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Secondary raw material markets in the C&D sector: Study on user acceptance in southwest Germany

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This empirical study analyses the acceptance of RC materials in Germany particularly of private awarding authorities in their private construction project(s). In 41 structured interviews, data is collected and evaluated based on hypotheses.

Qualitative and quantitative analyses show that acceptance problems cannot be stated. How-ever, medium knowledge and low experience with RC construction materials as well as communication problems are identified. The respondents have no concerns and tend to trust in RC construction materials, but this is decreasing with the increased structural importance of the materials. Surprisingly, quality is the most frequently mentioned decision criteria in private construction projects, followed by cost. Private awarding authorities see no increase of their property value by using RC construction materials. And, the majority is unwilling to pay a premium for RC construction materials. Higher material quality standards, regular government reviews and financial support are seen conducive.

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Key words: recycling construction materials; C&D sector; secondary raw materials; acceptance; private awarding authorities

Abstract

In industrialized countries, regulations demand increasingly higher recycling (RC) rates and many efforts are undertaken to recycle construction and demolition (C&D) waste fractions. The C&D sector has indisputable relevance due to the highest mineral waste fraction, high numbers of employees and turnovers. High-quality RC construction products can be produced to substitute primary resources and reduce land use.

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1 Introduction

In Germany, a high annual waste stream of 208[1] million tons resulted from the construction and deconstruction (C&D) sector in 2015 and is constituting 51.7% of the total annual waste generation (equals 2.5 per capita) (destatis (2015; 2017a,b)). About 25% origins in debris from demolished buildings and infrastructure, whereas ca. 60% are excavated material and ca. 7% are road construction wastes (Basten (2017), p.6).

To intensify efforts in resource efficiency and circular economy until 2020, EU member states aim at recycling rates of 50 wt.% for paper, metal, plastics and glass and a recycling rate of 70 wt.% for mineral C&D waste fractions (European Parliament and Council (2008), EU Commission (2015)) and harmonised marketing of construction products (European Parliament and Council, 2011).[2]

Although in countries like Germany the C&D waste material recycling[3] rate is high (89%) (Destatis (2017b)), the down-cycling[4] problem (Knoeri et al., 2011, p.1039, Basten, 2017, p. 12) remains, where about three quarters of the recycled aggregates flow to road construction or earth works. Despite the various fields of application of RC building materials in building construction (BMIBH and BMV, 2015), the high construction activity (Table 6) and demand for primary building materials and the high waste intensity index remains.

Stakeholders in C&D sector are clients and owners (awarding authorities), planners (such as architects and civil engineers), construction supervisors, construction and demolition companies, recycling and processing companies, landfill operators, public authorities and institutions of research and education. Decisive stakeholders with respect to resource efficiency in the C&D sectors are private, commercial or public awarding authorities and planners as they decide on applied materials and building products in all stages of building life cycle (Knoeri et al. 2011, p.1041; Bilitewski and Härdtle, 2013). As well, awarding authorities are decisive in demolition projects (Meetz et. al., 2015), as they create waste fractions and decide on their further destiny.

Private awarding authorities are responsible for the majority of residential construction in Germany (Figure 4) and planned in 2017 to invest 5.3 billion €[5] (annual value) (Figure 5) that equals 47% of the total investment in residential buildings per year. 61% is dedicated to new construction projects (Figure 4). Furthermore, Lu et al. (2016) show for Hong Kong that private construction projects have a considerably worse C&D waste management than public projects (Lu et al. 2016).

[1] The relative share of the C&D waste fraction lowered since 2000 from 64% to 52% (UBA (2018b)). The total amount decreased from 261 million tons in 2000 (64%) to 185 million tons in 2005 (55% share), but then increased again to 208 million tons in 2015 (52%).

[2] In annex I section 7, the regulation specifically indicates the “sustainable use of natural resources”. “The construction works must be designed, built and demolished in such a way that the use of natural resources is sustainable and in particular ensure the following: (a) reuse or recyclability of the construction works, their materials and parts after demolition; (b) durability of the construction works; (c) use of environmentally compatible raw and secondary materials in the construction works.” (European Parliament and Council, 2011). This has to be considered and respected by awarding authorities, planners, clients and owners in Europe.

[3] Recycled C&D waste or recycled construction materials/products are construction materials from processed C&D waste that are quality controlled and are partly officially accredited under EU-BauproduktenVO (EU-BauPV, EU No. 305/2011 from 9. March 2011) by an industry standard (e.g. DIN 4226-101/102:2017-08 following previous DIN EN 12620 for concrete aggregates).

[4] Definition: Use of processed C&D waste fractions in road construction, dams, fillings, etc. instead of the original use, e.g. in buildings.

[5] Furthermore, private awarding authorities invest 0.44 billion € in non-residential buildings (according to the planned cost of the permits in Baden-Württemberg in 2017). But this constitutes only 3% of the investment in non-residential buildings.

Due to the high influence of private awarding authorities on construction works in buildings and the resulting mass flows, this study focuses on their attitudes as potential customers of RC construction materials, aggregates and products[6] in their new or retrofit structural engineering projects. Especially, the priorities in decision making, the influence, the willingness to act or pay, the resentments (either due to ignorance or skepticism) and barriers (such as lack of information, for example) of private clients, private owners, private households and private investors (in the following summarized with the term "private awarding authorities" according to Knoeri et al. 2011) regarding resource efficiency in the C&D sector has not been investigated in detail yet.
The paper is structured as follows. A review of related literature is presented (chapter 2). Then, the applied methodology and research design is explained and the data and its generation is described (chapter 3). This is followed by the data analysis and results (chapter 4) and concluded (chapter 5).

2 Definition of acceptance and literature review

2.1 Definition of acceptance

Acceptance is often used as a general description for valuating something positively and for not rejecting it (Schweizer-Ries 2008, Wüstenhagen et al. 2007). In this paper, we define acceptance for a product in a technical context as the characteristic of an innovation that induces positive reactions from the affected people (Endruweit, 2002, p. 6.), as positive approval decision of a (technical product) innovation by the users (Dethloff, 2004) and as an active willingness to adopt a product or an idea instead of passive tolerance (Dethloff, 2004). Furthermore, acceptance is not only positive appraisal, but rather a willingness to act (Lucke, 1995; Dethloff, 2004, Schweizer-Ries et al., 2008). Especially, the use of a product is a decisive factor of acceptance of new products or technologies (Dethloff, 2004) and allows assessment e.g. by usage frequency.
Socio-economic studies show that the direct relation of environmental concern/ awareness and environmental behaviour is only weak (Kuckartz, 1998; Bamberg, 2003) and that environmental concern does not necessarily directly influence situation-specific behaviour. For some products, consumers are willing to pay a reasonable premium for environmentally friendly products (Laroche et al. 2001). Furthermore, context factors like the social, cultural, financial and organisational environment, the society as a whole as well as the way of the introduction of an innovation influence technical acceptance genesis (Schäfer and Keppler, 2013). Similarly, to the definition of Schweizer-Ries (2008), p. 4130), acceptance of RC construction materials can be seen as a complex construct, which is not a purely individual characteristic, but the constantly changing result of a social valuation process.

2.2 Review of acceptance studies in the C&D sector

A research with the key words "acceptance study construction waste recycling" (resp. "acceptance study demolition waste recycling") in the science-direct research database resulted

[6] In the following, the term "RC construction materials" are used to summarize recycled construction materials, recycled aggregates and recycled construction products. Also these three terms are used synonymously.

in more than 5,600[7] (resp. almost 700[8]) results. Thereof, 3,024 (resp. 382) research articles were found.

Many studies review the current state of the art recycling technology or situation in their countries regarding RC materials from C&D waste either in general, in geotechnical or civil engineering applications (e.g. Cardoso et al. 2016; Lu et al. 2016, Silva et al. 2017, Menegaki and Damigos 2018). They analyse technical issues, as well as factors, barriers and motivations that influence the generation and management of C&D waste and RC aggregates. However, they neglect the stakeholders without considering, surveying or analysing their information status, willingness and decision making.

Only some papers deal with stakeholders, decision making of building owners or public entities that act as clients in the context of C&D waste recycling as well as with empirical studies on stakeholder perception and expectation of C&D waste recycling and reuse. Publications in this field are very sparse and reviewed in the following (Table 1):

Knoeri et al. analyse stakeholder decisions regarding recycled mineral construction materials. They surveyed 414 stakeholders of the Swiss construction industry. Thereof, 50 respondents belong to the group of private awarding authorities. They found that the stakeholder interactions are most influential in decision making, even more than the original project specification (Knoeri et al., 2011). Private awarding authorities followed mainly (63-71%) architects' recommendations for conventional materials and preferred them in the final tender selection (87-93%) (Knoeri et al. p.1043). They also showed that engineers' material recommendations are mainly influenced by law, standards and experience (Knoeri et al. 2011, p.1049).

By unstructured stakeholder interviews, Knappe et al (2012) identified barriers for system change in the German C&D industry, as well as the interaction and mutual influence as a key point. Also, they state lacking impulses from industry and lacking knowledge and experience of planners and awarding authorities that lead to low acceptance. Many measures are proposed to increase sustainability or resource efficiency[9], but are not evaluated regarding the size of their reinforcing and mitigating impacts (Knappe et al. 2012).

By unstructured interviews and a quantitative questionnaire, Oyedele et al. (2014) rank hampering factors and propose improvement strategies for the use of RC construction products in UK. They found that designers rarely specify RC products due to lacking information on quality and availability, negative general perception from clients, high cost and perceived low quality. However, they do not evaluate the impact of the proposed strategies and focus on designers and contractors instead of awarding institutions.

In a preliminary survey, Ankrah et al. (2015) questioned commercial tenants with respect to cradle-to-cradle concepts. Particularly interesting are the categories "conversion of waste to beneficial resource" and "facilitated exchange of materials and services amongst users" that are particularly related to commercial building or infrastructure stock.

Freire et al. (2016) present questionnaire results for three Portuguese public entities and potential users of (C&DRM) in civil engineering to explore the types and quantities of C&D RC material produced/used, its main characteristics and fields of application. It is not representative, but Freire et al. conclude that C&D waste recycling is hampered by lack of acceptance

[7] In this search, the main share of the articles is published in the following journals: Journal of Cleaner Production (349; 12%), Waste Management (176; 6%), Resources, Conservation and Recycling (153; 5%), Energy Policy (133, 4%) and Construction and Building Materials (84; 3%).

[8] In this search, the main share of the articles is published in the following journals: Waste Management (57, 15%), Resources, Conservation and Recycling (50; 13%), Journal of Cleaner Production (47; 12%), Construction and Building Materials (28; 7%), Energy Policy (10; 3%) and Building and Environment (10; 3%).

[9] e.g. by pilot buildings, change price structure and competition with primary aggregates, obligatory quality control of RC material, improved selection of materials onsite by regulation, better information during tender processes, restrictiveness in backfilling of excavations.

and of “knowledge and awareness among designers and labour inspectorate” (Freire et al. 2016).
Jin et al. investigate on the current status of C&D waste and RC construction material in China (Jin et al. 2017). They review governmental policies and existing applications and perform a survey among stakeholders involved in C&D waste management. Jin et al. found that governmental policies, guidelines and strategies as well as client demands, available standards, waste classifications and early communication in projects were perceived as key issues in implementing C&D waste management in China (Jin et al. 2017, p.95f.). However, they do neglect private, commercial and public awarding authorities and do not distinguish between structural and civil construction.
Müller et al. identify relevant stakeholders, their characteristics and preferences as well as their level of influence in Germany (Müller et al., 2017). By intensive literature review, surveys and expert interviews, they investigate on resource-conserving measures concerning the C&D sector and the influence of measures on stakeholders as well as their willingness to take positive actions in terms of a circular economy (Müller et al., 2017). According to Müller et al., lifecycle oriented planning of buildings as well as the development of stakeholder cooperation are the most effective measures to save resources and to reduce the disposal of construction material. Furthermore, public authorities have a leading role to foster a circular economy (Müller et al., 2017).
Ajayi and Oyedele (2017) explore practitioners’ viewpoints on effective policies for minimising waste landfilled by C&D industry in UK in a twostep focus group discussion and questionnaire with 24 resp. 63 experts. They identified six key policy measures to divert C&D waste from landfill. However, they do not consider awarding authorities (Ajayi and Oyedele (2017), p. 60).

2.3 Conclusion of literature review

Until now, the social, economic, political and technical factors influencing the mechanisms of stock accumulation and removal within urban areas are not considered fully yet (Augiseau and Barles (2017), p. 163). In every C&D project, many stakeholders are involved with their differing objectives and diverging interests. Key stakeholders are decision makers (private, commercial and public awarding institutions) and planners (architects and engineers). But, especially the attitude and impact of private investment and decision making on recycling and resource conservation potentials in the C&D sector is not fully investigated.
Also, the application of (mineral) RC construction materials and products in structural engineering is still a niche. Broad application can be found in civil engineering, where RC materials are applied in many fields of application. And, material selection seems to be more influenced by cost than environmental benefits (Oyedele et al. 2014, p.28). Also, material selection is mainly determined by planners as awarding authorities often follow planners’ recommendations (Knoeri et al. 2011, p. 1043).

Table 1: Literature review on acceptance studies in the construction and demolition sector with respect to recycled C&D waste or resource efficiency

			Considered stakeholders											
Reference	**Country / Regions**	**Content**	**Private owners**	**Commercial owners/ investors**	**Public awarding authorities**	**Planners (Architects, engineers)**	**Construction Management**	**Construction industry**	**Demolition & recycling industry**	**Research institutes**	**Public environmental authorities**	**Structural engineering**	**Civil engineering**	**Methods**
Knoeri et al. (2011)	Switzerland (Zurich, Berne, Geneva, Vaud)	Analysis on stakeholder decision making in the proposal and tender process; analysis criteria: culture, rural-urban distribution, construction investments	X	X	X	X						X	X	Survey (total: 414 respondents), expert interviews AHP
Knappe et al. (2012)	Germany	Analysis of acceptance and hindrances of RC material use in construction; Recommendations for action	(X)	X	X	X	X	X	X	-	X	X	X	Expert workshops with public authorities and industry (associations), unstructured interviews
Oyedele et al. (2014)	United Kingdom	Use of recycled products in UK construction industry; Hindrances; analysis of designer and contractors' perspective and influence	-	-	-	X	X	X	-	-	-	X	X	Unstructured interviews (total: 10), quantitative questionnaire (total: 154 respondents)
Ankrah, et al. (2015)	United Kingdom	Cradle to Cradle Implementation in Business Sites and the Perspectives of Tenant Stakeholders; Understanding of preferences in business site developments	-	X	-	-	-	-	-	-	-	(X)	-	Preliminary survey (total: 21 respondents)
Freire et al. (2016)	Portugal	Types, main characteristics and applications of C&D recycled materials produced/ used in civil engineering works	-	-	-	-	-	X	X	-	-	-	X	Survey (total: 3 respondents)
Jin et al. (2017)	China	State of C&D waste and recycling; Benefits, difficulties and suggestions	-	-	-	X	X	X	-	X	X	X*	X*	Practice review, Survey (total: 77 respondents)
Müller et al. (2017)	Germany	Stakeholder analysis for resource-efficiency measures in construction industry	X	X	X	X	-	X	X	-	X	X*	X*	Literature review, survey (total: 9 respondents), expert interviews
		*: consideration of both without differentiation X: considered -: not considered												

3 Materials and Methods

3.1 Study design

Aim of the study is an analysis of the status quo of RC construction materials use and attitude of private awarding authorities in Germany. First, we identified relevant stakeholders by literature review (chapter 2.2), unstructured expert interviews to develop the questionnaire and by investment sum per year. Second, we surveyed private awarding authorities in structured interviews (chapter 3.3, 3.4, 3.5). In a third step, we analysed the interview results hypothesis-wise and compared the results to literature (chapter 4).

3.2 Hypotheses and constructs

Aim of the survey was to gather insights on information status of private awarding authorities, their decision making preferences, their experiences with RC material, their acceptance and potential future use.
The following hypotheses and constructs were developed[10] to analyse both acceptance and rejection of recycled C&D waste and its relation to knowledge/information on recycled C&D waste as well as RC construction material use in (new) residential construction.

Table 2: Overview on test hypotheses

Research subject	**Main hypotheses of the questionnaire**
Knowledge /information	• H_1: Private awarding authorities have few experiences in RC material application. • H_2: Information channels in Germany are underused to promote recycled construction materials from C&D waste to private awarding authorities.
Trust and scepticism	• H_3: Private awarding authorities have few trust in recycling construction materials and a general scepticism is prevailing.
Communication	• H_4: A respective communication between stakeholders of a construction project regarding RC materials is lacking.
Economic aspects/ incentives	• H_5: Cost are decisive for private awarding authorities in construction projects. • H_6: The perceived price difference between recycling materials and primary materials varies regionally. • H_7: Public subsidies, periodic quality checks of recycling companies and higher standards for RC materials would influence acceptance in a positive way.

3.3 Survey design and structure

The survey was designed and performed as structured[11] individual interviews with closed and hybrid[12] questions in 8 main fields (Table 7). The questionnaire consists of 39 items (Appendix

[10] The hypotheses were derived from literature (e.g. from Menegaki and Damigos (2018); Dechantsreiter et al. (2015); Knappe et al. (2012); Knoeri et al. (2011)).
[11] In contrast to the unstructured interview, the often applied structured interview offers advantages of the standardization of the interview situations and results as well as neutrality of the interviewer (Schnell et al. 2008).
[12] 66% of the questions were formulated in a closed and 33% were formulated in a hybrid way. For the 26 closed questions, we used either a dichotome scale, a 5-level Likert scale, a six-level ranking scale or different possible answers. In 13 items (6, 8, 13, 19, 21, 23, 24, 27, 28, 29, 31, 32, 38), an open response field was additionally provided. Four items (5, 10, 14, 32) have four to six sub-items. See Appendix B for the questionnaire.

B). With the restriction to closed questions, we accepted information loss, but increased the comparability of responses (Schnell et al. 2008, p. 332f.). The questionnaire was developed between April and May 2017. Then, a pre-study was done between May and July 2017. Due to experiences in the pre-study with low response and high dropout rates, we refrained from an online questionnaire. After a revision and extension of the questionnaire between October and November 2017, the questionnaire was pretested by six students. The final interviews were performed in multiple sampling periods between January and February 2018. The average responding time was 20 minutes.

3.4 Sample selection and collection of the data

For the study, we randomly selected private awarding authorities for the structured interviews in new or recent residential development areas. The sample was collected in rural and sub-urban areas in southwest Germany (Table 4). In Bellheim, Lingenfeld and Germersheim (RLP), there were brand new buildings as well as up to 10 years old buildings. In Stuttgart/Sindelfingen and Bruchsal (BW) the buildings were 2-3 years old.
In Baden-Württemberg, 11,971 permits for erection of new residential buildings[13] were issued to private awarding authorities in 2017, while 11,087 residential buildings were newly erected in this period (Destatis 2018). We use these numbers as reference for the sample size (Table 3). With 41 respondents, we have a confidence level of 80% with a 10%-error.

Table 3: Definition / Evaluation of the sample size per annual permits for erection and completion numbers of new residential buildings in Baden-Württemberg (in 2017)

	Erection permits for new residential buildings in Baden-Württemberg by private awarding authorities in 2017 (Destatis 2018)				**Completion of new residential buildings in Baden-Württemberg by private awarding authorities in 2017 (Destatis 2018)**			
Population size [#]	11971				11087			
Confidence level [%]	95%	80%	80%	99%	95%	80%	80%	99%
Error [%]	5%	5%	10%	1%	5%	5%	10%	1%
Required sample size for representativeness [#]	373	162	41	6963	372	162	41	6655

3.5 Description of the sample data

The final sample comprises 41 private awarding authorities in Germany (Table 4, Table 9). Of these, 25 (61%) live in sub-urban and 16 (39%) in rural areas with on average 3.2 persons per household. 65.9% of the respondents were male (n=27) and 34.2% were female (n=14). Compared to statistics of Germany, males are overrepresented. Furthermore, 41.5% were between 45 and 54 years old and the majority (75.6%) were employed or working. On average, the 22 households that reported their net monthly income have a 14.2% higher income than the average German household[14].

[13] without system building construction
[14] For an overview of the socio-demographic characteristics of the obtained sample compared to population statistics see Table 9.

Table 4: Sampling points of respondents

Region	Postal code	City / Village	Area classification (classified by respondents)	Number of respondents [#]	Relative share of respondents [%]
Baden-Württemberg	71063	Stuttgart/Sindelfingen	Suburban	3	7%
	67354	Römerberg	Rural	1	2%
	76646	Bruchsal-Büchenau	Suburban	21	51%
Rheinland-Pfalz	67365	Lingenfeld	Rural	1	2%
	76726	Germersheim	Rural	7	17%
	76756	Bellheim	Rural	8	20%

All respondents are owner-occupier. 40 of 41 (97.6%) are owners and awarding authorities of a single or twin family house. One respondent constructed a garage only. 75.6% mandated and supervised one construction project and 24.4% mandated two to ten construction projects (Table 9).
The assessment of the respondent's general lifestyle (their own rating), shows a small bias to a more sustainable lifestyle[15]. Furthermore, the respondents tend to avoid products with negative environmental impact (if known) and have a positive attitude towards RC-based products in general. In contrast, the respondents didn't agree with a higher price for environmentally friendly products (Figure 7, Table 11).

3.6 Rationality of behaviour and behavioural consistencies

3.6.1 Cross checks

We cross-checked the responses for items 4, 5, 10a, 10d, 24 and 33[16] (Table 13, Table 14). Furthermore, we tested items 4 and 5 with the ranking of the decision criteria for construction projects (item 12).
We see no influence of the lifestyle self-assessment on the knowledge of RC construction materials (Table 13), but we observe a higher fraction of respondents with a lower value of sustainable lifestyle which is not using RC construction materials (Table 14).
66% of the respondents are rather willing (3) or willing (24) to use RC construction materials in their future construction projects. Within these, 48% assessed their lifestyle as rather sustainable (within the interval of]60;100]). Furthermore, we see that those who actively informed themselves about RC construction materials (item 24) have a medium or rather sustainable lifestyle value while those that did not actively inform themselves show no special distribution.
Comparing items 4 and 5, we see that within the item 5a and 5b respondents with a higher value in item 4 tend to a higher sustainability. For items 5c and 5d, this relation cannot be seen (Table 17, Table 18, Table 19, Table 20). Furthermore, a higher self-assessed sustainable lifestyle does not considerably influence the priorities of decision criteria in construction projects (Table 21). The best ranking is still for decision criterion "Cost". Only in the highest class (interval]80;100]), we see a tendency towards decision criterion "environmentally friendly construction" (third rank instead of "Design").

[15] 55 points on average in the interval of [0;100] (Figure 6) with some respondents (9; 22%) with a low rating (less than 28 points) and others (13; 32%) with a high rating (with more than 73 points).
[16] Item 4 (sustainable lifestyle), item 5 (ecological attitude), item 10a (knowledge on RC construction materials), item 10d (use of RC construction materials), item 24 (active demand for information on RC construction materials) and item 33 (willingness to use RC construction materials).

A cross-check of items 5 and 12[17] reveals that private awarding authorities that (partly) agree on higher prices for environmentally friendly products (item 5c) rank energy efficient construction significantly higher (average rank = 2.00) than the rest of the respondents and considerably higher than environmentally friendly products. A similar effect can be seen for awareness of environmental effects (item 5d). For items 5a and 5b, the effect is not visible.

3.6.2 Factor and reliability analyses

In a factor analysis according to Finch and French 2015, we tested 10 Likert-scaled components of items 5a-d and 14a-f[18]. A hypothesis test revealed four with varimax orthogonally rotated underlying factors[19] (Figure 8, Table 25). The factors can be interpreted as risk/trust (factor 1), ecological impact (factor 2), cost/benefit (factor 3) and information (factor 4). We can see that for some values the 0.7 factor loading is exceeded, while for others it is almost reached (e.g. item 5c in factor 2). For the resulting four factors, we receive a Cronbach's alpha of $\alpha_1 = 0.72$ (Table 26, Table 27).

In the same way, we performed the second factor analysis for 16 components of Likert scaled items 5a-d (ecological attitude) and items 14a-f (attitude towards recycling) together with metric-scaled[20] items 15, 16, 17, 18 (trust) and items 33, 34 (future behaviour). We identify five factors[21] to explain the 16 components. The resulting factors can be interpreted as trust in specific materials (factor 1), ecological impact (factor 2), risk/trust (factor 3), price (factor 4) and willingness to consume RC materials (factor 5). For the five factors we calculated a Cronbach's alpha of $\alpha_2 = 0.88$ (Table 29, Table 30).

Thus, we can state a high interrelatedness and internal consistency as well as overlapping factors as a result of the two factor analyses.

Furthermore, we performed two latent variable analyses to identify similar respondent groups for specific items (Figure 10, Figure 11, Figure 12, Figure 13). Analysing the responses for items 10a-f, 13, 19, 21 and 26[22], we see two classes[23] (Figure 10). In a second latent variable analysis with items 10a-f, 13, 22-25[24] and 29[25] we identify three classes[26] with similar response

[17] Items 5a-d (ecological attitude); item 12 (decision criteria in construction projects).
[18] Items 5a-d (ecological attitude); items 14a-f (attitude towards recycling).
[19] With the most common criterion of the Eigenvalues <=1. The chi square statistic is 12.58 on 11 degrees of freedom and the p-value is 0.322. The proportion of variance (Proportion Var) shows the variance of the specific factor over all extracted factors, while the cumulative variance shows the cumulative value that sums up to 62% (Cumulative Var). Factors 1 and 2 have considerably higher sum of squared loadings (SS loadings) (=variance in the observed variables).
[20] For this analysis, the metric scale is divided into 5 equal-sized classes.
[21] With the most common criterion of the Eigenvalues <=1. The chi square statistic is 55.86 on 50 degrees of freedom and the p-value is 0.264. Here, the five factors sum up to 65% of the cumulative variance. The sum of squared loadings (SS loadings) of each factor shows considerably larger values (variances) for factors 1, 2 and 3.
[22] Item 10a-f: Previous experience; Item 13: Knowledge of materials; Item 19: existing application of RC material in the respondent's construction projects; Item 21: use of RC construction materials in the next construction project; Item 26: Perceived advantage of RC construction material.
[23] Class 1 has a rather high knowledge of RC construction materials (items 10a-e, 13), no concerns regarding their use (item 10f), some experience (item 19) and would use them again in future projects (item 21) (Figure 11). Class 2 has rather low knowledge (items 10, 13), no experience yet (item 19), but sees an advantage in using them (item 26).
[24] Item 22: Information status regarding RC construction materials during previous year; Item 23: Source of information; Item 24: Active demand for information on RC materials; Item 25: Passive information given by architect or engineer.
[25] Item 29: General knowledge about RC construction materials.
[26] Class 1 has good knowledge of RC construction materials (items 10a, 13, 29), but no experience (items 10b-e) and no concerns about their use (item 10f). This class received information on RC construction materials in the recent year (item 22) mostly in 2-3 different media (item 23), but did not inform themselves actively (item 24). Class 2 has low to medium knowledge on RC construction materials (items 10a, 29), but no experience (items

patterns (Figure 12, Figure 13). Interestingly, all classes were not informed by their architects, planners or consultants (item 25), but also have no concerns about RC construction material use (item 10f).

3.6.3 Relative Importance Index

The Relative Importance Index RII ($RII = \frac{\sum_i n_i * w}{A \times N}$, $[0; 1]$)[27] is calculated for the two Likert scaled items 5a-d and 14a-f (Table 31). The respondents have positive attitudes especially towards items 5b, 14b and 5a[28].

4 Results per hypothesis/construct

The gathered data was analysed per hypothesis/construct[29]. Not only single items but also multiple items were used to test the hypotheses/constructs. The results are shown in the following subsections.

4.1 H1: Private awarding authorities have few experiences in RC material application

The evaluation of experience of private awarding authorities (items10a-10c) shows that about 49% of the interviewees know recycled construction products or materials. 24% have already experience with the application of recycled construction materials and 29% know someone how has experience with recycled construction materials. Ca. 25% of the respondents has both knowledge and experience with recycled construction products, whereas ca. 25% has knowledge but no experience (Figure 14).
24% of the private awarding authorities state, that they had the possibility to apply RC construction materials in their buildings. 27% actually used RC construction materials in their project[30]. Furthermore, item 19 explored if and which RC construction materials are used by the respondents. The highest RC material use has RC concrete (12%) (Figure 16). Only 17% are worried about RC construction material use and the knowledge about selective deconstruction concepts[31] , is relatively low (Figure 17). Altogether, the empirical figures are not high enough to reject the hypothesis.

10b-e) and no concerns about their use (item 10f). This class did receive less information (item 22), at most in one medium (item 23) and did not inform themselves actively (item 24). Class 3 has very good knowledge on RC construction materials (items 10a, 29), previous experience (items 10b-e) and no concerns (item 10f). This class received information (item 22) in 4-5 different media (item 23) and actively informed themselves (item 24).

[27] w describes the respondents' Likert values (1 to 5), A describes the highest weight (here: 5) and N the number of the total sample (here: 41). The higher the RII-value, the more positive is the attitude of the survey population towards the target item.

[28] Item 5b (avoidance of products with high environmental impact); item 14b (lower environmental impact of RC construction materials/products) and item 5a (consumption of RC-based products in general).

[29] Hypothesis are usually tested with a single item. Constructs are tested/validated with multiple items.

[30] Here, one respondent answered inconsistently.

[31] E.g. building pass, or other life-cycle oriented measures (reuse, recycling)

4.2 H2: Information channels in Germany are underused to promote recycled construction materials to private awarding authorities

To validate this hypotheses, items 10a, 13, 22-25[32] and 29 (knowledge of materials) are evaluated. Item 10a already showed that ca. 49% have knowledge about RC construction materials (section 4.1). All respondents knew conventional concrete, brick and steel. Only PVC (83%) and shredded concrete (46%) are less known. Also, they knew RC concrete, RC brick, RC PVC and RC steel/metal much less (<49%) (Figure 18, Table 12).
51% received, read or perceived information on RC construction/materials/products in the past year. The information was mainly received via internet and professional journals (Table 32). 32% actively researched and informed themselves about potential construction materials and only 17% were informed by their planners (architects and general contractors) about RC construction materials.
Altogether, we can state that the internet and professional journals already contribute to the knowledge and information status of private authorities. However, the active informing by architects and planners with respect to RC construction materials could be improved during construction project planning phase.

4.3 H3: Private awarding authorities have little confidence in recycling construction materials and a general scepticism is prevailing.

To validate this hypothesis, we t-tested the respondents' confidence of RC construction materials in the following application areas: (1) RC concrete in foundations, storey ceilings, supports, beams and cellar walls; (2) RC steel in structure and reinforcements of masonry; (3) RC brick in masonry and roofing (4) RC PVC in shutters, pipes, window frames, floor coverings. On average, we see a quite high confidence (mean value >45%).
For the t-test, we assume that 50% of the private awarding authorities trust RC construction materials so that H_0: $\mu_{Concrete} = 0.5$ and H_1: $\mu_{Concrete} \neq 0{,}5$. The null hypothesis will be tested on a significance level of $\alpha = 5\%$. The arithmetic mean of the 41 responses of the sample is 45.976 for RC concrete. This results in a sample variance $S^{*2} = \frac{\sum_1^n (X_i - \bar{x})^2}{n-1}$ of 972.774. From this, the following t-statistic can be derived with the formula for calculating the single-sample t-test: -0.8262. This value is considerably lower that the value of the 95%-quantile for the two-sided single-sample sample t-test. Thus, H_0 cannot be rejected. This means that the data collected in this study regarding the confidence against a critical mark of 50% are significant at a significance level of 5%. The same applies for the RC construction materials RC steel and RC brick. It can be seen that RC PVC has the highest confidence values which might be caused by the perceived less importance of its application areas (no application in structural elements) (Figure 19). The linear regression has a relatively high coefficient of determination value R^2 = 13.62%. We observe an increasing confidence with the reduced structural importance in buildings. Furthermore, literature states that a potentials restraint to use RC building materials often results from the fear of not meeting the structural requirements (Schultz-Stemberg, 2017, p. 380).

[32] See footnote 24.

4.4 H4: A respective communication between stakeholders of a construction project regarding RC materials is lacking.

To evaluate this hypothesis, we asked if they informed themselves actively about potential construction materials (item 24) or if they have been informed by their architects and planners about RC construction materials (item 25). Normally, contractors and companies offering RC construction materials are not in direct contact with clients and private awarding authorities.
The assessment shows that 32% of the respondents informed themselves actively while only 17% were informed by their architect and planners (Figure 1 centre and right). The cross tabulation of both items shows that 63.4% hoped for a consultation by their architect or planner[33]. 26 respondents (56.1%) hoped for consultation but have neither informed themselves or been informed during the construction project planning. Thus, this hypothesis cannot be rejected.

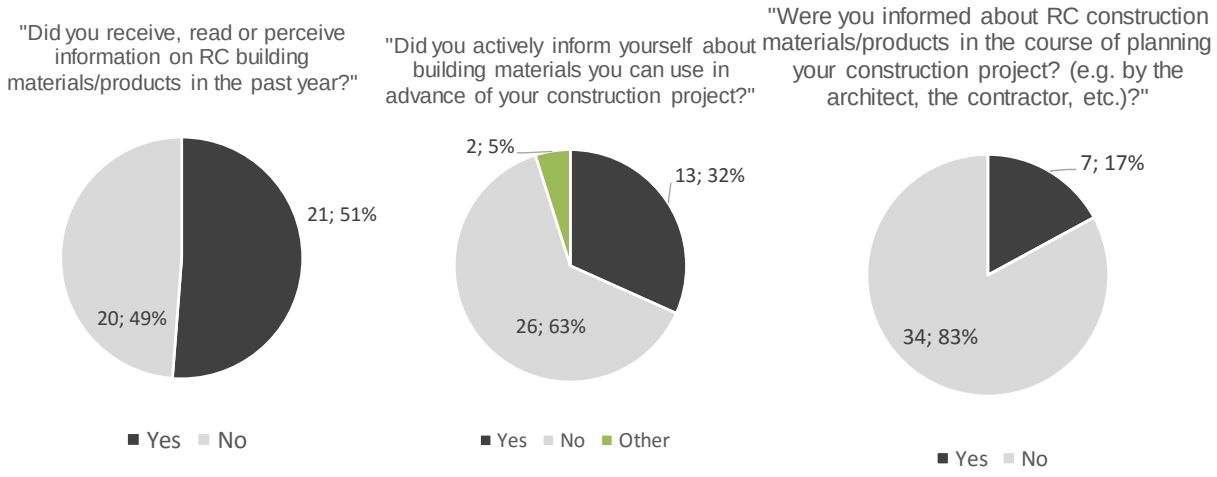


Figure 1: Information status of respondents

4.5 H5: Cost are decisive for private awarding authorities in construction projects

This hypothesis is evaluated with item 12 that requested interviewees to rank their decision criteria for construction projects according to their priorities from 1 to 6[34].
In contrast to the hypothesis, the assessed ranking of decision making shows (Table 35, Table 36, Figure 2) that quality is most frequently listed as decisive criteria (average value 1.27). This is followed by cost (2.17) and environmentally friendly construction (3.78).
Furthermore, the private awarding authorities see no increase in the value of their property through the use of RC building materials (No: 90%; No, in the contrary: 10%, n=41). And, the majority are unwilling (51.2%) or only partially willing (17.1%) to pay a premium for RC construction materials (Figure 20).

[33] Answer to item 24: no, we hoped for consultation by the architect/contractor.
[34] 1= high priority; 6 = low priority.

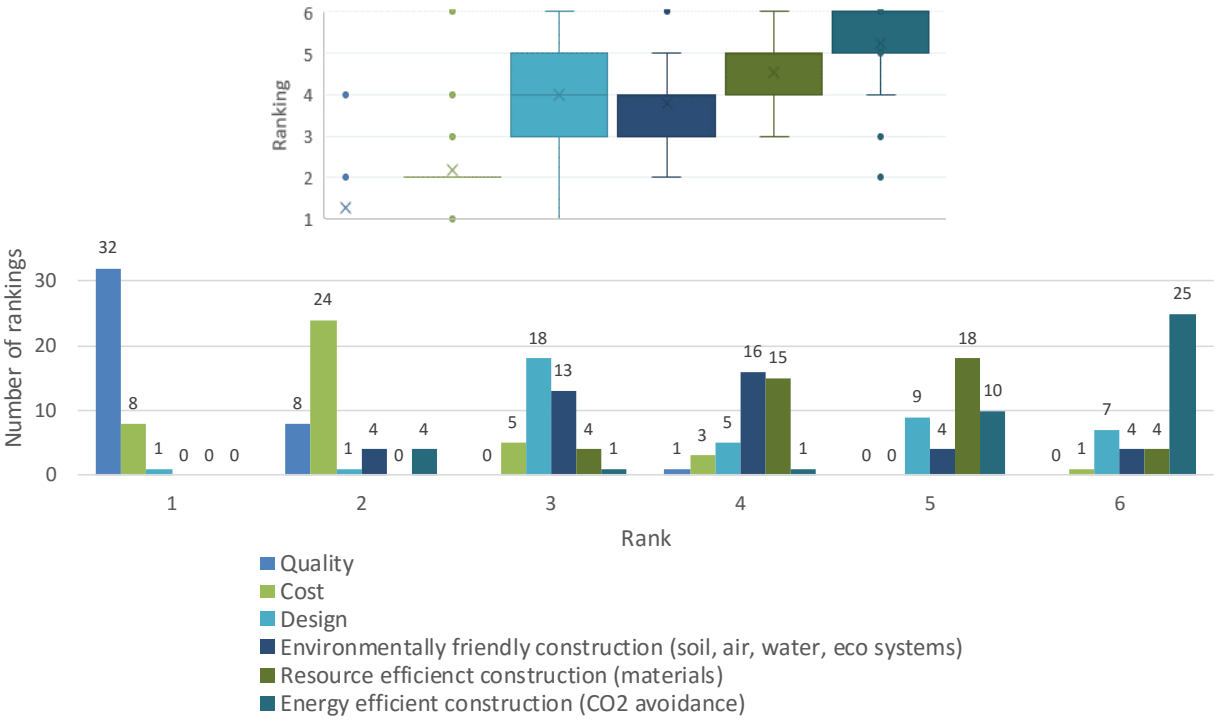


Figure 2: Boxplot and distribution of the ranking of decision criteria among private awarding authorities

4.6 H_6: The perceived price difference between recycling materials and primary materials varies regionally

To evaluate regionally varying perceived price differences between RC and conventional construction materials, we investigated the perceived price advantage or disadvantage of RC construction materials (items 27, 28). A t-test reveals no regional differences between regions Rheinland-Pfalz[35] and Baden-Württemberg[36] ($\mu_{RLP} = 0.4706;\ \mu_{BW} = 0.4167; S^{*2}_{RLP} = 0.2647;\ S^{*2}_{BW} = 0.3406; \mathrm{t-statistics} = 0.3058$) and between rural and suburban areas ($\mu_{rural} = 0.5;\ \mu_{suburban} = 0.4; S^{*2}_{rural} = 0.2667;\ S^{*2}_{suburban} = 0.3333; \mathrm{t-statistics} = 0.5630$). Both tests have 39 degrees of freedom, a significance level of 0.05 and a 95%-quantile of 2.02. Thus, the null hypothesis (acceptance of hypothesis) cannot be rejected; not even with a level of significance of 0.01. Thus, we cannot see any perceived regionally differing prices for RC construction materials. Also, a comparison of the importance of low RC construction material prices did not differ considerably between states or rural/suburban areas (Figure 21).

However, desk-based research showed that C&D waste price levels in Baden-Württemberg vary considerably (Figure 3). This can also result in varying prices of RC construction materials that is influenced by the varying secondary raw material price for the required material quality, and rather constant personal and processing cost, cost for quality management, transportation and storage. Thus, “waste” disposal fees can have a lowering effect on the RC construction material price that competes with the primary construction material price.

Today, the regional price information asymmetry leads to suboptimal supply-demand-matching and possibly higher transport distances due to economic benefits for demolition and recycling companies.

[35] Federal state Rheinland-Pfalz (RLP): postal codes: 67354, 67365, 76726 and 76756.
[36] Federal state Baden-Württemberg (BW): postal codes: 71063 and 76646.

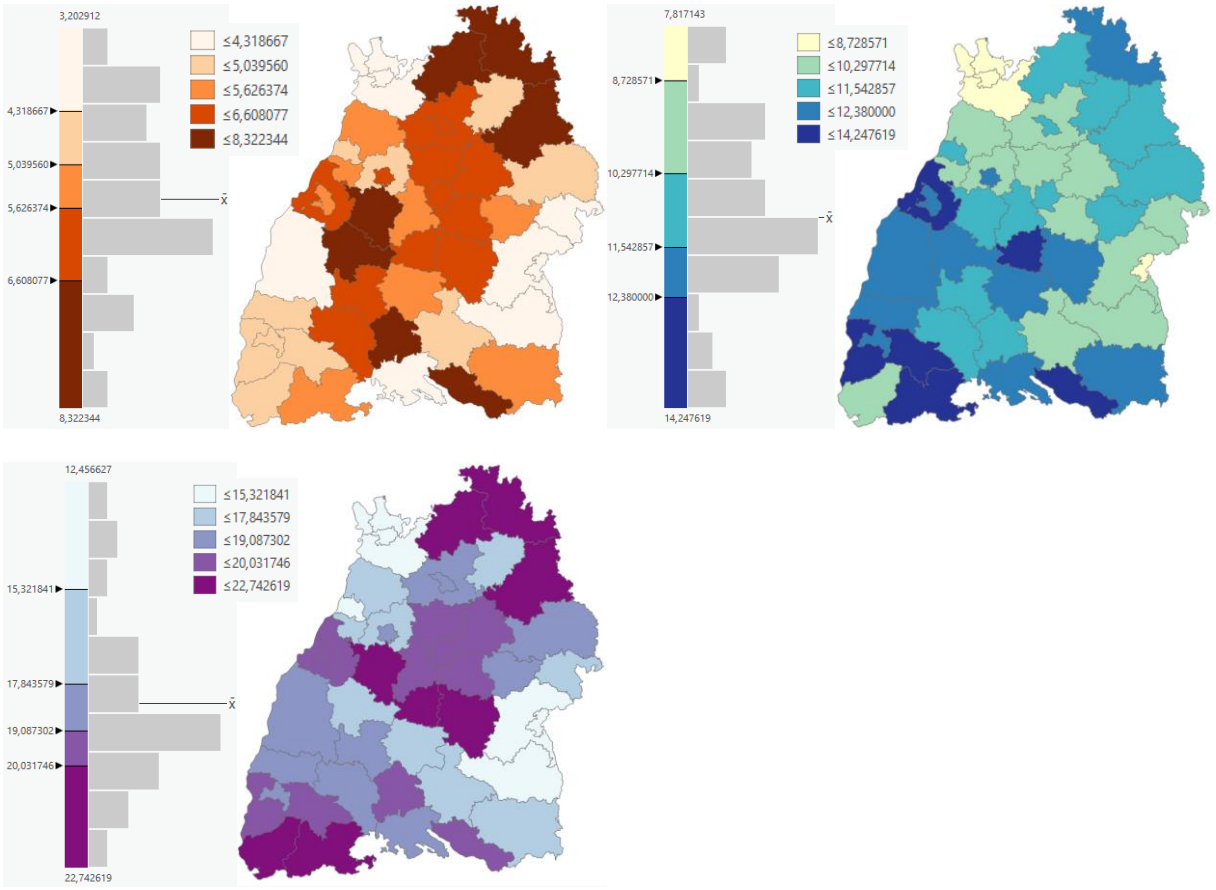


Figure 3: C&D waste ("Bauschutt", orange), used timber ("Altholz", AVV170201, blue) and mixed construction waste ("Baustellenabfälle", AVV1700904, purple) disposal cost [€ per ton and day (container rent)]. Note: In the figures, the commas are to be understood as points.

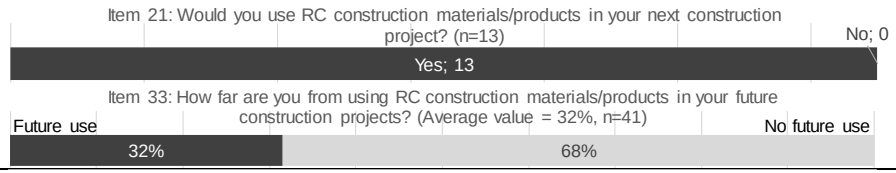
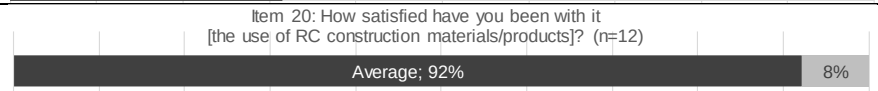
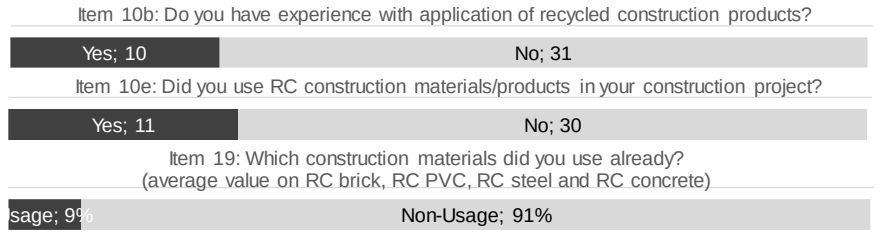
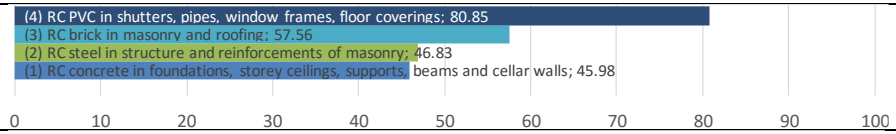
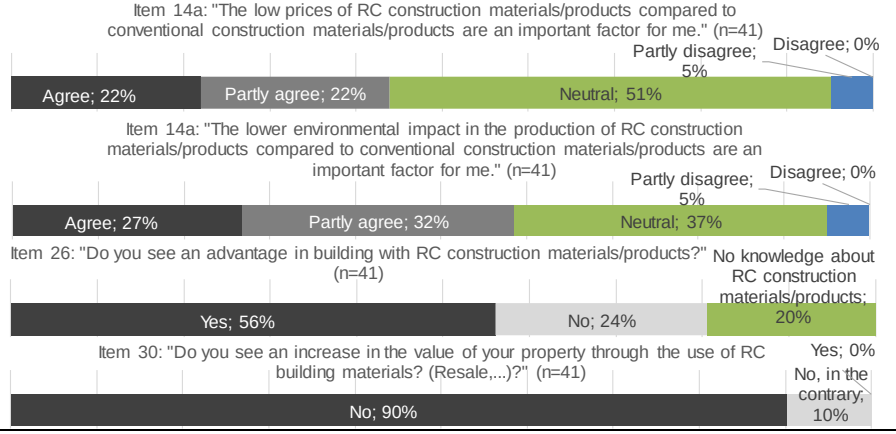
4.7 H_7: Public subsidies, periodic quality checks of recycling companies and higher standards for RC materials would influence acceptance in a positive way

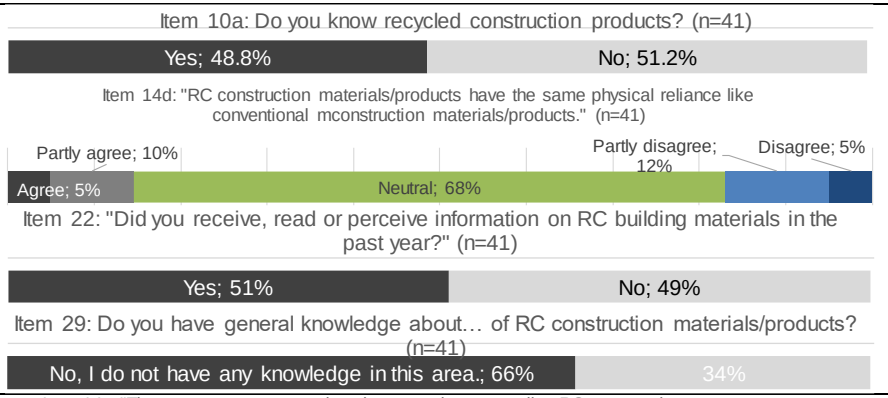
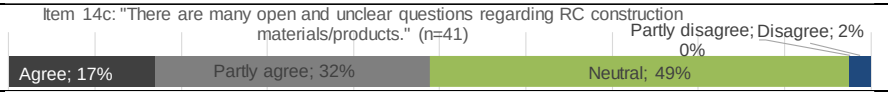
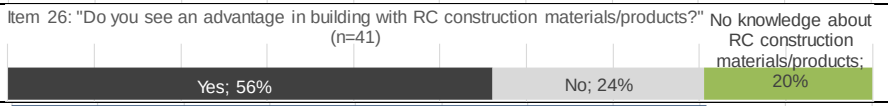
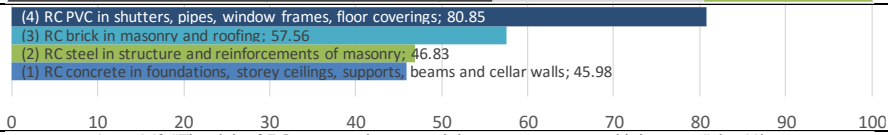
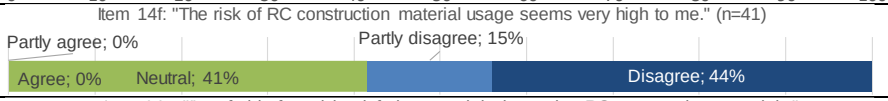
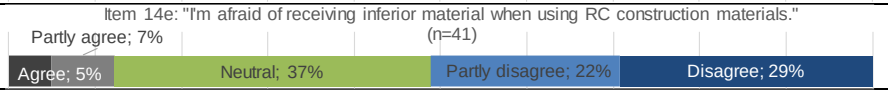
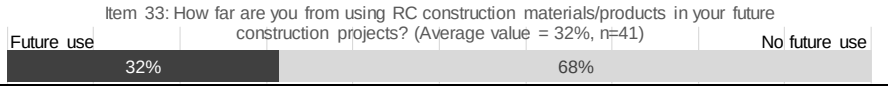
Evaluation of item 32 shows that almost all (98.4%) respondents agreed on the positive effect of measure (1) higher material standards, (2) regular government reviews and (3) financial support of RC construction materials (Figure 22). Thus, this hypothesis cannot be rejected.

4.8 Acceptance of RC construction materials/products

For the use of RC construction materials/products, socio-political, community or market acceptance research is still very sparse. Based on Dethloff (2004), Schweizer-Ries (2008) proposes a model of acceptance for renewable energy technology adoption and differentiates between two axes: (1) valuation ranging from adoption to rejection and (2) action ranging from active to passive. Rosenberg and Hovland (1960) propose cognitive, affective and conative components that can be distinguished in acceptance. Both model of acceptances can be consolidated and specified for the RC construction material acceptance issue (Table 5) including the active, conative part that is needed for the transition from tolerance to acceptance (Lucke 1997)).

Table 5: Model of acceptance with graduation of perceived positive, neutral and negative valuation divided into cognitive, affective and conative components (standard: main items; italic: detailing items)

Components*	Valuation ADOPTION	Items	Evaluation
Conative	Future use/ support	21, 33 (see also Figure 23)	
Affective	Satisfaction	20	
Conative	Application, Experience	10b, 10e, 19 (see also Figure 16)	
Affective	Trust / Confidence	15, 16, 17, 18 (see also Figure 19)	
Cognitive	Advantage	14a-b, 26, *27*, 30	

	Information	10a, *10c*, *13*, 14d, 22, *24, 25*, 29	
	Information gaps	14c	
	Disadvantages	26, *28*	
Affective	Mistrust	15, 16, 17, 18 (see also Figure 19)	
	Risk	14f	
	Fear	14e	
Conative	Future rejection/ resistance	33	
	REJECTION		

* according to Rosenberg and Hovland (1960):
cognitive component = argumentation, information collection and evaluation;
affective component = feelings, physical reactions, e.g. fear, anxiousness, happiness;
conative component = intention to act, concrete actions

The responses show that within the RC construction material users, the acceptance is very high (item 21) as all (n=12) would use RC construction materials in their next construction project. Also, there is a tendency to use RC construction materials among all respondents and low perceived mistrust, fear or risk. 24 respondents (58.5%) would use RC construction materials in the next construction project; thereof 16 state they would use them for sure[37]. A closer look at future rejection (item 33) shows that only 6 (15%) won't use RC construction materials.

4.9 Discussion and Comparison to existing approaches / literature

4.9.1 Decision criteria

Knoeri et al. state that in "private awarding authorities' initial project specification was mainly influenced by economic (39%) and ecological aspects (42%), whereas social aspects played a minor role." (Knoeri et al. 2011, p.1045f.). Knoeri et al. also showed that private awarding authorities decrease the weight of environmental aspects in their decision criteria over time and often follow the recommendations of architects and engineers. This can be confirmed by our study in hypothesis H_5 (section 4.5). However, we see that quality aspects play even a more important role that cost. Environmentally friendly construction (soil, air, water, eco systems) as well as resource and energy efficient construction (materials, resp. CO_2 avoidance) play a minor role. Thus, the extension of sustainable design appraisal in label systems as stated by Ajayi and Oyedele 2014 is even more important as private awarding authorities consider this less important.

4.9.2 Expert consultation of awarding authorities

Furthermore, "in the subsequent project confirmation, private awarding authorities relied to a large extent on the architects' recommendation (33%). Furthermore, they considered technical aspects (25%) and the expected costs (23%), whereas ecological considerations were the least important (19%). […] For the private awarding authorities' final tender selection (6), tender price (27%) and technical aspects (30%) were the deciding factors" (Knoeri et al. 2011, p.1045f.). This cannot be disproved, but we see in our survey that 63.4% hoped for a consultation by their architect or planner. But, 68.3% were not informed by their architect or planner about RC construction materials (section 4.4).

4.9.3 Image of RC materials

In Germany, reports stated a negative image of RC construction materials based on insufficient quality or materials turning out to be hazardous (Dechantsreiter et al. 2015), singular negative experiences and lacking confidence in quality standards or monitoring systems (Knappe et al. 2012). This could not be confirmed (see items 14e/f, Table 5).

4.9.4 Methods

Knoeri et al. 2011 use the analytical hierarchy process (AHP) with a decomposition of the decision[38], the comparative judgement and the synthesis to an overall ranking. In contrast, we

[37] If we transform the chosen metric scale into Likert scale (with five equally distributed intervals).
[38] definition of decision goal, alternatives and criteria

focused on the ranking of decision criteria and comparative judgement of the private awarding authorities' preferences[39] (section 3.1). Like Knoeri et al. 2011, we provide a behavioural consistency analysis and cross-checks of the general attitude towards sustainability and RC materials as well as the previous experience and the potential future use of RC materials.

5 Conclusion

5.1 Summary

Due to high investments of private awarding authorities in the German building stock, these stakeholders are very relevant in the transition to a more sustainable use of construction materials, e.g. by materials with a high(er) share of recycled C&D waste. But still, a broader market for RC construction materials for structural engineering is not established in Germany yet and construction engineers and building owners lack knowledge or experience (Knappe et al. 2012).

We performed a structured interview with 41 private awarding authorities in South-West Germany to evaluate the current state of information and acceptance of RC construction materials. The responses show a high interrelatedness and reliability.

As a result, acceptance problems cannot be stated. Rather, we see a low experience (25%) with RC construction materials and low knowledge about selective deconstruction concepts, building material pass, or other life-cycle oriented measures. Information channels are not underused, but an active informing of private awarding authorities by architects and planners with respect to RC construction materials could be improved during construction project planning. Among the respondents, most have no concerns about RC construction material use, but we see a decreasing confidence with increased structural importance of the materials. 32% informed themselves actively about potential construction materials, while only 17% were informed by their architect and planners but many more for a consultation.

A surprising result is that in contrast to the hypothesis, the quality is most frequently listed as decisive criterion, followed by cost. And, private awarding authorities see no increase in their property value through the use of RC building materials and the majority is unwilling to pay a premium for RC construction materials. Almost unanimously, higher material quality standards, regular government reviews and financial support are seen as advantageous for RC construction materials.

5.2 Limitations and future direction

Data for this study has been collected from private awarding authorities (households) in Germany. Neither semi- or non-private awarding authorities, NGOs, C&D experts or governmental stakeholders were surveyed. Further studies could explore the attitudes and perceptions of semi- or non-private as well as public awarding authorities of small, medium or large communities.

As a critical remark, we must state that the structured interviews could have been performed for a more representative sample. However, with respect to the argumentation in section 3.4 and compared to Knoeri et al. 2011[40], we interviewed the same magnitude of respondents. In

[39] low cost, low environmental impact, low energy consumption, low resource consumption, high quality, good design

[40] Knoeri et al. have a survey sample of 50 private awarding authorities.

comparison with the population in Germany, female respondents are underrepresented. The age distribution of the respondents seems plausible. However, we did not perform a gender-based evaluation.
Gaps remain regarding the further sampling of private awarding authorities in other regions e.g. Northern Germany. Also, further investigations on state and local regulations should be done[41]. This might have impact on the results due to lower availability, different quality standards or different price structures of primary stone, gravel, sand or aggregates in other parts of Germany. Furthermore, we did not differentiate between conventional and system building construction within the interviews.
During the interviews (on average 20 minutes) the interviewees could have changed their mind or develop a willingness to use or adopt RC construction materials (see unexpectedly high item 33, Figure 23).

5.3 Outlook

As a practical outlook, closing of information gaps (websites, qualified journals) and improved communication between planners and private awarding authorities (e.g. by non-discriminating tenders (Diebel and Knappe, 2010, Knappe et al. 2012, Dechantsreiter et al. 2015)) seems promising. As well, information, education and training of architects/planners could be improved regarding RC materials but also regarding sustainable construction concepts[42] (also stated by Knoeri et al. 2011, p.1049 citing Spoerri et al. 2009; Dechantsreiter et al. 2015). Information and labelling associated with compulsory quality assurance for RC construction materials could also help (Knappe et al. 2012) to inform private awarding authorities. However, it would require an extension of existing sustainability labels by material issues (also stated by Knoeri et al. 2011, p.1049).
Future research could investigate the effect of regionally different quality and price structures of primary and secondary C&D resources on the decision making of private awarding authorities in more detail. Also, this could be compared other regions in the world with different price structures[43] and acceptance.
Also, future research could focus on private awarding authorities' decision making in retrofit projects as well as in new system building constructions. Assuming that private awarding authorities only decide on the materials of the interior design of system building constructions [44], we neglected this stakeholder group. But, as system building construction constitutes 29.5% in new construction of Baden-Württemberg and 21.1% in Rheinland-Pfalz (BDF 2018), it should be considered in future research. Retrofit projects consume much less construction material per project. But, with a retrofit rate of ca. 1-2% of the total stock per year it might also matter.

[41] e.g. for areas with RC material use restrictions due to high groundwater levels such as close to the Rhine river.
[42] Sustainable construction concepts, case studies/ reference buildings, design-for-repair or design-for-deconstruction, multifunctional uses, flexibility etc.
[43] e.g. Switzerland, Sweden/Scandinavia or for Munich (Germany) where between 2011-2013 prices for backfill material categorised as Z0 (+0%), Z1.1 (+2,00 EUR/t (20%)), Z2 (+10,00 EUR/t (67%)), DK I (+25,00 EUR/t (100%)), DK II (+25,00 EUR/t (55%)), DK III (+20,00 EUR/t (20%)) increased considerably (Schmidmeyer (2014), p. 112)). An increase in disposal capacities or a price reduction is not projected for the future. Rather, experts expected further increasing disposal prices and reduced disposal capacities in many industrialized countries.
[44] and eventually on the concrete type of their basement

Acknowledgments

We gratefully acknowledge the contributions of Simon Föll, Elias Naber and Kira Schumacher.

Appendix A: Supplementary material and general statistics

Table 6: Structural engineering construction activity in Germany [measured in annual permits for structural engineering works], data source: https://www.destatis.de/DE/ZahlenFakten/Wirtschaftsbereiche/Bauen/Bautaetigkeit/Tabellen/Baugenehmigungen.html, last access: 14 June 2018

Objects of structural engineering	unit	2013	2014	2015	2016	2017
Buildings / construction projects (total)	number	213,362	209,295	222,280	233,833	221,871
Total number of apartments	number	272,433	285,079	313,296	375,388	347,882
Living space	1000m²	29,714	30,425	33,022	36,896	34,934
Estimated cost of buildings/ objects	million €	77,266	78,397	84,606	98,090	99,284
of which: construction of new buildings						
Buildings	number	141,902	138,375	147,304	154,258	146,012
Apartments	number	242,149	251,175	271,916	323,042	305,659
Living space	1000m²	25,967	26,499	28,510	31,805	30,377
Estimated cost of buildings/ objects	million €	63,357	63,937	69,596	81,617	82,418

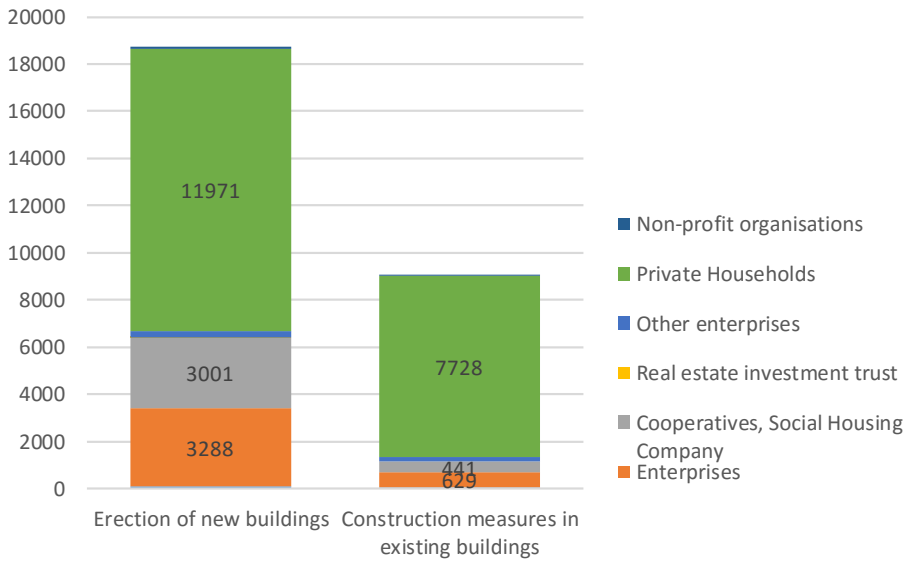


Figure 4: Number of construction permits for residential buildings in Baden-Württemberg in 2017 differentiated into owner/client type [in numbers] (data source: Destatis 2018)

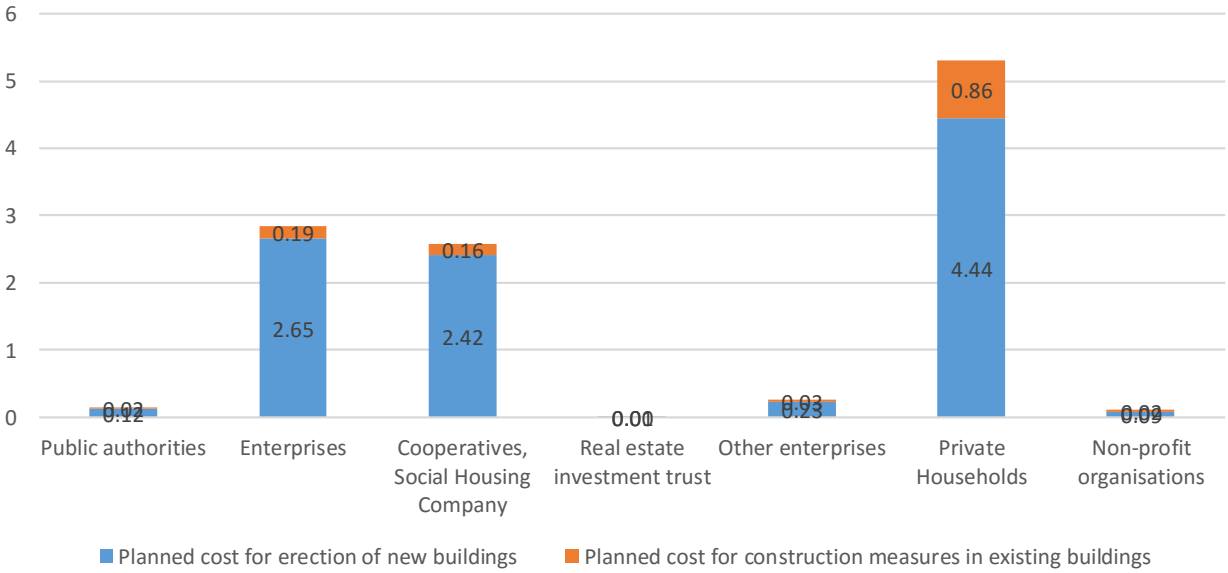


Figure 5: Planned cost / investments of construction permits in Baden-Württemberg for residential buildings per owner/client type (blue: new erections; orange: construction measures in existing buildings) in 2017, according to year, federal state and building type [in billion €] (Data source: Destatis 2018)

Appendix B: Questionaire [German]

1. Bitte geben Sie die Postleitzahl ihres Wohnortes an.

2. Bitte präzisieren Sie ihren Wohnort. Ich wohne ...

- ... in der Innenstadt
- ... in einem Vorort
- ... auf dem Land

3. Wie viele Personen leben in Ihrem Haushalt?

* 4. Wie nachhaltig schätzen Sie Ihren generellen Lebensstil ein?

nicht nachhaltig — äußerst nachhaltig

5. Inwiefern stimmen Sie folgenden Aussagen zu ihrer ökologischen Einstellung zu?

	Stimme voll zu	Stimme teilweise zu	neutral	Stimme teilweise nicht zu	Stimm gar nicht zu
"Ich konsumiere Produkte, die aus wiederverwertbaren Materialien hergestellt wurden (z.B. Recyclingpapier)."					
"Wenn ich mir der negativen Auswirkung mancher Produkte auf die Umwelt bewusst bin, versuche ich diese Produkte nicht zu kaufen."					
"Ein höherer Kaufpreis für umweltschonende Produkte sind für mich ok."					
"Wenn ich Produkte kaufe, versuche ich, mir der Auswirkungen auf die Umwelt bewusst zu werden."					

* 6. Welche Rolle nehmen Sie bei einem Bauvorhaben (Neubau, Modernisierungs-/Sanierungsmaßnahmen) ein?

- ◯ Eigentümer/privater Bauherr
- ◯ Baugenossenschaft/Bauverein
- ◯ Bauunternehmen
- ◯ Sonstiges (Bitte angeben)

* 7. Sind Sie Selbstnutzer Ihres Gebäudes/Ihrer Gebäude oder werden Sie das Gebäude/die Gebäude vermieten/verkaufen?

* 8. Wie würden sie Ihr aktuelles/Ihre hauptsächlichen Bauvorhaben betiteln?

- ☐ Einfamilienhaus/Doppelhaus
- ☐ Mehrfamilienhaus
- ☐ Zusatzbauten (Garage, Gartenhaus,...)
- ☐ Sonstiges (Bitte angeben)

* 9. Wie viele Bauvorhaben haben Sie bereits in Auftrag gegeben?

- ◯ 1
- ◯ 2 bis 10
- ◯ 10 bis 50
- ◯ mehr als 50

Fragen zu Ihrer Vorerfahrung:

10. Bitte beantworten Sie folgende Fragen.

	Ja	Nein
Kennen Sie RC-Baustoffe?	○	○
Haben Sie schon Erfahrungen mit dem Einsatz von RC-Baustoffen gemacht?	○	○
Kennen Sie jemanden, der Erfahrungen mit dem Einsatz von RC-Baustoffen gemacht hat?	○	○
Hatten Sie die Möglichkeit bei Ihrem Bauvorhaben RC-Baustoffe zu verwenden?	○	○
Haben Sie bei Ihrem Bauvorhaben RC-Baustoffe verwendet?	○	○
Haben Sie Bedenken, bei einem Bauvorhaben RC-Baustoffe zu verwenden?	○	○

11. Notizen (Bedenken)

* 12. Was ist Ihnen bei Ihrem Bauvorhaben am wichtigsten? (Bitte bringen Sie die folgenden Aspekte in eine Rangfolge; 1 = höchste Priorität, 6 = niedrigste Priorität)

	Qualität
	Kosten/Preis
	Design
	Umweltfreundliches Bauen (Boden, Luft, Wasser, Ökosysteme)
	Ressourceneffizientes Bauen (Rohstoffe)
	Energieeffizientes Bauen (CO2-Vermeidung)

* 13. Welche der folgenden Baustoffe kennen Sie?

- [ ] Beton
- [ ] RC-Beton
- [ ] Betonbruch
- [ ] PVC
- [ ] RC-PVC
- [ ] Ziegel
- [ ] RC-Ziegel
- [ ] Stahl / Metall
- [ ] RC-Stahl / RC-Metall
- [ ] keinen
- [ ] Sonstige (Bitte angeben)

14. Inwieweit stimmen Sie folgenden Aussagen zu?

	stimme voll zu		neutral		stimme gar nicht zu
"Die geringeren Einzelpreise von Baustoffen aus RC-Material im Vergleich zu herkömmlichen Baustoffen sind für mich ein wichtiger Faktor."	○	○	○	○	○
"Die geringere Umweltbelastung bei der Produktion von Baustoffen aus RC-Material im Vergleich zu herkömmlichen Baustoffen sind für mich ein wichtiger Faktor."	○	○	○	○	○
"Es gibt noch viele offene und ungeklärte Fragen rund um RC-Baustoffe."	○	○	○	○	○
"RC-Baustoffe besitzen dieselbe physikalische Zuverlässigkeit wie herkömmliche Baustoffe."	○	○	○	○	○
"Ich befürchte, bei der Verwendung von RC-Baustoffen, minderwertiges Material zu erhalten."	○	○	○	○	○
"Das Risiko bei der Verwendung von RC-Baustoffen erscheint mir sehr hoch."	○	○	○	○	○

Wie sehr würden Sie dem Einsatz von RC-Baustoffen in den folgenden Anwendungsbereichen vertrauen?

* 15. Beton (Fundament, Geschossdecken, Stützen, Balken und Kellerwänden)

0 50 100

* 16. Stahl (Tragwerke, Verstärkungen von Mauerwerken)

0 50 100

* 17. Ziegel (Mauerwerk, Dach)

0 50 100

* 18. PVC (Rolladen, Rohre, Fensterrahmen, Bodenbeläge)

0 50 100

19. Welche RC-Baustoffe haben Sie bereits verwendet/verwenden Sie aktuell?

- [ ] RC-Beton
- [ ] RC-Stahl
- [ ] RC-PVC
- [ ] RC-Ziegel
- [ ] Sonstige (Bitte angeben)

20. Wie zufrieden waren Sie damit? (in %)

0 50 100

21. Würden Sie RC-Baustoffe in Ihrem nächsten Bauvorhaben erneut einsetzen?

- ◯ Ja
- ◯ Nein, aus folgendem Grund:

* 22. Haben Sie im vergangenen Jahr Informationen zu RC-Baustoffen erhalten, gelesen oder wahrgenommen?

- ◯ Ja
- ◯ Nein

23. Falls "Ja", in welcher Form?

- ☐ Tageszeitung
- ☐ Fachzeitschrift
- ☐ Fernsehen
- ☐ Baugenossenschaft
- ☐ Kommune/Land
- ☐ Internet
- ☐ Sonstiges (Bitte angeben)

* 24. Haben Sie sich selbst im Vorhinein Ihres Bauvorhabens aktiv über für Sie einsetzbare Baustoffe informiert?

- ◯ Ja, in dem Umfang, dass wir eine Entscheidung über den präferierten Baustoff treffen konnten.
- ◯ Nein, wir erhofften uns Beratung durch den Bauunternehmer/Architekten.
- ◯ Nein, da (anderer Grund):

* 25. Wurden Sie im Zuge der Planung Ihres Bauvorhabens/Ihrer Bauvorhaben über RC-Baustoffe informiert? (z.B. vom Architekten, vom Bauunternehmen, etc)

- ○ Ja
- ○ Nein

* 26. Sehen Sie einen Vorteil darin, mit RC-Baustoffen zu bauen?

- ○ Ja
- ○ Nein
- ○ Keine Kenntnisse über RC-Baustoffe

27. Falls "Ja", welche Vorteile sehen Sie?

- ☐ Innovation
- ☐ Qualität
- ☐ Ressourcenschonung
- ☐ Preis
- ☐ Nachhaltigkeit
- ☐ Verfügbarkeit
- ☐ Sonstige (Bitte angeben)

28. Falls "Nein", welche Nachteile sehen Sie?

- ☐ Innovation
- ☐ Qualität
- ☐ Preis
- ☐ eingeschränkte Einsatzbereiche
- ☐ Verfügbarkeit
- ☐ Sonstige (Bitte angeben)

* 29. Haben Sie im Allgemeinen Kenntnisse über ... von RC-Baustoffen?

- [ ] rechtliche Rahmenbedingungen
- [ ] Qualität
- [ ] Einsatzmöglichkeiten
- [ ] Umweltauswirkung/-schonung
- [ ] Nein, ich habe keine Kenntnisse
- [ ] Sonstiges (Bitte angeben)

* 30. Sehen Sie eine Wertsteigerung für Ihre Immobilie durch die Verwendung von RC-Baustoffen? (Wiederverkauf,...)

- ( ) Ja
- ( ) Nein
- ( ) Nein, im Gegenteil.

* 31. Sind Sie im Zuge Ihres Bauvorhabens/Ihrer Bauvorhaben mit Folgendem konfrontiert worden?

- [ ] Konzept für selektiven Rückbau (Design-for-Deconstruction)
- [ ] Verwendung eines Gebäudepasses
- [ ] Keines davon
- [ ] Andere Maßnahmen, die sich mit dem Gesamtlebenszyklus der eingesetzten Baustoffe befassen (Wiederverwertung, Recycling,...)

32. Welche der folgenden Punkte würden Sie als entscheidende Vorteile von Recycling-Baustoffen im Gegensatz zu Primärbaustoffen erachten?

	Ja	Nein
Finanzielle Förderung der Bauvorhaben durch staatliche Zuschüsse	○	○
Regelmäßige staatliche Prüfungen von Recyclingunternehmen	○	○
Höhere Materialstandards für Recyclingmaterial zur Qualitätssicherung	○	○

Sonstige (bitte angeben)

33. Wie weit sind Sie davon entfernt, RC-Baustoffe in zukünftigen Bauprojekten zu verwenden?

"Ich würde RC-Baustoffe in künftigen Projekten verwenden." — "Ich würde RC-Baustoffe in künftigen Projekten nicht verwenden."

34. Wie bereit wären Sie, einen Mehrpreis für RC-Baustoffe zu bezahlen?

"Ich würde einen Mehrpreis für RC-Baustoffe bezahlen." — "Ich würde sie nur einsetzen, wenn sie günstiger wären."

Zum Schluss noch ein paar Daten zu statistischen Zwecken:

* 35. Ihr Geschlecht:

- ◯ männlich
- ◯ weiblich
- ◯ Sonstiges

* 36. Ihr Alter:

- ◯ 18 bis 24
- ◯ 25 bis 34
- ◯ 35 bis 44
- ◯ 45 bis 54
- ◯ 55 bis 65
- ◯ 66 bis 75
- ◯ 76 bis 85
- ◯ 85+

37. Geben Sie bitte Ihren höchsten Bildungsgrad an.

- ◯ kein Schulabschluss
- ◯ Volks- oder Hauptschulabschluss
- ◯ mittlere Reife/Realschulabschluss
- ◯ Fachhochschulreife/Fachabitur
- ◯ Hochschulreife/Abitur
- ◯ Abgeschlossene Berufsausbildung
- ◯ Hochschulabschluss
- ◯ Promotion
- ◯ Habilitation

38. Bitte geben Sie die Tätigkeit an, der Sie im Moment nachgehen.

- ○ Schüler/in
- ○ Student/in
- ○ Auszubildende/r
- ○ Berufstätige/r
- ○ Rentner/in
- ○ Hausfrau/Hausmann
- ○ zur Zeit arbeitssuchend
- ○ Sonstiges (bitte angeben)

39. Bitte geben Sie das in Ihrem Haushalt verfügbare monatliche Nettoeinkommen an.

- ○ weniger als 1.000 Euro
- ○ 2.000 bis 3.000 Euro
- ○ 3.000 bis 4.000 Euro
- ○ 4.000 bis 5.000 Euro
- ○ mehr als 5.000 Euro
- ○ keine Angaben

Vielen Dank, dass Sie sich Zeit für die Beantwortung unserer Fragen genommen haben.

Appendix C: Survey structure

Table 7: Survey structure

Main survey parts	Questionnaire details	Items
(A) General information of participants / socio-demographic characteristics	- Region (postal code) (Item 1), - Rural/suburban/urban area (Item 2), - Number of people in household (Item 3) - Gender (Item 35), - Age class (Item 36), - Level of education (Item 37), - Occupation (Item 38) - Net income (Item 39)	1 2 3 35 36 37 38 39
(B) General questions regarding sustainability	- Attitude towards sustainability of own lifestyle (Item 4) - Attitude towards sustainability (Items 5a-5d) (5-level Likert scale)	4 5
(C) Role as a stakeholder	- Private/ commercial stakeholder; (Item 6) - Own use versus commercial use of the structure; (Item 7) - Size / type of the project (single, double or multifamily house, other) (Item 8)	6 7 8
(D) Previous experience	- Number of previous construction projects; (Item 9) - Previous experience with recycled construction materials (dichotome scale) (Item 10a-10f) - Open reflection (Item 11)	9 10 11
(E) Personal preferences / Ranking of decision criteria in construction projects	- Ranking of (Item 12) (six-level ranking scale) o Quality, o Cost/price, o Design, o Environmentally friendly construction (soil, air, water, eco systems), o Resource efficient construction (materials), o Energy efficient construction (energy consumption reduction, CO2 emission avoidance)	12
(F) Acceptance of RC construction materials	- Trust / reliance on five available recycled construction materials in different application areas of structural engineering (Items 15-18) - Existing application of RC material in the respondent's construction projects (Item 19), - Satisfaction with the material/experience (Item 20), - Planned use of RC material in the future (Items 21, 33), - Willingness to pay more for RC materials (Item 34)	15-18 19 20 21, 33 34
(G) Identification of rejection of RC construction materials; Comparison to RC materials	- Advantages or disadvantages of RC materials (in general, value increase of the real estate, etc.) (Items 26-28, 30, 32a-32d) - Comparative questions about recycled and conventional construction materials or products (Items 14a-14f) (5-level Likert scale),	26-28, 30, 32 14
(H) Knowledge / Information on conventional construction materials and RC materials and instruments	- Knowledge of materials (concrete, RC concrete, crushed concrete, PVC, RC-PVC, brick, RC brick, steel/metal, RC steel/metal, none, others) (Items 13, 29) - Status of information regarding RC construction materials during previous year (Item 22), - Source of information (Item 23), - Active demand for information on RC materials/products (Item 24), - Passive information given by architect or engineer (Item 25), - Knowledge of concepts like "design-for-Deconstruction", "building pass" etc. (Item 31)	13, 29 22 23 24 25 31

Appendix D: Data base of the survey

Table 8: Complete dataset of the structured interviews

	Items							
	1	2	3	4	5a	5b	5c	5d
	Bitte geben Sie die Postleitzahl ihres Wohnortes an.	Bitte präzisieren Sie ihren Wohnort. Ich wohne ...	Wie viele Personen leben in Ihrem Haushalt?	Wie nachhaltig schätzen Sie Ihren generellen Lebensstil ein?	Inwiefern stimmen Sie folgenden Aussagen zu ihrer ökologischen Einstellung zu?			
No.	Open-Ended Response	Response	Response	Open-Ended Response	"Ich konsumiere Produkte, die aus wiederverwertbaren Materialien hergestellt wurden (z.B. Recyclingpapier)."	"Wenn ich mir der negativen Auswirkung mancher Produkte auf die Umwelt bewusst bin, versuche ich diese Produkte nicht zu kaufen."	"Ein höherer Kaufpreis für umweltschonende Produkte sind für mich ok."	"Wenn ich Produkte kaufe, versuche ich, mir der Auswirkungen auf die Umwelt bewusst zu werden."
1	76646	Vorort	3	10	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise nicht zu	neutral
2	76646	Vorort	2	15	neutral	neutral	Stimme teilweise nicht zu	Stimme nicht zu
3	76646	Vorort	4	15	Stimme nicht zu	Stimme nicht zu	Stimme nicht zu	Stimme teilweise nicht zu
4	76756	Land	4	15	Stimme teilweise zu	Stimme teilweise nicht zu	Stimme teilweise nicht zu	Stimme teilweise nicht zu
5	76756	Land	4	15	Stimme teilweise zu	neutral	Stimme teilweise nicht zu	Stimme teilweise nicht zu
6	76756	Land	3	15	neutral	Stimme teilweise nicht zu	Stimme nicht zu	Stimme teilweise nicht zu
7	76646	Vorort	2	20	Stimme teilweise nicht zu	Stimme teilweise zu	Stimme nicht zu	Stimme teilweise nicht zu
8	71063	Vorort	4	25	Stimme teilweise nicht zu	Stimme teilweise zu	Stimme nicht zu	Stimme teilweise nicht zu
9	76646	Vorort	4	25	Stimme teilweise zu	Stimme voll zu	neutral	Stimme teilweise zu
10	76756	Land	3	30	Stimme teilweise zu	neutral	Stimme teilweise nicht zu	neutral
11	76646	Vorort	4	45	Stimme teilweise zu	Stimme teilweise zu	neutral	neutral
12	76646	Vorort	3	50	Stimme teilweise zu	Stimme voll zu	neutral	Stimme teilweise zu
13	67365	Land	2	50	neutral	Stimme teilweise zu	neutral	neutral
14	76726	Land	4	50	neutral	Stimme teilweise zu	Stimme voll zu	Stimme voll zu
15	76726	Land	4	50	neutral	Stimme teilweise zu	neutral	Stimme teilweise nicht zu
16	76726	Land	3	50	Stimme teilweise zu	Stimme teilweise zu	neutral	Stimme teilweise nicht zu
17	76646	Vorort	2	50	Stimme voll zu	Stimme teilweise zu	neutral	Stimme teilweise nicht zu
18	76646	Vorort	3	50	Stimme teilweise nicht zu	neutral	Stimme nicht zu	Stimme nicht zu
19	76756	Land	3	50	Stimme voll zu	Stimme teilweise nicht zu	Stimme nicht zu	neutral
20	76646	Vorort	3	55	neutral	Stimme teilweise zu	Stimme nicht zu	neutral
21	76646	Vorort	2	55	Stimme voll zu	Stimme teilweise zu	Stimme teilweise nicht zu	neutral
22	76726	Land	3	55	neutral	Stimme voll zu	Stimme teilweise zu	Stimme teilweise zu
23	76726	Vorort	5	55	Stimme teilweise zu	Stimme voll zu	neutral	Stimme teilweise nicht zu
24	76726	Land	4	55	neutral	Stimme voll zu	neutral	Stimme teilweise nicht zu
25	71063	Vorort	4	60	Stimme teilweise zu	Stimme voll zu	Stimme teilweise nicht zu	neutral
26	67354	Land	3	60	Stimme teilweise zu	Stimme teilweise zu	neutral	Stimme voll zu
27	76646	Vorort	2	70	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise nicht zu	neutral
28	76726	Land	5	70	neutral	Stimme teilweise zu	Stimme teilweise zu	neutral

29	71063	Vorort	2	75	Stimme voll zu	Stimme voll zu	Stimme teilweise zu	neutral
30	76646	Vorort	3	75	Stimme voll zu	Stimme teilweise zu	Stimme teilweise nicht zu	neutral
31	76646	Vorort	2	75	Stimme voll zu	Stimme voll zu	neutral	neutral
32	76646	Vorort	2	75	Stimme teilweise zu	Stimme voll zu	Stimme voll zu	Stimme voll zu
33	76646	Vorort	4	75	neutral	Stimme voll zu	Stimme teilweise nicht zu	neutral
34	76646	Vorort	2	75	neutral	Stimme voll zu	Stimme nicht zu	neutral
35	76756	Land	2	75	Stimme voll zu	Stimme teilweise zu	Stimme teilweise nicht zu	Stimme teilweise zu
36	76646	Vorort	4	80	Stimme teilweise zu	Stimme voll zu	Stimme teilweise nicht zu	Stimme teilweise zu
37	76756	Land	3	95	Stimme voll zu	Stimme voll zu	Stimme nicht zu	neutral
38	76646	Vorort	4	100	Stimme teilweise zu	Stimme voll zu	Stimme teilweise zu	Stimme teilweise zu
39	76646	Vorort	3	100	Stimme voll zu	Stimme voll zu	Stimme teilweise zu	Stimme voll zu
40	76646	Vorort	4	100	Stimme voll zu	Stimme voll zu	neutral	Stimme teilweise zu
41	76756	Land	3	100	Stimme voll zu	Stimme voll zu	Stimme nicht zu	Stimme teilweise nicht zu

	Items							
	6		7	8				9
	Welche Rolle nehmen Sie bei einem Bauvorhaben (Neubau, Modernisierungs-/Sanierungsmaßnahmen) ein?		Sind Sie Selbstnutzer Ihres Gebäudes/Ihrer Gebäude oder werden Sie das Gebäude/ die Gebäude vermieten/verkaufen?	Wie würden sie Ihr aktuelles/Ihre hauptsächlichen Bauvorhaben betiteln?				Wie viele Bauvorhaben haben Sie bereits in Auftrag gegeben?
No.	Response	Sonstiges (Bitte angeben)	Response	Einfamilienhaus/ Doppel-haus	Mehrfamilienhaus	Zusatzbauten (Garage, Gartenhaus,...)	Sonstiges (Bitte angeben)	Response
1	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
2	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
3	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
4	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
5	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
6	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
7	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
8	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
9	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
10	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
11	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
12	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
13	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
14	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
15	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
16	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
17	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	1
18	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
19	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
20	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
21	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
22	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
23	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
24	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
25	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
26	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
27	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
28	n/A	Bauaufsicht	Selbstnutzer	1	0	0	0	1
29	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
30	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
31	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	1	n/A	2 bis 10
32	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
33	Eigentümer/privater Bauherr	n/A	Selbstnutzer	0	0	1	n/A	2 bis 10
34	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
35	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
36	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
37	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
38	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
39	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1

40	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1
41	Eigentümer/privater Bauherr	n/A	Selbstnutzer	1	0	0	n/A	1

	Items						
	10a	10b	10c	10d	10e	10f	11
	Bitte beantworten Sie folgende Fragen.						Notizen (Bedenken)
No.	Kennen Sie RC-Baustoffe?	Haben Sie schon Erfahrungen mit dem Einsatz von RC-Baustoffen gemacht?	Kennen Sie jemanden, der Erfahrungen mit dem Einsatz von RC-Baustoffen gemacht hat?	Hatten Sie die Möglichkeit bei Ihrem Bauvorhaben RC-Baustoffe zu verwenden?	Haben Sie bei Ihrem Bauvorhaben RC-Baustoffe verwendet?	Haben Sie Bedenken, bei einem Bauvorhaben RC-Baustoffe zu verwenden?	Open-Ended Response
1	Nein	Nein	Nein	Nein	Nein	Ja	Qualität
2	Ja	Nein	Ja	Nein	Nein	Nein	n/A
3	Nein	Nein	Nein	Nein	Nein	Nein	n/A
4	Ja	Nein	Nein	Nein	Nein	Nein	n/A
5	Nein	Nein	Nein	Nein	Nein	Nein	n/A
6	Nein	Nein	Nein	Nein	Nein	Nein	n/A
7	Nein	Nein	Nein	Nein	Nein	Nein	n/A
8	Nein	Nein	Nein	Nein	Nein	Ja	n/A
9	Ja	Nein	Nein	Nein	Nein	Nein	n/A
10	Nein	Nein	Nein	Nein	Nein	Nein	n/A
11	Ja	Nein	Nein	Nein	Nein	Nein	n/A
12	Ja	Nein	Nein	Nein	Nein	Nein	n/A
13	Nein	Nein	Nein	Nein	Ja	Nein	n/A
14	Ja	Ja	Ja	Ja	Ja	Nein	n/A
15	Nein	Nein	Nein	Nein	Nein	Nein	n/A
16	Nein	Nein	Nein	Nein	Nein	Ja	n/A
17	Nein	Nein	Nein	Nein	Nein	Nein	n/A
18	Nein	Nein	Nein	Nein	Nein	Nein	n/A
19	Ja	Nein	Nein	Nein	Nein	Nein	n/A
20	Nein	Nein	Nein	Nein	Nein	Nein	n/A
21	Ja	Ja	Nein	Ja	Ja	Nein	n/A
22	Nein	Nein	Nein	Nein	Nein	Nein	n/A
23	Ja	Nein	Nein	Nein	Nein	Nein	n/A
24	Ja	Nein	Nein	Nein	Nein	Ja	n/A
25	Ja	Ja	Ja	Ja	Ja	Nein	n/A
26	Ja	Ja	Ja	Ja	Ja	Nein	n/A
27	Nein	Nein	Nein	Nein	Nein	Nein	n/A
28	Ja	Ja	Ja	Ja	Ja	Nein	n/A
29	Ja	Nein	Ja	Nein	Nein	Nein	n/A
30	Ja	Ja	Ja	Ja	Ja	Nein	n/A
31	Nein	Nein	Nein	Nein	Nein	Nein	n/A
32	Nein	Nein	Ja	Nein	Nein	Nein	n/A
33	Nein	Nein	Nein	Nein	Nein	Ja	n/A
34	Nein	Nein	Nein	Nein	Nein	Ja	n/A
35	Ja	Ja	Ja	Ja	Ja	Nein	n/A
36	Ja	Nein	Nein	Nein	Nein	Nein	n/A
37	Ja	Ja	Ja	Ja	Ja	Nein	n/A
38	Nein	Nein	Nein	Nein	Nein	Ja	n/A
39	Ja	Ja	Ja	Ja	Ja	Nein	n/A

40	Ja	Ja	Ja	Ja	Ja	Nein	n/A
41	Nein	Nein	Nein	Nein	Nein	Nein	n/A

	Items																
	12a	12b	12c	12d	12e	12f	13										
	Was ist Ihnen bei Ihrem Bauvorhaben am wichtigsten? (Bitte bringen Sie die folgenden Aspekte in eine Rangfolge; 1 = höchste Priorität, 6 = niedrigste Priorität)						Welche der folgenden Baustoffe kennen Sie?										
No.	Qualität	Kosten/ Preis	Design	Umweltfreundliches Bauen (Boden, Luft, Wasser, Ökosysteme)	Ressourceneffizientes Bauen (Rohstoffe)	Energieeffizientes Bauen (CO2-Vermeidung)	Beton	RC-Beton	Betonbruch	PVC	RC-PVC	Ziegel	RC-Ziegel	Stahl / Metall	RC-Stahl / RC-Metall	keinen	Sonstige (Bitte angeben)
1	1	2	3	4	6	5	1	0	0	1	0	1	0	1	0	0	n/A
2	1	2	3	4	5	6	1	1	1	1	0	1	0	1	1	0	n/A
3	1	2	3	4	5	6	1	0	0	0	0	1	0	1	0	0	n/A
4	1	2	5	3	4	6	1	1	1	1	0	1	0	1	0	0	n/A
5	1	2	3	4	5	6	1	0	0	0	0	1	0	1	0	0	n/A
6	1	2	3	4	5	6	1	0	0	1	0	1	0	1	0	0	n/A
7	1	2	3	4	5	6	1	0	1	1	0	1	0	1	0	0	n/A
8	1	2	3	5	4	6	1	0	1	0	0	1	0	1	0	0	n/A
9	1	2	4	3	6	5	1	1	1	1	0	1	0	1	1	0	n/A
10	1	2	3	4	5	6	1	0	1	1	0	1	0	1	0	0	n/A
11	2	1	5	3	4	6	1	1	0	1	0	1	0	1	1	0	RC-Schotter
12	1	2	6	4	3	5	1	1	0	1	0	1	0	1	1	0	n/A
13	1	2	3	6	4	5	1	0	0	1	0	1	0	1	0	0	n/A
14	1	4	3	6	5	2	1	1	1	1	1	1	1	1	1	0	n/A
15	1	2	3	4	5	6	1	0	0	1	0	1	0	1	0	0	n/A
16	2	1	3	4	5	6	1	0	0	1	0	1	0	1	0	0	n/A
17	1	3	2	5	4	6	1	0	0	0	0	1	0	1	0	0	n/A
18	1	2	5	3	4	6	1	0	0	1	0	1	0	1	0	0	n/A
19	1	2	3	4	5	6	1	1	0	1	0	1	0	1	1	0	n/A
20	1	2	3	4	5	6	1	0	0	1	0	1	0	1	0	0	Holz, Kunststoff, Yton
21	2	1	3	4	5	6	1	1	1	1	0	1	0	1	1	0	Füllmaterial aus RC-Stoffen (RC-Schotter)
22	1	3	6	2	5	4	1	0	1	1	0	1	0	1	0	0	n/A
23	1	2	4	3	5	6	1	1	0	0	0	1	0	1	1	0	n/A
24	1	3	5	2	4	6	1	1	0	1	0	1	0	1	1	0	n/A
25	1	2	5	3	4	6	1	1	1	1	0	1	0	1	1	0	RC-Schotter
26	2	1	4	3	6	5	1	1	1	1	1	1	1	1	0	0	n/A
27	2	1	6	3	4	5	1	0	0	1	0	1	0	1	0	0	Kunststoff, Holz, Schotter, Granit
28	1	3	4	5	6	2	1	1	1	1	1	1	1	1	1	0	n/A
29	1	2	5	3	4	6	1	1	1	0	0	1	0	1	0	0	RC-Kunststoff
30	2	1	6	3	4	5	1	1	1	1	0	1	0	1	1	0	Schotter, Holz, RC-Holz
31	2	1	5	3	4	6	1	0	0	0	0	1	0	1	0	0	n/A
32	1	4	5	6	3	2	1	0	0	1	0	1	0	1	0	0	n/A
33	1	2	3	6	4	5	1	0	0	1	0	1	0	1	0	0	n/A
34	1	2	3	5	4	6	1	0	0	1	0	1	0	1	0	0	n/A
35	1	3	6	4	5	2	1	1	1	1	0	1	0	1	1	0	n/A
36	1	2	3	4	5	6	1	1	0	1	0	1	0	1	1	0	n/A
37	1	2	4	3	5	6	1	1	1	1	0	1	1	1	1	0	Füllmaterial

38	4	1	6	2	3	5	1	0	1	1	0	1	0	1	0	0	n/A
39	1	2	6	3	4	5	1	1	1	1	1	1	1	1	1	0	n/A
40	1	4	5	2	3	6	1	1	1	1	1	1	1	1	1	0	n/A
41	2	6	1	4	5	3	1	0	0	1	0	1	0	1	0	0	Ytong, Schotter

	Items									
	14a	14b	14c	14d	14e	14f	15	16	17	18
	Inwieweit stimmen Sie folgenden Aussagen zu?						Wie sehr würden Sie dem Einsatz von RC-Baustoffen in den folgenden Anwendungsbereichen vertrauen?			
No.	"Die geringeren Einzelpreise von Baustoffen aus RC-Material im Vergleich zu herkömmlichen Baustoffen sind für mich ein wichtiger Faktor."	"Die geringere Umweltbelastung bei der Produktion von Baustoffen aus RC-Material im Vergleich zu herkömmlichen Baustoffen sind für mich ein wichtiger Faktor."	"Es gibt noch viele offene und ungeklärte Fragen rund um RC-Baustoffe."	"RC-Baustoffe besitzen dieselbe physikalische Zuverlässigkeit wie herkömmliche Baustoffe."	"Ich befürchte, bei der Verwendung von RC-Baustoffen, minderwertiges Material zu erhalten."	"Das Risiko bei der Verwendung von RC-Baustoffen erscheint mir sehr hoch."	Beton (Fundament, Geschossdecken, Stützen, Balken und Kellerwänden)	Stahl (Tragwerke, Verstärkungen von Mauerwerken)	Ziegel (Mauerwerk, Dach)	PVC (Rolladen, Rohre, Fensterrahmen, Bodenbeläge)
1	Stimme teilweise zu	Stimme teilweise zu	Stimme voll zu	Stimme nicht zu	Stimme voll zu	neutral	0	0	0	0
2	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise nicht zu	Stimme nicht zu	Stimme nicht zu	50	60	80	100
3	neutral	neutral	neutral	neutral	neutral	neutral	50	50	75	75
4	neutral	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise nicht zu	neutral	Stimme teilweise nicht zu	25	50	50	100
5	neutral	Stimme teilweise zu	Stimme teilweise zu	neutral	Stimme teilweise nicht zu	Stimme nicht zu	50	50	100	100
6	neutral	neutral	neutral	neutral	Stimme teilweise nicht zu	Stimme nicht zu	25	25	50	50
7	neutral	neutral	neutral	neutral	Stimme teilweise nicht zu	Stimme nicht zu	35	50	50	100
8	Stimme teilweise nicht zu	Stimme teilweise nicht zu	neutral	Stimme nicht zu	Stimme nicht zu	Stimme teilweise nicht zu	0	0	0	0
9	neutral	neutral	Stimme voll zu	Stimme teilweise nicht zu	neutral	Stimme teilweise nicht zu	50	65	75	100
10	neutral	neutral	neutral	neutral	neutral	neutral	25	25	50	100
11	Stimme teilweise zu	Stimme voll zu	Stimme teilweise zu	neutral	Stimme nicht zu	Stimme nicht zu	100	100	100	100
12	neutral	Stimme teilweise zu	Stimme voll zu	Stimme teilweise nicht zu	neutral	Stimme teilweise nicht zu	40	55	70	100
13	neutral	neutral	Stimme teilweise zu	neutral	neutral	neutral	75	50	75	75
14	Stimme voll zu	Stimme voll zu	neutral	neutral	neutral	neutral	75	75	50	75
15	Stimme teilweise zu	neutral	neutral	neutral	neutral	neutral	25	25	25	30
16	Stimme teilweise zu	Stimme teilweise zu	Stimme voll zu	neutral	neutral	neutral	0	0	15	45
17	neutral	neutral	neutral	neutral	neutral	neutral	0	0	25	30
18	neutral	neutral	neutral	neutral	neutral	Stimme teilweise nicht zu	50	75	100	100
19	neutral	Stimme teilweise zu	Stimme teilweise zu	Stimme teilweise zu	Stimme nicht zu	Stimme nicht zu	20	0	25	50
20	neutral	neutral	neutral	neutral	Stimme teilweise zu	neutral	0	0	0	50
21	Stimme voll zu	Stimme voll zu	Stimme nicht zu	Stimme voll zu	Stimme teilweise nicht zu	Stimme nicht zu	45	45	45	100
22	Stimme teilweise zu	Stimme voll zu	neutral	neutral	neutral	neutral	75	35	80	100

23	Stimme voll zu	Stimme voll zu	Stimme teil-weise zu	neutral	neutral	neutral	50	50	50	100
24	Stimme voll zu	Stimme voll zu	Stimme teil-weise zu	neutral	neutral	neutral	50	50	75	100
25	Stimme voll zu	Stimme teilweise nicht zu	Stimme teil-weise zu	neutral	Stimme nicht zu	Stimme nicht zu	100	100	100	100
26	Stimme voll zu	Stimme teilweise zu	Stimme voll zu	Stimme teilweise zu	Stimme nicht zu	Stimme nicht zu	100	100	100	50
27	neutral	Stimme teilweise zu	neutral	neutral	Stimme teilweise nicht zu	neutral	50	50	75	100
28	Stimme voll zu	Stimme voll zu	Stimme voll zu	Stimme voll zu	Stimme nicht zu	Stimme nicht zu	100	100	100	100
29	neutral	Stimme voll zu	neutral	neutral	Stimme nicht zu	Stimme nicht zu	70	75	80	100
30	Stimme teilweise zu	Stimme teilweise zu	Stimme voll zu	neutral	Stimme teilweise nicht zu	Stimme nicht zu	50	50	75	100
31	neutral	Stimme teilweise zu	neutral	neutral	Stimme teilweise nicht zu	Stimme nicht zu	50	65	100	100
32	neutral	neutral	neutral	neutral	Stimme nicht zu	neutral	50	50	50	50
33	neutral	neutral	neutral	neutral	Stimme voll zu	neutral	0	0	0	100
34	neutral	neutral	neutral	neutral	Stimme teilweise zu	neutral	0	0	15	75
35	Stimme teilweise zu	Stimme teilweise zu	Stimme teil-weise zu	neutral	Stimme teilweise nicht zu	Stimme nicht zu	50	25	25	100
36	neutral	neutral	neutral	Stimme teilweise nicht zu	Stimme teilweise zu	neutral	25	25	45	100
37	Stimme teilweise zu	Stimme teilweise zu	Stimme teil-weise zu	neutral	Stimme nicht zu	Stimme nicht zu	45	25	25	100
38	neutral	neutral	neutral	neutral	neutral	Stimme teil-weise nicht zu	30	70	55	60
39	Stimme voll zu	Stimme voll zu	Stimme teil-weise zu	Stimme teilweise zu	Stimme teilweise nicht zu	Stimme nicht zu	100	100	100	100
40	Stimme voll zu	Stimme voll zu	Stimme teil-weise zu	neutral	Stimme nicht zu	Stimme nicht zu	100	100	100	100
41	Stimme teilweise nicht zu	Stimme voll zu	neutral	Stimme teilweise zu	Stimme nicht zu	Stimme nicht zu	50	50	50	100

	Items															
	19					20	21		22	23						
	Welche RC-Baustoffe haben Sie bereits verwendet/verwenden Sie aktuell?					Wie zufrieden waren Sie damit? (in %)	Würden Sie RC-Baustoffe in Ihrem nächsten Bauvorhaben erneut einsetzen?		Haben Sie im vergangenen Jahr Informationen zu RC-Baustoffen erhalten, gelesen oder wahrgenommen?	Falls "Ja", in welcher Form?						
No.	RC-Beton	RC-Stahl	RC-PVC	RC-Ziegel	Sonstige (Bitte angeben)	Open-Ended Response	Response	Nein, aus folgendem Grund:	Response	Tageszeitung	Fachzeitschrift	Fernsehen	Baugenossenschaft	Kommune/ Land	Internet	Sonstiges (Bitte angeben)
1	0	0	0	0	keine	n/A	n/A	n/A	Ja	0	0	0	0	0	1	0
2	0	0	0	0	keine	n/A	n/A	n/A	Ja	0	1	0	0	0	1	0
3	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
4	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	1	0	0	0	1	0
5	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
6	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
7	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
8	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
9	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	0	1	0	0	1	0
10	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
11	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	1	0	0	0	1	0
12	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	0	1	0	0	1	0
13	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
14	0	0	0	0	RC-Schotter	75	Ja	n/A	Ja	0	1	0	1	0	0	0
15	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
16	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
17	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
18	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
19	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	1	1	0	0	1	0
20	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
21	1	0	0	0	Schotter aus Betonbruch	100	Ja	n/A	Ja	0	1	0	0	0	1	0
22	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
23	0	0	0	0	keine	n/A	n/A	n/A	Ja	0	0	1	0	0	1	0
24	0	0	0	0	Füllmaterial	100	Ja	n/A	Ja	0	1	0	1	0	0	0
25	1	0	0	1	RC-Schotter	100	Ja	n/A	Ja	0	1	0	1	0	1	0
26	1	0	0	1	keine	100	Ja	n/A	Ja	0	1	1	0	0	1	0
27	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
28	1	1	1	0	keine	100	Ja	n/A	Ja	0	0	1	0	0	1	0
29	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	0	0	0	0	0	0
30	1	1	0	0	keine	100	Ja	n/A	Ja	0	1	0	0	0	1	0
31	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
32	0	0	0	0	keine	n/A	Ja	n/A	Nein	0	0	0	0	0	0	0
33	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
34	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0
35	0	0	1	0	keine	100	Ja	n/A	Ja	0	1	0	0	0	1	0
36	0	0	0	0	keine	n/A	n/A	n/A	Ja	1	0	0	0	0	1	0

37	0	0	1	0	Füllmaterial	100	Ja	n/A	Ja	0	1	0	0	0	1	0
38	0	1	0	1	keine	30	Ja	n/A	Nein	0	0	0	0	0	0	0
39	0	0	0	0	Betonbruch, Füllmaterial	100	Ja	n/A	Ja	1	1	1	0	0	1	0
40	0	0	0	0	RC-Schotter	100	Ja	n/A	Ja	1	1	0	0	0	1	0
41	0	0	0	0	keine	n/A	n/A	n/A	Nein	0	0	0	0	0	0	0

	Items										
	24		25	26	27						
	Haben Sie sich selbst im Vorhinein Ihres Bauvorhabens aktiv über für Sie einsetzbare Baustoffe informiert?		Wurden Sie im Zuge der Planung Ihres Bauvorhabens/Ihrer Bauvorhaben über RC-Baustoffe informiert? (z.B. vom Architekten, vom Bauunternehmen, etc)	Sehen Sie einen Vorteil darin, mit RC-Baustoffen zu bauen?	Falls "Ja", welche Vorteile sehen Sie?						
No.	Response	Nein, da (anderer Grund):	Response	Response	Innovation	Qualität	Ressourcenschonung	Preis	Nachhaltigkeit	Verfügbarkeit	Sonstige (Bitte angeben)
1	Nein	n/A	Nein	Nein	0	0	0	0	0	0	0
2	Nein	n/A	Nein	Ja	1	0	1	1	1	0	0
3	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	1	0	1	0	0
4	Nein	n/A	Nein	Ja	0	0	1	1	1	0	0
5	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	0	0	0	0	0
6	Nein	n/A	Nein	Ja	0	0	1	1	0	0	0
7	Nein	n/A	Nein	Ja	1	0	1	0	1	0	0
8	n/A	egal	Nein	Nein	0	0	0	0	0	0	0
9	Nein	n/A	Nein	Ja	0	0	1	1	1	0	0
10	Nein	n/A	Ja	Nein	0	0	0	0	0	0	0
11	Nein	n/A	Nein	Ja	0	0	1	0	1	0	0
12	Ja	n/A	Nein	Ja	0	0	1	1	1	0	0
13	Ja	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	0	0	0	0	0
14	Ja	n/A	Ja	Nein	0	0	0	0	0	0	0
15	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	1	0	1	0	0
16	Nein	n/A	Nein	Nein	0	0	1	0	1	0	0
17	Nein	n/A	Nein	Ja	0	0	1	0	0	0	0
18	Nein	n/A	Nein	Ja	0	0	1	1	1	0	0
19	Nein	n/A	Nein	Ja	0	0	1	1	1	0	0
20	n/A	Fertig-haus	Nein	Nein	0	0	0	0	0	0	0
21	Ja	n/A	Nein	Ja	0	0	1	1	1	0	0
22	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	1	0	0	1	1	0	0
23	Nein	n/A	Nein	Nein	0	0	1	0	1	0	0
24	Ja	n/A	Ja	Ja	0	0	1	1	1	0	0
25	Ja	n/A	Nein	Ja	0	0	1	1	1	0	0
26	Ja	n/A	Ja	Ja	0	0	1	1	1	0	0
27	Nein	n/A	Nein	Ja	1	0	1	1	1	0	0
28	Ja	n/A	Nein	Ja	0	0	1	1	1	0	0
29	Nein	n/A	Nein	Ja	0	0	1	1	1	0	0
30	Ja	n/A	Nein	Ja	1	0	1	1	1	0	0
31	Nein	n/A	Ja	Ja	1	0	1	0	1	0	0

32	Ja	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	0	0	0	0	0
33	Nein	n/A	Nein	Nein	0	0	0	0	0	0	0
34	Nein	n/A	Nein	Nein	0	0	0	0	0	0	0
35	Nein	n/A	Nein	Ja	1	0	1	1	1	0	0
36	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	1	0	1	0	1	0	0
37	Ja	n/A	Ja	Ja	0	0	1	0	1	0	0
38	Ja	n/A	Nein	Nein	0	0	0	0	0	0	0
39	Nein	n/A	Ja	Ja	1	0	1	1	1	0	0
40	Ja	n/A	Nein	Ja	0	0	1	1	1	1	0
41	Nein	n/A	Nein	keine Kenntnisse über RC-Baustoffe	0	0	0	0	0	0	0

	Items												
	28						29						30
	Falls "Nein", welche Nachteile sehen Sie?						Haben Sie im Allgemeinen Kenntnisse über ... von RC-Baustoffen?						Sehen Sie eine Wertsteigerung für Ihre Immobilie durch die Verwendung von RC-Baustoffen? (Wiederverkauf,...)
No.	Innovation	Qualität	Preis	eingeschränkte Einsatzbereiche	Verfügbarkeit	Sonstige (Bitte angeben)	rechtliche Rahmenbedingungen	Qualität	Einsatzmöglichkeiten	Umweltauswirkung/-schonung	Nein, ich habe keine Kenntnisse	Sonstiges (Bitte angeben)	Response
1	0	1	0	0	0	0	0	1	0	0	0	0	Nein, im Gegenteil
2	0	0	0	1	1	0	0	0	1	1	0	0	Nein
3	0	0	0	1	1	0	0	0	0	0	1	0	Nein
4	0	0	0	0	0	0	0	0	0	0	1	0	Nein
5	0	0	0	0	0	0	0	0	0	0	1	0	Nein
6	0	0	0	1	0	0	0	0	0	0	1	0	Nein
7	0	1	0	1	0	0	0	0	0	0	1	0	Nein
8	0	1	0	0	1	0	0	0	0	0	1	0	Nein, im Gegenteil
9	0	0	0	0	0	0	0	0	0	0	1	0	Nein
10	0	1	0	1	1	0	0	0	0	0	1	0	Nein
11	0	0	0	1	1	0	1	0	0	1	0	0	Nein
12	0	0	0	0	0	0	0	0	0	0	1	0	Nein
13	0	0	0	1	0	0	0	0	0	0	1	0	Nein
14	0	1	0	1	0	0	1	1	1	1	0	0	Nein
15	0	1	0	0	0	0	0	0	0	0	1	0	Nein
16	0	1	0	0	0	0	0	0	0	0	1	0	Nein, im Gegenteil
17	0	0	0	0	0	0	0	0	0	0	1	0	Nein
18	0	0	0	1	1	0	0	0	0	0	1	0	Nein
19	0	0	0	1	1	0	1	0	0	1	0	0	Nein
20	0	1	0	0	1	0	0	0	0	0	1	0	Nein
21	0	0	0	0	0	0	0	0	0	0	1	0	Nein
22	0	1	0	1	1	0	0	0	0	0	1	0	Nein
23	0	1	0	0	0	0	0	0	0	0	1	0	Nein
24	0	0	0	0	0	0	0	0	1	1	0	0	Nein
25	0	0	0	1	0	0	0	0	1	0	0	0	Nein
26	0	0	0	0	0	0	0	1	1	1	0	0	Nein
27	0	0	0	0	0	0	0	0	0	0	1	0	Nein
28	0	0	0	0	0	0	0	1	1	1	0	0	Nein
29	0	0	0	0	1	0	0	0	0	0	1	0	Nein
30	0	0	0	0	0	0	0	0	0	1	0	0	Nein
31	0	0	0	1	1	0	0	0	0	0	1	0	Nein
32	0	0	0	0	0	0	0	0	0	0	1	0	Nein
33	0	1	0	1	0	0	0	0	0	0	1	0	Nein, im Gegenteil
34	0	1	0	1	0	0	0	0	0	0	1	0	Nein
35	0	0	0	0	0	0	1	1	1	1	0	0	Nein
36	0	1	0	1	0	0	0	0	0	0	1	0	Nein
37	0	0	0	1	0	0	0	1	0	1	0	0	Nein
38	0	0	1	0	1	0	0	0	0	0	1	0	Nein

39	0	0	0	1	1	0	1	1	1	1	0	0	Nein
40	0	0	0	1	1	0	1	1	1	1	0	0	Nein
41	0	0	0	0	0	0	0	0	0	0	1	0	Nein

	Items									
	31				32				33	34
	Sind Sie im Zuge Ihres Bauvorhabens/Ihrer Bauvorhaben mit Folgendem konfrontiert worden?				Welche der folgenden Punkte würden Sie als entscheidende Vorteile von Recycling-Baustoffen im Gegensatz zu Primärbaustoffen erachten?				Wie weit sind Sie davon entfernt, RC-Baustoffe in zukünftigen Bauprojekten zu verwenden?	Wie bereit wären Sie, einen Mehrpreis für RC-Baustoffe zu bezahlen?
No.	Konzept für selektiven Rückbau (Design-for-Deconstruction)	Verwendung eines Gebäudepasses	Keines davon	Andere Maßnahmen, die sich mit dem Gesamtlebenszyklus der eingesetzten Baustoffe befassen (Wiederverwertung, Recycling,...)	Finanzielle Förderung der Bauvorhaben durch staatliche Zuschüsse	Regelmäßige staatliche Prüfungen von Recyclingunternehmen	Höhere Materialstandards für Recyclingmaterial zur Qualitätssicherung	Sonstige (bitte angeben)	Open-Ended Response	Open-Ended Response
1	0	0	1	0	Ja	Ja	Ja	n/A	100	100
2	0	1	0	0	Ja	Ja	Ja	n/A	10	85
3	0	0	1	0	Ja	Ja	Ja	n/A	100	100
4	0	0	1	0	Ja	Ja	Ja	n/A	50	100
5	0	0	1	0	Ja	Ja	Ja	n/A	65	100
6	0	0	1	0	Ja	Ja	Ja	n/A	50	95
7	0	0	1	0	Ja	Ja	Ja	n/A	90	100
8	0	0	1	0	Ja	Ja	Ja	n/A	100	100
9	0	0	1	0	Ja	Ja	Ja	n/A	0	50
10	0	1	0	0	Ja	Ja	Ja	n/A	50	100
11	0	1	0	0	Ja	Ja	Ja	n/A	0	50
12	0	1	0	0	Ja	Ja	Ja	n/A	0	50
13	0	1	0	0	Ja	Ja	Ja	n/A	50	50
14	0	0	1	0	Ja	Ja	Ja	n/A	25	50
15	0	0	1	0	Ja	Ja	Ja	n/A	100	100
16	0	0	1	0	Ja	Ja	Ja	n/A	65	100
17	0	0	1	0	Ja	Ja	Ja	n/A	15	100
18	0	0	1	0	Ja	Ja	Ja	n/A	15	65
19	0	0	1	0	Ja	Ja	Ja	n/A	15	100
20	0	0	1	0	Ja	Ja	Ja	n/A	75	100
21	0	0	1	0	Ja	Ja	Ja	n/A	0	100
22	0	0	1	0	Ja	Ja	Ja	n/A	0	100
23	0	0	1	0	Ja	Ja	Ja	n/A	35	70
24	0	0	1	0	Ja	Ja	Nein	n/A	0	100
25	0	0	1	0	Ja	Ja	Ja	n/A	0	75
26	0	1	0	0	Ja	Ja	Ja	n/A	10	30
27	0	1	0	0	Ja	Ja	Ja	n/A	20	100
28	0	0	1	0	Ja	Ja	Nein	n/A	0	100
29	0	0	1	0	Ja	Ja	Ja	n/A	0	50
30	0	1	0	0	Ja	Ja	Ja	n/A	0	100
31	0	1	0	0	Ja	Ja	Ja	n/A	15	65
32	0	0	1	0	Ja	Ja	Ja	n/A	0	0
33	0	0	1	0	Ja	Ja	Ja	n/A	100	100
34	0	0	1	0	Ja	Ja	Ja	n/A	80	80
35	0	0	1	0	Ja	Ja	Ja	n/A	0	0
36	0	0	1	0	Ja	Ja	Ja	n/A	20	70

37	0	0	1	0	Ja	Ja	Ja	n/A	0	75
38	0	0	1	0	Ja	Ja	Ja	n/A	40	55
39	1	1	0	0	Ja	Ja	Ja	n/A	0	50
40	0	1	0	0	Ja	Ja	Ja	n/A	0	0
41	0	0	1	0	Ja	Ja	Ja	n/A	0	20

	Items					
	35	36	37	38		39
	Ihr Geschlecht:	Ihr Alter:	Geben Sie bitte Ihren höchsten Bildungsgrad an.	Bitte geben Sie die Tätigkeit an, der Sie im Moment nachgehen.		Bitte geben Sie das in Ihrem Haushalt verfügbare monatliche Nettoeinkommen an.
No.	Response	Response	Response	Response	Sonstiges (bitte angeben)	Response
1	männlich	66 bis 75	Volks- oder Hauptschulabschluss	Rentner/in	n/A	2000 bis 3000
2	weiblich	25 bis 34	Hochschulreife/Abitur	zur Zeit arbeitssuchend	n/A	3000 bis 4000
3	weiblich	35 bis 44	Abgeschlossene Berufsausbildung	Hausfrau/Hausmann	n/A	keine Angaben
4	weiblich	45 bis 54	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	keine Angaben
5	weiblich	35 bis 44	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	3000 bis 4000
6	männlich	35 bis 44	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	keine Angaben
7	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	4000 bis 5000
8	weiblich	35 bis 44	Fachhochschulreife/Fachabitur	Berufstätige/r	n/A	keine Angaben
9	weiblich	55 bis 65	Volks- oder Hauptschulabschluss	Berufstätige/r	n/A	4000 bis 5000
10	männlich	35 bis 44	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	keine Angaben
11	männlich	66 bis 75	Hochschulabschluss	Rentner/in	n/A	2000 bis 3000
12	männlich	35 bis 44	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	keine Angaben
13	männlich	25 bis 34	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	keine Angaben
14	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	keine Angaben
15	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	keine Angaben
16	weiblich	55 bis 65	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	3000 bis 4000
17	weiblich	25 bis 34	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	2000 bis 3000
18	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	mehr als 5000
19	männlich	45 bis 54	Hochschulreife/Abitur	Berufstätige/r	n/A	3000 bis 4000
20	weiblich	45 bis 54	Abgeschlossene Berufsausbildung	Hausfrau/Hausmann	n/A	keine Angaben
21	männlich	45 bis 54	Fachhochschulreife/Fachabitur	Berufstätige/r	n/A	4000 bis 5000
22	männlich	45 bis 54	Fachhochschulreife/Fachabitur	Berufstätige/r	n/A	mehr als 5000
23	männlich	45 bis 54	Fachhochschulreife/Fachabitur	Berufstätige/r	n/A	keine Angaben
24	männlich	35 bis 44	Hochschulreife/Abitur	Berufstätige/r	n/A	3000 bis 4000
25	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	mehr als 5000
26	männlich	45 bis 54	Hochschulabschluss	Berufstätige/r	n/A	4000 bis 5000
27	männlich	35 bis 44	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	keine Angaben
28	männlich	45 bis 54	Fachhochschulreife/Fachabitur	Berufstätige/r	n/A	3000 bis 4000
29	weiblich	25 bis 34	Hochschulreife/Abitur	zur Zeit arbeitssuchend	n/A	3000 bis 4000
30	männlich	55 bis 65	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	3000 bis 4000
31	weiblich	35 bis 44	Abgeschlossene Berufsausbildung	zur Zeit arbeitssuchend	n/A	keine Angaben
32	weiblich	55 bis 65	Volks- oder Hauptschulabschluss	Berufstätige/r	n/A	4000 bis 5000
33	weiblich	45 bis 54	mittlere Reife/Realschulabschluss	Berufstätige/r	n/A	keine Angaben
34	männlich	66 bis 75	Hochschulreife/Abitur	Rentner/in	n/A	keine Angaben
35	männlich	45 bis 54	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	keine Angaben
36	männlich	45 bis 54	Hochschulabschluss	Berufstätige/r	n/A	4000 bis 5000
37	männlich	55 bis 65	Abgeschlossene Berufsausbildung	Rentner/in	n/A	2000 bis 3000
38	männlich	55 bis 65	Hochschulabschluss	Berufstätige/r	n/A	keine Angaben
39	männlich	45 bis 54	Hochschulabschluss	Berufstätige/r	n/A	keine Angaben
40	männlich	35 bis 44	Abgeschlossene Berufsausbildung	Berufstätige/r	n/A	3000 bis 4000
41	weiblich	25 bis 34	Abgeschlossene Berufsausbildung	Hausfrau/Hausmann	n/A	keine Angaben

Appendix E: Analysis tables of the survey

Tables

Table 9: Socio-demographic characteristics of the survey sample compared to population statistics

	Survey sample (n=41)		Population in Germany
Gender			
Male [%]	65.9		49.3[45]
Female [%]	34.1		50.7
Age [%]			
18 - 24 years	0	0	10.7[46]
25 - 34 years	12.2	36.6	24.9[46]
35 - 44 years	24.4		
45 – 54 years	41.5	56.1	30.1[46]
55 – 64 years	14.6		
65 – 74 years	7.3		
75 – 84 years	0	7.3	21.1[46]
> 85 years	0		
Employment rate [%]	92.7		96.6[47]
Employed persons [%]	75.6		-
Retired persons [%]	9.8		-
Housewife/-husband [%]	7.3		-
Unemployed persons [%]	7.3		-
Highest level of general education [%][48]			
Secondary education (Hauptschule)	7.3		30.4[49]
Secondary education (Realschule)	14.6		23.1[49]
Higher education entrance qualifications (Abitur, Fachabitur)	24.4[50]		31.9[49]
Highest level of professional education [%]			
University degree	12.2		16.5[49]
Industrial training (Berufsausbildung)	41.5		47.5[49]
Household net income per month [%]			
< 1000 €	0		-
2000 - 3000 €	9.8		-
3000 – 4000 €	22.0		-
4000 – 5000 €	14.6		-
> 5000 €	7.3		-
Not specified	46.3		-
Average household net income per month [€]	3861[51]		3314[52]

[45] Data from DESTATIS (2018a): Male population in Germany (status: 30.09.2017), https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Bevoelkerung/Bevoelkerungsstand/Tabellen/Zensus_Geschlecht_Staatsangehoerigkeit.html

[46] Data from DESTATIS (2018b): Age groups 15-25 years, 25-45 years, 45-65 years and >65 years (status 2015), https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Bevoelkerung/Bevoelkerungsstand/Tabellen/AltersgruppenFamilienstandZensus.html

[47] Data from DESTATIS (2018c): Unemployment rate (status: July 2018), https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/Arbeitsmarkt/Erwerbslosigkeit/Erwerbslosigkeit.html

[48] Due to the survey design, the total of the respondents responded

[49] Data from DESTATIS (2018d): Highest level of education (status: 2017), https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/BildungForschungKultur/Bildungsstand/Tabellen/Bildungsabschluss.html

[50] If the respondents with “university degree” are included, this value increases to 36.6%. The respondents with “industrial training” as the highest professional degree cannot be clearly assigned to a general education level.

[51] Calculated average value from specified household net income per month with weighted mean of the income classes.

[52] Data from DESTATIS (2018e): Income statistics (status: 2016) https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/EinkommenEinnahmenAusgaben/Tabellen/Deutschland.html

Table 10: Number of construction projects of interviewees (Item 9)

Number of awarded construction projects	Responses [number] [%]
1	31 [76%]
2-10	10 [24%]
10-50	0 [0%]
>50	0 [0%]

Table 11: Average values of ecological behaviour (Item 5)

Ecological behaviour	Average value of assessment
"I consume products made from recyclable materials (e.g., recycled paper)."	0.78
"When I am aware of the negative impact of some products on the environment, I try not to buy these products."	1.10
"A higher purchase price for environmentally friendly products are ok for me."	-0.56
"When I buy products, I try to be aware of the environmental impact."	-0.02

Table 12: Knowledge of materials in [%]; "Do you know the following materials? (yes/no)" (Item 13)

Material	[%]
Concrete	100
RC concrete	49
Shredded concrete	46
PVC	83
RC PVC	12
Brick	100
RC brick	15
Steel / Metal	100
RC Steel/ Metal	41
none	0

Table 13: Cross tabulation of items 4 (sustainable lifestyle) and 10a (knowledge on RC construction products)

		10a. Do you know RC construction materials/products?		
		Ja / Yes	Nein / No	Total
4. How sustainable do you think your general lifestyle is?	[0;20]	2 (29%)	5 (71%)	7 (100%)
	]20;40]	1 (33%)	2 (67%)	3 (100%)
	]40;60]	9 (56%)	7 (44%)	16 (100%)
	]60;80]	5 (50%)	5 (50%)	10 (100%)
	]80;100]	3 (60%)	2 (40%)	5 (100%)
	Total	20	21	41

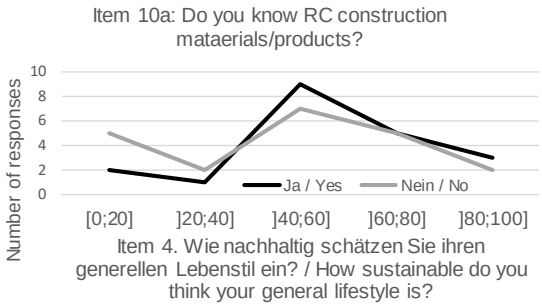


Table 14: Cross tabulation of items 4 (sustainable lifestyle) and 10d (usage of RC construction products)

		10d. Did you use RC construction materials/products in your construction project?		
		Ja / Yes	Nein / No	Total
4. How sustainable do you think your general lifestyle is?	[0;20]	0 (0%)	7 (100%)	7 (100%)
	]20;40]	0 (0%)	3 (100%)	3 (100%)
	]40;60]	5 (31%)	11 (69%)	16 (100%)
	]60;80]	3 (30%)	7 (70%)	10 (100%)
	]80;100]	3 (60%)	2 (40%)	5 (100%)
	Total	11	30	41

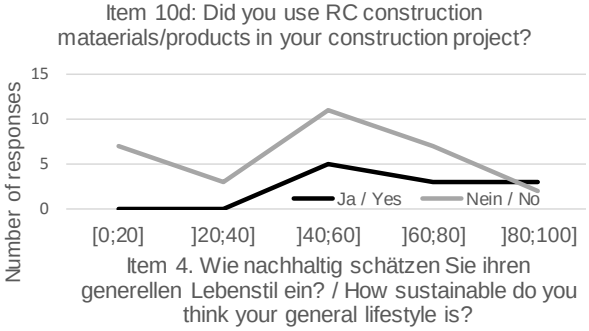


Table 15: Cross tabulation of item 4 and item 33 (colouring between matrix minimum and maximum)

		Item 33. How far are you from using RC building materials in future construction projects?					
		]80;100]	]60;80]	]40;60]	]20;40]	[0;20]	Total
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	3	1	2	0	1	**7**
	]20;40]	1	0	1	0	1	**3**
	]40;60]	1	2	1	2	10	**16**
	]60;80]	1	1	0	0	8	**10**
	]80;100]	0	0	0	1	4	**5**
	Total	**6**	**4**	**4**	**3**	**24**	**41**

Table 16: Cross tabulation of item 4 and item 24 (colouring between matrix minimum and maximum)

		Item 24. Did you actively inform yourself about construction materials you can use in advance of your construction project?			
		Yes	No	n/A	Total
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	0	7	0	**7**
	]20;40]	0	2	1	**3**
	]40;60]	7	8	1	**16**
	]60;80]	3	7	0	**10**
	]80;100]	3	2	0	**5**
	Total	**13**	**26**	**2**	**41**

Table 17: Cross tabulation of item 4 and item 5a (colouring between matrix line minima and maxima)

		Item 5a. "I consume products made from recyclable materials (e.g., recycled paper)."				
		Disagree	Partly disagree	Neutral	Partly agree	Agree
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	1	1	2	3	0
	]20;40]	0	1	0	2	0
	]40;60]	0	1	6	6	3
	]60;80]	0	0	3	3	4
	]80;100]	0	0	0	1	4

Table 18: Cross tabulation of item 4 and item 5b (colouring between matrix line minima and maxima)

		Item 5b. "When I am aware of the negative impact of some products on the environment, I try not to buy these products."				
		Disagree	Partly disagree	Neutral	Partly agree	Agree
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	1	2	2	2	0
	]20;40]	0	0	1	1	1
	]40;60]	0	1	1	9	5
	]60;80]	0	0	0	4	6
	]80;100]	0	0	0	5	4

Table 19: Cross tabulation of item 4 and item 5c (colouring between matrix line minima and maxima)

		Item 5c. "A higher purchase price for environmentally friendly products is ok for me. "				
		Disagree	Partly disagree	Neutral	Partly agree	Agree
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	3	4	0	0	0
	]20;40]	1	1	1	0	0
	]40;60]	3	2	9	1	1
	]60;80]	1	5	1	2	1
	]80;100]	2	0	1	2	0

Table 20: Cross tabulation of item 4 and item 5d (colouring between matrix line minima and maxima)

		Item 5d." When I buy products, I try to be aware of the environmental impact."				
		Disagree	Partly disagree	Neutral	Partly agree	Agree
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	1	5	1	0	0
	]20;40]	0	1	1	1	0
	]40;60]	1	5	6	2	2
	]60;80]	0	0	7	2	1
	]80;100]	0	1	1	2	1

Table 21: Cross tabulation of item 4 and item 12 (average ranking per interval of item 4) (colouring between matrix line minima and maxima)

		Item 12. "What is most important in your construction project?"					
		Quality	Cost /price	Design	Environm. friendly construction*	Resource efficient construction (raw materials)	Energy efficient construction (CO_2 avaoidance)
Item 4. How sustainable do you think your general lifestyle is?	[0;20]	1.00	2.00	3.29	3.86	5.00	5.86
	]20;40]	1.00	2.00	3.33	4.00	5.00	5.67
	]40;60]	1.25	2.06	3.94	3.75	4.56	5.44
	]60;80]	1.30	2.10	4.60	4.20	4.30	4.50
	]80;100]	1.80	3.00	4.40	2.80	4.00	5.00

*soil, air, water, eco systems

Table 22: Cross tabulation of importance of RC construction material/product prices (Item 14a) and rural or suburban (Item 2) area [Number of responses]

	Rural area	**Suburban area**	**Total**
Neutral	6	15	**21**
Partly disagree	1	1	**2**
Partly agree	5	4	**9**
Agree	4	5	**9**
Total	**16**	**25**	**41**

Table 23: Cross tabulation of RC construction material/product prices (Item 14a) and postal codes (Item 1) or states [Number of responses]

	Rheinland-Pfalz			**Baden-Württemberg**			
	67354 RLP	**67365 RLP**	**76726 RLP**	**76756 RLP**	**71063 BW**	**76646 BW**	**Total**
Neutral	0	1	0	5	1	14	**21**
Partly disagree	0	0	0	1	1	0	**2**
Partly agree	0	0	3	2	0	4	**9**
Agree	1	0	4	0	1	3	**9**
Total	**1**	**1**	**7**	**8**	**3**	**21**	**41**

Table 24: Cross-checks of items 5 (ecological attitude) and 12 (decision criteria for construction)

Item 5 (ecological attitude):		**Item 12 (decision criteria for construction):** What is most important to you in your construction project? [Average value of the rank]					
		Quality	Cost/ Price	Design	Environmentally friendly construction*	Resource efficient construction**	Energy efficient construction***
5a: "I consume products made from reusable materials (such as recycled paper). "	Disagree	1.00	2.00	3.00	4.00	5.00	6.00
	Partly disagree	1.00	2.00	3.67	4.00	4.33	6.00
	Neutral	1.00	2.45	3.55	4.36	4.73	4.91
	Partly agree	1.47	1.80	4.33	3.53	4.53	5.33
	Agree	1.36	2.45	4.18	3.45	4.36	5.18
5b: "When I am aware of the negative impact of some products on the environment, I try not to buy these products."	Disagree	1.00	2.00	3.00	4.00	5.00	6.00
	Partly disagree	1.00	2.00	3.67	3.67	4.67	6.00
	Neutral	1.00	2.00	3.50	3.75	4.75	6.00
	Partly agree	1.38	1.94	3.75	4.19	4.81	4.94
	Agree	1.29	2.47	4.47	3.41	4.18	5.18
5c: "A higher purchase price for environmentally friendly products is ok for me."	Disagree	1.10	2.40	3.10	4.00	4.70	5.70
	Partly disagree	1.25	1.83	4.08	3.83	4.67	5.33
	Neutral	1.33	2.00	4.08	3.50	4.42	5.67
	Partly agree	1.60	2.20	5.40	3.00	4.40	4.40
	Agree	1.00	4.00	4.00	6.00	4.00	2.00
5d:"When I buy products, I try to be aware of the effects on the environment."	Disagree	1.00	2.00	4.00	3.50	4.50	6.00
	Partly disagree	1.17	2.42	3.17	3.83	4.67	5.75
	Neutral	1.31	1.75	4.00	3.94	4.56	5.44
	Partly agree	1.43	2.43	5.14	3.00	4.29	4.71
	Agree	1.25	2.75	4.50	4.50	4.50	3.50

*: (soil, air, water, ecosystems); **: (raw materials); ***: (CO_2 avoidance)

Table 25: Factor analysis 1 of items 5a-d (ecological attitude) and 14a-f (attitude towards recycling)

Observed variables	Unique-ness[53]	Communality (sum of squared factor loadings) h_a^2	Loadings			
			Factor 1	Factor 2	Factor 3	Factor 4
Item_5a	0.58	0.3961	-0.44	0.45		
Item_5b	0.63	0.3712		0.56	0.24	
Item_5c	0.36	0.5986		0.69	0.35	
Item_5d	0.36	0.6400		**0.80**		
Item_14a	0.52	0.4630		0.30	0.47	0.39
Item_14b	0.22	0.7225			-0.85	
Item_14c	0.00	0.9409				**0.97**
Item_14d	0.69	0.2665	-0.37		0.36	
Item_14e	0.42	0.5876	**0.74**		-0.20	
Item_14f	0.00	0.9604	**0.98**			
SS loadings			1.90	1.79	1.33	1.20
Proportion Var			0.19	0.18	0.13	0.12
Cumulative Var			0.19	0.37	0.50	0.62

Table 26: Reliability analysis with Cronbach's Alpha for factor analysis 1

Values of Reliability analysis		
raw_alpha		0.72
std.alpha		0.72
G6(smc)		0.82
average_r		0.21
S/N		2.6
ase		0.065
mean		3.2
sd		0.54
median_r		0.21
95% confidence boundaries:	lower	0.6
	alpha	0.72
	upper	0.85

Table 27: Reliability analysis for received four factors of factor analysis 1

	Reliability if an item is dropped								**Item statistics**						
	raw_alpha	**std.alpha**	**G6(smc)**	**average_r**	**S/N**	**alpha se**	**var.r**	**med.r**	**n**	**raw.r**	**std.r**	**r.cor**	**r.drop**	**mean**	**sd**
Item_5a	0.69	0.69	0.80	0.20	2.2	0.073	0.045	0.16	41	0.59	0.60	0.54	0.45	3.8	1.01
Item_5b	0.70	0.71	0.80	0.21	2.4	0.071	0.040	0.20	41	0.54	0.52	0.45	0.38	4.1	1.02
Item_5c	0.68	0.69	0.79	0.20	2.2	0.075	0.038	0.20	41	0.63	0.61	0.58	0.48	2.4	1.14
Item_5d	0.69	0.69	0.80	0.20	2.2	0.073	0.041	0.21	41	0.60	0.58	0.53	0.45	3.0	1.04
Item_14a	0.68	0.68	0.79	0.19	2.1	0.075	0.045	0.17	41	0.64	0.66	0.62	0.52	2.6	0.89
Item_14b	0.71	0.71	0.80	0.22	2.5	0.068	0.038	0.21	41	0.51	0.47	0.42	0.32	3.3	1.18
Item_14c	0.73	0.74	0.82	0.24	2.8	0.064	0.037	0.23	41	0.30	0.34	0.26	0.15	2.6	0.80
Item_14d	0.70	0.70	0.81	0.21	2.4	0.071	0.043	0.20	41	0.51	0.53	0.46	0.39	3.0	0.79
Item_14e	0.70	0.70	0.79	0.21	2.3	0.069	0.037	0.21	41	0.54	0.54	0.52	0.37	3.6	1.13
Item_14f	0.71	0.71	0.78	0.21	2.4	0.067	0.032	0.21	41	0.48	0.50	0.49	0.33	4.0	0.94

[53] The uniqueness describes the unique variances of the variables that are not explained by the resulting factors (Finch and French, 2015).

	Non missing frequency of each item					
	1	**2**	**3**	**4**	**5**	**miss**
Item_5a	0.02	0.07	0.27	0.37	0.27	0
Item_5b	0.02	0.07	0.10	0.39	0.41	0
Item_5c	0.24	0.29	0.29	0.12	0.05	0
Item_5d	0.05	0.29	0.39	0.17	0.10	0
Item_14a	0.05	0.51	0.22	0.22	0.00	0
Item_14b	0.27	0.05	0.37	0.32	0.00	0
Item_14c	0.02	0.49	0.32	0.17	0.00	0
Item_14d	0.05	0.12	0.68	0.10	0.05	0
Item_14e	0.29	0.22	0.37	0.07	0.05	0
Item_14f	0.44	0.15	0.41	0.00	0.00	0

Table 28: Factor analysis 2 of items 5a-d (ecological attitude), 14a-f (attitude towards recycling), 15-18 (trust) and 33-34 (future behaviour)

Observed variables	Unique-ness	Communality (sum of squared factor loadings) h_a^2	Loadings				
			Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Item_5a	0.15	0.8411		0.39	-0.31		**0.77**
Item_5b	0.56	0.4096		0.64			
Item_5c	0.39	0.4811	0.31	0.65		0.25	
Item_5d	0.44	0.5184		**0.72**			
Item_14a	0.00	0.9509		0.22		**0.95**	
Item_14b	0.63	0.3219		-0.37		-0.25	0.35
Item_14c	0.81	0.1296				0.36	
Item_14d	0.74	0.2113			-0.33	0.32	
Item_14e	0.31	0.6890	-0.31		**0.77**		
Item_14f	0.14	0.8259	-0.29		**0.83**		-0.23
Item_15	0.07	0.8934	**0.70**	0.37	-0.36	0.37	
Item_16	0.12	0.8657	**0.78**	0.29	-0.34	0.24	
Item_17	0.00	0.9809	**0.97**		-0.20		
Item_18	0.65	0.3025	0.55				
Item_33	0.34	0.6241	-0.48	-0.38	0.27		-0.42
Item_34	0.31	0.6337		-0.71	0.36		
SS loadings			3.00	2.60	2.06	1.59	1.09
Proportion Var			0.19	0.16	0.13	0.10	0.07
Cumulative Var			0.19	0.35	0.48	0.58	0.65

Table 29: Reliability analysis with Cronbach's Alpha for factor analysis 2

Values of Reliability analysis		
raw_alpha		0.88
std.alpha		0.87
G6(smc)		0.94
average_r		0.29
S/N		6.7
ase		0.026
mean		3.2
sd		0.68
median_r		0.31
95% confidence boundaries:	lower	0.83
	alpha	0.88
	upper	0.93

Table 30: Reliability analysis for received five factors of factor analysis 2

	Reliability if an item is dropped								Item statistics						
	raw_alpha	std.alpha	G6(smc)	average_r	S/N	alpha se	var.r	med.r	n	raw.r	std.r	r.cor	r.drop	mean	sd
Item_5a	0.87	0.87	0.94	0.30	6.5	0.027	0.043	0.32	41	0.49	0.51	0.48	0.41	3.8	1.01
Item_5b	0.88	0.87	0.94	0.31	6.6	0.026	0.041	0.32	41	0.44	0.44	0.40	0.35	4.1	1.02
Item_5c	0.87	0.86	0.93	0.30	6.3	0.027	0.041	0.30	41	0.57	0.56	0.55	0.49	2.4	1.14
Item_5d	0.87	0.86	0.94	0.30	6.4	0.027	0.042	0.32	41	0.52	0.53	0.50	0.45	3.0	1.04
Item_14a	0.87	0.86	0.93	0.29	6.2	0.028	0.044	0.31	41	0.56	0.59	0.57	0.50	2.6	0.89
Item_14b	0.88	0.87	0.94	0.30	6.6	0.026	0.041	0.32	41	0.47	0.46	0.43	0.38	3.3	1.18
Item_14c	0.88	0.88	0.94	0.32	7.0	0.026	0.038	0.34	41	0.26	0.30	0.24	0.19	2.6	0.80
Item_14d	0.87	0.87	0.94	0.30	6.5	0.027	0.043	0.32	41	0.48	0.50	0.45	0.42	3.0	0.79
Item_14e	0.87	0.86	0.93	0.29	6.3	0.028	0.040	0.32	41	0.58	0.58	0.57	0.51	3.6	1.13
Item_14f	0.87	0.86	0.93	0.30	6.4	0.027	0.039	0.31	41	0.53	0.54	0.53	0.46	4.0	0.94
Item_15	0.85	0.85	0.92	0.27	5.5	0.032	0.036	0.29	41	0.88	0.87	0.89	0.85	2.8	1.29
Item_16	0.86	0.85	0.93	0.27	5.6	0.031	0.037	0.29	41	0.84	0.82	0.84	0.80	2.9	1.31
Item_17	0.86	0.86	0.93	0.28	5.9	0.030	0.037	0.31	41	0.74	0.71	0.73	0.67	3.3	1.34
Item_18	0.87	0.87	0.94	0.30	6.4	0.027	0.042	0.32	41	0.54	0.53	0.49	0.46	4.2	1.19
Item_33	0.86	0.85	0.93	0.28	5.8	0.030	0.042	0.25	41	0.78	0.76	0.75	0.71	3.9	1.56
Item_34	0.87	0.86	0.93	0.29	6.2	0.028	0.043	0.31	41	0.61	0.60	0.58	0.53	2.0	1.31

	Non missing frequency of each item					
	1	2	3	4	5	miss
Item_5a	0.02	0.07	0.27	0.37	0.27	0
Item_5b	0.02	0.07	0.10	0.39	0.41	0
Item_5c	0.24	0.29	0.29	0.12	0.05	0
Item_5d	0.05	0.29	0.39	0.17	0.10	0
Item_14a	0.05	0.51	0.22	0.22	0.00	0
Item_14b	0.27	0.05	0.37	0.32	0.00	0
Item_14c	0.02	0.49	0.32	0.17	0.00	0
Item_14d	0.05	0.12	0.68	0.10	0.05	0
Item_14e	0.29	0.22	0.37	0.07	0.05	0
Item_14f	0.44	0.15	0.41	0.00	0.00	0
Item_15	0.20	0.20	0.37	0.10	0.15	0
Item_16	0.20	0.17	0.34	0.15	0.15	0
Item_17	0.15	0.12	0.27	0.24	0.22	0
Item_18	0.05	0.05	0.17	0.10	0.63	0
Item_33	0.59	0.07	0.10	0.10	0.15	0
Item_34	0.10	0.02	0.20	0.17	0.51	0

Table 31: Relative Importance Index for Items 5a-5d and 14a-14f (with Likert's scale)

Item number	***5a***	***5b***	***5c***	***5d***	***14a***	***14b***	***14c***	***14d***	***14e***	***14f***
Agree	11	17	2	4	9	11	7	2	2	0
Partially agree	15	16	5	7	9	13	13	4	3	0
Neutral	11	4	12	16	21	15	20	28	15	17
Partial disagree	3	3	12	12	2	2	0	5	9	6
Disagree	1	1	10	2	0	0	1	2	12	18
Total	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
RII	***0.7561***	***0.8195***	***0.4878***	***0.5951***	***0.7220***	***0.7610***	***0.7220***	***0.5951***	***0.4732***	***0.3951***

Table 32: Used media for information on RC construction materials/products

Medium	Daily newspaper	Professional journal	TV	Cooperative building association	Municipality/ State	Internet	Others
Number of respondents	9	14	7	3	0	18	0
[%]	22.0%	34.1%	17.1%	7.3%	0.0%	43.9%	0.0%

Table 33: t-test of confidence in RC construction materials/products

	Mean	Sample variance	Standard error of the sample	Variance	Standard deviation	t-Statistics	95%-Quantile
Concrete	45.976	972.774	31.189	949.048	30.807	-0.826	2.02
Steel	46.829	1035.945	32.186	1010.678	31.791	-0.631	2.02
Brick	57.561	1066.402	32.656	1040.393	32.255	1.483	2.02
PVC	80.854	859.878	29.324	838.905	28.964	6.737	2.02

Table 34: Cross tabulation of items 24 and 25

		Item 25: Did you actively inform yourself about building materials you can used in advance of your construction project?		
		Yes	**No**	**Sum**
Item 24: Were you informed about RC construction materials/products in the course of planning your construction project? (e.g. by the architect, the contractor, etc.)	**Yes**	4 (9.76%)	9 (21.95%)	13 (31.71%)
	No	3 (7.32%)	**23 (56.10%)**	26 (63.41%)
	No, because…	0 (0,00%)	2 (4,88%)	2 (4,88%)
	Sum	7 (17.07%)	34 (82.93%)	41 (100%)

Table 35: Decision criteria of private awarding authorities

Decision criteria of private awarding authorities	Average value of ranking
Quality	1.27
Cost	2.17
Environmentally friendly construction (soil, air, water, eco systems)	3.78
Design	4.00
Resource efficient construction (materials)	4.54
Energy efficient construction (CO_2 avoidance)	5.24

Table 36: Heat map and cross tabulation of decision criteria of private awarding authorities and their priorities in their construction works (colouring follows equal intervals: 0-7, 8-15, 16-23, 24-31, 32-39, >40)

Decision criteria of private clients/owners	Priority (1: high priority, 6: low priority)					
	1	**2**	**3**	**4**	**5**	**6**
Quality	78,05%	19,51%	0,00%	2,44%	0,00%	0,00%
	32	8	0	1	0	0
Cost / price	19,51%	58,54%	12,20%	7,32%	0,00%	2,44%
	8	24	5	3	0	1
Design	2,44%	2,44%	43,90%	12,20%	21,95%	17,07%
	1	1	18	5	9	7
Environmentally friendly construction (soil, air, water, ecosystems)	0,00%	9,76%	31,71%	39,02%	9,76%	9,76%
	0	4	13	16	4	4
Resource efficient construction (materials)	0,00%	0,00%	9,76%	36,59%	43,90%	9,76%
	0	0	4	15	18	4
Energy efficient construction (CO_2 avoidance)	0,00%	9,76%	2,44%	2,44%	24,39%	60,98%
	0	4	1	1	10	25

Appendix F: Analysis figures of the survey

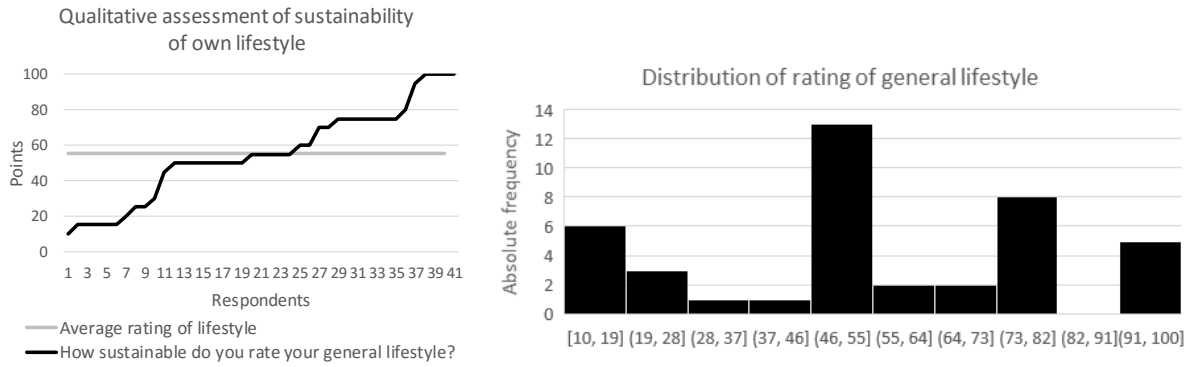


Figure 6: Assessment of general lifestyle (Item 4)

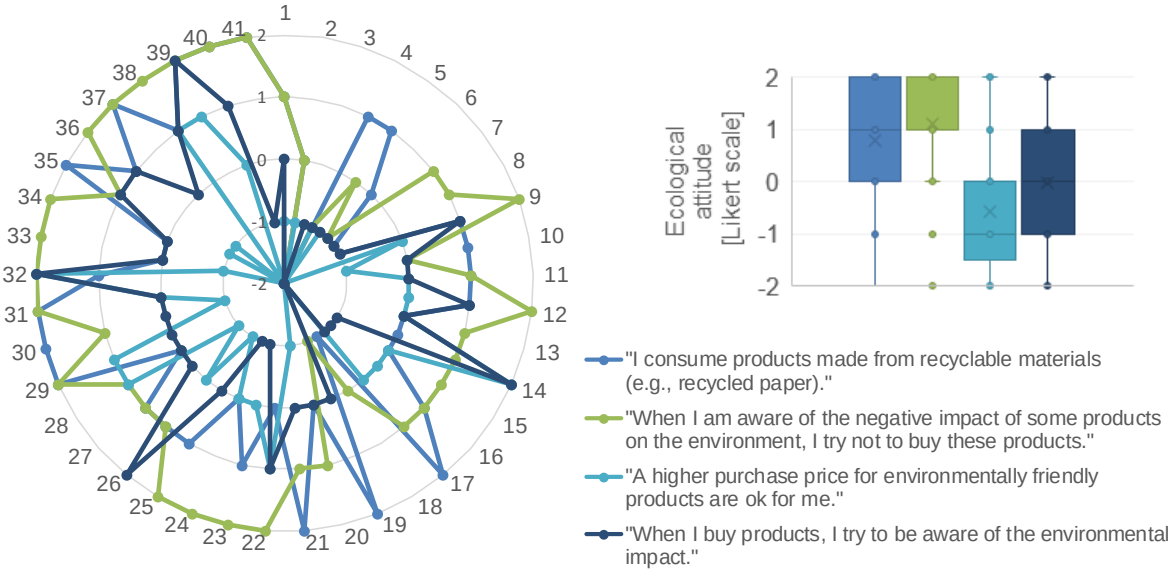


Figure 7: Ecological attitude of respondents (Item 5a-d) (measured with the shown questions on a five steps Likert-scale; -2: I disagree, -1: I partly disagree, 0: neutral, 1: I partly agree, 2: I agree)

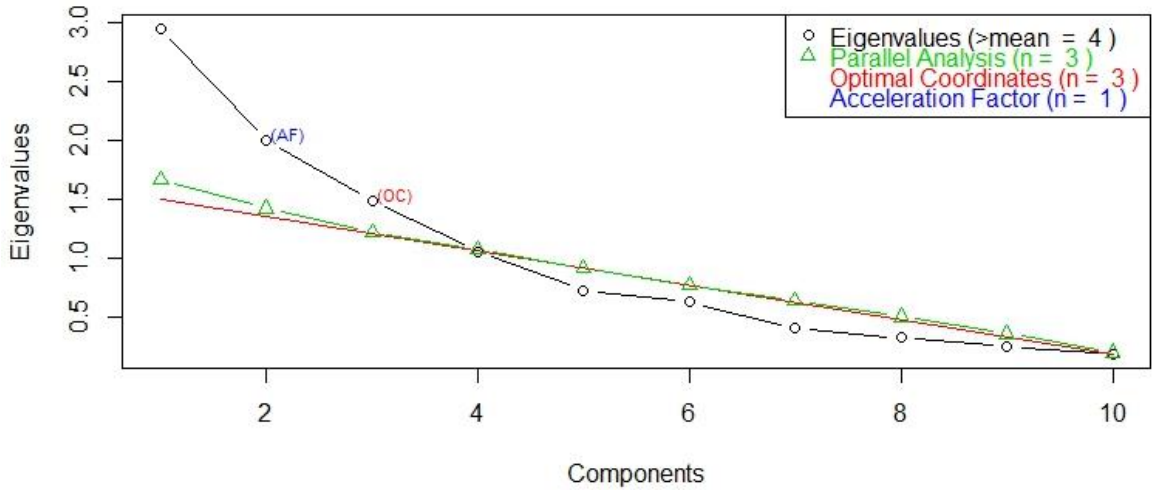


Figure 8: Results of factor analysis 1 for items 5a-d (ecological attitude) and 14a-f (attitude towards recycling)

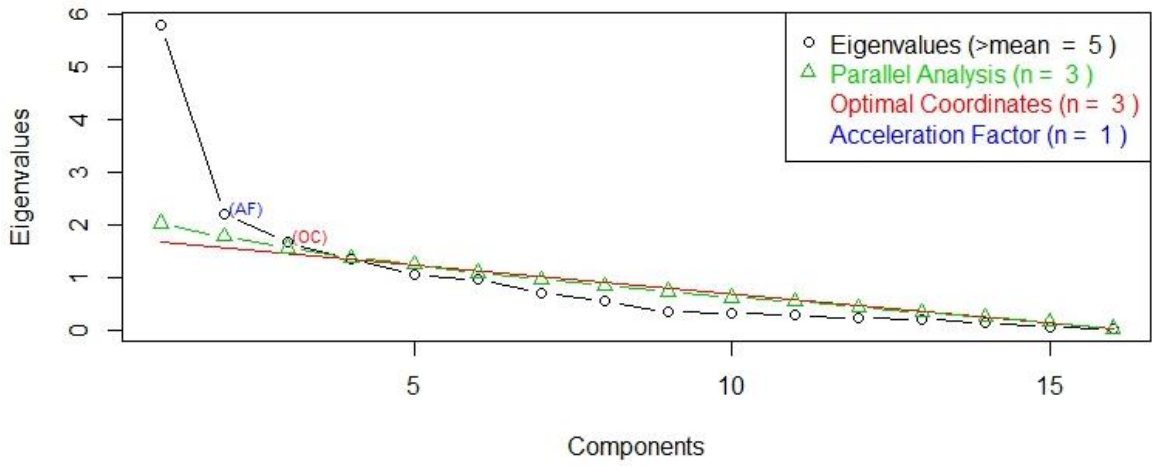


Figure 9: Results of factor analysis 2 for items 5a-d (ecological attitude), 14a-f (attitude towards recycling), 15-18 (trust) and 33-34 (future behaviour)

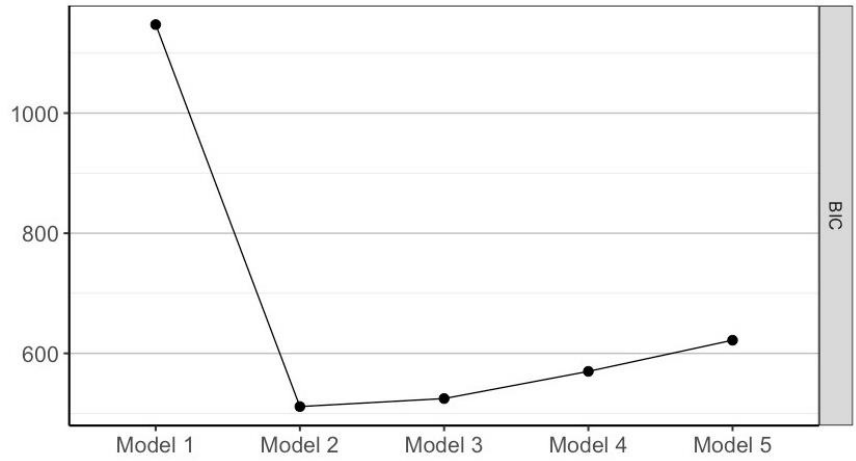


Figure 10: Bayesian Information Criterion (BIC) for latent variable analysis for items 10a-f, item 13, item 19, item 21 and item 26

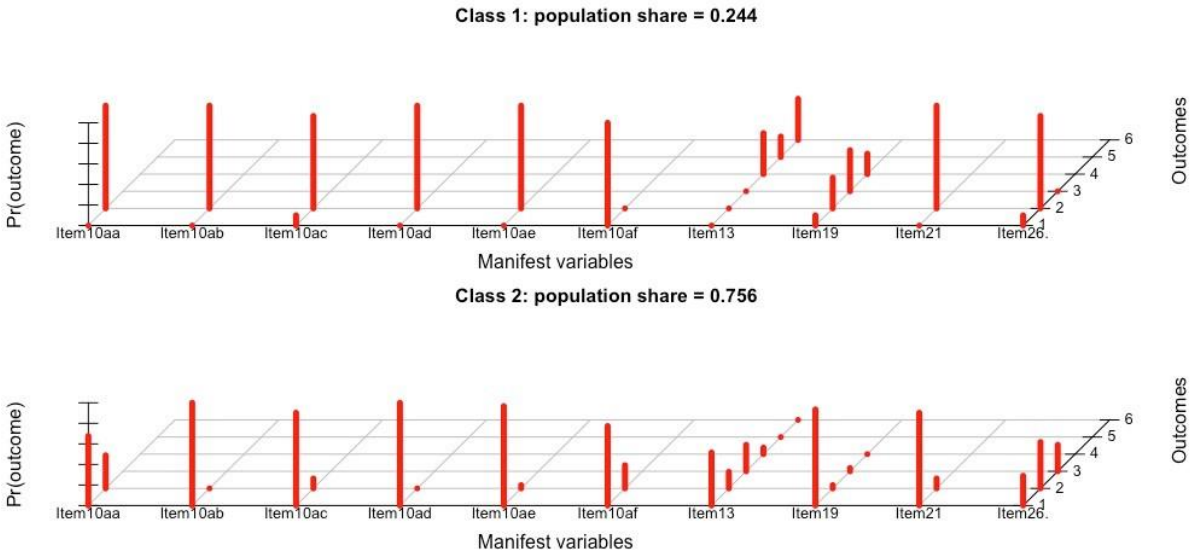


Figure 11: Latent variable analysis with two classes for items 10a-f, item 13, item 19, item 21 and item 26

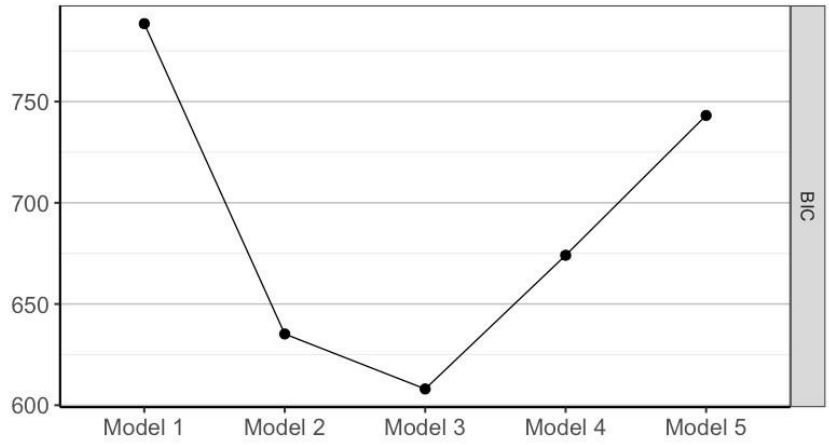


Figure 12: Bayesian Information Criterion (BIC) for latent variable analysis for items 10a-f, item 13, item 22-25 and item 29

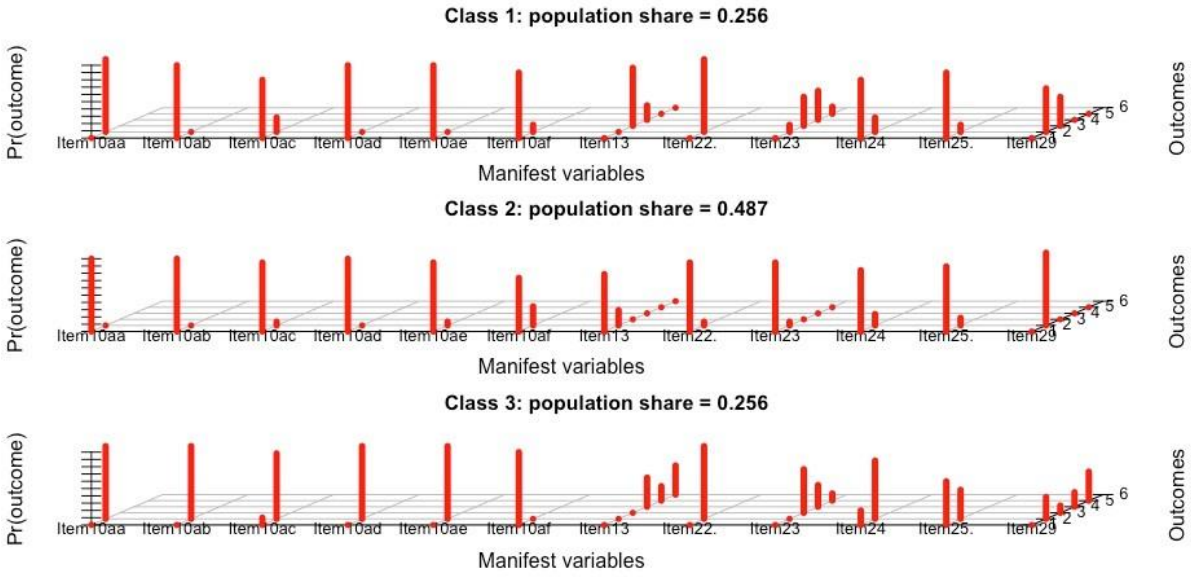


Figure 13: Latent variable analysis with three classes for items 10a-f, item 13, item 22-25 and item 29

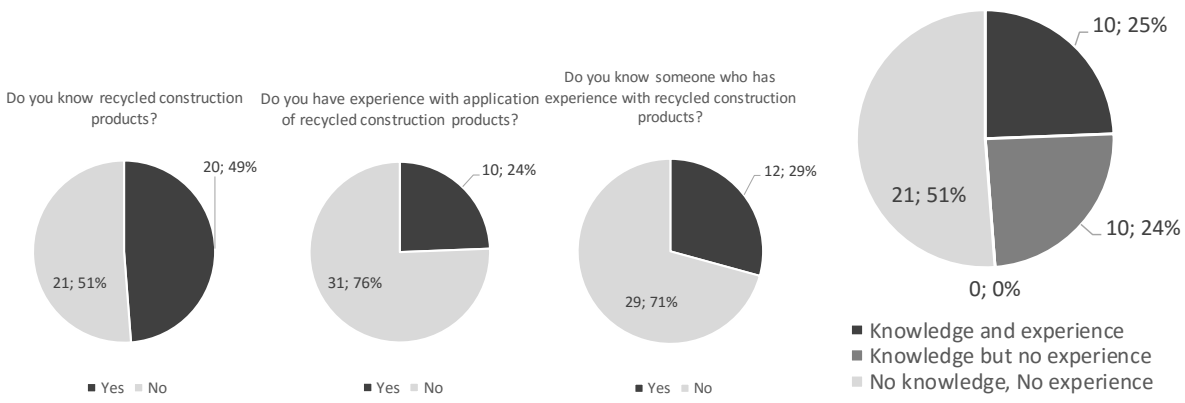


Figure 14: Knowledge and experience of private awarding authorities (items 10a-c)

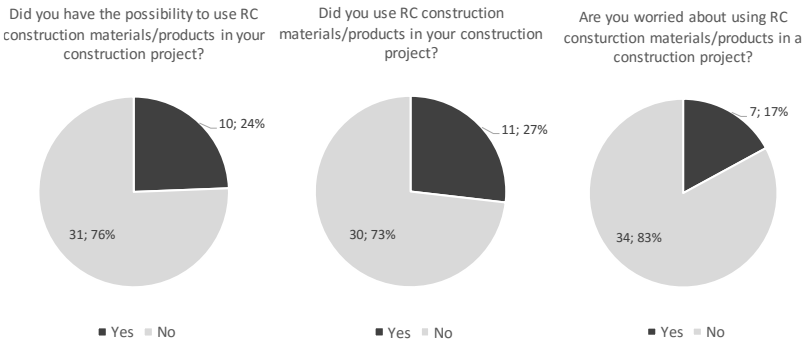


Figure 15: Possibility, use and worries of RC construction materials/products (items 10d-f)

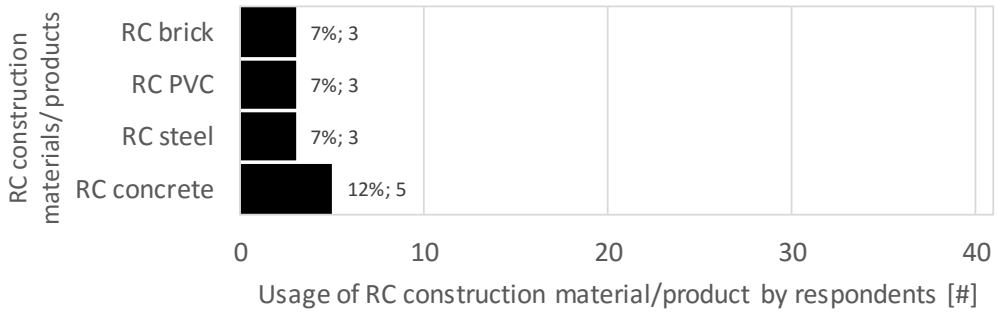


Figure 16: Usage of RC construction materials/products

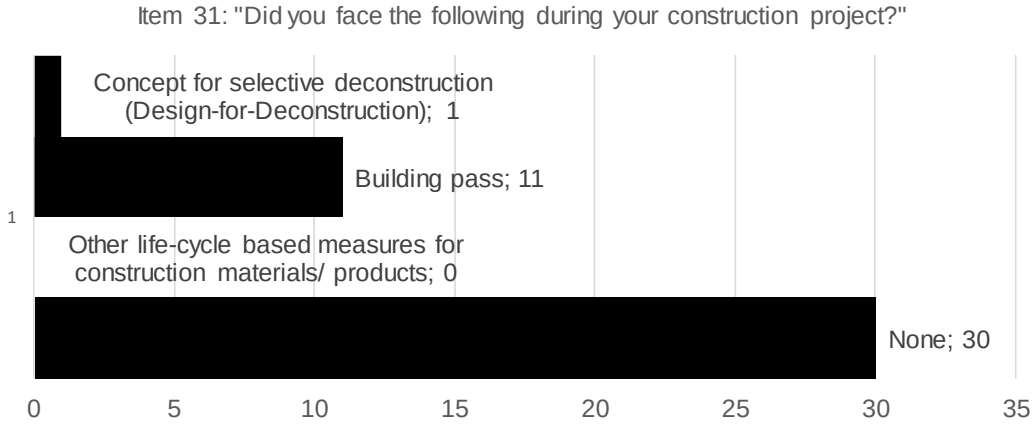


Figure 17: Knowledge about other resource-saving measures (Item 31)

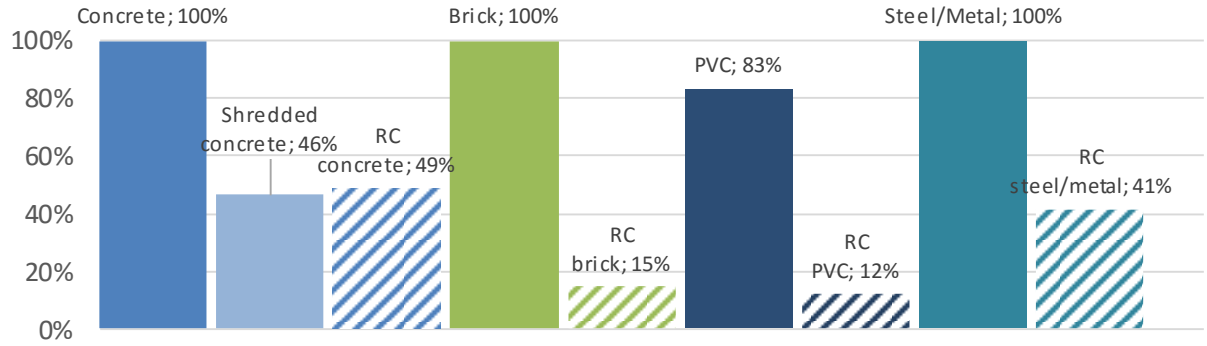


Figure 18: Knowledge of materials in [%]; "Do you know the following materials? (yes)"

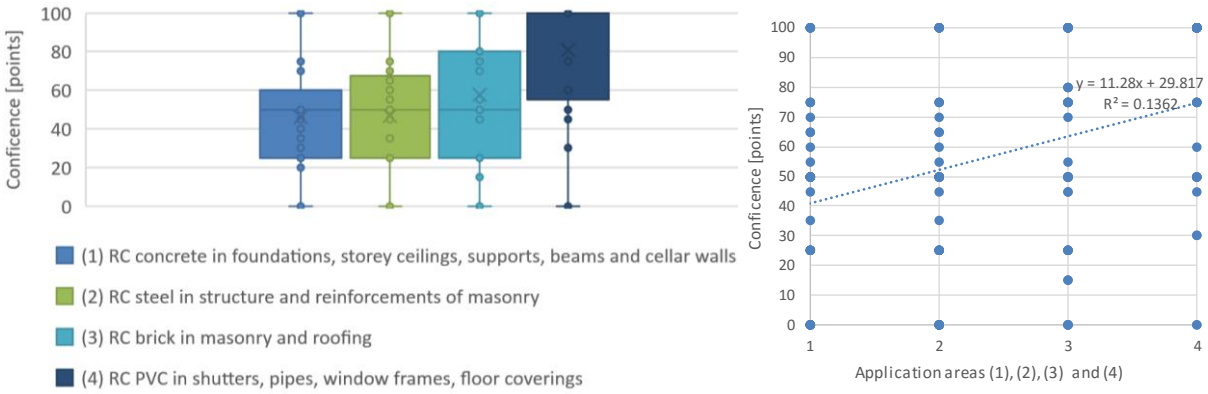


Figure 19: Boxplot and linear regression diagram of the confidence into different RC construction materials/products and their application areas

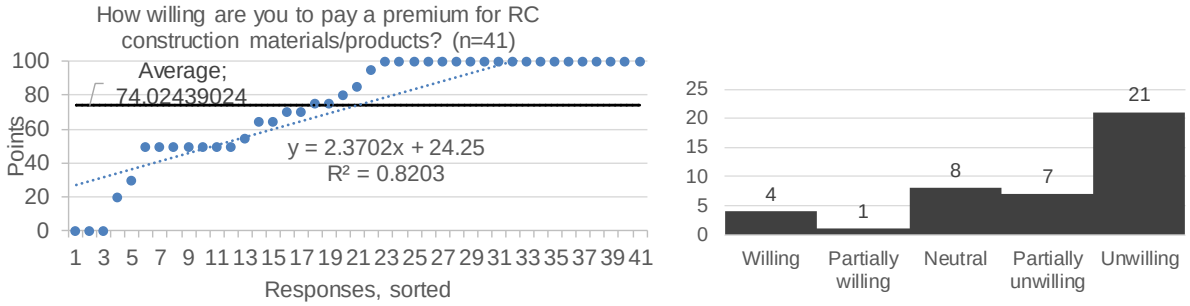


Figure 20: Willingness to pay more for RC construction materials/products (Item 34), [range: 0 = willing to pay a premium; 100 = not willing to pay a premium / use only if cheaper] with linear regression (left) and histogram (right)

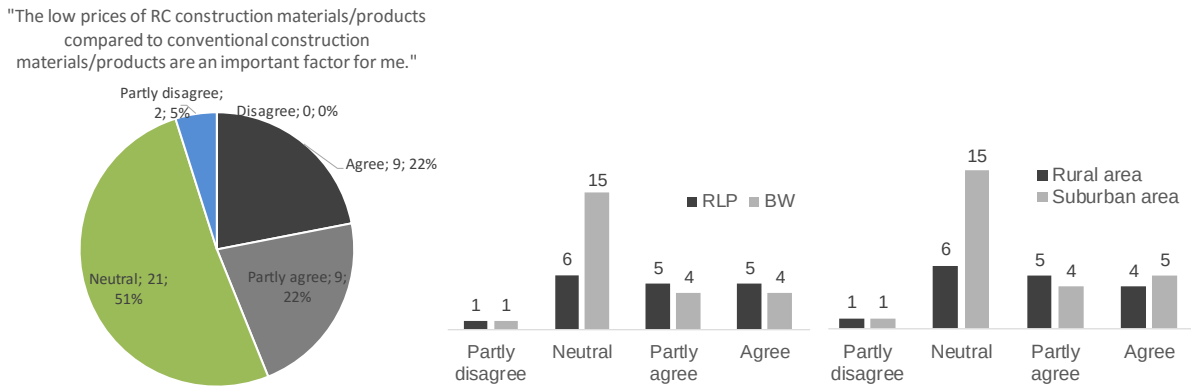


Figure 21: Importance of RC construction material/product prices (Item 14a) (left) and cross tabulation of importance of RC construction material/product prices with state (center) and with rural or suburban area (right)

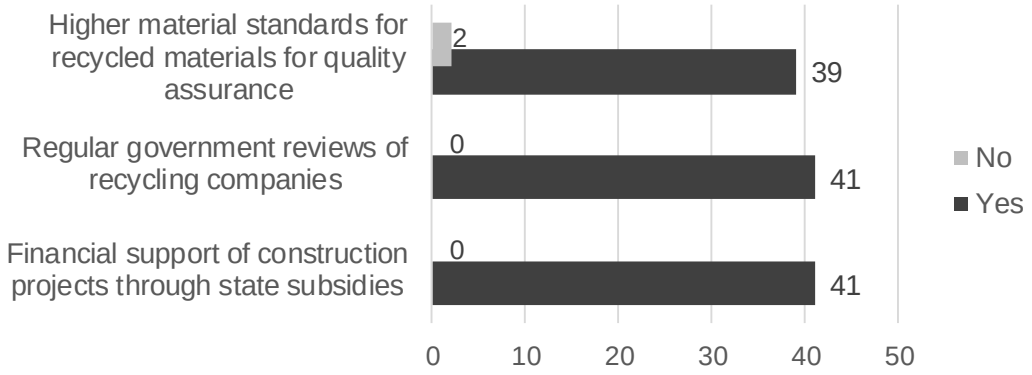


Figure 22: Responses to three potential measures to increase RC construction material/product acceptance (Item 32)

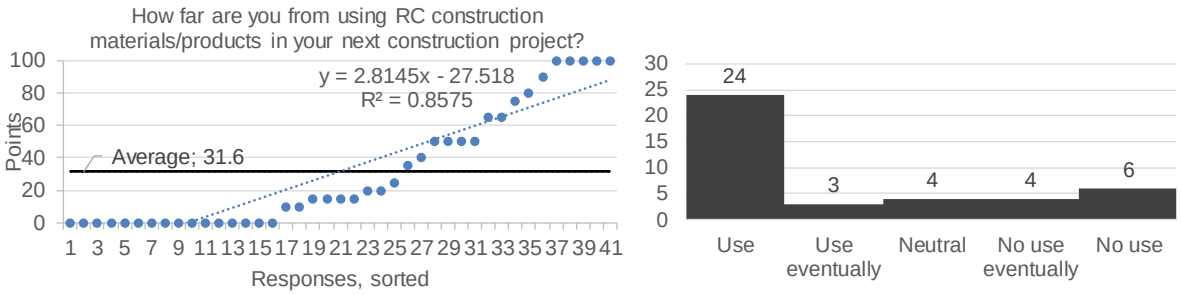


Figure 23: Tendency to use RC construction materials/products in the future (Item 33), [range: 0 = future use; 100 = no future use] with linear regression (left) and histogram (right)

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