangru, Tallinn -Lagedi Riste (OR0070), master design.   1. basics of the design   The load-bearing structures are designed in accordance with the standards of the Eurocode series EVS-EN 1990… EVS EN 1999.  Load-bearing structures are designed using the limit state method, considering the calculation situations in which the structure must fulfill its purpose. Strength and stability calculations are performed using the partial factor method.   |  |  |  | | --- | --- | --- | | Design service life category | 5 | EVS-EN 1990 table 2.1 | | Working life | 100 aastat | EVS-EN 1990 table 2.1 | | Consequence class | CC2 | EVS-EN 1990 table B.1 | | Reliability class | RC2 | EVS-EN 1990 table B.2 | | Factor for actions KFI | 1,0 | EVS-EN 1990 table B.2 | | Design supervision level | DSL2 | EVS-EN 1990 table B.4 | | Inspection level | IL2 | EVS-EN 1990 table B.5 |  * 1. Norms, standards and guidance documents   Norms, standards and guidance materials used in design:   * EVS-EN 1990:2002 Eurocode - Basis of structural design; * EVS-EN 1990:2002 Eurocode - Basis of structural design. Amendment A1 - Annex A2: Application for bridges; * EVS-EN 1991-1-1:2002 Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings; * EVS-EN 1991-1-3:2006 Eurocode 1: Actions on structures - Part 1-3: General actions - Snow loads; * EVS-EN 1991-1-4:2007 Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions; * EVS-EN 1991-1-5:2007 Eurocode 1: Actions on structures. Part 1-5: General actions - Thermal actions; * EVS-EN 1991-1-7:2006 Eurocode 1: Actions on structures. Part 1-7: General actions - Accidential actions; * EVS-EN 1991-2:2007 Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges; * EVS-EN 1992-1-1:2007 Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings; * EVS-EN 1992-2:2005 Eurocode 2 - Design of concrete structures – Part 2: Concrete bridges - Design and detailing rules; * EVS-EN 1997-1:2006 Eurocode 7: Geotechnical design - Part 1: General rules; * RT I, 22.11.2023, 9 Road design standards (17.11.2023 nr 71); * „Technical description of road works“, approved by Road Administration directive no 1-2/19/096.   1. Requirements for materials and construction work   Requirements for materials and construction work are presented in the following guidance documents:   * Rail Baltica Technical Specification for Construction RBDTD-EE-DS1-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_SP\_GP-AA\_MD\_00001;   In the event of any conflict between the above documents and current document, current document shall prevail.  It is allowed to exchange the products and materials mentioned in the project for analogous ones. Any changes must be agreed in advance with the designer and supervisor.   * 1. design changes   The following changes have been made in the Detailed Technical Design stage compared to Master Design:   * The part under the highway was extended by 3m (new length 16.5m) to build temporary traffic road. Full length of the Culvert remained the same. * The location of the openings in the culvert was specified according to the updated drainage and ditch solution.   1. geotechnical conditions   Detailed description of the geotechnical conditions is provided in Master Design Geotechnical report  RBDTD-EE-DS2-DPS1\_IDO\_RW0400-ZZ\_0001\_RP\_GEO-AA\_MD\_00002.  The geotechnical interpretations are based on geotechnical units found at studied area, where moraine deposits and bedrock govern and the geotechnical descriptions.  As per the field investigations performed at the area of the structure CU037082, the upper 0.6 m are constituted by topsoil materials that will be removed during construction operations. In addition, according to the percussion drilling DPS1-401 located just in the projected structure location, the ground is constituted by moraine deposits, which corresponds medium dense to very dense silty sand gravel deposits.  Bedrock occurs under the moraine deposits. The bedrock consists of limestone susceptible to weathering. Unweathered bedrock be deduced towards the bottom investigation.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Layer | Description | Weight density kN/m3 | Deformation modulud MPa | Friction angle | Undrained shear strength kPa | Effective cohesion c kPa | | III\_a | Med. dense sand-gravel | 21.5 | 40 | 34 | 0 | 0 | | III\_bc | Dense sand-gravel | 22.0 | 125 | 38 | 0 | 0 | | IV\_w | Weathered limestone | 24.0 | 500 | 34 | 0 | 50 | | IV\_un | Unweathered limestone | 25.0 | 2250 | 47 | 0 | 200 |   *Summary of characteristic values for geotechnical parameters*  Based on the geotechnical investigations performed near the structure (DPS1-401), the groundwater level was detected 0.55 m deep (absolute height of 38.70 m).   * 1. loads      1. Permanent loads with constant values         1. Dead loads   According to the design bases document „Road Bridges design basis. Master design  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  The self-weight of the structure will be considered in each model. Following design bases indications, the density value of the reinforced concrete will be 25 kN/m3.   * + - 1. Superimposed dead loads   According to the design bases document „Road Bridges design basis. Master design  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  For this structure, the following values are considered.   * Pavement: With a density of 25 kN/m3 * Sidewalk: With a density of 25 kN/m3 * Bridge cornice: With a density of 25 kN/m3 * Traffic barrier: 5 kN/m on each side. * Panel for OCS: 2,5 kN/m on both edges. * Railing: 0,7 kN/m on both edges.   + 1. Permanent loads with variable values        1. Prestress loads   Not applicable as this is a reinforced concrete structure.   * + - 1. Creep and shrinkage   Does not apply to the structure. No relevant in this type of structure.   * + - 1. Geotechnical actions          1. Horizontal earth pressure load   According to the design bases document „Road Bridges design basis. Master design  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  In this structure, for the earth and surcharge pressure the most unfavourable of at rest and active pressure has been considered.  The backfill material has been considered with the following characteristics:   * ɣ = 20 kN/m³ (bulk unit weight) * ɸ = 35º (internal friction angle) * c = nil (value of cohesion).   + - * 1. Differential settlement   Does not apply to the structure.   * + 1. Friction forces at pot bearings   Not applicable as the structure does not have pot bearings.   * + 1. Variable actions        1. Vertical loads due to road traffic   For culverts on access roads, they are applied in a carriageway width of 6 m. Additionally, according to technical conditions, the following adjustment factors and special vehicles are applied:   * Load model LM1: αQ1 = 0,8; αq1 = 0,8; αQ2 = αQ3 = αqi = αqri = 0,8 * Load model LM2: βQ=αQ1 * Load model LM3: Not applied as not required by local administration   + - 1. Horizontal actions due to road traffic          1. Brake and traction actions have been applied to the box culverts.   According to the design bases document „Road Bridges design basis. Master design  RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“   * + - * 1. Centrifugal forces   Does not apply to the structure.   * + - * 1. Nosing force   Does not apply to the structure.   * + - * 1. Aerodynamic effects   The aerodynamic effects are not relevant for the design.   * + - * 1. Others   Does not apply to the structure.   * + - 1. Groups of Traffic Loads on Road Bridges (EN 1991-2:2003 Table 4.4.a)   Does not apply to the structure.   * + - 1. Actions for non-public footpaths   Does not apply to the structure.   * + - 1. Temperature   Does not apply to the structure. No relevant in this type of structure.   * + 1. Accidental actions        1. Accidental actions due to road traffic (EN 1991-2:2003 Clause 6.7)   Does not apply to the structure.   * + - 1. Accidental actions due to road traffic (EN 1991-1-7:2006 Clause 4.3)   Does not apply to the structure.   * 1. culvert calculation   Culvert calculations are given in master design. Document number RBDTD-EE-DS2-DPS1\_IDO\_BR0070-ZZ\_0005\_RP\_STR-TS\_MD\_00001  2. STRUCTURE OF THE CULVERT   * 1. general description of the culvert   The current drainage system in the area includes the following items from upstream to downstream:   * An existing box culvert under the 1520 tracks. * A channel located between 1520 tracks and 11290 National road collecting the flows from the longitudinal ditches of 1520 tracks and 11290 National road. * A 800 mm diameter pipe culvert under 11290 National road. * A 800 mm diameter pipe culvert under Pedestrian road. * Land melioration network downstream of the pedestrian road.     In order to maintain flow conveyance during the time of project construction, two phases are considered to build the proposed culvert.  Phase 1 (CU037082) included in OR0070 Package. This phase includes the following items.   * Downstream riprap protection. * Downstream headwall. * Culvert under Pedestrian road. * Channel between 11290 National road and Pedestrian road. * Culvert under 11290 National road. * 4 meters long channel upstream of the culvert under 11290 National road. * Transition slab both sides of the culvert   Phase 2 (CU037081) included in RW400 Package. This includes the rest of the elements of the culvert.  The culvert consists in a precast reinforced concrete box section with a constant thickness for the top slab, bottom slab and walls.  Over the structure, there will be a coverage of fill and pavement. The terrain cover, measured until pavement level, for each structure is as indicated in the table below:   |  |  |  |  | | --- | --- | --- | --- | | **CODE MD** | **DP Station** | **Description** | **Terrain cover [m]** | | CU037082 | 4+063 | CULVERT + ANIMAL CROSSING | 0.5 |   Terrain cover over the precast box.  The joint between the frames will be solved following the indications described in UNE-EN 14844:2007+A2. “2.A joint” will be used particularized for each frame thickness as shown in the below table:   |  |  |  | | --- | --- | --- | | **Culvert thickness** [m] | **a** [m] | **b** [m] | | 0.2 | 0.075 | 0.1 | | 0.25 | 0.1 | 0.1 | | 0.35 | 0.15 | 0.1 | | 0.45 | 0.2 | 0.1 |     The channels between the national road and the pedestrian path and in the area between the road and the railway consist of prefabricated elements with the same cross-section as the culvert box, without a top plate.  On both sides of the culvert under national road transition slab must be casted, thickness 250mm, size 5,0mx11,5m. The modulus of elasticity under the surface of the crushed gravel base must be ≥180MPa, and under the transition slabs ≥80MPa.  At the end of the box, wingwall is attached to retain the backfill. The joint between the precast box culvert and the cast in situ wingwall will be protected with a Polyurethane Elastic Seal in the internal face and a Bituminous Seal in the external face. Each element will be composed by two walls, aligned with a skew angle from the axis of the culvert of 30º, joined by a slab foundation. They will be cast in situ and their dimensions will be adapted to the specific box culvert. Retaining walls are added at the end of the wingwall to retain the animal paths backfill. They will be cast in situ, the material to be used is the same as the wingwall.   * 1. stages of constraction   The culvert boxes are planned to be precast elements to be delivered at each location, following the specific construction process. A 3cm sand-base will be placed under the box structure to ensure uniform distribution of the loads to the terrain.  The culvert construction is devided into three stages to ensure temporary traffic control. Each stage requires following tasks: excavation, base concrete, assembly of elements, waterproofing, backfilling.  Regarding the wingwalls, they will be constructed once the box has been placed and previous to any embankment execution.   * 1. Concrete strength and covers      1. concrete structures   Requirements for concrete structures are shown in document „Road Bridges design basis. Master design RBDTD-EE-DS2-ZZ\_IDO\_ZZZZ-ZZ\_ZZZZ\_RP\_BR-TS\_MD\_00002“  In the following tables, it is defined the concrete for the different elements and the concrete covers according to the exposure conditions. The exposure class for retaining walls is the same of the wingwalls, as these elements are considered a prolongation of them.   | **CONCRETE SPECIFICATION ACCORDING TO EN-1992-1-1, EN 206, EVS-814 and EVS-EN 206** | | | | | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Element type** | | **Exposure class** | | **fck** | | **Min. Cement** | | **Max. w/c** | | **max. aggregate size** | | **(MPa)** | | **(kg/m3)** | | **(mm)** | | Lean Concrete | N/A | | N/A | | C16/20 | | N/A | | N/A | | 20 | |  | Wingwalls | | XC4/XD1/XF3 | | C35/45 | | 340 | | 0,45 | | 20 | |  | Precast culvert | | XC4/XD1/XF3 | | C35/45 | | 340 | | 0,45 | | 20 | | **CONCRETE SPECIFICATION ACCORDING TO EN-1992-1-1, EN 206, EVS-814 and EVS-EN 206** | | | | | | | | | | | | |  | **Element type** | **Frost Resistance class** | | **Structural class** | | **Cover cv**  **(mm)** | | **Min. Air content** | | **Other requirements** | | | **(%)** | | | Lean Concrete | N/A | N/A | | N/A | | N/A | | - | | - | | |  | Wingwalls | KK3-100 | | S5 | | 55 | | - | | - | | |  | Precast culvert | KK3-100 | | S4 | | 50 | |  | |  | |   Concrete specification  Minimum cover for concrete cast against prepared ground (including blinding) shall be 50 mm and for concrete cast directly against soil 75 mm.  Special quality control of concrete production shall be ensured according EN 1992-1-1 and EN 206-2013, for example by certification of the production control according to EN 206-2013, Annex C. Special quality control of the concrete production has been considered in the superstructure for the structural classification  2.3.2 sarrusteras  Reinforcing steel properties according to EVS-EN 10080:   * type of reinforcement - profiled steel bars; * characteristic yield strength fyk = 500 MPa; * elongation class B or C.   1. waterproofing   For waterproofing of the culvert top must be used System 2 solution - waterproofing of bridges with bitumen roll material according to EVS-EN14695.  Walls are covered by two coats of bituminous paint Asol-FE with geotextile protection GXP Drain geokomposiit.   * 1. grounding   Culvert structures are not grounded. |  1. ENVIRONMENTAL PROTECTION   The contractor follows good construction practice, follows the environmental laws, standards, norms and instructions related to the given activity.  The impact of climate change has been considered in accordance with the measures presented in the design stages prior to the preparation of the detailed technical design.  In case of signs of pollution of soil or water during excavation and construction work, the extend of pollution using water and soil samples must be clarified and further action plan must be prepared. Tallinn Environment and Municipal Board and the Customer must be informed immediately about the incident. All activities that promote the spread of pollution must be stopped immediately. |