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Final report: wastage rates for blocks and ready mixed concrete

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Executive Summary

Reusefully Ltd have completed a study for the MPA Masonry, the Brick Development Association (BDA) and the British Ready Mixed Concrete Association (BRMCA) to provide an updated set of wastage rates for blocks and ready mixed concrete. The current wastage rates were developed well over 10 years ago and are used in various assessments and guidance, including whole life carbon assessments.

In order to update the wastage rates, three main activities were undertaken. Firstly, a desktop review to review existing wastage rates that are used now and the related data sources, including a review of relevant EPDs (Environmental Product Declarations) for blocks and ready mixed concrete. Secondly, a survey targeting contractors (primarily for site waste data, including main causes of waste) and suppliers (primarily for product takeback data) was widely distributed (from July 2022 to December 2022). Thirdly, interviews were carried out to further establish waste data, causes of waste, trends, barriers and opportunities to reduce and recycle waste from these product groups.

The results of these activities for Concrete Blocks concluded that the wastage rates historically used for concrete block wastage is:

PRODUCT	Green Guide to Specification Wastage rate (%)	WRAP NetWaste tool Wastage rate (%) (baseline)	WRAP NetWaste tool Wastage rate (%) (good)
Dense Concrete Blocks	5	20	5
Lightweight Concrete Blocks	5	20	5

Based upon the combined results from the three study activities, the following wastage rate is estimated to be reasonable across most housebuilding projects for all causes of waste (subsequent to product leaving the supplier/distributor for the construction site).

Proposed wastage rate: Baseline 5 % (where there is evidence of multiple good practices, such as return of unused product and design to avoid cutting, this could be reduced to 3%)

From survey and interview feedback, there was a tendency to think that block waste has increased over the last 5 years with the main cause of waste around design and storage. Block waste is likely to be crushed and used on site in many cases so will not be captured in waste data based upon weights or volumes of material leaving the site or arriving at a resource management facility.
Blocks with minor visual imperfections can still be used. Some projects also move unused product to other sites if surplus to requirements.

The results of these activities for Ready Mixed Concrete concluded that wastage rates historically used for Ready Mixed Concrete is:

PRODUCT	Green Guide to Specification Wastage rate (%)	WRAP NetWaste tool Wastage rate (%) (baseline)	WRAP NetWaste tool Wastage rate (%) (good)
In-situ concrete	2.5/5/7.5	5	2.5

Based upon the combined results from the three activities, the following wastage rate is estimated to be reasonable across most commercial and public projects for all causes of waste (subsequent to product leaving the supplier/distributor for the construction site).

Proposed wastage rate: 1-2%

From survey and interview feedback, there was a tendency to think RMC waste rates are falling due to more efficient production, client ordering and usage with better control of quantities (pours). Often, small areas requiring concrete are reserved to make use of RMC left over from bigger pours. If not possible, waste concrete is often crushed and used as hard core/ fill material around the site.

Introduction

Reusefully Ltd have completed a study for the MPA Masonry, the Brick Development Association (BDA) and the British Ready Mixed Concrete Association (BRMCA) to provide an updated set of wastage rates for blocks and ready mixed concrete. The current wastage rates were developed well over 10 years ago and are used in various assessments and guidance, including whole life carbon assessments. These findings have been produced to feed into the consultation relating to updating of the RICS Professional Statement on whole life carbon assessment for the built environment.

Definition

Material wastage can be defined as *"The difference between the quantity of materials required and the actual quantity of materials ordered and delivered to site".* From this, the wastage rate (%) can be derived. It is important to make the distinction between the term "wastage rate" and 'material requirement' – the minimum quantity of materials required to construct the specified element(s) and wastage allowance – the quantity of materials that are purchased in order to ensure that the task can be completed without running out of materials. A certain level of wastage is therefore inevitable (to varying degrees).

Method

In order to update the wastage rates, three main activities have been undertaken:

1. A desktop review has been undertaken to review existing wastage rates that are used now and the related data sources, such as those specified in guidance documents and some academic research. This comprised of waste rates found in the WRAP Net Waste Tool (which is no longer available online) and those in BRE's Green Guide to Specification. Also reviewed where relevant EPD for blocks and ready mixed concrete and wastage rates assumed in these as well as LCA/Whole life carbon guidance. Cost books were also investigated in terms of wastage allowances. Moreover, a review of literature has been undertaken, which includes some academic sources; however, it should be noted that most of these are old or not from the UK.
2. A survey targeting contractors (primarily for site waste data, including main causes of waste) and suppliers (primarily for product takeback data) was widely distributed (from July 2022 to December 2022). The scope was focused on concrete block (light and dense) in the housebuilding sector; and ready mixed concrete in relation to commercial and public projects (for ready mixed concrete). 31 responses were received, broadly split as one third from contractors/ developers, two thirds from suppliers.
3. Interviews have been carried out to further establish waste data, causes of waste, trends, barriers and opportunities to reduce and recycle waste from these product groups. Those targeted include housebuilders, developers, main contractors, suppliers, trade bodies, LCA/environmental reporting software providers, and sub-contractors.

This report provides the findings from each of these tasks as well as presenting the recommended wastage routes together with recommendations for next steps.

Findings

Desktop Study

The desktop study firstly looked at existing wastage rates, which were found in the BRE's Green Guide to Specification (around 2008) and the WRAP NetWaste tool (first issued in 2008), these are summarized in Table 1. The WRAP Net Waste Tool (which no longer is available) contained wastage rates for good and baseline practice for over 6,000 construction components. Note: the data provided for these figures is likely to be even older than 2008. There was some insight provided into these figures used in the NetWaste tool in that for the 20% for blocks, 15% of the wastage occurs on delivery from site and 5% on site; it is not clear how many sites this data is from. For in-situ concrete, the data ranges from 2.5% to 5% based on research projects and trials (again it is not clear how many sites this data is derived from). A comparison of these rates with those in BRE's Green Guide to Specification[1] reveals a number of major discrepancies. It is not possible to state which rates are valid. Therefore, it might be that neither set of wastage rates gives a good prediction of the actual wastage that is likely to occur in any given situation. Moreover, it should be noted that the context for waste management is different compared to today in that there would have been a lower Landfill Tax, less focus on good practice and emerging Site Waste Management Plan Regulations (enacted in 2008 but then repealed in 2013).

PRODUCT	Green Guide to Specification Wastage rate (%)	WRAP NetWaste tool Wastage rate (%) (baseline)	WRAP NetWaste tool Wastage rate (%) (good)
Dense Concrete Blocks	5	20	5
In-situ concrete	2.5/5/7.5	5	2.5
Lightweight Concrete Blocks	5	20	5

Table 1: Wastage rates used in Green Guide to Specification and WRAP Net Waste Tool

The WRAP Net Waste Tool figures appear in a number of guidance documents related to undertaking whole life carbon assessments (WLC). This is because the standards require the use of a wastage rate for the A5 module, the construction installation process, to determine the impact of disposing this waste as well as applying to material quantities. There may also be wastage from the replacement of products/elements (B4.) The existing RICS guidance for WLC[2] states that:

- Appropriate allowances for site waste should be made.
- In the absence of project-specific information, default assumptions on site waste rates for the different materials should be determined based on the standard wastage rates provided by the WRAP net waste tool reference or equivalent.

[1] https://tools.bregroup.com/greenguide/podpage.jsp?id=2126
[2] https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/building-surveying-standards/whole-life-carbon-assessment-for-the-built-environment

- Any site waste data from component/product EPDs or equivalent allowable sources should be overridden by the rates from WRAP for consistency purposes, as EPD-specific site waste rates may vary largely according to different installation/construction assumptions for different product applications, locations, etc.
- The WRAP rates should by refined by substitution with specific information and/or site

The RICS Guidance has recently been consulted on (April 2023) and the consultation document[3] uses the WRAP NetWaste Tool figures. Other guidance that has wastage rates includes the IStructE, *How to Calculate Embodied Carbon*[4], which also recommends using the baseline rates in the WRAP Net Waste Tool, as per Table 1.

International LCA datasets and related guidance were also reviewed. To summarise, these include 5% for insitu products (where the products must be made to fit at the construction site) and 3% for pre-fabricated products[5]; most of the others had 5% for blocks and concrete[6,7]; though one guidance had concrete at 3%[8].

A review was undertaken of 43 Environmental Product Declarations (EPD). This indicated that the UK average wastage rates for blocks and ready mixed concrete (RMC) within EPDs are 5% and 3% respectively. Wastage rates globally are averaging 3.4% for blocks. Despite these findings, robust quantitative analysis was difficult due to the small sample size. The small sample size results from companies refraining from reporting Module A5 which contains the wastage rates, especially those in the UK. For the UK, only 4 EPDs were found to have wastage rate information (and these are generic); 14 did not have any information. For non-UK, 12 EPD had information and 13 did not. Table 2 and 3 summarises the rates used in the EPDs reviewed.

Product	Average	Sample Size
Blocks	3%	2 (note these are generic EPDs from the sector bodies)
RMC	3%	1 (note: this is a generic EPD from the sector body)

Table 2: Average wastage rates used in UK EPD

[3] https://consultations.rics.org/whole_life_carbon_standard/consultationHome
[4] https://www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/
[5] Environmental Performance Assessment Method for Construction Works - March 2022 - https://milieudatabase.nl/en/downloads-nmd/downloads-assessment-method/
[6] https://www.boverket.se/sv/om-boverket/publicerat-av-boverket/oppna-data/boverkets-klimatdatabas/
[7] https://www.base-inies.fr/iniesV4/dist/tableau-de-bord
[8] https://www.boverket.se/sv/om-boverket/publicerat-av-boverket/oppna-data/boverkets-klimatdatabas/

Product	Average	Sample Size
Blocks	3.4%	2
RMC	n/a	0

Table 3: Average wastage rates used in non-UK EPD

Table 4 shows the generic EPD reviewed for concrete blocks produced by the relevant sector bodies. The wastage rates are the same at 3%. No information is given on how these rates were derived.

Type of source:	Name/description	Wastage rates stated	What it covers	Date	Geographical areas	Source and link
EPD (generic)	CBA-Concrete Blocks	3%	Residential, commercial & infrastructure	2017	UK	Link
EPD (generic)	Aircrete Products Association (British Precast Ltd)- Aircrete Blocks	3%	Residential, commercial & infrastructure	2017	UK	Link

Table 4: Wastage rates used for concrete block EPDs - UK

Table 5 shows the two EPDs reviewed for concrete blocks with wastage rates of 3 and 3.8%.

Type of source:	Name/description	Wastage rates stated	What it covers	Date	Geographical areas	Source and link
EPD	Xella- Masonry blocks	3.8%	Not specified	2015	France	Link
EPD	Bloc En Beton- generic blocks	3%	Residential, commercial & infrastructure	2017	France	Link

Table 5: Wastage rates used for block EPDs – non-UK

For ready mixed concrete, the sector body has produced a generic EPD in 2018 [9], which has a wastage rate of 3%. It states that '*This EPD contains an allowance of 3% to represent the average difference between ready mixed concrete delivered and that accounted for in the permanent works. This difference may be due to the reliability of measurement, the use of surplus concrete as extra blinding or fill, or comprise inert material recovered from chute washing and invariably incorporated somewhere into the works. This material is not waste, but it may be colloquially identified as wastage by the contractor*'.

A review of cost books and the wastage allowances was also undertaken. Examples of price books include various guides by Spons [10] for different sectors and packages of construction, Laxtons [11], CESMM3 for civil engineering projects, Griffiths and Hutchins Books [12] for smaller projects. In some price books, such as CESMM3 and Laxtons, the wastage rates are given for a wide range of products; in others, such as Spons, the wastage rates are not explicitly quoted. There are also cost benchmarks within the BCIS online tool [13]. These wastage allowances are usually based on expert judgement of estimators or cost consultants and are intended primarily as a guide to estimating the cost of construction projects rather than as a means of estimating the amount of waste involved in construction. They may thus include other factors; CESMM3 [14], for example, states that the wastage rates include an allowance for unloading, storage and rehandling as well as wastage of materials. Spon's civil engineering price book includes a short statement that the price rates include an allowance for wastage rates of "typically 2.5% to 5%". No explanation of the figures is given. "Estimating and tendering for construction work", includes the rather plaintive statement that, "An allowance for waste is difficult to estimate". For unit rate estimating, a price is calculated for each item in the cost plan and will take account of labour costs, materials, and plant. For materials, a waste allowance is included, with 10% usually applied [15]. RICS provide guidance for prime cost sums, which include the calculation of the supply only cost of the specified material, including allowance for waste [16].

Other literature was reviewed which was largely research reports and academic papers – though no recent data was found. This included a study carried out by BRE for the Construction Resources and Waste Platform (CRWP) in 2008. This study looked at 14 key products on three housing sites and found that the volume of waste was almost twice that predicted from standard wastage rates. For concrete blocks, the average was 7.3%, 7% and 5.3% for the three sites. The main causes of waste, in order of importance, were methods of work/ offcuts; over ordering; unsuitable storage/ materials exposed to weather conditions; and rework done due to unclear drawings/ design specification. Another study by WRAP carried out over 10 years ago on 3 buildings found that the wastage rate varied from 10% to 23% for blockwork.

A study[17] of 19 construction projects, published in 2007 found that private housing construction projects resulted in higher wastage rates than commercial construction. They believe this is due to the

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[9] https://www.concretecentre.com/TCC/media/TCCMediaLibrary/PDF%20attachments/Generic-ready-mixed-concrete.pdf
[10] https://www.constructionbooks.net/building-price-guides/spons-price-books
[11] http://www.laxton-s.co.uk/index.php
[12] https://griffiths.guide/price-books/hutchins-priced-schedules-72nd-edition-2022/
[13] https://bcis.co.uk/product/bcis-online/
[14] https://www.icevirtuallibrary.com/series/scesm
[15] https://www.designingbuildings.co.uk/wiki/Unit_rate_estimating
[16] https://www.rics.org/globalassets/rics-website/media/upholding-professional-standards/sector-standards/construction/black-book/cost-reporting-1st_edition-rics.pdf
[17] Tam,C et al.2007. Assessing the levels of material wastage affected by contracting relationships and projects types with their correlations. Griffith University.

inability to standardize construction as private housing projects require different sizes and shapes of building components which leads to higher levels of waste. Following a study of 12 construction projects, Shen- Hua Wu[18] suggests pre-fabrication as a solution to reducing waste on residential construction. To reduce waste in general, much of the academic literature emphasize integrated waste minimization procedures at the tendering stage, waste reduction training and integrated waste control systems.

Table 6 and 7 show a summary of wastage rates found in academic literature, though it should be noted that the methodologies may vary substantially as well as the number of case studies and the context of the studies (i.e. geographically), as such it is not recommended to use these as a basis for comparison. Concrete wastage rates as shown in Table 6 vary from 1% to 12% and for blocks (which maybe included with bricks) from 1.6% to 17.5%.

Material	Average Rate (range if given)	Country	Source	Project Type
Concrete	1%	Brazil	Pinto 1989[19]	
Concrete	12%	Brazil	Soibelman et al 1994[20]	
Concrete	2%	Brazil	Pinto and Agopayan 1994[21]	
Concrete	4%	Egypt	Materials waste in the Egyptian construction industry[22]	
Concrete	3%	Netherlands	Bossink 1994[23]	Five housing projects
Concrete	7.5%	USA	Chen et al 2002[24]	
Concrete	2.5%	UK	Chen et al 2002	
Concrete	2.5%	China	Chen et al 2002	
Concrete	7.0%	Brazil	Chen et al 2002	
Concrete	1.5%	Seoul	Chen et al 2002	
Concrete	6.7%	Hong Kong	Chen et al 2002	Residential housing
Ready mixed concrete	6%	Turkey	Baytan, 2007 [25]	Observation of 8 construction projects (Residential commercial & infrastructure)

[18] Wu, S,H. 2017. Use of Bim and Prefabrication to reduce construction waste. University of Washington.
[19] Pinto, T.P. (1989) Perdas de materiais em processos construtivos tradicionais. Ph.D. Dissertation, Federal University of São Carlos, São Carlos.
[20] Soibelman, L et al (1994) A study on the waste of materials in the building industry in Brazil. In Sustainable Construction (Proc. 1st Conf. of CIB TG 16), C. J. Kibert (Ed.). Centre for Construction and Environment, Gainesville, Florida, 555-564.
[21] Pinto,T. P., and Agopayan, V. (1994). "Construction wastes as raw materials for low –cost construction products." Sustainable construction (Proc. 1 st Conf. Of CIB TG 16), J.Kibert,ed., Ctr. For Constr. and Envir., Gainesville, Fla., 335-342.
[22] Garas, G. L.et al (2001) 'Materials Waste in the Egyptian Construction Industry' In:, Ballard, G. & Chua, D., 9th Annual Conference of the International Group for Lean Construction. Singapore, Singapore, 6-8 Aug 2001.
[23] Bossink, B.A.G (1994), *Bouwafval op de bouwplaats: hoeveelheden, oorzaken en preventie-opties*. Onderzoeksrapport, Universiteit Twente, Enschede
[24] Chen, Z (2002) An Application of bar-code systems for reducing construction wastes. Vol 11, Issue 5
[25] Baytan , M (2007) Origins and Magnitude of Waste in the Turkish Construction Industry, MSc. Thesis, Middle East Technical University, Turkey

Material	Average Rate (range if given)	Country	Source	Project Type
Concrete	1.66%	Nigeria	Ugochukwu et al., 2017[26]	4 Sites over 4 months
Concrete	4 – 6.82%	Hong Kong	Tam et al., 2007[27]	7 projects (commercial, public and residential)
Concrete	4%	Hong Kong	Poon et al, 2010[28]	5 housing projects
Poured concrete	1.89%	Australia	Loizou et al, 2021[29]	1 conventional /modular construction
Poured concrete	1.82% - 2.17%	Australia	Loizou et al, 2021	1 conventional and 1 modular construction

Table 6: Summary of findings of literature for wastage rates for concrete

Material	Average Rate (range if given)	Country	Source	Project Type
Block and brick work	10%	Brazil	Soibelman et al 1994	
Brick and block	4.5%	UK	Chen et al, 2002	
Brick and block	3.5%	USA	Chen et al, 2002	
Brick and block	2.0%	China	Chen et al, 2002	
Brick and block	17.5%	Brazil	Chen et al, 2002	
Brick and block	3.0%	Seoul	Chen et al, 2002	
Cement block	6%	Sri Lanka	Rameezdeen 2006	Not specified
Sandcrete blocks	1.6%	Nigeria	Ugochukwu et al, 2017	4 Sites over 4 months
Brick/block	4.5 – 7.9%	Hong Kong	Tam et al., 2007	7 projects (commercial, public and residential)

Table 7: Summary of findings of literature for wastage rates for blocks

[26] Ugochukwu, S et al (2017) An onsite quantification of building material wastage on construction projects in Anambra State, Nigeria: a comparison with the literature. Journal of Architecture and Civil Engineering 3(6): 12–23.
[27] Tam, V et al (2007) Assessment of durability of recycled aggregate concrete produced by two-stage mixing approach. Journal of Materials Science, 42(10)
[28] Poon, C.S (2010) Design issues of using prefabrication in Hong Kong Building construction. Construction management and Economics. 28
[29] Loizou, L (2021) Quantifying advantages of modular construction: Waste Generation. Vol 11, Issue 12

Lastly, a never published WRAP report (2011) which aimed to update the then used wastage rates had information for concrete products has been reviewed. This took the approach of describing the factors influencing waste and material use and providing wastage rates in a range from standard to good practice. For insitu concrete in building projects the wastage rate varied from 5% (good practice) to 10% (standard practice). For blocks, the report stated that the management of the movement and cutting of masonry products is important in reducing wastage. Where significant brick/block cutting is required there will be savings from using a dedicated cutting tool (resulting in two usable halves). The wastage rates presented were 5-20% for lightweight concrete blocks and 2-7% for dense concrete blocks. It was noted that dense concrete blocks are less prone to damage than other block products and even damaged blocks can be reused in unseen areas or earthworks if planned appropriately.

Survey findings

The survey targeting contractors (primarily for site waste data, including main causes of waste) and suppliers (primarily for product takeback data) was widely distributed from July 2022 to December 2022). The scope was focused on concrete block (light and dense) in the housebuilding sector; and ready mixed concrete in relation to commercial and public projects (for ready mixed concrete). 31 responses were received, these were split as follows: 10 client/contractor and 21 from suppliers and manufacturers – however not all respondents answered all of the questions (of those that did there was 5 block manufacturers and 2 RMC suppliers). As such there is very limited information from the survey.

When asked to estimate wastage rates for blocks and RMC, the sole respondent for the question answered 5% for blocks and did not provide an estimate for RMC.

For blocks, all contractors (5) thought that the trend for block waste is increasing, due to design, poor storage, purchasing, over-ordering and packaging (ranked in order). Other comments included: poor quality (x2) and a lack of full coursing of wall heights. Suggestions for improvements for reduction in waste included monitoring manufacturing quality, wall heights for full course, and better storage and packaging. All contractors reused off cuts onsite; 2 reused offcuts via third parties and/or advertised them for sale; other routes included colleges donation. The manufacturers responded that they did not take back of blocks and a comment was that nothing is returned unless it has been a full load due to incorrect ordering or product fault (this was thought to be less than 1%). Two manufacturers thought that once block products have been on site, damage would occur making reselling difficult, but they are usually crushed are reused for fill etc. The transportation costs of returning blocks, was thought to be uneconomical together with the CO2 associated with extra return journeys. However, 4 manufacturers do reuse their own stock where possible. One manufacturer implied that they are being forced to skimp on packaging due to material costs and drive to reduce packaging waste and another responded that as blocks are a low value / low margin product, manufacturers are being forced to use alternative raw materials which can result in a lower quality product where more blocks are rejected whilst being placed. A suggestion for improvement was to store products better and protect them from the extremes of weather particularly in frosty conditions and use the right tools to cut blocks.

For Ready Mixed Concrete, it was commented by the contractors (5) that wastage rates are falling, and production is better, as well as client ordering is better. This was attributed to the cost of concrete, with the buyers and users aiming to reduce at all times. One suggested that the current waste rate is 1.25%. Waste concrete was kept on site wherever possible, crushed and used as hard core / fill for general engineering projects on sites. Two of the suppliers would take back concrete. A comment for improvement suggested better training of contractors on quantities and ordering correct materials.

Interview findings

Following the circulation of surveys, a series of interviews were conducted with contractors, suppliers and other organizations in order to obtain more detailed insights into waste data, causes of waste, patterns, barriers, and potential opportunities to reduce, reuse, and recycle waste from the selected products. This included 5 housebuilders, 3 contractors, 2 suppliers and 3 organisations involved in the collection and use of waste data. As requested by many of the interviewees, the information provided has been anonymised accordingly. The following sections provide an overview of the information received via these interviews, both generally and for the two targeted product areas.

General observations

A general theme is that there is very limited data available against which wastage rates can be calculated. This is due to a number of factors:

- Waste data is commonly collected but this is rarely related to actual deliveries of product, therefore a wastage rate is not able to be calculated.
- Materials that have not been installed can be recycled onsite, therefore these materials do not get included in waste generation data.
- Products get reused for other purposes, e.g. blocks to keep pallets off the ground.

However, this is not to say that there will always be a lack of data since most of the developers and contractors have waste reduction as a priority, leading to internal projects to understand better the amounts and causes of actual waste, alongside developing measures to reduce this wastage. These internal projects should start to yield better data (still quite limited in number though) over the next two to three years.

Those users of wastage rate information, such as life cycle assessment modelling tools, have embedded default data for this purpose. Although this can be overridden by the LCA practitioners, the software providers do not receive data on whether this has been done, or the alternative wastage rates used. A suggestion was made to obtain information from submitted information in relation to BREEAM and GLA Circular Economy statements, since predictions of waste arisings and building material (BoQ) information is required for certain credits in BREEAM and as part of the Circular Economy Statement for Greater London Authority.

Concrete Blocks

The figure of 5% wastage is the allowance for nearly all respondents, although it should be possible to achieve lower amounts of waste (suggested as 3%) in the following circumstances:

- Design related: Standard designs and having these fixed can lead to less waste, conversely changes to design and having varying features will have the opposite effect. It can also be quite wasteful if openings need to be made after blockwork has been installed.

- Quality related: Given the less visible nature of blocks, aesthetic quality is less of an issue, but this can also impact waste generation if a batch is delivered with quality issues.

- Procurement related: Wastage is thought to be lower when product has been bought by the same company installing the blockwork, whereas 'free issue' to sub-contractors is considered to be a contributing factor in higher wastage rates. Where there is a double charge to return unused product, this acts as a financial disincentive to doing so. In these cases, unused product tends to go to other sites (where possible and viable), sold to third parties at large discounts, or get crushed for fill material on site.

- Site management related: Good site management practices are considered to be a great factor in keeping amounts of avoidable block waste lower than average. Engaged site managers can have a great impact on day to day oversight of the efficient use of materials, including blocks, and ensure sites are set up to promote reuse of offcuts, flagging up quality issues and having more accurate ordering of new product as required.

Block wastage was also considered to be reduced due to be following reasons:

- For housebuilding, there is not much variation of block types used, thus enabling the transfer of unused product to other sites.
- Blockwork is typically not visible upon completion of residential properties, so minor visual imperfections can be tolerated leading to less rejected product on these grounds.
- There is some flexibility from suppliers in terms of receiving part-loads, reducing the amounts ordered and/or redirected to other sites if this would lead to surplus product.

In addition, blocks are also considered useful in other applications on site, such as raising pallets off the ground.

Ready Mixed Concrete

All interviewees suggested that the wastage from ready mixed concrete is low, and a primary driver for this is cost. There is now much better estimation of the quantities needed and therefore ordering of the materials. When asked for a waste allowance used, this was typically between 1 and 2%. However it is noted, that the interviews were undertaken with those who had larger sites, dominated in London. These figures maybe different elsewhere. The main reasons for the reduction of RMC wastage are:

- Better control and understanding of the batch quantities needed for each pour which minimizes the amount left after a pour. The amount left over is small compared to the overall pour. However, there may be some over ordering to avoid any issues with concrete joints and as one interview pointed out, it is better to have a bit more concrete that needed rather than running out, to ensure consistent pours.
- Better planning of the pours, especially linked to the timing requirements.
- When using shuttering/formwork, the amount of concrete used is reduced and the waste is minimized. Though if the formwork been poorly constructed, there could be more waste.
- The size and shape of the structure is important, there was thought to be less waste from simple, large structures; those less simple and more complex are likely to produce more waste.
- The less the number of pours, the less waste is likely to be produced; however this needs to be offset with the amount ordered and if there is excess in the mixer truck or pumping system which will need to be washed out.
- The need to reduce concrete washout waste, which can be difficult/costly to deal with onsite.
- Better processes for transportation in the mixer trucks has lead to less spillage, together with better chutes, pump and hose priming. There is also better logistics planning.

Suppliers indicated that there is very little concrete that is being returned, as there is a return charge for this. One supplier indicated that the return rates for was about 1.25%. On site, where there is space, any excess concrete maybe stored and then crushed and used in other applications.

Recommended wastage rates

Concrete Blocks

The wastage rates historically used for concrete block wastage is:

PRODUCT	Green Guide to Specification Wastage rate (%)	WRAP NetWaste tool Wastage rate (%) (baseline)	WRAP NetWaste tool Wastage rate (%) (good)
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Proposed wastage rate: Baseline 5 % (where there is evidence of multiple good practices, such as return of unused product and design to avoid cutting, this could be reduced to 3%)

Ready Mixed Concrete

Based upon the combined results from the three activities, the following wastage rate is estimated to be reasonable across most commercial and public projects for all causes of waste (subsequent to product leaving the supplier/distributor for the construction site).

Proposed wastage rate: 1-2%

From survey and interview feedback, there was a tendency to think RMC waste rates are falling due to more efficient production, client ordering and usage with better control of quantities (pours). Often, small areas requiring concrete are reserved to make use of RMC left over from bigger pours. If not possible, waste concrete is often crushed and used as hard core/ fill material around the site.

Conclusion

Based on the findings from the various work undertaken i.e. desk top review, surveys, interviews, it is recommended that the proposed wastage rates i.e. concrete blocks - baseline 5% , reducing to 3% for good practice and ready mixed concrete 1-2%, should be used until further analysis is undertaken or if robust site data is available. These rates supersede the wastage rates that are used in the WRAP Net Waste Tool as they are deemed to represent current industry practice.

Recommendations

Developing updated wastage rates for concrete blocks and ready mixed concrete has been hampered by an absence of data and lack of drivers to improve required data availability. Whilst there is significant amounts of data captured on waste arising on site, and the amounts procured to complete construction projects, these are collected separately and not combined to enable 'wastage rates' to be calculated accurately.

Therefore, there are limited options to improve upon wastage rates until better data, collected and reported in the required method, is forthcoming. Carrying out further surveys is unlikely to yield more quantitative information from industry stakeholders and there are fewer (zero) research/ publicly funded projects examining site waste and causes today than there were in the early 2000s.

However, this situation could change in the next few years as housebuilders and commercial contractors focus on reducing waste to reduce cost of materials and meet targets linked to Zero Avoidable Waste. To understand the priorities and cost benefit of undertaking waste minimization activities, there is a renewed interest in capturing site data at product level. Several interviewees are in the process of examining site waste and developing baselines against which targets can be set and monitored.

Therefore, a recommendation is to follow up with those interviewed in the next 12-18 months, to see if further data has been gathered and whether it provides further insight or grounds to revise the currently recommended wastage rates. Given the required anonymity, this would probably need to be carried out by a trusted 3rd party, i.e. not representing the suppliers.

Another opportunity to improve data could emerge from the GLA reporting requirements as part of the Circular Economy Statement to obtain planning permission for referable developments. The enhanced required came into effect one year ago, so the post development reporting will not have been undertaken as yet. In this sense, similar data from BREEAM certified projects could also yield relevant data but this is currently not accessible. Finally, there are software products, such as QualisFlow[30], that are collecting the required 'delivery of products vs. waste produced' for certain material and product streams that could provide useful data in the future. Some data from QualisFlow has been provided in this respect; how this data has been arrived at would be a useful discussion.

Therefore, a recommendation is to explore the opportunities listed above in more detail, perhaps initiated by meetings with GLA, BRE, and QualisFlow with MPA / BMRCA. This would probably need to be combined with actions/aspiration to reduce waste at a sector level to engage interest and promote the exchange of information.

Finally, it is recommended that there is follow up on the causes of waste described via the survey and interviews, and detailing the actions that could be taken to reduce accordingly. Evidence of taking active steps to reduce waste could then be set against a checklist to justify using lower wastage rates e.g. 1% for RMC and 3% for Concrete Blocks. Thus, acknowledging better supplier and site practices.

[30] https://qualisflow.com/

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