BS 8895-2:2015

BSI Standards Publication

Designing for material efficiency in building projects –

Part 2: Code of practice for concept design and developed design

bsi.

...making excellence a habit.™

Publishing and copyright information

Published by BSI Standards Limited 2015

ISBN 978 0 580 85618 1

ICS 91.040.01

The following BSI references relate to the work on this document:
Committee reference B/209
Draft for comment 15/30296207 DC

Publication history

First published July 2015

Amendments issued since publication

Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 30, an inside back cover and a back cover.

Foreword

Publishing information

This document is published by BSI Standards Limited, under license from The British Standards Institution, and came into effect on 31 July 2015. It was prepared by Technical Committee B/209, *General Building Codes*. A list of organizations represented on this committee can be obtained on request to its secretary.

Information about this document

The initial drafting of this British Standard was produced in association with BIS as part of their on-going programme of support for standardization.

This document gives recommendations for designing for material efficiency that are accepted as good practice by industry leaders and practitioners, and brings together the results of practical experience and acquired knowledge for ease of access and use of the information.

This code of practice sets out the process for the integration of designing for material efficiency into the concept design and developed design stages of the RIBA plan of work [N1]. It is the second part in a projected suite of British Standards that address specific and interrelated issues and processes of material efficiency in building projects in line with the RIBA plan of work [N1].

BS 8895, *Designing for materials efficiency in building projects*, comprises the following parts:

- Part 1 (published 2013): *Code of practice for strategic definition and preparation and brief*;
- Part 2 (this part): *Code of practice for concept and developed design*;
- Part 3: *Code of practice for technical design* [1)]; and
- Part 4: *Code of practice for operation, refurbishment and end of life*[1)].

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it was a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application. Compliance with a British Standard cannot confer immunity from legal obligations.

1) Planned for development.

Introduction

Material efficiency is a key part in achieving higher levels of resource efficiency in a building project. Material efficiency encompasses the efficient use of materials throughout the lifecycle of a building, waste prevention and reduction, minimizing damage to the environment and minimizing depletion of natural resources. The case for material efficiency is made in the Part 1 of this multi-part standard, BS 8895-1:2013, which covers 'Stage 0 Strategic Definition' and 'Stage 1 Preparation and Brief' of the RIBA plan of work [N1]. This includes clear drivers such as cost savings and reduced environmental impact through reduced resource use, corporate social responsibility commitments and meeting requirements for material efficiency performance. BS 8895-1:2013, Figure 3 illustrates the need to design for material efficiency at the earliest possible point within the design process – where the opportunities are the greatest and the cost of making the decisions the least.

Material efficiency in a building project involves the implementation of a hierarchy, (see BS 8895-1:2013, Figure 1) to optimize material usage and avoid the production of waste. It also encompasses design solutions to reduce material usage wherever possible, reuse materials and increase the use of materials which are reclaimed that can also be reused at the end of life, and specify materials with a high level of recycled content and that can be recycled.

Opportunities and solutions for material efficiency arise during the planning, design, procurement, construction, in use (including refurbishment) and end of life stages of a project. However, the most effective way to implement material efficiency is to comprehensively consider the use of materials during the planning and design stages. This is when maximum impact can be made. This British Standard covers 'Stage 2 Concept Design' and 'Stage 3 Developed Design' of the RIBA plan of work [N1] where there is much potential to implement material efficiency by taking forward the initial project brief and considering opportunities that arise from the work undertaken to develop the outline designs and specifications.

Opportunities also exist when the design is already formulated and construction is under way, particularly in contractual procedures where the contractor has the opportunity to put forward alternative design, procurement and construction methods that can accrue significant reduction in waste and improvement in material efficiency during the construction period.

1 Scope

This part of BS 8895 gives recommendations for the processes, information exchanges and responsibilities for design teams to incorporate into projects at the concept design and developed design stages of a building project. It provides recommendations on how to implement material efficiency after receiving the initial project brief at the end of stage 1 of the RIBA plan of work [N1] (preparation and brief).

NOTE 1 This British Standard follows the RIBA plan of work [N1] stages and requirements, focusing on 'Stage 2 Concept Design' and 'Stage 3 Developed Design'. 'Stage 0 Strategic Definition' and 'Stage 1 Preparation and Brief' are covered in BS 8895-1.

BS 8895-2 is intended to be used by the design team when preparing concept and developed designs to include proposals for material efficiency. These then inform the final project brief and other strategies such as the sustainability strategy and project execution plan. During the developed design stage the material efficient proposals are embedded within the design and other related information. Some of the design activities might occur in either the concept and/or developed design stages dependent upon the complexity and procurement route of the project. BS 8895-2 takes account of this, providing a flexible approach in applying material efficiency.

NOTE 2 Material efficiency includes optimizing material use, using reclaimed materials, increasing the proportion of materials with a higher level of recycled content, using durable materials, designing out waste, planning and enabling for deconstruction, waste reduction, reuse, and recycling. These are considered throughout the buildings lifecycle.

NOTE 3 For an explanation of the case for material efficiency including the financial, environmental and social drivers, see BS 8895-1.

NOTE 4 Annex A shows the core objectives and information exchanges in relation to material efficiency at each of the seven stages of the RIBA plan of work [N1] stages.

2 Normative references

The following reference documents are indispensable for the application of this document. For dated references, only the edition citied applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS 8895-1, *Designing for material efficiency in building projects – Part 1: Code of practice for Strategic Definition and Preparation and Brief*

Other publications

[N1] RIBA Plan of Work 2013 [2)]

3 Terms and definitions

For the purposes of this part of BS 8895, the terms and definitions given in BS 8895-1 and the following apply.

*NOTE **3.1** to **3.7** are referred to in RIBA plan of work [N1]. **3.11** is referred to in WRAP guidance.*

3.1 concept design
outline of proposals for structural design, building services systems, outline specifications and preliminary cost information along with relevant project strategies in accordance with the design programme

*NOTE It includes agreeing alterations to the initial project brief (**3.8**) and issuing the final project brief (**3.5**).*

3.2 construction strategy
strategy that considers specific aspects of the design that might affect the "buildability" or logistics of constructing a project, or may affect health and safety aspects

[2)] http://www.ribaplanofwork.com Last accessed 13th July 2015.

3.3 design responsibility matrix
matrix that sets out who is responsible for designing each aspect of the project

NOTE The project team might also have formal information exchanges, as well as the many informal exchanges that occur during the iterative design process.

3.4 developed design
coordinated and updated proposals for structural design, building services systems, outline specifications, cost information and project strategies in accordance with the design programme

3.5 final project brief
amended initial project brief (**3.8**) so that it is aligned with the concept design (**3.1**)

3.6 handover strategy
strategy for handing over a building including the requirements for phased handovers, commissioning, training of staff or other factors crucial to the successful occupation of a building

3.7 information exchanges
formal issue of information for review and sign-off by the client at key stages of the project

3.8 initial project brief
brief prepared following discussions with the client to ascertain the project objectives, the client's business case and, in certain instances, in response to site feasibility studies

3.9 maintenance and operational strategy
strategy for the maintenance and operation of a building, including details of any specific plant required to replace components

3.10 project execution plan
sets out the processes and protocols to be used to develop the design

NOTE The project execution plan is sometimes referred to as the project quality plan.

3.11 resource management plan
integrated management framework that can be used to consider and manage material efficiency impacts across a project's lifecycle from 'Stage 0 Strategic Definition' to 'Stage 7 In-Use' and 'End of life'

NOTE The resource management plan supersedes the site waste management plan.

3.12 sustainability strategy
strategy for delivering the sustainability aspirations (the client's aspirations for sustainability), which might include additional objectives, measures or specific levels of performance in relation to international standards, as well as details of specific demands in relation to operational or facilities management issues

*NOTE The sustainability strategy might also include the resource management plan (**3.11**).*

4 Design for material efficiency process

4.1 Design and project delivery considerations

The design for material efficiency should be included within the sustainability strategy and project execution plan to enable an integrated, continual process to optimize material use at all stages of a project's lifecycle. The design team should consider and record how individual decisions impact on material efficiency at each stage of a project's lifecycle, i.e. from design, to construction, to operation and end of life.

NOTE 1 Table 1 outlines example design and project delivery considerations to assist in developing an approach to incorporate material efficiency at the concept and developed design stages.

Information exchanges, specific to material efficiency should follow a managed design structure which allows an audit trail of key information used in decision-making throughout the course of a project.

NOTE 2 Typical information exchange points and client/employer decision points are shown in Figure 1 (Source: BS 7000-4). BS 7000-4 gives guidance on achieving a managed design which could be applied to material efficiency. It applies equally to projects using a traditional approach to preparing project information and to those using BIM.

Table 1 **Design and project delivery considerations to optimize material efficiency** (1 of 2)

Areas	Examples
Project delivery approach	Consider options to demolish, refurbish, or new build.
	Undertake pre-demolition/strip-out fit out audit, if the project involves refurbishment and/or demolition.
	Consider alternative procurement models that deliver improved material efficiency, particularly over the building's lifecycle.
Design optimisation	Consider the design in the context of using fewer materials and/or materials better suited to their functional need.
	Consider prefabricated solutions using modern methods of construction (MMC) or off-site solutions.
	Specify the modular/standard size supplies and prefabricated materials.
	Consider designs with a simple form, layout, mass, sizing and orientation, etc.
Outline material specification	Specify reclaimed materials and products with recycled content.
	Maximize the durability and service life of building elements and services in relation to their replacement cycle.
	Specify materials having resources with no scarcity and with source security.
	Use specifications to avoid materials that are potentially wasteful, hazardous or have potential issues at end of life.
	Consider materials and products which have their packaging optimized.
	Specify materials with low volatile organic compound (VOC) content to create a healthy indoor environment.
	Propose components/materials that can be reused or recycled after deconstruction.

Table 1 **Design and project delivery considerations to optimize material efficiency** (2 of 2)

Areas	Examples
Construction methods	Specify approaches to reduce and reuse excavation materials. Enable easy access for the replacement of materials to avoid damage to surrounding materials. Consider the potential for deconstruction at the end of useful life of individual building components to enable reuse and recycling.
On-site resource efficiency	Optimize ways to reduce construction waste arising by using building information modelling (BIM) for virtual waste generation, considering reuse of surplus materials, take back schemes, workforce awareness, layout of site, storage and handling of materials.

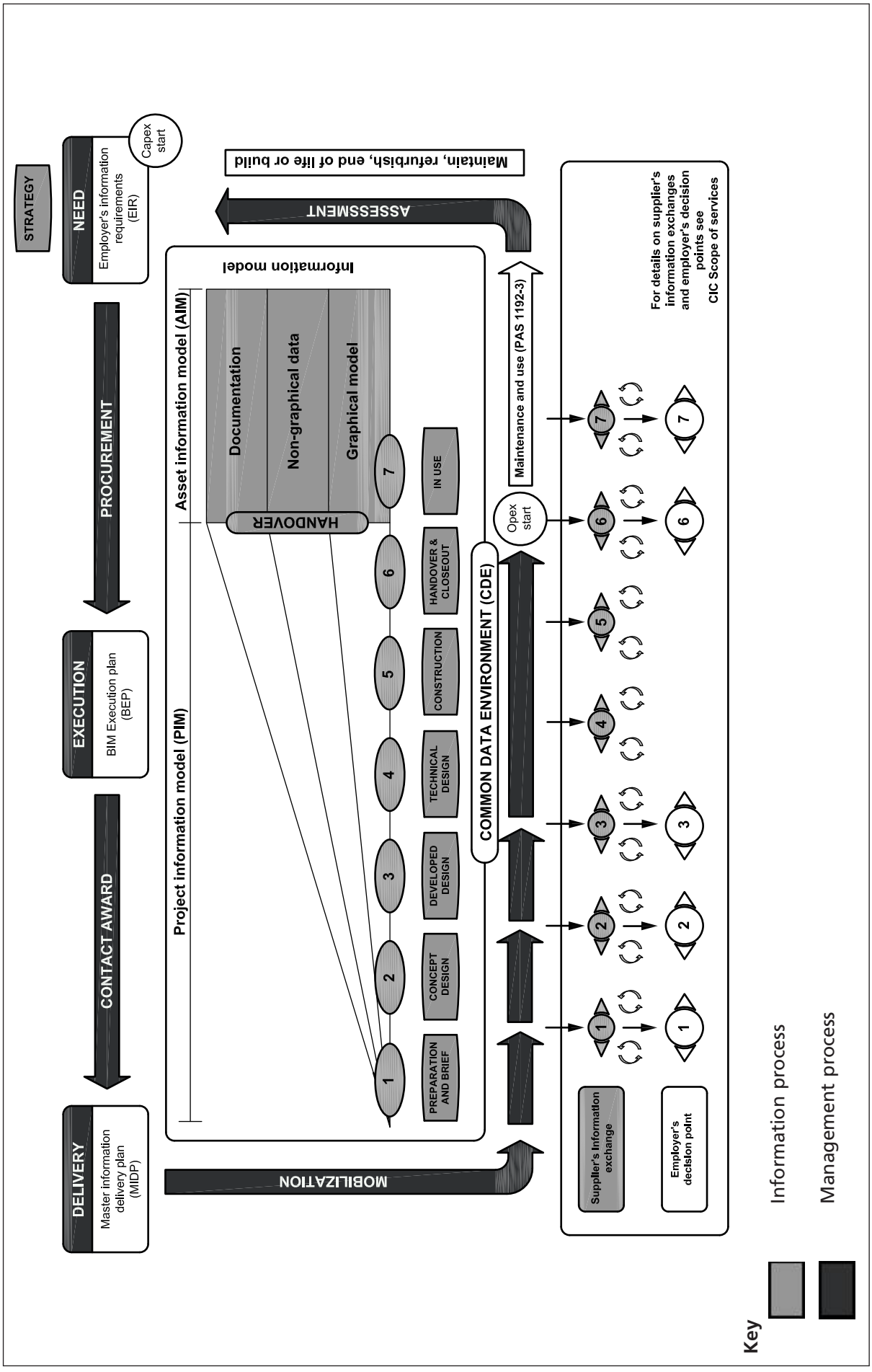


Figure 1 **Typical information delivery cycle**

4.2 Identify, investigate and implement at concept design and developed design stages

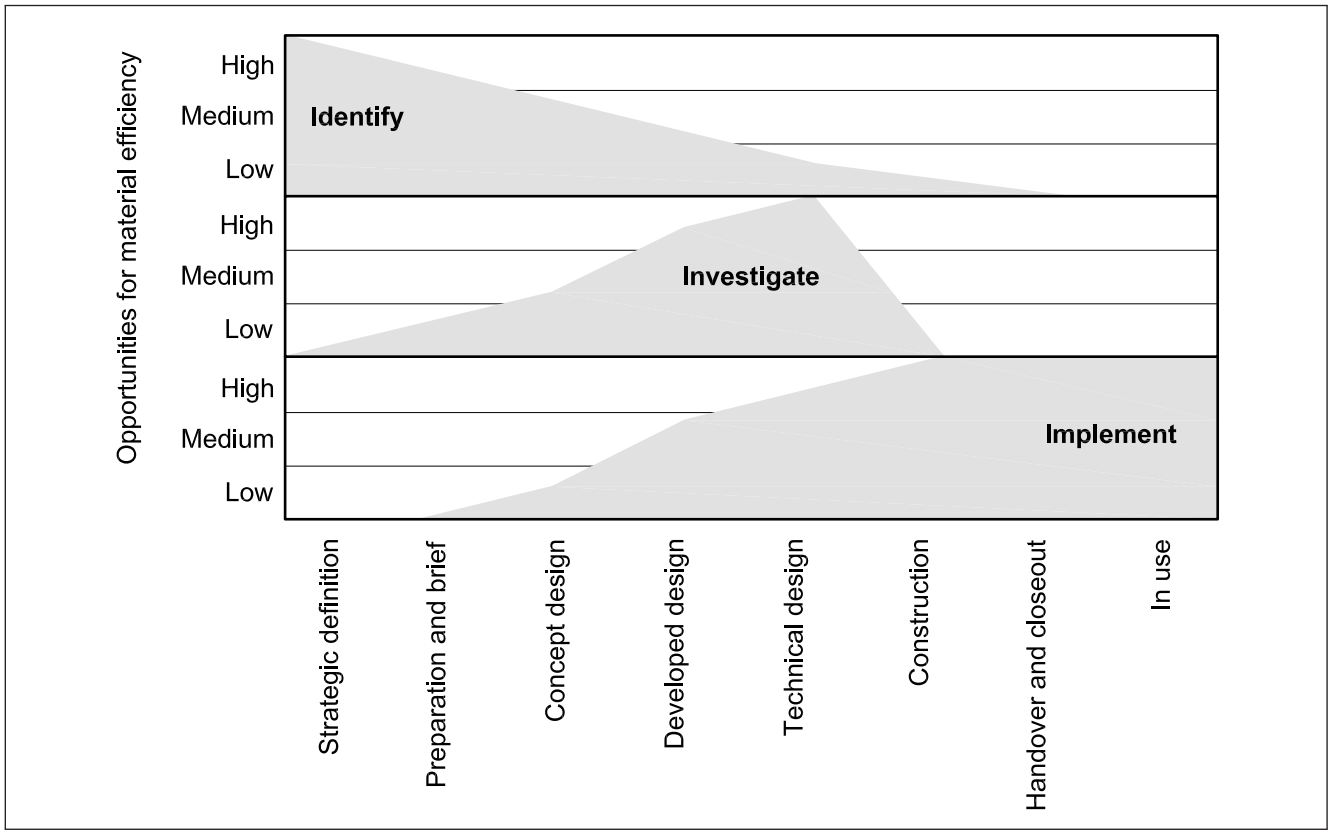
Throughout the lifecycle of a building project, opportunities to optimize material efficiency should be identified, investigated and implemented (see **5.2**, **5.3** and **5.4** for concept design and **6.2**, **6.3** and **6.4** for developed design).

At the early design stage of concept design, the focus should be on identifying and investigating ways to maximize the efficient use of materials. At the developed design stage, these opportunities should be further investigated and implemented where appropriate to achieve the objectives and targets established within the initial project brief.

NOTE 1 The level of effort required to address material efficiency varies at each RIBA plan of work [N1] design stage. Figure 2 highlights key areas of emphasis at each stage of delivery according to identify, investigate and implement.

*NOTE 2 See BS 8895-1:2013, **4.1** for material efficiency design principles in relation to identify, investigate and implement.*

Figure 2 **Level of importance of identify, investigate and implement throughout the design process**



4.3 Roles and responsibilities for material efficiency at concept design and developed design stages

Designing for material efficiency should be an integral part of design activities undertaken to deliver the project in accordance with the agreed initial project brief (see BS 8895-1), or in line with the employer requirements. The design efforts required to meet the brief should be undertaken by a number of project members such as the client, project lead, lead designer, etc. and should provide the design functions as given in Table 3 (for concept design) and Table 5 (for developed design). The responsibility for designing each aspect of the project and when should be recorded and updated in the concept design stage to ensure that each role is defined for developed design and later stages and may take the form of a design responsibility matrix.

*NOTE For roles and responsibilities for material efficiency see also BS 8895-1:2013, **4.6**.*

5 Concept design

5.1 General

The initial project brief should outline the client's requirements and set the direction for material efficiency, as described in BS 8895-1:2013, Figure 5c), and in particular in the design delivery plan or other documentation fulfilling that purpose such as the project execution plan.

The next stage in the design process is the concept design, for which the core objectives should be as follows:

a) take the information within the initial project brief with regard to material efficiency, as developed with guidance from BS 8895-1:2013, **6.4**, such as material efficiency objectives and targets and use it as the basis for the concept design;

b) identify and investigate proposals for material efficiency based on the design approaches and outline specifications for material selection and construction;

c) develop project strategies based on cost information, targets and key performance indicators (KPIs) for material efficiency to inform the final project brief for the client;

d) finalize the final project brief;

e) prepare information to be included in the information exchanges detailing the scope for the subsequent design stages; and

f) update design delivery plan (or equivalent).

Table 2 provides a list of key support tasks, essentially design services, which each stakeholder in a design team should undertake at concept design.

Table 3 provides a checklist of support tasks which should be undertaken by the design team responsible for delivery at the concept design stage and other potential contributors.

Table 4 provides a list of key support tasks which each stakeholder in a design team should undertake at developed design stages.

*NOTE Table 2 and Table 4 follow the process of identify, investigate and implement (see **4.2**).*

5.2 Identification

The focus of the design team at the concept design stage should be to progress the initial project brief into a design strategy. This should include a systematic identification of material efficiency opportunities and potential actions leading to detailed investigation and their potential benefits at subsequent design stages. A design review should be undertaken to identify the opportunities for optimizing material efficiency from design and project delivery stages.

5.3 Investigation

At this stage, the design team should respond to tender requirements provided by the client. Design measures specific to material efficiency should be investigated early in the process and the benefits should be included in the design documentation produced at the end of this stage.

The business benefits to the client as a result of the proposed outline material specifications and design solutions, which take into account material efficiency objectives, should be demonstrated.

The benefit of early supply chain involvement (such as suppliers and manufacturers), to influence decisions on how materials can be used efficiently and increase awareness for opportunities to innovate should be considered.

5.4 Implementation

Information exchanged at the end of this stage should include the design rationale and measures adopted to optimize material efficiency.

NOTE The sustainability strategy might form the central document where all decisions are recorded, for example, via the resource management plan, to continue to build on the outcomes from this design stage. The project execution plan might also include processes and procedures which relate to material efficiency.

The resource management plan should be initiated by the client during the strategic definition, preparation and brief stage, as described in BS 8895-1. It should follow a five stage process to enable continuous improvement including scoping, action planning, estimating, monitoring and reporting.

The resource management plan should sit as part of the sustainability strategy. The opportunities and actions considered for material efficiency, the final material resource efficiency requirements and any related benefits and costs should be recorded.

Table 2 **Concept design stage: actions and outputs** (1 of 4)

ACTIONS		**OUTPUTS** *(e.g. material for information exchanges)*
a) Identification	**b) Investigation**	**c) Implementation**
1) A design review should be undertaken to optimize material efficiency opportunities (see Table 1 for examples).	1) Based on the design review, a delivery approach should be investigated to meet the material efficiency requirements in the initial project brief, planning and legislative requirements. This should demonstrate actions taken to: a) identify opportunities for optimizing material efficiency (see Table 1); and b) identify opportunities for design for waste reduction.	1) The outcomes of the design review and delivery approach adopted within the key information exchanges at this stage of the project should be recorded within the sustainability strategy (which can include the resource management plan).
2) Feasibility studies should be undertaken at this stage of the project to inform the material efficiency aspect of the design development should be identified.	2) Feasibility studies (e.g. massing, orientation) should investigate solutions to set out a clear material efficiency design approach. *NOTE The studies might include: investigating effects (e.g. reduced waste, construction techniques, cost) of the proposed concept designs on material efficiency; and/or identifying types and normalization of indicators (waste arising, material usage/mass, wastage rates, and environmental impact) for the proposed concept design.*	2) Based on the design review, the information exchanges should be updated produced at the end of this stage highlighting potential targets for material efficiency.

Table 2 **Concept design stage: actions and outputs** (2 of 4)

ACTIONS		OUTPUTS *(e.g. material for information exchanges)*
3) Based on the outcomes from a)2) above, the review should identify potential material efficiency targets and KPIs.	3) The review should help to set targets and KPIs by investigating benefits (e.g. cost, time, programme management, procurement) as well as challenges (e.g. construction method, material availability, requirement for trained personnel) as a result of the considerations made to optimize material efficiency through the life cycle of the asset. The targets set should as a minimum cover the following aspects: a) strategic project delivery decisions (e.g. demolish or refurbish, procurement); b) architectural, structural and service design; c) materials and services specification; d) construction methods; e) on-site resource efficiency; f) buildings in-use; and g) end of life.	3) Targets and KPIs should be set out and the information exchanges in c)8) updated accordingly.
4) Any third party consultations to be undertaken to assist with optimizing material efficiency should be identified.	4) Material efficiency through rationalization of design, construction details and systems to be installed should be investigated. *NOTE For example, by engaging construction contractors and material suppliers, depending on the procurement route.*	4) Based on the outcomes of the consultations, areas for detailed investigation at subsequent design stages should be identified and the information exchanges should be updated.
5) Long term implications (e.g. handover strategy, maintenance and operational strategy) as a result of the proposed material efficiency approach for building owners and other stakeholders should be identified.	5) The proposed material efficiency actions on the building should be investigated when in use. *NOTE For example considering replacement requirements for certain materials and the opportunity for circular economy thinking, e.g. leasing.*	5) Links to the handover strategy, risk assessments, operational and maintenance manual and any 'soft landing' programme should be established.

Table 2 **Concept design stage: actions and outputs** (3 of 4)

ACTIONS		**OUTPUTS** *(e.g. material for information exchanges)*
6) Opportunities for deconstruction to enable reuse and recycling of materials and components should be identified.	6) The proposed material efficiency actions on the building should be investigated when at end of life. *NOTE For example, if the connections for components can be dismantled, and if components are accessible without damaging them on removal.*	6) Information that could be used to assist in deconstruction at end of life and link to the operational and maintenance manual should be established.
7) Roles and responsibilities for undertaking material efficiency actions by the design team members should be identified at this stage.	7) The implications of material efficiency actions on an individual design team scope of work should be investigated.	7) The project execution plan should capture added responsibility for the design team members. The responsibility matrix should be updated with material efficiency actions. The sustainability strategy, which can include the resource management plan, should be reviewed, and responsibility should be allocated against each action identified for materials efficiency to be followed up at the next design stage (see Table 3).

Table 2 **Concept design stage: actions and outputs** (4 of 4)

ACTIONS		**OUTPUTS** *(e.g. material for information exchanges)*
8) Information exchanges required to communicate opportunities and actions undertaken should be identified.	8) Information exchanges that can be undertaken during concept design and the timescales should be investigated.	8) The information exchanges produced at the end of this stage with measures undertaken to optimize material efficiency should be updated. This should set out: a) key options considered, the outcomes of feasibility studies, measures incorporated, design decisions and intended effect as a result; b) key metrics, targets and design approach that should be adopted to achieve materials efficiency objectives; c) an action plan, mapped against project lifecycle stages, in order to meet the objectives. *NOTE The information exchanges at this stage can include: project strategies and design programme; final project brief; sustainability strategy; resource management plan; construction strategy; or construction and health and safety strategies.* For projects using BIM it should be ensured that material efficiency requirements are identified at the appropriate level of definition in the BIM execution plan.

NOTE Table B.1 gives details of further guidance available to assist in identifying, investigating and implementing material resource efficiency actions across a project's lifecycle.

5.5 Material efficiency checklist

Table 3 is a checklist of tasks which should be undertaken by project team members responsible for delivering material efficiency at the concept design stage.

Table 3 **Concept design stage: material efficiency tasks checklist** (1 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer (architect)	Architectural, building services, civil an structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Review the proposed concept design and project strategies for achieving material efficiency.	✓	✓	✓				
Sign-off material efficiency related performance measures, outline targets and KPIs to be used in the final project brief and sustainability strategy.	✓	✓					
Arrange and undertake a design review workshop, attended by representatives of the project team, to optimize material efficiency.		✓	✓	✓	✓		
Collate and agree the design approach to materials efficiency. Review this periodically against the corresponding requirements in the initial project brief. Update and issue the final project brief for client sign off.		✓	✓				
Ensure all information exchanges include material efficiency requirements and actions needed at subsequent design stages.		✓	✓				

Table 3 **Concept design stage: material efficiency tasks checklist** (2 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer (architect)	Architectural, building services, civil an structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Ensure appropriate clauses related to material efficiency are included in the employer's requirements, identifying and communicating the responsibilities for material efficiency between all stakeholders.	✓	✓					
Implement change control procedures, to record any decisions related to the design and how it could affect material efficiency.		✓	✓				
Prepare sustainability strategy and maintenance and operational strategy identifying materials efficiency approach with the input from the design team as required.			✓	✓			
Review the outcomes from third party consultations with stakeholders and feasibility studies. Ensure the opportunities for material efficiency highlighted are addressed within the proposed design.			✓	✓	✓		
Review the project cost and programme against the opportunities identified for improving materials efficiency.			✓	✓			

Table 3 **Concept design stage: material efficiency tasks checklist** (3 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer (architect)	Architectural, building services, civil an structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Prepare architectural/structural and building services concept design in accordance with the initial project brief outlining how material efficiency aspects are addressed in the design.				✓	✓		
Incorporate supporting information exchanges and responsibility in the design responsibility matrix.		✓	✓	✓			
Undertake third party consultations with stakeholders and feasibility studies as required to investigate the opportunities for improving materials efficiency.			✓	✓	✓		
Provide information related to outline material specification and construction details for preparation of cost information and project strategies on how material efficiency supports the design programme.			✓	✓			
Prepare preliminary cost information identifying the benefits provided by the individual opportunities identified to improve materials efficiency.			✓	✓			
Include material efficiency within the construction strategy and design programme.		✓	✓		✓		

Table 3 **Concept design stage: material efficiency tasks checklist** (4 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer (architect)	Architectural, building services, civil an structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Highlight any potential material efficiency aspects for health and safety within the health and safety strategy including statutory requirements and any effect on health and wellbeing of the occupants.		✓	✓		✓		

6 Developed design

6.1 General

The material efficiency actions which have been identified and reviewed at the concept design stage should now be incorporated into the developed design stage through the generation of detailed proposals for structural design, building services and outline specifications.

NOTE This might require a number of iterations of the proposals.

The core objectives at this stage should be as follows:

a) use the information developed at the concept design stage to prepare developed design;

b) coordinate across the project team and update the proposals for material efficiency within the structural design, building services systems, outline specification and cost information; and

c) include key outputs for material efficiency within all relevant information exchanges in order to inform the client decisions.

6.2 Identification

The information exchanges produced at the concept design stage should be reviewed to identify all material efficiency related actions to be carried forward and carried out at this stage of the project.

6.3 Investigation

Any research and development activities undertaken during the concept design stage for material efficiency should be concluded. Additional investigations should be conducted as appropriate. The outcomes should be used to inform the material efficiency opportunities at this stage.

Positive project-related benefits include improvements in scheduling and timetabling, cost and greater material efficiency. At the developed design stage the cost information is aligned with the project budget and as such this should highlight cost benefits as a result of the design approach adopted to optimize materials efficiency as well as any cost allowances.

NOTE 1 The savings of material resources through greater efficiency and enabling greater reuse and recycling at end of life can lead to a reduction in carbon emissions.

NOTE 2 More consultation with potential main contractors and product suppliers is likely to be needed as the design progresses to enable the project team to define objectives targets and inform the project scope.

NOTE 3 Cost information can be recorded such as the cost of systems, materials, products and the cost of waste management options. This information can be used as a baseline to assess potential savings from material efficiency, e.g. using fewer materials, specifying materials that can be recycled and/or have minimal waste during installation.

NOTE 4 Positive project-related benefits include improvements in scheduling and timetabling, cost and greater material efficiency.

6.4 Implementation

The outcomes from investigations on optimizing material efficiency should be incorporated in key information exchanges (e.g. sustainability strategy, cost plan) at the end of the developed design stage. The information should set out design approach, actions needed and priorities for the subsequent stages of the project.

NOTE 1 Any material efficiency related procurement activities carried out at this stage depends on the route used to deliver the scheme. This might include consultation with contractor/material supplier to check the intended site outcomes and potential sequencing of works from adopting materials efficiency measures.

Table 4 and Table 5 outline the material efficiency related actions, outputs and a checklist of support tasks which should be undertaken by design team members and other potential contributors responsible for delivery at the developed design stage.

Table 4 **Developed design stage: actions and outputs** (1 of 3)

ACTIONS		**OUTPUTS** *(e.g. material for information exchanges)*
a) Identification	**b) Investigation**	**c) Implementation**
1) The design review for material efficiency should be updated based on the outcomes from Table 2, b)1).	1) The proposal given as per Table 2, b)1) should be reviewed and the changes as a result of progress made in design and planning should be updated.	1) Information exchanges should be finalized by updating key documentation produced in accordance with Table 2, 8). This should include producing design drawings/models which take into consideration material efficiency requirements.
2) Any detailed studies and research relating to material efficiency as per Table 2, b)3) should be completed.	2) Based on the detailed studies and research findings: a) outputs should be reviewed and actions prioritized; b) any variations or deviations as a result in the sustainability strategy (for example using the resource management plan) from the previous design stage should be investigated; c) the reasons for any variations in targets or design approach to material efficiency as a result of the detailed investigations at this stage should be demonstrated; and d) any further cost savings should be established.	2) The changes made to the material efficiency design approach as a result of actions undertaken against the detailed research should be reported.

Table 4 **Developed design stage: actions and outputs** (2 of 3)

ACTIONS		OUTPUTS *(e.g. material for information exchanges)*
3) Based on the outcomes from Table 2, b)3) material efficiency targets should be identified.	3) Based on the outcomes from Table 2, b)2), material efficiency targets should be set, or the targets set against Table 2, b)3) updated, for material efficiency related KPIs for the project. The KPIs should consider: a) material efficiency priorities for the proposed through design and specification; b) on-site resource use, waste reduction and recycling target; c) reuse and recyclability of materials specified; and d) requirements for health and safety in relation to material efficiency/waste assessments.	3) Information exchanges produced at the end of this stage as per c)8) highlighting clear targets to material efficiency should be updated.
4) Based on the outcomes from Table 2, b)4), third party consultations with stakeholders should continue to be undertaken.	4) An investigation through consultation of how to optimize material efficiency or the outcomes against Table 2, b)6) updated should be undertaken.	4) All material efficiency related information exchanges as per c)8) should be updated (e.g. developed design drawings, outline specifications) demonstrating how consultation influenced material efficiency design approach.
5) The building operations team or potential facilities managers should be identified for consultation on the designs in relation to material efficiency and the continued maintenance of the building.	5) The outcomes from Table 2, b)5) should be updated. The consultation with operations and maintenance team should investigate any: a) accessibility issues for maintenance (i.e. layering of components in relation to replacement cycle); and b) type of structural connections for flexibility and maintenance.	5) Information exchanges produced at the end of this stage as per c)8) highlighting details for material efficiency during operations and maintenance of the building should be updated.

Table 4 **Developed design stage: actions and outputs** (3 of 3)

ACTIONS		OUTPUTS *(e.g. material for information exchanges)*
6) The opportunities for deconstruction should be identified or the outcomes from Table 2, b)6) should be updated.	6) An investigation of where improvements can be made for design for deconstruction or the outcomes against Table 2, b)6) updated should be undertaken. *NOTE This might be done in consultation with demolition contractors.*	6) Information exchanges produced at the end of this stage as per this Table c)8) to incorporate deconstruction specific materials efficiency requirements should be updated.
7) Roles and responsibilities for material efficiency actions should be identified and updated for the design team members.	7) This should be reviewed from the concept design stage and updated with any new actions.	7) The project execution plan should be updated, identifying decisions, priority actions and allocating responsibilities for technical design in subsequent design stages. The responsibility matrix should be updated. with material efficiency actions.
8) Information exchanges required to communicate opportunities and actions undertaken should be identified.	8) An investigation of which information exchanges can be undertaken during developed design and the timescales should be undertaken.	8) The material for information exchanges should be finalized by updating key documentation produced at the concept design stage as given in Table 2, c)8). At this design stage, information produced for subsequent design stages should consider: a) implications of the proposed material efficiency strategy on procurement models, cost and delivery programme; b) incorporating appropriate material efficiency information such as targets and KPI's within the tender documentation; c) updating the construction strategy information with material efficiency requirements and risk assessments; and d) logistics requirements in relation to materials, including deliveries and materials storage to minimize damage on site and developing priority areas to consider within materials logistics plan.

NOTE 2 Design for deconstruction involves reviewing the opportunities to firstly reuse components and elements and secondly, opportunities for recycling. Key considerations include the connections used between the various elements, the level of access to components, any specific handling issues and end of life issues, e.g. if there is an established reuse/recycling route.

Table 5 **Developed design stage: material efficiency tasks checklist** (1 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer	Architectural, building services, civil and structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Review the proposed developed design and project strategies for achieving material efficiency.	✓	✓	✓				
Sign-off project strategy related to material efficiency including outline specifications, targets and KPIs to be used in the sustainability strategy.	✓	✓					
Assess the design review workshop to optimize material efficiency at concept design stage and update for information exchanges.		✓	✓	✓	✓		
Identify and communicate responsibilities for implementing actions related to materials efficiency to all project stakeholders. Implement change control procedures, as per BIM/information strategy, to record any decisions related to the design and how it could affect materials efficiency.		✓	✓				

Table 5 **Developed design stage: material efficiency tasks checklist** (2 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer	Architectural, building services, civil and structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Review all information exchanges (e.g. architectural, building services, civil and structural). Ensure appropriate clauses related to materials efficiency are included. Identify any further actions needed in subsequent design stages.		✓	✓	✓			
Co-ordinate and update proposals based on changes to the materials efficiency design approach since the concept design.		✓	✓				
Co-ordinate and ensure outline specifications are in line with materials efficiency principles. Check the cost information against the project budget.		✓	✓	✓	✓		
Co-ordinate consultation with contractor/material suppliers and third parties and ensure input on materials efficiency.		✓	✓	✓	✓		
Check architectural, building services, civil and structural information including in accordance with the final project brief outlining how materials efficiency aspects are addressed in the design.			✓	✓			
Check sustainability strategy and maintenance and operational strategy identifying materials efficiency approach with input from project team as required.			✓	✓	✓		

Table 5 **Developed design stage: material efficiency tasks checklist** (3 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer	Architectural, building services, civil and structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Review the outcomes from third party consultations with stakeholders and feasibility studies. Ensure the opportunities for materials efficiency highlighted are addressed within the proposed design.			✓	✓	✓		
Provide information related to material specification and construction details for the preparation of cost information and project strategies on how materials efficiency supports design programme.				✓	✓		
Prepare preliminary cost information identifying the benefits from material efficiency approaches adopted.			✓	✓	✓		
Verify that the cost information includes adequate allowances and that materials efficiency costs/savings are incorporated.			✓	✓	✓		
Prepare sustainability strategy and maintenance and operational strategy identifying materials efficiency approach with input from project team as required and issue the sustainability strategy.		✓	✓	✓	✓		
Incorporate supporting information exchanges in the design responsibility matrix.		✓	✓	✓			

Table 5 **Developed design stage: material efficiency tasks checklist** (4 of 4)

Material efficiency tasks	Client/client adviser	Project lead	Lead designer	Architectural, building services, civil and structural	Contributors (if appointed / consulted at this stage) e.g. cost consultant	Status: Completed (yes/no)	Notes
Update material efficiency related actions within the construction strategy and design programme.		✓	✓		✓		
Highlight any potential material efficiency aspects for health and safety within the health and safety strategy including statutory requirements and any effect on health and wellbeing of the occupants.		✓	✓		✓		

Annex A (informative) Material efficiency objectives and information exchanges across the design stages

Table A.1 shows the core objectives and information exchanges in relation to material efficiency at each of the seven stages of the RIBA plan of work [N1] stages.

NOTE Stage 0 strategic definition and stage 1 preparation and brief are covered in BS 8895-1. Stage 2 concept design and stage 3 developed design are covered in this part of BS 8895. It is intended that stage 4 technical design will be covered in a part 3 to BS 8895, and stages 5 to 7, as well as end of life, will be covered in a part 4.

Table A.1 **Material efficiency objectives and information exchanges across the RIBA plan of work [N1] stages** (1 of 2)

RIBA plan of work [N1] stages	Core objectives	Information exchanges
0 Strategic definition	Identify client's business case and strategic brief and other core project requirements including material efficiency.	Strategic brief to include client requirements and suggested approaches for material efficiency measurement and site appraisal.
1 Preparation and brief	Develop project objectives and sustainability aspirations including material efficiency to develop initial project brief. Undertake feasibility studies and review site information.	Initial project brief including feasibility studies and updates on project specific and targets for material efficiency.
2 Concept design	Prepare concept design, including identifying and investigating proposals for material efficiency based on a design approach.	Material efficiency information is within outline structural and building services design, associated project strategies, preliminary cost information and final project brief.
3 Developed design	Prepare developed design including coordinated and updated proposals for material efficiency and outline specifications for material selection and construction.	Materials efficiency information is in the information including the coordinated architectural, structural and building services design and updated cost information.
4 Technical design	Preparation of technical design(s) and specifications, sufficient to coordinate components and elements of the project and information for statutory standards.	Completion of technical design to incorporate material efficiency measures and related strategies.
5 Construction	Offsite manufacturing and onsite construction in accordance with the construction programme and resolution of design queries from site as they arise; implementation of material efficient principles on site and via supply chain.	Information, sustainability strategy and construction strategy with material efficiency measures.

Table A.1 **Material efficiency objectives and information exchanges across the RIBA plan of work [N1] stages** (2 of 2)

RIBA plan of work [N1] stages	Core objectives	Information exchanges
6 Handover and close out	Handover of building and conclusion of building contract with appropriate material efficiency information incorporated.	Information, handover strategy with material efficiency aspects.
7 In use	Undertake in use activities (repair, maintenance and improvement) in accordance with schedule of services and consideration of material efficiency.	Information with operational and maintenance requirements.

Annex B (informative) Guidance and tools for assisting with material efficiency across the design stages

Table B.1 shows guidance and tools for material efficiency.

Table B.1 **Guidance and tools for material efficiency**

Guidance/Tools	Material efficiency aspects	Relevant RIBA plan of work [N1] stages
WRAP Designing out Waste Guides and Tools [1]	Designing out waste principles and how to apply them	All stages
WRAP Net Waste Tool [2]	Measure the potential waste arisings and data on recycled content	Concept design and developed design
WRAP Site Waste Management Plan tool [2]	Tool to record material efficiency design decisions and monitor outcome	Concept design to construction
BRE SMARTWaste [3] System	Provision of benchmarks for waste arisings and a means to record decisions and monitor outcome	Concept design to construction
WRAP and BRE Facilities Manager Guidance [4], [5]	Frameworks, templates, clauses and case studies for managing material efficiency including waste contracts	In use
SEDA Designing for Deconstruction [6]	Guidance, principles and specifications for designing for deconstruction	Concept design, developed design, technical design and end of life
Manufacturers Environmental Product Declarations (EPDs) [7]	Information on material content, wastage rates, recycled content and recyclability	Concept and developed design
BREs Green Guide to Specification [8]	Outline specifications with information on material content, wastage rates, recycled content and recyclability	Concept and developed design
WRAP Materials logistics plan framework [9]	Material aspects such as supply routes, handling, storage use and reuse, recycling and disposal	Developed design to construction

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7000-4:2013, *Design management systems – Part 4: Guide to managing design in construction*

BS EN 15804:2012+A1:2013, *Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products*

Other publications

[1] WASTE RESOURCES ACTION PROGRAMME (WRAP). *Designing out Waste Guides and Tools.* Banbury: WRAP.

[2] WASTE RESOURCES ACTION PROGRAMME (WRAP). *Net Waste Tool and Site Waste Management Plan tools.* Banbury: WRAP.

[3] BUILDING RESEARCH ESTABLISHMENT (BRE). SMARTWaste. [3)]

[4] WASTE RESOURCES ACTION PROGRAMME (WRAP). *Facilities Management Tools, Case Studies and Guidance*. Banbury: WRAP. [4)]

[5] BLOFELD S (2014). Delivering waste efficiency in commercial buildings: A guide for facilities managers (IP 12/14). IHS BRE PRESS. [5)]

[6] MORGAN, C, STEVENSON F (2005). Design for Deconstruction – SEDA Design Guides for Scotland No 1. [6)]

[7] Environmental Product Declarations (EPDs). [7)]

[8] WRAP Materials logistics plan framework. [8)]

[9] BUILDING RESEARCH ESTABLISHMENT (BRE). *The Green Guide to Specification*. [9)]

Further reading

ADAMS, K, HOBBS G, YAPP C (2013). *Dealing with Difficult Demolition Wastes: A Guide.* IHS BRE Press.

CHARTERED INSTITUTION OF BUILDING SERVICES ENGINEERS (CIBSE). TM56 Resource Efficiency of Building Services 2014. [10)]

OSMANI, M, GLASS, J, PRICE, AD (2008). Architects perspectives on construction waste minimisation by design, *Waste Management*, 28(7), PP.1147-1158.

OSMANI, M (2013). Design waste mapping: a project life cycle approach. *Proceedings of the ICE – Waste and Resource Management*, 166 (3), PP.114-127.

---

3) http://www.smartwaste.co.uk Last accessed 15th July 2015.
4) http://www.wrap.org.uk/category/sector/facilities-management Last accessed 20th July 2015.
5) http://www.brebookshop.com/details.jsp?id=327448 Last accessed 20th July 2015.
6) http://www.seda.uk.net/assets/files/guides/dfd.pdf Last accessed 15th July 2015.
7) http://www.environdec.com/en/What-is-an-EPD/#.VaZavflVhBc Last accessed 15th July 2015.
8) http://www.wrap.org.uk/sites/files/wrap/MLP%20Guidance%20Document.pdf. Last accessed 15th July 2015.
9) http://www.bre.co.uk/page.jsp?id=499 Last accessed 15th July 2015.
10) http://www.cibse.org/Knowledge/CIBSE-TM/TM56-Resource-Efficiency-of-Building-Services-NEW Last accessed 15th July 2015.

SECTOR RESOURCE EFFICIENCY ACTION PLANS (REAPs). [11)]

WASTE RESOURCES ACTION PROGRAMME (WRAP). Design Review Workshop. [12)]

WASTE RESOURCES ACTION PROGRAMME (WRAP). Facilities Management. [13)]

[11)] http://www.wrap.org.uk/content/resource-efficiency-action-plans Last accessed 15th July 2015.

[12)] http://www.wrap.org.uk/content/design-review-workshop-facilitators-pack Last accessed 15th July 2015.

[13)] http://www.wrap.org.uk/category/sector/facilities-management Last accessed 15th July 2015.

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™