Latvijas
Betona
Savienība

32. zinātniski tehniskā konference

EKSPONĒTAIS BETONS

Dr.ing, asoc. prof. Rolands Cepurītis
Latvijas Betona savienības valdes priekšsēdētājs

2024. gada 28. novembrī
Rīga

Profesionālās tālāk apmācības kurss «Ar veltni blīvēta betona [RCC] ceļu un laukumu projektēšana un būvniecība»

Lūdzu, ņemiet vērā, ka raksts ir vairāk nekā piecus gadus vecs un ir pārvietots uz mūsu arhīvu. M
neatjauninām arhīvu saturu, tāpēc var būt nepieciešams meklēt jaunākus avotus.

Maksas raksts*

2014. gada 22. jūlijs 06:00

Sadarbībā ar Amerikas Betona Ceļu Asociāciju [ACPA] un CEMEX, SIA «Firma L4» Jūs aicina piedalīties Ar veltni blīvēta betona [RCC] segumu projektēšanas un būvniecības apmācībās.


JCDecaux
KĀ TU PRET TEKSTILU,
TĀ TEKSTILS PRET TEVI
ZAĻĀ JOSTA

ALKALI AGGREGATE REACTIONS (AAR) IN CONCRETE

WORKSHOP PROCEEDING

FROM A

NORDIC - BALTIC MINISEMINAR

RIGA - LATVIA

21. - 22. NOVEMBER 2013

KONFERENCES LIELDRAUGS

MB GRUPA

PARTNERI

Rigensi

MAPEI

SCHWENK

Latvijas Betona Savienība

stachema

1862

RĪGAS TEHNISKĀ UNIVERSITĀTE

PRIMX

1862
RĪGAS TEHNISKĀ UNIVERSITĀTE

Heidelberg Materials

SCHWENK

PERI®

stachema

R C K 1872
RĪGAS CELTNIECĪBAS KOLEDŽA

KORO BŪVE

A7 BETONS

VELVE MATERIĀLU SISTĒMAS

MAPEI

SAKRET®

PRE fabrica

semtu

Latvijas Biozinātņu un tehnoloģiju universitāte

DVL

CONCRETO

ADVENTUM TECH
EST 2020

ARILANS
BETONA RAŽOTNE

BETONAM

chryso
SAINT-GOBAIN

gcp

KILEN BALTIC X

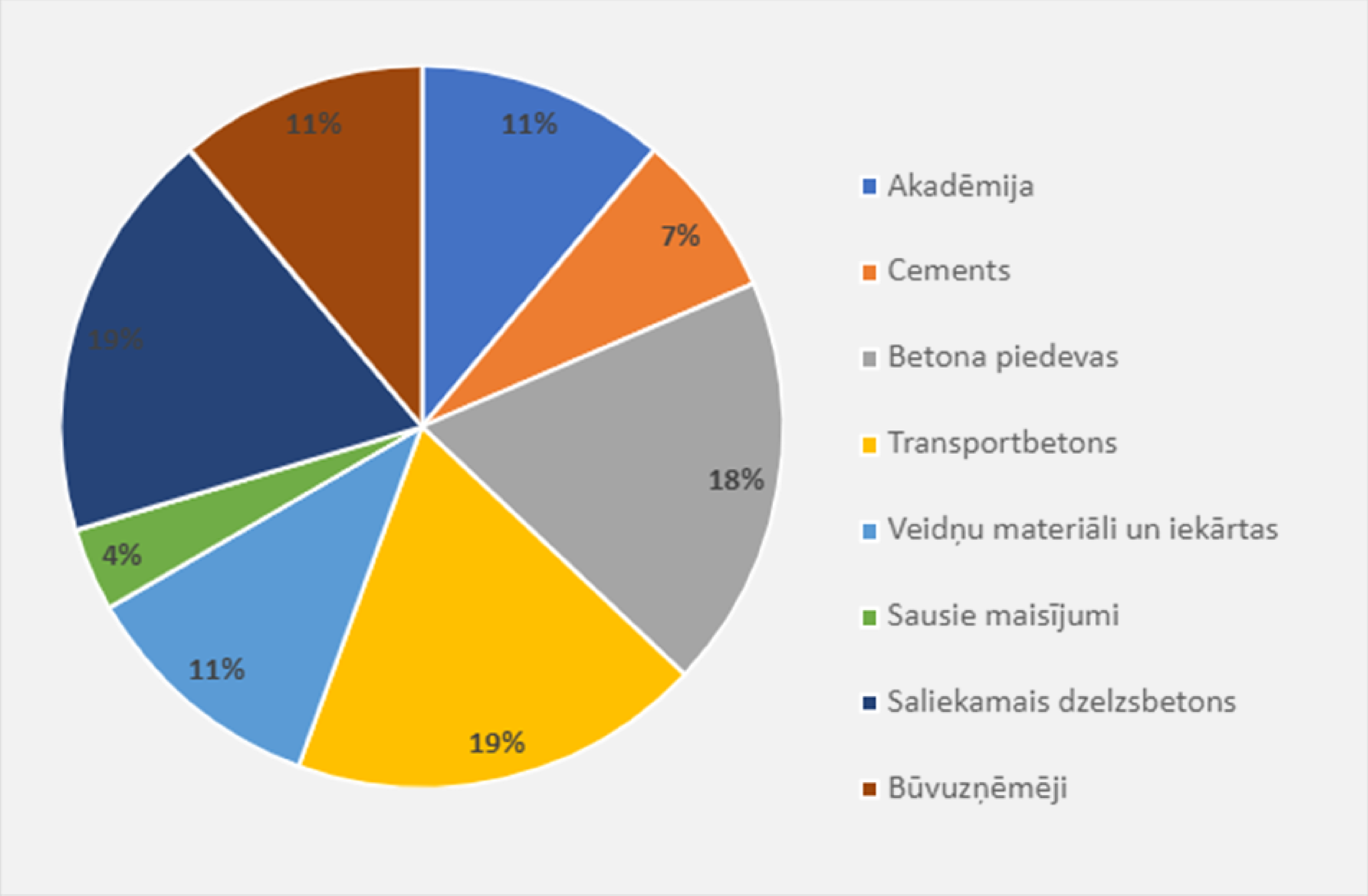
Concrete Colors – Concrete Technology
REMEI®

SALENIEKU BLOKS

CTB BETONS

Rigensi

LBS BIEDRI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Akadēmija
Cements
Betona piedevas
Transportbetons
Veidņu materiāli un iekārtas
Sausie maisījumi
Saliekamais dzelzsbetons
Būvuzņēmēji

LATVIJAS BETONA SAVIENĪBAS ADMINISTRATĪVAIS SASTĀVS

Didzis Malkausis, izpilddirektors

Tālrunis +371 29 337 714

e-pasts Didzis.Malkausis@betonasavieniba.lv

Maija Sadauska, izpilddirektora vietniece

Tālrunis +371 26 725 433,

e-pasts info@betonasavieniba.lv

GADA BETONA BŪVE

STUDENTU BALVA 2024

Konkursa uzvarētāji:

- Alise Sapata, RTU – pirmā vieta kategorijā "Labākais maģistra darbs"

- Alisa Počujeva, RTU – pirmā vieta kategorijā "Labākais bakalaura darbs"

Pirmās vietas ieguvējas saņems naudas balvu 700 eiro apmērā.

Veicināšanas balvu ieguvēji:

- Regnārs Beresinevičs, RTU

- Jānis Stūrītis, RTU

Veicināšanas balvas 300 eiro apmērā tiek piešķirtas, lai atzīmētu studentu centību, oriģinalitāti un radošu pieeju sarežģītu problēmu risināšanā.

GRĀMATA "BETONS"

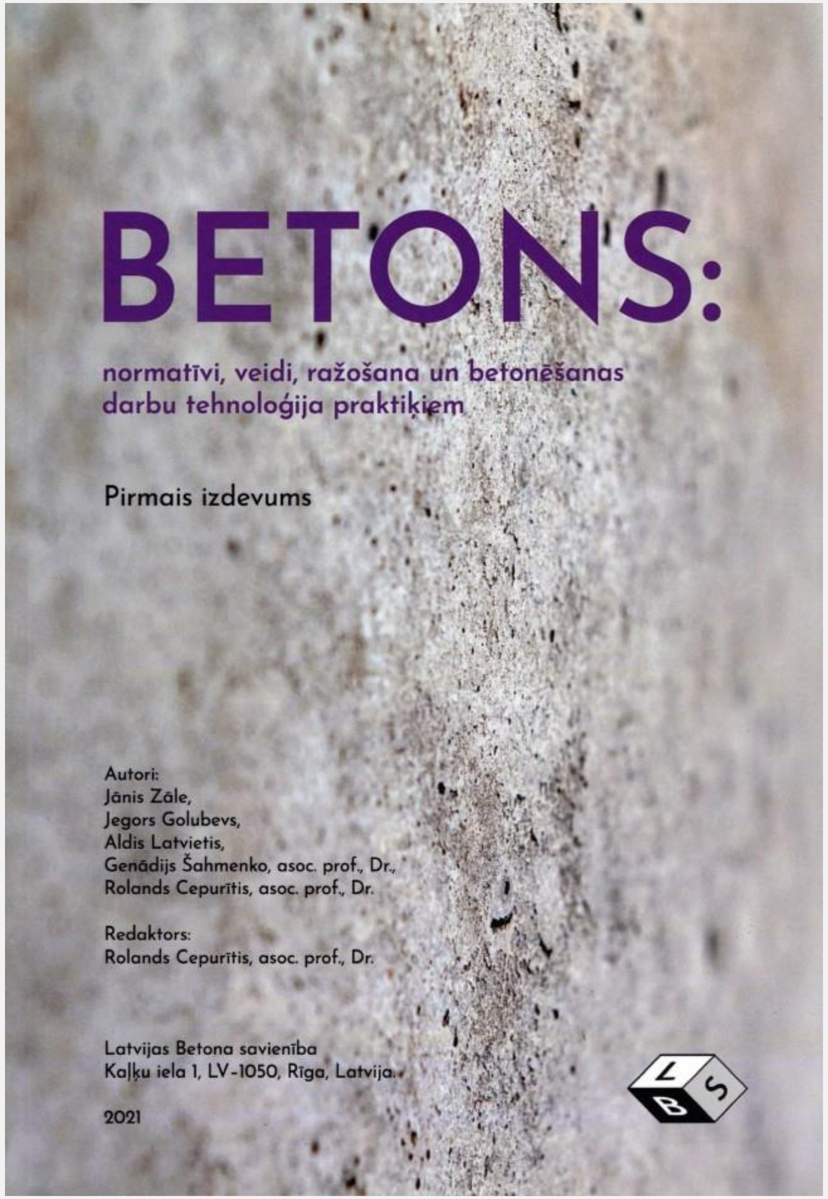
Betons: normatīvi, veidi, ražošana un betonēšanas darbu tehnoloģija praktiķiem. Pirmais izdevums.

Autori:

- Jānis Zale
- Jegors Golubevs
- Aldis Latvietis
- Genādijs Šahmenko, asoc. prof., Dr.
- Rolands Cepurītis, asoc. prof., Dr.

Redaktors:

- Rolands Cepurītis, asoc. prof., Dr.



Latvijas Betona Savienība

28/11 /2024 EKSPONĒTAIS **BETONS** I **Fair-faced concrete**

Latvijas Betona savienības
32. zinātniski tehniskās
konferences **programma**

Latvian Concrete Association's
32. scientific and technical
conference **program**

09:00 Konferences atklāšana / Opening session R. Cepurītis (LBS valdes priekšsēdētājs, Primekss, NTNU)

Eksponētais betons | Fair-faced concrete
Moderators: R. Cepurītis

09:20 Eksponētais betons SZK projektos. Problēmas un risinājumi / Fair-faced concrete in SZK projects. Problems and solutions [LV] A. Sīlis (Sīlis, Zābers un Kļava)
09:45 Betona recepte izcilam rezultātam: Ola Foundation projekts / Concrete mix-design for an excellent result: Ola Foundation project [LV] A. Lukašenoks (MB Betons)
10:05 The "mica crisis" in Donegal, Ireland: A case of internal sulfate attack / Vizlas krīze Donegālā, Īrijā: iekšējā sulfātu izraisītās korozijas gadījums [EN] P. Lura (EMPA)

10:25 Kafijas pauze / Coffee break

Eksponētais betons | Fair-faced concrete
Moderators: R. Cepurītis

11:05 Latvijas Betona savienības tehniskā komiteja: Eksponētais betons / Technical committee of the Latvian Concrete Association: Fair-faced concrete [LV] D. Malkausis (LBS izpilddirektors, TK03)
11:20 Eksponētais betons: Kaigan Villas / Fair-faced concrete: Kaigan Villas [LV] R. Pjaternevs (Kaigan Villas)
11:30 Rail Baltica centrālās stacijas eksponētais betons / The fair-faced concrete of Rail Baltica's central station [LV] L. Joksts (Bererix)
11:50 Betona Olimpiādes rezultāti / Concrete Olympics results [LV/EN] G. Šahmenko (LBS valdes loceklis, RTU), T. Nowacki (STACHEMA Polska)

12:05 Pusdienu pārtraukums / Lunch break

Eksponētais betons | Fair-faced concrete
Moderators: J. Zāle

13:05 Cold-bonded biochar-rich lightweight aggregates for net-zero concrete / Auksti granulētas bioogļu vieglās pildvielas neto nulles emisiju betonam [EN] N. Toropovs (EMPA)
13:25 Ramirent pieredze: redzamais betons / Ramirent experience: visible concrete [LV] A. Janbergs (Ramirent)
13:40 Competition Best Concrete Building of the year 21st century, 25 years / Konkurss Gada labākā betona būve. 21. gadsimts, 25 gadi [EN] J. Einpaul (Concrete Associaton of Estonia)
14:00 Standardization of concrete surface quality / Betona virsmas kvalitātes standartizācija [ENG]
M. Daukšys (KTU, Lietuva), G. Skripkiunas (VGTU, Lietuva), R. Moceikis (Betonika)
14:20 Betona virsmas kvalitātes defekti pēc konstrukciju atveidņošanas un to ietekmējošie faktori / Concrete surface defects after structure demoulding and their influencing factors [LV] I. Stefanovičs (Doka)
14:40 3D drukāts eksponētais betons / 3D printed fair-faced concrete[LV] M. Šinka (RTU), G. Šahmenko (LBS valdes loceklis, RTU)

15:00 Kafijas pauze / Coffee break

Nozares aktualitātes | Industry novelties
Moderators: D. Malkausis

15:20 Latvijas Betona savienības tehniskā komiteja: Betona ilgtspēja / Technical committee of the Latvian Concrete Association: Concrete Sustainability [LV] E. Ozoliņš (MB betons, TK04)
15:35 Tradicionālā tērauda šķiedru un PrīmX tērauda šķiedru pašspriegojošā betona pilna mēroga tests Jelgavā / Full-scale test of traditional steel fiber and PrīmX steel fibre reinforced self-stressing concrete in Jelgava [LV] M. Suta (Primekss)
15:55 Betona konstrukciju uzraudzība un savlaicīgas atveidņošanas ietekme uz betona virsmas vizuālo kvalitāti / Monitoring of concrete structures and its effecton the visual quality of the concrete surface [LV] Ņ. Gorbatko (Adventum Tech)
16:00 Saliekamā dzelzsbetona nozares ekonomiskās tendences un konkurētspējas veicināšanas stratēģijas / Economic trends and competitiveness strategies in the precast concrete sector [LV] R. Kaufiņš (Kilen Baltic)

16:20 Jautājumi, diskusijas un konferences noslēgums / Questions, discussions and conclusion of the conference R. Cepurītis (LBS valdes priekšsēdētājs, Primekss, NTNU)

Latvijas
Betona
Savienība

28/11 /2024

EKSPONĒTAIS **BETONS**
FAIR-FACED **CONCRETE**

Skenējiet, lai atvērtu programmu

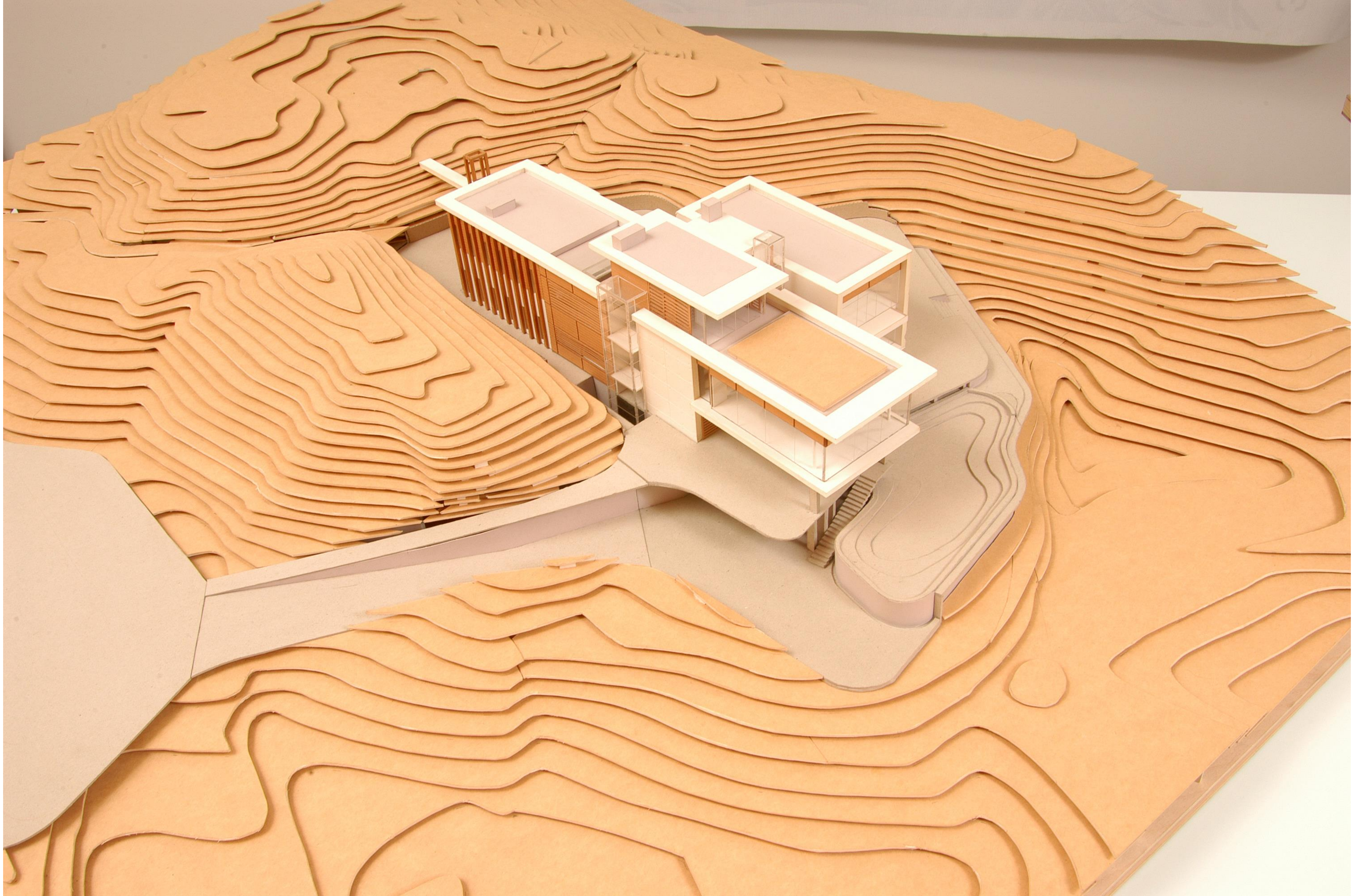
Scan to view the programme

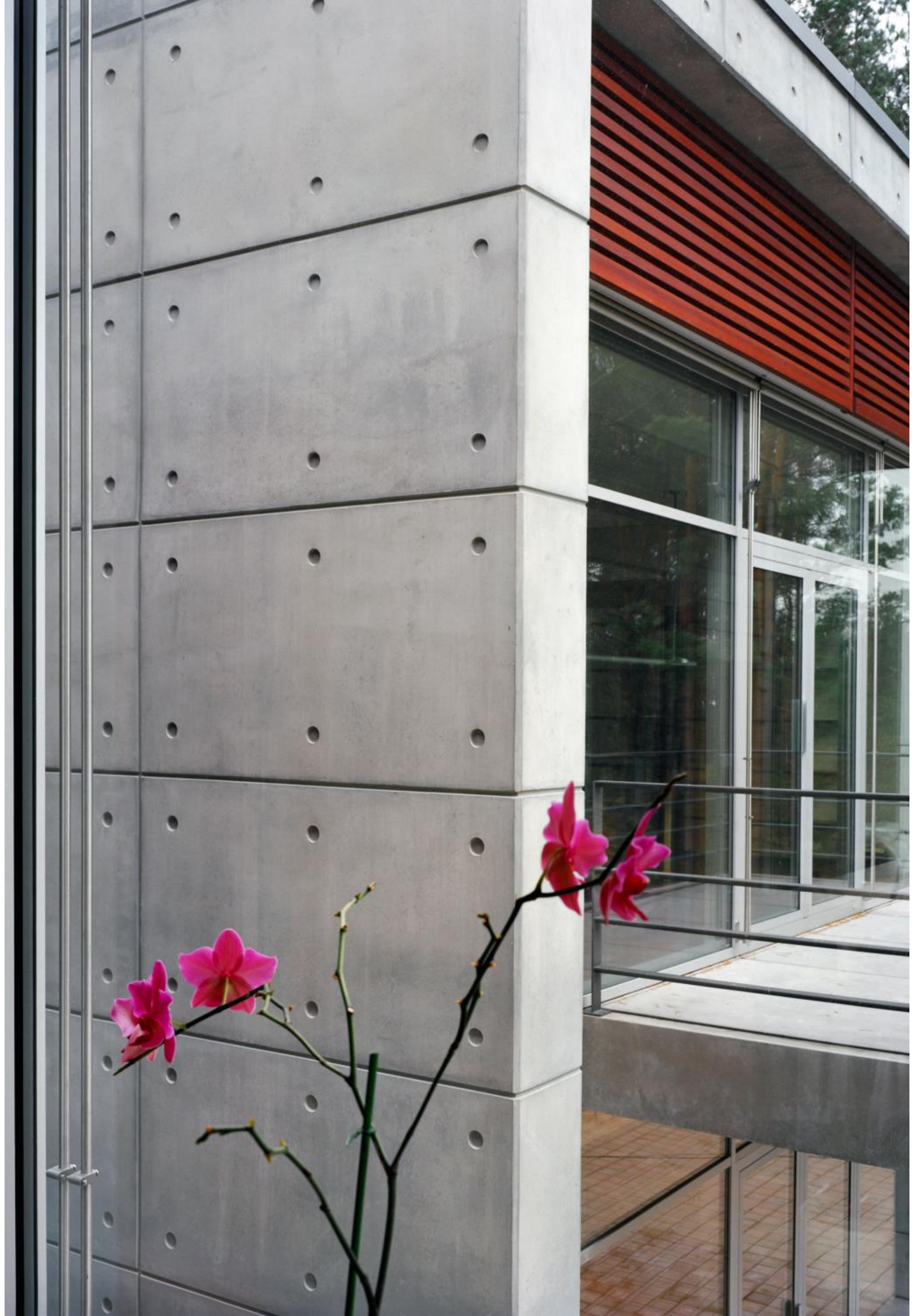
Latvijas Betona Savienība

PALDIES PAR UZMANĪBU!

EKSPONĒTAIS BETONS SZK PROJEKTOS

PROBLĒMAS UN RISINĀJUMI







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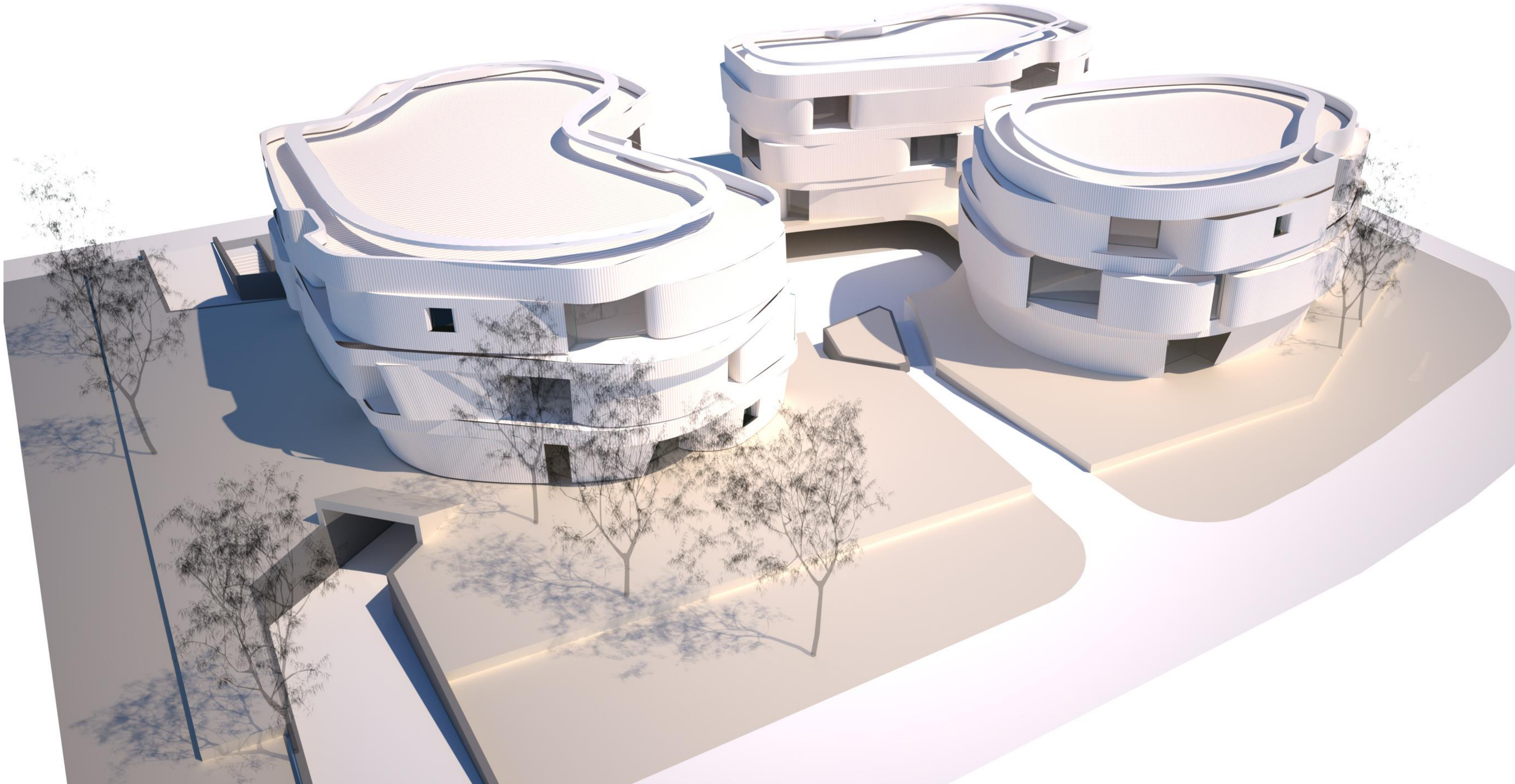
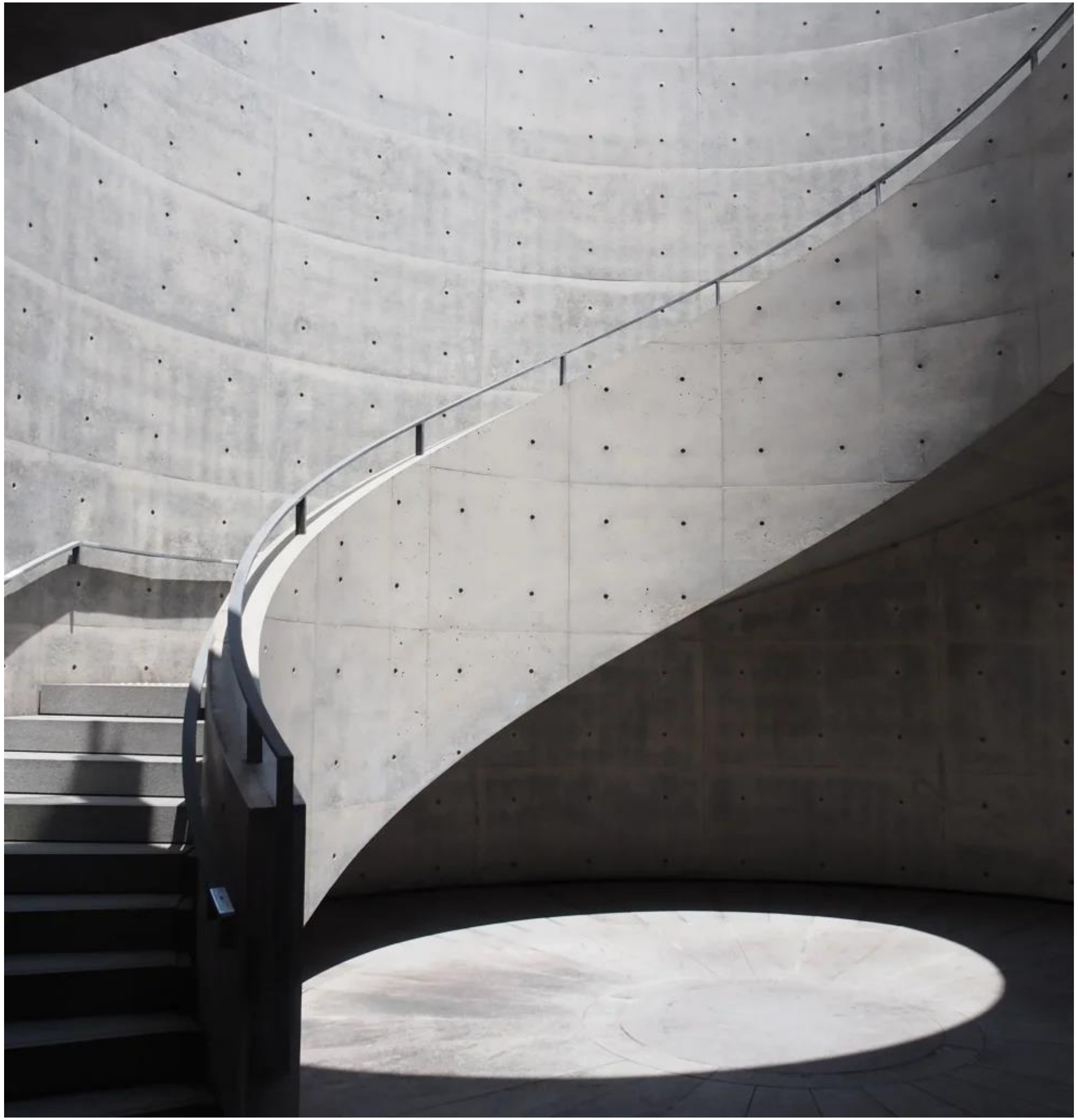
HV-7188






OPEN


21_21



PROBLĒMAS

1. **SASTĀVS**

- CEMENTS [BROCĒNI vs Igauņi],
- EKOLOĢIJA [cements “zaļi” = ekoapdedzināts]
- BALTS, KRĀSAINS – ražošana, izmaksas

2. **KLIMATS + TEHNOLOĢIJA**

- Eksponētais betons eksterjerā + interjerā = iestrādāšanas biezums, veidņi, izmaksas
- Aukstuma tiltiņi, inženierkomunikācijas
- Nekontrolējamas “Ziemas piedevas”
- IN SITU vs PREFAB; liets/vibrēts/blietēts; vertikāli vs horizintāli; piens, burbuļi

3. ILGMŪŽĪBA, AIZSARDZĪBA, KOPŠANA

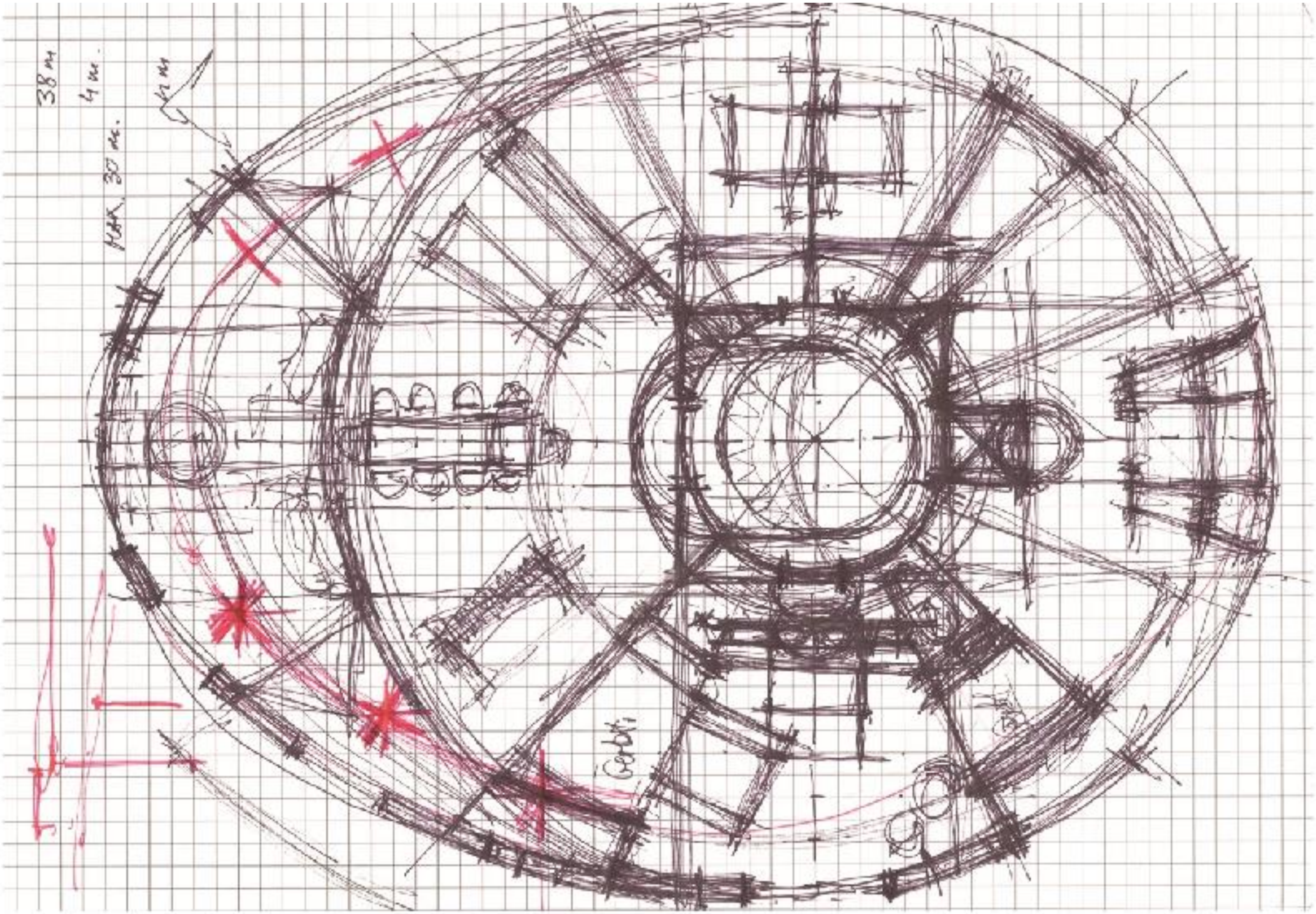
4. REMONTS/RISKI

MB GRUPA

BETONA RECEPTE IZCILAM REZULTĀTAM

OLA FOUNDATION PROJEKTS

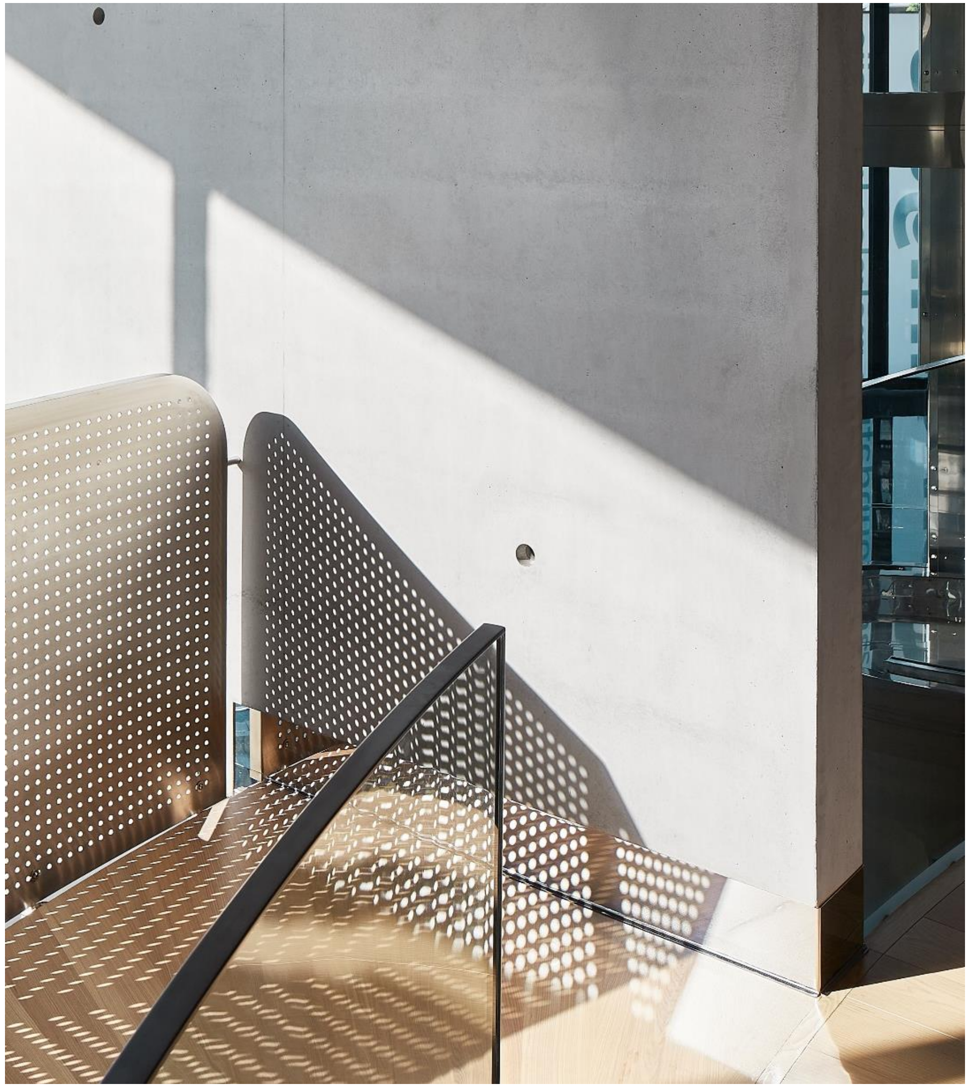
Dr. inž. Artūrs Lukašenoks
Tehniskais direktors, MB Betons



> Ja olu sasit no ārpuses, tās ir vēl nedzimušas dzīvības beigas, bet, ja olu sasit no iekšpuses ar palīdzību no ārpuses, tas ir kā jauna sākums

MB GRUPA


ILMĀRS
BLUMBERGS
THE SERVANT




GADA LABĀKĀ BŪVE LATVIJĀ
EUmies Awards
2024 Nominee

PROJEKTA DALĪBNIEKI

> Pasūtītājs: fonds *Ola Foundation*

> Arhitekts: Uldis Pīlēns

> Projektēšanas darbi: SIA *UPB Projekti*, SIA *Inženieru birojs Būve & Forma,* SIA *BICP*

> Ģenerāluzņēmējs: SIA *UPB Nams*

> Būvkonstrukcijas: SIA *RK Metāls*, SIA *Dzelzsbetons MB*

> Betona ražošana un piegāde: SIA *Transportbetons MB*

> Betona kvalitātes kontrole: SIA *Betona pētījumu centrs*

> Eksponētā monolītā dzelzsbetona konstrukciju izbūve: SIA *Rigensi*

BETONA RECEPTE

MB GRUPA

Īss raksturojums:

Dekoratīvais betons Ola Foundation projektam

Nr: **965JE**

Transportbetons
MB Jelgava

Materiāli	Betona sastāvdaļas	Blīvums, t/M3	Masas daļa, %	kg/m³	l/m³
Cements	CEM I 42.5 N	3.15	100%		
	-	1.00	0%	350	111.1
Ūdens	Ūdens				
	-	2.66	0%	189	188.6
Smalkā pildviela	Mazgāta Smilts 0/4 mm		45%		
	-		0%	791	297.5
Rupjā pildviela	2/8 mm	2.65	0%		
	8/16 mm	2.65	20%		
	-		35%	350	
	-	2.60	0%	613	132.2
Minerālās piedevas	Dolomīta milti		0%		231.4
	-		14.3%		
	-	1.05	0.0%	50.00	19.2
Ķīmiskās piedevas	Plastifikātors	1.05	0.0%		
	Aizkavētājs		1.00%	3.50	3.3
	-		0.50%	1.75	1.7
ū/c attiecība			0.00%		
Gaiss, %			0.550		
pastas tilpums, l			1.5%		15.0
				Σ 2349kg	343.6
					Σ 1000l

Izstradāja: janis.kudins

Paraksts:

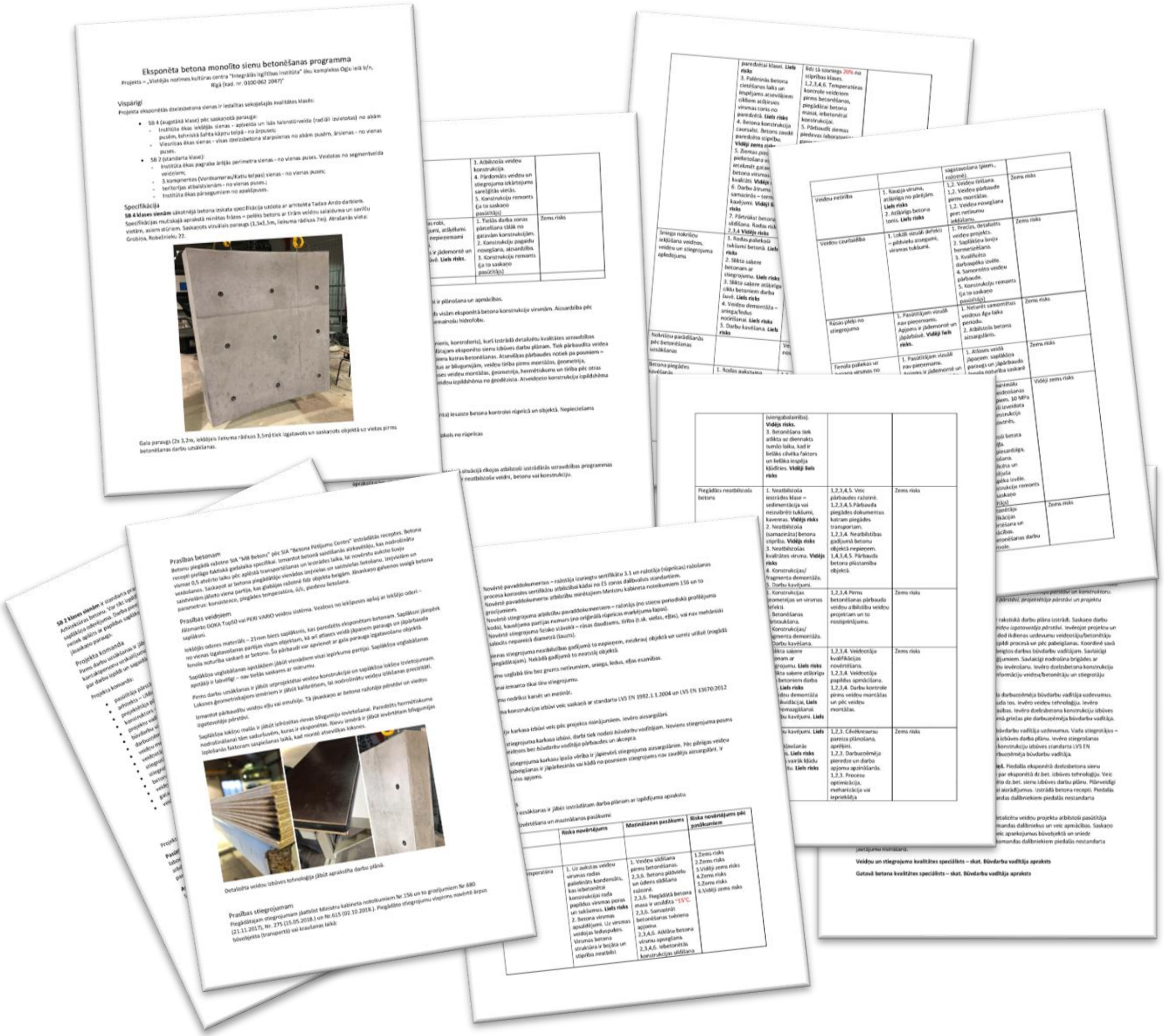
19.03.2020

VAI AR TO PIETIEK?

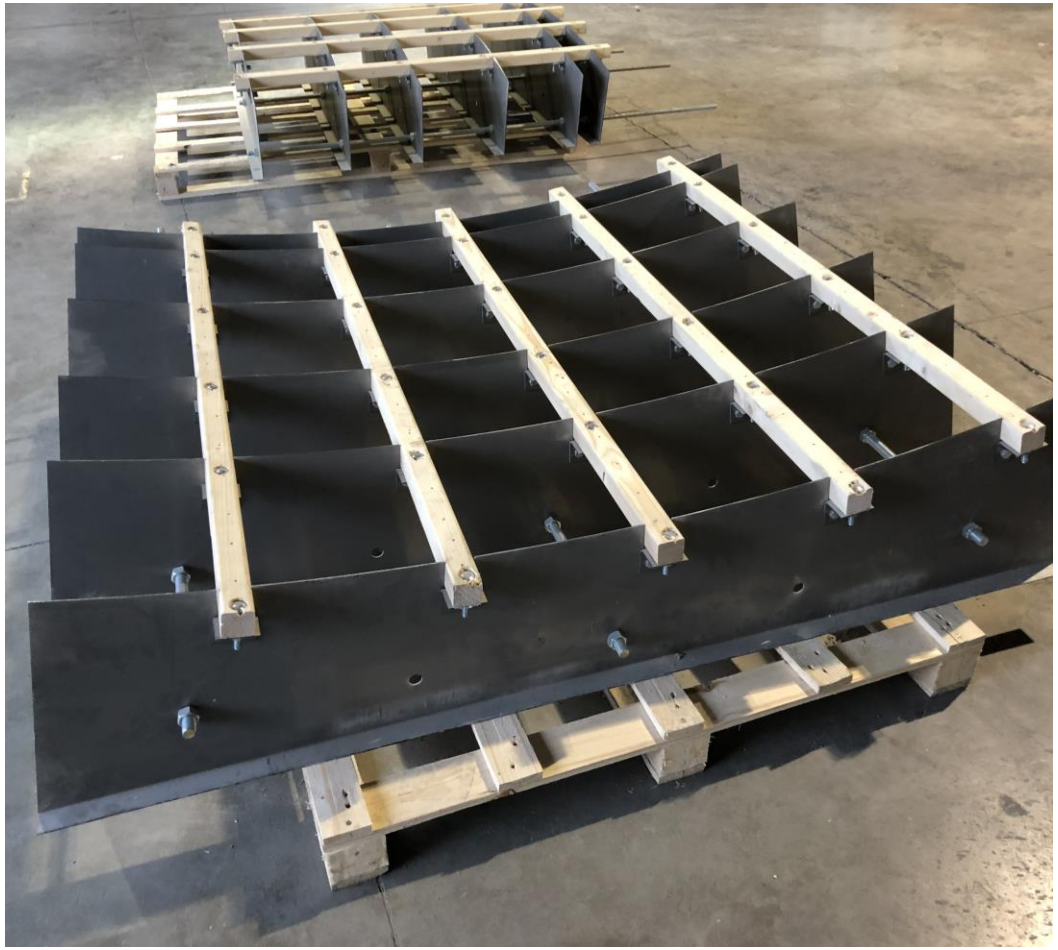
MB GRUPA

EKSPONĒTĀ BETONA TEHNOLOĢIJA

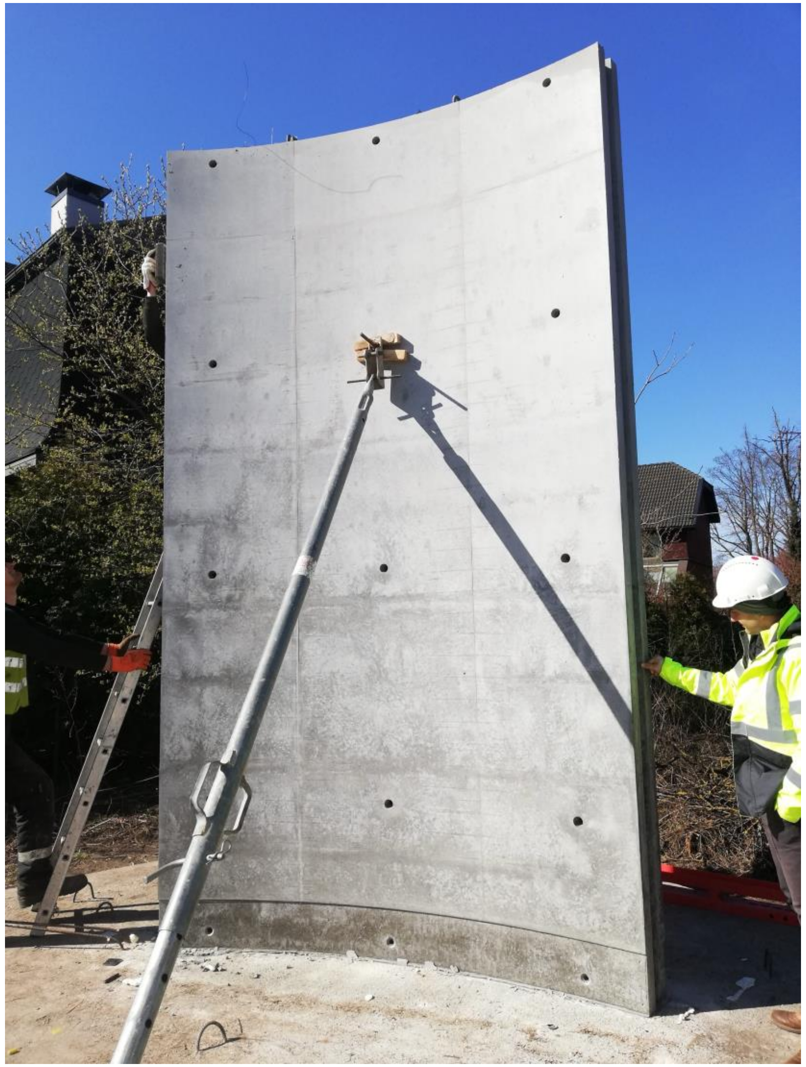
- > Virsmas kvalitātes prasības
- > Betona sastāva izstrāde
- > Iestrādes tehnoloģija
- > Prasības svaigam betonam, veidņiem
- > Risku izvērtējums & mazināšanas pasākumi
- > Tehnoloģijas uzraudzība
- > Projekta komandas lomas



PROTOTIPS



PILNIZMĒRA PARAUGI OBJEKTĀ



KAS VARĒJA NOIET GREIZI?

KAS VARĒJA NOIET GREIZI?

Betona piegāžu precizitāte

Saplākšņa virsmas nomaiņa

Laikapstākļi

Veidņu aizsardzība

Atveidņošana

Betona aizsardzība

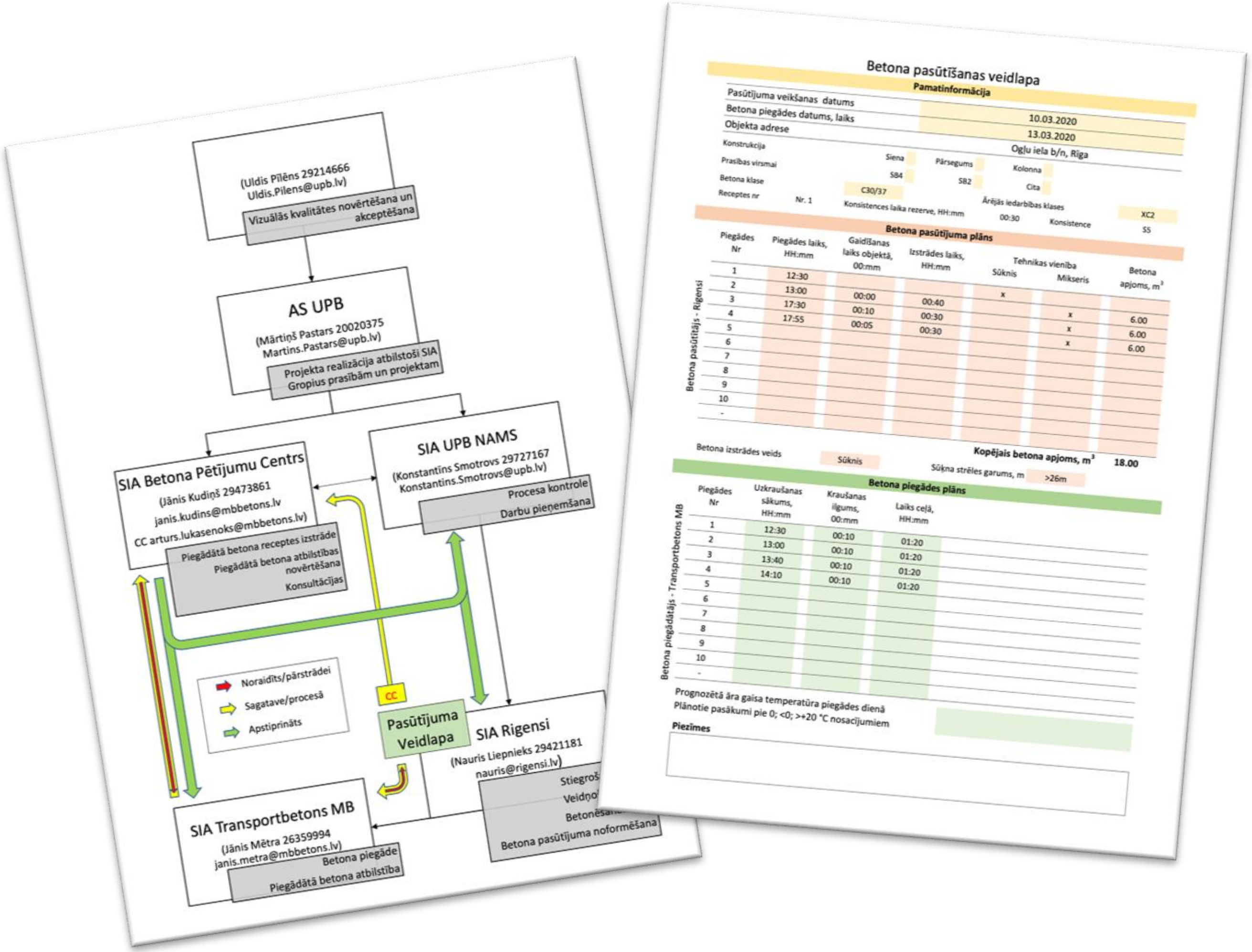
BETONA PIEGĀŽU PRECIZITĀTE

> Piegāžu attālums

> Šosejas remonti

> Iebraukšanas ierobežojumi

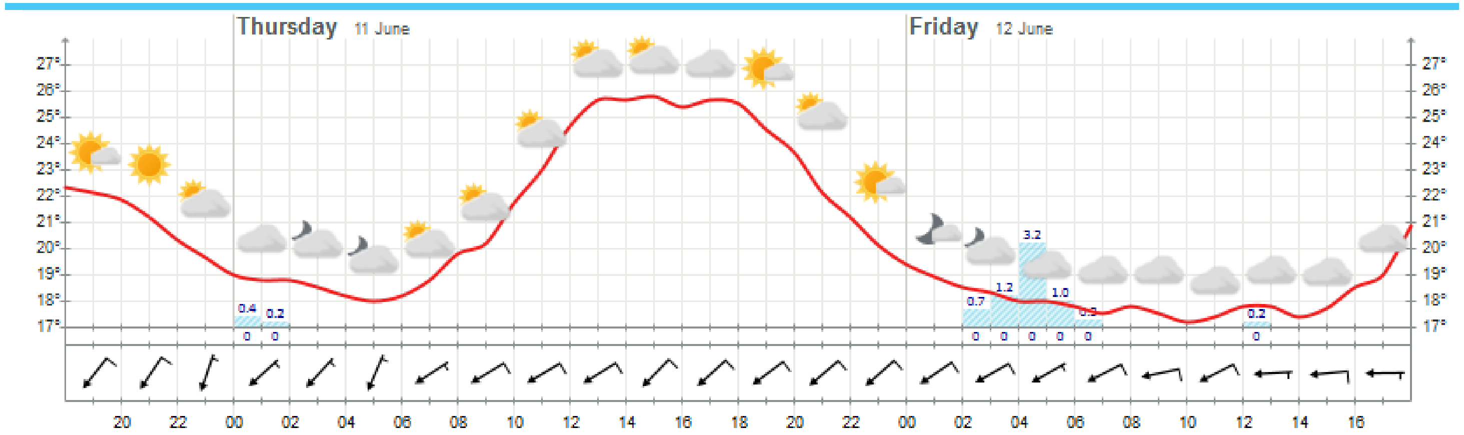
> Vienošanās ar kaimiņiem



SAPLĀKŠŅA VIRSMAS NOMAIŅA

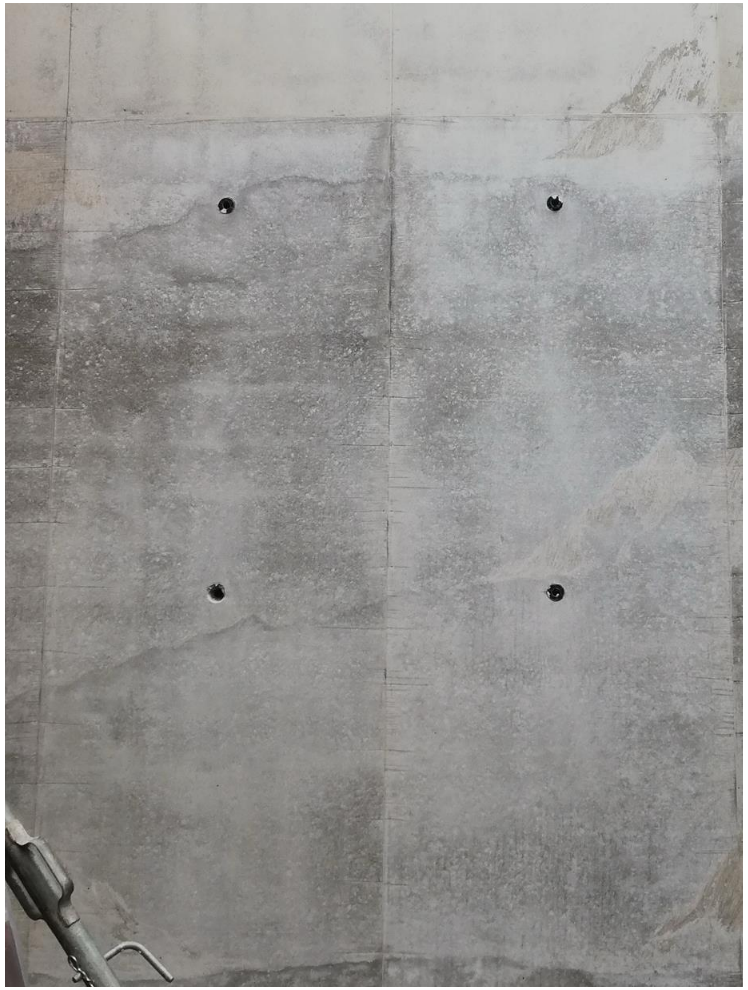
LAIKAPSTĀKĻI

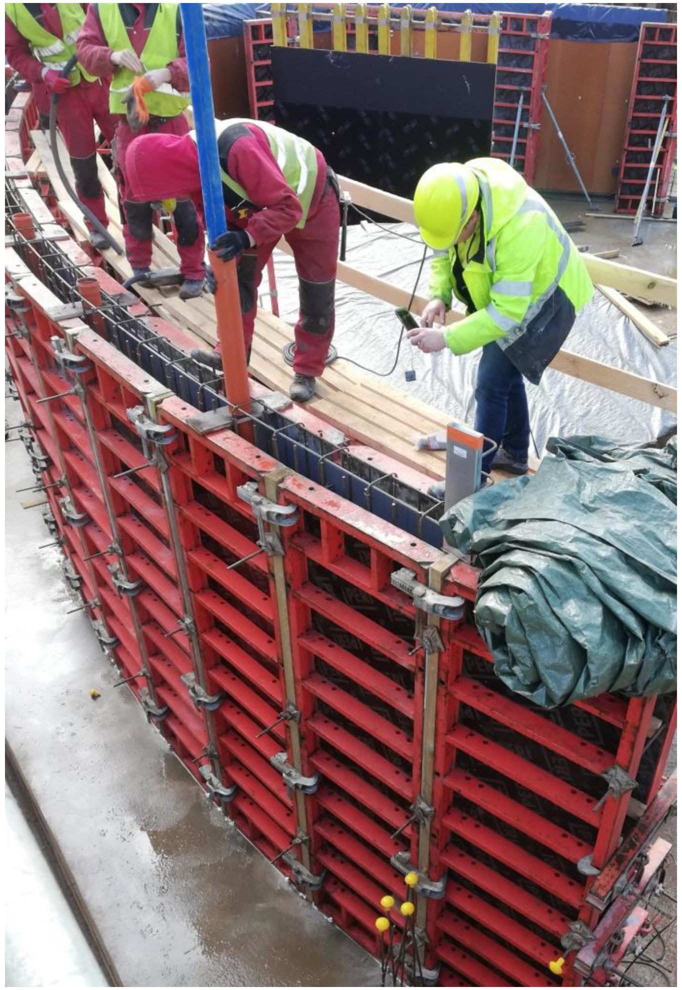
Meteogram, next 48 hours



The blue bars show max and min values for precipitation per hour.

VEIDŅU AIZSARDZĪBA





ATVEIDŅOŠANA

BETONA AIZSARDZĪBA

BETONA AIZSARDZĪBA

KAS ĻĀVA SASNIEGT REZULTĀTU?

MŪSU BETONA RECEPTE

Tehnoloģijas izstrāde un plānošana + Problēmu risināšana uz vietas + Īstā komanda + Sadarbība + Orientēšanās uz kopēju rezultātu

PALDIES!

Dr. inž. Artūrs Lukašenoks
Tehniskais direktors, MB Betons

Latvijas Betona Savienība

Eksponētā betona tehniskā komiteja (TK03)

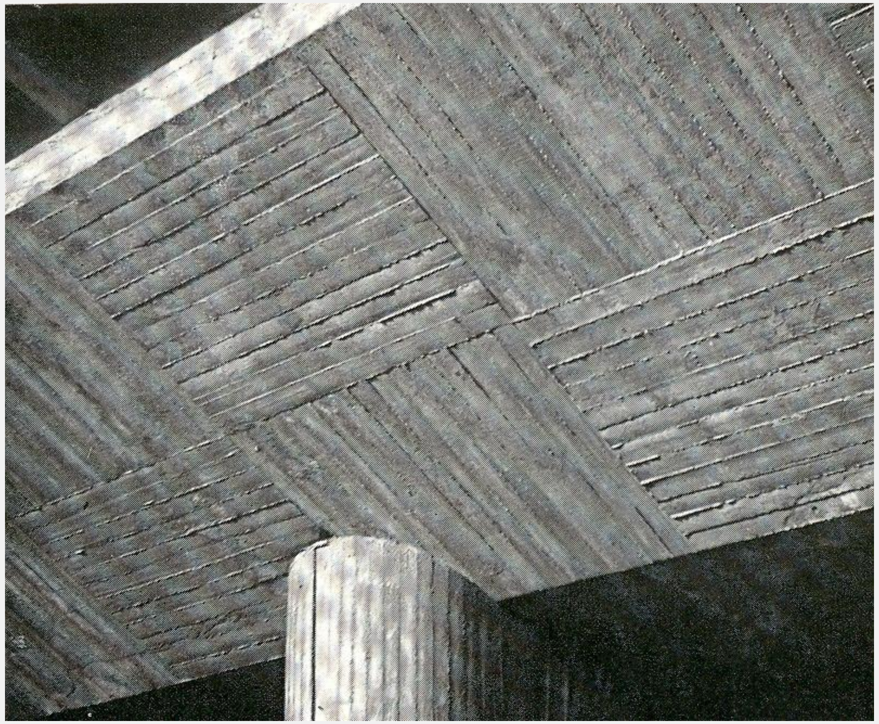
DIDZIS MALKAUSIS

- Eksponētais betons
- LBS izpilddirektors
- Eksponētā betona tehniskā komiteja (TK03)

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03)- IEVADS

EKSPONĒTAIS BETONS

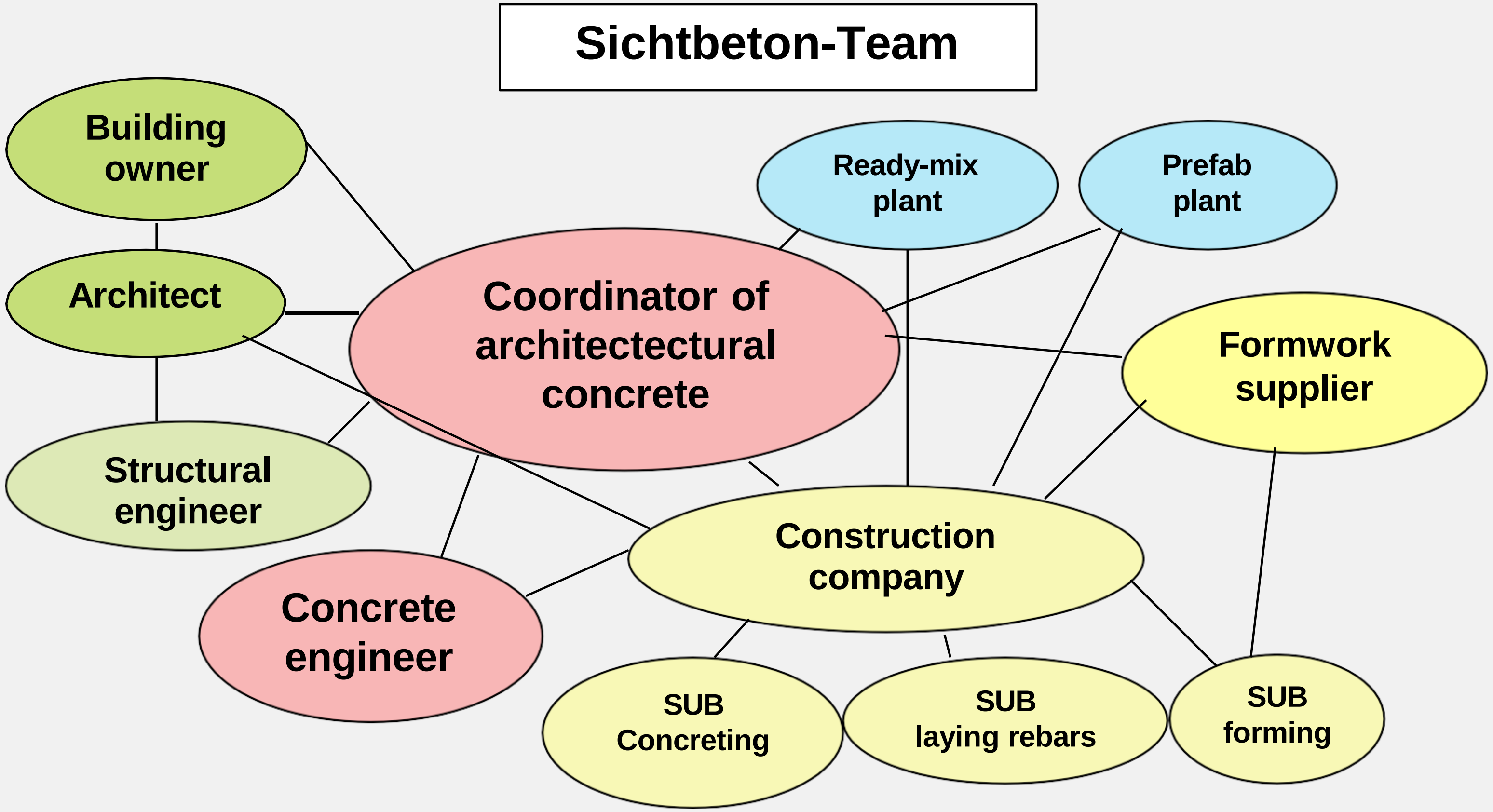
EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -IEVADS



EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -IEVADS

- Eksponētais betons
- Redzamais betons
- Betons bez apdares
- Arhitektoniskais betons
- «Fair face concrete»

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -IEVADS



Aus: K. Ebeling „Planungs- und Ausführungshinweise“; beton 4/98

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -IEVADS

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -IEVADS

- Eksponētā betona izstrādājumi vienmēr būs ar savu individuālu raksturu - nevis pelēkas viengabalainas sienas.

Eksponētais betons ir “dzīvs” materiāls, kas iegūst dažādību betonēšanas procesā un turpina “dzīvot” arī pēc tam - gaismas spēļu un apkārtējās vides ietekmē.

Eksponētā betona skaistums ir relatīvs - atkarīgs no skatu punkta.

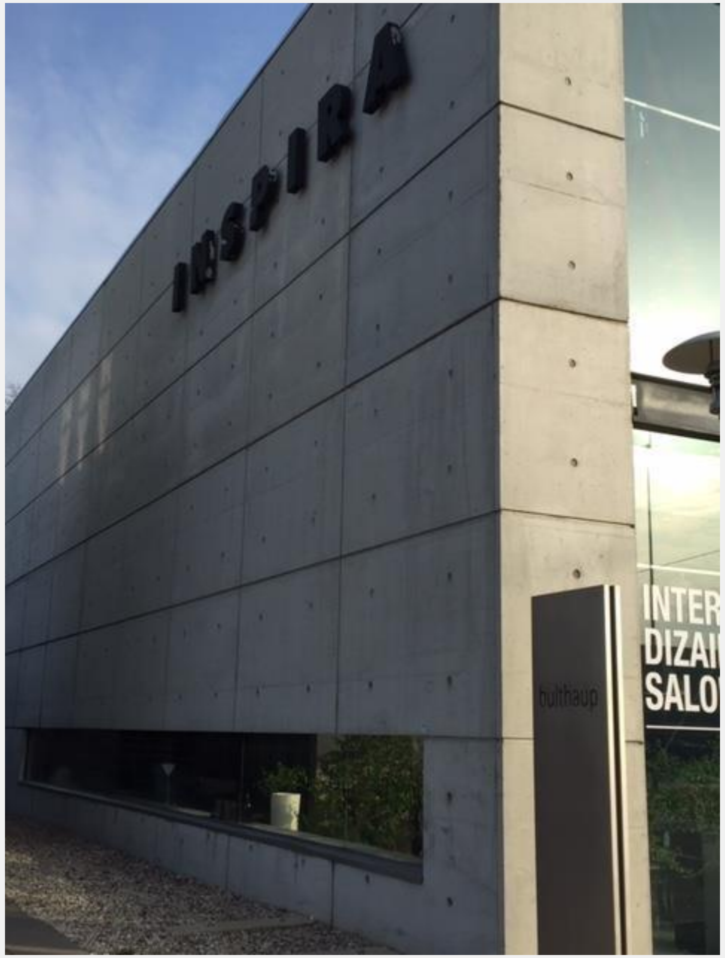
EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03)- MĒRĶI

- LBS 10.03.2022 apstiprināta tehniskā komitejas TK03 izveide
- Nodefinēt Eksponētā betona kā produkta kritērijus. Izstrādāt atbilstošu Valsts standartu un /vai tehniskos noteikumus.
- Darba grupā iesaistīt

  Mācībspēkus (RTU,LBTU)
  Arhitektus
  Konstruktorus
  Betona ražotājus
  Veidņu ražotājus
  Saliekamā dzelzsbetona ražotājus

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -PAVEIKTAIS

- Apzinājuši jau esošos standartus un noteikumus
    - Latvijas
    - Nīderlandes
    - Vācijas
    - Lielbritānijas
    - Poļu
    - Somu
    - Igauņu



EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03)- PAVEIKTAIS

- TK03 strādā pie Igaunijas tehnisko noteikumu pielāgošanas.
- Mērķis visās 3 Baltijas valstīs vienādi tehniskie noteikumi eksponētam betonam

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -PAVEIKTAIS

- «Eksponētā betona komandas» dalībnieki.
- Līdz 20 kolēģiem
- 3 apakšgrupas
  - Transportbetons – Jānis Kudiņš
  - Saliekamais dzelzsbetons – Edgars Andužs
  - Betonēšanas veidņi – Arnis Janbergs

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03) -PAVEIKTAIS

- «Eksponētā betona komandas» dalībnieki.
  - Tehniskais redaktors - Sandra Guzlēna

EKSPONĒTĀ BETONA TEHNISKĀ KOMITEJA (TK03)

- Aicinu iesaistīties komitejas darbā, izveidojot labākos iespējamos tehniskos noteikumus «Eksponētā betona komandai»
- Aicinu dalīties ar eksponētā betona objektu fotogrāfijām, dažādās objekta stadijās.

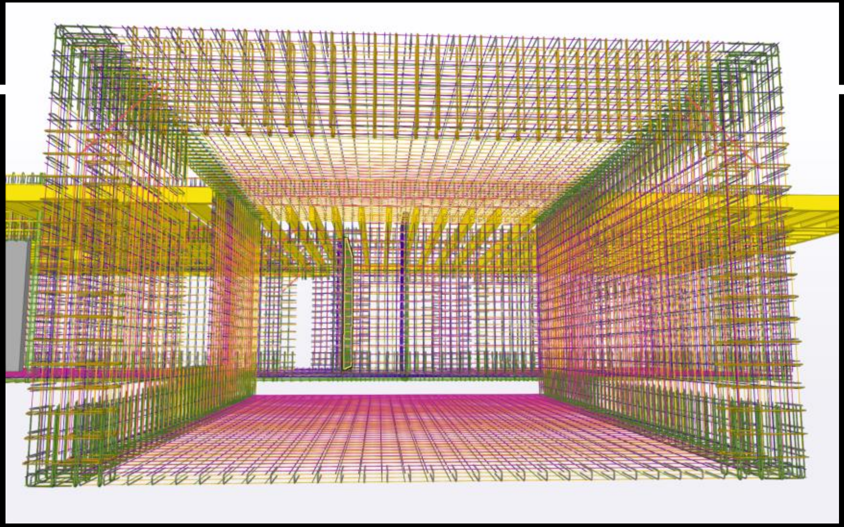
tk03lbseb@gmail.com

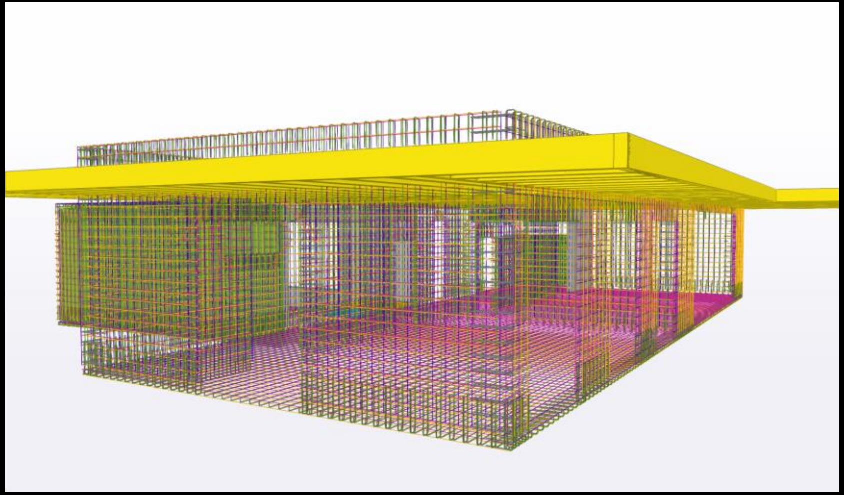

KAIGAN

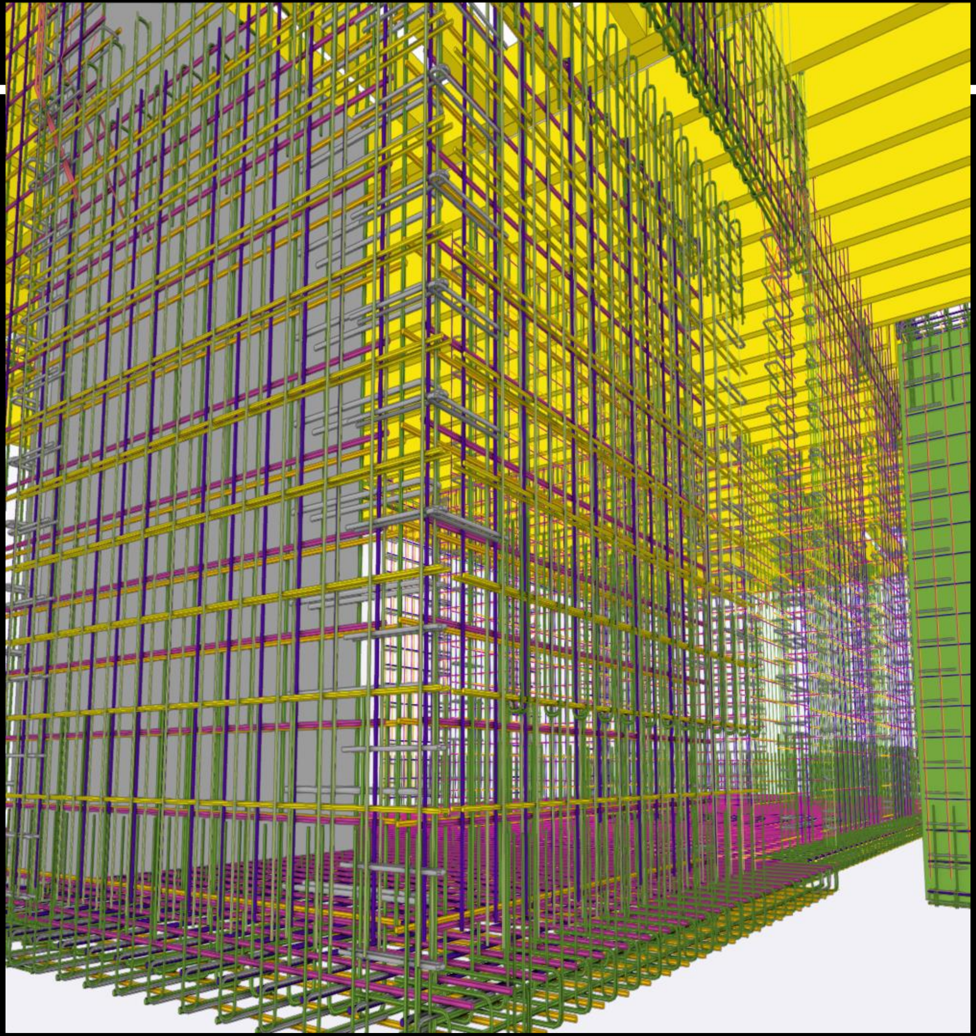
UNIKĀLS 26 VILLU CIEMATS/ EKSPONĒTAIS BETONS DOMINĒJOŠAIS BŪVMATERIĀLS VISĀ CIEMATĀ


doka H20 top P

BIM 3 MODEĻA PIELIETOJUMS MONOLITĀ DZEZSBETONA KONSTRUKCIJU IZBŪVEI (STIEGROŠANA, VEIDŅOŠANA, BETONĒŠANA)







Number of bars in group:	7
Grade:	Undefined
Size:	12
Shape:	1
Length:	8680 mm
Weight:	0.008 t
Weight total in group:	0.054 t

IfcMaterial

Material:	CONCRETE/C30/37

Tekla Common

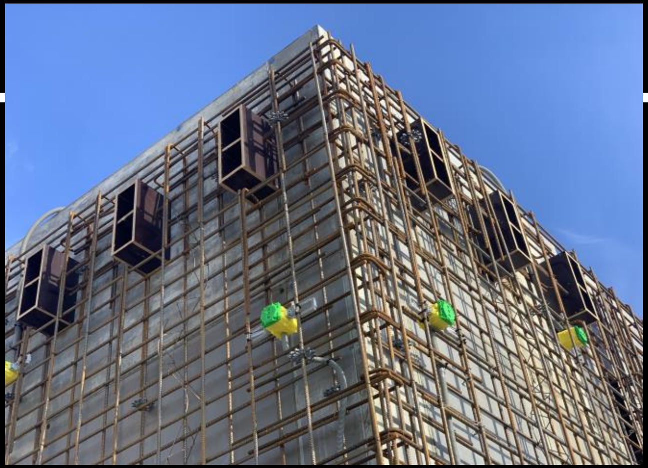
Bottom elevation:	-0.080
Top elevation:	+4.300

Weight:	36.980 t
Volume:	15.4 m3
Gross footprint area:	4.20 m2
Area per tons:	4.80 m2
Net surface area:	176.10 m2
Height:	4380 mm
Width:	200 mm
Length:	21000 mm

BaseQuantities

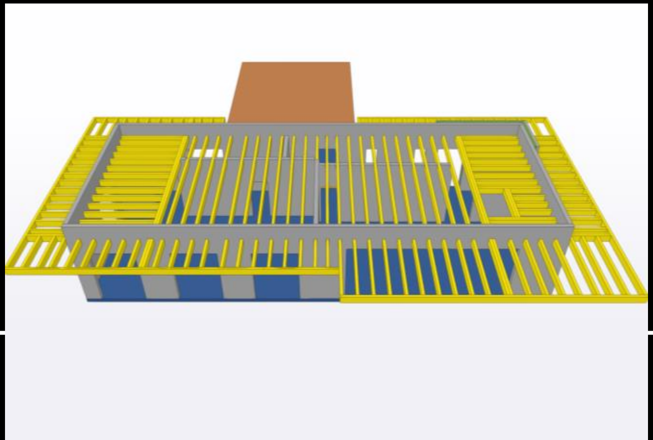
Length:	21000 mm
OuterSurfaceArea:	176.10 m2
NetVolume:	15.4 m3
NetWeight:	36.980 t

ARHITEKTONISKIE UN KONSTRUKTĪVIE RISINĀJUMI- 40 KM IEBŪVĒTU INŽENIERTĪKLU

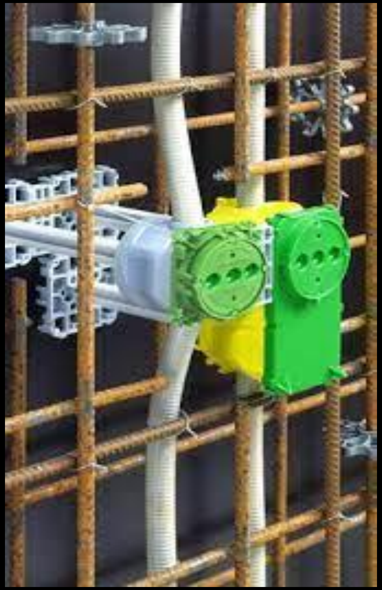


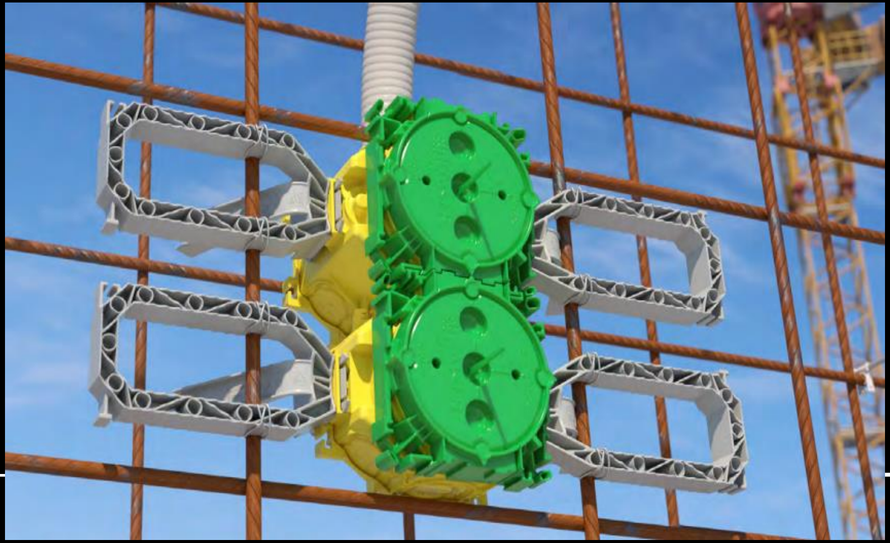
Iebūvētas vājstrāvas, elektrotīkli, ventilācija, zemējums, apkure, ūdensapgāde, kanalizācija, KNX sistēma, apsardze sistēma, ugunsgrēkas atklāšanas sistēmas, videonovērošanas sistēma uc.

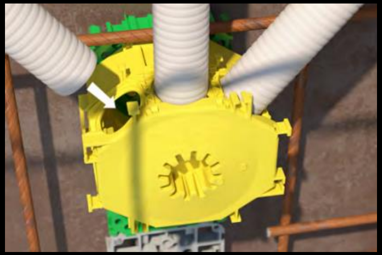
Iebūvēto monolotajā dzelzsbetona nepieciešamo inženiertīklu ģeodeziskā uzmērīšana

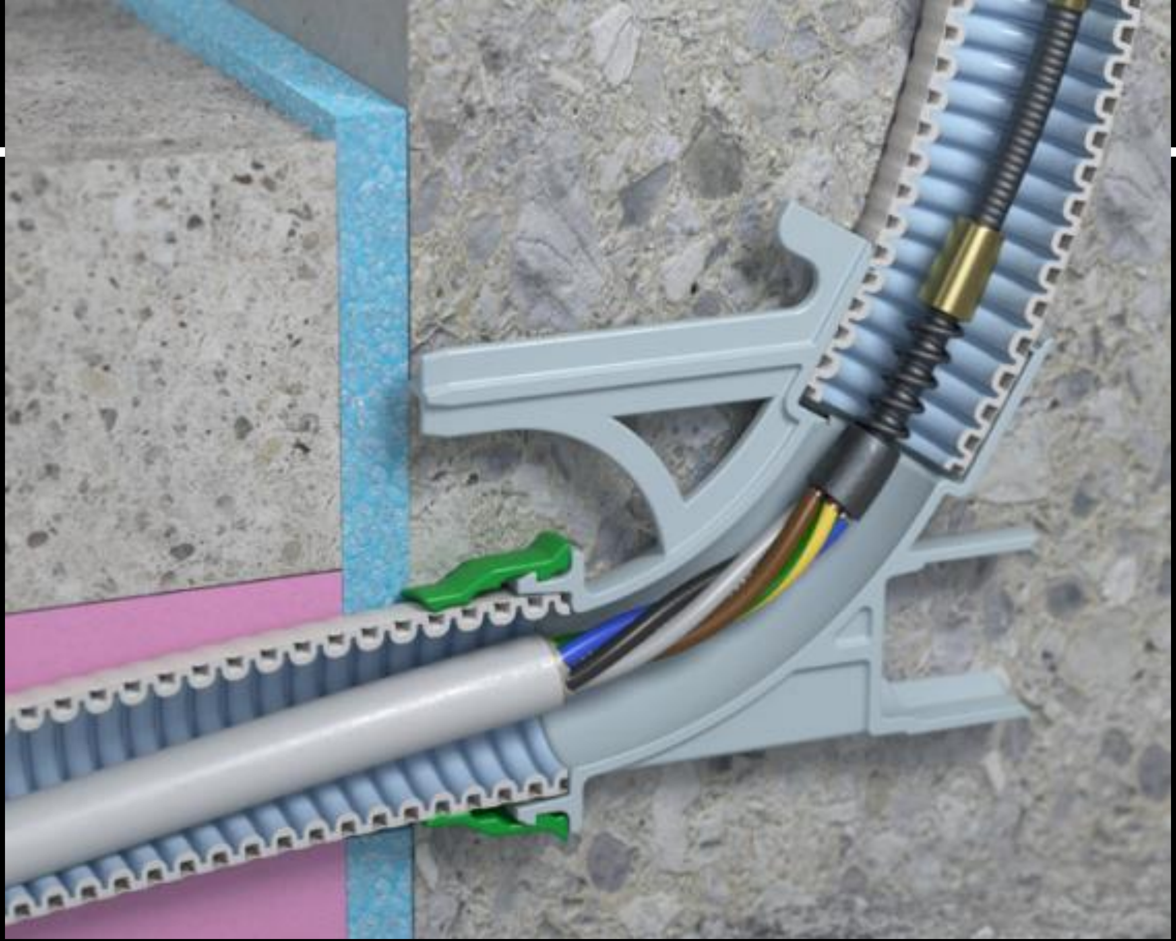


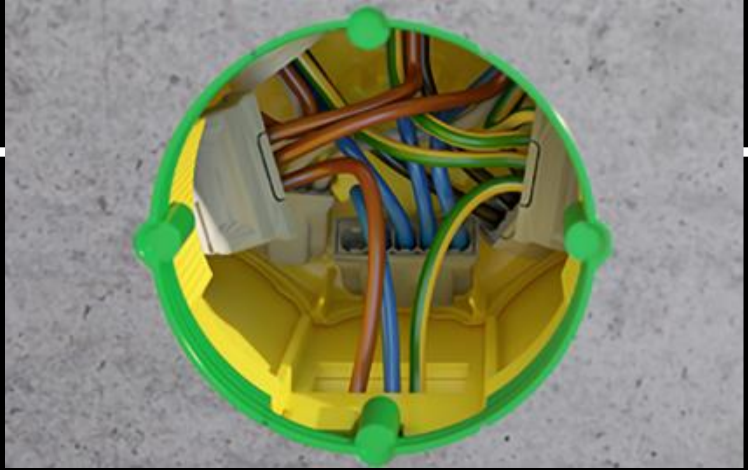
IEBŪVĒTO INŽENIERTĪKLU TEHNOLOĢIKSIE RISINĀJUMI- KAISER (2 DEFEKTI NO 10 000 DETAĻĀM)- 0.02%

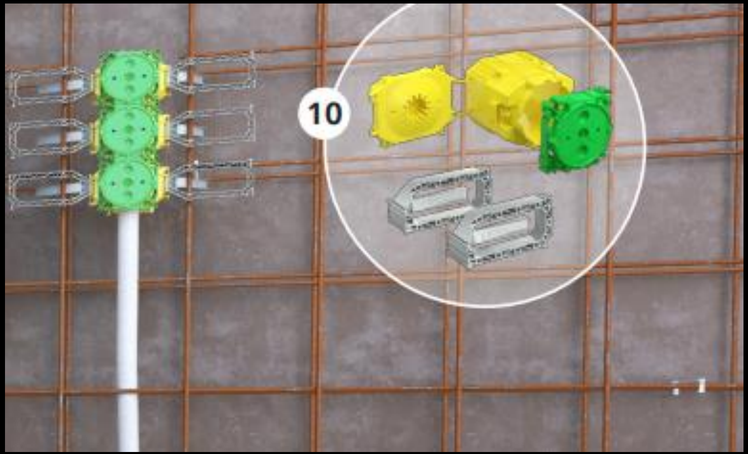


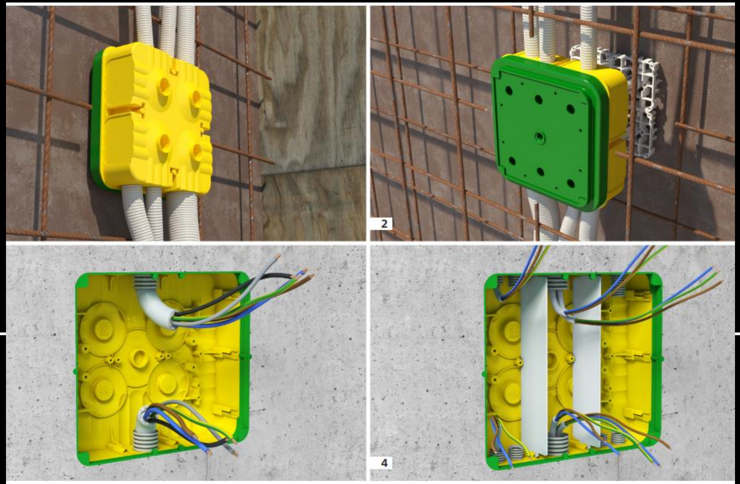









10


2
4


MAPEI
Mapecure WG
Plēvi veidojoša ūdens emulsijas pretizžūšanas membrāna betonam

MAPEI

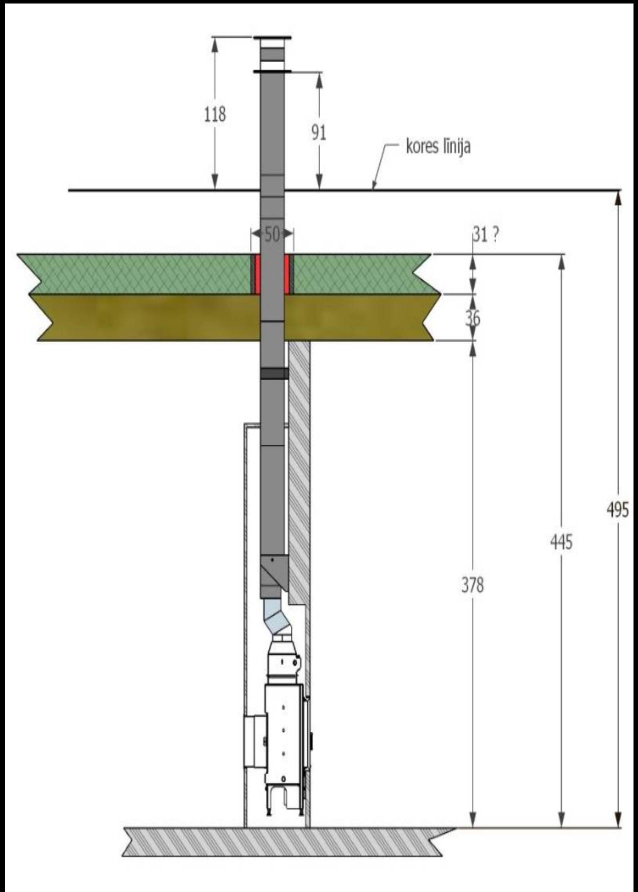
ARHITEKTONISKIE UN KONSTRUKTĪVIE RISINĀJUMI-EKSPONĒTIAS BETONS

ARHITEKTONISKIE UN KONSTRUKTĪVIE RISINĀJUMI-EKSPONĒTA ĀRA FASĀDE





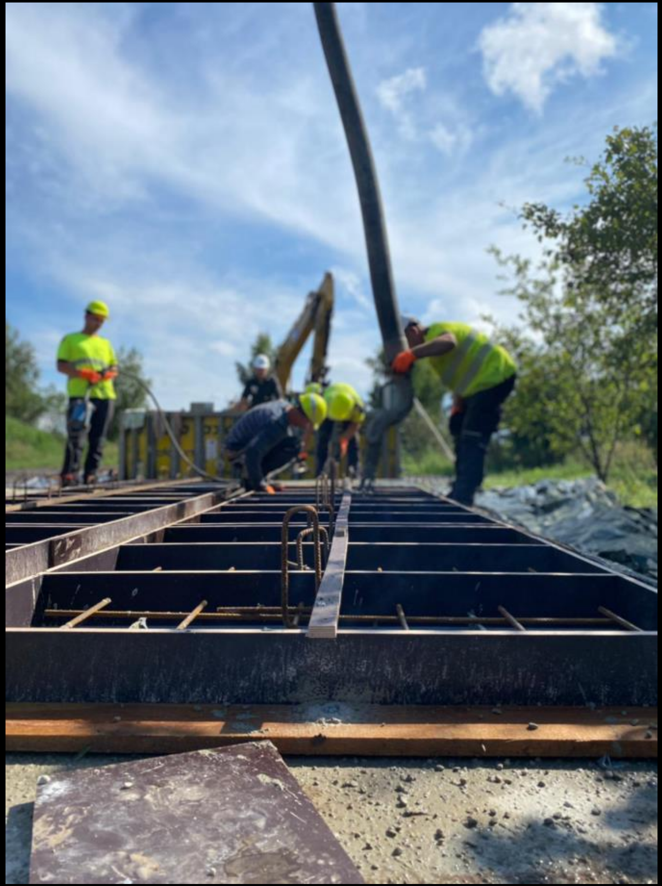
ARHITEKTONISKIE UN KONSTRUKTĪVIE RISINĀJUMI-EKSPONĒTA ĀRA FASĀDE


118
91
kores līnija
50
31 ?
36
495
445
378

INFORMĀCIJA PAR BŪVĒ IZMANTOTO BETONU

- Eksponēta betona nesošais karkass (C35/45 XC2 XF2 S5/ C35/ XC4 S4, XF2/C30/37 XC1 S3/ C35/45 XC2, 37XF2)
- Eksponētā betona fasāde (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakacija)
- Eksponēta betona žogs (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakacija)
- Eksponēta betona atpūtas vieta C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Ēksponētā betona puķu dobes C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Monolitā dzelzsbetona lievieņi C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija ar fibru 30kg/m3 Horex)
- Monolita dzelzsbetona terases (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija ar fibru 30 kg/m3 Horex)
- Monolitā dzelzsbetona vides objekti (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Monolitā dzelzsbetona stāvlaukums (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Monolita dzezsbetona atbalstsienas (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Eksponetais betona interjers (C35/45 XC2 XF2 S5/ C35/ XC4 S4)
- Tonetā melnā betona izmantošana (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija)
- Pāšvibrejošā betona izmantošana fasādei (C35/45 XC4 XS3 XD3 XF1 XA1 S4 W10 smalka frakcija Eksponēta recepte+pašvibrejošā recepte)

PILNĪGA TEHNOLOĢISKO BETONA PĀRPALIKUMU IZSTRĀDE ATBILSTOŠI RECEPTEI



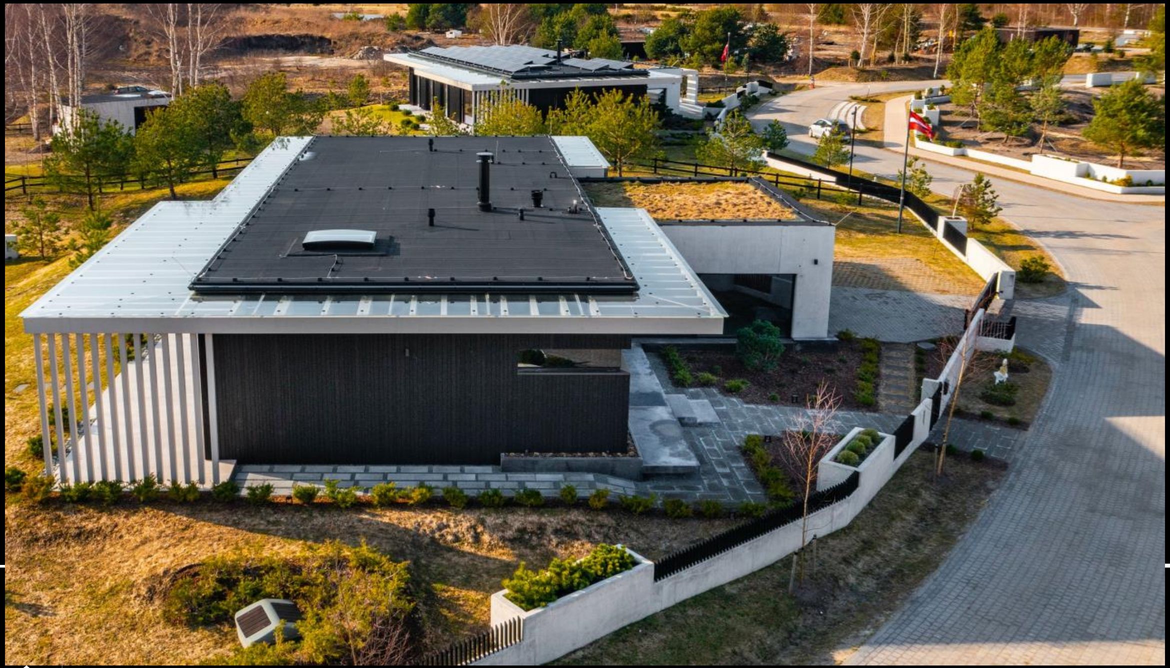
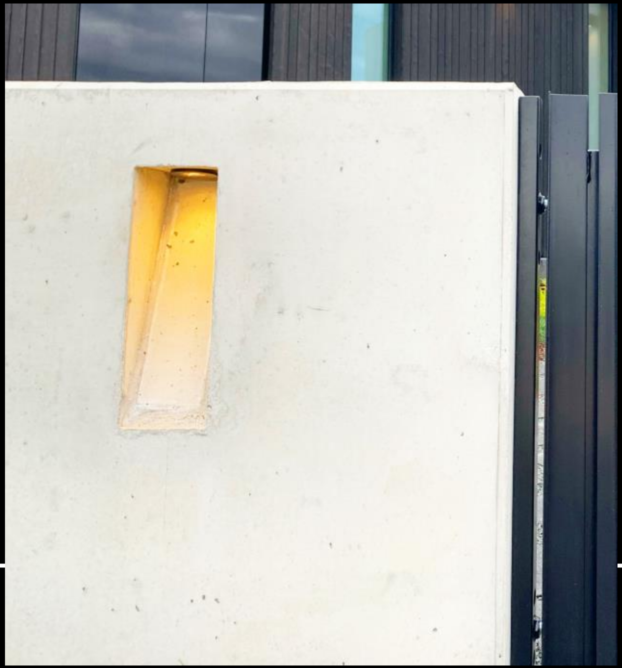
ARHITEKTORNISKIE UN KONSTRUKTĪVIE ELEMENTI- APSILDAMĀS CEĻA PLĀTNES

LABIEKARTOJUMA ELEMENTI- ĀRA VIRTUVES, ŽOGS



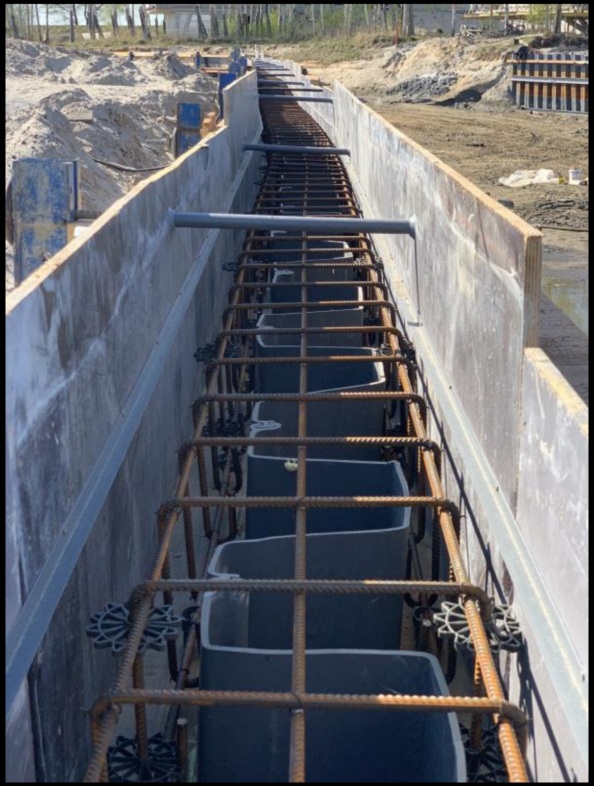

LABIEKARTOJUMA ELEMENTI- ŽOGS



LABIEKARTOJUMA ELEMENTI- ŽOGS 2000 m METRU GARUMĀ

ARHITEKTORNISKIE UN KONSTRUKTĪVIE ELEMENTI- RIEVSIENU STIPRINĀŠANA



VIDES DIZAINA OBJEKTI NO EKSPONĒTĀ BETONA





EKSPONĒTAIS BETONS INTERJERĀ

EKSPONĒTAIS BETONS INTERJERĀ


Cafe Music
BGMC

EKSPONĒTAIS BETONS INTERJERĀ


Cafe Music
BGMC

EKSPONĒTAIS BETONS INTERJERĀ

IEBŪVĒTO MATERIĀLU KVALITĀTE

doka
HILTI
GEBERIT
SCHWENK
Heidelberg Materials
PEAK NX
TECE
KAISER
SOUDAL
hoxter
TESCON
Kingspan
MAPEI
SCHÜCO
MB GRUPA


INDUSTRIAL SMART SOLUTION
KAIGAN

Rail Baltica

BERERIX

The fair-faced concrete of Rail Baltica's in Riga Central Station

28.11.2024.

Lauris Joksts

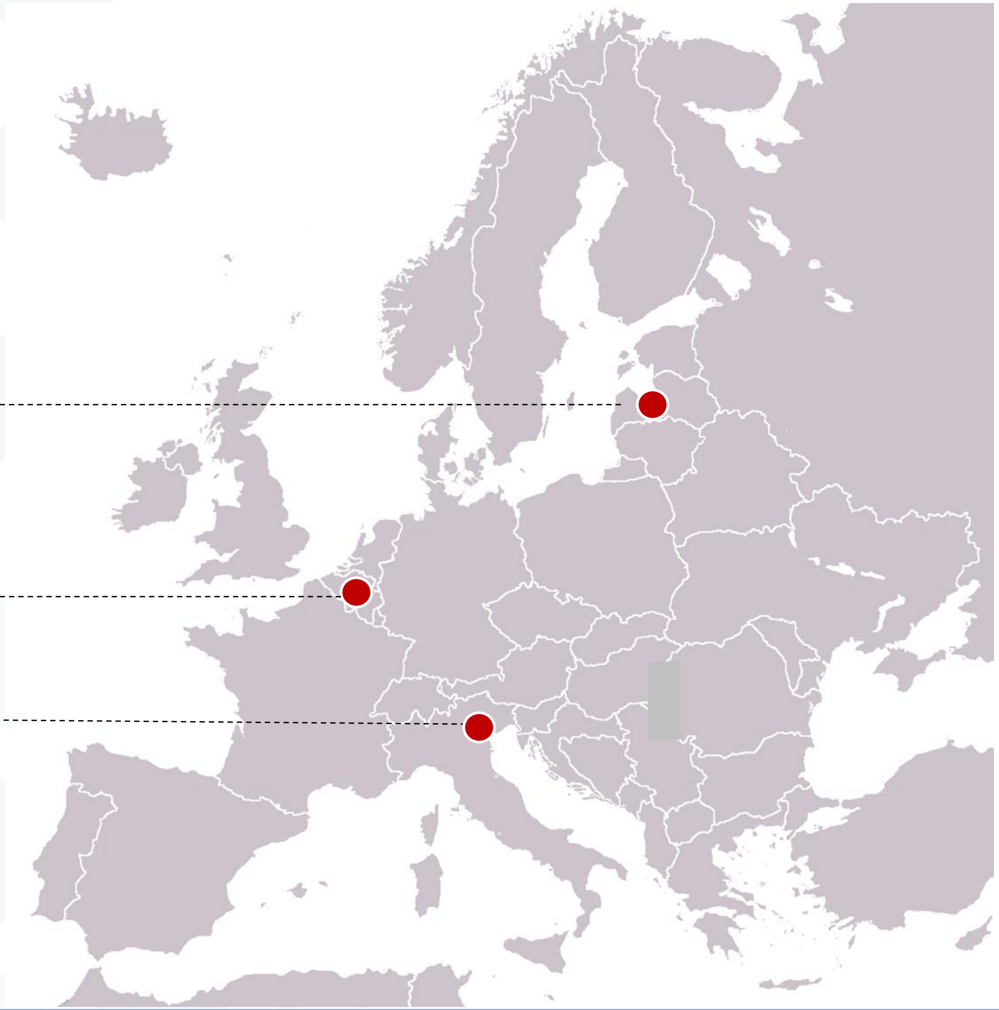
BERERIX

BERERIX TEAM

RERE GRUPA

BESIX

RIZZANI DE ECCHER



BERERIX

Contractor BERERIX, a General Partnership incorporated under the laws of Latvia,

The Employer of the Project is SIA “EIROPAS DZELZCEĻA LĪNIJAS”,

Engineer EGIS RAIL S.A.,
Egis Batiments International,
DB Engineering & Consulting GmbH


Lāčplēša iela
Station
Daugava
Jelgavas iela
Zaķusala

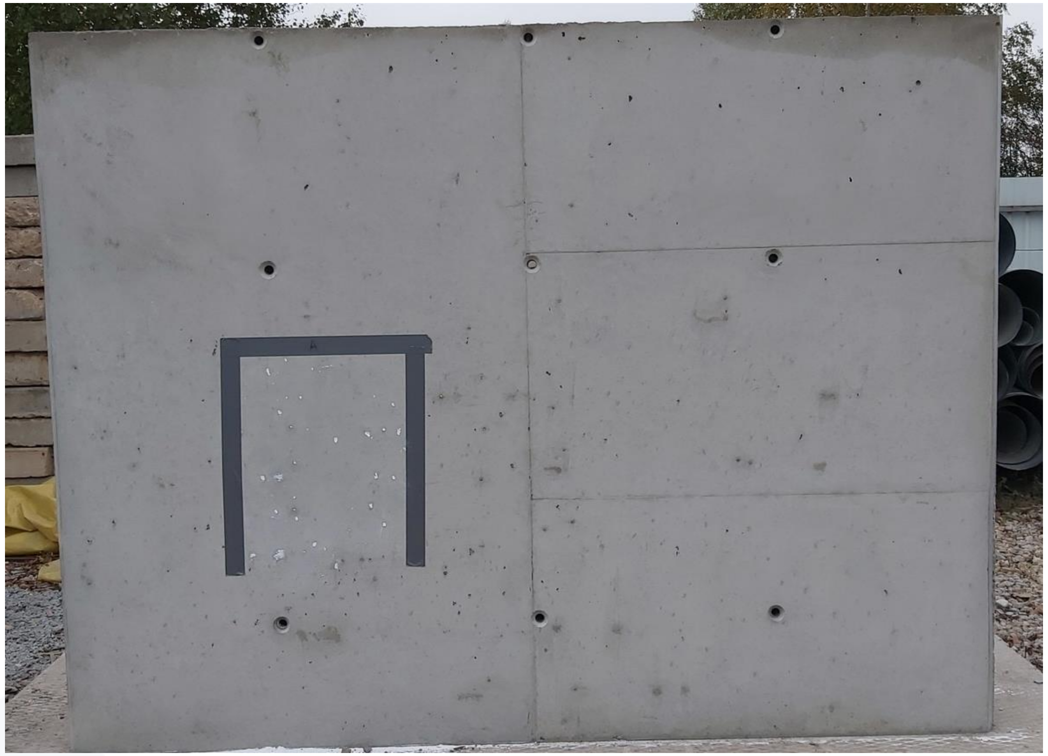
Project Quality requiremenets for fair-faced concrete

- ✓ Bridge specification 2020
- ✓ Technical specification 2018
- ✓ LVS EN 13670 Execution of concrete structures
- ✓ NBN B 15-007 Fair-faced Concrete - Classifications and specifications

BERERIX

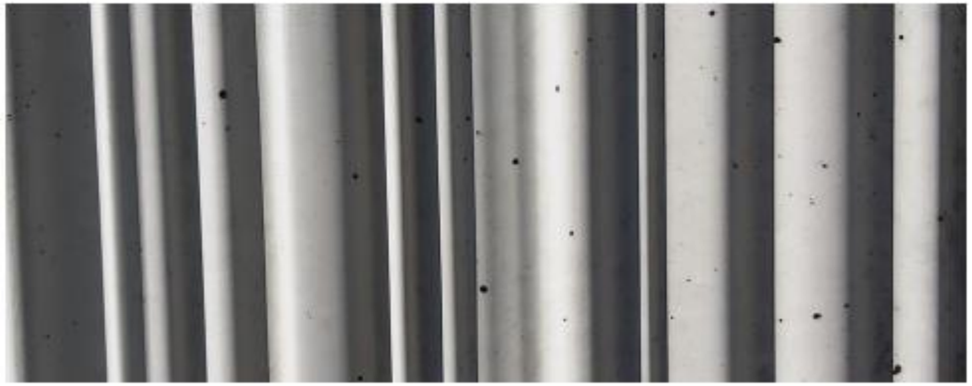
Mockup of fair-faced concrete

Mockup of fair-faced concrete



BERERIX

Mockup of fair-faced concrete



BERERIX

NBN B 15-007 Tekstūras novērtējums/Texture assessment

	Tekstūras novērtējums Texture assessment NBN B 15-007: 2018 "Fair-faced Concrete - Classifications and specifications"	**Rezultāts** Result	**Atbilst** Meets
T1	**Atsegtas pildvielas, izvirzījumi, tukšumi, izdrupumi nav pieļaujami**. Gravel nests (honeycombs), pop-outs, cavities, spalling are not permitted.	-	☐
	Viena smilšaina raupja zona ≤ 0,25 m² uz 10 m² ir atļauta. One sandy rougher zone up to ≤ 0.25 m² at area of 10 m² is permitted.	-	☐
	Rupjā zona cementa piena zuduma dēļ gar šuvēm ar max. platumu ≤30 mm. Rougher zone due to loss of cement milk maximum bandwidth of ≤ 30 mm.	-	☐
	Pēdas no veidņiem ir pieļaujamas. Framework printing of system formwork is permitted.	-	☐
T2	**Atsegtas pildvielas, izvirzījumi, tukšumi, izdrupumi nav pieļaujami**. Gravel nests (honeycombs), pop-outs, cavities, spalling are not permitted.	-	☐
	Viena smilšaina raupja zona ≤ 0,25 m² uz 15 m² ir atļauta. One sandy rougher zone up to ≤ 0.25 m² at area of 15 m² is permitted.	-	☐
	Rupjā zona cementa piena zuduma dēļ gar šuvēm ar max. platumu ≤20 mm. Rougher zone due to loss of cement milk maximum bandwidth of ≤ 20 mm.	-	☐
	Pēdas no veidņiem ir pieļaujamas. Framework printing of system formwork is permitted.	-	☐
	Tekstūras bojājumi no sitieniem nav pieļaujami. Damage to the texture due to impact of other materials not permitted.	-	☐
	Plaisas ar atvērumu ≥0.2 mm nav pieļaujamās. Cracks with width up to ≥0.2 mm are not permitted.	-	☐
T3	**Atsegtas pildvielas, izvirzījumi, tukšumi, izdrupumi nav pieļaujami**. Gravel nests (honeycombs), pop-outs, cavities, spalling are not permitted.	-	☒
	Viena smilšaina raupja zona ≤ 0,25 m² uz 30 m² ir atļauta. One sandy rougher zone up to ≤ 0.25 m² at area of 30 m² is permitted.	-	☒
	Rupjā zona cementa piena zuduma dēļ gar šuvēm ar max. platumu ≤10 mm. Rougher zone due to loss of cement milk maximum bandwidth of ≤ 10 mm.	-	☒
	Tekstūras bojājumi no sitieniem nav pieļaujami. Damage to the texture due to impact of other materials not permitted.	-	☒
	Plaisas ar atvērumu ≥0.2 mm nav pieļaujamās. Cracks with width up to ≥0.2 mm are not permitted.	-	☒

BERERIX

NBN B 15-007 Gaisa poru novērtējums/ Air bubble assessment

Gaisa poru novērtējums uz laukuma 400x400 mm. Air bubble assessment on an area 400x400 mm NBN B 15-007: 2018 “Fair-faced Concrete - Classifications and specifications”		**Rezultāts** Result %	**Atbilst** Meets
LBA1	**Virsmas gaisa poru kopējais laukums ir 2 mm <D eq <15 mm ≤ 1,20%.** Total area of the surface air pores is 2 mm < D eq <15 mm **≤ 1.20%.**	**0.72; 0.68**	☒
LBA2	**Virsmas gaisa poru kopējais laukums ir 2 mm <D eq <15 mm ≤ 0,6%.** Total area of the surface air pores is 2 mm < D eq <15 mm **≤ 0.6%.**	**-**	☐
LBA3	**Virsmas gaisa poru kopējais laukums ir 2 mm <D eq <15 mm ≤ 0,3%.** Total area of the surface air pores is 2 mm < D eq <15 mm **≤ 0.3%.**	**0.27**	☒

NBN B 15-007 Krāsu viendabīgums, Vērtēšanas zona 0.5x0.5m. Color uniformity.

	Krāsu viendabīgums Vērtēšanas zona 0.5x0.5m. Color uniformity. Area of evaluation 0,5x0.5m. NBN B 15-007: 2018 "Fair-faced Concrete - Classifications and specifications"	**Atbilst** Meets
HT 1	**Netīrumi un traipi no rūsas nav pieļaujami.** Soiling and stains from rust are not permitted.	☐
	Starpība starp tumšāko un gaišāko mērījumu* vietu ar BE Grey skalu ≤ 5 Difference between the darkest and the lightest measuring* with the BE Gray scale ≤ **5**	☐
	Pelēkā toņa starpība starp tumšāko un gaišāko vietu, kas noteikta ar kolorimetru ≤ 12,5.** Deviation of the shade of gray between the darkest and the lightest measurement** with the colorimeter **≤ 12.5**	☒
HT 2	**Netīrumi un traipi no rūsas nav pieļaujami.** Soiling and stains from rust are not permitted.	☐
	Starpība starp tumšāko un gaišāko mērījumu* vietu ar BE Grey skalu ≤ 4 Difference between the darkest and the lightest measuring* with the BE Gray scale ≤ **4**	☐
	Pelēkā toņa starpība starp tumšāko un gaišāko vietu, kas noteikta ar kolorimetru ≤ 10.** Deviation of the shade of gray between the darkest and the lightest measurement** with the colorimeter **≤ 10**	☐
HT 3	**Netīrumi un traipi no rūsas nav pieļaujami.** Soiling and stains from rust are not permitted.	☒
	Starpība starp tumšāko un gaišāko mērījumu* vietu ar BE Grey skalu ≤ 3 Difference between the darkest and the lightest measuring* with the BE Gray scale ≤ **3**	☐
	Pelēkā toņa starpība starp tumšāko un gaišāko vietu, kas noteikta ar kolorimetru ≤ 7.5** Deviation of the shade of gray between the darkest and the lightest measurement** with the colorimeter **≤ 7.5**	☐
* **	**- saskaņā ar 4.4.2.1. metodi NBN B 15-007: 2018,** according to method in 4.4.2.1 NBN B 15-007: 2018 **- saskaņā ar 4.4.2.2. metodi NBN B 15-007: 2018,** according to method in 4.4.2.2 NBN B 15-007: 2018	

NBN B 15-007 Formas pielaides Form tolerance

	Formas pielaides Form tolerance NBN B 15-007: 2018 "Fair-faced Concrete - Classifications and specifications"	**Atbilst** Meets
VTF1	**Maksimālais nelīdzenums uz veidotās virsmas mērot ar 200 mm līsti: ne lielāks par Δ 4 mm.** Maximum deviation on the flatness of molded surface measured by 200 mm slat does not exceed: **Δ 4 mm.**	☐
	Maksimālā novirze (d) divu virsmu savienojumam (pakāpiens) ne lielāks par Δ ± 5 mm Maximum deviation (d) for the joint of two surfaces does not exceed **Δ ± 5 mm**	☐
	Maksimālā novietojuma novirze caurumiem un padziļinājumiem ne lielāks par Δ ± 20 mm. Maximum deviation on the position of openings and recesses does not exceed **Δ ± 20 mm.**	☐
	Maksimālā novirze caurumu un padziļinājumu izmēriem ne lielāks par Δ ± 10 mm. Maximum deviation on the dimensions of openings and recesses does not exceed **Δ ± 10 mm.**	☐
VTF2	**Maksimālais nelīdzenums uz veidotās virsmas mērot ar 200 mm līsti: ne lielāks par Δ 3 mm.** Maximum deviation on the flatness of a molded surface measured by 200 mm slat not exceed: **Δ** 3 mm.	☐
	Maksimālā novirze (d) divu virsmu savienojumam (pakāpiens) ne lielāks par Δ ± 4 mm Maximum deviation (d) for the joint of two surfaces does not exceed **Δ ± 4 mm**	☒
	Maksimālā novietojuma novirze caurumiem un padziļinājumiem ne lielāks par Δ ± 12 mm. Maximum deviation on the position of openings and recesses does not exceed **Δ ± 12 mm.**	☐
	Maksimālā novirze caurumu un padziļinājumu izmēriem ne lielāks par Δ ± 6 mm. Maximum deviation on the dimensions of openings and recesses does not exseed **Δ ± 6 mm.**	☐
VTF3	**Maksimālais nelīdzenums uz veidotās virsmas mērot ar 200 mm līsti: ne lielāks par Δ 2 mm.** Maximum deviation on the flatness of a molded surface measured by 200 mm slat not exceed: **Δ** 2 mm.	☒
	Maksimālā novirze (d) divu virsmu savienojumam (pakāpiens) ne lielāks par Δ ± 3 mm Maximum deviation (d) for the joint of two surfaces does not exceed **Δ ± 3 mm**	☐
	Maksimālā novietojuma novirze caurumiem un padziļinājumiem ne lielāks par Δ ± 10 mm. Maximum deviation on the position of openings and recesses does not exceed **Δ ± 10 mm.**	☒
	Maksimālā novirze caurumu un padziļinājumu izmēriem ne lielāks par Δ ± 5 mm. Maximum deviation on the dimensions of openings and recesses not exceed **Δ ± 5 mm.**	☒

Conclusion according NBN B 15-007

Pārbaude pēc veidņu noņemšanas Inspection after formwork removing

	Atbilst Correspond	**Neatbilst** Does not match	**Izmēri, komentārs:** Dimensions, comment:	
Ģeometriskie izmēri Geometrical dimensions	☒	☐	**2400x1800x300**	
Stiprinājumi neizkustējās Connections not moved	☒	☐		
Tekstūras novērtējums Texture assessment	☐ **T1**	☐ **T2**	☒ **T3**	
Gaisa poru novērtējums Air bubble assessment	☒ **LBA1**	☐ **LBA2**	☒ **LBA3**	A,B-LBA1, C-LBA3
Krāsu viendabīgums Color uniformity	☒ **HT1**	☐ **HT2**	☐ **HT3**	
Formas pielaides Form tolerance	☐ **VTF1**	☐ **VTF2**	☒ **VTF3**	
Citas neatbilstības Other nonconformities	☐	☒	Damaged corner See photos Nr.7, 8.	

Slēdziens un komentāri Conclusion and comments

Sienas virsmas kvalitāte atbilst "C" klasei pēc NBN B 15-007:2018.

The overall quality assessment of concrete wall 0.3x1.8x2.4 m corresponds to class "C" NBN B 15-007:2018.

Piezīme Note: T1, LBA1, HT1, VTF1- Class C. T2, LBA2, HT2, VTF2- Class B. T3, LBA3, HT3, VTF3- Class A.

Acceptable tolerances and unified view for fair-faced concrete

Took place a lot of technical meetings with client

- Involved client architect
- Involved external concrete experts

->Fair faiced concrete assesment criteria:

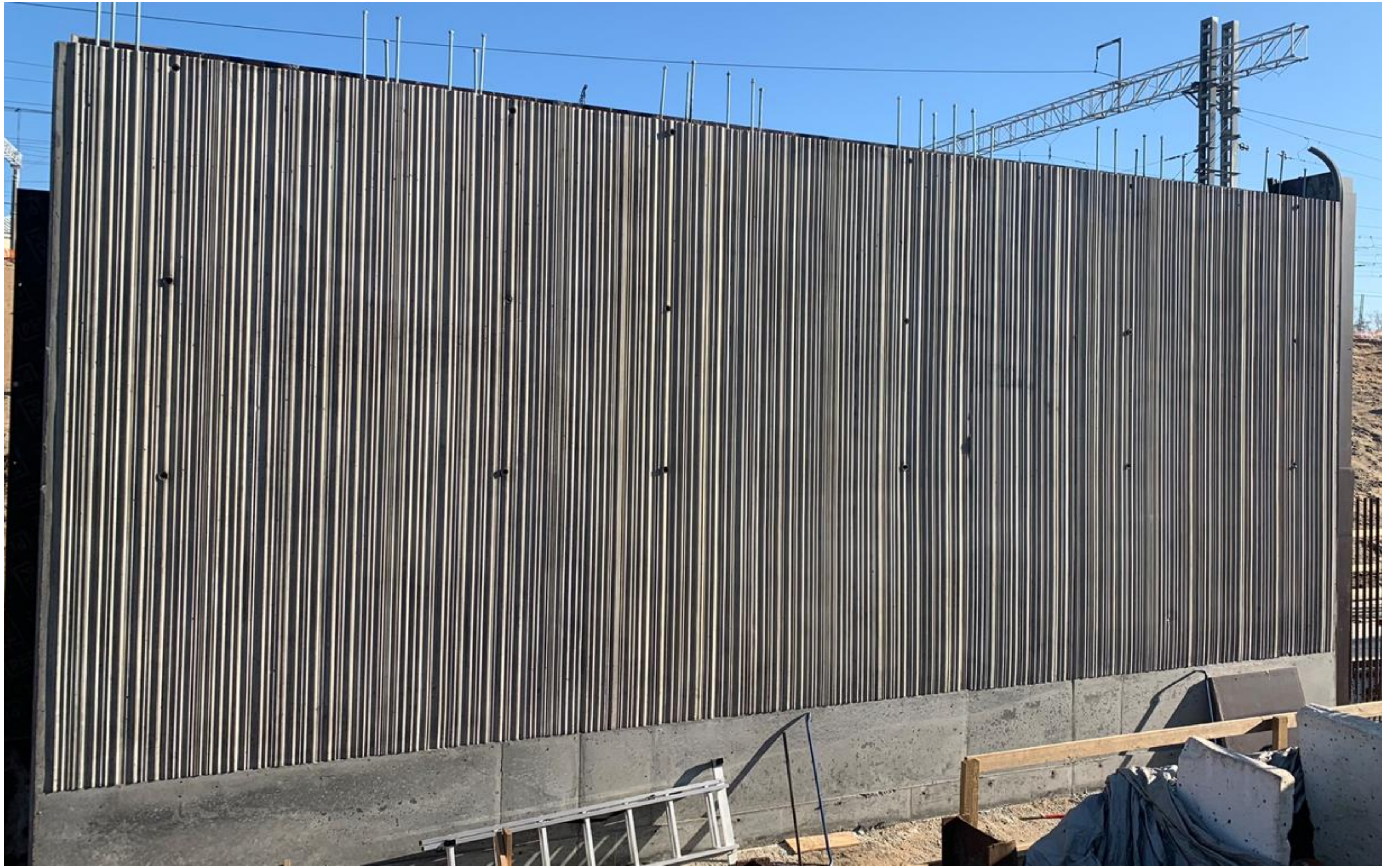
Pārbaudāma vienība Item to be checked	**Nosacījums NBN B15-007** Requirement NBN B 15-007	**Pārbaudāma vienība** Item to be checked	**Nosacījums EN 13670** Requirement EN 13670
1. Virsmas taisnums 1. Straightness of surface	**Uz L=0,2 m, Max. h≤3,0 mm.** At L=0,2 m, Max. h≤3,0 mm.	**2. Novietojums vertikālā virziena** 2. Position in vertical direction	**Max nobīde ± 15 mm.** Max deviation ± 15 mm.
3. Plaisas maks. atvērums 3. Surface cracks opening	**Maks. ≤ 0,2 mm** Max. ≤ 0,2 mm.	**4. Šķērsgriezuma izmēri** 4. Cross-sectional dimensions	**Max nobīde ± 10 mm.** Max deviation ± 10 mm.
5.1 Gaisa poru max. izmēri 5.1 Surface pores dimensions	**Max diametrs Ø≤15 mm.** Max diameter Ø≤15 mm.	**5.2 Gaisa poru max. dziļums** 5.2 Surface pores max depth	**Max dziļums h≤10mm.** Max depth h≤10mm.

Regarding color uniformity and possible defects, case by case shown to the client architect.

Quantities of fair-faced concrete for south part of RCS

- Retaining walls with cantilivers~10 500m2
- Piers-34pcs
- Columns-35pcs
- All 5 overpass (Lacplesa street, Dzirnavu street, E.Benjaminas street, over City canal, Pragas street) beams and deck surfaces

EAST-First wall P01-8 casted on 12.04.2022.



EAST-Skyline casted in summer 2022

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EAST-wall P03-2 casted on 30.11.2022.

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Team work with s/c to get best quality fair-faced concrete

Team work with s/c to get best quality fair-faced concrete

- Clear MS/DVP, ITP was approved and based on them checks on site was done
- Before concreting works was done pre-task meeting with every s/c
- At beginning every month concrete quality meetings with photo were done
- Regarding every defect/deviation on fair-face concrete surface NCR’s was opened and investigation was done to improve the next casting
- Clear rule was agreed: before Quality inspection and permission it is not allowed to do any kind of repairs or treatment on fair-faced concrete surface

Dzirnavu street overpass

BERERIX

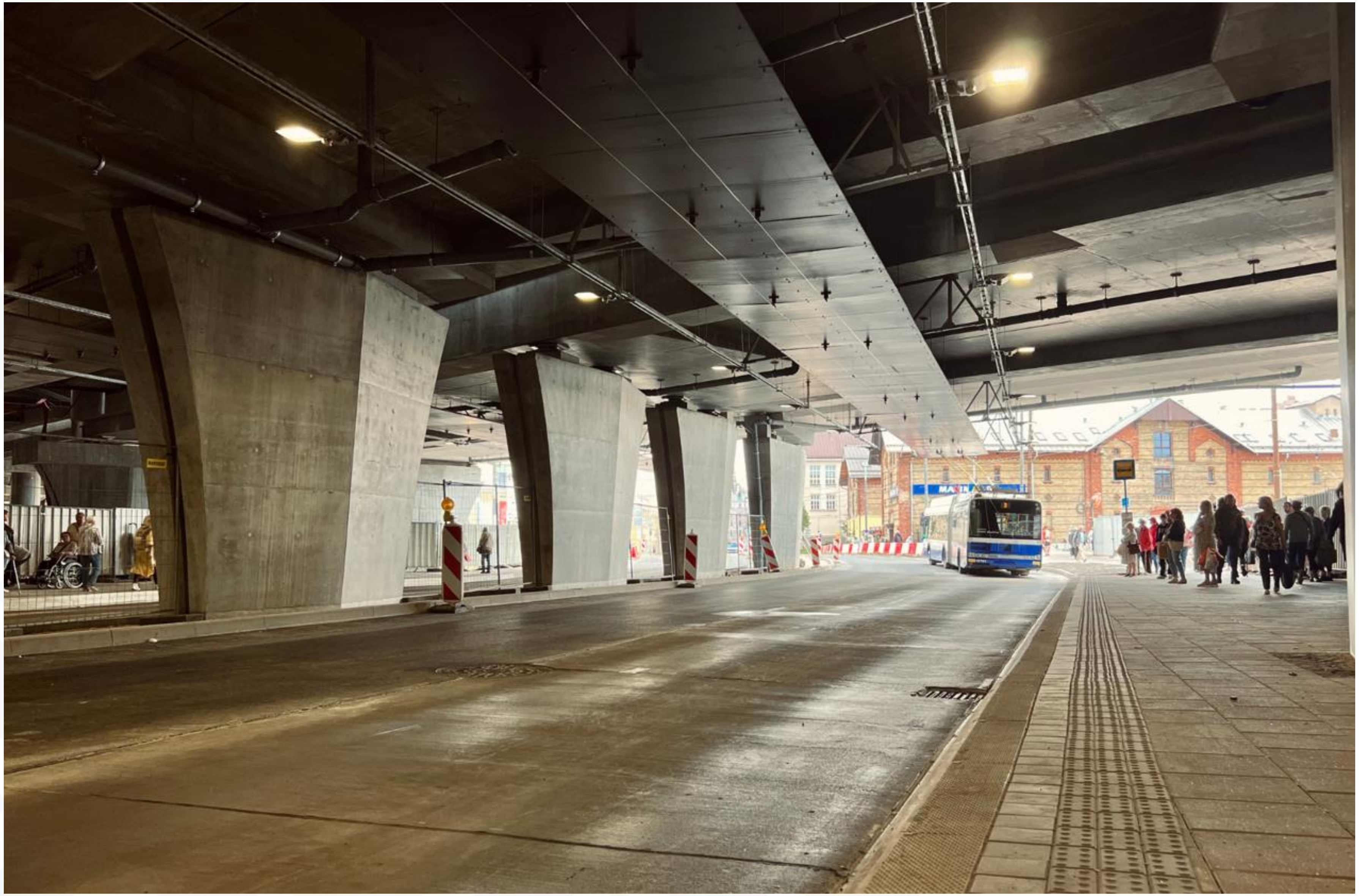
Dzirnavu street overpass

BERERIX

Central-Passanger concorslab casting

BERERIX

E.Benjaminas street overpass



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E.Benjaminas street overpass

Autoosta/Bus station overpass deck casting

BERERIX

Pier 2 in Daugava River

BERERIX

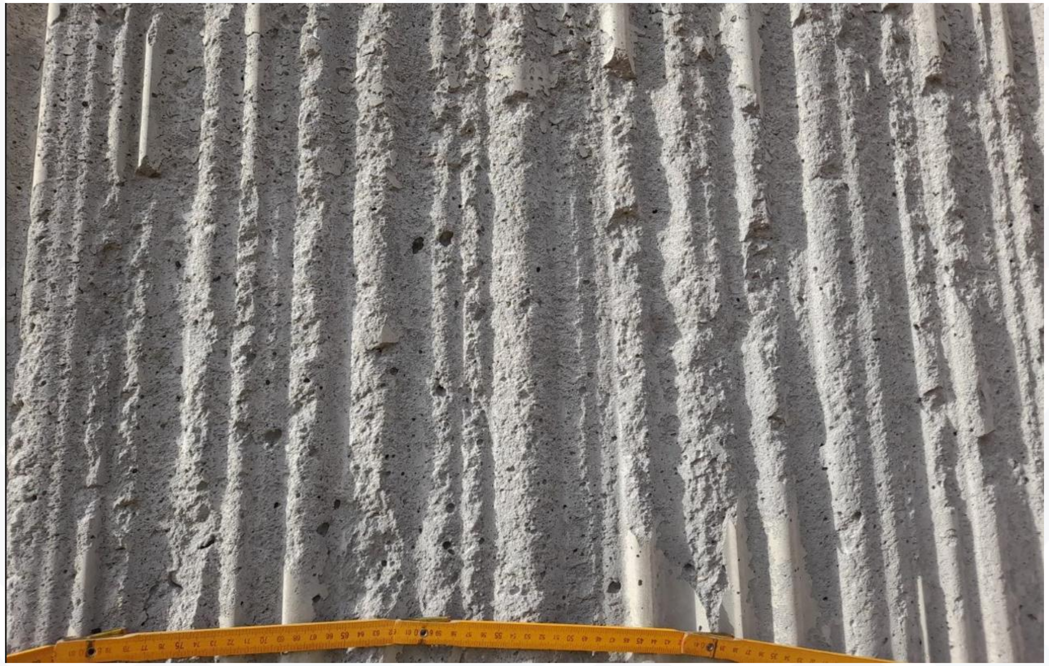
Biggest challanges

- Different weather conditions to cast fair-faced concrete elements from early spring till late autumn
- Cast fair-faced concrete in massive civil engineering structures, t monitoring, concrete curing
- Deshuttering of formwork with formliner not to late, that it starts to stick to concrete
- Working with four concreting teams to get similar result,with no possibility to tell where is work scope border
- Commissioning to the client
- To reach uniform result of fair-faced concrete in full project with wide range of formwork types

BERERIX

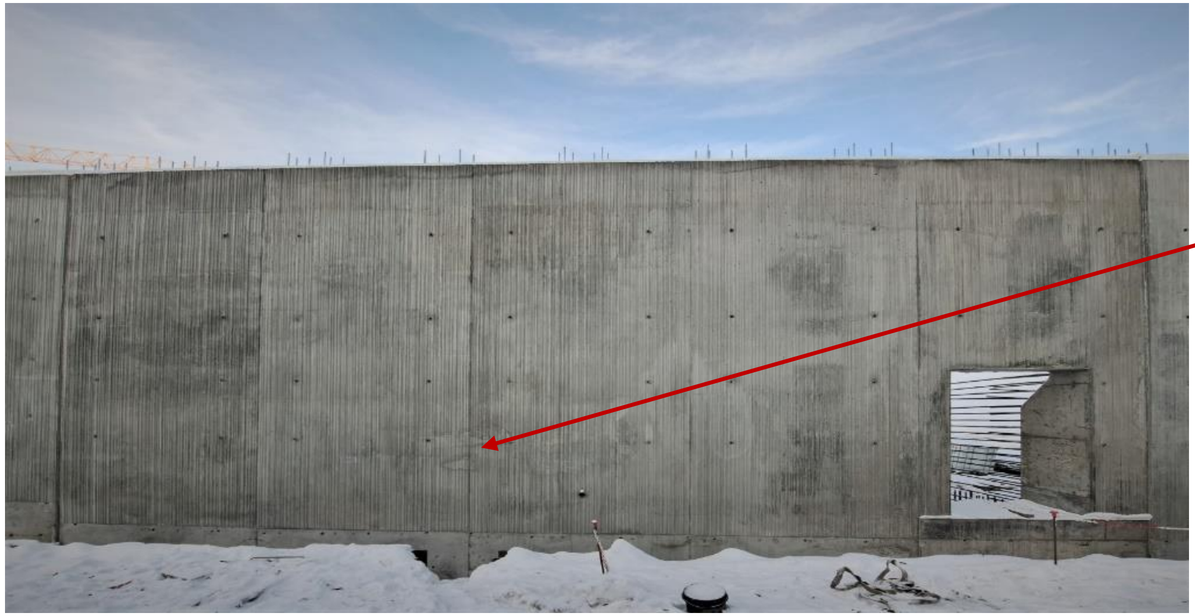
Defects to be repaired

Casted in summer



- **Reduce time to a maximum of 3 calendar days** between application of the formwork oil and casting of the structure.

Defects to be repaired



Defects to be repaired

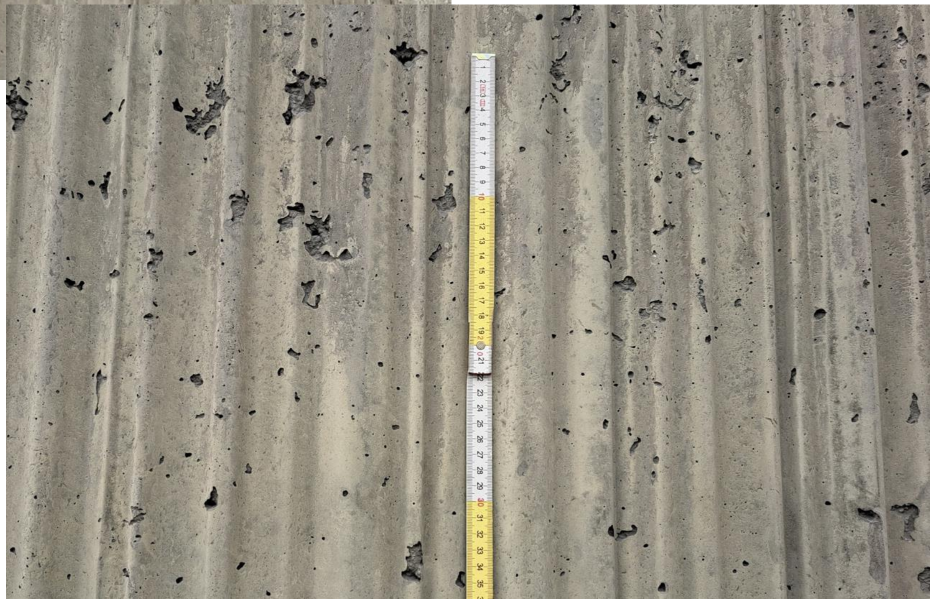
BERERIX

Defects to be repaired

BERERIX

Defects to be repaired

Defects to be repaired



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Defects to be repaired

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Defects to be repaired

Casted in autumn

Conclusions - what provides a good result

1. Before fair-faced concrete structure work execution do a pre-task meeting with construction team
2. Do every formwork surface check before closing formwork and after
3. Reduce time to a maximum of 3 calendar days between application of the formwork oil and casting of the structure.
4. Formwork tensioners and tubes during assembly are not too long and not too short, and that they are not damaged during the assembly.
5. Make sure that all the joints of the forms are hermetically sealed and there is no possibility for the cement paste to leak
6. Check every delivered concrete truck slump, it shold be S5 in range 240-260mm
7. Good comunication between concrete manufacturer, quality and delivery team;
8. Proper use of internal and external concrete vibrators
9. Good and smart repair management

BERERIX


THE RAIL BALTICA
RAILWAY BRIDGE &
RIGA CENTRAL STATION
R2I0G1A6

BERERIX

BERERIX

BERERIX

PALDIES!
THANK YOU!

Latvijas
Betona
Savienība

Latvijas XXI Betona olimpiāde – 2024

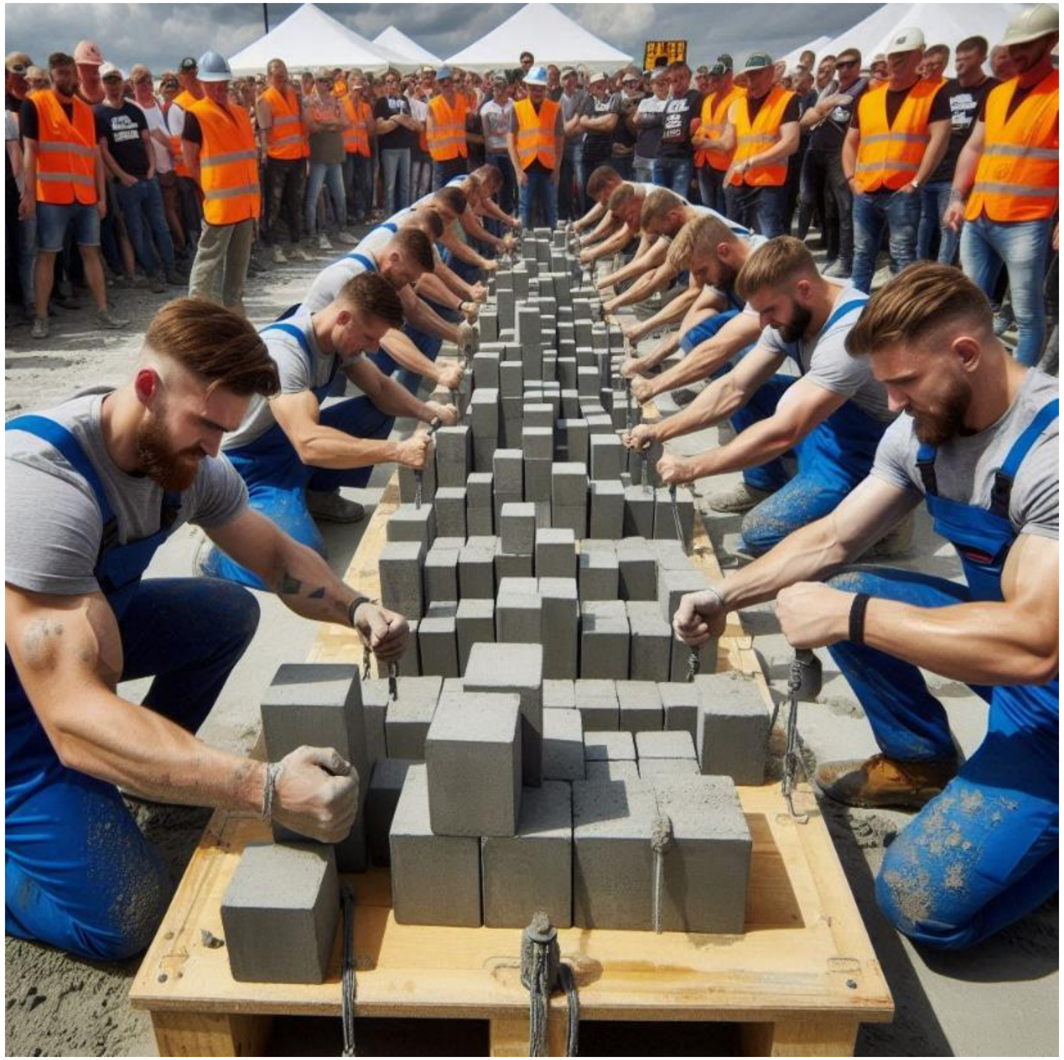
XXI Latvian Concrete Olympics – 2024

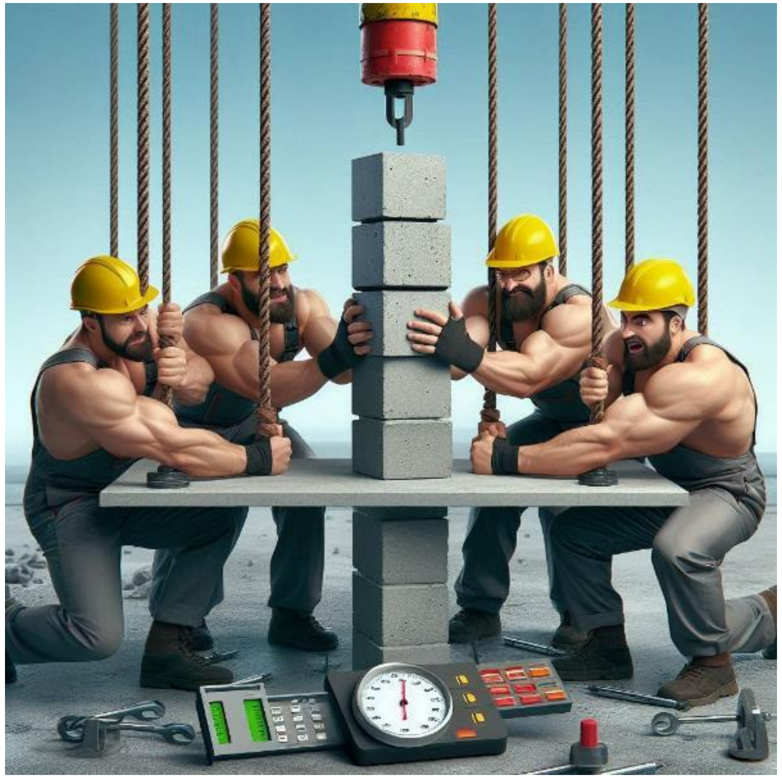
27-28th November, 2024

Prezentāciju sagatavoja:
Presentation prepared by:

Genādijs Šahmenko (RTU),

Tomasz Nowacki
(STACHEMA Polska)





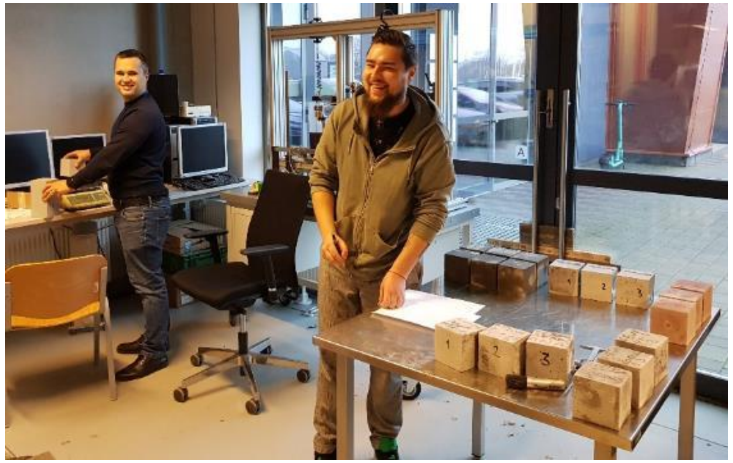
Created by artificial intelligence

Latvijas Betona olimpiāde – 2024 DALĪBNIEKI

No	Komandas nosaukums	Pārstāvētā organizācija, uzņēmums
1	**BPC Liepāja**	Betona pētījumu centrs
2	**Liepājas Dzelzsbetons**	BPC
3	**Cietais kodols**	Celmiņi-1
4	**Primekss Pinkstone**	Primekss
5	**Betona eksperti**	SCHWENK Latvija SIA
6	**Liepājas Transportbetons**	Betona pētījumu centrs
7	**ST1**	Saldus tehnikums
8	**ST2**	Saldus Tehnikums
9	**SAKRET 1**	SIA SAKRET
10	**SAKRET 2**	SIA SAKRET
11	**Betona akadēmija**	SIA Primekss
12	**Transportbetons MB Ādaži**	Transportbetons MB
13	**Transportbetons MB Valmiera**	Transportbetons MB
14	**BPC Rīga**	"Betona Pētījumu Centrs" SIA
15	**Consolis Latvija**	SIA Consolis Latvija
16	**Transportbetons MB Jelgava**	Transportbetons MB
17	**RTB Transportbetons MB Rēzekne**	Trandportbetons MB, SIA, Rēzekne
18	**DBPC BETONA PĒTĪJUNU CENTRS, Daugavpils**	Betona pētījumu centrs,SIA
19	**DDZB**	Daugavpils Dzelzsbetons,SIA
20	**DTB, Transportbetons MB, Daugavpils**	Transportbetons MB, SIA, DAUGAVPILS

Latvijas Betona olimpiāde 2024

ŽŪRIJAS KOMANDA



Eduards Protasevičs

Ģirts Būmanis

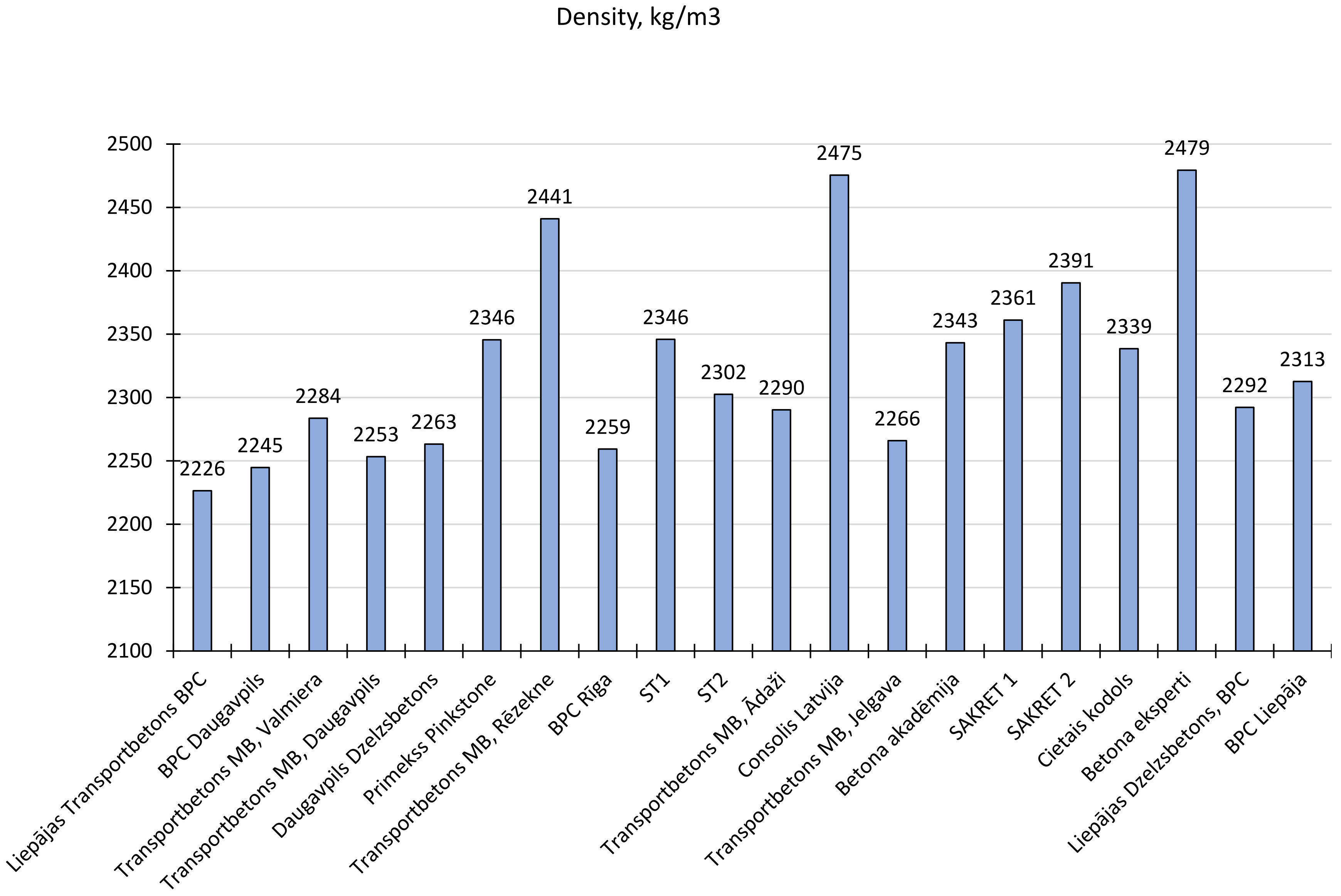
Pauls Ārgalis

Egīls Zvejnieks

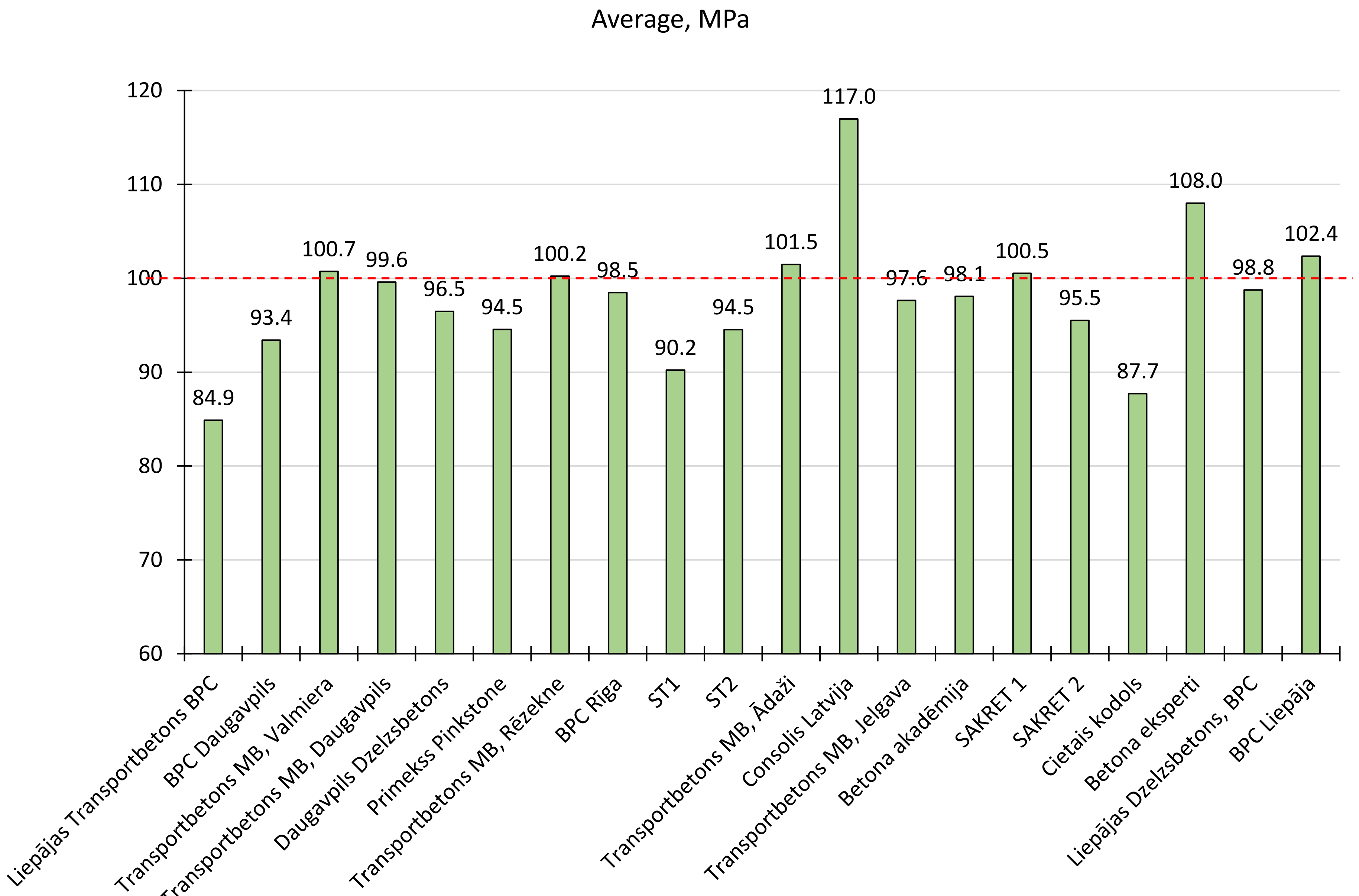
Andrejs Krasņikovs

Genādijs Šahmenko

Latvian Concrete Olympics – 2024



Latvian Concrete Olympics – 2024



Latvijas
Betona
Savienība

Betona olimpiādes atbalstītājs – Stachema Polska

Supporter of the Concrete Olympiad - Stachema Polska

Kopš 2018. gada STACHEMA Polska ir Latvijas Betona savienības biedrs, kā arī jau vairākus gadus ir galvenais atbalstītājs Latvijas Betona olimpiādei, ko organizē Latvijas Betona savienība (LBS) sadarbībā ar Rīgas Tehnisko universitāti.

stachema Polska

STACHEMA ir viens no vadošajiem betona piedevu ražotājiem, kas gadiem ilgi pierādījis sevi gan Polijas, gan starptautiskajos tirgos.

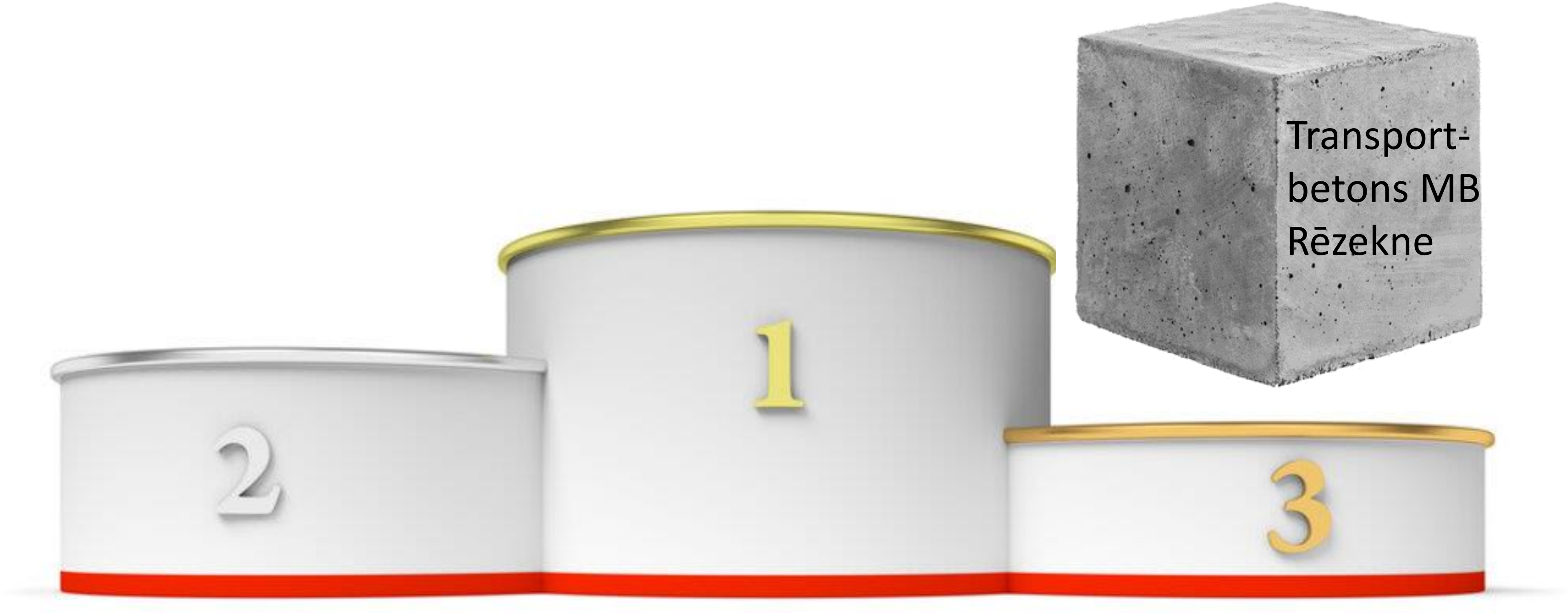
Tomasz Nowacki (STACHEMA Polska, Vice-President)

Latvijas
Betona
Savienība

Betona olimpiādes atbalstītājs – Stachema Polska

Supporter of the Concrete Olympiad - Stachema Polska

S = 1,73 MPa



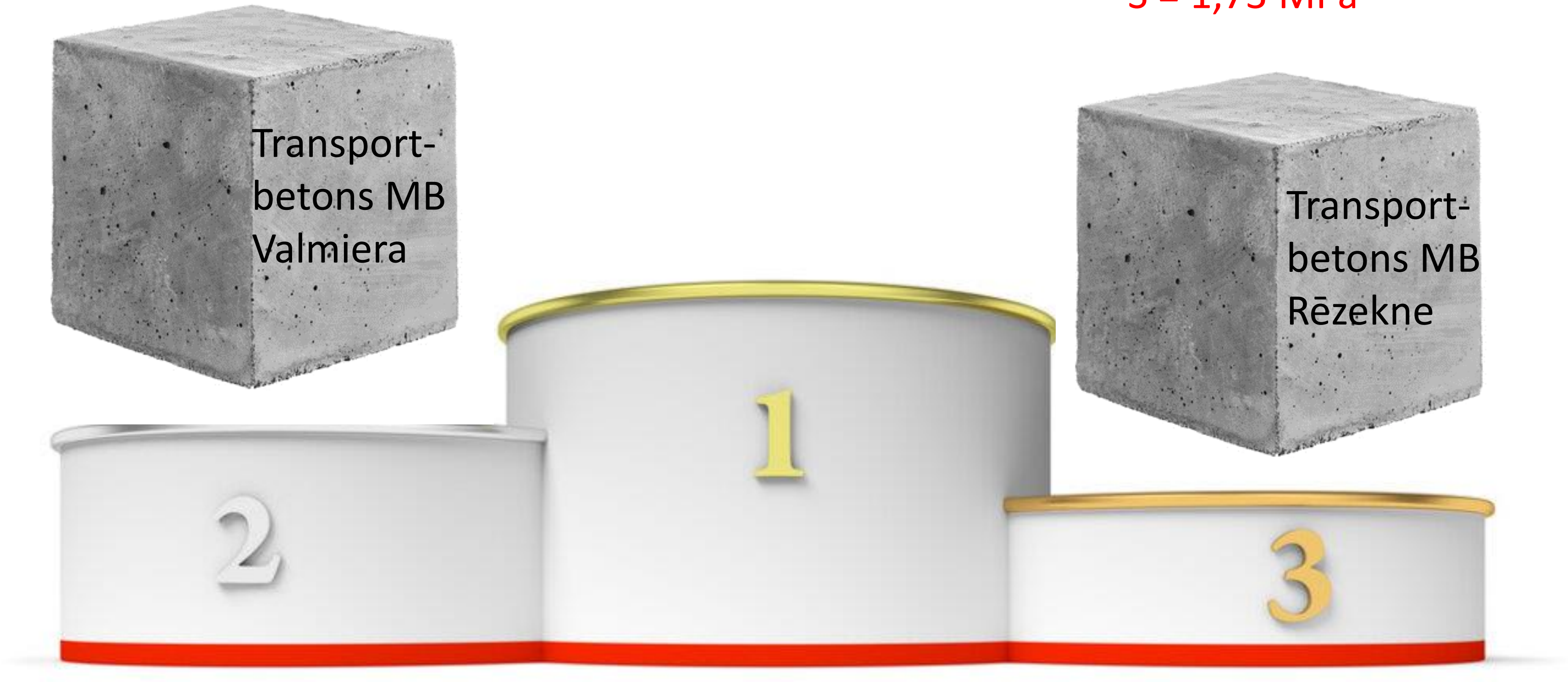
Latvijas Betona Savienība

Betona olimpiādes atbalstītājs – Stachema Polska

Supporter of the Concrete Olympiad - Stachema Polska

S = 1,47 MPa

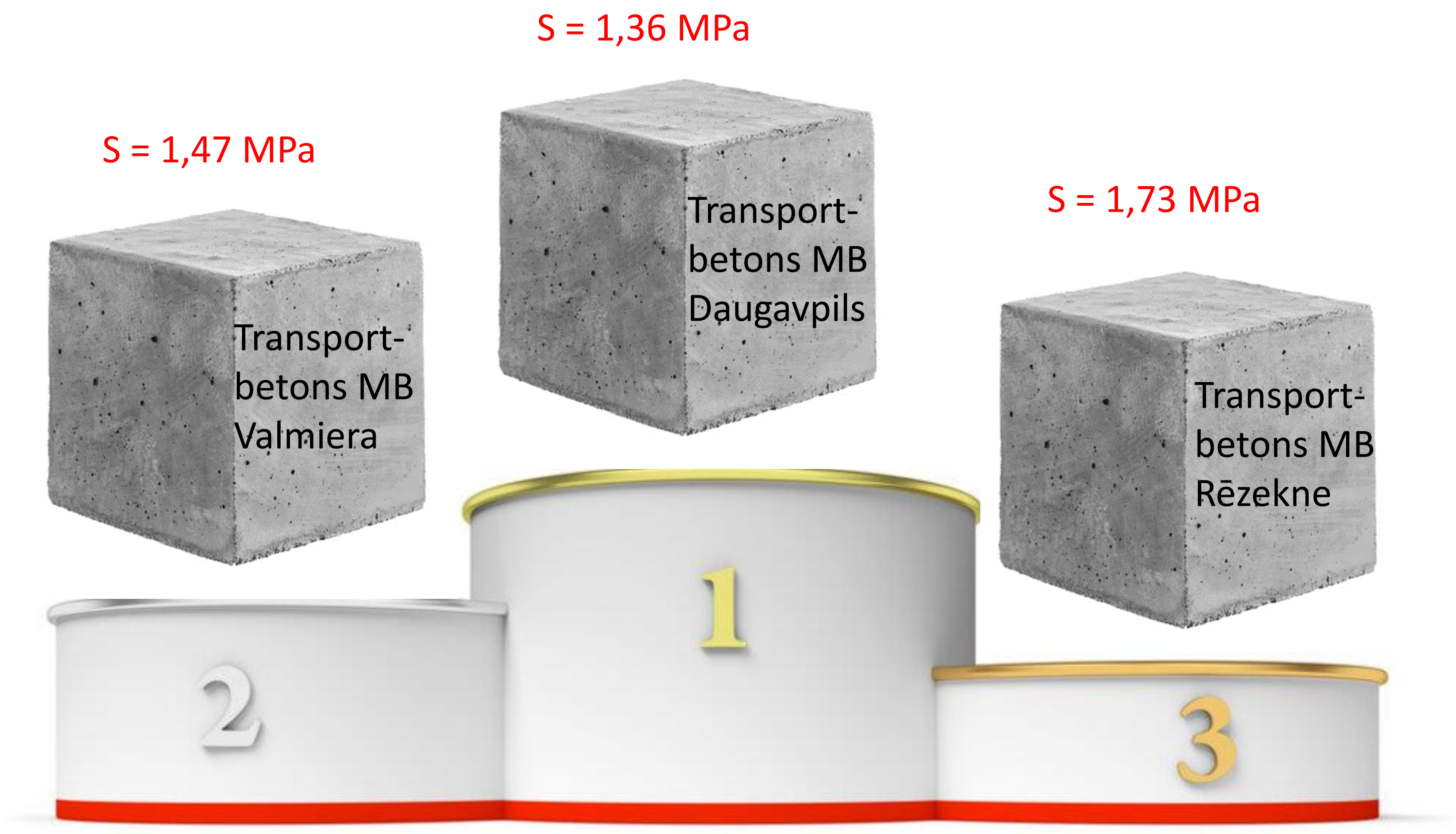
S = 1,73 MPa



Latvijas Betona Savienība

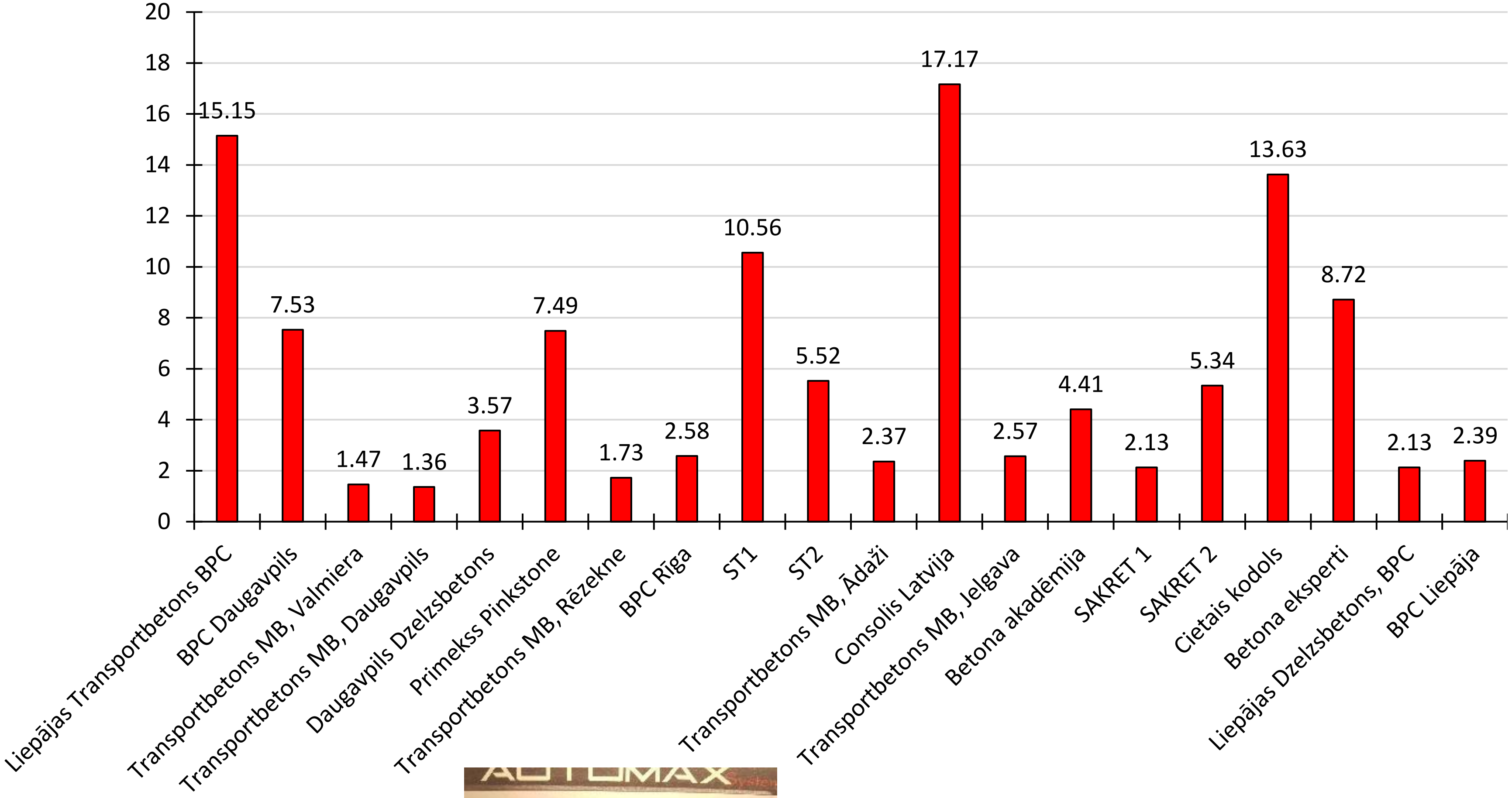
Betona olimpiādes atbalstītājs – Stachema Polska

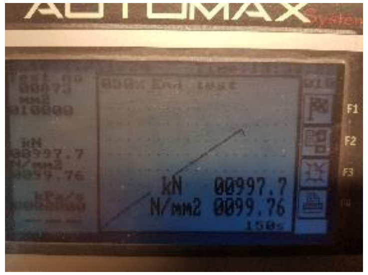
Supporter of the Concrete Olympiad - Stachema Polska



Latvian Concrete Olympics – 2024

Standard deviations from 100, MPa





Gatavojamies 2025. gada olimpiādei !

Izmaiņas nolikumā ?!

Cold-bonded biochar-rich lightweight **aggregates for net-zero concrete**

(Solid) carbon sequestration in concrete
Potential and challenges

Mateusz Wyrzykowski, **Nikolajs Toropovs**, Pietro Lura
Empa, Concrete & Asphalt Laboratory

Riga, 28.11.2024

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Negative emission technologies

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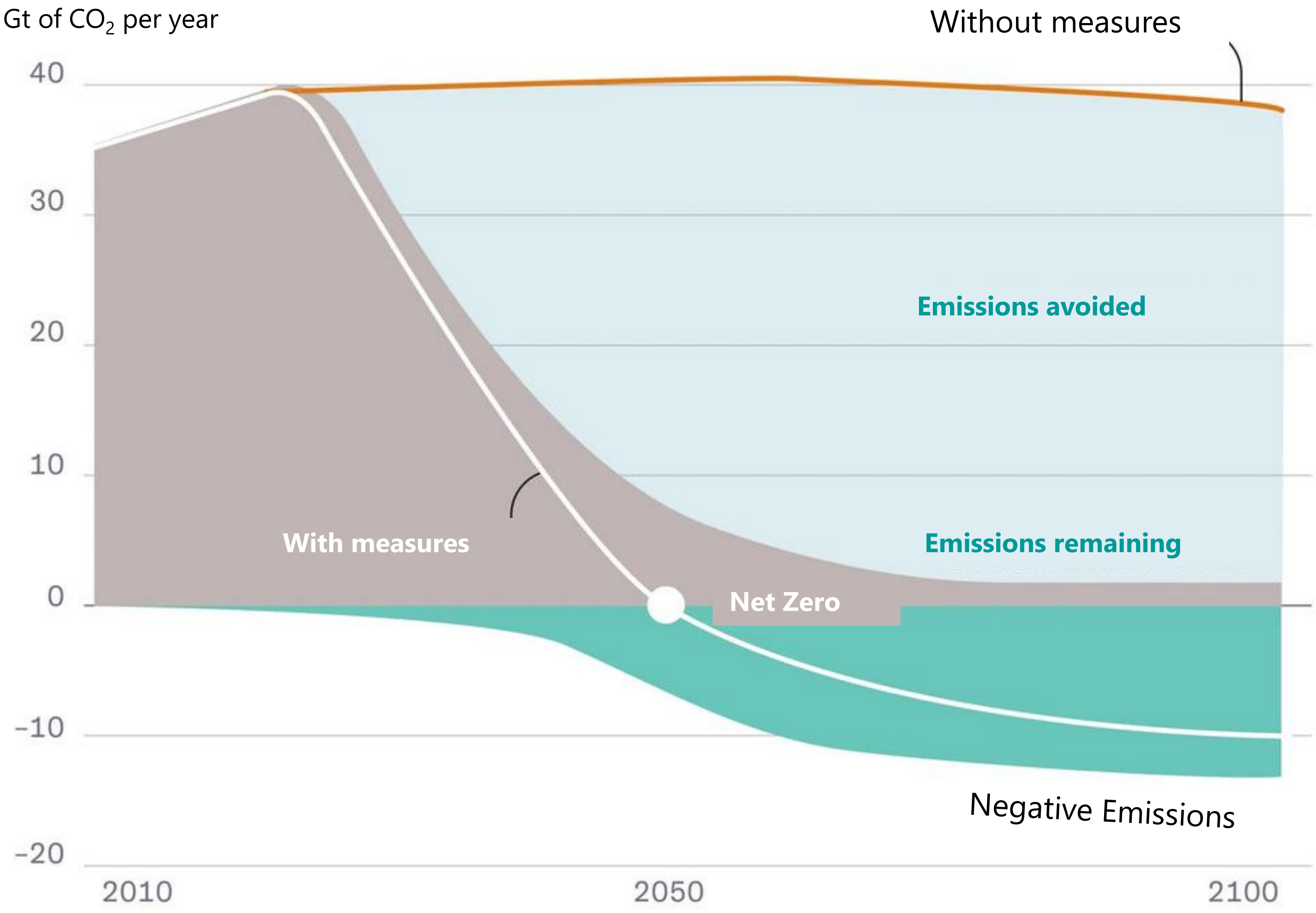


Reduce net emissions by:

Carbon Capture and Utilization/Storage (CCS/CCUS)

➔ avoidance

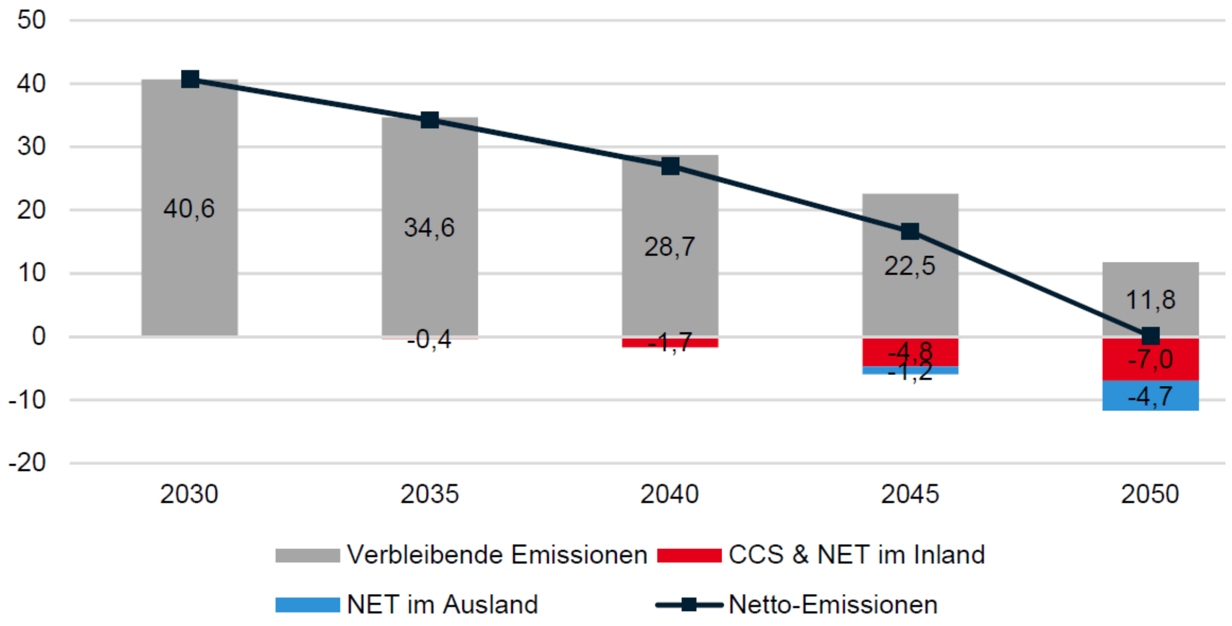
Negative Emission Technologies (NET)

➔ compensation/removal

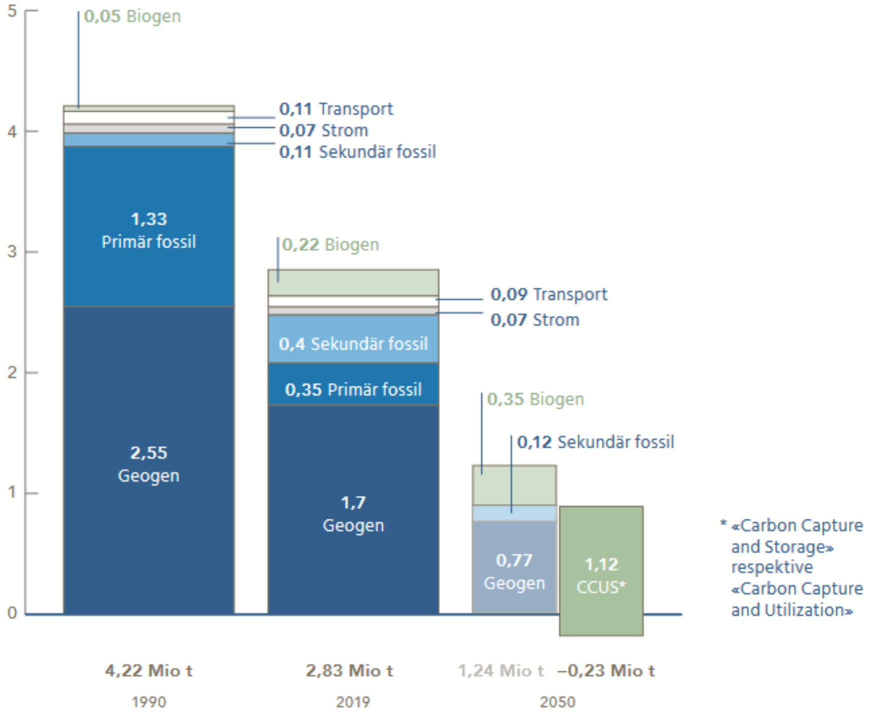
- 10-20 Gt CO_2/a

Cement and concrete: high emissions originate from high demand

- Global cement consumption: 4.2 Gt/y
- Switzerland: 4.2 Mt ➔ **2.4 Mt CO_2 (6% inland)**
- Prognosis 2050: 2.4 Mt CO_2 (~20%)



The Federal Council, Switzerland's long-term climate strategy, 2021



Cemsuisse Roadmap 2050, 2021

CO_2 sequestration in concrete

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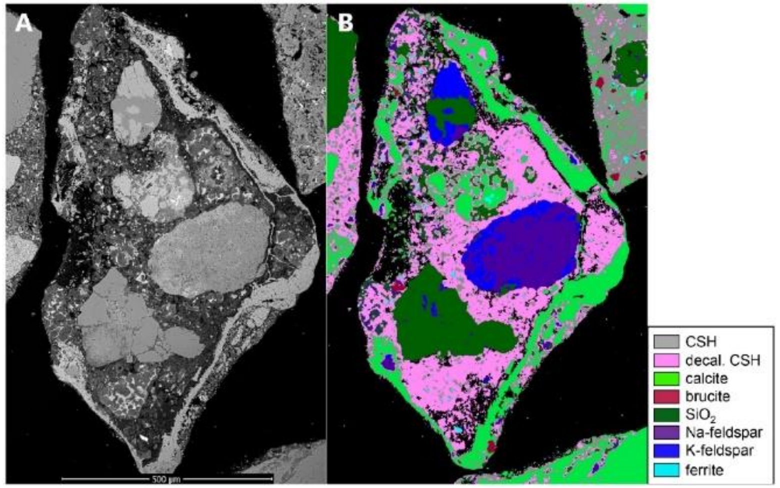
Materials Science and Technology

CO_2 absorption by concrete (carbonation)
➔ carbon mineralization



DEMO UP CARMA

Leemann, Winnefeld et al. 2023

Pyrolytic solid carbon sequestration

Carbon Capture and Use

Empa
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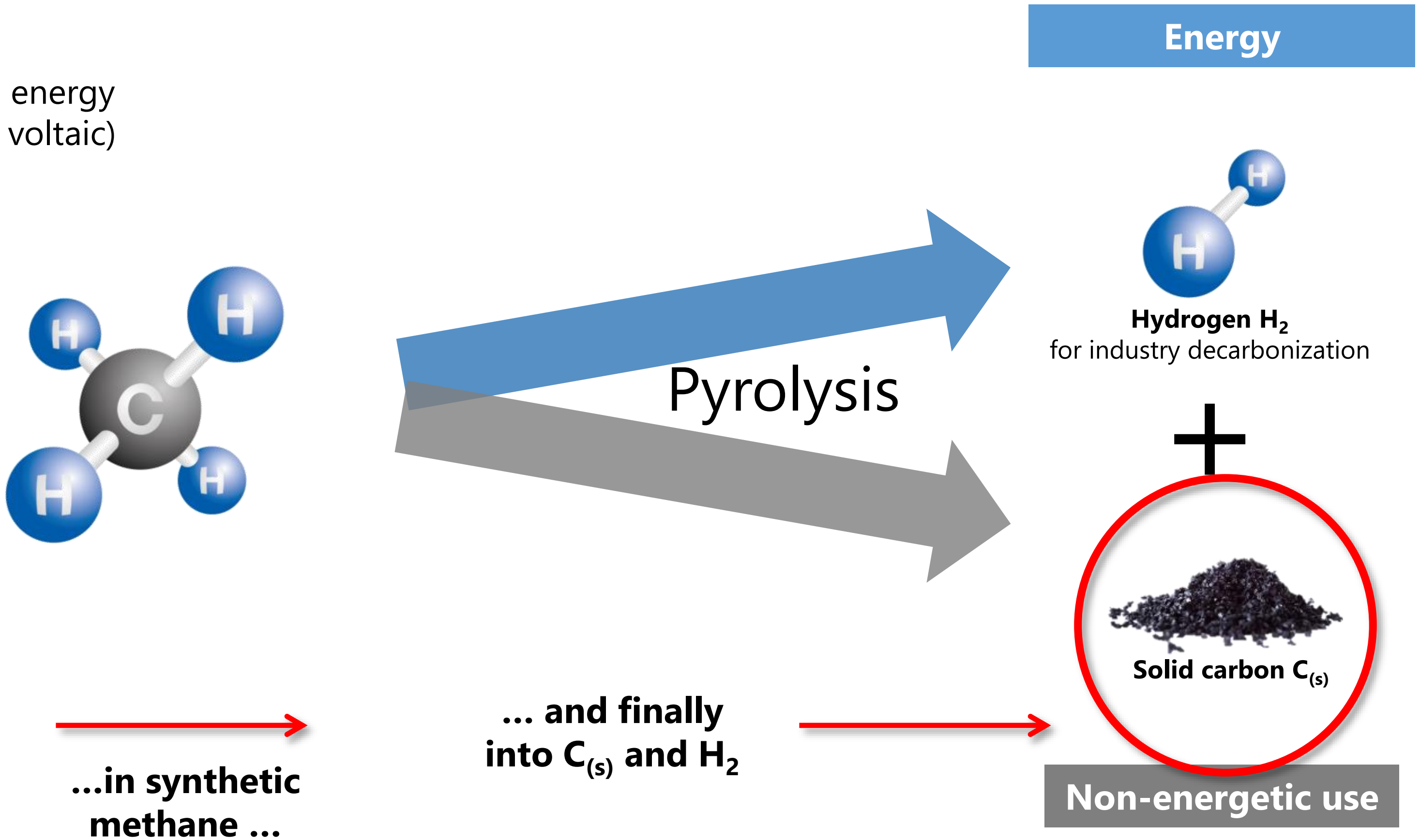
swiss center of excellence on net zero emissions
SCENE

e energy
ɔ voltaic)



Conversion of CO_2 from the atmosphere …

…in synthetic methane …

1st step: decarbonization of fossil natural gas
2nd step: decarbonization of renewable synthetic methane

… and finally into $C_{(s)}$ and H_2

See also: Association for the decarbonization of industry in Zug, Switzerland (VzDI)

Solid carbon – what do we do with it?

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Materials Science and Technology

Consumption of hydrogen: 0.1 Gt/y (2022) ➔ ~**0.5 Gt/y (2050)**

if obtained from CH_4 via pyrolysis ➔ ~**1.5 Gt/y $C_{(s)}$**

(IEA 2023, PwC 2024)

Current valorization paths:

Carbon black	~0.016 Gt/y
Graphite+graphene	~0.001 Gt/y
Activated carbon	~0.001 Gt/y
Fibers+nanotubes	~0.0001 Gt/y

(Dagle et al. 2017, Parkinson et al. 2018)

Bach et al. 2024

Advantages of solid carbon sequestration vs. Carbon Capture and Storage (CCS):

- Higher storage capacity (C vs CO_2)
- No need to ship the CO_2 to Norway/Island/North sea (pipelines/ships)
- No leaks
- C is solid, CO_2 needs to be liquefied (wasted energy)
- **Potential added value (instead of just costs)**

Lura, Lunati, Desing, Heuberger, Bach, Richner «Mining the atmosphere: a concrete solution to global warming» 2024

Concrete and asphalt: the burden becomes an opportunity

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Materials Science and Technology

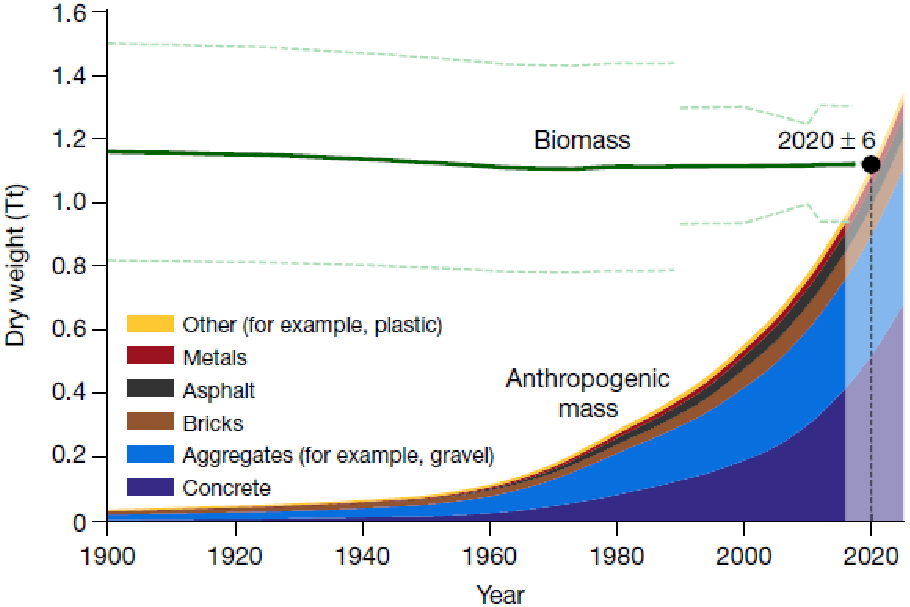
Worldwide:

~30 Gt/y concrete, ~8% of CO_2 emissions

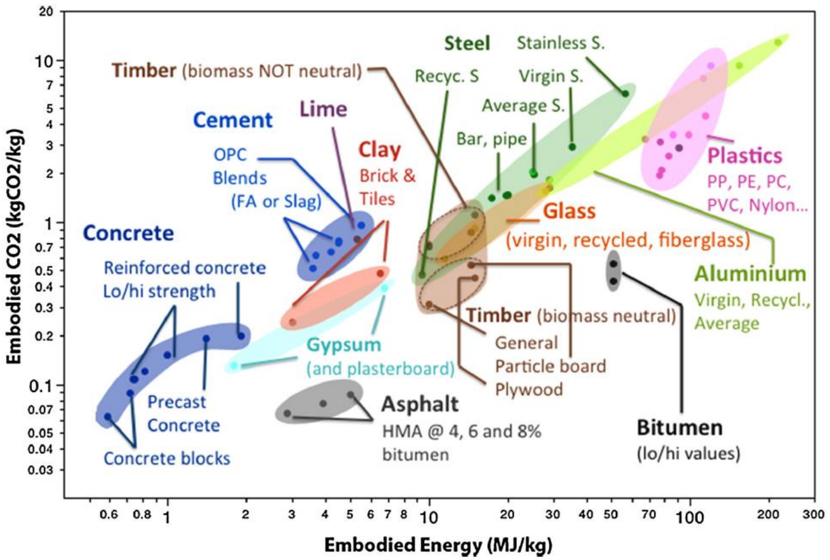
~1 Gt/y asphalt, 0.1-0.2% of CO_2 emissions

(Ashby 2009, Monteiro et al. 2017)

There are no (**better**) alternatives for these volumes / uses!



Global materials inventory (*Elhacham et al. 2020*)



Barcelo et al. 2014

Material consumption in Switzerland

Empa
Materials Science and Technology

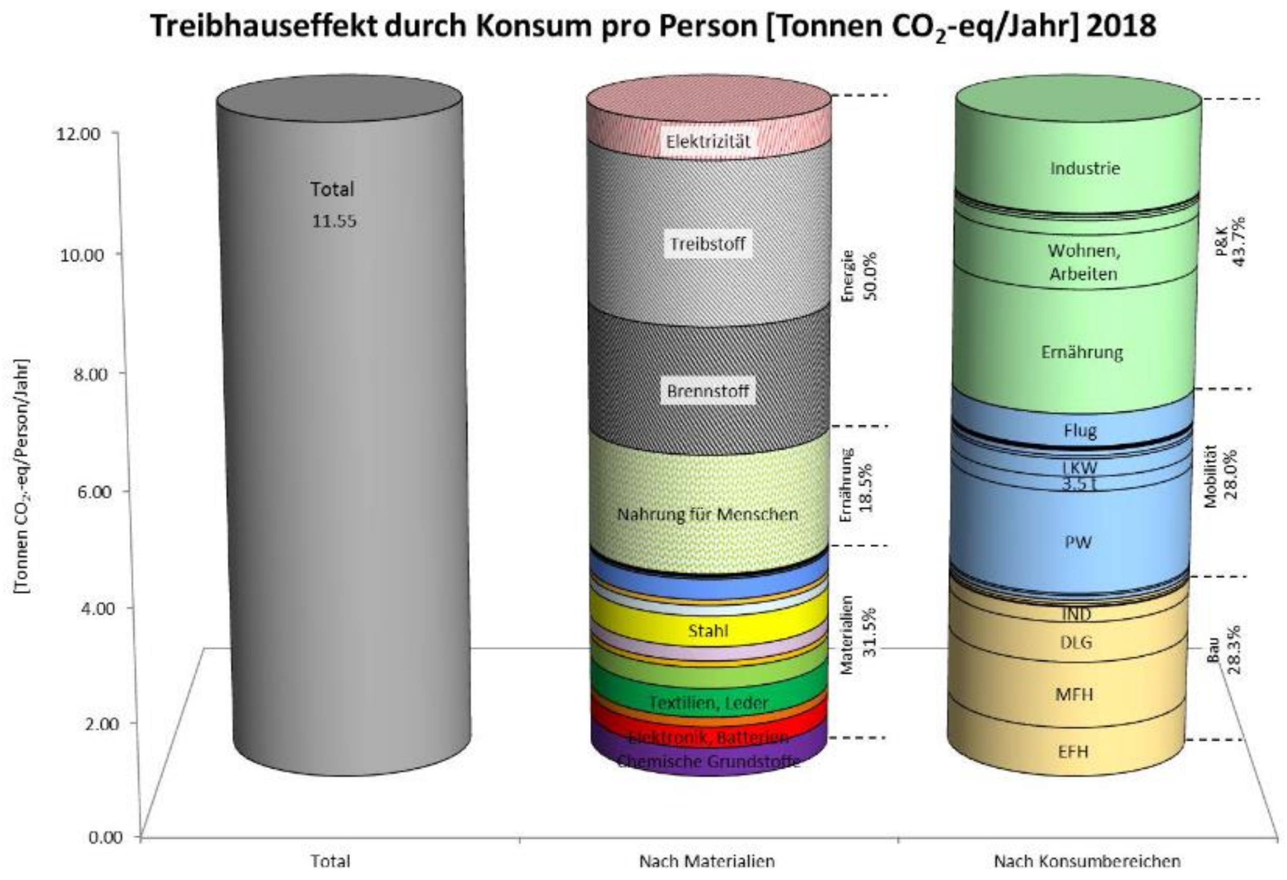
~40 Mt/y concrete

➔~3.2% of CO_2 emissions

~1.3 Mt/y asphalt

➔~0.4% of CO_2 emissions

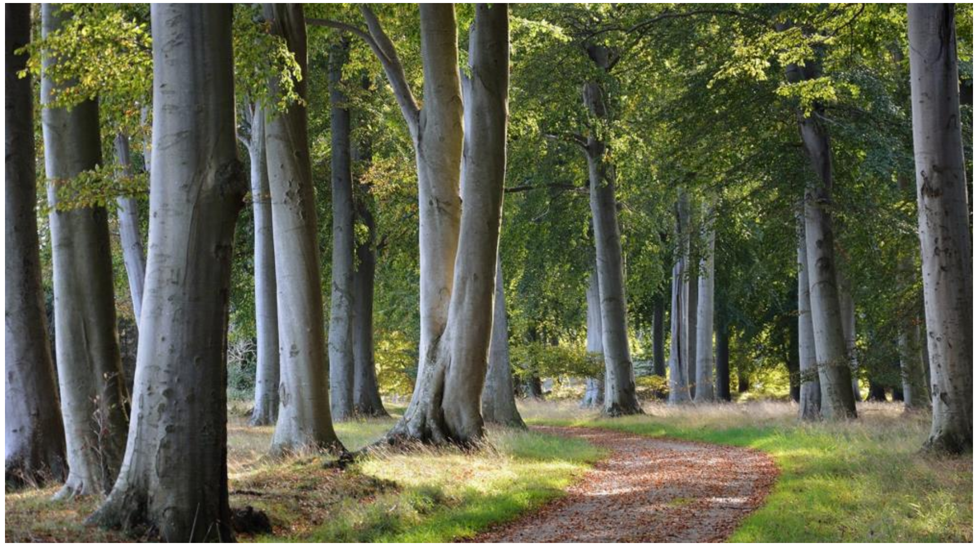
Goal: use concrete and asphalt as carbon sinks



Matasci et al. MatCH Studie, Empa 2019

Negative emissions – potential char sources

Empa
Materials Science and Technology



Long-term: char from (synthetic) methane

Biochar: intermediate step and model material

(Bio)char as Negative Emission Technology (NET)

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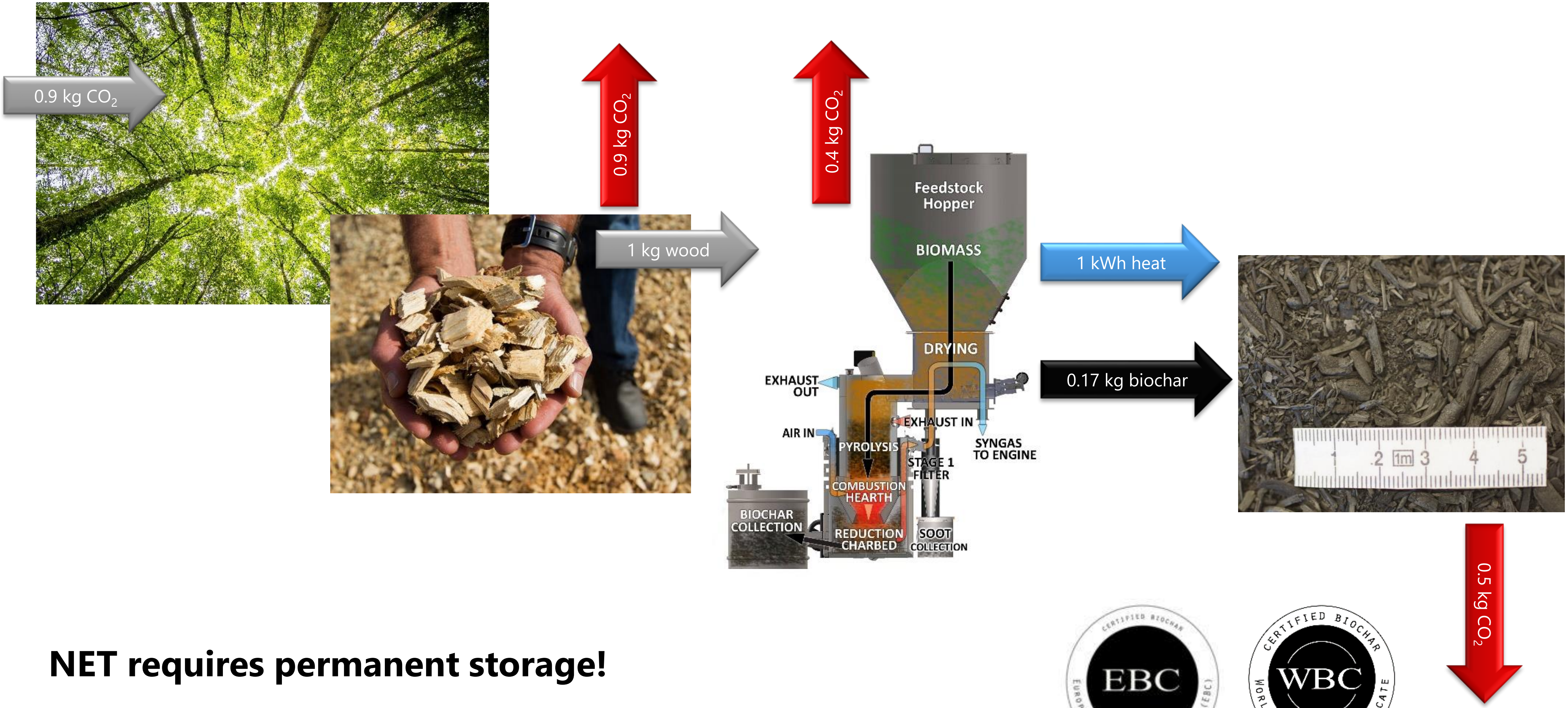
Materials Science and Technology



NET requires permanent storage!

Source: IWB, Switzerland

Sequestration of biochar in cement/concrete

- Part of cement replaced with (bio)char or biochar integrated directly into concrete
- Several (research) projects worldwide plus a couple of commercial applications ➔ feasibility proven

Wyrzykowski, Toropovs, Lura

«Carat», ©Vicat

«KLARK», ©Logbau 2022

Carbon-rich pellets as LWA for concrete (C-LWA)

Empa
Materials Science and Technology

M. Wyrzykowski, N. Toropovs, F. Winnefeld, P. Lura

Net CO_2 intensity of the pellets: **-1.05 kg CO_2/kg pellet** (CO_2 sink!)

Physical properties:

- Sizes: 4-32 mm
- Density in cured state: 1.0-1.5 g/cm^3

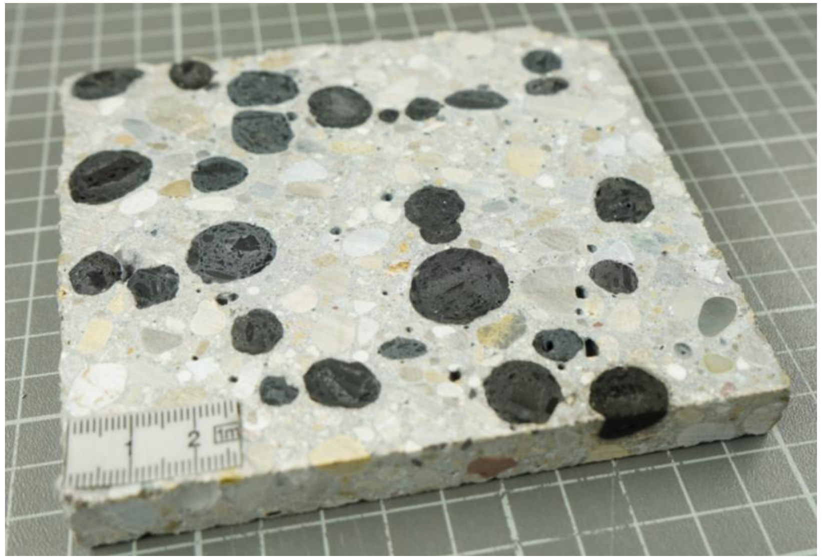
Pelletization + cold-bonding with cement

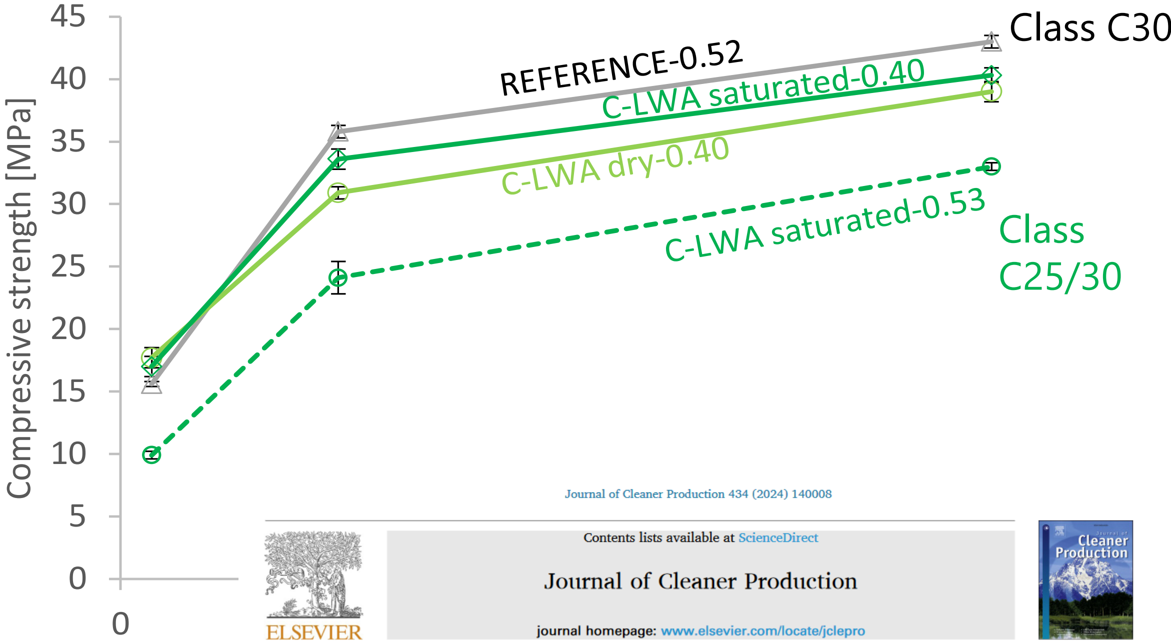
Net-zero concrete with C-LWA (1)

Empa
Materials Science and Technology

- Ordinary concrete as reference (C30/37), w/c 0.55, cement content 297 kg/m^3, density 2400 kg/m^3
- Concrete with C-LWA: C-LWA occupy 20% vol. of concrete, C-concentration ~3.3 mass-%, ρ~2100 kg/m^3
- Good durability (Buildings/Hochbau): XF2-3, XC3-4

- **Emissions of concrete:**
  - **REFERENCE**: 208 kgCO_2/m^3 of concrete
  - **C-LWA**: -1 kgCO_2/m^3 of concrete





Journal of Cleaner Production 434 (2024) 140008
Contents lists available at ScienceDirect
Journal of Cleaner Production
journal homepage: www.elsevier.com/locate/jclepro

Cold-bonded biochar-rich lightweight aggregates for net-zero concrete

Mateusz Wyrzykowski [a,*], Nikolajs Toropovs [a], Frank Winnefeld [a], Pietro Lura [a,b]
[a] Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, CH-8600, Switzerland
[b] Institute for Building Materials, ETH Zurich, Zurich, CH-8092, Switzerland

Net-zero concrete with C-LWA (2)

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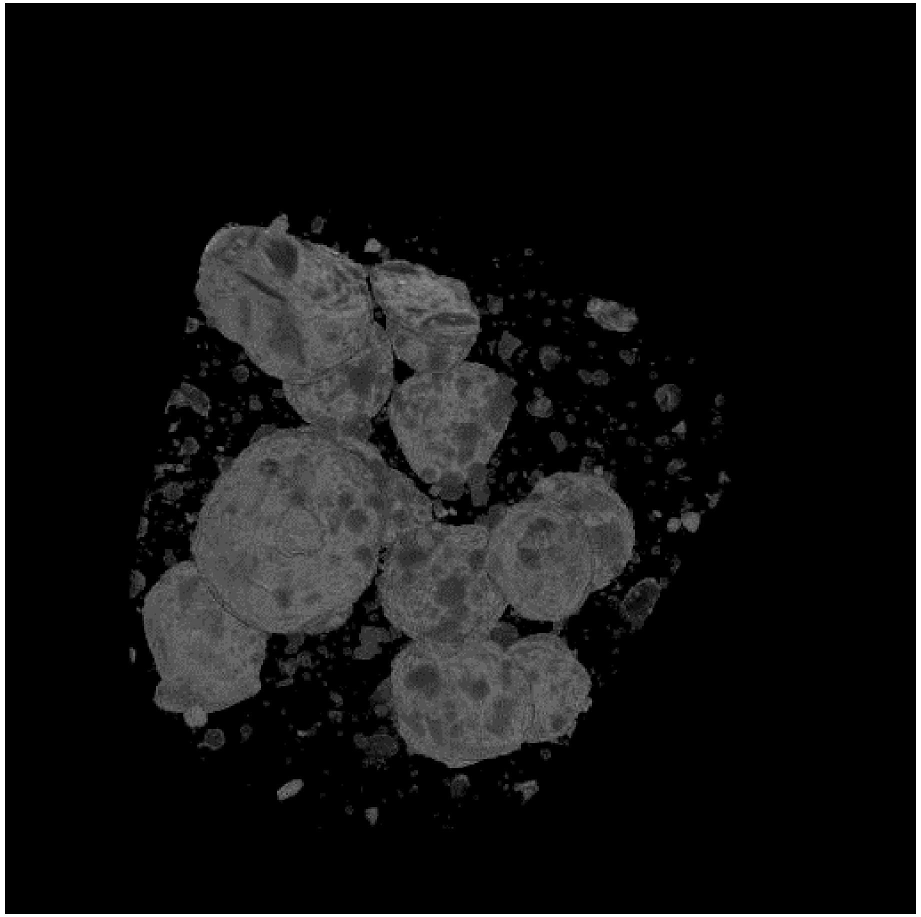
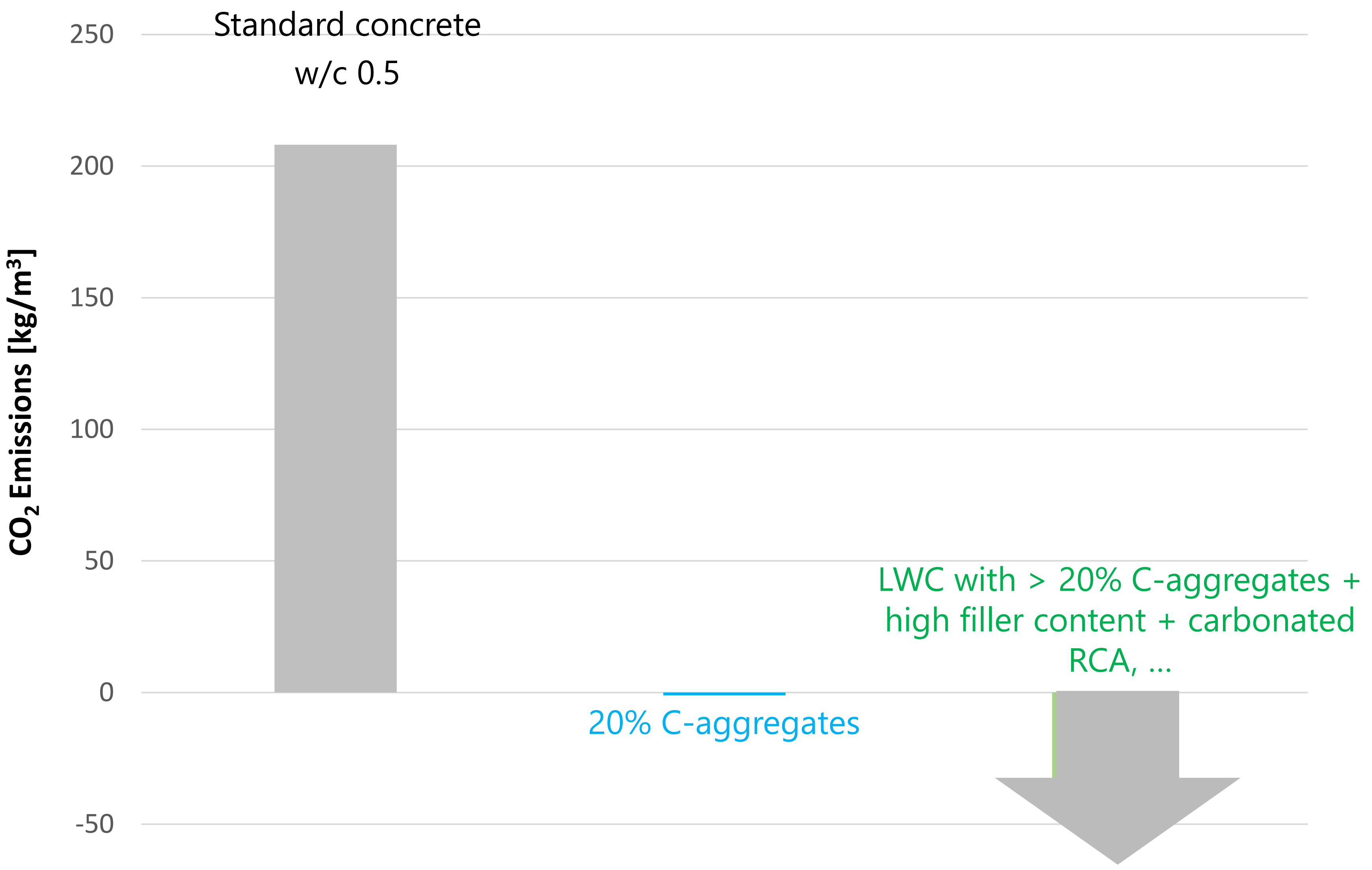


X-ray tomographies

Empa's X-ray center + M. Griffa

CO_2-negative concrete: potential



Multiple recycling is a necessity

*LWC: structural lightweight concrete

Biochar in asphalt

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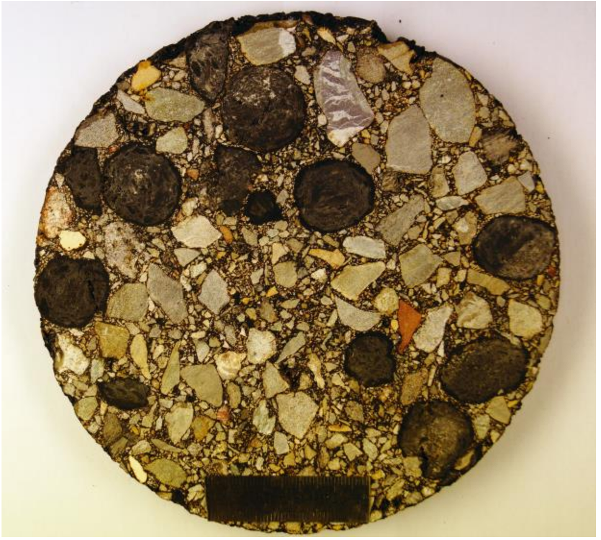
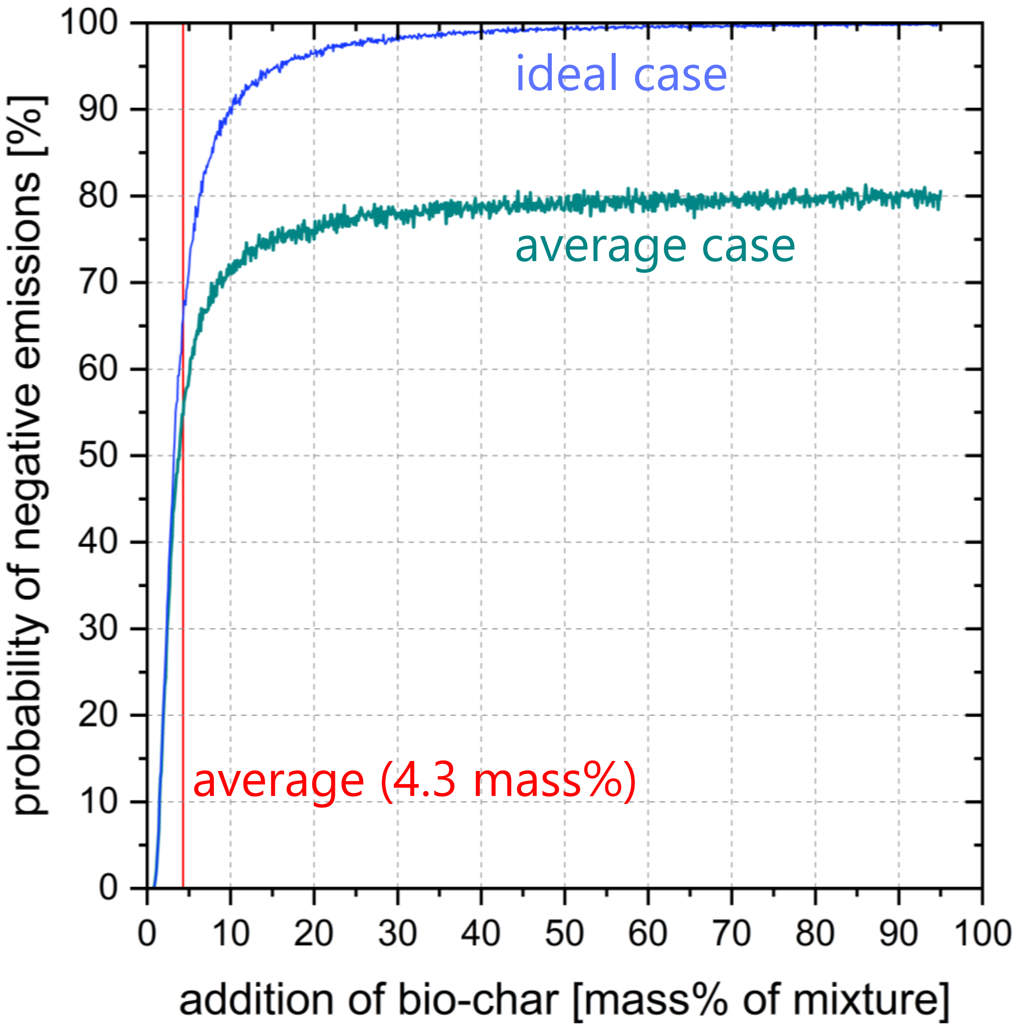
- Pilot project on asphalt with biochar: Basel-Stadt
  - 2% biochar addition ➔ "-50 kg CO_2/t asphalt"

- Adding biochar "as is" ➔ amount of fine fraction in asphalt is a limiting factor
- Similarly as for concrete, upcycling biochar into C-LWA pellets to replace aggregates in asphalt





D. Grossegger, M. Wyrzykowski, N. Toropovs, P. Lura, MaterStruct (submitted)

Conclusions

- Most of the chars act as inert fillers (not SCM!)
- Char can be used as a filler in concrete ➔ limited capacity
- Big potential by replacing aggregates in concrete or asphalt ➔ maximize density: currently cold-bonding, SiC in future
- Sufficient strength and durability for most structural applications
- Recycling ➔ ongoing studies on recyclability of concrete with carbon-aggregates

https://www.empa.ch/web/s604/mining-the-atmosphere

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Materials Science and Technology

Get informed when student recruitment starts

https://bit.ly/LACHMAT-info

bitly

Ramirent pieredze
Redzamais betons

Latvijas Betona savienības 32. zinātniski tehniskā konference
28.11.2024

Skaidri noteikumi

- Pieprasījums BK un AR daļa
- Iespējas – veidņu sistēma
- Piemēri no objekta – references
- Riski
- Izmaksas
- Sagatavošanās
- Tehnoloģija
- Laikapstākļi
- Rezultāts

RAMIRENT A LOXAM Company
HÜNNEBECK BY BRAND SAFWAY

Populārākā veidņu sistēmu izvēle Latvijā

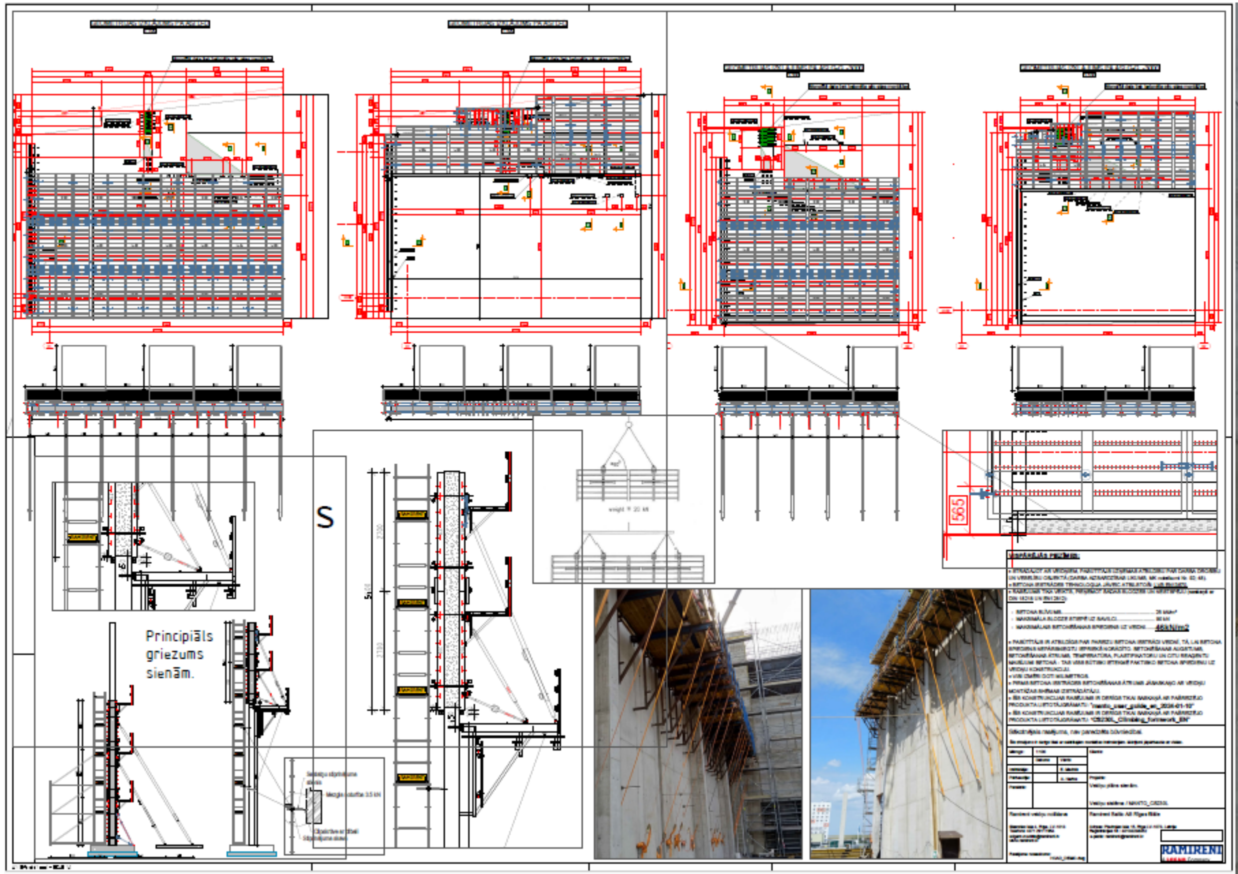
Standartu sienu paneļi

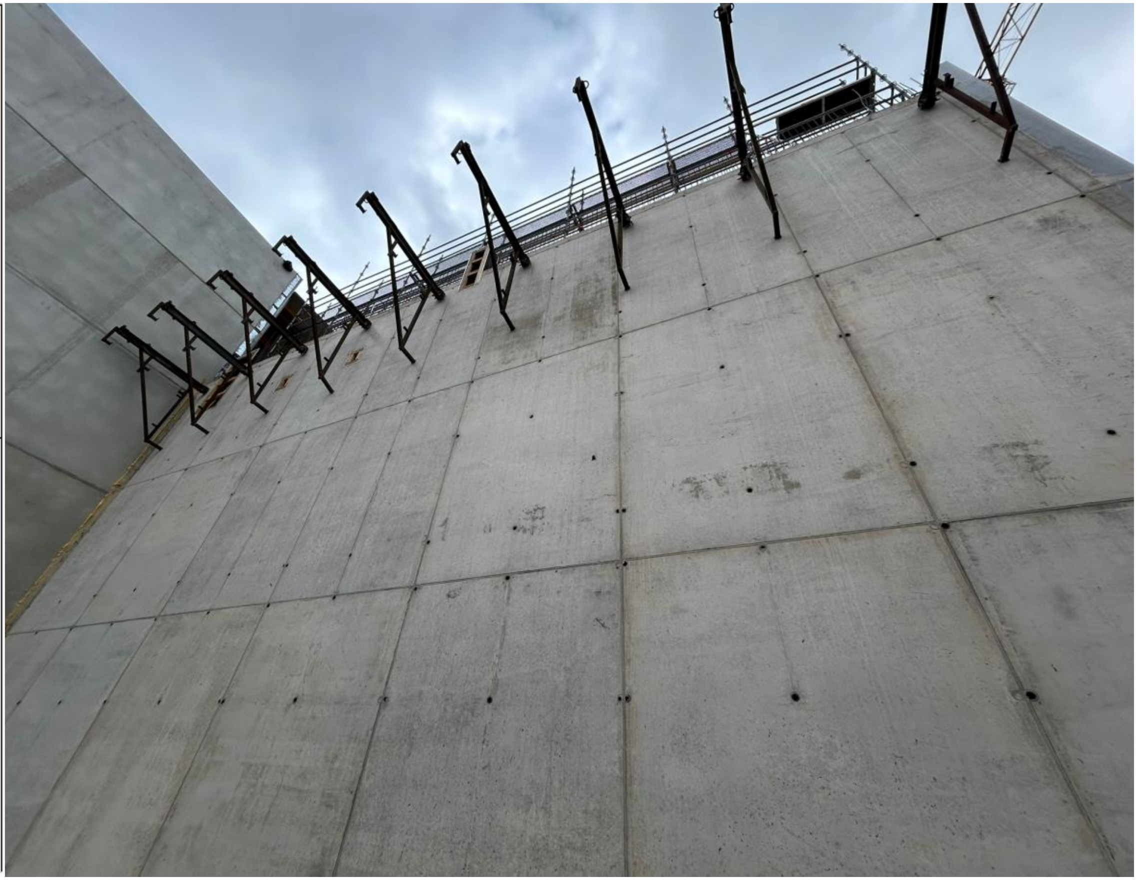
Standartu sienu paneļi apšūti ar finieri

H20 sijas +finieris 21mm

RAMIRENT

Rasējumu izstrāde



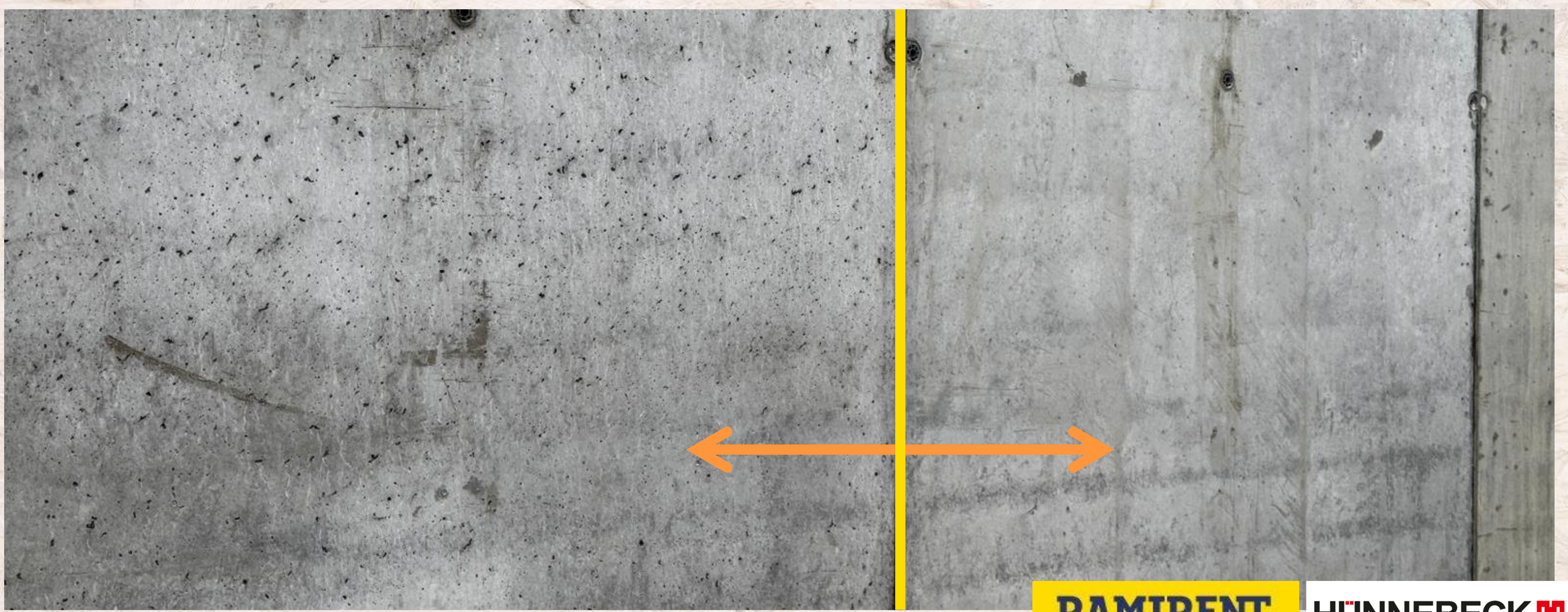


Materiālu sagatavošana noliktavā

RAMIRENT A LOXAM Company

HÜNNEBECK BY BRAND SAFWAY

Eļļa vai Emulsija



Rezultāts

RAMIRENT
A LOXAM Company

HÜNNEBECK
BY BRAND SAFWAY

Lai visām iesaistītām pusēm rezultāts liek priecāties!

RAMIRENT
A LOXAM Company

HÜNNEBECK
BY BRAND SAFWAY

Arnis Janbergs
Pārdošanas vadītājs
arnis.janbergs@ramirent.lv

HÜNNEBECK
BY BRAND SAFWAY

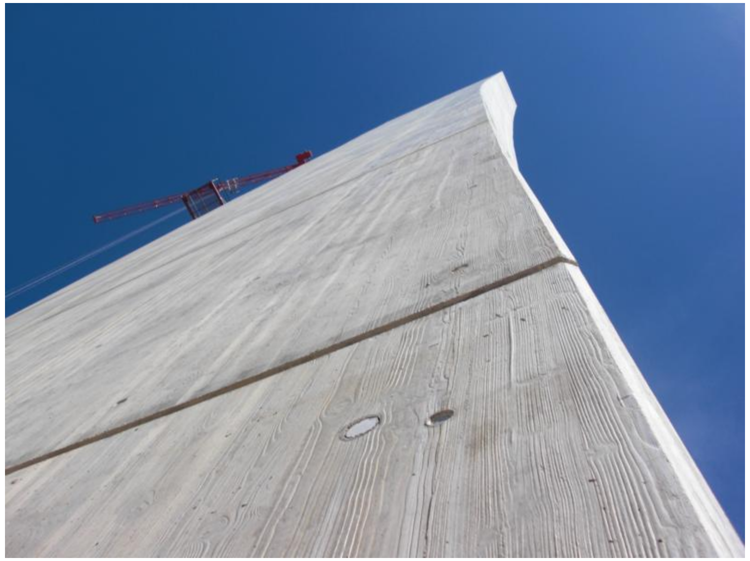
RAMIRENT
A LOXAM Company

Far Face Concrete

Plan
Fare face surface / FF-Team / Planning / Testwall / Site procedures / Protection of finished parts

Latvias Betona savienibas 32. Konference

Riga, 28.11.2024



Andreas Gugelmeier
Sales Director N.M. - Export
Hünnebeck Deutschland GmbH

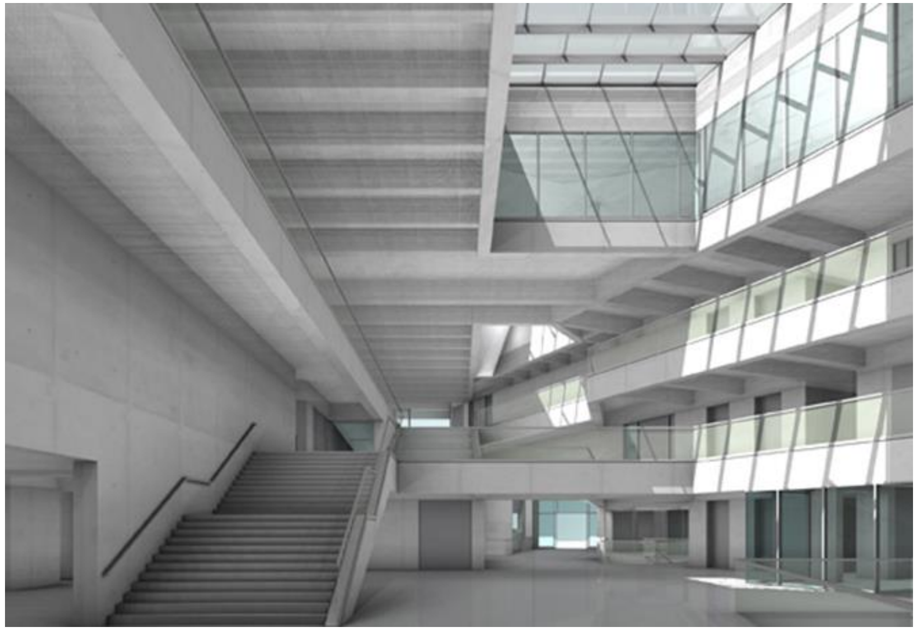
Fare Face = Sichtbeton SB01 – SB04 definition

Construction site – recommendation:

Formworksystem and Formwork panel (surface) selection

Project: University Kassel – Auditorium and Campus Center

› Hochkompliziertes Bauvorhaben Hörsaal und Campus Center der Universität Kassel in SB3-SB4;
Jede Ebene ist anders aber die horizontalen und vertikalen Fugen sollten durch das komplette Bauwerk laufen

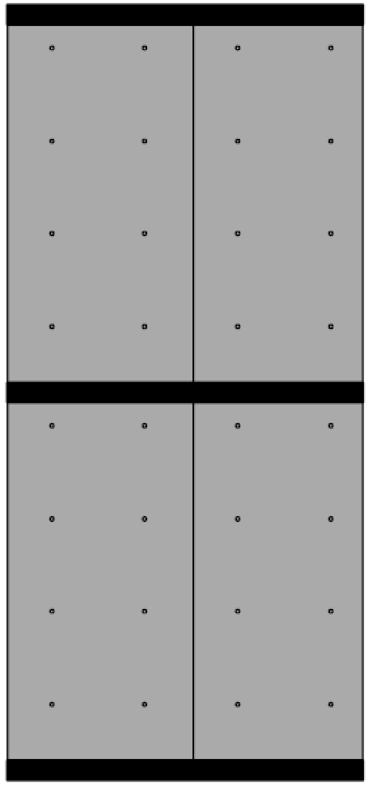


High complex Project „Hörsaal und Campus Center der Universität Kassel in Farface concrete SB3 – SB4
Each level/story of Building was different, but the horizontal and vertikal joints should be similar for the whole structure.

Tender requested similar Anchor and Formwork picture

- Anchor wholes:
  Raster von 1,00m * 1,00m
- Client provided on site: Betoplan Top
  Breite: 2,00m / Höhe: 4,00m
- Following „SB classes - DBV-Merkblatt „Sichtbeton“=Fare Face“ Tollerances DIN 18202

  Tabelle 3 line 6 (1m = 5mm Tolerance) and Tabel 3 line 7 (1m = 3mm Toleranz)
- Corners Tolerance < 10 mm
- Even for liftshafts and box out areas same Tollerances apply

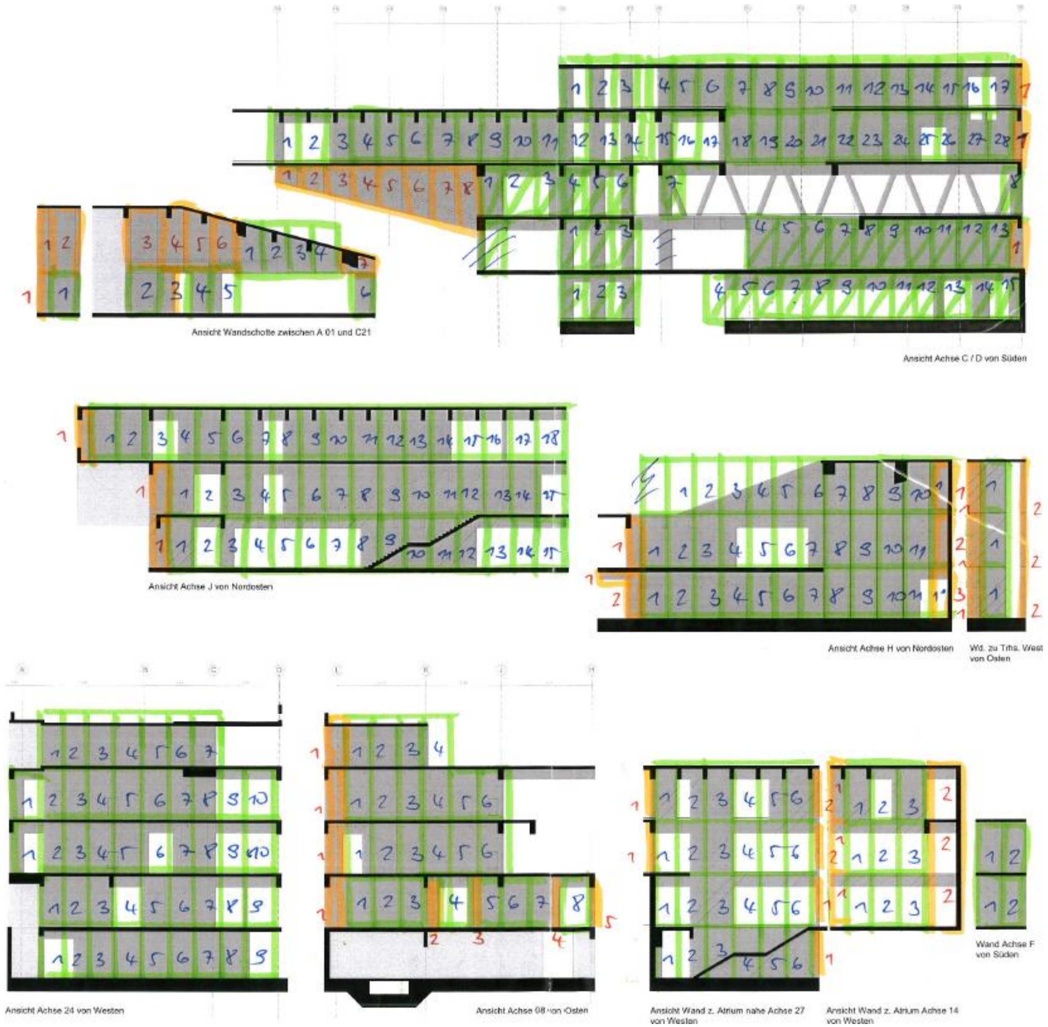


Wand Achse F
von Süden

Analyse the Formwork set in accordance to Timeline & Budget

- Formwork set and rental period on site planed in accordance to Budget
- Formwork planed:
  330 m² SB1 Trägerelemente / H20 waler
  150 m² SB3 Trägerelemente
  180 m² SB4 Trägerelemente
- 22 Stk. Standardelemente / standard panel
- 33 Stk: Sonderelemente / Special elements
- Analysis:
  Formwork ammount must be enough to

  Match timeline and budget.

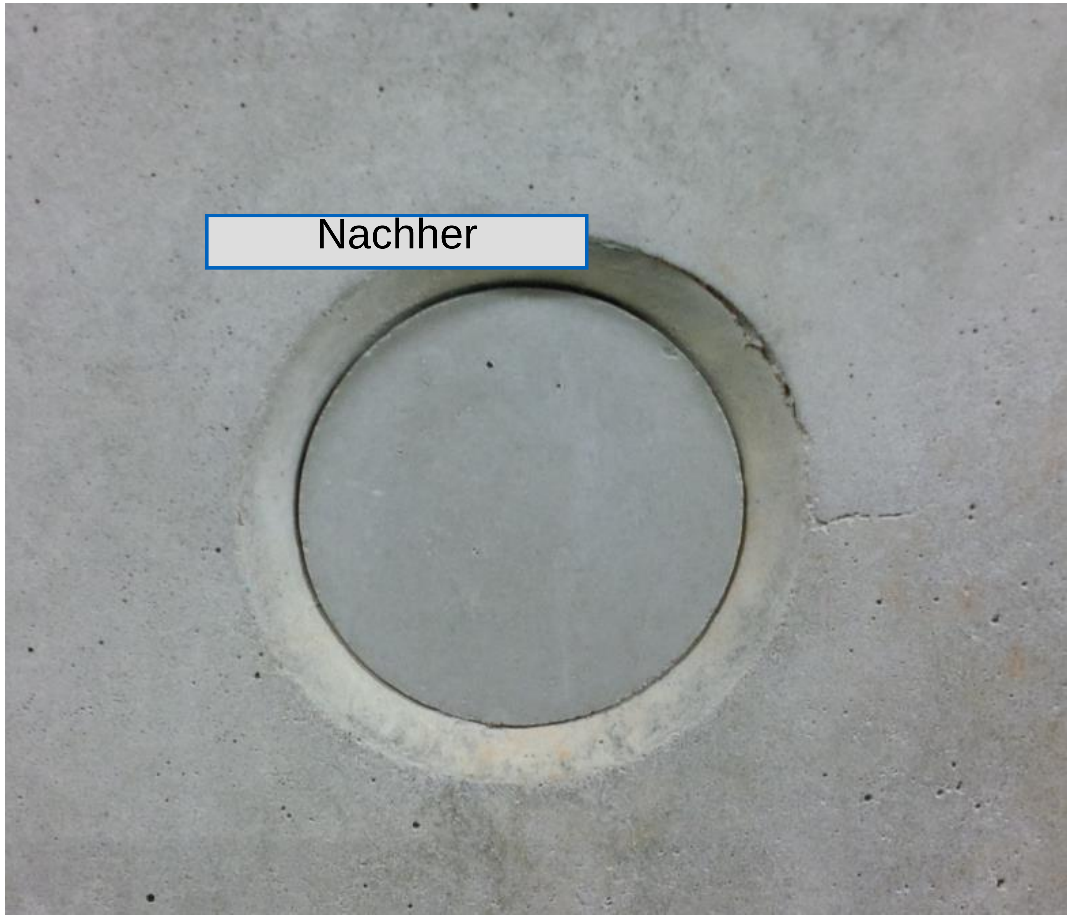


Agree on workflow – Pure Testwalls – Surface quality check & agree on documented result.

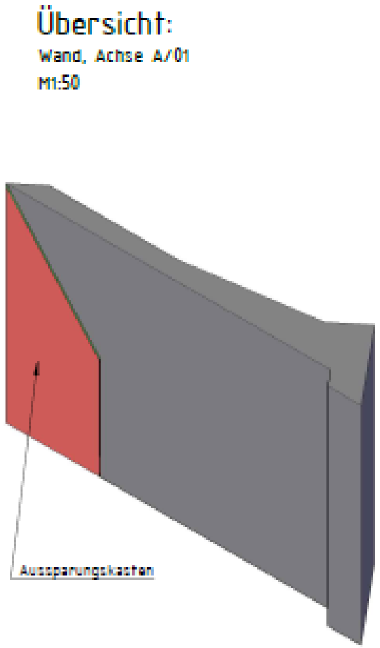
- Musterwände wurden betoniert und begutachtet
  Musterflächen haben den Vorteil, dass sich die Parteien während der Bauausführung darüber einig sind, wie die zu erstellenden Sichtbetonflächen auszusehen haben.

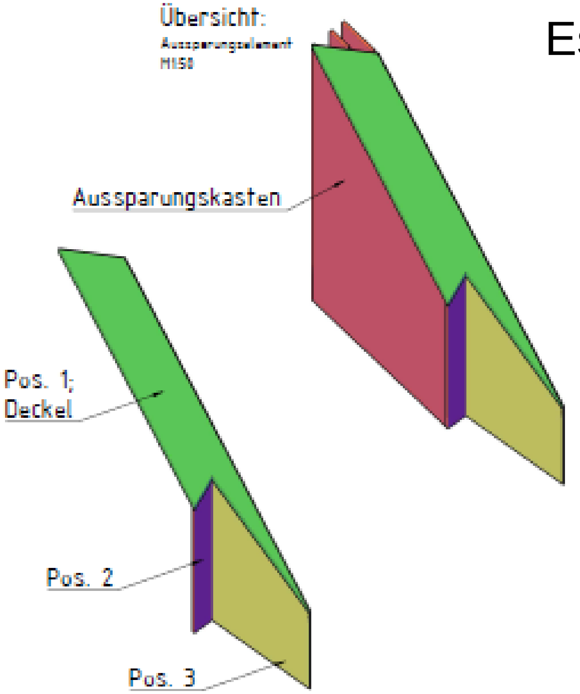
Festlegung der Arbeitsschritte und daraus resultierende Vorgehensweise

- Falts / Afterwork at concrete wall: Concrete finishing and afterwork steps agreed

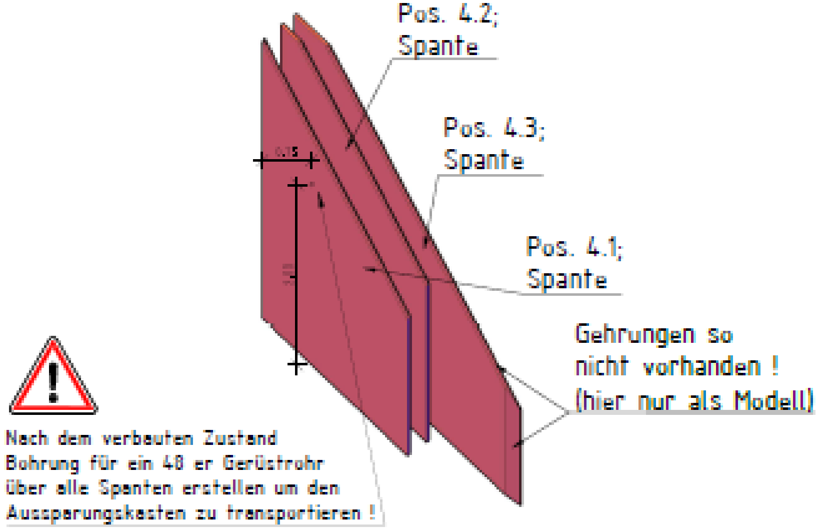


Boxouts in 3D



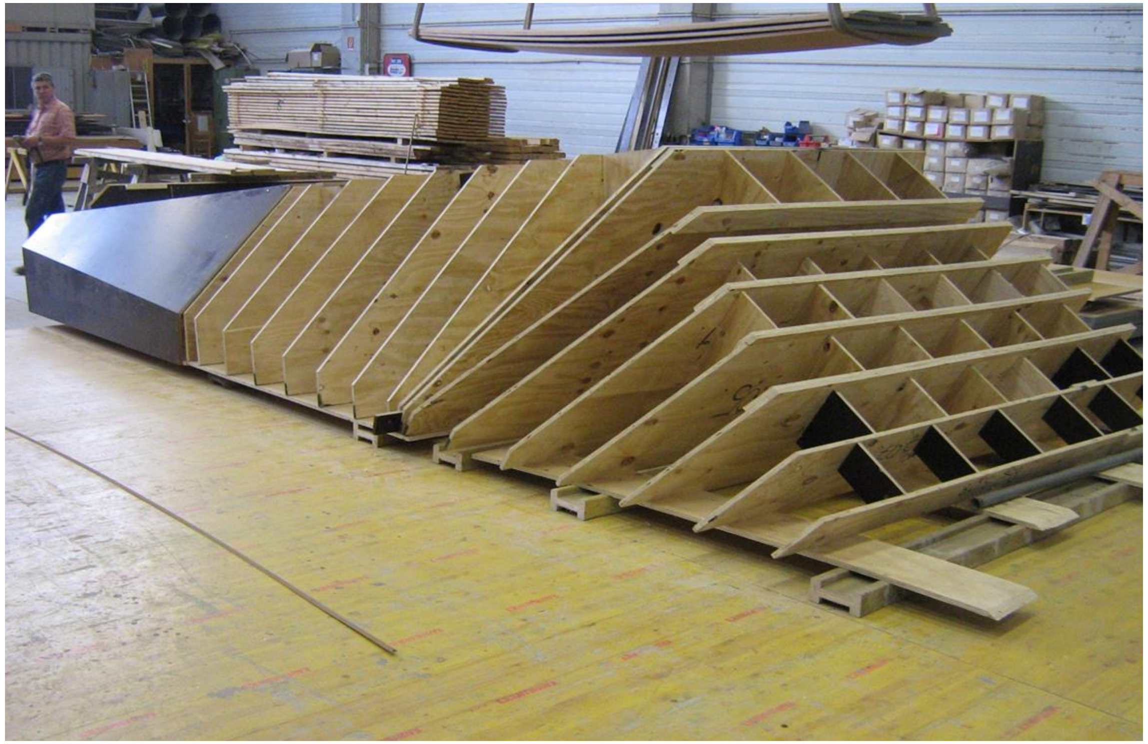


Es wurden ca. 40 Aussparrungs-kästen gebaut; Σ ca. 350m²



ohne 3-D Zeichnungen waren einige Aussparungskästen nicht herzustellen

Boxouts manufacturing:

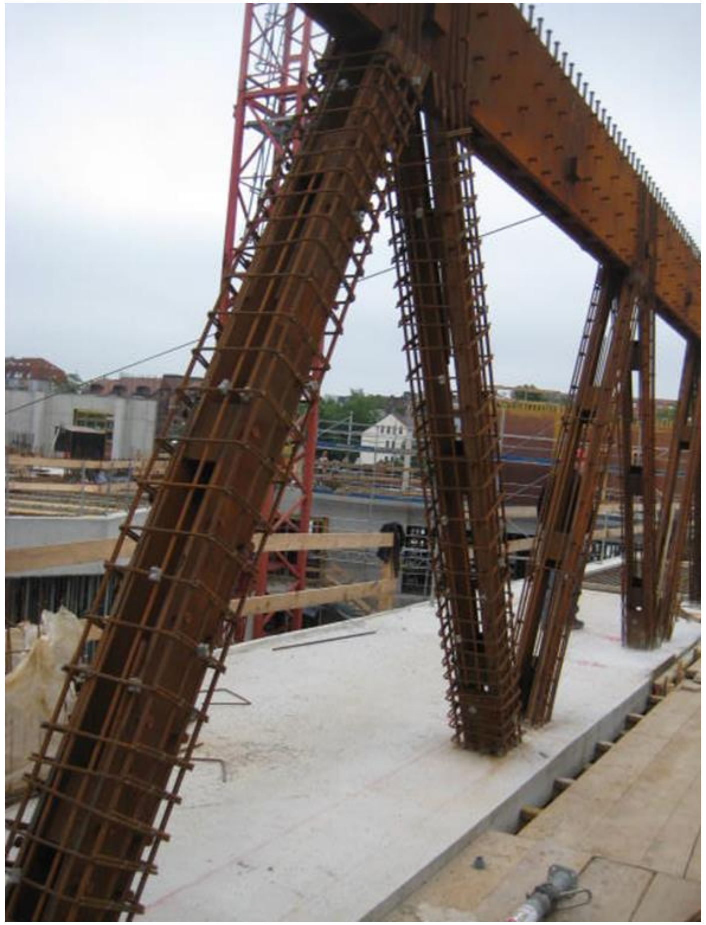


Part after concreted on site:

Cleaning and Storage of Elements

› Reinigung, Lagerung, Sicherungsmaßnahmen und Nacharbeiten

Steel – Concrete Beam - Production



Pictures under construction

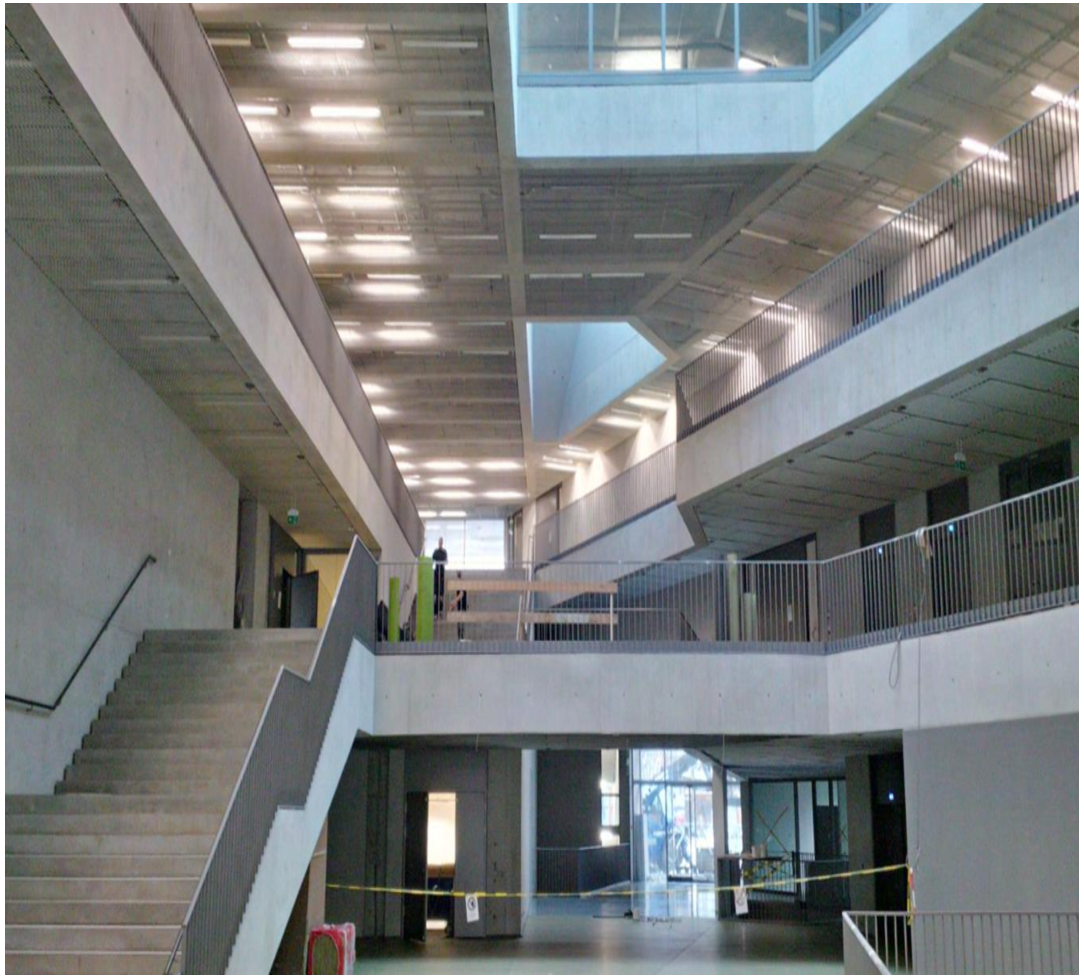
Pictures under construction

Different temperature and weather

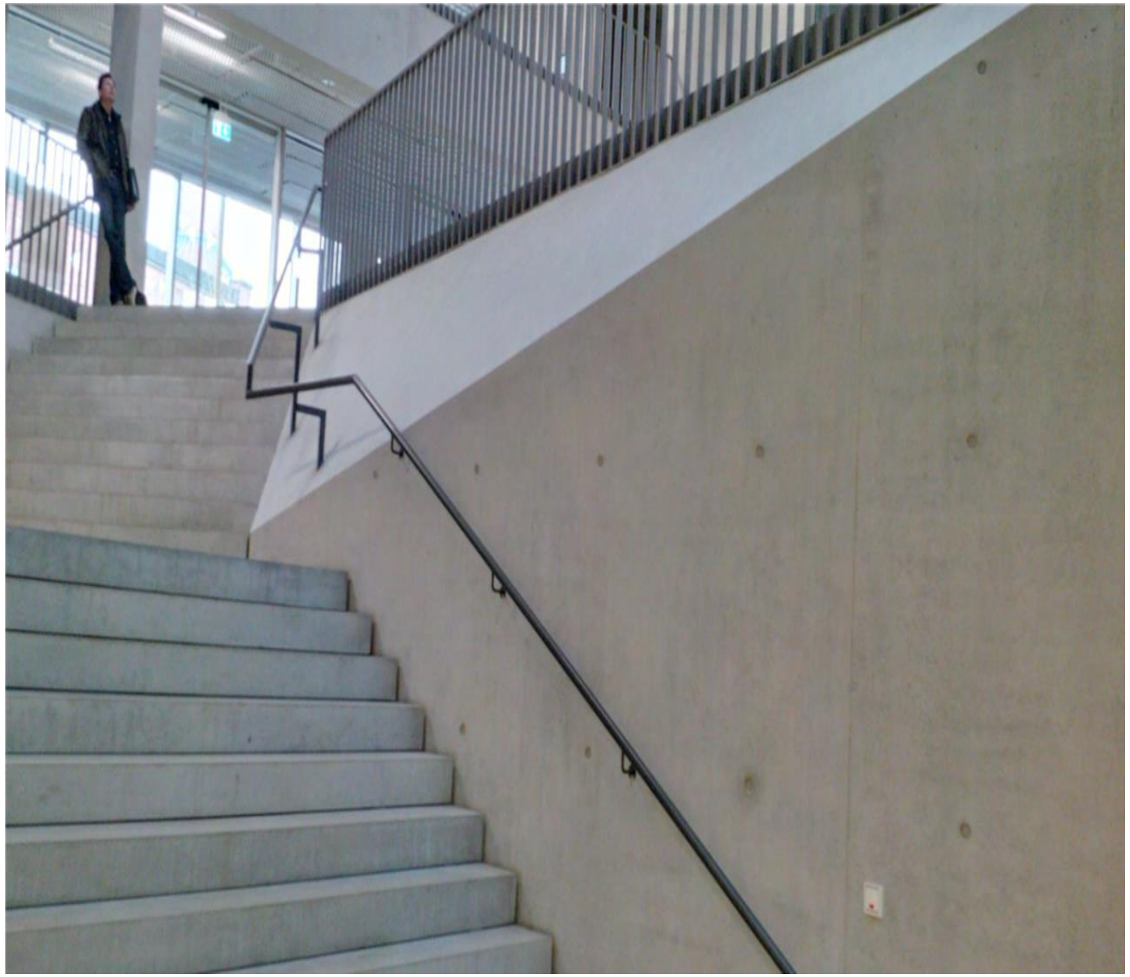
Allways same concrete surface?

Pictures under construction

Result before opening

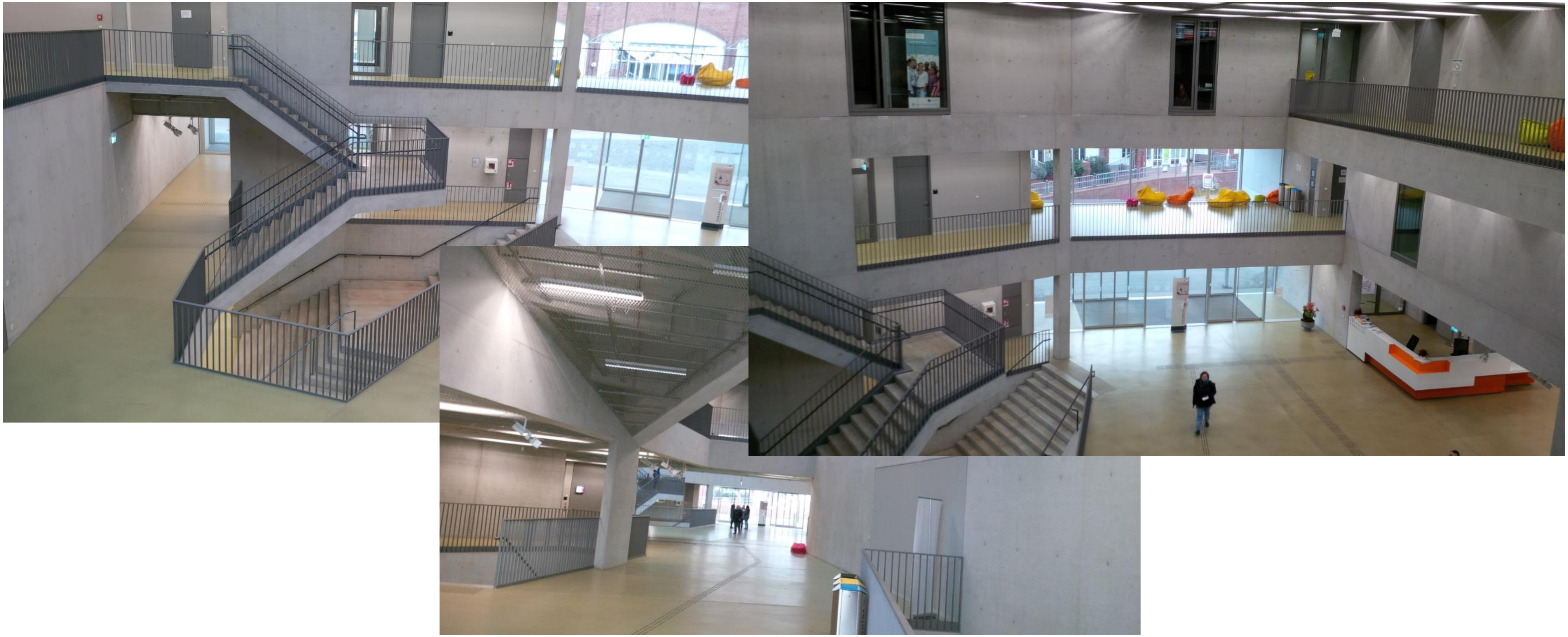


Result before opening



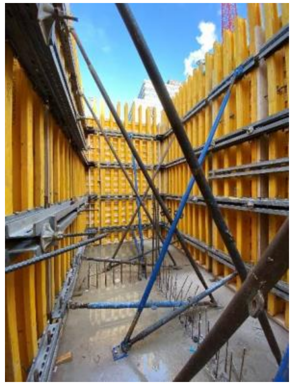
Final Building

Final Building

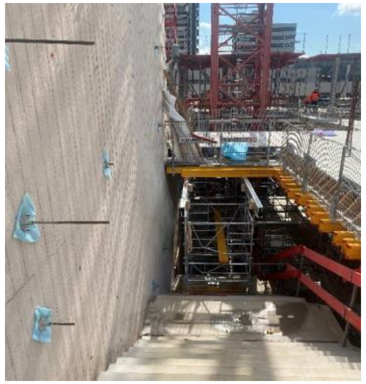


Final Building


Other References – Sichtbeton
Debeka Koblenz SB3 und SB4 Fotos









Other References–Sichtbeton Böblingen SB3 Fotos

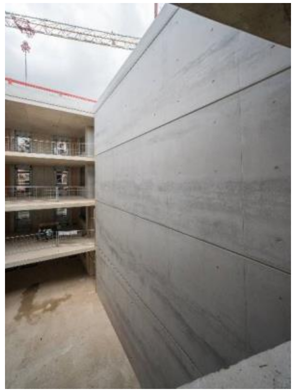
Other References –Sichtbeton
Baustelle Gießen SB3 Fotos

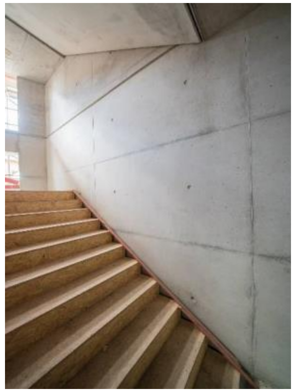




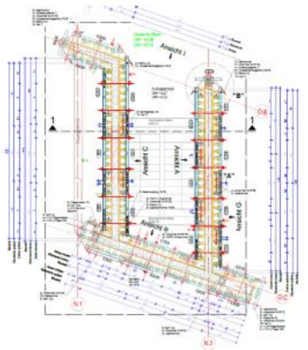


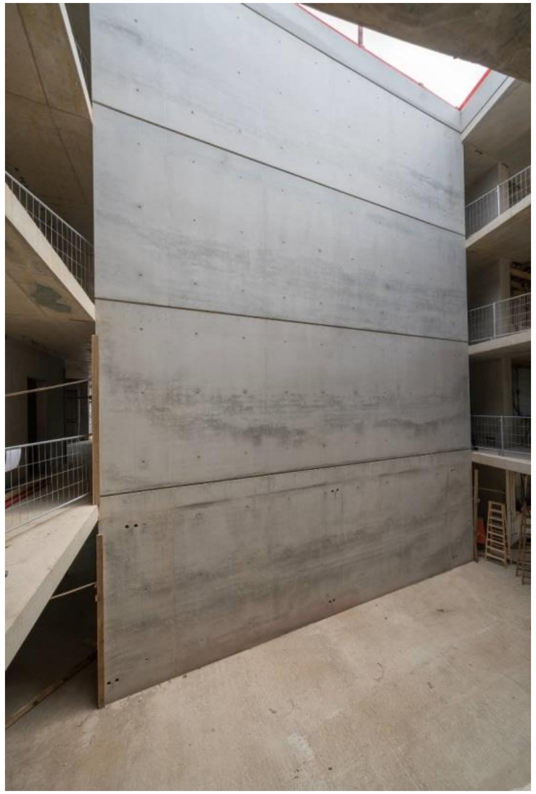
Other References –Sichtbeton
Max Planck Institut SB3





Stellplanung:





THANK YOU - Please contact us:

RAMIRENT
A LOXAM Company

Vielen Dank für ihre Aufmerksamkeit

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BY BRAND SAFWAY

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Kreisler, FFM

Andreas Gugelmeier

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25 years of the contest Concrete Building of the Year in Estonia

Jürgen Einpaul

Estonian Concrete Association

28 November 2024

eesti **betooniühing**

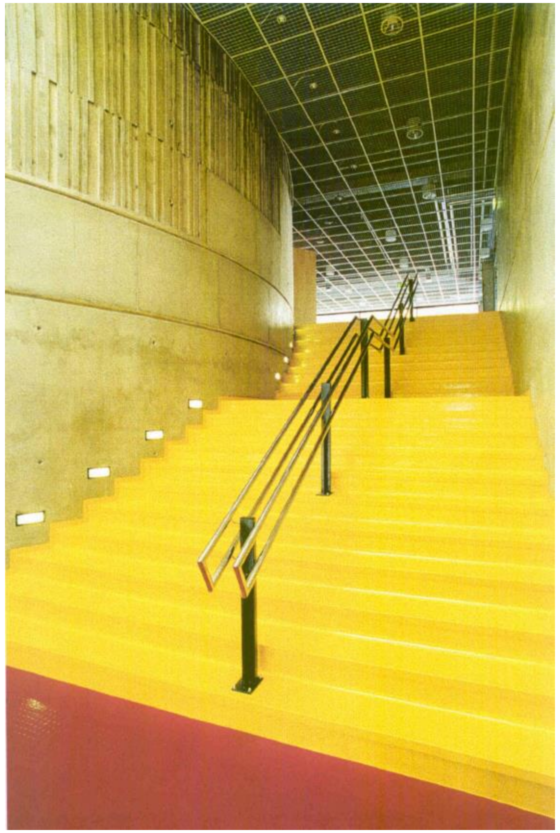
Concrete Building of the Year

- Contest organized in Estonia every year since 2000
- All structures can take part, from sculptures to buildings and bridges
- Prizes for all the involved parties are given out at the Concrete Day held in March
- The jury includes representatives from main trade organizations


PEAAUHIND:
ERAMU PIRITAL
PURJE TÄNAVAL
ARHITEKTUUR: ÖÖ-ÖÖ ARHITEKTID OÜ
ÜLO-TARMO STÖÖR, LEMBIT KAUR STÖÖR
SILVER LIIBERG, MARI-LIIS SÜLD
AASTA BETOON-EHITIS
2023
BÜ eesti betooniühing
eetl
Eesti Ehitusmaterjalide Tootjate Liit
TOM TAILOR
PREMIUM QUALITY

püh hing

First winner – Rocca al Mare School (2000)



Architect:
Urbel & Peil

BÜ eesti betooniühing

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hing

Dry bulk terminal in Muuga Harbour (2001)

Designer:
Randväli & Karema

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TTP office building (2005)

Architect: Meelis Press

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Puurmani arch bridge (2007)

Engineers:
Juhan Idnurm
Siim Idnurm

Tallinn Airport terminal expansion (2008)

Architect:
Sofreavia


Kauplus
Duty-free Shop
Wines


Cromatico sound sculpture (2011)

Sculptor: Lukas Kühne

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Reconstruction of seaplane hangars (2012)

Structural engineers:
Karl Õiger, Heiki Onton

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Ülemiste traffic junction (2013)

Designer: K-Projekt

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Tallinn cruise terminal (2021)

Architect: Salto

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AIDAcara
AIDAaura
Mein Schiff
TALLINNA SADAM
PORT OF TALLINN
KRUIISITERMINAL
CRUISE TERMINAL

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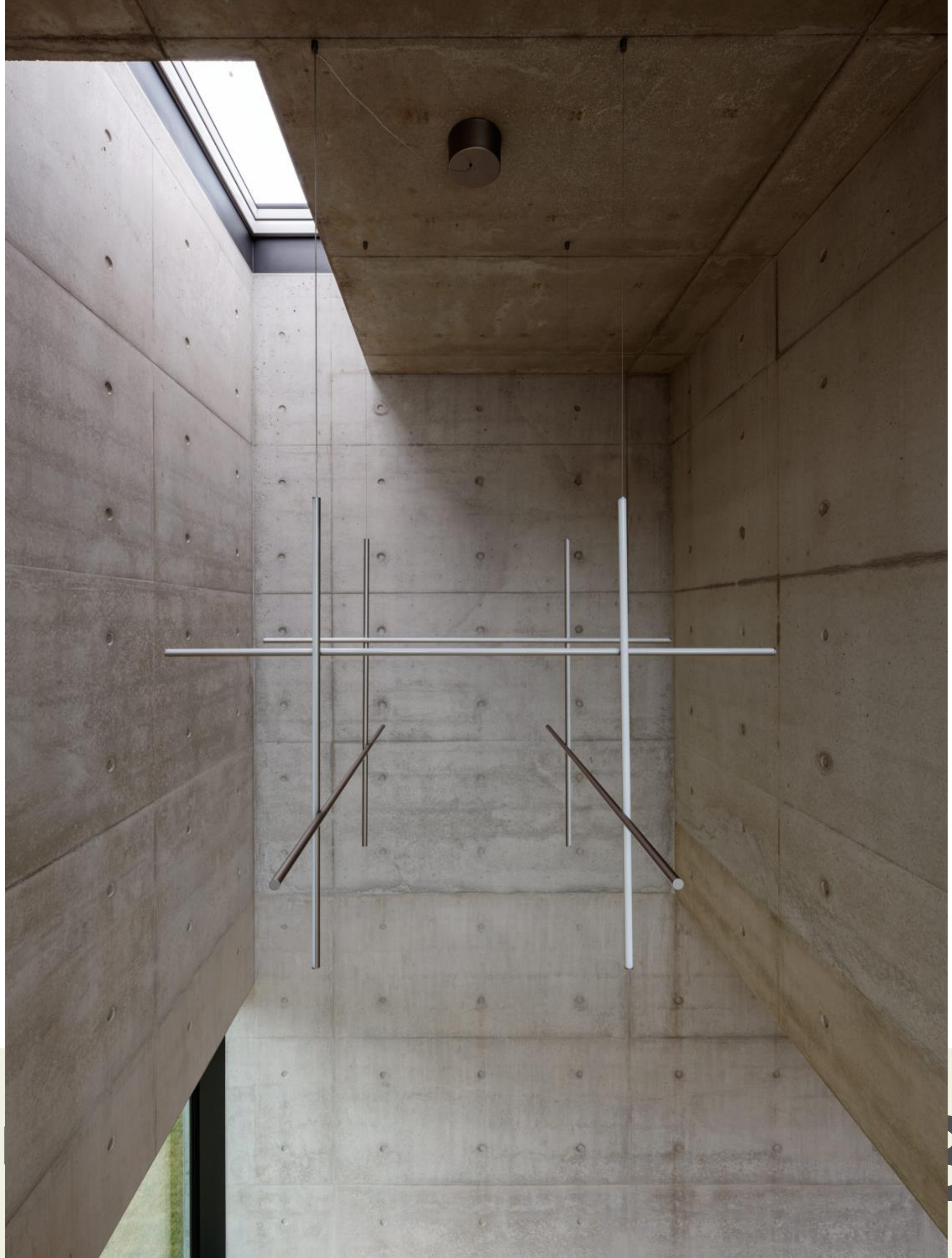
Private house in Pirita (2023)

Architect: ÖÖ-ÖÖ

eesti **betooniühing**



pühapäe

ooniühing

Concrete Building of the Year

- Concrete Building of the Year is the oldest contest of its kind in Estonia
- The contest highlights concrete in all its expressions
- It is well known by the public and covered my mass media

Standartisation of concrete surface

Rimvydas Moceikis, PhD, Betonika, CONSOLIS
Gintautas Skripkiūnas, Prof., VilniusTECH
Mindaugas Daukšys, Prof., Kaunas Technological University

National Lithuanian standard LST 2015:2020 “Precast concrete products. Surface appearance characteristics and the methods for inspecting”

LIETUVOS STANDARTAS **LST 2015**

Išleistas 2020-10-15

ICS 91.100.30

Surenkamieji betoniniai gaminiai. Paviršiaus išvaizdos charakteristikos ir jų tikrinimo metodai

Precast concrete products – Surface appearance characteristics and the methods for inspecting

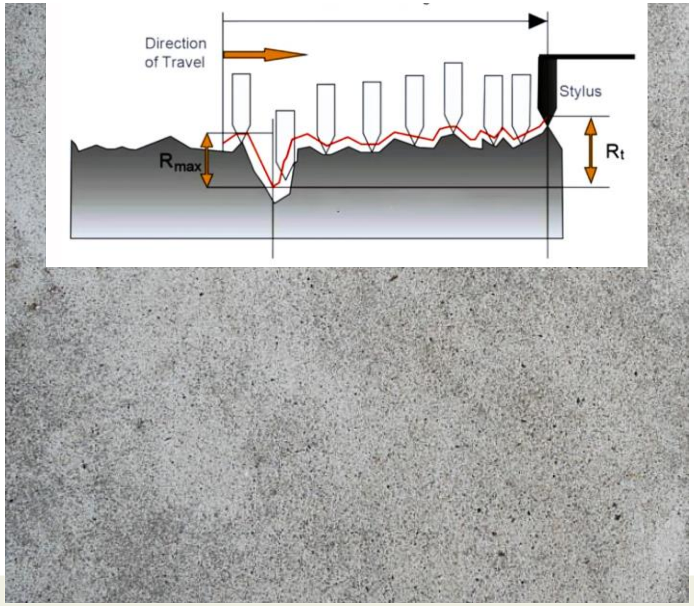
Terminų (lt): 24 Puslapių: 37

LIETUVOS STANDARTIZACIJOS DEPARTAMENTAS
Algirdo g. 31, LT-03219 Vilnius
Tel. 270 93 60, el. paštas lstboard@lsd.lt
interneto svetainė http://www.lsd.lt

Nuorodinis žymuo
LST 2015:2020 lt

EN 13369 is lacking requirements for concrete visual characterics.

LST 2015 is used to evaluate the surface characteristics of precast concrete elements according to their ***texture, structure and colour***



texture

structure

colour

eesti **betooniühing**

Important Terms and Deffinitions in LST 2015

normal surface

a surface of a product that **does not have special requirements** and that can have chipped edges or other minor surface defects repaired without color restrictions. It is also possible to print marks from the joints of the form, meeting the requirements of table 1.

special surface

concrete that meets at least one of the requirements regarding color, texture, structure, color of putty or repair mixture, marks from form joints, etc. The repair and finishing of special surfaces of products with repair compounds and/or putties is limited: it is allowed to repair chipped corners and edges up to 10 cm long in one linear meter (the width of one chip is allowed up to 5 cm) with repair compounds and/or putties corresponding to the strength of the concrete of the product and environmental impact class and close to the color of the concrete surface. **Factors that cause color or stains on the surface of the product and are difficult to control by humans (such as fading) are acceptable and not considered defects.**

Important Terms and Deffinitions

ordinary concrete

concrete made in accordance with LST EN 206, **the color of which is not subject to requirements**

colored concrete

concrete that is produced according to LST EN 206, using conventional cement that meets the requirements of LST EN 197-1, with or without the addition of pigments, and **whose color has certain requirements**

Surfaces of precast concrete elements

Horizontal form facing material (ex. steel table)

Vertical form facing material (ex. plywood moulds)

Surface without contact with the form-facing material

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https://www.vollert.de/en/references/detail-englisch/precast-concrete-elements-for-brazils-construction-industry

Surfaces in contact with the form-facing material

1. Surfaces in contact with the form facing material

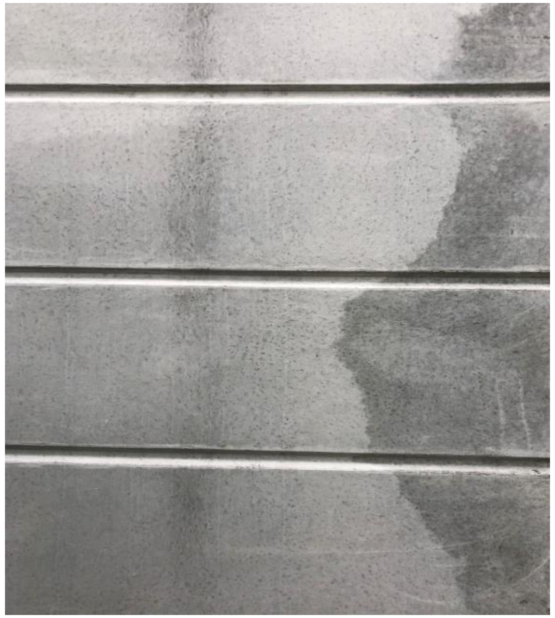
Smooth surface

The smooth surface when using noncolored concrete

The smooth surface when using colored concrete

A smooth surface of the product is obtained in contact with the smooth surface of the form.

Matrix surface



The matrix surface when using noncolored concrete

The matrix surface when using colored concrete

During production, the surface structure or pattern of the entire product or part of it is extracted using a special insert (matrix).

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1. Surfaces in contact with the form facing material

Graphical surface

The graphical surface when using colored concrete

During production, the pattern of the entire surface of the product or its part is extracted using a special material: graphic paper, which is laid into a mold.

Washed surface

The washed surface when using colored concrete

During production, paper impregnated with substances retarding the binding and hardening of concrete is used. After removing the product from the formwork, the surface is processed by washing.

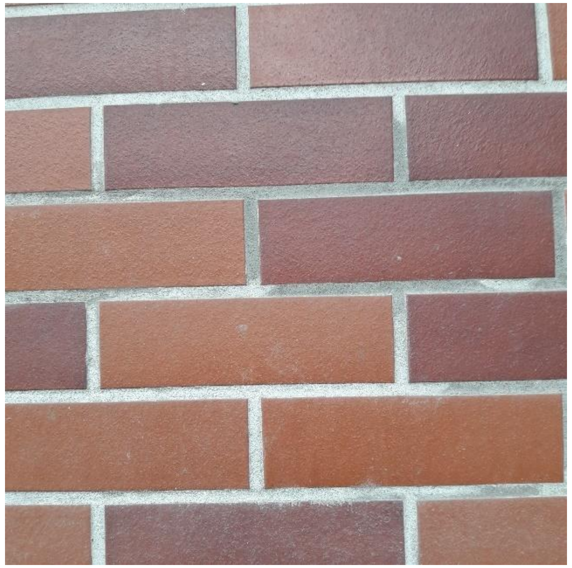
Mechanically treated surface

The mechanical treated surface when using colored concrete

Finishing of the surface of the hardened concrete product is obtained by processing the visible surface of the concrete with special tools.

1. Surfaces in contact with the form facing material

Tile's surface



The tile's surface when using noncolored concrete

The tile's surface when using colored concrete

During production, tiles (e.g. clinker tiles) are concreted into the visible surface of the product.

Brick's surface surface

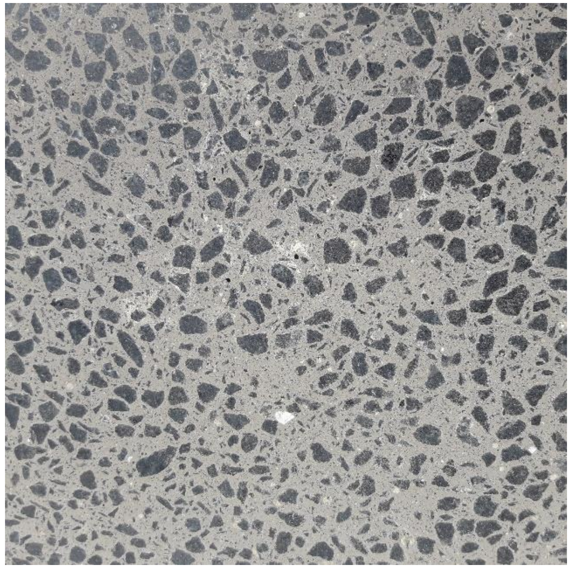
The brick's surface when using noncolored concrete

The brick's surface when using colored concrete

During production, bricks or half-bricks (e.g. ceramic bricks) are concreted into the visible surface of the product.

1. Surfaces in contact with the form facing material

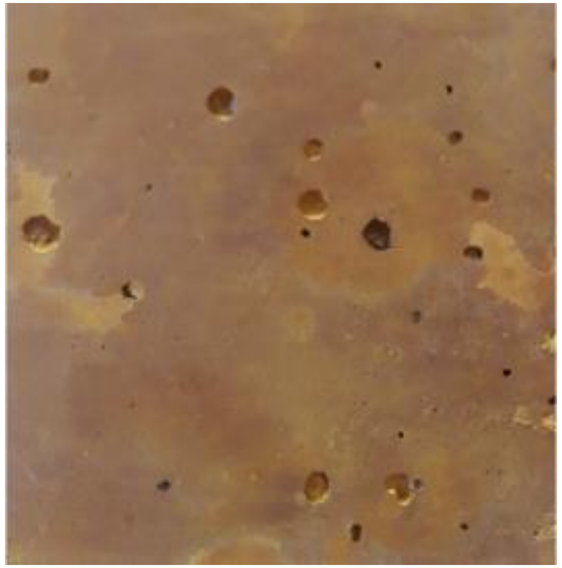
Terrazzo surface



The terrazzo surface when using colored concrete

During production, after removing the product from the mold, the visible surface is polished.

Chemically treated surface



The washed surface when using colored concrete

This is a product surface that is obtained by processing with special chemicals in order to obtain a specific surface color.

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Surfaces not in contact with the form-facing material

2. Surfaces not in contact with the form facing material

Untreated surface

Treated surface using vibro ruler

The untreated surface when using noncolored concrete

The untreated surface when using colored concrete

The vibroruled surface when using noncolored concrete

The vibroruled surface when using colored concrete

This is the surface of the product obtained after compaction of concrete when its horizontal surface is not additionally processed by any mechanical means, i.e. is left as is.

This is the surface of the product obtained after compaction of concrete when excess concrete is scraped off the horizontal surface of the product with a vibro ruler.

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2. Surfaces not in contact with the form facing material

Mechanically-grinded surface

The mechanically-grinded surface when using noncolored concrete

The mechanically grinded surface when using colored concrete

This is the surface of the product obtained by the compaction of concrete when the horizontal surface of the product is mechanically grinded.

Manually-grinded surface

The manually-grinded surface when using noncolored concrete

The manually-grinded surface when using colored concrete

The manually-grinded surface is the surface of the product resulting from the compaction of concrete, whereas the horizontal surface of the concrete product is manually-grinded.

eesti betooniühing

2. Surfaces not in contact with the form facing material

Roller-treated surface

The roller-treated surface when using noncolored concrete

The roller-treated surface when using colored concrete

The surface of the product is obtained after the compaction of concrete when the horizontal surface of the product is processed by rolling with a roller. In this way, the surface processed acquires a certain structure depending on the length of the roller hair or the pattern (indentation) of the roller.

Brushed surface

The brushed surface when using noncolored concrete

The brushed surface when using colored concrete

The surface of the product is obtained after the compaction of concrete when the horizontal surface of the product is processed by brushing.

Definitions of measurable surface characteristics

3. Measurable characteristics of the surface

Recess (voids)

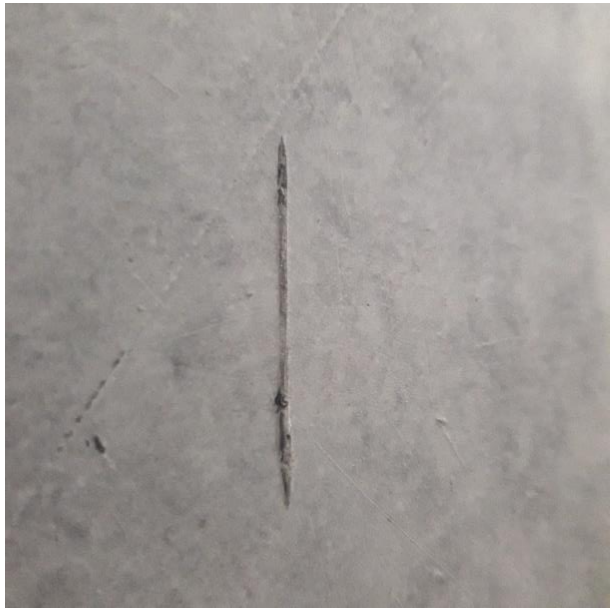
During the casting and compaction of the concrete mixture, part of the entrained air tries to escape from the mixture at the interface of the mixture-form-facing material. So when the mixture is in contact with the surface of the form, recesses are formed, which are visible on the surface of the finished product.

Lump

A lump formed on the surface of a concrete product may be due to irregularities in the form, screw impressions in the form, or a repair compound..

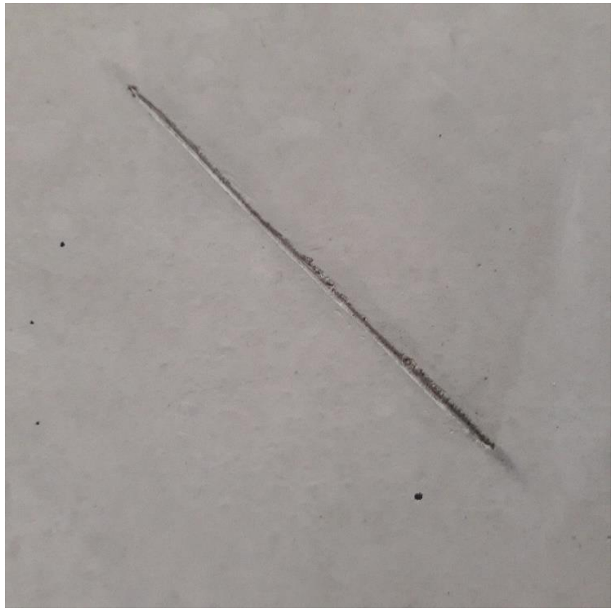
3. Measurable characteristics of the surface

Ridge



It is like a long, shallow hill that formed on the surface of the concrete product. The ridge on the surface of the product usually reproduces the scratches on the surface of the form-facing material.

Groove



It is like a long, shallow groove that formed on the surface of the concrete product. The groove on the surface of the product usually reproduces the protrusions on the surface of the mold.

Step discontinuity

A step discontinuity formed on the surface of the concrete product due to the non-coincident joint planes of the forms.

3. Measurable characteristics of the surface

Big recess ('moon's surface')

In products where planes of different heights are formed on a horizontal surface during production, such as balcony eaves, a wall panel gable, etc., a removable part of the form can be used that is removed when the concrete reaches the required strength. Under the removable part of the form, the air that has not been displaced during the compaction of the concrete mixture remains, which forms surface recesses of large irregular diameters. The permissible recess dimension at the longest point is 100 mm, maximum depth of 10 mm.

Cracks

Cracks appear as a result of direct loading (torsion, bending, shear) and/or strain restraint. The width of cracks in precast concrete products is limited according to standard LST EN 1992-1-1 requirements given in Table 7.1N.

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3. Measured characteristics of the surface

Chamfered edge

Filleted edge

Measurement of surface characteristics

4. Tolerances for ordinary and smooth special surfaces

Product surface category	The number of lumps per 1 m²			The number of recesses per square meter, when recess diameter (5-10) mm, and depth up to 5 mm	Maximum step discontinuity, mm	Maximum ridge height, mm	Maximum groove depth, mm
	Height, 1 mm	Height, 2 mm	Height, 3 mm				
A*	0	0	0	**10**	0	0	**0**
B	10	0	0	**20**	2	0	**2**
C	20	5	3	**50**	5	5	**5**

Explanation:

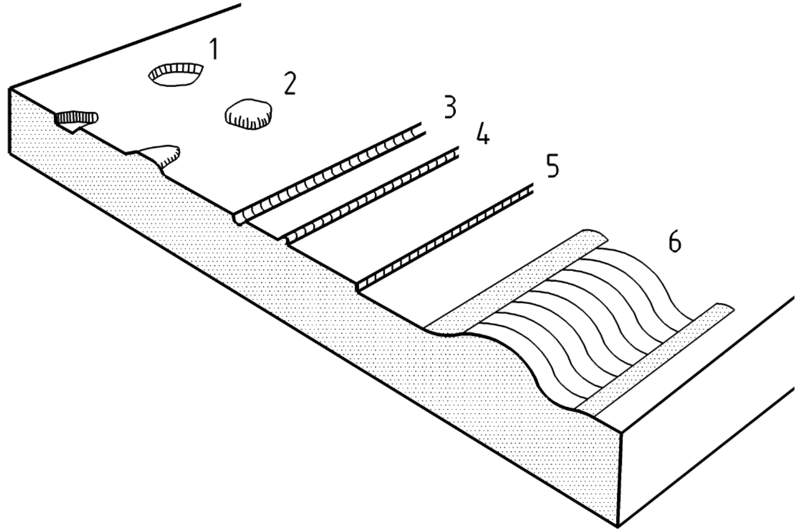
1) Category A* surfaces are formed in contact with the horizontal surface of the mold.

2) The amount of recess up to 5 mm in diameter when their depth does not exceed 5 mm, is not regulated.

3) Surface category C tolerances apply to the visible surface, for which the surface category is not specified in the factory drawings or the customer-manufacturer agreement. The deviations are not limited to the invisible surface, but a protective cover of concrete must be ensured within the permissible deviations.

6. Measured characteristics of the surface

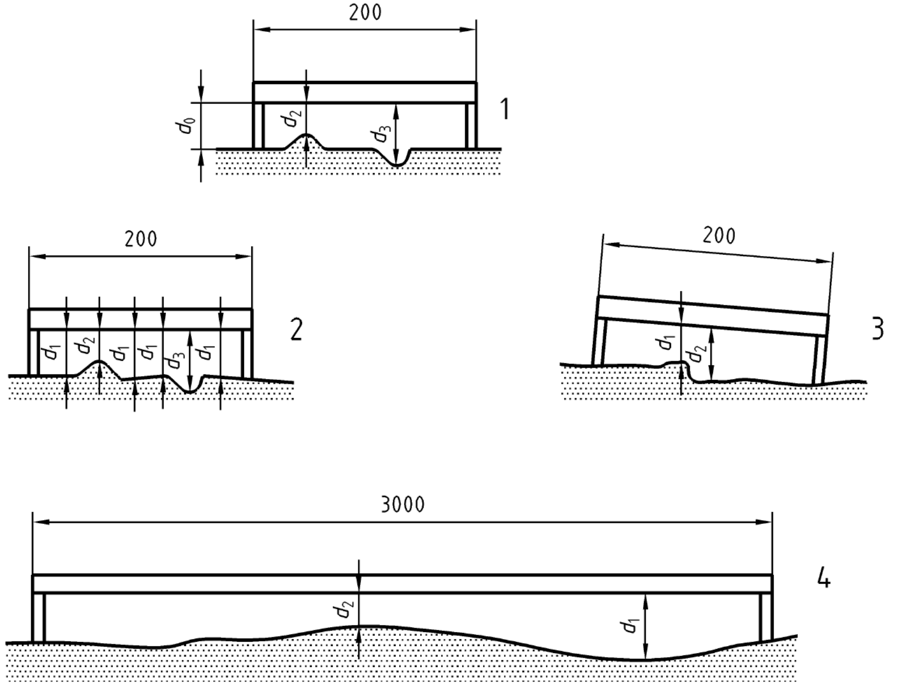
Definitions of surface characteristics



Key

1 Recess
2 Lump
3 Groove
4 Ridge
5 Step discontinuity
6 Undulation

Measurement of surface characteristics



Key

1 Lump: $d_2 - d_0$
Recess: $d_3 - d_0$
The ruler should be shifted to find the largest lump and recess

2 Ridge: $d_1 - d_2$
Groove: $d_3 - d_1$
The largest value of the differences is governing

3 Step discontinuity: $d_2 - d_1$

4 Undulation: $d_1 - d_2$
To be measured at the highest and lowest point within the ruler

Definitions of immeasurable surface characteristics

7. Immeasurable characteristics of the surface

Surface structure described by touch

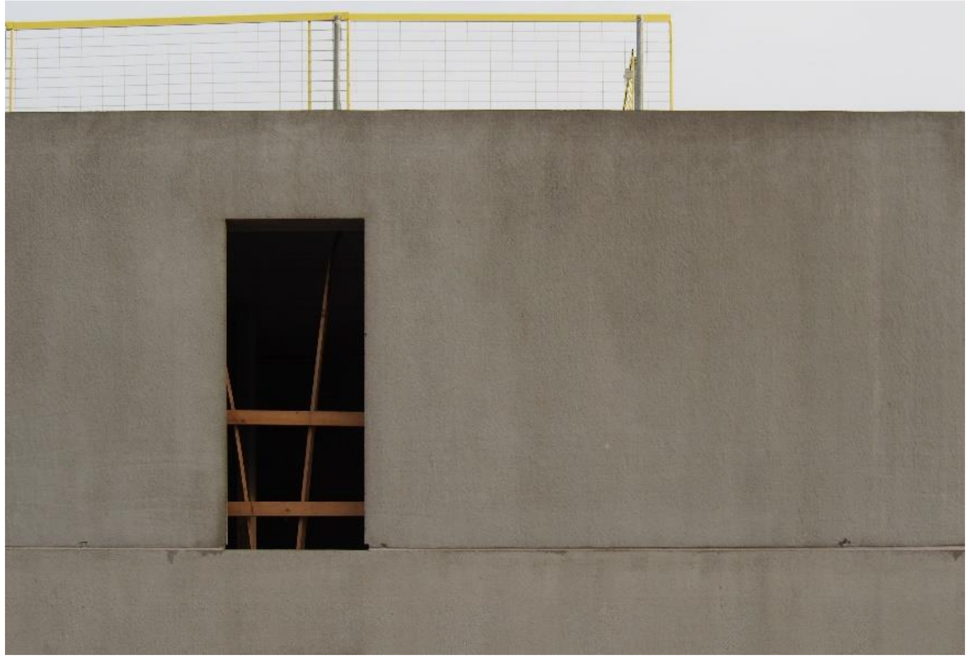
The structure of the surface is described by touch, when we experience a certain sensation when running our fingers over the surface, we recognize smoothness, roughness, roughness, or a certain pattern.

Surface structure described by looking at the surface closely

The structure of the surface is described by looking at the surface closely (at a distance of 1-2 m) we can see the surface: is smooth, rough, wavy, or patterned.

7. Immeasurable characteristics of the surface

Surface texture



The visible surface texture of the product is viewed from a distance of more than 20 m. The texture changes depending on the viewing distance and meteorological weather conditions: on a sunny day, the texture is visible in one way, on a cloudy day - in another way, and rain - in another way.

The production of products with special surfaces should be started only after determining the texture of real-size reference products.

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7. Immeasurable characteristics of the surface

Colour variation

The color variation of the product, which is made of conventional or colored concrete, can be affected by:

- type of cement;
- aggregates;
- water to cement (W/C) ratio of the concrete mixture;
- temperature and relative humidity of the product curing environment;
- pigments (in the production of colored concrete);
- surface structure and texture.

The factors that determine the color of the product are controlled in the production process, within the tolerances of the constituent materials of the concrete mix. Color variations on product surfaces are allowed. Allowable limits of color variation should be discussed between the customer and the manufacturer.

7. Immeasurable characteristics of the surface

Efflorescence

Efflorescence is white scales of calcium carbonate released on the surface of concrete products, which are formed by the reaction of excess lime with carbon dioxide. Molecular formula $CaCO_3$. Later, the calcium carbonate released on the surface of the product reacts with carbon dioxide (CO_2) dissolved in water and forms calcium hydro carbonate, which is soluble in water:

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

The released salts on the surface of the product are washed away by the rain after a long time.

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7. Immeasurable characteristics of the surface

Reinforcement shadow

The apparent position of the reinforcement is visible on the surface of the molded product, usually as darker lines. The image of reinforcement on the surface of the product can be caused by changes in the concrete matrix, which manifests itself in the appearance of lighter and darker tones on the surface of the product.

Aggregate transparency

The transparency of fillers on the surface of the product can occur due to the minimum distance between the aggregate and the surface of the mold. On the surface of the product, a variegated image of lighter and darker areas (spots) can be seen, which, according to their shape and size, reproduce the view of coarse aggregates.

7. Immeasurable characteristics of the surface

Leakage of fine particles

"Leakage of fine particles " is a mixture of water and fine concrete constituents that can escape due to leaks in the form, leaving visible spots on the edges of the product.

The imprint of plywood panel layers on the formed surface

Usually on the invisible surface

eesti betooniühing

7. Immeasurable characteristics of the surface

Visible impression of the joint of panels

It is a visible impression of the joint of panels on the formed concrete surface, forming a joint impression on the surface of the product. Joints on surfaces with special requirements should be coordinated with the customer..

Production of reference samples

8. Production of reference samples

Evaluation of structure and color variation of reference concrete products

The manufacturer shall photograph the structure of the existing reference sample from a distance of 25 cm in sufficient places to assess the differences in color and structure. But it should be photographed in at least three different places on the surface of the reference product. A ruler is used when photographing a structure.

Evaluation of the texture and color variation of the precast concrete product

The texture of the reference sample is photographed from a distance of 10 m. The customer can agree on another shooting distance with the manufacturer. It is recommended to photograph the texture of the reference sample in different weather conditions: a sunny day, a cloudy day, or a rainy day. The customer approves the photos of the reference sample.

Note: The texture and color captured in the photos may differ from the products displayed under natural conditions. This fact must be evaluated by the customer.

LST 2015:2020 “Precast concrete products. Surface appearance characteristics and the methods for inspecting”

Thank you for your attention!

1862

RIGA TECHNICAL UNIVERSITY

3D printed fair-faced concrete

RTU

Head of 3D Concrete Printing Scientific Laboratory

Dr. Sc. Ing.

Maris Sinka

MSc. Ing.

Alise Sapata

Dr. Sc. Ing.

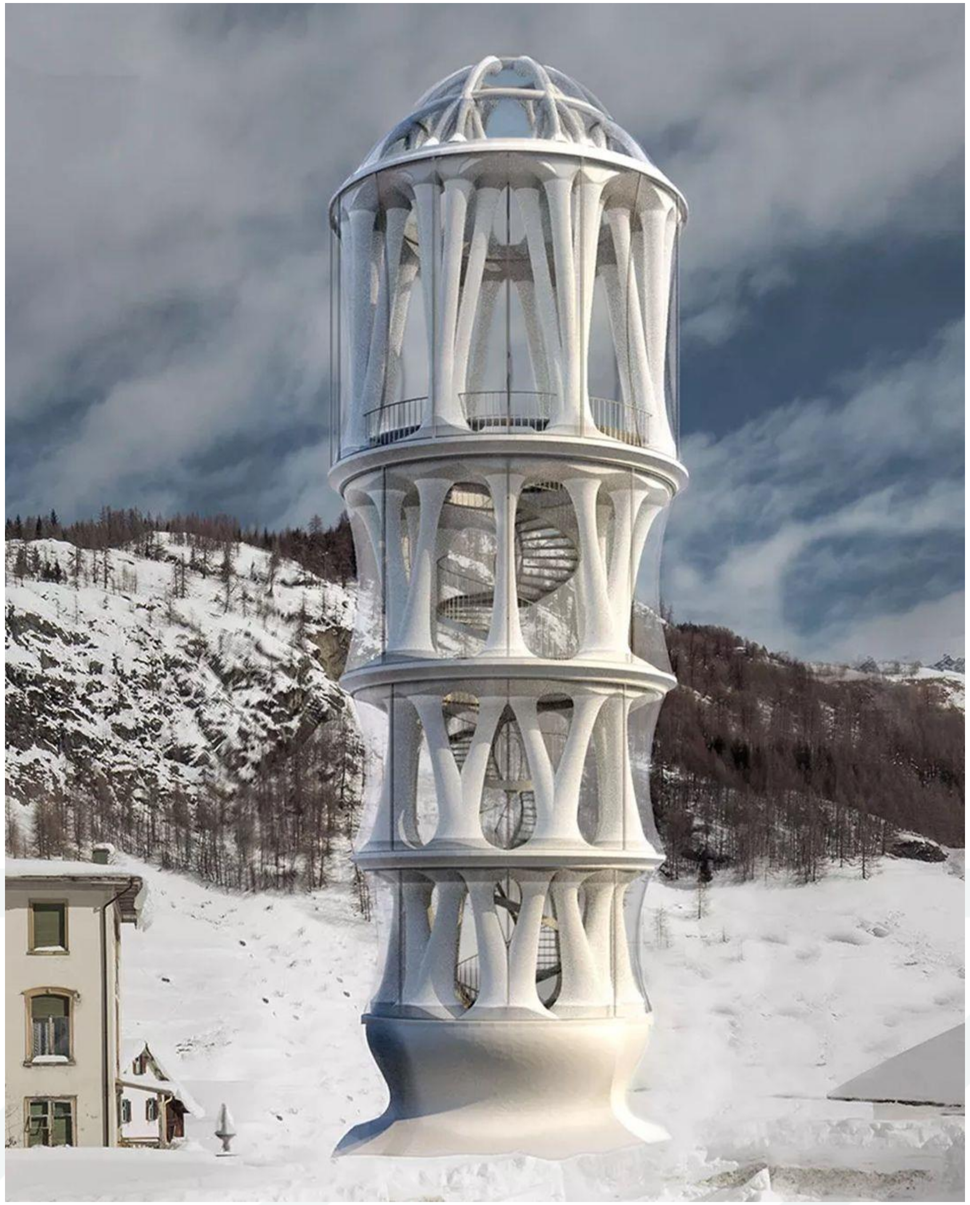
Genadijs Sahmenko

28.11.2024

3D printed concrete – 99% of the time - a fair-faced concrete

- *Tor Alva*, White Tower
- Will be the highest 3D printed structure in the world
- Located in Switzerland



- *Wolf ranch,* 100 residential units
- By ICON
- Located in USA

- *Water tanks*
- *Wind turbine towers*
- By COBOD

- *Europe's first 3D printed building*
- 2017, Denmark
- COBOD
- Shrinkage cracks and some surface deterioration

304

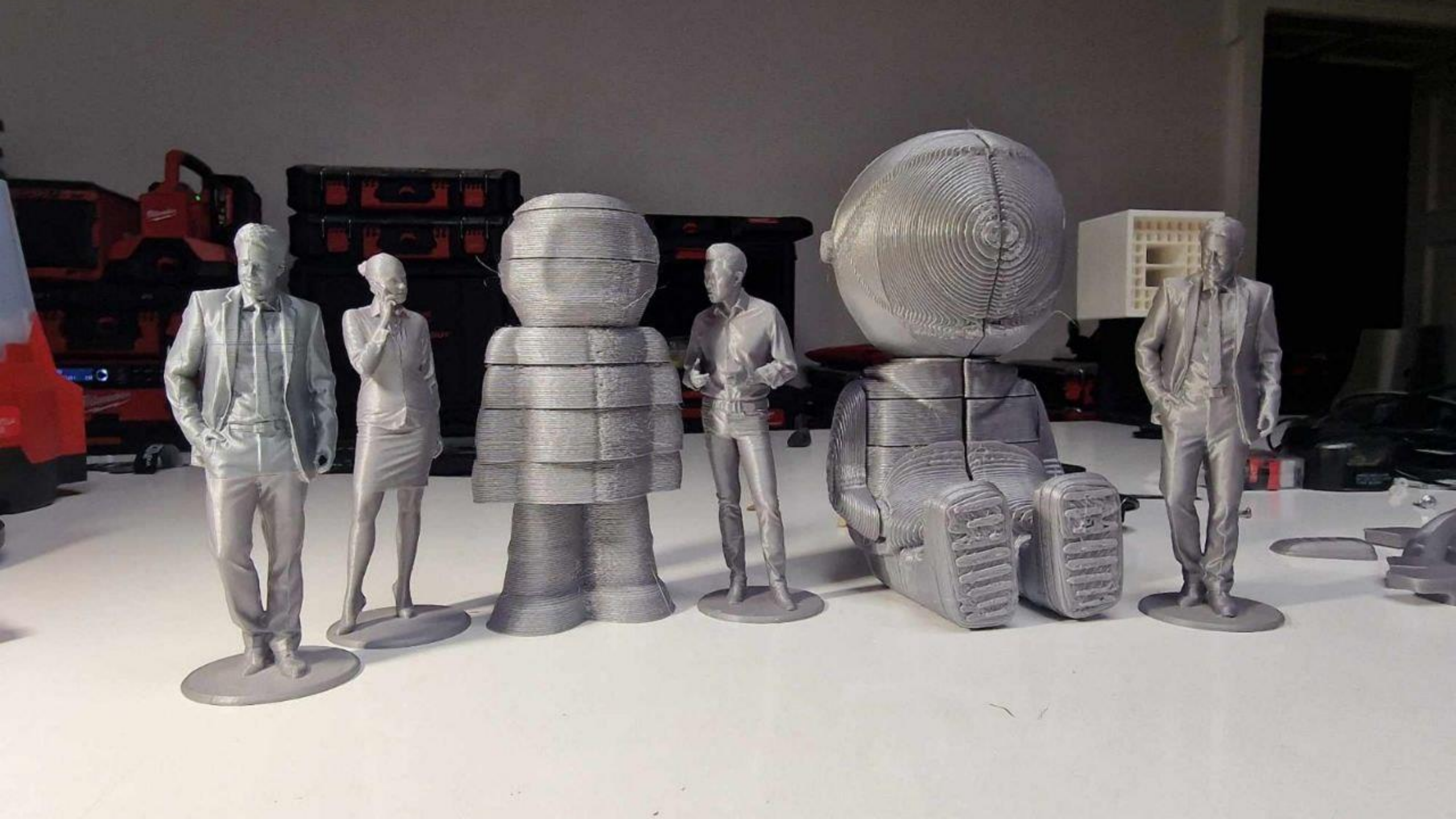
- *Europe's first 3D printed building*
- 2017, Denmark
- COBOD
- Shrinkage cracks and some surface deterioration

305


BTS

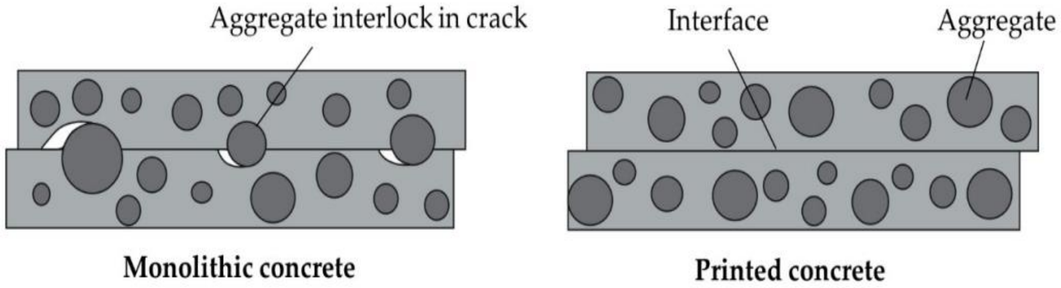

FRIDAY

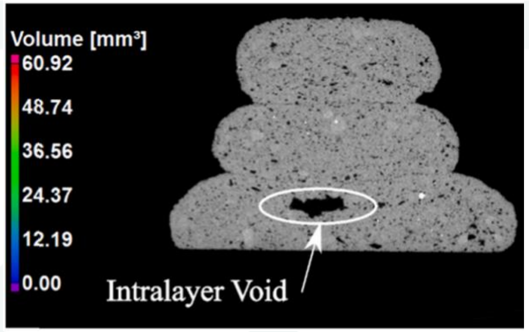
318



Quality of interlayer bond

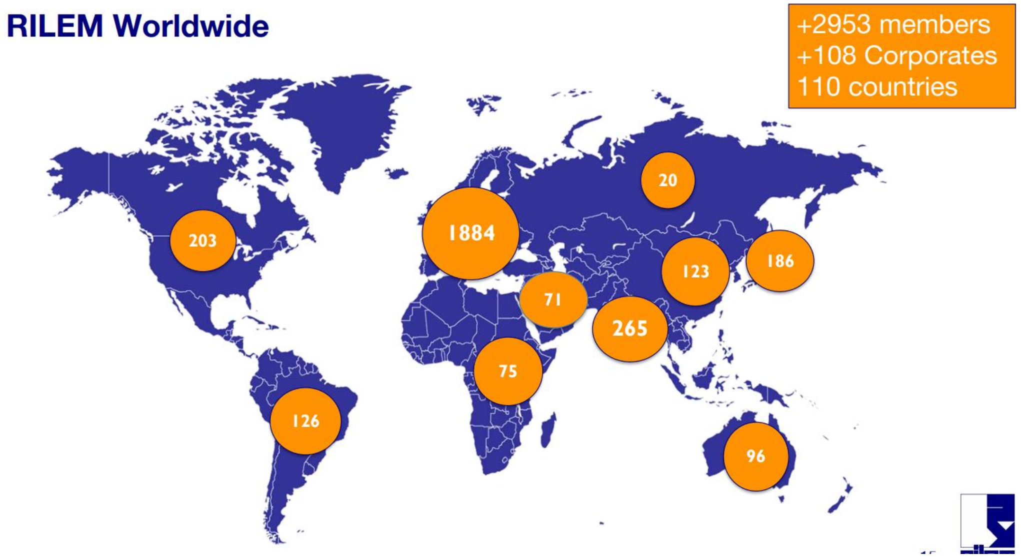
- **Low quality** interlayer zones in 3D-printed concrete can be considered as horizontal cracks.
- They severely affect the properties of **hardened concrete.**
- The **effect** is similar to **cold joints** in monolithic concrete.
- However, the bond is even lower due to lack of aggregates.
- Low interlayer bond quality is not always visible by eye.
- Ensure controlled environmental conditions during printing and curing (while the concrete is in a fresh state) – **protection from solar radiation, wind, maintain sufficient relative humidity !**

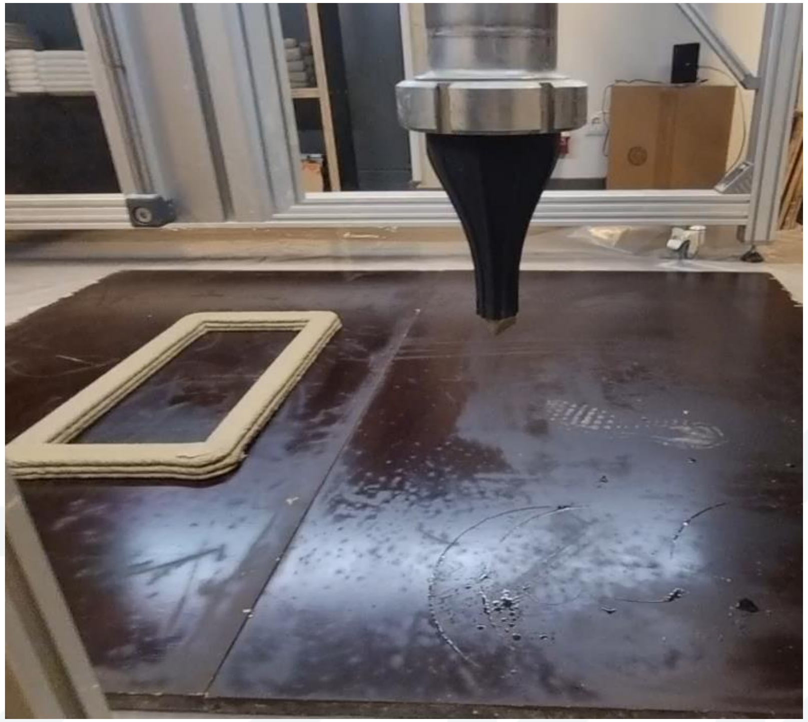




Interlayer effect on durability

- According to RILEM technical committee TC 304-ADC: *Assessment of Additively Manufactured Concrete Materials and Structures* interlaboratory guidelines **concrete durability tests** – water absorption and carbonation – were perfomed
- ***SAKRET* Ready-3D mix** was used
- 2 objects were printed:
  - 6 layer-sample **without cold joint**;
  - 6 layer-sample **with a horizontal cold joint** in the middle (printed after initial setting time of ~3h) izdrukāšanas.
- **Results:**
  - **The impact of technological process and concrete mixture on the quality of interlayer zone, therefore – on durability.**
  - **The effect of cold joint on the quality of interlayer zone and durability.**

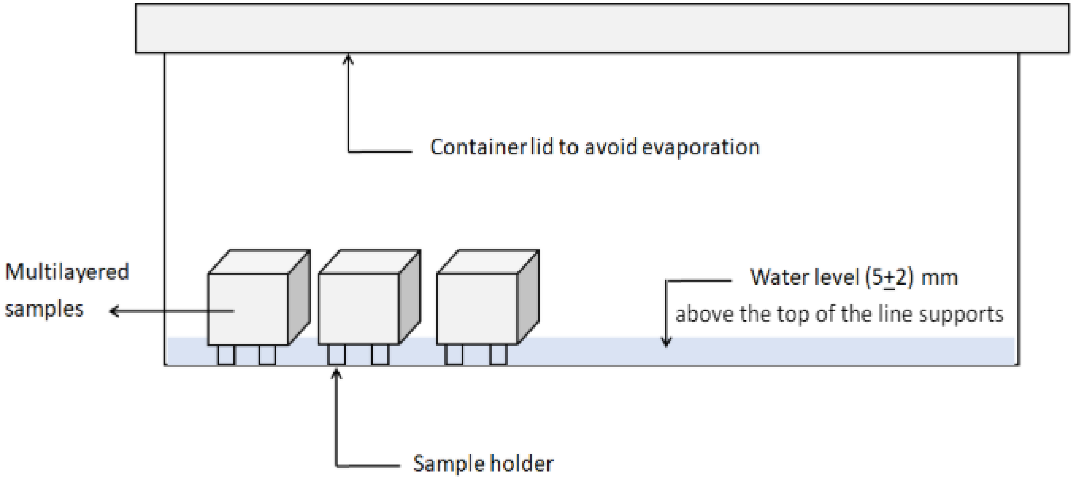


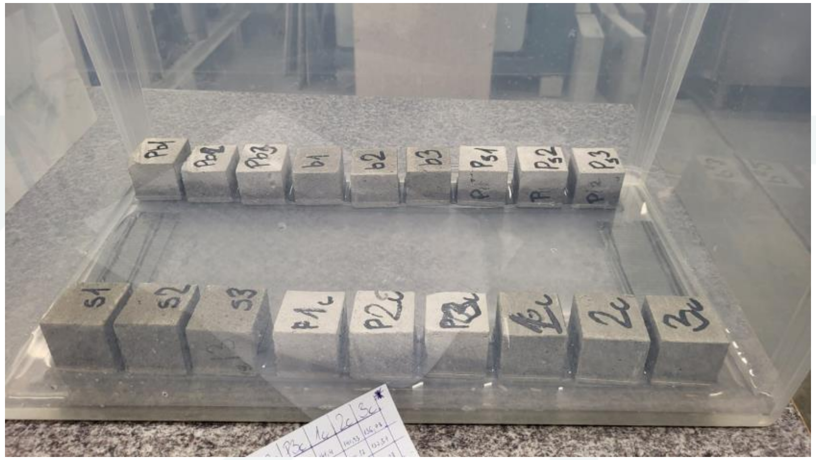


Water absorption test

- Simple, fast test method without expensive equipment.
- Easy method to **compare permeability of samples made with various methods and/or mixtures.**

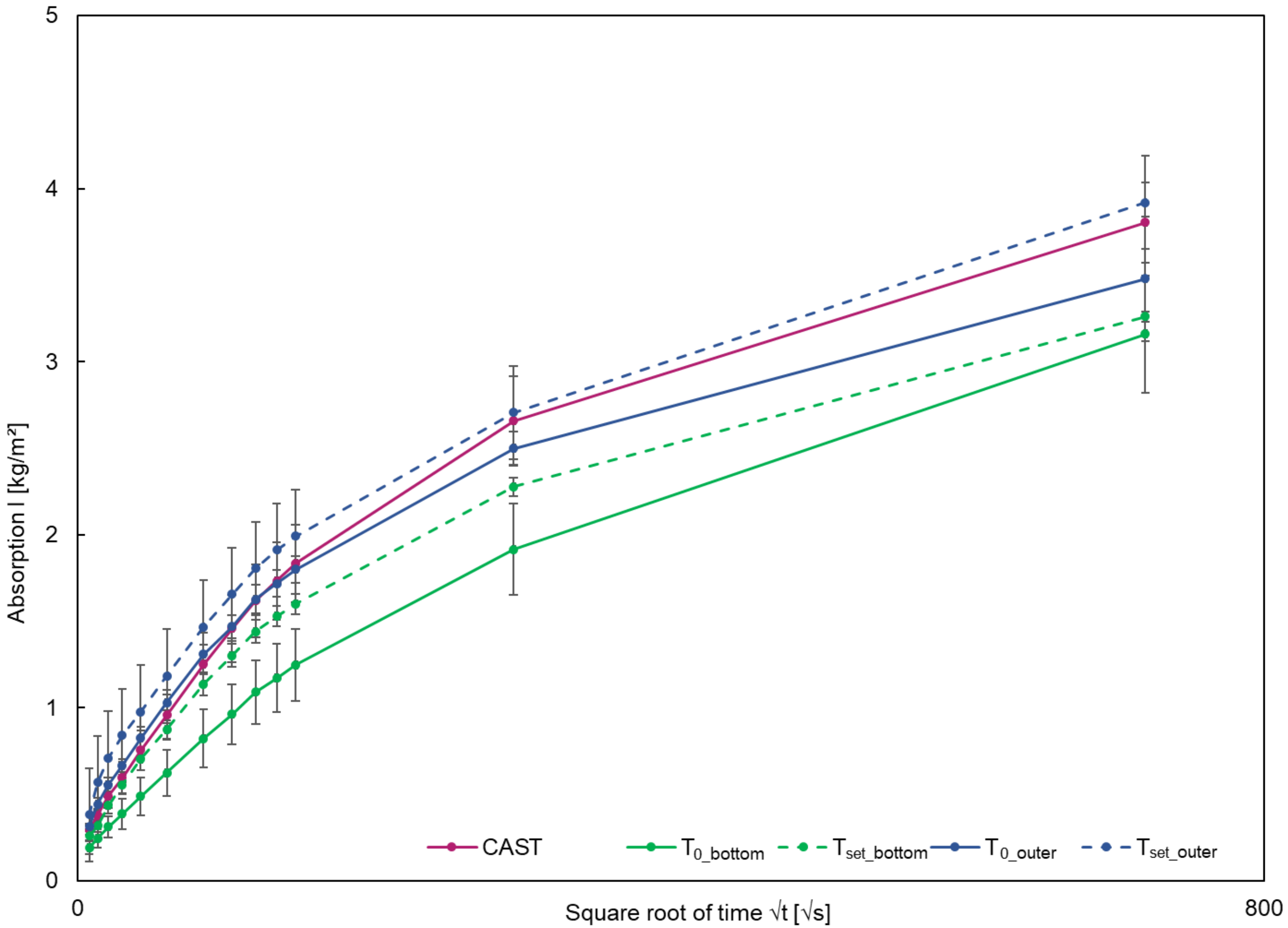
- 4 series of samples were tested:
  - Water absorption trough side plane, with cold joint
  - Water absorption trough side plane, without cold joint
  - Water absorption trough bottom plane, with cold joint
  - Water absorption trough bottom plane, without cold joint





Water absorption test

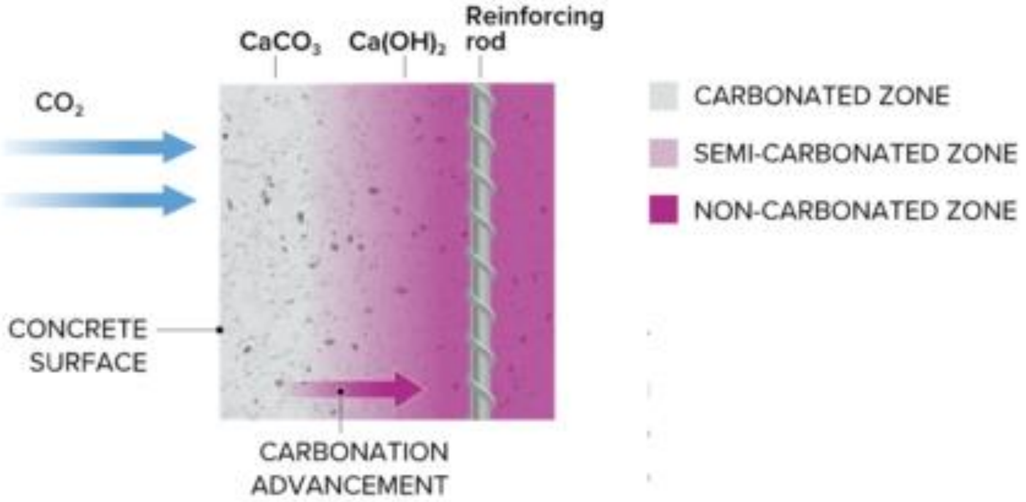
- All samples **without the cold joint** showed significantly **lower water absorption**
- Samples that absorbed water trough **bottom plane** had **lower water absorption** than from side plane



Carbonation test

- Carbonation process lowers the pH level of concrete
- When carbonation front reaches reinforcement, the **reduced pH level allows corrosion.**
- Corrosion products **expand** → **concrete spalling** occurs.
- **Interlayer regions** and **cold joints** are **more permeable** → easier peneteration of CO_2 → **faster carbonation rate**

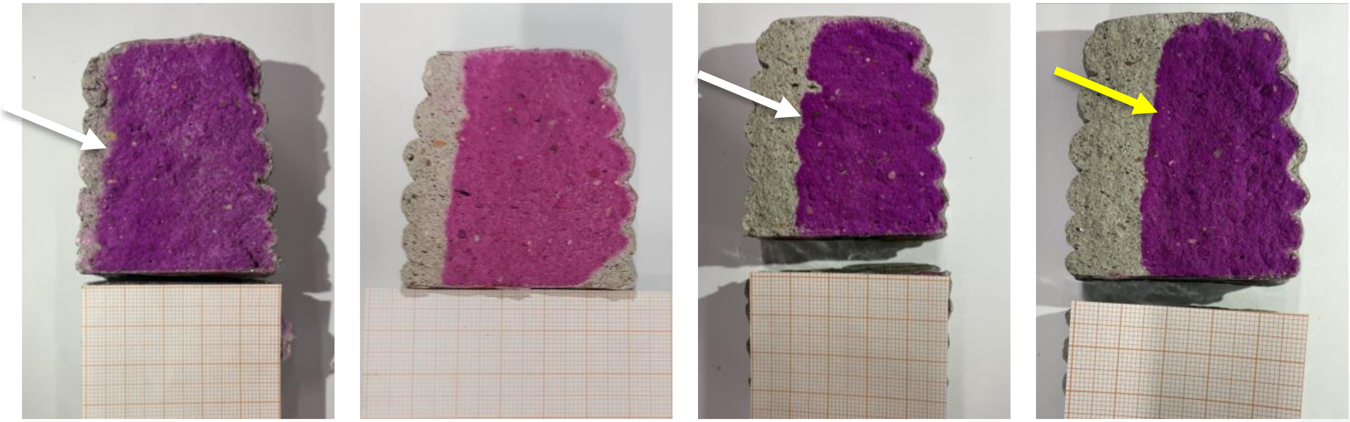
$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$



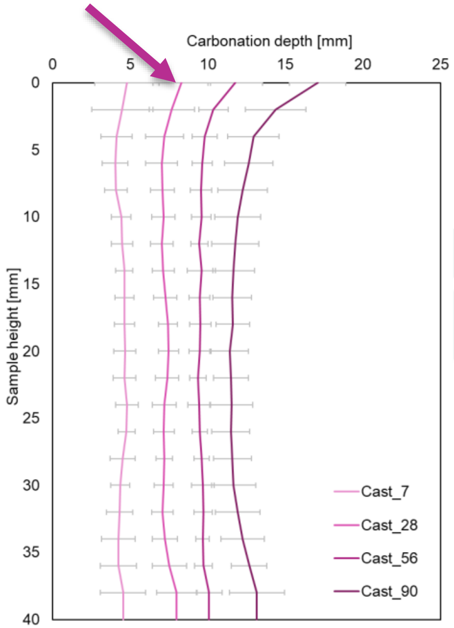
- 2 series of samples were tested:
  - carbonation trough side plane, **with cold joint**
  - carbonation trough side plane, **without cold joint**
- Accelerated tests: 1% CO_2; RH=60%; t=20◦C
- Carbonation depth was measured after 7, 28, 56, 90 days

Carbonation test without the cold joint

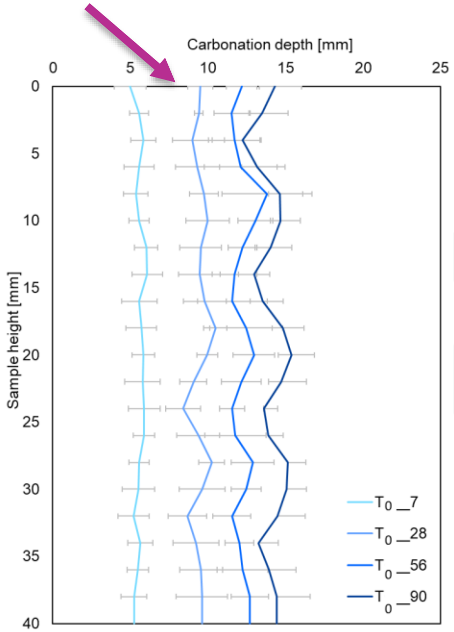
- **At early** age the effects of interlayer bond are evident – **carbonation front follows the geometry of printed layers**.
- **At later stages** (towards the center) the effect of interlayer bond reduces –**carbonation front** moves in **uniform, straight line**
- Overall, **cast** and **3D printed samples** show **similar carbonation rates** → the **interlayer bond is good**



7d 28d 56d 90d



(a)



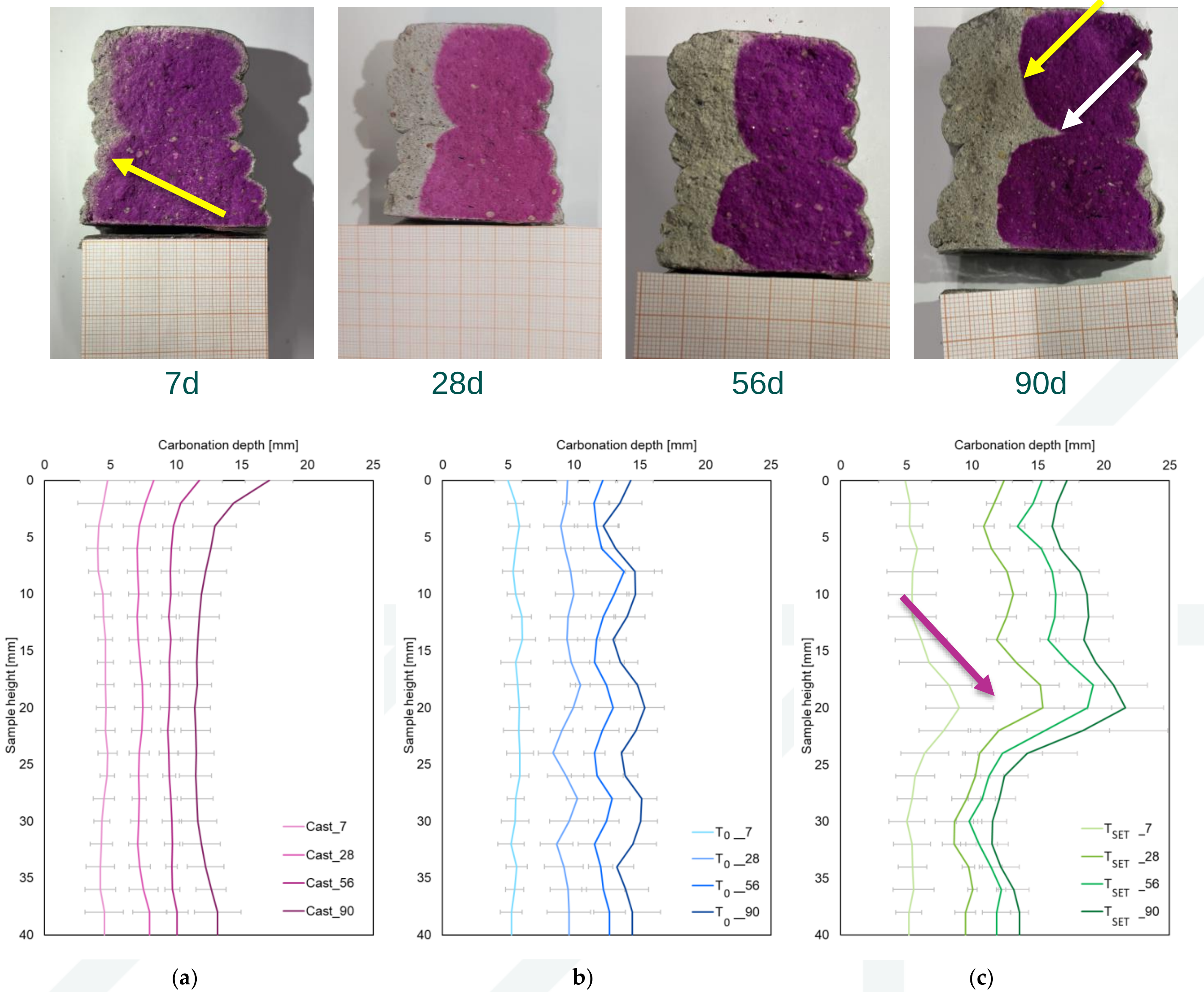
b)

Carbonation test with the cold joint

- **Cold joint** is **clearly visible** even after 90 days (center of the sample) contrary to the interlayer geometry

- Similar to samples without the cold joint, in the **center of samples**, the **carbonation front** moves **uniformly** – integration in the interlayer regions.
- **In the cold joint area integration doesn't happen!**

- **Cold joints** in concrete promote **deeper** and **faster** penetration of the **carbonation front** into the concrete.



Quality of interlayer bond

- These tests proved that:

If the printing process and concrete mixture ensure a high-quality interlayer zone → A homogenous structure can be obtained → Durability of 3D printed concrete is comparable to cast element concrete

The central area of 3D printed elements is more protected from environmental impacts during curing → In this area, water evaporation is slowed down during the printing and curing process → The durability of the central part of the printed element is higher

Regardless of the conditions, a low-quality interlayer zone will form at the cold joint → The cold joint will negatively affect the durability of the whole structure

Transforming Waste Into High-Performance 3D Printable Cementitious Composite

2023 SEPTEMBER – 2026 AUGUST
https://transition.rtu.lv/

Transforming waste into a high performance 3D printable cementitious composite

3D printed concrete with reduced CO2 emissions

3D printing enables creating optimized concrete structures with reduced material and labor consumption, while a specially developed recipe minimizes environmental impact by incorporating industrial waste.

3D printed concrete

LCC

Low – CO_2 concrete printing using waste materials

0% cement

+

High CaO ashes

+

pozzolan

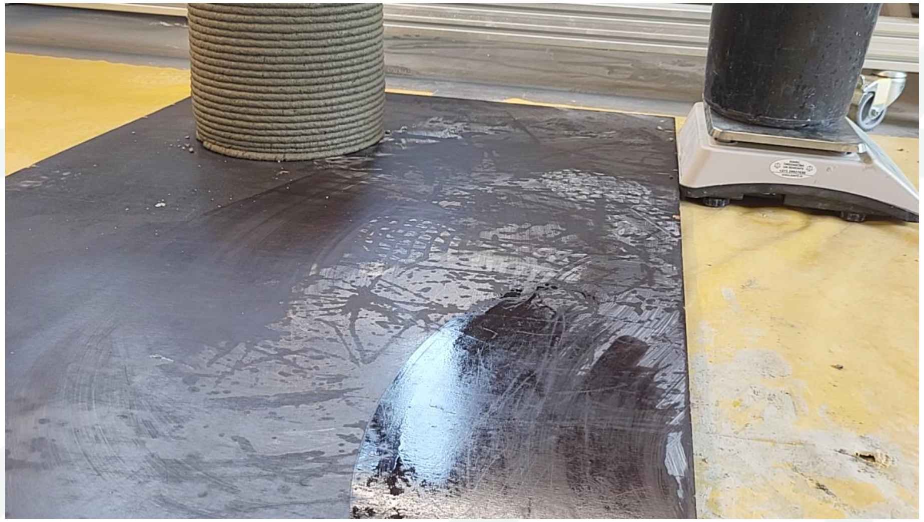
+

construction debris

=

LOW CO_2 PRINTED STRUCTURES

The objective of this project is to reduce CO_2 emissions by utilizing recycled waste aggregates (RWA) and industrial waste ash as binders in 3D printable concrete.



Development and characterization of environmentally friendly gypsum-cement-pozzolana ternary compositions for 3D printing

LZP projekts -lzp-2022/1-0585.

Scientific team: Genadijs Sahmenko, Girts Bumanis, Maris Sinka, Alise Sapata, Peteris Slosbergs, Rihards Bendrats, Liga Puzule, Diana Bajare

Portland cement content < 200 kg/m^3

55-60 %

The **quick setting time** of **gypsum**

20-25%

The **high final strength** of **Portland cement**

20-25 %

The **pozzolanic component** to ensure **chemical stability**

Used recycled gypsum

- Within the framework of this research, **ternary composites** were **developed**, containing:

Commercially available gypsum

Construction demolition waste gypsum (CDG)

A secondary product from gypsum board utilization.

Phosphogypsum (PG)

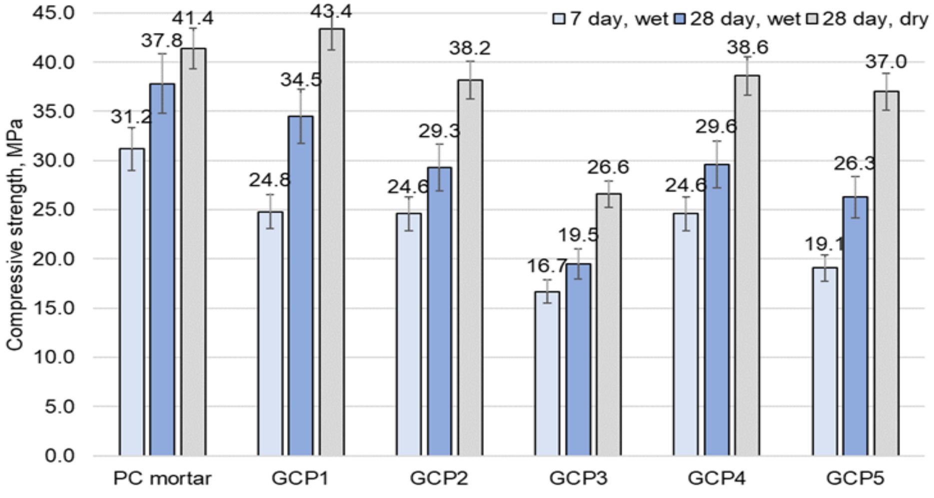
An industrial byproduct from agricultural fertilizers, only 15% is recycled for building materials.

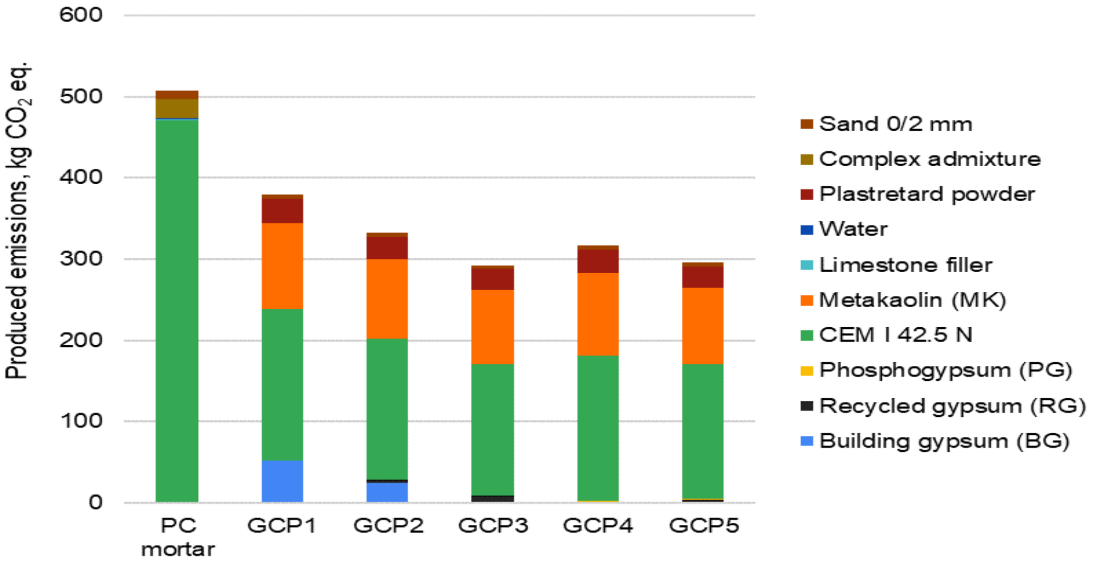
Exposed 3DP concrete: durability and mechanical properties

- Freeze-thaw tests: the developed mixtures are suitable for use in exterior environment condition (XF1).

- Compressive strength of 41 MPa in dry conditions and 38 MPa in wet conditions. (K>0.70)

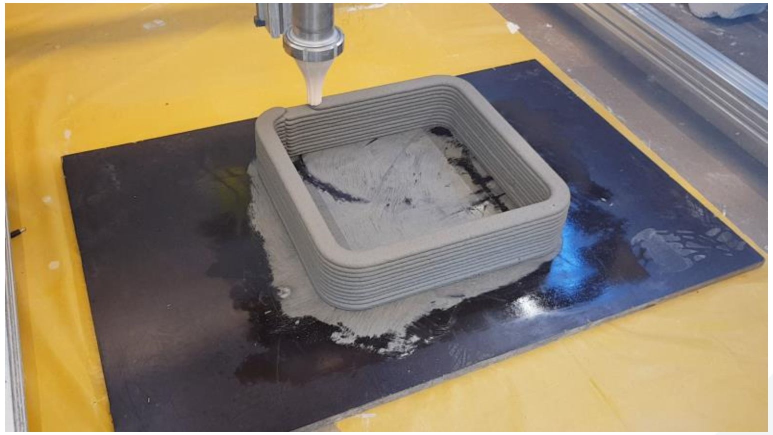
- Carbon dioxide footprint at least 1,5 times lower





Exposed 3DP concrete: composition and surface evaluation

G-C-P-Sand



G-C-P-Limestone-Sand

All the mixtures are printable immediately; open printing time of at least 25 min.

www.facebook.com/3DconcreteRTU

Thank you for attention!

maris.sinka@rtu.lv

Latvijas Betona Savienība

TEHNISKĀ KOMITEJA 04 – BETONA ILGTSPĒJA

Ernests Ozoliņš

VIEDAIS/LIELAIS IZAICINĀJUMS

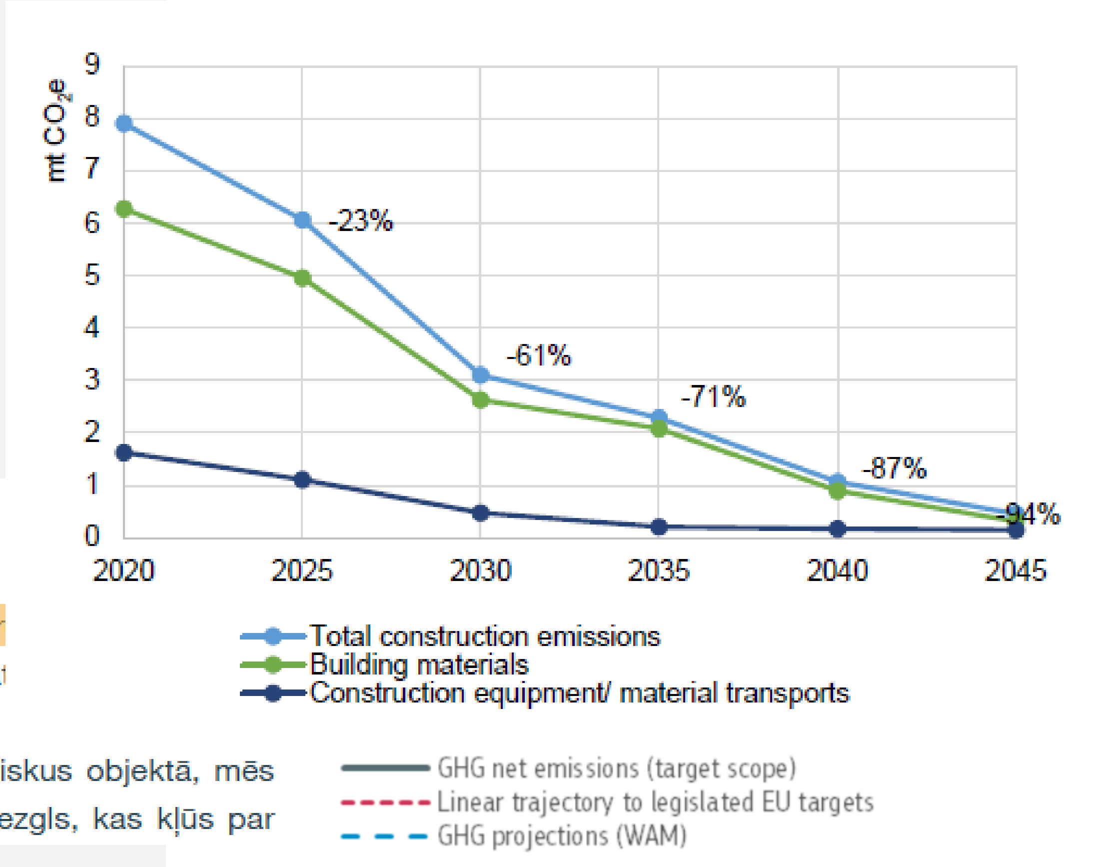
- **Kāds ir progress Eiropas CO2 izmešu samazināšanā kopumā?**
- **Kas mūs sagaida nākotnē?**
- **Viss ir zaļš! Vai spējam to novērtēt?**
- **Bet kā ir ar betonu? Vai ir iespējams saražot zaļāku betonu?**

Materiālu izvēle

Savos projektos mēs izvēlamies materiālus un produktus ar EPD (Envir
Declaration), t.i., ar minimālu ietekmi uz vidi. Mēs rūpīgi izvērtējam piegādāt
sadarbības kritērijiem ir atbilstība ISO 14001 standartam.

Lai projektos uzlabotu produktivitāti, kvalitāti, un samazinātu darba drošības riskus objektā, mēs ieviešam jaunas tehnoloģijas, viena no tām ir, moduļu sanitārais tehniskais mezgls, kas kļūs par

Figure 1.3.a



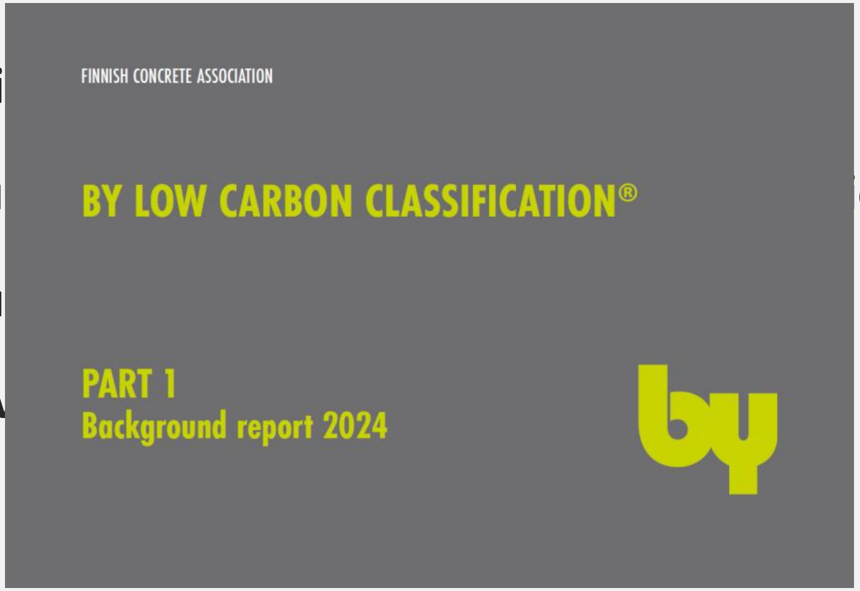
TEHNISKĀ KOMITEJA - BETONA ILGTSPĒJA

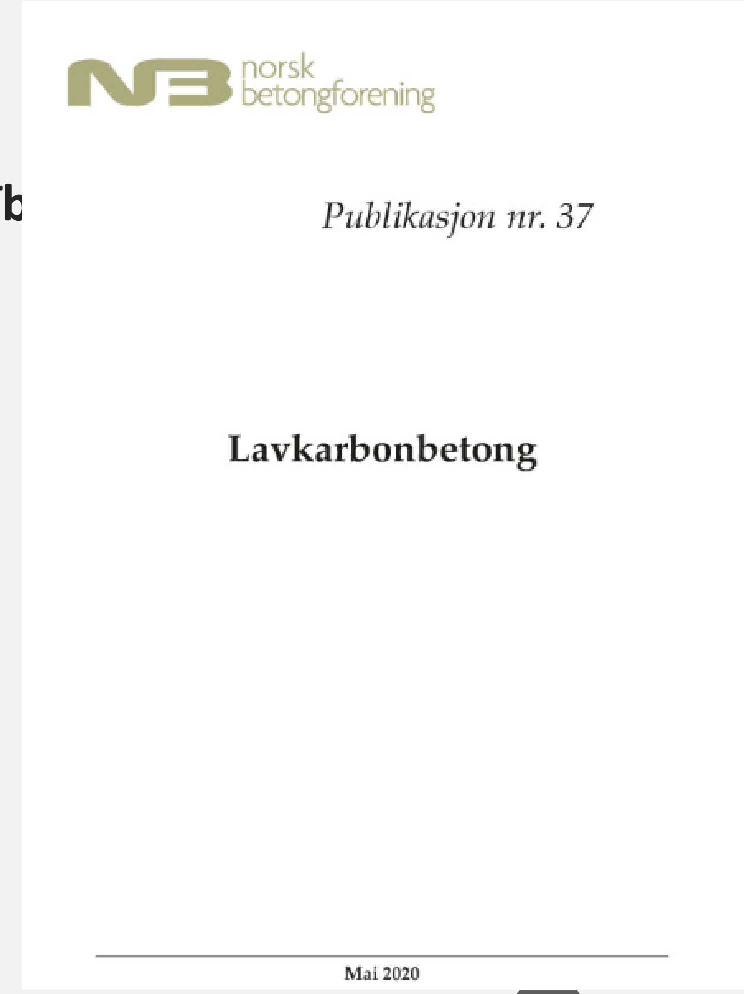
- **Izveidota 2024. gada aprīlī**
- **Komisijā pārstāvēti dažādi nozares eksperti:**
  - **No Latvijas lielākajiem betona produktu ražotājiem**
  - **Universitātēm**
  - **Projektētājiem**
- **Tikāmies 1 līdz 2 reizes mēnesī kopš komitejas izveidošanas**

KOMITEJAS MĒRĶI 2024 GADAM

- **Izstrādāt CO_2 gāzu emisiju vidējā līmeņa un samazināšanas līmeņu noteikšanas metodiku Latvijā ražotam betonam**
- **Izstrādāt sistēmu betona, ar samazinātām CO_2 emisijām, klasifikācijai Latvijā**

METODOLOĢIJA - DARBĪBA





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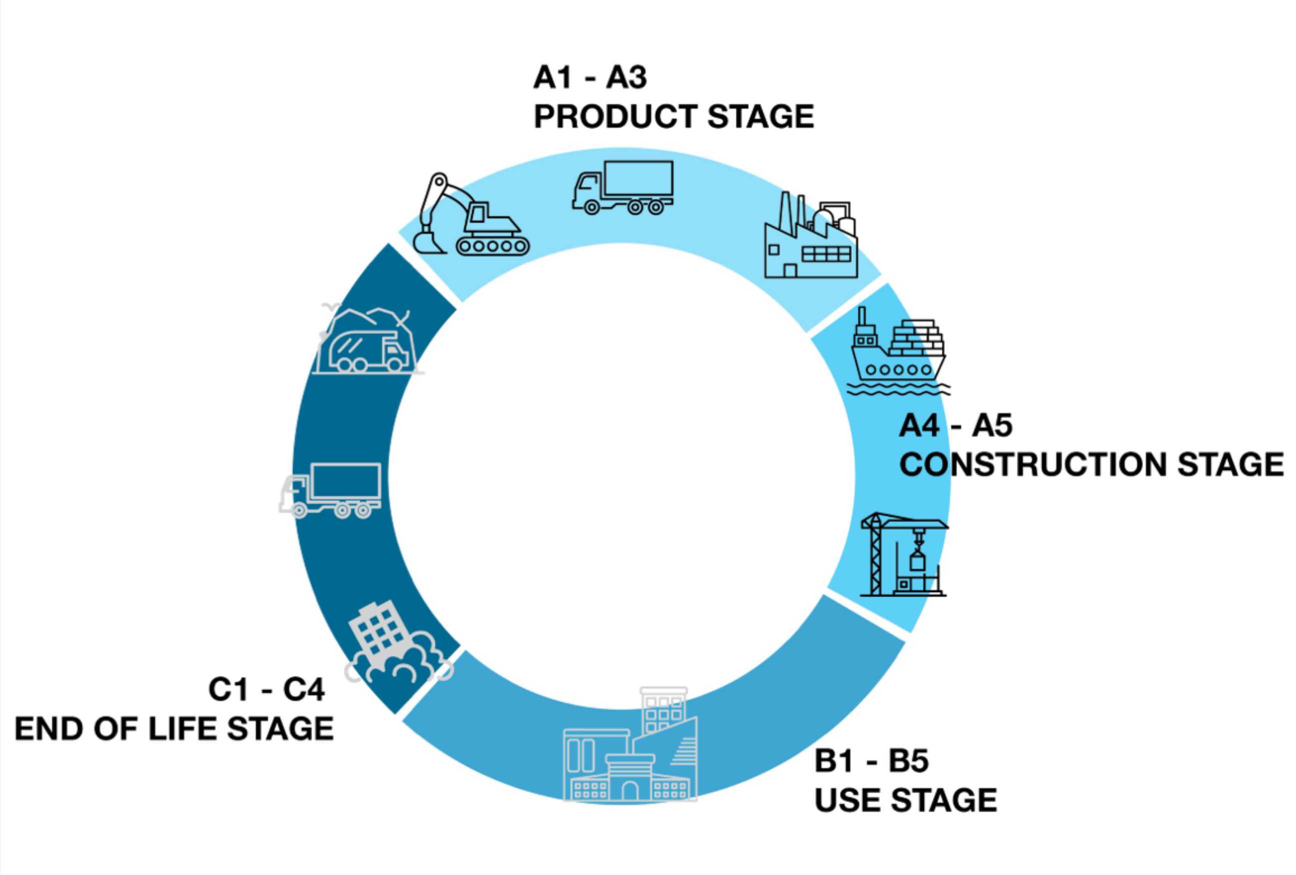
astāv

ar saliztur īgām pildvielām

Schwenk CEM I cements no Brocēniem

METODOLOĢIJA - CO2 EMISIJU APRĒĶINI

- **Emisiju aprēķini veikti pēc vienota standarta EN 15804+A2:2019 principiem**
  - **Aprēķinos iekļautas dzīvescikla stadijas:**
    - **A1 – Emisijas no izejmateriāliem**
    - **A2 – Emisijas no izejmateriālu transporta līdz ražotnei**
    - **A3 – Emisijas no ražošanas procesa**
  - **Aprēķinos nav iekļauta dzīves cikla sadaļa A4 – gatavā produkta transports līdz klientam**
- **Lai veiktu aprēķinus definējām:**
  - **Izejmateriālus un to emisiju faktorus**
  - **Transporta veidus un to emisiju faktorus**
    - **Izejmateriālu transporta vidējos attālumus**
  - **Citus emisiju ietekmējošus faktorus**

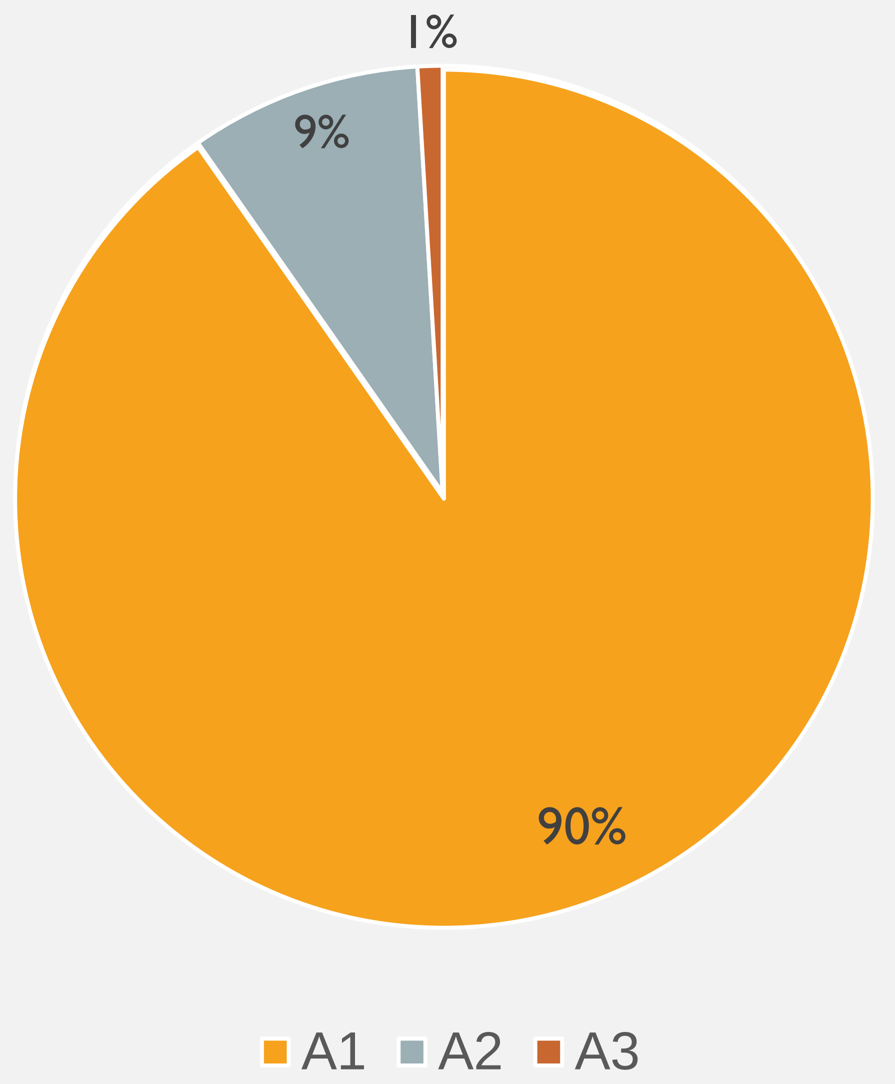


PARASTĀ REFERENCES BETONA SASTĀVI

Betona stiprības klase	Vides iedarbības klase/-s	ū/c attiecība	Cements, kg/m^3	Smilts/rupjās pildvielas attiecība	Plastifikators % no cementa
C25/30	XC2; XF1	0.6	300	1/1	0.85
C30/37	XC4; XD2; XF1	0.55	330	1/1	0.85
C40/50	XC4; XS3; XD3; XF1; XA1	0.45	400	1/1	0.85

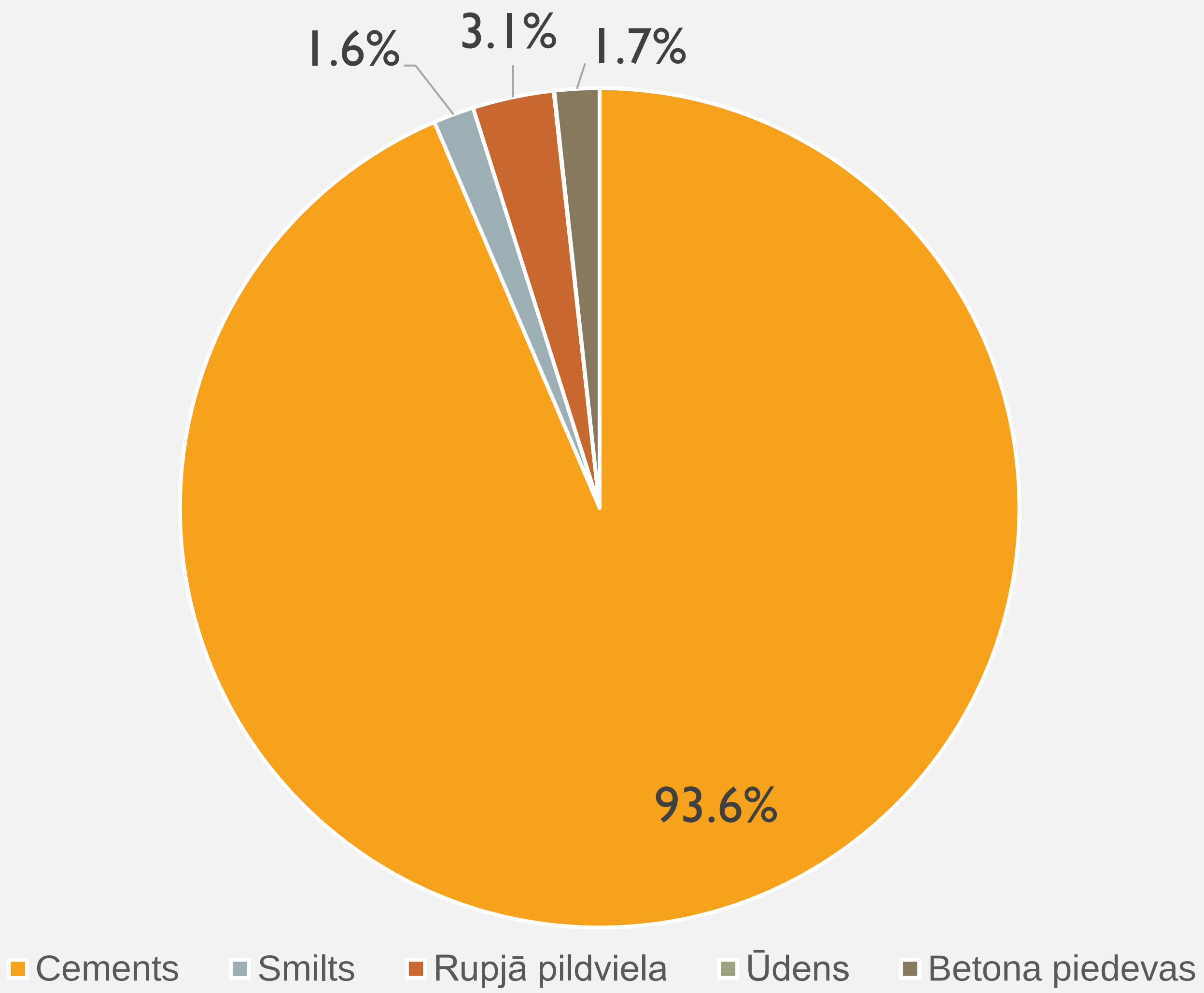
CO2 EMISIJAS C30/37 REFERENCES BETONAM

- **Kopā 276 kg CO2e/m3**
  - **A1 – 249 kg CO2e/m3**
  - **A2 – 24 kg CO2e/m3**
  - **A3 – 3 kg CO2e/m3**



CO2 EMISIJAS C30/37 REFERENCES BETONA IZEJMATERIĀLIEM

- **Kopā 249 kg CO2e/m3**
  - **Cements – 233 kg CO2e/m3**
  - **Rupjā pildviela – 8 kg CO2e/m3**
  - **Smilts – 4 kg CO2e/m3**
  - **Betona piedevas 4 kg CO2e/m3**
  - **Ūdens 0 kg CO2e/m3**



CO2 EMISIJU LĪMEŅI

Betona grupa	Betona stiprības klase	References betona emisijas A1-A3, kg CO_2e / m^3	LRB*90%	LRB*80%	LRB*70%	LRB*60%	LRB*50%	LRB*40%
Parastais betons	C8/10	**200**	180	160	140	120	100	80
	C12/15	**210**	190	170	145	125	105	85
	C16/20	**225**	205	180	160	135	115	90
	C20/25	**240**	215	190	170	145	120	95
	C25/30	**255**	230	205	180	155	130	100
	C30/37	**275**	250	220	195	165	140	110
	C35/45	**300**	270	240	210	180	150	120
	C40/50	**325**	295	260	230	195	165	130
	C45/55	**350**	315	280	245	210	175	140
	C50/60	**370**	335	295	260	220	185	150
Salizturīgais betons	C30/37	**300**	270	240	210	180	150	120
	C35/45	**320**	290	255	225	190	160	130
	C40/50	**350**	315	280	245	210	175	140
	C45/55	**370**	335	295	260	220	185	150
	C50/60	**390**	350	310	275	235	195	155
Salizturīgais betons ar salizturīgām pildvielām	C30/37	**315**	285	250	220	190	160	125
	C35/45	**340**	305	270	240	205	170	135
	C40/50	**365**	330	290	255	220	185	145
	C45/55	**390**	350	310	275	235	195	155
	C50/60	**405**	365	325	285	245	205	160

KĀ BETONA ĪPAŠĪBAS VAR IETEKMĒT CO2 EMISIJAS

Izmaiņa	Specifiska izmaiņa	Ietekme uz emisijām
Ilgmūžība	Kalpošanas laika palielināšana no 50 gadiem līdz 100 gadiem	+10-15 kg CO_2e/m^3
Pildvielas	Maksimālā pildvielas izmēra samazināšana no 16 mm līdz 8 mm	+10-15 kg CO_2e/m^3
	Maksimālā pildvielas izmēra palielināšana no 16 līdz 32 mm	-10-15 kg CO_2e/m^3
Konsistence	Konsistences klases maiņa no S4 uz S3	-5-10 kg CO_2e/m^3
	Konsistences klases maiņa no S4 uz S5	+5-10 kg CO_2e/m^3
Specifikācijas prasības	Palielināt specifikācijā norādīto stiprības sasniegšanas vecumu no 28 dienām uz 9 dienām	-15-30 kg CO_2e/m^3
	Samazināt specifikācijā norādīto stiprības sasniegšanas vecumu no 28 dienām uz 7 dienām	+20-40 kg CO_2e/m^3

Latvijas
Betona
Savienība

PALDIES PAR UZMANĪBU!

VADLĪNIJAS TIKS PUBLICĒTAS NĀKAMĀ GADA PIRMAJOS MĒNEŠOS

Tradicionālā tērauda šķiedru un PrīmX® tērauda šķiedru pašspriegojošā betona pilna mēroga tests Jelgavā

Mārtiņš Suta
Projektēšanas departamenta vadītājs,
Primekss SIA


PRIMX

Ievads

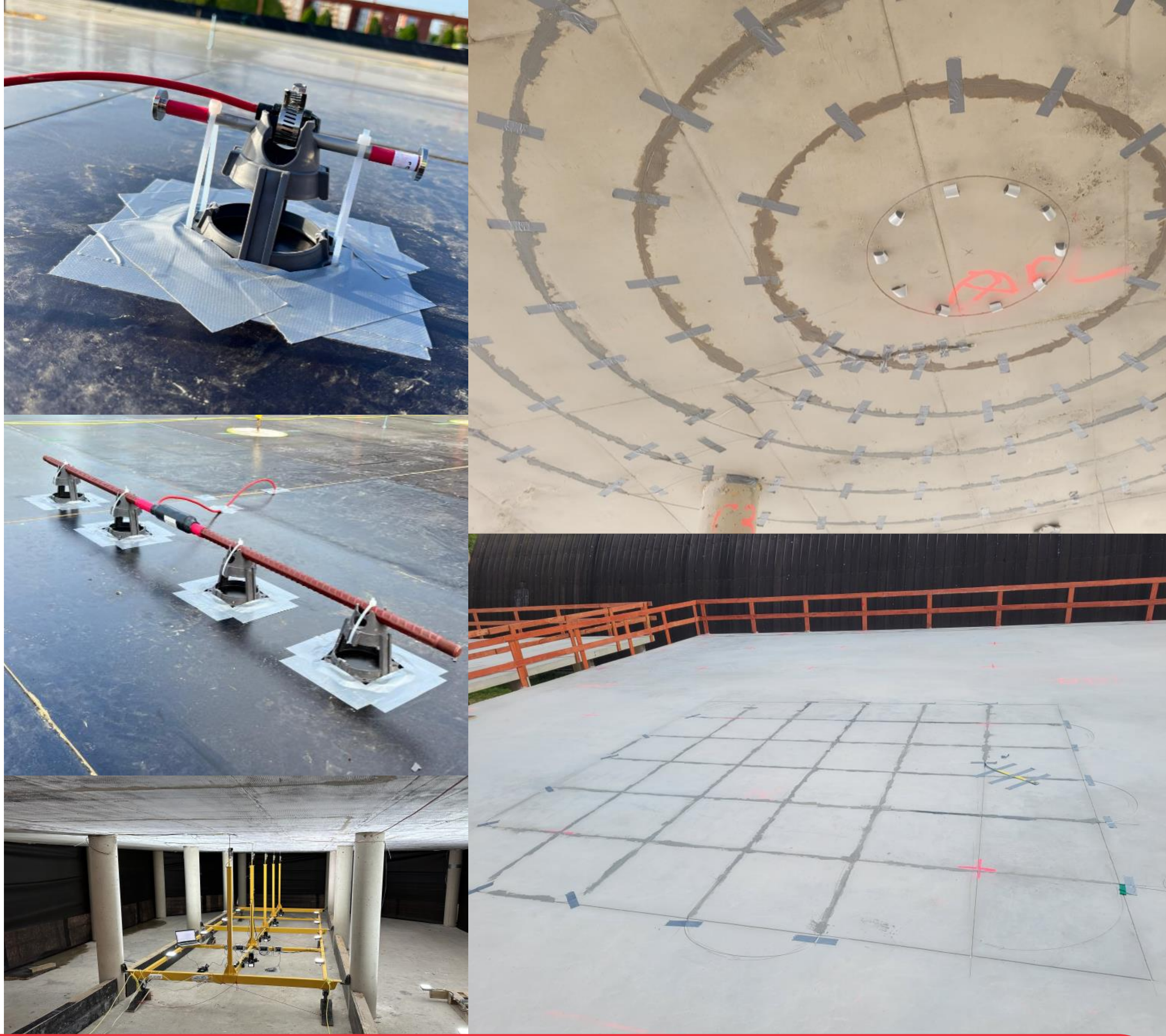
- Septembris – novembris 2023
- Jūnijs – oktobris 2024
- SFRC, SFRSSC – dubults tests pilnā izmērā
- Pārseguma plātnes, pāļu plātnes atveids
- Izkliedēta slodze ‘23
- Centra, malas un stūra punktveida slodze ‘24
- Ilgtermiņa izkliedēta slodze ‘24-’25

Ievads

- 3,0m x 3,0m kolonnu tīkls
- 2,1m malējais laidums
- D300mm kolonnas
- 150mm plātnes biezums
- Tikai tērauda šķiedras
- Bez stiegrojuma stieņiem

Mērījumi

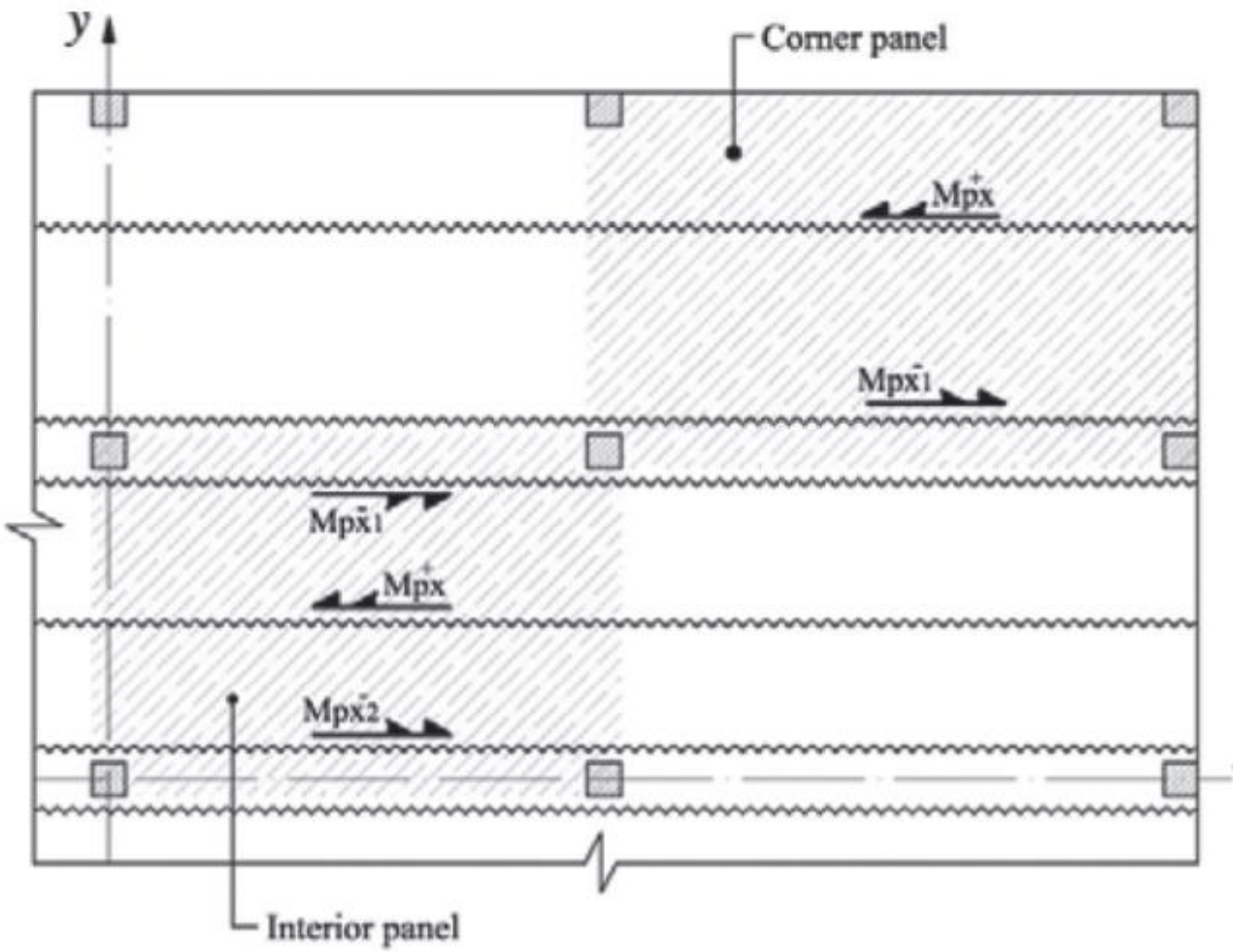
- Optisko šķiedru sensori
- LVDTs
- Deformāciju mērītāji
- VWSGs
- DIC



Slogojums ‘23

Sagaidāmais rezultāts ‘23

- Kontrolēts sabrukums (ductile)
- Taisnas plaisas augšā un apakšā – folded plate yield lines



[1]ACI544.6R-15 Fig.6.3.1.1a

Sagaidītais rezultāts ‘23

Sagaidītais rezultāts '23

SFRC

SFRSSC

PRIMX

Sagaidītais rezultāts '23

- Aprobēta ACI544.6R-15 aprēķina pieeja - gan SLS, gan ULS aprēķins ir tuvs realitātei
- Maksimālā izkliedētā slodze – 60,5kN/m^2

Slogojums ‘24

Sagaidāmais rezultāts ‘24

- Kontrolēts sabrukums (ductile)
- Radiālas plaisas apakšā
- Koncentriska plaisa augšpusē

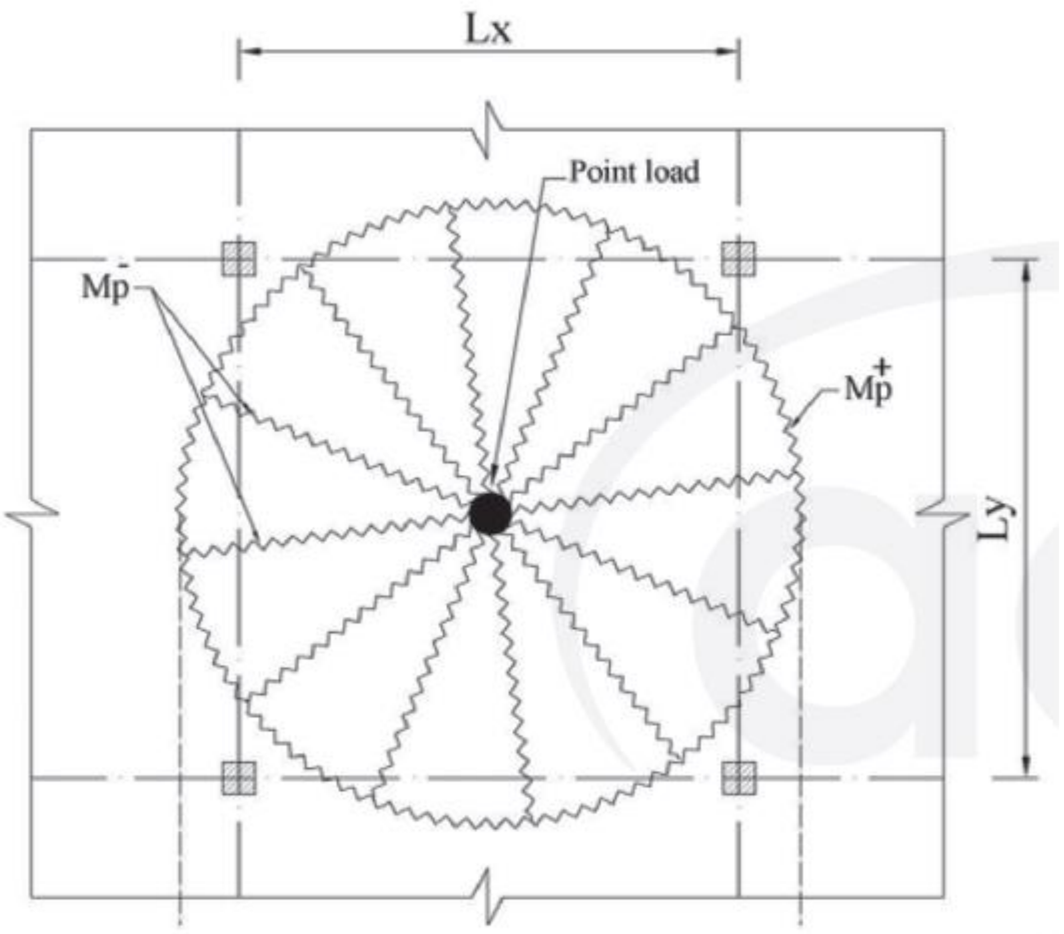
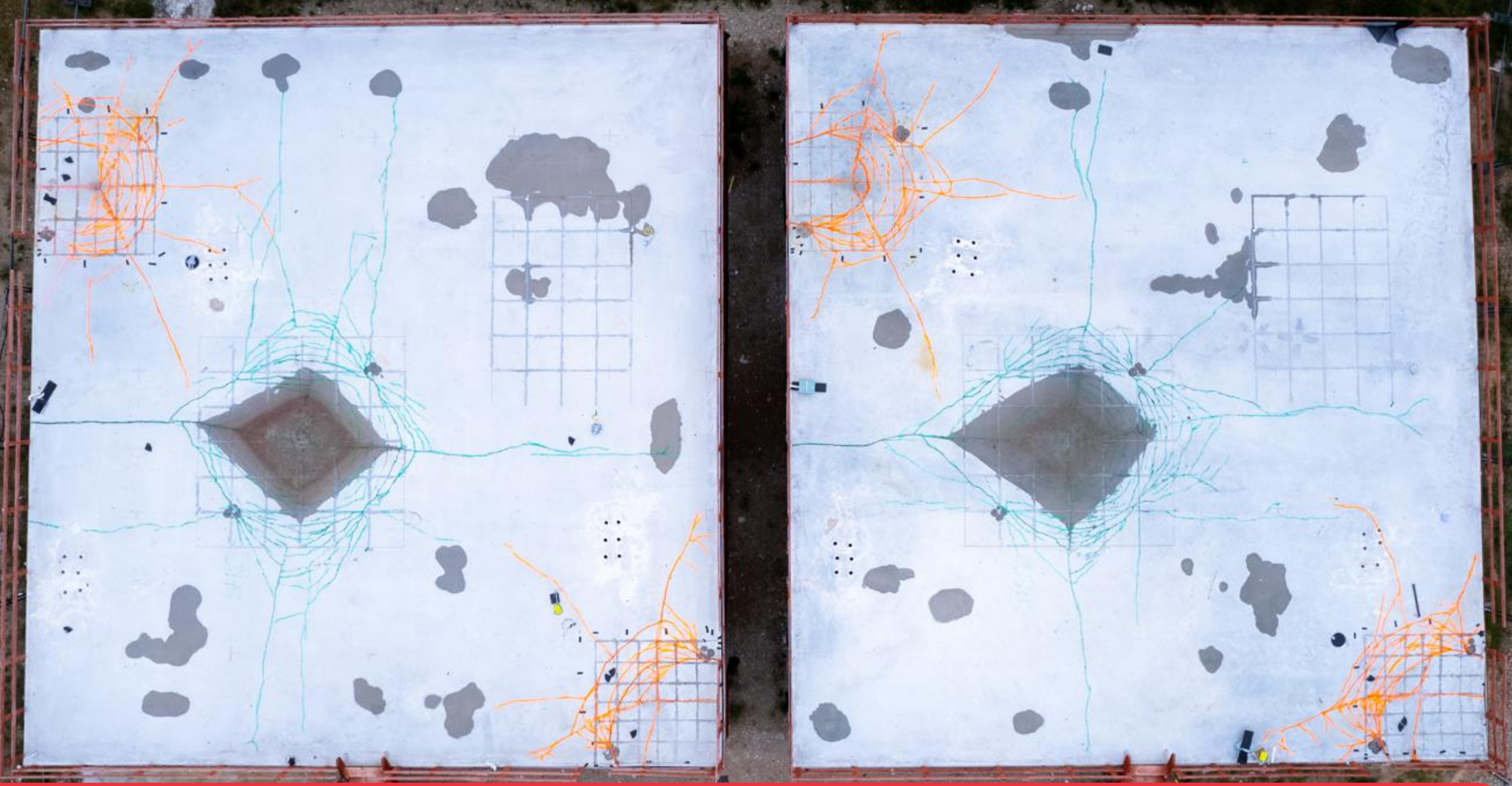
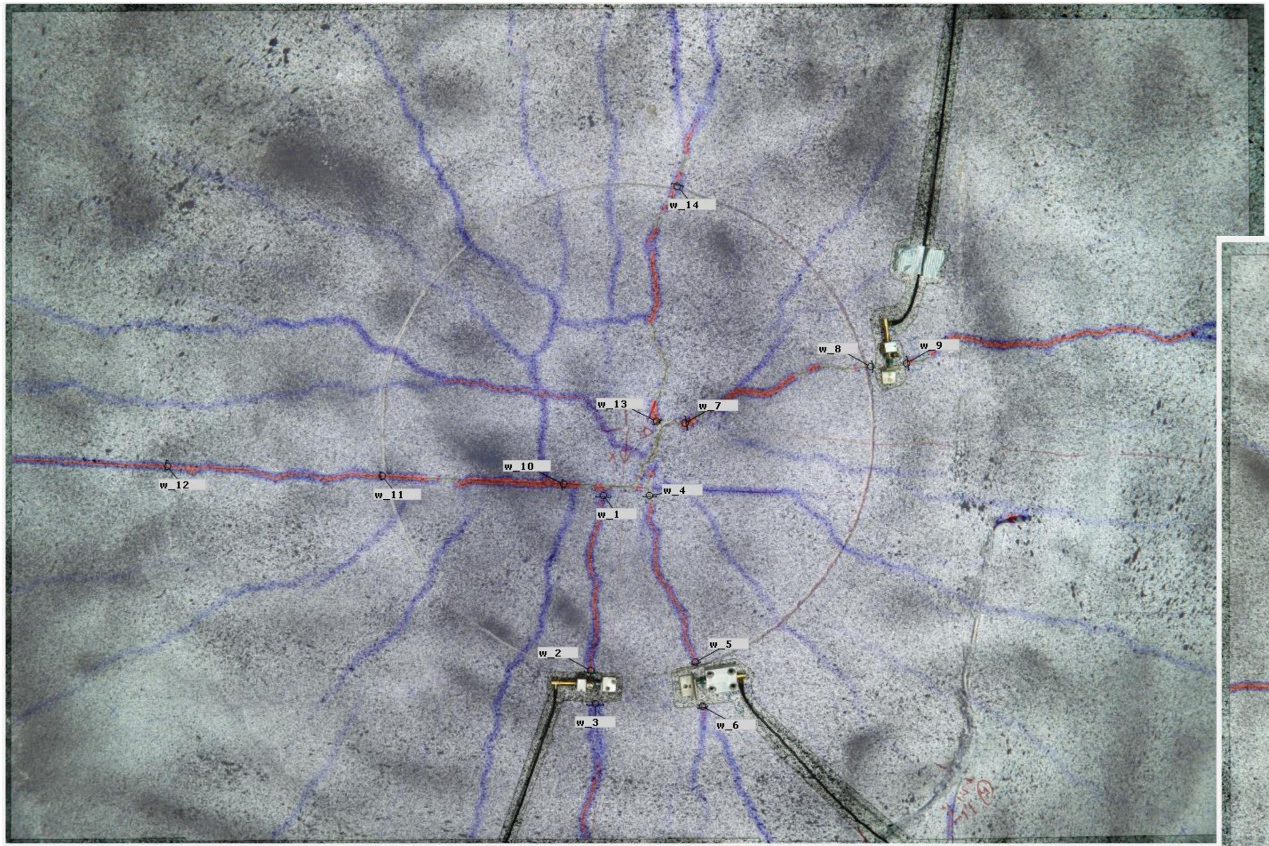
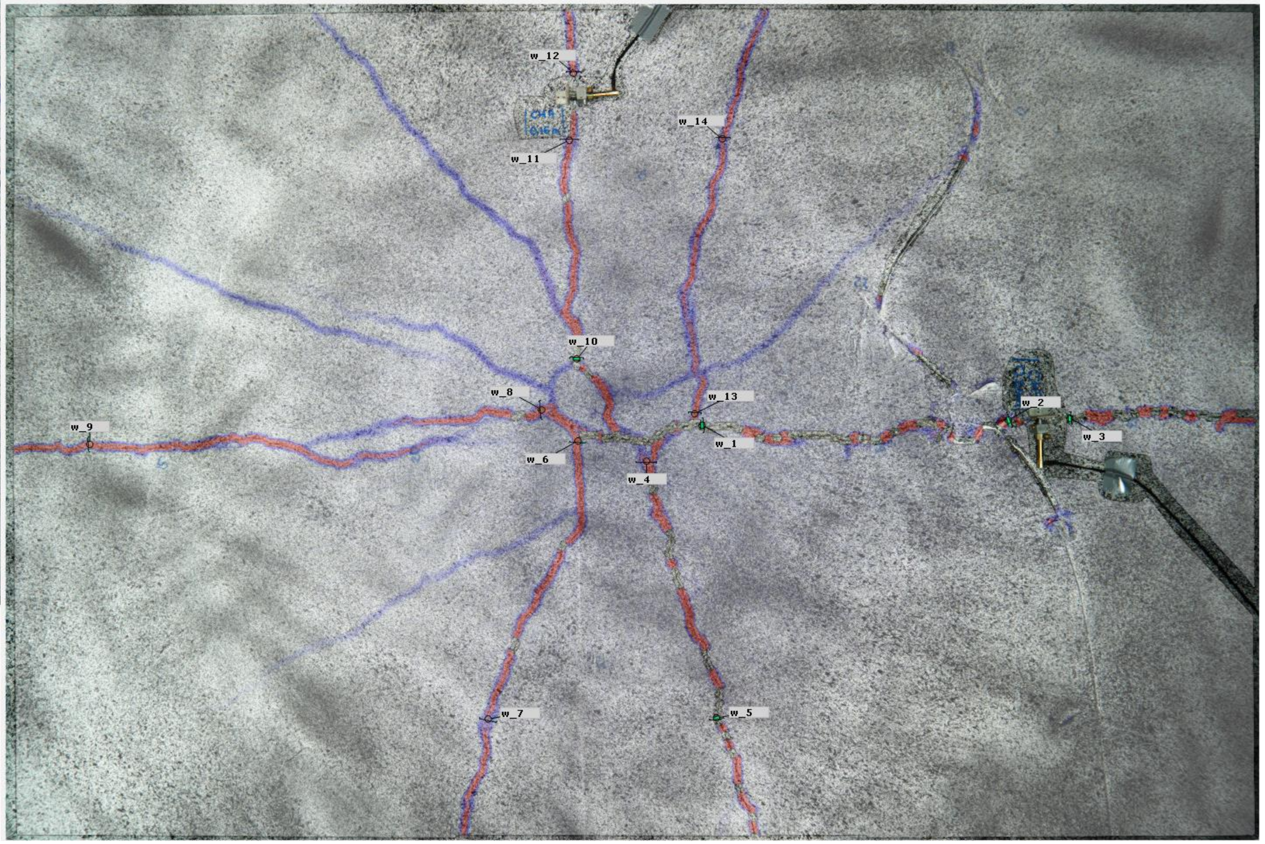


Fig. 6.3.3—Cracking pattern of slab under point load.



Sagaidītais rezultāts ‘24



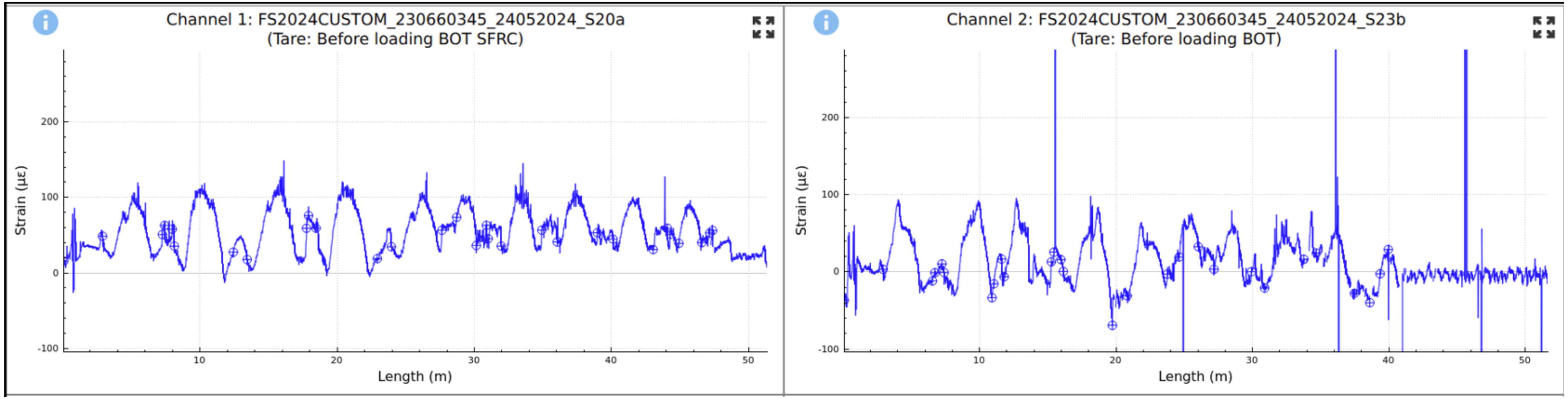


Sagaidītais rezultāts ‘24

- Aprobēta ACI544.6R-15 aprēķina pieeja - gan SLS, gan ULS aprēķins ir tuvs realitātei

- Maksimālā punktveida slodze – 390kN

Turpmākie pētījumi



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Monitoring of Concrete Structures and Its Effect on the Visual Quality of the Concrete Surface

Nikita

ADVENTUM
TECH

KEY POINTS

- Exposed concrete is both structural and aesthetic, requiring special care in curing and formwork removal

- Improper timing in formwork removal causes defects such as cracking, discoloration, or strength compromise

- Real-time monitoring is critical to ensure formwork is removed at the right moment, achieving high-quality surfaces and technical integrity.


FACTORS

- Climate – Surrounding environment conditions
- Moisture
- Type of concrete (aggregates, cement, receipe)
- **Curing time on formwork**

WHEN TO REMOVE FORMWORK

Early Removal:

Visual Defects: Cracks, honeycombing, and surface irregularities. Color variations from uneven hydration.

Technical Defects: Insufficient compressive strength and load-bearing capacity. Risk of deformation.

Late Removal:

Visual Defects: Stains, discoloration from trapped moisture, and rough patches due to prolonged contact.

Technical Defects: Shrinkage cracking and restraint-induced stress.

SEASON IMPACTS

Summer Conditions:

Visual Defects: Rapid surface drying leads to shrinkage cracking

Technical Defects: Overestimated strength gain due to high temperatures, causing premature formwork removal risks.

SEASON IMPACTS

Winter Conditions:

Visual Defects: Frost damage on exposed surfaces before sufficient curing.

Technical Defects: Delayed strength gain due to low temperatures increases risks of brittle concrete.

METHODS FOR CORRECT FORMWORK REMOVAL

Steps to Ensure Success:

- Verify concrete compressive strength using on-site testing.
- Follow guidelines for formwork types, concrete mix, and curing conditions.
- Incorporate real-time monitoring tools to track curing progress.

Best Practices:

- Maintain curing consistency with appropriate temperature and moisture control.
- Use data-driven thresholds to decide removal timing.

REAL-TIME MONITORING

How They Work:

- Measure in-situ strength, hydration, and temperature.
- Provide continuous data to track curing progress.

Benefits:

- Reduces guesswork, ensuring precise timing.
- Minimizes risk of visual and technical defects.
- Adapts to seasonal conditions, optimizing the curing process year-round.

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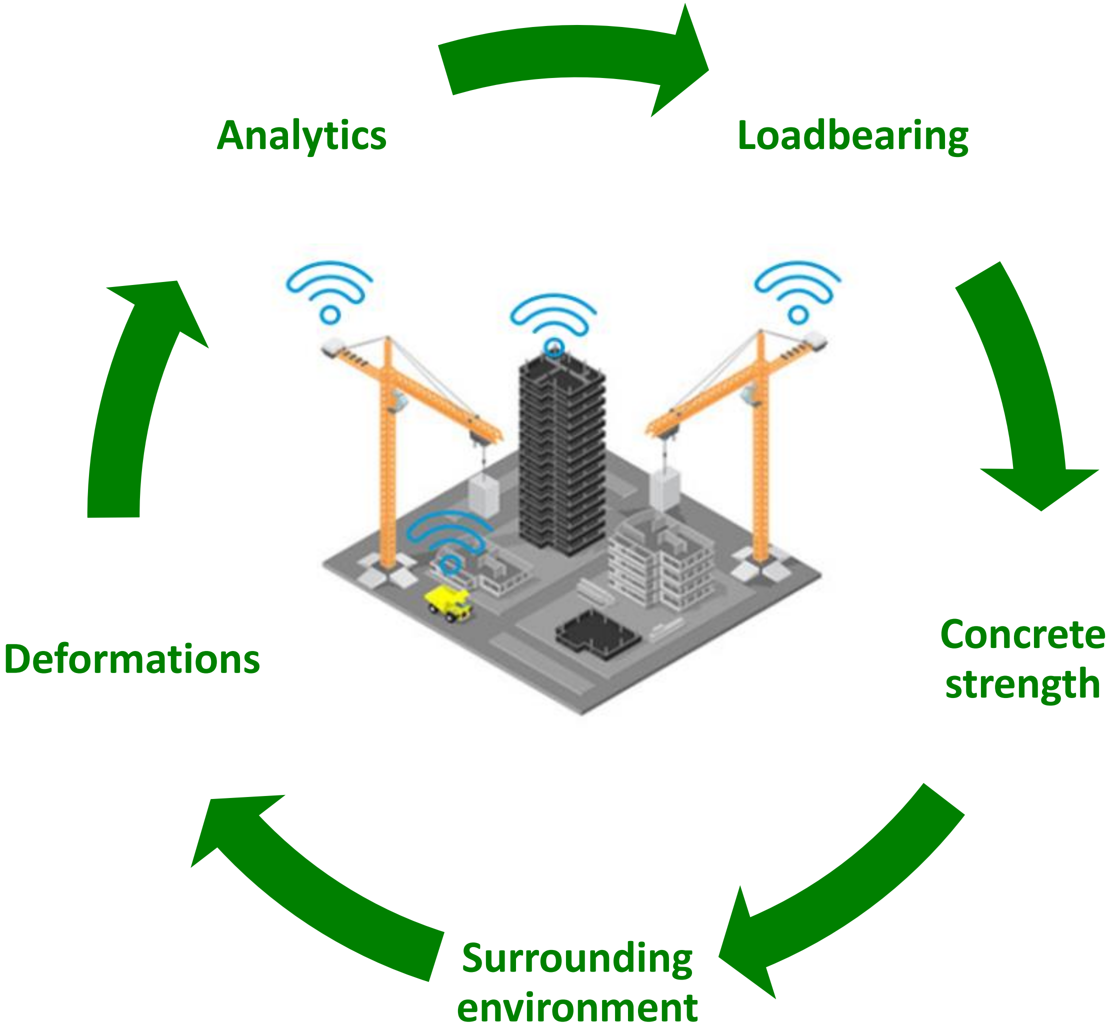
SERVICE



SENSORS

BASE

PRODUCTS

2021
Loadbearing

2022
Concrete strength

2023
Vibration

EUIPO
EUROPEAN UNION
INTELLECTUAL PROPERTY OFFICE

SLABCONTROL 5.0

1. Conrete strength
2. Temperature
3. Vibration
4. Settlement
5. Tension
6. Compression
7. Inclination
8. Deformations
9. Concrete shrinkage

CONCLUSION

- Timing in formwork removal is critical for achieving the desired visual and technical quality.
- Early removal leads to surface and structural defects, while late removal risks discoloration and shrinkage issues.
- Real-time monitoring ensures optimal decisions, reducing risks and improving efficiency.
- Investment in monitoring technologies is a vital step toward superior exposed concrete outcomes.

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MEASURING THE INVISIBLE

THANK YOU