ISB

INSTITUT SÜDTIROLER BAUTOFFTECHNOLOGIE KGMBH

INTERREG-PROJECT

SITAR

DELIVERABLE

WP2

EVALUATION OF LIMITS ON MATERIALS

Interreg Italia–Österreich
Co-funded by the European Union
Europe even closer

INTRODUCTION

In WP2, ISB focused on recycled aggregates in concrete. To build a wide knowledge base, codes, technical guidelines, and publications in technical journals were analyzed, separately for Italy and Austria. Both countries have many regulations, which led to the identification of limits and conflict points within the rules of each country. The goal was to show what is currently possible with recycled aggregates in concrete and to point out restrictions, such as those related to exposure classes. Clear and simple overview charts were created to help concrete producers, construction companies, and planning engineers understand the situation more easily. A comparison was also made between Italy and Austria to show their differences, what they can learn from each other, and where both countries can still improve. Finally, technical questions, challenges, and ideas for improvement regarding recycled aggregates and sustainable concrete were developed. These will be elaborated further in WP3.

ITALY

ANALYZED CODES AND TECHNICAL GUIDELINES

1. **UNI EN 12620:2008** - „Aggregates for concrete“
2. **UNI 8520-2:2022** - „Aggregates for concrete — Additional provisions for the application of EN 12620 – Part 2: Requirements”
3. **UNI EN 206:2021** - „Concrete – Specification, performance, production and conformity“
4. **UNI 11104:2016** - „Concrete – Specification, performance, production and conformity – Additional provisions for the application of EN 206”
5. **NTC 2018 - Norme tecniche per le costruzioni** - „Technical standards for constructions”
6. **CAM – Criteri ambientali minimi (2022)** - “Minimum Environmental Standards”

UNI EN 12620:2008

This code differs between coarse (grain size ≥ 4 mm) and fine aggregates and provides a classification for recycling aggregates, but only for coarse recycling aggregates.

Costituente	Descrizione
Rc	Calcestruzzo, prodotti di calcestruzzo, malta Elementi di calcestruzzo per muratura
Ru	Aggregato non legato, pietra naturale Aggregato legato idraulicamente
Rb	Elementi di laterizio per muratura (mattoni e piastrelle) Elementi di silicato di calcio per muratura Calcestruzzo aerato non galleggiante
Ra	Materiali bituminosi
FL	Materiale galleggiante in volume
X Rg	Altro: Coesivo (cioè argilla e terreno) Vari: metalli (ferrosi e non ferrosi) Legno non galleggiante, plastica e gomma Intonaco di gesso Vetro

prospetto 20 **Categorie dei costituenti di aggregati grossi riciclati**

Costituente	Contenuto Percentuale in massa	Categoria
Rc	≥90 ≥80 ≥70 ≥50 <50	Rc_{90} Rc_{80} Rc_{70} Rc_{50} $Rc_{Dichiarato}$
	Nessun requisito	Rc_{NR}
Rc + Ru	≥95 ≥90 ≥70 ≥50 <50	Rcu_{95} Rcu_{90} Rcu_{70} Rcu_{50} $Rcu_{Dichiarato}$
	Nessun requisito	Rcu_{NR}
Rb	≤10 ≤30 ≤50 >50	Rb_{10-} Rb_{30-} Rb_{50-} $Rb_{Dichiarato}$
	Nessun requisito	Rb_{NR}
Ra	≤1 ≤5 ≤10	Ra_{1-} Ra_{5-} Ra_{10-}
X + Rg	≤0,5 ≤1 ≤2	$XRg_{0,5-}$ XRg_{1-} XRg_{2-}
	Contenuto cm^3/kg	
FL	≤0,2[a)] ≤2 ≤5	$FL_{0,2-}$ FL_{2-} FL_{5-}

a) La categoria ≤0,2 è destinata solo ad applicazioni speciali che richiedono alta qualità di finitura superficiale.

There are also requirements for pollutant content and specific chemical properties (e.g. methylene blue value ≤ 1.5 g/kg).

UNI 8520-2:2022

In this code, recycled coarse aggregates, classified according to Table 20 of UNI EN 12620, belonging to the following types are considered suitable for use in concrete conforming to UNI EN 206:

Tipo A : Rc_{90}, Rcu_{95}, Rb_{10-}, Ra_{1-}, FL_{2-}, XRg_{1-}
Tipo B : Rc_{50}, Rcu_{70}, Rb_{30-}, Ra_{5-}, FL_{2-}, XRg_{2-}

Recycled fine aggregates, and recycled mixed aggregates can be used to make concrete with appropriate precautions!

The rules of use for concrete can be found in UNI 11104.

The quality of fines in recycled fine aggregates must fulfill the following criteria:

- Maximum quantity of fines as in Table 2
- Methylene blue MB value according to UNI EN 933-9 less than or equal to 1.5 g/kg
- Chemical-physical characterizations to identify the amount and type of harmful elements according to Table A1

Table 2 - Allowable limits for the content of fines:

prospetto 2 **Limiti ammissibili per il contenuto in fini**

	Tipo di aggregato	Categoria EN	Tenore massimo dei fini %
Aggregato grosso	Non frantumato o frantumato da depositi alluvionali	$\leq f_{1,5}$	1,5[a)]
	Frantumato da roccia	$\leq f_4$	4
	Aggregato riciclato Tipo A	$\leq f_4$	4
	Aggregato riciclato Tipo B	$\leq f_4$	4
	Aggregato industriale	$\leq f_{1,5}$	1,5[a)]
Aggregato fine (sabbia)	Non frantumato	$\leq f_3$	3
	Frantumato da depositi alluvionali	$\leq f_{10}$	10
	Frantumato da roccia di banchi omogenei	$\leq f_{16}$	16
	Aggregato riciclato da solo calcestruzzo[b)]	$\leq f_{10}$	10
	Aggregato riciclato da demolizioni	$\leq f_3$	3
	Aggregato industriale	$\leq f_3$	3
Misto naturale 0/8	Non frantumato o frantumato da depositi alluvionali	$\leq f_3$	3
Aggregato in frazione unica (misto) 0/*D*	Non frantumato o frantumato da depositi alluvionali	$\leq f_3$	3
	Frantumato da roccia	$\leq f_{11}$	11
	Aggregato riciclato da solo calcestruzzo[b)]	$\leq f_{10}$	10
	Aggregato riciclato da demolizioni	$\leq f_3$	3
	Aggregato industriale	$\leq f_3$	3

a) Si raccomanda un contenuto effettivo di fini non maggiore dello 0,5%.
b) Almeno il 90% derivante dalla frantumazione di calcestruzzo.

UNI EN 206:2021

This code provides "Recommendations" for the use of coarse recycled aggregates:

- Use of coarse recycled aggregates with d ≥ 4 mm
- Table E.2 contains the maximal limit values for the replacement of natural normal aggregates by coarse recycled aggregates depending on the exposure classes.
- The code doesn't mention fine recycled aggregates and doesn't prescribe anything

prospetto E.2 **Percentuale massima di sostituzione di aggregati grossi (% in massa)**

Tipo di aggregato riciclato	Classi di esposizione			
	X0	XC1, XC2	XC3, XC4, XF1, XA1, XD1	Tutte le altre classi di esposizione [a]
Tipo A: (Rc_{90}, Rcu_{95}, Rb_{10}, Ra_{1}, FL_{2}, XRg_{1})	50%	30%	30%	0%
Tipo B [b]: (Rc_{50}, Rcu_{70}, Rb_{30}, Ra_{5}, FL_{2}, XRg_{2})	50%	20%	0%	0%

a) Gli aggregati riciclati di tipo A di origine nota possono essere utilizzati nelle classi di esposizione alle quali era destinato il calcestruzzo originale con una percentuale di sostituzione massima del 30 %.
b) Gli aggregati riciclati di tipo B non dovrebbero essere utilizzati nel calcestruzzo con classi di resistenza a compressione > C30/37.

Table E.3 – "Recommendations" for coarse recycled aggregates according to EN 12620:

prospetto E.3 **Raccomandazioni per aggregati riciclati grossi secondo la EN 12620**

Proprietà [a]	Punto della EN 12620:2002+A1:2008	Tipo	Categoria secondo la EN 12620
Contenuto di fini	4.6	A + B	Categoria o valore da dichiarare
Indice di appiattimento	4.4	A + B	$\leq FI_{50}$ o $\leq SI_{55}$
Resistenza alla frammentazione	5.2	A + B	$\leq LA_{50}$ o $\leq SZ_{32}$
Massa volumica delle particelle essiccate in stufa ρ_{rd}	5.5	A	≤ 2 100 kg/m^3
		B	≤ 1 700 kg/m^3
Assorbimento d'acqua	5.5	A + B	Valore da dichiarare
Costituenti [b]	5.8	A	Rc_{90}, Rcu_{95}, Rb_{10}, Ra_{1}, FL_{2}, XRg_{1}
		B	Rc_{50}, Rcu_{70}, Rb_{30}, Ra_{5}, FL_{2}, XRg_{2}
Contenuto di solfati idrosolubili	6.3.3	A + B	$SS_{0,2}$
Contenuto di ioni cloruro solubili in acido	6.2	A + B	Valore da dichiarare
Influenza sul tempo di inizio presa	6.4.1	A + B	$\leq A_{40}$

a) La categoria NR (nessun requisito) si applica a tutte le altre proprietà non specificate nel presente prospetto per le quali può essere dichiarata una categoria NR secondo la EN 12620.
b) Per applicazioni particolari che richiedono una finitura superficiale di alta qualità il costituente FL dovrebbe essere limitato alla categoria $FL_{0,2}$.

Overview map created by ISB:

UNI EN 206:2021

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	0%	50%	0%	50%	0%
XC1							30%	20%	30%	20%	30%	0%	30%	0%	30%	0%
XC2							30%	20%	30%	20%	30%	0%	30%	0%	30%	0%
XC3									30%	0%	30%	0%	30%	0%	30%	0%
XC4											30%	0%	30%	0%	30%	0%
XS1											0%	0%	0%	0%	0%	0%
XS2													0%	0%	0%	0%
XS3													0%	0%	0%	0%
XD1									30%	0%	30%	0%	30%	0%	30%	0%
XD2											0%	0%	0%	0%	0%	0%
XD3													0%	0%	0%	0%
XA1									30%	0%	30%	0%	30%	0%	30%	0%
XA2											0%	0%	0%	0%	0%	0%
XA3													0%	0%	0%	0%
XF1											30%	0%	30%	0%	30%	0%
XF2							0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XF3							0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XF4									0%	0%	0%	0%	0%	0%	0%	0%

UNI 11104:2016

With Table 5 this code provides limit values for the composition and characteristics of concrete:

prospetto 5 **Valori limite per la composizione e le proprietà del calcestruzzo**

	Classi di esposizione																
	Nessun rischio di corrosione dell'armatura	Corrosione delle armature indotta dalla carbonatazione				Corrosione delle armature indotta da cloruri						Attacco da cicli di gelo/disgelo				Ambiente aggressivo per attacco chimico		
						Acqua di mare			Cloruri provenienti da altre fonti									
	X0	XC1	XC2	XC3	XC4	XS1	XS2	XS3	XD1	XD2	XD3	XF1	XF2	XF3	XF4	XA1	XA2	XA3
Massimo rapporto *a/c*	-	0,60		0,55	0,50	0,50	0,45		0,55	0,50	0,45	0,50	0,50		0,45	0,55	0,50	0,45
Minima classe di resistenza	C12/15	C25/30		C30/37	C32/40	C32/40	C35/45		C30/37	C32/40	C35/45	C32/40	C25/30		C30/37	C30/37,	32/40	35/45
Minimo contenuto in cemento (kg/m^3) [d]	-	300		320	340	340	360		320	340	360	320	340		360	320	340	360
Contenuto minimo in aria (%)												[b]	4,0[a]					
Altri requisiti						E' richiesto l'utilizzo di cementi resistenti all'acqua di mare secondo UNI 9156						E' richiesto l'utilizzo di aggregati conformi alla UNI EN 12620 di adeguata resistenza al gelo/disgelo				In caso di esposizione a terreno o acqua del terreno contenente solfati nei limiti del prospetto 2 della UNI EN 206:2014, è richiesto l'impiego di cementi resistenti ai solfati[c]		

a) Quando il calcestruzzo non contiene aria inglobata, le sue prestazioni devono essere verificate rispetto ad un calcestruzzo aerato per il quale è provata la resistenza al gelo/disgelo, da determinarsi secondo UNI CEN/TS 12390 -9, UNI CEN/TR 15177 o UNI 7087 per la relativa classe di esposizione. Il valore minimo di aria inglobata del 4% può ritenersi adeguato per calcestruzzi specificati con D_{upper} >20mm; per D_{upper} inferiori il limite minimo andrà opportunamente aumentato (ad esempio 5% per D_{upper} tra 12 mm e 16 mm).
b) Qualora si ritenga opportuno impiegare calcestruzzo aerato anche in classe di esposizione XF1 si adottano le specifiche di composizione prescritte per le classi XF2 e XF3.
c) Cementi resistenti ai solfati sono definiti dalla UNI EN 197-1 e su base nazionale dalla UNI 9156. La UNI 9156 classifica i cementi resistenti ai solfati in tre classi: moderata, alta e altissima resistenza solfatica. La classe di resistenza solfatica del cemento deve essere prescelta in relazione alla classe di esposizione del calcestruzzo secondo il criterio di corrispondenza della UNI 11417-1.
d) Quando si applica il concetto di valore *k* il rapporto massimo a/c e il contenuto minimo di cemento sono calcolati in conformità al punto 5.2.2.

Table 4 defines the maximum mass percentages of replacement of coarse aggregate by recycled coarse aggregate in relation to its type, exposure class and strength class in performance-guaranteed concrete:

prospetto 4 **Massima percentuale di sostituzione dell'aggregato grosso con aggregato grosso riciclato in funzione della tipologia di aggregato, della classe di resistenza e della classe di esposizione**

Tipologie di aggregato		Classe di resistenza	% massima di sostituzione												
			Classe di esposizione												
			X0	XC1 XC2 XC3	XC4	XS1	XS2 XS3	XD1	XD2	XD3	XF1	XF2 XF3 XF4	XA1	XA2	XA3
Tipo A	Rc_{90},Rcu_{95}, Rb_{10},Ra_{1},FL_{2}, Rg_{1}	≥C12/15 ≤C20/25	60%	-	-	-	-	-	-	-	-	--	-	-	-
		≤ C30/37	30%	30%	-	-	-	20%	-	-	-	20%	20%	-	-
		≤ C45/55	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Tipologie di aggregato		Classe di resistenza	% massima di sostituzione												
			Classe di esposizione non applicabile												
Tipo A	Rc_{90},Rcu_{95}, Rb_{10},Ra_{1},FL_{2}, Rg_{1}	C8/10	≤ 100%												
Tipo B	Rc_{50},Rcu_{70}, Rb_{30},Ra_{5}, FL_{2}, XRg_{2}														

Rc: calcestruzzo, prodotti di calcestruzzo e malta;
Ru: aggregati non legati, aggregati naturali, aggregati legati con leganti idraulici;
Rb: frammenti di mattoni o tegole in argilla, frammenti di mattoni silicei, frammenti di calcestruzzo aerato non galleggiante;
Ra: materiali bituminosi;
Rg: vetro;
FL: materiale lapideo galleggiante (in volume);
X: altri materiali: coesivi (argilla e terra); metalli ferrosi e non ferrosi; gesso, plastica e gomma, legno non galleggiante.

According to Table 4 Type A and Type B aggregates can be used for C 8/10 concretes.

According to Table 4 only Type A aggregates can be used for higher classes.

In prefabrication plants internal reuse of concrete as coarse aggregate is allowed, up to a maximum of 10 percent of the coarse aggregate for making concrete of the same class as the original concrete, and 15 percent of the coarse aggregate for making concrete of a lower class than the original concrete.

The code doesn't mention fine recycled aggregates and doesn't prescribe anything.

Overview map created by ISB:

UNI 11104:2016

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	100%	100%	60%	0%	60%	0%	30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC1							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC3									30%	0%	20%	0%	20%	0%	20%	0%
XC4											20%	0%	20%	0%	20%	0%
XS1											20%	0%	20%	0%	20%	0%
XS2													20%	0%	20%	0%
XS3													20%	0%	20%	0%
XD1									20%	0%	20%	0%	20%	0%	20%	0%
XD2											20%	0%	20%	0%	20%	0%
XD3													20%	0%	20%	0%
XA1									20%	0%	20%	0%	20%	0%	20%	0%
XA2											20%	0%	20%	0%	20%	0%
XA3													20%	0%	20%	0%
XF1											20%	0%	20%	0%	20%	0%
XF2							20%	0%	20%	0%	20%	0%	20%	0%	20%	0%
XF3							20%	0%	20%	0%	20%	0%	20%	0%	20%	0%
XF4									20%	0%	20%	0%	20%	0%	20%	0%

NTC 2018 – NORME TECHNICHE PER LE COSTRUZIONI

This code permits the use of coarse recycled aggregates, according to the limits in Table 11.2.III.

The precondition for this is that the mixture is preliminarily qualified, documented and accepted at the construction site.

The code doesn't mention fine recycled aggregates and doesn't prescribe anything.

Tab. 11.2.III

Origine del materiale da riciclo	Classe del calcestruzzo	percentuale di impiego	
demolizioni di edifici (macerie)	= C 8/10	fino al 100%	= Type B
demolizioni di solo calcestruzzo e c.a. (frammenti di calcestruzzo ≥ 90%, UNI EN 933-11:2009)	≤ C20/25	fino al 60%	= Type A
	≤ C30/37	≤ 30%	
	≤ C45/55	≤ 20%	
Riutilizzo di calcestruzzo interno negli stabilimenti di prefabbricazione qualificati - da qualsiasi classe	Classe minore del calcestruzzo di origine	fino al 15%	
	Stessa classe del calcestruzzo di origine	fino al 10%	

Overview map created by ISB:

NTC 2018 - TECHNICAL STANDARDS FOR CONSTRUCTIONS

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	100%	100%	60%	0%	60%	0%	30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC1							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC3									30%	0%	20%	0%	20%	0%	20%	0%
XC4											20%	0%	20%	0%	20%	0%
XS1											20%	0%	20%	0%	20%	0%
XS2													20%	0%	20%	0%
XS3													20%	0%	20%	0%
XD1									30%	0%	20%	0%	20%	0%	20%	0%
XD2											20%	0%	20%	0%	20%	0%
XD3													20%	0%	20%	0%
XA1									30%	0%	20%	0%	20%	0%	20%	0%
XA2											20%	0%	20%	0%	20%	0%
XA3													20%	0%	20%	0%
XF1											20%	0%	20%	0%	20%	0%
XF2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XF3							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XF4									30%	0%	20%	0%	20%	0%	20%	0%

Overview map created by ISB:

COMBINATION OF UNI 11104:2016 and NTC 2018 - MINIMUM VALUES

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	100%	100%	60%	0%	60%	0%	30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC1							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC3									30%	0%	20%	0%	20%	0%	20%	0%
XC4											20%	0%	20%	0%	20%	0%
XS1											20%	0%	20%	0%	20%	0%
XS2													20%	0%	20%	0%
XS3													20%	0%	20%	0%
XD1									20%	0%	20%	0%	20%	0%	20%	0%
XD2											20%	0%	20%	0%	20%	0%
XD3													20%	0%	20%	0%
XA1									20%	0%	20%	0%	20%	0%	20%	0%
XA2											20%	0%	20%	0%	20%	0%
XA3													20%	0%	20%	0%
XF1											20%	0%	20%	0%	20%	0%
XF2							20%	0%	20%	0%	20%	0%	20%	0%	20%	0%
XF3							20%	0%	20%	0%	20%	0%	20%	0%	20%	0%
XF4									20%	0%	20%	0%	20%	0%	20%	0%

COMBINATION OF UNI 11104:2016 and NTC 2018 - MAXIMUM VALUES

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	100%	100%	60%	0%	60%	0%	30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC1							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XC3									30%	0%	20%	0%	20%	0%	20%	0%
XC4											20%	0%	20%	0%	20%	0%
XS1											20%	0%	20%	0%	20%	0%
XS2													20%	0%	20%	0%
XS3													20%	0%	20%	0%
XD1									30%	0%	20%	0%	20%	0%	20%	0%
XD2											20%	0%	20%	0%	20%	0%
XD3													20%	0%	20%	0%
XA1									30%	0%	20%	0%	20%	0%	20%	0%
XA2											20%	0%	20%	0%	20%	0%
XA3													20%	0%	20%	0%
XF1											20%	0%	20%	0%	20%	0%
XF2							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XF3							30%	0%	30%	0%	20%	0%	20%	0%	20%	0%
XF4									30%	0%	20%	0%	20%	0%	20%	0%

CAM – CRITERI AMBIENTALI MINIMI (2022)

The national government has defined that for all public-building projects, concrete with at least 5% recycled content calculated on a dry weight basis must be used in the interests of sustainability.

The recycled content can be contained in the concrete aggregate in the form of RC-gravel or in the cement.

The following materials are considered recycled materials:

- Post-Consumer
- Pre-Consumer
- Sub-product

Post-Consumer: Existing material that is returned to the production cycle through recycling (e.g. recycled material from building demolition).

Pre-Consumer: Residual materials from industrial production processes that are processed for another use (e.g. processed residual materials from marble or stone processing). This category also includes excavation and tunnel excavation material, which is declared as waste and can be used as aggregate through processing.

Sub-product: Product that can be processed directly from production without any further processing (e.g. gravel from concrete washing plant, fly ash).

CERTIFICATION OF RECYCLED CONCRETE

Recognition of recycled material content in concrete requires an external certification by an Accredia-approved laboratory.

The certification is an EPD, UNI PdR 88:2020 or certification in accordance with ISO 14021.

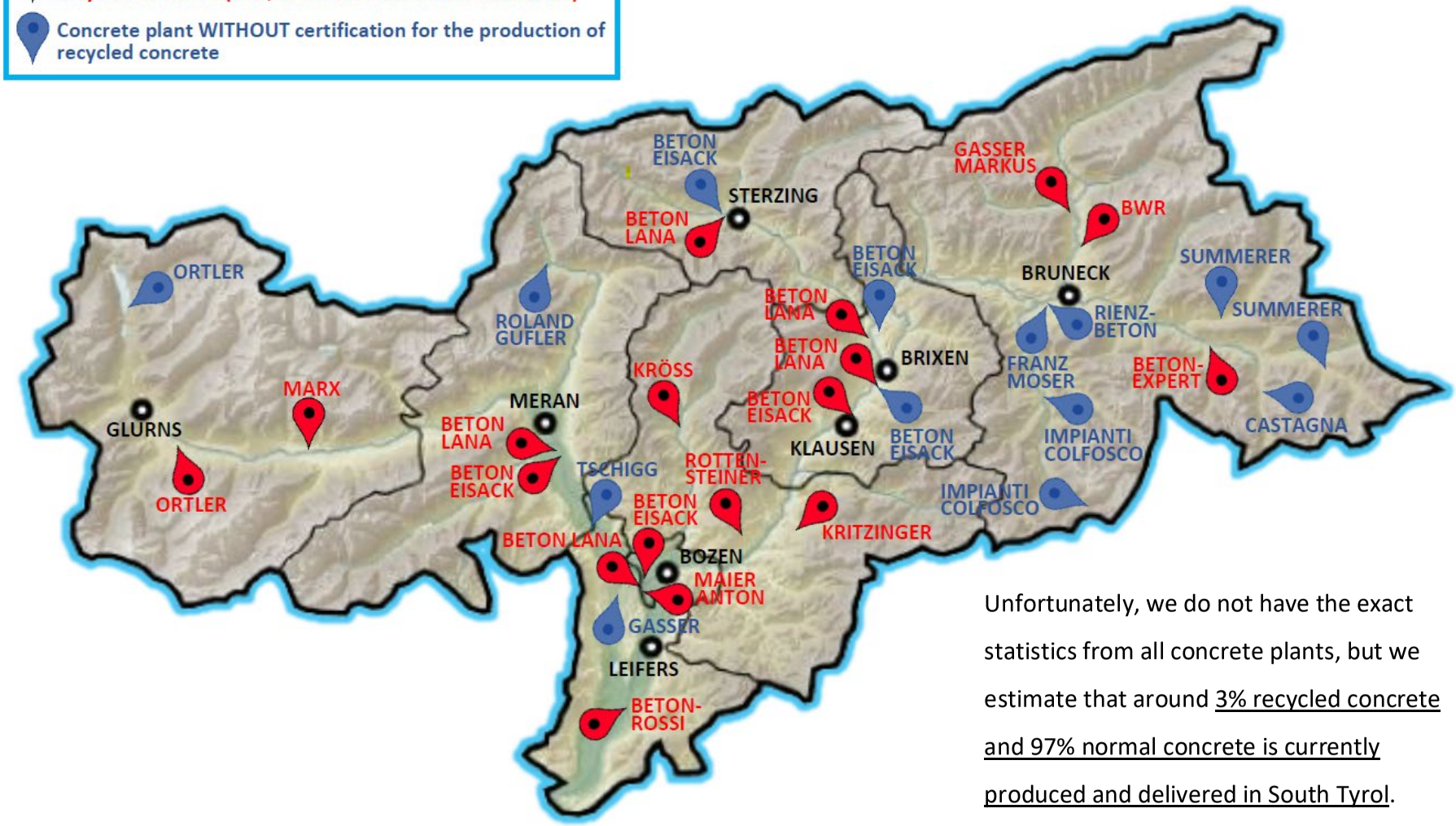
In South Tyrol, the “Concrete - Concrete Association” has agreed with ICMQ special conditions for certification using a CP DOC 262 in accordance with ISO 14021. The first producers are already in the process of implementing this certification.

GEOGRAPHICAL MAP OF THE PLANTS OF CONCRETE PRODUCERS IN SOUTH TYROL

Explanation:

Concrete plant WITH certification for the production of recycled concrete (EPD, CP DOC 262 or UNI PdR 88:2020)

Concrete plant WITHOUT certification for the production of recycled concrete



Unfortunately, we do not have the exact statistics from all concrete plants, but we estimate that around 3% recycled concrete and 97% normal concrete is currently produced and delivered in South Tyrol.

AUSTRIA

ANALYZED CODES AND TECHNICAL GUIDELINES

1. **ÖNORM EN 12620:2014** - „Aggregates for concrete“
2. **ÖNORM B 3131:2016** - „Aggregates for concrete — Rules for implementation of ÖNORM EN 12620”
3. **Recycling-Baustoffverordnung 2024** - „Recycled Construction Materials Ordinance“
4. **ÖNORM EN 206:2021** - „Concrete — Specification, performance, production and conformity”
5. **ÖNORM B 3140:2020** - „Recycled aggregates for unbound and hydraulically bound applications as well as for concrete”
6. **ÖNORM B 4710-1:2018** - “Concrete — Specification, performance, production, use and conformity — Part 1: Rules for the implementation of ÖNORM EN 206 for normal and heavy concrete”

ÖNORM EN 12620:2014

Identical to the Italian code this code differs between coarse (grain size ≥ 4 mm) and fine aggregates and provides a classification for recycling aggregates, but only for coarse recycling aggregates.

Bestandteil	Beschreibung
Rc	Beton, Betonprodukte, Mörtel Mauersteine aus Beton
Ru	Ungebundene Gesteinskörner, Naturstein, hydraulisch gebundene Gesteinskörner
Rb	Mauer- und Dachziegel aus gebranntem Ton Kalksandsteine Gasbetonsteine (nicht schwimmend)
Ra	Bitumenhaltige Materialien
FL	Schwimmendes Material im Volumen
X	Sonstige Materialien: Bindige Materialien (d. h. Ton, Erde) Verschiedene sonstige Materialien: (Eisenhaltige und nicht eisenhaltige) Metalle, nicht schwimmendes Holz, Kunststoff, Gummi, Gips
Rg	Glas

Tabelle 20 — Kategorien der Bestandteile von groben rezyklierten Gesteinskörnungen

Bestandteil	Gehalt Massenanteil in %	Kategorie
Rc	≥ 90	Rc_{90}
	≥ 80	Rc_{80}
	≥ 70	Rc_{70}
	≥ 50	Rc_{50}
	< 50	$Rc_{angegeben}$
	Keine Anforderung	Rc_{NR}
Rc + Ru	≥ 95	Rcu_{95}
	≥ 90	Rcu_{90}
	≥ 70	Rcu_{70}
	≥ 50	Rcu_{50}
	< 50	$Rcu_{angegeben}$
	Keine Anforderung	Rcu_{NR}
Rb	≤ 10	Rb_{10-}
	≤ 30	Rb_{30-}
	≤ 50	Rb_{50-}
	> 50	$Rb_{angegeben}$
	Keine Anforderung	Rb_{NR}
Ra	≤ 1	Ra_{1-}
	≤ 5	Ra_{5-}
	≤ 10	Ra_{10-}
X + Rg	≤ 0,5	$XRg_{0,5-}$
	≤ 1	XRg_{1-}
	≤ 2	XRg_{2-}
	Gehalt cm^3/kg	
FL	≤ 0,2[a]	$FL_{0,2-}$
	≤ 2	FL_{2-}
	≤ 5	FL_{5-}

[a] Die Kategorie ≤ 0,2 gilt nur für besondere Anwendungen, die eine hochwertige Oberflächenbeschaffenheit erfordern.

ÖNORM B 3131:2016

This code provides with Table 1 some requirements for the categorys of coarse and fine aggregates.

But the code mentions only coarse recycling aggregates.

Tabelle 1 (fortgesetzt)

Bezug zur ÖNORM EN 12620:2014		Bei CE-Kennzeichnung anzugebende Kategorien[a] bzw. Werte
Ab-schnitt	**Merkmal**	
5.8	Klassifizierung der Bestandteile von groben rezyklierten Gesteinskörnungen	Rc_{90}, Rc_{50}, Rc_{NR} Rcu_{95}, Rcu_{70}, Rcu_{NR} Rb_{30}[f], Rb_{NR}[f] Ra_{1-}, Ra_{5-}, Ra_{10-} XRg_{1-} FL_{2-}, $FL_{0,2-}$

RBV 2024 - RECYCLED CONSTRUCTION MATERIALS ORDINANCE

This document regulates the areas of application for recycled building materials of the individual quality classes.

Table B.2 - Parameters and limits for aggregates according to RBV:

Parameter	Einheit	Qualitätsklasse			
		U-A	U-B	U-E	H-B
Eluat bei L/S 10					
pH-Wert		7,5[a] bis 12,5[b]	7,5[a] bis 12,5[b]	7,5[a] bis 12,5[b]	bis 12,5[b]
Elektrische Leitfähigkeit	mS/m	150[b,c]	150[b,c]	150[b,c]	–
Chrom ges.	mg/kg TM	0,60	1,0[d]	0,60	1,0[d]
Cobalt	mg/kg TM	–	–	1,0	–
Kupfer	mg/kg TM	1,0	2,0	1,0	2,0
Molybdän	mg/kg TM	–	–	0,50	–
Nickel	mg/kg TM	0,40	0,60	0,40	–
Ammonium-N	mg/kg TM	4,0	8,0	4,0	8,0
Chlorid	mg/kg TM	800	1 000	800	1 000
Fluorid	mg/kg TM	–	–	10	–
Nitrit-N	mg/kg TM	2,0	2,0	2,0	–
Sulfat	mg/kg TM	2 500	6 000[d,e]	2 500	6 000
TOC	mg/kg TM	100	200	100	200
KW-Index	mg/kg TM	–	–	5,0	–
Anionenaktive Tenside – MBAS	mg/kg TM	–	–	1,0[m]	–
Gesamtgehalt					
Arsen	mg/kg TM	–	–	50/200[g]	–
Blei	mg/kg TM	150	150/500[f,g]	150/500[f,g]	150/500[f,g]
Cadmium	mg/kg TM	–	–	2,0/4,0[g]	–
Chrom ges.	mg/kg TM	90/300[g]	90/700[g]	300/700[g]	90/700[g]
Cobalt	mg/kg TM	–	–	50[h]	–
Kupfer	mg/kg TM	90/300[g]	90/500[g]	100/500[g]	90/500[g]
Nickel	mg/kg TM	60/100[g]	60[h]	100[h]	60[h]
Quecksilber	mg/kg TM	0,70[i]	0,70[i]	1,0/2,0[g,i]	0,70
Zink	mg/kg TM	450	450	500/1000[g]	450
TOC	mg/kg TM	–	–	30 000	–
KW-Index	mg/kg TM	150[j]	200[j]	150[j]	200[j]

Tabelle B.2 (fortgesetzt)

Parameter	Einheit	Qualitätsklasse					
		U-A	U-B	U-E	H-B	B-B	B-D
Eluat bei L/S 10							
Σ16 PAK (EPA)	mg/kg TM	12,0	20	12,0	20	20	20/300[o]
Benzo(a)pyren	mg/kg TM	–	–	1,2	–	–	–
FL[k]	cm^3/kg	≤ 4	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Rg + X[l]	% der Masse	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1

a Für natürliches, nicht verunreinigtes Gestein gilt der pH-Wertebereich ab 6,5.

b Bei Überschreitung des pH-Wertes und/oder der elektrischen Leitfähigkeit kann bei frischgebrochenen, betonhaltigen Recycling-Baustoffen eine Schnellkarbonatisierung in Anlehnung an die ÖNORM S 2116-3 durchgeführt werden. In diesem Fall hat eine nochmalige Eluatuntersuchung zu erfolgen. Jedenfalls müssen nach der Karbonatisierung die Grenzwerte eingehalten werden. Dies gilt sowohl für den pH-Wert als auch für die elektrische Leitfähigkeit.

c Bei einem pH-Wert zwischen 11,0 und 12,5 beträgt der Grenzwert für die elektrische Leitfähigkeit 200 mS/m.

d Für Recyclingbaustoffe, die mehr als 50 % der Masse Ziegel enthalten, gilt keine Begrenzung.

e Bei einem Ca/SO_4-Verhältnis von ≥ 0,43 im Eluat gilt ein Grenzwert von 8 000 mg/kg TM.

f Bei einem geogen bedingten Gehalt an Blei, der den Wert von 150 mg/kg TM überschreitet, ist der Parameter Blei im Eluat zu bestimmen und ein Grenzwert von 0,3 mg/kg TM einzuhalten.

g Für geogen bedingte Gehalte in Gesteinskörnungen gilt der höhere Wert.

h Für geogen bedingte Gehalte gilt keine Begrenzung.

i Bei Ausbauasphalt ist dieser Parameter nicht anzuwenden.

j Wird der Grenzwert für den KW-Index (C10-C40) aufgrund von bituminösen Anteilen überschritten, so ist dieser Wert für die Beurteilung des Materials nicht maßgeblich, sofern der (flüchtigere) Anteil an C10-C17 75 mg/kg TM bei der Qualitätsklasse U-A und 100 mg/kg TM bei der Qualitätsklasse U-B für den KW-Index nicht überschreitet. In diesem Fall ist im Prüfbericht das Ergebnis für C10-C17 sowie der Asphaltanteil in % der Masse anzugeben. Alternativ ist bei einem Recyclingbaustoff RA (rezykliertes gebrochenes Asphaltgranulat) mit einem Asphaltanteil von mehr als 90 % der Masse der Parameter KW-Index nicht anzuwenden. Stattdessen gilt ein KW-Index im Eluat von 2 mg/kg TM bei der Qualitätsklasse U-A und ein KW-Index im Eluat von 5 mg/kg TM bei der Qualitätsklasse U-B.

k Schwimmendes Material, bestimmt nach dem Stand der Technik.

l Glas und sonstige Materialien, bestimmt nach dem Stand der Technik.

m Auf die Bestimmung des Parameters kann verzichtet werden, wenn von der externen befugten Fachperson oder Fachanstalt begründet werden kann, dass aufgrund der Abfallherkunft bzw. des Entstehungsprozesses des Abfalls kein Verdacht auf eine Verunreinigung mit dem jeweiligen Stoff vorliegt.

n Bei einem Recyclingbaustoff RA (rezykliertes gebrochenes Asphaltgranulat) mit einem Asphaltanteil von mehr als 90 % der Masse ist der Parameter KW-Index nicht anzuwenden.

o Der Grenzwert von 300 mg/kg TM gilt für Gesteinskörnungen (insbesondere Ausbauasphalt), die in eingehausten Heißmischanlagen mit Dämpfeerfassung und -behandlung aus dem Mischprozess eingesetzt werden. Die Dämpfeerfassung und -behandlung muss die Freisetzung von Schadstoffen, insbesondere TOC, KW und PAK, nach dem Stand der Technik verhindern. Das Asphaltmischgut hat den Grenzwert von 20 mg/kg TM einzuhalten.

Recycled building materials of quality class U-A have no prohibitions of use.

A differentiation is made between bound and unbound application / slightly hydraulically bound.

Recycled building materials of quality class H-B may only be used for the production of concrete from strength class C 12/15 or, in the case of strength class C 8/10, from exposure class XC1.

Quality classes U-A, U-B and U-E may also be used for the production of concrete.

Possible raw materials can be found in Table 1 of Annex 1 of the RBV.

Correlation of the quality classes to the areas of use and prohibitions of use:

Qualitätsklasse	Beschreibung	Ungebundene Anwendung[1] ohne gering durchlässige, gebundene Deck- oder Tragschicht	Ungebundene Anwendung[1] unter gering durchlässiger, gebundener Deck- oder Tragschicht	Herstellung von Beton ab der Festigkeitsklasse C 12/15 oder der Festigkeitsklasse C 8/10 ab der Expositionsklasse XC1
U-A (ungebunden – A)	Gesteinskörnungen für den ungebundenen sowie für den hydraulisch oder bituminös gebundenen Einsatz	Ja	Ja	Ja
U-B (ungebunden – B)	Gesteinskörnungen für den ungebundenen sowie für den hydraulisch oder bituminös gebundenen Einsatz	Nein	Ja[2]	Ja
U-E (ungebunden – E)	Gesteinskörnungen für den ungebundenen sowie für den hydraulisch oder bituminös gebundenen Einsatz	Ja[2][3]	Ja[2]	Ja
H-B (für hydraulische Bindung – B)	Gesteinskörnungen ausschließlich zur Herstellung von Beton ab der Festigkeitsklasse C 12/15 oder der Festigkeitsklasse C 8/10 ab der Expositionsklasse XC1	Nein	Nein	Ja

[1] Einschließlich Herstellung von Beton unter der Festigkeitsklasse C 12/15 oder bis zur Festigkeitsklasse C 8/10 unter der Expositionsklasse XC1

[2] Verwendung gemäß § 13 Z 1 (sofern nicht eine wasserrechtliche Bewilligung für den Einsatz des Recycling-Baustoffes vorliegt nicht in Schutzgebieten, nicht in ausgewiesenen Kernzonen von Schongebieten, nicht in ausgewiesenen engeren Schongebieten, nicht im und unmittelbar über dem Grundwasser und nicht in Oberflächengewässern)

[3] Nur im Trapez des Gleiskörpers als Tragschicht (§ 13 Z 4)

Overview map created by ISB:

RBV 2024 - RECYCLED CONSTRUCTION MATERIALS ORDINANCE								
	valid for the following quality classes according to RBV: U-A, U-B, U-E, H-B;							
	C8/10	C12/15	C16/20	C25/30	C30/37	C32/40	C35/45	C40/50
X0	only U-A, U-B, U-E	Yes	Yes	Yes	Yes	Yes	Yes	Yes
XC1				Yes	Yes	Yes	Yes	Yes
XC2				Yes	Yes	Yes	Yes	Yes
XC3					Yes	Yes	Yes	Yes
XC4					Yes	Yes	Yes	Yes
XM1				Yes	Yes	Yes	Yes	Yes
XM2							Yes	Yes
XM3							Yes	Yes
XD1					Yes	Yes	Yes	Yes
XD2					Yes	Yes	Yes	Yes
XD3							Yes	Yes
XA1					Yes	Yes	Yes	Yes
XA2					Yes	Yes	Yes	Yes
XA3							Yes	Yes
XF1					Yes	Yes	Yes	Yes
XF2				Yes	Yes	Yes	Yes	
XF3					Yes	Yes	Yes	
XF4					Yes			

ÖNORM B 3140:2020

With Table 2 this code provides categories for the components of recycled aggregates according to ÖNORM EN 12620:

Material-bezeichnung	Beispiel	Kategorien nach Bestandteilen					
		Rc	*Rc* +*Ru*	*Rb*[a]	*Ra*	*X* + Rg	*FL*
RB-A1	sortenreiner Betonbruch, z. B. im Fertigteilwerk, Betonstraßen	Rc_{90}	Rcu_{95}	Rb_{NR}	Ra_{1-}	XRg_{1-}	$FL_{0,2-}$
RB-A2	Betonbruch	Rc_{90}	Rcu_{NR}	Rb_{NR}	Ra_{10-}	XRg_{1-}	FL_{2-}
RG-A3[b]	wiederaufbereitete, natürliche Gesteinskörnungen, z. B. gebrochener Gleisschotter	Rc_{NR}	Rcu_{95}	Rb_{NR}	Ra_{5-}	XRg_{1-}	$FL_{0,2-}$
RH-B	aufbereiteter Hochbausplitt (mindestens 50 % Betonanteile)	Rc_{50}	Rcu_{70}	Rb_{30-}	Ra_{5-}	XRg_{1-}	FL_{2-}
RMH-C	aufbereitete mineralische Hochbaurestmasse	Rc_{NR}	Rcu_{NR}	Rb_{NR}	Ra_{10-}	XRg_{1-}	FL_{2-}

[a] Masseanteil von glasierter Keramik höchstens 5 %
[b] Masseanteil von *Ru* mindestens 50 %

If recycled, crushed concrete granulate is used for the production of concretes of exposure classes XF2, XF3 and XF4 in accordance with ÖNORM B 4710-1, the old concrete (source material) must also be frost and de-icing salt resistant (XF2 and XF4) or frost resistant (XF3).

The identification of recycled aggregates produced in accordance with ÖNORM EN 12620 consists of:

- the material designation
- the particle size d/D and
- the corresponding quality class

→ Example: RG-A3, 4/16, H-B

ÖNORM EN 206:2021

Table F.1 – "Recommended" limit values for the composition and characteristics of concrete:

	Expositionsklassen																	
	Kein Korrosions- oder Angriffsrisiko	Durch Karbonatisierung verursachte Korrosion				Durch Chloride verursachte Korrosion						Frost-/Tauwechsel				Aggressive chemische Umgebung		
						Meerwasser			Chloride ausgenommen aus Meerwasser									
	X0	XC 1	XC 2	XC 3	XC 4	XS 1	XS 2	XS 3	XD 1	XD 2	XD 3	XF 1	XF 2	XF 3	XF 4	XA 1	XA 2	XA 3
Maximaler w/z-Wert[c]	–	0,65	0,60	0,55	0,50	0,50	0,45	0,45	0,55	0,55	0,45	0,55	0,55	0,50	0,45	0,55	0,50	0,45
Mindest-druckfestig-keitsklasse	C12/15	C20/25	C25/30	C30/37	C30/37	C30/37	C35/45	C35/45	C30/37	C30/37	C35/45	C30/37	C25/30	C30/37	C30/37	C30/37	C30/37	C35/45
Mindest-zement-gehalt[c] (kg/m^3)	–	260	280	280	300	300	320	340	300	300	320	300	300	320	340	300	320	360
Mindestluft-porengehalt (%)	–	–	–	–	–	–	–	–	–	–	–	–	4,0[a]	4,0[a]	4,0[a]	–	–	–
Andere Anforde-rungen	–	–	–	–	–	–	–	–	–	–	–	Gesteinskörnungen nach EN 12620 mit ausreichendem Frost-/ Tauwiderstand				–	Zement mit hohem Sulfat-widerstand [b]	

[a] Falls kein Luftporenbeton verwendet wird, sollten die Betoneigenschaften nach einem geeigneten Prüfverfahren im Vergleich zu Beton, für den der Frost-Tau-Widerstand für die maßgebende Expositionsklasse nachgewiesen ist, geprüft werden.

[b] Wenn Sulfat in der Umgebung zu den Expositionsklassen XA2 und XA3 führt, ist die Verwendung von Zement mit hohem Sulfatwiderstand nach EN 197-1 oder den entsprechenden ergänzenden nationalen Normen unabdingbar.

[c] Bei Anwendung des *k*-Wert-Ansatzes werden der maximale w/z-Wert und der Mindestzementgehalt nach 5.2.5.2 modifiziert.

"Recommendations" for XF2, XF3 and XF4:

- maximum C35/45 for XF2 and XF3
- maximum C30/37 for XF4

"Recommendations" for the use of coarse recycled aggregates:

- Use of coarse recycled aggregates with d ≥ 4 mm
- Table E.2 contains the maximal limit values for the replacement of natural normal aggregates by coarse recycled aggregates depending on the exposure classes:

Typ der rezyklierten Gesteinskörnung	Expositionsklassen			
	X0	XC1, XC2	XC3, XC4, XF1, XA1, XD1	Alle anderen Expositionsklassen[a]
Typ A: (Rc_{90}, Rcu_{95}, Rb_{10}, Ra_{1}, FL_{2}, XRg_{1})	50 %	30 %	30 %	0 %
Typ B [b]: (Rc_{50}, Rcu_{70}, Rb_{30}, Ra_{5}, FL_{2}, XRg_{2})	50 %	20 %	0 %	0 %

[a] Der Anteil an rezyklierten Gesteinskörnungen vom Typ A mit bekannter Herkunft darf bei Expositionsklassen, für die der ursprüngliche Beton entworfen worden war, bis zu 30 % der Gesamtmenge der Gesteinskörnung betragen.

[b] Rezyklierte Gesteinskörnungen vom Typ B sollten nicht in Beton mit einer Druckfestigkeitsklasse > C30/37 verwendet werden.

Table E.3 – “Recommendations” for coarse recycled aggregates according to EN 12620:

Eigenschaft[a]	Abschnitt in EN 12620:2002+A1:2008	Typ	Kategorie nach EN 12620
Gehalt an Feinanteilen	4.6	A + B	Kategorie oder anzugebender Wert
Plattigkeitskennzahl	4.4	A + B	≤ FI_{50} oder ≤ SI_{55}
Widerstand gegen Zertrümmerung	5.2	A + B	≤ LA_{50} oder ≤ SZ_{32}
Kornrohdichte (ofentrocken) ρ_{rd}	5.5	A	≥ 2 100 kg/m^3
		B	≥ 1 700 kg/m^3
Wasseraufnahme	5.5	A + B	Anzugebender Wert
Bestandteile [b]	5.8	A	Rc_{90}, Rcu_{95}, Rb_{10-}, Ra_{1-}, FL_{2-}, XRg_{1-}
		B	Rc_{50}, Rcu_{70}, Rb_{30-}, Ra_{5-}, FL_{2-}, XRg_{2-}
Gehalt an wasserlöslichem Sulfat	6.3.3	A + B	$SS_{0,2}$
Gehalt an säurelöslichem Chloridionen	6.2	A + B	Anzugebender Wert
Einfluss auf den Erstarrungsbeginn	6.4.1	A + B	≤ A_{40}

[a] Kategorie NR (keine Anforderung) gilt für alle anderen Eigenschaften, die nicht in dieser Tabelle aufgeführt sind und für die eine Kategorie NR nach EN 12620 angegeben werden kann.

[b] Für besondere Anwendungen, die eine hochwertige Oberflächenbeschaffenheit erfordern, sollte der Bestandteil *FL* auf die Kategorie $FL_{0,2-}$ begrenzt werden.

Overview map created by ISB:

ÖNORM EN 206:2021

	C8/10		C12/15		C16/20		C25/30		C30/37		C32/40		C35/45		C40/50	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
X0	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	0%	50%	0%	50%	0%
XC1							30%	20%	30%	20%	30%	0%	30%	0%	30%	0%
XC2							30%	20%	30%	20%	30%	0%	30%	0%	30%	0%
XC3									30%	0%	30%	0%	30%	0%	30%	0%
XC4									30%	0%	30%	0%	30%	0%	30%	0%
XM1							0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XM2													0%	0%	0%	0%
XM3													0%	0%	0%	0%
XD1									30%	0%	30%	0%	30%	0%	30%	0%
XD2									0%	0%	0%	0%	0%	0%	0%	0%
XD3													0%	0%	0%	0%
XA1									30%	0%	30%	0%	30%	0%	30%	0%
XA2									0%	0%	0%	0%	0%	0%	0%	0%
XA3													0%	0%	0%	0%
XF1									30%	0%	30%	0%	30%	0%	30%	0%
XF2							0%	0%	0%	0%	0%	0%	0%	0%		
XF3									0%	0%	0%	0%	0%	0%		
XF4									0%	0%						

ÖNORM B 4710-1:2018

According to this code only one type (e.g. RB-A1 or RG-A3) of recycled aggregate may be used within a concrete type. Mixing several types in one type of concrete is not permitted.

If recycled aggregates are used (>5% of the aggregate mass), this must be indicated in the concrete type denomination (e.g. C16/20/XC1/F52/GK22/RB-A1).

The use of recycled aggregates of types RB-A1, RB-A2 and RG-A3 is only permitted for concrete if all the following points are fulfilled at the same time:

- non-pre-stressed components
- components not subject to fatigue
- Compressive strength class < C40/50
- Components without driving attack (XAT)
- with low alkali input and low moisture penetration

In addition, the use of concrete with recycled aggregates of type RH-B is only permitted if all the following points are fulfilled at the same time:

- For use in dry conditions (e.g. concrete in buildings with low humidity and/or building components with suitable insulation)
- Compressive strength class < C30/37
- Components that are mainly subjected to compressive stress (excluding compressive stress due to prestressing), e.g. walls, columns, arches, vaults.

Fine aggregates:

- Fine recycled aggregates may only be used for concrete production in the case of wet processing. The proportion < 0.063 mm must be limited to 3% of the mass (f3) of the fine aggregate. Other processing methods are permitted if their suitability is proven.
- When using fine recycled aggregates, care must be taken to ensure that the water requirement varies only slightly.
- The addition of fine recycled aggregate when using natural or recycled aggregate mixtures (e.g. 0/16) is not permitted.

- Fine recycled aggregates with maximum particle size D ≤ 2 mm are not permitted, as a meaningful classification is not possible.

Aggregate mixtures:

- Aggregate mixtures from recycled aggregates must be verifiably composed of separately processed fractions (the fractions 0/1 and 0/2 are not permitted for this purpose).
- When using grain mixtures made from recycled aggregates, the specifications in Table 12 of this ÖNORM EN 4710-1 must be respected.

Table E.3 defines the maximum mass percentages of replacement of coarse aggregates, fine aggregates and aggregate mixtures by recycled coarse aggregates, fine aggregates and aggregate mixtures in relation to its type and exposure class in performance-guaranteed concrete:

Tabelle E.3 — Grenzwerte für den Austausch von natürlichen Gesteinskörnungen durch rezyklierte Gesteinskörnungen in Abhängigkeit der Expositionsklassen (in Relativ-% der Masse)

Materialbezeichnung der rezyklierten Gesteinskörnung gemäß ÖNORM B 3140	Gesteinskörnung	Expositionsklassen																			
		X0[a]	XC1	XC2	XC3	XC4	XF1	XF2[b]	XF3[b]	XF4[b]	XD1	XD2	XD3[b]	XW1	XW2	XA1[c]	XA2	XA3	XM1	XM2	XM3
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
RB-A1	Grob	50	50	50	50	50	50	30	30	30	50	30	30	50	50	50	0	0	30	0	0
	Fein[d]	25	25	25	25	25	25	15	15	15	25	15	15	25	25	25	0	0	0	0	0
	Korngemisch[d]	38	38	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RB-A2	Grob	50	50	50	50	30	0	0	0	0	0	0	0	50	30	0	0	0	0	0	0
	Fein[d]	25	25	25	25	15	0	0	0	0	0	0	0	25	15	0	0	0	0	0	0
	Korngemisch[d]	38	38	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RG-A3	Grob	50	50	50	50	50	50	30	30	30	50	30	30	50	50	50	0	0	30	0	0
	Fein[d]	25	25	25	25	25	25	15	15	15	25	15	15	25	25	25	0	0	15	0	0
	Korngemisch[d]	38	38	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RH-B	Grob	50[e]	35[e]	35[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fein[d]	25[e]	20[e]	20[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Korngemisch[d]	38[e]	25[e]	25[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Overview map created by ISB:

ÖNORM B 4710-1:2018

	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine[d]	Aggregate mixtures[d]	coarse	fine[d]	Aggregate mixtures[d]	coarse	fine[d]	Aggregate mixtures[d]	coarse	fine[d]	Aggregate mixtures[d]
X0[a]	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%[e]	25%[e]	38%[e]
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%[e]	20%[e]	25%[e]
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%[e]	20%[e]	25%[e]
XC3	50%	25%	0%	50%	25%	0%	50%	25%	0%	0%	0%	0%
XC4	50%	25%	0%	30%	15%	0%	50%	25%	0%	0%	0%	0%
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XM3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XD1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XD2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XD3[b]	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XA1[c]	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XA2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XA3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XF1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XF2[b]	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF3[b]	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF4[b]	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%

Additional regulations:

[a] Ein erhöhter Austausch ist zulässig:bei den Typen RB-A1, RB-A2 und RG-A3:
– bis zu 100 % bei groben Gesteinskörnungen bei Beton ≤ C16/20,
– bis zu 100 % bei feinen Gesteinskörnungen und Korngemischen bei Beton ≤ C8/10,
– bis zu 75 % bei feinen Gesteinskörnungen und Korngemischen bei Beton ≤ C12/15;
bei Typ RH-B:
– bis zu 75 % bei groben Gesteinskörnungen bei Beton ≤ C16/20,
– bis zu 75 % bei feinen Gesteinskörnungen und Korngemischen bei Beton ≤ C8/10,
– bis zu 70 % bei feinen Gesteinskörnungen und Korngemischen bei Beton ≤ C12/15.

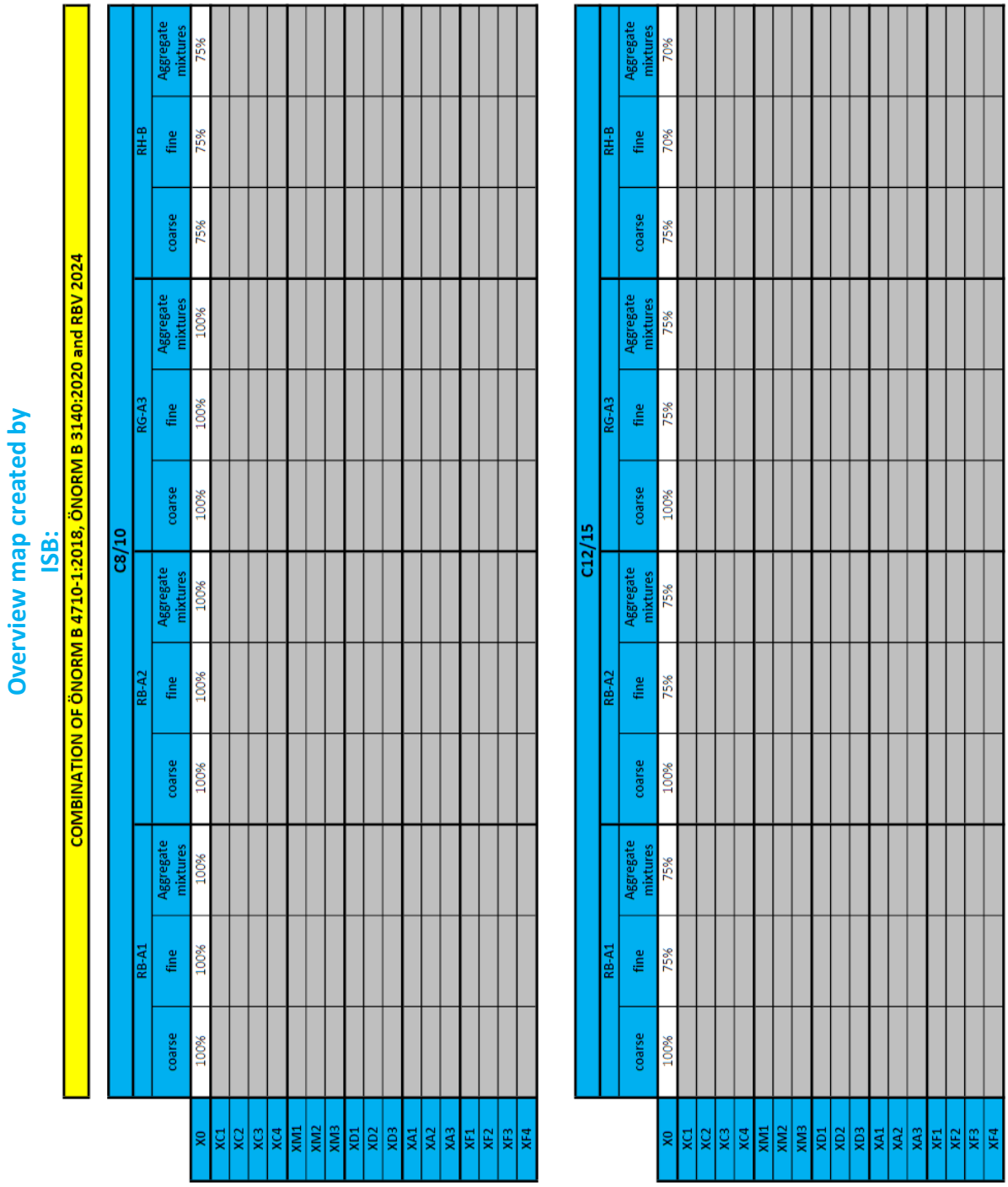
[b] Die rezyklierte Gesteinskörnung darf nur verwendet werden, wenn der ursprüngliche Beton nachweislich auch dieser Expositionsklasse entsprochen ha

[c] Bei treibendem Angriff (XAT) ist die Zugabe nicht zulässig.

[d] Bei Betonen mit GK ≤ 8 mm und mit rezyklierten Gesteinskörnungen sind diese maximal zulässigen Zugabemengen um 50 % zu reduzieren.

[e] Nur bei Anwendung im Trockenen und den weiteren Einschränkungen gemäß E.1 (9).

COMBINATION OF ÖNORM B 4710-1:2018, ÖNORM B 3140:2020 AND RBV



Overview map created by ISB:

	C16/20											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	100%	25%	38%	100%	25%	38%	100%	25%	38%	75%	25%	38%
XC1												
XC2												
XC3												
XC4												
XM1												
XM2												
XM3												
XD1												
XD2												
XD3												
XA1												
XA2												
XA3												
XF1												
XF2												
XF3												
XF4												

	C25/30											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%	25%	38%
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC3												
XC4												
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2												
XM3												
XD1												
XD2												
XD3												
XA1												
XA2												
XA3												
XF1												
XF2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF3												
XF4												

Overview map created by ISB:

	C30/37											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%	25%	38%
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC3	50%	25%	0%	50%	25%	0%	50%	25%	0%	0%	0%	0%
XC4	50%	25%	0%	30%	15%	0%	50%	25%	0%	0%	0%	0%
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2												
XM3												
XD1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XD2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XD3												
XA1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XA2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XA3												
XF1	50%	15%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XF2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF3	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF4	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%

	C32/40											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%	25%	38%
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC3	50%	25%	0%	50%	25%	0%	50%	25%	0%	0%	0%	0%
XC4	50%	25%	0%	30%	15%	0%	50%	25%	0%	0%	0%	0%
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2												
XM3												
XD1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XD2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XD3												
XA1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XA2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XA3												
XF1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XF2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF3	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF4												

Overview map created by ISB:

	C35/45											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%	25%	38%
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	35%	20%	25%
XC3	50%	25%	0%	50%	25%	0%	50%	25%	0%	0%	0%	0%
XC4	50%	25%	0%	30%	15%	0%	50%	25%	0%	0%	0%	0%
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XM3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XD1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XD2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XD3	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XA1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XA2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XA3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XF1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XF2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF3	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XF4												

	C40/50											
	RB-A1			RB-A2			RG-A3			RH-B		
	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures	coarse	fine	Aggregate mixtures
X0	50%	25%	38%	50%	25%	38%	50%	25%	38%	50%	25%	38%
XC1	50%	25%	38%	50%	25%	38%	50%	25%	38%	0%	20%	25%
XC2	50%	25%	38%	50%	25%	38%	50%	25%	38%	0%	20%	25%
XC3	50%	25%	0%	50%	25%	0%	50%	25%	0%	0%	0%	0%
XC4	50%	25%	0%	30%	15%	0%	50%	25%	0%	0%	0%	0%
XM1	30%	0%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XM2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XM3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XD1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XD2	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XD3	30%	15%	0%	0%	0%	0%	30%	15%	0%	0%	0%	0%
XA1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XA2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XA3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
XF1	50%	25%	0%	0%	0%	0%	50%	25%	0%	0%	0%	0%
XF2												
XF3												
XF4												

COMPARISON AND ANALYSIS

The Italian codes are characterized by a clear but partly limited structure. Italy is one of the only countries where the codes are also laws.

Austria offers a wider and more strictly regulated system of codes. But it is more difficult to understand all the requirements and areas of application of the quality classes.

MAXIMUM EXCHANGE PERCENTAGES OF NATURAL AGGREGATES WITH RECYCLING AGGREGATES

Note	Type A (Italy) = RB-A1 and RB-A2 (Austria) Type B (Italy) = RH-B (Austria)

CONCRETE TYPE	TYPE OF AGGREGATES	ITALY	AUSTRIA
C8/10 X0	Coarse aggregates	100% Type A	100% RB-A1, RB-A2
		100% Type B	75% RH-B
	Fine aggregates	not determined, but allowed	100% RB-A1, RB-A2
			75% RH-B
	Aggregate mixtures	not determined	100% RB-A1, RB-A2
			75% RH-B
C12/15 X0	Coarse aggregates	60% Type A	100% RB-A1, RB-A2
		0% Type B	75% RH-B
	Fine aggregates	not determined, but allowed	75% RB-A1, RB-A2
			70% RH-B
	Aggregate mixtures	not determined	75% RB-A1, RB-A2
			70% RH-B
C25/30 XC2	Coarse aggregates	30% Type A	50% RB-A1, RB-A2
		0% Type B	35% RH-B
	Fine aggregates	not determined, but allowed	25% RB-A1, RB-A2
			20% RH-B
	Aggregate mixtures	not determined	38% RB-A1, RB-A2
			25% RH-B
C30/37 XC3	Coarse aggregates	30% Type A	50% RB-A1, RB-A2
		0% Type B	0% RH-B
	Fine aggregates	not determined, but allowed	25% RB-A1, RB-A2
			0% RH-B
	Aggregate mixtures	not determined	0% RB-A1, RB-A2
			0% RH-B
C32/40 XC4	Coarse aggregates	20% Type A	50% RB-A1, 30% RB-A2
		0% Type B	0% RH-B
	Fine aggregates	not determined, but allowed	25% RB-A1, 15% RB-A2
			0% RH-B
	Aggregate mixtures	not determined	0% RB-A1, RB-A2
			0% RH-B
C40/50 XC4	Coarse aggregates	20% Type A	50% RB-A1, 30% RB-A2
		0% Type B	0% RH-B
	Fine aggregates	not determined, but allowed	25% RB-A1, 15% RB-A2
			0% RH-B
	Aggregate mixtures	not determined	0% RB-A1, RB-A2
			0% RH-B

ITALY

- There are clear regulations for coarse aggregates (Type A and Type B) with maximum percentages according to UNI 8520-2:2022, UNI 11104:2016 and NTC 2018.
- The code UNI 8520-2:2022 states that fine recycling aggregates are permitted if certain parameters are achieved, but all other codes do not specify any maximum percentages etc.
- Aggregate mixtures are not mentioned.
- Only Dosing concrete up to strength class C 8/10 can be produced with coarse recycling aggregates of Type B. Normal lean concrete with strength class C12/15 can only be produced with Type A, and that also only up to a maximum replacement of 60%.
- Other standard concretes can only be produced with a maximum replacement of 20-30% and only by coarse recycled aggregates of Type A.
- Recycled content (up to 10-15%) is allowed in in precast concrete elements if the concrete has the same or lower class than the old concrete.
- CAM requires a recycled content (at least 5%) for public construction projects, which promotes sustainable use.
- An external certification by an Accredia-approved laboratory is needed for the recognition of recycled material content in concrete (EPD, UNI PdR 88:2020 or certification in accordance with ISO 14021).

AUSTRIA

- The RBV 2024 regulates the areas of application for recycled building materials of the individual quality classes.
- Recycled building materials of quality class H-B may only be used for the production of concrete from strength class C 12/15 or, in the case of strength class C 8/10, from exposure class XC1. Quality classes U-A, U-B and U-E may also be used for the production of concrete.
- With Table 2 the code ÖNORM B 3140:2020 provides categories for the components of recycled aggregates: RB-A1, RB-A2, RG-A3 and RH-B.

- If recycled, crushed concrete granulate is used for the production of concretes of exposure classes XF2, XF3 and XF4, the old concrete (source material) must also be frost and de-icing salt resistant (XF2 and XF4) or frost resistant (XF3).
- According to the code ÖNORM B 4710-1:2018 only one type (e.g. RB-A1 or RG-A3) of recycled aggregate may be used within a concrete type. Mixing several types in one type of concrete is not permitted.
- Many requirements are defined for the individual categories when using recycled aggregates in concrete (e.g. which components can be built with them or maximum compressive strength classes)
- Fine recycled aggregates may only be used for concrete production in the case of wet processing. The proportion < 0.063 mm must be limited to 3% of the mass of the fine aggregate.
- Also recycled aggregate mixtures are allowed.
- ÖNORM B 4710-1:2018 defines clearly the maximum mass percentages of replacement by recycled coarse aggregates, fine aggregates and aggregate mixtures in relation to its type and exposure class in performance-guaranteed concrete.
- Dosing concrete and normal lean concrete up to strength class C12/15 can be produced with high replacement percentages of all aggregate types and categories (70-100%).
- For concrete of class C25/30 XC2, all aggregate types and categories are still permitted (20-50%).
- Beginning with concrete of class C30/37 XC3, only the categories RB-A1 and RB-A2 are permitted. 50% for coarse aggregates and 25% for fine aggregates. Aggregate mixtures are no longer permitted.
- Lack of environmental standards (such as CAM in Italy).

CONCLUSION: WHICH COUNTRY HAS MORE OPPORTUNITIES FOR THE USE OF RECYCLING AGGREGATES?

Austria has more possibilities for using recycled aggregates in concrete due to its flexible and detailed classification system, which allows higher replacement percentages in various strength classes. Italy has stricter regulations, limiting the use of recycled aggregates, especially in higher-strength concrete. Technically, Austria is more advanced because of its structured quality classes and specific guidelines for different exposure conditions, ensuring the durability of recycled materials (e.g. frost resistance). A key difference is the treatment of fine recycled aggregates. In Italy, they are allowed but generally not regulated in most codes, whereas Austria permits them only when wet-processed and limits the fraction below 0.063 mm to 3% of the total fine aggregate mass. Italy, however, has clearer and more straightforward regulations, making compliance easier. In terms of sustainability, Italy is ahead due to its CAM requirements, which mandate a minimum recycled content in public construction projects. Austria lacks similar environmental regulations, focusing more on technical aspects rather than sustainability targets. Additionally, Italy requires external certification for recycled materials, ensuring traceability and environmental compliance. Austria allows mixed recycled aggregates, while Italy does not explicitly address them. The Austrian approach offers more flexibility for concrete producers, while the Italian system ensures stricter environmental and quality control. Overall, Austria provides more technical opportunities, but Italy promotes sustainability more effectively.

TECHNICAL QUESTIONS

MATERIAL CHARACTERIZATION AND TESTS

- How can fine recycling aggregates (<4 mm) be efficiently integrated into concrete applications?
- Which test methods are most effective to ensure the long-term durability of recycled aggregates in concrete?
- How can the frost/de-icing salt resistance of recycled aggregates be reliably proven or improved?
- How can rapid and cost-effective tests for contaminant levels and material quality be developed?

RECYCLING PROCESS

- How can the sorting purity of recycled aggregates be improved, especially for mixed construction waste?
- Which technologies could be more efficient to clean fine aggregates through wet processing and remove contaminants?

PROCESSING AND MIXING

- What mixing proportions are optimal to both maximize recycled content and ensure compressive strength?
- How do recycled aggregates affect the rheological properties of fresh concrete and what adjustments are required?

ENVIRONMENT AND SUSTAINABILITY

- How can life cycle analyses for recycled concrete be standardized to make the environmental benefits transparent?
- What modifications are required to transfer CAM standards to private construction projects?

CODES AND REGULATIONS

- How could national codes be better harmonized with EN 206 to simplify international projects?

PROBLEM AREAS

CODES AND REGULATONS

- The lack of harmonization between international (e.g. EN codes) and national regulations makes cross-border projects more difficult and differences in exposure classes and compressive strength requirements make the cross-border use of recycled concrete more difficult and can lead to confusion.

QUALITY ASSURANCE

- The material quality of recycled aggregates varies significantly, especially from unknown sources. This makes it difficult to achieve consistent concrete quality.
- Current codes restrict mixtures of different recycled aggregates in Austria (e.g. no mixing of RG and RB types). These restrictions could limit flexibility and marketability.

COSTS AND AVAILABILITY

- Recycled building materials are often more expensive to process than natural aggregates, which reduces their market acceptance.
- Not all regions have sufficient processing plants, which limits their use regionally.

FINES AND WATER REQUIREMENT

- Recycled fine aggregates increase the water requirement of concrete mixtures, which has a negative impact on the fresh concrete properties.
- The variability of fine aggregates makes process control difficult, especially in industrial applications.
- Italian codes take insufficient account of fine aggregates, which limits their use.

LONG-TERM BEHAVIOR

- There is insufficient data on ageing processes and possible chemical reactions between recycled aggregates and cement matrix (e.g. alkali-silica reaction).
- The frost and de-icing salt resistance of concrete with recycled aggregates is not sufficiently documented in all exposure classes.

ACCEPTANCE ON THE MARKET

- Architects, construction companies and end consumers are often skeptical about the use of recycled materials, which limits their use.

OPPORTUNITIES FOR OPTIMIZATION

CODES AND REGULATONS

- Harmonization of codes and unified standards for exposure classes and maximum replacement percentages. One solution could be an EU-wide code for recycling aggregates that supplements national specifics.
- Extended approval tests: Inclusion of specific tests for fine aggregates and mixed aggregates. Standardized testing procedures for the qualification of recycled aggregates, especially for fine aggregates.

TECHNICAL INNOVATIONS

- Hydrophobization: Development of technologies that reduce the water absorption of fine aggregates.
- Thermal treatment: Use of heat to remove pollutants from recycled aggregates and improve mechanical properties.
- There is a need for research into the development of chemical additives that stabilize the fine aggregates.

EXTENSION OF APPLICATIONS

- Development of specific concrete classes for non-load-bearing components with a high recycled content.
- Introduction of prototypes for recycled concrete in innovative construction projects in order to establish the material.

DIGITALIZATION AND QUALITY ASSURANCE

- Use of AI and sensor technology for real-time monitoring of material quality in concrete production.

- Automated sorting systems for recycled aggregates could improve sorting purity.

ECONOMIC INCENTIVES

- Tax reliefs or subventions for companies that use recycled concrete.
- Introduction of a “green bonus” for construction projects that use a high percentage of recycled concrete.
- Sustainability incentives and sustainability as a standard: Mandatory requirements for minimum recycled content in Austria, similar to the CAM requirements.

LONG-TERM STUDIES AND CERTIFICATION

- Establishment of Europe-wide long-term monitoring of buildings with recycled concrete in order to collect data on durability.
- Introduction of an EU-wide certification system for recycled building materials to promote acceptance and quality.

PROMOTION OF SUSTAINABILITY GOALS

- Definition of binding recycling quotes for private construction projects, as prescribed by CAM for public projects.
- Development of indicators to measure CO_2 reduction through recycled concrete.

EDUCATION AND SENSIBILIZATION

- Training courses and workshops for architects and construction companies to introduce the benefits and correct use of recycled aggregates.
- Educating the public about the environmental benefits of recycled concrete.